Facilitating the Transition Towards Circular Economy Business Models in an Energy Park

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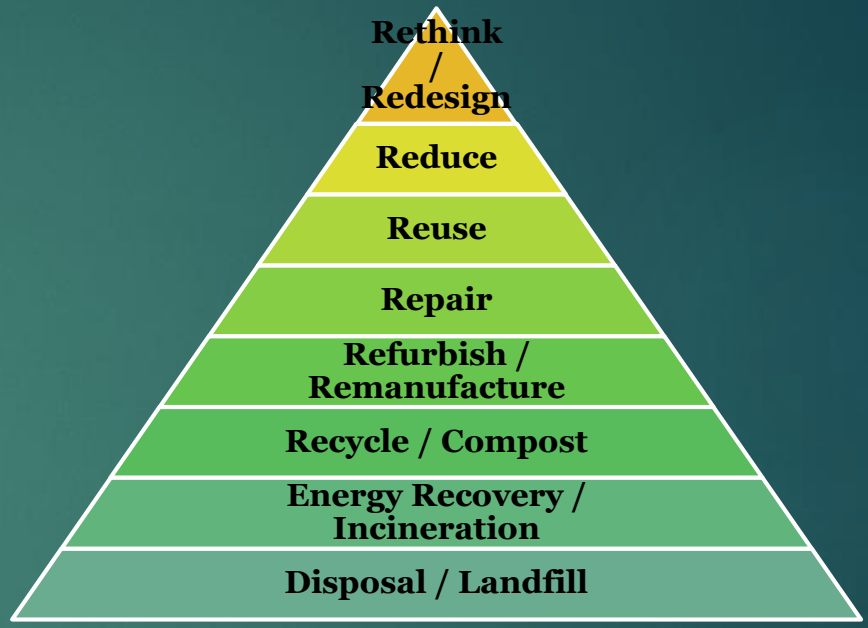
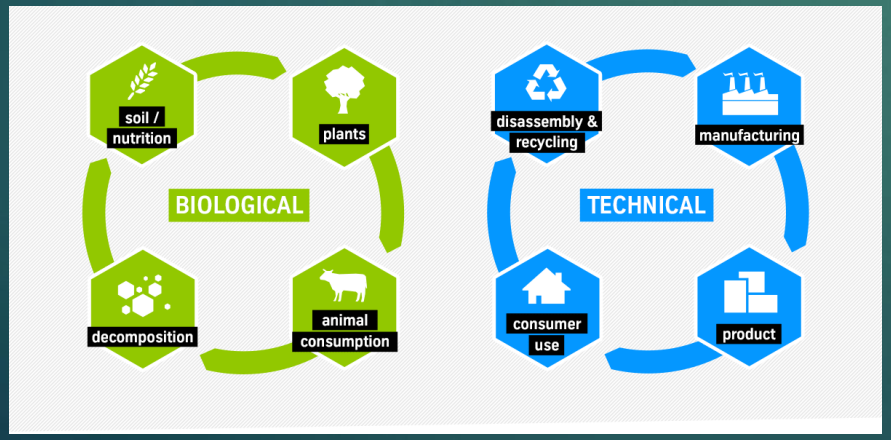
Circular Economy Principles

- Waste is food
- Diversity is strength
- Energy must come from renewable sources
- Prices must tell the truth
- Systems thinking



