

The transformation of the Hungarian basic materials sector towards a low carbon economy

Summary of a multi-stakeholder discussion at the
national level

Prepared by REKK Foundation in corporation with DIW Berlin,
IIT Comillas and WiseEuropa for the EUKI 2018 Project “Climate
Friendly Materials Platform: supporting transition in Central
and Southern Europe”

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The [REKK Foundation for Regional Policy Co-operation in Energy and Infrastructure](#) is a Budapest Based think tank. The goal of the REKK Foundation is to contribute to the formation of sustainable energy systems in Central Europe, both from a business and environmental perspective. Its mission statement is to provide a platform for open-ended, European-wide dialogue between government and business actors, infrastructure operators, energy producers and traders, regulators and consumers, professional journalists and other interested private entities. The Foundation develops policy briefs and issue papers with forward-looking proposals concerning challenges posed by energy and infrastructure systems and organize regional forums allowing stakeholders to become familiar with the latest technological and regulatory developments within the industry.

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Since the end of 2016 the Climate Friendly Materials Platform (CFMP) brings together policy makers, industry representatives, practitioners in industrial decarbonisation and applied researchers for the development of a shared understanding of tangible policy options and eventually common policy action at the national and EU level to the overall goal of successfully decarbonize the basic materials sector. The CFMP project is led jointly by Climate Strategies and DIW Berlin and delivered by a multidisciplinary, international team of researchers from a number of institutions, representing various fields (EU law and institutions, climate policy and economics, energy market and infrastructure policy and economics). The present report is based on analysis and workshops focusing on the transition in Central and Southern Europe funded by EUKI 2018 and implemented by DIW together with WiseEuropa, REKK and IIT Comillas.

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1. INTRODUCTION

1.1. Research areas of the Climate Friendly Materials Platform¹

Production of basic materials (cement, iron and steel, paper and board, aluminium, as well as chemicals and petrochemicals) account for around 16% of European GHG emissions (DIW calculations based on EEA (2012) and EEA (2016)).

For the most part this relatively smaller share of emissions has flown under the radar of policy makers more focused on the power sector and generally building efficiency. However, the Paris Climate Agreement commitment to net carbon neutrality by mid-century requires a comprehensive industrial policy strategy that targets CO₂ emissions from basic material production.

This is reflected in the reform of the EU ETS Directive approved in 2018 for the 2020-2030 period. The discussion focused on the allocation of free allowances to protect industries like steel against carbon leakage but also raised awareness within the senior management of the major material producers that business as usual investment plans are not compatible with the long-term emission reduction objectives of the Paris Climate Agreement, both at the European level and in many Member States.

This raises the question for the management of international companies in determining whether to pursue major (re-)investments in carbon intensive production processes of basic materials during a time of coal power divestment and large-scale write-offs in the power sector. Apart from concerns of carbon leakage, there are risks of changing demand patterns for carbon intensive materials and competition from new investments in climate friendly production processes.

In November 2018 the European Commission submitted its 2050 long-term vision for Europe to help guide Member States. (European Commission, 2018). The Commission, as well as several Member States, hosted workshops were provided a platform for basic materials sectors to share scenarios capable of delivering carbon neutrality by mid-century with existing and proven technologies.

Obviously, specific technology development and choices cannot be tested in complex market-based economy– particularly in an environment of widespread uncertainty and asymmetric information about costs and performance of such technologies. However, it can provide a starting point for dialogue among private actors about urgent decisions – and to identify the public policy to address knowledge spillovers and learning-by-doing externalities, financing constraints, and policy risks.

The EUKI Climate Friendly Materials European Roundtable convened national stakeholders from Hungary, Poland, and Spain in this European discussion focusing on the following elements:

1. What is the nature of 2050 roadmaps – what elements will be part of a transformation pathway for a basic material sector?
2. What is the status and outlook of national material industries?
3. What is the status of national policies, what are the lessons learned so far, what are the challenges ahead and what are the remaining gaps?
4. What is the policy toolbox to close the gaps - what solutions can allow private actors in market-based economies to pursue investments that follow the 2050 roadmaps?

¹ This section has been prepared based on the “*Inclusive Transformation of the European Materials Sector Report for the EUKI 2018 Project “Climate Friendly Materials Platform: supporting transition in Central and Southern Europe”*”

5. How can European policies be inclusive – e.g. support national developments? What is the value added of European cooperation?

UN Sustainable Development Goals defines seven categories of mitigation options to reduce the industry-based emission:

- 1) Share, repair and reuse (cars, buildings)
- 2) More and purer recycling (currently 80-90% of steel and only 18% of plastic is recycled)
- 3) Material efficient design of products
- 4) Material substitution with less carbon-intensive alternatives (For example, wood-based construction components)
- 5) Low-carbon processes (increasing the share of renewable-based processes)
- 6) Reduce plant emissions

Transformation of the basic materials sector that is compatible with the 2050 emission reduction targets can be achieved by pursuing and combining a number of the abovementioned mitigation options:²

As regards sharing and repair, for example the sharing of vehicles and buildings that together represent the largest portion of European demand for steel, cement and aluminium, would enable a much more productive use of these currently underused assets.

Recycling rates still vary across applications and material types. For example, 80-90% of end-of-life steel is collected for recycling, while across all uses of plastic only 18% is recovered.

Improved product design can achieve the same services with less but better tailored, higher value materials. For example, lightweight design (e.g. steel beams in construction and aluminium alloys in car bodies) can reduce the need for steel and aluminium by 25 to 30%.

Efficient manufacturing can reduce the loss of material during production processes and improve material reuse. For example, an improvement in material efficiency could reduce emissions and material costs in automobile manufacturing by 56% to 70%. Substitution of materials with alternatives characterised by lower life-cycle emissions can allow further emissions savings. For example, wood-based construction components can have much lower CO₂ intensity than steel and concrete.

The introduction of production processes formed with renewable energy (electrolysis or directly solar-derived hydrogen) or supported by carbon capture and sequestration or use can avoid or absorb most carbon emissions linked to primary production of materials.

In the short-term incremental efficiency improvements in conventional production processes may deliver small emission reductions but need to be aligned with the long-term phasing-out of carbon intensive processes to create space for new climate-friendly production processes.

1.2. Main focuses of the Hungarian research project

In Hungary, the economic crisis put significant pressure on energy intensive sectors to endure a painful rationalization process. Many companies managed to keep market shares within the bulk chemical and aluminium sectors, but are still characterized by higher than EU average GHG emission levels. This is

²Neuhoff et al. (2018)

mainly due to technology lock-in or limited flexibility in fuel usage. For these companies it is still a long-term challenge to transform their technologies and reduce emissions.

