HUNGARIAN HEAVY INDUSTRY DECARBONISATION

Policy and Financing Roadmap

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1. Preface/introduction

Heavy industries are said to be among the sectors that are the most difficult to decarbonize. Not only the sectors' high energy demand – both for heat and electricity – but also the so-called process emissions make them big emitters of carbon dioxide.

The 2050 climate neutrality objective of the EU – and obviously that of Hungary set in its own Climate Act – will not be attainable without ambitious decarbonization goals and actions for the years to come.

There are several barriers to the decarbonization of the heavy industries, policy barriers, technological barriers and financial barriers as well.

In this roadmap, we try to give a range of financing that would be needed in Hungary for the decarbonization of the production of cement, steel and chemicals. Financing options and some policy insights are also part of this roadmap that we hope will be useful for both the actors of the focus sectors, those of the policy-making arena and those of the financial sector.

2. Executive summary

2. Executive summary

The 1989 change of political regime in Hungary significantly altered the country's industrial landscape. Heavy industry, that was artificially kept alive, collapsed in just a few years. Due to this collapse, emissions of carbon dioxide and of atmospheric pollutants decreased significantly, but this was not connected to better energy efficiency or better technologies, which means that most of the industrial installations that are still functioning in the country need technological upgrading. **As the restructuring of the economy led to important CO_2-emission reductions, Hungary did not have to reach very important emission-reduction targets under EU climate policies until now.** Neither the Member State targets nor the relatively low price of carbon under the EU's Emission Trading System were motivating enough for Hungary's heavy industries to invest in drastic changes in energy use and/or in technology. **This was surely one of the main barriers to decarbonization until today.**

The war in Ukraine and the rise in energy prices surely altered this environment. **Energy efficiency and alternatives to fossil fuels** both as energy carriers and as feedstock **became much more important in the strategies of heavy industries.**

Since 2022, Hungarian heavy industry businesses are for most of them in crisis, they suffer their worst production drop in decades. The outcome of these very difficult quarters will have structural effect on the Hungarian industry since not all companies may make it after 2023-2024 as we know them today.

For now, from an emission perspective, chemical industry represents the largest share in total ETS emissions, closely followed by cement production, while steel production has a much smaller role.

For all companies of the heavy industry, the return on investment of energy efficiency and renewable energy projects is much better than in the previous years. **With rising energy prices, financial obstacles appear in a different light: it is worth investing** in projects that have a quick effect towards reducing energy and fossil fuel consumption.

In the steel sector, the biggest actor, ISD Dunaferr Ltd has been on the verge of bankruptcy for years, which creates an unfavorable investment environment. The other big actor, Ózdi Acélművek Ltd operates using the best available technology (BAT) and is financially sound. The production of the sector is expected to decrease in the years to come.

The sector has no thorough decarbonization plan.

In the cement sector, Holcim Hungary Ltd (LAFARGE Hungary until May 2023) and Duna-Dráva Cement Ltd are the two relevant actors. The sector is also in a difficult situation, but for other reasons: a mining fee was introduced in 2021 by the government, which is a special tax that takes away the profit of the actors of the cement sector, making Hungarian cement production impossible on the long run. For the moment, we expect stagnation in production levels of the sector, as the mining fee is said to be a temporary financial instrument.

Both cement companies analyzed have decarbonization strategies that are based on energy efficiency measures, on the development of low clinker content products and on the usage of alternative and renewable fuels.

As the chemicals industry is very heterogeneous, we focus on the three companies that are under the EU Emission Trading Scheme in Hungary: MOL Petrolkémia Ltd. and BorsodChem Ltd. producing bulk chemicals and Nitrogénművek Ltd. producing ammonia. The industry's production significantly dropped in 2022 due to surging energy prices, while a slight decoupling of production from greenhouse gas emissions was observable before the crisis, but now, the trend is unclear.

Even though the war in Ukraine is switching the focus from climate protection to energy security, big actors of the chemical sector have sustainability strategies and climate protection objectives: MOL Petrolkémia wishes to become a lead actor in the region in the field of R&D&I and implementation of carbon capture and storage technologies, while BorsodChem works on reaching its goal of carbon neutrality by 2050.

A general barrier to concrete industrial decarbonization roadmaps is the lack of details, timing, and dedicated funding options for decarbonization. Clear, predictable, and reliable policy environment is key to motivate industry actors in taking steps towards greening their production. Steel, cement and the chemical sectors all have their specific barriers, but a common point is the lack of research and development into new, low-carbon or carbon-free technologies. Both in the cement and in the steel sector **there is a significant gap between the demand for and the supply of skilled workforce needed. Thus, skilling and reskilling for the green transition is of utmost importance,** because no financial capital and no technology will be enough if the human capital is missing from the sector.

When it comes to financial barriers, transitioning is currently poorly financed in Hungary, and we see a clear market failure justifying state aid. In the EU, funds from the Multiannual Financial Framework (MFF) or from the Innovation and Modernisation Funds are all available for heavy industry as well, but very important limitations persist for industrial decarbonization, and we do not see that heavy industry decarbonization would be in the focus of EU-financed projects, especially when it comes to process emissions. **Not even the Hungarian Recovery and Resilience Facility focuses on these sectors.** Until spring 2023, **Hungary has not submitted any application to the Innovation Fund,** although EUR 40 billion are available in the Fund until 2030.

The Hungarian government took the first move toward encouraging green finance in June 2020, when it issued green government bonds, which raised cash for government initiatives relevant to Hungary's Clean Development Strategy's climatic and environmental goals, but the sum available is far from what is needed for the financing of decarbonization.

The MNB – the Hungarian central bank – was instrumental to foster green financing, as it helped its own Growth Bond Programme participating companies to issue HUF 189 billion of green bonds. The green capital requirement programme is set to phase out soon and there is uncertainty over its continuation in the light of the general monetary tightening.

The modelling tool used in our work is the Pathway Explorer 2050 model by Climact, which makes the results comparable between V4 countries if someone wishes to do so. The model addresses CO_2, CH_4 and N_2O. The model aims a net zero emission by 2050. The scenario we chose is more "bottom-heavy", because decarbonization measures kick in mostly from the second part of the forecast horizon. **The results of our modelling show that industry's contribution to overall CO_2 abatement will be around 7 percent. This can be met with technology shifts that are much more ambitious than current industry plans.** For the moment industry players do not fully consider large investments for technology shifts yet as they do not see a reliable market environment even with the current technologies and standards in place (especially in steel and cement) or are on a careful planning phase (chemicals).

Based on our modelling work, the total investment cost (CAPEX) to be spent between 2016 and 2050 for all 3 industries amounts to EUR 2.64 billion, which is approximately 1.6 percent of the current Hungarian GDP. The CAPEX split between our focus industries is very unequal, as chemical industry accounts for 78 percent of all CAPEX, while cement is responsible for 14 and steel for 8 percent of total CAPEX. Cement industry's CAPEX would reach EUR 314 million, steel industry's CAPEX sums up to EUR 186 million and chemical industry's CAPEX sums up to EUR 2.1 billion.

To see the private financing available for decarbonization until 2030, we analyzed a combination of the hard-to-abate sectors' estimated aggregated ability to generate free cash flow in 2023-2029 (i.e. until the last year before the roadmap´s 2030 target year) and their additional debt capacity. **The private financing potential of the three sectors considered** – taking into account the safe debt level – **is estimated at EUR 3.17 billion over the period 2023-29,** assuming zero dividend payments.

