Shaping a Sustainable Industry

Guidance for Best Practices & Policy Recommendations

Final report

Written by Erwin CORNELIS
Jan – 2020

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Shaping a Sustainable Industry

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Energy Efficiency
& Renewables
Round Tables

SHAPING A SUSTAINABLE INDUSTRY

GUIDANCE FOR BEST PRACTICES & POLICY RECOMMENDATIONS

BUILDING ON CONCLUSIONS OF FOUR ROUND TABLE MEETINGS WITH THE FOOD & BEVERAGE SECTOR

EXECUTIVE SUMMARY

Much like the ten previous warmest summers on record, the debate on how to decarbonise the European society is more heated than ever. In 2018, the European Commission adopted its Long Term Strategy by 2050 and is looking to involve all stakeholders, including the industry.

The European Commission has initiated a series of round tables over the course of 2018-2019 for the representatives of the industry (as announced in its Strategy on Heating and Cooling (COM(2016) 51 final)) to discuss the barriers for the sector in terms of policy, finance, behavioural aspects, and others along with solutions that are needed at the local, national or EU level. This interactive exchange served to capture the diversity and common ideas for an affordable energy future.

The **food and beverage sector** was chosen due to its diversity in size and composition and relevance for all EU Member States. Yet, the insights generated can be used to characterise the industry as a whole.

The key points from these meetings are also confirmed by studies that identify **barriers for investments in energy efficiency and renewable energy:**

- Insufficient access to **reliable information** on technical solutions and their costs;
- Lack of **awareness** of the potential for energy intensity reduction or use of renewables;
- **Behavioural** aspects such as having other priorities reducing the company's interest in energy efficiency and renewable energy;
- **Organisational** aspects of which the lack of time to investigate the potential and diverging interests within the company;
- Insufficient access to **competence** (inside or from outside the company) to investigate the potential or to support project implementation;
- **Lack of technologies** that would be commercially available or adapted for the company;
- **Economic barriers**, of which the low availability of capital and low return on investment are the major ones;

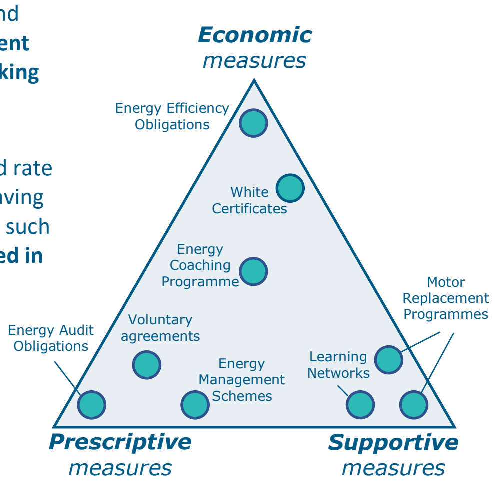
Some barriers are specific for renewable energy investments:

- **Regulatory barriers**, such as the related to the fiscal environment, reducing the appetite for renewable electricity investments;
- **Social barriers**: low social acceptance by local stakeholders for some renewable technologies in general or for specific projects.

Some **best practices of companies** who have overcome barriers were presented at the round table meetings. It became apparent that **companies focus on sustainability in general**; energy efficiency and renewable energy are in fact only two of various pillars in their decarbonisation strategy. These testimonials also confirmed that **companies with different characteristics face different barriers**.

To address barriers to action towards sustainability, various measures are available within the EU at different competence levels. In total 119 policies and measures, reported by the EU Member States in their National Energy Efficiency Action Plans for 2017, were identified and mapped according to type (**prescriptive, supportive and economic**) and the barriers they address. This policy mapping presents an useful tool for **assessing** gaps in existing policy framework **and** for **planning** new **policies**.

An analysis of **some exemplary policies and measures** from different categories resulted in some key lessons learnt:



- Various barriers, drivers and actors play a role **at different stages of the decision-making process**.
- No correlation was found between payback time and rate of implementing energy saving measures, confirming that such **investments are considered in a wider context**.
- **Energy Efficiency Obligation Schemes (EEOSs) are an effective tool** to overcome awareness, information and economic barriers for industry.
- The **commitment of the top management to sustainability**, including decarbonisation, **is a key driver** to overcome behavioural and organisational barriers
- The supply of **technical support improves the uptake** of energy efficient equipment by companies
- Best practice examples implemented at local level, underline the **need for coordination at various administrative levels**.

As a company that relies on natural resources to make our products we know that if we want to be brewing for the next 100+ years, what is bad for the climate is also bad for business.

Richard White – Vice President Procurement & Sustainability Europe, AB In Bev

From this analysis, the conclusion was drawn that a holistic approach, integrating all pillars of the decarbonisation strategies of companies, needs to be considered by policy makers when designing policies and that there is a need for a nuanced set of policy instruments to address various barriers.

Based on the input from the round table meetings and the analysis of barriers, drivers and best practice policies, recommendations for EU-level policy interventions are made to realise the strategic long-term decarbonisation vision by 2050.

Field of action	Recommended action	Prescriptive	Supportive	Economic
Working with companies	Assessment of the effectiveness of the IPPC-Directive on the requirements on an efficient use of energy	●		
	Standardisation of Corporate Climate Responsibility strategies	●	●	
	Establishment of technical knowledge centres to support companies		●	
Working with products	Revision of the regulation on industrial product groups under the Ecodesign and energy labelling framework	●		
	Regulation of the embedded carbon of products	●		
Working with EU Member States	Pan-EU study on best-practice policies stimulating energy efficiency and renewable energy		●	
	Creating a market for waste heat from industry	●	●	
Economic stimuli	Carbon credits for supplied waste heat			●

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1. Introduction

1.1. Introduction to the project

The project wants to foster the uptake of energy efficiency measures and renewable energy investments in the industry. To this end, a series of four roundtables discussing the opportunities and barriers are organised. Next to the roundtables, benchmarks and guidelines on best practices for the industry are produced.

The project targets five energy-intensive sectors. It takes a soft start, however, and includes hence roundtables with one sector as a trial prior to continuing the approach to other industrial sectors.

The food and beverage sector is selected at the start of the project as one of these five energy-intensive sectors. At the end of the project, the approach of roundtables is evaluated to see whether and how it can be copied to the other four sectors. It was concluded that this series of round tables meetings has generated insights that are general for the industry as a whole and no more additional insights are expected from additional round table meetings with other energy-intensive sectors.

The project is, in line with these objectives, structured in four tasks, see Figure 1.

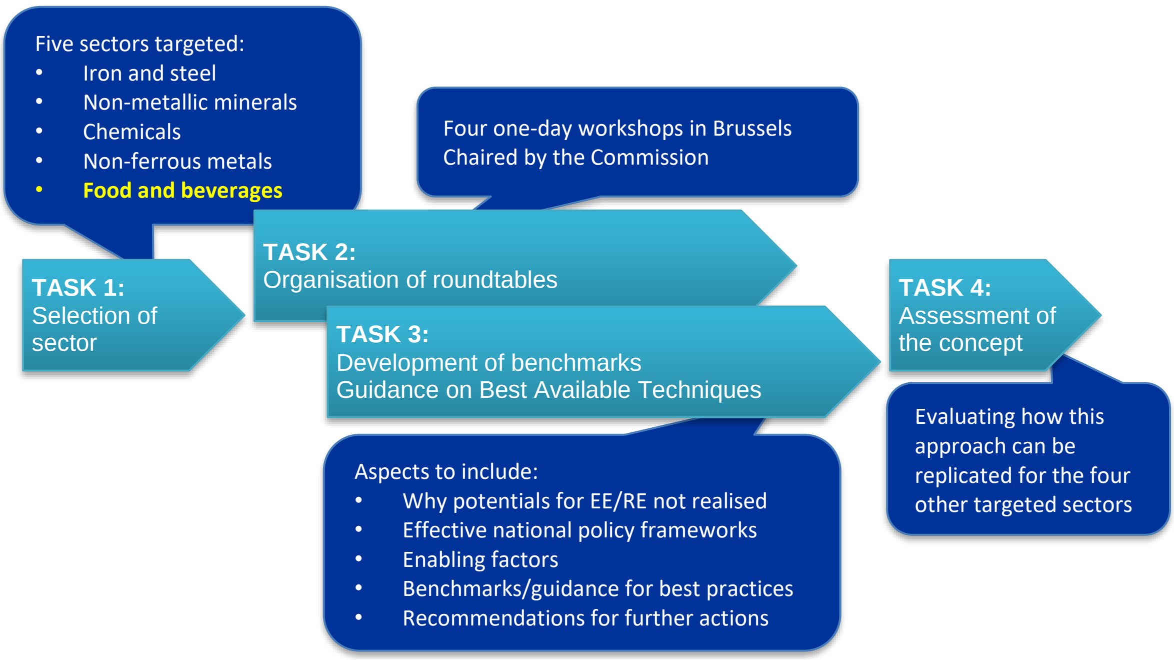

Figure 1: Different tasks of this series of round tables with the industry

1.2. Aim and structure of this document

This document is the final deliverable of this project. Its main aim is to discuss policies and programmes fostering investments in energy efficiency and renewable energy by companies of the food and beverage sector, as outcome of Task 3.

To this end, an overview is given of the barriers faced by enterprises in taking energy efficiency and renewable energy investments. This includes a discussion on how these barriers vary in function of the size of the enterprises.

Subsequently, an overview of policies implemented at different administrative levels is given and their impact on the barriers, faced enterprises in taking energy efficiency and renewable energy investments, is discussed.

Then, an overview of the policies and measures currently implemented in the EU is given and their effectiveness and cost-efficiency is discussed. Also, best practice policy and measures are illustrated.

Finally, the role of the EU to catalyse national and / or regional programmes and policies is discussed.

However, before discussing policies and measures in the next chapters, this introductory chapter continues with motivating why the food and beverage sector has been selected for this first series of round tables (outcome of Task 1), what the conclusions are of these round tables (outcome of Task 2) and which lessons can be learnt on round tables meetings as approach to engage with stakeholders (outcome of Task 4).

1.3. Task 1: Selection of sector to initiate round tables with

This project ended up focussing on one of the following five energy-intensive sectors to organise round table meetings:

- Iron and steel
- Non-metallic minerals
- Chemicals
- Non-ferrous metals
- Food and beverages

Factsheets were produced for each of these five energy-intensive sectors using different indicators on energy and socio-economic characteristics, see Table 1.

Based on this analysis, it was decided to continue with the food and beverage sector:

- In view of its significance both for the heating and cooling demand;
- In view of the sector's diversity in activities;
- In view of the significant share of SMEs, which are usually less targeted by energy efficiency policies than large, energy-intensive companies and hence has previously been less prominent in the energy efficiency debate.

The factsheet of the food and beverage sector is included as Appendix 1 to this report.

Indicators[1, 2]	**Iron and steel**	**Non-metallic minerals**	**(Petro-) chemicals and pharma**	**Non-ferrous metals**	**Food and beverages**
			Energy		
Share in industrial heating demand	***23%***	15%	***18%***	*2%*	10%
Share in industrial cooling demand	*0%*	*3%*	***33%***	*0%*	***49%***
Improvement in energy intensity [3]	-15%	-6%	***-27%***	*+13%*	-14%
Share of sustainable heat in final heating demand	*1%*	6%	***22%***	12%	12%
Of which from renewable sources	0%	***5%***	0%	0%	***5%***
Excess heat potential	2,5-12%	1,7-21%	***16-24,3%***	11,2-15%	***8,6-51%***
			BREFs		
Number of available BREF documents	1	3	10	1	2
			Structure of the sector		
Average number of employees per enterprise	56	***13***	53	60	***15***
Geographical distribution of the sector within the EU [4]	Less	***Most***	***Well***	Least	***Well***
			Structure of the federations		
Number of EU federations	1	4	3	1 / 6	4

Table 1: Summary table of the indicators on the five targeted energy-intensive sectors

1.4. Task 2: Conclusions of the round table meetings

Four round table meetings with the food and beverage sectors were organised in the framework of this project. Table 2 presents an overview of the schedule of these four meetings and of their focus.

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1 Maxima are indicated in green – bold – italic; minima in reed - italic

2 Based on data from: Eurostat; Joint Research Centre; Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables) (2016); Cronholm et al. (2009) Waste heat from industry and buildings. Svenska Fjärrvärme AB. Rapport 2009:12; Berthou M, Bory D (2012) Overview of waste heat in the industry in France. eceee 2012 Summer Study

3 The lower the "improvement in energy intensity", the less energy the sector has consumed for the same production and the more energy efficient is has become

4 Based on the ratio between standard deviation and average share of number of enterprises in the EU. Most: the lowest ratio and hence the best distributed – Least: the highest ratio and hence the most concentrated in some EU Member States

The conclusions of these four round table meetings are added as an appendix to this report.

	Date	Place	Focus – Objectives
1	22 October 2018	Brussels	Barriers to and solution for energy efficiency and renewable energy in the food and beverage sector • Introduction to this project • Presentation of the experience of company with a best practice • Presentation of some innovative approaches, tested in H2020 projects, to stimulate energy efficiency / renewable projects in the food and beverage sector • Discuss barriers to investments in energy efficiency and renewable energy investments
2	30 January 2019	Brussels	Key success factors of best performing policies and programmes • Discussion of policy options to overcome barriers to investments in energy efficiency and renewable energy investments • Policies stimulating such investments by SMEs were discussed in more detail
3	20 March 2019	Berlin	Decarbonisation strategies of corporate companies • Discussion of roadmaps for the food and beverage sector • Presentation of decarbonisation strategies of some large corporate companies
4	20 June 2019	Brussels	Shaping a sustainable industry: challenges and solutions • Presentation on how the elements of the previous round table meetings feed into the EU strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050 – A Clean Planet for all.

Table 2: Overview of the four round table meetings organised with the food and beverage sector

1.5. Task 4: Lessons learnt from this series of round table meetings

The purpose of this task was to reflect on this series of round table meetings with the food and beverage sector and to assess the applicability of this approach to foster energy efficiency and renewable energy in other (energy-intensive) sectors and to make recommendations on how eventually the approach needs to be adapted to increase its impact.

Quite soon in the course of this series of round table meetings, it was observed that their conclusions are general and applicable for the whole of the industry, although it targeted only one sector. Hence, it was concluded that a replication of such a series of round table meetings with the other targeted energy-intensive sectors, discussing the same topics, is less pertinent, as it will not lead to many additional insights on how to foster investments in energy efficiency and renewable energy in these sectors.

Some lessons could be learnt from the process to organise a series of round table meetings.

The main challenge encountered was to arrive at 50 participants, the anticipated number of participants. The actual number varied between 20 and 30 (apart from the fourth one, which had a more public character). Yet, European and national sector organisations were involved to increase the outreach to the target audience; one round table was organised back-to-back to an external event targeting the same audience and companies representatives were contacted directly to invite them to the meetings. However, these actions were not helpful in attracting more participants.

Nonetheless, it was observed that the actual number of participants (20 to 30) allowed a good interaction amongst the participants and stimulated a good debate at the round table meetings.

In addition, knowledge exchange in between participants was observed at the round table meetings. To illustrate; the testimony of a best practice example of a company at the third round table meeting, sourcing local biomass resources for making the heat supply renewable, inspired another participant to investigate the local biomass potential for some of his sites. At the fourth round table meeting, a vivid discussion on the benefits on waste heat valorisation between representatives of the copper industry and the brewing industry took place. The second round table meeting allowed public officers from different EU Member States, administering similar policy instruments, to compare the key catalysts of the discussed policies and programmes to mobilise companies towards energy efficiency and renewable energy investments.

The last round table meeting was organised in the framework of the European Sustainable Energy Week. Ending a series of round table meetings with a more public event allowed to reach out to a larger public and to disseminate the conclusions more broadly. Moreover, the use of attractive leaflets to present the agenda and the conclusions of the round table meetings (see also the Executive Summary) was found instrumental in increasing the visibility of this series of round table meetings.

To improve the impact of such series of round table meetings, one could opt for a regional approach instead of a sectoral approach. As already indicated, a sectoral approach is less pertinent as the discussed topics are quite often cross-cutting, as already indicated. A regional approach, on the contrary, offers the opportunity to discuss similar issues across sectors and can stimulate sector integration, as highlighted by the European Green Deal[5]: "The smart integration of renewables, energy efficiency and other sustainable solutions across sectors will help to achieve decarbonisation at the lowest possible cost." In addition, a regional approach can improve the participation of countries at a large distance from Brussels (such as the Baltics, the Balkan, Portugal, …).

[5] The European Green Deal. COM(2019) 640 final

2. Investments in energy efficiency and renewable energy: barriers and drivers

2.1. Barriers to energy efficiency investments

2.1.1. Overview of barriers: insights from scientific literature

Barriers to investments by industrial companies in energy efficiency and renewable energy has been widely studied in scientific literature. To illustrate, a literature review identified in total 35 studies on this topic, published between 2000 and 2015 and covering different sectors and countries from various continents.[6]

Researchers of the Polytechnical University of Milan, Italy, who are leading on this topic, developed a taxonomy clustering 27 identified barriers in 7 categories[7], see Table 3. The 7 categories are:

- Insufficient access to reliable information on technical solutions and their costs;
- Lack of awareness of the untapped potential;
- Behavioural aspects such as having other priorities reducing the company's interest in energy efficiency and renewable energy;
- Organisational aspects of which the lack of time to investigate the potential and divergent interests within the company are the most blocking barriers;
- Insufficient access to competence (inside or from outside the company) to investigate the potential or to support project implementation;
- Technologies that are not yet commercially available or not adapted for the company;
- Economic barriers, of which the low availability of capital and the low economic viability are the most blocking ones.

The researchers identified some causal relationships between the different barriers. Figure 2 indicates the main relationships. Strong relationships seem to exist between behavioural, organisational and competence-related barriers.

Categories	Barriers
Technology-related	Technologies not adequate Technologies not available
Information-related	Lack of information on costs and benefits Information not clear by technology providers Trustworthiness of the information source Information issues on energy contracts
Economic	Low capital availability Investment costs

6 Trianni A., Cagno E., Farné S. (2016) Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises. Applied Energy 162 (2016) 1537–1551

7 Cagno E., Worrell E., Trianni A., Pugliese G. (2013) A novel approach for barriers to industrial energy efficiency. Renewable and Sustainable Energy Reviews 19 (2013) 290–308

	External risks Intervention not sufficiently profitable Intervention-related risks Hidden costs
Behavioural	Other priorities Lack of sharing the objectives Lack of interest in energy-efficiency interventions Imperfect evaluation criteria Inertia
Organizational	Lack of time Divergent interests Lack of internal control Complex decision chain Low status of energy efficiency
Competence-related	Implementing the interventions Identifying the inefficiencies Identifying the opportunities Difficulty in gathering external skills
Awareness	Lack of awareness

Table 3: Barriers to industrial energy efficiency, clustered in 7 categories (Source: Cagno et al., 2013)

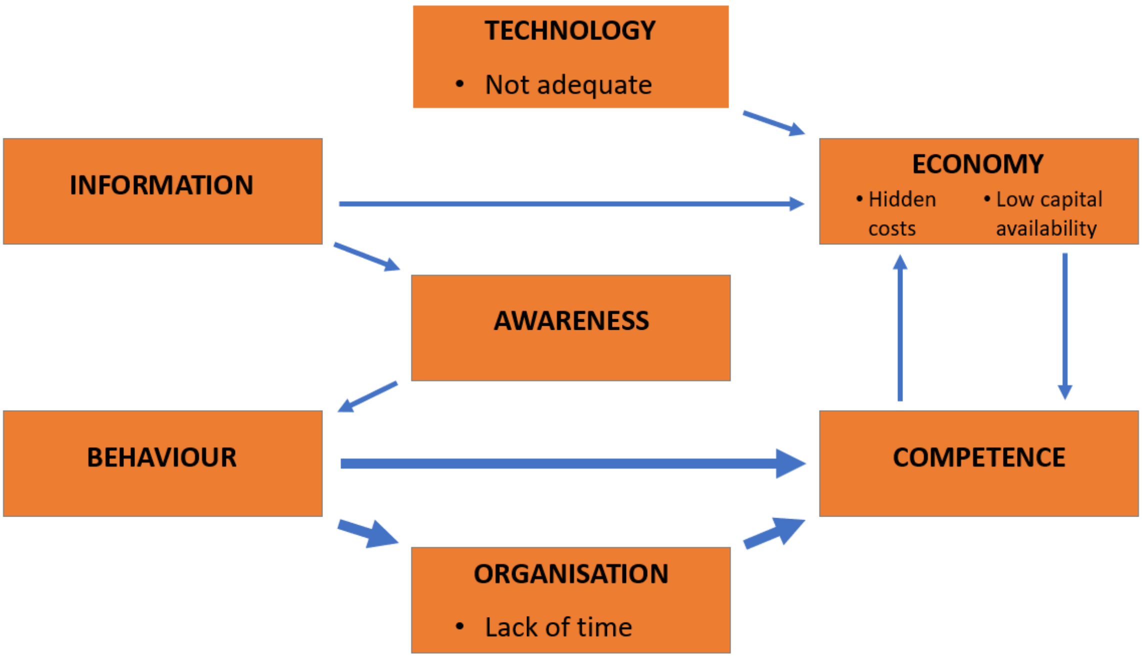

Figure 2: Overview of barriers hampering investments in energy efficiency and renewable energy in industry

2.1.2. Relation between barriers faced and size of company

The relation between prevalence of the barriers and company characteristics was studied for manufacturing companies in the Lombardy region, Italy; one of the most industrialised regions of Europe.

In a first study, semi-structured interviews with 15 metal processing companies of Lombardy were carried out.[8] Company representatives had to score the 27 identified barriers using a Likert-type scale, ranking from 1 (not important) to 4 (very important). The results are shown by Figure 3. A colour code is used to indicate the relation between barriers and company size (red: more at small companies / green: more at medium-sized companies / blue: no difference).