- **Cradle-to-Cradle (C2C)**

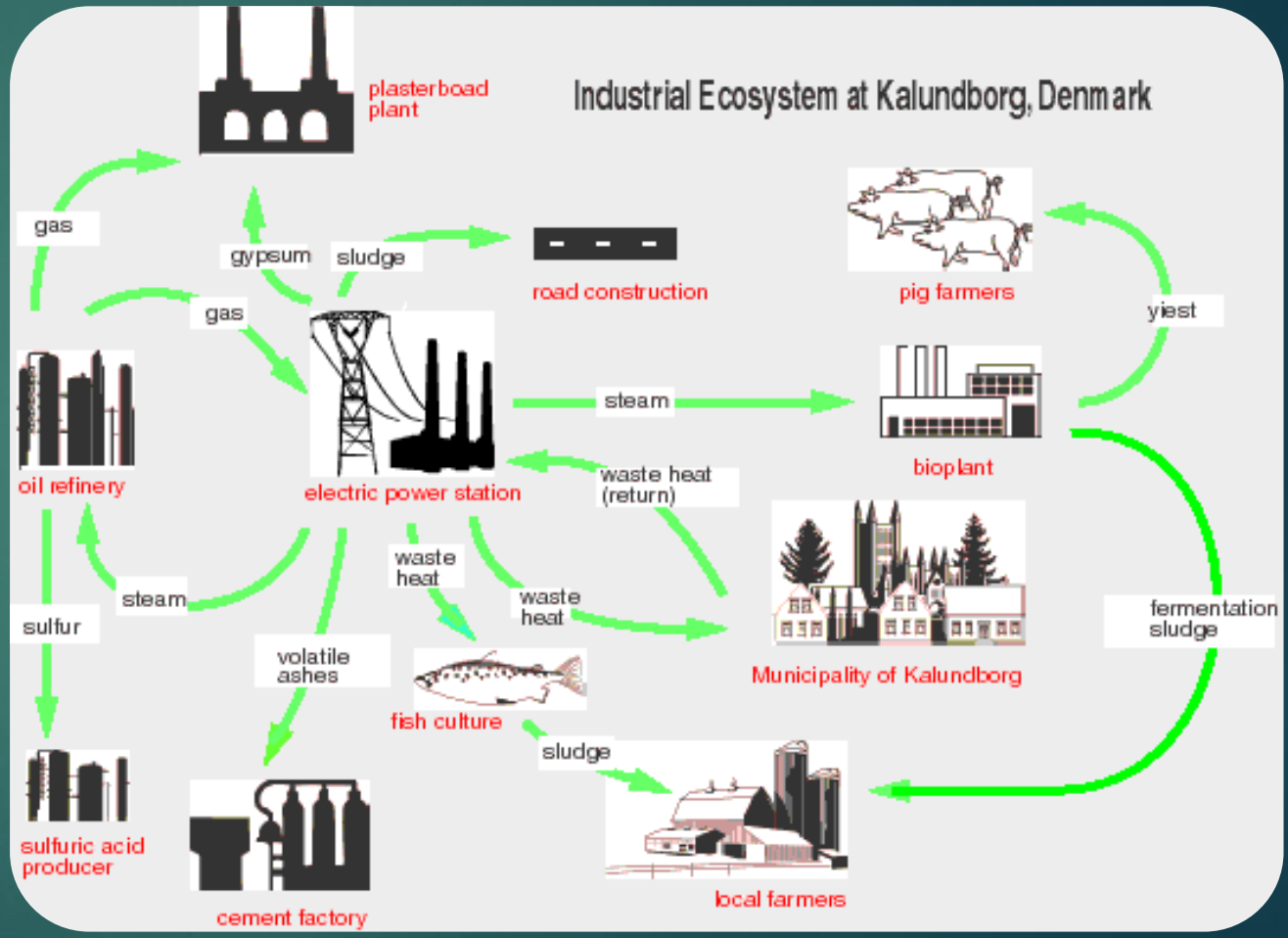


- **Product-Service Systems (PSS)**

Circular Economy Principles

Industrial Symbiosis

- Take advantage of multiple industries interactions
  - Waste = secondary source of resources
- Synergies in production processes
- Industrial Cluster ≠ Eco-industrial Park
  - Geographical proximity
  - Waste flows
  - Resources sharing and exchange
  - Shared information networks
  - Promote innovation



Definition

- Circular Economy is a **set of principles and tools** which aim to contribute to the planet's **sustainability** by **minimising** the extraction and degradation of materials, promoting resource and energy **conservation** (**reduce**, **reuse**, **recover** and **recycle**) and driving the **regeneration** of its sources.
- It fosters the ease to **repair** and **upgrade** products through I&D and systems thinking. It embraces **waste** as a main resource allowing its **reintroduction** into the consumption system. Finally, the Circular Economy is **inclusive** with the environment, society, governments, companies and academia, and boosts the development of resilient **business models** in which **various forms of value** are captured.