Besides the previously mentioned sectors, the oil refinery sector is the one, where the domestic company was able to increase its market share and expand its presence in neighbouring countries, but still faces challenges with GHG reduction. In addition, in the long term they have to see their future in a market where electrification of transportation would mean shrinking market for their products.

The higher interest rate in the region makes it more difficult for companies to finance measures to reduce GHG in energy and material use. In some specific sectors, exposure to carbon leakage is a problem in Hungary as well, in relation to non-EU member neighbours (e.g. petrochemical, or non-metallic minerals sectors). In addition, the industrial sector faces higher energy prices due to cross subsidization policies keeping residential end user prices lower, counterbalanced by higher regulated network tariffs for the industrial consumers.

The Hungarian research project had three main elements: 1) exploratory research based on available statistics and other secondary data sources; 2) national roundtable and 3) online questionnaires.

The Hungarian national roundtable consisted of industrial representatives from the material sectors (steel, cement, petrochemistry, oil-refinery), representatives of Government, NGOs and industrial associations.

The event was hosted by the Ministry for Innovation and Technology with 18 participants covering the following agenda:

1) Impacts of EU level and national regulation on energy efficiency of industries

- a. To what extent are energy saving measures induced by the energy audits prescribed by the Energy Efficiency Directive (if the company is compliant)?
- b. Do they have an energy management system in place at their companies based on EED Article 8?

2) National law and regulation

- a. Role of the Hungarian Energy Efficiency Act³ and related decrees
- b. Price impacts of households' energy bill cut on companies' energy efficiency actions (relatively high energy prices for industries resulting from the cross-subsidies between households and industrial users and its effects on investments)

3) Internal organization and processes (knowledge sharing, best practices)

- a. Ways and technics, which can help companies being incentivised to invest in low carbon solutions/energy savings;
 - i. Energy savings in buildings
 - ii. Energy savings related to the production process
- b. How does the share of energy costs in the different fields of their activities influence their energy efficiency related decisions?
- c. Do they consider using renewable energy at least partially in their production process and/or operating their buildings? What kind of factors influence this decision?
- d. In case they use/plan to use renewable energy, would they decide on producing it on-site or purchase (in form of PPA or certificate of origin)?
- e. How does their technology compare to the related Best Available Technics?

³ Act No. LVII of 2015

- f. Do they have smart energy management systems at their company? If not, are they thinking of implementing it?
- g. How is logistics and transportation of products/base materials arranged?

4) Corporate level best practices and local implementation. Impacts of mixed ownership structure in the energy intensive industries

- a. effort sharing / efficiency goal setting within the group
- b. sharing of responsibilities
- c. allocation of financial sources
- d. knowledge transfer between strategic business units / affiliates
- e. corporate level integration and synergy management

5) Risk of carbon leakage – non-EU competition and corporate adaptation

- a. Impacts of carbon leakage due to the non-ETS neighbours, such as Ukraine and Serbia
- b. The impacts of the phase out of free allocation of EUAs in several industrial sectors until 2030 (pharmaceutical, rubber, gas upstream)
- c. corporate adaptation strategies against the non-EU competition in high and moderate carbon leakage risky industries

This document will:

- 1) contextualize the Hungarian material industries and the regulatory and political environment related to the low-carbon transition process of the highest emitter industries;
- 2) summarize the main conclusions of the national roundtable discussions and
- 3) suggest further actions to support the transition of material industries.

2. OVERVIEW OF THE HUNGARIAN MATERIAL SECTOR

The manufacturing sector contributed 24,310 million euros to the total gross value added of 113,896 million euros of the Hungarian economy in 2017, having a share of 21,3 percent. The following chart depicts the contribution of different manufacturing industries to the gross value added. The chart shows that transport equipment and fabricated metal and machinery sectors accounted for nearly 2/3 of the total value added, followed by the food, chemicals and the non-metallic mineral sectors (Eurostat).

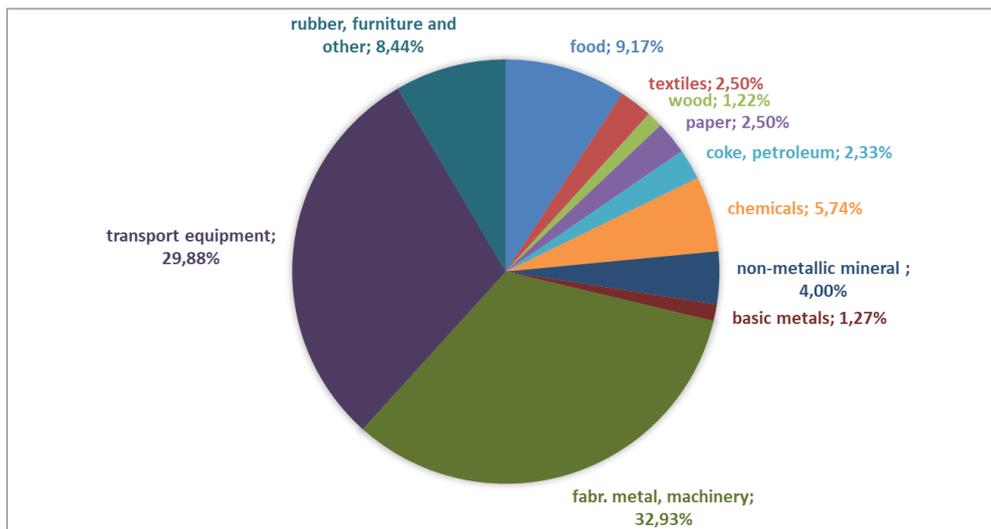


Figure 1: Contribution of sectors to the gross value added of the Hungarian manufacturing industry, 2017 (Source of data: Eurostat)

The Hungarian manufacturing sector mainly relies on natural gas and electricity as energy inputs, as demonstrated in the following graph; shares of these fuels were 31 and 33 percent in 2017, respectively, while petroleum products accounted for 15%. The level of energy consumption increased from 129 TJ in 2008 to 182 TJ in 2017 and has been rising continuously since 2009 (Eurostat). The contribution of electricity, natural gas and oil-based products expanded over the period, while the amount of heat remained relatively constant. A slight increase is observable in renewable energy use and applied wastes as fuel, although these energy sources remain exceptionally marginal. The carbon intensity of the Hungarian electricity generation is relatively low, reaching 260 g_{CO2}/kWh compared to the EU level of 295.8 g_{CO2}/kWh (EEA)⁴ in 2016, due to the high share of nuclear power in the electricity mix (contributing 49% to production and 42% to final energy consumption in 2017). Renewable-based electricity accounted for 7,49% of final energy consumption in 2017. (Eurostat)