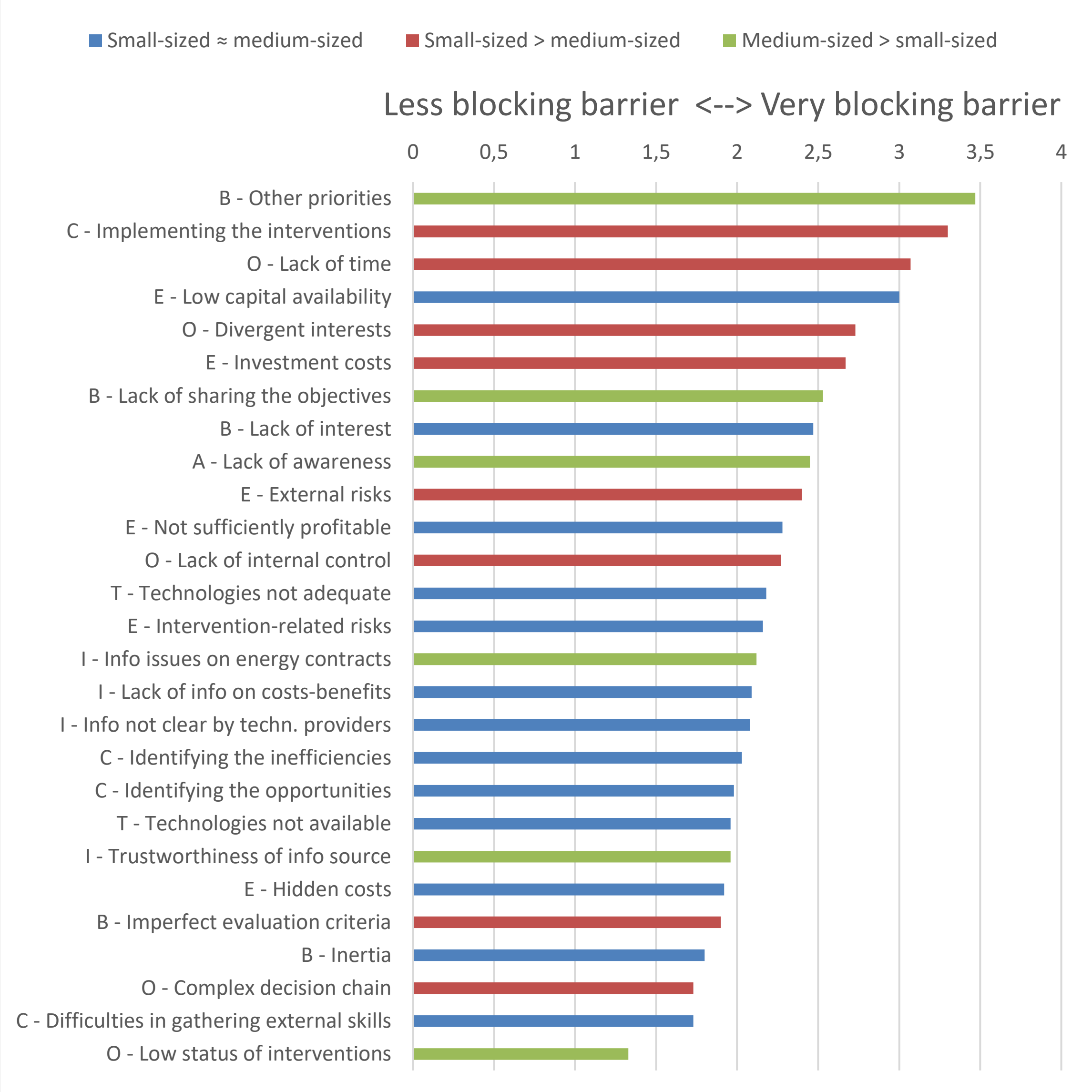

Figure 3: Rank of barrier - relation with company size (Source: Cagno and Trianni, 2014)

[8] Cagno E., Trianni A. (2014) Evaluating the barriers to specific industrial energy efficiency measures: an exploratory study in small and medium-sized enterprises. Journal of Cleaner Production 82 (2014) 70e83

These results indicated the small companies tend to view a larger number of barriers as important to them, relative to medium-sized companies. They also perceive different ones as most blocking; with on the top:

- Lack of competences to implement the interventions;
- Lack of time to investigate the energy efficiency options;
- Divergent interest within the companies.

On the other hand, following barriers are more prevalent at larger companies:

- Other priorities than energy efficiency investments
- Lack of sharing the objectives
- Lack of awareness

In addition, the study indicated that companies with a higher complexity of the production processes or which are more innovation oriented experience significantly less barriers than companies with a lower complexity or which are less innovative.[9]

In a second study, interviews were conducted with 222 manufacturing SMEs in the Lombardy region to collect scores on the same list of barriers using the same scale. Distinction was made between the size (small, medium-small and medium-large) and energy-intensity (low, high) of the companies, see Figure 4.[10]

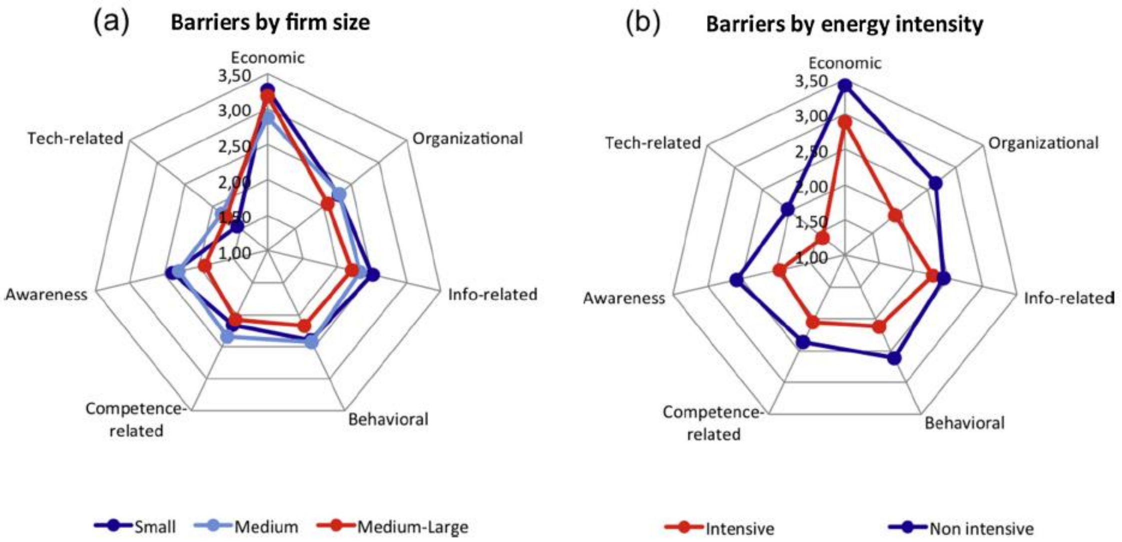

Figure 4: Barriers to energy efficiency by clusters of enterprises. (a) firm size; and (b) energy intensity (Source: Trianni et al., 2016)

9 There is one exception: the economic barrier 'external risks' is more prevailing at companies with a higher complexity or which are more innovative.

10 Trianni A., Cagno E., Farné S. (2016) Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises. Applied Energy 162 (2016) 1537–1551

These results confirm that smaller companies face more barriers than medium-sized ones. There is one exception: smaller companies perceive technology either as more adequate or available than medium- or medium-large ones. Smaller companies usually have a stronger relationship and trust with their technology suppliers – installers in particular – which can explain this difference in perception of barrier.

These results also indicate that non-energy intensive enterprises present higher values of barriers for all the categories compared with energy intensive ones. One can expect that energy intensive companies, in view of the significant share of energy costs in the overall operational costs, pay more attention to energy efficiency opportunities and are more eager to move toward a more efficient production.

2.2. Barriers to renewable energy investments

Barriers to renewable energy investments have been well studied as well, albeit more in general and not focussing on barriers perceived by industrial companies in particularly.

Hu et al. (2018)[11] reviewed 144 studies to identify barriers to variable renewable electricity generation projects, half of which peer-reviewed journal papers. The basis of their analytical framework is the decision-making process for such kind of investments, see Figure 5.

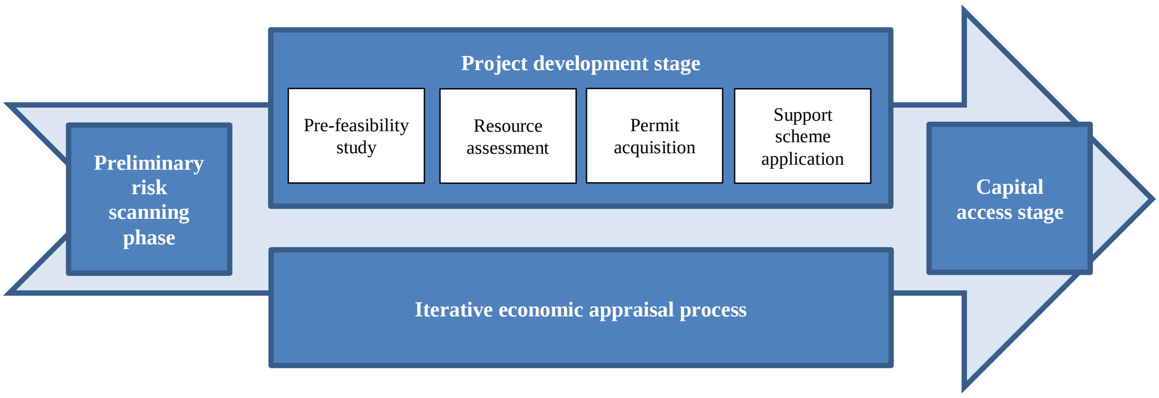

Figure 5: Decision making process for variable renewable electricity generation projects (Source: Hu et al, 2018)

Hu et al. (2018) identified in total 44 barriers to variable renewable electricity generation projects, see Figure 6. Similar categories of barriers, as the ones hampering energy efficiency investments, can be observed:

- In the preliminary risk scanning phase, behaviour barriers (lack of confidence; individualistic worldview and culture; lack of knowledge and experience) and organisational barriers (lack of sustainable strategic value) prevail.
- In the iterative economic appraisal phase, economic barriers prevail (such as high discount rates and reduced expected Net Present Value)

[11] Hu J., Harmsen R., Crijns-Graus W., Worrell E. Barriers to investment in utility-scale variable renewable electricity (VRE) generation projects. Renewable Energy 121 (2018) pp. 730-744

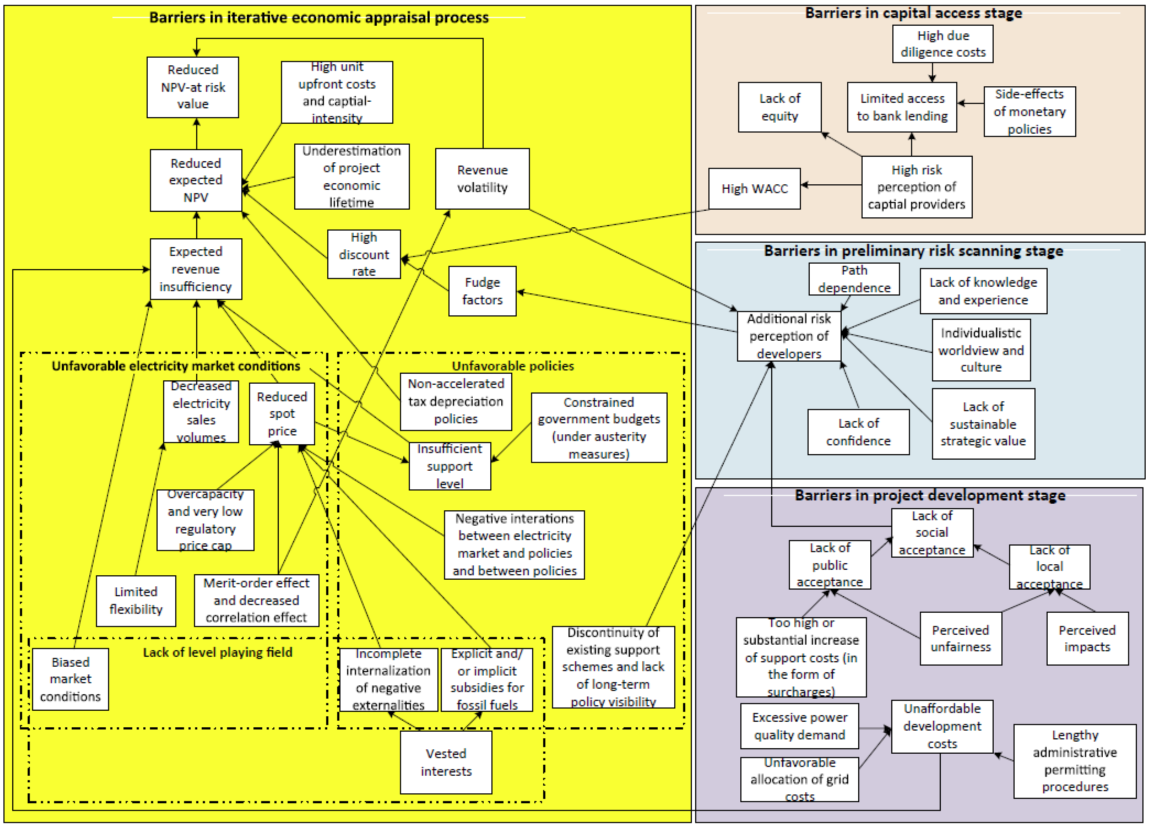

Figure 6: Overview of the identified barriers to variable renewable electricity generation investments (Source: Hu et al., 2018)

However, new categories of barriers are added to the overview; all related to external boundary conditions:

- Regulatory barriers:
  - Due to a high dependency on a specific energy mix in a particular country, dominating the country’s energy system, unfavourable electricity market conditions might be set, which can reduce the appetite for renewable electricity investments in the preliminary risk scanning stage and can negatively impact the expected revenues from the investment in the iterative economic appraisal process;
  - The policy framework might insufficiently compensate for the disadvantage position of renewable electricity projects versus the incumbent, fossil-based project or might lack stability to provide enough confidence for investors;
  - Lengthy administrative permitting procedures can delay the development of renewable electricity projects.
- Social barriers: low social acceptance for some renewable technologies in general (low public acceptance) of for specific projects by local stakeholders (low local acceptance), resulting in spontaneous protests, professional campaigns or even legal suits and causing delays in the project development stage.

Seetharaman et al (2019)[12] assessed the impact of these barriers on renewable energy projects. They conducted a survey to professionals in the energy industry (manufacturing of rigs, power generation, power distribution, oil and gas, mining and renewable energy) across the world. In total 223 practical survey responses were received (response rate 34.5%); of which one in ten from Europe and three in four from Asia-Pacific.

Categories	Barriers
Social	Public awareness and information barriers Not in my backyard' (NIMBY) syndrome Loss of other/alternative income, as a result of land occupation Lack of experienced professionals
Economic	Tough competition from fossil fuel Government grants and subsidies Fewer financing institutions High initial capital cost Intangible costs: damage costs of conventional fuels
Technological	Limited availability of infrastructure and facilities Lack of operation and maintenance culture Lack of research and development (R&D) capabilities Technical complexities
Regulatory	Ineffective policies by government Inadequate fiscal incentives Administrative and bureaucratic complexities Impractical government commitments Lack of standards and certifications

Table 4: Barriers to renewable energy investments, clustered in 4 categories (Source: Seetharaman et al., 2019)

Their analysis revealed that, see Figure 7:

- Social barriers have a moderate impact on the deployment of renewable energy and can hinder renewable energy projects;
- Technological barriers have a moderate impact on the deployment of renewable energy; for instance: lack of technology development has created obstacles for implementing renewable energy;
- Regulatory barriers have a significant impact on the deployment of renewable energy.
- Economic barriers
    - Have no direct impact on the deployment of renewable energy, but are strongly impacted by other barriers
    - Social barriers strongly impact economic barriers; opportunity costs and opposition by residents strongly influence the economic parameters of renewable energy projects;

[12] Seetharaman, Moorthy K., Patwa N., Saravanan, Gupta Y. Breaking barriers in deployment of renewable energy. Heliyon 5 (2019) e01166.

- Also technological barriers strongly impact economic barriers; for instance: lack of research and development has kept the costs of renewable energy higher compared to energy produced from fossil fuels;
- In addition, regulatory barriers strongly impact economic barriers.

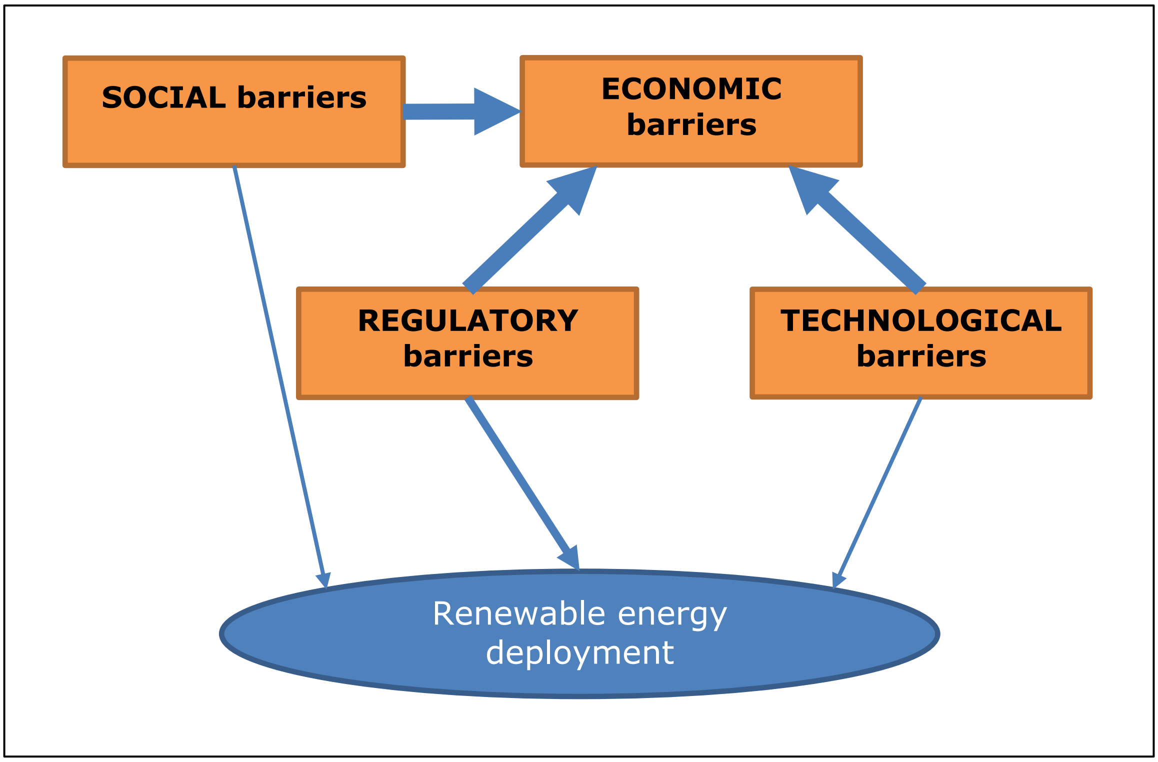

Figure 7: Impact of social, economic, technological and regulatory barriers on the deployment of renewable energy projects

2.3. Drivers for energy efficiency investments

Researchers of the Polytechnical University of Milan, Italy, not only have developed a taxonomy of barriers to industrial energy efficiency, but also have developed a structured list of drivers.[13]

They organised the drivers in four categories: regulatory, economic, information, and vocational training and distinguished between external (from outside the enterprise) and internal (from inside the enterprise) drivers, see Table 5.

Categories	Drivers - Internal	Drivers – External
Regulatory	Long-term energy strategy Willingness to compete Green image	Clarity of information External energy audit/submetering Increasing energy tariffs

[13] Trianni A., Cagno E., Farné S. (2016) Barriers, drivers and decision-making process for industrial energy efficiency: A broad study among manufacturing small and medium-sized enterprises. Applied Energy 162 (2016) 1537–1551

	Voluntary agreements	Efficiency due to legal restrictions Technological appeal Trustworthiness of information
Economic	Cost reduction from lower energy use Information about real costs	Management support Public investment subsidies Private financing
Informative	Management with ambitions Staff with real ambitions Knowledge of non-energy benefits	External cooperation Availability of information Awareness
Vocational	Programs of education and training	Technical support

Table 5: Drivers for industrial energy efficiency, clustered in 4 categories (Source: Trianni et al., 2016)

2.4. Drivers for investments and renewable energy

The literature review conducted by Seetharaman et al (2019)[14] included an analysis of drivers that can lift barriers to renewable energy deployment, next to the analysis of barriers:

- User-friendly procedures: Countries with excessively complicated administrative procedures have less penetration of renewable energy compared to countries with simple and straightforward procedures; aligning and simplifying procedures hence can lift bureaucratic barriers to renewable energy investments;
- Higher stakeholder satisfaction: the creation of jobs in the renewable energy sector and the participation of stakeholders in renewable energy projects can increase the public and local acceptance for renewable energy;
- Successful research and development (R&D) ventures: technological development is instrumental to build competence in renewable energy and to reduce the costs of the technologies;
- Cost reduction: of the renewable energy technologies and projects is needed, so that renewable energy can better compete against fossil-based energy.[15]

Engelken et al. (2016)[16] complement these findings by concluding from their research that renewable energy opportunities are driven primarily by climate change mitigation and energy efficiency improvements. In addition, they indicate that cooperation is a key in future business models to handle increasing complexity.

Input from the round table meeting participants on drivers and barriers

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14 Seetharaman, Moorthy K., Patwa N., Saravanan, Gupta Y. Breaking barriers in deployment of renewable energy. Heliyon 5 (2019) e01166.

15 See Foster E., Contestabile M., Blazquez J., Manzano B., Workman M., Shah N. The unstudied barriers to widespread renewable energy deployment: Fossil fuel price responses. Energy Policy 103 (2017) 258–264 for an in-depth analysis of fossil fuel prices on renewable energy deployment.