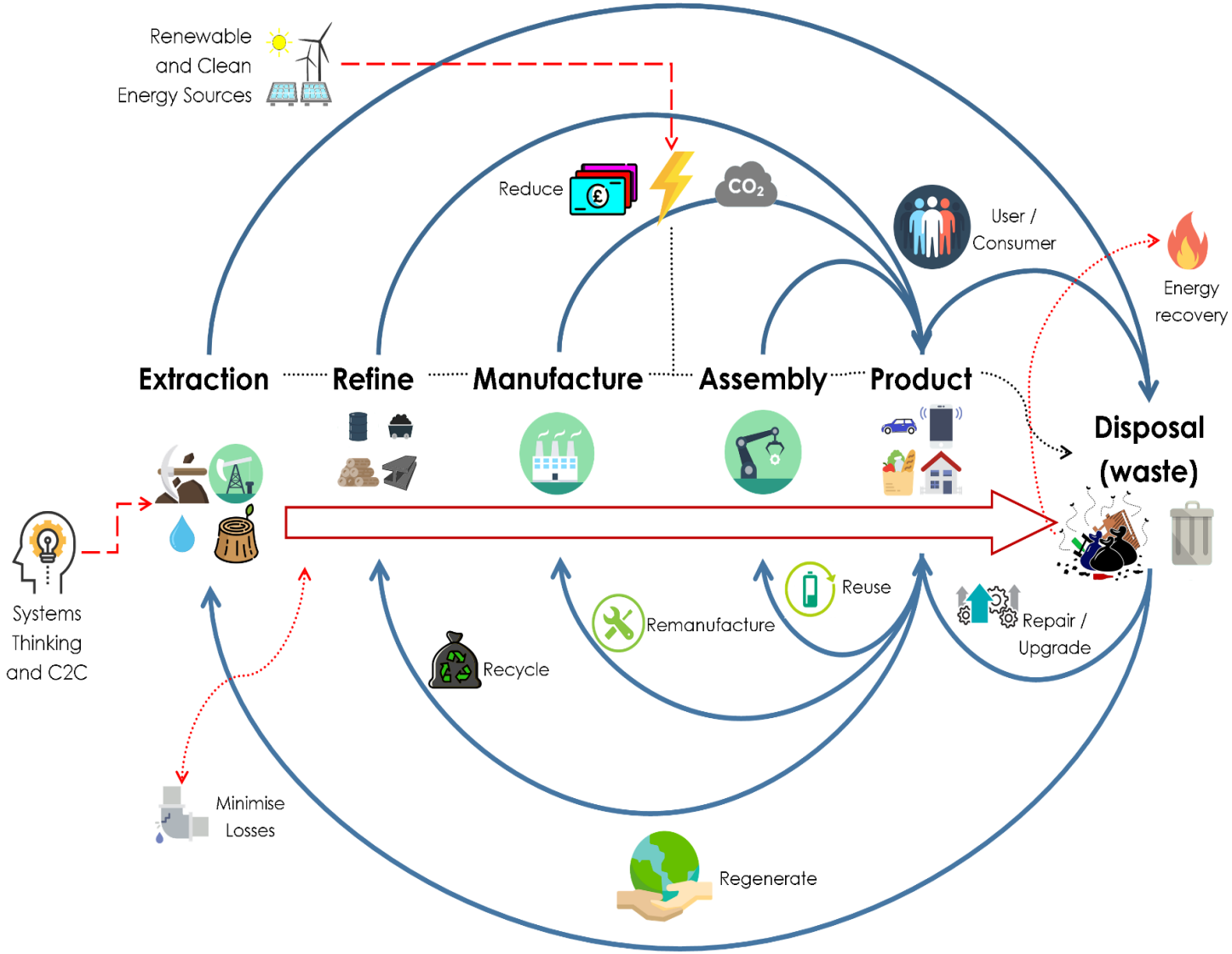
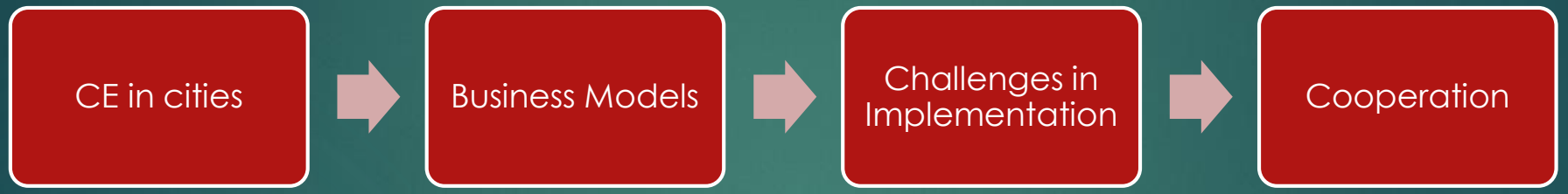


Image source (Palafox et al., 2017).

“Gap in Knowledge”



- Although several studies aim to facilitate CE implementation in business models (e.g. Bocken et al., 2016, Witjes and Lozano, 2016, Rizos et al., 2016), collaboration is not studied as a key element for successful adoption of CE principles.

AIM:

Facilitate transition towards a Circular Economy through an optimal equilibrium in the value capture process, thus, deliver better and informed decisions implementing circularity in business models.

