

# An exploratory study of the contributions to low carbon policy making in Bristol using WEF Nexus as a heuristic device

PhD Thesis  
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## **ABSTRACT**

Cities around the world have taken up the challenge to reduce their greenhouse gas emissions by designing policies to bring about low carbon futures. Research on climate change suggests that we are not only facing an issue of increased emissions but in fact, an array of interconnected planetary crises. Extreme weather events, resource scarcity, environmental deterioration and social inequalities could potentially reinforce each other and lead to an undesirable future.

Both academics and practitioners argue that we need to attend to interactions, trade-offs and unforeseen consequences. As a result, “Water-Energy-Food Nexus” has recently risen in popularity echoing this sentiment. The concept promises a low carbon future while ensuring water, energy and food security for all. Although the term has been increasingly prominent in the international policy circles, it has also been subject to a critique from the social sciences. Furthermore, it is not clear whether the lens of Water-Energy-Food Nexus would be applicable to urban scale challenges.

This research seeks to learn how urban sustainability practitioners discuss complexity and interconnections in sustainability issues. By illuminating the links between nexus-type considerations, climate justice and specific sustainability policy issues, the research aims to co-produce policy recommendations for a low carbon future of Bristol with a wide range of practitioners from the public, private and charity sectors.

Using action research methodology, the research engaged local sustainability practitioners to collaborate on the research design, preliminary results and dissemination. The thesis applied an innovative mix of methods (discourse analysis, focus groups, qualitative survey and self-reflection) to co-create policy recommendations in the themes of food waste management and energy/water metering.

The main practical contribution of this thesis lies in creating space for transdisciplinary research where the stakeholders from the public, private, charity and academic sectors are participating not only in theory formation but also in improving their practice. Meanwhile, the main theoretical contribution of the thesis is highlighting the relevance of the Water-Energy-Food Nexus and climate justice at the urban scale.

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*“Despite the usual prefix ‘the’ there is not one ‘Nexus’, but many nexūs”*

- Andy Stirling

## **List of Abbreviations**

- ABC – Attitudes, Behaviours, Choices  
AD – Anaerobic Digestion  
AHP – Analytic Hierarchical Processing  
AMI – Advanced Metering Infrastructure  
AMR – Automated Meter Reading  
BBC – British Broadcasting Corporation  
BCC – Bristol City Council  
BGCP – Bristol Green Capital Partnership  
BID – Business Improvement District  
BME – Black and Ethnic Minorities  
bn – billion  
CIWM – Chartered Institution of Wastes Management  
CO<sub>2</sub> – Carbon Dioxide  
CO<sub>2</sub>eq – Carbon Dioxide equivalent  
DBEIS – Department for Business, Environment and Industrial Strategy  
DECC – Department for Environment and Climate Change  
DEFRA – Department for Environment, Food and Rural Affairs  
DSM – Demand-side management  
EC – European Commission  
ESRC – Economic and Social Research Council  
EFRA Committee – Environment, Food and Rural Affairs Committee  
EU – European Union  
FAO – Food and Agriculture Organisation  
FG – Focus Group  
GDP – Gross Domestic Product  
GHG – Greenhouse Gases  
GIS – Geographic Information Systems  
ICLEI – Local Governments for Sustainability  
IHD – In-Home Display  
IPCC – Intergovernmental Panel on Climate Change  
IWRM – Integrated Water Resources Management  
LEDC – Less Economically Developed Country  
LSOA – Lower Layer Super Output Area  
MCDM – Multicriteria Decision-making  
MP – Member of Parliament  
Mt – Mega tonne

NASA – National Aeronautics and Space Administration  
ONS – Office for National Statistics  
ppm – parts per million  
RCUK – Research Councils UK  
REN21 – Renewable Energy Policy Network for the 21<sup>st</sup> Century  
SMEs – Small and Medium Enterprises  
STS – Science and Technology Studies  
The UN – The United Nations  
The U.S. – The United States of America  
The WEF Nexus – The Water-Energy-Food Nexus  
WoE – West of England  
WRAP – Waste and Resources Action Programme

# Table of Contents

ABSTRACT.....	ii
ACKNOWLEDGEMENTS .....	iv
List of Abbreviations .....	vi
Table of Contents.....	vii
List of Appendices .....	xvi
List of Figures .....	xvii
List of Tables .....	xviii
<b>Chapter 1. Introduction .....</b>	<b>1</b>
1.1. Cross-cutting global challenges .....	1
1.2. Cities and Climate Change.....	4
1.3. Local context.....	5
1.4. Research questions, aims and objectives .....	6
1.5. Boundary conditions.....	7
1.6. Thesis overview.....	9
<b>Chapter 2. Literature Review.....</b>	<b>11</b>
2.1. Climate justice .....	11
2.1.1. Central questions: Who benefits? Who pays? Who decides?.....	12
2.1.2. Multiple dimensions of climate justice.....	12
2.1.3. Overview of the literature and future directions.....	15
2.1.4. Exploring and quantifying climate justice .....	21
2.2. The Water-Energy-Food Nexus .....	26
2.2.1. Overview of nexus thinking .....	26
2.2.2. WEF Nexus as a contested term.....	28
2.2.3. Exploring and quantifying the WEF Nexus .....	33

2.3. Energy and water meters .....	39
2.3.1. What do meters do? .....	39
2.3.2. Metering in smart cities .....	40
2.3.3. User perceptions of metering .....	40
2.3.4. Metering as a science-policy issue .....	41
2.3.5. Metering: National policy context.....	42
2.4. Food waste in cities .....	44
2.4.1. Food waste in the catering industry .....	44
2.4.2. Reasons and solutions.....	44
2.4.3. Food Waste Discourses .....	46
2.4.4. Food waste: National policy context .....	47
2.5. Bristol – local context.....	49
2.5.1. Commitment to GHG emissions reduction .....	49
2.5.2. Climate injustices .....	50
2.5.3. Smart city projects.....	51
2.5.4. Food waste management.....	52
2.5.5. Governance .....	55
2.5.6. Citizenship .....	56
2.6. Chapter summary: Themes of enquiry and the theoretical framework.....	57
<b>Chapter 3. Methodology overview.....</b>	<b>59</b>
3.1. Stage 1: Discourse analysis .....	60
3.1.1. The aim of discourse analysis in the study .....	60
3.1.2. Role of discourse analysis in the wider context of the study .....	61
3.1.3. Advantages of discourse analysis .....	62
3.1.4. Limitations of discourse analysis .....	63
3.2. Stage 2: Exploratory focus groups .....	64
3.2.1. The aim of focus groups in the study.....	64
3.2.2. Role of focus groups in the wider context of the study.....	64

3.2.3. Advantages of focus groups.....	65
3.2.4. Limitations of focus groups.....	66
3.3. Stage 3: Policy co-design.....	67
3.3.1. The aim of policy co-design in the study .....	67
3.3.2. Role of policy co-design in the wider context of the study .....	68
3.3.3. Advantages of policy co-design .....	69
3.3.4. Limitations of policy co-design .....	69
3.3.5. Advantages of qualitative surveys .....	70
3.3.6. Limitations of qualitative surveys .....	71
3.3.7. Multicriteria decision-making: introduction .....	71
3.3.8. Advantages of Multicriteria decision-making .....	72
3.3.9. Limitations of Multicriteria decision-making.....	73
3.4. Stage 4: Critical reflection.....	74
3.4.1. The aim of critical reflection.....	74
3.4.2. Role of critical reflection in the context of the study.....	74
3.4.3. Advantages of critical reflection.....	75
3.4.4. Limitations of critical reflection.....	75
3.5. Methodological framework .....	76
3.5.1. Action research: definition .....	76
3.5.2. Action research: justification .....	76
3.5.3. Action research and participation .....	77
3.5.3. Triangulation and mixed methods research .....	79
3.5.4. Transdisciplinary research .....	80
3.6. Epistemology .....	81
3.6.1. Introduction.....	81
3.6.2. Pragmatism.....	82
3.6.3. Epistemological limitations.....	85
3.7. Considering researcher's biases .....	85
3.8. Research ethics.....	87
3.9. Chapter summary.....	87

<b>Chapter 4. Research Design .....</b>	<b>89</b>
4.1. Stage 1: Discourse analysis of WEF Nexus complexities in Bristol .....	89
4.1.1. Motivation: Highlighting current interdependencies .....	89
4.1.2. Discourse analysis framework.....	90
4.1.3. Discourse analysis of food waste .....	92
4.1.4. Discourse analysis of smart metering .....	95
4.1.5. Feeding the results into the next stage .....	96
4.2. Stage 2: Focus groups with local sustainability practitioners .....	96
4.2.1. Motivation: Facilitating collaboration across the sectors .....	96
4.2.2. Selection of participants.....	97
4.2.3. Topic guide and questions.....	99
4.2.4. Pilot stage .....	101
4.2.5. Data protection, storage and confidentiality .....	101
4.2.6. Thematic Analysis .....	101
4.2.7. Discourse Analysis.....	102
4.2.8. Feeding the results into the next stage .....	102
4.3 Stage 3: Policy co-design.....	102
4.3.1. Motivation: Providing recommendations to the local challenges .....	102
4.3.2. Qualitative survey (food waste theme) .....	103
4.3.2.1. Data collection.....	104
4.3.2.2.Data analysis.....	106
4.3.3. Targeted focus group (metering theme) .....	105
4.3.4. Multicriteria Decision-Making (metering theme) .....	108
4.3.4.1. Highly capable and highly disadvantaged residents.....	109
4.3.4.2. Translating socio-economic categories into data.....	111
4.3.4.3. Weighting and scoring.....	115
4.4. Stage 4: Critical Self-reflection .....	115
4.4.1. Motivation: Closing the action-reflection cycle .....	115
4.4.2. Records of self-reflection .....	116

4.5. Chapter summary.....	116
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## **Chapter 5. Results: Food Waste .....117**

5.1. Stage 1: discourse analysis.....	118
5.1.1. Analysis of food waste news .....	118
5.1.2. Synthesis: how results feed into next stage.....	121
5.2. Focus group .....	126
5.2.1. Thematic analysis.....	128
5.2.1.1. Ways of knowing.....	129
5.2.1.2. Direction of movement.....	129
5.2.1.3. What works and what does not.....	130
5.2.2. Discourse analysis .....	130
5.2.2.1. Ways of seeing the world through food waste.....	131
5.2.2.2. Interactions between participants.....	133
5.2.2.3. Speaking: anonymised, personal, professional.....	133
5.2.2.4. Academic language and language in practice.....	135
5.2.3. Synthesis: how results feed into the next stage .....	135
5.3. Policy co-design: Qualitative survey .....	135
5.3.1. Introduction .....	136
5.3.2. Characteristics of participants who recycle food waste .....	136
5.3.4. Need for top-down measures .....	139
5.3.5. Giving agency.....	140
5.3.6. Dominant, emerging, and conflicting discourses .....	141
5.4. Chapter summary.....	142

## **Chapter 6. Results: Water and Energy Metering .....144**

6.1. Discourse analysis of marketing materials .....	145
6.2. Exploratory focus group.....	151
6.2.1. Water-Energy Nexus as cross-sectoral learning .....	151
6.2.2. Theme 1: Misplaced aims .....	156
6.2.3. Theme 2: intelligent choices.....	157

6.2.4. Theme 3: Focus on the needs .....	158
6.2.5. How results feed into the next stage .....	160
6.3. Policy co-design: targeted focus group.....	160
6.3.1. Theme 1: Two markets .....	161
6.3.2. Theme 2: Tailored communication.....	162
6.3.3. Theme 3: The right narrative .....	163
6.4. Discourse analysis – summary of exploratory and targeted focus groups ....	164
6.4.1. Interactions between participants.....	165
6.4.2. Speaking as: customer vs professional .....	167
6.4.3. Academic language and language in practice .....	168
6.4.4. Feeding focus group results into the GIS decision-support tool.....	169
6.5. Multicriteria decision-making (MCDM).....	170
6.5.1. Cartography: Highly Disadvantaged areas.....	172
6.5.2. Cartography: Highly Capable areas .....	176
6.5.3. Testing data sensitivity:.....	180
6.6. Chapter summary.....	185

<b>Chapter 7. Discussion .....</b>	<b>186</b>
7.1. Research design. .....	187
7.1.1. Discourse analysis.....	188
7.1.1.1. Learning about the method.....	188
7.1.1.2. Selection of sources.....	188
7.1.1.3. Does discourse analysis "expire"?.....	189
7.1.2. Focus groups .....	189
7.1.2.1. Participants' recruitment.....	184
7.1.2.2. Facilitation .....	186
7.1.2.3. How useful were focus groups?.....	186
7.1.3. Policy co-design.....	192
7.1.3.1. Qualitative survey.....	187
7.1.3.2. Multicriteria Decision-making.....	188
7.1.4. Researching <i>with</i> practitioners.....	190
7.1.5. How did epistemology inform the research?.....	192

7.2. Discussion of results.....	198
7.2.1. Food waste theme.....	199
7.2.1.1 Discourses of food waste.....	199
7.2.1.2. Unintended policy consequences.....	202
7.2.1.3. Discussing survey results.....	204
7.2.1.4. Policy limitations.....	205
7.2.1.5. Food waste summary.....	206
7.2.2. Smart meters theme.....	207
7.2.2.1. Discourses of metering.....	207
7.2.2.2. Translating between the academia and practice.....	210
7.2.2.3. On quantifying policy deliberations.....	212
7.2.2.4. Did the MCDM analysis unveil anything surprising?.....	212
7.2.2.5. Metering summary.....	216
7.3. Chapter summary .....	216
<b>Chapter 8. Critical reflections from the process.....</b>	<b>219</b>
8.1. PhD as learning.....	218
8.2. Acknowledging research challenges .....	220
8.2.1. Not involving lay citizens.....	221
8.2.2. Integrating methods and concepts.....	222
8.2.3. Ambition to redefine the WEF Nexus.....	223
8.3. Lessons from another WEF Nexus project .....	223
8.4. Dissemination .....	224
8.5. Ideas I would like to take forward .....	226
8.6. PhD as a professional development.....	226
8.7. Chapter summary .....	228

<b>Chapter 9. Conclusions and recommendations.....</b>	<b>230</b>
9.1. Theoretical contributions.....	231
9.1.1. On practitioners' understanding of the WEF Nexus.....	232
9.1.2. On the WEF Nexus and climate justice.....	232
9.2. Policy recommendations.....	231
9.2.1 Food waste .....	231

9.2.2. Metering .....	232
9.3. Synthesis: Objective 1.....	233
9.4. Synthesis: <i>Objective 2</i> .....	237
9.5. Synthesis: <i>Objective 3</i> .....	237
9.6. Synthesis: Achieving research aim .....	238
9.7. Further research recommendations .....	238
9.7.1. Food waste theme .....	238
9.7.2. Smart metering theme.....	239
9.7.3. Methodological recommendations.....	239
9.7.4. Empirical recommendations.....	241
References .....	<b>242</b>

## List of Appendices

<b>Appendix A:</b> Peer-reviewed journal article “Co- designing food waste services in the catering sector”.....	259
<b>Appendix B:</b> Policy brief: “Changing landscape of food waste in the catering sector, Bristol UK”.....	295
<b>Appendix C:</b> Peer-reviewed journal article “Enhancing the communication potential of smart metering for energy and water”.....	299
<b>Appendix D:</b> Policy brief: “Communicating the potential and limitations of smart meters”.....	322
<b>Appendix E:</b> Participant Information Sheet (Focus Group 1).....	325
<b>Appendix F:</b> Participant Information Sheet (Focus Group 2 and 3).....	328
<b>Appendix G:</b> Participant Information Sheet (Survey).....	330
<b>Appendix H:</b> Consent Form (Focus Groups).....	332
<b>Appendix I:</b> Peer-reviewed journal article “Building smart cities, the just way. A critical review of ‘smart’ and ‘just’ initiatives in Bristol, UK”.....	334

# List of Figures

<b>Figure 1.1.</b> A Tree map of 10 Web of Science categories most commonly associated with transdisciplinary peer-reviewed publications.....	3
<b>Figure 1.2.</b> A map of the study area: Bristol Local Authority.....	5
<b>Figure 1.3.</b> Policy cycle diagram illustrating how the co-design approach relates to the other stages of policy development.....	8
<b>Figure 2.1.</b> Conceptualisation of climate justice based on the recognition of pre-existing injustices as a necessary basis for assessment of responsibilities, rights, distributions, and procedures.....	13
<b>Figure 2.2.</b> Relationships between various appellations of justice.....	17
<b>Figure 2.3.</b> Types of nexus applied in this research.....	27
<b>Figure 2.4.</b> Five possible combinations of the WEF Nexus with some example issues.....	28
<b>Figure 2.5.</b> Progress on smart meters installation between 2012 and 2018.....	43
<b>Figure 2.6.</b> Waste Hierarchy.....	46
<b>Figure 2.7.</b> Kilograms of household waste per person per year 2004/05 to 2014/2015.....	53
<b>Figure 2.8.</b> Results of waste composition analysis.....	54
<b>Figure 3.1.</b> Methodology applied to the research thesis – food waste theme.....	59
<b>Figure 3.2.</b> Methodology applied to the research thesis – smart metering theme....	61
<b>Figure 3.3.</b> Action-reflection cycle: theory and practice.....	76
<b>Figure 3.4.</b> A diagram of enablers, participants, stakeholders and researchers.....	78
<b>Figure 3.5.</b> From opinions to the new knowledge – how theories are formed in action research.....	85
<b>Figure 3.6.</b> My results of the Political Compass test.....	86
<b>Figure 4.1.</b> Action-Reflection cycle: theory and practice.....	90
<b>Figure 4.2.</b> Conceptualisation of climate justice based on the recognition of pre-existing injustices as a necessary basis for assessment of responsibilities, rights, distributions, and procedures.....	91

<b>Figure 4.3.</b> A diagram illustrating how three dimensions of capability/disadvantage were translated into data needs.....	113
<b>Figure 5.1.</b> Summary of research stages related to the food waste theme.....	117
<b>Figure 5.2.</b> A diagram of themes arising from the focus group data analysis.....	127
<b>Figure 5.3.</b> Barriers to food waste recycling in the catering sector.....	138
<b>Figure 5.4.</b> Policy measures recommended by the participants.....	140
<b>Figure 6.1.</b> Summary of research stages related to the metering theme.....	144
<b>Figure 6.2.</b> Themes and codes resulting from the analysis of the exploratory focus group.....	156
<b>Figure 6.3.</b> Diagram of main themes and nodes occurring during the targeted focus group on metering.....	161
<b>Figure 6.4.</b> Combined discourse analysis of two focus groups on metering.....	165
<b>Figure 6.5.</b> Three weighting techniques used to derive three policy prioritisation scenarios.....	171
<b>Figure 6.6.</b> The “Informed subjective” scenario resulting from the MCDM analysis.....	173
<b>Figure 6.7.</b> The “Equal weights” scenario resulting from the MCDM analysis.....	174
<b>Figure 6.8.</b> The “Random exaggeration” scenario resulting from the MCDM analysis.....	175
<b>Figure 6.9.</b> The “Informed subjective” scenario resulting from the MCDM analysis.....	177
<b>Figure 6.10.</b> The “Equal weights” scenario resulting from the MCDM analysis.....	178
<b>Figure 6.11.</b> The “Random exaggeration” scenario resulting from the MCDM analysis.....	179
<b>Figure 7.1.</b> Updated communication materials on smart meters.....	188
<b>Figure 7.2.</b> Income Deprivation in Bristol.....	213
<b>Figure 7.3.</b> The key output of the MCDM decision-support tool - “Highly Disadvantaged” areas according to the “Informed Subjective” scenario.....	214
<b>Figure 7.4.</b> The key output of the MCDM decision-support tool - “Highly Capable” areas according to the “Informed Subjective” scenario.....	215
<b>Figure 8.1.</b> A timeline of global energy consumption by fuel source.....	227

## List of Tables

<b>Table 2.1.</b> A review of methods used to research climate justice.....	22
<b>Table 2.2.</b> A review of methods used in the WEF Nexus research.....	35
<b>Table 2.3.</b> The UK annual food waste estimates for the hospitality and catering sector.....	48
<b>Table 2.4.</b> Main concepts investigated in the PhD thesis: potential and limitations.....	58
<b>Table 3.1.</b> Opportunities for knowledge co-production following the initial focus group.....	65
<b>Table 3.2.</b> A set of mixed methods applied in Stage 3 “Co-design of local policies”...	68
<b>Table 3.3.</b> Conceptual framework of the research.....	88
<b>Table 4.1</b> Heuristic for the discourse analysis applied in Stage 1.....	92
<b>Table 4.2.</b> A list of news articles on food waste analysed in this thesis.....	84
<b>Table 4.3.</b> A list of the promotional materials on energy and water metering analysed in this thesis.....	96
<b>Table 4.4.</b> A list of participants attending exploratory focus groups during Stage 2 of the research.....	98
<b>Table 4.5.</b> A list of questions for two exploratory focus groups in Stage 2.....	100
<b>Table 4.6.</b> Key characteristics of the areas surveyed.....	104
<b>Table 4.7.</b> Participants present during the targeted focus group on metering.....	106
<b>Table 4.8a.</b> List of questions for a targeted focus group.....	107
<b>Table 4.8b.</b> Examples of flashcards presented during the focus group.....	108
<b>Table 4.9.</b> A detailed description of datasets used during MCDM analysis.....	111
<b>Table 4.10.</b> “Informed subjective” scenario.....	114
<b>Table 4.11.</b> “Equal weights” scenario.....	115
<b>Table 4.12.</b> “Random exaggeration” scenario.....	115
<b>Table 5.1.</b> The results of discourse analysis of food waste news.....	119
<b>Table 5.2.</b> Ways of seeing the world through food waste: Whose responsibility? Whose solutions?.....	131
<b>Table 5.3.</b> Description of the policy co-design priority for the food waste theme....	135

<b>Table 5.4.</b> Survey participants' characteristics.....	136
<b>Table 5.5.</b> A proportion of participants already recycling food, outlined by area and type.....	137
<b>Table 6.1.a.</b> Key themes resulting from the discourse analysis of metering promotional materials (Source: Ofwat, 2013).....	146
<b>Table 6.1.b.</b> Key themes resulting from the discourse analysis of metering promotional materials (source: Bristol Water, 2016).....	147
<b>Table 6.1.c.</b> Key themes resulting from the discourse analysis of metering promotional materials (source: Bristol Energy, 2016).....	149
<b>Table 6.1.d.</b> Key themes resulting from the discourse analysis of metering promotional materials (source: Smart Energy GB, 2017).....	150
<b>Table 6.2.</b> The present and the future of water and energy meters – as predicted by the participants.....	152
<b>Table 6.3.</b> Conceptualisation of “highly capable” and “highly disadvantaged” areas applied to the MCDM analysis.....	170
<b>Table 6.4.</b> “Informed subjective” scenario.....	171
<b>Table 6.5.</b> “Equal weights” scenario.....	172
<b>Table 6.6.</b> “Random exaggeration” scenario.....	172
<b>Table 6.7.</b> A comparison of priority scores assigned to “highly disadvantaged” LSOAs as a result of the three different weighting scenarios.....	184
<b>Table 6.8.</b> A comparison of priority scores assigned to “high capability” LSOAs as a result of the three different weighting scenarios.....	179
<b>Table 7.1.</b> The composition of focus groups.....	190
<b>Table 7.2.a.</b> Discourses found in media representations of food waste (2015-2016): Who is responsible?.....	200
<b>Table 7.2.b.</b> Discourses found in media representations of food waste (2015-2016): attitudes present.....	201
<b>Table 7.2.c.</b> Discourses found in media representations of food waste (2015-2016): types of measures proposed.....	201
<b>Table 8.1.</b> What I was thinking when facing research challenges.....	220

**Table 8.2.** A list of the non-academic events, during which I disseminated my research.....225

**Table 9.1.** Selected discourses of food waste across the research stages.....234

**Table 9.2.** Selected discourses of metering across the research stages.....236

# 1. Introduction

Research on complexity in sustainability has a long history. The Water-Energy-Food (WEF) Nexus is a recent, yet one of the most frequently used formulations. The WEF Nexus aims to describe the interactions between water, energy and food systems to ensure resource security and sustainability for all. Since its inception in 2011, the WEF Nexus has risen in popularity in the international policy strategies. However, it is still unclear whether the term is relevant to the urban-scale policies. This thesis will develop a local understanding of the WEF Nexus to determine whether this concept could contribute to the low carbon future of Bristol.

## 1.1. Cross-cutting global challenges

In December 2015, 195 countries signed the Paris Agreement to "strengthen the response to the threat of climate change by keeping a global temperature rise "below 2 degrees Celsius above pre-industrial levels" (UNFCCC - United Nations Framework Convention on Climate Change, 2015). Several years earlier, the UK government pledged to reduce greenhouse gases (GHG) emissions by at least 80% by 2050 from a 1990 baseline in its Climate Change Act (HM Government, 2008). Cities around the world have taken up the challenge by joining programmes like the Covenant of Mayors (European Commission, 2008a), ICLEI – Local Governments for Sustainability (1990) and the Transition Network (2006). However, the key question remains: how to mobilise society and bring about the urgent and systemic change required?

There is a global consensus that anthropogenic climate change is a fact. Apart from a few populist political figures, the vast majority of policymakers, scientists, and businesses accept that human actions have caused unprecedented levels of GHGs (Pearce *et al.*, 2017). However, while debating whether climate change is real can be left to the climate scientists, grappling with the scale of danger, urgency and ethics of the issue is a question of politics (Demeritt, 2006).

In a search to unpack how dangerous climate change is, one could start with investigating the metrics of carbon emissions and temperatures. As from 2016, the global concentration of CO<sub>2</sub> passed 400 parts per million (ppm), which corresponds to the mid-Pliocene climate (3-5 million years ago), where the planet was 2-3 degrees Celsius warmer and ice sheet loss led to sea levels 10-20m higher than today's (World Meteorological Organisation, 2017). Moreover, each consecutive year is dubbed "the hottest on record", with the average global temperature in 2016 being already over 1 degree Celsius higher than the late 19<sup>th</sup> century temperatures when such

measurements started (NASA – The National Aeronautics and Space Administration, 2017). As of 2018, we have 10 years of the current “carbon budget”<sup>1</sup> left, before the global temperature will likely<sup>2</sup> rise above 1.5 degrees Celsius (IPCC – The Intergovernmental Panel on Climate Change, 2018). Yet, renewable energy still comprises only 18.2% of the total energy consumption worldwide (REN21 – Renewable Energy Policy Network for the 21<sup>st</sup> Century, 2018; data from 2016). These figures do not inspire optimism. In fact, the sheer scale and complexity of the issue has led to a sense of disempowerment and apathy regarding how best to tackle climate change (Marshall, 2014; Tollemache, 2018)

The reason for the slow progress so far might a result of inadequate framings – catchphrases like “1 centigrade warming” and “400 ppm CO<sub>2</sub>” are not deemed sufficient to mobilise the radical change required (Pearce *et al.*, 2017). Additionally, an increasing number of academics agree that mitigating climate change cannot be solely understood in terms of “decreasing GHG emissions” since it is, in fact, a symptom of multiple, interconnected planetary crises:

- The imperative of economic growth leading to excessive consumption of environmental resources (Meadows *et al.*, 1972; Boulding, 1966; Jackson and Webster, 2016);
- The depletion of resources leading to predictions of “the perfect storm” of water, energy and food scarcity and conflicts (Beddington, 2009);
- The risk of crossing the tipping point of irreversible environmental deterioration (i.e. due to the loss of biodiversity, ocean acidification, nitrates concentration) (Rockstrom *et al.*, 2009);
- The uneven distribution of climate change aftermaths (e.g. extreme weather events) deepening-socio-economic inequalities (Jenkins *et al.*, 2016; Bulkeley *et al.*, 2014)

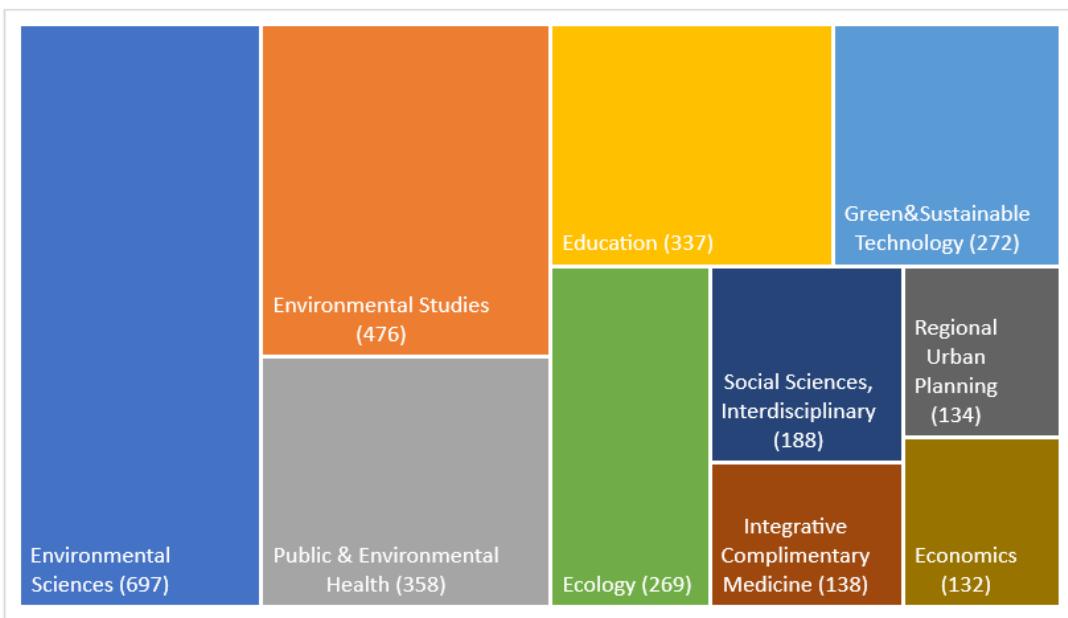
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<sup>1</sup> Carbon budget is an estimated amount of GHG a given area can emit to comply with the imperative to avoid dangerous climate change, as agreed by their carbon strategy (e.g. national legislation, Paris Agreement etc.) (World Resources Institute, n.d.)

<sup>2</sup> Here “likely” is defined as “66% chance” (IPCC – the Intergovernmental Panel for Climate Change, 2018)

Global warming is therefore both complex and urgent. It requires insights from a wide range of academic disciplines, just as much as it needs policy, civil society and business responses. Finally, it necessitates both technical and systemic actions.

Therefore, the shift in the orientation of climate change research has been characterised by a departure from theory formation in favour of synthesising interconnections in applied ways (Funtowicz and Ravetz, 1993). Sustainability research, therefore, calls for the transgression of disciplinary and sectoral boundaries (Gibbons *et al.*, 1994; Lang *et al.* 2012), in other words- co-production of research and policy recommendations. Transdisciplinary researchers argue that bringing together the expertise of a wide range of academic and non-academic actors in an egalitarian, deliberative and respectful way could pave the way to sustainable futures (Lang *et al.*, 2012; Stirling, 2015; Stokols, 2006; Klein, 2014). The notion of combining multiple disciplines and sectors has been applied to a variety of topics, but transdisciplinary research has predominantly attracted the attention of sustainability practitioners (Figure 1.1).



**Figure 1.1.** A Treemap of 10 Web of Science categories most commonly associated with transdisciplinary peer-reviewed publications (1980-2018)

This thesis suggests that the urban scale provides an appropriate locus for sustainability research undertaken in a transdisciplinary manner. Researching cities and local actions creates a fertile ground for co-production and makes it possible to “bind” the project in realistic timescales and aims.

## 1.2. Cities and Climate Change

In the UK, Cities emit over two-thirds of total GHGs and are home to over 80% of the population (World Bank, 2010; DEFRA, 2019). Cities are small enough to introduce tangible local low carbon actions (e.g. energy co-ops, congestion charges, waste collection services, discounts on local procurement) which can, collectively, work towards national targets (Bulkeley and Betsill, 2005). Urban scale actions can contribute to the empowerment of residents as they participate in decision-making and are directly impacted by the outcomes of their actions (Bulkeley and Mol, 2003).

Academics aren't the first to realise this. Numerous practitioners from across the public, private and charity sectors have been working on low carbon actions in cities for decades. By applying policy, manufacturing or market-based solutions, they have been enacting what academics theorise as "sustainability" (Luke, 2005). However, practitioners' understanding of popular terms in the sustainability discourse differs from the academic critiques of "buzzwords" such as "green", "fair", "smart" and "nexus" (Luke, 2005; Finger and Razaghi, 2017; Cairns and Krzywoszynska, 2016). This indicates a need to investigate the discourse of the emerging transdisciplinary sustainability praxis.

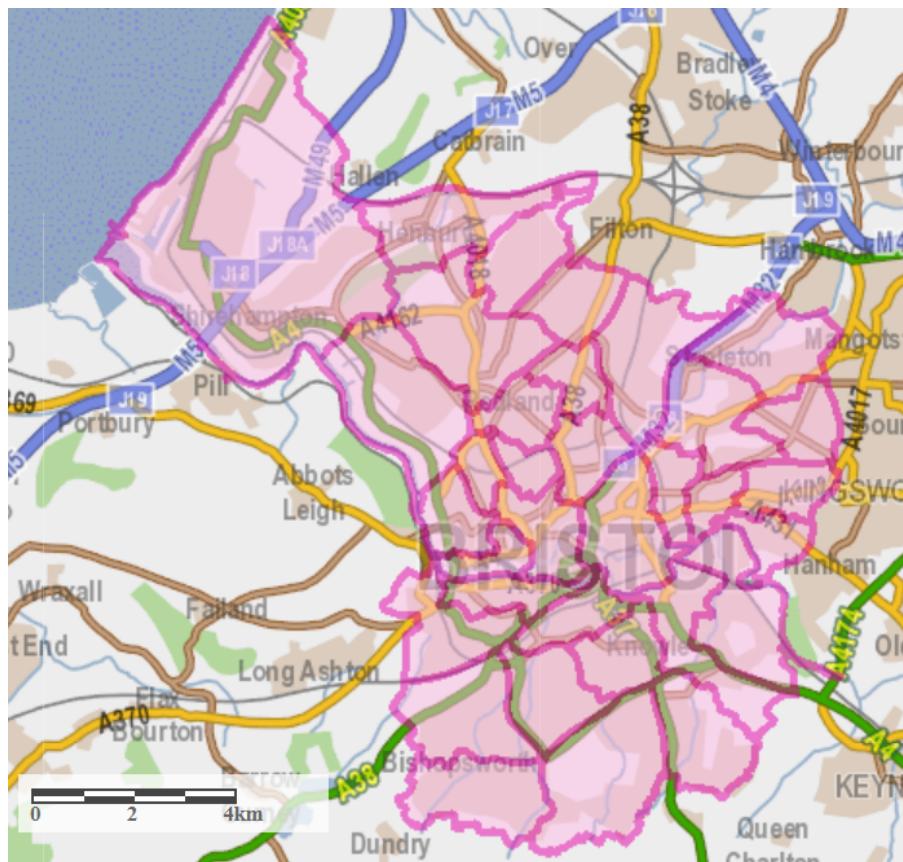
One of the buzzwords of sustainability research is the aforementioned "nexus". If climate change is the challenge and transdisciplinarity is the recommended mode of knowledge production, nexus is an analytic lens which complements integrative and co-productive approaches. While various nexus can be found across all topics and disciplines, in sustainability research the leading formulation has been "Water-Energy-Food Nexus" (the WEF Nexus) (Cairns and Krzywoszynska, 2016). There is no single definition of the WEF Nexus, however, in the broadest sense, it is understood as an analytical tool to investigate trade-offs, synergies, metrics, organisational practices, and policies relating to the relationships between water, energy and food (Hoff, 2011). The WEF Nexus approach is operational and popular at the global scale (e.g. FAO – Food and Agriculture Organisation, 2018; Hoff, 2011), however, it has not yet been widely applied within the context of cities.

While the focus of the WEF Nexus discourse has been on resources, it is ultimately people themselves who access them and who are affected by their availability, cost and quality (Cairns and Krzywoszynska, 2016). For this reason, climate change scholarship seeks to generate answers about the fairness of urban environmental actions: How will residents be affected by low carbon actions – who will benefit from,

pay for, decide about, or be excluded or included from the processes and their outcomes? As residents of UK cities are subjected to high levels of social inequality, environmental policies cannot be applied to everyone in the same way. Therefore, differentiation of responsibility and capability to change should be an essential consideration (Adger, 2001).

### 1.3. Local context

Consequently, this research is concerned with an integrated approach to climate change research through the co-design of local policy recommendations for the low carbon and just future for the city of Bristol, UK. The study boundaries, therefore, equal the administrative boundaries of Bristol City Council (BCC) (Figure 1.2).



**Figure 1.2.** A map of the study area: Bristol Local Authority (Adapted from Bristol City Council, 2015; Copyright by Ordnance Survey 2015)

Bristol is located in the South-West of the UK, with a population of 442 000 residents (Bristol City Council, 2015a). It is a signatory of the UN-wide climate change mitigation commitment, the Global Parliament of Mayors (2014). In 2015, the city adopted its own Climate Change Framework (Bristol City Council, 2015a), building upon the national, legally binding Climate Change Act (HM Government, 2008). The document sets targets to reduce urban GHG emissions by 40% by 2020 (based on

2005 baseline) and an ambition to become carbon neutral by 2050 (Bristol City Council, 2015a). More recently, BCC accepted the motion to bring the “carbon neutrality” target forward to 2030, following the release of the IPCC report which estimates that the world has 10 years left to become carbon neutral and stay within a 1.5 degrees Celsius temperature increase (Bristol Green Capital Partnership, 2018a; IPCC – The Intergovernmental Panel on Climate Change, 2018).

In 2015, the city was awarded the title of EU “Green Capital”, which was a recognition of its efforts in the field of sustainability, and an incentive for further local low carbon investments (Bristol Green Capital Partnership, 2015a). The Green Capital year left a legacy in the form of Bristol Green Capital Partnership, which represents a gathering together of over 850 local organisations, working together to campaign, educate and lobby for local sustainability (*ibid.*). Finally, there are indications that Bristol’s citizens are themselves increasingly concerned about climate change, as they are organising themselves into numerous grass-root groups – e.g. Bristol Energy Network, LifeCycle UK, Feed Bristol and Co-Resist (Torrens *et al.*, 2018; Lacey-Barnacle and Bird, 2018).

#### 1.4. Research questions, aims and objectives

The research seeks to answer the following question:

- 1. How can action research approach contribute to Bristol’s sustainability ambitions?*

Addressing the above questions helps to meet the overarching aim of the research, which is to co-produce policy recommendations for a low carbon future of Bristol with a wide range of practitioners from the public, private and charity sectors.

Three objectives have been determined to achieve the research aim:

- 1. To examine discourses on the selected sustainability challenges in Bristol.*
- 2. To provide the evidence base for the local low carbon policy recommendations.*
- 3. To exemplify the opportunities for just environmental policymaking.*

The main practical contribution of this thesis lies in creating a space for transdisciplinary research where the stakeholders from the public, private, charity

and academic sectors are participating not only in theory formation but also in improving their practice. Meanwhile, the main theoretical contribution of the thesis lies in illuminating links between the WEF Nexus and climate justice.

The aim and objectives of the thesis are achieved by drawing on cross-sectoral learning with sustainability practitioners using the themes of smart metering and food waste.

### 1.5. Boundary conditions

It is important to define the boundary conditions of the study. These include the meaning of the thesis title, key terms, the timescales, study area, research assumptions, and finally – the scope of the issues analysed.

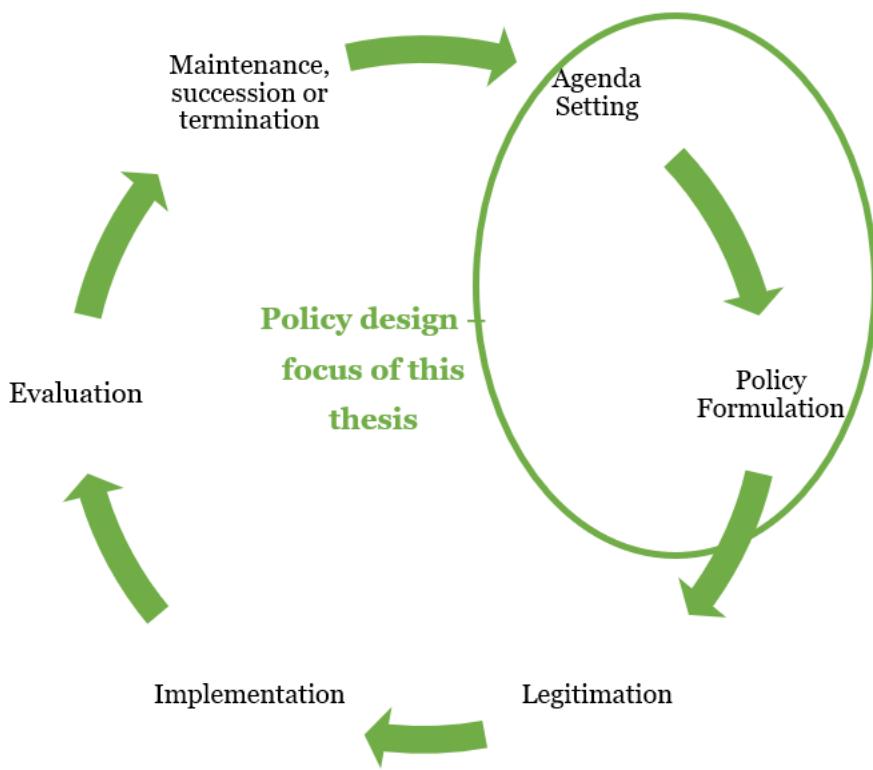
The research question is bounded in time and space. “Low carbon future” refers to the focus on climate mitigation policies, in line with Bristol’s ambition to become carbon neutral by 2030 (Bristol Green Capital Partnership, 2018a). The policies resulting from the research recommendations are intended to operate in Bristol – as defined by the Bristol Local Authority boundaries (Figure 1.2). The researcher acknowledges that the policymaking landscape involves multiple levels of governance and diverse actors. Therefore, throughout the thesis, “local policies” pertain to the collective of actions co-produced by the Bristol-based practitioners from the public, private and charity sectors.

The policies resulting from the research recommendations of the thesis can be were drawn using action research approach as they bring together stakeholders from a variety of sectors into the policy design cycle (Blomkamp, 2018). This differs from modes of “expert” knowledge production, where the researcher’s role is to build a theory based on dispassionate observations of the world (Nowotny, 2003). That the thesis draws from traditions such as living theory action research (McNiff and Whitehead, 2012), transdisciplinarity (Lang *et al.*, 2012) and co-production (Bevir *et al.*, 2019) which aim to co-create knowledge “together with” the local sustainability practitioners. In the context of the thesis, terms like “co-design” and “co-production” refers to the early phase of the policy cycle<sup>3</sup> rather than its implementation or evaluation (Figure 1.3). Usually, policies are designed behind closed doors by a narrow group of senior experts working from the same team (Blomkamp, 2018). The

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<sup>3</sup> Policy cycle is an idealized and simplified representation explaining how policies should be priorities, designed, implemented and evaluated (Cairney, 2015).

innovation of this thesis lies in bringing together a diversity of sustainability practitioners – people who work for different sectors and who have varying levels of seniority. In terms of the study design, the use of terminology like “co-design” and “co-production” is synonymous with the overarching methodology of action research – in-depth exploratory research *with* practitioners and policy recipients (here catering sector). Appreciating the debate on the multiple meanings and application of “co-production” and “co-design” (Oliver *et al.*, 2019; Pohl *et al.*, 2010) the researcher specifies her ambition as extending the circle of “policymakers” and “researchers” outside the government and academia. In doing so, the research involves a wide range of sustainability practitioners who are treated as “co-researchers”.



**Figure 1.3.** Policy cycle diagram illustrating how the policy design approach relates to the other stages of policy development. Green circle refers to the early stage of the policy cycle: policy design (adapted from Cairney, 2015)

The research investigates whether the scholarship of “the WEF Nexus” and “climate justice” is applicable and useful at the local scale. The WEF Nexus is understood as the array of intersections and relationships between water, energy and food systems and their impact on the city’s climate mitigation efforts (Hoff, 2011). Climate justice is understood as concerning equitable access to environmental resources,

responsibility for the GHG emissions, the right to benefit from policy incentives - including the notion of justice in the procedures, and recognition of pre-existing injustices (Bulkeley *et al.*, 2014).

As a result, the research was conducted in a transdisciplinary mode. First of all, the project spans the thematic domains of the WEF Nexus and the multiple dimensions of climate justice. Its transdisciplinarity also lies in the integration of mixed methods. Finally, the results are co-produced with non-academic actors across the private, public and charity sectors (Harris and Lyon, 2013).

Due to time and resource constraints, it is important to note the issues that do not fall within the scope of this research. First, the research is limited to urban actions – national and global scale policies were not addressed here. Similarly, the thesis does not consider the individual scale or the psychology of climate change. Although the researcher agrees that the impacts of environmental policy need to be accounted for in an integrative way, she accepts that a single PhD project cannot provide a complete assessment of all of the environmental and social impacts of the themes present in the thesis. For this reason, the thesis singles out the relationship between the WEF Nexus and climate justice, excluding issues such as resources quality, biodiversity, health, and climate adaptation.

Finally, the thesis focuses on working with local sustainability practitioners and the recipients of potential food waste policy (the local catering sector). While the researcher paid particular attention to ensure diversity within the sample (in terms of sectors, seniority of practitioners and localities of the catering businesses), the thesis didn't intend to represent the whole Bristol population for two reasons. Action research is defined as “researching with practitioners to improve their everyday practice” (McNiff and Whitehead, 2012) – hence asking questions about professional experiences rather than personal opinions. Second, the budgetary provisions of the PhD programmes do not typically allow fair inclusion of the lay members of the public.

## 1.6. Thesis overview

This thesis proceeds as follows. The first two chapters provide context to the research, as well as a literature review of the relevant peer-reviewed studies and policy documents. Chapter 2 reviews the literature on the WEF Nexus, urban climate justice and two themes selected as representative of these frameworks: smart metering and food waste. Furthermore, Chapter 2 introduces the reader to the local context:

specifically, regarding governance, environmental strategy, spatial injustices and community action in Bristol.

The next two chapters are concerned with methodology and research design. Chapter 3 focuses on the overarching methodology. It explains the overall strategy and briefly outlines each stage of data collection and analysis. It then discusses the epistemology of the research, as well as challenges typical to action research such as self-reflection, conceptual baggage and ethics.

Chapter 4 describes in detail the design of the research. It justifies each method, providing the rationale for data collection, the selection of sources and participants, data analysis and continuity between each phase of data collection.

Chapters 5 and 6 then present the results of the research, divided into the thematic and data collection phases.

The results are discussed in Chapter 7. The chapter elaborates on the role of each research stage in the process and their relevance to the WEF Nexus and climate justice. It also deliberates the significance of the results in light of the existing literature.

The researcher then reflects on the whole experience in Chapter 8, acknowledging challenges, successes as well as accounting for her professional development.

Finally, Chapter 9 draws conclusions about the study and provides practical recommendations for the city as well as for the WEF Nexus, action researchers and climate justice scholars. Finally, this chapter evaluates whether the research objectives and aims were met successfully.

## **2. Literature Review**

The following chapter reviews the academic and policy literature on the topics related to the thesis. It introduces the concepts of the WEF Nexus and urban climate justice and traces the recent developments in the areas of food waste management and smart metering. Furthermore, it sets the local context and presents policy progress.

The literature review aims to establish the “boundaries of knowledge” by familiarising the reader with the history of the issues investigated, locating the gaps in the literature, identifying seminal papers, critiquing the research to date, and finally - providing an overview of the relevant methods. Overall, the thesis is characterised by an interest in the transdisciplinary approaches and cross-cutting issues and the literature review reflects this. This is achieved by synthesising outputs from across the academic disciplines and combining policy with scientific documents. Finally, the literature review is bound by the urban scale and the relevance of the academic concepts to the local issues.

### **2.1. Climate justice**

Chapter 1 argued that although quantifying and describing global warming is a domain of academia, the decisions which follow are ultimately political. Since the challenge is unprecedented, global and complex, it involves plural and conflicting values at stake (Demeritt, 2006). Regardless of the political action taken (or missing), humans and non-humans will bear the consequences. Following Latourian (2004) formulation, climate change is not only a “*matter of fact*”, but also a “*matter of concern*” (Demeritt, 2006). Thus, climate change and associated policies create a potential for deepening social inequalities (Jenkins *et al.*, 2016). There is growing evidence demonstrating unfortunate positive feedback between climate change and social inequalities. People who emit the most GHG consume the most resources, often imported from least economically developed areas which then suffer from resources shortages and increased climate vulnerability (Fuchs, 2017). For example, although the total of African countries contributes only 4% of the global GHG emissions, 38 out of 50 most climate-vulnerable countries are on that continent (*ibid.*). At the UK scale, Preston *et al.* (2014) suggest a direct relationship between personal income and GHG emissions – the top 10 % earners emit more than twice as much GHG as the lowest 10%. Furthermore, Preston’s *et al.* (*ibid.*) review indicates that low earners pay the highest proportion of income (in the form of energy bills) towards climate policies, yet they benefit the least from these initiatives.

Climate policies are often exclusively designed with the principle of superficial improvement of life to those already privileged, empowered or wealthy, without questioning what the good standard of life should be in the first place (Kaijser and Kronsell, 2013). Such interventions often allow the current lifestyles to continue, rather than fundamentally challenge the basic assumptions behind them (Luke, 2005). Historically, the design of feed-in-tariffs for solar panels or electric vehicles investments have been criticised for overlooking the most deprived in the society (Preston *et al.*, 2014). To summarise, environmental policies require critical re-design with the principle of justice as a central tenet.

### **2.1.1. Central questions: Who benefits? Who pays? Who decides?**

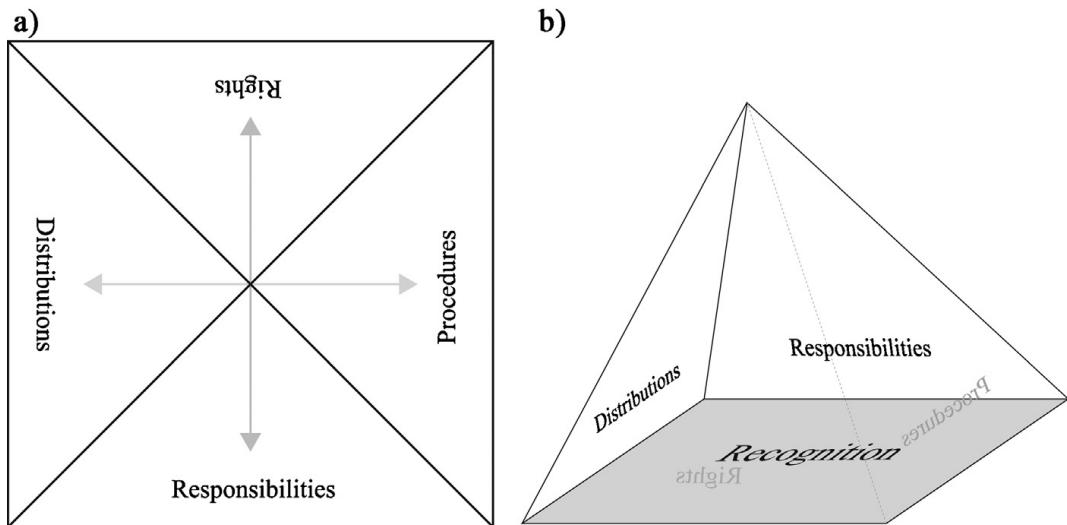
Climate action is a subject of lively debates amongst academics and policymakers; it generates questions about the nature of the transition to a sustainable future such as: “How will the residents be affected by the transition – who will benefit, pay, decide, be excluded or included?” (Sovacool and Dworkin, 2015, p.437; Bulkeley *et al.*, 2014, Jenkins *et al.*, 2016).

Climate justice is relatively new in the urban environmental policy discourse (Bulkeley *et al.*, 2014), therefore it creates a potential for terminological confusion. It is not clear whether politicians, local civil servants and grassroots communities have been applying “climate justice” in the manner as intended by the academics. For example, terms like “deprivation”, “equality”, “regional cohesion” were traditionally more common formulations which are reflected in specific policy documents and datasets (Bristol City Council, 2015b; HM Government, 2010; European Commission, 2014).

The following chapters will elaborate on the climate justice theories in academia and their application to policy. Chapter 2.1.2 outlines multiple dimensions of climate justice. Chapter 2.1.3 traces the history of the concept, including its early formulations as well as related terminology like “environmental justice”, “energy justice” or “fuel poverty”. Chapter 2.1.4 reviews qualitative and quantitative methods employed in climate justice scholarship. In particular, it emphasizes the geographical dimension of climate justice and the need for policy-design interventions.

### **2.1.2. Multiple dimensions of climate justice**

Climate justice is theorised as the consideration for the following factors in climate change policymaking: distribution of resources, procedures of inclusion, rights to benefit, the responsibility to pay and recognition of pre-existing injustices (Bulkeley *et al.*, 2014; Figure 2.1).



**Figure 2.1** Conceptualisation of climate justice based on the recognition of pre-existing injustices as a necessary basis for assessment of responsibilities, rights, distributions, and procedures. (Bulkeley *et al.*, 2014; licensed under Creative Commons BY 3.0)

### Early conceptions

Climate justice can be traced back to the Brundtland Report (United Nations World Commission On Environment and Development, 1987), which states that people have an equal right to basic liberties (e.g. provision of water, energy, and food). Second, early climate justice scholars emphasised that societal goods, risks, burdens and power ought to be distributed equitably in the society (Dobson, 1998). The development of the theory of justice has shifted its interest towards the assessments of capabilities and responsibilities (Sen, 2003).

### The Capability approach

What does it mean to be capable? Sen's (*ibid.*) emphasis is on a human rather than resources— his work brought attention to the notions of agency, opportunities and plural understandings of happiness. Capabilities approach (Sen, 2003) provides with tools for thinking about the agency *as well as* structure. Sustainability practice and research are well-known for the tension between the individual and the systemic change (Shove, 2010). While the individuals alone should not be blamed for systemic environmental crises, the same individuals often want to become part of a solution (Evans, 2012). Bringing attention to capabilities acknowledges people's capabilities (or their lack of) to make pro-environmental life choices. This shift allows to reconceptualise responsibility for climate action and assign it to actors, organisations or states with high capability. At the same time, it draws a hopeful vision of humans

who are willing to adopt sustainable policies and lifestyles, as long as they're in possession of the pre-requisite capabilities (Wood and Roelich, 2019).

Schlossberg (2012) argues that the hopeful and optimistic framing of capability approach allows focusing on the range of conditions necessary for people to develop free and productive lives they value for themselves. In practice, being capable could manifest as, for example:

- having enough money to purchase sustainable produce,
- owning a house and, therefore, being able to improve energy efficiency at the building level,
- being educated to make informed choices about environmental issues
- being included in activities related to knowledge production and policymaking.

While Sen (2003) doesn't provide a complete list of capabilities, Nussbaum (2001) suggests 10 capabilities 'essential for human dignity'. These are: 1. Life. 2. Bodily health. 3. Bodily integrity. 4. Senses, imagination and thought. 5. Emotions. 6. Practical reason. 7. Affiliation. 8. Other species. 9. Play. 10. Control over one's environment. Schlosberg (2012) and Wood *et al.* (2019) that capabilities 8 and 10 speak to climate action directly as they're concerned with the ability to be concerned and care for animals and plants and having opportunity to participate effectively in political choices that govern one's life.

Other climate researchers understood "the capability approach" as identifying people and areas where high GHG emissions are coupled with the high capability to reduce individual impacts. This was achieved by mapping and comparing energy consumption to income, education and tenure as illustrated by Chatterton *et al.*, (2016). Conversely, the capability approach could also bring attention to leveraging capabilities in disadvantaged areas or communities excluded from decision making or knowledge production (Middlemiss *et al.*, 2019). Schlosberg (2012) noted that for this reason the capability approach is strongly interconnected with the notion of procedural justice and policy processes.

## **Intersectionality**

More recent conceptualisations of climate justice emphasize the need to recognise the pre-existing and interconnected injustices (Bulkeley *et al.*, 2014). Recognition approach holds the view that distributional equities are fundamentally linked to cultural injustices, e.g. class, gender, ethnicity, health, age, or sexuality (*ibid.*). The inclusion of multiple social and cultural dimensions of injustice into the climate action

agenda echoes the theory of intersectionality, which investigates multiple structures of oppression and their interactions (Kaijser and Kronsell, 2013). Intersectionality brings attention to the experiences of injustice, which result from the interactions between the social, economic and cultural attributes of humans.

Critics, however, argue that the addition of “intersectionality” would complicate the climate justice framework making it difficult to apply in practice (Davis, 2008). There have been only a few attempts to outline methodological guidelines with regards to the intersectional analysis (McCall, 2005; Kaijser and Kronsell, 2013). The prevalent focus on the ultimate unifying theory leaves the researchers with an unexplored gap with regards to the appropriate techniques to employ. However, it must be noted that the goal of broadening climate justice agenda to “recognition” or “intersectionality” does not equate with including as many analytical categories as possible, instead, it aims to widen the perspective and reflect upon what factors may be decisive in a particular policy setting (Kaijser and Kronsell, 2013).

While the appreciation for complexities is a central tenet of this thesis, the researcher’s primary focus is on economic injustice (e.g. fuel/water poverty, income deprivation) and procedural justice (participation in policymaking). Intersectional approaches yield themselves better to an individual-scale, whereas this PhD is concerned with urban change (Martinez Dy *et al.*, 2014). Furthermore, intersectionality is often critiqued for treating class, economic inequality and poverty as one of the “categories of oppression”, whereas they, in fact, have often a complex relationship with socio-cultural forms of marginalisation like race, gender or sexuality (Block and Corona, 2014).

Next chapter will trace the developments in climate justice scholarship and methods as well as its applicability to research and policy.

### 2.1.3. Overview of the literature and future directions

Traditionally, the climate justice debate has been concerned with the responsibilities and vulnerabilities of the Global North vs the Global South (Schlosberg and Collins, 2014). The inhabitants of the world’s least economically developed countries (LEDCs) have limited contribution to climate change, yet they disproportionately suffer from its consequences. Following the years of global negotiations, the UN published the recommended course of action and the right of LEDCs to emit proportionately more GHG emissions in order to allow their economic development (United Nations, 1992).

Subsequently, the focus of climate justice shifted to investing in adaptation measures in countries most at risk of its aftermaths (Adger *et al.*, 2005). For example, Shi *et al.*

(2016) – proposed an urban climate adaptation research roadmap, which includes research priorities like broadening participation, supporting rapidly growing cities, integrating justice in infrastructure and planning processes.

### **Gap – urban climate justice and mitigation**

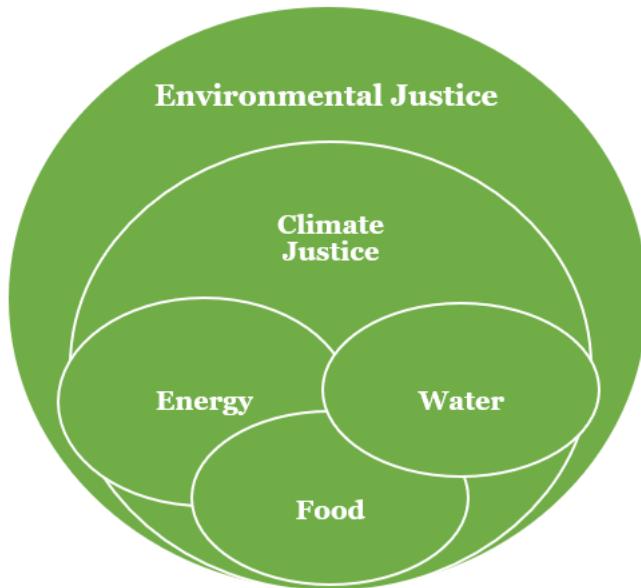
Although the above agenda is broadly transferable to climate *mitigation*, there is a significant gap in research concerned with applying justice theories to the local climate mitigation initiatives. Apart from the few exceptions of scholars like Bulkeley, Agyeman and Steele, climate justice has rarely been focusing on mitigation in cities. Bulkeley *et al.* (2014) offer a critique of climate initiatives based on the heuristic featuring pyramid-conceptualisation of climate justice (Figure 2.1 in Chapter 2.1.2). They conclude that the practitioners designing climate change interventions are already engaging with the notion of justice, however, they seem to be constantly reframing the scope of the concept. Bulkeley *et al.* (2014) paper become a conceptual cornerstone of the field. Despite its popularity in the academic circles, its practical application is limited. Bulkeley's *et al.* (2014) justice pyramid (Figure 2.1 in Chapter 2.1.2) is highly theoretical and does not suggest recommendations or questions which could be easily adopted by policymakers. Steele *et al.* (2015) put forward an agenda paper on urban climate justice, arguing for an emphasis on most vulnerable communities and therefore - an inclusion of non-human species into the framework. They propose employing ecological jurisprudence and biodiversity quantification as a way of shifting climate justice to biocentrism. However, this creates a potential for further terminological and methodological confusion, resulting from the amalgamation of climate justice, biodiversity and ecology.

### **American scholarship**

To complement the theoretical approaches, urban climate justice for decades has been featuring in civil rights and political movements. In the U.S., the practice draws from “environmental justice”, which historically focused on protecting vulnerable people (esp. ethnic minorities) from pollution (Schlosberg and Collins, 2014). Throughout the 20th century, the goal of environmental justice in the U.S. has been to highlight the spatial injustices related to locations of hazardous and polluting facilities (Agyeman, 2002).

Agyeman *et al.* (2016) provide an in-depth account of emerging themes in “just sustainabilities”, arguing that concepts like identity attachment, everyday practices and materiality are now finding a reflection in food, energy and climate justice civil society movements. By providing recent examples of justice mobilisation across the U.S., the paper concludes that the proliferation of “justice” appellations (e.g. climate,

energy, environmental, food justice) is a testimony to a demand for pluralistic, relatable and inclusive discourses (Figure 2.2).



**Figure 2.2.** Relationships between various appellations of justice

### **European Scholarship**

The UK scholars have predominantly focused on the links between energy and justice, namely how social inequalities are manifested in energy systems and sustainability transitions. Energy justice scholarship is rapidly growing and disseminated by the leading experts like Sovacool, Middlemiss, or Jenkins as well as think-tanks like Joseph Rowntree Foundation. Taken together, they provide evidence for multiple climate injustices in the UK. Joseph Rowntree Foundation's review states that disadvantaged groups pay, as a proportion of income, the most towards implementing environmental policy responses and participate the least in these policies (Preston *et al.*, 2014). This is illustrated with the Feed-in Tariff policy, which offers lower energy prices to those who can generate their own energy e.g. via own solar panels but is then funded in a form of levies on energy bills for the rest of the population (*ibid.*). Furthermore, the phenomenon of fuel poverty in the UK is indicative of the “non-recognition” of injustice. Social groups affected by fuel poverty were traditionally perceived as “lacking knowledge” to heat their homes efficiently. However, it has only been recently acknowledged that many of the fuel poor residents are in fact reliant on warm homes due to health conditions or age (Jenkins *et al.*, 2016). Furthermore, Middlemiss (2017) argued that “fuel poverty” indicators and definitions developed by the UK government between 2010 and 2015 are unlikely to have positive impacts on

poverty alleviation. Due to the government's change in policy direction, energy efficiency measures have been prioritised, whereas the role of rising energy prices has been underplayed (*ibid.*).

Over time, the term has gained popularity in the UK academia, largely thanks to a network of high-profile energy research groups (e.g. Energy Geographies at the Institute of British Geographers; Oxford Energy Network; The Sussex Energy Group; European Energy Poverty Observatory at the University of Manchester). Sovacool and Dworkin (2015) put forward “energy justice” as an ethical concept, analytical framework and an applied decision-making support tool. Jenkins (2018) went as far as arguing that framing policy issues as “energy justice” issues it more focused than “climate justice” (which is too complicated) or “environmental justice” (which is only applicable to grassroots movements). Nevertheless, a quick look at a variety of climate policies and sustainability actors leads to a conclusion that the interactions and complexity is there to be accounted for and highlighted, rather than reduced. Furthermore, not every climate policy decision is in the ownership of the energy sector. For this reason, this thesis broadens up the WEF Nexus concept with climate justice considerations when applied to urban policy design.

### **Policy and research procedures**

Policy research is inevitably linked to investigating procedures: including local knowledge and voices in decision-making an improving representation in research institutions. Procedural justice scholarship asks about the nature of participation: who should participate and to what extent? At heart, the call for democratizing expertise highlights epistemological and ethical concerns pertaining to political and knowledge production processes (Nowotny, 2003). For example, how to make decisions on the complex, wicked and value-laden climate change issues which can't be reduced to technical questions? Who has the right to and responsibility for making decisions: the directly affected citizens, the elected representatives or the unelected experts? (Yearley *et al.*, 2003).

Climate justice researchers emphasised a number of groups which ought to receive special attention in policymaking and knowledge production procedures. Traditionally, these groups were excluded from decision making. Often, they are at risk of suffering the worst consequences of climate change, while contributing the least (Adger, 2001). Examples of community involvement with procedural justice in mind could be:

- participatory modelling and policy consultations with lay citizens and communities of place (Yearley *et al.*, 2003; Piccolella, 2013)
- co-producing research with non-academic stakeholders, e.g. practitioners (Lang *et al.*, 2012; Forman, 2017)
- conducting research with marginalised groups, e.g. indigenous populations, low-income residents, disabled people, women (Roosvall and Tegelberg, 2015; Figuerido and Perkins, 2013).

While it's broadly agreed that people should have "control over own's environment" (Nussbaum, 2001; Schlosberg, 2012; Wood *et al.*, 2019), it is important to note that justice scholars argue that "physical" participation is not always the preferred practice (Jenkins *et al.*, 2016). In fact, the reality of the efforts of widening participation might easily slip into tokenism or putting unnecessary strain on those who do not have time, money or energy to involve deeply.

As such, despite its noble aims, widening participation is still perceived as challenging and not appropriate to all contexts. Barriers quoted previously in the literature are: lack of time to consult, perceiving public participation as causing delays, lack of practitioners' skills in public engagement, inaccessible documents, consultation fatigue, perception of public apathy, lack of trust towards the authority, not listening to the citizens' views, lack of resources, lack of cultural sensitivity and ability to engage with so-called "hard to reach" groups (Connelly, 2011; Lucas and Fuller, 2005).

Consequently, the literature suggests a disparity between the ambitious climate justice theory and the mundane empirics of difficulties participation. There is a dissonance between the theoretical drive for deeper, broader and more diverse public involvement and the conservative attitude to such practices on the ground. This tension raises the question of the 'appropriateness' of widening participation in policy and research procedures.

Therefore, the key task of procedural climate justice scholarship is establishing the appropriate depth of participation in knowledge production and policymaking, rather than unreflexively moving up the 'ladder of participation' (Sharp and Dixon, 2007). The researcher elaborates on these questions in Chapters 3.3 and 3.5, which introduce the overview of action research. By taking seriously the questions of "who should create theories and policies?" the thesis is integrating climate justice scholarship into the transdisciplinary mode of knowledge production.

### **Climate justice as "language in action"**

Decades of academic theorising and civil rights campaigning have led to the recognition of climate justice (and related terms) at the international level. For example, the Sustainable Development Goals framework pledged to “*promote peaceful and inclusive societies for sustainable development, provide access to justice for all*” (United Nations, 2015). At the national level, the UK government has included “environmental equality” as one of its sustainable development metrics (DEFRA - Department for Environment Food and Rural Affairs, 1999).

Yet, there is not enough empirical evidence suggesting whether the global and national frameworks are applied in cities and countries with the same principles in mind (Shi *et al.*, 2016). Similarly, the application of academic understanding of climate justice to the political sphere is not fully understood yet. Terms like “social justice”, “social sustainability”, “equality”, “equity” and “inclusion” carry varying degrees of ambiguity and potential to influence power structures (Luke, 2005). In his approach, Luke (*ibid.*) encouraged paying attention to “language in action”, as multiple rhetorical meanings and tools in environmental discourses are inherently political. When policymakers, media or businesses announce ‘sustainability’, “equality” or “climate justice” agenda, what logic and justifications do they use? Do they want to reform or transform the present power configurations or quite the opposite- maintain the existing social order by improving efficiency, productivity and competitiveness?

For example, in the UK, Equality Impact Assessments are commonly undertaken to assess potential requires every potential policy to be assessed against impacts on those with so-called “protected characteristics” of age, disability, gender reassignment, marriage and civil partnership, race, religion or belief, sex, and sexual orientation (Bristol City Council, 2018a). However, this procedure doesn’t require policy assessment against the economic criteria. As a result, policymakers still lack practical and comprehensive tools to assess the contribution to climate justice both before and after the implementation of the policy.

To summarize, the emerging agenda in climate justice scholarship is concerned with the following:

- spatial distribution of the resources and rights
- identification of the affected parties
- practical, policy-relevant framings
- analysis of the pre-existing intersected injustices

- identification of strategies for improvement: procedures, data collection and access. appropriate scale and participation

The following chapter compares the methods applied in recent climate justice research.

#### **2.1.4. Exploring and quantifying climate justice**

This chapter summarises the methodological advancements in climate/environmental/ energy justice research. The table below (Table 2.1.) considers both qualitative and quantitative methodologies, as well as the methods of data collection, analysis and analytical tools. This review concludes that a wide range of methods is currently applied to climate justice research. More recent scholarship has employed qualitative and mixed-methods (McCauley *et al.*, 2019). In particular, the spatial dimension of justice has been emphasised an integral part of the research agenda (Bouzarovski and Simcock, 2017; Fisher, 2015; Grineski *et al.*, 2012; Chatterton *et al.*, 2016).

Thanks to a long tradition in theorising climate justice and related concepts (Chapter 2.1.3. for the overview), climate justice lends itself as a useful conceptual framework ready to apply to policy evaluation work. However, this deductive and theory-driven direction of research does not provide insights into informing policy during the design stage.

Furthermore, numerous papers are concerned with public understanding and policy application, which implies the need to advance the scholarship beyond theory formation (Bulkeley *et al.*, 2013; Walker, 2010). However, it is unclear whether such studies are likely to be impactful if not published beyond the academic setting. To conclude, the methodological gap in climate justice scholarship requires further attention to the spatial nature of injustices, policy design studies and consideration of research impact beyond the academia.

**Table 2.1.** A review of methods used to research climate justice

Method/Tool	Applied to	Strengths	Limitations	Reference
Discourse Analysis	Review of policy documents, academic articles and websites on climate change urban experimentation and campaigns	* allows a flexible and iterative analytical framework * suitable for a variety of sources	* challenging to establish an analytical framework linked to a “definition” of justice as the notions of justice are part of the discursive formation of climate change * in-depth and labour intensive; requires a sifting phase to narrow down the review (e.g. using content analysis)	Bulkeley <i>et al.</i> , 2013; Davies, 2006
Participatory Mapping	GIS <sup>4</sup> -based participatory modelling applied to adaptation planning in the Solomon Islands	* bottom-up method involving indigenous communities * addresses the gap between scientific and local understandings of climate change * promotes feelings of inclusivity and increases the likelihood of policy acceptance	* poor availability of secondary data used for GIS mapping * possibility of technological overload to those not familiar with GIS * participation is subject to internal hierarchies and politics	Piccolella, 2013

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
Long-term fieldwork	12-month long fieldwork in Wales exploring community energy scene	* yields rich and varied data (e.g. interviews, workshops, participant observation) * embedding the researcher in the field long-term helps to build relationships and gain trust	* time-consuming and resource-intensive (both for the researcher and participants)	Forman, 2017
Policy evaluation	Evaluation of 16 UK Impact Assessment Guidelines against environmental justice principles	* assesses how practitioners understand and apply academic theories * could directly inform policy procedures	* secondary data analysis excludes the policymaker's view and practice * research needs to be published outside of academic setting to reach its target audience	Walker, 2010
Public Deliberation Analysis	Secondary analysis of transcripts of public dialogues on climate engineering	* links theoretical developments to public understanding of justice * opens up policy assessment to include a wide range of considerations	* secondary analysis of public engagement workshops has limited reach if only published via an academic journal * secondary analysis leaves the issues of data collection and participants' outside of the researcher's control	McLaren <i>et al.</i> , 2016

<sup>4</sup> GIS- Geographical Information Systems, a set of technologies and methods designed to analyse spatial data with the aid of computers

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
Quantitative Survey of Technology Acceptance	Questionnaire on proposals to construct a high voltage power line in the vicinity of a neighbourhood	* large dataset (n=503) allows a representative sample  * survey questions drawn from the literature	* time-consuming and resource-intensive  * closed survey design limits the potential for “thick” policy recommendations	Devine-Wright, 2012
Statistical typology	Secondary analysis of survey data used to develop a typology of household access to affordable warmth	* large scale dataset, replicable in other countries  * novel typology captures the interconnected issues of energy justice and capabilities	* secondary dataset doesn’t exactly answer research questions	Bartiaux <i>et al.</i> , 2018
Energy Justice Metric	Quantitative measurement for energy justice allowing comparison across countries	* reader-friendly visualisation of nine complex parameters and “ideal energy justice”  * tool readily applicable to policy analysis	* not possible to gather data allowing accurate international comparisons  * energy sector develops faster than secondary data gathered  * model of “ideal energy justice” based on authors’ assumption	Heffron <i>et al.</i> , 2018

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
Spatial regression and mapping	Statistical analysis of climate hazards and social indicators mapped in two cities in Mexico and the U.S.	* allows international comparison of two neighbouring areas * results presented as easy to understand maps could inform emergency response policies	* matching datasets across geographical boundaries is problematic * lack of compatible health data * requires longitudinal dimension	Grineski <i>et al.</i> , 2012
Cluster analysis and mapping	Spatial analysis of energy consumption and demographic data for 70 million UK households presented at LSOA <sup>5</sup> scale	* brings policy attention to different types of energy users and initiatives * the dataset provides coverage for the whole country at a fine level	* the relationship between socio-demographic factors and energy consumption is complex – clusters are a simplification * requires further cartographic steps to present data at a scale relevant for policy communication	Chatterton <i>et al.</i> , 2016

<sup>5</sup> LSOA - Lower Super Output Area, a geographical classification used in the English census applied to areas inhabited by 1500 people (median) (ONS – Office for National Statistics, 2017)

## 2.2. The Water-Energy-Food Nexus

The following chapter critically reviews the development of the WEF Nexus framework and associated methods. Chapter 2.2.1 outlines the history and plural understandings of the term. Then, Chapter 2.2.2 critiques the language of the WEF Nexus. Finally, Chapter 2.2.3 discusses the qualitative and quantitative methods applied and specifies which approaches are missing from the WEF Nexus scholarship.

### 2.2.1. Overview of nexus thinking

The etymology of the word “nexus” is “*binding together*”, which indicates alignment with interdisciplinary and transdisciplinary approaches. The reversal from the traditional, uni-disciplinary and reductionist solutions to the environmental issues was introduced by the researchers like Meadows *et al.* (1972) and Ostrom (1990) who advocated for deeper investigations of interconnections between the ecological and social systems. In their seminal work “The Limits to Growth”, Meadows *et al.* (1972) modelled future scenarios based on predictions of exponential economic and population growth with limited environmental resources availability. The scenarios alarmed the scientific community to the current rates of population growth, resources depletion and pollution. Ostrom’s “Governing the Commons” (1990) identified design principles of environmental management of the local common-pool resources<sup>6</sup> while arguing against the single solution to complex social and ecological systemic issues.

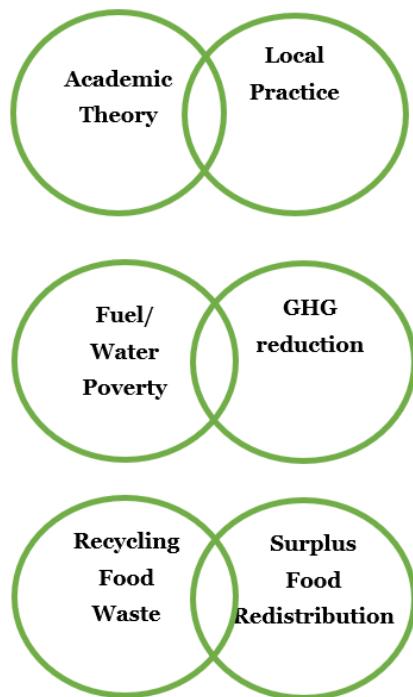
From the 1990s onwards, nexus-type thinking has been acknowledged by policymakers. For example, the 1992 framework for Integrated Water Resources Management (IWRM) was formulated as “*coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*” (Rahaman and Varis, 2005). In 2011, the UN Conference in Bonn called for the “nexus approach” in academia and policy (Hoff, 2011). The nexus approach is conceptualised as the combined efforts of academics and policymakers towards the integrated decision-making in water, energy and food sectors. It seeks to achieve its aims by combining the interdisciplinary

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<sup>6</sup>A common-pool resource is a type of good consisting of a natural or human-made resource system (e.g. an irrigation system or fishing grounds), whose size or characteristics makes it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use. Unlike pure public goods, common-pool resources face problems of congestion or overuse, because they are subtractable (Ostrom, 1990).

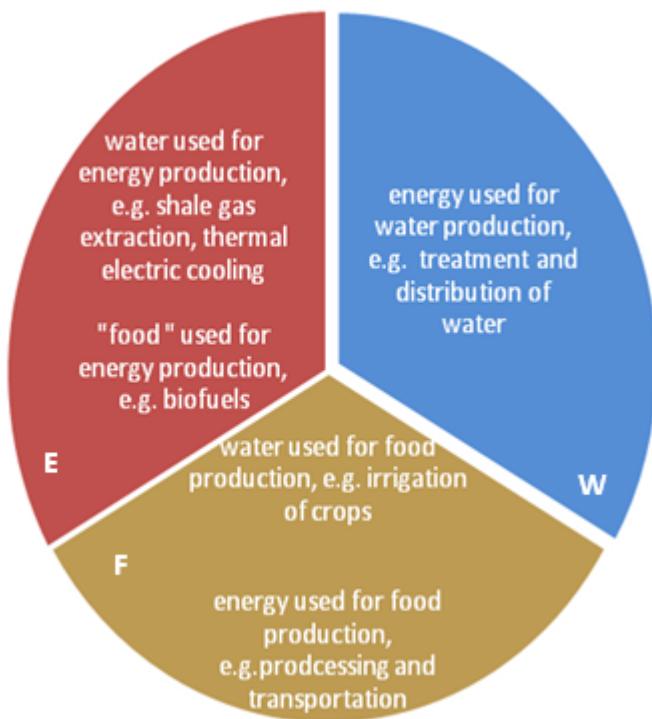
expertise and methods, environmental accounting and assessments, developing integrative indicators, and finally – evaluating technology and policy for nexus trade-offs and synergies (Bazilian *et al.*, 2011).

Currently the “Water-Energy-Food Nexus” (applied to this thesis) is the most popular formulation, however, researchers also look at nexūs of “Water-Energy-Climate”, “Water-Energy-Soil” etc. (Cairns and Krzywoszynska, 2016). To highlight plural meanings, Stirling (2015) points out the difference between “nexus” and the “WEF Nexus”. The first term is synonymous with systems thinking – an approach to a research question (in any field of enquiry, e.g. a nexus between academic theory and local practice, fuel poverty and GHG reduction, recycling and food redistribution; i.e. Figure. 2.3) which recognises the need for understanding of the interconnected issues and dynamic nature of the studied problems.



**Figure 2.3.** Types of nexus applied in this research. The intersecting space indicates nexus-type relationships found over the course of this research.

“The WEF Nexus” - often written with the definite article and the capital letter – is a subset of nexus thinking which signifies integration in the management of natural resources like energy, water, and food – as endorsed by the UN and illustrated in Figure 2.4.



**Figure 2.4.** Five possible combinations of the WEF Nexus with some example issues (adapted from Hayes and Crilly, 2014)

### 2.2.2. WEF Nexus as a contested term

Since its inception in 2011, the WEF Nexus framework has been applied to the numerous high-profile research projects (e.g. Magic NEXUS, WEFWEB, Foreseer, WEF Nexus Tool 2.0, and Nexus Network+). Despite the ongoing debate, the meaning and aims of the WEF Nexus have not been crystallised yet. Instead, the WEF Nexus remained a "buzzword" – a popular term characterised with strong normative resonance and ambiguity (Cairns and Krzywoszynska, 2016). Moreover, the WEF Nexus has received critique for the lack of conceptual innovation (Williams *et al.*, 2014; Allouche *et al.*, 2015), avoiding the political question of systemic change (Cairns and Krzywoszynska, 2016; Allouche *et al.*, 2015) and over-reliance on technological solutions which ignores the notions of rebound effect and social justice (Jackson and Webster, 2016; Cairns *et al.*, 2017).

Therefore, this PhD creates a discursive opportunity to reframe the WEF Nexus debate. The research investigates whether the WEF Nexus is operational at the urban scale and whether the WEF Nexus framework could evolve in response to the emerging critique. The following paragraphs provide a brief overview of the common criticisms of the WEF Nexus relevant to this PhD.

### *“Lack of conceptual innovation”*

Firstly, the WEF Nexus has received criticism for the lack of conceptual innovation (Williams *et al.*, 2014; Allouche *et al.*, 2015). Indeed, as outlined earlier in this chapter, the interdisciplinary and integrative approaches have been applied in the environmental sciences for decades. However, it has become apparent that the main difference between the established approaches and the WEF Nexus is the popularity of the WEF Nexus frame among the international policy and managerial circles, who are ultimately empowered to make decisions about which theories to apply to the environmental management practices (Hoolahan *et al.*, 2018).

### *“Boundaries of the Nexus”*

The WEF Nexus has not only been dubbed “*old wine in new bottles*” (Warner *et al.*, 2017); some critics went further arguing that the concept removes the social dimension from sustainability research (Allouche *et al.*, 2015). Indeed, the name suggests that sustainability could be achieved once the trade-offs and synergies between water, energy and food systems are accounted for and optimised. However, the emerging appellations of nexus (“*Water-Energy-Soil*”, “*Water-Energy-Climate*”) suggest that it is not advisable to bind the analysis to particular three types of resources. Indeed, “thick” and qualitative descriptions of the WEF Nexus reveal novel interdependencies: water-food-waste (Foden *et al.*, 2018), energy-waste-community; food-water-biodiversity (Cairns *et al.*, 2017). Hence, this PhD thesis directly links the WEF Nexus to the question of justice, examining connections to a fair distribution of benefits and burdens as well as participation in decision-making.

### *“Role of social sciences and qualitative inquiry”*

The role of social sciences and justice has been backgrounded from the Nexus discourse. Albrecht *et al.* (2018) undertook a systematic review of Nexus-type assessments, which revealed that the current literature strongly favours quantitative approaches (3/4 of the papers reviewed), while only 1/4 of the research crossed disciplinary boundaries and 1/5 applied mixed-methods. The language of “optimisation”, “efficiency” and “security” required definite, quantifiable and precise answers, so were the methods deemed as appropriate for the Nexus-type research. For example, Daher and Mohtar (2015) created a Nexus Tool 2.0, which models the competing scenarios for resource allocation in the area of complex policies (e.g. agriculture). Nexus Tool 2.0 provides a single answer with a preferable scenario framed using a “sustainability index”. Endo *et al.* (2015) reviews a range of methods suitable for the WEF Nexus questions, naming approaches such as Cost-Benefit Analysis, Integrated Footprints and Optimisation Management Models. It is

worth noting that even qualitative and transdisciplinary methods proposed by Endo *et al.* (2015, p. 5814), have quantitative attributes by design: “*Ontology Engineering is one of the base technologies in semantic web technology, where the Internet is used to create a knowledge base that computers can deal with directly by means of adding metadata*”. The WEF Nexus debate, however, continues, and the calls for the inclusion of social sciences, transdisciplinarity and social justice are becoming more prominent (Kurian, 2017; Albrecht *et al.*, 2018).

#### *“Multi-, inter- and transdisciplinarity”*

There is a growing recognition that the WEF Nexus scholarship should not only involve social sciences and mixed methods but also reflect on how to achieve academic integration and diversity of approaches. Numerous WEF Nexus empirical projects report their multi-, inter- and transdisciplinary character (e.g. Smith *et al.*, 2017; Howarth and Monasterolo, 2016; Hoolohan *et al.*, 2018), however, research policy literature acknowledges that the current UK funding climate conflates these modes (Lyall *et al.*, 2015). Multi-, inter- and transdisciplinarity vary in terms of academic integration and depth of collaboration with the non-academic partners. Both are key considerations in the debates on the future directions of knowledge production. In particular, justifying the WEF Nexus as an approach capable of handling the complexity of global challenges and engaging with the non-academic stakeholders would signal that transdisciplinary research is the most appropriate for nexus-type projects (Stirling, 2015). At the time of writing, there were only a few papers discussing the suitability of the WEF Nexus to the transdisciplinary mode of knowledge production. For example, Hoolohan *et al.* (2018) describe challenges and capacity building potential of engaging stakeholders, arguing that including non-academic partners provides a more nuanced representation of the WEF Nexus. Rasul (2016) points out that the knowledge integration requires effective science-policy interface, where shared objectives, agreed timescales and institutional mechanisms for change are identified. Albrecht’s *et al.* (2018) systematic review of 245 WEF Nexus studies highlighted 18 papers which demonstrate promising advances in terms of pioneering innovative mixed methods as well as inter- and transdisciplinary modes of engagement.

#### *“Integrated decision-making”*

The expectation resulting from combining multiple expertise, methods and considerations is that the WEF Nexus approach will lead to the integration in decision making. This is particularly relevant to the current environmental issues, as it is widely recognised that “*efforts to improve the sustainability of one domain, without*

*considering others, can fail or create vulnerabilities to shocks and feedback loops of various kinds*” (Cairns *et al.*, 2017). Although the WEF Nexus is popularised by the UN (Hoff, 2011), international think tanks (International Energy Agency, 2016; World Economic Forum, 2011; International Food Policy Research Institute, 2011) and some academics (Bazilian *et al.*, 2011; Daher and Mohtar, 2015; Bajzelj *et al.*, 2016), it is unclear whether and how it is understood and applied by the practitioners on the ground. The popular notion is that managerial and policy circles are “siloed”, academics are disconnected from practitioners and policymakers are disconnected from the citizens (Bazilian *et al.*, 2011). However, an alternative assertion states that the practitioners have already been using approaches similar to the WEF Nexus for a long time but without the theory and jargon as formulated by the academics (Allouche *et al.*, 2015).

### ***“Security”***

How important is the choice of words when stating the aims of the WEF Nexus approach? Water, energy and food “security” is often mentioned as the primary aim of the WEF Nexus research (Bazilian *et al.*, 2011; Daher and Mohtar, 2015). The need for ensuring water, energy and food “security” is often justified with the growing population and hence growing demand (*ibid.*). The current and projected “demand” for resources is rarely questioned, which leaves no room for the debate on the sustainability of the modern consumerist lifestyle (Jackson and Webster, 2016). Moreover, appeals for enhancing “security” do not consider the paradox of the minority of the population consuming the most resources, often imported from less economically developed areas which as a result stay water, energy and food scarce and unable to sustain own populations (Richards, 2016). Therefore, the concept of WEF Nexus “security” needs to be differentiated according to the research area.

### ***“Efficiency”***

Another term frequently used in the WEF Nexus research is “improving efficiency” of environmental resources. This is widely recognised among the WEF Nexus practitioners, but barely cautiously welcomed by the social scientists critiquing the concept (Allouche *et al.*, 2015; Stirling, 2015; Stein *et al.*, 2014; Cairns and Krzywoszynska, 2016). The imperative of efficiency does not consider the so-called “rebound effect” (Jackson and Webster, 2016). The rebound effect states that the increases in efficiency will not lead to an overall decrease in resource use in society without the complementing fiscal policies and initiatives encouraging sustainable behaviour (*ibid.*). As a result of efficiency gains, the price of a resource becomes cheaper per unit which might become an incentive for the increased use of resources overall.

### *“Optimisation”*

Similarly, many recent methods of the WEF Nexus research aim to provide “optimal” solutions by accounting for the combined resource use of available scenarios (e.g. WEF Nexus Tool 2.0 in Daher and Mohtar, 2015). In reality, the chances of obtaining an “optimal” solution are limited by the following:

- The scope of the research. For example, this PhD considers balancing the trade-offs across the WEF Nexus stakeholders, however, it excludes a number of other metrics from this “optimisation”, e.g. soil and water quality, biodiversity.
- The availability of data. Any potential difficulties to obtain local, up-to-date, complete and relevant datasets add to the challenge of undertaking the complete assessment essential for informed decision making.
- The acknowledgement of “bounded rationality” which departs from viewing decision-makers as fully rational, unbiased and in possession of all relevant information (Dietz *et al.*, 2011).

Taking the above limitations into account, “optimising” the WEF Nexus could be a useful decision support tool for the policymakers. However, the researcher ought to be cautious of falling into the reductionist approach, which proposes solving complex and “wicked” problems with a single index or metric (Boulton *et al.*, 2015). Optimisation approach could increase the risk of overlooking unquantifiable issues. This could be counteracted by careful consideration for any proposed interventions: do they address the systemic causes of climate change or barely cover their symptoms?