16 Engelken M. Römer B. Drescher M., Welpe I. Picot A. Comparing drivers, barriers, and opportunities of business models for renewable energies: A review. Renewable and Sustainable Energy Reviews (2016) Volume 0, pp 795-809.

The participants of the first round table meeting were requested to indicate which barrier to energy efficiency and renewable energy investments they considered as the most blocking ones. They were also requested to indicate the most important benefits from such investments. The results of this pop-poll are shown by Table 6.

Investments in	Top 3 barriers and benefits
Energy efficiency	**Top 3 barriers hampering these** • Low status of these investments by top management (12 votes) • Lack of internal competence to evaluate these opportunities (12 votes) • Energy managers lacking the time to investigate (7 votes)
	Top 3 benefits arising from these • Energy cost reduction (17 votes) • Better environmental performance (14 votes) • Lower vulnerability against energy price shocks (10 votes)
Renewable energy	**Top 3 barriers hampering these** • Lack of capital availability (13 votes) • Investments not profitable enough (11 votes) • Lack of internal competence to evaluate these opportunities (9 votes)
	Top 3 benefits arising from these • Better environmental performance (16 votes) • Improved corporate image (15 votes) • Lower vulnerability against energy price shocks (10 votes)

Table 6: Top 3 barriers and benefits of energy efficiency and renewable energy investments, according to the participants of the first round table

The barriers, that were selected the participants, confirm the ones reported in scientific research, see above.

Besides the difference between SMEs and large enterprises, the participants emphasised the difference between investing in energy efficiency, which is a step-by-step process, and investing in renewable energy, which immediately requires CAPEX.

The efforts in term of investments in renewable energy are also more visible in the company or for the public compare to the same level of investment in energy efficiency measures; for instance, a new solar panel or a new wind turbine has much more exposure than improved insulation of a building. In addition, the participants indicated the main benefits arising from investments in energy efficiency and renewable energy, being:

- Energy cost reduction;
- Better environmental performance;
- Improved corporate image;
- Lower vulnerability against energy price shocks.

At the third round table meeting, the motivation for energy efficiency and renewable energy investments by large corporate companies was discussed. Representatives of participating companies indicated that the companies' Corporate Social Responsibility is the basis for the companies' and decarbonisation strategies. The top management of these companies feels committed to climate action and consequently adds it to the company's agenda.

In addition, the present food and beverage companies all rely on feedstock from agriculture and hence are exposed to potential consequences of the climate change which can impact the supply of their raw materials. There is hence a sense of urgency to protect the business and brands from these potential risks.

The round table meetings revealed that companies focus on decarbonisation in general; energy efficiency and renewable energy are in fact only two of various pillars in the decarbonisation strategy, see Figure 8. To illustrate, some best practice examples of companies that participated to the round table are presented below.

From these discussions, one can conclude that a holistic approach, integrating all pillars, need to be considered by policy makers when designing policies stimulating the decarbonisation of the industry.

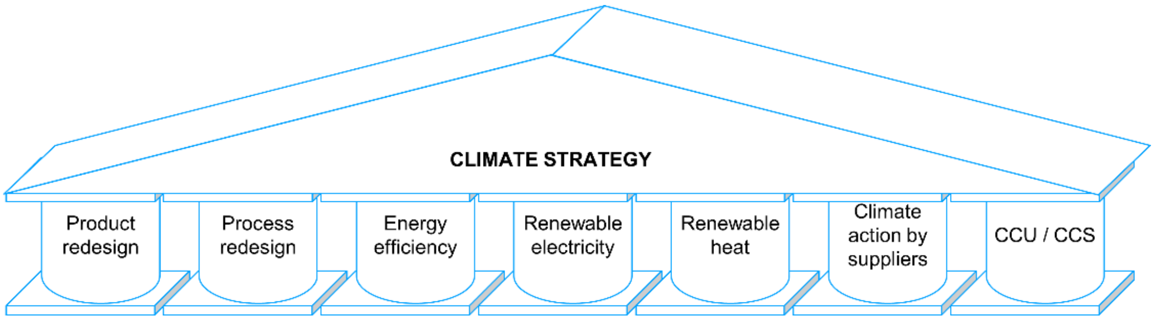

Figure 8: Pillars of the industrial climate strategy

2.5. *Best practice examples of companies who have overcome barriers*

At the round table meetings, some best practices of companies who have overcome barriers were presented. Table 7 presents which barriers have been addressed by these companies.[17]

Barrier	Alpro	Oleon	Mars	Astellas	AB Inbev
Technology		●	●		●
Information – related	●		●	●	
Economic			●		
Behavioural	●				
Organisational	●	●	●	●	●
Competence – related	●				
Awareness		●	●		●
Social				●	
Regulatory				●	

Table 7: Barriers addressed by the best practice examples presented at the round table meetings

[17] Only the barriers discussed at the round table meetings are highlighted in Table 7. That does not exclude that these companies have overcome other barriers as well.

2.5.1. Best practice example 1: Alpro

The sustainability strategy of Alpro, a subsidiary of Danone, consists of three pillars: healthy food, sustainable food and profitable growth. The mission of the pillar sustainable food is "Living comfortably within the natural capacity of our planet". Realising this ambition, the company has set objectives on carbon reduction, sustainable sourcing of our ingredients and making the most of water. [18]

At site-level an Energy Management Framework is implemented, consisting of four pillars, see Figure 9. To realise the third pillar – energy integration – Alpro Wevelgem, Belgium constructed a Hot Water Smart Grid, an internal thermal network, conveying excess heat from one process to supply heat at another process.

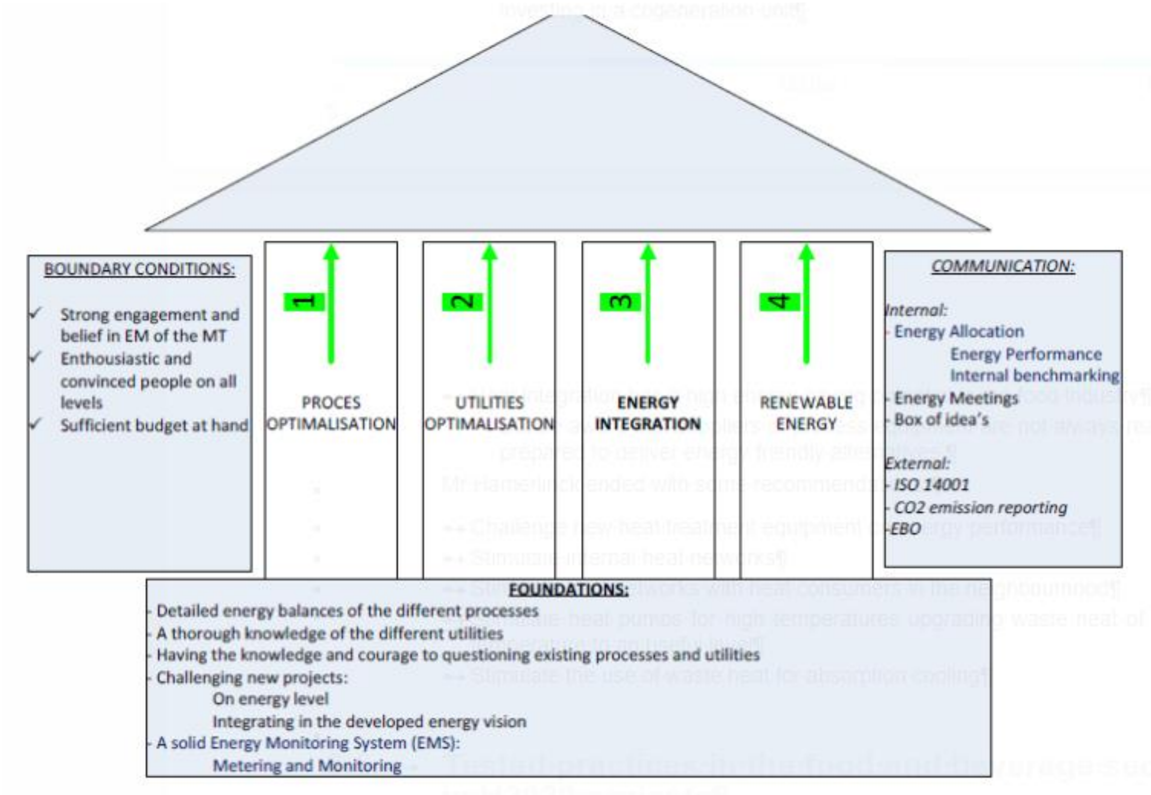

Figure 9: Energy Management Framework at Alpro (Source: Alrpo)

Realising this Hot Water Smart Grid was a process that took Alpro more than eight years. The First steps were set in 2009 when renovating the offices. In 2010-2011, the heat demand and potential supply was mapped in detail, and a major expansion of the production capacity in 2014-2016 created the momentum to complete the heat integration. Also two cogeneration units were added to provide heat with the appropriate characteristics.

[18] Source: Alpro Sustainabliliy Development Report 2018; https://www.alpro.com/pdf/alpro-sustainable-development-report-2018.pdf

This complex project required a step-wise approach, focusing first on metering and monitoring of energy (heat) flow, followed by process improvements in order to optimise the energy consumption, before integrating the thermal needs of the processes and adding new thermal generation capacity.

Alongside this technical approach, it was necessary to sell the project ideas by collecting data to build the case, to involve and convince the technical services and the designers, to make a roadmap, and finally to convince the management.

2.5.2. Best practice example 2: Oleon

oleon
a natural chemistry

Preserving the planet is one of the five sustainable development commitment of the Group Avril, shareholder of the company Oleon, see Figure 10. Oleon itself is committed to reduce their environmental footprint by focusing on consumption of energy and wastewater treatment[19].

As a practical implementation of this ambition, Oleon's energy roadmap consists of:

- Centralised purchase of (renewable) energy
- Energy efficiency: by setting ambitious targets for production
- Deployment of renewable energy;
- Awareness: by discussing sustainability topics every three months internally;
- Compliance with legislation and standards, such as the participation to a voluntary agreement on energy efficiency in Belgium and implementation of ISO 50001.

Figure 10: Corporate Social Responsibility at Oleon, subsidiary of Group Avril

[19] Source: Corporate Social Responsibility Progress report of Oleon 2017

On top of these investments in energy efficiency and renewable energy, Oleon strives to raise the share of renewable raw materials in their product portfolio. As an example, Oleon succeeded in replacing a fossil based alcohol by a bio-based alcohol for the production of an ester, which allows to reduce the carbon footprint from cradle-to-grave up to 75% for that product.

Also, a new hydrolysis process was developed allowing to drastically reduce the pressure and temperature; as a result, a 90% reduction in specific energy consumption for that product can be achieved. The process development continues to bring this technology from demonstration to full commercial scale.

2.5.3. Best practice example 3: Mars

MARS

Mars recognizes its responsibility to address the environmental and social impacts of its business, including its impact on climate change.[20]

Mars' global carbon emission along the value chain amount to 26.2 million tonnes (2015 data), which is comparable to the CO_2 emissions of Panama. Emissions from agriculture (46%). Land Use Change (29%) contribute the most to these emissions and the company's own industrial operations only contribute for 6% to the company's global footprint; yet Mars is dedicated to take full responsibility for all carbon emission along the whole value chain.

Mars set its first carbon reduction targets in 2009. The current targets are a 27% reduction by 2025 and a 67% reduction by 2050 compared to 2015 levels, see Figure 11.

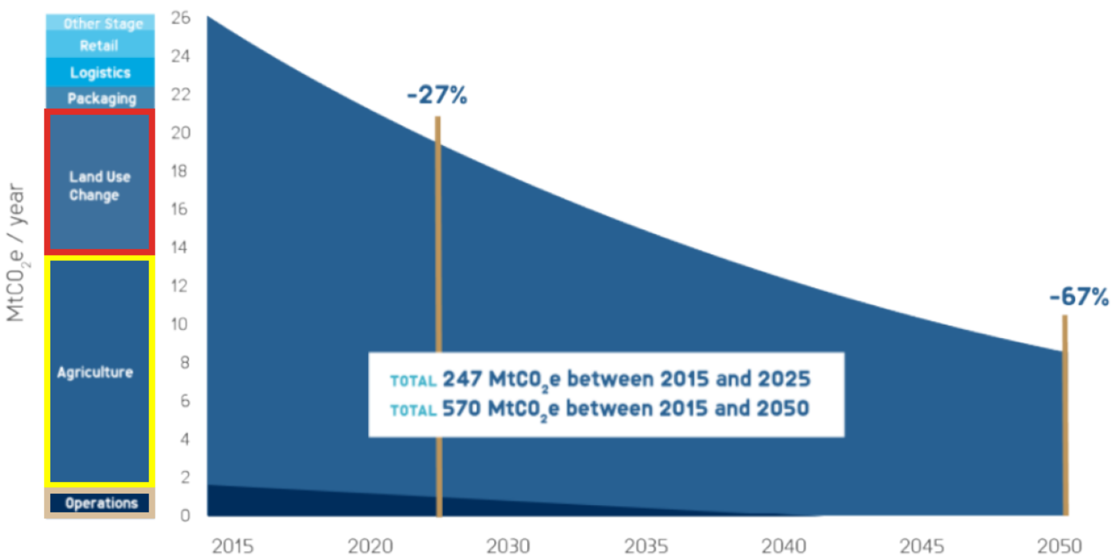

Figure 11: Mars carbon reduction glide path

[20] Source: https://www.mars.com/about/policies-and-practices/climate-action

The decarbonisation strategy of Mars consists of four pillars:

- Operational efficiency – Mars improves its energy efficiency with 3% per year, 5% of the total budget investment is allocated to energy efficiency improvement;
- Capital efficiency: by opting for energy efficient solutions when investing in new equipment or installations; for instance, all new buildings are LEED certified;
- New technologies: by redesigning the processes to the extent possible;
- Renewable energy: Mars has joined the RE100 initiative (www.re100.org) and has a target to source 100% renewable electricity by 2040.

The renewable energy pillar has contributed the most to the carbon reduction in the last ten years. Yet, decarbonising heat – taking 60% of the energy demand – remains a challenge. Mars has joined the "renewable thermal collaborative" to learn more about the technical options.

2.5.4. Best practice example 4: Astellas

Astellas Ireland is one of the manufacturing plants of the Japanese pharma group. Astellas recognizes that climate change will become a constraint on conducting sustained corporate activity, and considers it one of management's most important problems to address. Astellas has set reduction targets according to the method recommended by the Science Based Targets (SBT) Initiative. These targets are[21]:

- Reduce GHG emissions (Scope 1 + Scope 2) by 30% by fiscal 2030 (Base year: fiscal 2015) (Emissions in the base year: 211 kilotons)
- Reduce GHG emissions (Scope 3) by 20% per unit of revenue by fiscal 2030 (Base year: fiscal 2015)

Astellas Ireland has – at site level – a track record of combatting its greenhouse gas emissions. This plant realised a 98% cut in their CO_2 emissions from 2005 to 2017, see Figure 12.

Over 350 projects have been conducted in the last 10 years covering all aspects of plant operations including steam generation, chilled water, compressed air, lighting, production equipment, and environmental control. As a result, both the electricity consumption and heat consumption is reduced with about one third. Also, numerous standards have been implemented, such as the ISO50001 standard in 2011.

To decarbonise its electricity supply, Astellas Ireland erected a wind turbine in 2012 and installed a solar PV array on the roof of a new building. The remainder part is decarbonised via a Power Purchase Agreement.

In 2012, 1.67MW biomass steam boiler replaced a fossil fuel boiler. This boiler supplies 95% of Astellas' annual thermal energy requirements and is fuelled by locally sourced wood residues.

[21] Source: https://www.astellas.com/jp/en/responsibility/Measures-To-Address-Climate-Change

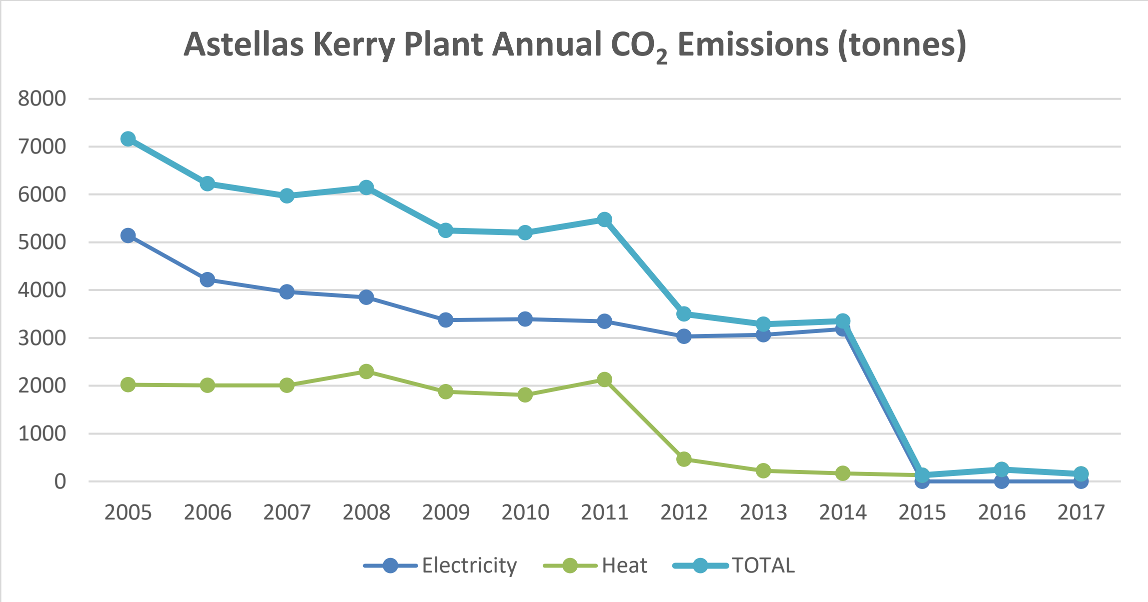

Figure 12: CO_2 emissions of Astellas Kerry, Ireland (2005-2017) (Source: Astellas Ireland)

Astellas Ireland participates to the Large Industry Energy Network, a voluntary agreement, set up by the Sustainable Energy Agency of Ireland. The knowledge sharing activities, organised in the framework of this network, have proven to be very instructive to exchange lessons learnt on the implementation of energy efficiency and renewable energy projects.

2.5.5. Best practice example 5: AB InBev

AB InBev experiences that the yield of barley, a core raw material for the beer production, is impacted by climate change. This has motivated AB InBev to include targets on climate action in the company's sustainability goals for 2025, see Figure 13.

For climate action, two goals are set. A first goal is to source all electricity from renewable sources by 2025. AB InBev purchases renewable electricity via off-site Virtual Power Purchase Agreements; projects in the same countries as the breweries or connected to the same grid have the preference. The company also invests in on-site renewable electricity generation where possible.

A second goal is a 25% carbon emission reduction across the value chain via energy efficiency and green logistics. To realise this objective, AB InBev is adding electric and hydrogen fuelled trucks to its fleets in the USA and Brazil.

With the support of European R&D fund, AB InBev has developed the "Simmer and Strip technology", an innovative method for treating a wort in a boiling kettle. This technology allows AB InBev to reduce its energy consumption by 12%, its greenhouse gas emissions by 8% as well as its water consumption.

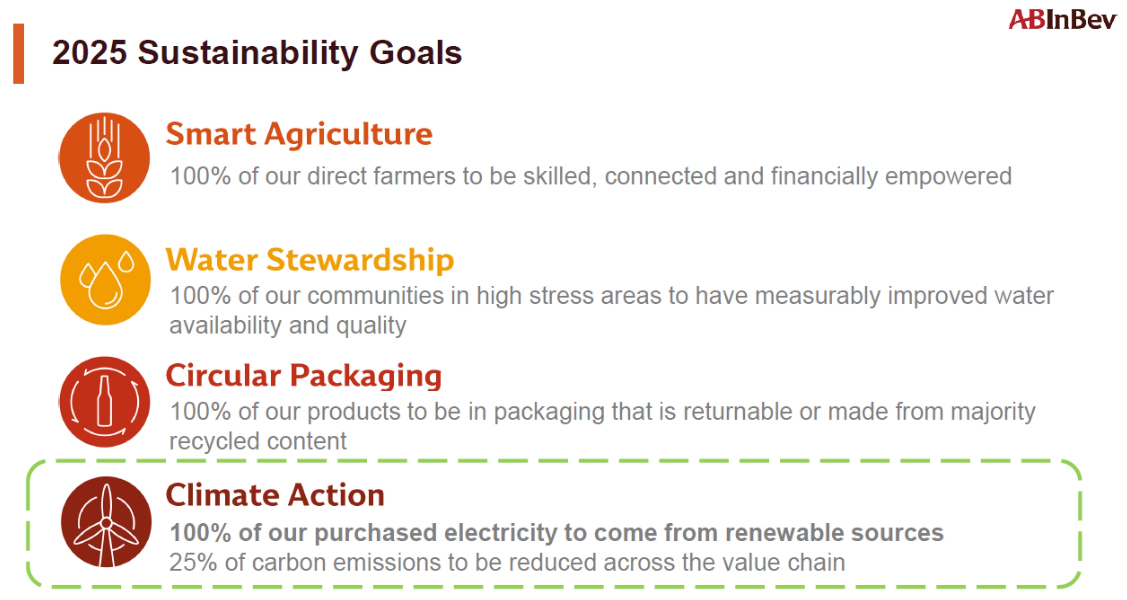

Figure 13: Sustainability goals of AB InBev for 2025 (Source: AB InBev)

Because sustainability has no borders, AB InBev committed to expand this technology in all its breweries. When successfully implemented in its biggest 200 breweries worldwide, it will approximately save every year the equivalent of the annual energy consumption of a city which counts more than 100 000 inhabitants. Because sustainability is not a competition, the use of the patent of this innovation has been offered for free to small and medium brewers.