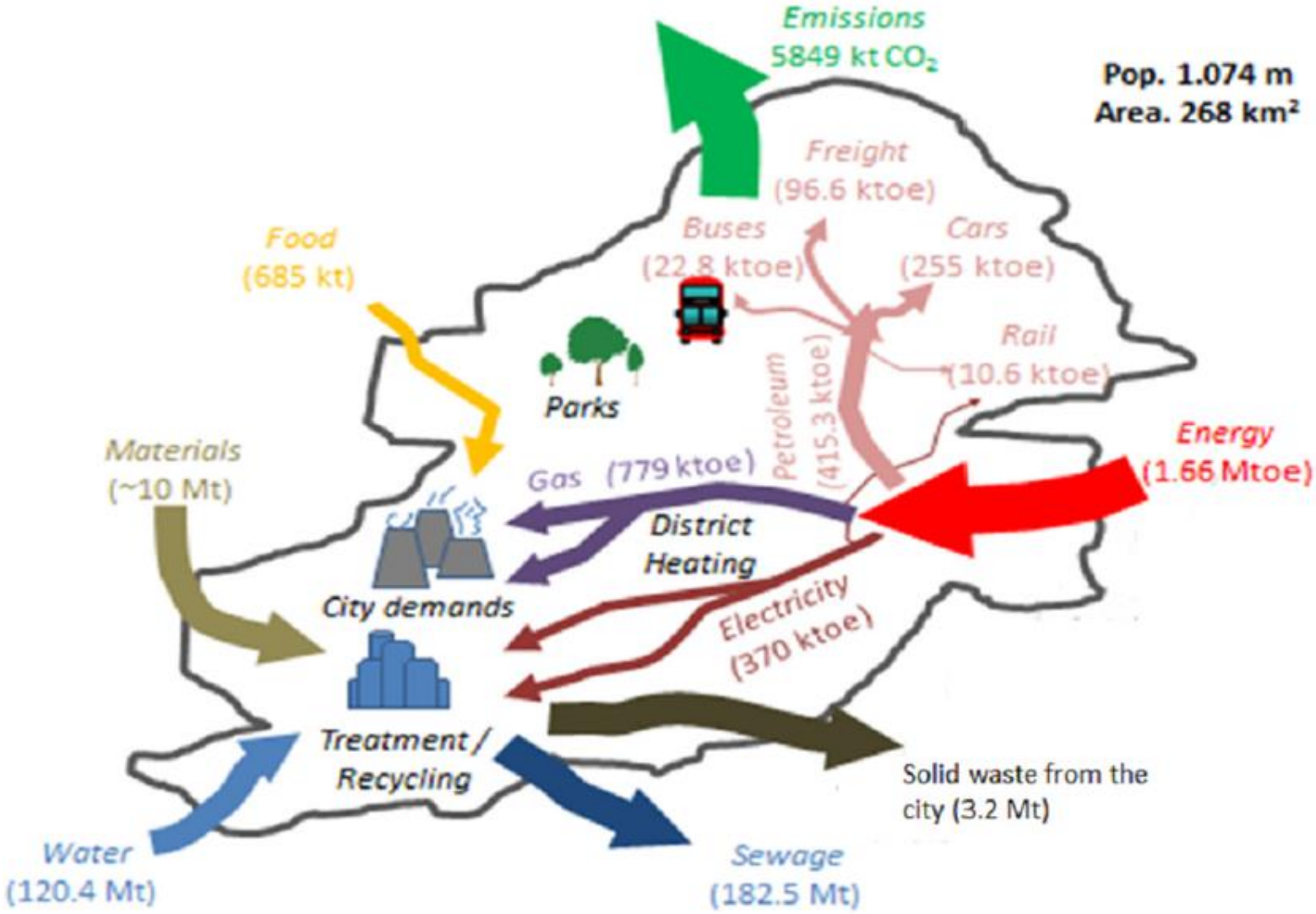
OBJECTIVES:

- Identify the forms in which Urban Metabolism can contribute to the design of Circular Economy urban areas.
- Understand how different stakeholder groups value the benefits of a circular business model.
- Deliver routes for optimal and stable decisions to the interactions of stakeholders derived from a negotiation position.

Urban Metabolism as framework for "Circular Cities" design

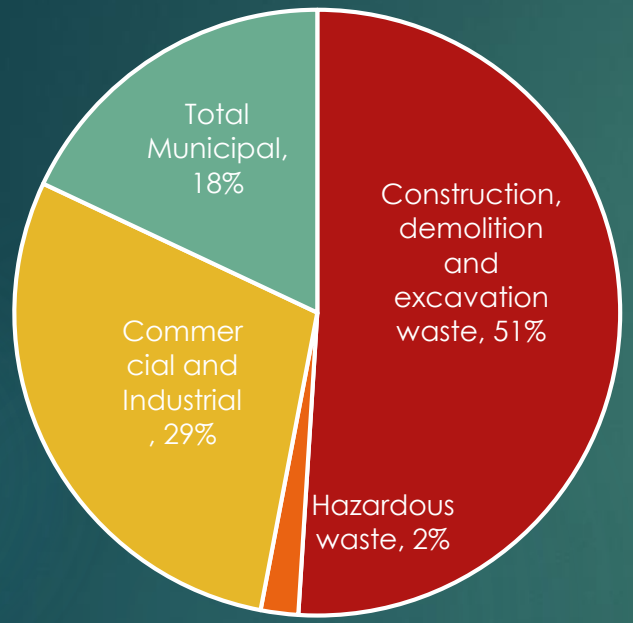
- **Urban Metabolism (UM):**
- identifies, quantifies and analyses the flows (in, within and out) of resources (water, materials, food, energy, etc.) and the waste (rubbish, wastewater, atmospheric emissions, etc.) in urban areas.
  - 'Emergy' - units (Joules, solar energy)
  - Mass-Energy Flows - (tonnes)
    - Life Cycle Assessment (LCA)
    - Material Flow Analysis (MFA)