⁴ <https://www.eea.europa.eu/data-and-maps/indicators/overview-of-the-electricity-production-2/assessment-4>

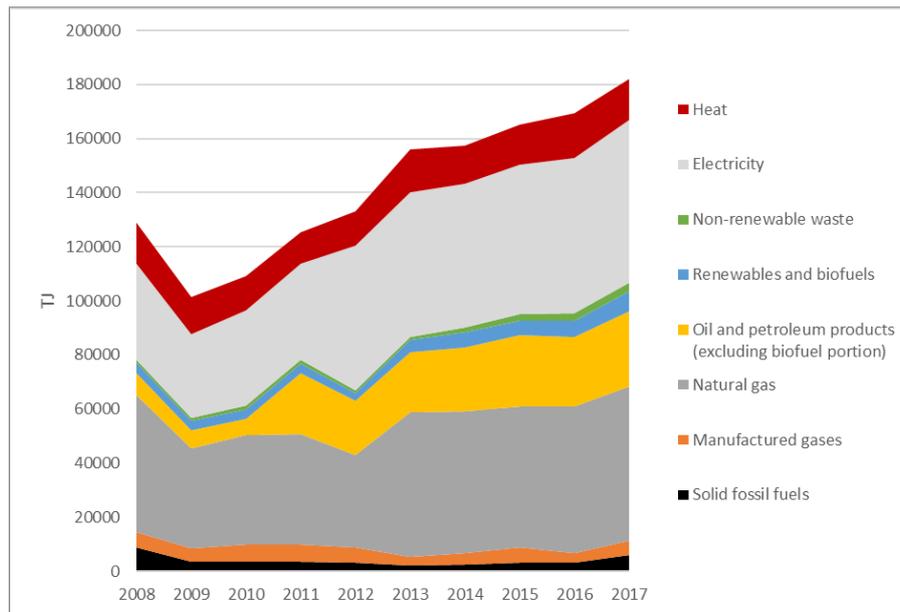


Figure 2: Energy consumption of the Hungarian industrial sector by fuel, 2008-2017, Tj (Source of data: Eurostat)

The next figure presents the share of energy costs as a portion of total costs for Hungarian companies in the manufacturing sector compared to the EU, based on the latest available data from Eurostat. Firms producing chemicals, wood, paper, basic metals and non-metallic mineral products have the highest energy cost share in Hungary, similarly to other European manufacturing companies.

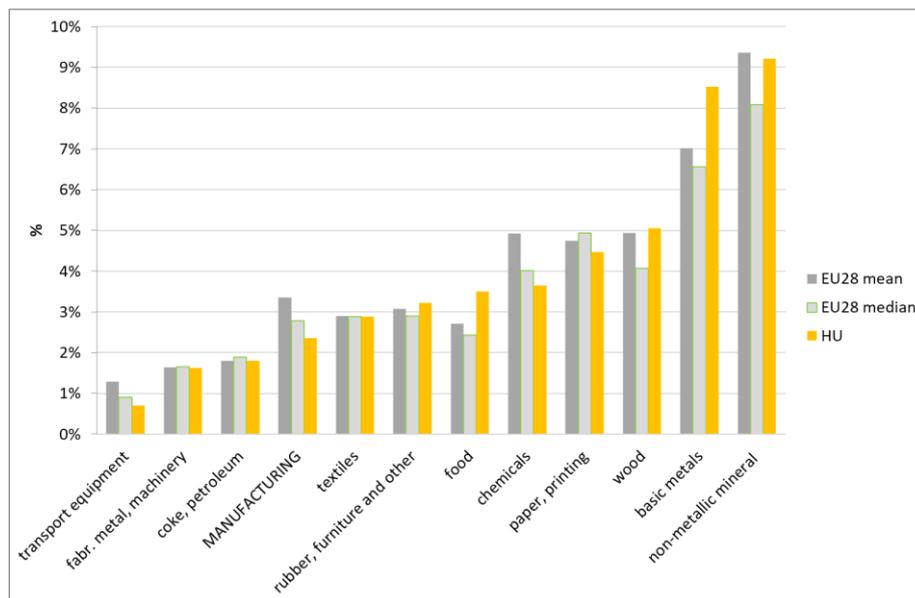


Figure 3: Share of energy costs in total purchases of goods and services in Hungary and the EU, 2016, % (Source of data: Eurostat)

Regarding the contribution of the most energy-intensive sectors to the Hungarian value added and exports, it is apparent from the next figure that the share in total manufacturing energy consumption of industries contributing most to export revenues and value added is relatively low (14%).

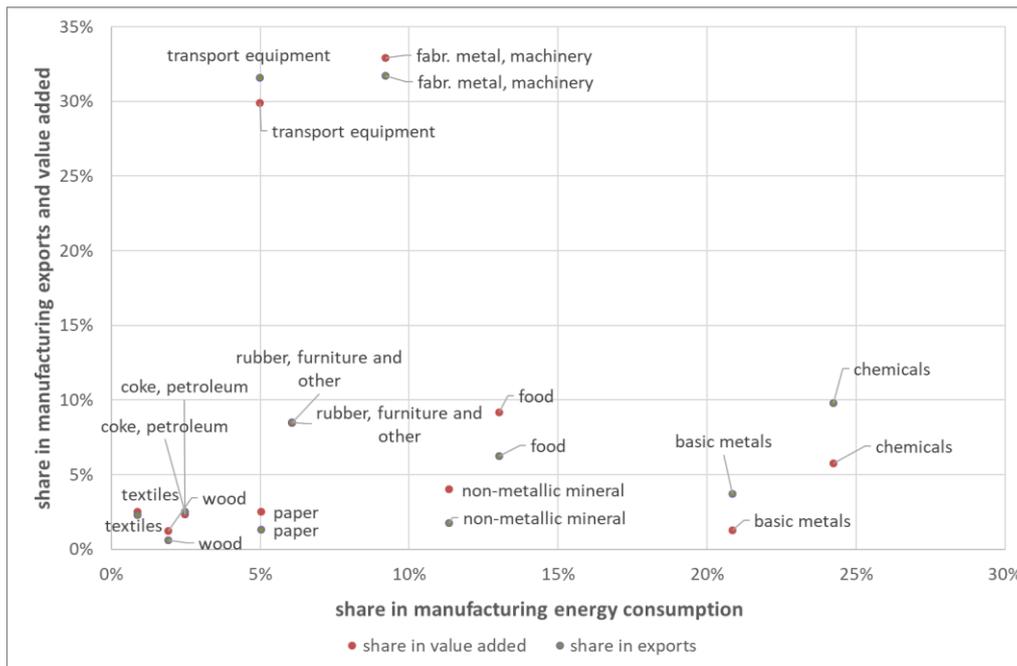


Figure 4: Share of domestic manufacturing industries in export revenues and value added according to their shares in the total energy consumption of the manufacturing sector, 2017 (Source of data: Eurostat)

Comparing the energy intensity of the manufacturing industries of the project participant countries and the EU28, we can see that the Hungarian companies are more energy intensive than the German and Spanish companies but in general use less energy per unit of gross value added than Polish firms.