3. Policies and measures

3.1. Overview of implemented policies and measures on industrial energy efficiency

To lift barriers to energy efficiency and renewable energy investments, a portfolio of policies and programmes have been developed by various jurisdictions.

Specific policies and measures addressing barriers to industrial energy efficiency have been designed and implemented, in contrast to policies and programmes addressing barriers to renewable energy investments that are usually technology specific. This chapter focuses for that reason on policies and programmes to stimulate investments by the industry on energy efficiency.

Tanaka developed a taxonomy to structured policies for industrial energy efficiency (2011)[22], see Table 8. This, in turn, can be considered as an elaboration of as the categorisation of policies as carrots, sticks and sermons:[23]

- Prescriptive policies are regulations, mandates and agreements that directly compel specific actions by, or communicate expectations to, industry companies and/or associations.
- Economic policies are taxes and tax reductions, directed financial support (e.g. subsidies and loans), cap and trade schemes, and differentiated energy prices that seek to influence the cost-effectiveness of technical actions.
- Supportive policies are energy efficiency opportunity identification tools (e.g., data collection, energy audits and benchmarking), cooperative measures (e.g. government-industry challenges and partnerships), capacity building and technical information and assistance information which help to establish a favourable environment in which industry implement energy efficiency actions more easily.

Category	Policies	Example of measures
Prescriptive	Regulations for equipment efficiency	Efficiency standards
	Regulations for process efficiency and configuration	Benchmark targets and/or energy saving goals process prescriptions
	Regulations for energy management	Energy management standards Preparation of conservation plans Appointing internal energy manager and employing external energy adviser
	Negotiated agreements	Benchmark targets and/or energy saving goals Preparation of conservation plans
Economic	Energy taxes	Taxes

[22] Tanaka K. Review of policies and measures for energy efficiency in industry sector. Energy Policy 39 (2011), pp. 6532–6550

[23] Bemelmans-Videc M.L., Rist R.C., Vedung E O. (1998) Carrots, Sticks, and Sermons: Policy Instruments and Their Evaluation; Transaction Publishers, London – New York

	Directed energy tax reductions	Tax differentiation/exemptions, credits and deductions
	Directed financial incentives	Preferential loans Subsidies and rebates
	Cap and trade schemes	GHG emissions trading
	Differentiated energy pricing	Energy tariff controls
Supportive	Identification of energy efficiency opportunities	Collection of energy consumption data Collection of technology installation information Monitoring Energy auditing Benchmarking
	Cooperative measures	Challenge and partnership programmes Promotion
	Capacity building	Advisory services, training and education

Table 8: Typology of energy efficiency policy for industry sector (Source: Tanaka, 2011)

Table 14, added as Appendix 6, analyses which policies and programmes on industrial energy efficiency, each of the EU Member States has implemented. They are related to one of the 7 barriers to industrial energy efficiency[24], see subchapter 2.1, and to one of the three categories. This overview is based on the information provided in the National Energy Efficiency Action Plan – 2017. Table 9 presents how many EU Member States[25] implemented policies and measures addressing a particular category of barriers, and in total (some EU Member States implement more than one policy to address a particular category of barriers).

Category of barriers	Number of EU MS implementing	Number of PRESCRIPTIVE policies	Number of SUPPORTIVE policies	Number of ECONOMIC policies
Awareness	6		6	
Behaviour / Organisation	16	17	2	4
Information	14	1	14	4
Competence	8		10	
Technology	5			7
Economic	25			51

Table 9: Implemented policies and measures by EU MS and their relation with barriers

[24] Behaviour and Organisation were grouped as it was difficult to make a distinction between both

[25] Belgium is decomposed in its three regions with competence on energy efficiency and renewable energy: Brussels Capital Region / Flanders / Wallonia.

Economic barriers are the most addressed; 25 out of the 30 assessed jurisdictions have implemented policies addressing these barriers. All of these are economic; in total 50 are recorded, or on average 2 per implementing Member State. All kind of economic policies are implemented: tax rebates, subsidies, certificates for energy savings[26] and soft loans. The EU Member States, that have opted to implement an energy efficiency obligation scheme also have included the industry in the target sectors. The share of industrial energy savings in the total reported savings is for some of these countries substantial:

- Italy: 56%
- Denmark: 40%
- France: 20%

About half of the competent jurisdictions have implemented policies and measures addressing barriers related to the behaviour / organisation or to information. However, the nature of implemented policy measure do differ:

- There is a preference for prescriptive policies to address barriers related to the behaviour / organisation. The most often implemented measure is an energy efficiency agreement with the industry. While this policy measure usually targets the energy intensive industry, some countries are redesigning these to fit SMEs. Less implemented are policies stimulating or imposing an energy management scheme.
- EU Member States facilitate access to information in various ways. In most case, they support access to information by publishing guidance notes or organising seminars. Some countries foster knowledge exchange in between companies by organising learning networks, such as in Germany, Hungary, Ireland and Sweden. Other support energy audits financially.

Only supportive measures are implemented to address barriers related to competences. Some jurisdictions establish public offices to support the industry, such as in Belgium (Brussels Capital Region and Wallonia [facilitators]) or Sweden (coaches for energy and climate matters). ESCOs are only mentioned once (Flanders).

Only supportive measures are implemented to address barriers related to awareness as well. They concern awareness raising campaigns, labelling schemes or the development of a benchmarking tool.

To address barriers related to technology, the EU Member States only included economic measures in their National Energy Efficiency Action Plans. These usually have a larger scope than just energy efficiency or renewable energy, but foster sustainable growth in general or new industrial development (industry 4.0).

Some of these policy measures were discussed at the second round table meeting. From the discussion, three key enablers emerged (see also Appendix 8):

- There is a request for training and knowledge sharing. This need manifests at various levels:

[26] Certificates for energy savings both include the so-called White Certificates, issued in the framework of an Energy Efficiency Obligation Scheme as certificates issued for energy savings, generated by cogeneration (Flanders, Belgium and Poland)

  - At the level of individual companies who need hands-on and practical advise on how they can reduce their energy consumption and make it more green;
  - Knowledge sharing amongst trainers themselves: within a country as well across borders;
  - Knowledge sharing between different level of authorities: European – national – regional/local;
- There is a need for tailored mentoring and advise to support the companies in the implementation phase of the sustainable energy projects;
- There is a need for engagement of the market participants and the companies' management; the most successful programmes succeed in committing the companies to implement the energy saving measures that are proposed in the energy audit report.

These conclusions emphasize the need for policies overcoming barriers related to information and competences, currently implemented by less than half of the EU Member States. While these need to be implemented at a local / national scale, there is a call to foster knowledge exchange across borders, asking for action at the level of the EU.

These conclusions also emphasize the importance of having the companies' commitment. Voluntary agreements are tested approaches to commit the management to action. The call towards a deep decarbonisation can create a new momentum to commitment to action; some vanguard companies already proactively move into action.

At the same time, voluntary agreements go local and turn into learning networks; although knowledge exchange and sharing practices are their key components, committing to a (collective) energy savings' target is also one of its key ingredients.

However, one step before is having the company's interest in energy efficiency and renewable energy. Companies are the most interested when they plan investments to renovate existing installations or to build new ones. Ireland hereto developed a standard to assure that new installations are designed to allow an energy efficient operation.

3.2. Use of public funding to finance energy efficiency measures

To better understand the demand side of the Institute for Energy Efficiency in Production (EEP) at the University of Stuttgart/Germany developed the Energy Efficiency Barometer of Industry to gather data evidence through a short survey of manufacturing companies' positions on energy efficiency – see: www.eep.uni-stuttgart.de/eeei. At the third round table meeting, results for Germany were discussed. In total 1162 German companies of different size and from different sectors were questioned about their attitude towards energy and climate targets, the usage of support programmes and source of financing for energy efficiency investments.[27]

The respondents were requested to indicate which policy measures should be taken to close the existing gap in the energy and climate targets for 2020. Nearly 70% of companies were open to additional requirements to achieve the energy and climate

[27] Büttner S. (2019) Advancing the Economy with Industrial Energy Efficiency Experiences, Opinions and Action. Presentation at the 3rd round table meeting, Berlin, 20 March 2019.

targets, while 30% called for stronger incentives for investments in energy efficiency. These results do not significantly different with the size of the companies, but differ significantly from one sector to another.

However, to finance energy saving investments, 70% of the respondents indicated to rely on equity, while other sources of financing (loan: 19% - others: <10%) are much less used, see Figure 14. Most companies relied on economic and financial criteria to decide on energy efficiency investments (energy savings, total CAPEX, payback time).

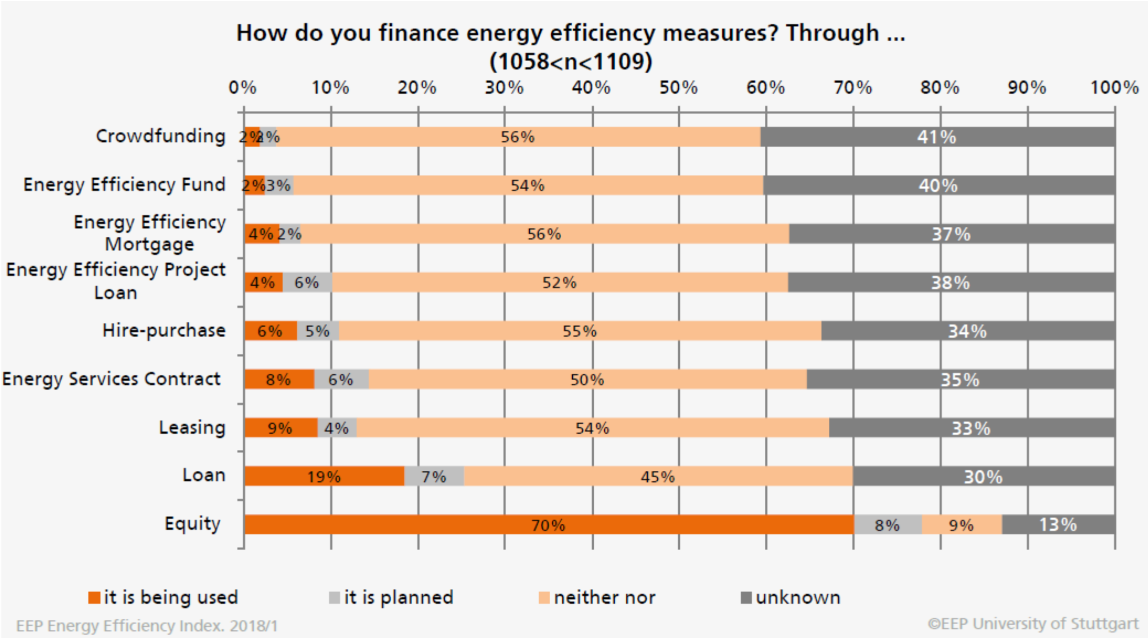

Figure 14: Source of financing for energy efficiency measures (Source: EEP - University of Stuttgart, 2019)

In line with that, 60% of the respondents did not consider subsidies or any other financial support when implementing energy efficiency measures. Only a quarter of the respondents indicated to have made use of a subsidy or public financial support already and another 17% intended to. The smaller a company, the less the current portfolio of support mechanisms seemed to be adequate or of interest; 71% of the micro-companies did not consider subsidies versus 43% of the large companies. Also large differences in between industrial sectors could be observed. Especially the complexity and the low effort-benefit ratio of application process for public support programmes was seen as the most unsatisfying aspect by respondents.

3.3. Lessons learnt from some selected policies and measures

This section discusses nine policies and measures that have been implemented in Europe. A palette of policies and measures have been selected to represent all three categories, defined by Tanaka, see 3.1 above; the selection prioritised policies and measures that are analysed in scientific literature. Figure 15 given an overview of the selected policies and measures. They mainly – but not exclusively – aim at fostering energy efficiency. Some lessons learnt on these selected policies and measures are highlighted.

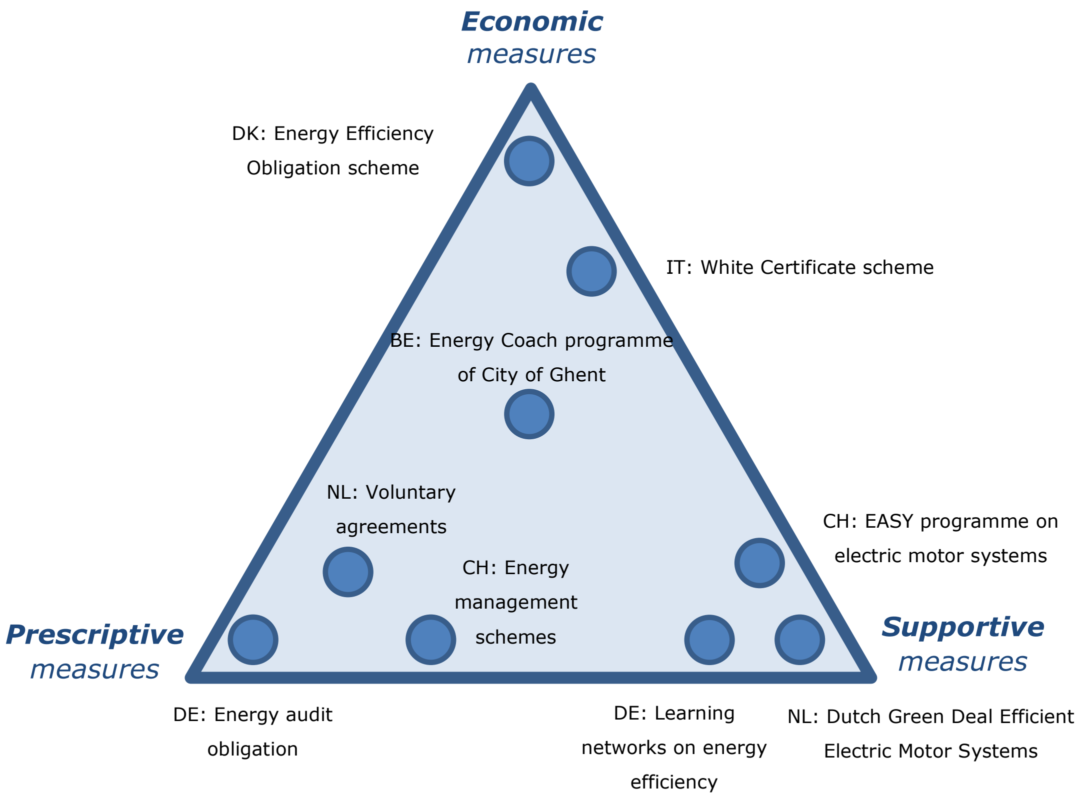

Figure 15: Overview of the discussed policy measures

3.3.1. Analysis of the barriers, drivers and actors

Abeelen (2015, 2019) interviewed energy managers of fifteen metalworking manufacturing SMEs and five experts of governmental bodies and industry associations in the Netherlands to learn more about the barriers, drivers and actors, they perceive as most relevant when making an investment decision on energy efficiency.[28,29] The taxonomy of drivers and barriers, developed by the researchers of the Polytechnical University of Milan, Italy – see subchapters 2.1 and 2.3 – was used as a basis for this study.

Economic barriers were perceived as most important by the respondents, followed by organisational and behavioural barriers, which is in line with the barriers observed at Italian metal processing companies, see section 2.1.2. As most important drivers, the respondents indicated: long-term energy strategies, clarity of information, cost reduction from lower energy use, public investment subsidies, technical support and trustworthiness and availability of information.

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28 Abeelen C., Harmsen R., Worrell E. (2015) Planning versus implementation of energy-saving projects by industrial companies. Insights from the Dutch Long-Term Agreements. Energy Efficiency. DOI 10.1007/s12053-015-9355-1

29 Abeelen C. (2019) Implementation of energy efficiency projects by manufacturing companies in the Netherlands. Thesis Utrecht University, Copernicus Institute for Sustainable Development and Innovation, Group Energy and Resources. Utrecht University, the Netherlands.

Table 10 indicates which barriers, drivers and actors were considered as significant in the different stages of an investment decision on energy efficiency. As can be observed from this table, a variety of barriers, drivers and actors play a role at different stages of the decision-making process. This underlines the complex nature of such investment decisions. This observation also illustrates the challenge for the policy maker. It indicates that there is no single policy instrument that can work as a panacea to remove all barriers. Instead, there is a need to design multi-facetted policy instrument impacting various barriers, stimulating various drivers and involving various actors in a well-considered way.

Decision-making step	Main barrier(s)	Main driver(s)	Main actor(s)
Awareness	Awareness Behavioural	Long-term energy strategy Clarity of information Voluntary agreement	Firm Technology supplier Government
Needs and opportunities identification	Information-related	Clarity of information Trustworthiness of information Availability of information	Technology supplier Technology supplier Energy provider
Technology identification	Technology-related	Technical support Trustworthiness of information Clarity of information	Installer + Technology supplier Technology provider Technology provider
Planning	Organisational Economic	Technical support Long-term energy strategy Management with real ambition	Installer + Technology supplier Firm Firm
Financial analysis and financing	Economic	Public investment subsidies Cost reduction from lower energy use Long-term energy strategy Increasing energy tariffs Information about real costs Voluntary agreements	Government Technology supplier / Energy supplier / Government Firm Energy supplier Industry association Government
Installation start-up and training	Behavioural	Staff with real ambition Technical support	Firm Installer + Technology supplier

Table 10: Main barriers, drivers and actors identified by participants to the Dutch voluntary agreements (Source: Abeelen, 2019)

3.3.2. Industrial energy savings triggered by Energy Efficiency Obligation schemes

The discussion of the selected policies and measures starts with economic ones as this category of instruments that is most often implemented in the European Union, see Table 9. There is a multitude of economic instruments, this discussion focuses on one particular instrument: Energy Efficiency Obligation schemes, which is considered as a key instrument to realise the EU energy efficiency ambitions.

3.3.2.1. Introduction to Energy Efficiency Obligation schemes

Energy Efficiency Obligation schemes (EEOSs) impose energy savings targets on obliged parties, typically energy distributors and/or retail energy sales companies who have close contacts with end-consumers. These obliged parties can meet their targets by supporting and/or implementing energy saving investments at end-consumers. Obliged parties who fail to meet their targets have to pay a fine in function of the gap between target and realised savings.

This policy instrument was first implemented in the USA in the 1970s and 1980s.[30] In Europe, Denmark and the UK were the first countries to introduce EEOSs in the 1990s, followed by Belgium, France, Italy and Poland in the 2000s.[31] The deployment of EEOSs in the EU was spurred by Article 7 of the Energy Efficiency Directive (EED – 2012/27/EU). This article requires EU Member States to impose EEOSs on obliged parties that must save an annual 1.5% of their energy sales with additional energy efficiency projects (or to implement alternative measures with an equal effect). In 2018, EEOs are in place in 15 of the 28 EU Member States, with significant differences in design amongst EU Member States.[32]

Article 7 of the EED mainly triggers energy efficiency investments in buildings; however, at least 8% of the energy savings, expected from the implementation of this article until 2020, will be realised in the industry sector.[33] Below, two EEOSs are discussed, of which a significant share of the realised energy savings are achieved in the industry.

3.3.2.2. Lessons learnt from the Danish Energy Efficiency Obligation Scheme

In Denmark, energy distribution companies have been involved in realising energy savings at the end-user level since the early 1990s. In 2006, a first Energy Efficiency Obligation was introduced as a voluntary agreement with the distributors of electricity, natural gas, and district heating. Collectively, the energy distribution companies had an obligation to collect 3 PJ of energy savings per year, which prompted them to involve end-consumers and to stimulate energy efficiency investments by granting subsidies.

In 2012, an evaluation of the Danish EEOS was carried out (Bundgaard et al, 2013)[34]. The evaluation assessed the effectiveness of the EEOS framework and provided recommendations for the following EEOS period, running from 2013 to 2020.

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30 Fawcett T., Rosenow J., Bertoldi P. Energy efficiency obligation schemes: their future in the EU. Energy Efficiency (2019) 12: 57. https://doi.org/10.1007/s12053-018-9657-1

31 VITO (2015) Report on existing and planned EEOs in the EU – Part I: Evaluation of existing schemes. Deliverable D2.1.1 of the ENSPOL project (Contract N°: IEE/13/824/SI2.675067)

32 See: Fawcett at al. (2019). EEOs are implemented in: Austria, Bulgaria, Croatia, Denmark, France, Greece, Ireland, Italy, Latvia, Luxembourg, Malta, Slovenia, Spain, Poland, the UK

33 Forster, D. et al. (2016). Study evaluating progress in the implementation of Article 7 of the Energy Efficiency Directive Final Report: report for DG energy. Ricardo Energy & Environment

34 Bundgaard S. S., et al. (2013) Spending to save: evaluation of the energy efficiency obligation in Denmark. Proceedings of the eceee Summer Study 2013, Presqu'Ïle de Giens, Hyères, France.

From 2006 to 2009, less than half of the energy savings were realised in the industry. In 2010 to 2011, the energy savings in industry doubled because of drastic increase of the global annual energy savings target from 3 to 6 PJ. Most often, the savings are realised by providing subsidies that reduce the payback time and the need for risk coverage of the investment; also industrial end-consumers could use the subsidies to buy the advice of professional consultants.

The additionality of the energy efficiency obligation schemes was assessed based on telephone interviews. The analysis revealed an additionality of 52% to 60% for realised investments in industry, which is much higher than the additionality for investments in the residential sector (6% to 8%). The energy distribution companies considered energy saving projects in industry as attractive and as a cost-effective way to reach their target with a minimum of administrative burden. The evaluation also revealed that the funded projects were profitable for the industrial companies.

However, an analysis of a sample of funded projects revealed that short pay-back times for many of these projects; one fifth has pay-back times shorter than 1 year. Moreover, the subsidy exceeded the investment cost in some of the cases.

Based on these findings, some design aspects of the next phase of energy efficiency obligation (2013-2020) were adapted. Energy saving projects with a payback time shorter than 1 year were no longer eligible for receiving subsidies by the obliged energy distribution companies. To support that, a requirement for documentation and calculation of simple payback time for projects using specific calculation method was introduced.