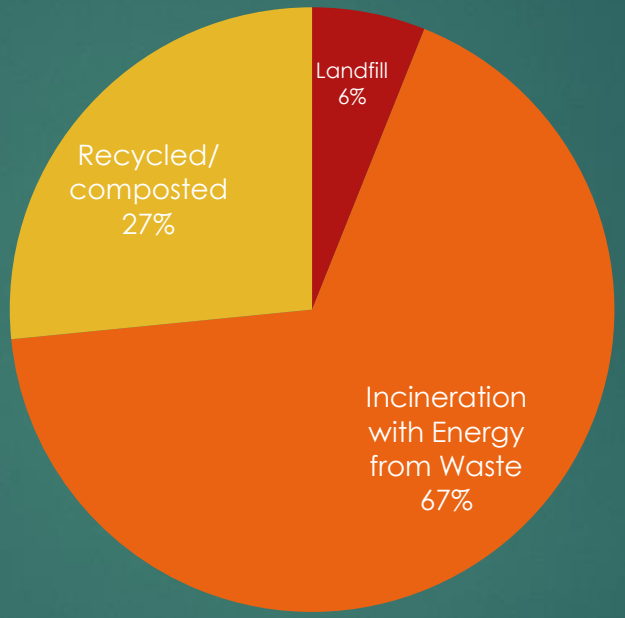
Birmingham Urban Metabolism Analysis (2012/2013a)

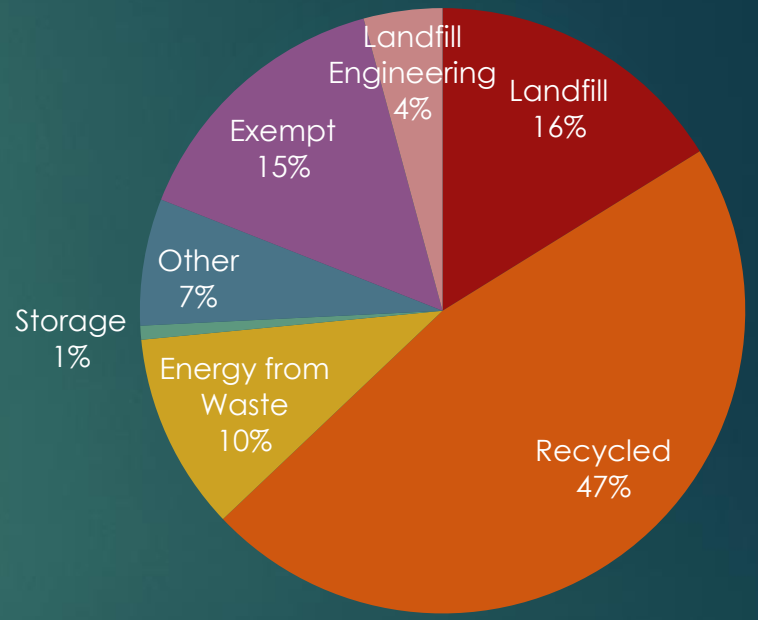


Resource flows for Birmingham 2012/2013a. Image source (Lee et al., 2016a).