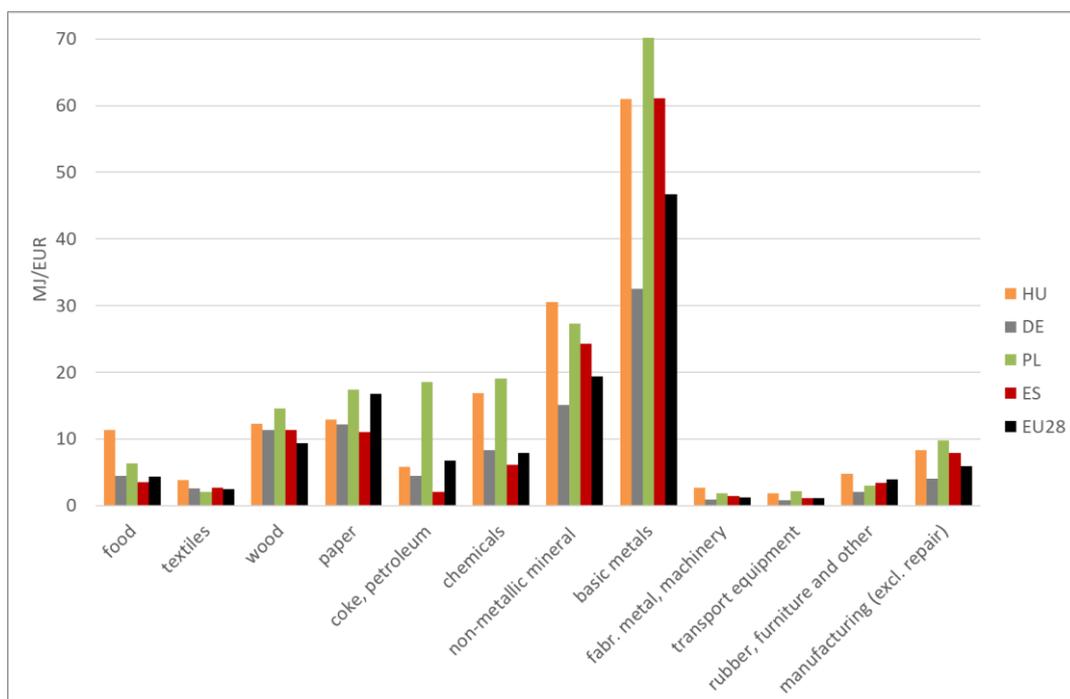


Figure 5: Energy intensity of manufacturing industries (energy consumption compared to gross value added in 2017) in Hungary, Germany, Poland, Spain and the EU28, 2017 (Source of data: Eurostat)

The Hungarian manufacturing industry emitted 11.2 Million tons CO_{2eq} in 2016, accounting for 21% of the total emissions⁵, of which 58 percent was attributable to emissions from industrial processes and product use (Eurostat). Firms producing chemical and non-metallic mineral products contributed most to the emissions (25 and 20 percent, respectively).

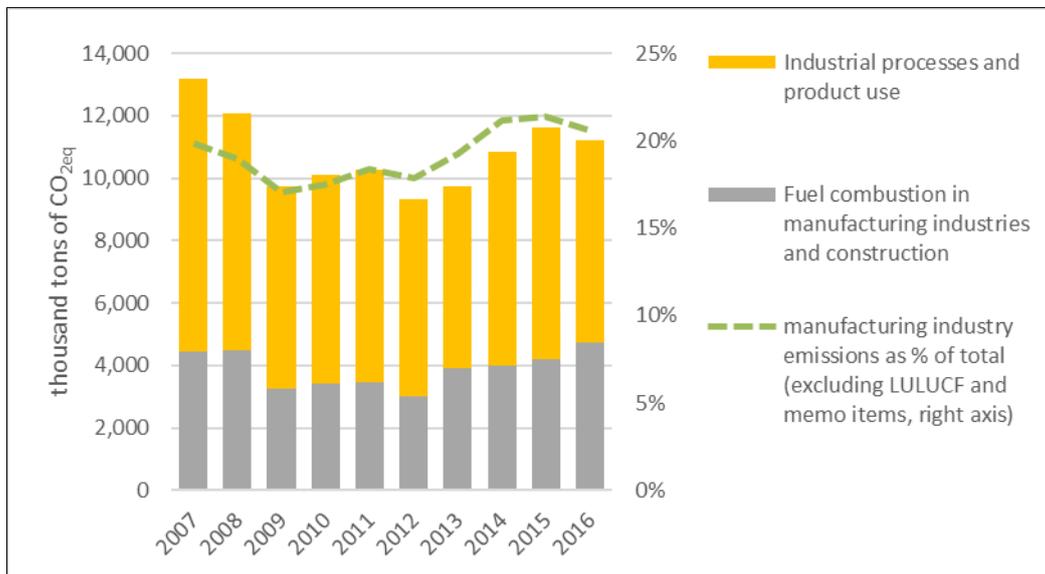


Figure 6: Greenhouse gas emissions of the manufacturing sector in Hungary and its share from total emissions, 2007-2016 (Source of data: Eurostat)

According to Figure 7, the declining GHG emissions intensity of the manufacturing sectors in the participating countries is reflective of the EU as a whole over the last 10 years. The Hungarian values are slightly lower than Poland, but more than the Spanish, German and EU levels. Of course, both the energy and the emissions intensity depend on the specific product structure of the industries in the various countries.