When it comes to public financing, **the main tools for heavy industry are expected to be the Innovation Fund and the Modernisation Fund.**

3. The Hungarian industry's current status

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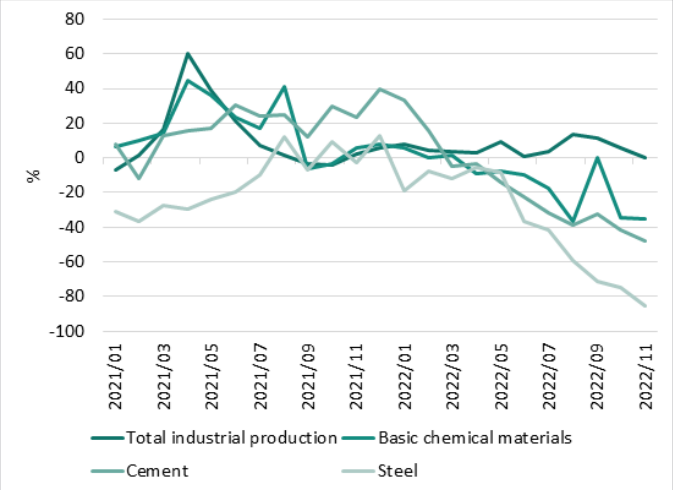
Stemming from the nature of the projects, the horizon of decarbonization efforts overlook business cycles. However, we have to emphasize that as of 2022, Hungarian heavy industry businesses are for most of them in a crisis situation. Indeed, based on production data, they suffer their worst production drop in decades. Turnover data seem to strengthen this view too. The steel industry in particular fares far below the total national industrial production. This is due to solvency problem by Dunaferr (see chapter 3.1). Besides of steel, the remaining 2 focus industries are having serious issues too, both on the cost side (energy prices OPEX) and demand side (backdrop of the economy and price caps for cement). The topline message is that the survival outcome of these very difficult quarters will have structural effect on the industry since not all companies may make it after 2023-2024 as we know them today. Import competition surged too, especially for cement and steel, making it even more difficult for local units to operate.

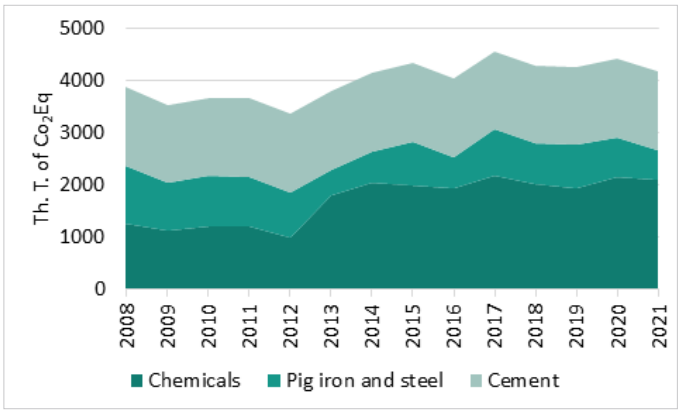
Figure 1: Industrial production dropped severely in 2022



Source: Hungarian Statistical Office

From an emission perspective, chemical industry represents the largest share in total ETS emissions, closely followed by cement production, while steel production has a marginal role. Based on recent production data (see chart above) it is safe to say that in 2022 cement and steel industries' emissions must have felt considerably. At the same time this dropback must have allowed to realize gains on ETS trading, resulting in a mitigation of some degree of losses caused by energy prices and general market environment.

Figure 2: Emissions registered after the production of chemicals is the biggest challenge to solve



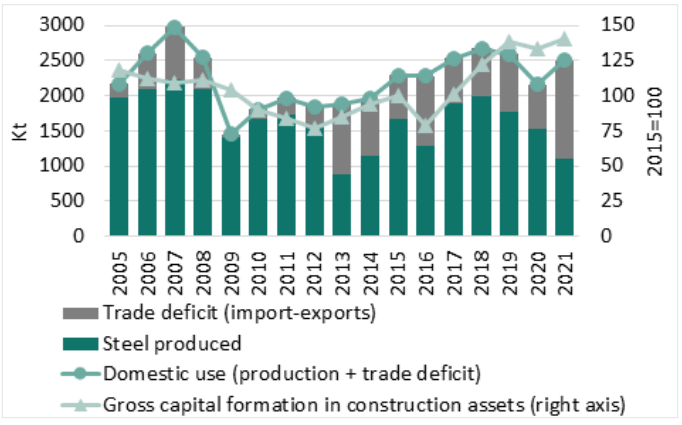
Source: EU transaction log

3.1. STEEL PRODUCTION

Visegrad 4 countries (V4) represented approximately 12.5 percent of the EU steel production in 2019. When looking at the long-term trends, steel production volumes follow a decelerating trend. Poland is a notable exception as its production has been increasing since 2010. Hungary's steel capacities are modest when compared to the regional peers.

Due to financial issues at Dunaferr (see further below), import steel gained more ground in domestic use, reaching a record 70% dependency ratio on imports. This is a 22-percentage point increase in just a year. Based on the 2022 figures available in spring 2023, there is a very strong possibility that this ratio increased further up in the territory of 85-90%. To sum up, current stance for Hungarian steel is worrying.

Figure 3: Currently steel import covers 70 percent of the domestic use



Source: Equilibrium Institute based on the Hungarian NFR report for the Convention on Long-Range Transboundary Air Pollution (CLRTAP), and Eurostat (2021)

In line with declining internal production figures, ETS emissions dropped in 2021 by 24 percent. That is roughly the same number as the drop in production (27 percent), meaning there was no change in emission efficiency.

In Hungary, there are two installations participating in the ETS whose market share totals at about 94 percent (ISD Dunaferr Ltd. in Dunaújváros and Ózd Steelworks Ltd. based in Ózd). Despite the robust building sector, domestic steel production could not meet the demand and has dwindled since 2005. Currently, steel import covers 58 per cent of the domestic use. According to the National Inventory Report of 2021, GHG emissions from the iron and steel producing sector decreased by 10 percent since 2018 thanks to a reduction of pig iron production. Emission intensities, however, did not budge throughout the period. Hungary benefited from an improvement in terms of trade. Against the backdrop of surge in base metal supplies, import prices flatlined between 2009 and 2020. Slovakia emerged as the key trading partner at 19 percent of import shares while imports from Germany and Italy were significant with a 15 percent cut respectively.

Stakeholders indicated that the steel industry grapples with structural problems. Local production falls short of delivering the quality and type of products needed. This also means that the emissions stemming from import of steel can be considerable due to transportation as well as the Scope 1 emissions of production. If the product structure could be modified to produce more for the Hungarian market – more steel products suitable for the Hungarian automotive industry, for example –, connected emissions would significantly decrease.

Another structural difficulty is that the steel market became a short delivery market in the past two decades and every actor wants to receive the products ordered as quickly as possible. This has changed the favoured form of transport from rail and shipping to road transport, which has a much bigger carbon footprint. Against the backdrop of plummeting production volumes, emissions almost halved since the ‘80s. The decline in emissions continued between 1990 and 2010s but the trend reversed around 2013–2014. Moreover, iron and steel production reached almost the level before the 2008 economic crisis by 2015. In conjunction with the volume gains, emissions rose as well, underscoring that no decoupling of emissions from production was achieved.