### *“Systemic change”*

Indeed, the main criticism of the WEF Nexus solutions is that they do not address “deeper systemic change” (Williams *et al.*, 2014; Cairns and Krzywoszynska, 2016). “Systemic change” is defined as a transition from the late neoliberal to the post-growth economy, which would enable sustainable use of environmental resources (Allouche *et al.*, 2015). The WEF Nexus is seen as barely techno-managerial, as it doesn’t challenge the existing modes of production of consumption. Therefore, the WEF Nexus has been criticised for privileging techno-fixes over systemic solutions and “*avoiding the political*” (*ibid.*).

### *“WEF Nexus and environmental discourse”*

Therefore, when evaluating the suitability of a framework to tackle climate change and enable low carbon future, one must not only trace the etymology of the concepts (Chapter 2.2.1.) but also their use in practice, what Luke (2005) calls “language in

action”. The researcher achieves that by analysing the actors who popularise the WEF Nexus, the contexts of application, the justifications and methods associated with the WEF Nexus in Chapter 2.2.3. As a result, the thesis will identify a discursive opportunity to reframe the WEF Nexus, so its further theoretical developments include climate justice considerations.

Finally, the researcher observes that the WEF Nexus is more than an emergent conceptual framework applied by the growing number of researchers and policymakers. The “buzzword” aspect of the WEF Nexus prevents the concept from crystallising, preserving ambiguity and mobilising funding opportunities (Cairns and Krzywoszynska, 2016). As the WEF Nexus remains popular, it creates space for collaborations across disciplines and sectors, therefore enabling fresh perspectives (Albrecht *et al.*, 2018; Cairns *et al.*, 2017). The ambiguity of the term could potentially be an opportunity rather than an obstacle: *“The concept, in its all fuzziness, has functioned as a helpful convening mechanism for diverse disciplinary and sectoral perspectives”* (Cairns *et al.*, 2017). The following Chapter will outline a variety of approaches used in the WEF Nexus projects.

### 2.2.3. Exploring and quantifying the WEF Nexus

The WEF Nexus framework is ambiguous enough to embrace a variety of methodologies (Cairns and Krzywoszynska, 2016). The early conceptualisation of the WEF Nexus as “water-energy-food interdependencies” highlighted the need to account for the objective flows of resources (Hoff, 2011). Nevertheless, last 3 years welcomed diversifying approaches to include *subjective* interdependencies, explicit valuing of social justice and deepening the collaboration with the non-academic partners (Cairns *et al.*, 2017).

In particular, Stirling’s (2015) seminal paper contributed to the theoretical discussion on the methods for nexus thinking. His review of over a hundred methods emphasised the need to “broaden out” methods and “open up” output types. This echoes Albrecht’s *et al.* (2018) selection of 18 papers featuring innovative methods of WEF Nexus research, such as the Delphi process, Decision Support Systems, Stakeholder Mapping or Scenario Analysis.

The recent projects funded by the Research Councils UK (e.g. Stepping Up, Nexus Network+) responded to the early criticisms of WEF Nexus methods. Contributions from Howarth and Monasterolo (2016), Foden *et al.* (2018) or Hoolohan *et al.* (2018) take further the notions of “engaging stakeholders”. The emerging nexus is not only between water, energy and food but also between the sectors and practitioners. Each stakeholder and their respective organisation are characterised by their idiosyncratic

objectives, understanding of evidence, acceptable timescales or trust towards external partners.

Finally, Table 2.2 critiques 10 different methods used during recent research on the WEF Nexus. To conclude, the review sees a revived interest in mixed methodologies and computer science methods. However, while the complexity of models increases, it is still not clear how data-intensive and sophisticated methods could be applied and understood as the science-policy interface. The thesis will explore this conundrum, investigating how to improve the WEF Nexus methods and render them useful to the local policy.

**Table 2.2.** A review of methods used in the WEF Nexus research

Approach	Applied to	Advantages and Innovations	Limitations	Reference
<b>Foreseer tool:</b> combining Material Flow Analysis and data visualisation with Sankey Diagram	Quantify natural resource supply, transformation, and use in order to investigate Water-Energy-Land Nexus	* software freely available * interactive and build to solve policy problems	* model doesn't communicate uncertainty; * model doesn't take into account social factors (e.g. impact on jobs, wellbeing, public health)	Bajzelj <i>et al.</i> , 2016
<b>WEF Nexus Tool 2.0:</b> decision support tool quantifying the sustainability of resource use scenarios	Provide an opportunity for resolving current and foreseen bottlenecks by answering critical questions related to energy, water and food securities	* tool allows the possibility of stakeholder consultation for acceptable resource use limits * applicable to a national scale * provides a rapid assessment tool to identify resource scarcity “hot spots”	* recommends a single “sustainability index” which is a reductionist approach to decision making * “self-sufficiency” and “import” scenarios in the model don’t take into account political complexities * model doesn’t account for soil and water quality	Daher and Mohtar, 2015
<b>Energy Portfolio Assessment Tool</b>	Provide a platform for energy stakeholders and policymakers who could create and evaluate the sustainability of various scenarios based on Texas case study	* allows local customisation * applied to every type of energy source	* tool doesn’t question the sustainability of fossil fuels * doesn’t take into account social or subjective policy trade-offs	Mroue <i>et al.</i> , 2019

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
<b>Optimal modelling tool for managing uncertainty in agriculture</b>	Facilitate sustainable management of limited resources in an agricultural system by highlighting trade-offs and policy scenarios	* model tested on a real-world case study in northwest China * handles uncertainty by using stochastic and fuzzy programming	* unclear how the model will apply to the science-policy interface * model doesn't reflect on the limitations to the language of "optimisation" and "efficiency"	Li <i>et al.</i> , 2019
<b>Multiple Mixed methods: stakeholder interviews, workshops, Agent-Based Modelling, Scenario Narratives, Decision Support Kit,</b>	Explore the potential of scaling up the WEF Nexus innovations using a case study of Anaerobic Digestion	* a novel way to integrate methods and sectors * mixed methods accommodate the complex and non-linear nature of the WEF Nexus * mixed methods allow a variety of stakeholder inputs	* combining method creates more risk for methodological pitfalls * it is not clear whether mixed methodology will mitigate or reinforce the limitations of each of the component methods	Hoolahan <i>et al.</i> , 2018
<b>Mixed method: Ontology Engineering</b>	Describes causal linkages and trade-off relationships between WEF resources and their stakeholders	* enhances the compatibility of qualitative descriptions logically or objectively using quantitative semantic web development * visualises links between resources and stakeholders	* method doesn't involve stakeholders' input * unclear how computer science terminology and tools could be received and adopted by the policymakers	Endo <i>et al.</i> 2018

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
<b>Problem Structuring Method</b>	To examine WEF Nexus and the associated governance issues; acknowledging the multi-level nature of governance and the need for coordination of stakeholders.	* approach handles complexity, ambiguity and vagueness * addresses both sustainability and governance issues	* assumption that it is possible to differentiate a single WEF Nexus method  * paper is quite theoretical and features complex jargon, it is unclear how such terminology will be received by the non-academic stakeholders	Harwood, 2018
<b>Exploratory stakeholder workshops</b>	Identify key policy priorities, challenges and barriers to decision making across the WEF Nexus	* opens up the WEF Nexus debate to sustainability practitioners * allows identifying “subjective” WEF Nexus interdependencies, not accounted for by models	* workshop approach doesn’t necessarily lead to long-term collaboration  * requires at least half-day commitment from a large number of participants	Howarth and Monasterolo, 2016

<b>Method/Tool</b>	<b>Applied to</b>	<b>Strengths</b>	<b>Limitations</b>	<b>Reference</b>
<b>Approach</b> Intervention co-production using <b>Change Point</b>	Communicate findings from Social Practice Theory scholarship to the UK policymakers in order to co-create nexus interventions	* long lasting collaborative project * offers improved mutual understanding of academic and policy practices	* success of the approach is contingent on the stakeholders' buy-in * requires commitment of stakeholders over several months	Foden <i>et al.</i> , 2018
<b>Diagrams</b> Participatory modelling using <b>Causal Loop Diagrams</b>	Explore responsibilities of different WEF Nexus stakeholders for the implementation of policies and provide information for reflexive governance processes	* provides qualitative, bottom-up and participatory analysis of the WEF Nexus innovations * systematically explores responsibilities of each stakeholder * supports the transition from control-and-predict paradigm to adaptive and integrative paradigm	* providing whole WEF Nexus perspective is problematic due to a high number of causal linkages * unclear how the recommended actions could be addressed at the science-policy interface	Halbe <i>et al.</i> , 2015

## 2.3. Energy and water meters

The literature review of metering will start by outlining the key challenges for policymakers and researchers. It will then place the devices in the context of “smart city” agenda, a concept both praised and contested by urban sustainability experts. Following on, the review will guide through the recent social science studies investigating the interactions between the technology and the end-users. It will then move onto the policy implications of the academic research, and finally, summarise the national policy context.

### 2.3.1. What do meters do?

Meters are devices recording resource consumption at a fine unit of analysis. In their basic form, they enable issuing accurate electricity, gas, or water billing as opposed to the approximated statements (DBEIS - Department for Business Energy and Industrial Strategy, 2017). Their functionality is predicted to increase with the advance of "smart" grids and homes; however, the available technology is at various stages of development and uptake, depending on the location and utility sector. The devices could provide basic information on resources consumption or go one step further and facilitate efficient behaviours. Sovacool *et al.* (2017) listed 67 anticipated benefits of energy metering. They included some advanced functionalities, such as uptake of microgeneration, easy switching between suppliers, new opportunities for energy storage.

Despite the industry promises of improved energy and water management and reduced carbon emissions, the research on metering as demand-side management (DSM) tool provides conflicting evidence with regards to its effectiveness. Metering can have a positive impact on resource efficiency provided that it:

- Improves the management of the energy grid and identifies water leaks (Cheong *et al.*, 2016);
- Leads to changes at the household level (e.g. decrease in consumption, purchase of smart equipment, change in social norms Bradley *et al.*, 2015; Buchanan *et al.*, 2015).

The extensive literature on climate change communication suggests that an appropriate engagement strategy is vital for the effective adoption of new technologies (*ibid.*)

### **2.3.2. Metering in smart cities**

The idea of metering individual resource consumption is often coupled with the so-called “smart cities” agenda. In summary, the literature on smart cities characterises its aims as:

- Improving economic and administrative decision making through networked infrastructures and technological innovations.
- Improving social inclusion in emerging technologies.
- Raising the profile of high-tech and creative industries and their contribution to economic growth.

Effective embedding of technology in wider physical and social systems (Caragliu *et al.*, 2011; Allwinkle and Cruickshank, 2011).

A body of academic critique questions the assumptions that emerge from the summary above. For example, Shelton *et al.* (2015) challenge the promise of “improved policymaking” using integrated technological infrastructure. They argue that all datasets are socially constructed and can, therefore, result in representations of the world, which are inherently biased, despite being presented as “neutral” (*ibid*). Similarly, Greenfield (2017) critiques the notion of embedding technology in wider social systems. He highlights the risk of “turning citizens into data points” who are objects of measurements, but who are excluded from the interpretation of the results and decision-making. Furthermore, upon completing a large-scale bibliographic and network analysis of peer-reviewed urban development literature, De Jong *et al.* (2015), argue that “smart cities” are only weakly related to the sustainability agenda. Instead, they suggested that the idea of “smart city” builds on the other conceptualisations of urban modernisation e.g. “information city”, “digital city” or “intelligent city” (*ibid*.). Their conclusions provoke a question investigated throughout this thesis: can smart meters be “low carbon” and “just”?

### **2.3.3. User perceptions of metering**

The literature is contested as to whether metering is an effective tool of DSM; the answers range from optimistic (Beckel *et al.*, 2014), cautious (Spence *et al.*, 2015; Bradley *et al.*, 2015, McKenna *et al.*, 2012) to sceptical (Loftus, 2006). Metering deployment could potentially facilitate targeted efficiency programmes (Beckel *et al.* 2015). It could also become an essential step in the development of smarter tariffs, which could communicate the availability of grid resources based on an improved understanding of peak demand times. For example, an analysis of “social practices”

could contextualise the technical notion of the energy or water consumption as more relatable activities like “cooking”, “washing” or “heating” (Torriti, 2017).

The successful rollout of metering is highly contingent on the interactions between the users and the emerging technologies, particularly perceptions, communications, design, and understanding. Spence *et al.* (2015) point out current shortcomings in public engagement of DSM. Similarly, Buchanan *et al.* (2015) call for a redesign of the current smart meters interfaces, In-Home Displays (IHD). Furthermore, McKenna *et al.* (2012) outline the unresolved privacy issues around the data. Sovacool *et al.* (2017) concluded that social aspects, such as apathy and resistance, should not be overlooked while dealing with the technical “teething” problems.

Since public engagement materials are often the first point of information between the user and the technology, they have a significant potential to influence opinions and acceptability. Previous research exploring user perceptions provides initial recommendations on future engagement with “smart” technologies. A survey of over 2400 British householders concluded that those concerned about the cost are the least likely to accept DSM and share their data, whereas participants concerned about climate change were more likely to be supportive (Spence *et al.*, 2015). Seyranian *et al.* (2015) researched the effectiveness of public engagement in the water efficiency context. They conducted an intervention study of over 370 American households, who received a variety of public engagement materials. The researchers found that individuals were most likely to reduce their water consumption if they received messages related to social norms and personal values. At the same time, the knowledge-deficit approach (i.e. only providing factual information) proved to be the least effective one (*ibid.*). More recently, Montginoul and Vestier (2018) conducted a natural field experiment on 261 French households, testing how communication methods affect smart water metering uptake. Their study resulted in an overall low adoption rate, which was linked to the lack of incentives, e.g. “smart” tariffs or appliances.

#### 2.3.4. Metering as a science-policy issue

Recent experimental studies on metering provide valuable insights into what the literature conceptualised as “Attitudes, Behaviours and Choices” (ABC). However, the ABC approach alone does not answer the political and ethical questions related to DSM technologies (Shove, 2010). For example, deployment of metering is closely related to the tariff redesign, which can be a contentious issue both in water and energy industries (Bertoldo *et al.*, 2015). Moreover, the ABC approach assumes that

people *have* the choice to consume less or switch their use to off-peak times. This premise does not apply to those on fixed shift patterns, renting properties or affected by health conditions requiring intensive water or energy use (*ibid.*).

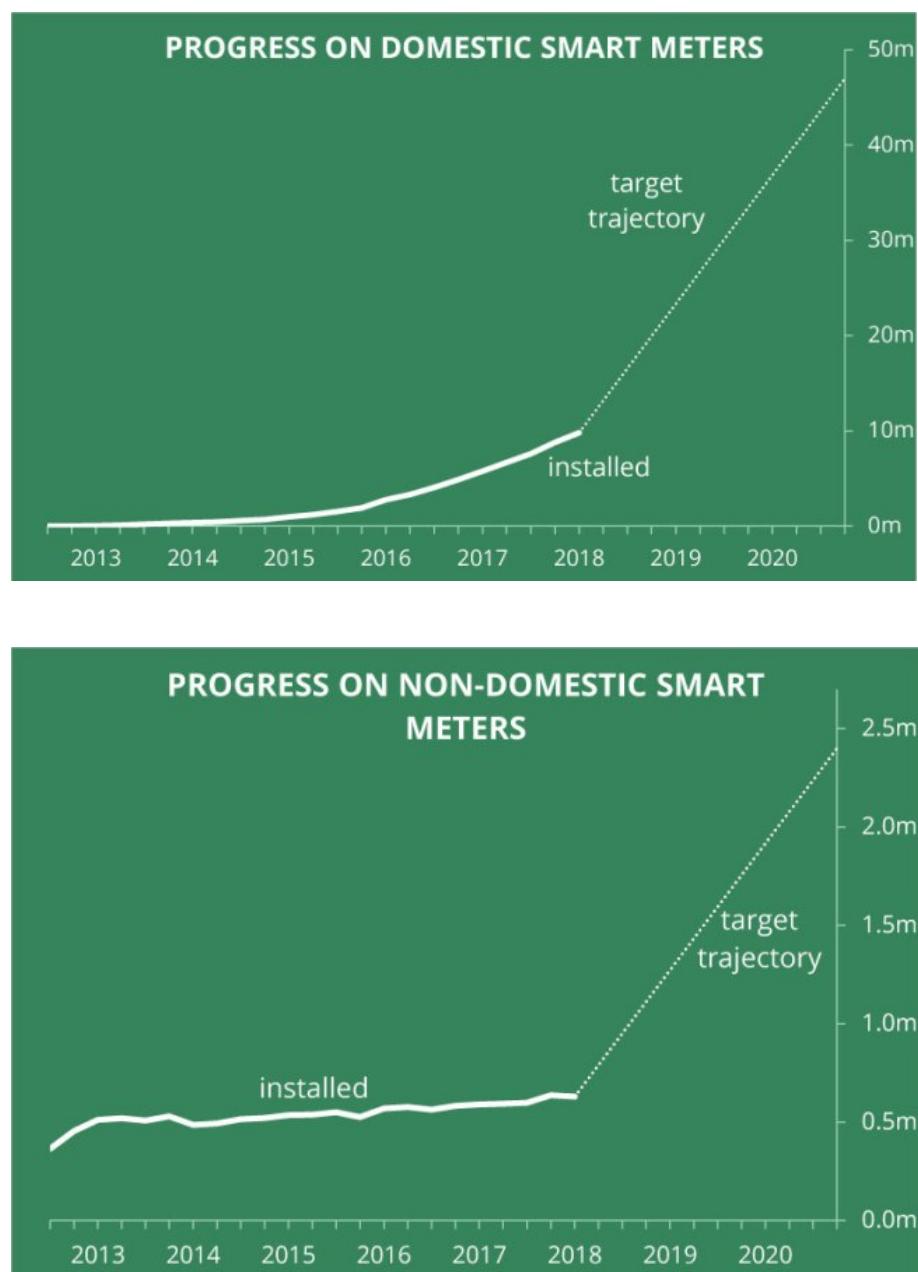
Indeed, French energy consumers who discussed time-of-use tariffs voiced the criticism that time-of-use tariffs disadvantage those who do not have the flexibility to shift their energy use beyond peak times (*ibid.*). An analysis of the Australian block tariffs concluded that this type of water pricing was neither efficient nor fair (Sibly and Tooth, 2014). Loftus (2006) went further to argue that the act of water meter alone contributes to the commodification of water. Instead, water should remain a basic human right. Although an emerging scholarship describes models for optimal pricing options (Eid *et al.*, 2016; Fahradi and Taheri, 2017), there are only weak signs of a wider “smart” tariff debate among members of the public in the UK (Hielscher and Sovacool, 2018).

Another political debate related to metering is centred on the question of governance. Smart meters are not solely installed to help customers manage their bills. In fact, many of the predicted benefits relate to large-scale improvements like enhanced data management, reduced operational costs, and avoided peak demand (Sovacool *et al.*, 2017). Stewart *et al.* (2018) envision the possibility of multi-utility service providers synthesising big data on water and energy use. Helmbrecht *et al.* (2017) argue that smart metering is vital if water and energy resources were to be managed in integration. However, at the moment is it not clear how the transition to the integrated decision making would occur. Collaboration (or at least communication) between water and energy sectors is in its infancy.

### **2.3.5. Metering: National policy context**

Smart metering within the energy sector is a part of the European Commission’s recommendation on energy efficiency 2012/148/EU (European Commission, 2012). Consequently, the UK government introduced the Smart Metering Implementation Programme, aiming to install over 53 million smart meters by 2020 in domestic and non-domestic properties (DBEIS - Department for Business, Energy and Industrial Strategy 2017). In the UK, Smart Meters GB is the national campaign with the budget of £100 million encouraging the installation of smart energy meters (Smart Energy GB, 2017; Sovacool *et al.*, 2017). While the customers do not pay for the installation of the smart meters, they will eventually bear the cost of the campaign and the rollout in a form of a levy on bills (Hinson, 2018). The recent government data reveals that

in early 2018, barely 11 million meters were installed, leaving the majority of work to do over the final years of the programme (Figure 2.5).



**Figure 2.5.** Progress on smart meters installation 2012-2018. A dotted line represents a trajectory required to meet the government target (Hinson, 2018; Copyright: Open Parliament Licence).

In contrast, measuring water consumption and upgrading the water “grid”<sup>7</sup> from analogue to smart metering is not a current policy priority in the UK (Priestley, 2016). In fact, it is estimated that half of the UK population does not have a water meter, in

<sup>7</sup> A Physical water supply grid exists at the regional level, unlike electricity and gas grids, which are networked at the national scale in the UK.

which case water bills are based on the so-called "rateable value" of the property, which is based on an estimate of rental value in 1990 (Bennett, 2013). Compulsory universal water metering has so far only been introduced in parts of the UK subjected to the highest water stress (i.e. south-east England). However, many English water companies see metering as a useful tool for resource management and are compelled to promote it to their customers (Priestley, 2016). With a predicted population rise of 10 million in 50 years, an additional 15% of water would be required to meet provide the supply, should the demand stay the same (Artesia Consulting, 2018). However, the risks related to forecasted droughts and the imperative to safeguard the environment in the face of climate change require policymakers and water suppliers to reconceptualise the traditional understanding of supply and demand.

## 2.4. Food waste in cities

The literature review will begin with the overview of reasons and solutions to food waste within the catering sector. It will introduce the concept of food waste as a political issue and the related discourses found within the academic literature. Finally, it will introduce the policy progress to date at the national level.

### 2.4.1. Food waste in the catering industry

The academic literature on food waste in the catering industry tends to focus on conceptualising reasons for the problem (Göbel *et al.*, 2015; Garrone *et al.*, 2014; Priefer *et al.*, 2016) and proposing systemic solutions (Priefer *et al.*, 2016, Mourad, 2016). Emphasis is often put on the international comparisons (Mourad, 2016; Priefer *et al.*, 2016; Sirieix *et al.*, 2017) and quantitative investigations (Porpino *et al.*, 2015; Silvennoinen *et al.*, 2014). Only a few researchers show interest in reviewing waste management practices and discourses (Mourad, 2016; Thompson and Haigh, 2017; Welch *et al.*, 2018).

### 2.4.2. Reasons and solutions

Academics agree that food waste is a complex problem, which cannot be attributed to a single reason or sector (Göbel *et al.*, 2015; Heikkilä *et al.*, 2016). Indeed, Welch *et al.* (2018) argue that food waste practitioners in the UK argue for distributed responsibility throughout the production-consumption system. Within the catering industry, food quality requirements, lack of co-operation along the supply chain, errors in forecasting customer demand, and portion sizes repeatedly appear as the main reasons for food waste (Göbel *et al.*, 2015; Garrone *et al.*, 2014; Priefer *et al.*,

2016, Heikkilä *et al.*, 2016). These studies predominantly used interviews and workshops with high-level professionals to reach the above conclusions.

Thus, the solutions proposed reflect the composition of the participants' pool, i.e. managers, academic experts, and policymakers. They suggest interventions at high-level decision-making, e.g. "a multi-stakeholder dialogue" (Göbel *et al.*, 2015; Priefer *et al.*, 2016), "improving data availability and measurements by agreeing on the definitions of "food waste/surplus food" or "mandatory collection of food waste" (Priefer *et al.*, 2016).

Nevertheless, interviews and workshops with food sector professionals yielded a few recommendations at the operational level. For example, recent studies suggested waste prevention ideas, such as offering individual portion sizes, careful menu planning and improvement of internal routines (Priefer *et al.*, 2016; Silvennoinen *et al.*, 2014). Duursma, *et al.* (2016) measured food waste in Dutch restaurants and concluded this an appropriate way of raising awareness among the kitchen staff. Porpino *et al.* (2015) conducted laboratory experiments demonstrating smaller starter size outperforms persuading customers to reduce waste. Finally, Strotmann *et al.* (2017) conducted an intervention study, where a set of measures (e.g. staff training, poster, improved communication across the supply chain, change portion size, analysis of customer preferences) contributed to a decrease in food waste in a cafeteria and a residential home. Despite the growing number of experimental and quantitative studies, there is a gap in research investigating the organisational side of food waste management.

While academics measure the effectiveness of food waste prevention, the industry tends to focus on recycling. Mourad (2016) critiqued French and the U.S. municipalities and food companies for promoting predominantly recycling measures as an answer to food waste. She pointed out that this practice is against the widely accepted hierarchy of waste, which seeks to prevent, then redistribute and then recycle waste (Papargyropoulou *et al.*, 2014; Figure 2.6). As a result, surplus food turns into a commodity (Mourad, 2016).



**Figure 2.6.** Waste Hierarchy (European Commission, 2008b)

However, even after reducing food production and redistributing surplus to people in need, there will be “unavoidable waste” left, e.g. peels, eggshells or bones. It is estimated that a quarter of food waste in catering is unavoidable (WRAP - Waste and Resources Action Programme, 2017a). This fact alone justifies the need for research and policy on effective food waste recycling services. Yet, despite the wide encouragement from the policymakers, it is not clear how to introduce food waste recycling to the catering sector.

#### 2.4.3. Food Waste Discourses

Food waste is a politicised issue. Mourad's (2016) paper differentiated between various framings for anti-food waste action:

- **Social**, expressed as cooking collectively with surplus produce, Slow Food movement, food banks, national policies to track food losses and redistributing surplus to tackle ethical and food security concerns.
- **Environmental**, e.g. diversion from landfills by composting or anaerobic digestion.
- **Economic**, understood as **either** “resource efficiency” - managing losses and surplus to maximise economic efficiency **OR** “a protest against capitalism” through radical bottom-up organising (e.g. freeganism).

Mourad (*ibid.*) critiqued the main discourses of waste management present in the French and the U.S. system where governments rely on technological improvements and large-scale optimisation of existing supply chains, leaving the current modes of over-production and over-consumption unchallenged. In other words, they are underpinned by the “economic” discourse understood as “resource efficiency” rather than “protests against capitalism”. In turn, Mourad (*ibid.*) suggests sustainability solutions, which challenge “over-industrialization,” and “homogenisation” of food production.

Thompson and Haigh (2017) explored food waste framings through media analysis. They described a societal shift from arguing for “wartime resourcefulness” to contemporary concerns about “feeding global population with limited resources” (*ibid*). Furthermore, they argued that at the catering level, food waste is constructed as a moral issue and a matter of incompetence in business management and food handling (*ibid*). Normative accounts of food waste are pervasive within the media and tend to focus on “blaming the consumer” (Watson and Meah, 2013). Yet, Evans (2011, 2012), in his extensive ethnographic fieldwork on food waste in the UK, found that practices of “wasting” food are riddled with anxiety and frequently justified by the desire to care for family members.

In summary, the academic literature provides comprehensive reasons for food waste and suggests solutions at various levels of engagement. There are numerous empirical and quantitative studies demonstrating the effectiveness of certain specific measures. However, academics have not focused sufficiently on addressing the organisational and policy sides of food waste in the catering sector.

#### **2.4.4. Food waste: National policy context**

Food waste arises from each stage of food handling; from growing, processing, preparation, retail to consumption. There are no empirical national-scale calculations of food waste alone, but it is estimated that the annual food waste in the UK totals around 10 million tonnes (Mt) (WRAP - Waste and Resources Action Programme, 2017a). This quantity is associated with estimated emissions of 20 Mt GHG (mostly through landfills releasing methane) and an economic cost £17 bn (*ibid*.). Therefore, tackling food waste presents a significant policy opportunity to deal with climate change, hunger and save money.

Avoiding food waste via redistribution or decrease in production lowers energy consumption, and therefore, GHG emissions. Moreover, redirecting food waste from landfill to power stations provides low carbon and renewable energy as well as GHG emission reduction if compared to landfill disposal. Waste hierarchy applied in the EU Waste Directive and the resulting UK national and local policies guide through the order of preference of actions against food waste. The waste hierarchy states that preventive and redistributive efforts should be prioritised before resources are recycled (Figure 2.6 in Chapter 2.4.3.).

The UK is a signatory to the international frameworks dealing with food waste, such as UN’s Sustainable Development Goals (goal 12.3 “*Halve per capita global waste at retail and consumer level by 2030*”; United Nations, 2015) and EU Waste Framework Directive (European Commission, 2008b). Despite the commitments to

the ambitious international targets, there is little national legislation in place (Priestley, 2016).

Waste in the UK is currently a devolved issue, managed and decided by the devolved countries and the local authorities. Currently, there are no mandatory food waste regulations in England (*ibid.*). The UK government favours voluntary approach, such as the Courtauld Commitment 2025, where its signatories (nearly 100 retailers, local councils, and manufacturers) aim to decrease waste from food and packaging by 20% between 2015 and 2025 (WRAP - Waste and Resources Action Programme, 2018). Commercial waste is managed privately, although businesses are under the Duty of Care, meaning that they have to “*take all reasonable steps to ensure that the waste is managed correctly throughout its complete journey to disposal or recovery*” (DEFRA - Department for Environment, Food and Rural Affairs, 2016). In practice, many do not choose to recycle or prevent waste; with the catering and hospitality industry alone leaving 0.92 Mt (or 3.6 Mt CO<sub>2</sub>eq) annually in the UK (WRAP - Waste and Resources Action Programme, 2017a). According to WRAP (2017b), only 12% of all food waste across catering and hospitality sectors is recycled. Table 2.3 describes the current estimates of food waste in the UK hospitality and catering sector.

**Table 2.3** The UK annual food waste estimates for the hospitality and catering sector (WRAP- Waste and Resources Action Programme, 2017a)

Waste stream	Carbon Footprint	Tonnage	Financial Cost
<b>Total Food Waste</b>	3.6 Mt CO <sub>2</sub> eq	0.92 Mt	£2.5 bn
<b>Avoidable Food Waste</b>	2.7 Mt CO <sub>2</sub> eq	0.68 Mt	N/A
<b>Unavoidable Food Waste</b>	0.9 Mt CO <sub>2</sub> eq	0.24 Mt	N/A

**Notes:** A quarter of food waste is estimated as “unavoidable” since it mainly consists of fruit and vegetable peelings. Estimates exclude waste associated with drinks.

In contrast, Scotland and Northern Ireland are ahead of England Wales in terms of business waste legislation. Businesses in Scotland and Northern Ireland producing more than 5kg of food waste per week are obliged to set up a separate waste collection

(Scottish Environmental Protection Agency, 2016; Department of Environment, Northern Ireland 2015).

## 2.5. Bristol – local context

The following chapter describes the local context of Bristol and the sustainability actions as well as political decisions until the end of 2018. It starts with reporting on the city's ambition to become "low carbon", as embedded in policy frameworks on energy, waste or food. This part critically reviews long-term targets, progress to date and the strategy for implementation. Chapter 2.5.2 then links the environmental challenges to urban injustices, supported by local evidence, such as the recent figures on social deprivation, fuel poverty, and child poverty. Chapter 2.5.3 summarises local "smart city" projects, while Chapter 2.5.4 traces the local efforts in the area of waste management. The final chapters (2.5.5 and 2.5.6) describe the politics of Bristol: the shift in power, West of England (WoE) devolution, and finally – cross-sectoral partnerships and grassroots organisations.

### 2.5.1. Commitment to GHG emissions reduction

Bristol is committed to mitigating climate change. In 2015, the city adopted a local carbon management framework, "Our Resilient City", (Bristol City Council, 2015a), which outlines GHG emissions reduction targets until 2050. The strategic document included a set of specific actions with an indication of their ownership, e.g. local council, businesses, universities. For example, the council pledged to "lead" on the sustainable energy improvement by investing in insulations and setting up own energy company (*ibid.*). The council also committed to "enable" community energy sector by allocating additional £880 000 of funding. Nevertheless, the strategy does not specify or quantify how the planned policies could contribute towards GHG reduction. Neither it does explicitly discuss the need to develop and implement policies in a just way. The strategy is a subject to annual reviews of GHG emissions reduced, which are measured using Carbonn Climate Registry (pers. comm.). It is important to notice that the majority of urban GHG accounting protocols focus on Scope 1 emissions<sup>8</sup>, which gives political priority to the energy policies. At the same

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<sup>8</sup> "Scope 1: Direct GHG emissions occurring from sources that are owned or controlled by an organisation, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.

Scope 2: GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought

time, policies from the emissions embedded in water, food and waste are outside of the compulsory scope of reporting due to the data availability and boundary setting challenges.

The city recognises the interconnectedness of carbon and other environmental policy domains. For example, it received a silver “Sustainable Food Award” in 2016 for work towards provision of “Good Food”, defined as “not only tasty, healthy, affordable, but also produced and distributed in a way that it is good for nature, good for workers, good for animal welfare and good for local businesses’ (Bristol Food Policy Council, 2015). It also aims to become a “Zero waste city” by producing the lowest amount of household waste (per person/per year) by 2025 and sending less than 5% of waste to landfill by 2030. Bristol has a reputation of economically prosperous and “smart” city, with a significant IT sector, open data initiatives and a rich offer in the field of digital education (Cowley *et al.*, 2017). In 2018, the council launched the “City Leap” initiative, which outlines partnership and investment opportunities in the field of low carbon and smart futures (Bristol City Council, 2018b).

However, despite its sustainable and smart ambitions, the city still struggles with a number of environmental issues. High levels of congestion and poor public transport infrastructure lead to air pollution and high GHG emissions related to transport (Prestwood *et al.*, 2018). Furthermore, the city is not water and energy secure in the long term. Bristol Water warns that the WoE region is lacking long-term resilience and might be affected both by droughts and floods (Bristol Water, 2018). Similarly, there is no clarity with regards to the long-term energy supply in the region, with potential sources ranging from Hinkley Point nuclear energy, Severn Channel tidal energy or locally produced community energy (Bristol City Council, 2015a).

### **2.5.2. Climate injustices**

Despite overall economic prosperity and the city’s reputation as “one of the best places to live in the UK” (BBC - British Broadcasting Corporation, 2017), it is evident

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into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where energy is generated.

Scope 3: Other indirect GHG emissions Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services” (Greenhouse Gas Protocol, 2014).

that not all residents can benefit from Bristol's political, cultural and environmental offer to the same extent. Numerous datasets confirm that Bristol citizens are subjected to injustices which become particularly visible once visualised according to their spatial distribution. In other words, the gap between the least and most deprived neighbourhoods is wide and shows no signs of narrowing. It is estimated that 69 000 (or 16%) people are amongst the poorest 10% of English residents. One in four children lives in poverty – which is the highest figure in the south-west of England (Bristol City Council, 2015b). Economic deprivation directly affects everyday lives with 13% of Bristolians in fuel poverty (comparing to the 10.6% of the national average) and a growing number of residents resorting to food banks (increase from 2,600 in 2011/12 to at least 7,600 people in 2012/13; Bristol City Council, 2013).

Moreover, the city planning ought to cater to the growing diversity present in Bristol, as this implies a variety of needs, capabilities and representations in decision-making. Some figures illustrating Bristol's diversity include:

- There are 91 languages spoken in the city (Bristol City Council, 2017a).
- 16% of residents belong to black or ethnic minority groups (BME) (Bristol City Council, 2012).
- 19% of the population is under 16, 13% is over 65 years old (*ibid.*).
- Approximately 55% of the housing stock is owned, 24% privately rented, 15% is council or social housing, 0.8% is shared ownership and 1.5% of households live rent-free (Open Data Bristol, 2015).

The city is committed to the improvement in social justice. Bristol is a part of 100 Resilient Cities Network and in 2016 it commissioned its own "Bristol Resilience Strategy" which aims to tackle the long-term issues like tackle some of Bristol's major issues, including, traffic congestion, affordable housing, poor air quality and child poverty (Bristol City Council, 2016a). It also aims to give the residents voice in decisions made in local government. Furthermore, the current mayor of the city, Marvin Rees, has voiced his support toward justice agenda, e.g. by launching "clean streets" campaign or by re-launching Mayors Fund to tackle homelessness in the city.

### 2.5.3. Smart city projects

In 2017, Bristol was ranked first in the UK Smart City Index (Huawei, 2017). Over the past five years, multiple projects have been investigating the potential of smart technologies in the city. For instance, in the Smart Spaces initiative (2012-2015), BCC installed smart meters and set consumption targets in public buildings (Bristol City Council, 2015c). Replicate (2016-2021) is an intervention-based EU-funded research

project involving stakeholders from the local universities, charities and BCC. Replicate focuses on deploying smart energy solutions and co-creating a smart city with digitally excluded communities (Connecting Bristol, 2016). Finally, during the 3E Houses scheme (2012-2013), BCC installed smart meters in 100 vulnerable households in collaboration with a local charity (Knowle West Media Centre, 2013). Users' experiences were then captured in a series of workshops, which led to the community-level policy recommendations.

Multiple metering pilot projects were located in deprived areas, which suggest an ambition to use metering to help tackle fuel or water poverty by encouraging sustainable behaviours (Connecting Bristol, 2016; Knowle West Media Centre, 2013). However, the potential for an overall decrease in resource consumption may be limited if building efficiency is sub-optimal (e.g. single glazed windows, drafts, leaking taps). Offering behavioural change as a way to tackle fuel poverty assumes that people in deprived areas waste energy, therefore metering could induce behavioural change (Shove, 2010). The local data on energy use suggests otherwise; people in the 10 most deprived areas consume far less gas compared to their more affluent counterparts. Average gas consumption in the most deprived areas (averaged from the 10 most deprived LSOAs) is about 9176.4 kWh/meter, where  $s^9=478.66$  kWh/meter. This stands in stark comparison to gas consumption of 17245.1 kWh/meter in the least deprived areas, where  $s=2441.83$  kWh/meter. Mean consumption figures were averaged from the 10 most and 10 least deprived LSOAs in Bristol using raw gas consumption data from Department for Business, Energy and Industrial Strategy, 2015 and deprivation data from Bristol City Council, 2015d and HM Government 2015.

The water efficiency dimension is mostly absent from smart and green projects and policies in Bristol. This might be due to the fact that water-efficient behaviours and infrastructure are largely outside of the remit of the local authorities. In the UK, the water sector is privatised and regionally monopolised, which hinders access to data, knowledge transfer and cross-sectoral governance (Loftus *et al.*, 2016).

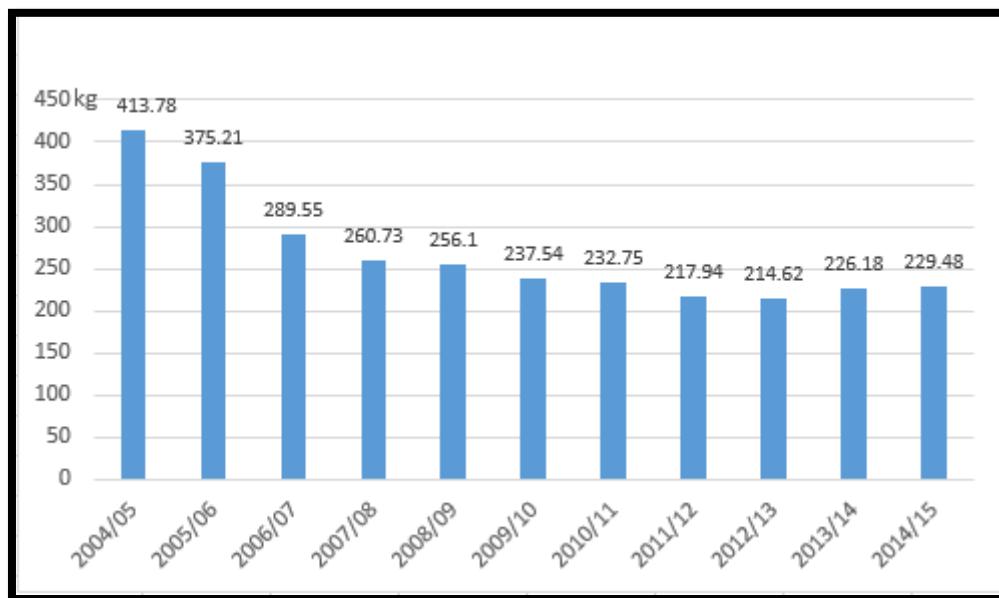
#### 2.5.4. Food waste management

Bristol City Council published a Zero Waste strategy setting out a vision and objectives for significant diversion of waste from landfill by 2030 (Bristol City Council, 2016b). However, Bristol has a considerably longer tradition in waste

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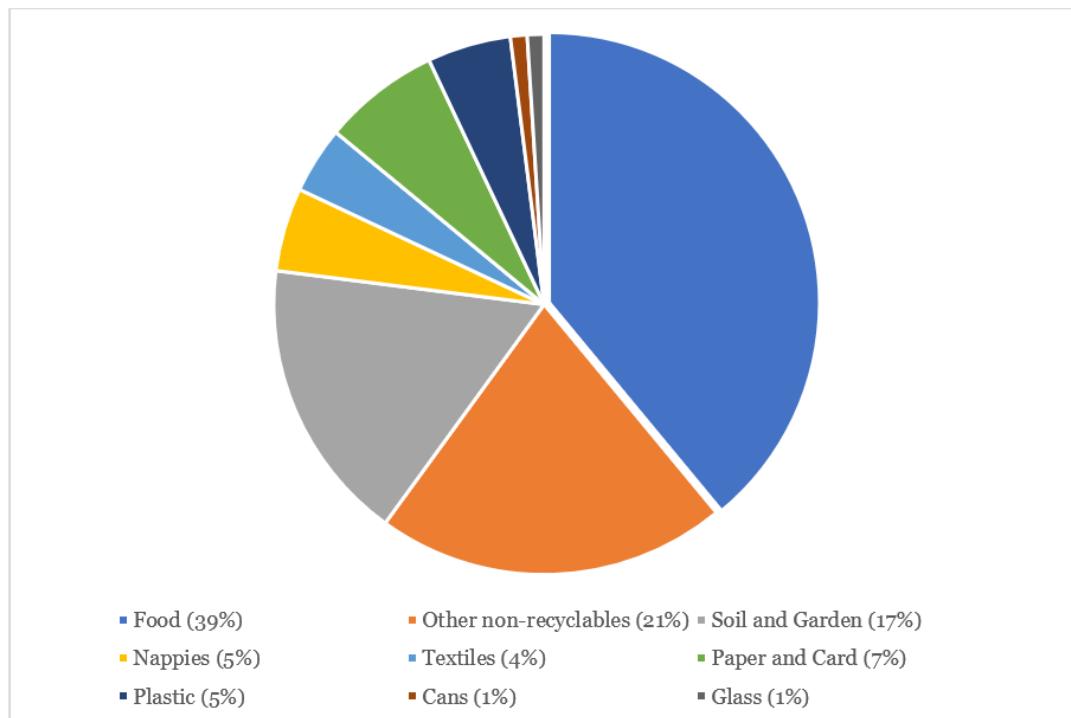
<sup>9</sup> s=standard deviation

management. In 2006, BCC introduced residential food waste collection, which together with recycling contributed to the reduction of household landfill waste from 413.78 kg per person in 2004/05 to 237.54 kg per person in 2009/10 (Figure 2.7). Local household food waste diverted from the landfill is currently processed in the local Anaerobic Digestion (AD) facility, which produces biofuels used to generate electricity and power local public transport (Bristol Waste Company, 2017). Furthermore, the diversion of food waste from the landfill contributes to GHG reduction reduces the city's carbon footprint and lowers the amount of landfill tax the council is liable for<sup>10</sup>. After 2009 the uptake of recycling and food waste collection stalled and in 2014/15, an average Bristol citizen produced 229.48 kg of landfill waste. Recent waste composition analysis shows that although plastic, glass and paper mostly end up in recycling bins, food waste comprises 39% of a general waste bin (Figure 2.8 overleaf; Bristol City Council, 2016b).



**Figure 2.7.** Kilograms of household waste per person per year 2004/05 to 2014/15 (adapted from Bristol City Council, 2016b)

<sup>10</sup> As of April 2017, the landfill tax is £86.1 per tonne of landfill waste, making landfill an expensive waste management option for the local authorities (HM Government, 2016).



**Figure 2.8** Results of waste composition analysis (adapted from Bristol City Council, 2016b). The figure shows the average composition of a residential general waste bin.

Within the city boundaries, food waste is also produced by catering sectors, manufacturers, retailers and small-scale food growers. However, the businesses in England are under no obligation to recycle their food waste (Priestley, 2016). As a result, it often ends up together with general waste, contributing to GHG emissions from landfill. The city is home to over 1000 hospitality and catering businesses (Carey, 2011). There is no data on the food waste practices and quantities in the area, however, Carey (2011) presumes that:

*“most shops, cafes, restaurants and large-scale kitchens are unlikely to separate out food waste and that it is therefore taken to landfill with all other waste through private contractors (...) more research is needed to establish the volume of food waste generated by the city, including commercial food waste, and to explore collaborative solutions that can serve the city as a whole”.*

In the absence of mandatory recycling, cross-sectoral partnerships and charities play a significant role in food waste via prevention and recycling in the catering sector. There are no overarching data on redistributed or recycled food, however, some notable examples are documented via case studies, such as FareShare and Bishopston

Trader's Group (Bristol Green Capital Partnership, 2015a; Resource Futures, 2013). FareShare<sup>11</sup> redistributes surplus food from retailers, restaurants and manufacturers to the local groups working with vulnerable people. FareShare transfers 30-40 tonnes of food to the charities in the wider Bristol region, supporting 150 organisations in Bristol and neighbouring municipalities (Bristol Green Capital Partnership, 2015a). Sustainable Bishopston Traders Group trialled a co-ordinated food collection scheme in 2013 (Resource Futures, 2013). The scheme conducted a survey of the local needs, secured a discounted deal, promoted it in the local media and organised catering staff visits to the waste treatment sites. The food waste scheme was well documented, however after the successful trial period, it ended due to issues with waste contractors. The report concluded that further collaboration between the catering sector, waste management companies and the local policymakers is required to overcome the barriers encountered in a trial period (*ibid.*).

#### **2.5.5. Governance**

Bristol City Council is governed by a slight majority of Labour councillors (37/70; Bristol City Council, 2018c). The city is one of the three authorities forming the West of England (WoE), a devolved region established in 2017 (West of England, 2019). WoE gained powers over issues like planning, transport, adult education and business infrastructure. WoE is led by a Conservative Metro Mayor Tim Bowles, whose manifesto focused on housing in urban regeneration areas, affordable homes and protecting the green belt (Bristol and South Gloucestershire Conservatives, 2017). Bristol has an elected mayor who holds executive powers in the city. The city's first mayor, an Independent George Ferguson was in office between 2012 and 2016 (Hambleton and Sweeting, 2018). His term left a legacy of environmental strategies (e.g. "Towards Zero Waste City", 2016; "Our Resilient City", 2016) and awards (Silver Sustainable Food Award, 2016; Green Capital 2015) relevant to this thesis. Nevertheless, some of his sustainable transport policies (e.g. Residents' Parking Scheme, Metrobus) were strongly opposed and criticised for leaving out those who do not have alternative travel choices (BBC – British Broadcasting Corporation, 2013).

As from 2016, the city is governed by a majority Labour cabinet as well as Labour mayor, Marvin Rees, whose main shift in the city agenda was to focus on improving social equality. The city has also been subjected to significant budget cuts – a knock-on effect of the national government "austerity agenda". The current gap of £120

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<sup>11</sup> FareShare is a UK-based charity which redistributed surplus food from retailers (e.g. supermarkets) to foodbanks and community groups (FareShare, 2019)

million might limit the potential to invest in innovative policies (Bristol City Council, 2018d). Hence, this PhD aims not only to inform policy design with evaluation for the environmental (the WEF Nexus) and social (climate justice) impacts but also make a case for cross-sectoral decision-making, which could save the public resources and improve citizens' participation in politics.

#### 2.5.6. Citizenship

Bristol's active third sector provides favourable conditions for co-designing local environmental policies. Some examples of citizen-led organisations and initiatives to improve the city are:

- Bristol Food Policy Council (2015), working on the “Gold” accreditation for the Sustainable Food Cities award.
- Global Justice Now (2019) campaigning for the betterment of the lives of the most disadvantaged people in the world.
- City to Sea (2019), lobbying against plastic pollution and the manufacturing of single-use plastic items.

Local charity organisations, businesses and educational institutions working on the sustainability agenda self-organised themselves into the Bristol Green Capital Partnership (BGCP), which at the time of writing attracted over 800 members (pers. comm.). The initiative was originally set up by the BCC in 2007 (BGCP-Bristol Green Capital Partnership, 2019). After receiving the EU “Green Capital” accreditation, the partnership received criticism for not engaging with the marginalised communities (Bristol City Council, 2016c). As a result, BGCP reflected on their inclusion of justice in the sustainability work by rolling out the “Green and Black” program, which focused on including the marginalised BME communities in climate leadership (Bristol Green Capital Partnership, 2018b). Currently, the theme of environmental equality is one of three strategic priorities for BGCP over 2019-2022 (Bristol Green Capital Partnership, 2018c).

Bristol is home to a thriving community energy sector, which released its own Community Energy Strategy (Bristol Energy Network, 2013). Organisations like Easton Energy Group or Ambition Lawrence West promote the installation of solar panels, offer “cold home” surveys and are soon to offer a first “street-scale” community tariff, where the energy comes from a low carbon district heating network (ICAX, 2018).

Bristol has also recently gained momentum in the food waste action, which focuses mainly on the redistribution aspect of the waste hierarchy. For example, Fare Share

South West (2018) collects surplus supermarket and restaurant food to circulate it back to people in need. Moreover, Feedback (2018) charity has been promoting “gleaning” initiatives, where volunteers collect the surplus harvest. Feedback also is a vocal campaigner for diverting food waste from AD to animal feed.

## 2.6. Chapter summary: Themes of enquiry and the theoretical framework

The emerging science-policy debates on local environmental issues require theoretical framing. This thesis proposes that the issues at the intersection of resources and sectors could be analysed using the lenses of WEF Nexus and climate justice introduced in Chapters 2.1 and 2.2.

To reiterate findings from Chapter 2.1, Sovacool *et al.* (2016) suggest rethinking climate change policies as justice concerns by drawing attention to availability, affordability, transparency, equity, and responsibility of policy decisions. In order to make this framework operational, the concept of climate justice must be explicitly addressed by the policymakers, designers, utility practitioners and the users themselves.

Furthermore, an increasing interest in the WEF Nexus and integrated resource management has drawn attention to synergies, trade-offs, efficiencies, and potential for collaboration (Hoff, 2011; Stewart *et al.*, 2018; Helmbrecht *et al.*, 2017). As explained in Chapter 2.2, the WEF Nexus agenda has not yet crystallised within the context of the UK environmental policymaking. However, its proponents argue that the improved data on water, energy, food and waste will lead to integration in policymaking and improved sustainability and security of resources (Cairns and Krzywoszynska, 2016). In the wake of urgent challenges such as population growth, growing inequalities droughts and resource scarcity; both the WEF Nexus and climate justice framings could offer novel insights.

The literature on the practical understanding of these frameworks in the context of smart metering of food waste is limited. This thesis theme aims to bridge this gap by exploring practitioners’ understanding of the concepts like “fairness”, “sustainability”, “smartness” or “the WEF Nexus” “joined up thinking” when applied to the debates of specific policy areas. Table 2.4 (overleaf) summarises main concepts explored in the thesis, their potential, critiques and opportunities for synthesis at the theoretical level. Chapter 3 will introduce the overarching methodology of the thesis, justifying each research stage and the epistemological standpoint.

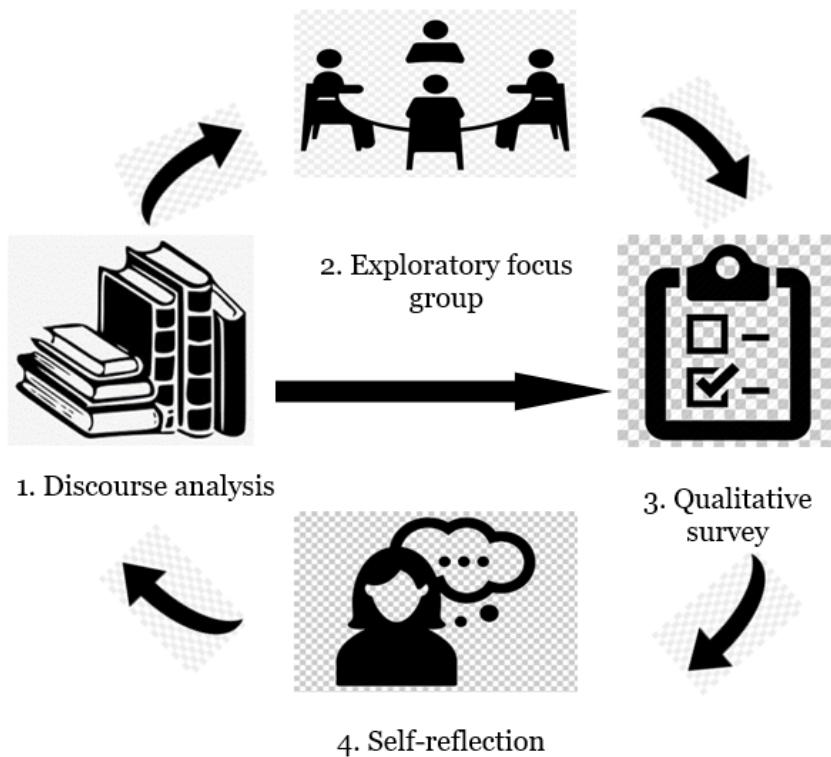
**Table 2.4.** Main concepts investigated in the PhD thesis: potential and limitations

Concept	Potential	Critiques	How was it synthesised in the thesis?
<b>Climate Justice</b>	* theory with a long tradition in the literature  * more urban scale studies needed	* too many dimensions and conceptualisations	* exploring whether the WEF Nexus analysis can account for justice  * investigating practitioners' understanding of climate justice using examples of food waste and smart metering
<b>WEF Nexus</b>	* popular among policymakers  * more qualitative studies needed	* a "buzzword", rather than well-grounded theory  * technocratic and managerial doesn't lead to a systemic change	* assessing the applicability of the WEF Nexus thinking at the urban scale
<b>Smart Metering</b>	* lowering bills  * upgrading water and energy grids  * resource efficiency  * integrated decision-making	* little evidence on their effectiveness  * lack of relevant policies, esp. in the water sector;  * delay in the implementation of energy smart meters	
<b>Food waste recycling</b>	* provision of low carbon energy  * reduction of GHG	* research focuses on prevention as recycling is less favourable in the waste hierarchy  * lack of relevant policies, esp. for commercial food waste	

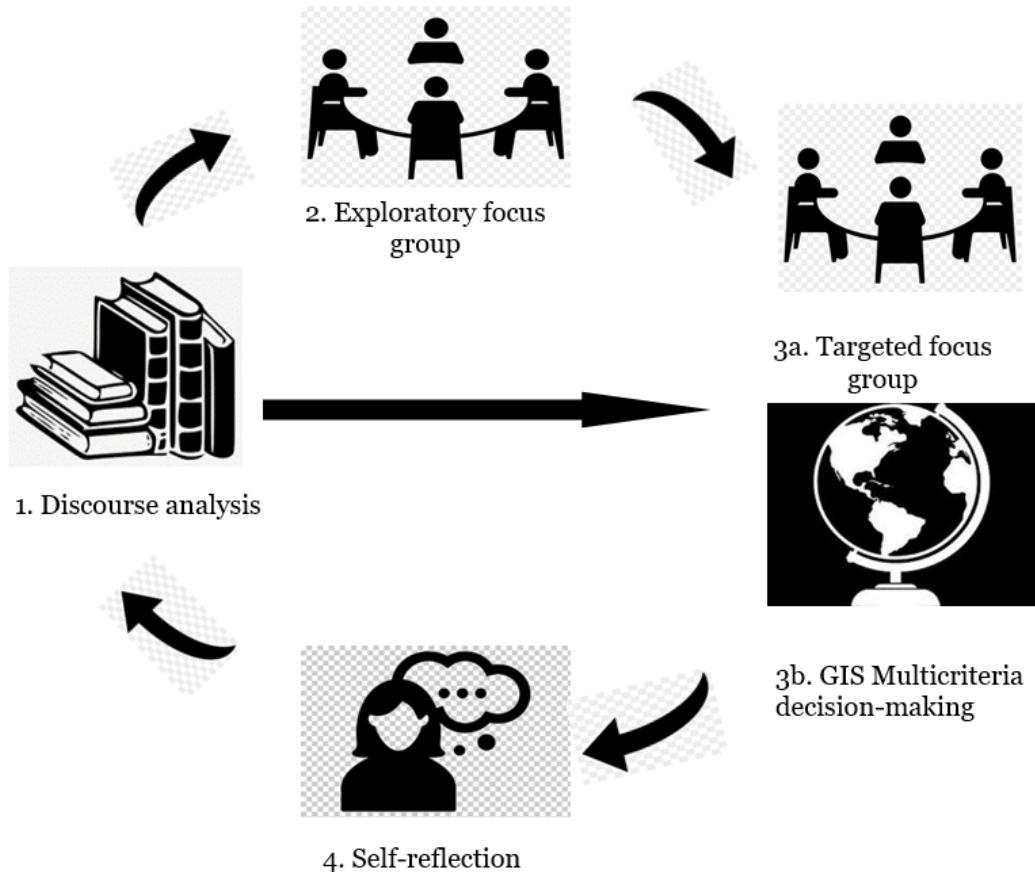
### 3. Methodology overview

The transdisciplinary nature of sustainability research calls for a methodological framework, which enables the combination of the expertise of the practitioners, the available local datasets and the researcher's skillset. Since this PhD aims to contribute to the local decision-making, it is vital that the results are supported by a variety of evidence, ranging from a desk-based literature review, participants' expertise to, finally, spatial analysis. Therefore, the 4-stage methodology of action research (McNiff and Whitehead, 2012) is applied in this thesis. Figures 3.1 and 3.2 provide a graphical representation of the research methodology in food waste and smart metering themes.

Chapters 3.1-3.4 outline four main stages of the research, whereas chapters 3.5-3.9 elaborate on the overarching methodology, the epistemological position, researcher's biases and research ethics



**Figure 3.1.** The methodology applied to the research thesis – food waste theme. Arrows demonstrate how each stage of the research feeds into the following one.



**Figure 3.2.** The methodology applied to the research thesis – smart metering theme. Arrows demonstrate how each stage of the research feeds into the following one.

### 3.1. Stage 1: Discourse analysis

#### 3.1.1. The aim of discourse analysis in the study

The aim of the first stage is to explore the current discourses<sup>12</sup> in the areas of food waste and metering. In doing so, the analysis primarily contributes to the theory-building part of the research (as outlined in Chapter 2). Discourse analysis investigates grey literature, news articles and marketing materials in order to evaluate whether and how the notions of low carbon and climate just future are embedded in these documents.

<sup>12</sup> In this thesis, “discourse” is defined as a text with an agenda or ideological underpinning (Bax, 2011). Discourses aim at establishing a particular dominant social reality, therefore they govern what is possible to think and do (Miller and Hoogstra, 1992).

### 3.1.2. Role of discourse analysis in the wider context of the study

Discourse analysis is deemed appropriate for this research as it studies how power<sup>13</sup> and inequalities are enacted and maintained through the social use of language (e.g. framing, rhetorical devices, images, normative phrasing; Van Dijk, 2008). Discourse analysis uncovers power relationships which inform what people think and do (Waitt, 2005). In doing so, discourse analysis sees language as capable of profoundly influencing politics. The methodological assumption which informs the choice of DA as a research method is that in policymaking, various stakeholders seek to establish a particular narrative, or their own understanding of contested terms related to sustainability (Jacobs, 2006).

Therefore, by questioning the issues of power and inclusion within a text, discourse analysis corresponds to objective #1 of this study: “*to examine discourses on selected sustainability challenges in Bristol*”. To link the PhD objective to the theory, Waitt (2005) argues that two key contributions of discourse analysis are 1) identification of regulatory frameworks, within which political arguments are produced and circulated; 2) uncovering ideological mechanisms which place certain practices and opinions as “normal” or “common-sense”. In practical terms, understanding the discourses of food waste and metering will help to frame the further stages of the research, by allowing to ask more critical questions and offer more relevant policy recommendations.

Moreover, discourse analysis helps to interpret the intent of the text, therefore allowing improved communication with participants. By examining the linguistic tools used in the data, the method employs a critical level of text analysis as it goes beyond that which is presented explicitly (Wodak and Meyer, 2009). A comprehensive review of policies, media and marketing materials is required for nexus-type projects since understanding the language used by the policymakers, journalists, practitioners, and academics creates favourable conditions for cross-sectoral collaborations across the domains of the WEF Nexus.

Finally, it should be noted that discourse analysis was used throughout, i.e. focus groups and a qualitative survey were analysed combining thematic and discourse analysis. The researcher, therefore, contends that discourse analysis is an approach integrating the whole thesis, rather than a technique used solely in the first phase of the project.

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<sup>13</sup> Power is understood as “the capacity or ability to direct or influence the behaviour of others or the course of events.” (Oxford Dictionary, 2018)

### 3.1.3. Advantages of discourse analysis

Discourse analysis fits with the aim of this PhD thesis as it is problem-oriented, considered with social justice and giving “voice” in a debate. It encourages the researcher’s explicitness, self-reflexivity and transparency, which are the essential qualities of a competent social scientist (Wodak and Meyer, 2009). Discourse analysis deepens an understanding of social relations and power structures by asking whether and how environmental and social challenges and solutions are incorporated into the dominant agenda (Colombo and Porcu, 2014). Moreover, discourse analysis rejects the notion of “value-free” science, instead of arguing that the scholarly discourse in itself is a form of power production (Van Dijk, 2008). This standpoint is well suited to a concept of a self-reflective PhD researcher, as one ought not only to critique dominant ideologies but also remain vigilant about how supposedly “neutral” discourses are created and maintained (*ibid.*).

The merit of traditional policy analysis has been in evaluating interventions and understanding managerial practices, yet it has been less successful in analysing power-related tensions and ideological conflicts arising during policy development processes (Jacobs, 2006). Traditional methods of policy analysis (e.g. logic model) do not question the assumptions behind the theory-laden concepts, potentially contributing to the creation of “buzzwords” (House and Howe, 1999). Therefore, the researcher opted for examining the discourses around food waste and metering as they are both subjects to contestations and complexities. Sustainability policies are commonly formulated as technical and administrative in order to appear neutral and devoid of ideology (Luke, 2005; Fuchs, 2017). Yet, inequitable power distribution is commonly legitimised and perpetuated through discourses appearing in such documents (Colombo and Porcu, 2014).

Application of discourse analysis in political studies and geography can be traced to the 80s, where scholars have been exploring contested meanings of urban living (Hastings, 1999). Researchers like Connolly (1983) influenced political studies as he encouraged researchers to see language not only as a conduit for concepts but also as a form of political activity. Further, Lees (2004) provided a typology of discourse analysis as deployed by human geographers. The first strand is associated with Norman Fairclough school of critical discourse analysis as seeks to establish the language strategies used by the key stakeholders (e.g. politicians, research participants) to shape policy agenda. In contrast, the second approach inspired by Michel Foucault claims that power is constituent of a network of relations and

evolving and negotiated historical usage of the key terms (what he calls “genealogy”) (Lees, 2004).

### 3.1.4. Limitations of discourse analysis

There are several limitations related to discourse analysis. At the theoretical level, critics of discourse analysis in urban policy claim that the method is unsystematic and adds little to the notion of policy evidence (Jacobs, 2006). Furthermore, scholars like Lees (2004) argue the limited use of discourse analysis in practice as it is a weak form of activism. Finally, another set of accusations made against that method posed that the method reduces all aspects of social life to discourse and text, excluding social practices, cultural norms and embodiment (Imrie *et al.*, 2000). While these criticisms are valid, they point to the need for further developing discourse analytic heuristic in urban policy and geography (Jacobs, 2006). Contested terms in geography, such as “sustainability”, “smart cities” or “nexus” has been a subject to limited scrutiny and offer a generative gap in theory development. Second, the limitations of the method suggest that it is likely to bring the best practical results and influence policy processes if it’s used in conjunction with other methods. In order to be incorporated into policy evidence, discourse analysis ought to be validated by the voices participating in the given discourse (hence combining focus groups with desk-based analysis of the discourse in this thesis).

In terms of practicalities, since the first stage of the study focuses only on secondary sources, it does not give a chance for the authors of the selected documents to defend the application of the ambiguous or contentious terms. A degree of the researcher’s own interpretation of the qualitative data is a necessary feature of discourse analysis (House and Howe, 1999). An appropriate way to respond to such criticism is to emphasise the analyst’s transparency and rigour, by providing a detailed account of heuristic (Chapter 4.1.2) and a self-reflective note (Chapter 3.7. and Chapter 7) (Wodak and Meyer, 2009).

As discourse analysis is a qualitative and interpretive method, there is no single standardised protocol for the research. Consequently, the researcher followed a heuristic<sup>14</sup> tailored to the thesis’ objectives and types of texts investigated, described in detail in Chapter 4.1.2. Compiling an appropriate heuristic was labour-intensive; it also required an extensive search of publications employing discourse analysis

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<sup>14</sup> Heuristics are methods for arriving at satisfactory solutions with modest amounts of computation (Simon, 1990)

across a variety of disciplines since there was no guidance or previous examples on discourse analysis for the WEF Nexus-type research.

The study is concerned with the emerging issues, which hinders the availability and access to the publicly available information. However, limited availability of data could be a point of reflection for the analysis as it sheds light on the existing procedures of communication with the public, e.g. what is (not) communicated to the public? When in the policy cycle does communication happen?

### 3.2. Stage 2: Exploratory focus groups

#### 3.2.1. The aim of focus groups in the study

The aim of focus groups is to facilitate co-producing recommendations about local policymaking and cross-sectoral learning. The events gather in one place a wide array of sustainability practitioners working for public, private, education and charity sectors; each of them brings their unique expertise and opinions on Bristol's environmental policy priorities.

#### 3.2.2. Role of focus groups in the wider context of the study

An exploratory focus group (Stage 2) acts as a link between the researcher's knowledge derived from the discourse analysis (Stage 1) and further collaboration with sustainability practitioners via policy co-design (Stage 3).

Focus group has been recognised as an appropriate method to tap into the interactions between participants. This allows an enhanced understanding of their agendas, points of consensus and dissensus (Liamputpong, 2011). During focus groups, participants are primarily encouraged to speak to each other, whereas the researcher's role is to listen and make sure the ongoing deliberation is related to the research question (Morgan, 1997). Therefore, the key feature differentiating focus groups from one-to-one interviews or surveys is participant interaction.

Human geographers like Breen (2006) or Wiles *et al.* (2005) argue for further traits distinguishing focus groups from interviews. These are: sharing and comparing experiences in the group, generating ideas and exploring the issue of shared importance. All of these purposes make the method appropriate for this thesis, where the researcher aims to tap into the opinions of the local sustainability practitioners and draw from their rich and diverse experiences to enhance the local policy evidence base.

Through focus groups, the researcher has access to the diverse range of expertise and experiences of the local actors. As a result, participants advised on future policy and

research priorities (Stage 3). Focus groups were a stepping stone towards lasting collaborations built on the notion of mutual trust and shared goals. Participants had further opportunities to engage with the research upon completion of a focus group, see Table 3.1.

**Table 3.1.** Opportunities for knowledge co-production following the initial focus group

Opportunities for policy co-design following from Stage 1
<ul style="list-style-type: none"><li>• facilitating access to data on water, food and energy in participants' organisations</li><li>• co-authoring peer-reviewed papers or policy briefs</li><li>• disseminating research outcomes during local events</li><li>• participating during the next phase of the research (Stage 3) and advising on research design and preliminary results</li></ul>

It is worth noting that the analysis of the focus group differs from one-to-one interviews. In the case of group discussion, more emphasis is placed on social interaction, such as the instances of consensus, dissensus (Breen, 2006). Geographers like Wiles *et al.* (2005) argue that this analytical perspective is particularly relevant to political questions, where the analysis extends to “how” people use contested terms such as “sustainability”, “climate justice” or “nexus”. Such analysis can uncover whether the “integrative imaginary” of the WEF Nexus, the idea of collaboration across sectors, is both possible and desirable (Cairns and Krzywoszynska, 2016).

Finally, it is worth noting that in the metering research theme, focus groups were used over two stages:

- Exploratory focus group to map key opportunities and challenges with regards to smart metering (Stage 2).
- Targeted focus group to co-design policy and public engagement recommendations on smart metering (Stage 3).

### 3.2.3. Advantages of focus groups

According to Liamputpong (2011), group conversations stimulate dynamic discussions which lead to discovering new directions and priorities about a given topic. They are often used as a way of scoping whether people would ‘buy into’ new ideas – in this case directions of future research and policy recommendations. Although originally used for market research, nowadays focus groups are applied to the policy consultation process to increase the legitimacy of ideas and anticipate possible tensions and “unintended consequences” (Hay, 2005).

Focus groups facilitate understanding of the other's point of view and complexities behind each argument. It is worth noting that the method is not oriented towards gaining consensus. Instead, it encourages a wide range of responses, which might lead to the intellectual shift towards "nexus" thinking (Hennink, 2007). Group interactions encourage making connections between new concepts which would not be considered during individual interviews (Liamputpong, 2011). Thus, focus groups are particularly suitable for exploring complex and contentious issues (*ibid.*).

Focus group resembles the "natural" forms of communication closer than the questionnaires or in-depth interviews. Therefore, it facilitates an applied understanding of the abstract concepts like the WEF Nexus or climate justice by referring to the real-life examples in everyday language.

Although focus groups are commonly associated with market research, there is a growing body of research suggesting a potential of cross-sectoral discussions as a tool for policymaking (Kahan, 2001; Horlick-Jones and Prades, 2014; Howarth and Monasterolo, 2016; Hoolohan *et al.*, 2018). Scholars agree that focus groups, therefore, are suitable for the exploratory stage of the policy cycle – the time when policymakers traditionally scope which issues are prioritised by the citizens and experts. Finally, careful and inclusive recruitment of the event democratises the process, contributing to the improvements in procedural justice in policymaking (Bulkeley *et al.*, 2014).

### 3.2.4. Limitations of focus groups

Despite being a well-recognised method, focus groups come with a range of limitations. However, many of them often result from the poor design of the study and can be counteracted with thoughtful recruitment, facilitation and adaptability to changing circumstances.

The researcher needs to be considerate from the point of selection of the participants, through question design to, finally, effective facilitation. In order to avoid falling into the risk of biased participants' selection, the researcher is required to be self-reflective and justify her sampling strategy. Morgan (1997) recommends that groups should be composed of individuals previously unknown to each other. However, in the case of this PhD, this cannot be guaranteed. Due to the small geographical scale, thematic scope and the emerging sustainability "community of practice" (formed via e.g. Bristol Green Capital Partnership), it is likely that some participants have met or worked before. In order to avoid the conversation swaying to the topics of the shared history of some group members, the researcher ought to set the tone of the meeting,

emphasising the purpose of the conversation as generating new ideas and policy directions across the WEF Nexus.

Some researchers (e.g. Breen, 2006; Morgan, 1997) argue for recruiting homogenous demographics for each focus group in order to minimise power imbalances and increase the chances of commonality in interests or experiences. In the case of this research, this meant ensuring a careful composition of the group, e.g. a wide variety of participants' backgrounds (sectors, genders and levels of seniority) while maintaining a certain degree of homogeneity (e.g. shared interests or experiences) (Morgan, 1997). Therefore, this methodological innovation allowed the participants to get out of their sectoral siloes and be faced with the opinion of colleagues at various levels of seniority. In order for a successful focus group to become comfortable space to express opinions with minimal power imbalances, the researcher has to take extra care while facilitating the event, by e.g. encouraging even expressions of opinions.

Focus groups can result in an uneven expression of opinions (e.g. if aggressive personalities dominate the conversation) or even an escalation of personal tensions (*ibid.*). Here, it is crucial that the researcher acts as a skilled group facilitator, who provides a non-threatening environment by agreeing on house rules and expectations beforehand, providing informal icebreakers and refreshments, and encouraging everyone to speak and respect each other's opinions (Hennink, 2007).

Further ethical challenges are related to the unpredictable nature of focus groups (Agar and MacDonald, 1995). Lack of total control over group dynamics led to some academics questioning the possibility of genuine consent (Sim and Waterfield, 2009). For example, the emergence of temporary group norms might lead to individuals being silenced (Kitzinger, 1995). Sim and Waterfield (2009) recommend a set of practices to enhance the validity of research, such as encouraging quieter participants to contribute or sharing transcripts ahead of data analysis.

Following the initial theoretical design of the study, it is advisable to conduct a pilot focus group to test the clarity of the questions, timings of the event and revise facilitating strategies.

### 3.3. Stage 3: Policy co-design

#### 3.3.1. The aim of policy co-design in the study

The aim of the co-design stage is to provide the evidence base for the local low carbon and just policy recommendations. The research output contains co-produced

rationale, practical guidelines for implementation, quantitative analysis and a strategy for dissemination.

### **3.3.2. Role of policy co-design in the wider context of the study**

Policy co-design phase is a continuation of Stage 2 (Exploratory focus group). Drawing from the priorities and data needs discussed during Stage 2, participants had an opportunity to engage deeper in the topic and become co-researchers for the project, which involved long-term collaboration via meetings and email exchanges. During the co-design process, a team of academic researchers and sustainability professionals works together in the space between the theory and practice. Together, they reflect on the recommendations arising from the literature and the relevant local experience.

As a result of the initial consultations with the participants and analysis of the local data availability, three methods were selected. They act as tools to facilitate the co-design of policy evidence and recommendations (Table 3.2). These methods are:

- Survey (commercial food waste)
- Targeted focus group (metering communications)
- Multicriteria Decision Making (metering policies)

**Table 3.2.** A set of mixed methods applied in Stage 3 “Co-design of local policies”

	<b>Food Waste – Mixed Methods</b>	<b>Metering – Qualitative</b>	<b>Metering – Quantitative</b>
<b>Description</b>	Survey on food waste recycling among the local catering businesses	Focus group with energy and water professionals, targeted at providing recommendations on communication	Multicriteria Decision Making analysis in Geographical Information Systems (GIS) for just deployment of smart policies
<b>Justification</b>	Chapters 3.3.5-3.3.6	Chapter 3.2	Chapters 3.3.7-3.3.9
<b>Research design</b>	Chapter 4.3.2	Chapter 4.3.3	Chapter 4.3.4

The protocol for each method is specified in Chapter 4. The rationale for each method is described below (with the exception of the targeted focus group, which follows the format of the exploratory focus groups – see Chapters 3.2 and 4.2).

### **3.3.3. Advantages of policy co-design**

Designing policies in collaboration with a wide range of sustainability practitioners stands in contrast to the traditional protocols of policymaking. Co-design breaks power barriers in decision making, contributing to the justice imperative of the thesis. Moreover, co-producing research is useful for capturing diverse framings, cross-sectoral learning and creating future opportunities for collaboration. (Howarth and Monasterolo, 2016). Conducting mixed-methods and participatory research together with sustainability practitioners complements prevailing quantitative and physical sciences approaches to the WEF Nexus (Albrecht *et al.*, 2018). As a result, the research is based on the combination of the academic and local understanding of the WEF Nexus and climate justice (*ibid.*).

The researcher decided on the methods, policy priorities and secondary data following the suggestions from the participants and stakeholders. Working from the point of shared goals makes the policy development process more robust. In the case of the thesis, research stakeholders were experts in their WEF Nexus domain and Bristol citizens themselves, which strengthens the democratic processes and procedural justice (Bulkeley *et al.*, 2014). It also improves the efficiency of the policy design as key points of consensus and dissensus can be identified in the early stages of the research (Blomkamp, 2018). This was achieved by analysing diverse discourses or probing for disagreement during an exploratory focus group. On occasions, the analysis brought attention to unexpected justice dilemmas or WEF Nexus trade-offs. They would have stayed unexplored if examined using traditional policy design frameworks.

Conversations revealing the “unexpected dilemmas” happen when people are allowed to be creative and reflexive (Hoolohan and Browne, 2018). In the context of the thesis, research participants were encouraged to get outside their professional practice (e.g. speaking on behalf of their organisation) and bring views from other roles and personal experiences.

### **3.3.4. Limitations of policy co-design**

Despite the growing popularity of policy co-design, the approach is still yet to benefit from a theoretical grounding. Although the related approaches such as action or transdisciplinary research are thoroughly conceptualised, “co-design” is still a buzzword in the public sector (Blomkamp, 2018). This means that although the term is common in the governmental discourse, the precise definition and practical guidelines are lacking.

At the time of writing, only few academic articles have been written about co-design in the public sector (*ibid.*) – the majority of knowledge is stored and disseminated via grey literature (e.g. the Bristol Method, as described by the Bristol Green Capital Partnership, 2015b) and local networks (e.g. Bristol Green Capital, Bristol Energy Network). In contrast, co-design and co-production are well theorised in the areas such a product design (Oldfield and Manchester, 2016) or education (Facer and Enright, 2016).

In light of this knowledge gap, the biggest limitation of the policy co-design is the lack of evidence of “what works” (O’Rafferty *et al.*, 2016). This creates a challenge as there are no clear guidelines on how to evaluate *and value* such research. What should be expected from the researcher and the stakeholders? What are their responsibilities? Cairney and Oliver (2017) argue that this ambiguity turns policy co-design ideas into unfeasible projects, with little chance of real-world impact. Without a theoretical grounding, co-design proposals are too ambitious given the timeframe and they do not allow enough time to build deep relationships between the stakeholders. Yet, the relational nature of policy co-design necessitates conditions of trust, mutual understanding and shared goals above all.

The future agenda of “policy co-design” should, therefore, explore the following pathways:

- The nature of stakeholder engagement in policy (Hoolahan *et al.*, 2018);
- Facilitating co-design mechanisms in the context of urban governance (Blomkamp, 2018);
- Providing evidence for the value of policy co-design (*ibid.*)

The following chapters will specify the advantages and disadvantages of the methods applied in Stage 3, namely, qualitative surveys and Multicriteria decision-making (MCDM).

### 3.3.5. Advantages of qualitative surveys

A qualitative survey is a method for conducting structured and clearly time-bound empirical research using a pre-defined set of questions. The design allows gathering a wider range of responses compared to in-depth interviewing.

The qualitative design was applied in this study to provide a “thick description” of the issue, rather than solely statistical correlation (Jansen, 2010). As such, the results do not aim to represent the whole catering sector, but they act as evidence for co-designing a policy specific to the local context. While the classic design of quantitative

survey analyses frequencies in responses in a given sample, the qualitative survey focuses on the diversity of answers within a population (ibid.).

Qualitative face-to-face surveys are suitable for exploratory research, where no previous studies on the issue were undertaken and in-depth understanding is required to derive sound policy recommendations (ibid.). Moreover, their format enables researching busy environments like restaurants and cafes. Unlike focus groups or in-depth interviews, they are more efficient at gathering key insights without much time commitment from the participants.

### 3.3.6. Limitations of qualitative surveys

Given the limited time available to conduct qualitative surveys, this method isn't suitable for researching sensitive issues, where the interviewer would usually take time to establish a rapport with participants. Similarly, qualitative "snapshot" surveys provide "face value" answers and would not typically yield a degree of nuance comparable to hour-long conversations.

Theoretically, the notion of a "*qualitative survey*" does not easily fit into classic research paradigms. For example, Groves *et al.* (2004) noticed that "*The survey is a systematic method for gathering information for the purpose of constructing quantitative descriptors of the attributes of the larger population*" (p.4). Jansen (2010) argued that the understanding of surveys as a quantitative and statistically representative method led to the omission of the method in textbooks on social research.

Lack of statistical representativeness of data is a key limitation of the method. One could argue: how could qualitative studies ever inform policy evidence? However, Cairney and Oliver (2017) pointed out that the *practices* of evidence-based policymaking differ from e.g. evidence-based medicine. Policies are decided based on a combination of evidence, power, democratic principles (e.g. co-production, majority vote) and value judgements. For this reason, researchers aiming to make an impact in the policy world ought to combine methods which allow for the inclusion of the above factors (ibid.). Here, a qualitative survey was designed using co-design methodology with explicit values of climate justice and sustainability. Therefore, it is expected that the method design could be impactful in the "real world" despite its statistical shortcomings.

### 3.3.7. Multicriteria decision-making: introduction

MCDM was applied in this study to map areas of high and low capability in terms of potential adoption of the WEF Nexus policies. The model was developed in GIS

spatial analysis software, ArcMap. It asked, “which neighbourhoods should be prioritised to a) maximise the emissions reduction potential **or** b) reduce socio-economic inequalities?”

Here, GIS mapping is used as an analytical and visual prompt to facilitate deliberation on prioritising of the hypothetical initiatives. MCDM calculates priority areas for policy implementation using a system of weights and scores. The local datasets are used as “criteria” (e.g. electricity consumption, income deprivation, house ownership); each of them is assigned with a “weight” when deliberating its importance to decision-making. Weighting is undertaken in a subjective and structured technique called the Analytical Hierarchical Process (AHP), which allows the researcher to decide on the relative weights of each dataset using an iterative procedure. The following website was used to set up an AHP model <https://bpmsg.com/academic/ahp.php>. In the AHP exercise, cumulative weights of all datasets add up to 100%. A GIS software (ArcMap) then spatially analyses the local datasets, scoring areas between 1 and 10 (10 being the most suitable) to determine priority areas for the policy interventions.

Priority is defined in agreement with climate justice scholarship following the capabilities approach developed in Chapter 2.1.2. Priority areas are understood either as a high capability or as a high disadvantage (Bulkeley *et al.*, 2014; Chatterton *et al.*, 2016). Theoretically, the work follows from Sen’s (2003) capabilities approach, which emphasises acknowledging people’s capabilities (or their lack of) to make pro-environmental life choices. The idea of “capability” and climate justice has been previously operationalised using GIS spatial analysis. For example, Chatterton *et al.* (2016) argued that high energy consuming *and* highly capable residents ought to be prioritised in policy interventions. Bouzarovski and Simcock (2017) argue that academics ought to “spatialise energy justice” by explicitly introducing the vocabulary and methodologies to understand justice through geographical lenses.

Following the capability approach, the thesis argues that policies ought to re-consider the notions of “targeting” beyond simple indices of deprivation. For example, lack of capability could be considered as a combination of income deprivation, lack of house ownership and high energy bills (this is further elaborated in Chapter 4, see Figure 4.3).

### 3.3.8. Advantages of Multicriteria decision-making

GIS-based MCDM continues the tradition of “Multicriteria Mapping” – a set of innovative approaches to science-policy advice developed by Andy Stirling in 1997 (The University of Sussex, 2019). In his seminal paper, Stirling (2010) argues that

researchers should challenge the notion that the role of science is to provide a single definitive answer to policy questions. Instead, science-policy collaborations should draw from the methods which highlight the plurality of expertise in structured and rigorous ways.

One of the advantages of MCDM is that the process is driven by the specific and quantitative datasets, which might yield surprising results contrary to stereotypes about the city. Moreover, quantifiable outputs of the exercise (e.g. scoring “10” for the most suitable location of the policy intervention) give more evidence for the policy comparing to the subjective judgement. The analysis of multiple datasets (varying from resource consumption, demographics to the economic situation) as an expression of nexus-type thinking, even though the nexus, in this case, does not precisely sit between water and energy. Kaijser and Kronsell (2013) note, however, that the aim of intersectionality is not to simply include as many analytical categories as possible. The goal instead, ought to be widening the perspective and reflecting upon multiple factors which might contribute to particular issues. Since MCDM is iterative, it allows running a variety of “scenarios”, each with a different set of data or weighting.

GIS mapping is used as an analytical and visual prompt to facilitate deliberation with regards to local policies. By combining and analysing a set of complex, quantitative and spatial data, MCDM enabled a formation of a decision support tool applicable to the local context.

Ultimately, the knowledge of the residents’ base helps to identify the right communication strategies: fair engagement with disadvantaged communities and the biggest potential for GHG emission reduction in the highest capability areas.

### 3.3.9. Limitations of Multicriteria decision-making

MCDM comes with a set of limitations. It is ultimately a reductionist method, which equates an answer to a complex question with a single figure (e.g. “10” for the most suitable location for a smart energy policy). For that reason, this approach should be applied as a part of a mixed-method approach and considered together with qualitative methods, especially those based on the local, contextual knowledge. Again, it has to be highlighted that MCDM ought to be used as a deliberation aid rather than a decision-making tool (Frame and O’Connor, 2011).

Furthermore, the approach receives criticisms for being “subjective” (Yeh and Xu, 2018). Yet, it would be difficult to think of any social policy which could be determined with an “objective” decision. The PhD researcher has been clear about

the agenda (low carbon and just Bristol), hence the datasets contributing to the results directly correspond to the aims of the PhD. In order to highlight how the differences in the weighting of various datasets can lead to different results, the researcher contrasted her “Informed Subjective” view with two other weighting scenarios.

This decision support tool relies on readily accessible secondary datasets. For this reason, the water dimension is absent from this research due to the lack of complete dataset – at the time of writing, water consumption datasets are privately owned and largely confidential. Similarly, electricity and gas consumption data were not obtained from smart meters. At the time of writing, smart meter data was incomplete and unreliable. Future research ought to incorporate further stakeholders’ involvement in the deliberation. For example, the stakeholders could run AHP exercise to weight the criteria and experiment with different outcomes. In case of this PhD, the stakeholders suggested research question (“can we prioritise smart energy policies using the segmenting the population into highly capable and highly disadvantaged residents?”) and advised on the appropriate datasets. They also could read and comment on the report with preliminary results. However, only the researcher analysed the data using scoring and weighting (AHP).

### 3.4. Stage 4: Critical reflection

#### 3.4.1. The aim of critical reflection

The aim of a critical self-reflection is to evaluate one’s own work and to learn from the research process. By tracing the evolution of research design from the start to finish, the researcher evidences the quality of work and her professional development as an academic.

#### 3.4.2. Role of critical reflection in the context of the study

Critical reflection closes the action-reflection cycle by re-conceptualising the learning process and highlighting future research directions. Furthermore, it enables the identification of improvements to both the researcher’s and the participants’ practice. Traditionally, the reflection stage does not merely signify the end of the project. It ought to be a stepping stone towards policy implementation and opportunity to generate further research questions (McNiff and Whitehead, 2012). However, due to the time-bound nature of a PhD, critical reflection acts as a final stage of this thesis.

### 3.4.3. Advantages of critical reflection

Conducting research carries an inherent risk of providing results skewed by biases. Every person carries a set of their own prejudices, opinions and agendas. To some extent, it is impossible to distance oneself from the topic of inquiry, particularly if the study is framed as “challenge-oriented”, a common characteristic of transdisciplinary research and critical sustainability studies (Lang *et al.*, 2012). In fact, within these schools of thought, acknowledging and explicating bias is a commonplace, rather than an attribute to be corrected for (*ibid.*).

Nevertheless, bias could interfere negatively with the study if the researcher is not proactive and critical about discovering their own ways of reasoning. Self-reflection is a way of being critical, yet also curious and compassionate towards own approaches and reasoning. It is a process of becoming aware of unconscious mechanisms which lead the research in various directions (Ortlipp, 2008). Political action does just simply “happen”; it is underlain by societal mechanisms, prevailing trends and networks of stakeholders in power (McNiff and Whitehead, 2012).

Further, Chapter 3.7 explores the researcher’s biases and outlines the self-reflective strategies applied in the study. Finally, Chapter 8 is a comprehensive account of self-reflection from the process, where the researcher evaluates the application of the methods and summarises her learning experience (Stage 4).

### 3.4.4. Limitations of critical reflection

Self-reflection is a widely acknowledged academic practice, seen by many social scientists as an essential element of professional development (McNiff and Whitehead, 2012; Stirling, 2015). However, although common in interpretivist paradigms and action research projects, self-reflection does not feature as a “standard” requirement of PhD theses. Rugg and Petre (2014) report that *“some people believe that this is pretentious navel-gazing at best, and gratuitous pouring of blood into the water at worst”* (p. 71). However, compiling a list of lessons learned and new best practices doesn’t exclude the possibility of producing good quality research outputs. On the contrary, an honest evaluation will increase the chances of engraining successful practices as habits and avoiding mistakes in the future.

There are a few challenges of critical reflections related to the execution of the method. First, it relies on establishing a framework of questions which will evoke honest and thoughtful responses. This method also requires conscientious journaling. Finally, self-reflection requires developing a strong first-person voice,

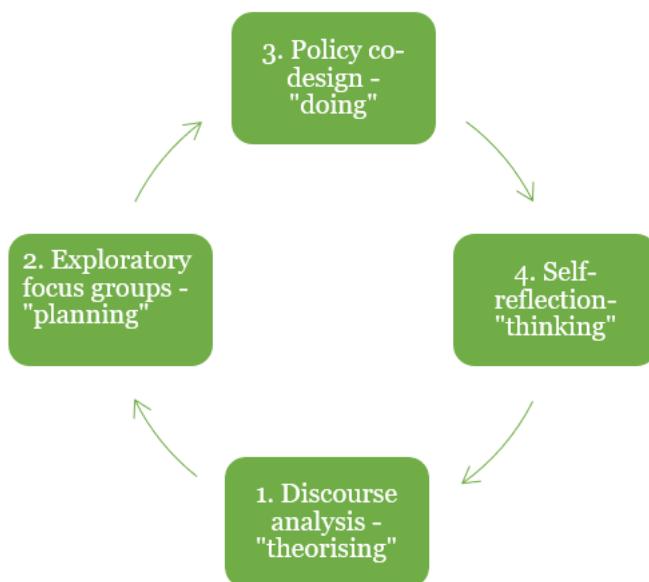
which might not come across easy if the remainder of the thesis is written in the third person.