Birmingham waste analysis







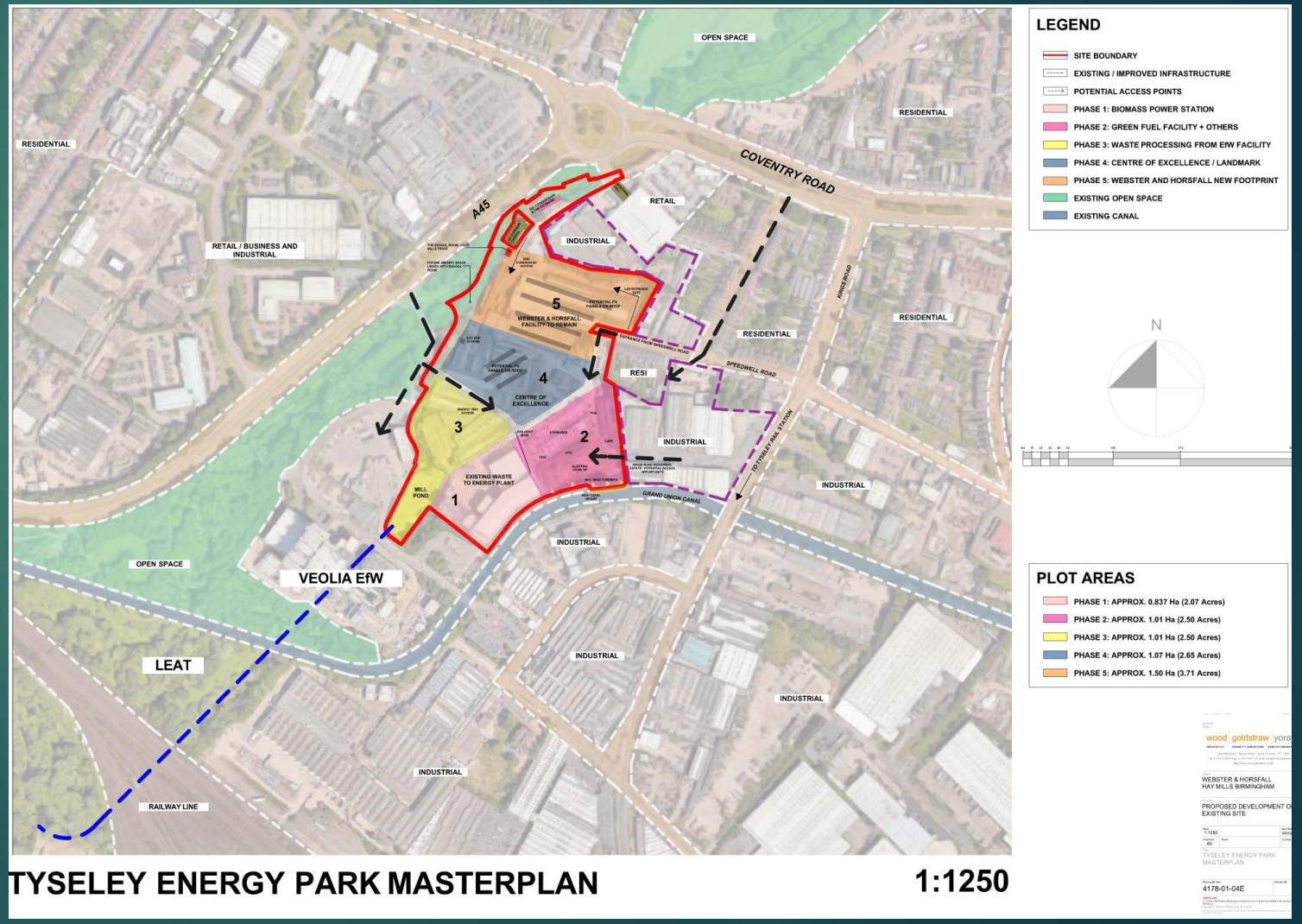
a) Types of waste for Birmingham; b) Municipal waste treatment (2013/14) for Birmingham; c) All types of waste treatment for Birmingham (data from Lee et al. (2016b); amounts in percentage per weight)

Case Study: Tyseley Energy Park (TEP)

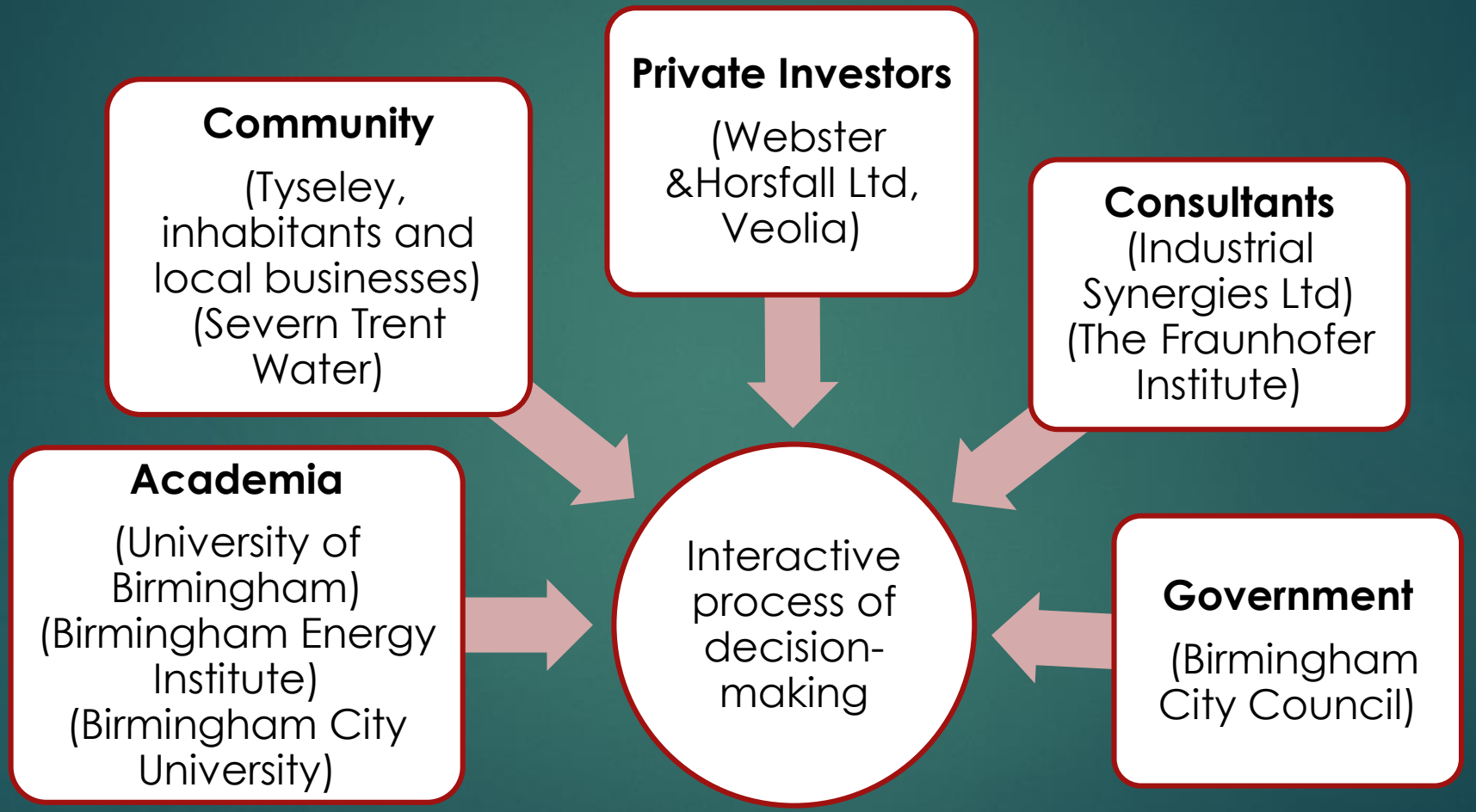
→ **Tyseley Environmental Enterprise District**