The evaluators also recommended to limit the subsidy to 30% of the total investment to increase the leverage effect of the Energy Efficiency Obligation scheme; however, this suggested modification was not included in the design of this next phase.

Lessons learnt:

- Energy saving projects in industry are an attractive and a cost-effective way for the energy distribution companies to reach their energy efficiency target with a minimum of administrative burden
- The additionality of energy efficiency obligation schemes for energy efficiency investments in industry is high
- The cost-efficiency of energy efficiency obligation schemes can be improved by excluding energy saving measures with a short pay-back time

3.3.2.3. Lessons learnt from the Italian Energy Efficiency Obligation Scheme

Italy launched its Energy Efficiency Obligation scheme (EEOS) in 2004. It imposes obligations to distributors of electricity or gas with more than 50,000 clients, but also non-obliged distributors, Energy Service Companies (ESCOs), companies with energy manager or energy management system can present eligible energy savings. The costs incurred by the obliged distributors are partially reimbursed through a tariff reimbursement component; in 2014, the cost was around 600 million euros, with 5,8 million of cancelled certificates.

The additional energy savings of eligible projects compared to baseline are translated in certificates – labelled as White Certificates – representing one ton oil-equivalent of saved energy. The Italian EEOS operates as a certificate scheme with an active interplay of demand / supply by and trade of White Certificates in between market players, comparable to green certificate schemes supporting renewable energy investments.

Figure 16 shows in which sectors, the Italian White Certificate scheme has generated energy savings from 2006 to 2015. The contribution of the industry in delivering savings has increased drastically from about 5% in 2006 to close to 75% in 2014 (Di Santo et al., 2016)[35].

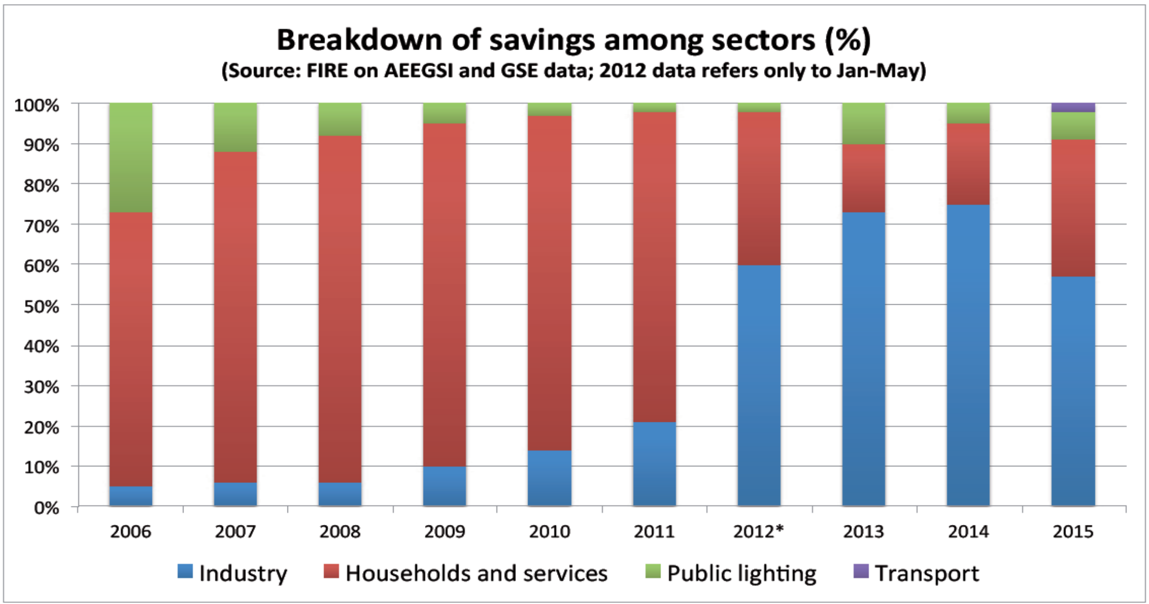

Figure 16: Sectoral breakdown of eligible savings in the Italian White Certificate scheme

The slow participation of the industrial sector in the first phase can be explained by the time needed to digest the complexity of the scheme. Industrial energy savings projects are often very specific. Tailored assessment is needed to define the baseline situation and to calculate energy savings that are additional to this baseline.

In 2011, the rules, stipulating how many White Certificates can be issued to energy savings projects, were adapted. In the original design, energy savings of only the first five years from the implementation of the project, could be translated into eligible White Certificates. Since 2011, these savings may be multiplied with a factor to count in the expected energy savings over the entire technical life time of the energy efficient equipment (15 to 20 years typically). As a result, more White Certificates were issued per project, which has spurred the uptake of energy efficiency investments by the industry from 2012 on, as can be seen in Figure 16.

The Italian White Certificate Scheme has triggered the ESCO-market in Italy. Some consultant companies specialised in preparing project applications, especially for complex projects requiring a tailor-made ex-ante assessment of the baseline, expected additional savings and procedure to validate the savings; about three in

[35] Di Santo D. et al. (2016) White certificates as a tool to promote energy efficiency in industry. Proceedings of the eceee Industrial Efficiency conference, Berlin, September 2016

four complex projects in the non-metallic mineral industry (2005 – 2012) was submitted by an ESCO (Di Santo et al., 2014)[36].

However, some issues with the Italian Energy Efficiency Obligation Scheme were observed as well (Di Santo et al., 2018)[37]. A first issue is related to the scheme's materiality. It was observed that some of the presented projects were already realised before applying for White Certificates. As a response, it was decided that, from 2014 on, applications for White Certificates should be submitted before the implementation of the project.

A second issue is related to over subsidizing energy efficiency projects. Especially project with a short pay-back time, the amount of White Certificates granted can exceed the investment cost.

As a response, measures with a short payback time were excluded from the scheme; the impact of receiving White Certificates on the economic feasibility of the project needed to be assessed ex-ante; and the rules concerning additionality compared to baseline were strengthened.

Lessons learnt:

- Energy Efficiency Obligation schemes demonstrate to be flexible instruments and do succeed in stimulating energy efficiency investments in a cost-effective way
- Support schemes can trigger the development of the ESCO market to support the industry in applying for subsidies
- Care should be taken to avoid subsidising projects with short payback times and to avoid over subsidising

3.3.3. Effects of the energy audit obligation for large companies in Germany

Mai and Gruber (2018)[38] evaluated the effects of the energy audit obligation for non-SMEs as imposed by the Energy Efficiency Directive Art. 8. They issued an online survey to about 10.000 German industrial companies asking about their energy consumption, energy practices and experiences in auditing the company's energy consumption and in implementing an energy management system.

About 900 complete surveys were returned; of which 462 have completed an energy audit and 403 had introduced a certified energy or environmental management system.

The survey results demonstrated that this obligation was effective. Three quarter of the companies having completed an energy audit, would not have done so without this legal obligation, and another one in six would have carried out the energy audit later and/or less extensive. Also half of the companies, having implemented an

[36] Di Santo D. et al. (2014) White certificates in industry: the Italian experience. Proceedings of the 2014 International Energy Policy & Programme Evaluation Conference (IEPPEC), Berlin

[37] Di Santo D. et al. (2018) White certificates in Italy: lessons learnt over 12 years of evaluation. Proceedings of the 2018 International Energy Policies and Programmes Evaluation Conference (IEPPEC), Vienna

[38] Mai M. and Gruber E. Effects of the energy audit obligation for large companies in Germany. Eceee Industrial Summer Study, Berlin, September 2018, Proceedings pp 129-138

energy management system would not have done so without this legal obligation as well. In addition, three quarter of the respondents would recommend other companies to complete an energy audit as well.

However, a low energy saving potential was identified. Mai and Gruber (2018) concluded that the legally obliged energy audits often lack profoundness and are often limited to crosscutting technologies, while larger savings could be realised in process optimisation. Also the quality of the energy audits and audit reports was unsatisfactory in about half of the cases.

In addition, the satisfaction of the respondents on the cost-benefit relation and the internal time spent for the audit was rather low. An average, the costs for an energy audit amounted to about €25,000 (€13,600 for the external auditor + €10,000 internal personnel costs) and the costs for certificating an energy management scheme amounted about €100,000 (€17,000 for the external expert + €9,000 for certification + €74,000 internal personnel costs). The costs were born by the companies themselves.

Lessons learnt:

- Obligations to audit the energy consumption and implement energy management schemes are effective in stimulating companies to take initial steps in the decision making process for energy efficiency and renewable energy investments
- They are less effective in stimulating companies to complete the decision making process and make them invest

3.3.4. Energy Management as a driver for improving a company’s energy performance

The Swiss M_Key project, part of the National Research Programme "Managing Energy Consumption"[39], aimed at assessing to what extent energy management is a key driver of energy performance of large enterprises.

The underlying core assumption of the study was that energy management acts as an organisational filter that positively influences company perception of the strategic character of energy efficiency investments and, in turn, influences their choices regarding these investments. In particular, the study analysed:

- How the energy management level of a company influences its perception of the strategic nature of an energy efficiency investment;
- How this perception influences energy efficiency investment decisions;
- How actual energy efficiency investments influence the energy performance level of the company.

To analyse these influences, more than 3.000 companies were contacted via a survey, more than 300 companies were interviewed and 5 in-depth case studies were carried out. The findings of their results are summarised in Table 11.

[39] Iten et at. Management as a Key Driver of Energy Performance. Zurich/Neuchâtel, 15 November 2017.

Assessed aspect	Findings
Level of the energy management in large enterprises and its determinants	The level of energy management of the assessed companies is rather low (10.3 points out of the maximum reachable score of 23 points). Support from the top management is the most determining factor for the company's energy management level. Other important factors are the company size, its energy intensity, public policies and the support of the energy manager.
Influence of energy management on perceived strategic nature of energy efficiency investments	No clear impact of energy management on the perceived strategic nature of energy efficiency investments could be observed. In the contrary: the more energy efficiency investments are perceived as strategic, the more strong energy management is considered as important.
Influence of perceived strategic nature of energy efficiency investments on actual energy efficiency investments	Energy efficiency investments have a limited strategic relevance. In contrast, corporate companies with sustainability strategies and/or targets pay more attention to energy efficiency and, as a result, to energy management. The more a project or investment is considered as strategic, the more sophisticated financial criteria are applied. This is valid for every kind of investment decision, not only for energy efficiency investments. Most companies indicate to take energy efficiency investment decision fully independently. Yet, input received from knowledge sharing activities help to identify untapped energy saving potential and new energy efficiency projects. Public policies have a strong impact on the companies' actions. The Swiss CO_2 target agreements, supported by the CO_2 levy reimbursement agreements were considered as most relevant by the respondents. Most companies take their investment decisions based on today's energy prices; possible changes in energy prices are rarely considered.
Influence of energy efficiency investment decisions on energy performance	In general, the contacted companies indicate a direct impact of energy efficiency investments on the companies' energy consumption but are unable to demonstrate this due to a lack of data.

Table 11: Findings of the Swiss study on the impact of energy management on the energy performance of large companies (Source: Iten et al., 2017)

This study allows to conclude that the commitment of the top management to sustainability action, including climate action, is a key driver for improving the company's energy performance. To complement, laws and regulation are effective for companies with a low commitment.

Lessons learnt:

- Commitment of the top management to climate action is a key driver for improving the company's energy performance
- Prescriptive measures are effective for companies with a low commitment

3.3.5. Long-term agreements in the Netherlands: the complexity of the decision-making process for energy efficiency investments

3.3.5.1. Introduction to voluntary agreements

Voluntary agreements are essentially contracts between the industry and the government to improve the sector's environmental performance. These contracts or agreements are voluntary, because targeted industrial companies are free to participate. Yet, participating companies must commit to mandatory actions and/or to achieve an agreed target. In return, the government offers the participants (financial) benefits, energy tax reduction most often, in case of compliance.

The Netherlands was the first European country to install long-term agreements or negotiated voluntary agreements with the industry to improve the sector's energy efficiency. First agreements were concluded already in 1991; the target for most sectors was to improve energy efficiency by 20% by 2000 compared with 1989. This target was overachieved – the actual energy efficiency improvement was 22.3%. As a result, the Dutch long-term agreements were considered as exemplary and many other European countries implemented voluntary agreements following the Dutch example.

The Netherlands was also an innovator in the field of voluntary agreements. It introduced benchmarking as a basis of setting the target for the energy intensive industry in its second generation of long-term agreements. In the third generation, the scope was expanded to outside the perimeter of the participants by allowing them to include actions in the supply chain or by allowing them to design products with less GHG emissions during their utilization phase; concepts that were copied by Belgium.[40]

The current generation of voluntary agreements is organised according to the companies' obligations under the EU Emissions Trading System (EU-ETS). The Long-Term Agreements on Energy Efficiency (LEE) targets companies with obligations under the EU-ETS. Their goal is a 'significant contribution' to improving energy efficiency for their facilities. The Long-Term Agreement 3 (LTA3) targets companies not participating in the EU-ETS. The objective of the LTA3 is a 30% improvement of the energy efficiency by 2020 (compared to 2005 levels). About 1100 companies participate to both agreements; they represent about 80% of the industrial energy consumption in the Netherlands.

Companies participating in one of the voluntary agreements have to audit their energy consumption every four years; all identified energy saving measures with a Pay-Back Time (PBT) of 5 years or less need to be implemented in the next four years.

To support the companies, a list with of candidate energy saving measures and a guideline to calculate their cost-benefit balance are provided by the Netherlands Enterprise Agency.[41] In addition, companies with an annual electricity consumption of 10 GWh or more can benefit from a rebate of energy taxes.

In 2013, the cost effectiveness of the LTA3 was assessed. Considering the total cost of the policy instrument (about €24 million per year), the resulting energy savings (30.6 PJ primary) and an additionality of 50%, the cost effectiveness was estimated at €1.6 per saved GJ. To compare, the cost-effectiveness of the ETS was estimated at €0.70-0.90 per saved GJ.[42]

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[40] Cornelis E. History and prospect of voluntary agreements on industrial energy efficiency in Europe. Energy Policy 132 (2019) 567–582

[41] See list of energy saving measures (in Dutch): https://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-besparen/mja3-mee/tools/maatregellijsten

[42] Ecorys (2013) Evaluatie Meerjarenafspraak Energie Efficiëntie 2008-2020 (MJA3). Ex-ante en ex-post analyse. (in Dutch)

3.3.5.2. Analysis of the payback time of the implemented measures

The participants to the Dutch voluntary agreements have the obligation to implement all detected energy saving measures with a payback time up to 5 years. Yet, Abeelen et al (2014)[43] observed that about one fifth of projects fulfilling this criterion have not been implemented.

In addition, no correlation between payback time and rate of implementation could be found; in other words: projects with a low payback time are implemented as often as projects with a higher payback time (>5 years).

One possible explanation is that no correct economic feasibility assessment could be made for these projects at the time of the planning or the used financial metric (payback time) was inadequate of assessing the economic feasibility of the projects correctly. Another possible explanation is that energy savings were not the dominant criterion for approving these investments by the board and that other considerations, such as the strategic nature of investments, non-energy benefits or an urgent need for a retrofit have been decisive.

Abeelen et al. (2013)[44] also observed that some companies succeeded in reducing their energy consumption to a half over a period of 10 years (2001 – 2011). These large savings typically come in large steps, when major installations are replaced.

Lessons learnt:

- A variety of barriers, drivers and actors play a role at different stages of the decision-making process, underlining the complex nature of such investments
- Hence, only well-designed policy instruments impacting a variety of barriers and drivers can be effective
- Non-energy-related factors often outweigh energy-related factors in economic feasibility assessments of energy efficiency and renewable energy investments
- Hence, care should be taken when embedding mandatory economic feasibility criteria in the design of policy instruments aiming to foster energy efficiency and renewable energy investments

3.3.6. Audit and retrofit programmes for electric engines

3.3.6.1. Lesson learnt from the Swiss 'Easy' programme

The Swiss Agency for Efficient Energy Use launched in 2010 the 'Easy'-programme. This audit and retrofit programme aimed at assessing and improving electric motor systems at energy-intensive end-consumers, mainly in the industry. It ran until the end of 2014. As a first step of the audit, the electric motor systems in the companies where listed; a more-in depth analysis resulted in recommendations for replacement

[43] Abeelen C. et al. (2014) Planning versus implementation of energy-saving projects by industrial companies. Insights from the Dutch Long-Term Agreements. Energy Efficiency. DOI 10.1007/s12053-015-9355-1

[44] Abeelen C., Harmsen R., Worrell E. (2013) Implementation of energy efficiency projects by Dutch industry. Energy Policy 63 pp 408-418. http://dx.doi.org/10.1016.enpol.09.048

of motors; actual replacements of the least efficient motor was the final step of the audit.

Financial incentives were offered to the participants, mainly to cover the cost for auditing the energy efficiency potential; the programme covered only 10% of the investment costs of an energy efficient motor. The financial incentives hence mainly served as a door opener.

Analysis of over 4,000 electric motors has revealed that more than half of these are older than their expected life time. Less than 20 % of the motors assessed have variable frequency drives to control their load. From the 104 motors measured, 68 % are oversized (average load factor below 60 %) (Werle et al, 2014)[45], see Figure 17.

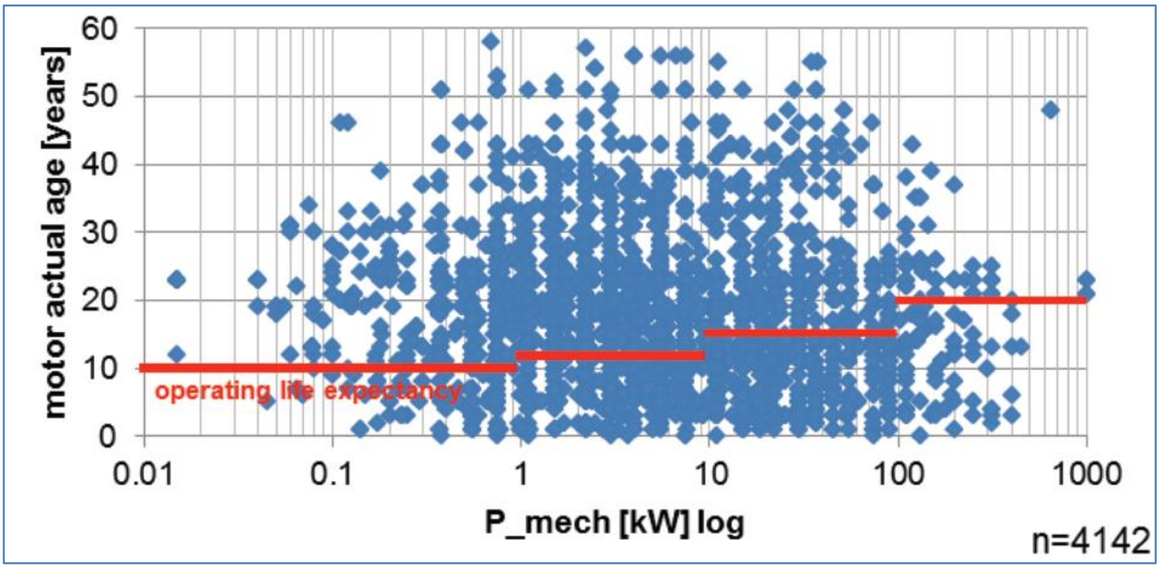

Figure 17: Analysis of actual age of 4,142 electric motors in Switzerland (Source: Werle et al., 2014)

It was observed that the implementation of motor systems efficiency projects was hampered by a lack of resources, time, responsibilities, technical know-how and financial resources. As a response, a training program: "Energy technology and management in industry" was introduced, targeting technical people and endowing them with both managerial and technical skills.

Experience with this programme revealed that external electric motor experts and internal energy experts need to interact well. The former bring in expertise on electric drives, while the latter bring in a good understanding of the company's processes. In addition, experience with this programme demonstrated that it is crucial to involve the suppliers of components and systems into the analysis and retrofit of motor systems from an early stage.

The Easy methodology, although comprehensive, demonstrated to be too time and resource consuming. Between 10 to 30 motors were measured in each factory in the pilot phase, while the cost of measuring one motor system and elaborating recommendations for the efficiency improvement was between €1,000 and 1,500. As

45 Werle R. et al. (2014) Financial incentive program for efficient motors in Switzerland: lessons learned. Proceedings of the eceee 2014 Industrial Efficiency conference, Arnhem.

a result, the cost for measuring electric motors varied between €10,000 and 40,000. Hence, an alternative approach grouping electric motor systems by application and resulting in a multi-annual retrofit plan for a continuous improvement process was suggested. There is a risk though that the company focuses on quick wins and does not embed electric motor management in a more comprehensive energy management system.

Finally, learning from other good examples demonstrated to be very instructive. The program managers of the programme participated to the international Electric Motor Systems Annex (EMSA) of the IEA 4E Implementing Agreement. This network brought experts from six countries (Australia, Austria, Denmark, Netherlands, Switzerland, and USA) together to exchange experience on motor policies. Especially the Dutch Green Deal Efficient Electric Motor Systems (see below) was appreciated as a good example.

Lessons learnt:

- Drafting a multi-annual plan and embedding it in the company's energy management system is an effective lever for an actual improvement of electric motor systems at energy-intensive end-consumers
- The applied methods need to find a trade-off between being comprehensive and being practical
- The involvement of various stakeholders along the supply chain catalyses the adoption of energy-efficient equipment by the industry
- International collaboration fostering a knowledge exchange on similar programmes is instructive

3.3.6.2. Lesson learnt from the Dutch 'Green Deal Efficient Electric Motor Systems' programme

The Dutch Green Deal Programme on efficient motor systems was launched in the Netherlands in 2012 and operated until 2015. The programme aimed at accelerating the penetration of energy efficient motors in the Dutch industry. (van Werkhoven et al., 2014)[46]

The programme was initiated by the FEDA (the Federation of suppliers of Electric Motors, Drives and Automation Engineering) and the Uneto-VNI (the trade association of installation and electromechanical maintenance companies). Thirty of their member companies joined the programme. The government was involved as secretary of the project group and had a representative in the steering committee. The programme was managed by an independent consultant.