### 3.5. Methodological framework

#### 3.5.1. Action research: definition

The study draws from the action research methodology as it is concerned with improving the current policy design practices using a collaborative inquiry approach (McNiff and Whitehead, 2012). The outcomes are expected to enhance local policies across the water, energy and food sectors. This is achieved by applying the co-produced understanding of terms like “smart cities”, “nexus”, “sustainability” and “justice” in the context of metering and food waste.

The methodology applies an action-reflection cycle which emphasizes the importance of informing practice with theory. In the case of this PhD, the cycle feeds practical experiences into the policy discourse and the resulting theory (Figure 3.3).



**Figure 3.3** Action-reflection cycle: theory and practice (adapted from McNiff and Whitehead, 2012)

#### 3.5.2. Action research: justification

The aim of action research is to improve practice in a given workplace (McNiff and Whitehead, 2012). This paradigm emerged in the times of “participatory turn”, which called for academia leaving the insulated labs and “ivory towers”. Instead, academics were encouraged to work with the “real-world” institutions and challenges (Stokols,

2006). Lewin (1946), who is credited for coining the term “action research”, believed people would be more willing to improve their work if they were involved in decision-making. Traditionally, only the academics were “qualified” to come up with theories, whereas the practitioners were expected to apply them (McNiff and Whitehead, 2012). This created a set of challenges due to the differences in jargon, lack of trust and limited access to peer-reviewed journals. To dissolve this tension, action research supports practitioners with theorising their work. As a result, it breaks down what Schön (1987) called the “high grounds of theory” and “swampy lowlands of practice”.

Historically, the “high grounds of theory” applied academic jargon to clarify and advance complex ideas. However, in doing so, the language separated the academics from the potential research users. Practitioners are expected to execute academic frameworks, yet rarely are they given access to new knowledge in an accessible and concise form. Academic discourse is, therefore argued to be a form of hegemony (McNiff and Whitehead, 2012). Action research aims to break down the power hierarchies embedded in the language. As a result, it democratises the process of policy development (Houston, 2010).

The emphasis on participation, shared language and challenging the notion of academics as “the knowers” makes action research a particularly appropriate methodology for researching climate justice. Historically, action research developed out of critical theory and went beyond it by asking, not only “How to understand oppression/power?”, but also “how can it be changed?” (McNiff and Whitehead, 2012). Therefore, action research finds commonalities with pragmatism, an epistemological approach guiding this thesis.

Some final assumptions resulting from the adopted methodology are:

- research is value-laden
- research is relational
- learning is open-ended (McNiff and Whitehead, 2012)

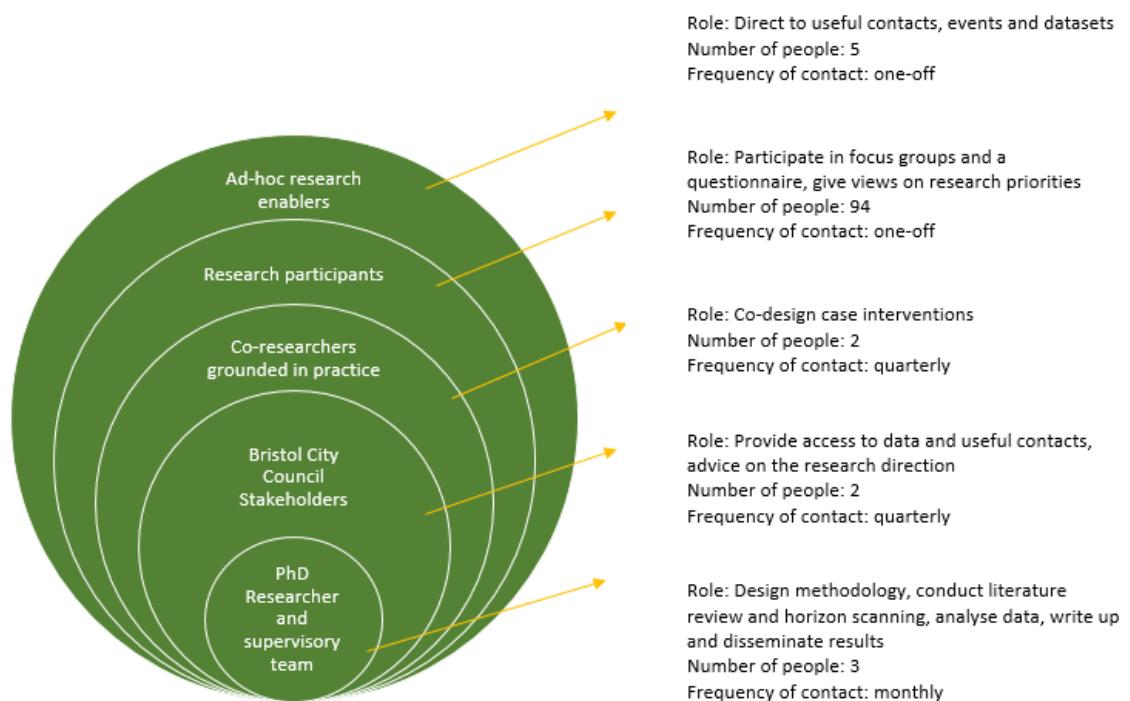
In this thesis, the researcher described her values in Chapter 3.7. The research is characterised as relational due to the presence of the multi-faceted accounts of collaboration (Figure 3.4), particularly applied in Stages 2 and 3.

### 3.5.3. Action research and participation

A key feature of transdisciplinary and action research is participation. A participatory inquiry is investigated *with* the stakeholders across disciplines and sectors. The reason for this is that action research sees practitioners’ living theories just as

important as academic theories (McNiff and Whitehead, 2012). Thus, each participant is seen as an “expert”, regardless of their level of seniority. Meanwhile, the PhD candidate studies her own living theory while developing credentials as a sustainability “expert”. The inherently participatory nature of action research makes it suitable for policy co-design methods and focus groups. However, it is important to note that although action research strives to nurture working relationships, it is not necessarily a consensus-building methodology (McNiff and Whitehead, 2012). Instead, the differences in opinions are expected and understood as potential discursive tensions but also potentially “less actionable” policy ideas.

The figure below (Figure 3.4) outlines the structure of participation in the research.



**Figure 3.4.** A diagram of enablers, participants, stakeholders and researchers

Firstly, the research is conducted by the core team of the PhD student and two supervisors. The PhD researcher is responsible for day-to-day tasks like:

- conducting a literature review
- data analysis
- write up
- dissemination

In a process of learning about the current academic debates, the PhD researcher decided on the theoretical underpinnings of her work. The supervisory team advised

on each of the methodological direction and scrutinised the preliminary results on a monthly basis. Bristol City Council (BCC) is the main stakeholder and a co-founder. The role of BCC stakeholders was to facilitate access to data and relevant contacts. The themes (food waste and metering) were explored with the research participants. In total, 15 sustainability professionals participated in focus groups and 79 catering sector employees agreed to take part in a face-to-face survey. Additionally, two of the focus group participants engaged deeper into the policy co-design, hence they are described as “co-researchers” grounded in practice. Co-researchers met with the PhD student quarterly and actively participated in research design. They also facilitated public engagement (as they have access to the relevant professional networks) and acted as research validators providing comments on draft results. As a result, three peer-reviewed articles, two policy briefs were disseminated as co-produced research outputs (Appendices A-D and I). Finally, an informal group of 5 ad-hoc enablers successfully propelled the research. Their role was to signpost the PhD researcher to potential participants, events and datasets (e.g. data on Bristol waste or recent smart city projects). The ad-hoc enablers didn’t directly participate in the research but were contacted during the data collection phase following the introductions from the co-researchers or supervisors.

According to McNiff and Whitehead (2012), those at the top of organisational hierarchies are recognised as “the knowers”. This PhD strives to resist such power structures by stating that anyone with professional experience in the subject area is an “expert”, regardless of the seniority. An interest in re-defining “the experts” originates from the researcher’s professional interest and past experience of working in a junior role for the local council and being “in the know” of the local policy issues, yet not being in power to communicate or influence them.

### 3.5.3. Triangulation and mixed methods research

The action-reflection cycle featured in Chapter 3.5 (Figure 3.3) is an illustration of a sequential mixed method design. Here, each phase of data collection provides a basis for the next stage of research (Cameron, 2009). The cycle started with “theorising”: the analysis of food waste and metering discourses. Then, the researcher facilitated exploratory focus groups with the local practitioners, who highlighted priorities for the next step of the research. This way, exploratory focus groups acted as a “planning” stage. The third stage of the research involved “doing”, or policy co-design. It involved a long-term collaboration with co-researchers, who provided further methodological recommendations and opportunities for research dissemination. Finally, reflective observations (“thinking”) closed the circle of action and reflection.

This PhD applies triangulation technique which facilitates understanding from multiple perspectives. Triangulation helps to ensure that the account is thick, robust and well-developed (Yin, 2009). A synthesis of methods provides an advantage when conducting research for policy evidence. In the context of this thesis, discourse analysis introduces the researcher to multiple understandings of the themes (food waste and metering). Then, focus groups and co-design stages support cross-sectoral decision-making. Evaluation of the policies using the WEF Nexus and climate justice concepts provides novel policy insights as it reveals where the unintended consequences may exist.

### 3.5.4. Transdisciplinary research

Action research is one of many methodologies available choose from. Whereas action research is far from a default methodology in social sciences, its rise in popularity is indicative of a wider “participatory turn”, observed in academia (McNiff and Whitehead, 2012).

For the past three decades, research funders and government agencies have encouraged framing the pursuit of knowledge in terms of “grand challenges”, with climate change being one of the main issues (National Science Foundation, 2011). Science and Technology Studies (STS) scholars agree that the complexity, urgency and scales of “grand challenges” require an innovative approach to research, which would integrate the existing expertise and democratise participation in research.

Transdisciplinary research was therefore proposed as a suitable mode of research for “real-world challenges” or “wicked problems” (Gibbons *et al.*, 1994). Not only it combines diverse academic expertise, but also it gives voice to the tacit knowledge of the policymakers, businesses, community members and “ordinary” residents (Klein, 2014; Lang *et al.*, 2012; Stokols, 2006). However, these claims have also led to scepticisms about the doability of complex, multi-stakeholder projects (Lyall *et al.*, 2015). Impactful, long-standing collaborations are rarely seen in practice (Petts *et al.*, 2008). Moreover, once created, the *temporary* spaces of “transdisciplinary practices” frequently encompass merely one-way “science communication” to the non-academic partners, rather than an egalitarian dialogue (Felt *et al.*, 2016).

However, “rarely seen in practice”, successful transdisciplinary collaborations require integrative, participatory and flexible methodologies. Unfortunately, these characteristics which do not sit comfortably with the notions of single-answer policy evidence (Stirling, 2010). Although many scholars agree that we should avoid pursuing a single transdisciplinary methodology, a closer inspection of cross-sectoral

knowledge production reveals that some approaches are better suited than others (Stirling, 2015). In his review of over a hundred methods, Stirling (*ibid.*) argues that the most needed transdisciplinary tools “broaden up inputs” and “open up outputs”. “Broadening up” refers to exploring uncertainties, addressing a comprehensive range of issues and engaging with all perspectives of interested parties in a balanced way. “Opening up”, in turns, is concerned with the engagement between science and policy, which acknowledges ambiguity, plurality and conditionality in results communication (*ibid.*). Reconciliation of qualitative and quantitative perspectives becomes a key concern, especially in the areas of research involving both social and physical systems (Lang *et al.*, 2012). The WEF Nexus is a prime example of a framework requiring both qualitative and quantitative lenses as well as transgressing disciplinary and sectoral boundaries (Albrecht *et al.*, 2018).

### 3.6. Epistemology

#### 3.6.1. Introduction

Since PhDs are concerned with producing “new knowledge”, it is vital that the researcher has a thorough understanding of what constitutes “knowledge”. Although the most concise definition of “knowledge” is “justified, true belief” (Oxford Dictionary, 2019), this does not mean that the debate on how one arrives at making such claim is over. Indeed, academia has a long history of heated debates between various epistemologies, with the main schools of thought being positivism (e.g. Comte, 1868), constructivism (Guba and Lincoln, 1994), critical realism (e.g. Bhaskar, 1975) and pragmatism (e.g. Dewey, 1916).

Positivists assert that the world can be defined, measured and observed objectively (Comte, 1868). This approach, therefore, aims to reduce the influence of the researcher from the object of study, treating the scientist as a “dispassionate observer” (Boulton *et al.*, 2015). For that reason, positivist epistemologies are usually applicable to researching natural phenomena, which are subjects of physical laws and can be observed or modelled. In the social sciences, positivist epistemology came under criticism as understanding of people, relationships and organisations is inherently much more value-laden and subjective (Stirling, 2015).

To counteract positivist tendencies in social science, many human geographers and sociologists adopted a constructivist approach. This epistemological position emphasises nuance, subjectivity and context as opposed to reducing “the social” to physical laws (Guba and Lincoln, 1994). Constructivists state that the data cannot be separated from the context and the researcher’s positionality (e.g. own values and

experiences), therefore an “objective reality” cannot be fully known (*ibid.*). While avoiding the act of producing research generalisable to the whole population, constructivists aim to make explicit tacit biases present in their and their informant’s lives. As a result, such research informs how people co-construct and interpret the world around them.

Critical realism is often said to occupy the middle ground between the pure constructivist and the pure positivist positions (Fletcher *et al.*, 2017). This epistemological position emerged from the works of Bhaskar (1975) as a result of “paradigm wars” between positivism and constructivism. Critical realists strive to reconcile both positions by arguing that the reality can be accessed by three levels of analysis: looking at the empirical level (what is directly observed or interpreted), the actual level (what happens, regardless whether observed or not) and real level (causal mechanisms which lead events to occur) (Danermark *et al.*, 2002). Despite this explanatory and theoretical strength, critical realism hasn’t yet inspired a coherent methodological development (Fletcher *et al.*, 2017). The main application of critical realism so far has been causal analysis, which differentiates this epistemological position from constructivism usually applying interpretations and detailed descriptions (*ibid.*).

Finally, a pragmatist epistemology has been developed over the 20<sup>th</sup> century as a philosophy of learning, and more recently, as a research epistemology arising from the aforementioned “paradigm wars” (Boulton *et al.*, 2015). Pragmatism, unlike critical realism, is not a ‘middle ground’ theory as it shifts attention to what ought to be considered as knowledge and knowledge production in research. The key tenet of pragmatism is a rejection of the correspondence theory of truth, the idea that beliefs and data are true if they correspond to reality (Rorty *et al.*, 2004). Instead, pragmatists focused on other conditions as requirements for sound research: appropriate justification, availability of evidence and freedom of the communicative situation (*ibid.*). The philosophy of pragmatism was applied to this thesis and is developed in Chapter 3.6.2. below.

### 3.6.2. Pragmatism

In this PhD, the research question is concerned both with the physical and social phenomena. Hence the need for a flexible epistemology, which embraces the plural ways of producing knowledge – pragmatism. On one hand, our experiences in the world are constrained by the senses and the physical. On the other, our understanding is intimately linked to our personal interpretations. As such, although social scientists favour qualitative and constructivist approaches for investigating

human experiences, the policymakers usually require quantifiable “evidence” for policy development and evaluation (Stirling, 2010). This thesis is an attempt to combine multiple perspectives and methods in the ultra-small geographical scale – two policy issues within a single city.

Here it is important to clarify that pragmatism is not a middle ground epistemology, but approach appropriate to the research questions and data available. Due to its flexibility and a focus on applied research, pragmatism can be seen as an “anti-theorising” epistemology rather than a “middle ground” (Dewey, 1916). By shifting attention from theorising to practising, pragmatists tell us that actions (here: political application), rather than contemplations tell us useful things about what counts as “knowledge” (Rorty, 1980).

Pragmatism justifies theories and concepts by examining their “usefulness” and the possibility of practical applications (Boulton *et al.*, 2015). Although the researcher maintains a degree of reflexivity over possible own bias as well as the participants’ agenda (especially during Stages 1 and 2), the main goal of the thesis is not finding out participants’ “opinions” but applying the results to the policy. Ultimately, the thesis aims to contribute to the development of low carbon and just climate policies in Bristol, as specified in Chapter 1. Although pragmatism has some links to critical theory (e.g. an interest in justice), it doesn’t stop at critiquing the power structures, but it strives to offer practical solutions. In doing so, it moves away from the “spectator” approach to social sciences and aims to generate knowledge through action and reflection (Dewey, 1916).

Pragmatism places an emphasis on the particularity of research (Boulton *et al.*, 2015). This PhD asks about the food, energy, and water issues particularly in Bristol and does not intend to make the results applicable elsewhere. However, the 4-stage methodology could be applied to other locations. Similarly, the secondary data are acquired from the local organisations (e.g. utility companies, local council) in order to reflect the case of Bristol.

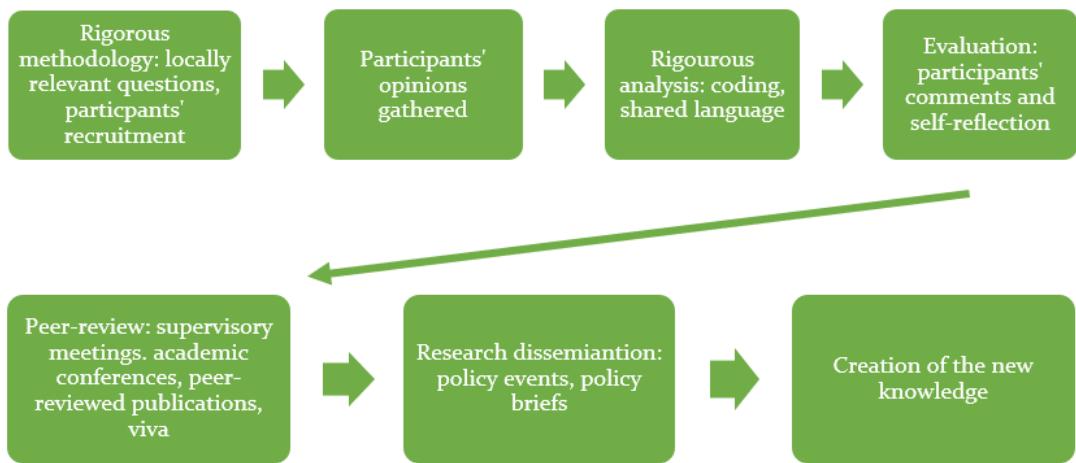
Pragmatic research is interested in working towards a tangible change in local policy practices. For the PhD to be pragmatic, the researcher focuses on what is achievable. She selected the themes based on the data availability and ownership of actions by the local authority. She then organised focus groups to build rapport with the participants, who contributed to the research results over the duration of the PhD. Ultimately, “what works” will be judged by the advances in policy, peer review and viva examination.

Finally, pragmatism is an epistemological stance appropriate to the methods used in the thesis, such as discourse analysis or focus groups. According to pragmatists, the purpose of an inquiry is not finding theoretical truth but deliberating between humans in order to solve real-world problems (Reason and Rorty, 2003). Therefore, pragmatism invites the researchers to apply methods which open up communicative space (like focus groups) and help to form “communities of enquiry” (like action research). With regards to language, pragmatism subscribes to the idea of “language as *making our world*” rather than “language as *representing the world*” (*ibid.*). This echoes the key tenet of discourse analysis, which is interested in how language is used to construct social reality (Bax, 2001).

### *Pragmatism and action research*

There are multiple similarities between pragmatism and action research. Rorty (1980) asserts that the researchers should care about “real theories” (term akin to “living theories” in action research scholarship) and let go of the primacy of idealised typologies or conceptual frameworks. In 2003, Richard Rorty (a key figure in modern pragmatism) and Peter Reason (leading figure in action research) recorded their conversation on the commonalities between these two schools of thought. Hereby, Reason and Rorty (2003) agreed that both philosophies reject the notion of “disinterested” researcher and instead are interested in problem solving, with an explicit statement of values and the researcher’s reflective standpoint.

Furthermore, Dewey’s (1916) concept of cyclical self-inquiry has been compared to with frameworks like e.g. action-reflection cycle (Figure 3.3 in Chapter 3.5). Dewey (*ibid.*) believes that there is no sharp boundary between action and research and knowledge results from taking action, which originates from self-aware decision making. Action research invites the questions: “who counts as a knower? About what? What counts as knowledge?” In doing so, both pragmatism and action research shift the question to investigating the practitioners and their practices. Figure 3.5 conceptualises how practitioners’ “opinions” can be reconstituted as “theory”.



**Figure 3.5.** From opinions to the new knowledge – how theories are formed in action research

### 3.6.3. Epistemological limitations

Despite the claims to go “beyond” the paradigm wars, pragmatism hasn’t escaped the criticisms. There are concerns that pragmatism can easily be reduced to “practicality”, if not the easiest methodological decisions, rather than choices most appropriate to the research question (Morgan, 2014). Similarly, the central tenet of pragmatism, researching “what works”, comes with its own load. For example, who decides “what works and for whom”? How to evaluate it? (*ibid.*). In the context of this thesis, “what works” is evaluated by the researcher, supervisors and examiners.

Finally, other critics of pragmatism claimed it “sidesteps the issues of truth and reality” (Felizer, 2010). However, the “wicked” nature of climate change requires urgent actions and close collaborations between academics and practitioners. Together, they will gain agency and legitimacy to implement co-created solutions.

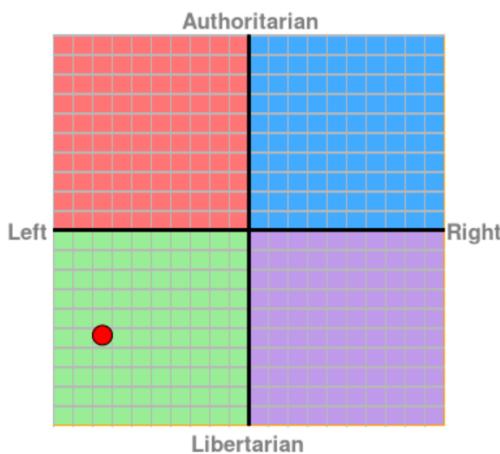
## 3.7. Considering the researcher’s biases

I have been living in Bristol since June 2014. While settling myself in the new place, I have got to know a number of local institutions, e.g. the Schumacher Institute or Bristol City Council. Volunteering at the Schumacher Institute exposed me to the “systems thinking” approach. This is when I concluded that acknowledging complexity, plurality and subjectivity more suitable for solving “grand challenges” that commonly employed reductionism. Working as a sustainable transport officer at the council made me respect the hard work of civil servants. Under the paradigm of austerity, local authorities are subjected to budget cuts, which is challenging for staff morale. Moreover, austerity is not conducive to urban experimentation and innovative policymaking. In particular, I found that it was very difficult to promote

the so-called “behavioural change” when the appropriate infrastructure or legislation was not in place beforehand. Despite gathering useful insights on needed and desired policies, I had no means to communicate or act on my findings. I was too junior to have a say. Even if I had more power, the chain of command is too long and too formal to make an impact in a timely manner.

Before moving to Bristol, I studied at the University of Manchester and graduated from BSc Geography and Geology. My degree primarily gave me a sense of appreciation towards the natural environment, but also the understanding of complexities around the contentious issues like shale gas or politics of climate change. Despite the fact that most of our career events were oriented towards the fossil fuel industry, I decided to apply for the sustainability jobs instead as this fitted better with my work ethics.

My results of The Political Compass test (<https://www.politicalcompass.org/>) depict me as a left-libertarian, where left-right spectrum refers to economic issues and libertarian-authoritarian range pertains to the social issues (Fig. 3.6). In practice, my political leanings favour remunicipalisation and heterodox economics. For that reason, I anticipate collaboration with private sector somewhat challenging, as I struggle to empathise with organisations driven by profit margins.



**Figure 3.6.** My results of the Political Compass test (December 2018).

I suspect that my background influenced my political leanings as well as research values to a considerable extent. Being a working-class, migrant woman automatically puts me in the “other” category – someone who by default is less likely to benefit from climate policies or participate in decision making. In particular, my personal interest in class (rather than gender or ethnicity) inspired me to seek research on socio-economic inequalities.

### **3.8. Research ethics**

Since the research involved human participants, it required ethical approval. The procedure followed the standard university protocol for ethical social research (i.e. there were no so-called “vulnerable” participants, e.g. children or ill people). Therefore, the ethical application primarily pertained to confidentiality, data sharing and the right to withdraw from the research. Each participant received a Participant Information Sheet (Appendices E-G) together with an email invitation to research. The information sheet included research questions, expected outputs and the value of participation for the prospective stakeholders. Participants were required to sign consent forms prior to their involvement in the research (Appendix H). Consent forms requested participants to decide whether they wish to disclose their (or their respective organisations’) identity in future publications or whether they would prefer to remain anonymous. Furthermore, participants had an option to withdraw from the research at any time, although if any publications contain quotations, it would not be possible for them to be removed once they are published. Consequently, the project received ethical approval in summer 2016 (for focus groups and data sharing).

In December 2017, the researcher received approval to conduct an additional stage of the research (qualitative survey), as this method emerged in the process of co-design and wasn’t anticipated in advance. The research was conducted face to face and due to the busy environment of the research participants consent was obtained verbally.

### **3.9. Chapter summary**

Chapter 3 has justified the philosophical underpinning of the thesis. It summarised the overarching methodology and epistemology, discussed the rationale for each research considered the methodological limitations outlined method biases and ethical considerations. Table 3.3 (overleaf) summarises the conceptual framework of the research. The following Chapter will detail the research design, providing the rationale for participant recruitment, secondary data selection and reporting on the data analysis techniques applied.

**Table 3.3.** A conceptual framework of the research

Research layers	Concepts applied	Main characteristics
<b>Epistemology</b>	Pragmatism	* Focus on the applied research, * Working with real-world problems
<b>Axiology</b>	Climate Justice	Importance of a fair transition to the sustainable future
<b>Mode of knowledge production</b>	Transdisciplinary Research	* Drawing from various disciplines and sectors when co-producing knowledge; * Research as a vehicle for solving societal challenges
<b>Methodology</b>	Action Research	* Researching with participants, not "on" them. * Building theory grounded in professional practice;
<b>Methods of collecting data</b>	a. Focus group, b. Qualitative Survey, c. Secondary Data Analysis	a. Deliberating contentious issues in a group; b. Grounding policy recommendations in the local knowledge c. Referring to the local and relevant datasets and documents
<b>Methods of data analysis</b>	a. Thematic Analysis b. Discourse Analysis c. MCDM	a. Grouping qualitative data into patterns b. Drawing key framings c. Enabling just decision making
<b>Theoretical Framework</b>	a. Climate Justice b. the WEF Nexus	a. Investigating the distribution of resources and inclusion in climate mitigation policies b. investigating dilemmas between sectors and disciplines
<b>Local themes</b>	a. water and energy metering b. food waste recycling	*investigating practitioners' understanding of climate justice using examples of food waste and smart metering; *assessing the applicability of WEF Nexus thinking at the urban scale, when applied to specific policy examples

## **4. Research Design**

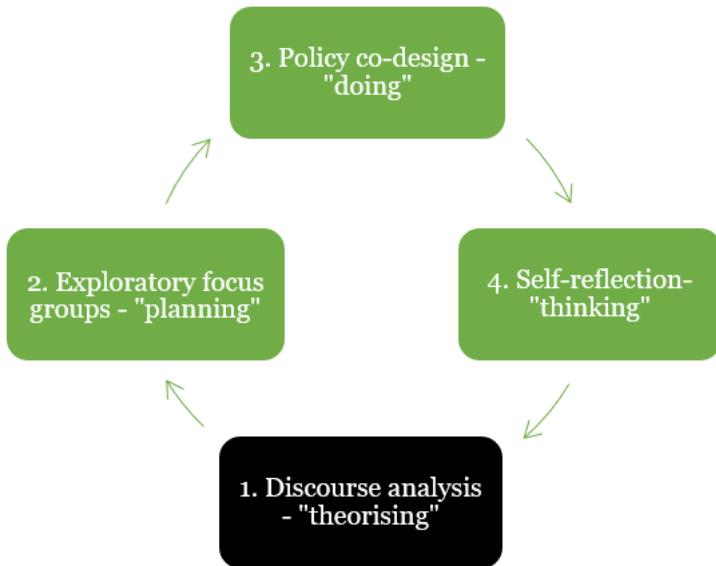
The following chapter specifies the methods applied in this thesis. Starting from the rationale for the selection of each method, it details analytical frameworks, data collection protocol, data analysis approach and discusses any ethical issues arising. Following the consequential research design (Cameron, 2009), this chapter makes connections between each stage of the thesis. The methods discussed are as follows:

- Stage 1: discourse analysis (Chapter 4.1)
- Stage 2: exploratory focus groups (Chapter 4.2)
- Stage 3: policy co-design methods, including a survey, a targeted focus group and Multi-Criteria Decision Making (Chapter 4.3)
- Stage 4: critical self-reflection (Chapter 4.4)

### **4.1. Stage 1: Discourse analysis of WEF Nexus complexities in Bristol**

#### **4.1.1. Motivation: Highlighting current interdependencies**

Chapters 2.3 and 2.4 justified the selection of topics, namely food waste (food-energy nexus) and smart metering (water-energy nexus). These two themes refer not only to the nexus between water, energy, and food but also to their cross-sectoral interdependencies. Once the researcher had decided on the scope of the PhD, the first task of the action research cycle was to disassemble the current discourses around food waste and metering (Figure 4.1). This contributed to the theoretical part of the thesis. Thus, Stage 1 of the PhD involved a desk-based discourse analysis of the literature on specific nexus issues.



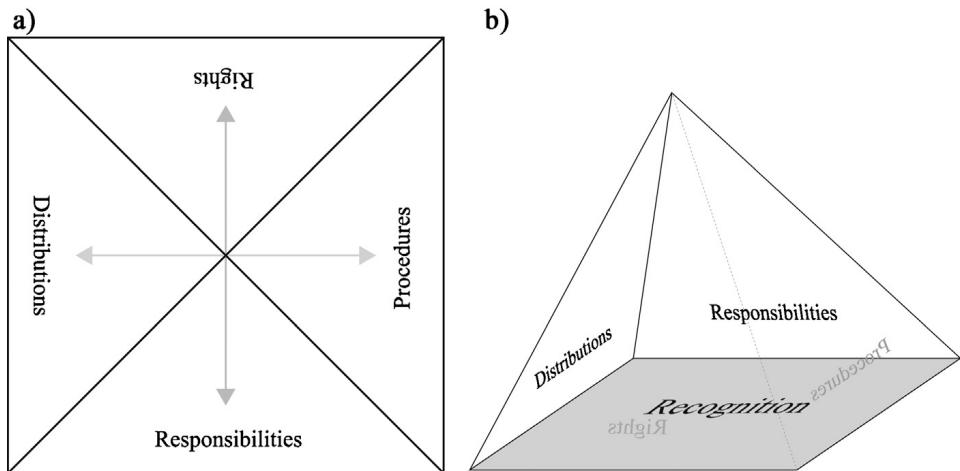
**Figure 4.1.** Action-Reflection cycle: theory and practice (adapted from McNiff and Whitehead, 2012)

#### 4.1.2. Discourse analysis framework

Discourse analysis is an interpretive method, which relies on the researcher's ability to be transparent in order to prevent or reduce any unwelcome biases. Since it can be applied to diverse genres of texts, it requires the use of flexible heuristics rather than a fixed protocol. Unlike "purely deductive" theoretical frameworks, heuristic methods account for context-specific data. The researcher is still expected to conduct the analysis in a rigorous manner (Bax, 2011). Detailed accounts of the research design and the researcher's positionality contribute to a high standard of analysis.

The researcher employed the following guidelines in her analytical framework:

- Bax (2011), in his general heuristic for discourse analysis, recommends investigating the aims and impacts of the analysed text at the explicit, implied, and obscured levels. Furthermore, his heuristic suggests paying attention to framings, conflicting agendas and imagery used.
- Bulkeley *et al.* (2014) conceptualisation of climate justice identifies the need for questions about the policy impact on stakeholders but also on issues of recognition, inclusion, exclusion, and omission of potential stakeholders (Figure 4.2).



**Figure 4.2.** The conceptualisation of climate justice based on the recognition of pre-existing injustices as a necessary basis for assessment of responsibilities, rights, distributions, and procedures. (Bulkeley *et al.*, 2014; licensed under Creative Commons CC BY 3.0)

- Luke (2005) provides a critical analysis of the United Nations' definition of "sustainable development". The United Nations' Brundtland Report (1987) declares that "*sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". Luke (2005) argues that this conceptualisation of sustainability fails to specify what kind of economic development, whose needs are catered for and how to define the appropriate level of "need". As such, the analytical framework of this thesis must consider how "sustainability" is constructed in practice.

Table 4.1 describes the detailed heuristic for the method. The purpose of the heuristic is not to present an exact protocol to follow, but rather to provide an exhaustive set of potential questions that could be asked about the textual data.

**Table 4.1** Heuristic for the discourse analysis applied in Stage 1

<b>The analytical framework for discourse analysis</b>
<b>1. What does the text achieve or aim to achieve?</b>
a. What is the intended function of the text? (E.g. to persuade, inform, advertise, shape identity)
b. What is the impact on the individual reader and the wider society? (Emotive, cognitive, reach, political power)
c. Who is the target audience?
<b>2. How does the text achieve their impact or function?</b>
a. What specific genre(s) does the text draw on? (Oratory, news, column, science article, strategy)
b. What aspects of the structure does the text apply?
c. What are the rhetorical means (metaphors, analogies, hyperboles, euphemisms)?
d. What layout, auditory or visual resources does the text draw on?
<b>3. How are climate justice and sustainability understood?</b>
a. How does the text conceptualise climate justice and sustainability – which terms are applied?
b. Are references to climate justice and sustainability explicit or implied?
c. Are there any references to justice by recognition, distribution, retribution, procedures, intersectionality?
d. Who is included/excluded/ from the context? How are these people characterised?
<b>4. Why does the text seek to achieve its aim and function?</b>
a. what are the ideological underpinnings/framings of the text?
b. What does the text seek to foreground or background and why?

The analysis was conducted following the heuristic in Table 4.1 as a preliminary set of questions guiding the process. In absence of the lack of explicit advice for researchers and students, the researcher followed Rose's (2001) strategies for scrutinising the text. First, she tried to suspend the pre-existing categories and biases (described in Chapter 3.7). Then, she familiarised herself with the text by repeated reading. The analysis was undertaken by the method of “coding”, where the key themes and questions from heuristic (Table 4.1. e.g. key framings, style, target audience) are highlighted. Finally, Rose (*ibid.*) recommends an active search for inconsistencies and mechanisms that silence (foregrounded vs backgrounded

information). Some examples of how raw data and quotation turn into an analytical draft are offered in Results Chapters (Tables 5.1 and 6.1).

#### 4.1.3. Discourse analysis of food waste

The researcher conducted an analysis of the emerging food waste discourses in the news. Investigating a large variety of news articles on food waste allows discovering how the problem is constructed. Why does it matter? Who is responsible? What are the suggested solutions? Discourse analysis explored the areas of agreement and disagreement, relevant actors, ideologies applied, and metaphors used. The researcher employed the Nexis database ([www.nexis.com](http://www.nexis.com)) to search for the news articles published between January 2015 and January 2017, limiting the search to the UK publications and using “food waste” as a keyword. The researcher took care to include news publications representing a wide variety of views: left- and right-wing, industry publications and community journalism, broadsheets and tabloids from both local and national press.

The researcher analysed twelve news items published in the UK media between January 2015 and January 2017. Table 4.2 (overleaf) provides a full reference list of the data. These include:

- 2 local newspapers
- 7 national newspapers
- 3 industry magazines
- 4 tabloids
- 3 broadsheets
- 4 left-wing newspapers
- 4 right-wing newspapers

**Table 4.2.** A list of news articles on food waste analysed in this thesis

Title	Source	Year	Attributes
<i>“Surge in population of rodents down to fewer bin collections”</i>	Bristol Post	2016	right-wing, tabloid, local
<i>“PUBLISHING DATA KEY TO TACKLING SUPERMARKET FOOD WASTE – TESCO”</i>	Resource	2016	Industry
<i>“We saved over £1,000 a year... and so can you!; YOUR LIFE CASH QUEENS”</i>	Daily Mirror	2016	left-wing, tabloid, national
<i>“Super (waste) markets”</i>	Bristol Cable	2015	left-wing, community, local
<i>“Only 3% of UK adults feel ashamed at wasting food, poll finds”</i>	The Guardian	2016	left-wing, broadsheet, national
<i>“Food waste UK: Britons bin £13BILLION worth of edible food each year”</i>	Daily Express	2017	right-wing, tabloid, national
<i>“Higher prices are the only way of dealing with Britain’s food waste problem”</i>	The Spectator	2017	right-wing, broadsheet, national
<i>“Shoppers face food waste warnings in supermarkets, as levels rise for the first time in a decade”</i>	The Telegraph	2017	right-wing, broadsheet, national
<i>“Food suppliers should be given tax break to curb waste, inquiry told”</i>	The Independent	2016	left-wing/liberal, national
<i>“Defra urged on mandatory food waste laws”</i>	Materials Recycling World	2016	Industry
<i>“Ricardo Urges Bio-Digester Exemption From Food Waste Law”</i>	Chartered Institution of Wastes Management	2016	Industry
<i>“SMELLY RUBBISH? JUST PUT IT IN YOUR FREEZER!”</i>	Daily Mail	2017	Right-wing, tabloid, national

The researcher selected printed media for the analysis due to their power to shape public opinion. Newspapers have a long-standing history in discourse analysis (Jacobs, 2006), due to their reach, wide audience and connections to power structures (i.e. big publishers) and politicians (who are often columnists). This is contrasted with social media, which give out the impression of elevating the voice of the ‘lay publics’ (Bartlett, 2018). As Bartlett (*ibid.*) shows, the history of algorithmic influence on ‘viral’ tweets in scandals over Trump elections or Brexit referendum, makes the claim of “public voice” dubious. Therefore, after careful consideration, the researcher decided to analyse “established” media sources, which explicitly influence the public. Furthermore, the sheer amount of data present in the social media data required computational data analysis (i.e. sentiment analysis, de Silva *et al.* 2014). At present, such techniques do not offer the same nuance as DA as their capability is limited to capturing a basic tone of speech (e.g. positive or negative). In contrast, DA is applied to smaller datasets (typically 1-10 texts, Bax, 2001), which allows critical, in-depth reading, references to the current events and intertextuality, typical to the qualitative nature of the research (Waitt, 2005). While seeking a justification for the selection of data, it is important to note that there are no set rules with regards to the sample size (Waitt, 2005). What qualitative researchers argue, instead, is that the validity is brought by the textual richness of data and consecutive analysis, rather than the number of texts analysed (Patton, 1990).

#### 4.1.4. Discourse analysis of smart metering

In addition to the discourse analysis of food waste news, the researcher applied this analytical tool to review the official promotional materials related to the energy and water meters in the UK. Discourses, especially if constructed by the authorities (in this case policymakers, experts or utility providers), indicate what can and cannot be expressed or challenged by the audience (Bax, 2011). Consequently, discourse analysis reveals whether and how sustainability and climate justice conceptualisations are embedded in the promotional materials. Documents selected for the analysis were industry websites and online leaflets explaining and encouraging metering. The researcher selected four secondary sources for the analysis. The inclusion criteria resemble the justification provided in Chapter 4.1.3., i.e. the researcher is interested in how “legitimised” texts (official websites or policy reports) form and stabilise discourses.

Two documents were obtained from the local utility providers and the two others from national-level organisations overseeing metering deployment. The researcher thoroughly analysed each document to unpack the rhetorical and linguistic tools

used. For example, the overall tone of the message (e.g. promotional, informational), arguments foregrounded and backgrounded (e.g. placed in the title vs. at the bottom of the page), and the main framings applied. Table 4.3 lists the documents analysed in this stage.

**Table 4.3.** A list of the promotional materials on energy and water metering analysed in this thesis

<b>Documents analysed</b>	<b>Description of the organisation</b>
Ofwat (2013) “ <i>Water meters- your questions answered</i> ” <a href="https://www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_lft_101117meters.pdf">https://www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_lft_101117meters.pdf</a>	National water industry regulator
Bristol Water (2016) “ <i>Water meters explained</i> ” <a href="https://www.bristolwater.co.uk/your-home/water-meters/">https://www.bristolwater.co.uk/your-home/water-meters/</a>	Local water services provider
Bristol Energy (2016) “ <i>Your smart meter and in-home display guide</i> ” <a href="https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering-Guide-WEB-low.pdf">https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering-Guide-WEB-low.pdf</a>	Municipally owned local energy company
Smart Energy GB (2017) “ <i>Smart meters- the simple way to control your energy use</i> ” <a href="https://www.smartenergygb.org/en">https://www.smartenergygb.org/en</a>	A national campaign for the smart meter rollout

#### 4.1.5. Feeding the results into the next stage

The results of discourse analysis help to frame focus group questions and anticipate the areas of consensus and dissensus. Investigating various meanings and standpoints is important as they might appear in later stages of the research, which involve working with the local sustainability practitioners. Therefore, discourse analysis helps to understand the language used and consequently the researcher is able to communicate effectively with the research participants and stakeholders.

### 4.2. Stage 2: Focus groups with local sustainability practitioners

#### 4.2.1. Motivation: Facilitating collaboration across the sectors

The purpose of the focus groups is to gather the views of sustainability practitioners with regards to sustainability and climate justice issues associated with metering and food waste. The discussions explored how participants understand the motivations and effectiveness of the recent metering and food waste initiatives in Bristol. Environmental policies do not arise in a conceptual vacuum, they are a result of

debates among stakeholders across the sectors, who often have clashing organisational goals. By deliberating on the possibility of the common goals and language, sustainability practitioners are more likely to build trust and rapport required for successful negotiation and policy implementation (Harris and Lyon, 2013).

The use of a focus group was deemed an appropriate method for this research, as it enables interactions between participants, and allows the researcher to observe the process of discourse formation, agreements, and disagreements (Morgan, 1997). This is particularly relevant for the policy issues, which are commonly co-produced in collaboration between private, public and charity sectors (Howarth and Monasterolo, 2016; Harris and Lyon, 2013).

#### 4.2.2. Selection of participants

Participant selection and recruitment is a crucial stage of a fair and transparent stakeholder engagement process. A focus group is a small-scale, qualitative method and therefore it is not intended to be representative of the local population. An extensive list of potential participants was collated using purposive sampling from a collection of the local organisations with expertise in at least one of the themes. Next, the participants were invited on a first-come-first-served basis to fit the sample size of  $3 < n < 9$  per group. The size of the sample follows Morgan's (1997) recommendation.

The researcher encouraged participants to come from a variety of backgrounds:

- education
- private sector
- public sector
- charity sector

The researcher is also mindful of engaging with people who traditionally were not in the position of power, i.e. women, ethnic minorities, junior staff. However, bearing in mind the relatively small size of one focus group (4-8 people), it was deemed inappropriate to establish quotas as this could negatively influence the group dynamics and the recruitment process.

The eligibility criteria are the following:

- Work or volunteer in the local water, energy or food sector.
- Represent one of the categories: education/private sector/public sector/charity sector.

- Be able to speak confidently about one of the following issues in the context of Bristol: energy/water metering, food waste.

There are no restrictions on participants' backgrounds or demographic characteristics (i.e. genders, ethnicities, nationalities and levels of seniority).

The researcher invited participants by contacting them directly (or a relevant organisation, if no specific contact is known) via email. Table 4.4 features a list of the participants attending exploratory focus groups.

**Table 4.4.** A list of participants attending exploratory focus groups during Stage 2 of the research

Focus group on food waste		Focus group on smart metering	
FG1_Po1	Senior Environmental Consultant	FG2_Po1	Energy Senior Researcher
FG1_Po2	Senior Staff Member of a food waste charity	FG2_Po2	Manager of a smart city project at the local authority
FG1_Po3	Sustainability Manager of an educational charity	FG2_Po3	Manager at the publicly owned energy company
FG1_Po4	Coordinator of the sustainable business network	FG2_Po4	Senior Executive at the local water utility company
FG1_Po5	Project Officer at a publicly-owned waste company	FG2_Po5	Water Junior Researcher
FG1_Po6	Graduate staff at food waste management company	FG2_Po6	Co-ordinator of a community energy organisation

So that people identified had an equal opportunity to participate in the study, the invitation e-mail contained the Participant Information Sheet for their consideration (Appendices E-G). The document provides a description of the research project and details of what is required from participants and information providing assurances about anonymity, data collection, security and governance. All potential participants had an opportunity to get involved with the research beyond the focus group stage, especially if they were not available to participate in the event. For example, their organisations could pilot actions resulting from the policy recommendations, benefit from the policy brief, or share their data on water, food and energy.

All information materials were made available in English. There are no potential participants who may not adequately understand verbal explanations or written information in English.

#### 4.2.3. Topic guide and questions

The researcher designed a shared topic guide shared for the two themes. However, the specific questions asked differed depending on the event (Table 4.5 overleaf). The inclusion of the shared topic guide ensured a level of consistency between the data which facilitates comparison of the themes. On the other hand, separate and detailed questions emphasize the uniqueness of the themes and keep the conversation relevant to the aims of the thesis. Additionally, the topic guide contains space for extra open questions or comments, so that the participants can remark on a point that has not been mentioned before.

There are twelve questions designed per group. The number was decided following the recommendation from Krueger (1998) and conducting a pilot study. It was expected that twelve questions would allow 1.5 hr discussion. The researcher allocated space for greetings, introductions, house rules, icebreaker as well as a break halfway through the event. The discussion was constructed using the spiralling method (Krueger, 1998; Kahan, 2001). This technique encourages the asking of general questions first and then moving onto more in-depth discussion once all participants feel comfortable to talk to each other. Since the discussion is cross-sectoral, it is important to establish a shared language. People across organisations have their own unique understanding and application of environmental policy language (Cairns and Krzywoszynska, 2016; Luke, 2005). Thus, at the beginning of the conversations, the researcher asked about the participants' definitions of key concepts such as "sustainability" and "justice".

Other "warm-up" questions included the following:

- favourite Bristol-based sustainability project
- favourite water/energy saving tip
- areas of most and least progress for the given theme.

Then, the key questions aimed to gather the information relevant to the research questions:

- access to relevant datasets proving areas of most and least progress
- barriers to success and ways to overcome them
- possible trade-offs and synergies between low carbon and equity agendas

- best practice for cross-sectoral collaborations

**Table 4.5.** A list of questions for two exploratory focus groups in Stage 2

<b>Focus group on food waste</b>	<b>Exploratory focus group on metering</b>
<p>1. What is your favourite sustainability project in Bristol?</p> <p>2. Let's establish a shared language. What comes to your mind when you hear words like "green", "sustainable" or "just"?</p> <p>3. When it comes to the issue of food waste in Bristol, which aspects are the most behind? Have you got any experience or data to demonstrate it?</p> <p>4. And now, to turn the question around, where is the most progress being made? Again, can you tell us about some experience or data reflecting it?</p> <p>5. What are the main barriers to implementation or success?</p> <p>6. Can you think about one thing which could be done to remove the mains barriers?</p> <p>7. What do you think about "green" and "social equality" agendas in Bristol? Do they work together? Or are there any dilemmas or trade-offs?</p> <p>8. How to cut food waste in the commercial sector?</p> <p>9. What do you already monitor and measure and what you should do in the future?</p> <p>10. How should we connect food waste stakeholders across the sectors and organisations?</p> <p>11. Are there any other issues we should discuss now?</p> <p>12. [Give 2 minutes summary] Is this an accurate summary? Should we add anything else?</p>	<p>1. What's the best energy or water saving tip you've been given?</p> <p>2. Let's establish a shared language. What comes to your mind when you hear words like "smart", "sustainable" or "just"?</p> <p>3. When it comes to water and energy metering in Bristol, which aspects are the most behind? Have you got any experience or data to demonstrate it?</p> <p>4. And now, to turn the question around, where is the most progress being made? Again, can you tell us about some experience or data reflecting it?</p> <p>5. Could you please give us a summary of the current situation with water and energy meters locally? What is the law, what are the targets, participation, strategy or state of technology?</p> <p>6. Is metering a tool for sustainability? Under what conditions? Does the answer depend on whether we talk about water vs energy?</p> <p>7. Can you think of any positive or negative impacts of metering on social equality?</p> <p>8. How should metering be communicated and implemented in order to tackle social inequalities?</p> <p>9. Does your organisation have any data or reports on energy or water metering?</p> <p>10. What could energy and water sectors learn from each other?</p> <p>11. How to improve collaboration across the sectors and organisations?</p> <p>12. [Give 2 minutes summary] Is this accurate? Do you have any final comments?</p>

#### **4.2.4. Pilot stage**

In order to develop experience in facilitating focus groups and in accordance with good research practice the researcher conducted a pilot study in November 2016, asking the “mock” participants to display a range of “challenging behaviours”, as outlined by Krueger (1998). She then prepared a range of stratagems for dealing with such behaviours and for dealing with silence, interruptions, arguments, rambling and unfocused contribution.

Organising a pilot study allowed testing of the logistical arrangements for the event: communication, recruitment, room booking, ordering refreshments and finally, recording the discussion. Following the event, the researcher recorded her impressions in a self-reflective document.

#### **4.2.5. Data protection, storage and confidentiality**

The research process has been scrutinised and approved by UWE Ethics process (FET.16.06.051 and FET.17.10.009). All information is handled and stored in accordance with the requirements of UWE policies, procedures and requirements. All personal information is stored separately to the focus group transcripts and stored in password-protected files on limited-access computers. Only the researcher and Director of Studies have access to it. Transcripts were analysed and coded in NVivo software which enhances the anonymity of the answers. Upon research completion, data were archived on the UWE central server in a project folder with restricted access.

All participants were allocated a unique identifier which can be found in the consent form. All participants have the options to either remain fully confidential or to disclose their or their organisation’s identity.

In the published outcomes, the participants’ identity is coded according to their field of expertise (unless they agreed to reveal their names), e.g. Public Sector Water Specialist, Food Security Academic, Third Sector Renewable Energy Campaigner. The unique participant identifier adopts a metadata format (GroupName/ ParticipantNumber e.g. FG1/P01) that facilitates confidential storage of data and efficient removal and deletion of participant files should they opt-out at any stage of the research process.

#### **4.2.6. Thematic Analysis**

The focus group data were analysed using NVivo software, which assists with the process of coding. The researcher investigated the data twofold: using discourse and thematic analysis. Thematic analysis allows capturing patterns and grouping

complex qualitative data (Braun and Clarke, 2006). First, the data were analysed at the deductive descriptive level, establishing codes like “solutions to food waste”, “the purpose of metering”). Then, after in-depth reading, analytical and inductive codes (e.g. “anecdotal evidence”, “intelligent choices”) were captured to derive the main themes presented in the results chapter.

#### 4.2.7. Discourse Analysis

In order to add a critical layer of analysis on the resulting themes, the researcher investigated the language and participants’ interactions using discourse analysis. The method is described in detail in Chapter 4.1. Discourse analysis sees the language as a tool for communication; therefore, it is suitable for group conversations (Wodak and Meyer, 2009). The method’s inherent interest in language makes it an appropriate tool for critiquing the applied understanding of emerging “buzzwords”, like WEF Nexus or smart cities. By examining the transcripts through the lens of discourse analysis, the researcher paid special attention to the instances of (dis)agreement and the nature of interactions (questioning, criticising, interrupting etc.). These are useful indicators for determining “pragmatic” options in policy design – actions doable within the timeframe of the PhD, where participants are willing to share their data and the results are likely to be relevant to the local priorities.

#### 4.2.8. Feeding the results into the next stage

Exploratory focus groups served three main aims:

- Facilitating future collaboration with the research participants.
- Discovering priority issues for Bristol, suitable to the time and resources available in the thesis.
- Understanding the language of “sustainability”, “climate justice” and “smart cities”, as applied in practice.

As a result of the focus group stage, the researcher established a deeper collaboration with willing participants, who provided city-specific datasets and further methodological guidance on the “co-design” actions suitable to the selected issues.

### 4.3 Stage 3: Policy co-design

#### 4.3.1. Motivation: Providing recommendations to the local challenges

If discourse analysis highlighted the complexities in the food waste and metering debates, then focus groups provided specific recommendations for local actions. Four data collection activities achievable within the timeframes of the PhD were agreed on collectively, thanks to the continuous engagement with the participants and access to

the local data. Chapters 4.3.2 – 4.3.4 detail the protocol for data collection in each method.

### **4.3.2. Qualitative survey (food waste theme)**

The idea of qualitative surveying originated from the meetings with sustainability practitioners, who were interested in the preliminary results of the research (exploratory focus group). Both focus group participants and practitioners who engaged with the preliminary result argued that the issue of food waste in the catering sector should be investigated further. In particular, one practitioner, a civil servant, was happy to provide methodological advice and contacts to the potential participants. In doing so, he effectively became a co-researcher on this project. Chapter 3.5.3 and Figure 3.4 outlined the structure of participation.

#### *4.3.2.1. Data collection*

The researcher carried out 79 face-to-face surveys in January 2018, interviewing staff members of catering businesses (i.e. cafes, restaurants, pubs, bakeries) in Bristol. Businesses were purposively selected, so each business type and research area (see Table 4.6 for area characteristics) was adequately represented. Furthermore, the areas selected reflect the diversity of Bristol's high streets. The sample size was determined so that the dataset achieves saturation (Morse, 2015), i.e. most opinions are covered, there are emerging patterns in data and there is considerable diversity within the sample itself.

**Table 4.6.** Key characteristics of the areas surveyed

<b>Area</b>	<b>Characteristics</b>
Easton	<ul style="list-style-type: none"><li>• Mostly small, independent businesses – Numerous Southeast Asian and African food outlets</li><li>• Higher than average social deprivation (Bristol City Council, 2015b)</li><li>• An area targeted for street cleaning (Bristol City Council, 2017b)</li><li>• 88% of residents concerned about climate change (Bristol City Council, 2016d)</li><li>• 91% of residents think litter is a problem (Bristol City Council, 2016d)</li><li>• No Business Improvement District present<sup>15</sup></li><li>• Most common socio-demographic ACORN<sup>16</sup> categories: Aspiring Singles, Starting Out, Blue-Collar Roots (ACORN, 2012)</li></ul>
City Centre	<ul style="list-style-type: none"><li>• High concentration and a large variety of catering businesses, including both independents and high streets chains, shopping centre, food markets, budget eateries and fine dining</li><li>• Most common socio-demographic categories: Educated Urbanites, Aspiring Singles and High-Rise Hardship (ACORN, 2012)</li><li>• Business Improvement District covering part of the city centre</li></ul>
Gloucester Road	<ul style="list-style-type: none"><li>• One of the UK's longest high streets with independents shops (Visit Bristol, 2018)</li><li>• 88% of residents concerned about climate change (Bristol City Council, 2016d)</li><li>• Most common socio-demographic categories: Prosperous Professionals, Educated Urbanites, Aspiring Singles (ACORN, 2012)</li><li>• Traders' Group and Business Improvement District covering part of Gloucester Road</li></ul>

The majority of the interviews lasted between 5 and 10 minutes, however, in 8 cases, they lasted 15-25 minutes (including 1 waste facilities tour). Moreover, 2 respondents opted for sending written responses instead of a face-to-face survey. The interviews were conducted with the staff at the front of the house unless they specifically requested another staff member to contribute (e.g. an off-duty manager or a chef). Since the level of seniority was not a requirement for participation, the survey allowed capturing of a more diverse range of experiences and opinions. Furthermore, the concise survey design contributed to a high response rate as the day-to-day work was not disturbed, nor was a separate meeting required.

Survey questions were created in a collaborative process involving the researcher and practice-based stakeholders. When distributing the survey, the researcher avoided prompting. She also took care to rephrase questions when a language barrier arose.

<sup>15</sup> Business Improvement District (BID) - a defined area in which a levy is charged on all business rate payers in addition to the business rates bill. This levy is used to develop projects which will benefit businesses in the local area. (HM Government, 2014)

<sup>16</sup> ACORN- a UK population segmentation tool, which categorises neighbourhoods in 18 groups according to a wide range of commercial and open data on age of residents, ethnicity profiles, benefits, population density and housing (HM Government, 2018)

The researcher used empathetic and non-judgemental language to encourage opinions from participants of all levels of seniority and build trust, which is essential to disclose sensitive information. The survey asked 5 open-ended questions about current food waste management practices (Question 1), reasons for (not) recycling (Question 2), perceived barriers (Question 3), and suggestions for improvement (both for catering sector, waste companies and policymakers; Question 4 and Question 5). Finally, the survey included 3 demographic questions (business type, location, membership in a traders' group) and an option to be contacted in the future.

#### *4.3.2.2. Data analysis*

The researcher coded participants' answers and analysed them using thematic-discourse analysis (Braun and Clarke, 2006). Thematic analysis allows the capturing of patterns in the data in an inductive and systematic way (*ibid.*). The critical lens of analysis and the comparison of the languages present in the dataset and the literature were drawn from the tradition of discourse analysis (Bax, 2011). Here discourse is understood as text or speech in a social context, analysed with the reference to ideologies, policies, and agendas. In the context of this research stage, discourse analysis challenges the dominant framings (e.g. resource efficiency, food security) which often appear as "neutral", leading the reader on to unexplored assumptions (*ibid.*). Detailed justification of the data analysis tools was presented in Chapter 3.1 (for discourse analysis) and 4.2.6 (for thematic analysis).

#### *4.3.3. Targeted focus group (metering theme)*

Following the exploratory focus group on smart metering, research participants had an opportunity to engage in the issue further by providing access to the city-level datasets, advising on the design of the following stages and participating in the research dissemination activities. In particular, one of the participants working for a community energy charity was happy to assist in the development of the policy co-design stage and therefore, became a project co-researcher. A detailed description of the structure of participation can be found in Chapter 3.5.3.

This collaboration resulted in a series of meeting and drafting the rationale for the following phase – focus group with energy and water professionals targeted at critiquing existing communication strategy and providing policy recommendations on metering communication. Participants' recruitment process followed the protocol of the exploratory focus group (Chapter 4.2). In total, six metering practitioners agreed to attend the targeted focus group (Table 4.7).

**Table 4.7.** Participants present during the targeted focus group on metering

<b>Targeted focus group on metering</b>	
FG3_Po1	Senior Executive at the local water utility company
FG3_Po2	Manager at the publicly owned energy company
FG3_Po3	Community Energy Organisation Officer
FG3_Po4	Co-ordinator of a Community Energy Organisation
FG3_Po5	Local councillor
FG3_Po6	Water Junior Researcher

The targeted focus group lasted 1.5 hours, which included a critique of the existing metering promotional materials and a question establishing shared definitions of terms like “sustainability” or “fairness”, “smartness”. In order to ground the critique in relevant and contemporary evidence, the researcher prepared a set of flashcards with quotes on metering from 12 energy and water providers based in the UK. A full topic guide is presented in Tables 4.8a-b. The data were analysed using thematic-discourse analysis, for which the protocol and can be found in Chapter 4.2.6.

**Table 4.8a.** List of questions a for targeted focus group

<b>Targeted focus group on metering</b>
<ol style="list-style-type: none"><li>1. Could you please introduce yourselves with your name and role and tell us about one interesting “smart” piece of technology which comes to your mind?</li><li>2. Both in the industry and in the academia, we use a variety of potentially ambiguous concepts, like “sustainability”, “low carbon”, “smart”, “tacking inequalities”. I’d like us to establish a sense of shared language during the discussion – can you please say what comes to your mind when you hear some of the above terms?</li><li>3. I have prepared flashcards with sentences from real energy and water meters leaflets and sorted them according to the themes prevailing in the last discussion. Now I’d like you to comments on them – say what you like and dislike about the words and arguments used. Is there anything unnecessary, exaggerated or missing?</li></ol> <p>[discussion on flashcards here – see Table 4.8b]</p> <ol style="list-style-type: none"><li>4. I’d like us to talk about the local scale – what could we tangibly propose at the city level, whether to the council, the residents, the water and energy companies. I am thinking of any policy or intervention ideas to do with the concept of “smart” over the next 10 years?</li><li>5. How can you improve collaboration across the private sector, local authorities and community organisations?</li><li>6. [give 2 mins summary] Is this accurate? Any final comments?</li></ol>

**Table 4.8b** Examples of flashcards presented during the focus group

<b>Focus group flashcards</b>
Example 1: <i>"The smart part is they also report to a useful portable screen (an In-Home Display), giving you your energy usage in near real-time, so you can see exactly what you're using. These meter readings get sent to us, your energy supplier, so you don't have to."</i>
Example 2: <i>"Using time of use tariff (brand name removed) is all about being smart. Your new meter is smart. Your tariff is smart. You're smart. By making some simple adjustments to the way you live will have a real impact on the environment, and help save you money, too. Simple changes like using the timers on your washing machine or dishwasher overnight will help. You can also charge your iPad, download your boxsets or update your laptop at night. All of these things use power and can be left to run safely in the background. If you've got an electric car, you can set it to charge automatically overnight and you'll be ready for the road the next morning!"</i>
Example 3: <i>"They take hourly, automatic readings meaning your bills will reflect the amount of water you use. This means it's a fairer way to pay giving you control over your use and bills."</i>

#### 4.3.4. Multicriteria Decision-Making (metering theme)

Targeted focus group participants admitted that they faced difficulties with equitable prioritising of “smart” policies in a diverse population of Bristol. Discussions tried to reconcile the goals of climate justice and climate mitigation. Eventually, this prompted the researcher to design a decision support tool grounded in the local data. The researcher applied a Geographic Information System (GIS) spatial analysis tool called Multicriteria Decision-Making (MCDM) to process and present the data. Consequently, MCDM asked, “which neighbourhoods should be prioritised to a) maximise the emissions reduction potential **or** b) reduce economic inequalities?”

##### 4.3.4.1. Highly capable and highly disadvantaged residents

MCDM applies the resident segmentation technique so the resulting policy recommendations are tailored and prioritised at the small geographical scale. In the absence of personal level data, MCDM uses LSOA-level data where the resolution is between 1000 and 3000 inhabitants. Segmentation assumes that policy priority areas are more likely to be inhabited by the “highly capable” or “highly disadvantaged”

residents. As a result, two areas were identified to illustrate how to achieve the goals of both GHG emissions reduction and reducing social inequalities by the implementation of differing yet complementing smart energy policies.

In the context of this study, “highly capable” residents are defined by the researcher as those displaying **all** of the following qualities:

- financially capable
- socially capable: house owners
- socially capable: competent internet users
- high energy consuming

The research theorised the first type of priority areas (“high capability”) as ready to accept smart technologies and pay for smart home appliances. Readiness and willingness to pay increase the potential to benefit from the policy, e.g. by lowering bills or reducing GHG emissions. Targeting areas with a high proportion of “highly capable” residents has been highlighted as an appropriate strategy for the adoption of emerging technologies (Zhang *et al.*, 2016). The research assumes that the high capability residents would not require additional incentives for engagement (e.g. behavioural change campaigns, free products, tariff deals) providing an opportunity to prioritise a limited budget.

On the other hand, the “highly disadvantaged” users are displaying **all** of the following qualities:

- financially deprived
- socially disadvantaged: renting (therefore usually excluded from energy policies like feed-in -tariffs)
- not displaying social barriers to technology adoption: competent internet users
- high energy consuming

The second priority area (“high disadvantage”) would result in the equitable implementation of smart energy policies, as its residents are likely to require additional support measures, e.g. public engagement, insulation programmes, free products etc. The research therefore explicitly acknowledges that policy has an ethical duty to assist the most disadvantaged residents with the transition to a low carbon future.

#### *4.3.4.2 Translating socio-economic categories into data*

The next step in the research design was to translate abstract concepts into quantitative local datasets (Figure 4.3 and Table 4.9). In a number of instances primary datasets were available, i.e. metered gas and electricity consumption (Department for Business Energy and Industrial Strategy: DBEIS, 2015a and DBEIS, 2015b) or housing tenure (ONS - Office for National Statistics, 2011). Whenever possible, the datasets were sourced from the official sources: government statistics and peer-reviewed research (Table 4.9).

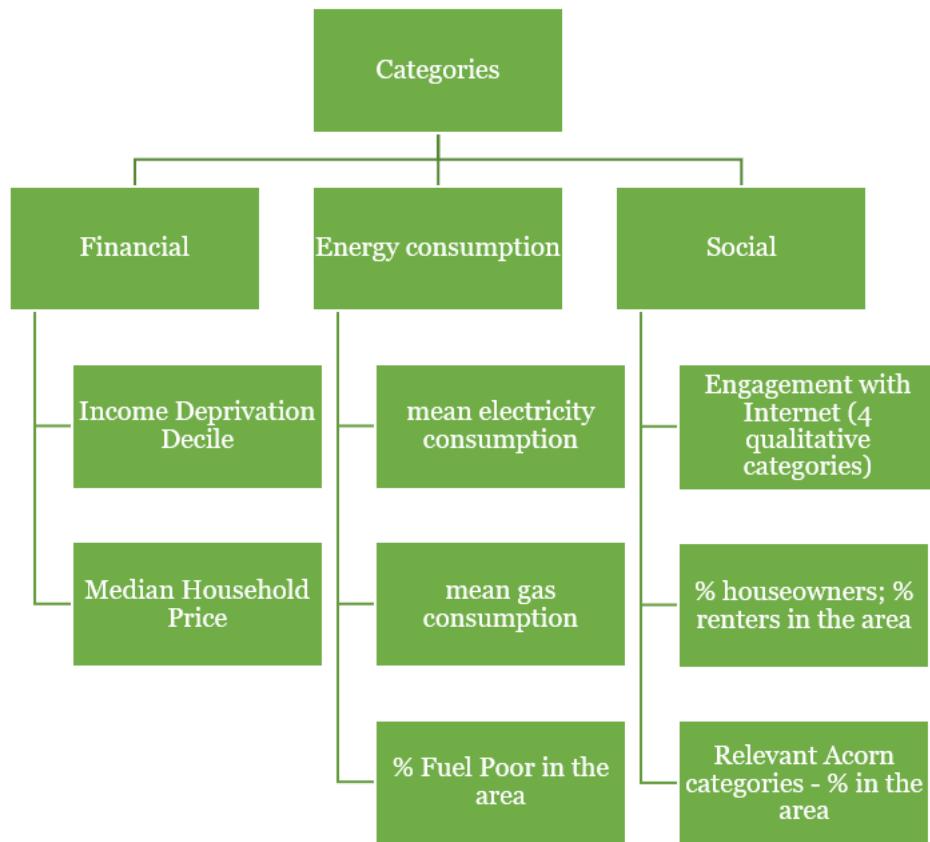
Many datasets accounting for the residents' socio-economic circumstances are based on the statistical calculations (deprivation indices). The exact methodology of algorithm-based data is frequently protected by a commercial patent (e.g. ACORN dataset). In the absence of direct empirical data, the MCDM tool is used here as a deliberation aid rather than a replacement of the decision-making process.

Finally, the MCDM decision-support tool is limited to smart energy policy questions only. Due to the lack of data on water consumption, the researcher was not able to explore the Water-Energy Nexus present in the smart city agenda. In England, app. 50% of households are metered (Water UK, 2019) which yields an incomplete picture of the city. Second, water data are owned by the local water provider, therefore there are not in the public domain. The lack of data (or the lack of their availability) suggests that the WEF Nexus concept, which is encouraged by international policy circles and theorised by the academy, is not mature enough to be operationalised at the urban scale. This will be tested in the discussion of the results.

**Table 4.9.** A detailed description of datasets used during MCDM analysis

<b>Dataset Name</b>	<b>Source</b>	<b>Resolution</b>	<b>Date</b>	<b>Format</b>	<b>Accessibility</b>	<b>Features Used</b>	<b>Limitations</b>
Multiple Deprivation Indices	HM Government	LSOA	2015	CSV	publicly accessible, free	Income Deprivation Decile in a given area	Deprivation index itself is composed of multiple primary datasets
Internet User Classification	Riddlesden, 2014	LSOA	2014	SHP	publicly accessible, free	4 qualitative categories: E-unengaged, E-professionals and students, Typical Trends, E-rural and fringe	Not a direct measurement; not directly connected to people's attitudes toward the emerging technologies
Fuel Poverty	Department for Environment and Climate Change	LSOA	2014	CSV	publicly accessible, free	% fuel poor inhabiting a given area	Middlemiss (2017) argues that the indicator doesn't contribute to decision-making likely to alleviate poverty
Electricity consumption	Department for Business, Energy and Industrial Strategy	LSOA	2015b	CSV	publicly accessible, free	total/mean/median electricity consumption per area (empirical data)	Data from analogue meters
Housing tenure	Office for National Statistics	LSOA	2011	CSV	publicly accessible, free	% owned, % shared ownership, % rented privately, % social rent, % rent free	Data from 2011
Median house price	Economic and Social Research Council – Consumer Data Research Centre	LSOA	2015	SHP	publicly accessible, free	median household price in a given area	N/A

<b>Dataset Name</b>	<b>Source</b>	<b>Resolution</b>	<b>Date</b>	<b>Format</b>	<b>Accessibility</b>	<b>Features Used</b>	<b>Limitations</b>
Resident Segmentation	ACORN / Bristol City Council	LSOA	2012	CSV	publicly accessible, free	% of relevant categories inhabiting a given area. Relevant Acorn categories are described as A-Lavish Lifestyle, B-Executive Wealth, C-Mature Money, N- Poorer Pensioners, O- Young Hardship, P- Struggling Estates, Q-Difficult Circumstances	Commercial dataset – the exact methodology of Acorn categories is unknown
Gas consumption	Department for Business, Energy and Industrial Strategy	LSOA	2015a	CSV	publicly accessible, free	total/ mean/ median gas consumption	Some data missing in the city centre and outer edges of the city
LSOA Base Map	Office for National Statistics	LSOA	2016	SHP	publicly accessible, free	named LSOA polygons	does not reflect political boundaries - e.g. wards or neighbourhood partnerships



**Figure 4.3.** A diagram illustrating how three dimensions of capability/disadvantage were translated into data needs

Figure 4.3 and Table 4.9 above describe in detail how and which elements of datasets were used in this thesis. The complex and multi-dimensional categories describing “capability” and “disadvantage” were effectively broken down into three categories (financial, energy consumption, social) and further nine sub-categories (Figure 4.3 above).

Once accessed, all datasets were processed in GIS software, ArcMap, to maintain a degree of uniformity:

- Qualitative internet engagement categories stayed the same.
- Qualitative and quantitative ACORN categories were summed up to give a percentage of the relevant residents per area. (Table 4.10)
- Where possible median values were selected to represent the accurate picture of average energy consumption.

- All quantitative categories were classified as deciles to enable easy comparison and multicriteria decision making.

#### *4.3.4.3. Weighting and scoring*

MCDM uses a system of weights (adding up to 100%) and scores (between 1 and 10, where 10 is the most suitable) to determine priority areas. In order to unify scoring, decile classification was used for all quantitative criteria. Since there is no literature on prioritising and targeting smart energy policies, the researcher ran three scenarios where varied weights were applied to each criterion. First, the researcher created an “Informed Subjective” scenario using focus group data. Then, she compared it to two other weighting scenarios, namely “equal weights” and “random exaggeration.” Thanks to sensitivity testing, the researcher could verify her “informed subjective” view. The scenarios resulting from a weighting exercise were as follows:

- Informed subjective: the researcher used her expertise to assign weights and scores using the AHP website (<https://bpmsg.com/academic/ahp.php>). The researcher based her expertise on the literature review and the preliminary results of the focus group data (Table 4.10)

**Table 4.10.** “Informed subjective” scenario (8 criteria, the researcher went through the AHP exercise for weighting)

<b>Financial (22%)</b>	<b>Social (28%)</b>	<b>Energy Consumption (50%)</b>
Income Deprivation (12%)	Tenure (10%)	Electricity consumption (15%)
House price (10%)	Acorn categories (15%)	Fuel Poverty (5%)
	Internet Engagement (3%)	Gas consumption (30%)

- Equal weights: the researcher manually assigned an equal weighting to every criterion (12-13% weight for each of 8 criteria, as seen in Table 4.11)

**Table 4.11.** “Equal weights” scenario (8 criteria, each 12-13% weight)

<b>Financial (25%)</b>	<b>Social (37%)</b>	<b>Energy Consumption (38%)</b>
Income Deprivation (12%)	Tenure (12%)	Electricity consumption (13%)
	Acorn categories (13%)	Fuel Poverty (12%)
House Median Price (13%)	Internet Engagement (12%)	Gas Consumption (13%)

- Random exaggeration: the researcher manually exaggerated the weighting of “internet engagement” and “tenure” criteria (Table 4.12)

**Table 4.12.** “Random exaggeration” scenario (8 criteria, randomly prioritised internet engagement and tenure)

<b>Financial (16%)</b>	<b>Social (60%)</b>	<b>Energy consumption (24%)</b>
Income deprivation (8%)	Tenure (26%)	Electricity consumption (8%)
Household median price (8%)	Acorn categories (8%)	Fuel Poverty (8%)
	Internet Engagement (26%)	Gas Consumption (8%)

#### 4.4. Stage 4: Critical Self-reflection

##### 4.4.1. Motivation: Closing the action-reflection cycle

Critical self-reflection is an inherent part of the action research methodology. It provides an opportunity to consolidate learning and evaluate professional growth as a researcher. It demonstrates critical engagement with the subject area, highlights ethical issues and encourages a challenge to the researcher’s own positionality in a fair, yet compassionate way.

Finally, self-reflection has also pragmatic function in the thesis. In an action research methodology, the frequent temptation is to engage deeply with the cause and continue practical work beyond the timeline of the PhD. However, it is important for the researcher to be aware of their own limitations and to be realistic about what is achievable within the scope of the research. Reflecting on the whole process, therefore, provides an opportunity to close the action-reflection circle and inform the

participants about the project end and ways to nurture the established connections. As a result, both the researcher and the participants are aware of their mutual expectations and have clear boundaries with regards to work ethics and resources available.

#### 4.4.2. Records of self-reflection

I recognise that in order to be a successful researcher I ought to outline my standpoint both pre-research (Chapter 3.7) as well as reflect on the evolution of the research over time (Chapter 8).

For the benefit of the regular record keeping, I established a paper journal, with weekly notes on new developments / rejected ideas / factual observations/ personal feelings. The journal was complemented with a monthly stream of consciousness notes, where I was free to write whatever I needed to “get out of the system” at the time. I recorded the circumstances when I am the most and least productive, in order to create a blueprint for the preferred work ethics for the next three years. Throughout the process, I strived to keep my composition of the entries in line with the Gibbs (1988) reflective cycle. The reflections are summarised in Chapter 8, which is divided into research stages and overall impressions from the process.

As a component of the mandatory Research in Contemporary Context module, a self-reflective piece is prepared for each class. By the end of the PhD, I constructed 12 self-reflective entries covering the whole of the PhD experience: coursework, time management, teaching, science communication, forming epistemological position, working across disciplines, publishing etc.

### 4.5. Chapter summary

Chapter 4 has detailed each stage of the research design: from the point of selecting secondary data, through the recruitment of participants, to, finally, bounding the PhD with a series of self-reflective entries.

The next two chapters will present the results from the PhD themes. Chapter 5 will discuss the topics of food waste, while Chapter 6 will present results from the investigation of energy and water metering. The results will be presented in the order of the research design:

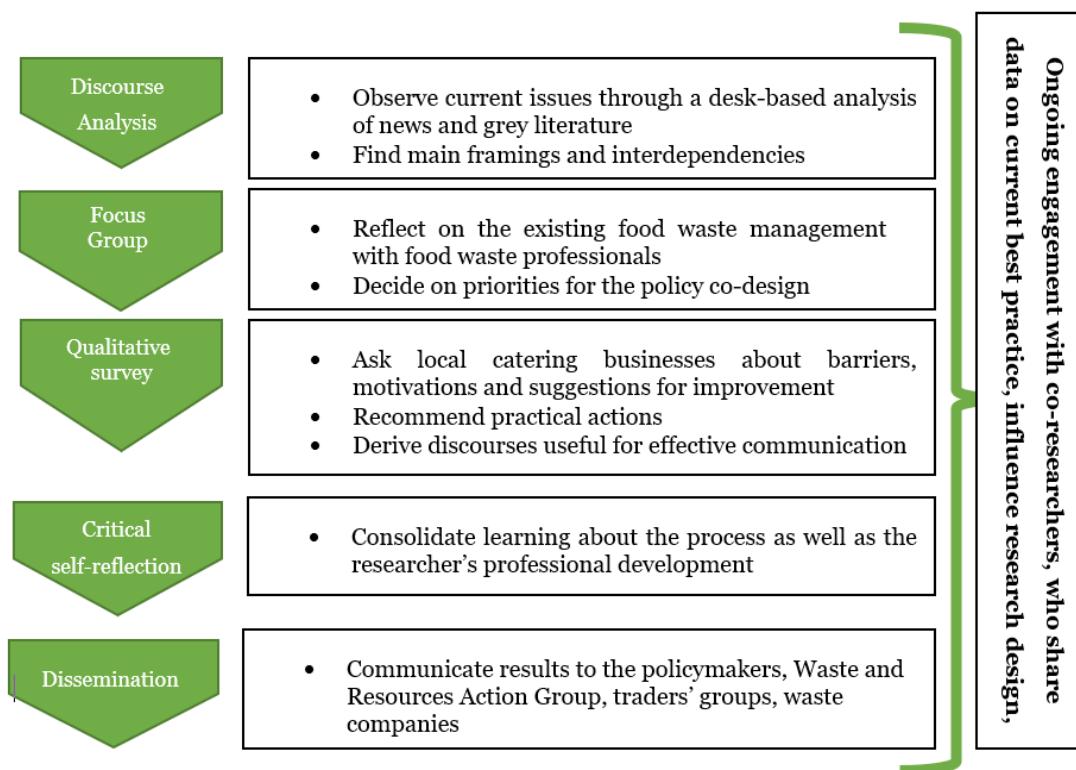
- Stage 1: discourse analysis
- Stage 2: exploratory focus groups
- Stage 3: policy co-design.

The final stage, critical self-reflection will be discussed in Chapter 8.

## 5. Results: Food Waste

The following chapter details the results of the food waste theme. Starting with a discourse analysis of the news articles, it reveals the main framings and highlights current interdependencies pertaining to food waste. Following the desk-based stage, it moves onto the exploratory stage of the research – focus group with sustainability practitioners. Focus group discussed the issue of food waste with the local experts from public, private and charity sectors. It pointed at knowledge and data gaps and the research priority for the next stage – food waste management in the catering sector. The third stage of the research, policy co-design, involves a qualitative survey of Bristol-based food businesses. The survey aimed to scope the current state of food waste recycling in the sector: participation in the services, motivations and perceived barriers. As a result, the research yielded a suite of policy recommendations and revealed the potential unintended consequences of future food waste management policies.

It is worth noting that the background to the topic of food waste in Bristol was described in Chapter 2.4. Finally, the last stage of the research, critical self-reflection, will be covered in Chapter 7. Figure 5.1 summarises the course of the research in food waste theme.



**Figure 5.1.** Summary of research stages related to the food waste theme

## 5.1. Stage 1: discourse analysis

### 5.1.1. Analysis of food waste news

The researcher analysed twelve news items on food waste published in 2016 and early 2017.

This phase of the research explored discourses of food waste related to the responsibility for the issue and proposed measures. The analysis recognised that although there is no single reason or solution, the debate remains highly normative, linking food waste to poor household management, family neglect or even unethical business practices.

Furthermore, discourse analysis highlighted a suite of proposed measures to tackle the issue. There is a movement towards acknowledging working in partnership by suggesting actions such as data sharing or transparency.

Finally, a new discourse of “optimistic solutions” is emerging as the most prominent among the sources analysed. These “optimistic solutions” are usually behavioural and technology-enabled (“smart”) interventions aimed at the individual consumer. It is worth noting that the actors who emphasise the need for consumer behaviour change are the leading supermarket chains. In doing so, supermarkets gain the power to present themselves in a positive light so they can be seen as an innovation rather than a problem. In doing so, they can deflect the attention from other types of measures, like regulating procurement practices or introducing compulsory surplus food donations or recycling.

Table 5.1 (overleaf) summarises the sources and provides key quotes for analysis.

**Table 5.1.** The results of discourse analysis of food waste news

Quotations	Key Observations
<p><b>Bristol Post: “Surge in population of rodents down to fewer bin collections”</b></p> <p><i>“The introduction of smaller bins, along with less frequent general waste collections, is intended to encourage recycling. It can produce significant savings for local authorities by boosting recycling rates and reducing landfill tax fine (...). But Mr Forrester said: "Councils are deluding themselves if they think that will avoid problems, because disused packaging is often contaminated with food”</i></p>	<ul style="list-style-type: none"> <li>* food waste as health and safety issue and responsibility of the local authority</li> <li>* seemingly discursive style as it shows arguments from both sides, but direct quotations are sourced only from the British Pest Control Association representatives</li> </ul>
<p><b>Resource: “PUBLISHING DATA KEY TO TACKLING SUPERMARKET FOOD WASTE – TESCO”</b></p> <p><i>“Tackling food waste makes sense for business, it will help people and our planet, and it's also the right thing to do.”</i></p>	<ul style="list-style-type: none"> <li>* reports on Tesco’s presentation at a major business summit</li> <li>* reports on various measures to tackle waste suggested by Tesco</li> <li>* suggests that collaboration and data sharing is the key</li> <li>* presents Tesco in a positive light, as an industry leader</li> <li>* multiple framings: financial, environmental, social, ethical</li> <li>* reports on Tesco’s “record high” waste but then proceeds to report on its progress in the same paragraph</li> <li>* reports Tesco’s definition of waste, but doesn’t comment on it</li> <li>* highlights the need for a consistent reporting framework</li> <li>* multiple direct quotations from Tesco</li> </ul>

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**Daily Mirror: “We saved over £1,000 a year... and so can you!; YOUR LIFE CASH QUEENS”**

*“A simple tweak to the shopping list and a rethink of meals can save families more than £1,000 a year on groceries”*

*“Brits are guilty of binning six meals a week, creating an annual 4.2 million tonne food waste mountain”*

- \* reports on a pilot scheme in South Derbyshire introduced by Sainsbury and WRAP
  - \* framing: financial, family
  - \* emphasis on simplicity and individual habits
  - \* normative language
- 

**Bristol Cable: “Super (waste) markets”**

*“Several organisations in Bristol work to recycle food waste. A job that should be the responsibility of the supermarkets creating the surplus in the first place. Food banks and homeless charities, the usual recipients of supermarket surplus, lack the capacity to distribute it fast enough to those in need”*

- \* an opinion piece written by the founders of the local food redistribution charity
  - \* argues that the current voluntary and unregulated arrangements between supermarkets and charities act as offloading of waste management to unpaid labour
  - \* core responsibility directly pointed at supermarkets and excessive food production
  - \* portrayed as the opposition between charities and supermarkets, but only a charity point of view is referred to and quoted
  - \* framing of unethical business practices
  - \* challenges the language of “solutionism”
  - \* refers to the waste pyramid
  - \* normative language around supermarkets: “exploitative”, “dubious” practices
-

\* supported by charity's own data and figures from think tanks

\* suggests data sharing, transparency and legislation as a solution

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### **The Guardian: “Only 3% of UK adults feel ashamed at wasting food, poll finds”**

*“In January, Sainsbury’s launched a partnership with the town of Swadlincote in Derbyshire, where it is spending £1m to cut food waste by trialling new technology (...). Working with the government’s food advisory body, Wrap, the initiative will be measurable so that it can be used as a blueprint for the future. Ideas include testing smarter kitchen appliances such as fridges to allow people to check on their phone what they have at home and food-sharing apps such as Olio”*

\* news article reporting on the pilot scheme in Derbyshire introduced by WRAP and Sainsbury

\* descriptive style with quotations, little commentary

\* reports on a survey done by Sainsbury’s which claims that people don’t see the stigma around food waste or that they aren’t aware of potential financial savings associated with it

\* no link to survey present, no commentary on the questions asked

\* argues wasting food is normalised in the society

\* suggests a suite of solutions proposed by the pilot scheme: done in partnership, measurable, technology-oriented

\* a supermarket gets to decide on the range of the appropriate solutions so it won’t lose profit

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### **Daily Express: “Food waste UK: Britons bin £13BILLION worth of edible food each year”**

*Environment Minister Therese Coffey said: "Good progress has been made by industry to tackle food and packaging waste in the supply chain and it goes to show the achievements that can be made through working together with partners across the UK. But we all have a role to play and despite a million-tonne fall in domestic food waste since 2007, there is clearly more we need to do. That is why we will continue to work with WRAP to support their new strategy*

\* reports recent WRAP figures of household waste estimated and progress in cutting food waste in the commercial sector

\* sensationalist headline and more measured content

\* partnership discourse: distributed responsibility and solutions, environmental framing;

\* solutions within ABC (Shove, 2010) framework: changing perceptions, attitudes, raising awareness

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*to raise awareness, increase education and change people's perceptions of food waste"*

- \* portrays Wales as a leader
  - \* combative language of "fight" and "battle", but no clear opponent;
- 

### **The Spectator: "Higher prices are the only way of dealing with Britain's food waste problem"**

*"An increase in food waste is possibly the clearest sign that food poverty is declining and most people have never had it so good when it comes to filling their stomachs"*

*"Wrap has now persuaded supermarkets to go further and become our substitute domestic science teachers. Notices such as 'one cup of rice feeds two people' and 'bread goes off faster in the fridge' will be found in shop aisles, on food packaging and when people buy groceries online. But there is only so much nannying signs and reforming packaging can really do"*

- \* opinion piece: argues that the reason for food waste are declining food prices
  - \* strong language: affirmative statements, references to government data
  - \* equates rising food waste with an assumed decline in food poverty
  - \* supermarkets portrayed as already making the effort yet bearing the burden of food waste
  - \* customers portrayed as wasteful and *too well-off*
  - \* critical and sarcastic of awareness-raising initiatives
- 

### **The Telegraph: "Shoppers face food waste warnings in supermarkets, as levels rise for the first time in a decade"**

*"Jim Fitzpatrick, a Labour MP and EFRA Committee member, said supermarkets had faced a conflict of interest between wanting to sell as much as possible and helping people reduce food waste to protect the environment. But Alice Ellison, environment policy adviser at the British Retail Consortium, which represents shops, said multi-buy deals had now been "modified" so consumers were*

- \* reports on an awareness-raising initiative to be introduced in supermarkets
  - \* reports on the rise in food waste and the possible reasons behind it
  - \* points out that the up-to-date government initiatives were ineffective, but no further critique
  - \* attributes responsibility to the food industry ("Multi-buy culture) and "frivolous" customers; \*portrays Wales as a leader
  - \* explicitly points out the industry dilemma between making profit and
-

*more likely to be offered two or more items across a range, rather than on the same product, therefore helping people "not to waste".*

protecting the environment, suggests modifying multi-buy offers as a way to solve it

\* multiple direct quotations from a variety of sources

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### **The Independent: “Food suppliers should be given tax break to curb waste, inquiry told”**

*“He also told The Independent that most of the food wasted is in the supply chain before it gets to the stores and supermarkets “but consumers don’t get that because they don’t see it”*

\* reports on the parliamentary inquiry into food waste  
\* only quotes FareShare (surplus food charity) staff  
\* environmental and social framings  
\* argues that food waste could be mainly attributed to pre-farm gate stage (no evidence provided), therefore incentives for food producers would tackle the issue and increase food redistribution  
\* attributes responsibility to the culture of the food industry  
\* compares the current voluntary approach to French-style tax break for food suppliers

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### **Materials Recycling World: “Defra urged on mandatory food waste laws”**

*“Defra minister Lord Gardiner of Kimble did not answer the question directly but praised WRAP’s voluntary Courtauld 2025 commitment. Liberal Democrats environment spokesperson Baroness Parminter asked whether the upcoming results from the third phase of WRAP’s Courtauld Commitment would include*

\* reports on the political pressure on DEFRA to introduce food waste legislation  
\* points out that DEFRA’s answer to this call was, in fact, question-dodging  
\* demonstrates arguments in favour of the introduction of policy measures: “unacceptably high” levels of waste, progress in places with existing legislation, the ineffectiveness of current approaches, urgency and timing

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*company names. Again, Gardiner (pictured) avoided the question, just saying he “would look at” the results”*

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#### **Chartered Institution of Waste Management: “Ricardo Urges Bio-Digester Exemption From Food Waste Law”**

*“It says the findings are significant for a technology that has previously fallen victim to restrictions on the disposal of any material to drain via maceration technologies. The sanction was first introduced in Scotland to prevent sewer blockages caused by the build-up of fats and residues from macerators, and Northern Ireland has since followed suit”*

- \* reports in detail on the consultancy research evaluating a range of food waste management methods
  - \* AD portrayed as a victim of current policy restrictions, which puts AD in the same category as macerators
  - \* suggests AD is the most environmentally preferable option of dealing with food waste
  - \* reports on the research method which accounts for subjectivity in policy advise, depending on criteria and weighting
  - \* provides a hyperlink to a full report
- 

#### **Daily Mail: “SMELLY RUBBISH? JUST PUT IT IN YOUR FREEZER!”**

*Daniella Maria added: “I’m so glad that my £99 council tax per month as a single parent goes towards the council thinking of tips such as freezing your food waste to stop it smelling, as opposed to it actually being collected and disposed of”*

- \* tone: critical of council’s decision to withdraw waste collection over Christmas
  - \* people described as “taxpayers” or “families” entitled to a basic service
  - \* awareness-raising initiatives critiqued as patronising
  - \* only quotes the residents critical of the council’s initiatives
-

\* framing council's policies as socially unacceptable and mismanaging finances

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### **5.1.2. Synthesis: how results feed into the next stage**

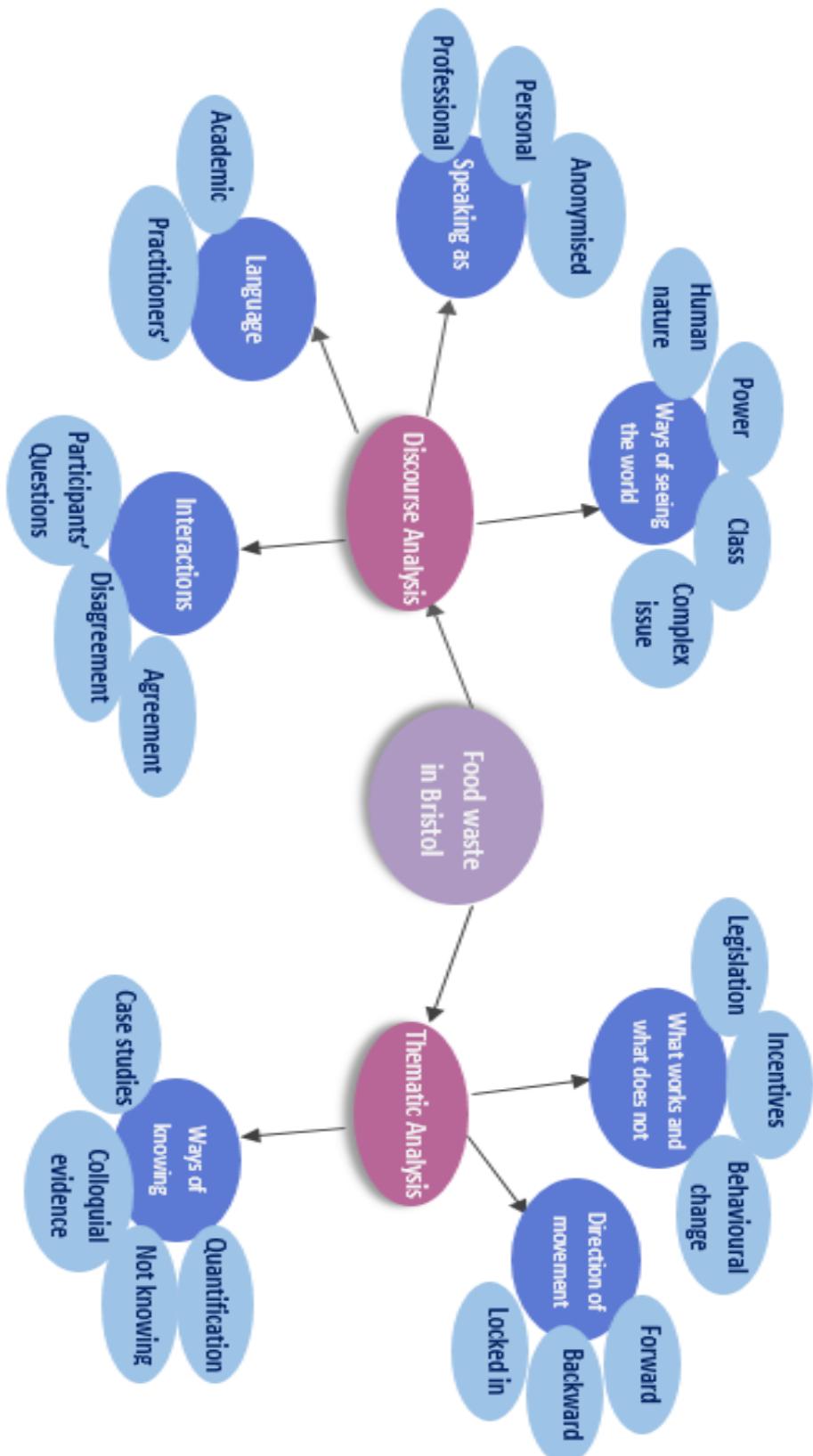
Discourse analysis of food waste news in the UK highlighted a variety of framings applied. The sources analysed point out the reasons behind food waste as well as attribute responsibility to particular actors. Furthermore, they report on a range of initiatives proposed or recently introduced in the country. Commenting on responsibility and solutions is often charged with normative language. Some sources, when directly compared, tend to show contradictory commentaries, which is not surprising given the diversity of the news sources analysed.