- Site owned by W&H Ltd
- Tyseley Incineration Plant
- Material separation plant

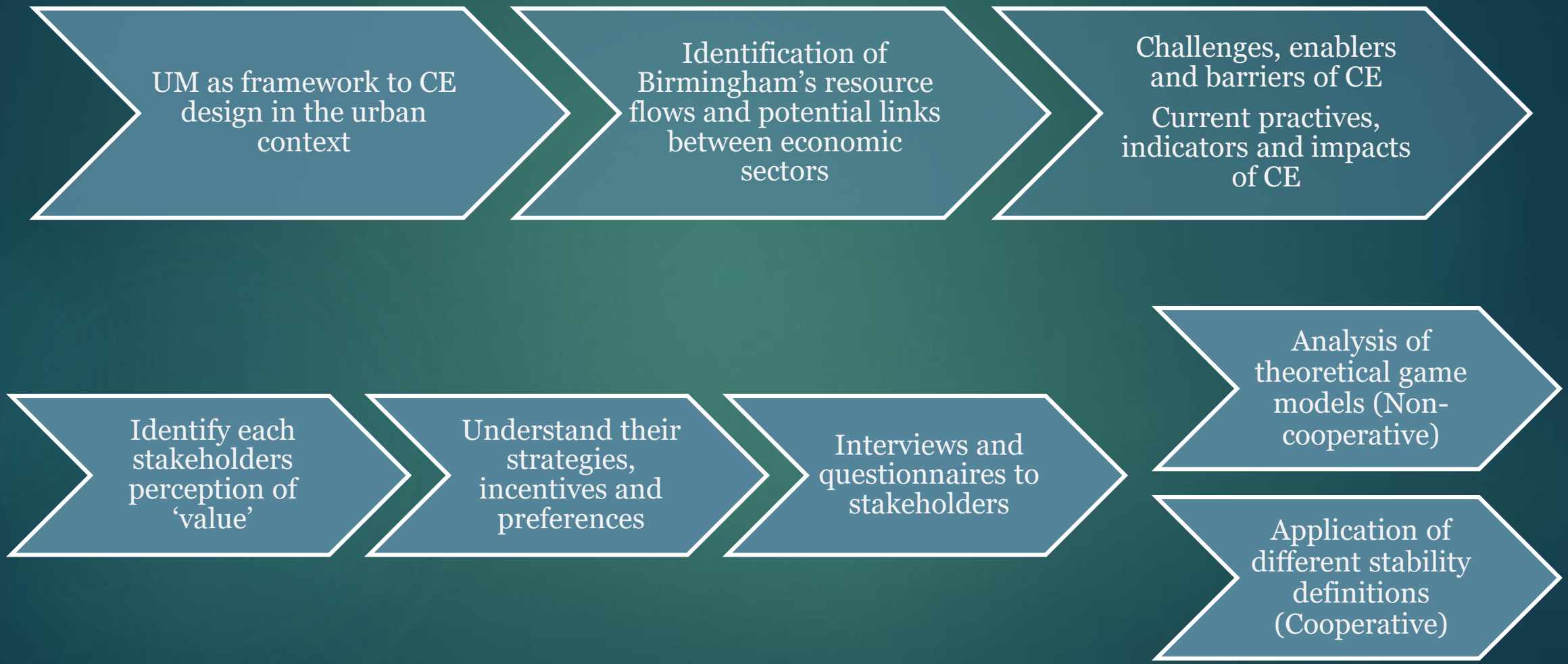
- Different energy technologies:
  - 'Liquid air" cryogenic network
  - Natural gas network
  - Hidrogen network
  - Urban heating network
  - Smart Micro grid
    - Energy generated in situ (solar, wind and biogas)
- EfW vs recycling