The key aspects of this program were three fold.

1. The development of a standard method for the analysis of opportunities for efficiency improvements in motor systems.
2. The development of sound business cases on efficient motor systems, delivering concrete energy savings.
3. Knowledge transfer and communication to end users and the supply chain to create leverage in terms of working methods, capacities and energy savings.

[46] Werkhoven, van M. et al. (2014) Engaging Dutch industry in implementing efficient motor systems with the Green Deal Program. Proceedings of the eceee Industrial Efficiency conference, Arnhem, 2014

In 2013, several pilots were started in various industrial sectors, see Figure 18.

Sector		Inven-tory	Selec-tion	Otions	Ex-ante meas.	Busi-ness case	Imple-men-tation	Ex-post meas.
Metals industry	Cooling water pumps, VSD + IE4							
Water distributor	New pump chamber							
Water treatment	Aeration process plant							
Metals industry	Process fan VSDs							
Water distributor	Pumps, VSD + motors							
Paper mill	Cooling water pumps							
Dairy industry	Motor systems analysis							
Dairy industry	Pump systems analysis							
Pharmaceuticals	Ventilation cleanrooms							
Food industry	Compressor VSD + motors							
Water treatment	Cooling systems, pumps and fans							
Plastics production	Motor systems analysis							

Figure 18: Projects of the Dutch Green Deal Programme on efficient motor systems (source: van Werkhoven et al., 2014)

The project itself did not provide financial support, but it was well aligned with existing policy instruments from which the participating companies could receive subsidies.

The project partners participated to the 4E Electric Motor Systems Annex (EMSA), part of the IEA Implementing Agreement for a Co-operating Programme on Efficient Electrical End-Use Equipment (4E). This fostered knowledge exchange with project managers of similar programmes in other countries (Australia, Austria, Denmark, Switzerland, and USA).

The two initiating organisations together with the Dutch Pump Association and the Netherlands Enterprise Agency started a 'knowledge network' in the wake of this programme to support the implementation of Efficient Electric Motor Systems and raise the awareness of its potential. The network worked on capacity building in the market and on awareness raising at the end-users. The network is still operational today (see: http://www.keea.nl/ - in Dutch).

Lessons learnt:

- The involvement of suppliers of equipment catalyses the uptake of energy efficient equipment by companies
- Programme managers benefit from learning from other best practises, implemented by other countries

3.3.7. Energy Efficiency networks

Energy Efficiency Networks or Learning Networks aim at stimulating the uptake of sustainable energy projects by facilitating the knowledge exchange on energy efficiency and renewable energy projects between energy managers of a selected group of companies – about ten typically, usually from the same area. This collaboration has a predefined duration, three to four years typically. An energy auditor assesses the potential for energy efficiency and renewable energy projects in the beginning; the companies agree collectively on an energy savings or carbon reduction target. A moderator organises regularly – typically four times a year – meetings with the energy managers of the participating companies and invited experts to discuss practical aspects of such projects and to exchange knowledge and lessons learnt with the objective to facilitate the implementation of the identified energy saving measures.

The concept of such networks was developed in Switzerland in 1980s and 1990s. As the concept demonstrated to be successful, Germany started to introduce learning networks as well. A first pilot network was introduced in 2002, where it expanded. In 2014, Learning Networks became a main pillar in the German National Action Plan on Energy Efficiency; The Energy-Efficiency-Networks Initiative (IEEN) was launched as a voluntary agreement with the German economy aiming at the creating of 500 such networks between 2014 and 2020.

Companies, that wish to participate to a learning network, have to pay an annual fee to be part (ranging from 1000 to 5000 €) and to participate actively. In return, they receive tailor-made and hands-on advice on energy efficiency and renewable energy measures.

Durand et al., 2018 assessed the IEEN-initiative[47]. In 2018, 154 such networks were registered to which more than 1,500 companies participate. Various topics are discussed in meetings of the learning networks are: experience exchange, energy efficiency measures development, expert presentations, site visits, Energy Management System (EMS), regulatory frameworks, cross-sectional technologies, support schemes, measurement concepts and energy supply.

On average, the networks commit to 32 GWh final energy savings. A preliminary assessment of the additionality of the learning networks indicated that:

- Almost 60% of the implemented measures have been detected in the course of the network activities and was not suggested in earlier energy audits;
- 45 % of the interviewed companies said that they implemented measures because of their participation in their learning network.

A survey addressed to about 140 involved stakeholders revealed a high satisfaction amongst the participating companies; 94 % of companies would recommend network participation to other companies. As a result, more and more learning networks initiate a second cycle of 3-4 years after concluding a first one.

Durand et al. 2018 observed that, the longer companies participate in a learning network, the more they are likely to question the energy efficiency of their production plants in more depth. In a few companies, new ideas for energy efficient

[47] Durand A. et al. (2018 Energy efficiency networks: lessons learned from Germany. Proceedings of the 2018 eceee Industrial Efficiency conference, Berlin.

solutions in production processes or in own products have been observed as well. Moreover, some large companies started own internal learning networks, some of which have set energy saving targets.

Learning networks face one main challenge: convincing companies to join a learning network is a very time-consuming and cost-intensive process. Similar observations were made in Sweden[48]. The acquisition process is often a matter of trust; therefore, the trustworthiness of the organisation/person carrying out the acquisition is of vital importance.

Lessons learnt:

- Local, financially self-supporting learning network demonstrate to be very effective in stimulating energy efficiency and renewable energy investments
- Especially the hands-on support by experts and knowledge exchange from other companies foster the uptake of energy efficiency and renewable energy investments
- However, convincing companies to join such a learning network is a time- and resource consuming process

3.3.8. The Energy Coach Programme of the City of Ghent, Belgium

As part of the Climate Action Plan of the City of Ghent, Belgium, the city has implemented a local programme to support companies (De Grande, 2019)[49]. It targets companies with an annual electricity consumption of at least 100 MWh or fuel consumption or at least 345 MWh. Companies, participating to the Energy Governance Agreements, a regional voluntary agreement on energy efficiency, are not eligible.

1. The programme follows a three steps' approach:
2. First, an energy audit is carried out by an independent energy consultant;
3. Second, the company agrees upon an energy action plan, in which to company commits to implement all energy saving measures with a pay-back time up to 2 years;
4. Third, the companies are coached in the implementation process.

This audit focuses on the most cost-effective measures, as most of the addressed companies have no experience in managing their energy consumption and improving the energy efficiency.

The programme is funded by the city's Environmental & Climate Service. However, in order to commit the companies, they have to pay a limited contribution in function of their electricity consumption, see Table 12.

[48] Strömvall E.. (2018) Energy Efficiency Network Programme for SMEs. Proceedings of the eceee Industrial Efficiency conference 2018, Berlin

[49] De Grande B. (2019) What is energy coaching? Presentation at the second round table meeting, Brussels, 30 January 2019

Electricity consumption (MWh/year)	Offer	Energy audit	Coaching	Coaching value (€)	Contribution of company (€)
<100	LIGHT	✓	Tailored advice in ½ day 10 additional days on demand	> 500	Free
100-500	MEDIUM	✓	1 year, including preparation and implementation of energy saving plan	4,000	400
500	MAXI	✓	1 year, including preparation and implementation of energy saving plan (more consultancy hours and MEDIUM offer)	7,000	700

Table 12: Different offers in the energy coaching programme of Ghent

The programme started at the end of 2014 after a pilot project of two years. More than 250 companies from various sectors have been coached. On average, their annual energy savings amount to 45 MWh of electricity and 56 MWh of fuels.

After some years of experience, some challenges related to the programme have been observed:

- The acquisition process is very time consuming, it is also very difficult to convince the non-believers to participate. This challenge has also been observed for the learning networks in Germany and Sweden.
- The implementation of measures is often delayed. This especially the case for capital-intensive investments, investments with a longer payback time and/or in case approval from a parent company abroad is necessary.
- Change of staff, both inside the company or of external energy coaches, can cause additional delays.
- Monitoring the implementation of the measures, in line with the expressed commitments by the company, is a time consuming process for the Climate team of the City of Ghent.

Lessons learnt:

- Also the local level can implement effective programmes on energy efficiency and renewable energy, targeting the industry
- The commitment by the participating company to implement cost-effective measures is one of the key success factors of the Energy Coach Programme of Ghent
- The companies have to pay a limited contribution in order to anchor their commitment
- Convincing companies to participate to the programme is a time- and resource consuming process

4. What can the EU do?

The European Commission is the executive arm of the EU. It is responsible for drawing up proposals for new European legislation, implementing the decisions of the European Parliament and the Council of the EU, upholding the EU treaties and managing the day-to-day business of the EU. This chapter suggests actions that the European Commission can take in view of the information presented in the previous chapters.

Field of action	Suggested action	Prescriptive	Supportive	Economic
Working with companies	Assessment of the effectiveness of the IPPC-Directive on the requirements on an efficient use of energy	●		
	Standardisation of Corporate Climate Responsibility strategies	●	●	
	Establishment of technical knowledge centres to support companies		●	
Working with products	Revision and update of the regulation on industrial product groups under the Ecodesign and energy labelling framework	●		
	Regulation of the embedded carbon of products	●		
Working with EU Member States	Pan-EU study on best-practice policies stimulating energy efficiency and renewable energy		●	
	Creating a market for waste heat from industry	●	●	
Economic stimuli	Carbon credits for supplied waste heat			●

Table 13: Overview of the suggested actions for the European Commission to foster the uptake of energy efficiency and renewable energy by the industry

4.1. *Working with companies*

4.1.1. Assessment of the effectiveness of the IPPC-Directive on the requirements on an efficient use of energy

The analysis of the implementation of energy efficiency projects by Dutch industry (Abeelen et al., 2013)[50] – see section 3.3.5.2 – revealed that significant energy efficiency improvements can be realised when industrial installations undergo major refurbishments, up to 50%. Retrofits of existing installations, as well as the construction of new installations, offer a window of opportunity to promote sustainable and efficient use of renewable energy.

Both substantial retrofits and the construction of new installations require a permit, granted by the competent authority.

[50] Abeelen C., Harmsen R., Worrell E. (2013) Implementation of energy efficiency projects by Dutch industry. Energy Policy 63 pp 408-418. http://dx.doi.org/10.1016.enpol.09.048

Article 12 of the IPPC-Directive – short for: Integrated Pollution Prevention and Control (Directive 2010/75/EU)[51] – stipulates that "Member States shall take the necessary measures to ensure that an application for a permit includes a description of the following: […] (i) further measures planned to comply with the general principles of the basic obligations of the operator as provided for in Article 11; […]". Article 11 of this Directive stipulate that "Member States shall take the necessary measures to provide that installations are operated in accordance with the following principles: […] (f) energy is used efficiently; […]".

Hence, the European Commission could launch a study to evaluate the implementation of these articles of the IPPC-Directive by the EU Member States and to assess whether the uptake of energy efficiency and renewable energy can be included as a core consideration in the design of these installations when granting a permit.

4.1.2. Standardisation of Corporate Climate Responsibility strategies

The round table meetings demonstrated that industrial companies are increasingly committed to climate action and that they are ready act accordingly. Rather than assessing the potential of energy efficiency and renewable energy in isolation, they see it in the context of a more comprehensive Corporate Social Responsibility strategy. For instance for Oleon and its corporate stakeholders, 'Energy efficiency & CO_2 emissions' is one of topics of the highest importance, see Figure 19.[52]

Currently, companies rely on the standards for sustainability reporting the Global Reporting Initiative (GRI)[53]. The European Commission can develop a European standard for Corporate (Social) Responsibility Strategies to ensure that companies contribute to the European Union's climate strategy and European Commission's climate policy.[54]

This standard serve as a European seal of quality and adherence to the sustainability agenda. It could be developed as an action under the LIFE programme. Later on, it could gradually become mandatory for certain companies (for instance those that emit more GHG or consume more energy, possibly aligning the scope to Article 8 of the Energy Efficiency Directive 2012/27/EU). Knowledge sharing in the initial stages could increase levels of acceptance and support proper implementation. All companies and entities should be encouraged to follow the corporate (social) responsibility standard and SMEs and voluntary movers could receive separate support.[55]

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[51] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)

[52] Source: Corporate Social Responsibility Progress report of Oleon 2017

[53] See: https://www.globalreporting.org/standards

[54] The term CSR is not defined in a harmonised way. Some companies refer to CSR as Corporate Social Responsibility, even though the scope is larger than social aspects only. Some define CSR as Corporate Sustainability Strategy, while other only refer to CR – Corporate Responsibility

[55] See Smith H. C., Litsheim B. CSR (2016) Corporate Social Responsibility or Corporate Sustainability Responsibility. Proceedings of the Conference: SPE International Conference and Exhibition on Health, Safety, Security, Environment, and Social Responsibility, 11-13 April, Stavanger, Norway. DOI: 10.2118/179249-MS

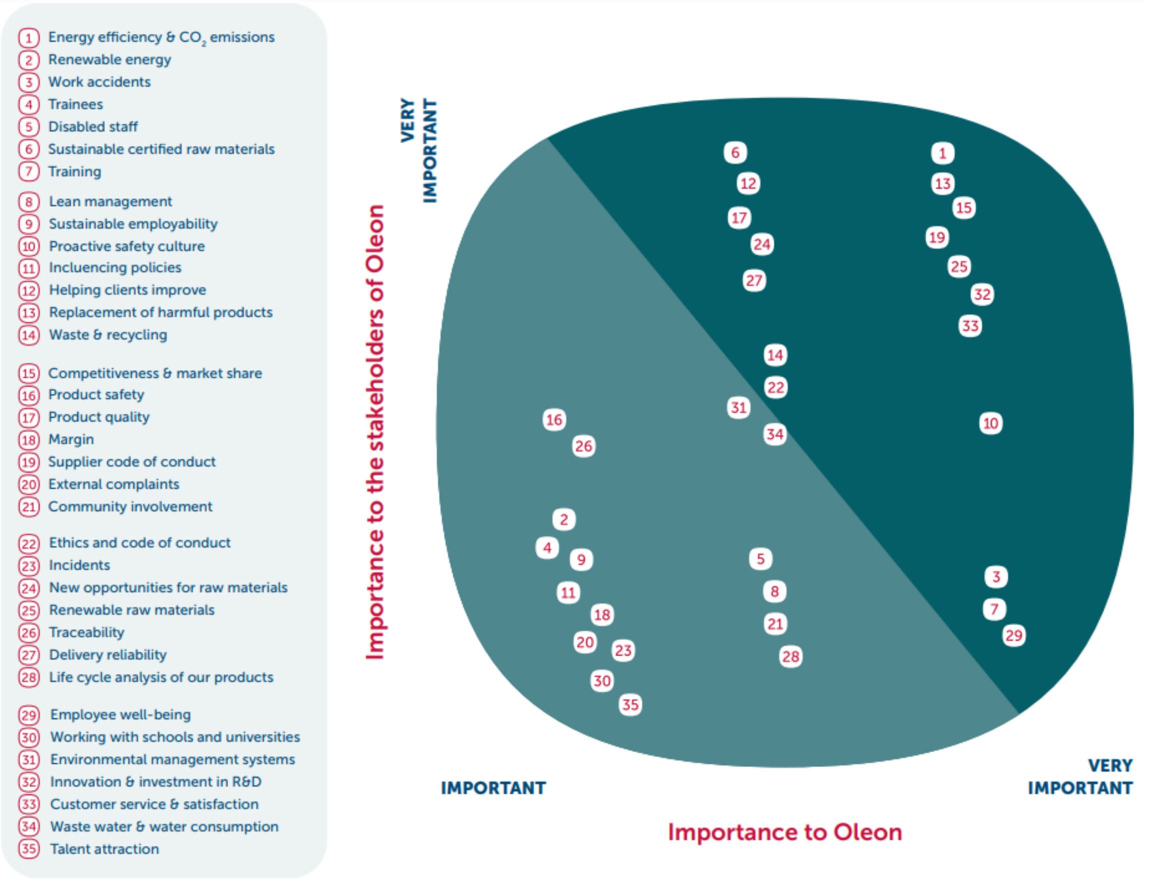

Figure 19: Materiality matrix - basis of the Corporate Social Responsibility strategy of Oleon[56]

4.1.3. Establishment of technical knowledge centres to support companies

Audit programmes for electric motors, see subchapter 3.3.6, highlighted the synergetic effect of international collaboration and knowledge exchange. In the field of energy efficiency and renewable energy projects there is experience from across the Atlantic to learn from.

In the USA, an institutionalised network of Industrial Assessment Centers (IACs) is created to support small and medium sized manufacturers in saving energy, improving productivity, and reducing waste – see https://iac.university/. This network consists of polytechnical faculties and research centres, see Figure 20. The IAC programme is administered by the US Department of Energy.

University-based teams of engineering students provide no-cost technical assessments according to a harmonised protocol, resulting in a comprehensive report with specific details on all identified opportunities, including applicable rebates and incentives. About 19,000 assessments have been carried out in the framework of this programme, which has resulted in about 150,000 recommendations to improve energy efficiency. These are uploaded in a central, open database (respecting the anonymity of the companies). Based on these data technical papers, case study reports and scientific papers are drafted.

[56] Source: Corporate Social Responsibility Progress report of Oleon 2017

The network of centres – at the time called the Energy Analysis and Diagnostic Centers – was created by the US Department of Commerce in 1976 in the wake of the oil crisis. The original mission of the network was to avoid an inefficient energy use. Gradually evaluations of ineffective production procedures, excess waste production, and other production-related problems were included to the network's mission. More recent additions to the IAC programme scope include improving cybersecurity awareness, exploring smart manufacturing technologies, and implementing comprehensive energy management systems.

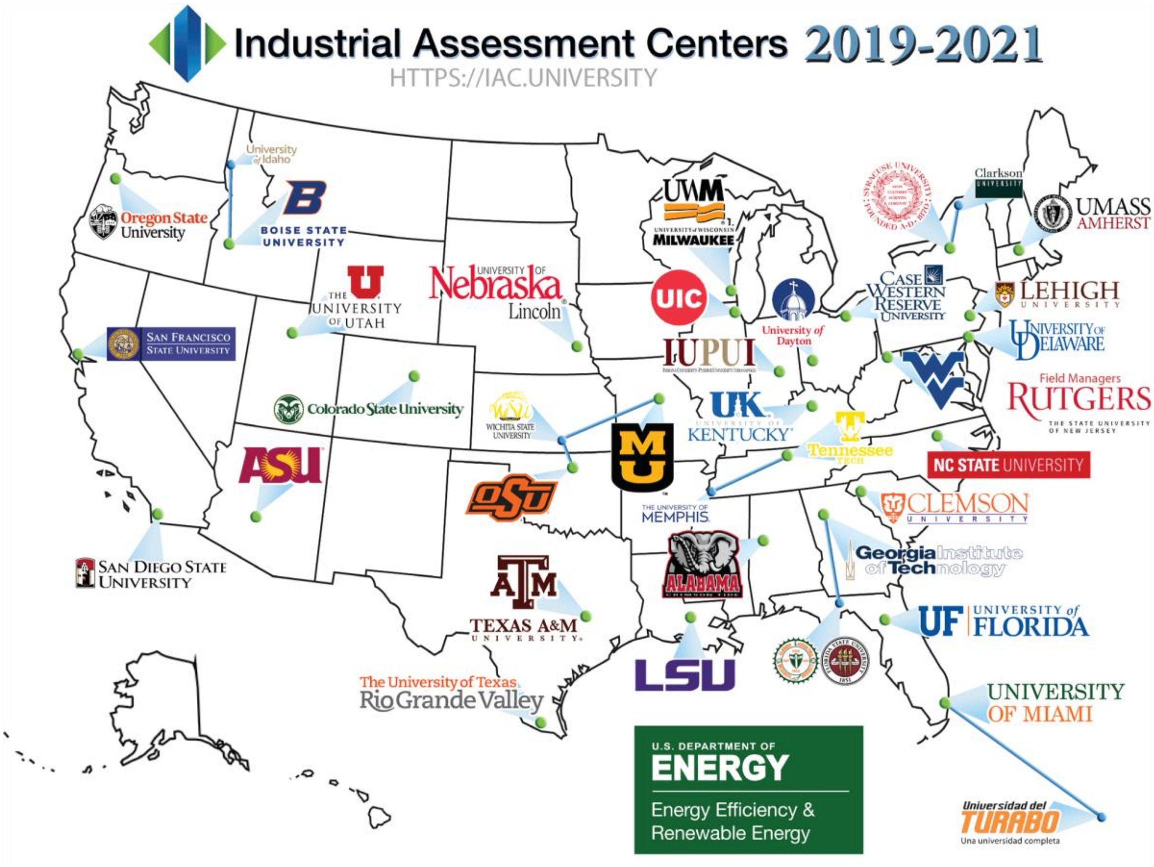

Figure 20: Network of Industrial Assessment Centres in the United States[57]

Europe could establish a similar network, bringing various already well reputed knowledge centres on industrial process together. They should be well distributed over the EU, without excluding regional collaboration between EU Member States. They can cover different topics, such as: decarbonisation, circular economy, digitalisation, cybersecurity, smart manufacturing technologies and should work closely together with the industry and foster knowledge exchange in between these.

Such a network could be financed by the LIFE programme or by other EU funds; the Joint Research Centre could administer this network.

[57] Source: https://www.energy.gov/eere/amo/locations-industrial-assessment-centers

4.2. Working with products

4.2.1. Revision of the regulation on industrial product groups under the Ecodesign and energy labelling framework

In October 2019, the Commission adopted Ecodesign implementing regulations, among others those relevant for the industry:

- External power suppliers
- Electric motors
- Power transformers
- Welding equipment

Three of these four regulations revise already existing requirements, whereas welding equipment is regulated for the first time.