The results of discourse analysis informed the questions asked during the focus group. The framings and language usage pervasive in the news articles made the researcher aware of the potential conflicts of interest.

## **5.2. Focus group**

Consistent with the action research approach, this focus group provided an opportunity to complement the knowledge about media discourses around food waste. By gathering local sustainability professionals from various backgrounds, the event allowed a discussion on the current state of food waste management in Bristol. Consequently, this focus group revealed key policy priorities and knowledge gaps which were taken into consideration in the policy co-design stage.

The figure below illustrates the main themes and codes applied using thematic and discourse analysis (Figure 5.2). The event took place in February 2017.



**Figure 5.2.** A diagram of themes arising from the focus group data analysis (food waste theme).

### 5.2.1. Thematic analysis

#### 5.2.1.1. Ways of knowing

The question of “how do we know about food waste?” is still a pressing one. Throughout the discussion, it turned out that the participants were often aware that all they could provide was colloquial evidence or case studies. For example, Participant 4, a coordinator of the sustainable business network, admits: “*I don't have any figures, but you know – the colloquial evidence we've been given is that it's making potentially big changes in some spaces*” (FG1\_Po4). Despite a lack of relevant peer-reviewed studies on food waste, he stressed that “*we have case studies on behavioural change; we have resources for people looking to minimise their waste*” (FG1\_Po4).

Although quantification of food waste is in plans, there is still a large amount of work required to receive a complete picture of Bristol’s food waste. Participant 5, who works as a participation officer for the local waste company admits:

*“Participatory data [in waste collection services] is quite tricky to get. It's just huge - 196 000 households in Bristol - so for an accurate thing, you really need every single street... So, it's quite tricky. We don't have it yet, but we've got an indication, but ought to do that”* (FG1\_Po5).

The reason for a gap in quantification is linked to the lack of resources to gather data on food waste. On one hand, local organisations already measure some aspects of recycling participation, waste composition, tonnage, waste processing. However, participants would often admit themselves that their data often lack satisfactory resolution. For example, Participant 3 who manages sustainable facilities in the local education charity said:

*“We know how much roughly is leaving the site, but we don't have that kind of granularity...and in terms of food waste, we only studied it for about 6 months, so we had a little bit of data then. Since we switched to compost on site, we're not really recording exactly what's going on because it's such a small team. It's very little data...”* (FG1\_Po3).

#### 5.2.1.2. Direction of movement

A second theme emerging from the discussion is “direction of movement”. Participant 2, a senior staff member the food waste charity summarised how the work on food waste has moved forward over the past decade:

*“Everybody knows and talks about food waste now. You know, when we started 10 years ago in Bristol, trying to talk to people about food waste, they would think that we were diving in the bins and getting food from there (laughter)”* (FG1\_P02).

Despite the fact that food waste currently benefits from political attention, this level of interest cannot be taken for granted. Political priorities shift over time, often at timescales faster than those typical of policy cycles or research grants. For example, Participant 2 warned against the instances of going “backwards”:

*“I think it’s a bit of an issue when governments change, or mayors change and therefore the whole focus shifts. And all the good work that might have been done beforehand is rewritten. And I just...I find it so frustrating...”* (FG1\_P02).

Furthermore, participants recalled issues, which were “tricky” or “full of barriers”, for example, food waste collection in the commercial sector:

*“In Bristol, first of all, domestic food waste collection is free, but for businesses it’s expensive, so we thought one thing to do to make it cheaper as to team up with other businesses. So, we started asking around expecting that at least some of them were doing food waste collection, but no one was doing it at the Harbourside”* (FG1\_P03)

Overall, the conversation was characterised by a rather insoluble, if not futile atmosphere. Participants were quick to mention obstacles, knowledge gaps and paradoxes, rather than optimistically acclaim potential innovations.

#### *5.2.1.3. What works and what does not*

Participants have been asked to comment on the types of food waste interventions present in Bristol. They agreed that individual interventions are unlikely to deliver the desired outcome and that the city needs stronger legislation. For example, Participant 3 admits: *“I think I’d also be tempted to say – legislation is the main one. I know that’s ironic because I work in the education and engagement side, so I should say it’s all about changing values”* (FG1\_P03). Food waste policy was perceived as a potentially unpopular, yet likely an effective measure. In particular, compulsory recycling received attention among some participants:

*Anon: “I’ve been thinking of the term “legislation”, I know it’s unpopular, but if [collecting] food waste was made compulsory... I believe this would have a knock-on effect and be more cost-effective. That’s me personally, not my organisation”*

Participant 6, who works as a graduate staff member at a food waste management facility, added that incentives could also constitute the policy side of food waste management: *“[People would waste less food] if they’d been incentivised and*

*whether it'd genuinely impact them on an individual level, otherwise they've got no sense of responsibility to do it*” (FG1\_Po6). The idea of tax incentives was also proposed as a way to resolve the dilemma between redistributing surplus food and recycling food waste:

*FG1\_Po2: Is there going to become a point when AD [anaerobic digestion] will pay for their food waste because they will essentially be making money out of it?*

*FG1\_Po6: Yeah, that's a good question. At our organisation, we believe the future is paying for all our waste because we can see how valuable it is. It's only a matter of time before this will be happening, and there is already a lot of competition for AD.*

*FG1\_Po2: So in a way, it's really good, but in another, it's really bad because if a supermarket has a choice to donate for redistribution or to get money for AD, you know they're going to choose money, aren't they? (...)*

*FG1\_Po1: So, for the taxes to reflect perhaps that, donating food to people rather than AD as a social value. The tax system could perhaps reflect that.*

Participant warned against the unregulated growth of AD, which could lead to disincentivising edible surplus food donations to charities. In other words, food waste is an example of food-energy nexus, or, as widely known in policy jargon, “unintended consequences” (Cairney, 2012).

Behavioural change approach frequently employed by the local authorities (Bristol City Council, 2016b) and government-funded charities (Waste and Resources Action Programme, 2008) was dubbed too problematic to successfully implement: “*It's very, very easy to do behavioural change badly and it's very difficult to do it well...*” (FG1\_Po3). Participants stressed the abundance of behavioural change initiatives and the resulting gap in legislation: “*We have case studies on behavioural change, we have resources for people looking to minimise their waste. What we don't have is the legislation side*” (FG1\_Po4). Participants’ recommendations about the effective and ineffective policy tools will be taken into account during the next phase of the research (Stage 3 – Policy co-design with sustainability practitioners).

### 5.2.2. Discourse analysis

#### 5.2.2.1. Ways of seeing the world through food waste

Participants’ opinions were analysed at the “implicit” level by drawing inferences about their possible worldviews. Do they see food waste as the issue of human nature, class, power? The researcher observed a considerable variety of opinions presented, given the size of the group (Table 5.2 overleaf).

**Table 5.2.** Ways of seeing the world through food waste: Whose responsibility? Whose solutions?

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**Class:**

*“I think it’s recognising that for some people food waste is going to be at down their list of priorities they have to worry about with their lives...Sustainability, it shouldn’t be a luxury, but it is kind of be easier for people in the middle class because they have time and resources to think about it...and it can become a badge of pride, especially in Bristol, whereas I think if you look at areas of society which have far greater concerns than what they’re putting in their food waste bin” (FG1\_P03)*

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**Human nature:**

*“FG1\_P06: Humans are selfish, and they just care about what suits them*

*FG1\_P02: Time and money.*

*FG1\_P06: Yeah, and unless they’ve got the bigger picture and can understand why it’s impacting them, I don’t think people have a sense of responsibility to do it...”*

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**Complex issue:**

*“The only way to break that cycle really is for consumers to either shop somewhere else – which is quite radical - or for supermarkets to take a huge risk of what they stock... but within that cycle it’s always like “we can’t buy it because it’s not there” and “we’re not going to supply, because you’re not going to buy it”. And I don’t know quite...because it is a bit of a cycle...work out how to break it...” (FG1\_P03)*

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**Power:**

*“They’re always saying “we do what customers want us to do; we are being led by the customers” I do not... I kind of disagree with that now, because I think they do have so much power, you know, there’s a big 5 ...they dominate the market, they have so much power, so that they could actually start to change behaviour, the way we consume, the way we cook...” (FG1\_P02)*

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**Customers’ Expectations:**

*“We spoke to some manufacturers about that...they say for their brand, the customers expect a certain taste every single time. And if it’s past the best before date, it might be perfectly edible, but it might not taste as they expect, and therefore they think it’s wrong” (FG1\_P01).*

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On a few occasions, participants actively disagreed over the root cause of the issue. Some participants implied that food waste is strongly connected with class and power, and therefore, the responsibility should be attributed to the institutions and businesses rather than individuals (Table 5.2). Whereas the others attributed it to individualistic factors, like “*selfish human nature*” or the inherent customer expectation for food to taste in a particular way.

#### *5.2.2.2. Interactions between participants*

The analysis of the transcript identified 21 instances of agreement and 11 instances of disagreement. In particular, participants agreed on:

- the definition of “sustainability”
- the progress in the food waste sector over the past decade
- barriers for SME businesses wanting to recycle food waste
- the lack of adequate regulations “locking in” wasteful practices in the commercial sector
- a difficult policy dilemma between encouraging Anaerobic Digestion (AD) and worsening food poverty.

Nevertheless, participants disagreed on the agency and responsibility for the issue: whether it could be attributed to the citizens or the commercial sector. They also disagreed whether AD is an effective low-carbon solution:

*FG1\_P06: “I suppose AD is about waste essentially being used as something valuable...for it to have a price on, I would say that’s good.”*

*FG1\_P02: Yeah but the energy it takes...if you measure the carbon footprint...”*

Participants were interacting with each other frequently, asking each other questions on 25 occasions, which indicates willingness for cross-sectoral learning and understanding of each other’s point of view:

*“FG1\_P01: Is it encouraging that there is not enough waste [for AD]?”*

*FG1\_P06: It is encouraging, and in our best interest not to create food waste at all.”*

#### *5.2.2.3. Speaking: anonymised, personal, professional*

Each of the participants signed consent forms, agreeing that they are happy for their comments to be identified with their names in the future publications. This came

across as a surprise, as the researcher assumed that food waste is a contentious issue and that the participants would prefer to speak anonymously.

Participants exhibited a degree of critical self-reflection and awareness of the faults and drawbacks in their own sectors or organisations: “*There are 196 000 households in Bristol. For an accurate measurement, you really need every single street... so it's quite tricky.... we don't have it yet, but we've got an indication ... but ought to do that*” (FG1\_P05).

Although everyone was happy to share their views and identities, some tended to speak in a more formal language, implying that they represent their organisations:

*“We at our company, we believe—the future is – paying for all our waste, because we can see how valuable it is, and It's only a matter of time before that will be happening...and there is already a lot of competition for AD”* (FG1\_P06).

However, on a few occasions, participants switched between representing their organisations and presenting own opinions, explicitly voicing how their worldview can be perceived through the conversation about food waste: “*There are lots of options if businesses have the time and capacity to do it [tackle food waste] ...but if they don't...there has to be a push... I'm speaking personally...*” (Anon.)

On top of presenting their own opinions, on a number of occasions participants spoke as Bristol residents rather than professionals. This usually occurred while explaining the reasons for food waste, e.g.:

*“FG1\_P05: Is it best to limit what you can buy and get people to be more resourceful about things they're eating as opposed to having so much choice and then wasting because they're don't know what to do with it? For example, celeriac-we got it in the veg box- we don't know what to do with it!*  
*Everyone: [Laughter]*  
*FG1\_P04: I stopped mine because... we got stuck with a lot of cabbage, at one point we had 6 cabbages”.*

Although focus groups with stakeholders should not replace formal residents' consultation, encouraging food waste professionals to think like the residents during policy design could be a useful exercise and help to predict controversies and issues with participation.

Throughout the discussion, participants voiced their opinions and criticisms in a reasoned and engaged way. This might indicate readiness for collaborative action in the sector and significant overlap in the agenda of the food waste practitioners. Ultimately, the process of formation of people's opinions is complex and multi-faceted. Being aware of the richness of participants' professional and private

experiences allows more effective communication, mutual understanding and working towards common aims with methods endorsed by all parties.

#### *5.2.2.4. Academic language and language in practice*

One of the considerations for the cross-sectoral research is the language used in conversations, writing and everyday practices. Although the WEF Nexus is a theoretical framework applied in this research, the word “nexus” was not explicitly mentioned during the event. Drawing from the literature review of local policies and initiatives (Chapter 2.5), the researcher concluded that the concept of the WEF Nexus is not popular among the local food waste practitioners. However, both the researchers and the participants were aware of the presence of cross-cutting issues in the sector, framing them as:

**Competing sustainability measures:** “*With the money we had to spend in on sustainability measures, not just on food, but across energy, waste, water...food waste collection for businesses was very expensive*” (FG1\_P03)

**Waste hierarchy dilemma:** “*FG1\_P02: Manufacturers, distributors, you know – these are the big guys basically. There is still 98% there, which is going to AD... and potentially landfill*

*FG1\_P01: [Redistribution] should be on the food waste hierarchy of course...*”

Additionally, food waste practitioners were comfortable and confident discussing political and contentious questions related to class, power, sustainability and environmentalism. For example, Participant 2 eagerly mentioned the intersection between sustainability and class: “*I think there is also an issue around the middle class. The middle class is being able to act sustainably, being able to access organic food – there is a big issue with that*” (FG1\_P02).

At the beginning of the focus group, participants were asked to share and comment on their own definitions of “sustainability”. It turned out that there were numerous overlaps in how participants understood “sustainability” i.e., they would commonly mention its “broadness” of the concept and “doing things differently”. Asking about the “shared language” helped to establish mutual understanding and commonality between the people gathered in the room. It also helped the researcher to speak the language used among the participants, rather than utilise an academic jargon.

*FG1\_P02: I think the word “sustainability” is so **broad** – unless you’re in the industry - too broad for people to tangibly grasp”*

*FG1\_P03: I suppose I see it much more as just “the **new way** of doing things” across businesses and public sector and*

*anything, really. The current way we're going is not sustainable”*

*FG1\_Po4: “Well, “sustainable” for me, well for the organisation I work with is any **alternative to the traditional model** which uses fewer resources, energy, creates less waste”.*

### 5.2.3. Synthesis: how results feed into the next stage

As a result of the focus group data analysis, the researcher identified the direction of the further stages. The issue of food waste management in the catering sector will be taken forward to the next phase, policy co-design with sustainability practitioners and catering sector. The table below summarises an action plan for the policy co-design (Stage 3) of the research.

**Table 5.3.** Description of the policy co-design priority for the food waste theme.

<b>Policy co-design priority: food waste recycling in the catering sector</b>	
<b>Justification</b>	<b>Participatory Actions</b>
<p><i>“The contracts apply only to residential properties, anything else would be chargeable...We've started up our commercial side which is due to go live in April, and we'll do food waste, but lots of companies don't produce enough volumes to make it feasible...”</i></p> <p>(FG1_Po5, Project officer at the local waste company)</p> <p><b>Comment:</b> Currently, businesses have no legal obligation to recycle food waste. Although there are commercial waste services and positive case studies encouraging recycling, many organisations still do not regard this as an option. The aim of this study to gather evidence on motivations and barriers for an improved food waste collection service for the catering sector.</p>	<ul style="list-style-type: none"><li>* Meet local food waste actors to co-create survey design.</li><li>* Gather the opinion of the local catering sector on the motivations and barriers to food waste recycling.</li><li>* Work with waste companies and businesses willing to disseminate the results and apply policy recommendations.</li></ul>

### 5.3. Policy co-design: Qualitative survey

The following chapter will report on the results of the qualitative survey conducted among Bristol's catering sector. As detailed in Chapter 5.2.3, the issue of food waste in the commercial sector was highlighted as a research priority which requires further data collection, policy evidence and, finally, local actions. Following the exploratory focus group on food waste, the researcher requested willing participants to contribute to the design of the qualitative survey, pointing at possible research questions,

relevant participants and dissemination channels. In December 2017, the researcher obtained an additional ethical approval to collect data from a new participants' group and in January 2018, she conducted the qualitative survey with the local catering businesses (i.e. staff members of bars and restaurants).

### 5.3.1. Introduction

In total, 79 out of a population of 95 approached businesses responded to the survey (83% response rate). Table 5.4 outlines the demographic characteristics of survey respondents. The participating businesses were located in the following areas: city centre (39.2%), Gloucester Road (40.5%) and Easton (20.3%). The smaller sample size in Easton reflects the size of the area. Participants characterised themselves as the following: restaurants (29.1%), pubs (12.7%), cafes (30.4%), fast food takeaways (22.8%) and bakeries (5%).

**Table 5.4.** Survey participants' characteristics

Area	Total count and percentage	Type	Total count and percentage
City Centre	32 (39.2%)	Restaurant	23 (29.1%)
Gloucester Road	31 (40.5%)	Pub	10 (12.7%)
Easton	16 (20.3%)	Café	24 (30.4%)
		Fast Food Takeaway	18 (22.8%)
		Bakery	4 (5%)

Responses to the open-ended questions in the survey ranged widely from a few words to more detailed answers containing a few paragraphs. The researchers generated three themes described in Chapters 5.3.3-5.3.5. The themes are as follows: “*Barriers or excuses?*”; “*Need for top-down measures*”; “*Giving agency*”. After the categorisation of answers in thematic patterns, the researchers investigated the language used by the participants. As a result, dominant, emerging, and conflicting discourses were identified and are described in Chapter 5.3.6.

### 5.3.2. Characteristics of participants who recycle food waste

Out of 79 respondents, 42 (53%) confirmed that they already use food waste collection services. Table 5.5 outlines the response by area and business type. The recycling rate

is not evenly distributed across the areas and business types, with Easton having much lower participation rate than other areas. While restaurants achieved high recycling participation rate (78%), takeaways and bakeries recycled the least (respectively 33% and 0% participation in recycling services). Although the results are not statistically significant, they indicate that participation in recycling services may depend on the type of business and the location of the catering business. As such, improved waste services could target its recipients according to businesses in needs and potential priority areas.

**Table 5.5.** A proportion of participants already recycling food, outlined by area and type.

Area	Count and percentage of participants recycling	Type	Count and percentage of participants recycling
City Centre	18 (56%)	Restaurant	18 (78%)
Gloucester Road	19 (61%)	Pub	5 (50%)
Easton	5 (31%)	Café	13 (54%)
		Fast Food	6 (33%)
		Takeaway	
		Bakery	0 (0%)

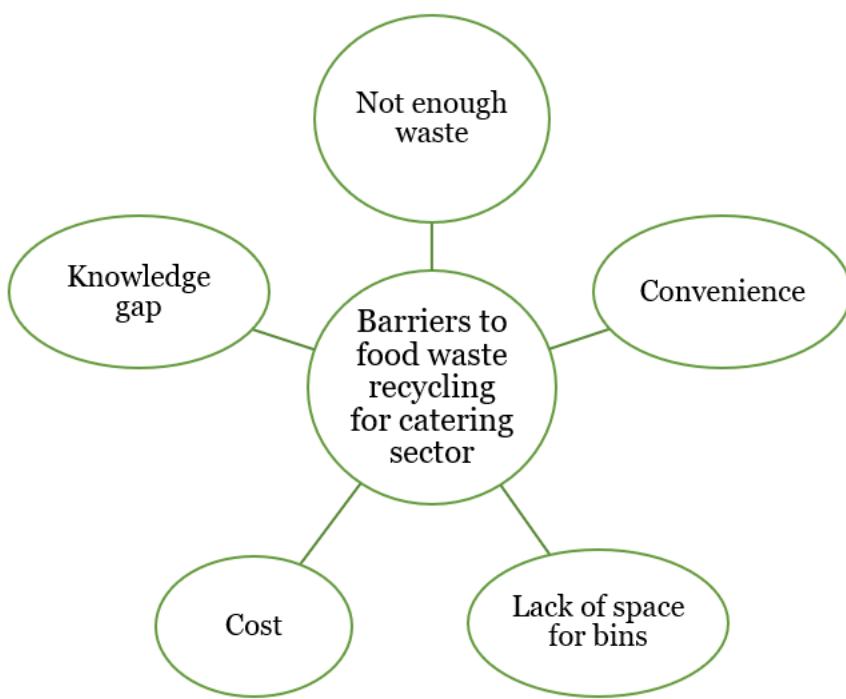
### 5.3.3. Barriers or Excuses?

Perceived barriers to uptake in recycling services vary depending on whether the interviewees participated in recycling themselves. According to the participants who do not recycle food waste, the main barriers are:

- Not enough waste (recorded 18 times, e.g. “*We have very little waste comparing to other restaurants*” restaurant/Gloucester Road)
- Lack of space for bins (recorded 7 times, e.g. “*It’s the practicalities of handling and storing food waste on site until collection*” café/Gloucester Road)
- Cost (recorded 5 times, e.g. “*We used to do it, no it’s too expensive for the amount of waste produced*” café/City Centre)
- Convenience (recorded 5 times, e.g. “*It takes too much work to arrange*” restaurant/ Easton)

However, the landscape changes once the answers of participants, who already recycle included:

- Convenience (recorded 20 times, e.g. “*It’s laziness – there should be no excuse!*” Café/Gloucester Road)
- Cost (recorded 16 times, e.g. “*I imagine it would be the price, it’s easier for big businesses like ours*” restaurant/ city centre)
- Lack of space (recorded 5 times, e.g. “*I’d assume it would not be feasible in small spaces*” pub/ Gloucester Road)
- Knowledge gap (recorded 5 times, e.g. “*Not many people have the knowledge of what can and cannot be recycled, for example, biodegradable cups*” restaurant/ Gloucester Road)



**Figure 5.3.** Barriers to food waste recycling in the catering sector.

There is a clear discrepancy between the barriers mentioned by those who recycle and those who do not. It is questionable whether the issues of space and small quantities are the complex, systemic barriers claimed or rather - are they “excuses”, which could be overcome with quality communication and simple measures? For example, a participant working in a café on Gloucester Road said: “*we should emphasise how easy it is, for example, use myth busters*”. Similarly, a look at existing practices in Scotland and Northern Ireland challenges the idea of “Not having enough waste”. Scottish and Northern Ireland businesses are obliged to separate food if they produce as little as 5kg of food waste (Scottish Environmental Protection Agency, 2016; Department of Environment, Northern Ireland 2015).

Many concerns expressed by the participants reflect the issue of scale. Recycling is more challenging for independent, small, and budget eateries. However, the dilemma can be resolved with communication and improvements in recycling services. The following paragraphs analyse the solutions proposed by the participants.

#### 5.3.4. Need for top-down measures

The UK Government currently favours voluntary measures and is reluctant to adopt compulsory food waste management in England since “*there are more efficient options than restrictions in this area and evidence suggests that restrictions would likely impose additional costs on businesses, particularly SMEs*” (Environment, Food and Rural Affairs Committee, 2015). However, 13 participants indicated said that food waste recycling should be a legal requirement, e.g. “*It should be done by the council, not waste companies*” (take away/ city centre). Notably, 12 out of 13 answers came from participants, who already recycle. This result should not be used as an extrapolation for the acceptance of compulsory food waste recycling policy. The survey did not explicitly ask “are you in favour of compulsory food waste management”, rather the question was: “how could waste collection services be improved?”

Another popular suggestion was “lower price”, mentioned by 12 participants. This solution could be implemented as either policy or market measures. Participants disagreed on whether recycling should be subsidised, e.g. “*Everyone should do it; businesses shouldn't be subsidised to do so*” (café/Gloucester Road) vs “*State should subsidise it and convert waste to energy*” (restaurant/city centre). Some other ideas proposed by the participants were “*local targeting of areas in need*” (take away/city centre) or “*tax relief for green businesses*” (restaurant/Easton). Finally, achieving better value for money could be facilitated using organisational measures, for example, a co-ordinated cost-efficient service for shopping centres, markets, areas with large concentration of businesses etc. (“*Business Improvement Districts should coordinate it*” restaurant/Gloucester Road).



**Figure 5.4.** Policy measures recommended by the participants

### 5.3.5. Giving agency

While large-scale and systemic measures are often preferable for addressing complex issues like food waste, they are usually challenging and timely to implement. Meanwhile, participants recommended a range of operational solutions, which could give the agency to both catering staff and waste companies.

First, waste companies could improve their service by responding to the varied needs of both smaller and bigger businesses (recorded 21 times). A staff member based in the city centre restaurant suggests: “*They should offer different bag and bin sizes for small businesses*”. Flexible collection times could mitigate the space issues; the owner of a café located in the city centre speculates “*since we don't have space to store an extra bin, we would appreciate daily or on-demand collection*”.

Second, improving communication (recorded 17 times) between the researchers, waste companies, catering businesses, and customers could improve the food waste landscape. Participants emphasised that the quality of the communication, rather than the quantity is the key. In extreme cases, a lack of communication is the issue. For example, a manager of an Easton restaurant recalls “*we've never even been offered recycling, only general waste!*” Participants believe that business engagement should be meaningful and offer more than factual information. A staff

member at a Gloucester Road restaurant concluded that “*conversations are better than leaflets*”, while a participant from a Gloucester Road café admitted “*We only had one door-knocking so far. Now you got me thinking about waste*”. Researchers also have a role in communicating the value of food waste recycling. The owner of a Gloucester Road restaurant said: “*You need to demonstrate the undesirable effect of sending huge amounts of food waste to landfill when it could be converted into energy*”.

The issue of recycling food waste is not communicated enough to the customers and within the business network. Meanwhile, participants suggested that championing the right attitude and pledges would create a social norm, for example, a staff member at an Easton café recommends: “*we should be championing businesses who already do it, so others follow*”. Additionally, a staff member of a city centre cafe proposes “*businesses should put a sign in the window, advertise it and make it a selling point*”.

Finally, committing to food waste collection could result in co-benefits to the business (recorded 9 times). Participants, who already recycle shared that it helps them with stock management and saves money in the long term. For example, an owner of Gloucester Road café said: “*it increases awareness of what's happening in the kitchen and helps to manage stock*”. A staff member of a Gloucester Road restaurant argues “*separation keeps the general waste low, you can save money as a result*”.

### 5.3.6. Dominant, emerging, and conflicting discourses

Discourse analysis of the arguments used by the participants reveals that the most common frames used are:

- Environment/sustainability – dominant frame for those, who already recycle (e.g. “*We do not want our food waste to be sent to landfill when there is an opportunity for it to be recycled*” restaurant/ Gloucester Road)
- “Not our problem” – dominant frame for participants, who don’t recycle, e.g. “*We don't have enough waste as we cook to order*” restaurant/ Easton; “*We have very little waste and donate all leftovers to neighbours and friends*” bakery/ Easton
- Ethical and normative, (e.g. “*it's a good deed, no food should ever be wasted*” restaurant/ Easton; “*I haven't thought much about it before but it's a company policy – we just have to do it*” Pub/ Gloucester Road)
- Competent business management - used **both** by recycling and non-recycling businesses, e.g. “*We're staying ahead of the law. It makes sense in the long term- it's better to do it now before it's enforced by law, it's good for our*

*reputation” restaurant/ city centre **but also** “Main barrier is the cost. However, our menu is devised to minimise food waste. Food waste is expensive for businesses just as unsold stock” café/Gloucester Road*

Understanding the discourses used by non-recycling participants could help with effective engagement. The perception of “not having enough waste” ought to be tackled in the first place, for example by referring to the regulations in Scotland and Northern Ireland. Second, applying “competency” framing could reach businesses who don’t recycle due to practical reasons, like cost or space. Business engagement should contain a mix of “myth-busting” information and tailored persuasion. This way, communication closes the environmental knowledge-gap and emphasises shared benefits.

#### 5.4. Chapter summary

This chapter presented the results from the primary and secondary research on food waste theme. Starting from the discourse analysis of the food waste news in the UK over 2016-17, it highlighted a variety of framings, attributed responsibilities and praises as well as a critique of the proposed solutions. Discourse analysis outlined normative framings related to wasting food and pointed at the distribution of responsibility as well as preferable answers. It highlighted an emergence of a novel discourse of “optimistic solutions” where supermarket chains are given platform to portray themselves in a positive light, potentially deflecting attention from legislative measures. It then went to report on the current state of food waste movement, as described by the local sustainability practitioners during a focus group in February 2017. The exploratory focus group highlighted the areas of recent progress, gaps in local data as well as policy priorities. When discussing policy complexities, participants pointed at the potential impact of AD on the availability of surplus food for charitable distribution.

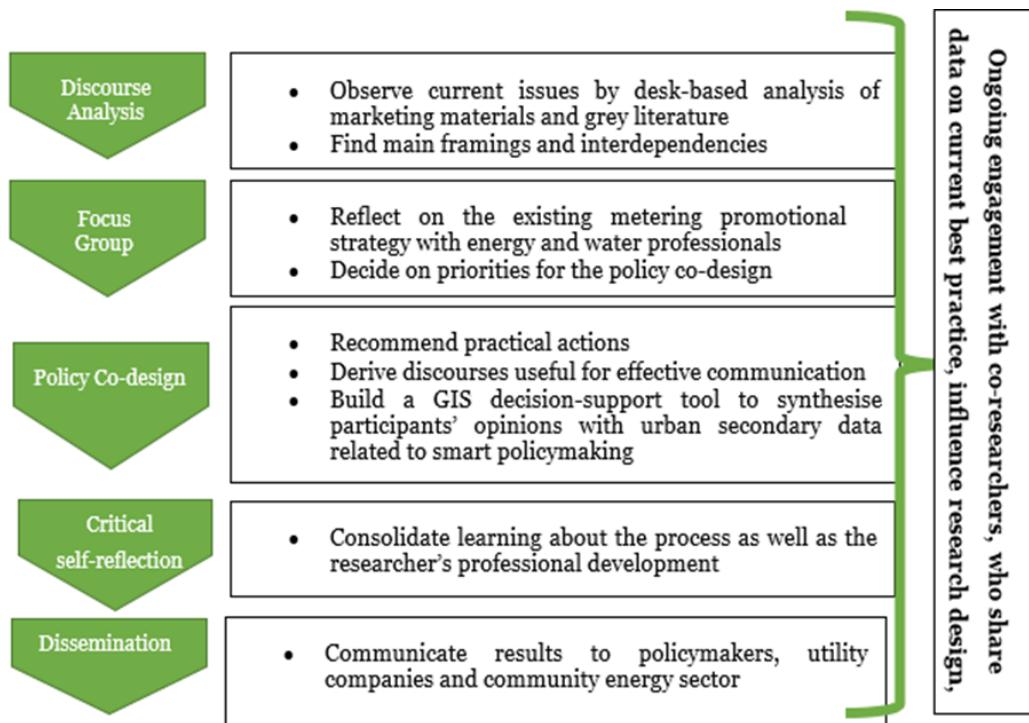
Thanks to the participants’ contribution, the issue of food waste recycling in the catering sector was prioritised as a theme of the policy co-design stage. As a result of a series of further meetings with the research stakeholders, a qualitative survey was designed. The questionnaire asked about current food waste management practices, reasons for (not) recycling, barriers to participation in recycling and suggestions for improved food waste management in the catering sector. In January 2018, the researcher spoke to 79 local catering businesses and gathered local and practical policy recommendations for improved food waste management which could be improved both at the operational as well as policy levels.

Survey participants emphasized that bottom-up and operational solutions will give agency to the catering sector, for example implementing flexible and co-ordinated waste services. Effective engagement is the key: for example, displaying pro-recycling stickers or setting up a peer-learning network emphasising business benefits of recycling (e.g. improved stock and portion monitoring). It has to be noted that not all surveyed areas had the pre-existing traders' networks in place which could leverage these recommendations. The results demonstrate that business engagement with future policies should address the barriers voiced by the participants applying the framings and arguments used by the catering sector, rather than assuming that restaurants and cafes are not aware of the issue. The action-reflection cycle will be completed in Chapter 8, where the researcher reflects on the whole project.

The following Chapter 6 will present the results from the metering theme.

## 6. Results: Water and Energy Metering

This chapter presents the results of the metering theme. It commences with a discourse analysis of the marketing materials that reveals the main framings and highlights current interdependencies pertaining to energy and water meters. It then considers the participatory stage of the research – an exploratory focus group with sustainability practitioners. This event discussed the issue of metering with the local experts from public, private, education and charity sectors. The discussion revealed data gaps and generated research priorities for the next stage. The third phase of the research, policy co-design with sustainability practitioners, involved a targeted focus group and a creation of GIS decision-support tool using the Multicriteria Decision Mapping (MCDM) technique. The aim of the targeted focus group was to narrow the general discussion on metering in order to provide practical guidance in the areas of communication and policymaking. The aim of the GIS decision-support tool was to translate the key findings from the discussions into policy questions, which would be possible to answer using urban secondary datasets as well as the local expertise. As a result, the research yielded a suite of recommendations for metering communication. Finally, it revealed the potential climate justice implications of the energy and water metering policies. Figure 6.1 summarises the course of the research in energy and water metering theme. A critical self-reflection of this research process is presented in Chapter 8.



**Figure 6.1.** Summary of research stages related to the metering theme

## 6.1. Discourse analysis of marketing materials

The researcher analysed four customer-oriented documents on metering in the energy and water sectors.

The prevailing framings in the metering promotional materials are “control”, “savings” and “convenience”, as these are the keywords appearing most commonly in each document. Despite the commonalities, there are also significant differences in communication between the leaflets, depending on the sector and organisation.

The main differences between the documents are the inclusion of individualist versus collectivist arguments and their informational versus promotional character. Notably, the individualist arguments were commonly presented in the promotional materials, whereas collective reasoning was included in the informational materials.

Tables 6.1 a-d summarise the findings and provide key quotes for the analysis.

**Table 6.1.a.** Key themes resulting from the discourse analysis of metering promotional materials (source: Ofwat, 2013)

<b>Quote</b>	<b>Key observations</b>
<b>Ofwat (2013) Water meters- your questions answered</b>	
<p><i>“Although it seems to rain a lot in England and Wales, water is a scarce resource in some parts of the country - particularly in the south and south-east of England. And it is likely to become more scarce in the future as our demand for water grows, our population increases and our climate changes”</i></p>	<p><b>Location:</b> first page - foregrounded  <b>Tone:</b> Informational  Water scarcity: an issue contrary to common opinion  Environmental and long-term planning reasoning.</p>
<p><i>“If you have a meter, the amount you pay will depend on how much water you have used. If you do not have a meter, you will be charged a fixed amount each year (unmetered charges). These charges usually relate to the rateable value of your property. (...) Some people regard meters as the fairest way to charge for water and sewerage services. This is because you pay for how much water you use.”</i></p>	<p><b>Location:</b> the first half of the document  <b>Tone:</b> informational  *Metering as a fair solution  **“Water service” rather than the right to water</p>
<p><i>“Your bill will be higher or lower depending on:  * how much you pay now *the number of people in your home * how much water each of you uses  * how much you are able to reduce your water use”</i></p>	<p><b>Location:</b> the first half of the document  <b>Tone:</b> informational  *Transparent about the impact on bills</p>

**Table 6.1.b.** Key themes resulting from the discourse analysis of metering promotional materials (source: Bristol Water, 2016)

Quote	Key observations
<b>Bristol Water (2016) Water meters explained</b>	
<b><a href="https://www.bristolwater.co.uk/your-home/water-meters/">https://www.bristolwater.co.uk/your-home/water-meters/</a></b>	
<p>“*You could save up to £100 a year on your water bill. *You will probably save money on your energy bill too. *About 25% of your energy bill is for heating water. *It helps us detect leaks much quicker. *Having a water meter helps to save water. * You only pay for what you use”</p>	<p><b>Location:</b> Landing page – foregrounded</p> <p><b>Tone:</b> promotional</p> <p>*Focus on savings (3 mentions).</p> <p>*Brief mention of Water-Energy Nexus</p> <p>*Lack of reference to the £100 figure</p> <p>*A presumption that without a meter you pay more than what you use</p>
<p>“Most of us do everything we can to save water, we know it's important to everyday life. By switching to a meter, you can also save money from all that hard work. With a meter, you don't pay for what you don't use. On average, people who have one save about £100 a year. It's free to switch and if you don't save money within the first two years you can switch back for free too.”</p>	<p><b>Location:</b> Landing page – foregrounded</p> <p><b>Tone:</b> Promotional</p> <p>*A presumption that people already commonly engage in water-efficient behaviour</p> <p>*Focus on savings throughout the paragraphs (4 mentions).</p> <p>*Not specified whether savings are likely to be “up to” or “on average” £100 pounds</p>
<p>“How will I benefit? 1) The Modha family have four children and will not necessarily see a reduction in their bills (...) 2) Susan and Mike live in the home where they have brought up their three children, who have now left home. They have a large house with more rooms than people, and also have a large, well-maintained garden. A water meter could save them money and they could also use water butts in the garden”</p>	<p><b>Location:</b> First page – foregrounded</p> <p><b>Tone:</b> Informational and promotional</p> <p>*An indication that bill savings are a function of the following: a number of rooms VS a number of householders, the demographic</p>

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make-up of the household and presence of the garden.

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*“\*Is there an externally located stop tap controlling water to the property? \*Location of stop tap (if known) \*Do you share a water supply with your neighbour?”*

**Location:** end of the document - backgrounded

\*Discourse of ease, convenience and straightforward application process present throughout the document, followed by an application form asking technical questions

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**Table 6.1.c.** Key themes resulting from the discourse analysis of metering promotional materials (source: Bristol Energy, 2016)

Quote	Key Observations
<b>Bristol Energy (2016) Your smart meter and in-home display guide</b>	
<p><i>"We believe being smarter with energy is important for customers and our environment. If everyone used less energy, then we would all have lower energy bills (...), so everyone would reduce their carbon footprint. We believe in giving everyone access to fair, transparent tariffs and great customer service."</i></p>	<p><b>Location:</b> first page – foregrounded  <b>Tone:</b> Persuasive            *Discourse of environment, savings, fairness</p>
<p><i>"It's important to note that just by having a smart meter and in-home display, you're not automatically going to use less energy and start spending less money, but these devices put the power in your hands. Using in-home display will give you a greater understanding of what you're spending, identifying when you use the most energy and highlighting in near real-time they way you use energy in your home"</i></p>	<p><b>Location:</b> second page – foregrounded  <b>Tone:</b> Explanatory and promotional            *Discourse of control, energy consumption awareness            *Transparent and honest about bills reduction</p>

**Table 6.1.d.** Key themes resulting from the discourse analysis of metering promotional materials (source: Smart Energy GB, 2017)

Quote	Key Observations
<p><b>Smart Energy GB (2017) Smart meters- the simple way to control your energy use <a href="https://www.smartenergygb.org/en">https://www.smartenergygb.org/en</a></b></p> <p>“*see exactly how much energy you use, in pounds and pence; *get accurate bills instead of estimates; *say goodbye to manual meter readings”</p>	<p><b>Location:</b> landing page, foregrounded  <b>Tone:</b> promotional  *Discourse of control, accuracy and convenience</p>
<p>“This means the end of estimated bills. No more having to read the meter or trying to work out your bill. No more strangers coming into your home for meter readings. Once you have a smart meter, you'll only get accurate bills from your energy supplier, just like your phone bill.”</p>	<p><b>Location:</b> landing page, foregrounded  <b>Tone:</b> promotional  *Discourse of ease, accuracy, privacy,  *An analogy to an already common procedure</p>
<p>“The European Union asked all member governments to look at smart meters as part of measures to upgrade our energy supply and tackle climate change. After an initial study, the British government decided to adopt smart meters as part of their plan to update our ageing energy system.” They'll give you more control over your energy use, help you understand your bills and allow you to see what the energy you use is costing you.”</p>	<p><b>Location:</b> Not on a landing page, backgrounded  <b>Tone:</b> informational and promotional  *Discourse of climate change action and upgrade of technology</p>
<p>“By 2020, every home in Great Britain will be able to use smart meter technology to see exactly how much energy they're using, and what it's costing in pounds and pence. In addition to these immediate benefits, the rollout also lays the foundation for Great Britain's move to a lower carbon economy and a secure energy supply. So, we'll be able to work out where we can save energy, cut our bills and do our bit for the environment.”</p>	<p><b>Location:</b> not on a landing page – backgrounded  <b>Tone:</b> informational, promotional  *Discourse of technology upgrade, cost-saving and climate change action</p>

## 6.2. Exploratory focus group

Following desk-based discourse analysis, the researcher facilitated an exploratory focus group with energy and water professionals, held in Bristol in July 2017. During the event, participants discussed the aims, the potential and challenges related to water and energy metering. This stage of the research was analysed using thematic and discourse analysis. The results of the thematic analysis are presented in Chapters 6.2.2-6.2.4.

### 6.2.1. Water-Energy Nexus as cross-sectoral learning

The first half of the event involved a descriptive element where participants had a chance to learn about each other. They briefly introduced current debates, policies and technologies present across water and energy sectors. This chapter compares participants' views on the present and predicted state of metering. Consequently, it provides an account of Water-Energy Nexus understood here as cross-sectoral learning.

The role and popularity of metering differ depending on the sector, country or even region. Table 6.2 (overleaf) summarizes the main characteristics of water and energy metering in the Bristol region in 2017 and as predicted for the future by the focus group participants.

**Table 6.2.** The present and the future of water and energy meters – as predicted by the participants

	<b>“Dumb” Water meters currently</b>	<b>“Smart” Water meters by 2030</b>	<b>“Dumb” Energy meters currently</b>	<b>“Smart” Energy meters by 2030</b>
<b>Technology</b>	Manual reading every few months	Automated Meter Reading: Data collected automatically by passing vehicles  OR  Automated Meter Infrastructure: 2-way digital communication, half-hourly metering with in-home-display	Analogue, monthly manual reading	Digital Two-way communication between the grid and customers; user-friendly in-home display (IHD)
<b>How widespread</b>	Less than 50% of households	Compulsory - universal metering	Compulsory	Have to be <i>offered</i> to everyone by 2020; widespread by 2030
<b>Functionality</b>	Pricing reflects consumption for households who own a meter; unmetered households are on a different tariff	Pricing accurately reflects consumption for everyone, data on leaks	Helps to estimate energy consumption	Helps to manage peak demand, store energy at the street level and determine fair tariffs

	<b>“Dumb” Water meters</b> <b>currently</b>	<b>“Smart” Water meters by</b> <b>2030</b>	<b>“Dumb” Energy meters</b> <b>currently</b>	<b>“Smart” Energy meters by</b> <b>2030</b>
<b>Sector governance</b>	Regional monopoly	Partial competition	Competition	Street level co-operation between providers, community energy, remunicipalisation

Currently, analogue energy meters are widespread. Usually, a customer or an energy company employee collects readings from the devices, e.g. once a month, in order to estimate the bill amount. However, the UK government aims to offer smart meters to every household by 2020 with an ambition for the technology to be fully adopted within the next decade. The energy companies competing in a fully privatised market are responsible for the delivery at the household level. Smart meter technology allows monitoring in-time energy consumption translated into user-friendly units on the in-house display (IHD). The information on energy consumption, grid demand, current tariff etc. is processed wirelessly and can be mutually communicated between the customer and the grid. In words of a Participant 3, who works for an energy company: “*The fundamental thing that smart meters do differently there's 2-way communication between the meter and energy supplier.*” (FG2\_Po3). The main purpose of smart meters is to increase awareness of energy consumption and help with household management, and this is how the technology is promoted. However, the installation of smart meters could also provide a step change towards a fully operational “smart grid”. For example, it could help with the efficient management of peak demand, energy storage at the neighbourhood level or even determining smart tariffs (e.g. time-of-use, block pricing). However, in order to achieve full functionality, a level of local co-operation between householders and energy companies is needed. For this reason, participants agreed that a different organisational structure can be anticipated; e.g. community energy, remunicipalisation, co-operation within the private sector. Participant 6, who works for the community energy network foresees future functionality as follows:

*“We thought about how communities could share the energy between each other so if you're in your house and your neighbours are out, you could use their solar energy. And where smart meters come into that – half-hourly metering enables you the opportunity to buy the energy as it is generated and offset that generation. The model means that you have less demand on the [national grid] infrastructure. Basically, using a smart meter as a tool, rather than just accepting it as a thing that informs the customer about what they're using in their home...”* (FG2\_Po6)

In contrast, water meters are not compulsory in the UK, except for the “water-stressed areas” (currently south-east England) and properties with large gardens. In other cases, an opt-in policy is implemented. Participant 4, who works for water utility company speculates: “*So we have a policy, people can opt-in to have a meter (...) but what we could have is universal metering policy*” (FG2\_Po4). At present, residents with water meters can check them manually, which then helps to estimate the bill

based on water consumption. Unmetered customers (over 50% of households) are charged for water services based on the so-called rateable value, which is a proxy for the value of the house as calculated between 1973 and 1990 (Ofwat, 2017). Focus group participants anticipated that within the next decade water metering will undergo both technological and organisational upgrade. Despite the lack of the compulsory metering policy, water services providers commonly express interest in universal metering in the long term, FG2\_Po4:

*"It could give you more control over your water use, you've got that ability to see what you're using...For [water] companies it's better to reduce the amount of leakage, for example, make sure there is water available, we have resilient reliable water supply."*

From the technological point of view, water companies can upgrade meters to Automated Meter Readings (AMR) or Advanced Metering Infrastructure (AMI). During the discussion, Participant 4 explained the difference between these technologies:

*FG2\_Po4: AMR tend to be the drive-by meters, you don't need somebody to physically go and read the meter. You could, for example, put sensors on things like bin wagons, they drive up and down the street every week, they collect the data for you, then that data gets downloaded. Or you got for the AMI - complete smart meter, which you link back, complete and real-time data. So, AMI - really expensive. AMR - going down in price. Relative pricing of AMR against "dumb" meters for the benefits you get in the data that you get from AMR I think is...*

*FG2\_Po5: ...worth going for AMR*

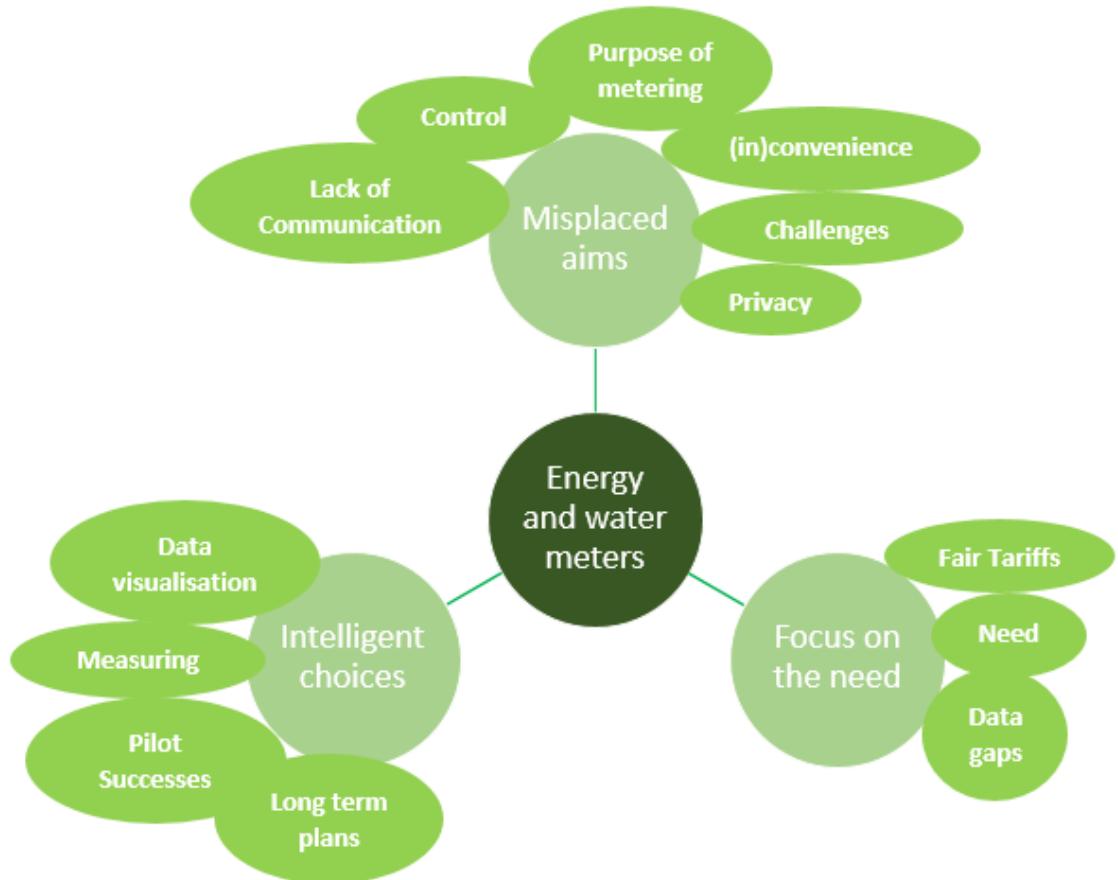
*FG2\_Po4: definitely.*

AMR might use a level of automation, but cannot be considered fully "smart", as it does not come with IHD and cannot communicate 2-ways with water appliances (e.g. showers, dishwashers). They can detect abnormal usage, e.g. pipe leaks but the data quality is not sufficient for a fine-grained analysis of water consumption at the household level. AMI, in turn, is an equivalent of smart energy meters as it records information in real-time and connects the data to IHD. However, it comes at a much higher price than AMR.

Chapters 6.2.2-6.2.4 will present the key findings from the exploratory focus group. Following an introductory part on learning across the WEF Nexus, participants discussed the language around energy and water meters and whether they could become a tool for sustainability or/and social equality. The results are organised into three themes: 1) Misplaced aims; 2) Intelligent choices; 3) Focus on the needs.

### 6.2.2. Theme 1: Misplaced aims

Figure 6.2 below illustrates how the process of thematic analysis helped to find patterns in the discussion and group commonly occurring codes.



**Figure 6.2.** Themes and codes resulting from the analysis of the exploratory focus group.

Thematic analysis of the exploratory focus group was contrasted against the results of Stage 1. In the first phase of the research, discourse analysis of metering marketing materials revealed that smart meters are commonly promoted under the discourses of convenience and control (Chapter 6.1). Yet, focus groups participants reported that the customers frequently perceive the installation process as an inconvenience or even a potential barrier to the uptake. Participants, all with professional expertise in metering, recalled their own experiences as utilities customers, e.g.:

*FG2\_Po5 (Water researcher): “Does it mean that I am going to be harassed by my energy supplier? [Laughter]”*

*FG2\_Po4 (Water professional): “My energy company contacted me, and their letter was ‘we need to turn every*

*'appliance off in your house' - but I don't want to. I had an argument with that woman for 15 minutes, because I just don't want one...as a consumer, I have that choice"*

Similarly, the discourse of control over energy and water use stands in contradiction with the perceived loss of control over privacy and data. According to Participant 5, who researches water consumption, this could be a serious consideration for some customers: *"With water 2/3 of water consumption is done in privacy and in a bathroom and maybe you don't want people to know what your bathroom habits are"* (FG2\_P05).

Participants admitted that the promotional strategies are yet to address the above issues. The customers haven't received convincing arguments, for which they would be willing to give up their data privacy and temporal convenience:

*FG2\_P03: I think the energy industry as a whole hasn't really made a good enough offer to people...A really good offer, a really good service, as long as they give away a certain amount of their data privacy around their energy consumption. That's the exchange that people can understand, can opt into...*

*FG2\_P04: The "what's in it for me?" question.*

### 6.2.3. Theme 2: intelligent choices

The purpose of metering, as explained by the participants, turns out to differ significantly from the justification provided in the promotional materials. Participants agreed that "smartness" is about enabling "intelligent choices" – both for the customers and the industry. For example, Participant 1 who researches smart energy, referred to the idea of "intelligent choices": *"I'm just going to get a highlighter pen and put "intelligent choices", I'd highlight that bit, because I think that unless you're using it to inform decision making then it's not smart, then it's just measuring stuff..."* (FG2\_P01). In fact, the "convenience" and "savings" arguments present in the promotional materials have been explicitly categorised as "not smart per se". One of the participants working for an energy company argued: *"That's a lot around convenience, which I think it's great and it drives efficiency and drives cost, it's not, it's not 'smart' per se"* (FG2\_P03).

The water sector participants focused on the potential for the improved, intelligent choices at the organisational level, *"We can spend millions of pounds replacing pipes but if we have no idea where the water is going... the data is far more important to make those informed decisions"* (FG2\_P04). In turn, the energy sector participants

emphasized the potential to make “smart decisions” at the street or neighbourhood level:

*FG2\_Po3: What you could potentially do on a street level is a demand-side response. So, if there are particular times of the day, where there is a particularly high demand on the grid, you could aggregate the energy from a collection of houses and decrease the consumption based on turning on and off appliances. And if you can pull that into a street or a neighbourhood, suddenly you have an economic value to that, excess energy that you can then sell back to the grid”.*

Participants reported on a range of successful pilot energy projects, which enabled them to test the potential for “intelligent choices” in metering. The highlighted lessons learnt from the past projects were:

- The importance of data-visualisation.
- The need for the re-design of energy tariffs to e.g. block pricing or time-of-use tariff.

#### 6.2.4. Theme 3: Focus on the needs

The original purpose of metering technology was to facilitate energy and water efficiency, and therefore, the sustainable management of environmental resources. However, the sustainability dimension of metering was backgrounded from the discussion in favour of its social aspect. Participants, even when prompted about the meaning of “sustainability”, explicitly stated: “*I would probably add “social”: once you look at sustainability, you should be looking at in both environmental and social terms... so I think that immediately takes you to equality and the issues around equity...*” (*FG2\_Po1*). There are numerous ways to conceptualise the “social” side of meters, with terms like social justice, equality, inclusion, vulnerability, class used interchangeably. The discussion, however, would always eventually refer to defining, measuring and providing for “the basic level of need” as the following examples illustrate:

*FG2\_Po2: Is there a significant difference between how much you can save by behavioural change...by energy use and water use? Because water is sort of fundamental, you **need** to drink, you need to cook, occasionally need to bathe...*

*FG2\_Po1: Just to tie it back to sustainability issues, one of the possible benefits of metering is, you can then say, "here is the **social amount** that someone would **need** for the social use level that we think we would price it to the lower level," so you'd have that block pricing, and then you'd charge extra.*

*FG2\_Po4: It's only been the most recent price review that we've introduced social tariffs to benefit those in **lower socio-economic classes**...So people are able to make sure their bills are capped, but we're not at the point yet that we've got enough data to be able to charge people extra for the more water that they use, and we would have to move to 100 per cent metering in order to be able to do that.*

Framing metering as a technology helping to define, measure and provide for the basic level of need led to a discussion about tariffs and universal metering. Participants agreed that if metering is promoted as a “fair” measure, then universal metering is necessary to acquire data which would determine a fair tariff for everyone. A fair tariff would include the notion of affordable water and energy to cover for the basic level of need. Finally, participants acknowledged that a time-of-use tariff is a likely way to manage peak demand on the grid, although it comes with limitations in terms of its fairness.

It is not yet clear how metering would facilitate intelligent and equitable decision making at the individual level. Currently, meters focus on lowering resource consumption under the assumption that being aware of the energy and water consumed will drive further resource-efficient behaviours and encourage purchasing smart appliances. Still, there is a missing link between metering and tackling fuel/water poverty. Evaluating the success of metering by tracking changes in fuel/water poverty and the rates of engagement across various socio-economic groups could provide relevant insights. Participants agreed that the data gathered with metering ought to be used for conceptualising the notion of “need”.

*FG2\_Po1: “It’s about measuring the right things. So, I think it’s driven from needs, intelligent choices backwards into what they measure rather than ‘we can measure this, therefore drive behaviour according to what you can measure’.*

*FG2\_Po6: I think there is still a question about how we work with people who have not been in the education system, don't have access to the internet, the elderly, and how we reach those groups, because actually quite often they are those with windows, leaks, things needing to be sorted out.  
FG2\_Po1: I think that's why... there's that focus towards warm homes rather than energy use for some people.*

In the water sector, considering the introduction of the universal water metering calls for a debate on the relationship between the people and water. As one of the participants stated, “water is sort of fundamental, you need to drink” (FG2\_Po2). Access to clean water and sanitation is recognised as a human right by the United

Nations (United Nations, 2010). Re-designing the tariffs using the data obtained from metering provides an opportunity to introduce a fair, transparent and data-supported policy, which would recognise the argument of “human right” as well as “scarce resource”. However, before metering could become a “fair” reflection of water tariffs, the industry ought to collect baseline data, determine the “essential” amount of water, and deal with leaks. One of the water sector participants admitted: *“I’d quite happily meter everybody with intelligent meters and not charge people against the meter, it’s so just we have the data.”* (FG2\_P04).

#### 6.2.5. How results feed into the next stage

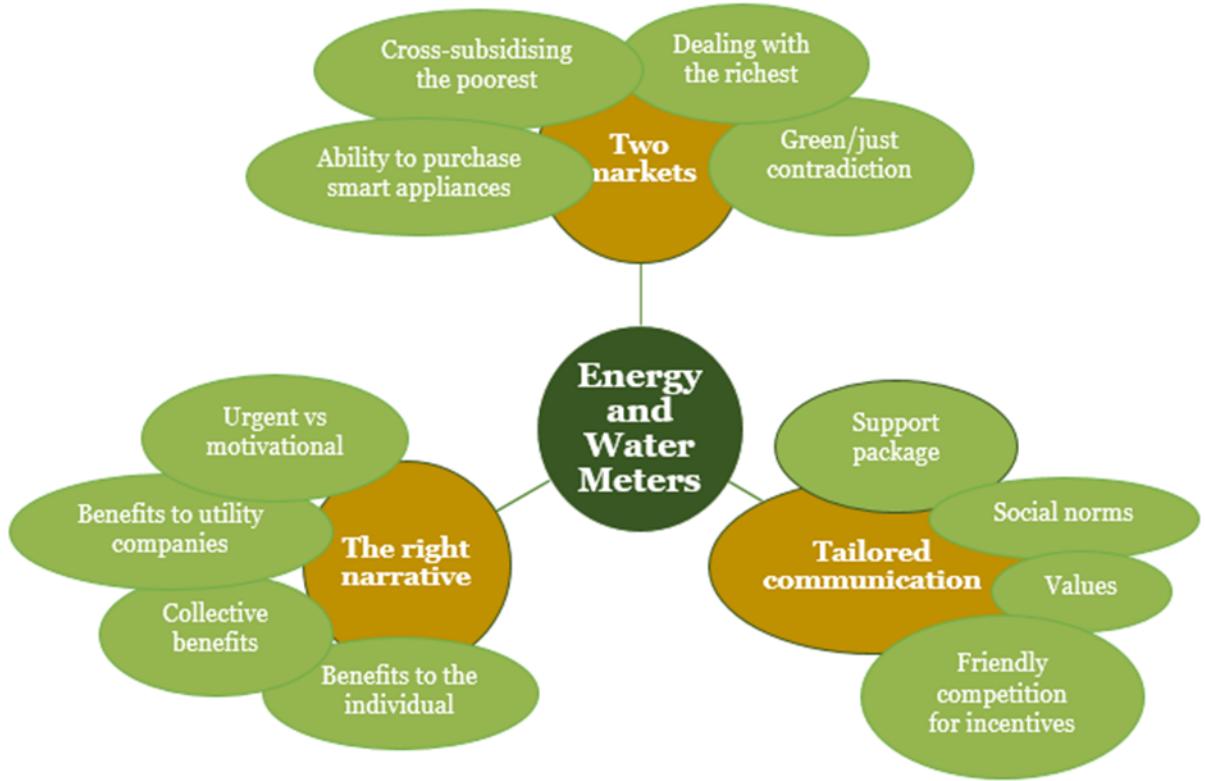
The analysis of the research data concluded with the following suggestions for action, which were implemented in Stage 3 of the research:

- Transparent and honest public engagement materials, which would refer to the full functionality of metering as well as a notion of a fair tariff;
- Policy design, which would reflect the ambitions of the sectors to be fair and low carbon.

In addition, participants emphasized the need to discuss water and energy tariffs as well as improve the data visualisation. However, the researcher decided that these suggestions are outside of the scope of the PhD. Firstly, resource economics is not an area of expertise of the researcher. Second, the access to the local data gathered by the meters was limited, therefore so was the potential for the effective data visualisation. In contrast, both policy and public engagement documents were readily available and familiar both to the participants of the targeted focus group and the researcher herself.

### 6.3. Policy co-design: targeted focus group

During the targeted focus group, participants critiqued the existing strategies for promoting metering. Drawing from the local expertise, they provided recommendations for designing smarter local policies and communicating the metering implementation plans. Three key themes resulting from the analysis are the following: 1) Two markets; 2) Tailored communication 3) The right narrative. Figure 6.3 illustrates how the process of thematic analysis helped to find patterns in the discussion and group commonly occurring codes.



**Figure 6.3.** Diagram of main themes and nodes occurring during the targeted focus group on metering (communication and policymaking)

### 6.3.1. Theme 1: Two markets

The literature on metering suggests that the technology was originally designed to facilitate energy and water efficiency, and therefore, sustainable management of environmental resources (Chapter 2.3). However, throughout the discussion, participants emphasised that in practice, the agenda of sustainable environmental management is yet to incorporate the values of “fairness” (i.e. synonyms of “fairness” were recorded 36 times during the targeted focus group). Furthermore, there are potential complications as these agenda serve two different types of customers and need two complementing policy approaches. Participant working for an energy company suggested: “*One of the ways to look at it, that there are two markets, there's early adopter market and what we call vulnerable households in the industry*” (FG3\_Po2).

Metering alone does not tackle fuel and water poverty. Yet, reducing resource consumption among affluent residents is essential for meeting climate mitigation targets. Participants brought attention to this paradox and suggested explicit

differentiation and subsidisation between these two markets while designing policies and public engagement.

*"I think finding the way to reach out and engage...to be blunt, to engage rich people... and I am probably in that category myself. I don't struggle to pay my water bill if it went up, I still wouldn't struggle" (FG3\_Po1, Water Company)*

*"The contradiction is – we actually need the early adopters, we need the people who don't need to worry about the bills, otherwise we won't have the technology available for the lower retail cost in place. Then the early adopters can cross-subsidise a charitable project that will sort out the mess of fuel poverty and water poverty." (FG3\_Po5, civil service)*

Participants' deliberations demonstrate their awareness of the contradiction between climate mitigation and climate justice goals. At the same time, they point out that the official metering implementation strategies lack consideration for the aforementioned "two markets".

### 6.3.2. Theme 2: Tailored communication

The discussions on the purpose and the potential of metering concluded with recommendations for communication materials. Given the observation that there are (at least) two markets of consumers affected differently by metering, future communications could reflect their needs, values and priorities:

*FG3\_Po1 (water company): "I am motivated to save water because of my personal commitment, that's not normally the case for people who can easily afford something. So, I am interested in how you can engage with people on perhaps values-based basis.*

*FG3\_Po4 (community energy network): I'd say that's exactly the same problem with energy when we've done the studies where there are the wealthiest communities that are spending the most on their energy bills, but they're not caring about it."*

Since the participants agreed that metering devices alone would not reduce resource consumption, they suggested that public engagement should come in a "support package" form, together with tailored advice on smart appliances and appropriate building level schemes tackling draft and leaks at vulnerable households. Current promotional materials rely too heavily on the assumption that being able to see the energy and water use will lead to behavioural change and reduction in bills. One of the participants pointed to the potential risk of smart meters discouraging people

from learning about their consumption, as the process of meter reading might induce too much stress if the residents already live in poverty:

*"You can make things visible to people, but if you just make more problems visible to them, you're adding stress so you're making their lives worse. If you offer support, like you both suggested [pointing at other discussants], it goes alongside that awareness raising. Smart metering needs to have that support package explaining how you can be a part of it and how you could benefit" (FG3\_Po4)*

### 6.3.3. Theme 3: The right narrative

Finally, participants collectively critiqued the framings present in the current marketing materials and agreed that the main priority is to create a compelling and motivational narrative, which refers to both individual and collective benefits (i.e. to the planet, society and utility providers) of smart technologies:

*"Starting with a person and then through the narrative coming to the community, I think that's when the marketing drive needs to be a bit personalised to the individual, but then stepping up...so the context and the country and then the planet. We need to do this together and I think there's not enough 'we', there's a lot of 'I' in this [the current marketing materials]". (FG3\_Po4)*

*"I totally agree with you that at that collective level where the benefit is greater but if you're trying to enact behavioural change in people, saying 'metering will make our planet less crap in years' time' is an important part of the message but it can't be the only message" (FG3\_Po2)*

Participants noticed that the current marketing documents do not convey a sense of climate change urgency. One explanation is that “urgency” framing could be damaging to the public perception of utility organisations.

*FG3\_Po4: "I think they almost don't state the problem at the end of the day these aren't really saying: 'we have a massive problem with our energy system, with our water system. We need to sort this out. We haven't got long to do this. We need to start addressing this".*

*FG3\_Po6: They don't want to scare and frighten people...cause they're in charge and that's just poor management if you not managing it properly"*

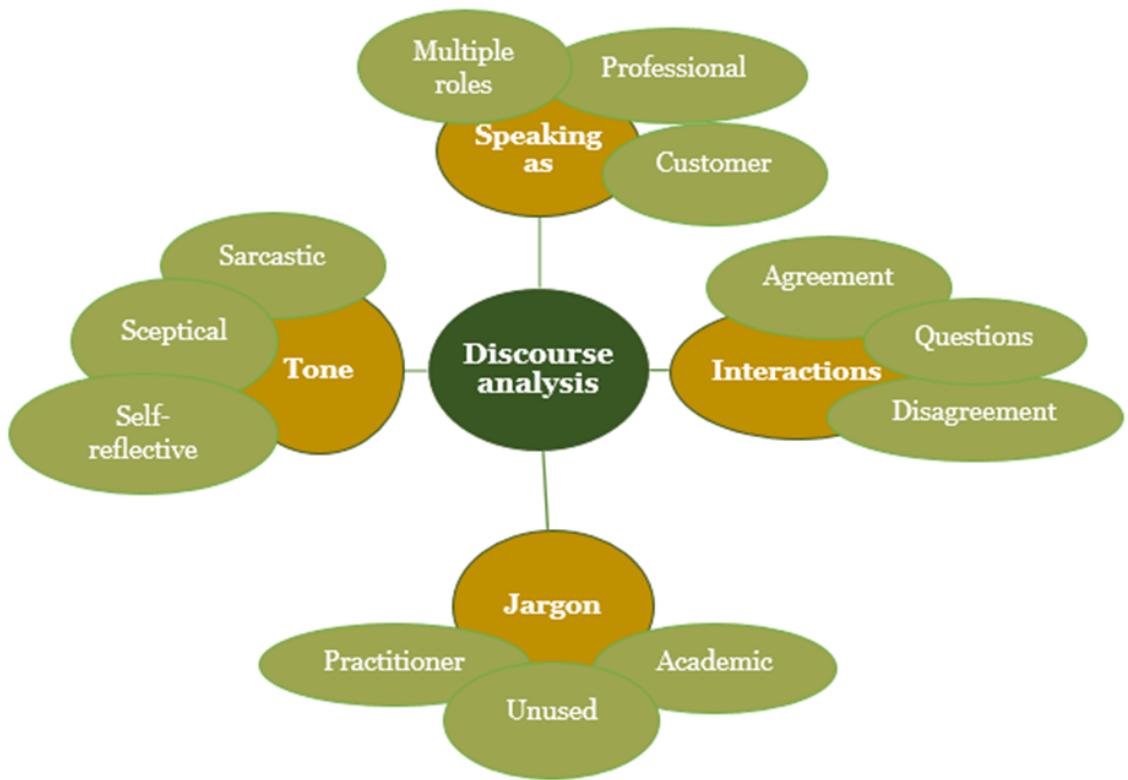
Metering is more likely to be an accepted and effective measure if it is understood as a social norm. Therefore, future communication materials could refer to examples of

communities and countries where meters were adopted successfully. Framing the present water and energy infrastructure as lagging behind in terms of pro-environmental efforts and technological advancements could enhance the transparency of the utility providers as it would demonstrate the motivations behind the deployment strategy.

*"What about saying: 'smart metering is more prevalent in Holland. And water metering is almost universally applied across the whole rest of the world. England is a weird one.' Not just talking about the local resilience and how nice it is to be good but actually almost saying 'you realise, we aren't that great' would be one way to frame this."* (FG3\_P01)

#### 6.4. Discourse analysis – summary of exploratory and targeted focus groups

After sorting and coding the transcripts data, the researcher investigated the language and interactions present during both exploratory and targeted focus groups. Thanks to discourse analysis, the researcher can derive pragmatic communication and policy recommendations as well as foresee likely disagreements and obstacles. Finally, a closer examination of the language bridges the academic and practitioners' understanding of the key environmental policy terms like "sustainability", "climate justice" or "smart cities". Figure 6.4 (overleaf) summarises key findings resulting from the discourse analysis of two focus groups.



**Figure 6.4.** Combined discourse analysis of two focus groups on metering

#### 6.4.1. Interactions between participants

The analysis of the transcript identified 32 instances of agreement (13 during the first, 19 during the second event). In particular, participants agreed that the energy and water sectors did not communicate the benefits of metering in a persuasive enough way:

FG2\_Po3: *"I just think the energy industry as a whole hasn't really made a good enough point yet, a good enough offer to people...A really good offer, a really good service, as long as they give away a certain amount of their data privacy around their energy consumption.*  
 FG2\_Po4: *The "what's in it for me?" question."*

FG3\_Po4: *I think the individual benefit is minor, but the collective benefit is huge... the messaging in all of these doesn't talk about the collective benefits at all...it talks about the 'government-led' initiative, but it doesn't say anything about 'we' as "we the people"*  
 FG3\_Po2: *Yeah, I think you're right...and I think one of these might be from our company"*

In turn, participants disagreed with each other 14 times (twice during the first, 12 during the second event). This might be justified by the fact that a significant proportion of the "exploratory" event involved a comparison of the policies and technologies available in water and energy sectors. Meanwhile, the second, targeted event focused on discussing recommendations for the future communication strategy and policy design. Participants mostly disagreed on how to embed climate justice principles in policies by deliberating:

- Is water metering a "fair" policy option for everyone?

*"But comparing between people who don't have a water meter, they pay on the rateable value of their house, and there is an element of affordability in that, the assumption that if you live in a smaller house, that is of a lower rateable value, that's what you could afford and therefore your water bills is moderated because of that" (FG3\_P06)*

- When introducing block tariffs, how should the "basic level of need" be determined and by whom?

*"My problem with block tariffs is... and actually I have quite a big problem with it... which is that it means that I get to decide what somebody else needs and why the hell should it be up to me?" (FG3\_P01)*

Participants asked each other questions 54 times (31 during the first, 23 during the second event), ranging from the explanation of the jargon (FG2\_P02: *"What's PCC? FG2\_P04: per... capita consumption?"*) to the big-picture enquiries (FG2\_P02: *"Is there a significant difference between how much you can save by behavioural change...by energy use and water use?"*). This, on one hand, indicates the potential for further Water-Energy Nexus learning. On the other, it suggests that the ways water and energy metering work is not well understood by the people outside of the utility companies. Some of the questions asked had a sarcastic undertone, which reflects the overall sceptical and critical atmosphere of both events:

*"FG3\_P02: In the 10-year roll out, we're now 3 years away and actually a lot of the infrastructure still isn't in place.*

*FG3\_P05: Isn't it standardised yet?*

*FG3\_P02: So, there are standardised meters out there, I think so far we've installed 40*

*FG3\_P05: Who do you mean by "you"?*

*FG3\_P02: Not by us, nationwide.*

*Everyone: [Laughter]*

*FG3\_P05: That's unbelievable"*

#### 6.4.2. Speaking as: customer vs professional

Participants exhibited a degree of critical self-reflection and awareness of the gaps and drawbacks in their own organisations. They admitted that utility companies are not typically trusted by consumers. They also reflected on the lack of data as an obstacle for introducing smarter policies. Finally, they agreed that decision-making in sectoral siloes prevents practitioners from recognising the systemic trade-offs and co-benefits present across the WEF Nexus policies.

*"I think that energy companies are not particularly trusted and in general our company has a higher trust rating than larger energy companies, but it's still an energy company, we all have to work against that public perception"* (FG2\_P03)

*"For us, in particular, I mean there's under 50 per cent of the network is metered, so over 50 per cent of our network, we have no idea how much water we're using apart from the district meters that we have. And it's very difficult to encourage customers to be efficient if you've got no benchmark for them."* (FG2\_P04)

*"I think the problem we have at the moment with all of the big structural things we're trying to deal with is that they're cross-cutting across departments. The energy department in the government is trying to deal with energy but it's not recognising that at the same time it's a health issue (...) That's the problem we're struggling with is we're actually trying to see things through a much-engineered focus and not seeing the bigger picture."* (FG3\_P04)

One way to acknowledge the systemic nature of environmental policies is to recognise the multiple roles of sustainability practitioners. They often work on a variety of projects across the sectors. Not only they are practitioners in the energy and water sectors, but they are also resource consumers themselves.

*"I am really here I think with my water hat on, so previously before working at the university, I always worked in the water industry."* (FG3\_P06)

*"One of the hats I am wearing is that I have been running workshops for several years around Bristol on home energy, including sort of heat power and water. (...) Also, I am a member of Bristol City Council and I used to be the local government sector energy advisor."* (FG3\_P05)

On multiple occasions, participants attempted to tap into an understanding of the customers' perceptions of metering. Past initiatives, which involved researching user experiences brought some illuminating insights:

*“We’re going through customer research at the moment, to understand the appetite our customers have for metering. The one I went in, everyone was in favour of reducing leakage further.”* (FG2\_P04)

*“For me, it’s about visualising and interpreting what the data is telling you. From a couple of the projects we’ve done in the past and we’ve seen that’s the most important component...”* (FG2\_P02)

Furthermore, at times, participants would slip into a customer’s point of view reminiscing on their own experiences:

*“I wouldn’t have a clue what was the use of water in my place”* (FG2\_P02 - Energy professional)

*“My own experience of In-home Displays is that we look at them for a couple of weeks and then forget about them. And actually, it’s not really a great incentive for anyone...really. It’s certainly not a great incentive for an average individual...in an average property.”* (FG3\_P02 – Energy Professional)

Spontaneous reflections of participants-as-customers highlighted the possible risks to the effective implementation of metering: lack of appropriate policy incentives and lack of bill literacy. This is echoed in Chapter 6.2.1, which argues the aims of the smart meters have been misplaced in the marketing strategy. The comparison between the discourse analysis of the secondary data and the investigation of the focus groups reveals a disparity between the promoted, the actual and the perceived functionality of metering. Although it shouldn’t replace formal resident consultation, encouraging professionals to think like the customers (especially if done across the sectors) during policy design could be a useful exercise and help to predict controversies and issues with public engagement.

#### 6.4.3. Academic language and language in practice

One of the conditions for success in the cross-sectoral research is understanding the language used in the conversations, writing and practice. Focus groups allowed to explore whether the practical understanding of "sustainability", "climate justice" and "smart cities" follows the agenda advanced by the academics. The events demonstrated that the local practitioners themselves are already sceptical and critical of the notion of “smart” cities, policies or appliances. Nevertheless, the reasons for apprehension vary from person to person. This indicates that there is no single widely accepted political solution to apply to the question of metering. Similarly, although participants reached a broad consensus on prioritising economic inequality, they actively disagreed on how to tackle this issue. Academic scholarship on climate justice and smart cities could provide practitioners with a degree of nuance and further

explore possible, desirable and unfavourable policy options and the WEF Nexus interactions.

Drawing from the literature review and focus groups, it can be concluded that the concept of the Water-Energy Nexus is not explicitly used across the water and energy sectors in Bristol. Both the researchers and the participants were only beginning to realise the presence of cross-cutting issues in the sector: FG2\_P05: “*Water needs to work with energy... so much water is hot water, so that's the linkage. And a lot of people don't make that connection*”. This might be due to the fact that water and energy industries have traditionally worked in siloes developing their own jargon, technologies, and organisational cultures (Bazilian *et al.*, 2011). Despite the relative infancy of the term in Bristol, the Water-Energy Nexus has implications for the communication strategy and cross-sectoral learning about price tariffs. For example, water efficiency messaging could become a part of the smart energy meters communication strategy in order to ensure a noticeable decrease in household bills.

#### 6.4.4. Feeding focus group results into the GIS decision-support tool

The analysis of both focus groups helped to define how smart technologies could be fair and contribute to the reductions of GHG emissions. In particular, the notion of two markets revealed that smart policies ought to differentiate between the types of customers and offer a variety of measures towards resource efficiency and alleviating poverty. These findings fall in line with one of the priorities for the research resulting from the exploratory focus group: co-designing policies reflecting the ambitions of the industry to be low carbon and fair.

Thanks to the ongoing collaboration with participants who were willing to provide further methodological consultation and the raw data on the local energy and water use, the researcher was able to build a decision-support tool in GIS, using Multicriteria Decision Making (MCDM). The tool assigned the LSOA level spatial datasets on resource consumption, internet literacy, fuel poverty, house prices, income deprivation to the notions of “high capability” and “high disadvantage” (see Table 4.9 in Chapter 4.3.5.2 for a detailed description of the datasets how they were conceptualised). Plotting the data against the local neighbourhoods (LSOAs) resulted in a series of maps, prompting which areas ought to receive policy priority during the co-design of smart city policies aimed at either maximising GHG emission reduction or minimising social inequalities.

## 6.5. Multicriteria decision-making (MCDM)

The following chapter presents the results of the MCDM exercise. The researcher employed the concepts of “high capability” and “high disadvantage” to reflect the findings from the targeted focus group (notably, theme 1: “two markets”, as discussed in Chapter 6.2.3). Consequently, MCDM asked, “which neighbourhoods should be prioritised to a) maximise the GHG emissions reduction potential **or** b) reduce socio-economic inequalities?”

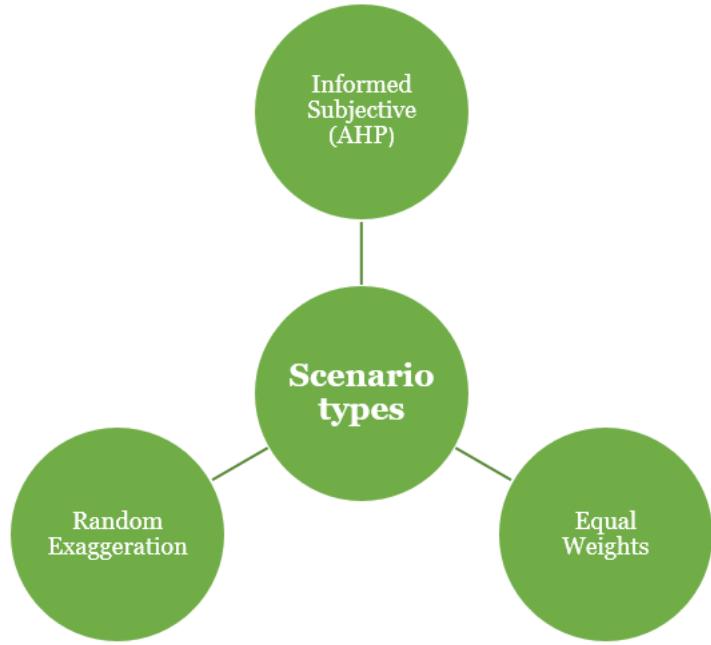
These research questions follow from the development of Sen’s (2003) “capabilities approach” and apply it to practical considerations about just climate mitigation policymaking (detailed explanation of climate justice theories can be found in Chapter 2.1). Table 6.3 demonstrates how “capability” and “disadvantage” were understood in the context of MCDM analysis.

**Table 6.3.** A conceptualisation of “highly capable” and “highly disadvantaged” areas applied to the MCDM analysis. Areas are considered “highly capable” or “highly disadvantaged” if they meet **all** of the criteria below

Highly Capable	Highly Disadvantaged
<ul style="list-style-type: none"><li>• financially capable</li><li>• socially capable: house owners</li><li>• socially capable: competent internet users</li><li>• high energy consuming</li></ul>	<ul style="list-style-type: none"><li>• financially deprived</li><li>• socially disadvantaged: renting (therefore usually excluded from energy policies like feed-in -tariffs)</li><li>• not displaying social barriers to technology adoption: competent internet users</li><li>• high energy consuming</li></ul>

MCDM technique here was utilised in GIS Software (ArcMap) in order to build a decision-support tool. The researcher grounded the model in the local context by processing the relevant LSOA-scale data and drawing from participants’ deliberations.

Nevertheless, weighting and scoring of data were undertaken solely by the researcher. In order to illustrate how subjective perception of relative importance (aka “weights”) of particular datasets influences the decision-support tool, the researcher ran three scenarios: 1) informed subjective; 2) equal weights; 3) random exaggeration (Figure 6.5). Chapter 4.3.5.3 detailed how these three scenarios were formed.



**Figure 6.5.** Three weighting techniques used to derive three policy prioritisation scenarios

To reiterate, the definitions of the scenarios are as follows:

- Informed subjective: the researcher used her expertise to assign weights and scores using the AHP website (<https://bpmsg.com/academic/ahp.php>). The researcher based her expertise on the literature review and the preliminary results of the focus group data (Table 6.4).

**Table 6.4.** “Informed subjective” scenario (8 criteria, the researcher went through the AHP exercise for weighting)

Financial (22%)	Social (28%)	Energy Consumption (50%)
Income Deprivation (12%)	Tenure (10%)	Electricity consumption (15%)
House price (10%)	Acorn categories (15%)	Fuel Poverty (5%)
	Internet Engagement (3%)	Gas consumption (30%)

- Equal weights: the researcher manually assigned an equal weighting to every criterion (12-13% weight for each of 8 criteria, as seen in Table 6.5).