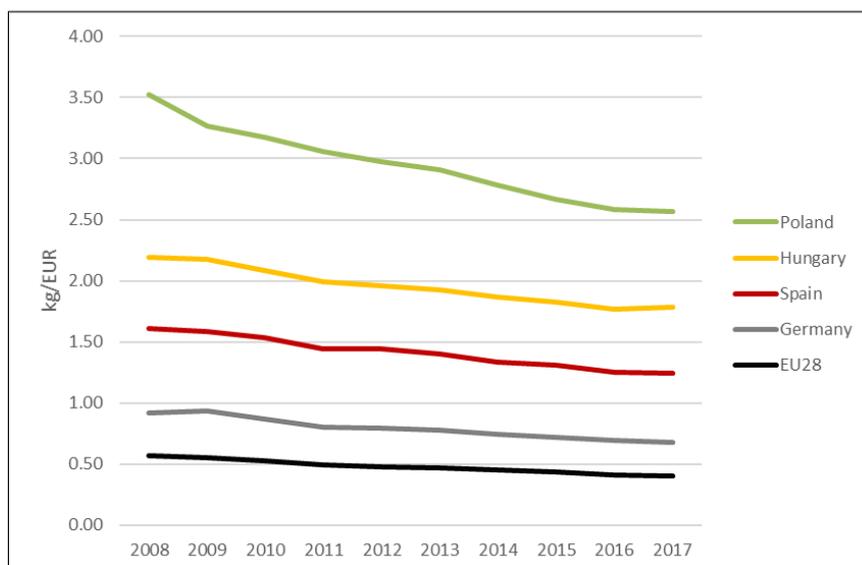


Figure 7: Evolution of the GHG emission intensity of the manufacturing sectors of the participating countries and the EU28, 2008-2017, (Source of data: Eurostat, Note: GHG emissions cover CO₂, N₂O and CH₄ in kg of CO₂ equivalent, the values refer to the ratio of emissions to gross value added in Euros, chain linked values)

⁵ Excluding LULUCF and memo items.

However, looking at the same period for the most energy-intensive sectors of the Hungarian manufacturing industry, it is clear that the expansion of production in the period of the economic recovery after 2008 was accompanied by increasing emissions per value added in some sectors, especially in the coke and refinery and chemical sectors, as shown in the next figure.

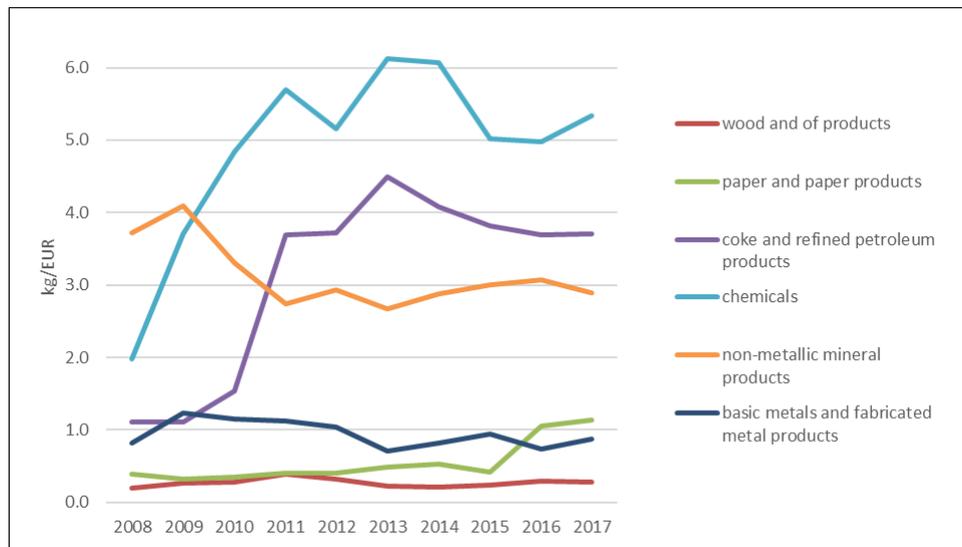


Figure 8: GHG emission intensity of the Hungarian manufacturing sectors, 2008-2017 (Source of data: Eurostat, Note: GHG emissions cover CO₂, N₂O and CH₄ in kg of CO₂ equivalent, the values show the ratio of emissions to gross value added in Euros, chain linked values, 2010)

Comparing the relative emission intensity of the different sectors across countries, we can see that in case of non-metallic mineral products, chemicals and paper sectors, the Hungarian companies emit relatively more emissions per gross value added, albeit the producers of coke and petroleum products and basic metals were less emission intensive in Hungary than in the EU and most of the other countries depicted on the graph.

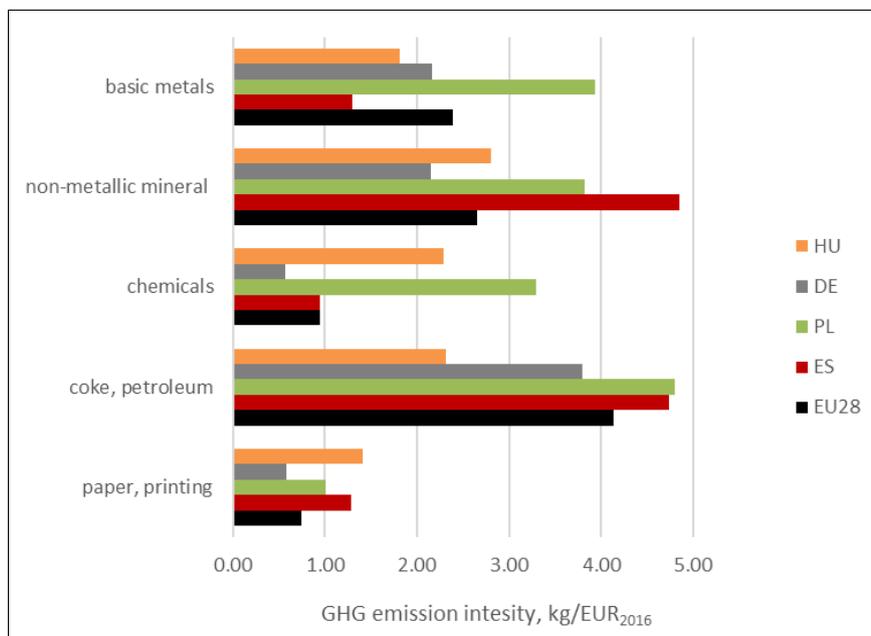


Figure 9: GHG emission intensity of the large energy using sectors in 2016 compared to the same sectors in participating countries and the EU (Source of data: Eurostat, Note: GHG emissions cover CO₂, N₂O and CH₄ in kg of CO₂ equivalent, the intensity shows the ratio of emissions to gross value added in 2016 Euros)

The Hungarian industrial sector is deeply integrated into the European and global value chains. The share of foreign-controlled enterprises in Hungary is the highest in the EU with a 51.4% share of value added 2016.⁶ The major firms of the most energy intensive material industries are local subsidiaries of multinational companies, so in their case the implementation of new, environmental-friendly technologies is a complex assessment of internal optimization at a company level and analysis of the demand of the main buyers of materials.