The European Commission could plan the revision of Ecodesign implementing regulation of other product groups, relevant for the industry, in particular injection moulding machines.

Also, for some product groups, such as for industrial and laboratory furnaces and ovens and steam boilers, Ecodesign of Eco-Labelling Regulations will not be proposed.[58] These studies could be reviewed to validate whether these conclusions are still up-to-date. In addition, the role and regulation of smart and ICT equipment could be assessed.

4.2.2. Regulation of the embedded carbon of products

Companies committed to climate action usually include the lifetime emissions from different phases of the supply chain in their greenhouse gas inventory. Therefore it is important to allow transparency for procurement of products with reduced embedded carbon.

As an example, in 2017 the state of California enacted the "Buy Clean California Act", a bill that aims at limiting the embedded carbon emissions of some construction materials used in public works projects: structural steel (hot-rolled sections, hollow structural sections, and plate), carbon steel rebar, flat glass, and mineral wool board insulation.[59]

Contractors, that wish to use such products for public works need to present a facility-specific Environmental Product Declaration (EPD). Such a declaration is an independently verified and registered document that communicates information about the life cycle environmental impact of products. The raw material producer conducts a product life cycle assessment and works with a program operator to verify and publish an EPD. An EPD needs to follow the guidelines of ISO 14025 (Type III Environmental Declarations – Principles and Procedures) and the applicable Product Category Rule (PCR), a set of rules, requirements and guidelines for a product group. This requires thorough monitoring and verification.

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[58] Ecodesign Working Plan 2016-2019 - COM(2016) 773 final.

[59] https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act

On January 1, 2019, authorities awarding tenders for public works will request that each successful bidder for a contract submit a facility-specific EPD for all eligible materials. On or after July 1, 2021, only eligible materials compliant with the Global Warming Potential (GWP) limit will be acceptable for use on public works projects.

The European Commission could test a similar approach for elaborating a methodology for monitoring, verifying and making use of embedded carbon in products. That would require a stepwise approach: development of a procedure on how to regulate the embedded carbon of products and an assessment of which the types of products groups would benefit the most of such a regulation.

4.3. Working with EU Member States

4.3.1. Pan-EU study on best-practice policies stimulating energy efficiency and renewable energy

The analysis of policies and measures reported in the National Energy Efficiency Action Plans of 2017 – see appendix 6 – revealed a huge variety of implemented policies and measures in the different EU Member States. (some best practice policy measures are presented in subchapter 3.2). There is no single policy instrument and different barriers require various instruments.

Understanding decision-making processes in industrial companies and the role of barriers, drivers and actors is in its infancy. Such understanding would be needed to link policies and measures on investment decisions by the industry.

The European Commission could study how currently implemented policies and measures relate to barriers and drive energy efficiency and renewable energy investments. As a result, measures should be adjusted to involve the right actors in the right way and a catalogue of best practice policies could be created for EU Member States, along with recommendations on how to best disseminate them.

4.3.2. Creating a market for waste heat from industry

About three quarters of the final energy consumption in industry in the EU28 comes from direct combustion of fossil fuels, the lion's share is used for heating purposes[60]. Heat degrades with use (second law of thermodynamics). Part of it can be reused within the installation for lower temperature heat or supplied to nearby companies via thermal networks. Yet, the majority of waste heat is still dumped into the environment.

The waste heat supply potential of about 1,200 energy-intensive industrial companies is estimated at 2.9 EJ.[61] This technical potential has been estimated to cover the EU's space heating demand. The economically recoverable potential, however, requires analysis of local conditions.

[60] Study for the European Commission under contract N°ENER/C2/2014-641 (2016) Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables)

[61] Urban P. (2015) Quantifying the Excess Heat Available for District Heating in Europe. Deliverable No. D 2.2: public document of the IEE project STRATEGO (Multi-level actions for enhanced Heating & Cooling plans) Work Package 2 Background Report 7. Halmstad University, Halmstad, Sweden.

Article 14 of the Energy Efficiency Directive[62] stipulates that the cost and benefits of utilising the waste heat should be assessed for every new of refurbished industrial installation (with a waste heat capacity of at least 20 MW). Although this requirement is helpful in raising awareness of the benefits on the valorisation of industrial waste heat, it is on its own not powerful enough to create a market for industrial waste heat.

One of the barriers to waste heat utilisation is the concern about the security of supply by the district heat grid operators and competition with the heat sources, they operate themselves. As a result, third party access to district heat networks is blocked in many cases. Yet, experience from Sweden demonstrate that the waste supply contracts last on average for 15 years, the risk of the waste heat source going out of business is between 13-20 % and that the investments, made by district heat grid operators, are paid back in 4 to 8 years.[63]

Article 24 of the revised Renewable Energy Directive (RED)[64] obliges operators of district heating or cooling systems to connect suppliers from waste heat and cold or to purchase waste heat and cold from them.

The European Commission could evaluate the implementation of this article to verify to what extent it lifts barriers to supply of waste heat from industry to district heating systems. Additional measures, such as the obligation for district heating system operators to take inefficient heat generation capacity out of service or to allow Third Party Access to these systems[65], could support the implementation of Art. 24 of the RED.

In addition, the organisation of peer-to-peer meetings among the suppliers and district heating / cooling system operators can help to demonstrate the economic feasibility of waste heat supply and to exchange lessons learnt on real business cases on waste heat delivery. The involvement of local authorities and consumers can improve the public acceptance of waste heat as a sustainable source of heating.

4.4. Economic stimuli

4.4.1. Carbon credits for supplied waste heat

An assessment of the preconditions, drivers and barriers for the development of waste heat-based district heating in two Swedish communities highlights financial

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62 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC Text with EEA relevance

63 Lygnerud K., Werner S. (2017) Risk assessment of industrial heat recoveries in district heating systems. Proceedings of the 3rd international conference on Smart Energy Systems and the 4th Generation District Heating; Copenhagen, 12-13 September 2017

64 Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)

65 See for instance 'Pöyry (2018) Third party access to district heating networks' for an assessment of Third Party Access to district heating systems in Finland

aspects as being the both the main driver and the main barrier behind such a development.[66]

As the costs of developing district heating networks can be very considerable, investment subsidies are instrumental in supporting this development. While the implementation of subsidy schemes is a competence of the EU Member States, the European Commission could consider issuing credits for the European Emission Trading Scheme for the supplied heat by eligible installations to improve the economic viability of waste heat supply by the industry.

[66] Persson S., Hjelm O., Gustafsson S. (2012) Development of excess heat-based district heating – A case study of the development of excess heat-based district heating in two Swedish communities. Engineering.

Appendices

1. Fact-sheet of the food and beverage sector
2. Conclusions of 1st Round Table Meeting (22 October 2018): Barriers to and solution for energy efficiency and renewable energy in the food and beverage sector
3. Conclusions of 2nd Round Table Meeting (30 January 2019): Key success factors of best performing policies and programmes
4. Conclusions of 3rd Round Table Meeting (20 March 2019): Decarbonisation strategies of corporate companies
5. Conclusion of 4th Round Table Meeting (20 June 2019): Shaping a sustainable industry: challenges and solutions
6. Overview of the policies and measures on industrial energy efficiency implemented by the EU Member States

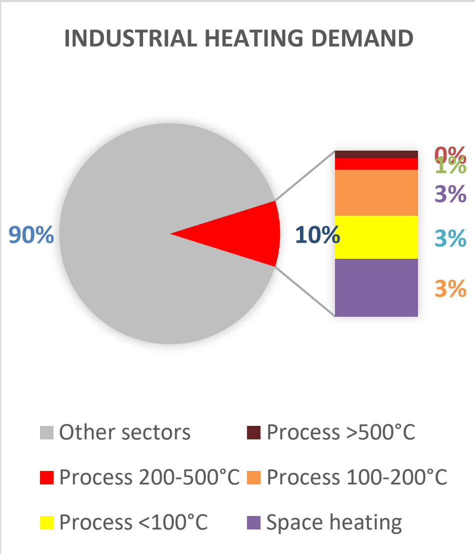
FOOD AND BEVERAGES

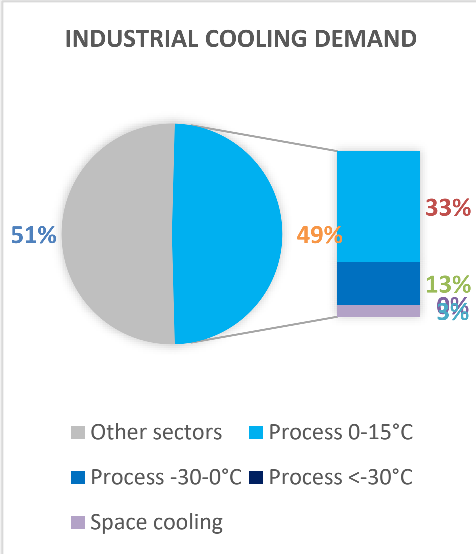
Energy

Heating and cooling needs

Total final heating demand (2012): 219 TWh/y – **10% of total industrial heating demand**

Total final cooling demand (2012): 48 TWh/y – **49% of total industrial cooling demand**



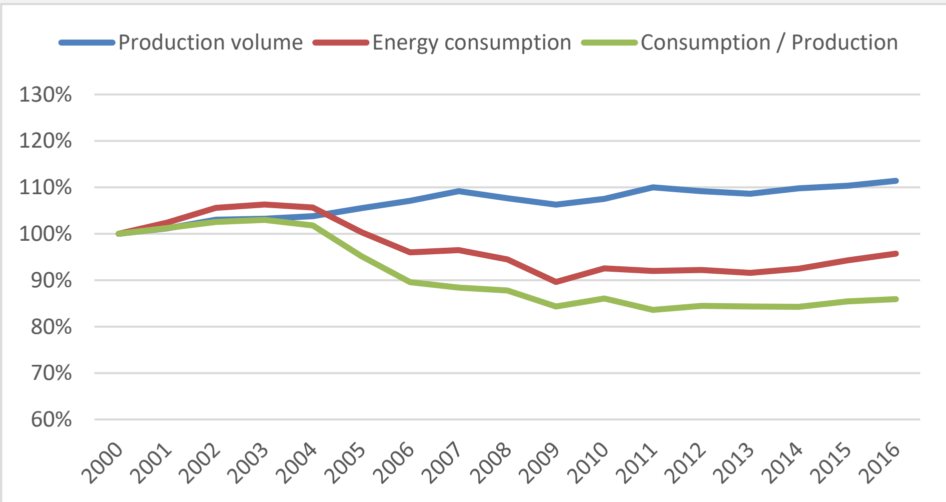


Source: DG ENER study (2016): Mapping and analyses of the current and future (2020 - 2030) heating/cooling fuel deployment (fossil/renewables)

Improvement in energy intensity

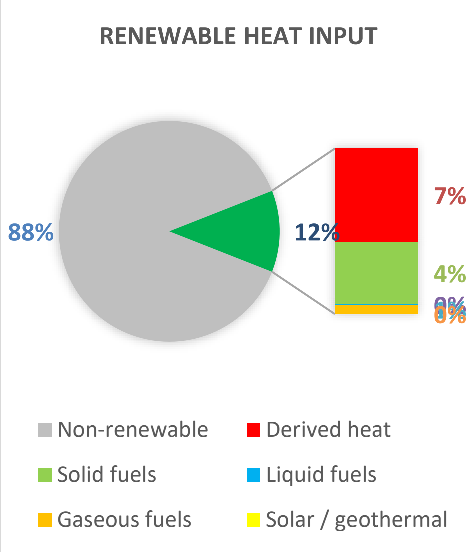
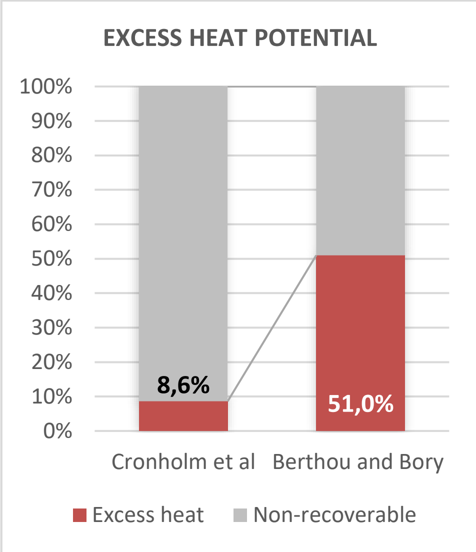
Variation in production volume (2000-2016): +11%

Variation in final energy consumption (2000-2016): -4%



Variation ratio (final energy consumption / production volume): -14%

Source: EUROSTAT

Renewable energy Excess heat potential	Consumption renewable heat (2012): 26 TWh/y  **12% of total final heating demand of the sector** Source: EUROSTAT	Excess heat potential versus fuel consumption  Source: Cronholm et al (2009); Berthou and Bory (2012)

Best available techniques Reference document (BREFs) developed under the IPPC Directive and the IED

BREFs

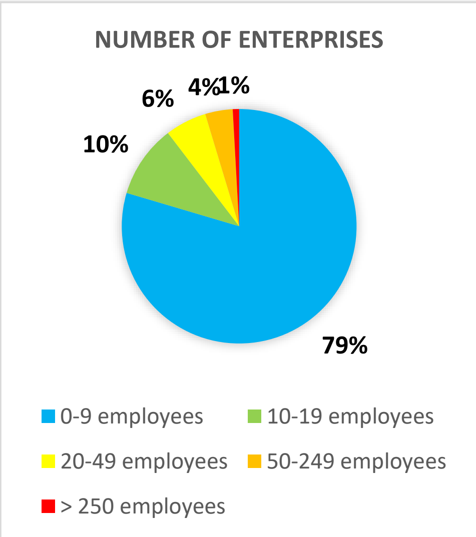
Best available techniques Reference documents:

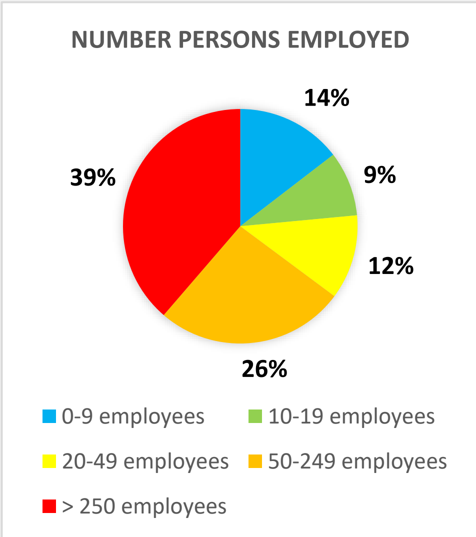
- Food, Drink and Milk Industries – BREF (08/2006) – Formal draft of 01/2017 available – http://eippcb.jrc.ec.europa.eu/reference/fdm.html
- Slaughterhouses and Animals By-products Industries – BREF (05/2005) – Formally adopted – http://eippcb.jrc.ec.europa.eu/reference/sa.html

Structure of the sector

Size of companies

Distribution of enterprises and total number of persons employed by employment class (2015)





On average: **15** number of persons employed per enterprise

Source: EUROSTAT

European Commission

Energy Efficiency & Renewables

Round Tables

ROUND TABLE MEETINGS

WITH THE FOOD & BEVERAGE SECTOR

FIRST ROUND TABLE MEETING CONCLUSIONS

BARRIERS TO AND SOLUTIONS FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY IN THE FOOD AND BEVERAGE SECTOR

22 OCTOBER 2018

ENGIE TOWER
SIMÓN BOLÍVARLAAN 34-36
BRUSSELS, BELGIUM

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The debate on **how to decarbonise** the European society by 2050 is on. Last year the European Commission adopted its Long Term Strategy and is looking to involve stakeholders from all the sectors of the industry. The European Commission has initiated a special set of round tables for the representatives of the food and beverage sector.

The **food and beverage sector** has already taken steps to improve its energy demand and green its energy mix. The level of ambition seems to increase constantly so keeping up with the expected rates of decarbonisation remain a challenge.

In order for the transition to become easier and more affordable, the European Commission is organising a **set of round table meetings with the industry**.

The objective is to discuss the **barriers** for the leaders of the sector in the EU in terms of policy, finance, sector coupling and others, and the **solutions** that are needed at the local, national or EU level. This **interactive exchange** will serve to capture the diversity and common ideas for an affordable energy future.

A series of four round table meetings is organised in the course of 2018 and 2019.

At the **first round table meeting**, in Brussels on October 22nd, 2018, **barriers** for energy efficiency and renewable energy investments were discussed and how they vary according to size of the companies.

At the **second round table meeting**, in Brussels on January 30th, 2019, **best performing** European, national and local **strategies** were discussed for overcoming the barriers identified during the first round table.

At the **third round table meeting**, in Berlin on March 20th, 2019, **best** practice examples of **decarbonisation strategies of some corporate companies** in the food and beverage and pharma sector were discussed.

The **fourth round table meeting**, scheduled in European Sustainable Energy Week (June 2019 in Brussels), builds on the conclusions of the previous round table meetings and presents how these elements are instrumental for a strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050 – A Clean Planet for all.

This study was ordered and paid for by the European Commission, Directorate-General for Energy, Contract no. ENER/C3/2017-513/01/SI2.778443.

FIRST ROUND TABLE MEETING WITH FOOD & BEVERAGE SECTOR

Barriers to and solution for energy efficiency and renewable energy investments in the food and beverage sector

AGENDA

REGISTRATION AND WELCOME COFFEE

09:00 – 10:00	Poll amongst the participants: - What are the 3 most important BARRIERS hampering investments in - What are the 3 most important BENEFITS arising from investments in Energy efficiency and renewable energy

INTRODUCTION

10:00 – 10:10	Introduction to the EU heating and cooling strategy and the role of round tables in this strategy Speaker: **Radoš Horáček** (DG ENER)
10:10 – 10:25	Introduction to this series of roundtables Motivation to select the food and beverage sector Speaker: **Erwin Cornelis** (TRACTEBEL)
10:25 – 10:40	Climate action of the European Food and Drink Industry Speaker: **Tom Quintelier** (FoodDrinkEurope)
10:40 – 11:10	Investing in energy efficiency and renewable energy: benefits – barriers – solutions Reflection on the poll; evidence from best practices Speaker: **Erwin Cornelis** (TRACTEBEL)
11:10 – 11:30	COFFEE BREAK

SHOWCASES OF BEST PRACTICES

11:30 – 11:50	Presentation of a best performing company: Alpro, Belgium Speaker: **Dominique Hamerlinck** (Alpro, Belgium)
11:50 – 12:30	Which practices in the food and beverage sector have been tested in the H2020 projects? SCOoPe project (https://scoope.eu/) Speaker: **Gema Millán** (CIRCE, Spain) INDUCE project (https://www.induce2020.eu/) Speaker: **Koen Straver** (TNO, the Netherlands) TrustEE project (https://www.trust-ee.eu) Speaker: **Christoph Brunner** (AEE, Austria)
12:30 – 13:30	LUNCH

INTERACTIVE WORKSHOP

13:30 – 13:40	Introduction to the workshop
13:40 – 14:40	**SESSION 1**: What does not allow companies to invest in energy efficiency and renewable energy projects? How does it differ based on size and local circumstances?
14:40 – 15:00	COFFEE BREAK
15:00 – 16:00	**SESSION 2**: How to support companies in energy efficiency and renewable energy investments? By which means should this support be provided at? Which concrete action can this series of round tables propose to make a difference?

CONCLUSIONS

16:00 – 16:30	Conclusions of the day – Next steps – Closing remarks

CONCLUSIONS

Mr Horáček **introduced** this first round table by referring to the strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050. To realise this ambition, the investment rate in energy efficiency and renewable energy need to be increased. The European Commission started to this end a direct dialogue with representatives of the industry to better understand the dynamics behind these investments, the barriers currently faced by the industry hampering such investments and solutions to overcome these barriers.

Erwin Cornelis motivated **why the food and beverage sector** was selected for this series of round table meetings. It is a very diverse sector with a significant share in the overall industrial energy demand. The sector is also well distributed in the EU and is characterised by a large share of SMEs, which are less often targeted by energy efficiency and renewable energy policies.

Tom Quintelier addressed the **climate actions by the food and beverage sector**. These are clustered in four pillars: technology change, sector-wide voluntary actions and agreements, behaviour change and optimisation.

Erwin Cornelis dived deeper into **barriers** hampering investments in both energy efficiency and renewable energy in industry. These are related to information, awareness, behaviour, organisation, context, competence, technology and economics. The exposure to these barriers depends on size of the companies: **SMEs** face more barriers than large enterprises; they also are hampered by different ones.

There is also a **difference** between barriers to **energy efficiency and renewable energy**, the former demands a step-wise approach while the latter involves immediately an investment. Companies should hence first invest in energy efficiency and then in renewable energy. Dominique Hamerlinck illustrated this step-wise approach by explaining how the hot water smart grid was developed at the Alpro site in Wevelgem, Belgium.

To overcome these barriers, different **policies** are implemented by government. They can be categorised as : a) prescriptive policies, such as regulations; b) economic policies: subsidies, grants, …, and c) supportive policies. Yet, innovative approaches are continuously tested; while innovative supportive actions are tested in the SCOoPe and INDUCE projects, an innovative financing scheme is tested in the TrustEE project.

Investments in energy efficiency not only help to reduce the energy costs and the CO_2 emissions, but also have **other economic, environmental and societal side-effects**, such lower vulnerability against energy price shocks, better environmental performance and improved corporate image.

The interactive workshop confirmed the discussed barriers. The participants highlighted in addition inappropriate financial signals, such as a low CO_2 price, and a lack of harmonisation of operational conditions in between different countries or within one country. Different solutions to overcome the barriers were suggested, including facilitated access to information, competence and financing.