Stakeholders in TEP



Methodology

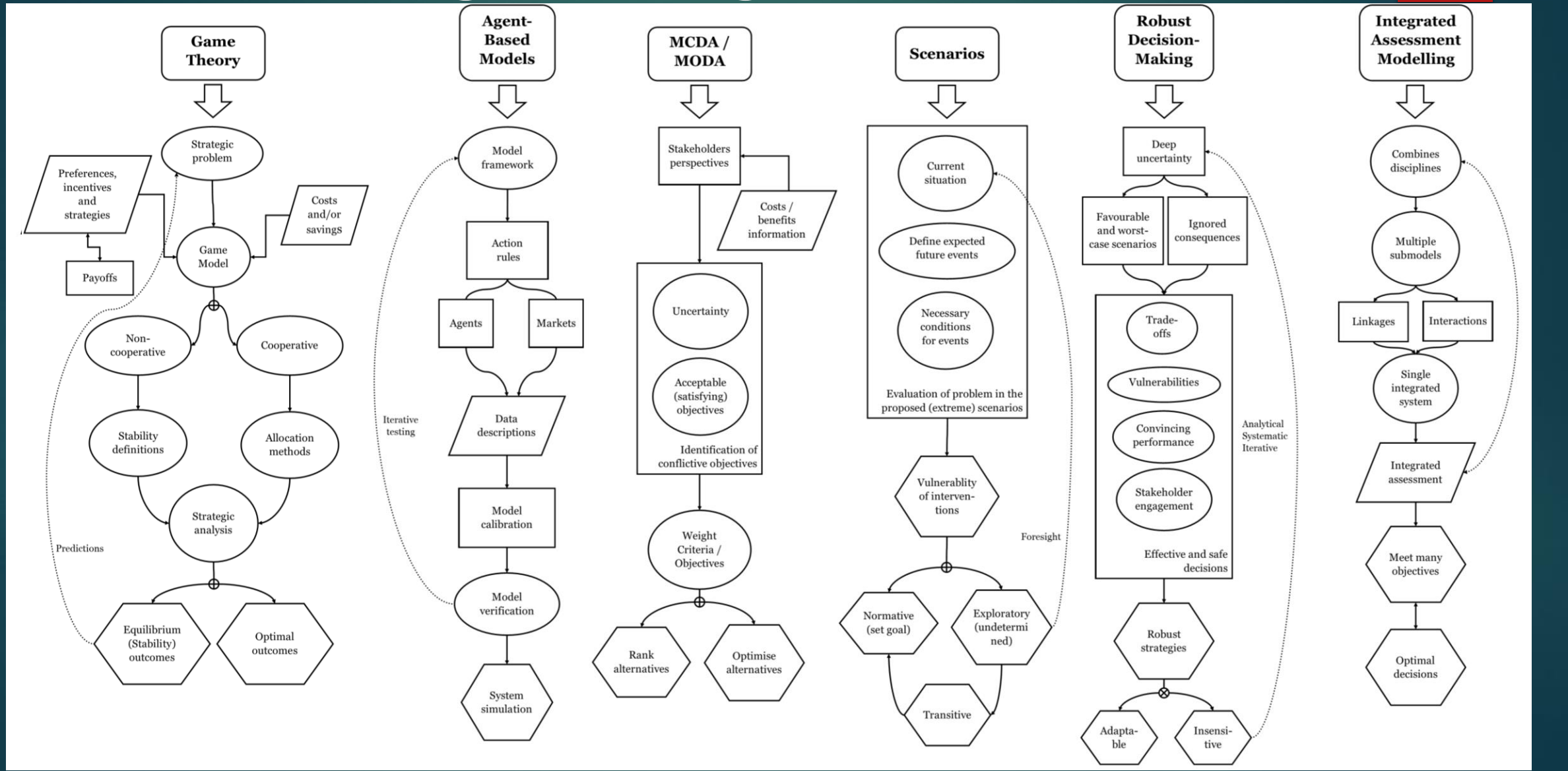


Methodological Argument

Characteristic	Methodology					
	Game Theory	Agent-Based Models	MCDA / MODA	Scenarios	Robust Decision-Making	Integrated Assessment Modelling
Foresight	✓			✓	✓[6]	
Optimisation	✓	✓	✓	✓[5]		✓[7]
Conflictive objectives	✓		✓[3]		✓	
Decision making	✓	✓	✓	✓	✓	✓
Stakeholders' interactions	✓	✓[2]				✓[1]
Uncertainty	✓	✓	✓	✓	✓	✓
Strategic behaviour	✓[1]					
Cooperation	✓	✓				
Rank alternatives			✓[4]			

1 (Madani et al., 2015); 2 (Zechman, 2011); 3 (Santos et al., 2017); 4 (Ali et al., 2017; Hadian and Madani, 2015; Zhao et al., 2017); 5 (Geng et al., 2010); 6 (Matrosov et al., 2013); 7 (Tol, 1997)

Methodological Argument



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Thank you!

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