3. NATIONAL PERSPECTIVE FOR THE 2030 AND 2050 HORIZON

3.1. Existing measures - Energy efficiency

Among the measures implemented under Hungary's energy efficiency policy, two are dedicated to the industrial sectors:

- mandatory employment of energy engineers prescribed for large companies,
- and tax advantages for corporate energy investments;

Companies consuming over 400,000 kWh of electricity or 100,000 m³ gas consumption per year are required to employ energy auditors.⁷ Corporate tax reimbursement is available for companies that invest in energy efficiency development, capped at 30% of the total investment value and maximum 15 million euro.⁸

Despite the current measures, Hungary lags behind its intermediate energy efficiency goals, meaning the current policy will require an overhaul. It is not yet decided how the tasks and burdens will be shared among the different energy consuming sectors.

Energy use:

With the industrial sector's recovery from the lows of the crisis years energy use has rebounded quickly, but this is predominantly attributable to growth in electricity consumption which is favourable to decarbonization efforts.

The Hungarian Government developed and published its preliminary estimate on the sectoral contributions to the energy efficiency targets expected under Article 7(a) and 7(b) of Directive 2012/27/EU (the Energy Efficiency Directive)⁹. The expected targets were published by the Government in the draft version of the National Energy and Climate Plan, as shown by the following table:

⁶ EUROSTAT data publication 11.04.2019

⁷ Governmental Decree No 122/2015 (V.26). § 7/A

⁸ Act 1996. LXXXI. § 22/E

⁹ Directive 2012/27/EU

Year	Residential buildings	Industry	Transport	Other	Awareness raising	Small-scale electricity generation from renewable sources	Distribution/R epowering/Pro duction, other measures
2021	3.30	1.49	0.397	0.10	0.6	0.30	0.50
2022	3.34	1.50	0.398	0.10	0.5	0.40	0.50
2023	3.34	1.50	0.398	0.12	0.5	0.50	1.00
2024	3.38	1.50	0.399	0.12	0.4	0.60	1.00
2025	3.38	1.50	0.399	0.15	0.4	0.62	1.50
2026	3.30	1.49	0.397	0.15	0.6	0.62	1.70
2027	3.47	1.50	0.402	0.15	0.2	0.72	2.00
2028	3.47	1.50	0.402	0.15	0.2	0.72	2.50
2029	3.51	1.51	0.404	0.15	0.1	0.82	2.70
2030	3.51	1.51	0.404	0.15	0.1	0.82	2.99
Total	34.0	15.0	4.0	1.3	3.6	6.1	16.4

Figure 10. Preliminary energy efficiency targets for the Industry and other sectors (PJ) Source: The Hungarian Draft National Energy and Climate Plan¹⁰

Targets and objectives on GHG emissions and removals:

- in industry, Hungary aims to limit the increase of emissions to 11.37 million tCO_{2eq}, notwithstanding an increase in production
- this cap is broken down to energy and process emissions as follows:
 - 5.05 mtCO_{2eq} of energy emissions
 - 6.32 mtCO_{2eq} of process emissions

Based on the prognosis of the Hungarian government, Hungary’s GDP will be 76% higher in 2030 than 2015, with growth predominately in industry, construction, and services, and agricultural largely stagnant.

The estimation calculates the industrial share of 28.9% in 2030 compared to 27.0% in 2015. Industrial non-energy emissions are expected to grow by 33% in 2030 compared to 2015. Fluorinated GHG emissions are expected to significantly fall by 2030 as a result of EU common policy actions (prohibitions and quota scheme).

3.2. Additional measures (as of draft NECP by the Hungarian government)

As a result of additional measures, GHG emissions of end consumers are expected to be 5.9 mtCO_{2eq} lower in 2030 than under the WEM scenario, or 13% less than 2005.

Fewer efficiency measures apply to industrial sectors and, as a result, energy consumption is expected to increase by 29% between 2015 and 2030. In the same period the largest rate of growth is expected in renewable energy and electricity while coal consumption is expected to decrease.

- The government plans to implement an energy efficiency obligation scheme through a pilot project in 2019.
- The Hungarian government is considering introduction of a cost compensation for indirect carbon emissions in Hungary for competitiveness reasons. The responsible Ministry presently

¹⁰ https://ec.europa.eu/energy/sites/ener/files/documents/ec_courtesy_translation_hu_necp.pdf

collects suggestions from stakeholders for technological innovation projects that can be supported from the modernization fund and EUA auction revenues.

There is not much left in the toolbox of the Hungarian government to decrease industrial GHG emissions any further. The following figure compares industrial GHG emissions under existing measures compared to additional measures, showing only a 3-4% difference between WEM and WAM scenarios. The modest additional emission reduction achieved by additional measures is explained by the government in NECP as follows:

- Firstly, the two scenarios assume identical production patterns and an identical growth in production value, i.e. energy efficiency is the only source of the difference;
- The existing energy efficiency aids have substantial incentivising power;
- The tightening standards, which are mandatory in all EU Member States, and provisions of the Energy Efficiency Directive (2012/27/EU) were already considered in the WEM scenario;
- In addition, the new policy measures result in a faster increase in housing construction under the WAM scenario, resulting in higher energy conservation in the household sector, but more energy consumption in the manufacturing of building materials in Hungary.

See following graph illustrates the results of additional measures on industrial energy consumption.

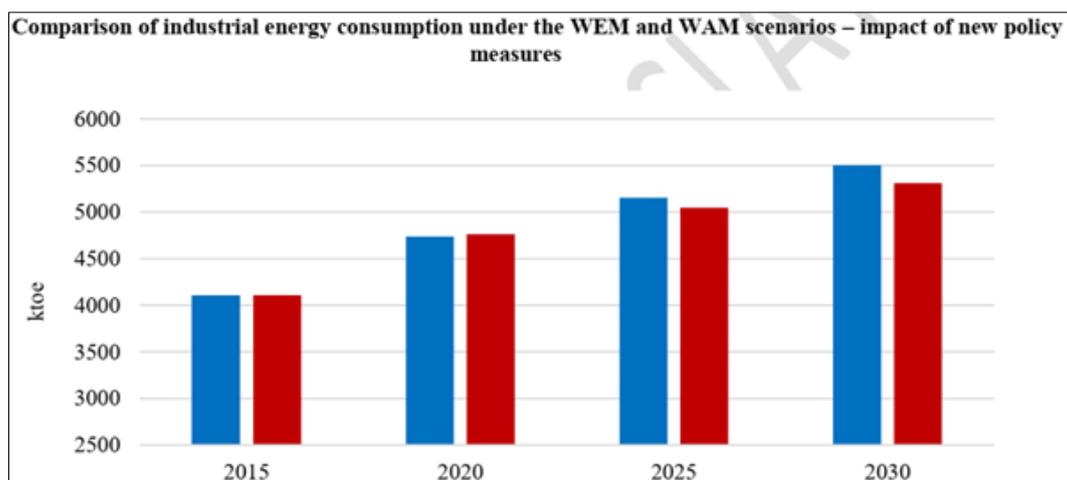


Figure 11. Impact of new policy measures Source: The Hungarian Draft National Energy and Climate Plan

4. RESULTS OF THE CFM NATIONAL DISCUSSIONS

4.1. National roundtable

The Hungarian roundtable was organised on 12 December 2018 in Budapest, hosted by the Ministry for Innovation and Technology. 18 participants were involved in the discussion representing the largest Hungarian industrial companies, industrial associations, NGOs, and the government.