Financial woes of ISD Dunaferr might be both help and hindrance to the decarbonization agenda. For one, the impending solvency issues coupled with the mounting legal and operational risks can drive the company to the ground in the short run. According to stakeholders close to the industry, insolvency can’t be averted. Shutting down the production then could mean a full decarbonization. However, the looming controversies also present a key obstacle: the biggest Hungarian steel producing plant lacks transparency and a viable business model that renders any planning for sectoral decarbonization futile. The fact that ISD Dunaferr has no decarbonization plan or strategy in the offing is not surprising given the financial backdrop. Hungarian government resisted intervention during a long time, but finally stepped in at the end of 2022.

Dunaferr has been in liquidation since mid-December 2021, but in mid-January 2022, Liberty Steel, which is actively interested in the company, signed a three-month contract – probably for contract manufacturing – with the trustee in charge of the liquidation of Dunaferr. This secured the operation of the steel manufacturer for at least three months. Most recently (January 2023), a new modification in the law has been passed to allow companies to operate at a loss, provided that this allows their assets to be preserved. Then, the company, long in a state of bankruptcy and difficult to keep track of due to its confused ownership, accelerated the payment of back wages – the government decided to pay the wages of the Dunaferr employees during six months –, and now the new regulation allows it to continue operating at a loss for a while, looking for a way out and a possible new owner[1].

Contrast to Dunaferr, Ózdi Acélművek Ltd is financially sound and its machinery is in a much better state. Currently, the installation operates leveraging the best available technology (BAT) and has a much more favorable emission intensity profile, however the company has not made information available about its sustainability strategy or climate pledges. In publicly available documents however, the company enclosed its carbon footprint data for 2018. The mandatory energy report for 2020 stresses the importance of energy efficiency and climate protection but fails to mention any emission-reduction targets.

The Hungarian steel sector is in a troubled state and both technological and financial barriers to decarbonization are daunting. The sector can get stuck in the rut and lack meaningful movement on those issues if the primary producer, Dunaferr’s status stays unresolved. Lack of transparency can hold back on decarbonization investment. Deep-pocket investment to overhaul the old steel-making capacities is then unlikely, barring significant state support and guarantees. Without the government guiding the way, the sector’s biggest actor is likely to disappear in a few years. Some light at the end of the tunnel has begun to manifest, when the government announced it will pay the payroll of Dunaferr for 6 months[2], but the future of the plant is still unclear.

3.2. CEMENT PRODUCTION

When it comes to cement production Visegrad Four (V4) countries have about 16 percent cut of aggregate EU production. The country’s contributions follow the size of the national markets. Poland tops the chart at a hefty 10,8 percent share of EU production. The rest of the pack has a more moderate contribution with the Czech Republic printing at 2,6 percent, Slovakia at 2,3 percent and Hungary at 0,6 percent. When considering ETS emissions there are three installations participating: two facilities (Vác and Beremend sites) under the supervision of Duna-Dráva

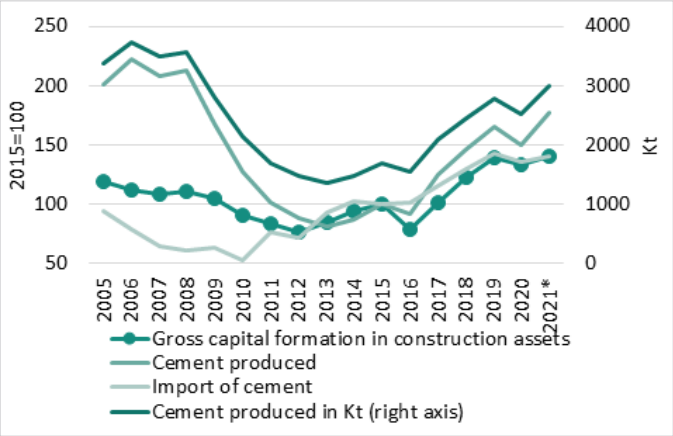
1 https://forbes.hu/uzlet/kormanyrendelet-mentes-dunaferr/?utm_source=hirstart&utm_medium=referral&utm_campaign=hiraggregator
https://hvg.hu/gazdasag/20230131_Dunaferr_kormanyrendelet_vesztesegesmukodes

2 https://24.hu/belfold/2023/02/01/kormany-kifizeti-dunaferr-berek-orban-viktor/#

Cement Ltd. and LAFARGE Cement Magyarország Ltd (based in Királyegyháza), called Holcim Magyarország Ltd. since May 2023[3]. The two companies' market share is at 82 percent.

Based on our estimate,[4] cement production increased by 18 percent in 2021 from the previous year, however – based on a smaller subset of data available – the industry suffered a backdrop in 2022 of about the same magnitude as the growth a year earlier. Thus, the industry is stagnating. This is in line with the general economic downturn, particularly hardly affecting investments via the elevated interest rates and subdued government fixed capital formation. Import ratio did not change from the previous year.

Figure 4: The evolution of cement production is linked to demand of national investments in construction assets



Source: Equilibrium Institute based on the Hungarian NFR report for the Convention on Long-Range Transboundary Air Pollution (CLRTAP), and Eurostat. (2021)

In line with the patterns observed in production, emissions increased too, but possibly to a lesser extent than the increase in production. While production increased by 18 percent, emissions only grew by 8.2 percent. Despite the favorable preliminary figures, it is too early to draw conclusion that significant efficiency has been achieved.

Construction boom bolstered cement production after 2017. Despite the 15-year peak in cement demand, domestic production still has not reached its pre-2008 levels. The share of imported cement in total domestic use more than doubled since 2008 (from 16.4 percent to 38.4 percent). National inventory data confirms that emission intensity did not improve over the past 15 years. CO_2 emissions of cement production closely tracks the production data. We only observed tepid signs of decoupling from 2016 on. Industry experts state that the decoupling might continue as the sector moves to reduce clinker content of cement produced, which reduces emissions.

Duna-Dráva Cement Ltd. aims to reduce its emissions by 15 percent by 2030 from 2019 levels, building on a reduction of 22 percent achieved since 1990. The 2030 target means emission-reductions of 33 percent compared to 1990 levels according to the company's decarbonization pathway. If we consider that the company should reach emission levels close to net zero by 2050, the pace of decarbonization is still too slow. LAFARGE Cement Magyarország Ltd, as a member of the Holcim Group, also adheres to a decarbonization roadmap at the group level, with concrete objectives for 2030 in the plan called "The 2030 Plan". Holcim Group wishes to reduce its emissions by 40 percent by 2030 compared to 1990 levels.

Running up to 2030 we expect the cement industry to make steps towards reducing energy use and dependence on fossil energy use by investing in energy efficiency and renewable energies. To that we can add that both Duna-Dráva plant and Lafarge-Holcim have ongoing photovoltaics projects working towards that aim. What is more, clinker content reduction projects are also under way which will reduce process emissions.

At the same time transition plans are unlikely to fulfil net zero objectives. Companies set GHG-emission reduction objectives of around 30-40 percent for 2030, compared to 1990 levels. That means that the actors plan to do 30-40 percent of the job in forty years and then leave the bigger part, 60–70 percent of emission-reduction efforts to the last twenty years, waiting for a technological breakthrough that will help the sector reach carbon neutrality by 2050.

The situation of the cement industry is even more complicated considering the government's decree in 2021 aimed at addressing and reducing the soaring prices of construction raw materials, which, among other things, attempted to freeze the price of cement. Under the regulation that came into force in summer 2021, a maximum price was introduced for many mined construction materials, above which production companies must pay 90 percent of the revenue generated to the budget as a mining fee. The only non-mined product for which this was introduced was cement. From July 2021, domestic producers have to pay a tax of HUF 9 per month for every HUF 10 of revenue above HUF 20 per kilogram, which is now exceeded by both the cost price and the market price of cement[5].