**Table 6.5.** “Equal weights” scenario (8 criteria, each 12-13% weight)

Financial (25%)	Social (37%)	Energy Consumption (38%)
Income Deprivation (12%)	Tenure (12%)	Electricity consumption (13%)
House Price (13%)	Acorn categories (13%) Internet Engagement (12%)	Fuel Poverty (12%) Gas Consumption (13%)

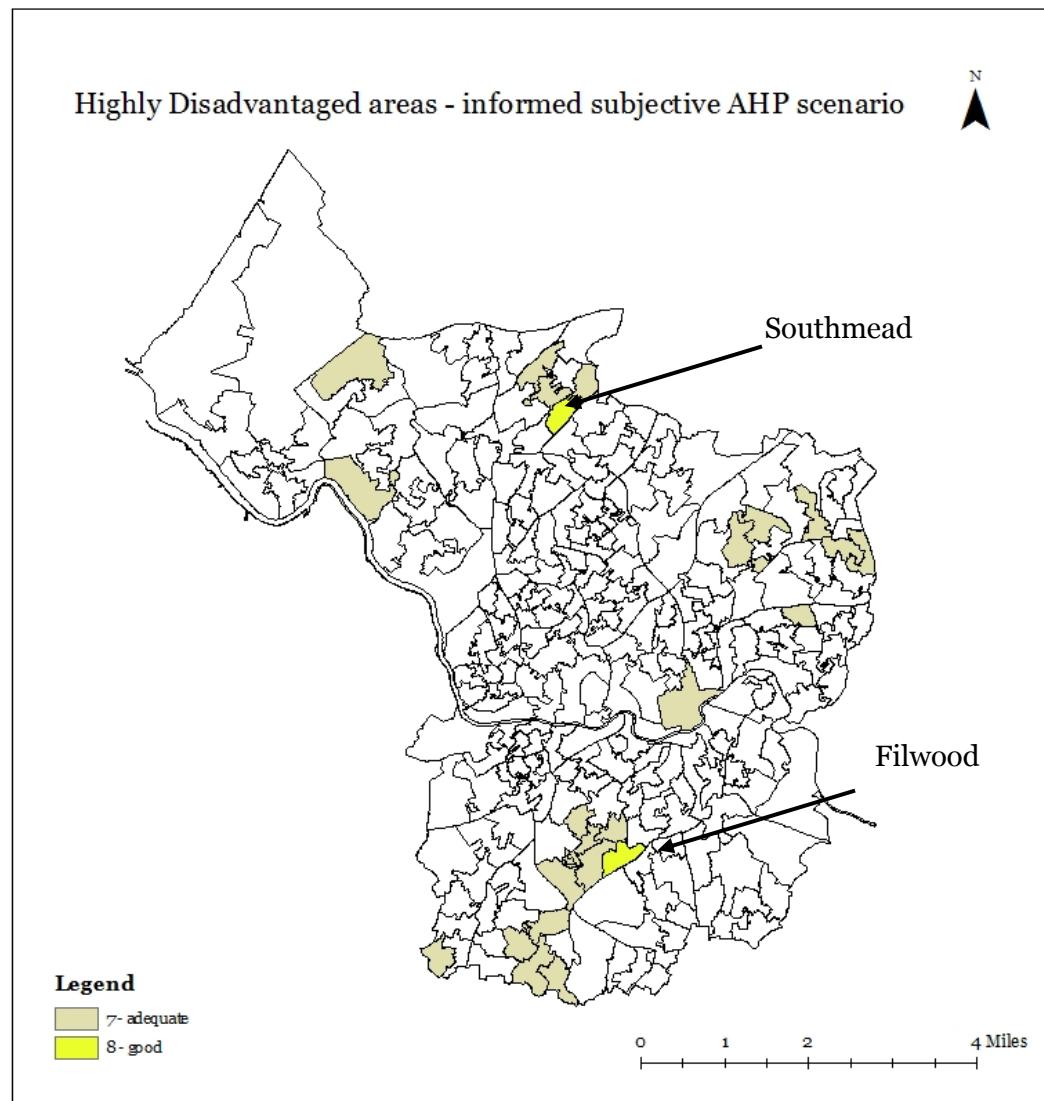
- Random exaggeration: the researcher manually exaggerated the weighting of “internet engagement” and “tenure” criteria (Table 6.6)

**Table 6.6.** “Random exaggeration” scenario (8 criteria, randomly prioritised internet engagement and tenure)

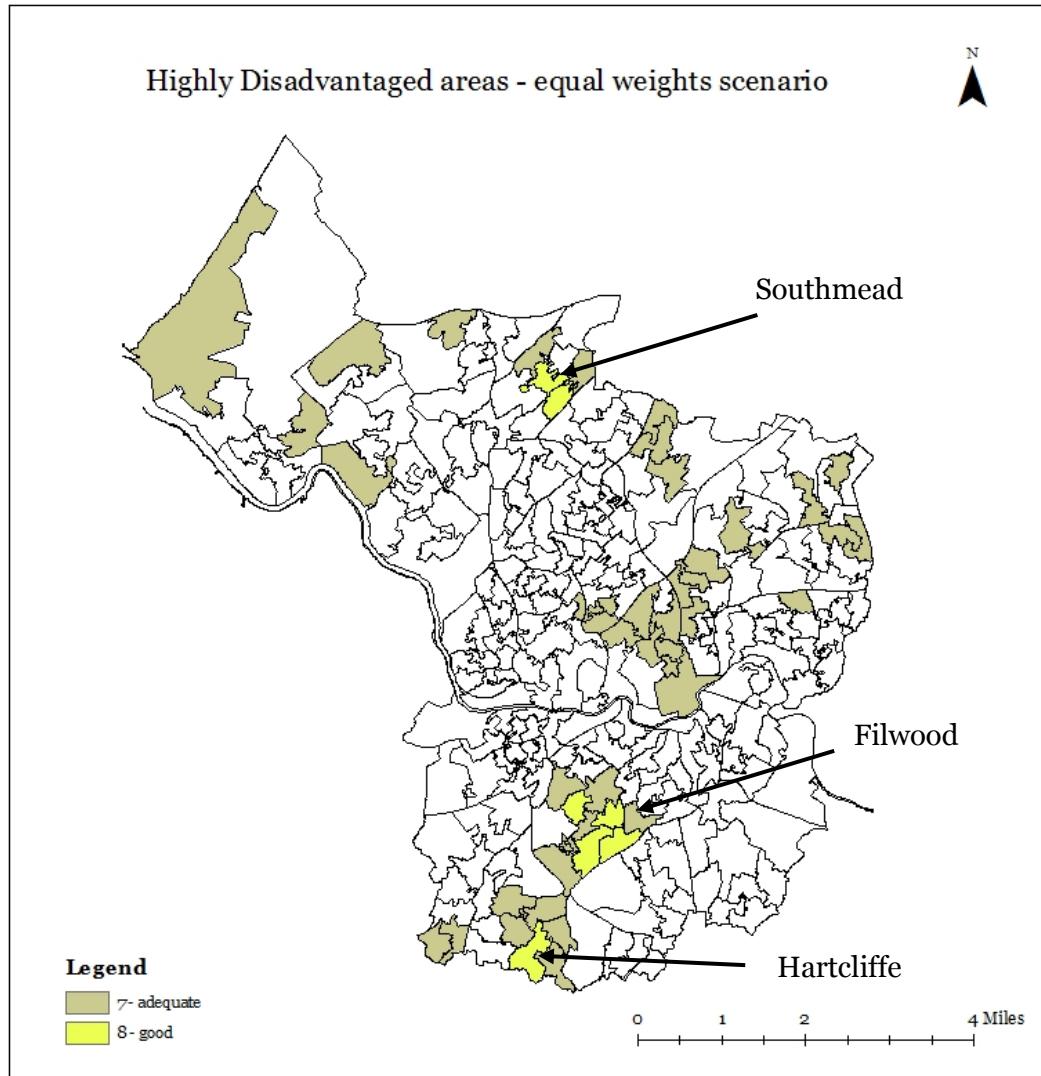
Financial (16%)	Social (60%)	Energy consumption (24%)
Income deprivation (8%)	Tenure (26%)	Electricity consumption (8%)
House price (8%)	Acorn categories (8%) Internet Engagement (26%)	Fuel Poverty (8%) Gas Consumption (8%)

### 6.5.1. Cartography: Highly Disadvantaged areas

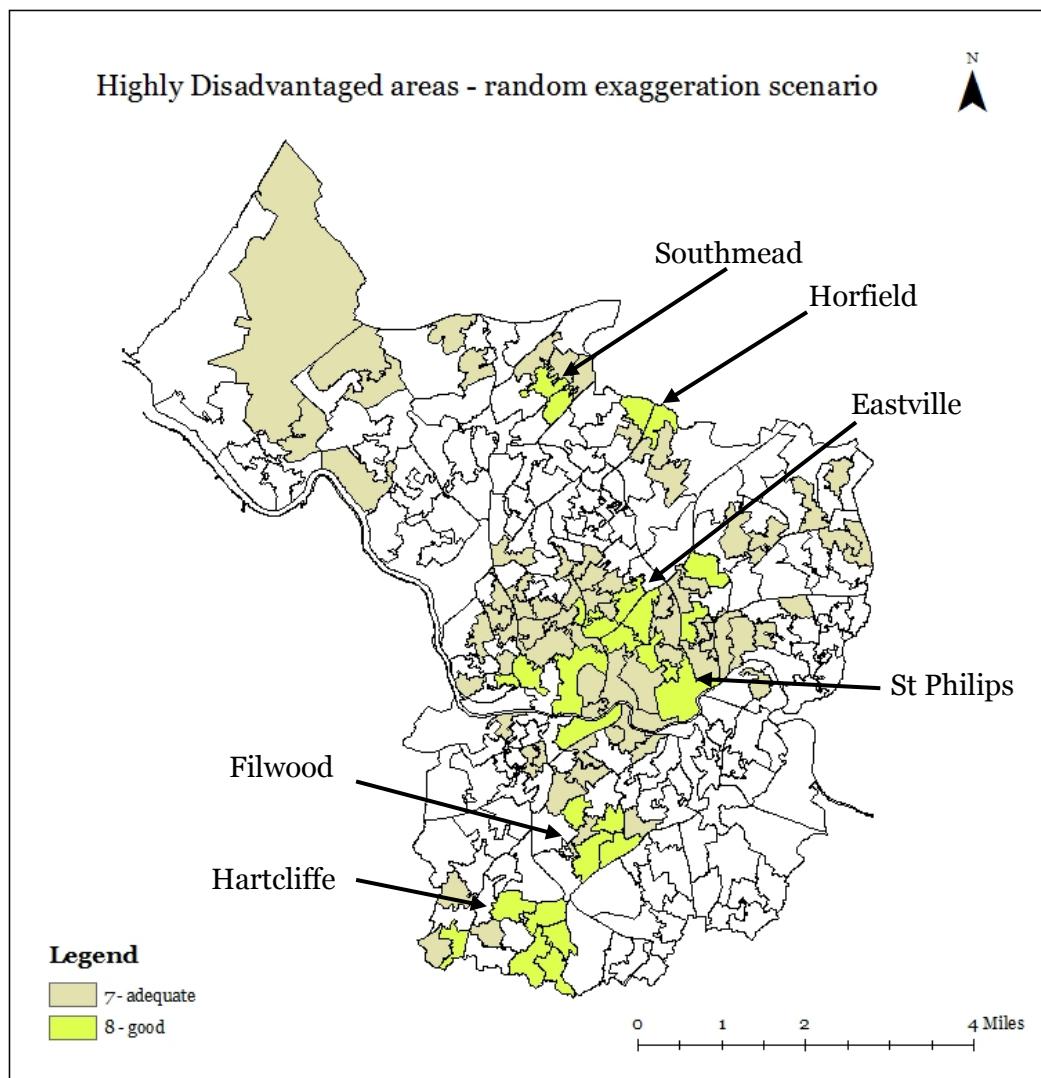
Figures 6.6, 6.7 and 6.8 (overleaf) present the results of the MCDM analysis for highly disadvantaged areas. Highly disadvantaged areas are likely inhabited by the residents who are both high energy consumers **and** don’t have high agency over energy consumption (e.g. due to low income, renting, as defined in Chapter 4.3.5.1). Therefore, the potential policy tools targeted at highly disadvantaged areas would aim to build capability of the residents rather than impose additional charges on energy consumption. This approach would enable equitable policy prioritisation in line with climate justice agenda. The following maps compare three scenarios:



**Figure 6.6.** The “Informed subjective” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “good” in terms of equitable policy prioritisation.



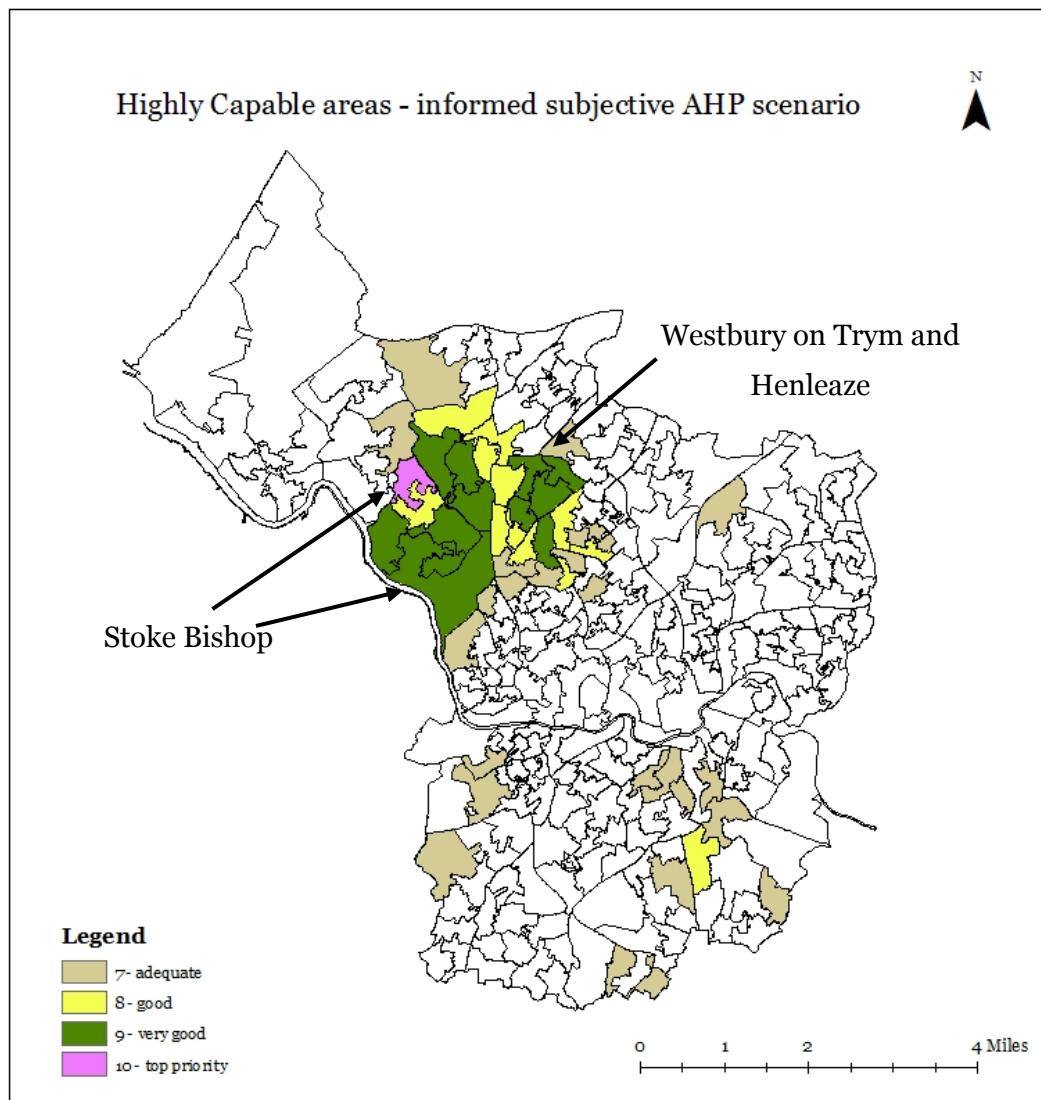
**Figure 6.7.** The “Equal weights” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “good” in terms of the equitable policy prioritisation.



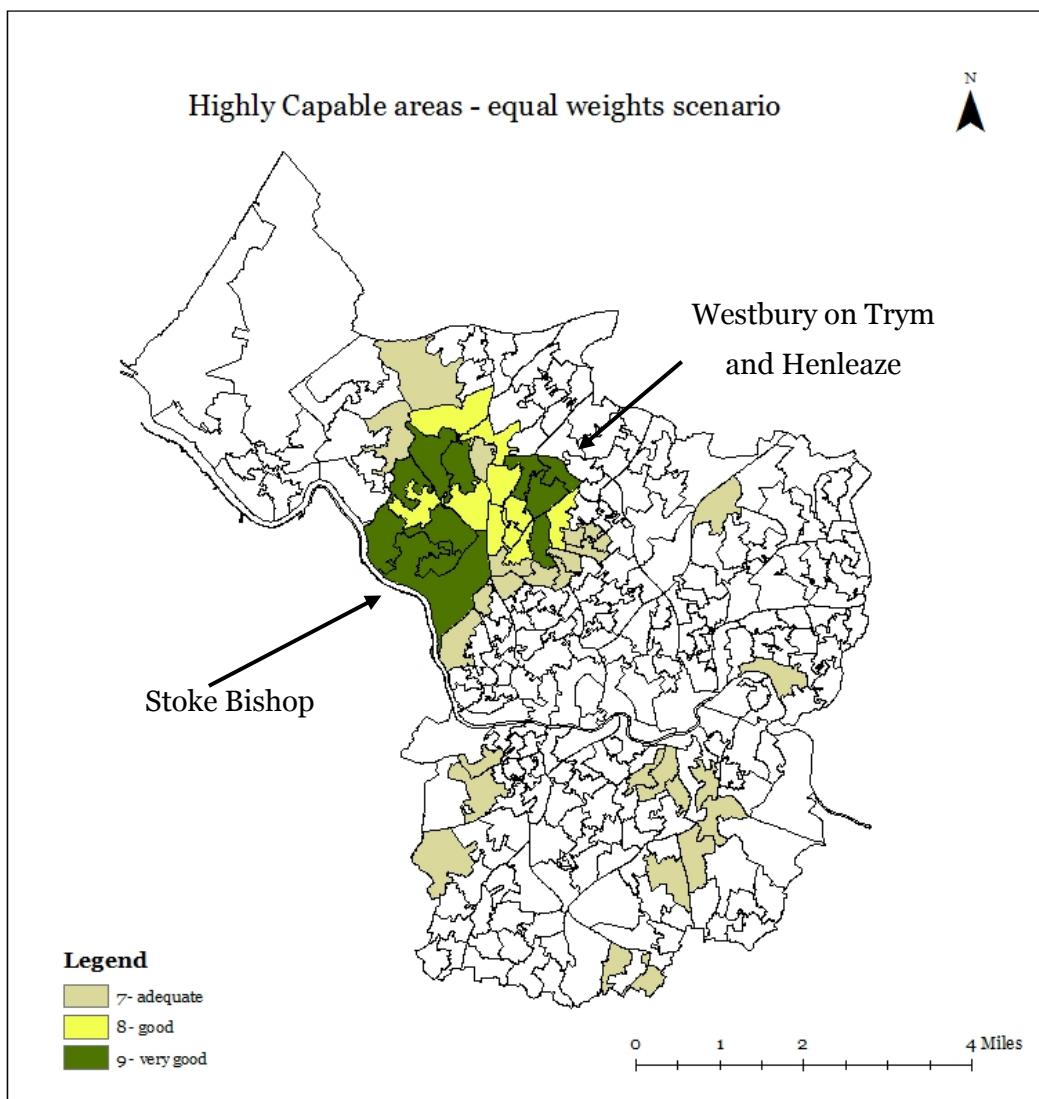
**Figure 6.8.** The “random exaggeration” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “good” in terms of the equitable policy prioritisation.

### 6.5.2. Cartography: Highly Capable areas

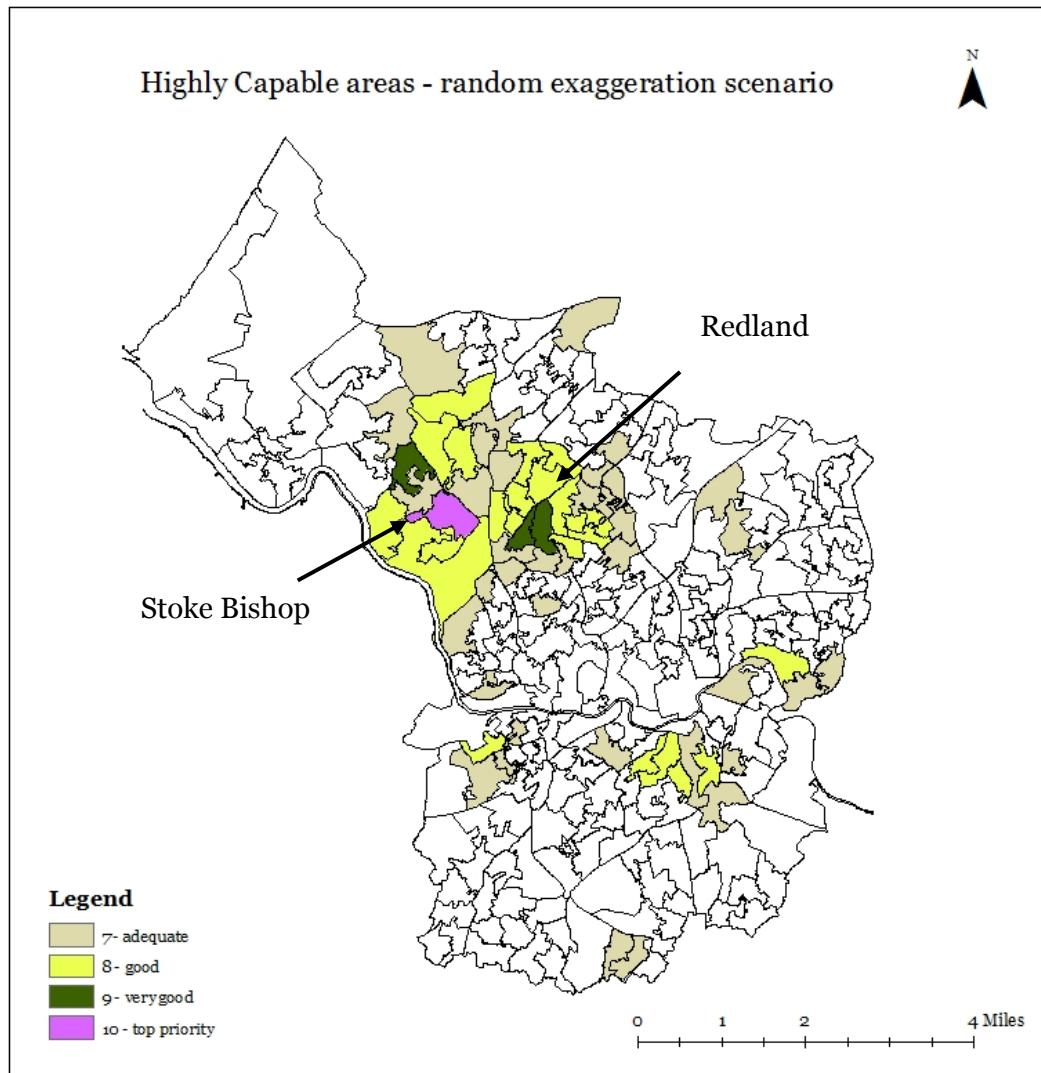
Figures 6.9, 6.10 and 6.11 (overleaf) present the results of the MCDM analysis of highly capable areas. Highly capable areas are likely inhabited by the residents who are both high energy consumers **and** have adequate agency to reduce their consumption (e.g. high earners, homeowners, as defined in Chapter 4.3.5.1. Therefore, the potential policy tools targeted at highly capable areas would aim to maximise GHG reduction by e.g. imposing additional charges on energy consumption. The following maps compare three scenarios:



**Figure 6.9.** The “Informed subjective” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “very good” or “top priority” in terms of maximising GHG emissions reduction.



**Figure 6.10.** The “Equal weights” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “very good” in terms of policy prioritisation maximising GHG emissions reduction.



**Figure 6.11.** The “Random exaggeration” scenario resulting from the MCDM analysis. Arrows point at wards quantified as “very good” or “top priority” in terms of maximising GHG emissions reduction.

### 6.5.3. Testing data sensitivity

Following the MCDM calculations, the researcher compared the highest scores produced as a result of each of the three possible scenarios. Tables 6.7 and 6.8 (overleaf) details how the top-scoring areas differ (or not) depending on the scenario applied. Here, the researcher compared her “Informed subjective” view against two other methods of weighting: a) equal weighting all of the criteria, b) random exaggeration of tenure and internet engagement criteria.

First of all, it is worth noting that 13 LSOAs received high scores (9/10 and 10/10) for “high capability” in the “Informed Subjective” scenario. Meanwhile, the highest possible score in “high disadvantage” calculation was 8/10 which occurred only in two LSOAs (with additional 22 LSOAs receiving 7/10 scores). This suggests that far more people are high energy consumers **and** are highly capable to reduce their GHG emissions, comparing to a number of people who are high energy consumers **and** are highly disadvantaged. This should be taken into account designing smart city policies aiming to reduce GHG emissions and/or improve climate justice.

Furthermore, contrasting the AHP scenario (“informed subjective”) against the alternative ways of calculating weights (“equal weights” and “random exaggeration” scenarios) allowed noticing any inconsistencies in analytic choices. The comparison between the top scores (9/10 and 10/10) in three “high capability” scenarios did not reveal any considerable differences (i.e. the maximum discrepancy in scoring was 2 points). In addition, Figures 6.9-6.11 in Chapter 6.5.2 illustrated the differences between scenarios on maps – indicating that the high priority area common to all three “high capability” scenarios was northwest of Bristol, in particular, Stoke Bishop and Westbury on Trym&Henleaze wards<sup>17</sup>. Finally, a number of scattered LSOAs were marked as “adequate” (7/10) according to the “Informed Subjective” scenario, e.g. Blaise, Coombe Dingle East, Stapleton, Bridgewater Road or Stockwood Lane South (as shown in Figure 6.9).

In terms of the “highly disadvantaged” areas, all three weighting methods indicated that Southmead and Filwood wards should receive top priority as they received at least 8/10 mark (Figures 6.6-6.8). Table 6.7 (overleaf) points out at specific LSOA in need of prioritisation: Trymside and Thogmorton Road.

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<sup>17</sup> Wards are electoral district at local level represented by at least one councillor. Each ward has an average electorate of app. 5 500 people (Office for National Statistics, 2019)

Data sensitivity analysis showed only minor inconsistencies between the three scenarios (Tables 6.7 and 6.8). Therefore, it demonstrates that undertaking AHP exercise to obtain an “informed subjective” scenario can be justified under the following conditions:

- Priority cut-off point is high.
- The number of criteria (datasets used) is low.
- The aim to prioritise very small geographical areas.

In this case, the researcher used 8 datasets to inform criteria, which decreased the importance of weighting. Similarly, she defined “priority” scores as min. 7/10 points (for highly disadvantaged areas) and 9/10 points (for highly capable areas). In order to fully benefit from the functionality of the AHP scenario creation, future researchers and practitioners are recommended to use fewer criteria (max 6) and defined their priority in a strict way (e.g. a min. 9/10 points). They could also perform the analysis using high-resolution data (e.g. postcode rather than LSOA scale) to improve geographical accuracy.

Thanks to the data sensitivity test, MCDM decision-support tool could encourage reflection on the city datasets in comparison to practitioners’ knowledge. In particular, future research projects with practitioners should ask:

- What policies could be implemented in “high capability” and “highly disadvantaged” areas?
- Who funds/subsidises proposed policies?
- Who is likely to benefit?
- Who can be enabled? / How to increase capability?
- Are policies voluntary, mandatory, market-based – and how does it inform likely uptake?

Going further, future researchers should take care to present MCDM as a deliberation method, not an algorithm-based replacement of a political decision.

**Table 6.7.** A comparison of priority scores assigned to “highly disadvantaged” LSOAs as a result of the three different weighting scenarios. Here “priority” as a minimum 7/10 score in “informed subjective” scenario.

Scenario \ Area	Trymside	Throgmorton Rd	Lawrence Weston East	Sea Mills South	Southmead North	Southmead Central	Fonthill	Upper Eastville
<b>Informed Subjective (AHP)</b>	8	8	7	7	7	7	7	7
<b>Equal weights</b>	8	8	7	7	7	8	7	7
<b>Random</b>	8	8	7	7	7	8	7	7
<b>Exaggeration</b>								
Scenario \ Area	Whitefield Fishpond	Fishponds	Hillfields North	East Hillfields	Whiteway	St Phillips	Glyn Vale	
<b>Informed Subjective (AHP)</b>	7	7	7	7	7	7	7	
<b>Equal weights</b>	7	7	7	7	7	7	8	
<b>Random exaggeration</b>	7	7	7	7	7	8	8	

Scenario\ Area	Leinster Avenue	Ilminster Avenue	Filwood Broadway	Inns Court	Fulford Rd North	Fair Furlong	Sherrin Way	Haredrive	Bishport Ave East
									West
<b>Informed Subjective (AHP)</b>	7	7	7	7	7	7	7	7	7
<b>Equal weights</b>	7	8	8	7	7	7	7	8	7
<b>Random exaggeration</b>	7	8	8	7	8	7	7	8	8

**Table 6.8.** A comparison of priority scores assigned to “high capability” LSOAs as a result of the three different weighting scenarios. Here “priority” as a minimum 9/10 score in “informed subjective” scenario.

Scenario \ Area	Stoke Bishop North	Old Sneyd Park	Sneyd Park and the Downs	Rockleaze	University Halls	Elmlea	Canford Park	Canford Lane	Henleaze South	Henleaze North
<b>Informed Subjective</b>	10	9	9	9	9	9	9	8	9	9
<b>Equal weights</b>	9	9	9	9	9	8	8	9	8	9
<b>Random Exaggeration</b>	9	8	8	8	10	7	8	8	8	8
Scenario \ Area	West Broadway	Golden Hill	Cranbrook Road							
<b>Informed Subjective</b>	9	9	9							
<b>Equal Weights</b>	9	9	9							
<b>Random Exaggeration</b>	8	8	9							

## 6.6. Chapter summary

This chapter presented the results from the primary and secondary research metring theme. Starting from the discourse analysis of the metering marketing materials in the UK, it highlighted a variety of framings used by the utility companies and the government agencies. The main discourses used in the marketing materials were “control”, “convenience” and “savings”. The chapter then reported on the current state of water and energy metering implementation programmes, as described by the local sustainability practitioners during a focus group in July 2017. The exploratory focus group highlighted the areas of recent progress, knowledge gaps as well as policy priorities. The discussion also revealed that practitioners’ perceptions of metering significantly differ from the way this technology is promoted.

Thanks to the participants’ contribution, the issues of communication strategy and equitable policy prioritisation were selected as themes for the policy co-design stage. As a result, a series of further meetings with the research stakeholders, a second, “targeted” focus group was held in March 2018. The event provided a critique of the current marketing materials and “smart city” policies. The “targeted” focus group invited participants to suggest viable communication and policy recommendations. The event was complemented by GIS analysis using MCDM technique. As a result, the researcher produced a decision support tool which prioritises “smart city” policies for low carbon and just Bristol. The following chapter will discuss the methodology and the results. In doing so, Chapter 7 will evaluate whether the thesis answered the research question posed and whether it met the aims and objectives. Finally, the action-reflection cycle will be completed in Chapter 8, where the researcher considers the learning from the complete doctoral experience.

## 7. Discussion

The previous chapters have presented the results in the themes of food waste and metering, the following chapter will discuss their significance in the context of the research questions and objectives (Chapter 1), the academic literature (Chapter 2) and the methodology (Chapter 3).

Chapter 7.1 will discuss how the research design was applied in practice contrasting it with the anticipated outline of the methods. It will analyse practical challenges, theoretical issues and methodological strengths of each research phase observed following the completion of the empirical stage of the thesis (Chapters 7.1.1-7.1.3). Subsequently, Chapters 7.1.4 and 7.1.5 will bring the discussion back to the themes of “usefulness” and “co-design”, which were informed by the overarching epistemology (pragmatism) and methodology (action research). In doing so, the researcher provides a *theoretical* answer to the question posed in the introduction to the thesis:

*. How can action research approach contribute to Bristol’s sustainability ambitions?*

Chapter 7.2 then will discuss the findings in light of the remaining research questions and objectives. Chapters 7.2.1.1 and 7.2.2.1 will examine the discourses of food waste and metering. Following, Chapters “Unintended policy consequences” (7.2.1.2) and “Translating between the academia and practice” (7.2.2.2) provide theoretical contributions to the concepts of WEF Nexus and climate justice referring to one of the key research questions and objectives:

*To examine discourses on the selected sustainability challenges in Bristol (Objective 1)*

Following the academic deliberations, “Discussing results with co-researchers” (7.2.1.3), “Policy limitations” (7.2.1.4) and “Quantifying policy deliberations” (7.2.2.3) will reflect the pragmatic side of the research. Here, the reader will find the practice-oriented answers to the research questions 2 and 3 (see above) and, therefore, provide locally-relevant recommendations to the remaining objectives of the thesis:

*To provide the evidence base for the local low carbon policy recommendations (Objective 2)*

*To exemplify the opportunities for just environmental policymaking (Objective 3)*

## 7.1. Research design

### 7.1.1. Discourse analysis

#### 7.1.1.1. Learning about the method

Discourse analysis was judged appropriate to apply in the thesis as this method was originally developed to provide clarity on the political and ambiguous terms, which are relevant to research on the WEF Nexus. Furthermore, the epistemological principles and values embraced by discourse analysis (i.e. social equality, breaking down power hierarchies; Bax, 2010) align with those embodied in the overarching methodology of action research (see Chapter 3.5.2).

The selection was informed by the arguments of Wodak and Meyer (2009) – “Methods of critical discourse analysis”. This provided a historical context and theoretical background. Discourse analysis varies in scope from detailed linguistic investigations to the broad overview of the rhetoric, with the second approach resembling the methodology applied in the thesis. Next, the researcher read sustainability-related peer-reviewed journal articles employing discourse analysis (Watson and Meah, 2012; Mourad, 2016; Hambleton, 2014) and Bax’s handbook “Discourse and Genre” (2011) to understand how this method worked in practice and what level of detail can be conveyed in a concise form.

The key observation taken from a review of the above journal articles is that they tend to critique the policymakers and practitioners without addressing the context of their work cultures or their professional constraints. Therefore, the direction of the thesis was identified as bringing the results of discourse analysis (Stage 1) into a space of contestation and thereby enabling critical discussion during focus group meetings.

#### 7.1.1.2. Selection of sources

Discourse analysis is a thorough method of textual interpretation – it is not uncommon that one newspaper article covers the whole content of a peer-reviewed journal publication (e.g. as seen in Stoegner and Wodak, 2016). However, in order to improve the rigour, applicability and credibility of the study, the researcher decided to investigate a larger number of sources (4 for the metering theme and 12 for the food waste theme).

Another methodological choice pertained to the types of sources suitable for the analysis. In this case, the research focused on marketing materials and news whilst

treating policy analysis to a literature review task (Chapters 2.3.5 and 2.4.4). The examination of the marketing materials shed light on how energy and water meters are promoted by the utility companies and the government. News analysis, on the other hand, would familiarise the reader with common perceptions of food waste in the local and national contexts.

#### *7.1.1.3. Does discourse analysis “expire”?*

Following the completion of the discourse analysis stage in early 2017 (Chapters 5.1 and 6.1), some of the framings present in the news and marketing materials have changed. For example, despite the noticeable media attention food waste received in early 2017, over the following year, food waste dropped from the political and media agenda in favour of plastic pollution (HM Government, 2018; British Broadcasting Corporation, 2018a). Similarly, as of 2018, Smart Energy GB communication strategy has incorporated data privacy considerations and therefore has contributed to the transparency of communication materials, which is one of the recommendations resulting from this research (Figure 7.1).



**Figure 7.1.** Updated communication materials on smart meters (Smart Energy GB, 2018)

Ultimately, the timescales in journalism, academia and policy differ significantly. The framings in media can change quickly. In academia, the peer-review process leads to several months' lag between researching and publishing. In the public sector, the

complexity of policy design often requires a period of a few years between an idea being proposed and then implemented. One way to align these timescales is to conduct and present discourse analysis in a) further research stages; b) policy and stakeholder reports; c) peer-reviewed articles published before the submission of the thesis. This thesis combined the aforementioned three tactics and, therefore, successfully employed discourse analysis – a method which captures a set of prevailing debates in a particular window of time.

### 7.1.2. Focus groups

#### 7.1.2.1. Participants' recruitment

As an early-career scholar without previous experience in food waste or metering, the researcher had to undergo a set of preparations before organising focus groups. An approach of immersing in the issues on the ground in addition to conducting a literature review increased the likelihood of successful recruitment. In particular, attending professional events to engage participants was a crucial part of the research design.

The potential interviewees introduced via events tended to respond more favourably to focus group invitations than people approached using cold-calling (i.e. via emails found on their organisations' websites). Nevertheless, the initial challenges of recruitment did not have a negative impact on the composition of the group. Participants came from diverse fields and represented a variety of agenda. The researcher successfully managed to recruit at least one person from the following sectors: public, private, voluntary, and education. Furthermore, when composing an invitation message, the researcher strived to improve diversity by specifying that there are no limits on participants' seniority, gender or ethnic origin. As a result, the composition of the focus groups was as follows:

**Table 7.1.** The composition of focus groups

	<b>Seniority</b>	<b>Gender</b>	<b>Nationality</b>	<b>Sectors</b>
<b>Focus group 1 (Food Waste)</b>	Junior: 2 Middle-career: 2 Senior: 2	Men: 3 Women: 3	British: 6	Public: 1 Private: 3 Voluntary: 1 Education: 1
<b>Focus group 2 (Metering)</b>	Junior: 1 Middle-career: 3 Senior: 2	Men: 4 Women: 2	British: 5 Other: 1	Public: 2 Private: 1 Voluntary: 1 Education: 2
<b>Focus group 3 (Metering)</b>	Junior: 1 Middle-career: 3 Senior: 2	Men: 5 Women: 1	British: 6	Public: 2 Private: 1 Voluntary: 2 Education: 1

Achieving a balance between the levels of seniority<sup>18</sup> and genders was easier for the food waste theme. Here, the scope of discussion was broader, and the topic was familiar and relevant to numerous practitioners across the sectors. Achieving diversity during the discussions on metering was more challenging. In this case, the topic was specialised, and the participants came from traditionally male-dominated organisations. Furthermore, the vast majority of stakeholders in all focus groups were white and British. Investigating the possibility of recruiting non-white and non-British practitioners was important as the researcher, who as a migrant herself, appreciates how challenging is to bring “foreign” voices to the mainstream discourse. Nevertheless, in terms of nationality and ethnicity, participants were very homogenous, which is likely a reflection of the workforce in their respective organisations. Ultimately, the research aims to qualitatively interview sustainability practitioners rather than survey a statistically representative group of Bristol citizens. Hence the notion of reflecting the diversity of the local population was a personal aspiration rather than a methodological requirement.

<sup>18</sup> Participants’ seniority was inferred based on their roles, e.g. “officer”, “manager”, “executive director”

### *7.1.2.2. Facilitation*

Due to the participants' busy schedules, gathering all interested parties in one room proved to be a challenge. Despite giving a sufficient notice (a doodle poll, emails in advance, a map with directions and careful planning of the conversation), a few participants were not able to attend the whole events. For example, one interviewee turned up 50 minutes late and another one had to leave 15 minutes before the event finished. In order to offer everyone a chance to fully contribute to the agenda, the remaining questions were supplied to the participants who were not able to attend the full session.

Apart from reviewing the academic literature and conducting discourse analysis, the researcher did not have a professional background in food waste or metering. Therefore, she can be considered to enter the research space from an "outsider" perspective. To some extent, this improved the facilitation process as the researcher could come across as agenda-free and genuinely curious about the themes. On the other hand, having extensive experience in the topic area would have allowed asking more precise questions rather than organising two exploratory events.

During all three focus groups, all pre-scripted questions were covered in the allocated time, however, at times the discussion felt intense and information-heavy. Some participants took more time to voice their opinions and interrupted others, therefore moderation of the discussion was necessary to keep it close to the topic and ensure the event kept within the schedule. The event required a lengthy exchange of background information (e.g. on the current state of technology of metering across water and energy sectors) before the group could move towards a more discursive element of the event. Therefore, the research recommends that, in the future studies of issues across the WEF Nexus, the facilitators should provide cross-sectoral background information (such as leaflets, visual clues) in advance of the discussion.

### *7.1.2.3. How useful were focus groups?*

The pragmatic and practice-oriented nature of research prioritises research methods which have the potential to influence participants' practices. While Chapter 3.2.3 outlined the general advantages of focus groups, their usefulness in the context of the research aims could only be determined once the data collection and analysis finished.

Below, the researcher presents three arguments exploring and critiquing the usefulness of focus groups in the context of the thesis.

First, focus groups acted as a dialogic space (Buber, 1965). This was achieved with the maturity of expression, willingness to interact, and organisation of follow-ups

meetings. Second, focus groups functioned as cross-sectoral learning opportunities. They addressed gaps in knowledge and brought together stakeholders from a variety of sectors. Finally, there is a growing body of research suggesting a potential of group discussions as tools for policymaking (Kahan, 2001; Horlick-Jones and Prades, 2015; Howarth and Monasterolo, 2017, Hoolohan *et al.*, 2018). While focus groups did not directly result in binding legislation, they presented a suitable opportunity for the exploratory stage of the policy cycle – the time when policymakers wish to scope which issues are prioritised by the local practitioners. Communicating the practical potential as well as the limitations of focus groups in advance was crucial for managing expectations of the policy stakeholders.

Arranging a formal, yet relaxed setting encouraged the building of trust essential for successful partnerships (Harris and Lyon, 2014). Moreover, the academic rigour present during data collection and analysis improved the legitimacy of the method. This increased the probability of including the focus group results in policy design. Finally, focus groups were suitable to the WEF Nexus issues as environmental management policy issues span sectoral and organisational boundaries (Howarth and Monasterolo, 2017).

### **7.1.3. Policy co-design**

The third stage of the research involved gathering further primary data in order to aid policy co-design with a wide range of sustainability practitioners and policy recipients (catering businesses). The protocols for collecting data were constructed with practice-based co-researchers. Following the preliminary data analysis, co-researchers commented on the results and helped with dissemination outside the academic context. Following two chapters discuss the methods comprising the co-design stage: qualitative survey and Multicriteria decision-making. The researcher discussed all three focus groups (both in explanatory and targeted phases) in Chapter 7.1.2. Finally, Chapter 7.1.4 will reflect on the entirety of the collaboration process.

#### **7.1.3.1. Qualitative survey**

The idea of a qualitative survey resulted from the discussions with one of the co-researchers, who undertook preliminary research on food waste management practices in 2013 and documented it in a local consultancy report (Resource Futures, 2013). The results of the 2013 survey revealed that recycling food waste is rare in the catering sector. Businesses often perceive that its complexities (logistics, costs, health and safety) overshadow the potential benefits. Focus group organised as a part of this thesis confirmed this argument, highlighting the unfavourable policy climate

(Chapter 5.2.1.2). Therefore, conducting a qualitative survey provided an opportunity to map the contemporary landscape of commercial food waste management in Bristol.

Qualitative surveys allow undertaking a structured investigation and a comparison of the answers within the sample. At the same time, their qualitative nature provides space for expressing additional comments, attending to the richness and diversity of the answers. Medium sample size (here, n=79) renders mixed-methods analysis possible. On one hand, the researcher performed simple descriptive statistics to find out an indication of the recycling participation rate. On the other hand, she was able to provide a “thick description”, useful for future communications in this policy area (Geertz, 1973).

Despite these pragmatic and theoretical advantages, the design of qualitative surveys contains some limitations. First, the analysis of survey data could not be relied upon statistically since the sample size is not representative of the whole city. In total, 79 participants and 3 neighbourhoods cannot reflect the participation rate for some 1,000 catering outlets located across all 34 wards in the city. The results intend to be an indication of a changing landscape of food waste practices in the catering sector. It is worth noting that qualitative surveys do not require results to be generalisable by design. Instead, the primary value of the research lies in the themes and discourses derived from the qualitative data.

Another limitation is related to a language barrier encountered in a few cases. This affected the quality of the dataset, particularly in Easton. The researcher used plain language and repetitions to encourage complete answers. Finally, the length of the questionnaire (five open-ended questions) could potentially affect the “richness” of data. However, a variety of answers, high response rate and the presence of forward-looking insights suggest that the data achieved saturation and could lead to “thick” policy recommendations. The researcher decided to conduct short surveys, as this was more appropriate in busy, customer-facing environments.

In summary, despite its limitations, a qualitative survey was a suitable method to investigate participation in food waste recycling services. It was grounded in the previous work of the co-researchers as well as the focus group data (Stage 2). As a result, it led to a peer-reviewed publication and local policy recommendations.

#### *7.1.3.2. Multicriteria Decision-making*

Performing MCDM analysis was justified by the necessity of connecting participants’ deliberations to the local quantitative datasets. In this stage, the research question

was based on the targeted focus group, where participants discussed the possibility of prioritising neighbourhoods with the relevant “smart city” policies (see Chapter 6.3). Participants highlighted that two distinct groups of energy/water users (“most capable” and “most disadvantaged”) require different policy tools to enable them to reduce their resource consumption. Consequently, MCDM asked, “which neighbourhoods should be prioritised to a) maximise the emissions reduction potential **or** b) reduce economic inequalities?”

Following the focus group, the researcher identified and converted the datasets to conceptualise an abstract research question. Data identification was the most time-consuming stage, mostly due to the lack of awareness of which datasets were publicly available and whom to contact to request the data with restricted access.

Carrying out MCDM analysis turned out to be quite a straightforward process, although it required following exact and repetitive procedures. ArcMap software can be quite challenging to work with if an analyst misses a single step or one is not quite sure how to do the calculation the right way. On the other hand, completing a task independently after a long struggle was very satisfying. Once the workflow was understood and memorised, the process appeared quite simple.

The limitations of this research stage were predominantly linked to the quality and availability of secondary datasets. First, the quality of data was not consistent across all datasets. For example, household income dataset didn’t include the neighbourhoods in the city centre, therefore it was excluded from the final analysis. Moreover, some datasets are only approximations and algorithms rather than empirical data (e.g. Acorn socio-demographic categories, internet engagement), which might affect the accuracy of the results.

All datasets were available at LSOA level and collected from respectable and reliable sources, namely, the government websites, the UK census, peer-reviewed research, ESRC and Acorn (see Table 4.9. for a list of the datasets used). They were accessed after following suggestions from the research participants.

Future versions of this decision-support tool could fully utilise the data from smart metering, assuming water and energy smart meters would be widely implemented over the next decade. As they were not common at the time of writing, the researcher didn’t include them in the decision-support tool. Similarly, further research in this area ought to ensure that the data-sharing agreements are in place in the early stage of the project, to ensure timely analysis and policy engagement.

The research yields a methodological recommendation related to dealing with subjectivity, a common criticism of MCDM (Kumar *et al.*, 2017). Indeed, the acts of scoring and weighting (“informed subjective AHP scenario”) were ultimately decisions of the researcher. However, illuminating subjectivity is the sole purpose, not weakness, of MCDM. This tool serves as a reminder that when faced with complex socio-environmental issues *all* expert judgements are subjective. Grounding deliberations in quantitative data and an algorithm does not increase the objectivity of the debate. Nevertheless, quantifying multiple scenarios and running a data sensitivity test helps to provide transparent and reproducible results. In the future, the weights could be assigned by a group of local experts during a workshop or a survey. Going further, MCDM could be used as a means to facilitate science-policy interactions by making stakeholders comfortable with the notions of plurality and uncertainty (Stirling, 2010).

It has to be noted that a successful application of this GIS-based decision-support tool depends on two factors:

- practitioners’ comprehension of the methodology
- quality and access to data.

An in-depth understanding of the tool encompasses an awareness of its advantages and limitations, as well as an ability to follow the analytical step involved in scoring, weighting and sensitivity analysis. Therefore, sustainability practitioners willing to utilise MCDM ought to gain relevant competencies in IT and be able to differentiate between algorithm-supported **decision-making** and algorithm-supported **deliberation**. Above all, in the times of rapid development of digital technologies, policymakers and researchers ought to ensure that the gathered “smart city” data is freely available and that it measures phenomena relevant to the vision of “just” and “low carbon” cities.

#### 7.1.4. Researching *with* practitioners

The key theoretical terms applied throughout the thesis, “transdisciplinarity”, “action research”, “policy co-design”, emphasise the importance of participation and collaboration. Here, the participation and collaboration commenced during Stage 2 (focus groups) and continued right through to the dissemination of the results.

Following the exploratory focus groups, participants were sent “thank you” messages and transcripts for approval. They were offered an opportunity for further collaboration in a form preferred by the participants. For example, they could have

shared the data from their organisations, consult on the further methodological steps, or help to recruit participants for the next stage. Where possible, the researcher offered professional benefits in exchange, e.g. authorship on a peer-reviewed article or support with data collection and event organisation for participants' own projects. Not every participant had the availability to involve deeper in the PhD research. However, the researcher ensured that those who were happy to collaborate and become "co-researchers" appropriately benefitted from their engagement.

Action research theory emphasises the importance of meaningful participation and opposes it to "researching on" participants (McNiff and Whitehead, 2012). Indeed, conducting an inquiry *with* the practitioners provided them with an opportunity to suggest policy priorities, comment on the results and contribute to the dissemination. In other words, it contributed to the shared ownership of the research ideas.

Yet, one ought to be careful when discussing shared ownership of the research, particularly in the context of a sole-authored thesis and unpaid participation. Although the extent of collaboration exists on the continuum, more involvement does not equate superior results. Dixon and Sharp (2007) reflected on the tension between the depth and appropriateness of collaboration, arguing that Arnstein's (1969) normative "ladder of participation" is not sensitive to the unique context of each research (or policy) project.

An antidote to Arnstein's somewhat linear and simplistic treatment of participation is a regular reflection on the methodology as it evolves throughout the project. In future collaborative activities, the researcher invites her peers to ask themselves: "What is appropriate?", given a) project timescales b) participants' availability c) project budget d) formal procedures (e.g. bidding, submitting a thesis) e) power dynamics present within the project f) values embedded in the project aims (both explicitly and implicitly). In doing so, the researcher defines "meaningful participation" as one addressing the above practical and theoretical issues, rather than one aiming to climb to the top of Arnstein's (1969) ladder.

Academics who define themselves as "researching with" practitioners ought to reflect on theoretical connections between action research and transdisciplinarity. In particular, transdisciplinary projects should draw from the ethics of action research, by including concerns such as a) who is given a platform to collaborate? b) who has the power to create knowledge? As such, transdisciplinarity encompasses more than a mere crossing of disciplinary and sectoral boundaries. Transdisciplinarity drawing from action research focuses on *how* disciplinary and sectoral crossing is done and whether it leads to low carbon and just future.

### 7.1.5. How did epistemology inform the research?

Pragmatism emphasises the importance of “being useful” and deriving policies and frameworks from experience and practice (Boulton *et al.*, 2015). Pragmatic research is interested in working towards a tangible change – designing policy recommendations and creating a learning environment.

In order for the PhD to be pragmatic, the researcher focused on what was achievable. She selected the case studies based on the data availability and ownership of actions by the local stakeholders. She organised focus groups as a starting point for building long-term rapport with the participants, who contributed to the research results over the duration of the PhD.

Pragmatic research aims to gather the attention of the target audience, in this case, environmental policy researchers and practitioners. By constraining dissemination to a thesis format, the research would inevitably be read by the maximum of five people (the researcher herself, two supervisors and two examiners). Therefore, focusing on the timely publication of results became an imperative. As a result, three peer-reviewed and two policy papers (Appendices A-D and Appendix I) were issued in 2018. The research outputs also were presented at practitioners’ events and academic conferences (see a self-reflection in Chapter 8.4).

Finally, the emphasis on “usefulness” had to be confronted with theory-building expectations of academic research. This led to an exploration of how academics and practitioners understand key ideas (and their “synonyms”) related to the thesis, namely, the WEF Nexus and climate justice. By analysing the discourses present throughout the media, grey literature and participants’ interactions, the researcher demonstrated the conceptual merit of the thesis. At the same time, action research “with” the practitioners ensured the work is relevant to the local issues and stakeholders. This reflects Dennett’s (2013) appeal to avoid researching “high-order truths about chmess”, a common occurrence in academia. “Chmess”, as Dennett (*ibid.*) explains, is a version of chess “invented” by him, without any relevance to the real world. This thesis avoided researching “chmess” by exploring the language of interconnections and integration in participants’ own language, rather than by requiring them to understand the WEF Nexus, as conceptualised by nearly a decade of academic and policy publications.

## 7.2. Discussion of results

### 7.2.1. Food waste theme

#### 7.2.1.1. Discourses of food waste

Despite the acknowledgement in the academia and food industry that food waste is a complex issue which cannot be attributed to a single sector or demographic group (Chapter 2.4.2), the media sources analysed in the thesis pointed at a range of people and organisations to “blame” for food waste. This confirms Evans (2011, 2012) thesis that the discourses around food waste are highly normative. However, judging from the state of media over 2016-2017, the analysis only partially confirms Welch *et al.* (2018) thesis on “distributed responsibility”, as the indication of this attitude was only found in two articles. Two other articles, in Evans’ term, “blamed the consumer” (e.g. using terms like “*frivolous*”, “*wasteful*”, Daily Mirror, 2016; The Spectator, 2017). Two pieces suggested the responsibility of the food industry (“*unethical business practices*”, Bristol Cable, 2015) and three – of the politicians (“*unacceptably high levels [across the country]*” Materials Recycling World, 2016). Finally, three papers haven’t indicated who/what is responsible for food waste at all (Table 7.2.a). The diversity of opinions suggests that there is no mainstream voice with regards to highlighting the reasons for food waste. On one hand, this could facilitate democratic debates. On the other, the lack of acknowledgement of the “distributed responsibility” might stifle the capacity for collaborative efforts.

Evans’ (2011, 2012) ethnographic fieldwork explored the everyday practices linked to buying, preparing and wasting food. In his sympathetic account, Evans (*ibid.*) recorded that participants “wasted” food as an expression of love and care for other household members. For example, they “wasted” food for out of safety fears or to provide varied and interesting meals to their loved ones. In contrast, this discourse analysis found only one case of food waste being justified by health and safety (Bristol Post, 2016). In fact, wasting food in households was deemed as a *lack of care* for family members, as those who waste food also waste money (Daily Mirror, 2016).

Despite The Guardian (2017) claiming that “*wasting food has become so normal, there is now no stigma attached to throwing food away*” (nota bene, the majority of the article directly cites a report compiled by a major supermarket chain, Sainsbury), eight out of twelve sources analysed used a normative tone throughout the text. Only four articles attempted to appear as neutral, usually through relying on direct quotes and figures rather than a journalist’s analysis. Finally, three articles are characterised by a “solutionist” (Montero, 2018) attitude (Table 7.2.b). “Solutionist” discourse is

increasingly popular in sustainability policymaking as it portrays accessible, attractive (usually referring to “smart technologies”) and ground-breaking measures in an optimistic tone, usually without referring to potential complexities or anticipated criticisms. This discourse can be contrasted to the focus group (Chapter 5.2), where the conversation was characterised by a rather insoluble, if not futile atmosphere. For example, participants were quick to mention obstacles, knowledge gaps and paradoxes, concluding that food waste can only be resolved by a political and systemic change. The focus group acknowledged the complexity of food waste, which is “locked-in” in politics at various scales (Boulton *et al.*, 2015).

Following the need to investigate the “solutionist” discourse in-depth, the researcher identified eight types of measures proposed by the sources (Table 7.2.c). Here, it is important to note that although some measures might appear similar on the surface (e.g. three types of policy measures and two types of measures aimed at the individual consumer), the key difference between them is the case of *who* frames the solutions.

For example, supermarkets face the question of how to engage in the food waste debate without a) losing profit b) damaging their reputation. By being in power to suggest appropriate solutions (e.g. leading campaigns, pro-environmental messaging, promoting “smart home” gadgets), supermarkets deflect the attention from the criticisms, such as “*unethical business practices*”, “*promoting multi-buy culture*” (Bristol Cable, 2015; The Telegraph, 2017). At the same time, they can define the scope of the problem and can be seen as leaders in the field, rather than a part of the problem. Out of twelve sources, only two referred to the role of the supermarkets with critical reflexivity (Bristol Cable, 2015; The Telegraph, 2017), e.g.: “*supermarkets had faced a conflict of interest between wanting to sell as much as possible and helping people reduce food waste to protect the environment*” (The Telegraph, 2017).

**Table 7.2.a.** Discourses found in media representations of food waste (2015-2016): Who is responsible?

<b>Who is responsible?</b>				
<b>Individuals:</b>	<b>Industry:</b>	<b>Politicians:</b>	<b>Distributed responsibility:</b>	<b>Not indicated:</b>
Daily Mirror, The Spectator	Bristol Cable, The Independent	Bristol Post, Materials Recycling World, Daily Mail	Daily Express, The Telegraph	Resource, The Guardian, CIWM

**Table 7.2.b.** Discourses found in media representations of food waste (2015-2016): attitudes present

<b>Attitude</b>		
<b>Neutral:</b>	<b>Normative:</b>	<b>Solutionist:</b>
Resource, The Guardian, The Independent, CIWM	Daily Mirror, Bristol Cable, Daily Express, Daily Mail, The Telegraph, Materials Recycling World, The Spectator, Bristol Post	Resource, Daily Mirror, The Guardian,

**Table 7.2.c.** Discourses found in media representations of food waste (2015-2016): types of measures proposed

Types of measures			
<b>Supermarkets - partnerships</b> (as framed by the food industry): Resource, Daily Mirror, The Guardian The Telegraph	<b>Individual habits</b> (as framed by the food industry): Daily Mirror, The Guardian	<b>Individual habits</b> (as framed by the government): Daily Express	<b>Policy – targets</b> (as framed by the government): Materials Recycling World,
<b>Policy - regulation</b> (as framed by the citizens/ NGOs): Bristol Cable, The Independent	<b>Policy – tax breaks</b> (as framed by the food industry): CIWM	<b>Technology</b> (as framed by the food industry): The Guardian	<b>Market - rise in food prices:</b> The Spectator

#### 7.2.1.2. Unintended policy consequences

Proponents of the WEF Nexus framework argue that this analytical lens brings attention to the previously under-explored connections between water, energy and food (Bazilian *et al.*, 2011). In policy jargon, a lack of consideration for the potential trade-offs or synergies is understood as “unintended policy consequences” (Cairney, 2012). This thesis revealed that designing policies in the complex environmental issues such as food waste is riddled with such “unintended consequences”. Every stage of the research highlighted the potential of (usually negative) side-effects.

Discourse analysis of food waste news highlighted the following unintended consequences of potential food waste policies. Firstly, less frequent general waste collections might lead to waste spillages and constitute health and safety risk, should excess waste attract vermin (Bristol Post, 2016). Secondly, the current design of semi-formal surplus food distribution agreements is being used by food retailers to offload waste management duties to the unpaid labour of volunteers working for surplus food charities (Bristol Cable, 2015). Thirdly, AD is portrayed as unfairly suffering from the stringent environmental regulations, whereas in fact, this technology is viewed as the

most environmentally preferable option of dealing with food waste (Chartered Institute of Wastes Management, 2016).

Meanwhile, the focus group elaborated on the unintended consequences of AD with regards to surplus food donations. Taken together, the analysis of the first and second stages provides a more nuanced view on this issue. AD is classed as an environmentally preferable option to deal with food waste due to low CO<sub>2</sub> emissions and the energy generated through the process. However, encouraging large scale development of AD in the future could discourage donating edible surplus food to people affected by food poverty:

*FG1\_P02: “Is there going to become a point when AD [anaerobic digestion] will pay for their food waste because they will essentially be making money out of it?*

*FG1\_P06: Yeah, that’s a good question. At our organisation, we believe the future is paying for all our waste because we can see how valuable it is. It’s only a matter of time before this will be happening, and there is already a lot of competition for AD.*

*FG1\_P02: So in a way, it’s really good, but in another, it’s really bad because if a supermarket has a choice to donate for redistribution or to get money for AD, you know they’re going to choose money, aren’t they? (...)*

*FG1\_P01: So, for the taxes to reflect perhaps that, donating food to people rather than AD as a social value. The tax system could perhaps reflect that”.*

The third stage, policy co-design, reinforced this point. Although the questionnaire asked specifically about food waste *recycling*, participants were keen to mention food waste *prevention* measures, such as menu control or formal and informal donations. Such conversations were unexpected and unprompted and often occurred as a justification for not recycling food waste. In the UK, regulations around donating food through charities are quite strict, e.g. businesses cannot donate warmed or buffet food (FareShare, 2018). Yet, 18 out of 79 survey participants would admit that they regularly donate food “informally” to other staff members, friends or the homeless.

The social sciences literature on waste confirms that the boundary between disposing, recycling and preventing is, to say the least, blurred. For example, Gregson *et al.* (2007) show that the act of “disposing” household goods is intimately connected to the narration of the self and the enactment of love relationships. Hereby, they argue that “disposing” is riddled with normative considerations, worries and simultaneous practices of “saving”. Evans’ (2011, 2012) continuation of Gregson’s work in the context of food waste points to the particularity of food waste as a subject of analysis and policy design. Food waste is susceptible to spoilage and it is deeply intertwined with the flows of everyday life. Following Evans, this research suggests that calls for

surplus food donations policies would have to consider the realistic timescales of food safety and potential labour resulting from donating, rather than disposing or recycling food. As mentioned earlier, discourse analysis of food waste news unveiled the potential “dark side” of surplus food management practices (Chapter 5.1.1).

*“Several organisations in Bristol work to recycle food waste. A job that should be the responsibility of the supermarkets creating the surplus in the first place. Food banks and homeless charities, the usual recipients of supermarket surplus, lack the capacity to distribute it fast enough to those in need” (Bristol Cable, 2015)*

So far, the academic literature is unclear with regards to the impacts of various food waste management practices on the actions further up the waste hierarchy. Mourad (2016) suggests that small-scale and informal surplus donations could get disrupted in favour of industrialised and formalised food waste prevention and recycling policies. However, further research is needed to provide sufficient evidence on the relationships between informal and formal surplus food/food waste conduits.

#### *7.2.1.3. Discussing survey results with co-researchers*

Following the recommendations resulting from the focus group, the researcher explored the issue deeper in a qualitative survey of the catering sector. As discussed in Chapter 7.1.3.1, the qualitative survey was an elaboration and an update of the co-researchers’ earlier attempts (Resource Futures, 2013) to map the landscape of food waste recycling in the catering sector. The survey yielded the following policy recommendations for an improved food waste recycling service in the catering sector:

- Bottom-up and operational solutions will give agency to the catering sector, for example implementing flexible and co-ordinated waste collection services.
- Engagement is the key: for example, displaying pro-recycling stickers or emphasising business benefits of recycling (e.g. improved stock and portion monitoring).
- Business engagement should address the barriers voiced by the participants applying the arguments used by the catering sector, rather than assuming that restaurants and cafes are not aware of the issue.

After the preliminary analysis of the survey data, the researcher deliberated on the results with the practice-based stakeholders, who were able to provide comments and compare the findings with their practice-based knowledge. Drawing from combined several years of experience in the sustainability sector, practice-based co-researchers

signalled the following complexities, which might arise during the design of the improved food waste policies:

- If food waste recycling is introduced to the commercial sector, will it be charged by weight or volume? This is an important consideration as food waste is one of the heaviest recyclables.
- Will future recycling policy then repurpose food waste to anaerobic digestion, compost, or animal feed?

Co-researchers agreed that sharing stories and discourses ought to help with the acceptance of a potential food waste recycling policy. Traders groups could act as knowledge sharing spaces. Meanwhile, areas lacking such way of self-organising (i.e. Easton) should get help from the local authority with setting up such business communities. The spatial differences in the recycling participation rates (Easton businesses scored lower than Gloucester Road or city centre) are not only reflective of the socio-demographic characteristics of the neighbourhood or the nature of the businesses. The differences also prompt to reflect on the *capabilities* present to be represented by traders' groups, request improved services and ultimately, contribute to low carbon vision of Bristol.

Finally, co-researchers also agreed that the lack of space is a major issue for small cafes. However, a group deal and a discount could be paired with frequent collections, which would reduce the need for storage.

To summarise, discussing the results with co-researchers verified the theoretical debates on food waste and improved local relevance of the subsequent policy recommendations.

#### *7.2.1.4. Policy limitations*

This thesis explores a number of policy recommendations suggested by the food outlet employees. The ideas ranged from partnerships between the council and waste companies, through targeting the non-participating and deprived areas to finally-mandatory food waste recycling. Nevertheless, there is no agreement among the policymakers and academics about whether to treat food waste recycling as a matter of obligation or voluntary business practices. The English Government currently favours voluntary measures and is reluctant to adopt compulsory food waste recycling since “*there are more efficient options than restrictions in this area and evidence suggests that restrictions would likely impose additional costs on businesses, particularly SMEs*” (Environment, Food and Rural Affairs Committee, 2015). Similar concerns were expressed by the participants. Major barriers reflect the issue of scale

– recycling is more challenging for independent, small, and budget eateries as it is less cost-effective and takes up too much space. This finding is in line with the literature on barriers to sustainable practices for SMEs, who argue that small businesses experience more barriers while engaging in sustainable actions (Lepoutre and Heene, 2006, Rizos *et al.*, 2016). WRAP (2015) echoes the argument of cost-effectiveness, stating that “*businesses need to be producing more than 40kg of food waste per week for a separate collection to be viable*”. Yet, a look at the existing practices in Scotland and Northern Ireland challenges the idea of “Not having enough waste”. Scottish and Northern Ireland businesses are obliged to separate food if they produce as little as 5kg of food waste. This approach is an example of the government taking responsibility to establish a code of environmental conduct (Lepoutre and Heene, 2006). At the moment, further research is needed to establish the effectiveness of the mandatory approaches.

Furthermore, although the policy recommendations in this thesis are linked to a potential local policy, mandatory food waste recycling is a domain of the national government. In the light of this caveat, the scope of the local actions is bound to:

- A non-mandatory paid service delivered by the municipally owned waste company.
- Change of planning regulations, requiring food waste recycling in newly built commercial areas.
- Improvement of food waste recycling in the areas currently managed by the council, e.g. markets.
- Local MPs lobbying for the introduction of mandatory food waste recycling.

Finally, the issue of lacking data brought up during an exploratory focus group encourages a reflection about the limits of designing food waste policies grounded in quantitative evidence. However, can food waste policies ever be based on this type of “evidence”, when all available information is scattered and incomplete (Cairney and Oliver, 2017)? In times of climate urgency (Intergovernmental Panel on Climate Change, 2018) on one hand and limited policy resources on the other, environmental policymakers are encouraged to re-think what type and scale of data are deemed sufficient and appropriate to inform their decisions.

#### *7.2.1.5. Food waste summary*

The thesis explored the locally-relevant discourses of food waste related to the responsibility for the issue and the proposed measures. The analysis recognised that although there is no single reason or solution, the debate remains highly normative,

linking food waste to poor financial management, even family neglect or unethical business practices. In each stage of the research, both primary participants and secondary sources readily discussed the responsibility and reasons for food waste, indicating that the debate over “naming and blaming” will continue.

Furthermore, discourse analysis highlighted an emergent discourse of “optimistic solutions”. These are usually behavioural and technology-enabled (“smart”) interventions aimed at the individual consumer. It is worth noting that the actors who optimistically emphasise the need for consumer behaviour change are leading supermarket chains. In doing so, supermarkets are seen in a positive light while deflecting the attention from other types of measures, like regulating procurement practices or introducing compulsory surplus food donations or recycling.

The thesis yielded policy recommendations for an improved food waste recycling service in the catering sector related to a) bottom-up and operational solutions giving agency to the catering sector, b) effective business engagement and communication.

Although the policy recommendations are linked to a potential local policy, mandatory food waste recycling is a domain of the national government. In light of this caveat, the research outlined the scope of the local actions.

Finally, the research reveals the following complexities related to food waste recycling:

- food waste-energy nexus, as diverting food waste from landfill could generate more energy
- energy-food poverty nexus, as the large-scale deployment of AD could affect the availability of food for people affected by poverty.

Further research is required to quantify the energy generating potential of food waste management (especially AD). This should be complemented with a qualitative inquiry on formal and informal practices of donating surplus food and dealing with food poverty.

### 7.2.2. Smart meters theme

#### 7.2.2.1. Discourses of metering

As shown in Tables 6.1a-d (Chapter 6.1), the prevailing themes in the metering promotional materials are “control”, “savings” and “convenience”, as these are the keywords appearing most commonly in each document, often on the first page or written using larger font size. The analysed sources emphasise that the customers will

be able to gain control over their energy or water use (“*Using in-home display will give you a greater understanding of what you’re spending*” Bristol Energy, 2016) and therefore lower their bills as a result of meter installation (“*You could save up to £100 on your water bill*”; Bristol Water, 2016). The leaflets also emphasize the ease of installation process and the convenience-related benefits resulting from having a meter (“*No more having to read the meter or trying to work out your bill. No more strangers coming into your home for meter readings*”; Smart Energy GB, 2017). However, despite the commonalities, there are also significant differences in communication between the leaflets, depending on the sector and organisation.

Smart Energy GB (2017) repeatedly uses the discourses of control, savings, and convenience – notably, these are all benefits to the individual. Even the title of the leaflet – “*The simple way to control your energy use*” – is meant to evoke the above qualities. When justifying the rollout in the further paragraphs, the organisation provides the context of the EU-led regulation implemented in the interest of mitigating climate change and upgrading the energy grid. It is worth noting that the reasons for policy implementation are not located on the landing page or the front of the leaflet, suggesting that the benefits to the environment and the energy sector have been backgrounded from the promotional strategy.

Similarly, Bristol Energy (2016) uses the discourses of “control” and “savings”. In addition, they emphasize the environmental and fairness values from the beginning, providing a more collectivist justification for metering. Their messaging is characterised by a level of transparency – owning a meter will not make a difference, engaging with it – could do so.

*“It’s important to note that just by having a smart meter and in-home display, you’re not automatically going to use less energy and start spending less money, but these devices put the power in your hands. Using in-home display will give you a greater understanding of what you’re spending, identifying when you use the most energy and highlighting in near real-time the way you use energy in your home”*  
(Bristol Energy, 2016).

Bristol Water (2016) focuses its messaging on savings, and the ease of the application and installation process, both benefits to the individual. Additionally, one of the benefits of metering outlined on the landing page is “*it helps us to detect leaks much quicker*” (Bristol Water, 2016), an advantage to the industry. However, this point is not elaborated further in the document. The Bristol Water leaflet contains presumption about customers’ attitude to water (“*Most of us do everything we can to*

*save water, we know it's important to everyday life*", Bristol Water, 2016). Further pages of the document explain how the metered water bill might change, revealing that it is, in fact, a function of a number of householders, number of the rooms, personal water usage and the presence of the garden. The final page of the document contains an application form asking questions like "*Is there an externally located stop tap controlling water to the property? Do you share water supply with your neighbour?*" (Bristol Water, 2016). There is no evidence whether the above questions are easily answerable by an average water customer, indicating that the application process might not in practice be perceived as "easy".

The communication prepared by the industry regulator, Ofwat (2013), has an entirely different character as it is informative and explanatory rather than promotional. Ofwat (*ibid.*) justifies metering as an environmental and strategic intervention, aiming to improve the management of scarce water supplies and increasing demand as a result of population growth. The document aims to improve bill literacy, providing a comparison of water tariffs in the unmetered versus metered scenarios. It then reports that "*some people regard meters as the fairest way to charge for water and sewerage services. This is because you pay for how much water you use*" (Ofwat, 2013). However, Ofwat does not comment on this opinion nor elaborates why the other water tariffs would not be as fair.

The main differences between the documents are the inclusion of individualist versus collectivist arguments and their informational versus promotional character. Notably, the individualist arguments were commonly presented in the promotional materials, whereas collective reasoning was included in the informational materials. However, it should be noted that on a few occasions, the messages managed to be both promotional and informational as well as to contain both individualist and collective arguments:

*"Smart meters are part of the government's plan to bring our energy system up to date. By 2020, every home in Great Britain will be able to use smart meter technology to see exactly how much energy they're using, and what it's costing in pounds and pence. In addition to these immediate benefits, the rollout also lays the foundation for Great Britain's move to a lower carbon economy and a secure energy supply"*  
(Smart Energy GB, 2017).

Combining a range of arguments and communication styles results in the honest and transparent disclosure about the limits to the potential benefits of metering.

#### *7.2.2.2. Translating between academia and practice*

Apart from uncovering key framings used to promote metering, discourse analysis allowed translation between academia and practice. At the heart of this method, lies the question: “What do you mean, when you say *x*? ” In particular, the thesis inquired:

- Do practitioners use the concepts of the WEF Nexus or climate justice explicitly? Or do they use synonymous concepts?
- To what extent can we claim that these potential “synonyms” are, in fact, an accurate reflection of academic theories?

In the case of the WEF Nexus, the research concludes that the local sustainability practitioners in Bristol do not use this term. Indeed, the history of the WEF Nexus (Chapter 2.2) demonstrates that the concept has been primarily discussed in the international policy circles. Although the specific WEF Nexus formulation does not immediately resonate with Bristol’s sustainability challenges, focus groups participants admitted that integration of decision-making across sectors and data analysis are crucial to tackling climate change. In doing so, participants effectively translated the WEF Nexus concept to the local context, highlighting the importance of cross-sectoral learning and data access. Finally, they illuminated that any attempt of analysing water, energy and food interactions brings attention to the other dimensions of social or physical systems, e.g. waste or social inequality. Noticing new feedbacks, trade-off and co-benefits will yield to an improved understanding of unintended policy consequences. Therefore, the WEF Nexus in Bristol is understood as:

- Cross-sectoral learning
- Enabling data access
- Analysing both social and physical interactions to reveal the unintended consequences of local policies.

In turn, climate justice jargon was not expected to feature in the discussions as currently its application (at least in the explicit form) is limited to the academia. However, the participants would often implicitly express the ethical aspirations of their respective organisations by using terms like “fair”, “need”, “equal”. However, the closer examination of these concepts within the context of the conversations (Chapter 6.4) revealed differences in participants’ standpoints, and therefore, proposed solutions to the current injustices. The results highlighted varying ethical understanding, diverse organisational strategies and, finally, limitations to the practices of policymaking. In other words, the participants understood “climate justice” as:

- Providing affordable water and energy for the basic level of need
- Designing fair tariffs
- Making sure no one is excluded from technological progress.

Gathering primary data through group conversations and ongoing action research facilitated with “translation” (Horlick-Hones and Prades, 2015; first featured in Kuhn, 1970) of the academic concepts into the ideas and policy recommendations appropriate and useful to the local context. This is contrasted with a policy analysis of the secondary data, which does not usually allow policy actors to elaborate on the political decisions in their own words. As a result, policy analyses resulting from the research “on” rather than “with” practitioners (Shove 2010; Mourad, 2016; Middlemiss, 2017), tend to be more critical of the direction sustainability movement is heading. The downside of such analyses is that they do not account for the practices of policymakers since grey literature is not informative of the factors like industry ideas, accepted modes of collaboration, organisational constraints or differences between personal opinion and organisational strategy (Hoolohan and Browne, 2018).

The discussion inevitably points at the question: how to bridge the gap between the academic and practitioners? Are their jargons and forms of knowledge ultimately incompatible? Horlick-Jones and Prades (2015), in their focus group research on understanding sustainable consumption across lay citizens and policymakers, argued that language has a constitutive role in social life. They demonstrated that different social groups play by the rules of their own “language-games” (Wittgenstein, 1958), which are governed by cultural rather than linguistic factors. Therefore, during focus groups held as a part of the thesis, participants could be using the same term while arguing different ethical standpoints or policy ideas:

*FG3\_Po2: [pointing at water metering leaflet] “Fair”, in this regard, I think, is slightly different from how we identified it as the start of the session. “Fair” here just means you pay for what you’ve used as opposed to the broader definition of fairness, which is generally used more in the energy industry, which is um... “Not ripping people off”...*

*FG3\_Po4: That’s a “value-based fairness”, whereas this is “quantitative fairness”*

Discussing seemingly synonymous concepts across sectoral boundaries, especially using real-life examples from grey literature or marketing materials will help to overcome the differences in the respective “language-games” and build a common understanding necessary for successful partnerships.

### *7.2.2.3. On quantifying policy deliberations*

Translation across academia and policy can also be facilitated by quantitative methods. As the targeted focus group highlighted the notion of “two markets” (Chapter 6.3.1), the subsequent stage aimed to explore whether “highly capable<sup>19</sup>” and “highly disadvantaged<sup>20</sup>” neighbourhoods could be defined and localised using quantitative local spatial data. MCDM analysis, therefore, contributed to the policy co-design process as it was grounded in stakeholders’ views and local data recommendations. By separating “capable” from “disadvantaged” neighbourhoods, this decision-support tool allows solving the dilemma between maximising GHG emissions reductions and improving justice. In words of one of the participants:

*“The contradiction is – we actually need the early adopters, we need the people who don’t need to worry about the bills, otherwise we won’t have the technology available for the lower retail cost in place. Then the early adopters can cross-subsidise a charitable project that will sort out the mess of fuel poverty and water poverty.” (FG3\_P05, civil service)*

### *7.2.2.4. Did the MCDM analysis unveil anything surprising?*

In popular accounts, Bristol is known for a stark difference between the most and least deprived areas. The local media and residents would typically point at Clifton and Henleaze as the most affluent areas and then at Hartcliffe, Filwood, Lawrence Hill, Southmead as the most deprived. This chapter will discuss whether the MCDM analysis reveals anything novel about Bristol beyond the popular representations of affluence and poverty.

A direct comparison of the results showing “highly disadvantaged” areas with the Income Deprivation Map (Figures 7.2-7.4 overleaf) reveals mixed results. To some extent, the results of the analysis confirm that, indeed, financial deprivation (or the lack of) is a significant predictor for the suitability of smart city policies, regardless of whether they are related to GHG emissions reduction (e.g. Stoke Bishop, Henleaze) or tackling poverty (Filwood, Hartcliffe). Nevertheless, since the decision-support tool takes into account other datasets (e.g. house ownership, energy use), it provides tailored results. For example, MCDM suggests that Clifton (e.g. Clifton Central, Queens Rd LSOAs), a well-known wealthy neighbourhood, is not a “highly capable” area (most likely due to the high proportion of student accommodation). On the other

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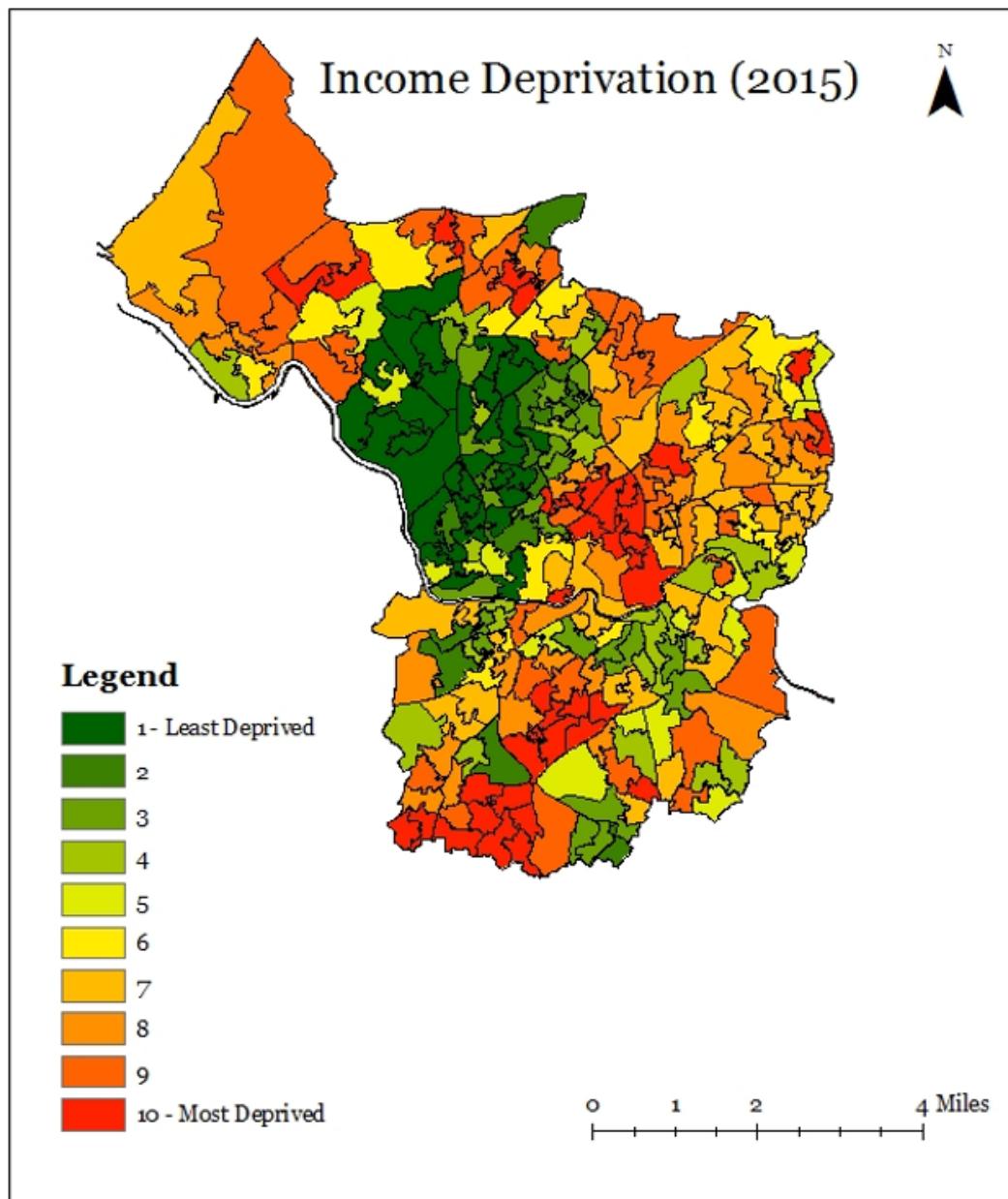
<sup>19</sup>“highly capable” is defined as: financially capable, house owners competent internet users, high electricity and gas consumers (see Chapter 4.5.5.1)

<sup>20</sup>“highly deprived” is defined as: financially deprived, renters, competent internet users; high electricity and gas consumers (see Chapter 4.5.3.1)

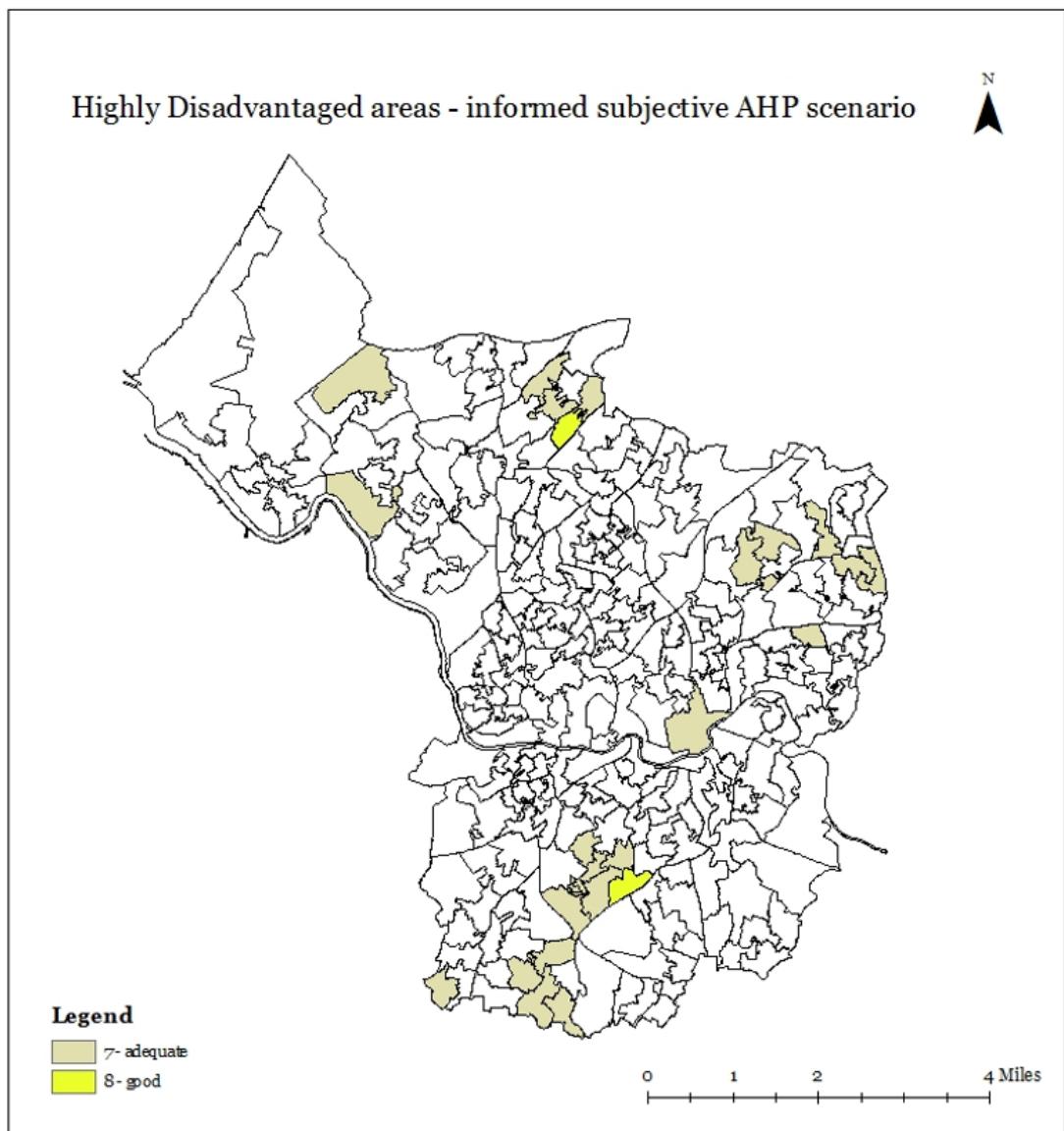
hand, MCDM suggests that some “high capability” areas are characterised by average income deprivation but unusually high energy consumption (i.e. Hazelbury or Somerville Road).

The final surprise was that the inner-city wards of Lawrence Hill and Easton, well known for the presence of deprivation, abundant social housing and uninsulated terraced houses, was not marked as a priority for the smart policies at all. The reason for that might be relatively low energy consumption in the area. In this case, a postcode level analysis is recommended, so it could identify particular streets in need of energy interventions aiming at building capacity.

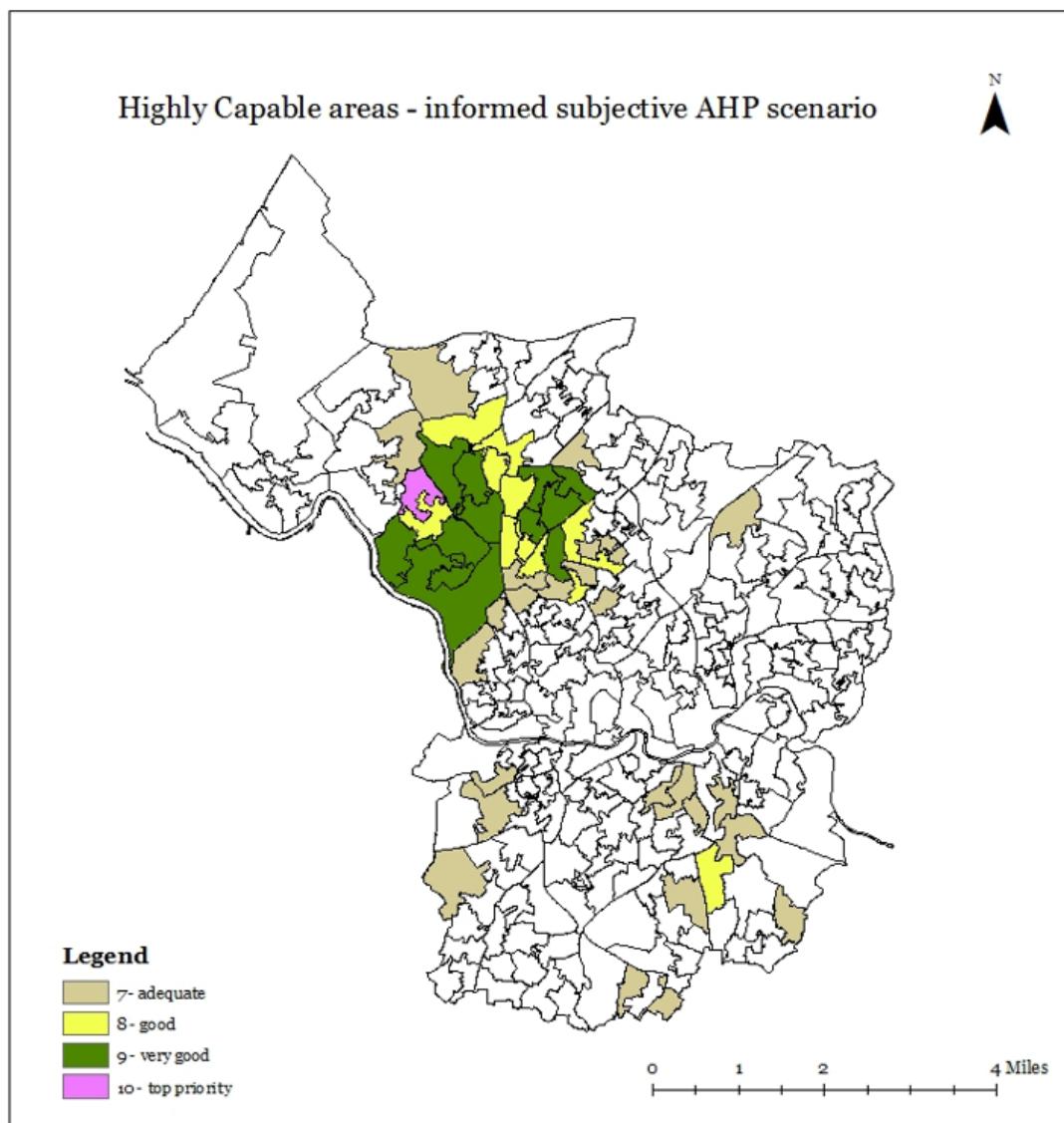
In further research, the thesis recommends that MCDM could be used as an effective deliberation tool as it allows to compare detailed and high-resolution data with common or expert perceptions of capability and disadvantage. As a result, MCDM is expected to add a degree of nuance to policy co-design processes.



**Figure 7.2.** Income Deprivation in Bristol (2015)



**Figure 7.3.** The key output of the MCDM decision-support tool - “Highly Disadvantaged” areas according to the “Informed Subjective” scenario



**Figure 7.4.** The key output of the MCDM decision-support tool - “Highly Capable” areas according to the “Informed Subjective” scenario

#### *7.2.2.5. Metering summary*

The section has explored the contemporary discourses of smart metering present in the marketing materials. The analysis recognised three emerging themes: convenience, control and saving.

Furthermore, exploratory focus group identified that the above three themes are misaligned with the practitioners’ view on the technology. Indeed, sustainability practitioners expressed more sceptical and complex views with regards to the potential positive contribution of metering to low carbon and just future.

The thesis yielded policy recommendations for an improved communication strategy, which ought to become more transparent and explicit about the benefits and limitations of metering.

Although the recommendations are targeted at the local practitioners, metering (both for water and energy) is largely a domain of the national government or national water regulator. As such, the research outlined the scope of the local actions, namely, continuing cross-sectoral collaboration (water-energy nexus) and enabling access to data.

At the theoretical level, the thesis facilitated the “translation” between the academic theories and the practitioners’ work. In particular, it focused on the current and possible application of the climate justice scholarship.

Finally, the research expanded the notion of “climate justice” by theorising and quantifying “high capability” and “highly disadvantaged” area using MCDM. The analysis was grounded in the results of the targeted focus group as well as the local datasets.

Further research is required to implement MCDM in deliberations on smart policies. This should be complemented with an in-depth investigation of the future energy and water tariffs.

### 7.3. Chapter summary

This chapter discussed the strengths and limitations of the research design, methodology and epistemology. It also debated the significance of results in light of research questions and objectives. As a result, it evidenced theoretical and practical contributions of this thesis.