The main focuses of the roundtable discussion were as follows:

- i) incentivizing companies to invest in low carbon solutions/energy savings
- ii) impact of carbon leakage due to the non-ETS neighbours, such as Ukraine and Serbia
- iii) impact of mixed ownership structure in the energy intensive industries (effort sharing, responsibilities, allocation of financial sources between the mother companies and local affiliates)

The introductory presentation by REKK provided an overview of the main goals and research focus of the „Climate Friendly Materials” research programme, and raised some issues related to the current trends of industrial energy consumption, the relationship between energy costs, energy intensity and competitiveness, and the potential of carbon leakage. Participants inquired about the expected outcomes of the research programme, the possible benefits they could gain from being involved, and what level of decision-making will be targeted by the resulting policy recommendations.

The representative of the Ministry for Innovation and Technology talked about the aim of the government to introduce cost compensation for indirect carbon emissions in Hungary for competitiveness reasons, and also noted that the Ministry presently collects suggestions from stakeholders for technological innovation projects that can be supported from the modernization fund and EUA auction revenues. The presentation underlined, that Hungary lags behind its intermediate energy efficiency goals, as the alternative policy measures applied by Hungary to meet its obligations under Article 7 of the Energy Efficiency Directive¹¹ have not delivered the expected outcomes, therefore the current policy will require an overhaul. It is not yet decided how the tasks and burdens will have to be shared among the different energy consumer sectors.

During the discussion following the presentations, industry representatives shared their opinion on the current level of energy prices in Hungary compared to those in surrounding countries, the energy consumption effects of increased economic activity associated with the recovery, and the danger of carbon leakage in some sectors. They argued that the intensity of support in industrial energy efficiency programs should reward combined energy efficiency measures that result in multiple benefits, to encourage higher energy savings.

4.2. Questionnaires and feedbacks on efficiency-related activities of participant companies

A small questionnaire of 18 questions related to energy efficiency measures and renewable energy use were sent to the contributing companies. Answers were received from 7 large industrial energy consumers belonging to the cement, chemical, iron and steel and refinery sectors. In this subsection we summarize the main outcomes.

All but one company engaged in energy efficiency improving measures during the last 5 years related to the production process and production site infrastructure. Two companies also invested in HVAC, more efficient lighting and business processes. The main motivation for energy efficiency improvements for 3 respondents was to reduce energy costs, while the others identified saving carbon emissions, increasing the good reputation of the company, and the need to change outdated machinery.

¹¹ 2012/27/EU

From among the possible factors influencing energy-efficiency decisions, decreasing production costs and improving the competitiveness of the company and reducing energy costs were scored the highest on a Likert scale ranging from 1 to 5.

4 out of the 7 companies have already installed smart systems for managing and monitoring energy consumption at their facilities. Only one company uses renewable energy to meet the demand of its production and facilities, albeit 4 of the other companies are planning to in the future. Of those, 2 companies will invest in on-site installation of RES-E generating systems, one is considering a PPA, and the others would purchase renewable electricity from their energy suppliers.

The respondents were asked whether their technologies and associated emissions meet (or will meet) the requirements laid down in the relevant BAT documentation in line with the requirements of Industrial Emissions Directive¹². Two companies admitted to lagging behind with the necessary improvements, and in one case it quite doubtful that required investments can be implemented by the deadline.

Decisions on the implementation of energy-efficiency measures are made at the corporate management level in 5 cases and plant management at production sites for the other two belonging to the chemical industry.

Plants at lower company levels can rely heavily on corporate resources for technical/technological expertise and financing of energy-efficiency measures in case of the participating companies. Company-wide synergies are also exploited in most of the cases, while energy-saving opportunities are identified at both the corporate and the plant levels.

Companies were asked to evaluate on a Likert scale ranging from 1 to 5 the current energy efficiency level of their activities. As the next figure shows, most areas received scores of 3 and 4, suggesting that there is room for efficiency improvement, especially in the area of transportation.

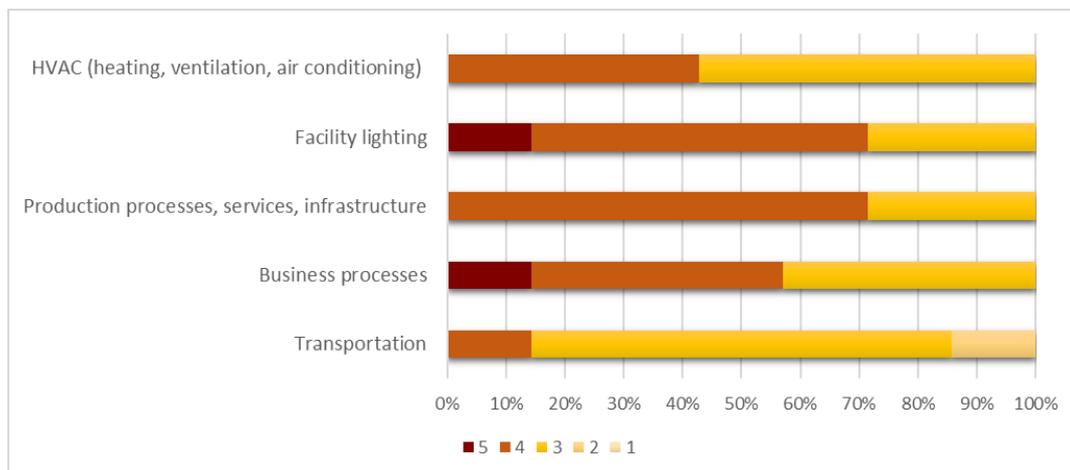


Figure 12: How would you evaluate the energy efficiency of the following activities at your company? (5-high, 1-low; N=7)

Respondents were asked to identify those areas in which they see opportunities for electrification in their companies. Except for two iron and steel producers, all of them mentioned production

¹² 2010/75/EU

technologies. Heating and cooling were cited by 3 companies, while 4 of them consider the use of electric vehicles a feasible option.