One of the many flaws of the mining tax is that it only applies to domestic production and not to imports, giving foreign firms a competitive advantage over domestic producers paying extra taxes. On the long run this tax makes Hungarian cement production impossible, causing shortages on the market as not only the profit is missing but the production costs are higher than what they can get on the market. This also leads to a lack of investments aimed at compensating infrastructure amortization. Foreign trade statistics already show an import increase of 6.4 percent in volumes for cement, while exports have decreased by a very considerable margin (33 percent year-on-year).

3 In this document, Lafarge Hungary and Holcim Hungary refer to the same company.

4 Industry production data are available, however material production data are not. Nevertheless, the two are strongly correlated.

5 https://g7.hu/vallalat/20230113/az-epitoipar-mukodeset-veszelyezteti-a-kormanyzati-cement-arsapka/

3.3. PRODUCTION OF CHEMICALS

In Hungary, the chemicals sector is one of the industries with the biggest energy demand, this, added to process emissions of some of the industrial processes makes the sector one of the biggest CO_2-emitters of the country. As the chemical sector is very heterogenous, we decided to narrow down the scope of our analysis in this sector: in Hungary, the major chemical sector CO_2-emitters are concentrated under two ETS-activities: production of bulk chemicals (MOL Petrolkémia Ltd. and BorsodChem Ltd.) and production of ammonia (Nitrogénművek Ltd.). Thus, these are the companies that we focus on in our report. They have high energy and/or process emissions and represent around 2/3ds of the net revenue of the sector (66 percent according to a 2018 analysis). In the past ten years ammonia and bulk chemicals emission processes have been stable over time and the industry produces 2000 tons of CO_2/year.

The industry's production significantly dropped in 2022 (as shown on Chart 1) due to surging energy prices. Emission data is available for 2021, showing a 2 percent decrease vs. a growth in production volumes of about 15 percent. This signals an increase of production efficiency although statistics of emission and production do not fully comply with each other.

The Hungarian chemical sector chiefly benefits from the generous free allowances that account for ¾-th of their total emissions and gives them a wild card. Although allowances have been declining over time, the free transfer is still very important from the financial and competitiveness perspectives. In the recent years prices of CO_2-quotas were still not high enough to motivate emission-reductions at the pace needed to reach the 2050 net zero target. The CO_2-emissions of the three companies analyzed flatlined in the past 7 years while productivity barely nudged in the period of 2014 to 2017. The COVID shock in 2020 curbed outputs and ate into the revenues of the chemical producers. However, emissions showed an upward trajectory.

Even though the war in Ukraine is switching the focus from climate protection to energy security, big actors of the chemical sector have sustainability strategies and climate protection objectives: it is not clear yet how the energy crisis will affect these goals in the middle-term and longer term. MOL Hungary refreshed its long-term strategy in 2021, paving the way for decarbonization. It wishes to become a lead actor in the region in the field of R&D&I and implementation of CCSU-technologies. According to its sustainability strategy, MOL plans to increase its capital expenditure in investments fulfilling the EU Taxonomy criteria above 50 percent by 2030 and ideally to 100 percent by 2050. BorsodChem Ltd. introduced a detailed GHG-inventory based on the international "Greenhouse Gas Protocol" to be able to quantify its direct and indirect emissions as well and reach its goal of carbon neutrality by 2050. The company's objective is to reduce GHG emissions per unit of production by 40 percent until 2030 compared to 2013 levels. Nitrogénművek Ltd. does not have specific climate protection goals.

For all three companies analyzed (just as for all companies since the beginning of the energy crisis), the return on investment of energy efficiency and renewable energy projects is much better than in the previous years. With rising energy prices, financial obstacles appear in a different light: it is worth investing in projects that have a quick effect towards reducing energy consumption.

3.4. GENERAL BARRIERS TO DECARBONIZATION

Decarbonization of the industrial sector is considered as one of the most difficult tasks for realizing a net zero emissions economy. When analyzing the barriers that hinder decarbonization efforts, we took a closer look at the policy barriers, the technological barriers and the financial barriers.

A general barrier to concrete industrial decarbonization roadmaps is the lack of details, timing, and dedicated funding options for decarbonization. Clear, predictable, and reliable policy environment is key to motivate industry actors in taking steps towards greening their production. Strategies need to be translated into action plans and the forward-looking Hungarian Climate Act needs to be supplemented with concrete actions, deadlines, and funding options. In Hungary, there are plenty of strategies, but often, the work on the strategies stops when the strategy is ready, and it is not transformed into an action plan.

Steel, cement and the chemical sectors all have their specific barriers, but a common point is the **lack of research and development into new, low-carbon or carbon-free technologies**. Emission-reductions are mostly realized through energy efficiency projects but there is no viable solution for reducing process emissions, meaning the emissions that occur as a by-product of the chemical processes happening during production.

Both in the cement and in the steel sector there is a significant gap between the demand for and the supply of skilled workforce needed. Thus, skilling and reskilling for the green transition is of utmost importance, because no financial capital and no technology will be enough if the human capital is missing from the sector. When it comes to policy making, we can also see a workforce problem, several skilled experts left public administration in the past years to work for the private sector, meaning that **the Hungarian public sector cannot retain enough talent and specialized workforce for better climate intelligence, policymaking, and implementation.**

There is also a lack of efficient and effective government communication towards the population on the need for decarbonization, on the need for energy efficiency, on the linkages between energy consumption, energy security and climate protection. The cooperation with the civil sector and other stakeholders is weak, consultations on strategies and new legislation are short, superficial, or often non-existent.

3.5. FINANCIAL BARRIERS TO DECARBONIZATION

Transitioning is currently poorly financed in Hungary, and we see a clear market failure justifying state aid. High energy prices revealed the vulnerability of the heavy industry, which is likely to move the sector towards greening the mix of its energy inputs (ie. making it more resilient to external shocks), while green manufacturing process solutions will be less attractive to finance. This is where the state comes as a facilitator of transition. Overlooking economic cycles, a serious underlying knowledge gap comes from the fact that return on investment (ROI) numbers are dependent on external (regulatory) costs, mainly ETS prices. In the EU, funds from the Multiannual Financial Framework (MFF) or from the Innovation and Modernisation Funds are all available for heavy industry as well, **but very important limitations persist for industrial decarbonization**. Steel companies may be able to apply for R&D funds, however it is highly unlikely that they are willing to do so. Moreover, the implementation of existing technologies is not supported as it is not novel enough, while a certificate of R&D content from the relevant state authority is requested and difficult to obtain. Another current issue of regional support aid rules is the fact that **large companies are only eligible for support if the scope of outcome of the project mostly benefits SMEs**. Companies in scope for industrial decarbonization are exclusively large companies and their operations are not linked to SMEs. A third issue is that currently, **member state financed decarbonization projects need to undergo Commission approval mechanism**, however this is likely to change from next year. Despite the new 2023 European Commission state aid rules being more favorable for decarbonization, they will probably need to be reconsidered. Our general assessment of the new legislation by the EC is that it needs to be adjusted to better align with the information gap for decarbonization projects.