The main theoretical contribution of this thesis is illuminating links between the WEF Nexus and climate justice. This was achieved by applying these concepts to the themes of metering and food waste and discussing their relevance and usefulness to the local policy design.

Meanwhile, the main practical contribution of this thesis lies in creating a space for action research where the stakeholders from the public, private, charity and academic sectors are participating not only in theory formation but also in improving policy design practice.

To summarise, this chapter demonstrated how the thesis answered the research questions and fulfilled each objective. Consequently, the researcher showed how she met the overarching aim of the PhD: “to co-produce policy recommendations for a low

carbon future of Bristol with a wide range of practitioners from the public, private and charity sectors”. The following Chapter will present the researcher’s critical reflections from the process (Stage 4 of the methodology).

## **8. Critical Reflections from the process**

Reflecting on work-in-progress is an essential element of action research. The process of self-reflection evaluates the use of the WEF Nexus framework, the application of the methodology and the quality of collaboration. In the context of the thesis, the reflective chapter is also a testimony for the professional development of a researcher-to-be. Although Rugg and Petre (2004) warn that the inclusion of self-reflection might be seen unfavourably (“*Some people believe that this is pretentious navel-gazing at best, and gratuitous pouring of blood into the water at worst, not to mention a gross breach of the third golden rule: don’t panic and blurt out the truth*” (p.71)), the researcher decided not only to keep a reflective diary over the course of the PhD, but also to elaborate on the key achievements and challenges in the thesis itself. In doing so, self-reflection leads to practical and theoretical recommendations. It also evidences the learning process and encourages a candid discussion with colleagues and participants.

The chapter is organised as follows: it starts with a reflection on key learning points in Chapter 8.1,-moving on to discussing the challenges in Chapter 8.2, providing a reflection from a parallel WEF Nexus-oriented project (Chapter 8.3) and dissemination record to date (Chapter 8.4). Going forward, Chapter 8.5 sketches the researcher’s intellectual ambitions for the future. Consequently, Chapter 8 aims to report on the researcher’s professional development. The remainder of the chapter is written in the first person to convey the subjectivity of personal experience.

### **8.1. PhD as learning**

PhD is not only a research project aiming to produce new, publishable knowledge. It is also a training programme, resulting in a degree which gives me a licence to practice as a research professional. Three years of being a PhD student, therefore, presented me with plenty of learning opportunities. Here are the key research capabilities I have gained while working towards the submission of the thesis.

First of all, I ought to acknowledge my disciplinary transition. With a background in BSc Geology and Geography, I understood the physical mechanisms contributing to climate change and other environmental processes. Yet, my understanding of political and social factors contributing to it was limited to my professional experience in Bristol City Council. Similarly, my interest in philosophy, languages and social sciences stemmed from personal reading time rather than formal training. In hindsight, I would have benefitted from an extra Masters’ year focused on social research methods (if only higher education was free). In the absence of social science

Masters' qualification, I strived to reach an appropriate level of expertise by organising a qualitative methods journal club together with my peers. Discussing a wide variety of data collection and analysis methods proved to be the single most useful thing when justifying own research methodology.

In fact, peer debates made me acknowledge that the whole research process is, in fact, a social practice (Bozeman and Rogers, 2001). Fellow PhD students proved invaluable when discussing shared dilemmas and emotional states. Senior colleagues provided me with a sense of direction, reassurance and tacit knowledge about navigating through the university formal and unspoken rules. Professional services staff curated a whole series of skills development events, ensuring that we take the notion of learning seriously.

Besides the social side of research, this PhD provided me with an excuse to spend an extensive period of time reading key theorists as well as contemporary debates in my field. Familiarising myself with a history of environmentalism, climate justice and research epistemologies is certainly a privilege which I need to be aware of when interacting with people who were not able to spend as much time in the university library. Ironically, I still occasionally get a sense that I haven't read "enough", perhaps due to the fact that nexus-style PhD necessitates reading "broadly" to make connections between ideas rather than reading "deeply" to specialise in one area.

Finally, I treated this PhD as training in project management. Somewhat generously, we're given three years to find our preferred workflow in order to navigate through mostly self-structured deadlines. Personally, I'd like to think I thrive on independence, yet, just like other researchers, I had to learn how to stay focused despite distractions. In the age of instant notifications, it is too easy to disrupt own workflow with emails, let alone the rest of the Internet. Moreover, our society holds normative judgements about work, glorifying visible busyness and displaying contempt for signs of procrastination. Meanwhile, I believe that *good quality* research is a result of careful balancing between efficiency and a scheduled redundancy. On one hand, discipline and diligence are essential when producing research outputs to a deadline. On the other, research occurs in a mental space involving creativity, undivided attention and high-level analytical processing, all of which require an appropriate emotional state (Csikszentmihalyi, 2008). Researchers, when not realising their fullest intellectual capabilities, are in fact often disrupted by unprocessed insecurities (Mann, 2016). However, to an outsider, this looks like procrastination. Therefore, researchers need to observe their own working habits and

proactively schedule “redundancy time” for self-reflection to work towards the best possible emotional state.

## 8.2. Acknowledging research challenges

An inherent feature of writing a thesis is a paradox of hindsight. If I could do my research again, would I do it differently? Coming across challenges was inevitable as I was inexperienced when beginning the project. Research is by definition innovative; however, we are not bound to face the same obstacles when embarking on the new projects. Dennett (2013) offers an optimistic outlook on such research challenges as he sees them as necessary conditions for learning. He invites to think back to when a challenge happened and ask: “what was I thinking?”

*“When we reflect, we confront directly the problem (...) What was it about what I just did that got me into all this trouble? The trick is to take advantage of the particular details of the mess you’ve made, so that your next attempt will be informed by it and not just another blind stab in the dark” (ibid. p. 23)*

Table 8.1 signposts to a list of challenges which could only be acknowledged once I have completed the 3-year training, commonly known as “the PhD”.

**Table 8.1.** What I was thinking when facing research challenges

Research challenge	What was I thinking?	My response
Not involving lay citizens	<i>“I cannot remunerate members of the general public in a fair way, therefore I shouldn’t get them involved”</i>  <i>“Everyone can have an opinion on sustainability issues, but whose views are valid and relevant here?”</i>	Chapter 8.2.1
Integrating methods and concepts	<i>“As a PhD student in modern times, I need to be transdisciplinary and innovative, therefore, integrate multiple methods”</i>	Chapter 8.2.2
Ambition to redefine the WEF Nexus	<i>“As a researcher, I have the power to create scientific discourse”</i>	Chapter 8.2.3

### 8.2.1. Not involving lay citizens

One of the key dilemmas I faced in the early stages of research design was the question of whom to involve and how. After careful deliberation on the research questions and

recruitment practicalities, I decided not to involve lay citizens (i.e. the end-users of smart technologies) in the research. Firstly, the thesis is concerned with improving policy practices in the niche and emerging areas. Therefore, the research required inputs from participants who had both professional, local and private experience of food waste and metering issues. Secondly, my PhD budget did not allow reaching out to the general public. I could have conducted focus groups and surveys with professionals without remunerating them as it was treated as a part of their jobs. I would not have felt comfortable following this format with the lay citizens, especially if they were coming from disadvantaged backgrounds.

Last but not least, I am aware of the challenges of co-producing research and policies with lay citizens. Claims on policy co-design include higher acceptability of ideas (Blomkamp, 2018). However, do citizens want to create policies? Do they want to commit their time and energy to it? Taking the argument further - is direct democracy a solution? There is surprisingly little “evidence” on co-design in the public sector, and the question of “whom should I involve and how?” was on my mind throughout the whole time. Having previously worked for the Bristol City Council where I had to engage lay citizens in a controversial transport policy area (see Chapter 3.7 for the details of my professional past), I knew that when asked about contentious issues, everyone has an opinion. In fact, it is very challenging to differentiate between an informed opinion and unfounded prejudice. Therefore, I decided to conduct research with sustainability practitioners. In other words, those with experience and awareness of food waste and metering debates.

### 8.2.2. Integrating methods and concepts

Another challenge pertaining to this PhD was to synthesise multiple methods, themes and theoretical concepts. I acquired an interest in integrative frameworks and methodologies a few months before starting the PhD degree. In early 2015, I volunteered at the Schumacher Institute for Systems Thinking. That’s where the ideas of “getting out of siloes” first appealed to me. I realised that we cannot reduce sustainability issues to singular indices and “silver bullet” solutions. Synthesising and collaborating seemed to be an appropriate answer to the complex nature of sustainability challenges.

As my research project developed, I engaged with numerous topics and methods. At the beginning of my third year, I realised that my literature review is considered with five sub-chapters and that in total I employed five methods (thematic analysis, discourse analysis, focus group, qualitative survey, MCDM).

Have I succeeded as a transdisciplinary researcher? Firstly, I made the most of the training received in a number of useful methods and theories – as a researcher, I am now well-rounded and could fit into numerous research projects in the future. Has the PhD succeeded? Yes, each topic was covered to an appropriate depth, given the word limit and available time. A part of me thinks that incorporating multiple methods, concepts of both climate justice and the WEF Nexus, as well as two themes, made it challenging to pull together a single PhD narrative. I am not researching **solely** the WEF Nexus, or smart cities or waste management. However, if I had to point at one idea which binds the thesis, it would be the climate justice approach as it permeates both the theoretical and methodological sections. Moreover, climate justice, as opposed to the WEF Nexus is a more established concept, therefore I did not have to re-define and contest it throughout the research.

### 8.2.3. Ambition to redefine the WEF Nexus

The initial title of my thesis was “Quantifying WEF Nexus-friendly GHG emissions pathways to the low carbon future of Bristol”. By the third month, I realised this direction of research was not feasible in the Bristol context. Firstly, the WEF Nexus was driven by international discourses and data. Meanwhile, I didn’t have access to data on the relationships between water, energy and food at the urban scale. This information probably exists but is securely stored by commercial organisations, e.g. waste management, energy or water companies. The future urban WEF Nexus research would ideally produce data sharing agreements at the very start of the project.

One event which directed my thinking was the Royal Geographical Society conference in 2016, which was themed around the WEF Nexus. To the human geographers, the WEF Nexus seemed managerial and technocratic. The WEF Nexus discourse reduced key sustainability challenges to the questions of “efficiency” and “optimisation” (see Chapter 2.2 for social science critique of the WEF Nexus). How to then proceed as a self-reflective WEF Nexus researcher? Can I re-define or critique it? Ultimately, I decided to welcome the WEF Nexus approach with caution and scepticism. On one hand, it is broad enough to contain my understanding of the WEF Nexus as “the cross-sectoral and mixed-method investigation of complex environmental issues”. On the other, the “original” WEF Nexus, as endorsed in the United Nations’ circles (Hoff, 2011) lacked qualitative and critical perspectives, which my research addressed. As a result, this PhD found several nexûs, not only between water, energy and food but also between the sectors and the issues of social justice.

Once, I identified these critical and under-researched interactions, I strived to share my contribution within the academic setting by a) by participating in a panel discussion on applying the WEF Nexus in practice (the United Nations Dresden conference, 2017) and b) discussing water-energy nexus and cross-sectoral learning in a peer-reviewed paper on metering (Michalec *et al.*, 2018).

Was I able to influence the understanding of the WEF Nexus? The debate during the UN Conference proved very popular and following the event, I was approached by multiple people who thanked me for explicitly bringing up the issues of justice. Meanwhile, academic papers are traditionally considered “impactful” if they subsequently cited by other researchers. At the time of submission, I have been cited by one academic paper and I hope that promoting my paper to fellow researchers in the field will further improve my exposure. In mid-2018, I took a 5-month sabbatical from the PhD to work for the Economic and Social Research Council (ESRC) funded Nexus Network+. I utilised that period to connect with the existing WEF Nexus community of practice in the UK. The following paragraph will summarise how Nexus Network+ informed subsequent thesis write-up stages.

### 8.3. Lessons from another WEF Nexus project

Between June and October 2018, I was employed as a full-time Research Assistant at the University of Sussex. Together with two other part-time early-career academics, we led the final part of the ESRC 4-year funding scheme called Nexus Network+ (<https://thenexusnetwork.org/>). The aim of our research was to revisit the recipients of five Partnership Grants who between 2016 and 2017 undertook research across the domains of the WEF Nexus using transdisciplinary approaches. We surveyed, interviewed and did a bibliometric analysis of over 30 academics and external stakeholders. Our research questions asked what capabilities (here understood as skills, personality traits, attitudes, opportunities, networks) are required for transdisciplinary research across the WEF Nexus domains.

The results revealed the richness of the Partnership Grant Projects accounts. We found what the official documents (i.e. project reports, published papers, staff web profiles and Web of Science databases) present as work bound within the project timescales is, in fact, reaching significantly beyond the projects’ start and end dates. Our research calls for the explicit recognition of the “background arena” – the sum of tacit knowledge, connections nurtured over decades, local understandings, work experiences beyond academia. Following participants’ reflections, we argue that while the financial backing for short-term transdisciplinary projects grows, the current research funding climate does not recognise the need for supporting longer timescales

required for the successful crossing of sectors and disciplines. We suggest that evaluating and, ultimately, valuing transdisciplinary research should first and foremost bridge the gap in current institutional capacities and work on enabling new networks, un-disciplining promotion panels and changing grant writing procedures which impede co-production.

This research project allowed me to make parallel observations in the context of my PhD. After all, I also wrote a thesis on co-producing knowledge across the domains of the WEF Nexus. Interviewing fellow researchers and hearing them sharing difficulties with doing transdisciplinary and WEF Nexus projects provided me with a degree of reassurance over my thesis. If some distinguished professors are struggling with applying WEF Nexus to the UK policy context, then I am legitimised to find it challenging as well. If a Principal Investigator admits that their collaboration with an external stakeholder was successful due to 20 years' worth of professional friendships, then I can manage my expectations accordingly. Despite the fact that I didn't have much lead-up time to build the network, I consider my collaborative outputs (namely, three collaborative peer-reviewed publications, two policy briefs and two practitioners' events) a success.

Last but not least, working for the Nexus Network+ allowed me to "buy time" necessary to go through a peer review process and publish two articles before submission of the thesis. Knowing that publishing is the currency of the trade, I now feel more optimistic about my career options. Similarly, the time away from the PhD gave me a cognitive distance invaluable during the write-up stage. I stopped being attached to my writing outputs and gained a more objective view of the entire process.

#### 8.4. Dissemination

I acknowledge that publishing the results in the academic context (Appendices A, C and I) is merely a beginning of the dissemination process and needs to be supported with continuous engagement with co-researchers and other stakeholders using the appropriate format. For example, in the policy setting, it is crucial to keep concise and avoid academic jargon. Practical recommendations resulting from the research were communicated to the following stakeholders:

- Local councillors
- Municipally owned Waste Company
- Cross-sectoral Waste and Resources Action Group
- Bristol Food Policy Council
- Traders' groups and Business Improvement Districts

- Energy and water companies
- Community Energy Network

Thanks to the connections made throughout the PhD, I was invited to participate in numerous consultations and strategic events. When possible, I made sure I communicated the research results or advocated climate justice agenda. Yet, there is no guarantee our research recommendations will ever inform policies. The policy design process is too long to ever evaluate the success within the PhD timeframes.

Table 8.2 outlines events during which I had the opportunity to disseminate research results outside of the academic environment.

**Table 8.2.** A list of the non-academic events, during which I disseminated my research

Event name and date	Event Description	My contribution
“Going for Gold” Bristol Food Policy Council Roundtable on commercial food waste March 2018	Setting priority actions needed to be completed before submitting the evidence for the “Gold Sustainable Food City Award” in 2020	I communicated policy recommendations for improved food waste service and called for the Mayor to lead on the improvements in the deprived areas.
Bristol One City Plan – consultation event February 2018	Discussing local priorities for Bristol between 2018 and 2050	I advocated for the climate justice agenda during the discussions on waste and resources.
Waste and Resources Action Group (quarterly meetings over 2017-2019)	Discussing work in progress on waste issues in Bristol	I reported research results to waste companies, environmental consultancies and the local council
Community Energy Fortnight July 2018	Evaluating the progress of the Community Energy Strategy and setting priorities for the future	I presented the results of the research on smart meters
Bristol Forum March 2019	Exploring how research, knowledge and practical action can address key challenges facing the city	I delivered a workshop on building capabilities for smart policymaking

## 8.5. Ideas I would like to take forward

Although a thesis is a time- and space-bound project, it inevitably results in further questions. While recommendations for future research and policy can be found in the Conclusions Chapter, satisfying one's intellectual curiosity in one field increases an appetite for investigating theories and methods in other areas. By following the contemporary debates in social sciences, I have started a process of carving my own niche for future employment. Thus, here are the ideas I'd like to work with:

### **Collaboration**

The paradigm of “grand challenges” calls for collaborative action on researching, designing and co-creating preferable futures. At the same time, I have recognised that working with differences is inherently challenging. Diversity comes in multiple forms: personality traits, values, organisational cultures, academic disciplines, socio-economic backgrounds, training received, just to name a few. I would like to know “what is it like to be you?”, an engineer, a civil servant, a sociologist, a software developer? How can cross-sectoral teams successfully align their values and practices?

### **Urgent social change**

Research is traditionally considered to be a slow process with timescales mediated by bureaucracies, peer-review and attention to detail required to produce a high-quality analysis. Meanwhile, both society and the planet seem to be evolving faster than ever. How could research on global challenges keep up with a pace of change? I would like to know how universities could contribute to the notion of urgency. How could we, as researchers, work in-between the notions of “impartial evidence” and “political pressure”?

## 8.6. PhD as a professional development

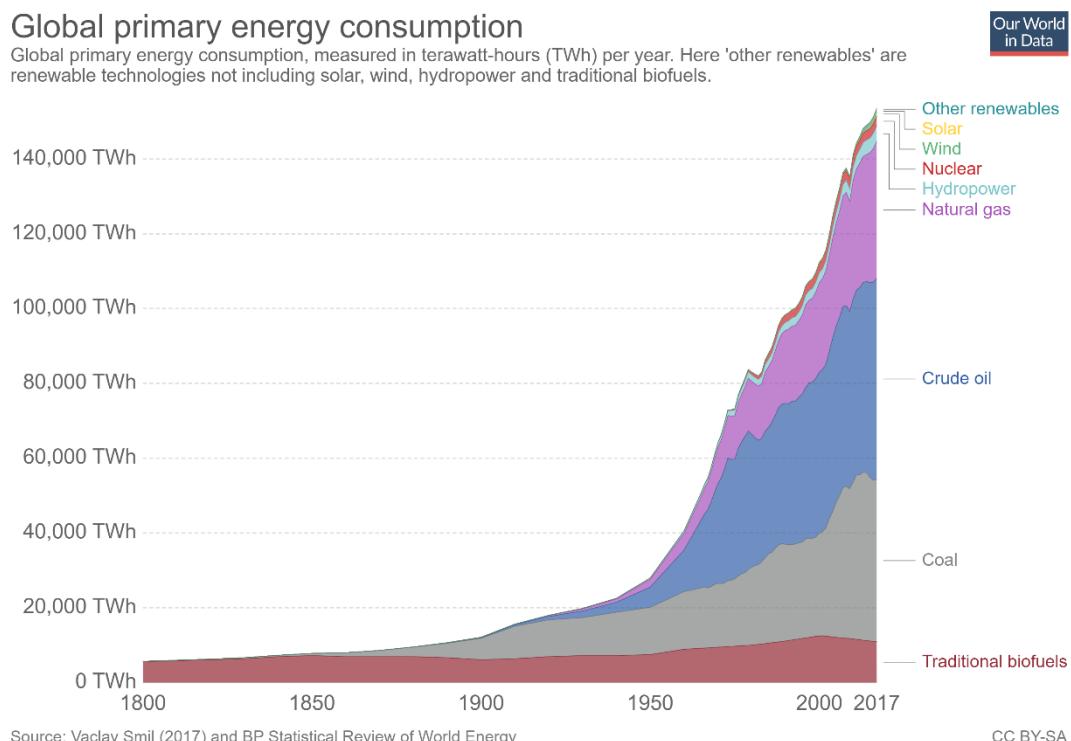
The goal of action research is to improve the professional practice by researching *with* the practitioners, in this case, sustainability workers across the private, public, voluntary and education sectors. While I cannot make claims about the professional development of my participants as individuals, I can state that the research results – co-designed policy recommendations *are* the improvement to the local policymaking practices, which to date had little consideration for climate justice and the WEF Nexus.

“Improving professional practice” refers also to my own development. Here are the areas, in which I have gained a license to practice as a researcher:

- I have an in-depth understanding of the “meta” level of research, in particular, current methodological and epistemological debates.
- I know Bristol well as a city. I am familiar with its assets, challenges and the strategy for the future. I know the key stakeholders who strive to make it a better place.
- I have strengthened my dedication to research for the social good – whether by tackling poverty, improving participation or mitigating climate change.

Over time, my professional interests progressed in the direction of smart cities and future technologies. Doing research on smart meters felt truly innovative and gaining capabilities in GIS methods made me appreciate the power of data science. Digital technology is one field of study which gathers concerned people from across backgrounds and political leanings. So far, there is no single dominant narrative and no denial that emerging technologies could bring both benefits and challenges.

On the other hand, deliberating the possibility of mitigating climate change left me demoralised. Each time, when I looked at the global scale and the rate of progress in reducing GHG emissions, I began to doubt my efforts (Figure 8.1).



**Figure 8.1.** A timeline of global energy consumption by fuel source (Our World in Data, 2017) (CC BY licensed)

In particular, the year 2018 marked the formation of new discourses of “urgency” and “extinction”. In 2018, the IPCC report announced that we have 12 years left to avoid *“an urgent and potentially irreversible threat to human societies”* (United Nations, 2018, p.79). Following the release of the document, a series of direct action initiatives, Extinction Rebellion, has emerged across the country, signalling the need for systemic change (British Broadcasting Corporation, 2018b). Not only did the campaign emphasise the need for action, but it also started a conversation about the feelings of grief and anxiety, increasingly present among the population. It took me a while to realise that the shift of my motivation from environmental to science and technology studies was primarily caused by these difficult emotions.

I am curious to see whether in 10 years’ time I will work in climate change, social justice or a technology-related field. The future will be probably mediated by the political trends and jobs available at the time, but I would like to think I will have a considerable degree of agency over it. For now, if I was to provide a recommendation related to the professional development of fellow sustainability academics, it would be to discuss climate change more often and more openly; both as a personal and a research issue.

## 8.7. Chapter summary

Chapter 8 extended the discussion of methods and results by reflecting on the process of learning, personal attitude towards research challenges and, finally, ongoing professional development. Following this critical reflection, the next chapter will synthesise themes and method to explicitly draw out the answers to the specific research questions documented in Chapter 1. In doing so, Chapter 9 will evaluate whether the thesis has met its aim and objectives and will conclude with recommendations for future research and policy design.



## 9. Conclusions and recommendations

This thesis has explored the potential for co-designing environmental policies together with the local sustainability practitioners. It has drawn attention to the multiple discourses of food waste and smart metering present across the grey literature, news and marketing materials. Using the lens of the WEF Nexus, the thesis aimed to understand how practitioners discuss complexity, integration and justice in policymaking. This was presented in two themes (food waste and metering) and the results were summarised in Chapters 5 and 6. Subsequently, the discussion on how this research has contributed to the existing field of knowledge is considered in Chapter 7. Chapter 8 included the researcher's reflections on her professional development and the experience of working across the boundary of academia and practice. This thesis has illustrated how the methodology of action research can yield both theoretically grounded and pragmatic results in the area of environmental policy.

This chapter will summarise theoretical contributions and policy recommendations resulting from this thesis. It will evaluate whether the researcher met the aim and objectives set in the introductory Chapter 1. Finally, it will suggest a suite of actions applicable to future research projects in cognate areas.

### 9.1. Theoretical contributions

#### 9.1.1. On practitioners' understanding of the WEF nexus

The thesis examined the usefulness of the WEF Nexus lens on an urban scale by applying it to the real-world cases of policy co-design in Bristol. Debating the local interactions, potential for integrating decision-making and data gaps demonstrated that the WEF Nexus could become a relevant framework **only if** its understanding is extended beyond the original conceptualisation (Hoff, 2011). Drawing from the findings from the practitioner engagement, the thesis concludes that the urban-scale WEF Nexus bears relevance to the following:

- Learning across organisations working in the areas of water, food, energy sectors.
- Preventing the unintended consequences of environmental policies impacting the most disadvantaged citizens.

At the same time, the research demonstrated the limitations of Hoff's (2011) WEF Nexus thinking when applied to the urban context:

- There is not enough local data to accurately model flows of resources at the urban scale.

- Political decisions with regards to the water, energy and food management are rarely in the hands of the urban actors.

### 9.1.2. On the WEF Nexus and climate justice

The novelty of the research lies in explicitly illuminating links between the WEF Nexus and climate justice on an urban scale. The research indicated that the academic movement towards investigating interactions across water, energy and food risks a significant omission of ethical considerations in policymaking. Increased demands on data and analysis must not detract the policymakers from discussing the core question of the climate justice agenda: “how to enable low carbon **and** just future?”

In the context of the policy research applying WEF Nexus lens, “just policymaking” is understood as:

- Preventing the unintended policy consequences on disadvantaged people.
- Maximising GHG emissions reduction by prioritising those already capable of doing so.
- Building capability of the most disadvantaged people so they have the agency to contribute towards a low carbon future.
- Improving participation in policymaking by reaching out to the local practitioners.

In conclusion, explicit ethical grounding of the research and policy proposals is necessary **before** increasing the complexity of analysis. In order to maximise GHG reduction **and** tackle social inequalities, cities need a suite of complementary policies. These should be designed so as to simultaneously reduce GHG emissions of the most capable citizens and reduce deprivation among the most disadvantaged people, so their capability to contribute towards low carbon future could increase accordingly.

## 9.2. Policy recommendations

The following two sections detail how the thesis meets the practical side of the objectives #2 (“*to provide the evidence base for the local low carbon policy recommendations*”) and #3 (“*to exemplify the opportunities for just environmental policymaking*”).

### 9.2.1 Food waste

The research yielded the following policy recommendations for an improved food waste recycling service in the catering sector:

- Bottom-up and operational solutions will give agency to the catering sector, for example implementing flexible and co-ordinated waste collection services.
- Engagement is the key: for example, displaying pro-recycling stickers or emphasising business benefits of recycling (e.g. improved stock and portion monitoring).
- Business engagement should address the barriers voiced by the participants applying the arguments used by the catering sector, rather than assuming that restaurants and cafes are not aware of the issue.

Furthermore, focus groups revealed the following complexities related the potential policy co-design:

- Diverting food waste from landfill could generate more low carbon energy through AD.
- Large-scale deployment of AD could affect the availability of food for people affected by poverty.

Discussing preliminary results with co-researchers highlighted the following questions ought to be considered during policy design:

- If food waste recycling is introduced to the commercial sector, will it be charged by weight or volume? This is an important consideration as food waste is one of the heaviest recyclables.
- Will future recycling policy then repurpose food waste to anaerobic digestion, compost, or animal feed?

Finally, although the policy recommendations are linked to a potential local policy, mandatory food waste recycling is a domain of the national government. In the light of this caveat, the scope of the local actions is bound to:

- A non-mandatory paid service delivered by the municipally owned waste company.
- Change of planning regulations, requiring food waste recycling in newly built commercial areas.
- Improvement of food waste recycling in the areas currently managed by the council, e.g. markets.
- Local MPs lobbying for the introduction of mandatory food waste recycling.
- Gathering and sharing data on food waste and food surplus.

### **9.2.2. Metering**

The research resulted in a suite of recommendations for improved communication of metering technology:

- Future communication materials should be transparent about potential benefits to the individuals and utility companies.
- They should be tailored to customers' diverse needs, values and priorities.
- They should reflect the advanced functionality of metering.

Furthermore, the research revealed climate justice complexities related to the implementation of metering across water and energy sectors:

- Metering doesn't automatically lead to a reduction in consumption. Its functionality is contingent on purchasing further smart home gadgets and the re-design of water and energy tariffs.
- The most disadvantaged people might not benefit from metering, as they often do not have the capability to invest in home improvement measures.
- This dilemma could be solved by a complementary suite of policies: smart metering implementation targeted at the affluent early adopters who would then subsidise a support package aimed at the most disadvantaged citizens.

Currently, the limits to the above policy recommendations are:

- Access to energy and water data is restricted.
- Integration of decision-making across water and energy sectors is yet to materialise.

### 9.3. Synthesis: Objective 1

The following tables illustrate how the thesis Objective 1: “*to examine discourses on the selected sustainability challenges in Bristol*”.

**Table 9.1.** Selected discourses of food waste across the research stages

<b>Academic Literature</b>	<b>Grey Literature</b>	<b>News articles</b>	<b>Practitioners (focus group)</b>	<b>Catering businesses (qualitative survey)</b>
Wasting food as a result of business incompetence (Thomson and Haig, 2017)	Food waste is divided into “avoidable” and “unavoidable” (Waste and Resources Action Programme, 2017a)	There is no single reason or solution	Knowledge about food waste is mostly anecdotal	Food waste recycling in an environmental obligation
Distributed responsibility for food waste (Welch <i>et al.</i> , 2018)	The waste hierarchy shows a preferable course of action (European Commission, 2008b)	The debate is highly normative	The anti-food waste movement has risen in popularity over the past 10 years	Food waste recycling isn't our problem
Blurred boundaries between wasting and saving; between food waste and food surplus (Evans, 2011)	There is a clear line between food waste and surplus food (European Commission, 2008b)	Supermarkets promote customer-oriented solutions	We lack quantitative data on food waste	Recycling food waste is a sign of competent business management

<b>Academic Literature</b>	<b>Grey Literature</b>	<b>News articles</b>	<b>Practitioners (focus group)</b>	<b>Catering businesses (qualitative survey)</b>
Wasting food causes anxiety (Evans, 2011)	The UK lacks food waste regulations (Priestley, 2016)	Food waste as a result of poor financial management	We lack food waste regulations	N/A
Wasting food as a result of family care (Evans, 2012)		Food waste as a sign of family neglect		
Current food waste measures do not follow the waste hierarchy framework (Mourad, 2016)		Food waste as a result of the unethical business practices		
		The current unregulated system of food redistribution is exploited by retailers		

**Table 9.2.** Selected discourses of metering across the research stages

Academic Literature	Grey Literature	Marketing Materials	Practitioners (focus groups)
Lack of agreement with regards to the effectiveness of metering	Smart metering as a resource efficiency policy (European Commission, 2012)	Meters are convenient	Marketing materials aren't transparent and honest
The successful rollout of metering is highly contingent on the interactions between the users and the emerging technologies (Spence <i>et al.</i> , 2015)	Smart energy metering implementation programme is a subject to serious delays (Hinson, 2018)	Installing a meter will reduce your bill	Marketing materials do not reveal the full functionality of metering
Metering water contributes to its commodification (Loftus, 2006)	Water metering implementation is not a policy priority in the UK (Priestley, 2016)	Installing a meter will put you in control of your consumption	Smart metering should enable intelligent choices
The integration between the water and energy sector is in its infancy (Helmbrecht <i>et al.</i> , 2017)			Smart metering should focus on fair policy implementation
			Diverse types of customers require tailored communication and policy approaches

#### 9.4. Synthesis: Objective 2

The paragraph below summarises how the overall research design applied in the thesis contributed towards objective #2, “*to provide the evidence base for the local low carbon policy recommendations*”:

- Discourse analysis acted as a bridge between academia and practice allowing effective translation and learning across the sectors.
- Focus groups highlighted current data gaps and policy priorities.
- The qualitative survey gave voice to the catering sector when co-designing food waste recycling policy.
- Discussing preliminary results with co-researchers improved their applicability to the local context.
- MCDM analysis grounded practitioners’ discussions in the urban quantitative data.
- Subsequent results were collaboratively disseminated using multiple channels (peer-reviewed articles, policy briefs, practitioner and academic conferences).
- Meaningful participation in policy co-design improves participants’ ownership of policy recommendations and could, therefore, contribute to the higher acceptability of policy proposals.

#### 9.5. Synthesis: Objective 3

The following paragraph summarises how the research design applied in the thesis contributed towards objective #3, “*to exemplify the opportunities for just environmental policymaking*”:

- Discourse analysis was concerned with the issues of power and voice, by answering “to whom we give agency to frame environmental issues?”
- Focus groups gathered practitioners across a variety of organisations, regardless of their seniority.
- Focus group discussions illuminated the unintended consequences of future environmental policies.
- The qualitative survey highlighted the issue of capability and agency over resource consumption.

- MCDM quantified the notion of “high capability” and “high disadvantage”, demonstrating the need for complementary approaches when implementing “smart” policies.
- The methodology of action research incorporated the notion of meaningful participation throughout the research design. The thesis demonstrated that “meaningful participation” is, therefore, context-sensitive rather than linear.

## 9.6. Synthesis – achieving the research aim

The following paragraph outlines how the thesis met the overarching aim of the research, *“to co-produce policy recommendations for a low carbon future of Bristol with a wide range of practitioners from the public, private and charity sectors”*:

- Policies recommended were within the scope of action of the local authority and cross-sectoral partnerships.
- Local practitioners indicated the priority policies and contributed to each step of the research process.
- The research highlighted complex interactions between environmental and social domains of co-designed policies.
- The research explicitly defined sustainability policies as those contributing towards low carbon and just futures.

## 9.7. Further research recommendations

The results of the research (Chapters 5 and 6) and the discussion in Chapter 7 highlighted a number of areas for further work. As such, these form the recommendations from the thesis subdivided into a) food waste theme (Chapter 9.7.1); b) metering theme (Chapter 9.7.2); c) methodological comments (Chapter 9.7.3).

### 9.7.1. Food waste theme

1. To quantify the energy-generating potential of food waste management policies (especially AD). This should be complemented with a qualitative inquiry on formal and informal practices of donating surplus food and dealing with food poverty.
2. To examine the feasibility of compulsory food waste recycling in the catering sector by evaluating the existing policies in Scotland and Northern Ireland.

### 9.7.2. Smart metering theme

1. To investigate the equitable re-design of energy and water tariffs to e.g. block pricing or time-of-use.
2. To discuss the results of MCDM with the local practitioners. Future researchers should take care to present MCDM as a deliberation method, not an algorithm-based replacement of a political decision. Going further, MCDM could be used as a means to facilitate science-policy interactions by making stakeholders comfortable with the notions of plurality and uncertainty.
3. To fully utilise the data from smart metering (assuming water and energy smart meters would be widely implemented over the next decade). In particular, high-resolution data (e.g. postcode level) would improve the sensitivity of the analysis.

### 9.7.3. Methodological recommendations

1. To finalise data sharing agreements at the early stage of future projects. This will increase the likelihood of timely analysis and policy engagement.
2. To provide background information on the WEF Nexus issues, if engaging stakeholders working across the sectors. This will ensure that all participants will be able to confidently discuss key issues to an appropriate depth.
3. To reflect on “what is appropriate?”, given a) project timescales b) participants’ availability c) project budget d) formal procedures e) power dynamics present within the project f) values embedded in the project aims. In doing so, the future researchers will establish a meaningful collaboration with the non-academic stakeholders.
4. To establish a stronger theoretical link between action research and transdisciplinarity. Transdisciplinary researchers should draw from the ethics of action research, by including concerns such as a) who is given a platform to collaborate? b) who has the power to create knowledge? As such, transdisciplinarity encompasses more than a mere crossing of disciplinary and sectoral boundaries. Transdisciplinarity drawing from action research focuses on *how* disciplinary and sectoral crossing is done and whether it leads to low carbon and just future.

#### **9.7.4. Empirical recommendations**

This thesis brought a necessary groundwork for the future work of co-designing environmental policies with justice as a guiding principle. Future work in the field should extend the notions of climate justice and co-design to involve lay members of the public, marginalised residents as well as intersectional analysis of climate justice. In particular, this could cover research on public participation in policymaking and mapping multiple dimensions on justice in GIS. The researcher recommends that in order to materialise this research direction, universities ought to:

- Find financial resources to appropriately engage with marginalised residents
- Collaborate closely with non-academic organisations (e.g. governments, utilities) to collect data on water, energy and food consumption and poverty.

## References

- ACORN (2012) CACI Acorn Segmentation. Map commissioned by the Bristol City Council. [online] Available from: [http://maps.bristol.gov.uk/instantatlas/Acorn/Map%20%20Acorn%20Segmentation%20\(Brisol\).pdf](http://maps.bristol.gov.uk/instantatlas/Acorn/Map%20%20Acorn%20Segmentation%20(Brisol).pdf) (last accessed: 3<sup>rd</sup> May 2019)
- Adger, N. (2001) Scales of governance and environmental justice for adaptation and mitigation of climate change. *Journal of International Development*. 13 (7), pp. 921.
- Adger, N. W., Arnell, N. W. and Tompkins, E. L. (2005) Successful adaptation to climate change across scales. *Global Environmental Change*. 15 (2), pp. 77-86.
- Agar, M. and MacDonald, J. (1995) Focus Groups and Ethnography. *Human Organization*: Spring 1995, Vol. 54, No. 1, pp. 78-86.
- Agyeman, J. (2002) Constructing Environmental (in)justice: Transatlantic Tales. *Environmental Politics*. 11 (3), pp.31-53.
- Agyeman, J., Schlosberg, D., Craven, L. and Matthews, C. (2016) Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainable. *Annual Review of Environment and Resources*. 41 (1), pp.321-340.
- Albrecht, T.R., Crootof, A., Scott, C.A., (2018) The Water-Energy-Food Nexus: a systematic review of methods for nexus assessment. *Environmental Research Letters*. 13 (4), 43002.
- Allouche, J., Middleton, C. and Gyawali, D. (2015) Technical Veil, Hidden Politics: Interrogating the Power Linkages behind the Nexus. *Water Alternatives*. 8 (1), pp. 610-626.
- Caragliu, A., Del Bo, C. and Nijkamp, P. (2011) Smart Cities in Europe. *Journal of Urban Technology*. 18 (2), pp.65-82.
- Arnstein, S.R. (1969) A Ladder of Citizen Participation, *Journal of the American Institute of Planners*, 35 (4), pp. 216-224.
- Artesia Consulting (2018) *The long-term potential for deep reductions in household water demand*. Report for Ofwat. [Online]. Available from: <https://www.ofwat.gov.uk/publication/long-term-potential-deep-reductions-household-water-demand-report-artesia-consulting/> (last accessed: 3rd May 2019)
- Bajzelj, B., Fenner, R.A., Curmi, E., Richards, K.S. (2016) Teaching sustainable and integrated resource management using an interactive nexus model, *International Journal of Sustainability in Higher Education*. 17 (1), pp. 2-15.
- Bartiaux, F., Vandeschrick, C., Moezzi, M. and Frogneux, N. (2018) Energy justice, unequal access to affordable warmth, and capability deprivation: A quantitative analysis for Belgium. *Applied Energy*. 225, pp. 1219-1233.
- Bartlett, J. (2018) *The People Vs Tech: How the Internet is Killing Democracy (and how We Save It)*. Penguin
- Bax, S. (2011) *Discourse and genre: analysing language in context*. Basingstoke: Palgrave Macmillan, pp. 98-99.

Bazilian, M., Rogner, H., Howells, M., Hermann, S., Arent, D., Gielen, D., Steduto, P., Mueller, A., Komor, P., Tol, R. S. J. and Yumkella, K. K. (2011) Considering the energy, water and food nexus: Towards an integrated modelling approach. *Energy Policy*. 39(12), pp. 7896-7906.

Beckel, C., Sadamori, L., Staake, T., Santini, S., (2014) Revealing household characteristics from smart meter data. *Energy*. 78, p. 397

Beddington, J. (2009) *Food, energy water and the climate: a perfect storm of global events?* [online]. London: Government Office for Science. Available from: <http://webarchive.nationalarchives.gov.uk/20121206120858/http://www.bis.gov.uk/assets/goscience/docs/p/perfect-storm-paper.pdf> (last accessed: 3rd May 2019)

Bennet, O., (2013) *Water Bills and Rateable Values*. House of Commons Briefing Paper. [online]. London: House of Commons. Available from: <http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06647#fullreport> (last accessed: 3rd May 2019)

Bertoldo, R., Poumadère, M., Rodrigues Jr., L.C., (2015) When meters start to talk: the public's encounter with smart meters in France. *Energy Research & Social Science*. 9, pp. 146–156.

Bevir, M, Needham, C, Waring, J. (2019) Inside co-production: Ruling, resistance, and practice. *Social Policy Administration*. 53, pp. 197– 202.

Bhaskar, R. (1975) A realist theory of science. Taylor and Francis

Block, D. and Corona, V. (2014) Exploring class-based intersectionality. *Language, Culture and Curriculum*. 27 (1), pp.27-42.

Blomkamp, E. (2018) The Promise of Co-Design for Public Policy. *Australian Journal of Public Administration*. 77, pp. 729-743.

Boulding, K. (1966) *The Economics of Coming Spaceship Earth*. Baltimore: John Hopkins University Press

Boulton, J.G., Allen, P.M. and Bowman, C. (2015) *Embracing complexity: strategic perspectives for an age of turbulence*. Oxford: Oxford University Press.

Bouzarovski, S. and Simcock, N. (2017) Spatializing energy justice. *Energy Policy*. 107, pp. 640-648.

Bozeman, B. & Rogers, J. (2001) Strategic Management of Government-Sponsored R&D Portfolios, *Environment and Planning C: Government and Policy*. 19, (3), pp. 413-442.

Bradley, P., Fudge, S., Leach, M. (2015) Motivating energy conservation in organisations: smart metering and the emergence and diffusion of social norms. *Technology Analysis and Strategic Management*. 28 (4), 435–461.

Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*. 3 (2), pp. 77-101;

Breen, R.L. (2006) "A Practical Guide to Focus-Group Research", *Journal of Geography in Higher Education*, vol. 30, no. 3, pp. 463-475.

- Bristol and South Gloucestershire Conservatives (2017) *Tim Bowles*. Available from: <https://www.bsgconservatives.com/people/tim-bowles> (last accessed: 3rd May 2019)
- Bristol Cable (2015) *Super (waste) markets*. [online]. 31 October. Available from: <https://thebristolcable.org/2015/10/super-waste-markets/> (last accessed: 3rd May 2019)
- Bristol City Council (2012) *Key statistics about Bristol from the 2011 Census*. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/34008/2011%20Census%20Key%20Statistics%20about%20Bristol%20LA%20areaUpdate.pdf/ob99e5ff-6e5b-4219-8177-35a5bfbed738> (last accessed: 3rd May 2019)
- Bristol City Council (2013) *Food Poverty: What does the evidence tell us?* [online] Bristol: Bristol City Council. Available from: <http://bristolfoodpolicycouncil.org/wp-content/uploads/2013/08/Food-Poverty-Report-July-2013-for-publication.pdf> (last accessed: 3rd May 2019)
- Bristol City Council (2015a) *Our Resilient Future: A framework for climate and energy security*, pp. 120- 198. [online]. Bristol: Bristol City Council. Available from: [https://www2.bristol.gov.uk/committee/2015/ua/uaooo/1103\\_binder.pdf](https://www2.bristol.gov.uk/committee/2015/ua/uaooo/1103_binder.pdf) (last accessed: 3rd May 2019)
- Bristol City Council (2015b) *Deprivation in Bristol. The mapping of deprivation within Bristol Local Authority Area*. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/32951/Deprivation+in+Bristol+2015/429b2004-eeff-44c5-8044-9e7dc002faf> (last accessed: 3rd May 2019)
- Bristol City Council (2015c) *Smart spaces project*. Available from: <http://www.smartspace.eu/en/pilot-sites/bristol> (last accessed: 3rd May 2019)
- Bristol City Council (2015d) *Deprivation data- local ward profiles. Statistics census information*. [online]. Available from: <https://www.bristol.gov.uk/statistics-census-information/new-wards-data-profiles> (last accessed: 3rd May 2019)
- Bristol City Council (2016a) *Bristol Resilience Strategy* [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/1308373/Bristol+Resilience+Strategy/31a768fc-2e9e-4e6c-83ed-5602421bb3e3> (last accessed: 3rd May 2019)
- Bristol City Council (2016b) *Towards a Zero Waste Bristol: Waste and Resource Management Strategy*. Bristol. pp. 1-40. [online]. Bristol: Bristol City Council. Available from: <http://www.bristol.gov.uk/documents/20182/33395/Towards+a+Zero+Waste+Bristol++Waste+and+Resource+Management+Strategy/102e90cb-f503-48c2-9c54-689683df6903> (last accessed: 3rd May 2019)
- Bristol City Council (2016c) *Review of Bristol 2015 Green Capital year*. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/1352057/European+Green+Capital+Review+report/f7ae017a-57b5-4bco-acdf-a1ed61380a35> (last accessed: 3rd May 2019)
- Bristol City Council (2016d) *Quality of Life in Bristol 2015-16*. Results of 2015 survey. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/33896/Results+of+quality+of+life+in+Bristol+survey+2015+to+2016/2a83bda4-fed5-400d-b638-2d2c72f67507> (last accessed: 3rd May 2019)

Bristol City Council (2017a) *State of Bristol: Key facts* [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/32947/State+of+Bristol+Key+Facts+2017-18> (last accessed: 3<sup>rd</sup> May 2019)

Bristol City Council (2017b) *Clean Streets Strategy*. [online]. Bristol: Bristol City Council. Available from: 502 <https://www.bristol.gov.uk/bins-recycling/clean-streets-campaign> (last accessed: 3<sup>rd</sup> May 2019)

Bristol City Council (2018a) *Our equality policies and equalities legislation*. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/people-communities/equalities-policy> (last accessed: 3<sup>rd</sup> May 2019)

Bristol City Council (2018b) Bristol launches search for partners to help build sustainable future. [online]. 9 May. Available from: <https://news.bristol.gov.uk/news/council-launches-city-leap-prospectus-3> (last accessed: 3<sup>rd</sup> May 2019)

Bristol City Council (2018c) *Find your councillor*. Available from: <https://www.bristol.gov.uk/council-and-mayor/find-your-councillor> (last accessed: 3<sup>rd</sup> May 2019)

Bristol City Council (2018d) *Overview and Scrutiny Management Board Supplementary Information*. [online]. Bristol: Bristol City Council. Available from: <https://democracy.bristol.gov.uk/documents/b9233/Bristol%20City%20Council%202018-19%20Budget%20-%20Full%20Report%2018th-Jan-2018%2016.00%20Overview%20and%20Scrutiny%20Manage.pdf?T=q> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Energy (2016) *Your smart meter and in-home display guide*. Available from: <https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering%20Guide-WEB-low.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Energy (2018) *About us*. Available from: <https://www.bristol-energy.co.uk/about-us> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Energy Network (2013) *Bristol Community Strategy for Energy*. [online]. Bristol: Bristol Energy Network. Available from: <http://bristolenergynetwork.org/legacy/strategy/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Food Policy Council (2015) *A Good Food Plan for Bristol* [online]. Available from: [http://bristolfoodpolicycouncil.org/wp-content/uploads/2013/03/Bristol-Good-Food-Plan\\_lowres.pdf](http://bristolfoodpolicycouncil.org/wp-content/uploads/2013/03/Bristol-Good-Food-Plan_lowres.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2015a) *Bristol Green Capital*. Available from: <https://bristolgreencapital.org/who-we-are/european-green-capital-award/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2015b) *The Bristol Method: how to use partnerships to drive change*. [online]. Available from: <https://bristolgreencapital.org/the-bristol-method-how-to-use-partnerships-to-drive-change/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2018a) *Bristol's new carbon neutral 2030 ambition is a game-changer*. Blog. [online] <https://bristolgreencapital.org/bristol-carbon-neutral-2030-ambition-nov-2018/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2018b) *Green and Black Ambassadors. Pilot Project Report*. [online]. Available from: [https://bristolgreencapital.org/wp-content/uploads/2018/04/Green-and-Black-Ambassadors-Pilot-Report-2018\\_Final.pdf](https://bristolgreencapital.org/wp-content/uploads/2018/04/Green-and-Black-Ambassadors-Pilot-Report-2018_Final.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2018c) *Mission and Vision*. Available from: <https://bristolgreencapital.org/who-we-are/mission-vision/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Green Capital Partnership (2019) *History*. Available from: <https://bristolgreencapital.org/history/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Post (2016) *Surge in population of rodents down to fewer bin collections*.

Bristol Waste (2017) *Main page*. Available from: <http://www.bristolwastecompany.co.uk> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Water (2016) *Water meters explained*. Available from: <https://www.bristolwater.co.uk/your-home/water-meters/> (last accessed: 3<sup>rd</sup> May 2019)

Bristol Water (2018) *clearly resilient*. Report. [online]. Available from: <https://www.bristolwater.co.uk/wp-content/uploads/2018/09/Section-C4-Bristol-Water-Clearly-Resilient-1.pdf> (last accessed: 3<sup>rd</sup> May 2019)

British Broadcasting Corporation (2013) *Q&A: How will Bristol parking permits affect residents?* [Online] 30 July. Available from: <https://www.bbc.co.uk/news/uk-england-bristol-22715999> (last accessed: 3<sup>rd</sup> May 2019)

British Broadcasting Corporation (2017) *Bristol named best place to live in Britain in 2017* [online]. 19 March. Available from: <http://www.bbc.co.uk/news/uk-england-39320118> (last accessed: 3<sup>rd</sup> May 2019)

British Broadcasting Corporation (2018a) 'Single-use' has been named word of the year 2018. [online]. 8 November. Available from: <https://www.bbc.co.uk/newsround/46123738> (last accessed: 3<sup>rd</sup> May 2019)

British Broadcasting Corporation (2018b) Extinction Rebellion: Who are the activist group? [online]. 21 December. Available from: <https://www.bbc.co.uk/news/av/science-environment-46626582/extinction-rebellion-the-story-behind-the-activist-group> (last accessed: 3<sup>rd</sup> May 2019)

Buber, M. (1965) *The knowledge of man*. St Leonards: Allen and Unwin

Buchanan, K., Russo, R., Anderson, B. (2015) The question of energy reduction: the problem(s) with feedback. *Energy Policy*. 77, pp. 89-89

Bulkeley, H. and Betsill, M.M. (2005) Cities and the Multilevel Governance of Global Climate Change, *Global Governance*. 12 (2), pp. 141-159.

- Bulkeley, H., Carmin, J., Castán Broto, V., Edwards, G.A.S. & Fuller, S. (2013) Climate justice and global cities: mapping the emerging discourses. *Global Environmental Change*. 23 (5), pp. 914-925.
- Bulkeley, H., Edwards, G.A.S. & Fuller, S. (2014) Contesting climate justice in the city: Examining politics and practice in urban climate change experiments, *Global Environmental Change*, 25, pp. 31-40;
- Bulkeley, H. and Mol, A.P.J. (2003) Participation and Environmental Governance: Consensus, Ambivalence and Debate. *Environmental Values*. 12 (2), pp.143-154.
- Cairney, P. (2012) Complexity Theory in Political Science and Public Policy, *Political Studies Review*, 10 (3), pp. 346-358.
- Cairney, P. (2015) How can policy theory have an impact on policymaking? The role of theory-led academic-practitioner discussions. *Teaching Public Administration*. 33 (1), pp. 22-39.
- Cairney, P. and Oliver, K. (2017) Evidence-based policymaking is not like evidence-based medicine, so how far should you go to bridge the divide between evidence and policy? *Health Research Policy and Systems*. 15(35)
- Cairns, R. and Krzywoszynska A. (2016) Anatomy of a buzzword: The emergence of 'the water-energy-food nexus' in UK natural resource debates. *Environmental Science & Policy*. 64, pp. 164-170
- Cairns, R., Wilsdon, J. and O'Donovan, C. (2017) *Sustainability in Turbulent Times: Lessons from the Nexus Network for supporting transdisciplinary research*. The Nexus Network. [online]. Available from: <https://steps-centre.org/publication/sustainability-turbulent-times-lessons-nexus-network-supporting-transdisciplinary-research/> (last accessed: 3<sup>rd</sup> May 2019)
- Cameron, R. (2009) A sequential mixed model research design: Design, analytical and display issues. *International Journal of Multiple Research Approaches*. 3 (2), pp. 140-152.
- Caragliu, A., Del Bo, C. and Nijkamp, P. (2011) Smart Cities in Europe. *Journal of Urban Technology*. 18 (2), pp.65-82.
- Carey, J. (2011) *Who feeds Bristol? towards a resilient food plan: production: processing: distribution: communities: retail: catering: waste*. [online]. Bristol: Bristol City Council. Available from: <https://www.bristol.gov.uk/documents/20182/32619/Who-feeds-Bristol-report.pdf> (last accessed: 3<sup>rd</sup> May 2019)
- Chartered Institution of Wastes Management (2016) *Ricardo Urges Bio-Digester Exemption From Food Waste Law*. [online]. 7 December. Available from: <https://ciwm-journal.co.uk/ricardo-urges-exemption-bio-digesters-food-waste-law/> (last accessed: 3<sup>rd</sup> May 2019)
- Chatterton, T.J., Anable, J., Barnes, J. and Yeboah, G. (2016) Mapping household direct energy consumption in the United Kingdom to provide a new perspective on energy justice, *Energy research & social science*. 18, pp. 71-87;
- Cheong, S., Choi, G. & Lee, H. (2016) Barriers and Solutions to Smart Water Grid Development, *Environmental Management*. 57 (3), pp. 509-515.

- City to sea (2019) *About the issue*. Available from: <https://www.citytosea.org.uk/about-page/plastic-pollution/> (last accessed: 3<sup>rd</sup> May 2019)
- Colombo, D. and Porcu, M. (2014) Environment and neoliberalism: a critical discourse analysis, *Essachess*. 7 (13), pp. 63-82.
- Compact of Mayors (2014) *Compact of Mayors*. Available from: <http://www.compactofmayors.org/> (last accessed: 3<sup>rd</sup> May 2019)
- Comte, A. (1868) The positive philosophy of Auguste Comte.
- Connecting Bristol (2016) *Replicate Project – Overview*. Available from: <http://www.connectingbristol.org/replicate-project/> (last accessed: 3<sup>rd</sup> May 2019)
- Connolly, W. (1983) *The Terms of Political Discourse*. Princeton University Press
- Connelly, S. (2011) "Constructing Legitimacy in the New Community Governance", *Urban Studies*, vol. 48, no. 5, pp. 929-946.
- Consumer Data Research Centre (2015) Median house price. *Consumer data research centre*. [online]. Available from: <https://esrc.ukri.org/research/our-research/consumer-data-research-centre-cdrc/> (last accessed: 3<sup>rd</sup> May 2019)
- Cowley, R., Joss, S. & Dayot, Y. (2017) The smart city and its publics: insights from across six UK cities. *Urban research & practice*. pp. 1-25.
- Csikszentmihalyi, M. (2008) *Flow: the psychology of optimal experience*. London: Harper Perennial Modern Classics.
- Daher, B.T. and Mohtar, R. (2015) Water–energy–food (WEF) Nexus Tool 2.0: guiding integrative resource planning and decision-making. *Water International*. 40 (5–6), pp. 748-771.
- Daily Express (2017) *Food waste UK: Britons bin £13BILLION worth of edible food each year*. Online: <https://www.express.co.uk/news/uk/751977/how-much-food-is-wasted-uk-cost-weight-each-year> (last accessed: 3<sup>rd</sup> May 2019)
- Daily Mail (2017) *Smelly rubbish? Just put it in your freezer!*
- Daily Mirror (2016) “*We saved over £1,000 a year... and so can you!*”; *Your life cash queens*
- Danermark, B., Ekstrom, M., Jakobsen, L., and Karlsson, J. C. (2002) *Explaining Society: Critical Realism in the Social Sciences*, London: Routledge
- Davies, A. R. (2006) Environmental justice as subtext or omission: Examining discourses of anti-incineration campaigning in Ireland. *Geoforum*. 37 (5), pp. 708-724.

- Davis, K. (2008) Intersectionality as buzzword. *Feminist Theory*. 9 (1), pp. 67-85.
- de Jong, M., Joss, S., Schraven, D., Zhan, C. and Weijnen, M. (2015) Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*. 109, pp. 25-38.
- Demeritt, D. (2006) Science studies, climate change and the prospects for constructivist critique. *Economy and Society*. 35 (3), pp. 453-479.
- Dennett, D.C. (2006) Higher-order truths about chmess. *Topoi*. 25 (1), pp. 39-41.
- Dennett, D.C. (2013) *Intuition Pumps and Other Tools for Thinking*. New York: W. W. Norton & Company.
- Department for Business Energy and Industrial Strategy - DBEIS (2015a) *Sub-national gas consumption data*. [online]. Available from: <https://www.gov.uk/government/collections/sub-national-gas-consumption-data> (last accessed: 3<sup>rd</sup> May 2019)
- Department for Business Energy and Industrial Strategy - DBEIS (2015b) *Electricity consumption in the UK*. [online]. Available from: <https://data.gov.uk/dataset/26afb14b-be9a-4722-916e-1065doedc38/energy-consumption-in-the-uk> (last accessed: 3<sup>rd</sup> May 2019)
- Department for Business Energy and Industrial Strategy - DBEIS (2017) *Smart Meters: a guide*. [online] Available from: <https://www.gov.uk/guidance/smart-meters-how-they-work> (last accessed: 3<sup>rd</sup> May 2019)
- Department for Energy and Climate Change - DECC (2014) Percentage of households – fuel poor. *Data Bristol*. [online]. Available from: <http://profiles.bristol.gov.uk/LAS/dataviews/report?reportId=1206&viewId=626&geoReportId=5203&geoId=26&geoSubsetId=> (last accessed: 3<sup>rd</sup> May 2019)
- Department for Environment, Food and Rural Affairs (1999) *Better Quality of Life: A Strategy for Sustainable Development for the United Kingdom*. London: The Stationery Office
- Department for Environment, Food and Rural Affairs (2016) *Waste Duty of Care Code of Practice*. [online]. Available from: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/506917/wasteduty-care-code-practice-2016.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506917/wasteduty-care-code-practice-2016.pdf) (last accessed: 3<sup>rd</sup> May 2019)
- Department for Environment, Food and Rural Affairs (2019) *Rural population 2014/15*. [online]. Available from: <https://www.gov.uk/government/publications/rural-population-and-migration/rural-population-201415> (last accessed: 3<sup>rd</sup> May 2019)
- Department of Environment Northern Ireland (2015) Waste management strategy. [online]. Available from: <https://www.daera-ni.gov.uk/articles/waste-management-strategy> (last accessed: 3<sup>rd</sup> May 2019)
- Devine-Wright, P. (2013) Explaining “NIMBY” Objections to a Power Line: The Role of Personal, Place Attachment and Project-Related Factors. *Environment and Behaviour*. 45 (6), pp. 761–781.

- Dewey, J. (1916) "Theories of knowledge". In: Mendant, L. (1997) *Pragmatism: a reader*. New York: Vintage
- Dietz, S., Michie, J. & Oughton, C. (2011) *The political economy of the environment: an interdisciplinary approach*. London: Routledge.
- Dixon, J. & Sharp, L. (2007) Collaborative research in sustainable water management: issues of interdisciplinarity, *Interdisciplinary Science Reviews*. 32 (3), pp. 221-232.
- Dobson, A. (1998) *Justice and the Environment: Conceptions of Environmental Sustainability and Theories of Distributive Justice*. Oxford: Oxford University Press.
- Duursma, G., Vrenegoor, F. and Kobus, S. (2016) Food waste reduction at Restaurant DePleats: Small steps for mankind. *Research in Hospitality Management*. 6(1), pp. 95–100.
- Eid, C., Koliou, E., Valles, M., Reneses, J., Hakvoort, R., (2016) Time-based pricing and electricity demand response: Existing barriers and next steps, *Utilities Policy*. 40, pp. 15–25.
- Endo, A., Burnett, K.; Orencio, P.M.; Fukazawa, T.; Wada C.A.; Ishii, A.; Tsurita, I.; and Taniguchi, M. (2015) Methods of the Water-Energy-Food Nexus, *Water*. 7 (10), pp. 5806–5830.
- Endo, A.; Kumazawa, T.; Kimura, M.; Yamada, M.; Kato, T.; Kozaki, K. (2018) Describing and Visualizing a Water–Energy–Food Nexus System. *Water*, 10, 1245.
- Environment, Food and Rural Affairs Committee (2015) *Waste management in England*. Government response. [online]. Available from: <https://publications.parliament.uk/pa/cm201415/cmselect/cmenvfru/921/92104.htm> (last accessed: 3<sup>rd</sup> May 2019)
- European Commission, (2008a) *Covenant of Mayors*. Available from: <https://www.globalcovenantofmayors.org/> (last accessed: 3<sup>rd</sup> May 2019)
- European Commission, (2008b) *Directive 2008/98/EC on waste (Waste Framework Directive)*. [online]. Available from: <http://ec.europa.eu/environment/waste/framework/> (last accessed: 3<sup>rd</sup> May 2019)
- European Commission (2012) *Commission Recommendation of 9 March 2012 on preparations for the roll-out of smart metering systems (2012/148/EU)*. [online]. Available from: <https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters> (last accessed: 3<sup>rd</sup> May 2019)
- European Commission (2014) *An introduction to EU cohesion policy 2014-2020*. [online]. Available from: [https://ec.europa.eu/regional\\_policy/sources/docgener/informat/basic/basic\\_2014\\_en.pdf](https://ec.europa.eu/regional_policy/sources/docgener/informat/basic/basic_2014_en.pdf) (last accessed: 3<sup>rd</sup> May 2019)
- Evans, D. (2011) Blaming the consumer—once again: the social and material contexts of everyday food waste practices in some English households. *Critical Public Health*. 21 (4), pp. 429-440.
- Evans, D. (2012) Beyond the Throwaway Society: Ordinary Domestic Practice and a Sociological Approach to Household Food Waste. *Sociology*. 46 (1), pp. 41-56.
- Facer, K. & Enright, B. (2016) *Creating Living Knowledge: The Connected Communities Programme, community-university partnerships and the participatory turn in the production of knowledge*. Bristol: Arts and Humanities Research Council.

Fahradi, P. and Taheri, B. (2017) Smart Meter Tariff Pricing using Load Demand Response Model, *Proceedings of the International Istanbul Smart Grids and Cities Conference and Fair* [online]. Available from: <https://ieeexplore.ieee.org/document/7947618/> (last accessed: 3<sup>rd</sup> May 2019)

FareShare (2019) *The food we take*. Available from: <http://fareshare.org.uk/giving-food/the-food-wetake/> (last accessed: 3<sup>rd</sup> May 2019)

Fare Share South West (2018) *About us*. Available from: <http://faresharesouthwest.org.uk/> (last accessed: 3<sup>rd</sup> May 2019)

Feedback (2018) *The pig idea. Let's put food waste back on the menu for pigs*. Available from: <https://feedbackglobal.org/campaigns/pig-idea/> (last accessed: 3<sup>rd</sup> May 2019)

Felt, U., Igelsböck, J., Schikowitz, A. and Völker, T. (2016) Transdisciplinary Sustainability Research in Practice: Between Imaginaries of Collective Experimentation and Entrenched Academic Value Orders. *Science, Technology, & Human Values*. 41 (4), pp. 732-761.

Figueiredo, P. & Perkins, P.E. 2013, "Women and water management in times of climate change: participatory and inclusive processes", *Journal of Cleaner Production*, vol. 60, pp. 188-194.

Finger, M. and Razaghi, M. (2017) Conceptualizing Smart Cities. *Informatik-Spektrum*. 40 (1), pp. 6-13.

Fisher, S. (2015) The emerging geographies of climate justice. *The Geographical Journal*. 181 (1), pp.73-82.

Fletcher, A.J. (2017) Applying critical realism in qualitative research: methodology meets method, *International Journal of Social Research Methodology*, 20:2, 181-194, DOI: 10.1080/13645579.2016.1144401

Foden, M, Browne, AL, Evans, DM, Sharp, L, Watson, M. (2018) The water–energy–food nexus at home: New opportunities for policy interventions in household sustainability. *The Geographical Journal*; 00: 1– 13.

Food and Agriculture Organisation (2018) *Water-energy-food Nexus for the review of SDG 7. Policy brief*. [online]. Available from: [https://sustainabledevelopment.un.org/content/documents/17483PB\\_9\\_Draft.pdf](https://sustainabledevelopment.un.org/content/documents/17483PB_9_Draft.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Forman, A. (2017) Energy justice at the end of the wire: enacting community energy and equity in Wales. *Energy Policy*. 107, pp. 649-657.

Frame, B. and O'Connor, M. (2011) Integrating valuation and deliberation: the purposes of sustainability assessment. *Environmental Science & Policy*. 14 (1), pp. 1-10.

Fuchs, C. (2017) Critical Social Theory and Sustainable Development: The Role of Class, Capitalism and Domination in a Dialectical Analysis of Un/Sustainability, *Sustainable development*.

Funtowicz, S. O. and Ravetz, J. R. (1993) Science for the post-normal age. *Futures*. 25 (7), pp. 739-755.

- Garrone, P., Melacini, M. and Perego, A. (2014) Opening the black box of food waste reduction. *Food Policy*. 46, pp. 129-139.
- Geertz, C. (1973) Thick Description: Toward an Interpretive Theory of Culture. In: *The Interpretation of Cultures: Selected Essays*. New York: Basic Books.
- Gibbons, M., Limoges, C., Nowotny, H., Schwarzmann, S., Scott, P., Trow, M. (1994) *The New Production of Knowledge*. The Dynamics of Science and Research in Contemporary Societies. London: SAGE.
- Global Justice Now (2019) *About us – Bristol*. Available from: <https://www.globaljustice.org.uk/bristol> (last accessed: 3<sup>rd</sup> May 2019)
- The Global Parliament of Mayors (2014) *About us*. Available from: <https://globalparliamentofmayors.org/about-us/> (last accessed: 3<sup>rd</sup> May 2019)
- Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P. and Ritter, G. (2015), Cutting food waste through cooperation along the food supply chain, *Sustainability*. 7 (2), pp. 1429-1445.
- Greenfield, A. (2017) *Radical technologies: The design of everyday life*. London: Verso.
- Greenhouse Gas Protocol (2014) *Global Protocol for Community-Scale Greenhouse Gas Emission Inventories*. An Accounting and Reporting Standard for Cities. [online]. Available from: [https://ghgprotocol.org/sites/default/files/standards/GHGP\\_GPC\\_o.pdf](https://ghgprotocol.org/sites/default/files/standards/GHGP_GPC_o.pdf) (last accessed: 3<sup>rd</sup> May 2019)
- Gregson, N., Metcalfe, A. and Crewe, L. (2007) Identity, Mobility, and the Throwaway Society, *Environment and Planning D: Society and Space*. 25 (4), pp. 682-700
- Grineski, S. E., Collins, T. W., Ford, P., Fitzgerald, R., Aldouri, R., Velázquez-Angulo, G., de Lourdes Romo Aguilar, M. and Lu, D. (2012) Climate change and environmental injustice in a bi-national context. *Applied Geography*. 33, pp. 25-35.
- Groves, R. M.; Fowler, F.J.; Couper, M.P.; Lepkowski, J. M.; Singer, E. and Tourangeau, R. (2004). *Survey methodology*. Hoboken, NJ: John Wiley & Sons.
- The Guardian (2016) *Only 3% of UK adults feel ashamed at wasting food, poll finds*. [online]. 6 September. Available from: <https://www.theguardian.com/business/2016/sep/06/food-waste-uk-householders-sainsburys-survey-saving-money> (last accessed: 3<sup>rd</sup> May 2019)
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105-117). Thousand Oaks, CA, US: Sage Publications, Inc.
- Halbe, J., Pahl-Wostl, C., Lange, M.A. and Velonis, C. (2015) Governance of transitions towards sustainable development – the water–energy–food nexus in Cyprus. *Water International*. 40 (5-6), pp. 877-894.
- Hambleton, R. (2014) From the smart city to the wise city: The role of universities in place-based leadership. In: *Smart City: New Media, Social Participation and Urban Governance*, Shanghai, China, 5-7 June 2014. Shanghai, China: Shanghai University. [online]. Available from: <http://eprints.uwe.ac.uk/24142> (last accessed: 3<sup>rd</sup> May 2019)

Hambleton, R. and Sweeting, D. (2018) Place-based leadership and radical public innovation: Lessons from mayoral governance experimentation in Bristol, UK. In: *Political Studies Association Conference*, Cardiff 28<sup>th</sup> March 2018. [online]. Available from: [https://www.psa.ac.uk/sites/default/files/conference/papers/2018/PSA%202018%20Cardifff%20Sweeting%20Hambleton.pdf](https://www.psa.ac.uk/sites/default/files/conference/papers/2018/PSA%202018%20Cardiff%20Sweeting%20Hambleton.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Harris, F. and Lyon, F. (2013) Transdisciplinary environmental research: Building trust across professional cultures, *Environmental Science and Policy*. 31, pp. 109-119.

Harwood, S. (2018) In search of a (WEF) Nexus approach. *Environmental Science and Policy*. 83, pp. 79-85.

Hastings, A. (1999) "Discourse and Urban Change: Introduction to the Special Issue", *Urban Studies*, vol. 36, no. 1, pp. 7-12.

Hay, I. (2005) Qualitative research methods in human geography, Oxford University Press, Don Mills, Ontario.

Hayes, E. And Crilly, D. (2014) The water-energy-food nexus – balancing our (in) securities. *Environmental Scientist- Water Security*. 23 (3), pp. 30-36.

Heffron, R. J., McCauley, D. and de Rubens, G. Z. (2018) Balancing the energy trilemma through the Energy Justice Metric. *Applied Energy*. 229, pp. 1191-1201.

Heikkila, L., Reinikainen, A., Katajajuuri, J.M., Silvennoinen, K. and Hartikainen, H. (2016) Elements affecting food waste in the food service sector. *Waste Management*. 56, pp. 446-453.

Helmbrecht, J., Pastor, J. & Moya, C. (2017) Smart Solution to Improve Water-energy Nexus for Water Supply Systems. *Procedia Engineering*. 186, pp. 101-109.

Hennink, M.M. (2007) *International Focus Group Research: A Handbook for the Health and Social Sciences*. Cambridge: Cambridge University Press.

Hielscher, S. & Sovacool, B.K. (2018) Contested smart and low-carbon energy futures: Media discourses of smart meters in the United Kingdom, *Journal of Cleaner Production*. 195, pp. 978-990.

Hinson, S. (2018) The smart meter roll-out: Will the 2020 deadline be met? London: *House of Commons Library*. [online]. Available from: <https://commonslibrary.parliament.uk/social-policy/housing/the-smart-meter-roll-out-will-the-2020-deadline-be-met%20%AF%20%AF/> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2008) *Climate Change Act 2008*. [online]. Available from: <http://www.legislation.gov.uk/ukpga/2008/27/contents> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2010) *Equality Act 2010*. [online]. Available from: <https://www.legislation.gov.uk/ukpga/2010/15/contents> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2014) *Business Improvement Districts – Guidance*. [online]. Available from: <https://www.gov.uk/guidance/business-improvement-districts> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2015) *English indices of deprivation 2015*. [online]. Available from: <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2016) *Landfill tax: increase in rates*. Policy paper. [online]. Available from: <https://www.gov.uk/government/publications/landfill-tax-increase-in-rates/landfill-tax-increase-in-rates> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2018) Acorn consumer classification. *CACI*. [online]. Available from: <https://www.gov.uk/government/publications/quality-assurance-of-administrative-data-in-the-uk-house-price-index/acorn-consumer-classification-caci> (last accessed: 3<sup>rd</sup> May 2019)

HM Government (2018) *Government's vision for a greener future launched*. Press release. [online]. 11 January. Available from: <https://www.gov.uk/government/news/governments-vision-for-a-greener-future-launched> (last accessed: 3<sup>rd</sup> May 2019)

Hoff, J. (2011) Understanding the Nexus. In: *Proceedings of the Bonn 2011 Conference: The Water, Energy and Food Security Nexus*, Bonn, Germany, 16–18 November 2011.

Hoolohan, C. and Browne, A. (2016) On the practices of managing demand in the UK water industry management. In: *DEMAND Centre Conference*, Lancaster, 13–15 April 2016.

Hoolohan, C. and Browne, A.L. (2018) Reimagining spaces of innovation for water efficiency and demand management: An exploration of professional practices in the English water sector. *Water Alternatives*. 11 (3), pp. 957-978.

Hoolohan, C, Soutar, I, Suckling, J, Druckman, A, Larkin, A, McLachlan, C. (2018) Stepping-up innovations in the water–energy–food nexus: A case study of anaerobic digestion in the UK. *The Geographical Journal*. 00: 1– 15.

Horlick-Jones, T. and Prades, A. (2015) Translating between social worlds of policy and everyday life: The development of a group-based method to support policymaking by exploring behavioural aspects of sustainable consumption, *Public Understanding of Science*. 24 (7), pp. 811-826.

House, E.R. and Howe, K.R. (1999) *Values in Evaluation and Social Research*. London: Sage.

Houston, S. (2010) Rising Open the Black Box: Critical Realism, Action Research and Social Work. *Qualitative Social Work*. 9 (1), pp. 73–91.

Howarth, C. & Monasterolo, I. (2016) Understanding barriers to decision making in the UK energy-food-water nexus: The added value of interdisciplinary approaches. *Environmental Science & Policy*. 61, pp. 53-60.

Huawei (2017) *UK Smart Cities Index*. [online]. Available from: [https://e.huawei.com/uk/special\\_topic/solution/smart\\_cities\\_index\\_2017](https://e.huawei.com/uk/special_topic/solution/smart_cities_index_2017) (last accessed: 3<sup>rd</sup> May 2019)

ICAX (2018) *Owen Square Community Energy Project*. [online]. Available from: [http://www.icax.co.uk/Owen\\_Square\\_Community\\_Energy\\_Project.html](http://www.icax.co.uk/Owen_Square_Community_Energy_Project.html) (last accessed: 3<sup>rd</sup> May 2019)

Imrie, R. (2000) "Disability and discourses of mobility and movement", *Environment and Planning A*, vol. 32, no. 9, pp. 1641-1656.

The Independent (2016) *Food suppliers should be given French-style tax break to reduce food waste, parliamentary inquiry told*. [online]. 30 November. Available from: <https://www.independent.co.uk/news/uk/politics/food-suppliers-should-be-given-french-style-tax-break-to-reduce-food-waste-parliamentary-inquiry-a7448206.html> (last accessed: 3<sup>rd</sup> May 2019)

International Energy Agency (2016) *Water-Energy Nexus* [online]. Available from: <https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlook2016ExcerptWaterEnergyNexus.pdf> (last accessed: 3<sup>rd</sup> May 2019)

International Food Policy Research Institute (2011) *Global Food Policy Report* [online]. Available from: <http://www.ifpri.org/publication/2011-global-food-policy-report> (last accessed: 3<sup>rd</sup> May 2019)

The Intergovernmental Panel on Climate Change (2018) *Global Warming of 1.5° C. Special Report.* [online]. Available from: <https://www.ipcc.ch/sr15/> (last accessed: 3<sup>rd</sup> May 2019)

Jacobs, K. (2006) "Discourse Analysis and its Utility for Urban Policy Research", *Urban Policy and Research*, vol. 24, no. 1, pp. 39-52.

Jackson, T. and Webster, R. (2016) *Limits Revisited: A review of limits to growth debate.* [online]. Available from: <http://limits2growth.org.uk/wp-content/uploads/2016/04/Jackson-and-Webster-2016-Limits-Revisited.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Jansen, H. (2010) the Logic of Qualitative Survey Research and its Position in the Field of Social Research Methods. *Forum: Qualitative Social Research.* 11(2).

Jenkins, K., McCauley, D., Heffron, R., Stephan, H. and Rehner, R. (2016) Energy justice: A conceptual review. *Energy Research & Social Science.* 11, pp. 174-182.

Jenkins, K. (2018) Setting energy justice apart from the crowd: Lessons from environmental and climate justice. *Energy Research & Social Science.* 39, pp. 117-121.

Kahan, J.P. (2001) Focus Groups as a Tool for Policy Analysis, *Analyses of Social Issues and Public Policy.* 1 (1), pp. 129-146.

Kaijser, A. & Kronsell, A. (2014) Climate change through the lens of intersectionality, *Environmental politics.* 23 (3), pp. 417-433.

Klein, J. T. (2014) Discourses of transdisciplinarity: Looking Back to the Future. *Futures.* 63, pp. 68-74.

Knowle West Media Centre (2013) *3E Houses Project.* Available from: <http://kwmc.org.uk/projects/3ehouses/> (last accessed: 3<sup>rd</sup> May 2019)

Krueger, R. (1998) *Designing and Conducting Focus Group Interviews* [online]. Available from: <http://www.eiu.edu/ihec/Krueger-FocusGroupInterviews.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Kuhn, T. (1970) *The Structure of Scientific Revolutions*, 2nd edn (enlarged). Chicago, IL: University of Chicago Press.

Kumar, P., Kumar, A., Sah, B., Singh, A.R., Deng, Y., He, X. & Bansal, R.C. (2017) A review of multi criteria decision making (MCDM) towards sustainable renewable energy development, *Renewable and Sustainable Energy Reviews.* 69, pp. 596-609.

Kurian, M. (2017) The water-energy-food nexus. *Environmental Science & Policy.* 68, pp. 97-106.

Lacey-Barnacle, M. and Bird, C. M. (2018) Intermediating energy justice? The role of intermediaries in the civic energy sector in a time of austerity. *Applied Energy*. 226, pp. 71-81.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J. (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability Science*. 7 (Suppl 1), pp. 25-43.

Latour, B. (2004) Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern. *Critical Inquiry*. 30 (2), pp. 225-248.

Lees, L. (2004) "Urban geography: discourse analysis and urban research", Progress in Human Geography, vol. 28, no. 1, pp. 101-107.

Lepoutre, J., & Heene, A. (2006) Investigating the impact of firm size on small business social responsibility: A Critical Review. *Journal of Business Ethics*. 67, 257-273.

Lewin, K. (1942) Action research and minority problems. *Journal of Social Issues*. 2(4) pp. 34-46.

Li, M., Li, T., Fu, Q., Singh, V.P., Ji, Y., Liu, D. & Zhang, C. (2019) An optimal modelling approach for managing agricultural water-energy-food nexus under uncertainty. *Science of the Total Environment*. 651 (1), pp. 1416-1434.

Liamputpong, P. (2011) *Focus Group Methodology: Principle and Practice*. London: SAGE

Local Governments for Sustainability - ICLEI (1990) *Local Governments for Sustainability*. Available from: <https://www.iclei.org/> (last accessed: 3<sup>rd</sup> May 2019)

Loftus, A. (2006) Reification and the Dictatorship of the Water Meter. *Antipode*. 38 (5), pp. 1023-1045.

Loftus, A., March, H. & Nash, F. (2016) Water infrastructure and the making of financial subjects in the south east of England. *Water Alternatives*. 9 (2), pp. 319-335.

Lucas, K. & Fuller, S. (2005) "Putting the 'E' into LSPs: Representing the Environment within Local Strategic Partnerships (LSPs) in the UK", *Local Environment*, vol. 10, no. 5, pp. 461-475.

Luke, T.W. (2005) Neither sustainable nor development: reconsidering sustainability in development. *Sustainable Development*. 13 (4), pp. 228-238.

Lyall, C., Meagher, L. and Bruce, A. (2015) A rose by any other name? Transdisciplinarity in the context of UK research policy. *Futures*. 65, pp. 150-162.

Mann, L. (2016) Procrastination Revisited: A Commentary: Procrastination revisited, *Australian Psychologist*. 51 (1), pp. 47-51.

Marshall, G. (2014) *Don't Even Think About It. Why Our Brains Are Wired to Ignore Climate Change*. London: Bloomsbury.

Martinez Dy, A., Martin, L. and Marlow, S. (2014) Developing a Critical Realist Positional Approach to Intersectionality. *Journal of Critical Realism*. 13 (5), pp. 447-466.

Materials Recycling World (2016) *Defra urged on mandatory food waste laws*. [online]. 8 December. Available from: <https://www.mrw.co.uk/latest/defra-urged-on-mandatory-food-waste-laws/10015623.article> (last accessed: 3<sup>rd</sup> May 2019)

McCall, L. (2005) The Complexity of Intersectionality. *Signs*. 30 (3), pp. 1771-1800.

McCauley, D., Ramasar, V., Heffron, R. J., Sovacool, B. K., Mebratu, D. and Mundaca, L. (2019) Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research. *Applied Energy*. 233-234, pp. 916-921.

McKenna, E., Richardson, I. & Thomson, M. (2012) Smart meter data: Balancing consumer privacy concerns with legitimate applications. *Energy Policy*. 41 (1), pp. 807-814.

McLaren, D., Parkhill, K. A., Corner, A., Vaughan, N. E. and Pidgeon, N. F. (2016) Public conceptions of justice in climate engineering: Evidence from secondary analysis of public deliberation. *Global Environmental Change*. 41, pp. 64-73.\

McNiff, J. & Whitehead, J. (2012) *Action research: principles and practice*, 2nd edn, Falmer, London: Routledge.

Meadows D.; Meadows D.; Randers, J.; and Behrens, W.W. (1972) *Limits to growth: A Report for THE CLUB OF ROME'S Project on the Predicament of Mankind* [online]. Available from: <http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Middlemiss, L. (2017) A critical analysis of the new politics of fuel poverty in England. *Critical Social Policy*. 37 (3), pp. 425-443.

Miller, P. J., & Hoogstra, L. (1992) Language as tool in the socialization and apprehension of cultural meanings. In T. Schwartz, G. M. White, & C. A. Lutz (Eds.), *Publications of the Society for Psychological Anthropology, 3. New directions in psychological anthropology* (pp. 83-101). New York, NY, US: Cambridge University Press.

Montero, S. (2018) Leveraging Bogota: Sustainable Development, global philanthropy and the rise of urban solutionism. *Urban studies*, p. 1-19.

Montginoul, M. & Vestier, A. (2018) Smart metering: A water-saving solution? Consider communication strategies and user perceptions first. Evidence from a French case study" *Environmental Modelling and Software*. 104, pp. 188-198.

Morgan, D.L. (1997) *The Focus group guidebook*. London: SAGE.

Morgan, D.L. (2014) Pragmatism as a Paradigm for Social Research. *Qualitative Inquiry*. 20 (8), pp. 1045-1053.

Morse, J.M. (2015) Critical Analysis of Strategies for Determining Rigor in Qualitative Inquiry. *Qualitative Health Research*. 25 (9), pp. 1212-1222.

Mourad, M. (2016) Recycling, recovering and preventing "food waste": Competing solutions for food systems sustainability in the United States and France. *Journal of Cleaner Production*. 126, pp. 461-477.

Mroue, A. M., Mohtar, R. H., Pistikopoulos, E. N. and Holtzapple, M. T. (2019) Energy Portfolio Assessment Tool (EPAT): Sustainable energy planning using the WEF nexus approach – Texas case. *Science of the Total Environment*. 648, pp. 1649-1664.

The National Aeronautics and Space Administration - NASA (2017) *Global temperature anomalies from 1880 to 2017*. [online]. Available from: <https://svs.gsfc.nasa.gov/4609> (last accessed: 3<sup>rd</sup> May 2019)

National Science Foundation (2011) *Cyberinfrastructure Task Force on Grand Challenges*. [online]. Available from: [https://www.nsf.gov/cise/oac/taskforces/TaskForceReport\\_GrandChallenges.pdf](https://www.nsf.gov/cise/oac/taskforces/TaskForceReport_GrandChallenges.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Nowotny, H. (2003) Democratising expertise and socially robust knowledge. *Science and Public Policy*. 30 (3), pp.151-156.

Nussbaum, M. (2011) *Creating Capabilities: The Human Development Approach*. Harvard University Press

Office for National Statistics (2011) *2011 Census* [online]. Available from: <https://www.ons.gov.uk/census/2011census> (last accessed: 3<sup>rd</sup> May 2019)

Office for National Statistics (2016) *Lower Layer Super Output Area (LSOA) boundaries*. [online]. Available from: <https://data.gov.uk/dataset/fa883558-22fb-4a1a-8529-cffdee47d500/lower-layer-super-output-area-lsoa-boundaries> (last accessed: 3<sup>rd</sup> May 2019)

Office for National Statistics (2017) *Census Geography: An overview of the various geographies used in the production of statistics collected via the UK census*. [online]. Available from:

<https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeography> (last accessed: 3<sup>rd</sup> May 2019)

Office for National Statistics (2019) *Electoral wards/ Electoral divisions*. [online]. Available from: <https://webarchive.nationalarchives.gov.uk/20160108131156/http://www.ons.gov.uk/guide-method/geography/beginner-s-guide/administrative/england/electoral-wards-divisions/index.html> (last accessed: 3<sup>rd</sup> May 2019)

Ofwat (2013) *Water meters – your questions answered*. Information for household customers [online]. Available from: [https://www.ofwat.gov.uk/wpcontent/uploads/2015/11/prs\\_lft\\_101117meters.pdf](https://www.ofwat.gov.uk/wpcontent/uploads/2015/11/prs_lft_101117meters.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Ofwat (2017) *Unmetered customers*. Available from: <https://www.ofwat.gov.uk/households/your-water-bill/unmetered/> (last accessed: 3<sup>rd</sup> May 2019)

Oldfield, A & Manchester, H. (2016) *'Designing Playful Products: Nine principles for including children in collaborative, rapid R & D'* Bristol: REACT.

Oliver, K., Kothari, A. & Mays, N. (2019) "The dark side of coproduction: do the costs outweigh the benefits for health research?", *Health research policy and systems*, vol. 17, no. 1, pp. 33-10.

Open Data Bristol (2015) Bristol Housing Market in 2015- a Summary [online]. Available from: [https://bristol.citizenspace.com/business-change/draft-housing-strategy/supporting\\_documents/Bristol%20Housing%20Market%20June%2015th%202015.pdf](https://bristol.citizenspace.com/business-change/draft-housing-strategy/supporting_documents/Bristol%20Housing%20Market%20June%2015th%202015.pdf) (last accessed: 3<sup>rd</sup> May 2019)

O'Rafferty, S., DeEyto, A. and Lewis, H. (2016) Open Practices: lessons from co-design of public services for behaviour change. In: *Design Research Society Conference*. 27-30<sup>th</sup> June 2016, Brighton, UK.

Ordnance Survey (2015) *Bristol – Pinpoint local information*. Image. [online]. Available from: <https://maps.bristol.gov.uk/pinpoint/> (last accessed: 3<sup>rd</sup> May 2019)

Ortlipp, M. (2008) Keeping and Using Reflective Journals in the Qualitative Research Process. *Qualitative Report*. 13 (4), pp. 695-705.

Ostrom, E. (1990) *Governing the commons: the evolution of institutions for collective action*. Cambridge: Cambridge University Press.

Our world in data (2017) Global primary energy consumption. Image. [online]. Available from: <https://ourworldindata.org/energy-production-and-changing-energy-sources> (last accessed: 3<sup>rd</sup> May 2019)

Oxford Dictionary (2018) Definition of power in English. [online]. Available from: <https://en.oxforddictionaries.com/definition/power> (last accessed: 3<sup>rd</sup> May 2019)

Oxford Dictionary (2019) Definition of knowledge in English. [online]. Available from: <https://en.oxforddictionaries.com/definition/knowledge> (last accessed: 3<sup>rd</sup> May 2019)

Papargyropoulou, E., Lozano, R., Steinberger, J.K. and Wright, N. (2014) The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*. 76, pp.106-115.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Thousand Oaks, CA, US: Sage Publications, Inc.

Pearce, W., Grundmann, R., Hulme, M., Raman, S., Hadley Kershaw, E. and Tsouvalis, J. (2017) Beyond Counting Climate Consensus. *Environmental Communication*. 11 (6), pp. 723-730.

Petts, J., Owens, S. & Bulkeley, H. (2008) Crossing boundaries: Interdisciplinarity in the context of urban environments. *Geoforum*. 39 (2), pp. 593-601.

Piccolella, A. (2013) Participatory mapping for adaptation to climate change: the case of Boe Boe, Solomon Islands. *Knowledge Management for Development Journal*. 9(1): 24-36.

Pohl, C., Rist, S., Zimmermann, A., Fry, P., Gurung, G.S., Schneider, F., Speranza, C.I., Kiteme, B., Boillat, S., Serrano, E., Hadorn, G.H. & Wiesmann, U. (2010)"Researchers' roles in knowledge co-production: experience from sustainability research in Kenya, Switzerland, Bolivia and Nepal", *Science and Public Policy*, vol. 37, no. 4, pp. 267-281.

Priestley, S. (2016) *Water meters: the rights of customers and water companies*. House of Commons Briefing Paper. [online]. Available from: <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7342> (last accessed: 3<sup>rd</sup> May 2019)

Porpino, G., Wansink, B. and Cheek, K. (2015) Saving Food in Restaurants: Half-Sized Portions Outperform Persuasion on Mitigating Waste. *Journal of Nutrition Education and Behavior*. 47 (4), pp. S46.

Preston, I.; Banks, N.; Hargreaves, K.; Kazmierczak, A.; Lucas, K.; Mayne, R.; Downing, C.; and Street, R. (2014) *Climate Change and social justice: an evidence review*. York: Joseph Rowntree Foundation.