The next two figures show how much firms rely on the listed options for reducing carbon intensity, and the potential they see in the given measures to decrease carbon intensity at their companies (1 – not at all, 5 – largely).

	Cement	Cement	Iron and steel	Iron and steel	Chemical	Chemical	Refinery and chemical
Share, repair, reuse (tools, appliances, vehicles)	2	5	4	2	3	1	3
Reuse/recycling of wastes	5	5	5	3	3	1	4
Material-efficient design (introducing products including reduced amounts of raw materials)	2	5	4	3	4	1	3
Material-efficient manufacturing (reduced material use during the production process)	3	5	4	2	4	1	4
Using substitute products/materials having lower carbon-intensity	4	5	4	2	4	1	5
Reduced the carbon-intensity of the production processes	3	4	3	2	4	2	4
Reducing carbon emissions of the production site (renewable energy use, improvement of the energy performance of buildings, etc.)	3	4	2	2	5	5	4

Table 1: Please indicate to what extent your company relies on the following carbon-intensity reducing options! (5 - largely, 1- not at all)

	Cement	Cement	Iron and steel	Iron and steel	Chemical	Chemical	Refinery and chemical
Share, repair, reuse (tools, appliances, vehicles)	1	3	4	2	4	1	3
Reuse/recycling of wastes	4	5	5	4	3	1	4
Material-efficient design (introducing products including reduced amounts of raw materials)	2	3	4	5	3	1	3
Material-efficient manufacturing (reduced material use during the production process)	3	5	4	5	3	1	4
Using substitute products/materials having lower carbon-intensity	5	5	4	4	3	1	5
Reduced the carbon-intensity of the production processes	3	3	3	4	5	3	4
Reducing carbon emissions of the production site (renewable energy use, improvement of the energy performance of buildings, etc.)	3	5	2	3	5	5	4

Table 2: Please evaluate the following options according to their potential for reducing carbon emissions at your company! (5-high, 1-low)

As we can see, reliance on the listed options is somewhat correlated with their perceived potential to reduce emissions. Cement producers and iron and steel companies mainly rely on or see potential in the reuse/recycling of wastes, efficient material use and using substitute products, while firms belonging to the chemical industry focus on reducing the carbon intensity of production processes and reducing the emissions of their facilities.

Finally, some questions specifically referred to their attitude towards low-carbon production, and the results are summarized in the next table. Although answers tend to vary even among companies within the same industry, some patterns emerge. While the producers of chemical products find less carbon-intensive and carbon-neutral solutions still unprofitable and therefore postpone the investment decision, steel-makers appear to see more immediate opportunity. The top management of cement and steel industries devote particular attention to carbon-neutral solutions, though uncertainty in the regulatory environment and innovation pathways are considered problematic only by cement industry representatives. As the carbon-neutral options are non-profitable for the chemical producers, they are driven by regulation.

	Cement	Cement	Iron and steel	Iron and steel	Chemical	Chemical	Refinery and chemical
We produce highly marketable products, therefore we do not pay particular attention to replacing our inputs or technologies by less carbon-intensive alternatives.	2	1	1	3	2	2	2
We continuously monitor the options of switching to less carbon-intensive raw materials.	2	5	1	4	3	4	3
Less carbon intensive or carbon-neutral solutions are not profitable for our business at the moment, so their introduction is postponed.	4	1	1	1	5	5	4
The top management of the corporation devotes a particular attention to exploring and switching to carbon-neutral solutions.	5	5	5	4	3	4	3
The most important drivers of switching to carbon-neutral alternatives are obligations set by the regulation.	3	1	1	1	4	2	4
We are committed to implement carbon-neutral solutions, and are even ready to make our short-term profit interests subordinate to this long-term objective.	4	4	4	2	1	3	2
We are uncertain about the long-term effects of legal regulation.	4	5	1	3	3	3	3
We are uncertain about the long-term innovation effects, technology pathways and dominant technologies.	3	5	1	1	3	3	3

Table 3: Please indicate how relevant are the following statements in case of your company (1- not at all, 5 - highly relevant)

5. CONCLUSIONS

The outcomes of the project have shown that the majority of Hungarian material industries have not yet started to align their long-term strategies with the 2050 decarbonization goals of the EU. Many of them have implemented energy efficiency measures related to their manufacturing processes as well as the energy consumption in their facilities, but the main reasons for the investments were regulatory provisions, competitive pressure due to increased energy prices, and the need to avoid costs related to carbon-emissions. Finding the way of reducing their emissions in the medium and long term poses a significant challenge, not only in terms of financing, but also due to the uncertainties in the possible innovation pathways, as well as the yet unknown changes in the markets of material products. The current Hungarian measures do not seem to provide appropriate incentives for industrial stakeholders to invest into less carbon intensive technologies without losing their profitability.

The participants in the Hungarian national roundtable argued that the intensity of support in industrial energy efficiency programs should reward combined energy efficiency measures that result in multiple benefits, thus encouraging higher energy savings.

For Hungary, the dominance of foreign ownership in the leading companies of the material sector makes it more difficult to optimize the technology investments on national level. The internationalization of material sector firms is both an opportunity and a threat from a host country perspective. The innovation potential of these companies significantly outreaches the playing field of local competitors. Despite this fact, without a credible incentive from a European level policy framework, multinational companies tend to optimize their investments, technologies and production based on short-term financial gains without considering the environmental aspects. For example, the danger of carbon-leakage might increase if an EU based multinational company operates plants located outside of the EU borders.

Hungarian plants at lower company levels can rely heavily on corporate resources with respect to technical/technological expertise and financing energy-efficiency measures. Company-wide synergies are also exploited in most cases, while energy-saving opportunities are identified at both the corporate and the plant levels. As a result of falling renewable energy production costs, more than half of the 7 material producers participating in our survey use or plan to use renewable electricity in the future.

A credible EU-level policy framework that provides sustainable price signals to invest in low-carbon technologies is crucial for incentivizing international companies to transform, especially during the phase of mass deployment of these solutions within the EU market. Another option is to put in place discriminatory, regionally-sensitive EU policies e.g. subventions for Innovation R&D to local producers, to give these countries a preferential treatment that enables them to become an early mover in the transformation.

The Hungarian climate strategy has yet to incorporate the issue of industry decarbonisation. Except for some energy-efficiency encouraging measures, mainly stemming from European climate policy obligations, no attempts have been made to outline options and possible scenarios for a gradual move towards a climate-friendly material production. The outcomes of the present project highlighted the need for a dialogue between the companies and the policy-makers related to the carbon emission abatement options and the necessary incentives that may be necessary to be provided.

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