Because of financial regulation by the EU, SMEs were favored against large companies between 2014 and 2020 to carry out **decarbonization projects through process or energy efficiency measures.** However, **Hungary like most countries in the EU, did not use this possibility, we see that allocations to this matter were low in the respective national operational programmes (OPs).** Nevertheless, Hungary was not far behind the European average allocation for the broader "low-carbon economy" allocations. Most of the available funding for low-carbon economy was allocated for renewable energy and energy efficiency in buildings (insulation) projects.

Another barrier is that the **Hungarian Recovery and Resilience Facility (RRF) does not feature any element dedicated to make industrial production processes greener, especially the reduction of process emissions is generally out of focus**. Unlike for the ESIF, centrally allocated state support programmes (Horizon 2020, Innovation Fund etc.) are not subject to state aid regulation. This means even steel activities are eligible for grants and there is no business size class restriction either. However, these funds do not represent a viable option for the focus group companies for various reasons.

The Hungarian government took the first move toward encouraging green finance in June 2020, when it issued green government bonds, which raised cash for government initiatives relevant to Hungary's Clean Development Strategy's climatic and environmental goals. Unfortunately, the Hungarian Green Bonds Programme's reception is ambiguous. Background expert information stated that most of the projects included in the Programme were already sanctioned to be financed prior to the start of the Green Bonds, which hurts the green credibility of the programme. Also, the total sum of the Programme is far from being in line with the investment needs to reach the national green targets.

As part of the UN NetZero initiative, the greening of bank portfolios is challenging, because banks may choose to divest brown assets rather than actually cleaning them. In Hungary, the primary financing mean of green projects is equity financing (securities), mostly because the risk associated with green investments is high, and by consequence collateral-based financing is not an option. Bank loan financing is mainly used for mortgage.[6] The regulatory authority will need to be wary of how banks execute the greening of their portfolios: there is a significant risk they will choose to drop "brown" assets rather than choose to engage with the counterparties to move towards a greener set-up.

The current situation on the energy markets requires tangible awareness-raising for decarbonization. There are ready-to-use methods which can help to persuade companies that decarbonization actually has a financial value for them. Heavy industry players are generally focused on OPEX, moving them away from this set-up would either require a stricter state regulation (as a negative incentive), higher expected ETS costs (also as a negative incentive) or positive financial returns (positive incentive) from green investments. A different approach is indirect benefits through value creation. Methods such as the True Value approach from KPMG offers a way to assess externalities. For instance, the return on capital expenditure can be higher if one accounts for externalities. If these externalities can be numerated, there is higher probability that risk pooling options will become available.

The MNB's (the central bank's) green capital requirement programme is set to phase out soon and there is uncertainty over its continuation in the light of the general monetary tightening. The MNB was instrumental to foster green financing, as it helped its own Growth Bond Programme participating companies to issue HUF 189 billion of green bonds. In addition to promoting green lending and its green bond programme, the MNB introduced a capital requirement discount programme for the purchase of corporate green bonds by commercial banks, among other things, as a further greening of the bond market. The future of the recently experienced dynamism in the Hungarian green capital market is somewhat in doubt because – as part of its tightening process on the monetary variables – the MNB stopped the Growth Bond Programme in 2021, but the capital requirements discount programme will remain in place until 2023.

6 For more information on the state of play of Hungarian Green finances please refer to the Annual Green Finance Report of the MNB.

Decarbonization related technology projects (such as CCS or CSU) are out of scope for both the industry and the State, because these technologies offer less return than green hydrogen projects. Green hydrogen projects are the most current focus areas of the state and private companies too, while process CO_2-emission reduction technologies lack the incentive to prosper. Although Hungary has relatively good attributes to store and use carbon-dioxide, market incentives to decarbonize production processes do not exist yet. First, carbon-dioxide based final products that could use for instance CCS technologies in the process would see output prices rise two to three times the current ones, because the technology is costly. There is no stable demand for greener products in the market either. On the other side, there are opinions about a breakeven price for natural gas high enough so that hydrogen technologies become a viable substitute, but again, the technological viability is a concern. Another issue faced by possible investors is that existing decarbonisation solutions compete with other decarbonisation alternatives, mostly targeting energy production and use. A serious concern is the long-term viability of the technologies. CCS is limited because storage capacities are finite in Hungary and there is no guarantee that an alternative technology building on simultaneous capture and use might become more viable than CCS. Yet, because CCS is currently in use in US and Europe, the required R&D investment risk is lower compared to other decarbonization alternatives.

4. Policy environment

Policy environment

4.1. GENERAL POLICY ENVIRONMENT IN THE EU

Since the first summary report of the Intergovernmental Panel on Climate Change in 1990, the climate policies of the European Union have been expanding in numbers and in their impact on a wide range of the EU's sectors, including transport, industry, agriculture, and others. At the same time, the climate-related policies of the EU have become more ambitious. For instance, the target of emissions reduction developed from 20% till 2020, to 40% till 2030, with the most recent increase to a 55% net emissions reduction target till 2030, compared to 1990 levels. In 2020, the EU also introduced its plan to make Europe the first climate neutral continent in the world by 2050.

To reach the primary objectives *(*reducing greenhouse gas emissions and enhancing energy security) and secondary objectives (supporting low-carbon technologies and protecting industrial competitiveness), the EU currently employs a variety of policy instruments. The most common type of instruments used by the EU are of regulatory nature. These instruments set the targets for the different areas of the EU's economy, such as the required perceptual increase in energy efficiency or in the use of renewable energy. In addition, the EU adopts "New" Environmental Policy Instruments (NEPI), which include emissions trading, eco-taxes, environmental charges, tradable permits, and voluntary agreements. The latest efforts of the EU in navigating the different trade-offs and designing a comprehensive set of policies are incorporated into the European Green Deal.[7]

4.1.1. EUROPEAN GREEN DEAL

The European Green Deal, endorsed by the European Commission in 2020, is a set of policy initiatives to make the European Union climate neutral by 2050, setting out a roadmap for all policy areas to make the EU economy sustainable and the green transition fair and inclusive for all. The European Green Deal aims to transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net greenhouse gas emissions by 2050
- economic growth decoupled from resource use
- no people or places are left behind.

The European Green Deal is funded by one third of the EUR 1.8 trillion investment in the NextGenerationEU Recovery Plan and the EU's seven-year budget.[8]

4.1.2. FIT FOR 55 PACKAGE

In 2021, the European Commission adopted a package of proposals called the **Fit for 55 Package**, which aims to make EU's climate, energy, transport and tax policies capable of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

The package of proposals aims to provide a coherent and balanced framework for achieving the EU's climate objectives, which:

- ensure a just and socially fair transition,
- maintain and strengthen the innovation and competitiveness of EU industry, while ensuring a level playing field with third country operators,
- underpin EU leadership in the global fight against climate change.