Prestwood, E., Calvert, T., Clayton, W., Longhurst, J., Manchester, H., Parkhurst, G., Rosenberg, G., Taylor, C. and Townsend, I. (2017) Barriers to a better Bristol: Diagnosing city strategic challenges using systems, co-production and interdisciplinary approaches. In: *Wessex 9th International Conference on Sustainable Development and Planning*, Bristol, England, 27 - 29 June 2017. [online]. Available from: <http://eprints.uwe.ac.uk/32276> (last accessed: 3<sup>rd</sup> May 2019)

Priefer, C., Jörissen, J. and Bräutigam, K. (2016) Food waste prevention in Europe – A cause driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*. pp. 155-165.

Rahaman, M.M. and Varis, O. (2005) Integrated water resources management: evolution, prospects and future challenges. *Sustainability: Science, Practice and Policy*. 1(1), pp. 15-21.

Rasul, G. (2016) Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia. *Environmental Development*. 18, pp. 14-25.

Reason, P. (2003). Pragmatist philosophy and action research: readings and conversation with Richard Rorty. *Action Research*, 1(1), 103-123.

Renewable Energy Policy Network for the 21<sup>st</sup> Century (2018) *Renewables 2018*. Global Status Report [online]. Available from: <http://www.ren21.net/gsr-2018/pages/summary/summary/> (last accessed: 3<sup>rd</sup> May 2019)

Resource (2016) *Publishing data key to tackling supermarket food waste*. [online]. 17 June. Available from: <https://resource.co/article/publishing-data-key-tackling-supermarket-food-waste-tesco-11180> (last accessed: 3<sup>rd</sup> May 2019)

Resource Futures (2013) *On the Sustainable Bishopston Traders' Food Waste and Recycling Service*. [online]. Available from: <http://bristolfoodpolicycouncil.org/wp-content/uploads/2013/06/CCF-2062-Final-report-commercial-food-waste.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Richards, K. (2016) Foreseer: visualisation, decision support and analytical framework for the water-land-energy nexus. In: *Royal Geographical Society: Annual International Conference*, London 30.08-2.09. 2016.

Riddlesden, D. (2014) *Internet User Classification: User Guide*. [online]. Available from: [https://files.datapress.com/london/dataset/the-2014-internet-user-classification--iuc---lsoa/2015-10-07T13:39:42/IUC\\_User\\_Guide.pdf](https://files.datapress.com/london/dataset/the-2014-internet-user-classification--iuc---lsoa/2015-10-07T13:39:42/IUC_User_Guide.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Rizos, V., Behrens, A., van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M. & Topi, C. (2016) Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. *Sustainability*. 8 (11), pp. 1212.

Rockström, J., Steffen, W., Noone, K. and Scheffer, M. (2009) A safe operating space for humanity. *Nature*. 461 pp. 472-475.

Roosvall, A., Tegelberg, M. (2015) "Media and the Geographies of Climate Justice: Indigenous Peoples, Nature and the Geopolitics of Climate Change", *tripleC: Communication, Capitalism & Critique*. Open Access Journal for a Global Sustainable Information Society, vol. 13, no. 1, pp. 39-39-54.

- Rose, G. (2001). *Visual Methodologies: An Introduction to the Interpretation of Visual Materials*. London: Sage
- Rorty, R. (1980) "Pragmatism, Relativism, and Irrationalism." *Proceedings and Addresses of the American Philosophical Association*, vol. 53, no. 6, 1980, pp. 717-738.
- Rorty (2004) Philosophy as a transitional genre. In: In Richard J. Bernstein, Seyla Benhabib & Nancy Fraser (eds.), *Pragmatism, Critique, Judgment: Essays for Richard J. Bernstein*. MIT Press. pp. 3--28
- Rugg, G. and Petre, M. (2014) *The Unwritten rules of PhD research*. Open University Press: Maidenhead.
- Schlosberg, D. (2012) "Climate Justice and Capabilities: A Framework for Adaptation Policy", *Ethics & International Affairs*, vol. 26, no. 4, pp. 445-461.
- Schlosberg, D. and Collins, L.B. (2014) From environmental to climate justice: climate change and the discourse of environmental justice. *Wiley Interdisciplinary Reviews: Climate Change*. 5 (3), pp. 359-374.
- Schön, D. A. (1987). Jossey-Bass higher education series. *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA, US: Jossey-Bass.
- Scottish Environmental Protection Agency (2016) Recycling (including food waste). [online]. Available from: <https://www.sepa.org.uk/regulations/waste/recycling-including-food-waste/> (last accessed: 3<sup>rd</sup> May 2019)
- Sen, A. (2003) Development as Capability Expansion. In: S. Fukuda-Parr and *et al*, eds. (2003) *Readings in Human Development*. New Delhi and New York: Oxford University Press.
- Seyranian, V., Sinatra, G.M. & Polikoff, M.S. (2015) Comparing communication strategies for reducing residential water consumption. *Journal of Environmental Psychology*. 41, pp. 81-90.
- Shelton, T., Zook, M., Wiig, A. (2015) The 'actually existing smart city'. *Cambridge Journal of Regions. Economy and Society*. 8 (1), pp. 13–25.
- Shove, E. (2010) Beyond the ABC: Climate Change Policy and Theories of Social Change. *Environment and Planning A*. 42 (6), pp. 1273-1285.
- Sibly, H. & Tooth, R. (2014) The consequences of using increasing block tariffs to price urban water. *Australian Journal of Agricultural and Resource Economics*. 58 (2), pp. 223-243.
- da Silva, N.F.F., Hruschka, E.R. & Hruschka, E.R. (2014) "Tweet sentiment analysis with classifier ensembles", *Decision Support Systems*, vol. 66, pp. 170-179.
- Silvennoinen, K., Katajajuuri, J. M.; Hartikainen, H., Heikkilä, L. and Reinikainen, A. (2014) Food waste volume and composition in Finnish households. *British Food Journal*. 116 (6), pp. 1058-1068.
- Sim, J. & Waterfield, J. (2019) "Focus group methodology: some ethical challenges", *Quality & Quantity*, vol. 53, no. 6, pp. 3003-3022.
- Simon, H.A. (1990) Invariants of human behaviour. *Annual reviews of psychology*. 41, pp. 1-19.

Sirieix, L., Lála, J. and Kocmanová, K. (2017) Understanding the antecedents of consumers' attitudes towards doggy bags in restaurants: Concern about food waste, culture, norms and emotions. *Journal of Retailing and Consumer Services*. 34, pp. 153-158.

Shi, L., Chu, E., Anguelovski, I. & Aylett, A. (2016) Roadmap towards justice in urban climate adaptation research. *Nature climate change*. 6, pp. 131-137.

Smart Energy GB (2017) *Smart meters- the simple way to control your energy use*. [online]. Available from: <https://www.smartenergygb.org/en> (last accessed: 3<sup>rd</sup> May 2019)

Smart Energy GB (2018) *Is my data safe?* [online]. Available from: <https://www.smartenergygb.org/en/about-smart-meters> (last accessed: 3<sup>rd</sup> May 2019)

Smith, D.W., Welch, M., Bennett, K.E., Padgham, J. and Mohtar, R. (2017) Building a WEF Nexus community of practice. *Current Sustainable/Renewable Energy Reports*. 4 (168).

Sovacool, B.K. & Dworkin, M.H. (2015) Energy justice: Conceptual insights and practical applications. *Applied Energy*. 142, pp. 435-444.

Sovacool, B.K.; Heffron, R.J.; McCauley, D.; Goldthau, A. (2016) Energy decisions reframed as justice and ethical concerns. *Nature Energy*.

Sovacool, B.K., Kivimaa, P., Hielscher, S. & Jenkins, K. (2017) Vulnerability and resistance in the United Kingdom's smart meter transition. *Energy Policy*. 109, pp. 767-781.

The Spectator (2017) *Higher prices are the only way of dealing with Britain's food waste problem*. [online]. 10 January. Available from: <https://blogs.spectator.co.uk/2017/01/higher-prices-way-dealing-britains-food-waste-problem/> (last accessed: 3<sup>rd</sup> May 2019)

Spence, A., Demski, C., Butler, C., Parkhill, K. & Pidgeon, N. (2015) Public perceptions of demand-side management and a smarter energy future. *Nature Climate Change*. 5 (6), pp. 550-554.

Stanford Encyclopaedia of Philosophy (2005) *Epistemology*. [online]. Available from: <https://plato.stanford.edu/entries/epistemology/> (last accessed: 3<sup>rd</sup> May 2019)

Steele, W., Mata, L. & Fangled, H. (2015) Urban climate justice: creating sustainable pathways for humans and other species. *Current opinion in environmental sustainability*. 14, pp. 121-126.

Stein, C, Barron, J and Moss, T. (2014) Governance of the nexus: from buzzwords to a strategic action perspective. *Nexus Network Think Piece Series*, Paper 003. [online]. Available from: <https://www.thenexusnetwork.org/wp-content/uploads/2014/08/Stein-Barron-and-Moss-Strategic-Action-Perspective-Nexus-Thinkpiece-2014-page-numbers.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Stewart, R. A., Nguyen, K., Beal, C., Zhang, H., Sahin, O., Bertone, E., Vieira, A. S., Castelletti, A., Cominola, A., Giuliani, M., Giurco, D., Blumenstein, M., Turner, A., Liu, A., Kenway, S., Savić, D. A., Makropoulos, C. and Kossleris, P. (2018) Integrated intelligent water-energy metering systems and informatics: Visioning a digital multi-utility service provider. *Environmental Modelling & Software*. 105, pp. 94-117.

Stoegner, K. & Wodak, R. (2016) "'The man who hated Britain' - the discursive construction of 'national unity' in the Daily Mail". *Critical Discourse Studies*. 13 (2), pp. 193-209.

- Stirling, A. (2010) Keep it complex. Comment. *Nature*. 468, pp. 1029–1031.
- Stirling, A. (2015) *Developing 'Nexus Capabilities': towards transdisciplinary methodologies*. Draft discussion paper. The Nexus Network [online]. Available from: <http://www.thenexusnetwork.org/wp-content/uploads/2015/06/Stirling-2015-Nexus-Methods-Discussion-Paper.pdf> (last accessed: 3<sup>rd</sup> May 2019)
- Stokols, D. (2006) Toward a Science of Transdisciplinary Action Research. *American Journal of Community Psychology*. 38 (1-2), pp. 79-93.
- Strotmann, C., Friedrich, S., Kreyenschmidt, J., Teitscheid, P. & Ritter, G. (2017) Comparing Food Provided and Wasted before and after Implementing Measures against Food Waste in Three Healthcare Food Service Facilities. *Sustainability*. 9 (8), pp. 1409.
- The Telegraph (2017) *Shoppers face food waste warnings in supermarkets, as levels rise for the first time in a decade*. [online]. 10 January. Available from: <https://www.telegraph.co.uk/news/2017/01/10/shoppers-face-food-waste-warnings-supermarkets-levels-rise-first/> (last accessed: 3<sup>rd</sup> May 2019)
- Thompson, K., and Haigh, L. (2017) Representations of Food Waste in Reality Food Television: An Exploratory Analysis of Ramsay's Kitchen Nightmares. *Sustainability*. 9 (7), pp. 1139.
- Tollemache, R. (2017) *Thoughts and feelings about climate change: an in-depth investigation*. PhD Thesis. The University of the West of England. [online]. Available from: <http://eprints.uwe.ac.uk/30586/8/18.01.%20THESIS.%20approved.%20diagram%20redacted%20%282%29.pdf> (last accessed: 3<sup>rd</sup> May 2019)
- Torrens, J., Johnstone, P. and Schot, J. (2018) Unpacking the Formation of Favourable Environments for Urban Experimentation: The Case of the Bristol Energy Scene. *Sustainability*. 10(3).
- Torriti, J. (2017) Understanding the timing of energy demand through time use data: Time of the day dependence of social practices. *Energy Research & Social Science*. 25, pp. 37–47.
- Transition Network (2006) *About the movement* [online]. Available from: <https://transitionnetwork.org/> (last accessed: 3<sup>rd</sup> May 2019)
- United Nations (1992) *The Rio Declaration on Environment and Development*. [online]. Available from: [http://www.unesco.org/education/pdf/RIO\\_E.PDF](http://www.unesco.org/education/pdf/RIO_E.PDF) (last accessed: 3<sup>rd</sup> May 2019)
- United Nations (2010) *The human right to water and sanitation*. Resolution 64/292. [online]. Available from: [https://www.un.org/waterforlifedecade/human\\_right\\_to\\_water.shtml](https://www.un.org/waterforlifedecade/human_right_to_water.shtml) (last accessed: 3<sup>rd</sup> May 2019)
- United Nations (2015) *Transforming our world: the 2030 Agenda for Sustainable Development*. Report [online]. Available from: <https://sustainabledevelopment.un.org/post2015/transformingourworld> (last accessed: 3<sup>rd</sup> May 2019)
- United Nations Framework Convention on Climate Change (2015) *The Paris Agreement* [online]. Available from: <https://unfccc.int/resource/docs/2015/cop21/eng/lo9.pdf> (last accessed: 3<sup>rd</sup> May 2019)

United Nations World Commission On Environment and Development (1987) *Our Common Future*. Brundtland Report. [online]. Available from:  
[https://en.wikisource.org/wiki/Brundtland\\_Report](https://en.wikisource.org/wiki/Brundtland_Report) (last accessed: 3<sup>rd</sup> May 2019)

The University of Sussex (2019) Science-Policy Research Unit. Multicriteria Mapping - helping to understand complex decisions. [online]. Available from:  
<http://www.sussex.ac.uk/spru/impact/mcm> (last accessed: 3<sup>rd</sup> May 2019)

van Dijk, T.A. (2008) *Discourse and Power*. London: Red Globe Press

Visit Bristol (2018) *Gloucester Road and Stokes Croft* [online]. Available from:  
<https://visitbristol.co.uk/shopping/gloucester-road-and-stokes-croft> (last accessed: 3<sup>rd</sup> May 2019)

Waitt, G. R. (2005). Doing Discourse Analysis. In I. Hay (Eds.), Qualitative Research Methods in Human Geography (pp. 163-191). U.K.: Oxford University Press.

Walker, G. (2010) Environmental justice, impact assessment and the politics of knowledge: The implications of assessing the social distribution of environmental outcomes. *Environmental Impact Assessment Review*. 30 (5), pp. 312-318.

Warner, J.F.; Hoogesteger, J. and Hidalgo, J.P. (2017) Old wine in new bottles: The adaptive capacity of the hydraulic mission in Ecuador. *Water Alternatives*. 10 (2), pp. 322-340.

Waste and Resources Action Programme (2009) *A targeted campaign to increase participation in recycling services by black and minority ethnic groups*. Local authority communications case study: Bristol. [online]. Available from:  
[http://www.wrap.org.uk/sites/files/wrap/BCLF\\_Bristol\\_15.09.08.5866.pdf](http://www.wrap.org.uk/sites/files/wrap/BCLF_Bristol_15.09.08.5866.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Waste and Resource Action Programme (2015) *Commercial food waste collections guide*. Final report. [online]. Available from:  
[http://www.wrap.org.uk/sites/files/wrap/Commercial\\_food\\_waste\\_collections\\_guide.pdf](http://www.wrap.org.uk/sites/files/wrap/Commercial_food_waste_collections_guide.pdf) (last accessed: 3<sup>rd</sup> May 2019)

Waste and Resources Action Programme (2017a) *Estimates of food surplus and waste arisings in the UK*. [online]. Available from:  
<http://www.wrap.org.uk/sites/files/wrap/Estimates%20in%20the%20UK%20Jan17.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Waste and Resources Action Programme (2017b) *Overview of Waste in the UK Hospitality and Food Service Sector*. [online]. Available from:  
<http://www.wrap.org.uk/sites/files/wrap/Overview%20of%20Waste%20in%20the%20UK%20Hospitality%20and%20Food%20Service%20Sector%20FINAL.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Waste and Resources Action Programme (2018) *Courtauld Commitment*. [online]. Available from:  
<http://www.wrap.org.uk/category/initiatives/courtauld-commitment> (last accessed: 3<sup>rd</sup> May 2019)

Water UK (2019) Water meters. [online]. Available from: <https://www.water.org.uk/advice-for-customers/water-meters/> (last accessed: 3<sup>rd</sup> May 2019)

Watson, M. and Meah, A. (2013) Food, waste and safety: negotiating conflicting social anxieties into the practices of domestic provisioning. *The Sociological Review*. 61, pp. 102.

Welch, D., Swaffield, J. and Evans, D. (2018) Who's responsible for food waste? Consumers, retailers and the food waste discourse coalition in the United Kingdom. *Journal of Consumer Culture*.

West of England (2019) *About us*. [online]. Available from: <https://www.westofengland-ca.gov.uk/about-us-2/> (last accessed: 3<sup>rd</sup> May 2019)

Wiles, J., Rosenburg, M. & Kearns, R. (2005) Narrative analysis as a strategy for understanding interview talk in geographic research, *Area*, 37(1), pp. 89–99.

Williams, J., Bouzarovski, S. & Swyngedouw, E. (2014) *Politicising the nexus: nexus technologies, urban circulation, and the coproduction of water-energy*; No.001. [online]. Available from: <https://www.thenexusnetwork.org/wp-content/uploads/2014/08/Williams-Bouzarovski-Swyngedouw-Politicising-the-nexus-Nexus-Thinkpiece-2014-page-numbers.pdf> (last accessed: 3<sup>rd</sup> May 2019)

Wittgenstein, L. (1958) *Philosophical investigations*. Hoboken: John Wiley and Sons

Wodak, R. & Meyer, M. (2009) *Methods of critical discourse analysis*, 2nd ed, London: SAGE.

Wood, N. & Roelich, K. (2019) "Tensions, capabilities, and justice in climate change mitigation of fossil fuels", *Energy Research & Social Science*, vol. 52, pp. 114-122.

World Bank (2010) *Cities Contribution to Climate Change*. Report. [online]. Available from: <http://siteresources.worldbank.org/INTUWM/Resources/340232-1205330656272/4768406-1291309208465/PartIII.pdf> (last accessed: 3<sup>rd</sup> May 2019)

World Economic Forum (2011) *Water Security: The Water-Energy-Food-Climate Nexus* [online]. Available from: <https://www.weforum.org/reports/water-security-water-energy-food-climate-nexus> (last accessed: 3<sup>rd</sup> May 2019)

World Meteorological Organisation (2017) *Greenhouse gas bulletin*. No 13 pp. 1-8 [online]. Available from: [https://ane4bf-datat1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/GHG\\_Bulletin\\_13\\_EN\\_final\\_1\\_1.pdf?LGJNmHpwKkEG2Qw4mEQjd\\_m6bWxgWAJHa](https://ane4bf-datat1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/GHG_Bulletin_13_EN_final_1_1.pdf?LGJNmHpwKkEG2Qw4mEQjd_m6bWxgWAJHa) (last accessed: 3<sup>rd</sup> May 2019)

World Resources Institute (n.d.) *Understanding the IPCC reports* [online]. Available from: <https://www.wri.org/ipcc-infographics> (last accessed: 3<sup>rd</sup> May 2019)

Xu, Y. and Yeh, CH. (2017) Sustainability-based selection decisions for e-waste recycling operations. *Annals of Operation Research*. 248 (1-2), pp. 531-552.

Yearley, S., Cinderby, S., Forrester, J., Bailey, P. & Rosen, P. (2003) "Participatory Modelling and the Local Governance of the Politics of UK Air Pollution: A Three-City Case Study", *Environmental Values*, vol. 12, no. 2, pp. 247-262.

Yin, R.K. (2009) *Case study research. Design and methods*. Fourth edition. London: SAGE.

Zhang, T., Siebers, P. and Aickelin, U. (2016) Simulating user learning in authoritative technology adoption: An agent based model for council-led smart meter deployment planning in the UK. *Technological Forecasting and Social Change*. 106. Pp. 74-84.

## **Appendix A**

### **Co-designing food waste services in the catering sector**

Michalec, A., Fodor, M., Hayes, E. and Longhurst, J. (2018) [Co-designing food waste services in the catering sector](#). *British Food Journal*, 120 (12). pp. 2762-2777. ISSN 0007-070X Available from: <http://eprints.uwe.ac.uk/36869>

#### **ABSTRACT**

##### **Purpose**

This paper presents results from the action research project, where sustainability professionals, local businesses and academic researchers collaborated on exploring barriers for food waste recycling in SMEs food outlets in order to inform local policy and business practices in Bristol, UK.

##### **Design/methodology/approach**

The researchers conducted face-to-face, qualitative surveys of 79 catering businesses in three diverse areas of the city. The action research methodology was applied, where a range of co-researchers contributed towards study design and review.

##### **Findings**

The research reveals the main barriers to recycling and how such perceptions differ depending on whether the respondents do or do not recycle, with “convenience” and “cost” being the main issue according to the already recycling participants. On the other hand, participants who do not recycle state that their main reason is “not enough waste” and “lack of space.”

##### **Practical implications**

Participants recommended a range of measures, which could improve the current food waste services in Bristol. For example, they suggest that business engagement

should address the barriers voiced by the participants applying the framings used by them, rather than assuming restaurants and cafes are not aware of the issue. By inviting a variety of non-academic stakeholders into the process of research design and analysis, the project addressed the imbalances in knowledge production and policy design.

### **Originality/value**

Despite the local and qualitative focus of this paper, the results and research methodology could act as a useful a guide for conducting food waste action research in the policy context.

## **1. Introduction**

### ***1.1. The landscape of food waste in the UK***

Food waste is a complex problem. It arises from each stage of food handling; from growing, processing, preparation, retail to consumption. There are no empirical national-scale calculations of food waste alone, but it is estimated that the annual food waste in the UK totals around 10 million tonnes (Mt). This quantity is associated with estimated emissions of 20 Mt greenhouse gases (mostly through landfills releasing methane) and an economic cost £17 bn (WRAP, 2017). Therefore, tackling food waste presents a significant policy opportunity to tackle climate change, hunger and save money.

The UK is a signatory to the international frameworks dealing with food waste, such as UN's Sustainable Development Goals (UN, 2015) and EU Waste Framework Directive (Papargyropoulou *et al.*, 2014). Despite the

commitments to the ambitious international targets, there is little national legislation in place (Priestley, 2016).

Waste in the UK is managed by the devolved countries and the local authorities. Currently, there are no mandatory food waste regulations in England (*ibid.*) and the government favours voluntary approach, such as the Courtauld Commitment 2025, where its signatories (nearly 100 retailers, local councils, and manufacturers) aim to decrease waste from food and packaging by 20% between 2015 and 2025 (WRAP, 2018). Commercial waste is managed privately, although businesses are under the Duty of Care, meaning that they have to “take all reasonable steps to ensure that the waste is managed correctly throughout its complete journey to disposal or recovery” (DEFRA, 2016). In practice, many do not choose to recycle or prevent waste; with the catering and hospitality industry alone leaving 0.92 Mt (or 3.6 Mt CO<sub>2</sub>eq) annually in the UK (WRAP, 2017). According to House of Commons (2017), 41% of waste from hospitality sector<sup>21</sup> is food waste and 43% of waste is sent for disposal. Table 1 describes the current estimates of food waste in the UK hospitality and catering sector.

#### **[TABLE 1 HERE]**

In contrast, Scotland and Northern Ireland are ahead of England in terms of business waste legislation. Businesses in Scotland and Northern Ireland producing more than 5kg of food waste per week are obliged to set up

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<sup>21</sup> Defined by WRAP (2018) as pubs, restaurants, hotels and quick service restaurants.

a separate waste collection (Scottish Environmental Protection Agency, 2016; Department of Environment, Northern Ireland 2015).

### **1.2. Bristol's answer to food waste issues**

Bristol, a city in the southwest of England with some 442 000 residents, is the area of this study (BCC, 2016). The city aims to become carbon neutral by 2050 (BBC, 2015). It also published a Zero Waste strategy setting out a vision and objectives for significant diversion of waste from landfill by 2030 (BCC, 2016).

The city is home to over 1000 hospitality and catering businesses (Carey, 2011). There is no data on the food waste practices and quantities in the area, however Carey (2011) presumes that:

*“most shops, cafes, restaurants and large scale kitchens are unlikely to separate out food waste and that it is therefore taken to landfill with all other waste through private contractors (...) more research is needed to establish the volume of food waste generated by the city, including commercial food waste, and to explore collaborative solutions that can serve the city as a whole”.*

In the absence of mandatory recycling, cross-sectoral partnerships and charities play a significant role in food waste via prevention and recycling in the catering sector. There are no overarching data on redistributed or recycled food, however some notable examples are documented via case studies, such as FareShare and Bishopston Trader's Group (BGCP, 2015; Resource Future,

2013). FareShare redistributes surplus food from retailers, restaurants and manufacturers to the local groups working with vulnerable people. FareShare transfers 30-40 tonnes of food to the charities in the wider Bristol region, supporting 150 organisations in Bristol and neighbouring municipalities (BGCP, 2015). It can be argued that in the absence of mandatory food redistribution laws and restrictions on types of food allowed to be redistributed (i.e. charities cannot accept warmed or cooked food, FareShare, 2018), food still remains the concern of the waste sector rather than the charity sector.

Another example of a local initiative is Sustainable Bishopston Traders Group. In 2013, they trialled a co-ordinated food waste collection scheme (Resource Futures, 2013). The scheme conducted a survey of the local needs, secured a discounted deal, promoted it in the local media and organised catering staff visits to the waste treatment sites. The food waste scheme was well documented, however after the successful trial period, it ended due to issues with waste contractors.

### **1.3. Research aims and objectives**

This research explores current food waste practices and barriers to food waste recycling <sup>22</sup>in the SME food outlets, with the aim of informing policies and business practices for improved waste management in Bristol, UK. This is achieved by applying a sequential methods research design, where each phase of data collection provides a basis for the next data collection phase

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<sup>22</sup> Food waste recycling is defined here as the waste management processes diverting inedible wasted food from the landfill, e.g. composting of anaerobic digestion.

(Cameron, 2009). In particular, this paper reports on the results from the qualitative survey of 79 catering<sup>23</sup> businesses and links the findings back to the previous phases of the project. In doing so, the paper answers the following research questions: What are the main barriers for participation in the commercial food waste recycling services? How can these barriers be addressed at the city and organisational levels? Therefore, the paper contributes to the debates on food waste management at the organisational and policy levels. The findings show how action research approach can address sustainability issues and contribute towards the knowledge creation.

## **2. Literature review**

The literature on surplus food and food waste in the catering industry was reviewed according to three perspectives:

- reasons for food waste;
- proposed and implemented solutions;
- dominant discourses.

The academic literature on food waste in the catering industry tends to focus on conceptualising reasons for the problem (Goebel *et al.*, 2015; Garrone *et al.*, 2014; Priefer *et al.*, 2016) and proposing systemic solutions (Priefer *et al.*, 2016, Mourad, 2016). Emphasis is often put on the international comparisons (Mourad, 2016; Priefer *et al.*, 2016, Sirieix *et al.*, 2017) and quantitative investigations (Porpino *et al.*, 2015; Silvennoinen *et al.*, 2014). Only a few

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<sup>23</sup> For the purposes of primary data collection, we define catering businesses as the following: cafes, restaurants, pubs, fast food takeaways and bakeries.

researchers show interest in reviewing waste management practices and discourses (Mourad, 2016; Thompson and Haigh, 2017).

Academics agree that food waste is a complex problem, which cannot be attributed to a single reason or sector (Goebel *et al.*, 2015; Heikkilä *et al.*, 2016). Food quality requirements, lack of co-operation along the supply chain, errors in forecasting customer demand, and portion sizes repeatedly appear as the main reasons for food waste within the catering industry (Goebel *et al.*, 2015; Garrone *et al.*, 2014; Priefer *et al.*, 2016, Heikkilä *et al.*, 2016). These studies predominantly used interviews and workshops with high-level professionals to reach the above conclusions.

Thus, the solutions proposed reflect the composition of the participants' pool, i.e. managers, academic experts, and policymakers. They suggest interventions at high-level decision-making, e.g. "a multi-stakeholder dialogue" (Goebel *et al.*, 2015; Priefer *et al.*, 2016), "improving data availability and measurements by agreeing on the definitions of "food waste/surplus food" or "mandatory collection of food waste" (Priefer *et al.*, 2016).

Nevertheless, interviews and workshops with food sector professionals yielded a few recommendations are the operational level. For example, recent studies suggested waste prevention ideas, such as offering individual portion sizes, careful menu planning and improvement of internal routines (Priefer *et al.*, 2016; Silvennoinen *et al.*, 2014). Duursma, *et al.*, (2016) measured food waste in Dutch restaurants and concluded this is an appropriate way of raising awareness among the kitchen staff. Porpino *et al.*, (2015) conducted laboratory experiments demonstrating smaller starter size outperforms

persuading customers to reduce waste. Finally, Strotmann *et al.* (2017) conducted an intervention study, where a set of measures (e.g. staff training, poster, improved communication across supply chain, change portion size, analysis of customer preferences) contributed to a decrease in food waste in a cafeteria and a residential home. Despite the growing number of experimental and quantitative studies, there is no research investigating the organisational side of food waste management.

While academics measure the effectiveness of food waste prevention, the industry tends to focus on recycling. Mourad (2016) critiqued French and the US municipalities and food companies for promoting predominantly recycling measures as an answer to food waste. She pointed out that this practice is against the widely accepted hierarchy of waste, which seeks to prevent, then redistribute and then recycle waste (Papargyropoulou *et al.*, 2014). As a result, surplus food turns into a waste commodity (Mourad, 2016).

However, even after reducing food production and redistributing surplus to people in need, there will be “unavoidable waste” left, e.g. peels, eggshells or bones. It is estimated that a quarter of food waste in catering is unavoidable (WRAP, 2017). This fact alone justifies the need for research and policy on effective food waste recycling services. Yet, despite the wide encouragement from the policymakers, it is not clear how to introduce food waste recycling to the catering sector.

Food waste is a politicised issue. Mourad’s (2016) paper differentiated between various framings for food waste:

- **Social**, expressed as cooking collectively with surplus produce, Slow Food movement, food banks, national policies to track food losses and redistributing surplus to tackle ethical and food security concerns;
- **Environmental**, e.g. diversion from landfills by composting or anaerobic digestion;
- **Economic**, understood as **either** “resource efficiency” - managing losses and surplus to maximise economic efficiency **OR** “a protest against capitalism” through radical bottom-up organising (e.g. freeganism or Food Not Bombs).

Mourad (2016) critiqued the main discourses of waste management present in the French and US governments. She found that the authorities rely on technological improvements and large-scale optimisation of the existing supply chains, leaving the current modes of over-production and over-consumption unchallenged. In other words, they are underpinned by the “economic” discourse understood as “resource efficiency” rather than “protest against capitalism”. In turn, Mourad (*ibid.*) suggests sustainability solutions, which challenge “over-industrialization,” and “homogenisation” of food production.

Thompson and Haigh (2017) explore food waste framings through media analysis. They describe a societal shift from arguing for “wartime resourcefulness” to contemporary concerns about “feeding global population with limited resources” (*ibid.*). Furthermore, they argue that at the catering

level, food waste is constructed as a moral issue and a matter of incompetence in business management and food handling (*ibid*).

In summary, the academic literature provides comprehensive reasons for food waste and suggests solutions at various levels of engagement. There are numerous empirical and quantitative studies demonstrating effectiveness of certain specific measures. However, academics have not focused sufficiently on addressing the organisational side of food waste in the catering sector – perhaps due to prevailing engagement with the most senior staff. Research approaches exploring the barriers and practices together with the food waste practitioners and food outlet staff members are therefore critical for providing appropriate policy and managerial recommendations. The following section will elaborate why the approach presented in this paper – action research is suitable for closing the gap in the literature.

### **3. Materials and methods**

#### ***3.1. Methodology: Action Research***

The findings reported in this paper contribute to co-designing policy and organisational recommendations related to food waste recycling in Bristol, UK. Hence, the overall methodology applied was action research. Action research is characterised by an emphasis on improving and informing practice while engaging with participants throughout the research design, analysis and dissemination stages (McNiff and Whitehead, 2011). Sequential methods design was applied in this project: the researchers started with the analysis of food waste discourses (summarised in the section 2). Then, they facilitated a series of meetings with 9 local food waste practitioners (Appendix

1), who highlighted commercial food waste arisings as the key challenge and a tangible opportunity for the city-scale policy. For example, during a group discussion in February 2017, a participant working for the municipally-owned waste company predicts that collecting food waste from businesses will be challenging even once waste collection service is in place: "*The [free waste collection] contracts apply only to residential properties, anything else would be chargeable...We've started up our commercial side and we'll do food waste, but lots of companies don't produce enough volumes to make it feasible*". Figure 1 (below) describes the research process: timescales, meetings and data collection.

#### **[INSERT FIGURE 1 HERE]**

The central point of the primary data collection was the qualitative survey, designed in collaboration with the practice-based co-researcher (Author 2). Following the data collection and preliminary analysis stage, co-researchers also contributed to the scrutiny of the results and commented on policy implications. Finally, the ultimate test of "usefulness" of action research approach is the dissemination stage, described in section 6.

Action research is used in this study as it focuses on practical and applied knowledge, and it strives to break down the hierarchies and imbalances in knowledge production (Hawkins, 2015). It acts as a conduit between practitioners, policymakers, and researchers. Moreover, giving voice to the food waste practitioners and catering sector staff has important epistemological implications for research and policymaking. It invites questions like: who should design policies? Which questions should be

research? What constitutes as knowledge in complex and transdisciplinary social settings? (ibid.).

Action research is well established in areas like education studies. Nevertheless, there has been little guidance how it could enhance policy and sustainability sectors. This paper aims to fill this gap by providing detailed guidelines on researching with practitioners, reflecting, and evaluating own work.

### ***3.2. Qualitative surveys***

The idea of qualitative surveying emerged from the meetings with sustainability practitioners. The qualitative design was applied in this study to derive diversity and “richness” of answers and participants rather than statistical analysis of results (Jansen, 2010). Therefore, the results do not aim to represent the whole catering sector, but they act as an evidence for co-designing a policy specific to the local context. Qualitative face-to-face surveys are suitable for exploratory research, where not enough studies on the issue were undertaken and in-depth understanding is required to derive sound policy recommendations (ibid.).

### ***3.3. Data collection***

The researchers carried out 79 face-to-face surveys in January 2018. Businesses were purposively selected, so each business type and research area (see Table 2 for area characteristics) was adequately represented. Furthermore, the areas selected reflect the diversity of Bristol’s high streets. Sample size was determined so that the dataset achieves saturation (Morse,

2015), i.e. most opinions are covered, there are emerging patterns in data and there is a considerable diversity within the sample itself.

**[TABLE 2 HERE]**

The majority of the interviews lasted between 5 and 10 minutes, however in 8 cases they lasted 15-25 minutes (including 1 waste facilities tour). Answers were recorded in writing on a survey sheet. Two respondents opted for sending email responses instead of participating in a face-to-face survey. The interviews were conducted with the staff at the front of the house, unless they specifically requested another staff member to contribute (e.g. an off-duty manager or a chef). Since the level of seniority was not a requirement for participation, the survey allowed to capture a more diverse range of experiences and opinions. Furthermore, the concise survey design contributed to a high response rate as the day-to-day work wasn't disturbed, nor was a separate meeting required as the willing participant were recruited using the door-knocking technique.

When distributing the survey, the researchers avoided prompting. They also took care to rephrase questions when a language barrier arose. The researchers used empathetic and non-judgemental language to encourage opinions from participants of all levels of seniority and build trust, which is essential to disclose sensitive information. The survey asked 5 open-ended questions about present food waste management practices (Q1), reasons for (not) recycling (Q2), perceived barriers (Q3), and suggestions for improvement (both for catering sector, waste companies and policymakers; Q4 and Q5). Finally, the survey included 3 demographic questions (business

type, location, membership in a traders' group) and an option to be contacted in the future.

### ***3.4. Data analysis***

The researchers coded participants' answers and analysed them using thematic-discourse analysis (Braun and Clarke, 2006). Thematic Analysis allows the capturing of patterns in the data in an inductive and systematic way (*ibid.*). The critical lens of analysis, and the comparison of the languages present in the dataset and the literature were drawn from the tradition of discourse analysis (Bax, 2011). Here discourse is understood as text or speech in a social context, analysed with the reference to ideologies, policies, and agendas (*ibid.*).

First, discourse analysis encourages critical reading – beyond the level of what is explicitly stated in the data. Second, by asking “What is the message?”, “How it is communicated and to whom?” and “Why is it communicated?”, discourse analysis challenges the dominant framings (e.g. resource efficiency, food security) which often appear as “neutral”, leading the reader on to unexplored assumptions (*ibid.*).

### ***3.5. Limitations and advantages***

The analysis of survey data should not be statistically relied upon since the sample size is not representative of the whole city. Seventy-nine participants and three neighbourhoods cannot reflect the participation rate for some 1000 catering outlets located across all 34 wards in the city. However, the nature of action research does not require results to be generalisable as the

focus of the survey is the themes and discourses emerging from the qualitative data.

Similarly, the recycling participation figure might be an overestimation, as participants who do not recycle could refuse taking part in the surveys or do not reveal its practices truthfully. However, a high response rate and a range of honest and detailed responses from non-recycling businesses encourages trust in the data.

The researchers encountered a language barrier in a few cases, which affected the “richness” of the dataset, particularly in Easton. The researcher used plain language and repetitions to encourage complete answers. For the future, the researchers recommend working with interpreters.

The length of the questionnaire (5 open ended questions) could potentially affect the “richness” of data. However, a variety of answers, high response rate and the presence of forward-looking insights suggest that the data achieved saturation. The researchers decided to conduct a short survey, as this was more appropriate in busy, customer-facing environments.

### ***3.6. Evaluating action research***

The researchers employed the following strategies to enhance scientific rigour and enable comprehensive justification and transparency of each research stage. They kept a diary to reflect on the process and arising personal viewpoints, which could bias the research analysis. Sequential methods design and an exhaustive literature review allowed a trustworthy justification of the method and a research gap. While the authors acknowledge that they cannot

be fully neutral as action researchers, they strived to present the complexity of the arguments arising from the literature review and the primary data. Although the findings cannot be directly applied in other contexts, there is an indication that the barriers, motivations, solutions, and discourses used by the participants could be relevant for the catering sector in other geographical areas, which share some of the social, policy and economic characteristics.

#### **4. Results**

In total, 79 out of a population of 95 approached businesses responded to the survey (83% response rate). Table 3 outlines the demographic characteristics of survey respondents. The participating businesses were located in the following areas: city centre (39.2%), Gloucester Road (40.5%) and Easton (20.3%). The smaller sample size in Easton reflects the size of the area. They characterised themselves as the following: restaurants (29.1%), pubs (12.7%), cafes (30.4%), fast food takeaways (22.8%) and bakeries (5%).

#### **[TABLE 3 HERE]**

Responses to the open-ended questions in the survey ranged widely from a few words to more detailed answers containing a few paragraphs. The researchers generated three themes described in sections 4.2-4.4. The themes are as follows: “Barriers or excuses? “Need for top-down measures”; “Giving agency”. After the categorisation of answers in thematic patterns, the researchers investigated the language used by the participants. As a result, dominant,

emerging, and conflicting discourses were identified and are described in the section 4.5.

#### ***4.1. Characteristics of participants who recycle food waste***

Out of 79 respondents, 42 (53%) confirmed that they already use food waste collection services. Table 4 outlines the response by area and business type. The recycling rate is not evenly distributed across the areas and business types, with Easton having much lower participation rate than other areas. While restaurants achieved high recycling participation rate (78%), takeaways and bakeries recycled the least (respectively 33% and 0% participation in recycling services). Although the results are not statistically significant, they indicate that participation in recycling services may depend on the type of the business and the location of the catering business. As such, improved waste services could target its recipients according to businesses in needs and potential priority areas.

**[TABLE 4 HERE]**

#### ***4.2. Barriers or Excuses?***

Figure 2 summarises the main barriers to participation in food waste recycling, as voiced by the food outlets employees.

**[INSERT FIGURE 2 HERE]**

According to the participants who don't recycle food, the main barriers are:

- Not enough waste (recorded 18 times, e.g. "*We have very little waste comparing to other restaurants*" restaurant/Gloucester Road)

- Lack of space for bins (recorded 7 times, e.g. “*It’s the practicalities of handling and storing food waste on site until collection*” café/Gloucester Road)
- Cost (recorded 5 times, e.g. “*We used to do it, no it’s too expensive for the amount of waste produced*” café/City Centre)
- Convenience (recorded 5 times, e.g. “*It takes too much work to arrange*” restaurant/ Easton)

However, the landscape changes once the answers of participants, who already recycle included:

- Convenience (recorded 20 times, e.g. “*It’s laziness – there should be no excuse!*” Café/Gloucester Road)
- Cost (recorded 16 times, e.g. “*I imagine it would be the price, it’s easier for big businesses like ours*” restaurant/ city centre)
- Lack of space (recorded 5 times, e.g. “*I’d assume it would not be feasible in small spaces*” pub/ Gloucester Road)
- Knowledge gap (recorded 5 times, e.g. “*Not many people have the knowledge of what can and cannot be recycled, for example biodegradable cups*” restaurant/ Gloucester Road)

There is a clear discrepancy between the barriers mentioned by those who recycle and those, who do not. It is questionable whether the issues of space and small quantities are the complex, systemic barriers claimed or rather - are they “excuses”, which could be overcome with quality communication and simple measures? For example, a participant working in a café on Gloucester Road said: “*we should emphasise how easy it is, for*

*example use myth busters*”. Similarly, a look at existing practices in Scotland and Northern Ireland challenges the idea of “Not having enough waste”. Scottish and Northern Ireland businesses are obliged to separate food if they produce as little as 5kg of food waste.

Many concerns expressed by the participants reflect the issue of scale – recycling is more challenging for independent, small, and budget eateries. However, the issue can be resolved with communication and improvements in recycling services. The following sections analyses the solutions proposed by the participants.

#### **4.3. Need for top-down measures**

The UK Government is currently favours voluntary measures and is reluctant to adopt compulsory food waste management in England since “there are more efficient options than restrictions in this area and evidence suggests that restrictions would likely impose additional costs on businesses, particularly SMEs” (EFRA Committee, 2015). However, 13 participants indicated that food waste recycling should be a legal requirement, e.g. “*It should be done by the council, not waste companies*” takeaway/ city centre. Notably, 12 out of 13 answers came from participants, who already recycle. This result should not be used as an extrapolation for the acceptance of compulsory food waste recycling policy. The survey did not explicitly ask: “are you in favour of compulsory food waste management?”. Instead, the question was the following: “how could waste collection services be improved?”.

Another popular suggestion was “lower price”, mentioned by 12 participants. This solution could be implemented as either policy or market

measures. Participants disagreed on whether recycling should be subsidised, e.g. “*Everyone should do it; businesses shouldn't be subsidised to do so*” (café/Gloucester Road) vs “*State should subsidise it to convert to energy*” (restaurant/City Centre). Some other ideas proposed by the participants were “*local targeting of areas in need*” (takeaway/city centre or “*tax relief for green businesses*” (Restaurant/Easton). Finally, achieving better value for money could be facilitated using market measures, for example, a co-ordinated cost-efficient service for shopping centres, markets, areas w large concentration of businesses etc. (“*Business Improvement Districts should coordinate it*” restaurant/Gloucester Road). Figure 3 summarises the policy measures recommended by the participants.

### [FIGURE 3 HERE]

#### **4.4. Giving agency**

While large scale and systemic measures are often preferable for addressing complex issues like food waste, they are usually challenging and timely to implement. Meanwhile, participants recommended a range of operational solutions, which could give the agency to both catering staff and waste companies.

First, waste companies could improve their service by responding to the varied needs of both smaller and bigger businesses (recorded 21 times). A staff member based in the city centre restaurant suggests: “*They should offer different bag and bin sizes for small businesses*”. Flexible collection times could mitigate the space issues; the owner of a café located in the city centre

speculates “*since we don’t have space to store an extra bin, we would appreciate daily or on-demand collection*”.

Second, improving communication (recorded 17 times) between the researchers, waste companies, catering businesses, and customers could improve the food waste landscape. Participants emphasised that the quality of the communication, rather than the quantity is the key. In extreme cases, a lack of communication is the issue. For example, a manager of an Easton restaurant recalls “*we’ve never even been offered recycling, only general waste!*”. Participants believe that business engagement should be meaningful and offer more than factual information. A staff member at a Gloucester Road restaurant concluded that “*conversations are better than leaflets*”, while a participant from a Gloucester Road café admitted “*We only had one door-knocking so far. Now you got me thinking about waste*”. Researchers also have a role in communicating the value of food waste recycling. The owner of a Gloucester Road restaurant said: “*You need to demonstrate the undesirable effect of sending huge amounts of food waste to landfill when it could be converted into energy*”.

The issue of recycling food waste is not communicated enough to the customers and between businesses. Meanwhile, participants suggested than championing the right attitude and pledges would create a social norm, for example a staff member at an Easton café who recommends: “*we should be championing businesses who already do it, so others follow*”. Additionally, a staff member of a city centre cafe proposes “*businesses should put a sign in the window, advertise it and make it a selling point*”.

Finally, committing to food waste collection could result in co-benefits to the business (recorded 9 times). Participants, who already recycle shared that it helps them with stock management and saves money in the long term. For example, an owner of Gloucester Road café said: “*it increases awareness of what's happening in the kitchen and helps to manage stock*”. A staff member of a Gloucester Road restaurant argues “*separation keeps the general waste low, you can save money as a result*”.

#### **4.5. Dominant, emerging, and conflicting discourses**

Discourse analysis of the arguments used by the participants reveals that the most common frames used are:

- Environment/sustainability – dominant frame for those, who already recycle (e.g. “*We do not want our food waste to be sent to landfill when there is an opportunity for it to be recycled*” restaurant/ Gloucester Road)
- “Not our problem” – dominant frame for participants, who don’t recycle, e.g. “*We don't have enough waste as we cook to order*” restaurant/ Easton; “*We have very little waste and donate all leftovers to neighbours and friends*” bakery/ Easton
- Ethical and normative, (e.g. “*it's a good deed, no food should ever be wasted*” restaurant/ Easton; “*I haven't thought much about it before but it's a company policy – we just have to do it*” Pub/ Gloucester Road)
- Competent business management - used **both** by recycling and non-recycling businesses (number), e.g. “*We're staying ahead of the law. It makes sense in the long term- it's better to do it now before it's enforced*”

*“by law, it’s good for our reputation” restaurant/ city centre **but also** “Main barrier is the cost. However, our menu is devised to minimise food waste. Food waste is expensive for businesses just as unsold stock” café/Gloucester Road*

Understanding the discourses used by non-recycling participants could help with effective engagement. The perception of “not having enough waste” ought to be tackled in first place, for example by referring to the regulations in Scotland and Northern Ireland. Second, applying “competency” framing could reach businesses who don’t recycle due to practical reasons, like cost or space. Business engagement should contain a mix of information and tailored persuasion. This way, the communication will close the environmental knowledge-gap and emphasise shared benefits.

## **5. Discussion**

### **5.1. *The unexpected and unprompted***

Although the questionnaire asked specifically about food waste recycling, 23 participants were keen to mention food waste prevention measures, such as menu control or formal and informal donations. Such conversations were unexpected and unprompted and often occurred as a justification for not recycling food waste. In the UK, regulations around donating food are quite strict, e.g. businesses cannot donate warmed or buffer food (FareShare, 2018). Yet, participants would admit that they regularly donate food informally to other staff members, friends or the homeless. It is unclear whether recycling has a negative impact on the actions further up the waste hierarchy. Mourad (2016) suggests that small scale and informal

donations get disrupted in favour of industrialised and formalised forms of exchange. However, further research is needed to provide evidence on the relationships between informal and formal waste conduits.

## **6. Next steps and conclusions**

### ***6.1. Co-creation of the results***

Following the action research protocol outlined in the section 3.1., the authors presented the survey results to the co-researchers who were able to provide comments and compare the findings with their up-to-date knowledge. Drawing from several years of experience in sustainability sector, co-researchers signalled the following complexities, which might arise during the design of the improved food waste service:

- Whether food waste is charged by weight or volume (food waste is one of the heaviest recyclables)
- Whether such service would repurpose food waste to anaerobic digestion, compost, or animal feed.

Co-researchers agreed that sharing stories and discourses ought to help uptake. Traders groups could act as knowledge sharing spaces; areas lacking such way of self-organising should get help from the local authority with setting up such business community. They also agreed that lack of space is the major issue for small businesses. However, a group deal and discount could offer frequent collection, which would reduce the need for storage.

### ***6.2. Strategy for dissemination, engagement and implementation***

The overall aim of the action project is to improve existing commercial food waste practices in the local context. Therefore, the researchers acknowledge that publishing the results in the academic context is merely a beginning of the dissemination process and needs to be supported with continuous engagement with existing co-researchers and other stakeholders using appropriate format, i.e. concise and jargon-free reporting.

Using themes and discourses reoccurring throughout the datasets, the researchers derived practical recommendations, which were communicated to the following stakeholders:

- Waste, Economy and Regeneration officer in the local council
- City Mayor
- Local councillors
- Municipally-owned Waste Company
- Cross-sectoral Waste and Resources Action Group
- Local Food Policy Council
- Traders' groups and Business Improvement Districts

Should the engagement result in implementation of the recommended measures, the researchers will contact the 24 participants, who expressed interest in further information about the future improvements in the local waste management sector.

### **6.3. Concluding comments**

This paper presented results the exploratory action research project investigating commercial food waste collection services in Bristol. The aim of

action research is finding out which policies and interventions would work in a particular context. By bringing together researchers and practitioners, the study can draw evidence for co-designed policies supported by democratic voices and academic theory.

This paper opens new avenues for policymaking by suggesting initiatives and discourses, which are likely to receive support within the catering sector. Such initiatives range from mandatory collections to co-ordinated services operated by the partnerships between traders' organisations and waste companies. Most importantly, the research brought attention to the need of high quality communication of the food waste information, which ought to be tailored towards the relevant framings (e.g. sustainability, social norm, competent business management). The researchers recommend that business engagement should address the barriers voiced by the participants applying the framings used by the catering sector, rather than assuming that restaurants and cafes are not aware of the issue. Participants recommended a range of measures, which could improve the current food waste landscape in Bristol. They emphasised that bottom-up and operational solutions will give agency to the catering sector.

The findings were grounded in a qualitative survey using sample size from a small geographical area. Further research on effectiveness of recycling policies is therefore required. In particular, investigating recent food waste policies in Scotland and Northern Ireland ought to be a priority. Finally, a large-scale survey conducted across Bristol could yield recycling rate representative for the whole city.

## **References**

- ACORN, (2012) CACI Acorn Segmentation. Map commissioned by the Bristol City Council. Online:  
[http://maps.bristol.gov.uk/instantatlas/Acorn/Map%20%20Acorn%20Segmentation%20\(Bristol\).pdf](http://maps.bristol.gov.uk/instantatlas/Acorn/Map%20%20Acorn%20Segmentation%20(Bristol).pdf)
- Bax, S. (2011) *Discourse and Genre*. Macmillan International, London
- Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3 (2). pp. 77-101.
- BCC - Bristol City Council (2015) Deprivation in Bristol. The mapping of deprivation within Bristol Local Authority Area. Online:  
<https://www.bristol.gov.uk/documents/20182/32951/Deprivation+in+Bristol+2015/429b2004-eeff-44c5-8044-9e7dc002faf>
- BCC- Bristol City Council (2015) Our Resilient Future: A framework for climate and energy security, pp. 120- 198. Online  
[https://www2.bristol.gov.uk/committee/2015/ua/ua000/1103\\_binder.pdf](https://www2.bristol.gov.uk/committee/2015/ua/ua000/1103_binder.pdf)
- BCC - Bristol City Council (2016) Quality of Life in Bristol 2015-16. Results of 2015 survey. Online:  
<https://www.bristol.gov.uk/documents/20182/33896/Results+of+quality+of+life+in+Bristol+survey+2015+to+2016/2a83bda4-fed5-400d-b638-2d2c72f67507>
- BCC -Bristol City Council (2016) Towards a Zero Waste Bristol: Waste and Resource Management Strategy. Bristol, pp. 1-40. Online  
<http://www.bristol.gov.uk/documents/20182/33395/Towards+a+Zero+Waste+Bristol+-+Waste+and+Resource+Management+Strategy/102e90cb-f503-48c2-9c54-689683df6903>
- BCC -Bristol City Council (2017) Clean Streets Strategy. Online:  
<https://www.bristol.gov.uk/bins-recycling/clean-streets-campaign>
- BGCP - Bristol Green Capital Partnership (2015) Bristol Method: How to tackle food waste in cities. Online: <https://bristolfoodpolicycouncil.org/the-bristol-method-and-food-how-we-do-it-here-in-bristol>

Cameron, R. (2009) A sequential mixed model research design: Design, analytical and display issues. *International Journal of Multiple Research Approaches*, 3 (2), pp.140-152.

Carey, J. (2011) Who feeds Bristol?: towards a resilient food plan : production : processing : distribution : communities : retail : catering : waste, Bristol City Council, Bristol.<https://www.bristol.gov.uk/documents/20182/32619/Who-feeds-Bristol-report.pdf>

DEFRA (2016) Waste Duty of Care Code of Practice. Online  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/506917/waste-duty-care-code-practice-2016.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506917/waste-duty-care-code-practice-2016.pdf)

De Vaus, D. (2013) *Surveys in Social Research*. 6<sup>th</sup> Ed. Routledge: Oxford

Duursma, G., Vrenegoor, F. and Kobus, S. (2016) Food waste reduction at Restaurant De Pleats: Small steps for mankind. *Research in Hospitality Management*. 6(1): pp. 95–100

FareShare (2018) The food we take [online] <http://fareshare.org.uk/giving-food/the-food-we-take/>

Garrone, P., Melacini, M. and Perego, A. (2014) Opening the black box of food waste reduction. *Food Policy*. 46, pp.129-139.

Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P. & Ritter, G. (2015), Cutting food waste through cooperation along the food supply chain, *Sustainability*, 7(2), pp. 1429-1445.

Hawkins, K.A. (2015) The complexities of participatory action research and the problems of power, identity and influence. *Educational Action Research*, 23 (4), pp.464-478.

Heikkila, L., Reinikainen, A., Katajajuuri, J.M., Silvennoinen, K. and Hartikainen, H. (2016) Elements affecting food waste in the food service sector. *Waste Management*, 56 pp.446-453.

Jansen, H. (2010) the Logic of Qualitative Survey Research and its Position in the Field of Social Research Methods. *Forum: Qualitative Social Research*. 11(2).

Online: <http://www.qualitative-research.net/index.php/fqs/article/view/1450/2946>

JRF - Joseph Rowntree Foundation (2005) Environmental problems and service provision in deprived and more affluent neighbourhoods. Online:  
<https://www.jrf.org.uk/file/35922/download?token=UKOiwQya&filetype=findings>

McNiff, J. & Whitehead, J. (2011) *All you need to know about action research*, 2nd edn, SAGE, London

Morse, J.M. (2015) Critical Analysis of Strategies for Determining Rigor in Qualitative Inquiry. *Qualitative Health Research*, 25 (9), pp.1212-1222.

Mourad, M. (2016) Recycling, recovering and preventing "food waste": Competing solutions for food systems sustainability in the United States and France. *Journal of Cleaner Production*, 126 pp.461-477.

Papargyropoulou, E., Lozano, R., Steinberger, J.K. and Wright, N. (2014) The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*, 76 pp.106-115.

Porpino, G., Wansink, B. and Cheek, K. (2015) Saving Food in Restaurants: Half-Sized Portions Outperform Persuasion on Mitigating Waste. *Journal of Nutrition Education and Behavior*, 47 (4), pp. S46.

Priefer, C., Jörissen, J. and Bräutigam, K. (2016) Food waste prevention in Europe – A cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling*, pp. 155-165.

Resource Futures (2013) on the Sustainable Bishopston Traders' Food Waste and Recycling Service. Online: <http://bristolfoodpolicycouncil.org/wp-content/uploads/2013/06/CCF-2062-Final-report-commercial-food-waste.pdf>

Silvennoinen, K., Katajajuuri, J. M.; Hartikainen, H., Heikkilä, L. and Reinikainen, A. (2014) Food waste volume and composition in Finnish households. *British Food Journal*, 116 (6), pp.1058-1068.

Sirieix, L., Lála, J. and Kocmanová, K. (2017) Understanding the antecedents of consumers' attitudes towards doggy bags in restaurants: Concern about food waste, culture, norms and emotions. *Journal of Retailing and Consumer Services*, 34 pp.153-158.

Strotmann, C., Friedrich, S., Kreyenschmidt, J., Teitscheid, P. & Ritter, G. (2017) Comparing Food Provided and Wasted before and after Implementing Measures against Food Waste in Three Healthcare Food Service Facilities, *Sustainability*, 9, (8), pp. 1409

Thompson, K., and Haigh, L. (2017) Representations of Food Waste in Reality Food Television: An Exploratory Analysis of Ramsay's Kitchen Nightmares. *Sustainability*, 9 (7), pp.1139.

Visit Bristol (2018) Gloucester Road and Stokes Croft [online]  
<https://visitbristol.co.uk/shopping/gloucester-road-and-stokes-croft>

WRAP - Waste and Resources Action Programme (2017) Household Food Waste in the UK, 2015. Final report. Online  
[http://www.wrap.org.uk/sites/files/wrap/Household\\_food\\_waste\\_in\\_the\\_UK\\_2015\\_Report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_waste_in_the_UK_2015_Report.pdf)

WRAP - Waste and Resources Action Programme (2018) Courtauld Commitment. Online: <http://www.wrap.org.uk/category/initiatives/courtauld-commitment>

## TABLES

<b>Waste stream</b>	<b>Carbon Footprint</b>	<b>Tonnage</b>	<b>Financial Cost</b>
Total Food Waste	3.6 Mt CO <sub>2</sub> eq	0.92 Mt	£2.5 bn
Avoidable Food Waste	2.7 Mt CO <sub>2</sub> eq	0.68 Mt	N/A
Unavoidable Food Waste	0.9 Mt CO <sub>2</sub> eq	0.24 Mt	N/A

Notes: A quarter of food waste is estimated as unavoidable and mainly consists of fruit and vegetable peelings. Exc. Waste associated with drinks.

*Table. 1 UK annual food waste estimates for the Hospitality and Catering Sector (WRAP, 2017)*

Area	Characteristics
Easton	<ul style="list-style-type: none"> <li>• Mostly independent businesses – Numerous independent businesses southeast Asian and African food outlets</li> <li>• Higher than average social deprivation (BCC, 2015)</li> <li>• Area targeted for street cleaning (BCC, 2017)</li> <li>• 88% residents concerned about climate change (BCC, 2016)</li> <li>• 91% residents think litter is a problem (BCC, 2016)</li> <li>• No Business Improvement District present<sup>24</sup></li> <li>• Most common sociodemographic ACORN<sup>25</sup> categories: Aspiring Singles, Starting Out, Blue Collar Roots (ACORN, 2012)</li> </ul>
City Centre	<ul style="list-style-type: none"> <li>• High concentration and large variety of catering businesses, including both independents and high streets chains, shopping centre, food markets, budget eateries and fine dining</li> <li>• Most common sociodemographic categories: Educated urbanites, Aspiring Singles and High-Rise Hardship (ACORN, 2012)</li> </ul>

<sup>24</sup> Business Improvement District (BID) - a defined area in which a levy is charged on all business rate payers in addition to the business rates bill. This levy is used to develop projects which will benefit businesses in the local area. (HM Government, 2014)

<sup>25</sup> ACORN- a UK population segmentation tool, which categorises neighborhoods in 18 groups according to a wide range of commercial and open data on age of residents, ethnicity profiles, benefits, population density and housing

	<ul style="list-style-type: none"> <li>Business Improvement District covering part of city centre</li> </ul>
Gloucester Road	<ul style="list-style-type: none"> <li>One of the UK's longest high streets with independents shops (Visit Bristol, 2018)</li> <li>88% residents concerned about climate change (BCC, 2016)</li> <li>Most common sociodemographic categories: Prosperous Professionals, Educated urbanites, Aspiring Singles (ACORN, 2012)</li> <li>Traders' Group and Business Improvement District covering part of Gloucester Road</li> </ul>

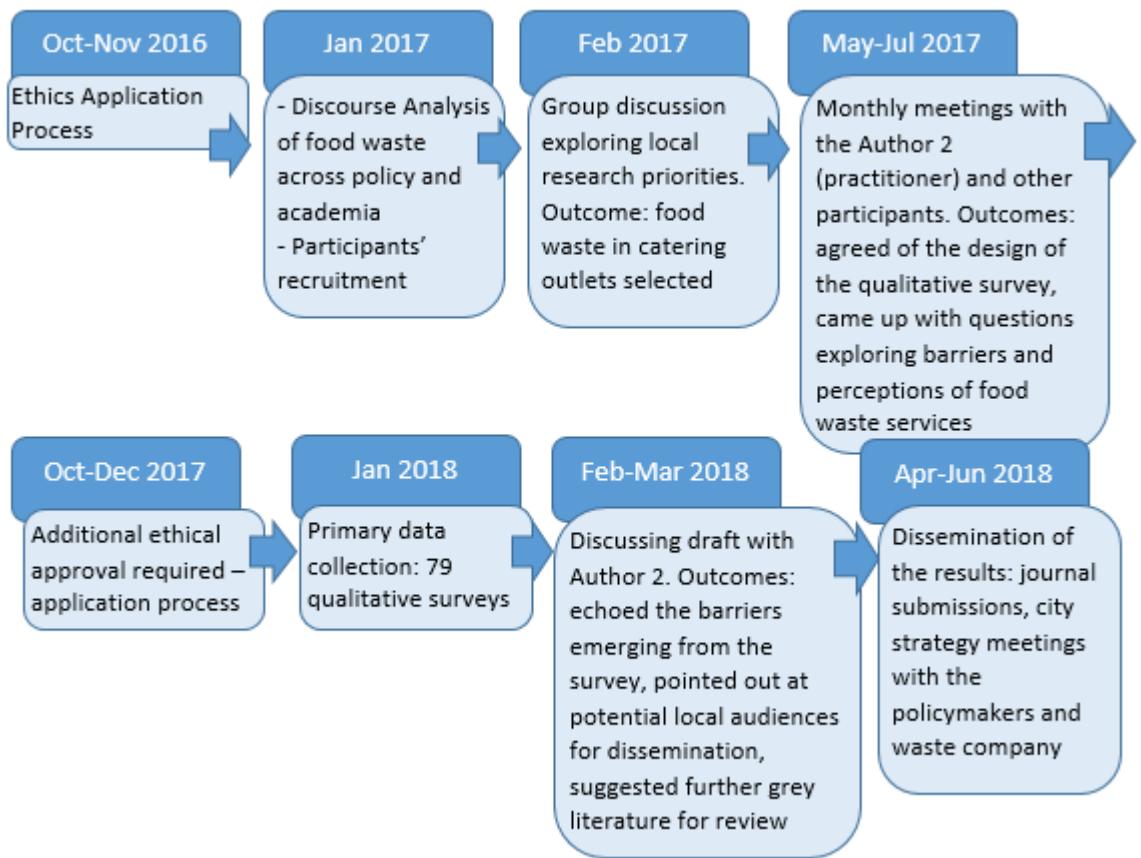
*Table 2. Key characteristics of the areas surveyed in the paper*

<b>Area</b>	<b>Total count and percentage</b>	<b>Type</b>	<b>Total count and percentage</b>
City Centre	32 (39.2%)	Restaurant	23 (29.1%)
Gloucester Road	31 (40.5%)	Pub	10 (12.7%)
Easton	16 (20.3%)	Café	24 (30.4%)
		Fast Food Takeaway	18 (22.8%)
		Bakery	4 (5%)

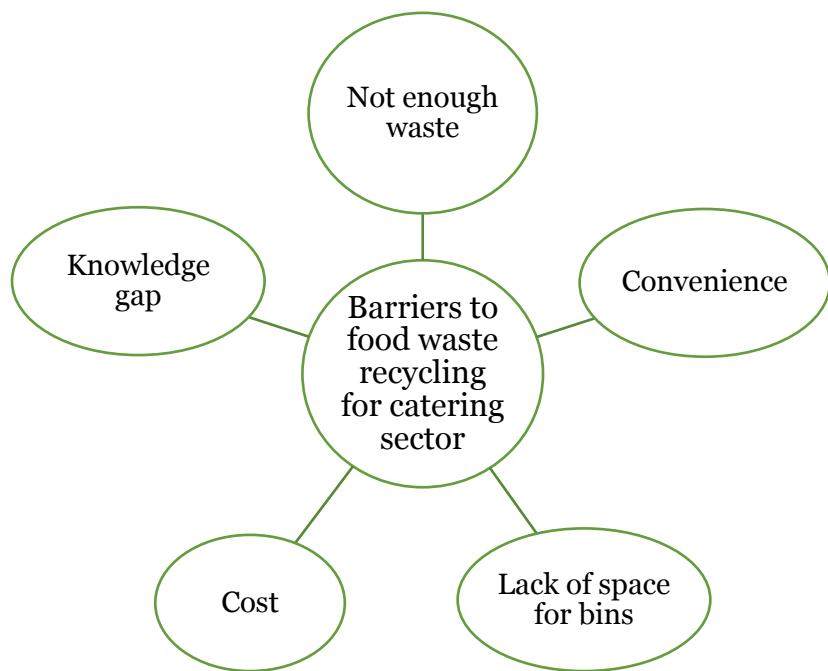
*Table 3. Survey participants' characteristics.*

<b>Area</b>	<b>Count and percentage of participants recycling</b>	<b>Type</b>	<b>Count and percentage of participants recycling</b>
City Centre	18 (56%)	Restaurant	18 (78%)
Gloucester Road	19 (61%)	Pub	5 (50%)
Easton	5 (31%)	Café	13 (54%)
		Fast Food	6 (33%)
		Takeaway	
		Bakery	0 (0%)

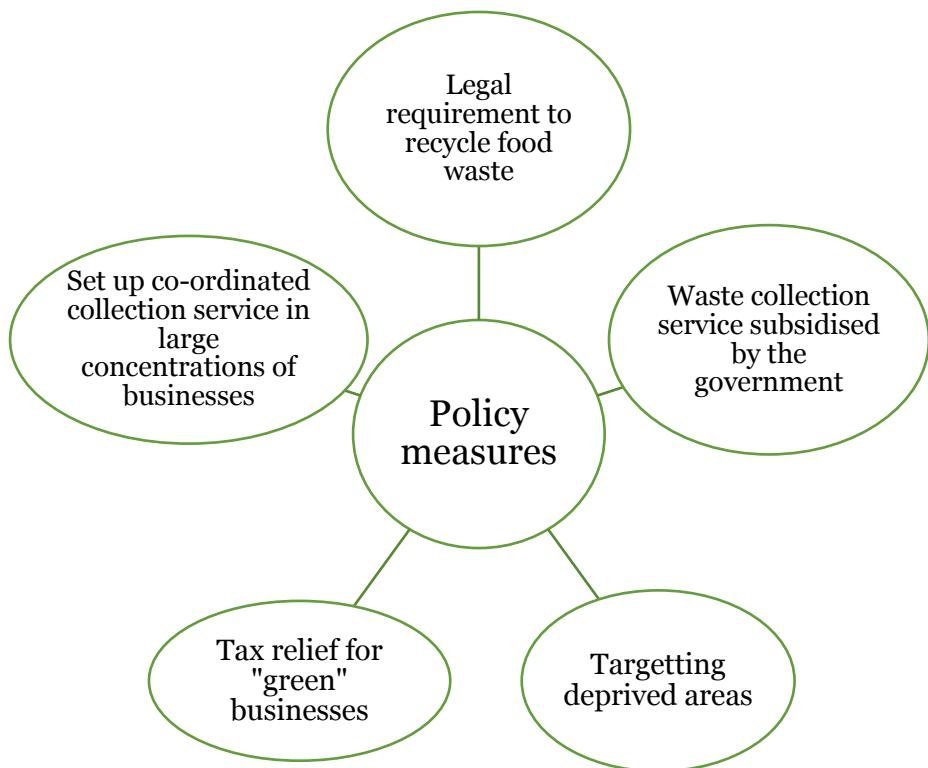
*Table 4. Proportion of participants already recycling food, outlined by area and type.*



*Figure 1. Stages of the research process: timescales, meetings and data collection.*



*Figure 2. Barriers to participation in food waste recycling according to the SME food outlets*



*Figure 3. Policy measures recommended by the participants*

## **Supplementary documents**

*Supplementary document 1. List of the research contributors and authors.*

*Practitioners listed below contributed to the research design and the discussion of the results. NB. Table 3 and Section 3.3. describe the participants of the qualitative survey.*

Name	Occupation	Contribution
Author 1	Academic Researcher	Data collection, analysis, and write-up
Author 2/Co-researcher 1	Civil servant and environmental consultant	Collaboration on research design and results
Author 3	Academic Researcher	Collaboration on each stage of the research
Author 4	Academic Researcher	Collaboration on each stage of the research
Co-researcher 2	Manager in municipally-owned waste company; oversees setting up of a commercial food waste collection service	Contribution towards research design and literature review
Co-researcher 3	Officer in municipally-owned waste company	Contribution towards research design and literature review
Co-researcher 4	CEO of Food Redistribution Charity – works with shops and food outlets on donating edible surplus food	Contribution towards research design and literature review

Co-researcher 5	Environmental Consultant- works on waste reduction in the commercial sector	Contribution towards research design and literature review
Co-researcher 6	Sustainability manager of a science centre (an education charity) – works on reducing waste and energy use during events, catering and day-to-day activities	Contribution towards research design and literature review
Co-researcher 7	Manager of the sustainable business network – offers tools and knowledge exchange for companies willing to reduce waste	Contribution towards research design and literature review
Co-researcher 8	Officer in Anaerobic Digestion company	Contribution towards research design and literature review
Co-researcher 9	Civil Servant in the Council Sustainability Team – manages long-term strategy and partnerships across the sectors	Review of the first draft

## **Appendix B**

### **Policy brief: Changing landscape of food waste in the catering sector, Bristol UK**

#### **Plain text version**

Currently, a significant proportion of food waste in the catering and hospitality sectors ends up in the landfill, resulting in significant greenhouse gas emissions and financial losses. Tackling food waste presents a significant policy opportunity to tackle climate change, food poverty and improve local economic development.

#### **Context**

This document reports on the research done on food waste recycling in Bristol between 2016 and 2018. The aim of the research is to co-design food waste recycling interventions with people who work across the diverse range of organisations in Bristol. The project involved a focus group with sustainability experts and a qualitative survey of 79 catering businesses (e.g. cafes, restaurants, pubs) in three areas of Bristol (Easton, Bishopston, and City Centre).

#### **Research results**

In total, 52% of participants already recycle food waste. Nevertheless, the rate varies depending on the area and type of the business surveyed. Restaurants performed above the average, whereas fast food takeaways and Easton businesses performed below the average. A vast majority of participants were

aware of the issue and even if they did now have recycling in place, they were keen to minimise waste by informal/formal donations, discounts and stock control.

The research reveals the main barriers to recycling and how such perceptions differ depending on whether the respondents do or do not recycle. Convenience and cost are the main issues according to the already recycling participants. On the other hand, participants who do not recycle state that their main reasons are “not enough waste” and “lack of space”. Catering outlets already participating in food waste management outlined their contractual requirements. The answers revealed a considerable diversity in volumes of waste (between 30L to 6600L) and collection frequencies (between twice a day to once a fortnight) demonstrating how varied the needs of businesses are.

### **Local recommendations**

Participants suggested a range of measures, which could improve the current food waste landscape in Bristol and address barriers to waste management. They emphasized that bottom-up and operational solutions will give agency to the catering sector, for example implementing flexible and co-ordinated waste services.

The results demonstrate that business engagement should address the barriers voiced by the participants applying the framings and arguments used by the catering sector, rather than assuming that restaurants and cafes are not aware of the issue. Given the variety of results across the types of businesses and Bristol neighbourhoods, the research argues that enabling the capability to

engage in pro-environmental actions is a climate justice issue. For example, low participation areas like Easton could be supported with a creation of a BID or a Traders' Group and a synergy with the "Clean Streets" campaign.

### **High time for food waste legislation?**

The researchers urge policymakers to reconsider the current absence of commercial food waste policies in England. This is in contrast to Scotland and Northern Ireland, where businesses have to recycle food waste if they produce min. 5kg of waste/week (House of Commons, 2016). Given that WRAP (2017) estimates that 25% of food waste is "unavoidable" (e.g. peels, bones or shells), there are a number of measures, which can be implemented locally and nationally. We suggest that the public debate about commercial food waste recycling would be beneficial to the stakeholders such as Bristol Waste Company, Business Improvement Districts and Traders' Group, Waste and Resources Action Group, Cabinet members for Waste, Economy, and Planning and finally – Bristol MPs committed to the case of further food waste legislation.

Trade-offs and unintended consequences Finally, while this research summarises policy opportunities in commercial food waste recycling, policymakers ought to remain sensitive to the potential trade-offs and unintended impact on the following: food donation conduits, preferred ways of waste management (e.g. a choice between anaerobic digestion, composting and animal feed), waste hierarchy framework, independent businesses in deprived areas, the quality of streetscape and street cleanliness.

*Policy brief for the Bristol City Council based on the research done at the University of the West of England, Bristol by Aleksandra Michalec, Prof Enda Hayes and Prof James Longhurst in collaboration with Martin Fodor. Please email Aleksandra.michalec@uwe.ac.uk for more information.*

*The research has been supported by:*

*You can find the full version of the paper in the peer-reviewed British Food Journal: Michalec et al. (2018) Co-designing food waste services in the catering sector, vol. 120, issue 12; <https://www.emeraldinsight.com/doi/full/10.1108/BFJ-04-2018-0226>*

#### **References:**

1. House of Commons (2017) “Food waste in England”, available at:  
<https://publications.parliament.uk/pa/cm201617/cmselect/cmenvfru/429/429.pdf>
2. House of Commons (2016) “Food Waste: key facts, policy and trends in the UK”, available at:  
<https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7552>
3. WRAP (2017) “Household food waste in the UK, 2015”, Final report, available at:  
[www.wrap.org.uk/sites/files/wrap/Household\\_food\\_waste\\_in\\_the\\_UK\\_2015\\_Report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_waste_in_the_UK_2015_Report.pdf)

Photo credit: Flickr; ZWSPo383 iStock - Food Waste

## Appendix C

### Exploring the potential and communication of metering in the energy and water sectors.

Michalec, O. A., Hayes, E., Longhurst, J. and Tudgey, D. (2019) [Enhancing the communication potential of smart metering for energy and water](#). *Utilities Policy*, 56. pp. 33-40. ISSN 0957-1787 Available from: <http://eprints.uwe.ac.uk/38596> Item availability may be restricted.

#### ABSTRACT

Although utility sectors promote metering as “sustainable” and “fair”, these values are not reflected in customer messaging. The discourse analysis of marketing materials suggests that the main framings applied are “control”, “convenience”, and “savings”. Focus groups revealed the potential paradoxes contained in these framings. Consumers might perceive a loss of control over their data, inconvenience due to installation and a lack of financial savings if their lifestyles cannot support “smart” decisions. Participants agreed that the strategies for deployment should reconcile sustainability and social agenda. Future communications ought to be tailored to the consumers’ values and needs.

#### Keywords:

smart city, co-production, discourse analysis, meters, STS, climate justice,

#### Highlights:

\*Promotional materials do not reflect the full functionality of metering  
\*Tariff re-design and transparent communication needed for fair implementation  
\*Potential for further collaboration and mutual learning between water and energy sectors

#### Funding:

The project is jointly funded by the University of the West of England, Bristol City Council and Lloyd’s Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and application of research.

#### Conflict of interest:

None. Bristol City Council’s sustainability team is the funder and stakeholder in the research. However, the role of the council is limited to the provision of official local government datasets, the funders were not involved in participants’ selection, research design, data collection or analysis.

#### 1. Introduction

##### 1.1. Defining metering

Meters are devices recording resource consumption at a fine unit of analysis. In their simplest form, they enable the issuing of accurate electricity, gas or water billing as opposed to approximated statements (DBEIS, 2017b). Their functionality is predicted to increase with the advance of smart homes and smart grid abilities; however, the current available technology is at various stages of development and uptake, depending on the location and sector. Metering devices can provide basic information on the resources consumption or go one step further and facilitate efficient behaviours (Bertoldo *et al.*, 2015).

Despite the industries' promises of improved carbon and water management, research on metering as a demand-side management (DSM) tool provides conflicting evidence with regards to their effectiveness. Metering can only have a positive impact on resource efficiency provided that it: a) improves the management of the energy grid and tackles water leaks (Cheong *et al.*, 2015); b) leads to changes at the household level (e.g. decrease in consumption, purchase of smart equipment, change in social norms) (Bradley *et al.*, 2014; Buchanan *et al.*, 2014). The extensive literature on climate change communication suggests that the appropriate engagement strategy is vital for the effective adoption of new technologies (*ibid.*)

## **1.2. Research questions and aim**

The primary aim of the paper is to understand the shortcomings of current smart meter communications by answering the following questions:

1. How is metering understood across the water and energy practitioners in Bristol, UK?
2. What is the role of “sustainability”, “fairness”, and “smartness” in discourse formation?
3. How can the communication of information relating to the metres be improved?

The paper is structured as follows: sections 1.3-1.4 provide an overview of the literature regarding smart cities and metering. Section 1.5 introduces the reader to the local context. Section 2 justifies the methodology and outlines the research design. Section 3 then summarises the results of discourse analysis of both the promotional materials, and focus groups undertaken with participants from the public, private and third (charitable) sectors. Drawing from the synthesis of these findings, section 4 concludes with recommendations for policy, public engagement, and further research.

The target audience of this paper are “smart technology” practitioners from the energy and water sectors, and academics interested in science and technology studies (STS) and/or knowledge co-production approaches.

### **1.3. Metering in smart cities**

The idea of metering individual resource consumption is often coupled with the so-called “smart cities” agenda. In summary, the literature on smart cities characterises its aims as: 1) Improving economic and administrative decision making through networked infrastructures and technological innovations 2) Improving social inclusion in emerging technologies 3) Raising the profile of high-tech and creative industries and their contribution to economic growth 4) Effective embedding of technology in wider physical and social systems (Caragliu *et al.*, 2011; Allwinkle and Cruickshank, 2011).

A body of academic critique arising from a closer examination of the smart city goals, question the assumptions that emerge from the summary above. For example, Shelton *et al.* (2015) challenges the promise of “improved policymaking” using integrated technology infrastructure. They argue that all datasets are socially constructed and can therefore result in representations of the world, which are inherently biased, despite being presented as “neutral” (*ibid.* 2015). Similarly, Greenfield (2017) critiques the notion of embedding technology in wider social systems. He highlights the risk of “turning citizens into data points” who are objects of measurements, but who are excluded from decision-making and the interpretation of results upon which this decision making rests. Furthermore, upon completing a large scale bibliographic and network analysis of peer-reviewed urban development literature, De Jong *et al.* (2015), argue that “smart cities” are only weakly related to the environmental agenda (e.g. “sustainable” or “low carbon” city). Instead, they suggested that the idea of “smart city” builds on the other conceptualisations of urban modernisation e.g. “information city”, “digital city” or “intelligent city” (*ibid.*). Their conclusions lead to asking further: are smart meters “green” and “fair”?

### **1.4. Metering: effectiveness and fairness**

Currently there is no clarity about how to embed “smartness” in metering design, implementation, learning and promotion (Zhang *et al.*, 2016). Yet, governments and utilities providers have already taken an active interest in metering in the context of the smart cities agenda. Smart metering of the energy sector is a part of the European

Commission's recommendation on energy efficiency 2012/148/EU (European Commission, 2012), subsequently rolled out by the UK national government (DBEIS 2017b). In the UK, Smart Meters GB is a national campaign encouraging installation of smart energy meters (Smart Energy GB, 2017).

In contrast, measuring water consumption and upgrading the "grid" from analogue to smart metering is not a current policy priority in the UK (Priestley, 2016). In fact, it is estimated that half of the UK population does not have a water meter, meaning their water bill is decided by the so-called "rateable value" of the property – an estimation of the rental value of a property in 1990 (Bennett, 2013). Compulsory universal water metering has so far only been introduced in those parts of the UK subjected to the highest water stress (i.e. south-east England). However, many British water companies see metering as a useful tool for resource management and are compelled to promote it to their customers (Priestley, 2016).

The research is not yet clear on whether metering is an effective tool of DSM – the answers range from optimistic (Beckel *et al.*, 2014), cautious (Spence *et al.*, 2015; Bradley *et al.*, 2014, McKenna, 2012) to sceptical (Loftus, 2006). Metering deployment could potentially facilitate targeted resource efficiency programmes (Beckel *et al.* 2014) and become an essential step towards the developments of smart tariffs, which respond to the availability of the grid and engage with the existing social practices (Torriti, 2017).

However, the successful rollout of metering is highly contingent on the interactions between its users and the technology: the perceptions, communications, design and understanding. Spence *et al.* (2015) point out current shortcomings in public engagement of DSM. Similarly, Buchanan *et al.*, (2014) call for a redesign of existing smart meters interfaces, In-Home Displays (IHD), whilst McKenna *et al.* (2012) outline the unresolved privacy issues around the data collected via such devices.

Since public engagement materials are often the first point of information between the user and the technology, they have a significant potential to influence perceptions and acceptability. A survey of over 2,400 British householders concluded that those concerned about the cost are the least likely to accept DSM and share their data, whereas participants concerned about climate change were more likely to be supportive of DSM (Spence *et al.*, 2015). Seyranian *et al.* (2015) researched

effectiveness of public engagement in the context of water metering. They conducted an intervention study of over 370 American households, who had received a variety of public engagement materials. The researchers found that individuals were most likely to reduce their water consumption if they received messages relating to their social norms and personal values. In contrast, the knowledge-deficit approach (i.e. only providing information) was least effective (*ibid.*).

Deployment of metering is closely related to tariff redesign, which is a contentious issue within both the water and energy sectors. French energy consumers who discussed the time of use<sup>26</sup> tariffs, voiced criticisms, arguing that the time of use tariff leaves behind those who do not have the flexibility to shift their energy use beyond peak times (Bertoldo *et al.* 2015). The analysis of the Australian block tariffs<sup>27</sup>, concluded that such water pricing was neither efficient, nor fair, (Sibly and Tooth, 2014). Loftus (2006) goes even further, arguing from the position that water ought to remain a basic human right and that the very act of water meter installation only contributes to the further commodification of water.

Since “fairness” of energy and water metering is a subject of academic and policy debate, it would benefit from a theoretical lens that explicitly seeks to address the question of climate justice. Sovacool *et al.* (2016) suggest reframing climate change policies as justice concerns by drawing attention to the availability, affordability, transparency, equity and responsibility of policy decisions. In order to make this framework operational, the concept of climate justice must be addressed directly to policymakers, designers, utilities practitioners as well as the end-users themselves. Nevertheless, at the time of writing, the literature on the practical understanding of climate justice in the context of metering is limited. This paper aims to bridge this gap by exploring the applied understanding of concepts such as “fairness”, “sustainability” and “smartness”.

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<sup>26</sup>Time of use tariff has different time periods with varying price blocks (e.g. called ‘peak’ weekday evenings or ‘off-peak’ weekend daytime). (CAB, 2017)

<sup>27</sup> Block tariff establishes zero-tariff for consumption up to a certain threshold. The zero-tariff, which equates the household “essential needs”, charges below the real production cost as an incentive for clients to reduce their consumption. Following the zero-tariff block, each successive block is priced higher. The aim of the tariff is to encourage low consumption while reducing the pressure on low-income households (Sibly and Tooth, 2014)

## **1.5. Study context: Bristol, UK.**

Bristol is located in the South-West of England, UK, with a population of some 442,000 (BCC, 2016). The city boasts both smart reputation and sustainability ambitions. In 2017, Bristol was ranked first in the UK Smart City Index (Huawei, 2017). Over the past five years, multiple projects have been launched investigating the potential of smart technologies in the city. For instance, in the Smart Spaces initiative (2012-2015), Bristol City Council (BCC) installed smart meters and set consumption targets in public buildings (BCC, 2015c). Replicate (2016-2021) is an intervention based research project involving stakeholders from the local universities, charities and BCC, which focuses on deploying smart energy solutions and co-creating a smart city with digitally excluded communities (Connecting Bristol, 2016). Finally, during 3E Houses scheme (2012-2013), BCC installed smart meters in 100 vulnerable households in collaboration with a local charity (KWMC, 2013). Users' experiences were then captured in a series of workshops, which led to community-level policy recommendations.

In 2015, the city won the EU “Green Capital” award, attracting over £12.6 million of private and public sector funding (Bristol Green Capital Partnership, 2016). Bristol also adopted its own Climate Change Framework which sets the roadmap towards becoming carbon neutral by 2050 (BCC, 2015a).

Despite the city's green and smart ambitions, numerous citizens struggle with social deprivation and fuel poverty<sup>28</sup>. In Bristol 16% of residents - 69,000 people - live in the most deprived areas. Bristol has proportionally more Lower Super Output Areas (LSOAs<sup>29</sup>) in the lowest decile for Multiple Deprivation index<sup>30</sup>, compared to other areas in England (BCC, 2015b). Similarly, the figures for fuel poverty in Bristol are three percent higher than the national average, with an estimated 13.2% of residents living in cold homes (DECC, 2014).

Multiple metering pilot projects were located in deprived areas, which suggest an ambition to use metering to help tackle fuel or water poverty by encouraging

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<sup>28</sup> A household is considered to be fuel poor if: 1. It has required fuel costs that are above average (the national median level) 2. Were they to spend that amount, they would be left with a residual income below the official poverty line (DBEIS, 2017a)

<sup>29</sup> LSOA stands for Lower Super Output Area, a geographical classification used in the English census applied to areas inhabited by app. 1500 people (ONS, 2017)

<sup>30</sup> Multiple Deprivation Index is an official measure of social deprivation (i.e. income, employment, crime) applied to the small areas (LSOAs) of England (DCLG, 2015)

sustainable behaviours (Connecting Bristol, 2016; KWMC, 2013). However, the potential for an overall decrease in resource consumption may be limited if building efficiency is sub-optimal (e.g. single glazed windows, drafts, leaking taps). Offering behavioural change as a way to tackle fuel poverty comes with the assumption that people in deprived areas are wasting energy, and therefore that metering could induce behavioural change. The local data on energy use, however, suggests otherwise – people in the 10 least deprived areas consume far more gas compared to the residents of the 10 most deprived neighbourhoods (Table 1).

<b>Names of 10 most deprived LSOAs</b>	<b>Mean gas consumption (kWh/meter)</b>	<b>Names of 10 least deprived LSOAs</b>	<b>Mean gas consumption (kWh/meter)</b>
Bishport Avenue	8588	St Bonaventures	29900
Hareclive	9082	Cranbrook Road	30071
Fulford Road North	9029	Henbury Hill	30625
Bishport Avenue East	9124	Elmlea	30882
Inns Court	9219	Stoke Bishop North	30934
Easton Road	9779	Canford Lane	31529
Filwood Broadway	9070	Henleaze North	31692
Ilminster Avenue West	8586	West Broadway	31799
Southmead Central	10154	Canford Park	32130
Whitchurch Lane	9133	Golden Hill	32150
<b>Average from 10 most deprived LSOAs</b>	<b>9176.4</b>	<b>Average from 10 least deprived LSOAs</b>	<b>17245.1</b>

*Table 1. Mean gas consumption in 10 most and least deprived LSOAs in Bristol in 2015 (raw gas consumption data from DBEIS, 2015a; deprivation data from BCC, 2015b)*

The water dimension is mostly absent from smart and green projects and policies in Bristol. This might be due to the fact that water efficient behaviours and infrastructure are largely outside of the remit of the local authorities. In the UK, the water sector is privatised and regionally monopolised, which hinders access to data, knowledge transfer and cross-sectoral governance (Loftus *et al.*, 2016).

## **2. Methods**

### **2.1. Methodology framework**

The researchers adopted a knowledge co-production approach, combining two qualitative methods: discourse analysis of metering promotional materials and two focus groups held with metering practitioners. Applying this approach across public, private and charity sectors is useful for capturing different discursive framings and for cross-sectoral learning. Furthermore, it facilitates an active deliberation on policy recommendations (Howarth and Monasterolo, 2016).

The research was held between June 2017 and April 2018 and involved the following stages:

- Literature review of the smart cities and metering scholarship, examination of the local context;
- Discourse analysis (DA) of metering promotional materials from four organisations;
- Recruitment of participants, preparation of a topic guide and prompts;
- Facilitation of two focus groups;
- Transcribing, coding, analysing, and synthesising the results.

### **2.2. Discourse analysis of promotional materials**

The notion of the discourse describes the sum of communications on a particular topic: the language, form, images, metaphors and arguments used. Discourses, especially if written by authorities (in this case policymakers, experts or utility providers), indicate what can and cannot be expressed or challenged by the audience – which information is seen as a “fact” and which is open to a dispute (Bax, 2011). DA is used to critically unpack the current debates in the areas of water and energy metering in order to evaluate whether and how sustainability, smartness and climate justice ambitions are embedded in the promotional materials. The data selected for the analysis was selected from websites and online leaflets providing information about metering in the water and energy sectors. The researchers selected four sources from two key local service providers and from two national-level organisations overseeing metering deployment. The researchers thoroughly analysed each document to unpack the rhetorical and linguistic tools used. For example, they looked to determine the overall tone of the message (e.g. promotional, informational), arguments fore- and backgrounded (e.g. placed in the title vs at the bottom of the page), and main frames applied (e.g. savings, sustainability, control). Table 2 lists the

documents analysed together with the heuristic for the process (adapted from Bax, 2011).