Energy Efficiency
& Renewables
Round Tables

ROUND TABLE MEETINGS

WITH THE FOOD & BEVERAGE SECTOR

SECOND ROUND TABLE MEETING CONCLUSIONS

KEY SUCCESS FACTORS OF BEST PERFORMING POLICIES AND PROGRAMMES

30 JANUARY 2019

ENGIE TOWER
SIMÓN BOLÍVARLAAN 34-36
BRUSSELS, BELGIUM

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SECOND ROUND TABLE MEETING WITH FOOD & BEVERAGE SECTOR

Key success factors of best performing policies and programmes

AGENDA

REGISTRATION AND WELCOME COFFEE

09:00 – 10:00	WELCOME COFFEE

INTRODUCTION

10:00 – 10:10	Introduction to this round tables in the framework of the EU heating and cooling strategy Speaker: **Karlis Goldstein** (DG ENER)
10:10 – 10:20	Conclusions of the first round table: motivation to select the food and beverage sector; barriers to energy efficiency and renewable energy investments; solutions to overcome these barriers Speaker: **Erwin Cornelis** (TRACTEBEL)
10:20 – 10:35	Overview of policies and programmes, implemented in the EU targeting SMEs Speaker: **Erwin Cornelis** (TRACTEBEL)
10:35 – 10:50	How to realise the decarbonisation of SMEs and very small enterprises? Speaker: **Antoine Bonduelle** (CESE, France)

EXAMPLES OF BEST PERFORMING POLICIES OR PROGRAMMES

10:50 – 11:05	Best practice policy approach targeting SMEs in Italy Speaker: **Enrico Biele** (ENEA, Italy)
11:05 – 11:20	Spill-over effects of the Large Industry Energy Network Speaker: **Ivan Sproule** (SEAI, Ireland)
11:20 – 11:40	COFFEE BREAK
11:40 – 11:55	Walloon action plan to boost the energy efficiency in industry Speaker: **Jean-Benoît Verbeke** (Pirotech, Belgium)
11:55 – 12:10	Flemish action plan to boost the energy efficiency at SMEs Speaker: **Joris Recko** (VEA, Belgium)
12:10 – 12:25	Local programme: energy coaching for industrial companies by the City of Ghent, Belgium Speaker: **Björn De Grande** (City of Ghent, Belgium)
12:25 – 12-40	Lessons learnt from 1) a learning network on energy efficiency and 2) from an energy audit programmes targeting butchers and bakers Speaker: **Erwin Cornelis** (TRACTEBEL)
12:40 – 13:30	LUNCH

INTERACTIVE WORKSHOP

13:30 – 13:40	Introduction to the workshop
13:40 – 14:40	**SESSION 1**: What are the key catalysts of the discussed policies and programmes to mobilise SMEs towards energy efficiency and renewable energy investments?
14:40 – 15:00	COFFEE BREAK
15:00 – 16:00	**SESSION 2**: How can the interaction between the European – national – local level be improved to support these best performing policies and programmes better?

CONCLUSIONS

16:00 – 16:30	Conclusions of the day – Next steps – Closing remarks

CONCLUSIONS

As an **introduction** to this second round table, Mr Goldstein referred to the EU strategic long-term vision for a prosperous, modern, competitive and climate-neutral economy by 2050 and the efforts involved in maintaining a 1.5 degree target of the Paris agreement.

Erwin Cornelis explained the diverse composition of **the food and beverage sector** which was the reason behind selecting this industrial sub-sector for the pilot series of round table meetings. He went on to present an overview of the **barriers** hampering investments in energy efficiency and renewable energy in industry. The exposure to these barriers depends on size of the companies: **SMEs** face more barriers than large enterprises; and these barriers differ from those of the large companies.

He continued by presenting an overview of **policies**. Authorities **support** investments by facilitating access to information and/or by organising energy audit programmes. Some also support the implementation via public or private Energy Services Companies (ESCOs). **Financial instruments** are widely implemented in the EU in various forms and targeting different stages of the projects. **Prescriptive policies** include regulations on companies, such as the mandatory execution of an energy audit. Voluntary agreements and learning networks are a specific kind of prescriptive policies as the targeted companies are free to join.

Antoine Bonduelle, member of the French Economic, Social and Environmental Council (CESE), presented the report on the decarbonisation of the small and smallest enterprises. Although **SMEs** represent probably 1% or less of the total emissions of the French industry, this data is often underestimated and SMEs play a major role in the supply chain. As a consequence, their **indirect emissions** amount to 12% to 14% of national emissions.

Various **best performing policies and programmes targeting SMEs** from different countries were presented. Italy stimulates **energy auditing** in SMEs together with the development of supportive tools, administrative documentation and co-funding schemes. The Large Industry **Energy Network** initiative is the backbone of Ireland's policy to improve the energy efficiency of large enterprises. It also has significant spill-over effects to SMEs by developing standards and tools, knowledge sharing networks and supply chain initiatives. Wallonia appointed four **facilitators** to offer free tailor-made advice to the SMEs. Flanders plans to design a **voluntary agreement**, specially conceived for the SMEs, facilitating access to information and the implementation phase .The City of Ghent is experimenting with such a voluntary agreement at a local level: an energy audit is offered at low cost and the companies are supported in implementing the measures, while they must **commit** to carry out the most economic ones. **Learning networks** of Germany, Sweden and Belgium were discussed. They are proven to be effective, especially for SMEs that often fall between other policies. In all three countries, it turned out difficult to persuade companies to join such a network. Experience with an energy **audit programme** targeting butchers and bakers indicated that the best opportunity for energy investments is during renovation and that comparing to business-as usual or other enterprises can be an eye-opener.

The discussion of these policies and programmes concluded that **technical assistance**, offered by **independent**, **trustworthy** specialists and the **commitment** to implement the measures, indicated by an **energy audit** are the key catalysts. While such actions should be taken at local and national level; collaboration can be fostered at EU level.

European Commission

Energy Efficiency & Renewables

Round Tables

ROUND TABLE MEETINGS

WITH THE FOOD & BEVERAGE SECTOR

THIRD ROUND TABLE MEETING

CONCLUSIONS

DECARBONISATION STRATEGIES OF CORPORATE COMPANIES

20 MARCH 2019

Maritim proArte Hotel
Friedrichstrasse 151
10117 BERLIN
GERMANY

Back-to-back with

ener.CON EUROPE

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The debate on **how to decarbonise** the European society by 2050 is on. Last year the European Commission adopted its Long Term Strategy and is looking to involve stakeholders from all the sectors of the industry. The European Commission has initiated a special set of round tables for the representatives of the food and beverage sector.

The **food and beverage sector** has already taken steps to improve its energy demand and green its energy mix. The level of ambition seems to increase constantly so keeping up with the expected rates of decarbonisation remain a challenge.

In order for the transition to become easier and more affordable, the European Commission is organising a **set of round table meetings with the industry**.

The objective is to discuss the **barriers** for the leaders of the sector in the EU in terms of policy, finance, sector coupling and others, and the **solutions** that are needed at the local, national or EU level. This **interactive exchange** will serve to capture the diversity and common ideas for an affordable energy future.

A series of four round table meetings is organised in the course of 2018 and 2019.

At the **first round table meeting**, in Brussels on October 22nd, 2018, **barriers** for energy efficiency and renewable energy investments were discussed and how they vary according to size of the companies.

At the **second round table meeting**, in Brussels on January 30th, 2019, **best performing** European, national and local **strategies** were discussed for overcoming the barriers identified during the first round table.

At the **third round table meeting**, in Berlin on March 20th, 2019, **best** practice examples of **decarbonisation strategies of some corporate companies** in the food and beverage and pharma sector were discussed.

The **fourth round table meeting**, scheduled in European Sustainable Energy Week (June 2019 in Brussels), builds on the conclusions of the previous round table meetings and presents how these elements are instrumental for a strategic long-term vision for a prosperous, modern, competitive and climate neutral economy by 2050 – A Clean Planet for all.

THIRD ROUND TABLE MEETING WITH FOOD & BEVERAGE SECTOR

Decarbonisation strategies of corporate companies

AGENDA

REGISTRATION AND WELCOME COFFEE

09:00 – 10:00 WELCOME COFFEE

THE ROLE OF INDUSTRY IN DECARBONISING EUROPE

10:00 – 10:20 Introduction to this round tables in the framework of the EU heating and cooling strategy
Conclusions of the 1st and 2nd round table meetings on barriers and solutions
Speaker: **Erwin Cornelis** (TRACTEBEL)

10:20 – 10:40 What future for the European Union on a climate neutral path by 2050?
Speaker: **Radoš Horáček** (DG ENER)

10:40 – 11:00 How and when making Industrial Energy Efficiency the New Normal?
Speaker: **Stefan Büttner** (UNECE Task Force on Industrial Energy Efficiency)

11:00 – 11:20 Decarbonisation strategies for the food and beverage industry
Speaker: **Erwin Cornelis** (TRACTEBEL)

11:20 – 11:50 **Panel discussion:**
On which actions should we focus first to arrive at a deep decarbonisation of the food and beverage sector: 1) a change of consumer preference; 2) a redesign of the production processes; 3) supply of 100% decarbonised energy and feedstocks?

DECARBONISATION STRATEGIES OF CORPORATE COMPANIES – EXAMPLES OF BEST PRACTICES

13:00 – 13:10 Introduction to the session

13:10 – 15:20 Presentation of best practices decarbonisation strategies of corporate companies
With contributions by:

15:20 – 15:50 **Panel discussion:**
What are the benefits and value of decarbonisation for the company? How to convince the top management to commit to a decarbonisation strategy? What is the role of learning and experience sharing? How can replication of these best practices by other companies be stimulated?

CONCLUSIONS

15:50 – 16:00 Conclusions of the day – Next steps – Closing remarks

CONCLUSIONS

As an **introduction**, Erwin Cornelis presented the conclusions of the first two round tables on the **barriers** towards energy efficiency and renewable energy and on **effective policies**.

Radoš Horáček explained the **EU vision for a clean planet by 2050**. To respect the Paris Agreement and for the EU to lead the world in climate action, net-zero greenhouse gas emissions must be achieved by 2050. Realising this requires radical changes in all sectors, which is challenging but feasible from a technological, economic, environmental and social perspective. Energy efficiency, renewable energy and a competitive, resource-efficient industry are the main building blocks to realise this ambition in the industry sector.

Stefan Büttner presented **results of the Energy Efficiency Index** gauging the interest in energy efficiency in the German industry. Regardless of company size, nearly 70% of companies are open to additional requirements to achieve the energy and climate targets. Yet, despite the call for stronger incentives for energy efficiency investments, most companies have not yet made use of any subsidies or public financial support and rely mainly on equity. The application process should be simplified to make public support more attractive.

Erwin Cornelis compared the UK and Walloon (Belgium) **deep decarbonisation by 2050 strategies for the food and beverage sector.** Both strategies rely on a fierce improvement of the energy efficiency, process innovation, use of decarbonised electricity and fuels and CCS, but in different extents. A full application of the technical potential would result in a reduction of the greenhouse gas emissions by 77%-93% compared to present emission levels.

Four best practice examples of decarbonisation strategies of corporate companies were discussed.

Oleon sets **ambitious energy savings targets** for production plants. Also, a **new process** was **developed** allowing to drastically reduce the pressure and temperature and hence the specific energy consumption.

Mars set its first carbon reduction targets in 2009. The four pillars of Mars' decarbonisation strategy are operational efficiency, capital efficiency, new technologies and **renewable energy**. The last pillar has contributed the most to the carbon reduction in the last ten years; yet, decarbonising heat remains a challenge.

Astellas realised a 98% cut in their CO_2 emissions by covering 95% of the annual thermal energy requirements by locally available **biomass** residues, by energy savings and by wind and PV-energy production. The possibilities to redesign the processes are limited.

A first goal of **ABInBev**'s Climate Action is source all **electricity** from renewable sources by 2025, via on-site production or off-site Virtual Power Purchase Agreements. A second goal is a 25% **carbon emission reduction across the value chain** via energy efficiency and green logistics.

All these companies indicate that the **Corporate Social Responsibility** is the basis for the decarbonisation strategies, stimulating the top management to commit to actions beyond mandatory by legislation. Moreover, a strong involvement of staff locally is key to successfully implement climate actions.

This study was ordered and paid for by the European Commission, Directorate-General for Energy, Contract no. ENER/C3/2017-513/01/SI2.778443.

European Commission

Energy Efficiency & Renewables

Round Tables

ROUND TABLE MEETINGS

WITH THE FOOD & BEVERAGE SECTOR

FOURTH ROUND TABLE MEETING

INVITATION

SHAPING A SUSTAINABLE INDUSTRY: CHALLENGES AND SOLUTIONS

20 JUNE 2019
11:00 – 12:30

BERLAYMONT BUILDING
ROOM **WALTER HALLSTEIN**
BRUSSELS, BELGIUM

In the frame work of EUSEW

SUSTAINABLE ENERGY WEEK

An initiative of the European Commission

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FOURTH ROUND TABLE MEETING WITH FOOD & BEVERAGE SECTOR

SHAPING A SUSTAINABLE INDUSTRY: CHALLENGES AND SOLUTIONS

AGENDA

11:00 – 11:20 **THE ROLE OF INDUSTRY IN DECARBONISING EUROPE**

INTRODUCTION
The EU decarbonization strategy
Speaker: **Karlis Goldstein** (DG ENERGY)

VISION
The effort and the fruit
Speaker: **Tomas Wyns** (VUB-IES, Belgium)

11:20 – 12:20 **PAVING THE WAY: TESTIMONIALS OF ACTORS REALIZING THE DECARBONISATION OF INDUSTRY**

TESTIMONIAL
Getting the corporation and the local community to back clean transition
Speaker: **Sven Reynaert** (Oleon)

MINI-COMMENT
Solutions for stimulating energy efficiency and renewable energy action in the industry: SMEs and local branches of multinationals
Speaker: **Erwin Cornelis** (Tractebel ENGIE)

TESTIMONIAL
Local energy coaching for industrials in the City of Ghent, Belgium
Speaker: **Björn De Grande** (City of Ghent, Belgium)

MINI-COMMENT
Role of municipal policy to stimulate energy efficiency and renewable energy action
Speaker: **Erwin Cornelis** (Tractebel ENGIE)

TESTIMONIAL
Investment decisions based on local legal framework
Speaker: **Adam Pawelas** (Carlsberg)

MINI-COMMENT
Bright ideas excellence in climate action for large companies
Speaker: **Erwin Cornelis** (Tractebel ENGIE)

TESTIMONIAL
Building a city on waste heat – a technological perspective
Speaker: **Marko Riipinen** (HELEN, Finland)

MINI-COMMENT
Waste heat potentials and their potential contribution to the decarbonisation of Europe
Speaker: **Erwin Cornelis** (Tractebel ENGIE)

12:20 – 12:30 **EMBEDDING THE INDUSTRY IN THE EU DECARBONISATION STRATEGY 2050**

CONCLUSION
How to use these findings to decarbonise the European Union?
Speaker: **Karlis Goldstein** (DG ENERGY)

CONCLUSIONS

A year after the announcement of round tables with the industry to identify barriers and solutions to Energy Efficiency and Renewable Energy, the insights from these round tables were summarised and presented to the public.

Five selected speakers provided their view from an academic, regulatory, municipal, small and large business perspective on the challenges and solutions for shaping a sustainable industry:

- The industry has already realised a significant reduction of their CO_2 emissions. The change has been partly due to economic, partly technologic developments. Yet, **significant efforts for all stages of industrial processes** are required to continue to decarbonise.
- Industrial decarbonisation strategies require adopting a **holistic mind set to** energy efficiency first. Process and product redesign, sourcing of renewable energy and stocking carbon should create new resource flows that keep the products affordable for consumers.
- In contrast to renewable electricity, **renewable thermal energy sourcing lacks maturity**. Also the **potential of excess heat valorisation** with associated benefits for the industry remain **largely untapped**.
- Decarbonisation strategies for the industry need to **take the carbon footprint of the whole value chain into account.** Process emissions are usually a minor part of the total footprint. This requires **sector coupling** and a **coordinated action with all actions of the supply chain and international coordination**.
- **Ensuring trust, commitment and buy-in** of the implementing actors are the tree golden stages for delivery. These principles should be the **cornerstones of policy interventions** for decarbonising the industry.
- Consistent reinvestment of corporate **revenue into R&D** and **consistent policy signals** are needed to build trust and cultivate commitment.

Appendix 6: Overview of the policies and measures on industrial energy efficiency implemented by the EU Member States

The policies and measures below are categorised according to the taxonomy, developed by Tanaka – see subchapter 3.1: P: prescriptive policies and measures – E: economic policies and measures – S: supportive policies and measures.

EU MS	Awareness	Behaviour / organisation	Information	Competence	Technology	Economic
AT			E: Energy efficiency obligation scheme: energy audits E: Domestic environmental support: energy audits S: Guidelines and training	S: Energy performance contracting		E: Energy efficiency obligation scheme: CHP E: Green electricity subsidies: CHP E: Domestic environmental support: fund for EE measures E: Subsidy for thermal building renovation
BE - BXL	S: label «Entreprise écodynamique»		S: Support via sector organisations	S: Coaching on EE		E: Financial support for EE investments E: Deductions for investments in energy saving equipment by enterprises
BE - FLA	S: Benchmark tool for SMEs	P: Voluntary agreement for energy-intensive companies P: Mini voluntary agreement for SMEs E: Subsidy for CO_2-neutral industrial parks		S: ESCOs for SMEs programme	E: call for innovative corporate networks	E: Ecology premium for EE investments E: premiums for distribution grid operators E: CHP certificate scheme E: Deductions for investments in energy saving equipment by enterprises

BE - WAL		P: Voluntary agreement for energy-intensive companies P: Mini voluntary agreement for SMEs		S: Facilitators on energy efficiency, renewable energy, CHP		E: Investment support E: Deductions for investments in energy saving equipment by enterprises
BG		P: Energy efficiency targets for energy-intensive systems				E: Investment support E: Energy efficiency obligation scheme
CY			S: Exhibition, workshops, training programmes			E: Special Fund for RES and ES E: 'Save & Upgrade' scheme for industrial buildings
CZ		P: Voluntary agreement (planned)				E: Operational Programme Enterprise and Innovation for Competitiveness E: ENERG Programme for SMEs
DE			S: Programme to roll out learning networks in Germany			E: Energy Efficiency National Fund
DK		P: Voluntary agreement	S: Information campaign aimed at SMEs S: Special advice tools			E: Energy efficiency obligation scheme (2016: Industry 40%)
EE			S: raising awareness, training specialists, carrying out audits or analyses of resource use, and investment for SMEs			E: Financial support for EE investments

ES						E: Fund for Clima projects E: Aid programme for energy efficiency measures in SMEs and large industrial enterprises E: Industrial competitiveness incentive programme
FI		P: Energy Efficiency Agreements with energy-intensive and with medium-sized industry				
FR		S: PRO-SMEP: energy management scheme for SMEs P: ISO 50001 certification for energy-intensive companies (linked to tax reduction)	E: support for pre-diagnostic, diagnostic and feasibility studies S: energy and environment policy offices for SMEs S: Sectoral Guides	S: Training programme for energy adviser in industry	E: Green industry initiative E: Support for innovation	E: Energy efficiency obligation scheme (2015-2017: Industry 20,3%) E: Aid scheme Rational energy use – Investment E: Heat fund for recovering waste heat E: Green loans scheme for SMEs and mid-cap investments E: Eco-energy loans

GR						E: Relocation of enterprises to industrial-business zones and business parks E: Innovative Entrepreneurship, Supply Chain, Food, Drinks E: Green Business E: Support for improving energy efficiency in manufacturing enterprises E: Programme ‘Modern manufacturing’
HR				S: Industrial Energy Efficiency Network (IEEN)		E: Financial support for EE investments
HU		P: Employment of an energy specialist	S: National Energy Network			E: Corporate normative tax relief for energy efficiency measures
IE		P: Large Industry Energy Network	S: Energy Audit Handbook S: Strategic support, training funding, and advice for energy projects for SMEs			
IT	S: Awareness campaigns to perform energy audits and use incentives	E: Support for energy management at SMEs			E: R&D tax credit	E: Energy efficiency obligation scheme (2016: 56% industry) E: Super-amortisation and hyper-amortisation to encourage companies to invest E: Soft loan: Capital assets – Nuova Sabatini
LT			E: Funding for energy audits			

LU		P: Voluntary agreement				E: Energy efficiency obligation scheme E: investment aid
LV						E: Energy efficiency obligation scheme
MT		P: Energy Efficiency Partnership Initiative - Voluntary agreements S: Knowledge exchange on energy management between SMEs	S: Guidance note and seminars on energy auditing E: Financial support for energy audits at SMEs			E: Tax rebates to support energy efficiency investments
NL		P: Long Term Agreements (non-ETS / ETS)			E: Green Investing: Green Projects Regulation - Tax benefit/interest rate cut	E: Energy Investment Allowance - Tax reduction
PL	S: Information campaigns to promote ESCO funding					E: Energy efficiency obligation scheme E: Funds for energy saving measures
PT	S: Voluntary system for the energy labelling of industrial undertakings		P: Mandatory audits for energy-intensive SMEs			
RO						E: Energy efficiency projects in the industry financed by FREE (Fondul Român pentru Eficienţă energetică)

SE			S: Energy networks (for undertakings with energy consumption > 1 GWh)	S: energy audit support (for undertakings with energy consumption > 300 MWh) S: coaches for energy and climate matters (for undertakings with energy consumption < 300 MWh) S: Sectoral projects: "Projektet GeniAL" for aluminium industry - "Jernkontorets Energiprogram" for steel industry		E: incentives for energy efficiency
SI	S: Awareness raising campaigns	E: Eco-fund for implementing an energy management scheme E: Incentives for introducing energy management systems at SMEs		S: networking and training of energy managers	E: Financial incentives for innovation and research E: Incentives for demonstration projects	E: Energy efficiency obligation scheme E: Financial incentives for the wood processing industry E: Soft loans from a revolving fund
SK		P: Mandatory energy monitoring	E: Scheme for energy audits at SMEs			
UK		P: Climate Change Agreements P: CRC Energy Efficiency Scheme				E: Climate Change Levy

Table 14: Overview of policies and programmes on industrial energy efficiency implemented by the EU Member States

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