The Fit for 55 package addresses the energy sector, including district heating and cogeneration, land use and forestry, road transport and energy taxation.[9]

4.1.3. EMISSIONS TRADING SYSTEM (ETS)

The EU's **Emissions Trading System**, which enshrines the "polluter pays" principle, is a central element of European climate policy and key to achieving the EU's climate neutrality objective. By putting a price on greenhouse gas (GHG) emissions, the ETS has led to significant emission reductions in the EU by encouraging industries to reduce their emissions and invest in climate-friendly technologies.[10] It is the world's first major carbon market and remains the biggest one. ETS started its operation in 2005 and after multiple revisions, it currently functions in its 4th phase (2021-2030) in all EU countries, plus Iceland, Liechtenstein and Norway. The ETS works on a cap-and-trade principle ("Cap" referring to the fact that ETS sets a limit on overall emissions that can be produced by the installations covered by the system and "Trade" referring to the allowances which represent the right to emit 1 ton of CO_2 or its equivalent, that are then bought by or allocated to the installations). Many industrial installations are not covered by the EU ETS because of their small size, their emissions reductions are therefore not incentivized by this instrument. However, they are also affected by the current high energy prices.[11]

The manufacturing sector, including, cement, steel and chemicals production, has been understood as the sector at a high risk of relocating outside of the EU (carbon

7 https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/

8 https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_hu

9 https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

10 https://www.europarl.europa.eu/news/en/press-room/20221212IPR64527/climate-change-deal-on-a-more-ambitious-emissions-trading-system-ets

11 https://www.greenpolicycenter.com/2023/01/25/a-mirror-projekt-kereteben-keszult-elemzesek-es-javaslatcsomagok-gyujtemenye/

leakage) and has been, therefore, receiving free emission allowances since the establishment of the ETS, although only to a certain level of emissions, if the installations emit more than the amount of free allowances, they have to buy emission permits on the market. The updates of phase 4 of the EU ETS announced that the allocation to individual installations may be adjusted annually to reflect relevant increases and decreases in production and free allocation for the sectors at the highest risk of relocating will continue for another decade (including steel, cement and chemicals sectors).

According to the latest agreement between MEPs and EU governments in December 2022, sectors covered by the EU Emissions Trading Scheme (EU ETS) will have to cut their emissions by 62% compared to 2005 levels to meet the EU's overall greenhouse gas emission reduction target for 2030.[12]

The EU is currently also preparing other supportive measures, namely the **Carbon Border Adjustment Mechanism** (CBAM) and an updated version of the **Energy Taxation**. If the CBAM is accepted, it will slowly take up the role free allowances had in the fight against carbon leakage.

4.1.4. CARBON BORDER ADJUSTMENT MECHANISM (CBAM)

The main objective of the **Carbon Border Adjustment Mechanism (CBAM)** is to avoid carbon leakage and to equalize the price of carbon between domestic products and imports in selected sectors. It will also encourage partner countries to establish carbon pricing policies to fight climate change. The CBAM is targeted at imports of carbon-intensive products in full compliance with international trade rules, to prevent the EU's greenhouse gas emission reduction efforts from being offset by imports of products from non-EU countries where climate policies are less ambitious than in the EU. It will also help prevent the relocation of carbon-intensive production processes.[13]

The following sectors will be covered by CBAM: production of cement, aluminium, fertilizers, electricity, iron and steel.

The transitional period for CBAM is expected to start in October 2023, and to last until 2027: during this period EU importers will have to submit quarterly CBAM reports showing imports of CBAM products and emissions "embedded" in imported products. These emissions should include direct and indirect emissions from the manufacturing process of imported products. From 2026, importers will be required to report the quantity of emissions in their goods. Accordingly, free allowances should be phased out from the CBAM sectors from 2026.[14]

4.1.5. ENERGY TAXATION DIRECTIVE

As part of the Fit for 55 package, the European Commission proposed a revision of the **Energy Taxation Directive ETD)** to bring it more in line with EU climate policy objectives. The Energy Taxation Directive currently uses a taxation mechanism that allows subsidies for fossil fuels. Under the new revision, the most polluting fuels would be taxed at higher rates.

The Energy Taxation Directive intends to "lay down structural rules and minimum excise duty rates for the taxation of energy products used as motor fuel and heating fuel, and electricity". The changes aim to:

- Set a "new structure for minimum tax rates based on the real energy content and environmental performance of fuels and electricity",
- Remove outdated exemptions for the use of fossil fuels in aviation and maritime transport,
- Set a five-yearly review safety net to keep the ETD updated,
- Encourage the Member States to make use of new revenues and use tools that promote social fairness.

The new legislation was due to enter into force in January 2023, but the **European Parliament's Economic and Monetary Affairs Committee** (ECON) decided that more time was needed to work on the ETD.[15]

4.1.6. REPowerEU PLAN

In 2021, the European Commission proposed a package of measures to tackle the transition to more sustainable energy systems as part of the Fit for 55 package. If all the proposals in the package were implemented, annual fossil gas consumption could be cut by 30% or 100 billion cubic meters (bcm) by 2030. However, in the light of Russia's invasion of Ukraine and the subsequent energy crisis, the REPowerEU plan aims to accelerate this process.

The REPowerEU plan is based on three main elements, out of which the two first ones have a direct impact on heavy industries as well:

- Saving more energy (and thus reduce energy dependence) by promoting energy efficiency,
- Accelerating Europe's transition to clean energy (through a combination of investment and reform),
- Diversifying energy supply (finding new import markets) to reduce dependence on Russian energy.

12 https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/revision-phase-4-2021-2030_en

13 https://www.consilium.europa.eu/en/press/press-releases/2022/03/15/carbon-border-adjustment-mechanism-cbam-council-agrees-its-negotiating-mandate/

14 https://www2.deloitte.com/nl/nl/pages/tax/articles/eu-carbon-border-adjustment-mechanism-cbam.html

15 https://marine-offshore.bureauveritas.com/sustainability/fit-for-55/energy-taxation-directive

The REPowerEU plan is a landmark publication with far-reaching implications for different industries – the heavy industries as well – and is expected to guide reforms and investments in the years up to 2030. To replace Russian fossil fuels and diversify the EU's energy mix, the Commission is significantly increasing targets for the production and import of energy carriers such as renewable hydrogen, biomethane and LNG. The plan also proposes a significant shake-up of the investment climate, for example amending the legislation linked to the Recovery and Resilience Facility and simplifying authorization procedures. It is expected that this combination of measures will strengthen the business case for energy transition projects and provide guarantees for investors.[16] In October 2022, the Council agreed on its position to add a new REPowerEU chapter to EU member states' national Recovery and Resilience Plans (RRPs) under NextGenerationEU to finance key investments and reforms to help achieve REPowerEU objectives.[17]

4.1.7. RENEWABLE ENERGY DIRECTIVE

In November 2022, the Commission proposed a new amendment to the Council Regulation establishing a framework for accelerating the deployment of renewable energy (RED IV). Under the proposal, renewable energy plants would be considered to be of overriding public interest, allowing for faster new authorization procedures and specific derogations from EU environmental legislation.[18] The proposal to reform the Renewable Energy Directive also sets targets for the industry. **This would require the share of renewable energy in industrial final energy consumption and in the energy used as feedstock to increase by 1.1% per year per Member State by 2030.** [19]

4.1.8. EU HYDROGEN STRATEGY

The EU Hydrogen Strategy was adopted in 2020 and sets out a vision for the creation of a European hydrogen ecosystem, from research and innovation to scaling up production and infrastructure to an international dimension. Hydrogen is an important part of the EU strategy for the integration of energy systems.