Documents analysed	Description of organisation	Heuristic
Ofwat (2013) Water meters- your questions answered <a href="https://www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_lft_10117meters.pdf">https://www.ofwat.gov.uk/wp-content/uploads/2015/11/prs_lft_10117meters.pdf</a>	National water industry regulator	<ul style="list-style-type: none"> <li>• Location in the text (e.g. title/ front page/ last page)</li> <li>• Aim (e.g. inform/ promote)</li> <li>• Main framings used (e.g. savings, convenience, control)</li> <li>• Unchallenged assumptions?</li> <li>• Admitted uncertainties?</li> <li>• Provided balanced arguments?</li> </ul>
Bristol Water (2016) Water meters explained <a href="https://www.bristolwater.co.uk/your-home/water-meters/">https://www.bristolwater.co.uk/your-home/water-meters/</a>	Local water services provider	
Bristol Energy (2016) Your smart meter and in-home display guide <a href="https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering-Guide-WEB-low.pdf">https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering-Guide-WEB-low.pdf</a>	Municipally owned local energy company	
Smart Energy GB (2017) Smart meters- the simple way to control your energy use <a href="https://www.smartenergygb.org/en">https://www.smartenergygb.org/en</a>	National campaign for the smart meter rollout	

Table 2. List of documents analysed and a heuristic for DA.

### 2.3. Focus groups

If DA was selected to understand how utility providers construct their engagement, focus groups to clarify the extent to which metering professionals regard metering as a “sustainable”, “fair” and “smart” tool of DSM. In doing so, the discussions explored the understanding of the purpose and potential of metering across the utilities professionals in Bristol, UK. Environmental policies do not arise in a conceptual vacuum, but are the result of debates between stakeholders across the sectors, who build trust and develop rapport while deliberating on their language and goals (Harris and Lyon, 2013).

Following the exploratory part of the event, participants discussed the recommendations for the policy and public engagement. Focus group was deemed an appropriate method for this research, as it taps into the interactions between

participants, observing the process of discourse formation, agreements and disagreements (Morgan, 1998). This is particularly relevant for policy issues, which are commonly co-produced in collaboration between private, public and charity sectors (Howarth and Monasterolo, 2016; Harris and Lyon, 2013).

The following paragraphs outline the research design. First, the researchers identified key local organisations with experience in water and energy metering. Then, they approached eligible organisations and purposively selected participants, so that the composition of each group achieved a diversity of sectors and roles. As a result, the researchers conducted two focus groups with 6 participants in each (Table 3).

Focus group 1		Focus group 2	
Participant	Sectors	Participant	Sectors
FG1_Po1	Academia (Energy)	FG2_Po1	Water company
FG1_Po2	Local Authority – Smart Futures	FG2_Po2	Energy company
FG1_Po3	Energy Company	FG2_Po3	Community Energy Local Project
FG1_Po4	Water Company	FG2_Po4	Community Energy Network
FG1_Po5	Academia (Water)	FG2_Po5	Local Authority – Household Resource Efficiency
FG1_Po6	Community Energy Network	FG2_Po6	Academia (Water)

*Table 3. Focus groups participants*

The discussions lasted 1.5 hours each, and included both pre-scripted questions and the critique of existing metering promotional materials (i.e. documents specified in Table 2). The researcher-facilitator focused the discussion on the purpose of metering, biggest challenges, cross-sectoral learning and recommendations for communication. In order to establish a sense of shared language, the researcher-facilitator asked the participants to discuss the terms commonly used in their roles, such as “sustainability”, “fairness” and “smartness”.

The focus groups were audio recorded, and the data transcribed and examined using thematic analysis. The method allows capturing patterns and the grouping of complex

qualitative data (Braun and Clarke, 2006). First, the data were analysed at the descriptive level, establishing codes derived from the questions (e.g. “solutions”, “challenges”, “purpose of metering”). Then, after an in-depth reading, the interpretive and analytical inductive codes were captured to compose a thematic narrative present in section 3.

#### **2.4. Research limitations**

The qualitative methodology, small sample size and geographic scale of the study suggest high contextuality of the results and suggest a need for further research exploring different locations and organisations. Nevertheless, findings from the study provide valuable insights into the knowledge co-production approach. Detailed heuristics and critical reflections on discourse analysis, focus group recruitment and data analysis will facilitate the reproduction of results in future studies. Furthermore, the validity and accuracy of the research was enhanced by combining two methods and sampling participants across a variety of sectors (Harris and Lyon, 2013).

By conducting cross-sectoral focus groups, the research informed the debate on metering, which usually takes place in sectoral siloes that separate practical and academic knowledge from each other. Hoolohan and Browne (2016) pointed out that the limited occurrences of participatory and deliberative methods deprived utility sectors of creativity essential for the introduction of the innovative DSM tools. In order to ensure inclusivity, further research on metering ought to tap into experiences of a wide variety of users and bring explicit attention to the notions of “smartness”, “sustainability” and “fairness”.

### **3. Results and discussion**

#### **3.1. Discourse analysis of marketing materials**

The researchers analysed four customer-oriented documents on metering from the following organisations: Bristol Water, Ofwat, Bristol Energy and Smart Energy GB. The prevailing themes in the metering promotional materials are “control”, “savings” and “convenience”, as these are the key words appearing most commonly in each document, often on the first page or written in a larger font size. The messages emphasize that the customers will be able to gain control over their energy use (“*Using in-home display will give you a greater understanding of what you're spending*” Bristol Energy, 2016) and therefore lower their bills as a result of meter installation (“*You could save up to £100 on your water bill*”; Bristol Water, 2016). The leaflets

also emphasize the ease of installation process and the convenience related benefits resulting from having a meter (“*No more having to read the meter or trying to work out your bill. No more strangers coming into your home for meter readings*”; Smart Energy GB, 2017). However, despite the commonalities, there are also significant differences in communication between the leaflets, depending on the sector and organisation.

Smart Energy GB repeatedly uses the discourses of control, savings, and convenience – notably these are all benefits to the individual. Even the title of the leaflet – “*The simple way to control your energy use*” – is meant to evoke the above qualities. When justifying the rollout in the further paragraphs, the organisation provides the context of the EU-led regulation implemented in the interest of mitigating climate change and upgrading the energy grid. It is worth noting that the reasons for policy implementation are not located on the landing page or the front of the leaflet, suggesting that the benefits to the environment and the energy sector have been backgrounded from the promotional strategy.

Similarly, Bristol Energy uses the discourses of “control” and “savings”. In addition, they emphasize the environmental and fairness values from the beginning, providing a more collectivist justification for metering. Their messaging is characterised by a level of transparency and honesty – owning a meter will not make a difference, engaging with it – could do so.

*“It’s important to note that just by having a smart meter and in-home display, you’re not automatically going to use less energy and start spending less money, but these devices put the power in your hands. Using in-home display will give you a greater understanding of what you’re spending, identifying when you use the most energy and highlighting in near real-time the way you use energy in your home”.* (Bristol Energy, 2016)

Bristol Water focuses its messaging on savings, and the ease of the application and installation process, both benefits to the individual. Additionally, one of the benefits of metering outlined on the landing page is “*it helps us to detect leaks much quicker*” (Bristol Water, 2016), an advantage to the industry. However this point is not elaborated further in the document. The Bristol Water leaflet contains presumption about customers’ attitude to water (“*Most of us do everything we can to save water, we know it’s important to everyday life*” Bristol Water, 2016). Further pages of the

document explain how the metered water bill might change, revealing that it is in fact a function of a number of householders, number of the rooms, personal water usage and the presence of the garden. The final page of the leaflet contains an application form asking questions like “*Is there an externally located stop tap controlling water to the property? Do you share water supply with your neighbour?*” (Bristol Water, 2016). There is no evidence whether the above questions are easily answerable by an average water customer, indicating that the application process might not in practice be perceived as “easy”.

The communication prepared by the industry regulator, Ofwat, has an entirely different character as it is informative and explanatory rather than promotional. Ofwat justifies metering as an environmental and strategic intervention, aiming to improve the management of scarce water supplies and increasing demand as a result of population growth. The document aims to improve bill literacy, providing comparison of water tariffs in the unmetered vs metered scenarios. It then reports that “*some people regard meters as the fairest way to charge for water and sewerage services. This is because you pay for how much water you use*” (Ofwat, 2013). However, Ofwat does not comment on this opinion nor elaborate why other water tariff would not be as fair.

The main differences between the leaflets are the inclusion of individualist versus collectivist arguments and their informational versus promotional character. Notably, the individualist arguments were commonly presented in the promotional materials, whereas collective reasoning was included in the informational materials. However, it should be noted that on a few occasions, the messages managed to be *both* promotional and informational as well as to contain *both* individualist and collective arguments, e.g.:

*“Smart meters are part of the government's plan to bring our energy system up to date. By 2020, every home in Great Britain will be able to use smart meter technology to see exactly how much energy they're using, and what it's costing in pounds and pence. In addition to these immediate benefits, the rollout also lays the foundation for Great Britain's move to a lower carbon economy and a secure energy supply” (Smart Energy GB, 2017)*

Combining a range of arguments and communication styles results in the honest and transparent disclosure about the limits to the potential benefits of metering.

### **3.2. Theme 1: Misplaced aims**

DA of promotional materials revealed that meters are commonly promoted under the discourses of convenience and control. Yet focus groups participants reported that customers frequently perceive the installation process as inconvenience, which is seen as a major barrier to uptake of the meters. Participants, all with professional expertise in metering, recalled their own experiences as energy *customers*, e.g.:

*"My energy company contacted me, and their letter was "we need to turn every appliance off in your house" - but I don't want to. I had an argument with that woman for 15 minutes, because I just don't want one...as a consumer I have that choice"* (FG1\_Po4)

Similarly, the discourse of control over energy and water use stands in contradiction with perceived loss of control over privacy and data: *"With water 2/3 of water consumption is done in privacy and in a bathroom and maybe you don't want people to know what your bathroom habits are"* (FG1\_Po5). On the other hand, ensuring adequate privacy settings could pave the way to innovative ways of engagement, such as data visualisation or competitions with incentives.

*"If you want people to engage and to know what their data mean, then having them compete with other members of their family or the friendship group takes that ownership away from the organisational structure, but it does actually creates a real engagement that may last a lot longer than anything that comes top down"* (FG2\_Po1)

*"Can I pick up what came up...so if it's a comfortable thing to do with smart meters or water meters, I mean not necessarily names, it could still be anonymous, but you could get the message like 'there are people in the intermediate community who are doing this and you're not'..."* (FG2\_Po3)

Water and energy sectors would have to consider at what level the data are gathered (e.g. person, household, LSOA, city) and who they are shared with (e.g. utility company, the government, academics, advertisers). In its current state, the privacy

settings hinder accessing, analysing and visualising data which could be useful for effective public engagement.

*FG2\_Po3: If there was a target for Bristol average per capita consumption for water then you see where you are comparing to the average.*

*FG2\_Po1: We do this.*

*FG2\_Po3: Oh, you do?*

*FG2\_Po4: Do you include that information on your customer sheet?*

*FG2\_Po1: We don't do it at the moment, largely because we don't know how many people are in the house.*

Participants admitted that the promotional strategies are yet to address the above issues. The customers haven't received convincing arguments, for which they would be willing to give up their data privacy and temporal convenience:

*FG1\_Po3: I think the energy industry as a whole hasn't really made a good enough offer to people...A really good offer, a really good service, as long as they give away a certain amount of their data privacy around their energy consumption. That's the exchange that people can understand, can opt into...*

*FG1\_Po4: The "what's in it for me?" question.*

### **3.3. Theme 2: intelligent choices**

The purpose of metering, as explained by the participants, turns out to differ significantly from the justification provided in the promotional materials. Participants agreed that “smartness” is about enabling “intelligent choices” – both for the customers and the industry: “*I'm just going to get a highlighter pen and put “intelligent choices”, I'd highlight that bit, because I think that unless you're using it to inform decision making then it's not smart, then it's just measuring stuff...*”. (FG1\_Po1). In fact, the “convenience” and “savings” arguments have been explicitly categorised as “not smart per se”, i.e. “*That's a lot around convenience, which I think it's great and it drives efficiency and drives cost, it's not, it's not "smart" per se*” (FG1\_Po3). Water participants focused on the industry’s intelligent choices, “*We can spend millions of pounds replacing pipes but if we have no idea where the water is going... the data is far more important to make those informed decisions*”

(FG1\_Po4). In turn, energy participants emphasized the potential to make “smart decisions” at the street or neighbourhood level,

*“What you could potentially do on a street level is demand-side response. So if there are particular times of the day, where there is a particularly high demand on the grid, if you could aggregate the consumption from that collection of houses and increase or decrease the consumption based on turning on and off appliances - if you can pull that into a street or neighbourhood, suddenly you have an economic value to that, energy you can then sell back to the grid”. (FG1\_Po3)*

Participants reported on a range of past pilot energy projects (including Replicate or Smart Spaces, as mentioned in section 1.5.), which enabled them to test the potential for “intelligent choices” in metering. The highlighted lessons learnt from the past projects were:

- The question of the capacity to change lifestyle and purchase smart products in disadvantaged households;
- The need for the re-design of energy tariffs to e.g. block pricing or time-of-use tariff.

Gathering fine level data on energy consumption is essential for the introduction of smart tariffs, however the technology alone does not guarantee that all customers will benefit in equitable way: *“One flipside of ‘smart’ to be aware of, the potential for that not to be fair... and to actually just privilege people who are more tech-savvy or who have the ability to organise their lifestyle”* (FG2\_Po2).

### **3.4. Theme 3: Focus on the needs**

Meters have been originally designed as the technology facilitating energy and water efficiency, and therefore sustainable management of environmental resources. Throughout the discussions, participants emphasised the need to reconcile “sustainability” and “fairness” agenda. However, there are potential complications as these agenda serve two different types of customer, and need two tailored policy approaches accordingly. One of the participants suggested: *“One of ways to look at it, that there are two markets, there’s early adopter market and what we call vulnerable households in the industry”* (FG2\_Po2).

A DSM approach alone does not tackle fuel and water poverty. Yet reducing individual resource consumption amongst affluent residents is essential for meeting climate

mitigation goals. Participants brought attention to this paradox and suggested cross-subsidising and explicit differentiation between these two markets when designing policies and public engagement.

*“I think finding the way to reach out and engage...to be blunt, to engage rich people... and I am probably in that category myself. I don’t struggle to pay my water bill, if it went up, I still wouldn’t struggle” (FG2\_P01)*

*“The contradiction is – we actually need the early adopters, we need the people who don’t need to worry about the bills, otherwise we won’t have the technology available for the lower retail cost in place. Then the early adopters can cross-subsidise a charitable project that will sort out the mess of fuel poverty and water poverty.” (FG2\_P05)*

There are numerous ways to conceptualise the “social” side of meters, with terms like social justice, equality, inclusion, vulnerability and class used interchangeably. The discussion however, would always eventually refer to defining, measuring and providing for “the basic level of need”.

*“Is there a significant difference between how much you can save by behavioural change...by energy use and water use? Because water is sort of fundamental, you **need** to drink, you need to cook, occasionally need to bathe...” (FG1\_P02)*

*“Just to tie it back to sustainability issues, one the possible benefits is that metering is, you can then say, ‘here is the **social amount** that someone would **need** for the social use level that we think we would price it to the lower level’, so you’d have that block pricing, and then you’d charge extra” (FG1\_P01)*

*Researcher: “What would be the fair pricing? What do you reckon? FG1\_P03: I think it’s something we’re really aware of in Bristol Energy and we’re making sure we’re taking to account when we do start to use time-use tariff because there are certain people, without wanting to generalise, possibly at the more **vulnerable** customer end, who just, for whatever reason in their lifestyles don’t have the ability to change their consumption (...) we have to make sure those*

*customers don't get left behind in this kind of smart energy revolution”.*

Framing metering as a technology helping to define, measure and provide for the basic level of need led to a discussion about tariffs and universal water metering. Participants agreed that if metering is promoted as a “fair” measure then universal metering is necessary to acquire data which would determine a fair tariff for everyone. However, they disputed the perceived fairness of block tariffs. Although such a pricing structure could include the notion of affordable water to cover the basic level of need, it is not clear how the “basic level of need” would be determined: *“My problem with block pricing is...and actually I have quite a big problem with it... which is that it means that I get to decide what somebody else needs and why the hell should it be up to me?”* (FG2\_P01).

If universal water metering is being considered, there needs to be a debate on the relationship between residents and water. Although water metering is promoted as the “fairest way to pay” (section 3.1), one of the participants pointed out that the current tariff based on rateable value is more affordable: *“People who don't have a water meter, pay [bills] on the rateable value of their house, and there is an element of affordability in that, the assumption that if you live in a smaller house, that is of a lower rateable value”* (FG2\_P06).

Nevertheless, as one of the participants stated, *“water is sort of fundamental, you need to drink”* (FG1\_P02). Access to clean water and sanitation is recognised as a human right by the United Nations (UN, 2010). Re-designing the tariffs using the data obtained from metering provides an opportunity to introduce fair, transparent and data-supported policies, which would recognise the argument of “human rights” as well as “scarce resources”. However, before metering could become a “fair” reflection of water tariffs, the industry ought to collect baseline data and deal with leaks. One of the water sector participants admits: *“I'd quite happily meter everybody with intelligent meters and not charge people against the meter, it's so just we have the data.”* (FG1\_P04).

### **3.6 Theme 4: Tailored communication**

The discussions on the purpose and potential of metering concluded with recommendations for public engagement. Given the observation that there are (at least) two markets of consumers affected differently by metering, future communications could reflect their needs, values and priorities:

*FG2\_Po1: I am motivated to save water because of my personal commitment, that's not normally the case for people who can easily afford something. So I am interested in how you can engage with people on perhaps values-based basis.*

*FG2\_Po4: I'd say that's exactly the same problem with energy, when we've done the studies where there are the wealthiest communities that are spending the most on their energy bills, but they're not caring about it.*

Since the participants agreed that metering alone would not reduce resource consumption, they suggested that public engagement should come in a “support package” form, together with tailored advice on smart appliances and appropriate building level schemes tackling drafts and leaks at vulnerable households:

*“You can make things visible to people, but if you just make more problems visible to them, you're adding stress so you're making their lives worse. If you offer support, like you both suggested [pointing at other discussants], it goes alongside that awareness raising. Smart metering needs to have that support package explaining how you can be a part of it and how you could benefit”*  
*(FG2\_Po4)*

Finally, participants collectively critiqued the framings present in the current marketing materials and pointed out that the main priority is to create a compelling narrative, which refers to both individual and collective benefits (i.e. to the planet, society and service providers) of metering and smart technologies. *“Starting with a person and then through the narrative coming to the community, I think that's when the marketing drive needs to be a bit personalised to the individual, but then stepping up...so the context and the country and then the planet”*. (FG2\_Po4).

#### **4. Conclusions and further research**

By way of discourse analysis and focus groups, this paper unpacked assumptions and contradictions present within the energy and water industries with regards to metering. The research found disparities in the customer-facing messages and potential functionality of meters. Metering is advertised as a tool ensuring “control” over consumption, however the users tend to perceive a possible “loss of control” due to potential privacy issues. Similarly, despite the industry promises of “fairness” and lower bills, metering would not address the issues of water and fuel poverty if deployed without adequate public engagement, tariffs and an appropriate support package.

The analysis of research data concludes with the following recommendations for customer communication: a) A transparent and honest public engagement strategy is required which would refer to the full functionality of metering as well as the long-term ambitions of tariff re-design; b) Communication materials need to be tailored to consumers' values and needs; c) Metering deployment should be supported by a whole package of policy and communication, which includes advice and building efficiency schemes. Only tailored and comprehensive policy design would reflect the reality of two distinct markets: early adopters and vulnerable households.

Despite their narrow geographical focus, the research outcomes are internationally relevant due to the ongoing rollout of smart technologies across the EU member states. Although smart technologies have advanced considerably over the past years, the EU member states are yet to understand the interplay between promotional strategies, sustainability/justice discourse formation and the effectiveness of the devices. Further research on the interactions between smart technologies and consumers could shed the light on the issue of the interplay between smart meters and user experiences.

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### **References**

1. Allwinkle, S. and Cruickshank, P. (2011) Creating Smart-er Cities: An Overview. *The Journal of Urban Technology*. 18 (2), pp. 1-16;
2. Bax, S (2011) *Discourse and Genre: Using Language in Context*. MacMillan: London
3. Beckel, C., Sadamori, L., Staake, T. & Santini, S. (2014) Revealing household characteristics from smart meter data, *Energy*, vol. 78, pp. 397-410.
4. Bennet, O. (2013) Water bills and rateable values. House of Commons Briefing Paper [online]  
[http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN066\\_47#fullreport](http://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN066_47#fullreport)
5. Bertoldo, R., Poumadère, M. & Rodrigues Jr, L.C. (2015) When meters start to talk: The public's encounter with smart meters in France, *Energy Research & Social Science*, vol. 9, pp. 146-156.
6. Bradley, P., Fudge, S. & Leach, M. (2016) Motivating energy conservation in organisations: smart metering and the emergence and diffusion of social norms, *Technology Analysis & Strategic Management*, vol. 28, no. 4, pp. 435-461.

7. Buchanan, K., Russo, R. & Anderson, B. (2015) The question of energy reduction: The problem(s) with feedback. *Energy Policy*, vol. 77, pp. 89-89
8. Bristol City Council – BCC (2015a) Our Resilient Future: A framework for climate and energy security, pp. 120- 198 [online]  
[https://www2.bristol.gov.uk/committee/2015/ua/ua000/1103\\_binder.pdf](https://www2.bristol.gov.uk/committee/2015/ua/ua000/1103_binder.pdf)
9. Bristol City Council – BCC (2015b) Deprivation in Bristol 2015. The mapping of deprivation within Bristol Local Authority Area [online]  
<https://www.bristol.gov.uk/documents/20182/32951/Deprivation+in+Bristol+2015/429b2004-eeff-44c5-8044-9e7dc002faf>
10. Bristol City Council – BCC (2015c) Bristol City Council celebrates its SmartSpaces and pilot scheme success [online]  
[http://news.bristol.gov.uk/bristol\\_city\\_council\\_celebrates\\_its\\_smartspace\\_s\\_and\\_pilot](http://news.bristol.gov.uk/bristol_city_council_celebrates_its_smartspace_s_and_pilot)
11. Bristol City Council – BCC (2016) The population of Bristol [online]  
<https://www.bristol.gov.uk/statistics-census-information/the-population-of-bristol>
12. Bristol Energy (2016) Your smart meter and in-home display guide. [online]  
<https://www.bristol-energy.co.uk/sites/default/files/Smart-Metering-Guide-WEB-low.pdf>
13. Bristol Green Capital Partnership (2016) Review of Bristol 2015 European Green Capital Year. Report to Bristol City Council [online]  
<https://www.bristol.gov.uk/documents/20182/1352057/European+Green+Capital+Review+report/f7ae017a-57b5-4bco-acdf-a1ed61380a35>
14. Bristol Water (2016) Water meters explained. [online].  
<https://www.bristolwater.co.uk/your-home/water-meters/>
15. Caragliu, A., Del Bo, C. and Nijkamp, P. (2011) Smart Cities in Europe. *Journal of Urban Technology*. 18 (2), pp.65-82.
16. Cheong, S., Choi, G. & Lee, H. (2016) Barriers and Solutions to Smart Water Grid Development, *Environmental Management*, vol. 57, no. 3, pp. 509-515.
17. Citizens' Advice Bureau – CAB (2017) The Value of TOU Tariffs in Great Britain:
18. Insights for Decision-makers. Final Report. [online]  
<https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/The%20Value%20of%20TOU%20Tariffs%20in%20GB%20-%20Volume%20I.pdf>
19. Connecting Bristol (2016) Replicate Project – Overview [online]  
<http://www.connectingbristol.org/replicate-project/>
20. De Jong, M., Joss, S., Schraven, D., Zhan, C. & Weijnen, M. (2015) Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*, vol. 109, pp. 25-38
21. Department for Business Energy and Industrial Strategy - DBEIS (2015a) Sub-national gas consumption data [online]  
<https://www.gov.uk/government/collections/sub-national-gas-consumption-data>
22. Department for Business Energy and Industrial Strategy -DBEIS (2017a) Fuel Poverty Statistics [online]  
<https://www.gov.uk/government/collections/fuel-poverty-statistics>
23. Department for Business Energy and Industrial Strategy - DBEIS (2017b) Smart Meters: a guide [online] <https://www.gov.uk/guidance/smарт-meters-how-they-work>

24. Departments for Communities and Local Governments – DCLG (2015) English indices of deprivation 2015. Official Statistics [online] <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015>
25. Department for Energy and Climate Change- DECC- (2014) Percentage of households – fuel poor [online] <http://profiles.bristol.gov.uk/IAS/dataviews/report?reportId=1206&viewId=626&geoReportId=5203&geoId=26&geoSubsetId=>
26. European Commission (2012) Commission Recommendation of 9 March 2012 on preparations for the roll-out of smart metering systems (2012/148/EU) [online] <https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters>
27. Harris, F. and Lyon, F. (2013) Transdisciplinary environmental research: Building trust across professional cultures, *Environmental Science and Policy*, vol. 31, pp. 109-119.
28. [Greenfield, A. \(2017\) Radical Technologies and the Future of Cities. Presentation. Festival of the Future City. 18<sup>th</sup> October 2017 \[online\]](http://www.ideasfestival.co.uk/seasons/festival-future-city/) <http://www.ideasfestival.co.uk/seasons/festival-future-city/>
29. Hoolahan, C. and Browne, A. (2016) On the practices of managing demand in the UK water industry management. DEMAND Centre Conference, Lancaster, 13-15 April 2016
30. Howarth, C. and Monasterolo, I. (2016) Understanding barriers to decision making in the UK energy-food-water nexus: The added value of interdisciplinary approaches. *Environmental Science and Policy*. 61 pp.53-60.
31. Huawei (2017) Smart city index. Report [online] [http://e.huawei.com/uk/special\\_topic/solution/smart\\_cities\\_index\\_2017](http://e.huawei.com/uk/special_topic/solution/smart_cities_index_2017)
32. [Knowle West Media Centre \(2013\) 3E Houses Project \[online\]](http://kwmc.org.uk/projects/3ehouses/) <http://kwmc.org.uk/projects/3ehouses/>
33. Loftus, A. (2006) Reification and the Dictatorship of the Water Meter, *Antipode*, vol. 38, no. 5, pp. 1023-1045.
34. Loftus, A., March, H. & Nash, F. (2016) Water infrastructure and the making of financial subjects in the south east of England, *Water Alternatives*, vol. 9, no. 2, pp. 319-335.
35. McKenna, E., Richardson, I. & Thomson, M. (2012) Smart meter data: Balancing consumer privacy concerns with legitimate applications, *Energy Policy*, vol. 41, no. 1, pp. 807-814.
36. Morgan, D.L. (1998) *The Focus group guidebook*. SAGE: London
37. Office for National Statistics – ONS (2017) Census Geography: An overview of the various geographies used in the production of statistics collected via the UK census. [online] <https://www.ons.gov.uk/methodology/geography/ukgeographies/censusgeography>
38. Ofwat (2013) Water meters –your questions answered. Information for household customers [online] [https://www.ofwat.gov.uk/wpcontent/uploads/2015/11/prs\\_lft\\_101117metres.pdf](https://www.ofwat.gov.uk/wpcontent/uploads/2015/11/prs_lft_101117metres.pdf)
39. [Ofwat \(2017\) Unmetered customers \[online\]](https://www.ofwat.gov.uk/households/your-water-bill/unmetered/) [http://www.ofwat.gov.uk/households/your-water-bill/unmetered/](https://www.ofwat.gov.uk/households/your-water-bill/unmetered/)
40. Priestley, S. (2016) Water meters: the rights of customers and water companies. House of Commons Briefing Paper [online]

<https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7342>

41. Seyranian, V., Sinatra, G.M. & Polikoff, M.S. (2015) Comparing communication strategies for reducing residential water consumption, *Journal of Environmental Psychology*, vol. 41, pp. 81-90.
42. Sibly, H. & Tooth, R. (2014) The consequences of using increasing block tariffs to price urban water, *Australian Journal of Agricultural and Resource Economics*, vol. 58, no. 2, pp. 223-243.
43. Shelton, T., Zook, M. and Wiig, A. (2015) The 'actually existing smart city'. *Cambridge Journal of Regions, Economy and Society*. 8 (1), pp. 13-25;
44. Smart Energy GB (2017) About Smart Energy GB  
<https://www.smartenergygb.org/en/about-us/about-smart-energy-gb>
45. Sovacool, B.K.; Heffron, R.J.; McCauley, D.; Goldthau, A. (2016) Energy decisions reframed as justice and ethical concerns. *Nature Energy*. 1
46. Spence, A., Demski, C., Butler, C., Parkhill, K. & Pidgeon, N. (2015) Public perceptions of demand-side management and a smarter energy future, *Nature Climate Change*, vol. 5, no. 6, pp. 550-554.
47. Torriti, J. (2017) Understanding the timing of energy demand through time use data:  
Time of the day dependence of social practices. *Energy Research & Social Science* 25, pp. 37-47
48. Zhang, T., Siebers, P. & Aickelin, U. (2016) Simulating user learning in authoritative technology adoption: An agent based model for council-led smart meter deployment planning in the UK, *Technological Forecasting & Social Change*, vol. 106, pp. 74-84

## **Appendix D**

### **Policy Brief: Communicating the potential and limitations of smart meters**

Version 1.1. December 2018

Plain text version

Final version available from: <http://eprints.uwe.ac.uk/38984/>

Despite the industry promises of improved grid management and reduced carbon emissions, the research on metering provides conflicting evidence with regards to its effectiveness. Metering can have a positive impact on resource efficiency provided that it improves the management of the grid and leads to changes at the household level (e.g., decrease in consumption, purchase of smart equipment, change in social norms) (Bradley et al., 2016; Buchanan et al., 2015). Therefore, the success of the UK Smart Metering Implementation Programme is highly contingent on a successful communication strategy.

#### **Context**

This document reports on a study involving analysis of smart meters marketing materials and two focus groups with utility professionals across private, charity and public sectors. The aim of the project was to understand the shortcomings in the current marketing materials and enhance the potential for transparent, clear and effective communication. The research was conducted in Bristol between July 2017–February 2018 and coordinated by the researchers from the University of the West of England.

#### **Current marketing materials**

Promotional materials assume convenience, savings and control over utility bills thanks to metering. However, focus groups revealed paradoxes contained in these framings as the participants associated metering with the loss of control over private data, inconvenience during the installation process, and

lack of financial gains if customers' lifestyles cannot support "smart" decisions. Participants agreed that the current promotional materials do not reflect advanced functionalities of smart meters, e.g. opportunity to re-design energy tariffs or community scale demand-side response: "Unless you're using it to inform decision making then it's not smart, then it's just measuring stuff".

### **Enhancing future communication**

Combining a range of arguments (e.g. benefits to the individual, the country, the environment) and communication styles (e.g. informational and promotional) could result in the honest and transparent disclosure about the limits and the potential benefits of metering. Future communications should be tailored to the capabilities and values of energy users.

### **Need for energy justice**

Future energy policies should be guided by the imperatives of climate change mitigation and tackling fuel poverty. While smart meters could make energy grid more efficient, the technology alone does not guarantee that all users will benefit from it the same way. Participants emphasised that the energy market is diverse and requires varied approaches: "One of the ways to look at it, that there are two markets, there's early adopter market and what we call vulnerable households in the industry". They called for recognising that not all user have the capability to change their lifestyles and behaviours, e.g. due to illness, shift work pattern or short-term renting contracts. Therefore, smart meters implementation programme should be accompanied by further energy justice "support package", e.g. thermal imaging surveys, retrofits, piloting smart appliances in vulnerable households.

### **Mutual learning across the sectors**

Finally, the project created a novel space for engagement among the government officials, academics, community energy members, energy companies and water providers. Although water and energy meters occupy different policy areas, both are fundamentally concerned with the same issues of resource management, improved efficiency, and fair provision. The study concludes that further collaboration and data sharing between utility

companies, academic researchers, and the government will help to create a space for integrated decision-making.

*This policy brief is based on the research done at the University of the West of England, Bristol by Aleksandra Michalec, Prof Enda Hayes and Prof James Longhurst in collaboration with Bristol Energy Network.*

*Please email Aleksandra.michalec@uwe.ac.uk for more information.*

*You can find the full version of the paper in the peer-reviewed journal Utilities Policy: Michalec et al. (2019) “Enhancing the communication potential of smart metering for energy and water”, vol. 56; pp. 33-40.  
<https://doi.org/10.1016/j.jup.2018.11.002>*

*The research has been supported by:*

*References:*

1. Bradley, P.; Fudge, S.; Leach, M. (2016) *Motivating energy conservation in organisations: smart metering and the emergence and diffusion of social norms* *Technol. Anal. Strat. Manag.* 28 (4), pp. 435-461
2. Buchanan, K.; Russo, R.; Anderson, B. (2015) *The question of energy reduction: the problem(s) with feedback.*

*Energy Pol., 77, 89-89*

*Photo credit: Smart Energy GB (2018) <https://www.smartenergygb.org/en/about-smart-meters/what-is-a-smart-meter>*

# Appendix E

## Participant Information Sheet

**Project title:** Local Water, Local Energy, Local Food? – can they contribute towards low carbon and equitable future of the Bristol region?

You are invited to take part in a 2-hour focus group investigating the complexities of local environmental actions. Using the example of three case studies, the research aims to enrich the local carbon management framework with wider environmental (e.g. non-CO<sub>2</sub> emissions, water use) and social (e.g. equity) implications.

### **About your case study: Low carbon and equitable solutions for food waste and surplus food**

How to tackle food waste and make the most of surplus food in Bristol? The city is booming with initiatives targeting food waste: from GenEco's poo bus, through numerous local charities (FareShare, FoodCycle, Skipchen – just to name a few) to Bristol's own municipal waste company. West of England produced its Waste Strategies in 2016 and committed to reporting emissions from waste as well as reducing amount of food waste going into residual waste from almost 40% to 10% by 2025. This focus group aims to gather public servants, private sector, academics and food charities in order to assess the potential of scaling up Bristol's current ambitions. The points for discussion will be:

- How to cut food waste in big facilities and small businesses?
- How to encourage food composting in residential areas?
- How to connect food waste actors? (e.g. a business will surplus/food waste, with a food surplus charity or anaerobic digestion)
- How to tackle dilemma between categorising food as edible surplus and potential energy from waste?

### **About the participants....**

Members of the focus groups will:

- Work or volunteer in the local water, energy or food sector
- Represent one of the categories: research/business/public sector/third sector
- Be able to speak confidently about the issues listed above
- There are no restrictions on participants' backgrounds (i.e. genders, ethnicities, nationalities and levels of seniority).

### **Arranging focus groups...**

The researcher will email the potential participants and organisations with anonymised online polls to schedule a focus group. The size of a single focus group should be between 4 and 8 people, and the availability will be coordinated on the first come, first served basis. Finally, all

volunteers who decide to take part will be asked to sign a consent form and retain this information sheet.

Focus group will be scheduled for the 10:00, 8 February 2017 in Arnolfini; expected time of the event is up to 2 hours.

### **How will the results be presented?**

Anonymised transcripts of the focus group discussion will be used in the researcher's PhD thesis. In addition, the research findings will be used in academic publications and presentations. In recognition of participant contribution and assistance, copies of outputs resulting from the study will be shared with you.

### **How will I, my organisation or Bristol region benefit from participation?**

Your opinions on the local priorities, challenges and opportunities will be analysed and taken into consideration while working towards the result of the project – toolkit for enriching urban carbon management frameworks with environmental and social implications of your case study. Therefore, you are actively contributing to and shaping the research process as it evolves and develops. As such, your continued participation in the process will really help to make the study a success and therefore will enhance a sustainable approach in the decision-making for the benefit of all Bristol region citizens and organisations.

### **Will my taking part in the project be confidential?**

You can participate on the condition of full anonymity in published materials. If you decide to remain anonymous, your contribution will refer only to whom you represent, i.e. Public Sector Water Specialist or Private Sector Energy Professional. Alternatively, you can allow your name, role and organisation to be mentioned. You can specify how you would like to be referred to.

Focus groups will be audio-recorded and only the researcher will hear the recording. Notes or any transcripts from interviews shall be provided to you for review, enabling the opportunity to clarify or amend any information held on record. You will have 14 days to amend comments on record prior to analysis, however the right to amend comments is reserved throughout the study unless already available in the public domain. All research data files are stored securely and in accordance with data protection regulations of the University of the West of England.

### **Can I withdraw from the study?**

Your participation is entirely voluntary and you can withdraw from the study any time without giving any reason by emailing the researcher at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk). There is no penalty for withdrawal. If you decide to withdraw, all information not accessible in the public domain will be removed from the data set and future outputs with any information you have given destroyed in line with UWE data protocol.

### **Any questions?**

If you have any concerns, or wish to discuss any aspect of the project, please contact the researcher, Aleksandra (Ola) Michalec at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk)

### **Who is funding the research?**

This project is jointly funded by:

- Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research
- The University of the West of England
- Bristol City Council

**Who is supervising the project?** The project is supervised by Prof James Longhurst ([James.longhurst@uwe.ac.uk](mailto:James.longhurst@uwe.ac.uk)) and Dr Enda Hayes ([Enda.hayes@uwe.ac.uk](mailto:Enda.hayes@uwe.ac.uk))

## **Appendix F**

### **Project Information Sheet**

**Project title:** Co-producing water and energy interventions in Bristol

How to provide sustainable and affordable energy and water services to all? The idea of “smart cities” promises accurate and effective policymaking driven by big data on resources consumption. However, is the technology enough to cut energy and water consumption, and help the residents to save money?

The research asks the following questions:

- How to improve promotional materials on water and energy metering?
- What could “smart” mean in the context of community energy?
- Can water and energy efficiency be promoted together?

#### **How will I, my organisation or Bristol benefit from participation?**

Your opinions will be analysed and taken into consideration while working towards the project outputs: organisational and policy recommendations as well as chapters in the strategic documents (BCC climate change framework and Bristol Community Energy Strategy). Therefore, you are actively shaping the research process as it evolves and develops.

#### **About the participants....**

Members of the focus groups will:

- Represent one of the categories: academia/business/public sector/third sector
- Be able to speak confidently about the issues listed above
- There are no restrictions on participants’ backgrounds (i.e. all genders, ethnicities, nationalities and levels of seniority are welcomed).

#### **Arranging focus groups...**

The researcher will email the potential participants and organisations to schedule a focus group. The size of a single focus group should be between 4 and 8 people, and the availability will be coordinated on the first come, first served basis. Finally, all volunteers who decide to take part will be asked to sign a consent form and retain this information sheet.

Focus group will be scheduled for [insert date] at Arnolfini;

#### **Will my taking part in the project be confidential?**

You can participate on the condition of full anonymity in published materials. If you decide to remain anonymous, your contribution will refer only to whom you represent, i.e. Public Sector

Water Specialist or Private Sector Energy Professional. Alternatively, you can allow your name, role and organisation to be mentioned.

All research data files are stored securely and in accordance with data protection regulations of the University of the West of England.

### **How will the results be presented?**

Anonymised transcripts of the focus group discussion will be used in the researcher's PhD thesis. In addition, the research findings will be used in academic publications and presentations. In recognition of participant contribution and assistance, copies of outputs resulting from the study will be shared with you.

### **Can I withdraw from the study?**

Your participation is voluntary and you can withdraw from the study any time without giving any reason by emailing the researcher at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk). There is no penalty for withdrawal. If you decide to withdraw, all information not accessible in the public domain will be removed from the data set and future outputs with any information you have given destroyed in line with UWE data protocol.

### **Any questions?**

If you have any concerns, or wish to discuss any aspect of the project, please contact the researcher, Aleksandra (Ola) Michalec at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk)

### **Who is funding the research?**

This project is jointly funded by:

- Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research
- The University of the West of England
- Bristol City Council

### **Who is supervising the project?**

The project is supervised by Prof James Longhurst ([James.Longhurst@uwe.ac.uk](mailto:James.Longhurst@uwe.ac.uk)) and Dr Enda Hayes ([Enda.Hayes@uwe.ac.uk](mailto:Enda.Hayes@uwe.ac.uk))

# **Appendix G**

## **Participant Information Sheet**

**Project title:** Local Food Waste Services – can they contribute towards low carbon and equitable future of the Bristol region?

You are invited to take part in a research investigating the potential of food waste services to improve Bristol's future. Our aim is to enrich the local council carbon management framework with environmental (carbon footprint of waste) and social (e.g. social equality, street scene) implications.

### **Background...**

The city is booming with initiatives targeting food waste: from GenEco's poo bus, through numerous local charities (FareShare, FoodCycle, Skipchen – just to name a few) to Bristol's own municipal waste company. West of England produced its Waste Strategy in 2016 and it is committed to reporting emissions from waste as well as reducing amount of food waste going into residual waste from almost 40% to 10% by 2025. However, locally food waste is still an issue: for example, only a small number of local businesses separate food waste from landfill. The aim of the research is to quantify the potential carbon emission savings arising from business food waste reduction as well as to draw out the best practice guidelines, which could be disseminated across the city.

**About the participants...** Participants will be staff members of the local businesses.

**Your role...** You are invited to take part in a survey asking about waste quantities, details of the waste collection service, motivations, barriers as well as positive experiences. The survey will take approximately 5 minutes. The researcher is happy to assist with waste measurements, should such need arise.

### **How will the results be presented?**

Anonymised surveys will be used in the researcher's PhD thesis. In addition, the research findings will be used in academic publications and presentations. In recognition of participant contribution and assistance, copies of outputs resulting from the study will be shared with you.

### **How will I, my organisation or Bristol region benefit from participation?**

Your answers will contribute to raising the profile of food waste initiatives in the local policy. The researcher aims to encourage more businesses to reduce their waste and to report on a

best practice to the industry. Therefore, you are actively contributing to and shaping the research process as it evolves and develops.

### **Will my taking part in the project be confidential?**

You can participate on the condition of full anonymity in published materials. If you decide to remain anonymous, your contribution will refer only to whom you represent, i.e. *Café Owner #1*. Alternatively, you can allow your name, role and organisation to be mentioned. You can specify how you would like to be referred to.

All research data files are stored securely and in accordance with data protection regulations of the University of the West of England.

### **Can I withdraw from the study?**

Your participation is entirely voluntary and you can withdraw from the study any time without giving any reason by emailing the researcher at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk). There is no penalty for withdrawal. If you decide to withdraw, all information not accessible in the public domain will be removed from the data set and future outputs with any information you have given destroyed in line with UWE data protocol.

### **Any questions?**

If you have any concerns, or wish to discuss any aspect of the project, please contact the researcher, Aleksandra (Ola) Michalec at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk)

### **Who is funding the research?**

This project is jointly funded by:

- Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research
- The University of the West of England
- Bristol City Council

### **Who is supervising the project?**

The project is supervised by Prof James Longhurst ([James.longhurst@uwe.ac.uk](mailto:James.longhurst@uwe.ac.uk)) and Dr Enda Hayes ([Enda.hayes@uwe.ac.uk](mailto:Enda.hayes@uwe.ac.uk))

## Appendix H

### Research consent form

**Project title:** Co-design of local actions for the low carbon and just future of the Bristol region

**Dear Participant,**

Thank you for agreeing to take part in the above research project. This form will be retained by the research team as evidence of consent and stored separately to other documents.

**Please input your initials to confirm:**

*I have read and understood the participant information sheet for the above study and have had the opportunity to ask question.*

*I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason.*

*I agree to take part in the above study.*

**Please input your initials to select how you would like to be referred to :**

*All identifying information is removed so that I remain completely anonymous*

**Or**

*You may identify my comments in publications with:*

*My name*

*My organisation/group*

Name of Participant:

---

Organisation:

---

Work email:

---

---

Date

---

Participant's signature

\* Please note typed response in the signature field is permitted when e-mailed from an authorised work account.

\* If you have any concerns, or wish to discuss any aspect of the project, please contact the researcher Aleksandra (Ola) Michalec at [Aleksandra.michalec@uwe.ac.uk](mailto:Aleksandra.michalec@uwe.ac.uk) or my supervisors: Prof James Longhurst ([James.longhurst@uwe.ac.uk](mailto:James.longhurst@uwe.ac.uk)), Dr Enda Hayes ([Enda.hayes@uwe.ac.uk](mailto:Enda.hayes@uwe.ac.uk))

\* The research is jointly funded by The University of the West of England, International Water Security Network and Bristol City Council.

# **Appendix I**

## **“Building smart cities, the just way. A critical review of “smart” and “just” initiatives in Bristol, UK”**

Michalec, A. O., Longhurst, J. and Hayes, E. (2019) Building smart cities, the just way. A critical review of “smart” and “just” initiatives in Bristol, UK. Sustainable Cities and Society, 47 (101510). ISSN 2210-6707 Available from: <http://eprints.uwe.ac.uk/40176>

### **1. Introduction**

#### **1.1 Towards “smart” and “just” cities?**

The “grand challenges” of the future such as climate change, limited resources availability and widening social inequalities are likely to transform how cities are governed. Meanwhile, the unprecedented development of technologies promises solutions to these issues. Yet, without an inclusive deliberation, technology poses further risks to security or democracy (Stilgoe, 2017).

Sustainable urbanisation is indeed a subject of lively debates amongst academics and policymakers. The initiatives promoting “smart cities” and “urban climate justice” are components of this debate generating questions about the nature of the transition to a sustainable future such as:

- How to harness the potential of technology?
- How will the residents be affected by the transition? Who will benefit, pay, decide, be excluded or included?

Both concepts are relatively new in the urban policy realm, therefore they create a potential for terminological confusion (de Jong *et al.*, 2015; Bulkeley

*et al.*, 2014). Additionally, it is not clear whether politicians, local civil servants, collaborating start-ups and grassroots communities apply these ideas in the manner as intended or expected by theorists who had proposed them.

In the context of this study, we define “smart cities” and “urban climate justice” as follows:

- “Smart cities” as an agenda aiming to implement technological innovations and utilise digital data collected about society as a means of policymaking and urban development (Shelton *et al.*, 2015).
- Urban climate justice is theorised as the consideration for ethical issues in policymaking. The key concerns are the distribution of resources, procedures of inclusion, rights to emit GHG emissions, responsibility to ameliorate climate change and the recognition of pre-existing injustices (Bulkeley *et al.*, 2014).

## **1.2. Policy developments to date**

The idea of “smart cities” has gained remarkable popularity over the last few years (De Jong *et al.*, 2015). For example, one of the strategic priorities of the World Economic Forum (WEF) is co-creating “Fourth Industrial Revolution”. This involves multi-stakeholder dialogue and concrete cooperation on urban governance challenges and opportunities presented by advanced technologies (WEF, 2019). Similarly, the European Commission (EC) established the European Innovation Partnership on Smart Cities and Communities which aims to provide a “marketplace of ideas” for smart mobility, procurement, planning etc. (EC, 2019). Following the agenda set by the international organisations, tech companies and universities have mobilised their resources

to describe, account and rank the emerging “smart cities” (Huawei, 2017; IESE, 2018, Eden Strategy Institute, 2018). Drawing from the smart city rankings (*ibid.*), Table 1 outlines the instances of the “smart city” agenda applied in practice:

**Table 1.** Examples of smart city projects implemented around the world.

Name	Description	Cities	Reference
GrowSmarter	Setting up a network of charging terminals for electric vehicles at strategic locations in the city.	Barcelona, Stockholm, Cologne	European Commission, 2019
Matchup – Internet of Things	Gathering urban data and designing Key Performance Indicator (KPI) dashboards to manage all of the city’s assets in the mobility, transport and energy sectors.	Valencia, Dresden, Antalya	European Commission, 2009
Project-DISC	Informing policy and strategic service developments using unified data, simulation, and modelling. This will be applied to the construction of a new rail terminus.	Birmingham	Huawei, 2017
Smart Street Lighting	Improving energy efficiency while supporting other applications such as monitoring movement (footfall and traffic flow), air, and noise pollution levels.	Glasgow	Huawei, 2017

Tech Skills Accelerator	Training over 27,000 people in data analytics, artificial intelligence, and cybersecurity.	Singapore	Eden Strategy Institute, 2018
Ofo Bike sharing	Sharing the location, distribution data and utilization heatmaps with the government. The data allows the city to support new bus routes planning.	Shanghai	Eden Strategy Institute, 2018

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Meanwhile, calls for climate justice at the urban level have also been raised by high-profile strategies, such as Sustainable Development Goals (SDGs) (UN, 2015). For example, Goal 11 of SDGs (Sustainable cities and communities) specifies:

*“11.2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons”* (UN, 2015).

Indeed, both academics and practitioners have started to recognise the importance of citizens in co-creation of “smart cities” (Saunders and Baeck, 2015). However, there is little clarity, guidelines and evidence on what people-centred “smart cities” could mean in practice (Cowley *et al.*, 2017). Without the explicit reference to the justice discourse, “smart cities” might become a

buzzword, a term characterised by a high frequency of usage but a low potential for accountability (Rist, 2013; Finger and Razaghi, 2016).

## **2. Theory**

### **2.1. Smart cities**

The literature on smart cities characterises its agenda as 1) Improving economic and administrative decision making through technological innovation; 2) Improving social inclusion in the development and adaptation of the emerging technologies; 3) Raising the profile of high-tech industries in contributing to the economic growth 4) Effective embedding of technology in wider physical and social systems (Caragliu *et al.*, 2011; Allwinkle and Cruickshank, 2011).

However, an academic critique arising from the closer examination of the smart city goals questions the assumptions coming from the paradigm. For example, Shelton *et al.* (2015) challenge the notion of “objectivity” as a result of the integration of technology into policymaking. They argue that all datasets are socially constructed and can, therefore, result in competing representations of the world (*Ibid.*).

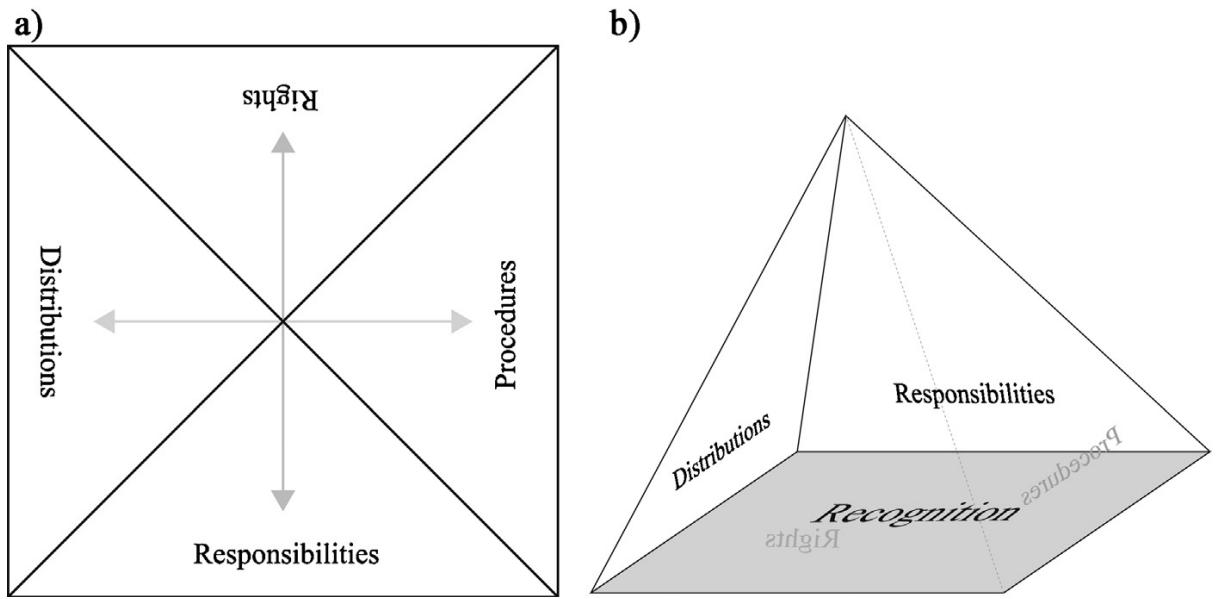
Furthermore, upon completing a large scale bibliographic analysis of peer-reviewed urban development literature, De Jong *et al.* (2015), argues that “smart cities” are only weakly related to the environmental agenda (e.g. “sustainable” or “low carbon” cities). Instead, they suggested that the idea of “smart city” builds on the other conceptualisations of urban modernisation, e.g. “information city”, “digital city” or “intelligent city” (*Ibid.*). The database analysed by de Jong *et al.* (2015) spanned the period 1996 to 2013. Their

analysis revealed that in the final year of the analysis, “smart city” was the most commonly used urbanisation concept in the academic discourse (de Jong *et al.*, 2015). Nevertheless, without a detailed analysis of the “actually existing” smart initiatives, it is difficult to assess whether this correlates to the popularity of the term in practice and how the decision makers bring academic concepts to life.

To explore whether the real-life applications of smart city conceptualisations stands up to scrutiny, Caprotti *et al.* (2016) examined 398 UK initiatives labelled as “smart” by their organisers. Here, the researchers highlighted the issues of the longevity of the projects, long-term adaptation of the technology from the bottom-up and, finally, upscaling pilot initiatives. As a result, UK-based smart initiatives could potentially become unaffordable and unengaged with the majority of citizens. Caprotti *et al.* (*ibid.*) highlighted that the impact of smart technologies on social equality remains underexplored.

## **2.2. Urban Climate Justice**

Urban climate justice is conceptualised at a more academically mature level comparing to the emergent “smart cities” discourse. Numerous definitions of climate justice have burgeoned over the past few years (Bulkeley *et al.*, 2014; Steele *et al.*, 2015; Shi *et al.*, 2016). What they all have in common is the emphasis on 1) equitable access to resources 2) responsibility for emissions 3) right to emit GHG gases and benefit from policies 4) inclusion and diversity in policy procedures 5) recognising the pre-existing injustices in the first place (Fig.1).



*Figure 1. A conceptualisation of climate justice based on recognition of injustice as a necessary basis for assessment of responsibilities, rights, distributions and procedures. (Bulkeley et al., 2014; licensed under CC BY 3.0)*

Climate justice is explicitly recognised at the international level by the major frameworks like Sustainable Development Goals (UN, 2015) or Paris Agreement (UNFCCC; 2015). However, similarly to the smart cities agenda, there is not enough empirical evidence suggesting whether the international frameworks set from the top-down are applied in cities with the same ethical principles in mind (Shi *et al.*, 2016). Policymakers still lack practical and mixed method tools (e.g. applying both “smart” data and qualitative reviews) to assess the contribution to climate justice both before and after the implementation of the policy.

Furthermore, the application of climate justice to the political sphere is not fully understood yet. Terms like “social justice”, “social sustainability”,

equality”, “equity” and “inclusion” carry varying degrees of ambiguity (Michalec *et al.*, 2019). They can be either explicitly politically charged or appropriated to suit the current hegemony (Fuchs, 2017).

Finally, urban climate justice is most commonly researched in terms of climate adaptation policies in the Global South (Shi *et al.* 2016). However, climate mitigation policies are also subjected to possible injustices which exist across all scales of governance and dimensions of the justice pyramid (Bulkeley *et al.*, 2014). This argument furthered the climate justice agenda into exploring the possibility of “intersectional” analysis and policymaking. Intersectionality research calls for the recognition of the multiple co-existing forms of disadvantage and vulnerability, e.g. income, gender, ethnicity, age and health. Despite a growing body of research on intersectionality and climate justice, these ideas are yet to be encountered in policy practice (Kaijser and Kronsell, 2014; Agyeman *et al.*, 2016).

### **2.3. The potential for cross-fertilisation of “smart” and “just” agenda**

The potential for co-creating “smart” **and** “just” cities has not been fully realised so far (De Jong *et al.*, 2015). This raises the questions:

- Do “smart city” initiatives take into account social justice issues?
- Do climate justice policies make the most of the available opportunities provided by technology and open data?

The point of departure of this article is building on the promises of “smart city” and “urban climate justice” agenda. Whereas both theories propose improvements in sustainable policymaking, “smart cities” tend to be most

commonly driven by “objective” data, and depoliticised decision-making (Cowley *et al.*, 2017). On the other hand, the “urban climate justice” paradigm is explicitly value-laden (Agyeman *et al.*, 2016). Therefore, the article examines whether “smart cities” can be deliberately politicised so they openly include urban climate justice aims. The paper also considers the potential for improvements in urban climate justice methodologies – whether the recent advancements in data science and technology can offer new insights beyond the traditional evaluation methods.

#### **2.4. Research aims**

The aim of this paper is to enrich the agendas of smart cities and urban climate justice as well as contribute to their development in practice. By critically reviewing existing projects in Bristol, UK, this article investigates how justice is understood and applied to “smart city” initiatives. Finally, the paper presents a heuristic for evaluating urban initiatives through the lens of climate justice. This methodology could be readily applied by practitioners, policymakers and researchers. Finally, the paper concludes with suggestions on communicating the results of the analysis as well as the methodology to the decision makers.

#### **3. Research design**

This paper presents a critical in-depth review of two qualitative case studies. Both projects are focused on climate mitigation initiatives labelled as “smart”. The work builds upon the previous conceptualisations of “smart cities” (Caprotti *et al.*, 2016; de Jong *et al.*, 2015) and “urban climate justice” (Bulkeley *et al.*, 2014).

### **3.1. Study area**

The research is concerned with climate change mitigation initiatives implemented in the city of Bristol, UK. The city is located in the South-West of the UK, with a population of 442 000 residents. It is a signatory of the UN-wide climate change mitigation commitment; Compact of Mayors (2014). In 2015, the city adopted its own Climate Change Framework (BCC, 2015a), building upon the national legally binding Climate Change Act (HM Government, 2008). The document sets ambitious targets of reducing urban CO<sub>2</sub> emissions by 40% by 2020 (based on 2005 baseline). Recently, Bristol City Council declared an ambition to become carbon neutral by 2030 (BBC, 2018).

In terms of technological improvement, Bristol has already been embracing the “smart city” agenda at the project-scale in recent years (Cowley *et al.*, 2017). This led to city scoring first position in the Huawei UK Smart Cities Index (Huawei, 2017). The city topped the ranking thanks to the implementation of the innovative initiatives, such as:

- Data Dome: data visualisation facility
- Bristol is Open: data sharing platform
- Citizen Sensor: a project involving citizens in prioritising policy issues which can be then tackled using technology
- Bristol Energy: a municipally-owned energy company, responsible for the smart meters rollout
- Electric vehicles charging points (Woods., 2016)
- Cold Homes Energy Efficiency Surveying (BEN, 2017).

Out of the above projects, three have encompassed climate change mitigation explicitly in their agenda. Smart meters rollout, cold homes energy efficiency surveying (CHEESE) and electric vehicles (EV) initiatives are concerned with reducing CO<sub>2</sub> emissions with the help of state-of-the-art technology.

Despite its recent technological innovations, as the city struggles with social inequality. It is estimated that 69 000 (or 16%) people are amongst the poorest 10% of English residents. Over 13% live in fuel poverty, comparing to 10.6% of the national average. One in four children lives in poverty – which is the highest figure in the south west of England (BCC, 2015b). As tackling social inequalities is one of Bristol's strategic priorities, the emerging “smart city” projects ought to consider their impact on the most vulnerable residents (BCC, 2019).

### **3.2. Selection process**

CHEESE project and Electric Vehicles rollout were selected as case studies for the research. These initiatives were selected as currently little is known about the inclusion of justice agenda in them. So far, the theoretical literature on “smart cities” and “urban justice” warned against technologies and policies impacting the residents unevenly, as a result, deepening social inequalities (Shelton *et al.*, 2015; Preston *et al.*; 2014). The issues of metering implementation in Bristol are described elsewhere (Michalec, 2019).

In order to select suitable case studies, the researchers undertook a detailed database search using specialist literature on smart cities (Woods *et al.* 2016; Caprotti *et al.*, 2015), the local council website

(<https://democracy.bristol.gov.uk/>) and websites of the sustainability sector organisations (<http://bristolenergynetwork.org/>; <http://bristolgreencapital.org/>). The initial literature review led to the selection of two case studies based on the variety of information and diversity of the projects (Tab. 2). Selected case studies reflect various types of climate mitigation initiatives present in the city:

- EV: A major national government-led initiative. It aims to disseminate the electric transport infrastructure, so EV become more accessible and affordable.
- CHEESE: A community-led small size project. CHEESE project offers low-cost and free thermal imaging surveys and advice on affordable insulation. The project aims to tackle fuel poverty by giving the residents the capability to improve the efficiency of their households.

**Table 2.** Case studies selected for the discourse analysis

Name of the project	Short description	Number of sources	References used for the analysis
Electric Vehicles (EV)	Infrastructure features (e.g. charging stations) and financial incentives (e.g. reduction in parking fees) aimed at EV owners, car clubs and council fleet vehicles.	2	BBC, 2016; WoE, 2016;
Cold Homes Energy Efficiency	A community-led project using thermal imaging surveys indicating the best ways to	1	BEN, 2017

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Surveying (CHEESE)	improve energy efficiency in the local households.
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### 3.3. Discourse Analysis

The case studies were investigated qualitatively, using desk-based analysis. Following the selection of the relevant initiatives, the initiatives were assessed using discourse analysis (DA), in particular:

- Bulkeley *et al.* (2014) framework for climate justice (Fig. 1) asking not only about the impact on stakeholders but also on issues of recognition, inclusion, exclusion and omission of potential stakeholders (Tab. 3)
- Bax (2010) heuristic for aims and impact of the project at the explicit, implied and obscured levels (Tab. 3).

This stands in contrast to the evaluation criteria commonly applied in policy studies: logic model and stakeholder analysis (Smith, 2010). A departure from the traditional methods of policy analysis is justified with a need for self-reflexivity and caution of the analyst when it comes to assessing the application of emerging, complex and contested terms. Methods like logic model do not question the assumptions behind the theory-laden terms, potentially contributing to further misuse of the aforementioned “buzzwords” (House and Howe, 1999). Similarly, although stakeholder analyses often ask about impacts and involvement of the stakeholders, they do not question who is *not* considered a stakeholder; neither who is *not* impacted by a policy at all and whether this is a positive thing. The paper argues for practicing self-reflexivity

and caution both by academics conceptualising the urban development theories as well as policymakers, whose framing often contributes to the prevailing discourse in practice.

The researchers chose DA as a vehicle of policy and project analysis. The method employs a critical level of text analysis as it goes beyond that which is presented explicitly (Wodak and Meyer, 2009). Questioning the issues of power, inclusion, foregrounding and backgrounding, typical for DA, fits well with the objectives of the paper. By examining the understanding and application of “smart” and “just” projects in Bristol, the paper aims to improve the clarity of the urban climate change mitigation policies.

Table 3 outlines the detailed heuristic for the application of the method both within and outside of the academia. The purpose of the heuristic is not to present an exact protocol to follow, but rather to provide an exhaustive set of potential questions that could be asked about the smart initiative analysed. When reproducing the results, it is critical to identify both the explicit, implied and obscured aims. The analysts ought to pay attention to the definitions, language and tone present in the. A set of detailed questions referring to rhetorical tools contributes to the rigour of the analysis. They ask to draw the conclusions directly from the text, as opposed to the analyst’s prejudices and positionality.

**Table 3.** *A heuristic for the analysis of justice in sustainable and smart projects*

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**Questions for discourse analysis**

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**1. What does the text achieve or aim to achieve?**

1. A What is the intended function of the text?
  1. B What is the impact on the individual reader and wider society?
  1. C Who is the target audience?
- 

**2. How does the text achieve their impact or function?**

2. A What specific genre(s) does the text draw on?
  2. B What aspects of the structure does the text apply?
  2. C What layout, auditory or visual resources does the text draw on?
- 

**3. How is justice understood?**

3. A How does the text conceptualise justice/inequality/fairness/equity – which words are used?
  3. B Are references to climate justice explicit or implied?
  3. C References to justice by recognition?
  3. D References to distributive justice?
  3. E References to retributive justice?
  3. F References to procedural justice?
  3. G References to Intersectionality?
  3. H Who is included /excluded/omitted in policy/consultations/decision making? How are these people characterised?
- 

**4. What are the methods of achieving justice?**

4. A At what stages of policy/project cycle is justice considered?
  4. B Do these methods draw from local/ expert/ citizen/ community/ research knowledge?
  4. C Do these methods draw from quantitative data?
  4. D Methodological assumptions and limitations?
  4. E Methodological innovations?
  4. F Are these methods “smart”? (As defined by the authors OR by the researchers?)
- 

**5. Why does the text seek to achieve its aim and function?**

5. A what are the socio-political and ideological underpinnings of the text?
  5. B What does the text seek to foreground or background and why?
-

### **3.4. Limitations to the methodology**

There are several limitations related to the application of DA and the design of the research. As the analysis is concerned with the ambiguity and complexity of language, the results will be most relevant to the organisations and countries using English as their first language. Moreover, as this study focuses on secondary sources, it does not give a chance for the authors of the selected documents to defend their application of the ambiguous terms present. A degree of the researcher's own interpretation of the complex data is a necessary feature of DA. However, sometimes it is poised as an overall criticism of qualitative methods positioned in the social constructivist paradigm (House and Howe, 1999). An appropriate way to respond to such criticism is to emphasise the analyst's transparency and rigour. This could be achieved by providing a detailed account of the methodology and a self-reflection on the researcher's agenda (Yanow, 2000). The requirements for rigour, a critical level of analysis and self-reflection make this methodology labour-intensive and challenging to disseminate across academic disciplines, let alone across the urban practitioners. Nevertheless, the researchers anticipate that publicising a detailed heuristic will increase the likelihood of its successful dissemination.

The study is concerned with the emerging policies and projects, which hinders access to the policy-relevant information. At the time of writing, the available data were incomplete. Moreover, acquiring the data via direct contact or a Freedom of Information Request proved to be complicated and lengthy.

However, limited availability of information could be a point of reflection for the analysis as it sheds light on the existing procedures of communication with the public. The questions arising are: what is communicated to the public and at which point in the policy cycle?

Finally, the small sample size could be considered as a drawback of the research. As mentioned previously, the depth and rigour of the research are expected to compensate for the small sample size. Since DA is seen here as a pilot method for project design evaluation, there is a potential for other organisations and cities to adopt and apply this heuristic.

## **4. Results and Discussion**

### **4.1. Electric vehicles (EV)**

The rollout of the Electric Vehicles is a part of the national government decarbonisation strategy. In 2016, the UK government awarded the city of Bristol £2.2 millions of direct funding for promotion and uptake of EV. The policy package includes a set of infrastructure features (e.g. charging stations, car club bays, rapid charging hubs, priority lanes, preferential parking spaces) and financial incentives (e.g. reduction in parking fees, discounts for taxi licensing, business engagement) aimed at EV owners, car clubs and council fleet vehicles (BBC, 2016). This case study analyses two documents submitted to the Bristol City Council as a part of EV policy design:

- A detailed funding bid drafted by “Business West”, a partnership between the private and public sector (WoE, 2016).

- An internal cabinet report with recommendations for the Mayor’s approval (BCC, 2016).

#### **4.1.1. Funding bid**

The first document relevant to the EV policy is a funding bid authored by “Business West” a partnership between local authorities and private sector representatives. The aim of the bid is to present a business case for the large-scale uptake of EV, providing a vision for Bristol as a city leading the trend. The text is written in a formal, yet promotional language, bringing attention to the opportunities and plans. It includes numerous figures (infographics, bar charts, maps), many of them illustrating potential for the growth of the project. Photographs present in the bid are symbolic of innovative technologies (e.g. photographs of EV charging points; WoE, 2016, pp. 1, 11, 12), Bristol’s prosperity (a photograph of fireworks over Harbourside; WoE, 2016, p II) and people leading the initiative (photographs of senior professionals at meetings; out of 48 identifiable people, 48 are white, 41 are male and 7 are female; WoE, 2016, p. 16).

The bid does not explicitly refer to the “smart” or “just” agenda. However, the consideration for “smart” and just” city is implied in the text as the bid frames its aims as follows: 1) commitment to low carbon objectives 2) improving air quality for all 3) raising the city profile as a “*laboratory for change*” - place for creativity, new technologies, innovation (WoE, 2016, p.3). The document explicitly targets the proposed policies (e.g. locations of charging stations and discounts for parking) at people most likely to purchase EV. In the document,

they are described as “*male, aged 40-69, likely to be educated to degree level, affluent, have access to two or more cars*” (WoE, 2016, p.17). The bid recognises the need to “*help those residents without the means to purchase an ultra-low-emission vehicle (ULEV) to join a car club*” by releasing a “*community package*” with support for car club initiatives (WoE, 2016, p.17). However, the bid does not specify the level of support in comparison to the owners of EVs; neither does it provide a plan of engagement with the disadvantaged communities. This poses a risk of the already wealthy target demographics disproportionately benefitting from the discounts for EV charging or parking.

The lack of engagement with the idea of distributive justice might stem from the fact that the EV technology is still in a development phase, therefore requiring so-called “*early adopters*” to help with dissemination (WoE, 2016, p. 8). However, in the age of austerity and council budget cuts (BCC, 2017) any policy benefitting a privileged few becomes problematic. The EV bid is keen to portray Bristol as a leader in innovation (WoE, 2016, p.4). However, more needs to be done in order to make sure no one will be left behind as a result of modernisation.

Two other potentially socially just EV policy options were outlined in the bid. Namely, the development of EV council fleet and freight consolidation scheme (WoE, 2016, p.12). However, none of them was justified with a social justice agenda. This leaves the policy proposals open to an interpretation for the council officers on the ground.

The bid does not acknowledge the need for procedural justice – including diverse demographic of citizens as both precursors and beneficiaries of the policy. Photographs presented throughout the document show a very narrow demographic of sector leaders (WoE, 2016, p. 16). The policy explicitly targets people who are already in financial advantage as they “(*represent*) socio-economic segments with characteristics which increase the likelihood of ULEV purchase” (WoE, 2016, p.7).

#### **4.1.2. Cabinet report**

The aim of the cabinet report was to analyse the impacts of the proposed bid and provide comprehensive evidence for policymaking. The text uses formal language, passive voice and includes figures and references to interconnected assessments in order to create an impression of legitimacy and neutrality. The report states the objectives of the policy as: reducing carbon emissions, supporting economic growth and improving air quality.

The report mentions justice-related terms numerous times (e.g. “*burden not distributed equally*”, “*living in more deprived areas*”, BCC, 2016, p. 4). However, this is mostly in the context of indirect anticipated policy outcomes, such as reduction in air pollution. In terms of the just participation in policy design and the uptake of the initiative itself, the council frames it as the case of having “*no negative impact on equalities communities*” (BCC, 2016, p. 9). The document doesn’t refer to a risk of a low take up of EVs by the disadvantaged people. This understanding of climate justice makes EVs a solution potentially benefiting all citizens indirectly in the long term. However, in short timescales it is likely to directly benefit merely a privileged few.

Although the notion of “equality” is considered at the early stage of policy design, the cabinet report concluded that a brief impact assessment is satisfactory and there is no need for a full analysis. This might be due to the fact that the council frames “equality analysis” as a question of the potential negative impact rather than a risk of low participation. Finally, the UK Government defines “*equality groups*” as those with the following protected characteristics: “*age, disability, gender, marriage, civil partnership, pregnancy, maternity, race, religion, belief, sex, sexual orientation*” (BCC, 2016, p. 8). Absent from the formal consideration is any identification of income deprivation as a consideration. This is particularly surprising in the context of the common criticism about EV present in media, e.g. “Electric cars - the ultimate subsidy for the rich” (The Spectator, 2013) or “Minorities Are Being Left out of the Electric Vehicle Revolution” (Schwarz, 2011).

#### **4.1.3. Suggestions for improvement**

This paper suggests methodological improvements in assessing the success of the urban “smart” policy in terms of climate justice. Firstly, the policy proposals ought to link to climate justice in an explicit way, taking into account income deprivation as one of the factors affecting pre-existing inequalities. Secondly, forming partnerships between the public and private sector creates new opportunities for data collection on the popularity of the technology and uptake of policy. Increased awareness of the customer base could improve the allocation of funding in future policy cycles, e.g. by helping to determine whether to spend it on purchased cars, car clubs, fleet vehicles or public transport. Moreover, since the policy is explicitly linked with the air quality

objectives, the data from pollution monitoring could be further utilised for prioritising EV in air pollution hotspots, e.g. using community transport or council fleet cars on routes with the highest air pollution. Finally, opening up the datasets and referring to urban climate justice agenda in press releases will improve the communication between the local authorities and the citizens.

#### **4.2. Cold Homes Energy Efficiency Surveying (CHEESE project)**

CHEESE project is a small-scale initiative led by a community energy organisation, Bristol Energy Network. The project was designed in 2014 and started its official development phase in 2016, after receiving nearly £20 000 of funding from the UK Government and The Big Lottery. This case study analyses the report entitled “Progress of the CHEESE Project” (BEN, 2017).

The aim of the progress report was to inform the BEN stakeholders on the development phase of CHEESE project. The idea behind CHEESE project is to provide local householders with low cost (or free for the residents on low income) energy efficiency surveys using thermal imaging technology. The developers of the projects argue that gaining knowledge about gaps in building efficiency will incentivise Bristol residents to invest in home improvements (e.g. insulation, stopping of draughts) and behavioural change measures (BEN, 2017, p. 5). The report tells the story of project development from the managerial point of view, praises achievements of the team, shares best practice, justifies delays and sets out plans for the future. The report is written in a semi-formal language using first person to convey a narrative about project development. The paragraphs are brief and the author avoids specialist jargon. The document provides quantitative data on issues like the length of

staff training, funding received, number of images and surveys taken. Although the report avoids technical details, it includes comprehensive references to the academic literature, videos with staff training and hyperlinks to the software used in the project.

The report explicitly includes urban climate justice, both by recognising that “*poor and black neighbourhoods*” suffer disproportionately from inefficient housing and targeting “*fuel-poor areas*”<sup>31</sup> (BEN, 2017, p. 2). The procedure of targeting disadvantaged areas is undertaken using “smart” technology as, “(*the*) *technical manager has developed energy mapping by ward in Bristol which allows us easily to select fuel-poor target areas*” (BEN, 2017, p.2). Nevertheless, the report does not outline whether the targeting strategy was successful and who benefitted from the initiative in the first few months of operation. The report to some extent recognises the complexity and intersectionality of climate justice, referring to poverty, tenure (e.g. owning or renting property) and race. However, it does not mention the age, health or digital literacy as factors potentially contributing to fuel poverty and the uptake of the initiative.

The text emphasizes the community-oriented nature of the project, e.g. partnerships with neighbourhood-level low carbon energy groups, work of volunteers and managing the initiative on a low budget. However, it obscures the demographics of the beneficiaries of the project. For example, whether the residents living in fuel poverty benefitted from the CHEESE survey and made

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<sup>31</sup> A household is considered to be fuel poor if they have required fuel costs that are above average (the national median level), were they to spend that amount, they would be left with a residual income below the official poverty line (DBEIS, 2017)

subsequent improvements to energy efficiency in their homes. This might be due to the fact that the document reports on the early phase of the project, e.g. “*We have so far done 13 (surveys) and are just gearing up, but we think 120 surveys may be more realistic target before it gets too warm after Easter. However, the time has been well spent on perfecting equipment and all the ancillary management tools needed to record and interpret the results. This is still the second development phase*” (BEN, 2017, p.4; emphasis added by the report author).

The notion of urban climate justice is embedded in every stage of the project development: from the recruitment of the target area, the design of advertising (“*we are putting up flyers in libraries, community centres, shops, local notice boards (...) We are using the contacts of other community organisations to seek out fuel-poor*”, BEN, 2017; p. 5) to finally – the design of survey tools (“*In the event of a lack of Wi-Fi, we have printed forms for householders*”, BEN, 2017, p. 4). Methods of improving urban climate justice through the project are both qualitative (e.g. multiple channels of advertising, adjustments done for the residents without access to the Internet) and quantitative (interactive energy mapping). The project developed a number of technical innovations, e.g. “*own sophisticated, unique software*” (BEN, 2017, p. 3) and an app compatible with smartphone cameras.

#### **4.2.1. Suggestions for improvement**

Discourse analysis reveals that in the CHEESE project “smart” and “just” agenda are understood in line with the academic literature. The progress

report analysed provided an explicit justification of the climate justice agenda. It also set out a detailed protocol for the project, involving both qualitative local knowledge and quantitative “smart” equipment. The researchers, however, recommend placing more emphasis on consistently updating on the uptake of the project. The project stakeholders would also benefit from finding out about the successes and limitations related to the recruitment of fuel poor households. The second recommendation is to consider analysing data on health and age while conducting surveys. Health and age are significant dimensions of intersectionality in climate justice; they also might potentially be significant barriers for benefiting from the project. The above practices are expected to improve the accountability of the project and facilitate the replicability of the protocol.

### **4.3 Synthesis**

Bristol City Council’s cabinet report on EVs frames “justice” as a potential for negative impact on equality groups enshrined in law (which include e.g. gender, race but not income deprivation), without referring to the risk of a low uptake of a policy by the disadvantaged residents. The West of England EV bid does not recognise income deprivation as a dimension of inequality either - it actively targets financially privileged residents as the potential beneficiaries. Although the policy includes a “community package” aimed at those without the means to purchase EVs, it does not specify the level of support in the budget outline.

In contrast, the CHEESE project progress report embeds justice explicitly in its aims. The project’s targeting strategy refers to the ideas of justice by

recognition, redistribution and – to a certain extent – intersectionality (of income deprivation, tenure type and race). Although CHEESE aims to target fuel-poor households, it does not report on whether it achieved the expected outcomes at the time of writing.

Although both projects display a potential to contribute to the ideas of smart and just Bristol, they require further detailed analyses in terms of policy impact on climate justice. Bristol City Council ought to report how EVs could benefit the most deprived residents. An analysis of impacts on income deprivation could complement the current equality assessments. CHEESE project would benefit from a thorough account of the survey uptake and following home improvements in order to improve the accountability of the project. Table 4 summarises how these two case studies contributed towards tackling climate injustices.

**Table 4.** A summary of the research results

EV	CHEESE
<b>Understanding of justice</b>	
<ul style="list-style-type: none"> <li>• Avoiding negative impacts on “equality groups”,</li> </ul>	<ul style="list-style-type: none"> <li>• Recognising that income, race and tenure are relevant to the project design</li> </ul>
<b>Potential benefits</b>	
<ul style="list-style-type: none"> <li>• Improving air quality for all,</li> <li>• Widespread dissemination of an emerging technology,</li> <li>• Community package for those without means to purchase own EVs</li> </ul>	<ul style="list-style-type: none"> <li>• Tackling fuel poverty,</li> <li>• Improving home efficiency,</li> <li>• Improving the awareness of low-cost efficiency measures</li> </ul>

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### Suggestions for improvements

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- Adding “income deprivation” dimension to equality assessments,
  - Considering benefits of the policy to the most deprived residents.
  - Adding dimensions of health and age when targeting vulnerable participants,
  - Regularly publishing information on the project uptake.
- 

## 5. Conclusions

This paper outlined a new heuristic for DA as a tool for project evaluation of “smart” and “just” initiatives and presented a critical review of two urban development initiatives in Bristol, UK. DA was applied in the study, as it is suitable for contested and politically charged terms, which are often applied differently by the theorising academics comparing to the practitioners working on the ground. The review of two case studies of urban level projects reveals differing conceptualisations and applications of urban climate justice in the local policies and community projects. Although both initiatives acknowledged justice as an overarching goal for urban development, each case study defined justice differently and embedded it at different stages of project development.

This article suggests methodological improvements in policy design, which would ensure rigorous implementation of “smart” and “just” agendas. The researchers recommend benefitting from the “smart” data collected about the residents (data on air quality, fuel poverty, tenure, car ownership, income deprivation, uptake of environmental policies and voluntary initiatives) in order to target policies with social justice in mind.

Furthermore, the paper suggests taking into account multiple dimensions of justice (e.g. recognition, rights, distributions, intersectionality) at every stage of project development. Finally, the article suggests that the techniques drawn from DA could be introduced into policy analysis. DA has the potential to clear the conceptual ambiguities, improve transparency and encourage critical self-reflection of urban development practitioners.

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## References

- Agyeman, J., Schlosberg D., Craven L. and Matthews C. (2016) 'Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities. *Annual Review of Environment and Resources*. vol. 41, pp. 321-340
- Allwinkle, S., Allwinkle, S. & Cruickshank, P. (2011) "Creating Smart-er Cities: An Overview", *The Journal of urban technology*, vol. 18, no. 2, pp. 1-16;
- Bax, S. (2011) *Discourse and genre: analysing language in context*. Palgrave Macmillan, Basingstoke. Pp. 98-99
- Bristol City Council (2015a) *Our Resilient Future: A framework for climate and energy security*, pp. 120- 198. [online]  
[https://www2.bristol.gov.uk/committee/2015/ua/uaooo/1103\\_binder.pdf](https://www2.bristol.gov.uk/committee/2015/ua/uaooo/1103_binder.pdf)
- Bristol City Council (2015b) *State of Bristol: Key facts* [available online]  
<https://www.bristol.gov.uk/documents/20182/32947/State%2520of%2520the%2520City%25202013-%2520Ma%20yoral%2520vision%2520v8.pdf/cd19638b-9a4d-4b40-833f-c5866896db17> [last accessed 04/07/2017]

- Bristol City Council (2016) *Ultra-Low West 2016/17 – 2020/21*. Cabinet Report [available online]  
[https://democracy.bristol.gov.uk/Data/Cabinet/201604051800/Agenda/0405\\_5.pdf](https://democracy.bristol.gov.uk/Data/Cabinet/201604051800/Agenda/0405_5.pdf)  
[last accessed 04/07/2017]
- Bristol City Council (2017) *Corporate Strategy 2017–2022* [available online]  
<https://www.bristol.gov.uk/documents/20182/1188753/Corporate+Strategy+2017-2022+D5/c545c93f-e8c4-4122-86b8-6foe054bb12d> [last accessed 04/07/2017]
- Bristol City Council (2017) Meetings, agendas and minutes [available online]  
<https://democracy.bristol.gov.uk/> [last accessed 04/07/2017]
- Bristol City Council (2019) One City Plan. [available online]  
<https://www.bristolonecity.com/one-city-plan/> [last accessed 14/3/2019]
- Bristol Energy Network (2017) *Progress of the CHEESE Project* [available online]  
<https://cheeseproject.co.uk/static/files/CHEESE-progress-Jan17.pdf> [last accessed 04/07/2017]
- Bristol Energy Network (2017) [available online] <http://bristolenergynetwork.org/> [last accessed 04/07/2017]
- Bristol Green Capital (2017) [available online] <http://bristolgreencapital.org/> [last accessed 04/07/2017]
- BBC – British Broadcasting Corporation (2018) Bristol's 2030 carbon neutral plan 'ambitious' [available online] <https://www.bbc.co.uk/news/uk-england-bristol-46343383> [last accessed 14/03/2019]
- Bulkeley, H., Edwards, G.A.S. & Fuller, S. (2014) "Contesting climate justice in the city: Examining politics and practice in urban climate change experiments", *Global Environmental Change*, vol. 25, pp. 31-40;
- Caprotti, F., Cowley, R., Flynn, A., Joss, S., & Yu, L. (2016) *Smart-Eco Cities in the UK: Trends and City Profiles*. Exeter: University of Exeter (SMART-ECO Project).
- Caragliu, A., Del Bo, C. & Nijkamp, P. (2011) "Smart Cities in Europe", *Journal of Urban Technology*, vol. 18, no. 2, pp. 65-82.

- Compact of Mayors (2014) [available online]  
<https://www.compactofmayors.org/history/> [last accessed 04/07/2017]
- Cowley, R., Joss, S. & Dayot, Y. (2017), "The smart city and its publics: insights from across six UK cities", *Urban research & practice*, pp. 1-25;
- de Jong, M., Joss, S., Schraven, D., Zhan, C. & Weijnen, M. (2015) Sustainable-smart-resilient-low carbon-eco-knowledge cities; making sense of a multitude of concepts promoting sustainable urbanization. *Journal of Cleaner Production*, vol. 109, pp. 25-38
- Department for Business, Energy & Industrial Strategy (2017) Fuel Poverty Statistics [available online] <https://www.gov.uk/government/collections/fuel-poverty-statistics> [last accessed 04/07/2017]
- Eden Strategy Institute (2018) Top 50 smart city governments [available online]  
[https://static1.squarespace.com/static/5b3c517fec4eb767ao4e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD\\_Top+50+Smart+City+Governments.pdf](https://static1.squarespace.com/static/5b3c517fec4eb767ao4e73ff/t/5b513c57aa4a99f62d168e60/1532050650562/Eden-OXD_Top+50+Smart+City+Governments.pdf)  
[last accessed 14/03/2019]
- European Commission (2019) The Marketplace of the European Innovation Partnership on Smart Cities and Communities [available online] <https://eu-smartcities.eu/> [last accessed: 14/03/2019]
- Finger, M., Razaghi, M. (2016) "Conceptualizing "Smart Cities", *Informatik-Spektrum*, vol. 40, no. 1, pp. 6-13;
- Fuchs, C. (2017) "Critical Social Theory and Sustainable Development: The Role of Class, Capitalism and Domination in a Dialectical Analysis of Un/Sustainability", *Sustainable development*,
- HM Government (2008) *Climate Change Act* [online].  
<http://www.legislation.gov.uk/ukpga/2008/27/contents> [last accessed 04/07/2017]
- House, E.R. & Howe, K.R. (1999) *Values in evaluation and social research*, Sage, London.

- Huawei (2017) UK Smart Cities Index [available online]  
[https://e.huawei.com/uk/special\\_topic/solution/smart\\_cities\\_index\\_2017](https://e.huawei.com/uk/special_topic/solution/smart_cities_index_2017) [last accessed: 14/03/2019]
- ISESE (2018) Cities in Motion Index [available online]  
<http://citiesinmotion.iese.edu/indicecim/?lang=en> [last accessed 14/03/2019]
- Kaijser, A. & Kronsell, A. (2014) "Climate change through the lens of intersectionality", *Environmental politics*, vol. 23, no. 3, pp. 417-433;
- Michalec, A.; Hayes, E.; Longhurst, J. and Tudgey, D. (2019) Enhancing the communication potential of smart metering for energy and water, *Utilities Policy*, 56, pp. 33-40, [available online] <https://doi.org/10.1016/j.jup.2018.11.002> [last accessed 14/03/2019]
- Preston, I., Banks, N., Hargreaves, K., Kazmierczak, A., Lucas, K., Mayne, R., Downing, C. and Street, R. (2014) Climate change and social justice: an evidence review. John Rowntree Foundation: York
- Rist, G. (2013) Development as a Buzzword Development. *Development in Practice*. vol. 17, pp. 485–491.
- Saunders, T., Baeck, P. (2015) *Rethinking smart cities from the ground up*. Nesta: London
- Schwarz, A. (2011) Minorities are being left out of electric vehicle revolution. Fast Company. [available online] <https://www.fastcompany.com/1769539/minorities-are-being-left-out-electric-vehicle-revolution> [last accessed 04/07/2017]
- Shelton, T., Shelton, T., Zook, M. & Wiig, A. (2015), "The 'actually existing smart city'", *Cambridge journal of regions, economy and society*, vol. 8, no. 1, pp. 13-25;
- Shi, L., Chu, E., Anguelovski, I. & Aylett, A. (2016) "Roadmap towards justice in urban climate adaptation research", *Nature climate change*, vol. 6, pp. 131-137;
- Smith, C. F. (2010) *Writing Public Policy*. Oxford University Press: Oxford
- Steele, W., Mata, L. & Fünfgeld, H. (2015) "Urban climate justice: creating sustainable pathways for humans and other species", *Current opinion in environmental sustainability*, vol. 14, pp. 121-126;

- United Nations (2015) *Transforming our world: the 2030 Agenda for Sustainable Development*. Report [online]  
<https://sustainabledevelopment.un.org/post2015/transformingourworld> [last accessed 04/07/2017]
- United Nations Framework Convention on Climate Change (2015) *The Paris Agreement* [online]  
[http://unfccc.int/files/essential\\_background/convention/application/pdf/english\\_paris\\_agreement.pdf](http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf) [last accessed 04/07/2017]
- Ware, M. (2013) Electric cars - the ultimate subsidy for the rich. *The Spectator* [available online] <https://www.spectator.co.uk/2013/09/electric-daydreams/> [last available 04/07/2017]
- West of England (2016) GoUltraLowWest: The West of England Go Ultra Low Cities Bid [available online]  
[https://democracy.bristol.gov.uk/Data/Cabinet/201604051800/Agenda/0405\\_5.pdf](https://democracy.bristol.gov.uk/Data/Cabinet/201604051800/Agenda/0405_5.pdf) [last accessed 04/07/2017]
- Wodak, R. & Meyer, M. (2009) *Methods of critical discourse analysis*, 2nd edn, SAGE, London
- Woods, E., Alexander, D. Rodriguez Labastida, R., Watson, R. (2016) *UK Smart Cities Index: Assessment of Strategy and Execution of the UK's Leading Smart Cities*. Commissioned by Huawei. Navigant Consulting, Inc: Boulder
- World Economic Forum (2019) [WEF, 2019](#)
- Yanow, D. (2000) *Conducting interpretive policy analysis*, Sage, Thousand Oaks, Calif; London.