The strategy looked at how the production and use of renewable hydrogen can help decarbonize the EU economy in a cost-effective way, in line with the European Green Deal, and contribute to the post-COVID-19 economic recovery. The strategy listed 20 action points to be implemented by the first quarter of 2022. The focus of these actions is on accelerating the use of renewable hydrogen and other derivatives in hard-to-decarbonize sectors such as transport and energy-intensive industrial processes. Stepping up the development of hydrogen infrastructure and supporting hydrogen investment is also a key area to support the uptake of hydrogen in the EU.[20]

In its own National Hydrogen Strategy, Hungary sets out overarching objectives for 2030. One of its priority objectives is the decarbonization of industrial consumption.[21]

4.1.9. TAXONOMY REGULATION

The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities and pointing out those that contribute most to the EU's climate goals. The Taxonomy Regulation entered into force in 2020 and laid the foundations for sustainable investments by defining six environmental objectives and four broad criteria that an economic activity must meet to be considered environmentally sustainable.[22] There are six environmental objectives that (under the EU Taxonomy) must be respected to consider an activity sustainable:

- Climate change mitigation
- Climate change adaptation
- The sustainable use and protection of water and marine resources
- The transition to a circular economy
- Pollution prevention and control
- The protection and restoration of biodiversity and ecosystems.

The European Commission created a Technical Expert Group on sustainable finance. The Group's task is to provide technical screening criteria and methodologies that can be used by the companies for assessing their activities. To be classified as sustainable, a company's activity must comply with four rules:

- The economic activity contributes to one of the six environmental objectives.
- The economic activity "does no significant harm" to any of the six environmental objectives.
- The economic activity meets "minimum safeguards" such as the UN Guiding Principles on Business and Human Rights to not have a negative social impact.
- The economic activity complies with the technical screening criteria developed by the EU Technical Expert Group.[23]

16 https://dr2consultants.eu/repowereu-a-boost-for-the-european-energy-transition/

17 https://www.consilium.europa.eu/en/press/press-releases/2022/10/04/repowereu-council-agrees-its-position/

18 https://www.europarl.europa.eu/factsheets/hu/sheet/70/megujulo-energia

19 https://www.greenpolicycenter.com/2023/01/25/a-mirror-projekt-kereteben-keszult-elemzesek-es-javaslatcsomagok-gyujtemenye/

20 https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/key-actions-eu-hydrogen-strategy_en

21 https://kormany.hu/dokumentumtar/magyarorszag-nemzeti-hidrogenstrategiaja

22 https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en#documents

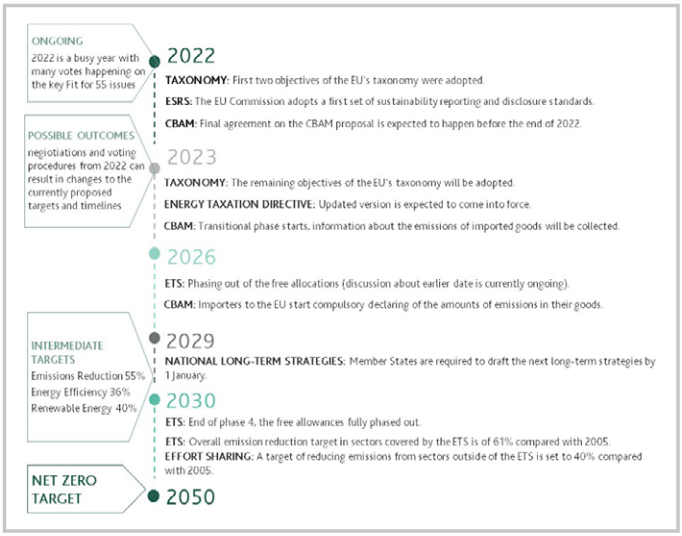
23 https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/

4.1.10. EU GREEN BOND STANDARD (EUGBS)

The European Green Deal stressed the need to better channel financial and capital flows towards green investments. The Investment Plan of the European Green Deal of January 2020 announced that the Commission would establish an **EU Green Bond Standard (EUGBS).** The proposal for a European Green Bond Standard is a voluntary standard that would help to expand the green bond market and increase environmental ambition. The creation of the standard was one of the actions of the Commission's 2018 Action Plan on Financing Sustainable Growth and is part of the European Green Deal. The standard is based on the recommendations of the Technical Expert Group on Sustainable Finance.[24]

The European Parliament's proposal in 2022 calls for better regulation of the entire green bond market, not just the European Green Bond label (EUGB), and for a reduction in so-called "greenwashing". Transparency requirements will be introduced for all bonds marketed as green, including alignment with tax legislation on the use of proceeds from bond issues. This would allow investors to compare EUGBs with other existing green bonds. In addition, green bond issuers should have safeguards to ensure that they do not cause harm to people and the planet.[25]

Figure 5: Timeline for the EU-level policy developments



Source: https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/

4.2. PARTICULAR POLICY ENVIRONMENT IN THE FOCUS INDUSTRIES

The role of industry in the decarbonization process cannot be overstated, as it is a central target group, lobbyist, and implementer in this process. Within the industry sector, the Union has competencies for providing support and coordination and for taking actions complementary to actions taken by the Member States.

Up until recently, protecting and supporting the industry have been the main aims of the industrial policies as the narrative of the need for safeguarding industry's role in creating jobs and contributing to the EU's economic growth was dominant. The past decarbonization strategies for industry focused on improving energy efficiency, increasing the use of biomass and enhancing research and development and some pilot projects in the field of carbon capture and storage technologies. Although the combination of such measures initially brought decrease in emissions from the industry at the EU level, emissions have been stagnating since 2012 till the start of economic downturn due to the Covid-19 pandemic.

4.2.1. NEW INDUSTRIAL STRATEGY FOR EUROPE

The development of the EU's approach towards decarbonizing the industrial sector is mirrored in its more recent strategies, namely the **New Industrial Strategy for Europe** from 2020. This strategy mentions the need for a green transition towards circular economy. Thus, a shift from a narrow approach to decarbonization by the use of technological improvements to an approach that supports the presence of more substantial transformation. The update of the New Industrial Strategy focuses on a quick recovery of the EU's economy, while less attention is paid to the issue of climate change. Moreover, industrial decarbonization strategies currently lack clearly set targets as well as guidelines on how the progress with decarbonization should be measured. Unfortunately, with the post-pandemic version of the strategy the need for systemic changes is left aside, once again.

In order to reach a net zero emissions' economy, the EU's industrial sector needs to increase its decarbonization efforts and start the demonstration and deployment of the emissions reduction strategies by 2030.[26] When it comes to the heavy industries, process emissions account for more than half of their emissions, which means that these emissions cannot be tackled with energy efficiency or renewable energies: these need new production technologies that thoroughly change the industrial landscape. To this end, significant investments are needed in research, development and implementation.

To reach the **European Green Deal** goals, reductions in emissions are required across all industry sectors. However, the concentration of greenhouse gases differs substantially between subsectors, this is the reason why currently, the EU pays special attention to the steel, chemicals and cement sectors as these were highlighted as the "areas of relevance" for its green, digital and resilient transformation in the Annual Single Market report from 2021.

24 https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard_en

25 https://www.europarl.europa.eu/news/en/press-room/20220516IPR29640/european-green-bond-standard-new-measures-to-reduce-green-washing

26 https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/

4.2.2. CHEMICALS STRATEGY FOR SUSTAINABILITY

While a more detailed strategy for the cement sector is currently lacking, the approach toward chemicals can be identified in the **Chemicals Strategy for Sustainability** (2020). This strategy only mentions the decarbonization goal of the EU in relation to improving the EU's resilience to supply disruptions, as particular chemicals are needed for the green technologies, such as batteries, wind turbines and photovoltaics. The aim of climate neutrality is not explicitly mentioned in the strategy. The document's focus areas are:

- Prioritizing energy efficiency
- Stepping up of existing EU chemicals policies
- Supporting innovation for the green transition of the chemical industry and its value chains.[27]

4.2.3. TOWARDS COMPETITIVE AND CLEAN EUROPEAN STEEL

The EU's approach to decarbonizing steel can be understood from its working document entitled **Towards competitive and clean European steel** (2021), in which steel is said to be capable of being "one of the first hard-to-abate sectors to produce green products". At the same time, the strategy highlights the need for acting now, as for sectors with long-lasting capital assets, such as steel, "2050 is just one investment cycle away". To achieve climate neutrality, it proposes to:

- Focus on radical changes required in the steel production process.
- Focus on attracting necessary investment.
- Support further research, close-to-market innovation and demonstration of multiple pathways.
- Support steel becoming a nearly fully circular material.
- Support further digitalization in the sector.

The sectoral coverage is still uneven, with the most attention being paid to decarbonization strategies for the steel sector. Chemical and cement sectors are now understood as important for reaching the EU's decarbonization targets, however, this is not translated into strategies that lead to net zero by 2050. [28]

4.3. POLICY ENVIRONMENT IN HUNGARY

4.3.1. CLIMATE LAW

The Hungarian Climate Law entered into force before its European counterpart but also sets the objective of reaching climate neutrality by 2050. It contains an intermediate objective of 40 percent reduction in GHG-emissions by 2030 compared to 1990 emissions. Although the legislation can be praised for being a forward-looking element of the Hungarian policy scenery, criticism is also fair: the level of ambition is low as the 40 percent objective leaves the bulk of the reduction efforts for the post 2030 era. Furthermore, the Act is very short and details about how to reach the objectives are missing.[29]

4.3.2. THE SECOND CLIMATE CHANGE STRATEGY OF HUNGARY (NCCS-2)

In 2013, a new National Climate Change Strategy (NCCS-2) was developed in line with international climate change treaties, providing guidance for the coordination of climate protection and development policy. The document sets out Hungary's responsibilities for mitigating greenhouse gas emissions and adapting to the impacts of climate change. The strategy provides guidance on how to achieve the various objectives: short, medium and long-term action lines have been developed.[30]

4.3.3. NATIONAL ENERGY AND CLIMATE PLAN

According to its National Energy and Climate Plan (NECP), Hungary intends to ensure that its final energy consumption does not exceed the value of 2005 in 2030 (785 PJ). If this would still happen, such an increase should come from carbon neutral energy resources. The improvement of energy efficiency in the economy is a key project of the Energy Strategy as well. Furthermore, the so-called energy efficiency innovation programme aims to reduce – amongst others – the energy consumption per unit of industrial production.

With the introduction of an obligation scheme ensuring the cost-effective fulfilment of energy efficiency targets, the country intends to drive investment to areas with the highest energy consumption and energy efficiency potential on a market basis.

The NECP intends to develop a sustainable and climate-friendly energy management scheme while maintaining the industry's share in the national economy. Furthermore, it also encompasses investment plans into the transition of energy intensive and GHG intensive industries. Construction

27 https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/
28 https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/
29 https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/
30 https://nakfo.mbfsz.gov.hu/en/node/365

sector is envisaged to have increasing energy demand while others – like lime production – will probably have a declining demand.

Hydrogen is recognized as a key solution for the decarbonisation of the country, as beyond its reconversion into electricity, it can be blended with natural gas, and can contribute to satisfying the energy demand of the industry. Hungary, under the NECP, will support the decarbonisation of industrial production schemes with the help of pilot projects on green hydrogen.[31]

The Hungarian NECP – as all EU NECPs – is under revision in 2023-2024.

4.3.4. LONG-TERM STRATEGY

In the Hungarian Long-Term Strategy (LTS) also dubbed as National Clean Development Strategy 2020–2050, three scenarios were analyzed: a "business as usual" one, a late action on climate one and an early action on climate one. Just as the NECP, the LTS heavily relies on hydrogen switch in decarbonizing the industrial sector. Both in early and late action scenarios, carbon capture and storage (CCS) technologies are seen to become scalable and economically viable after 2030 and help emission reductions. Energy demand of the industrial sector increases in both scenarios until 2030 and then decreases. The LTS is counting on four measures to tackle emissions from the industry: energy efficiency improvements, electrification of the production phases, CCS deployment and hydrogen deployment.[32]

4.3.5. ENERGY STRATEGY

According to Hungary's Energy Strategy the industrial subsectors' GHG-intensity and energy use per unit of production cannot exceed the EU-average of the specific sector. The Energy Strategy reinforces what was presented in the above-mentioned documents: to decarbonize the industry, Hungary wishes to start pilot projects on green hydrogen. To help communication between the different actors, and sound strategy development, an Energy Innovation Council was set up in 2018, with the participation of energy and industrial companies, universities, research establishments, professional organizations, and the relevant national bodies.[33]

The Hungarian Energy Strategy is under revision just as the NECP, a new strategy on energy is set to be adopted by 2024.

4.3.6. HYDROGEN STRATEGY

Hungary's National Hydrogen Strategy sets several objectives for 2030. First, reaching significant results in the decarbonization of the industrial sector with hydrogen. In the 2020s, mainly low carbon hydrogen would be used to decarbonize the industrial processes and product use, but later, green hydrogen would take the place of grey hydrogen. The concrete objective set in the strategy is to reach 20 thousand tons of low-carbon hydrogen production per year, plus 4 thousand tons of "green and other carbon-free hydrogen" per year in the period going till 2030. According to the strategy, this would help Hungary avoid 95 thousand tons of CO_2-emissions. The strategy presents blue hydrogen (hydrogen made from natural gas and helped with CCS technologies) as the most cost-efficient option for Hungary as time until 2030 is relatively short. Parallelly to this, the conditions for decentralized, carbon-free hydrogen production with electrolysis must also be established. To help the deployment of CCS a stimulating regulatory environment and support system will also be established. Hungary is also planning to develop hydrogen clusters, where the functioning of a whole so-called hydrogen-ecosystem can be presented. Two clusters are planned near petrochemical industrial plants (one around Miskolc and one around Százhalombatta).[34]

4.3.7. RECOVERY AND RESILIENCE FACILITY (RRF)

The Recovery and Resilience Facility (RRF) is the centerpiece of NextGenerationEU, the EU's recovery plan. It supports the way out of the Covid-19 crisis and aims at making Europe more resilient and better prepared for the challenges and opportunities of the green and digital transitions.

To achieve these goals, the RRF makes available more than EUR 700 billion in grants and loans to Member States. The funds finance reforms and investments to be implemented by 2026. To receive the funding, Member States had to prepare plans that identify the reforms and investments to be financed by the RRF. These plans, called "national recovery and resilience plans", had to be assessed by the European Commission and approved by the Council.

31 https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/

32 https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/

33 https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/

34 https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/

The plans address policy areas of European relevance organized under six pillars, namely:

- green transition,
- digital transformation,
- smart, sustainable and inclusive growth,
- smart growth, inclusive and inclusive growth,
- health; and economic, social and institutional resilience,
- policies for the next generation, i.e. children and young people.35

In line with the pillars of the RRF, investments will support the achievement of a number of energy efficiency and sustainability targets set out in Hungary's National Energy and Climate Plan and the National Energy Strategy 2030. 48.1% of the Hungarian RRF will be allocated to climate objectives[36], if it is fully approved. In 2023, the approval of the EUR 5.8 billion plan was subject to Hungary meeting some rule of law milestones[37].

35 https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en

36 https://commission.europa.eu/system/files/2022-12/HU%20RRP%20Summary.pdf

37 https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_7274

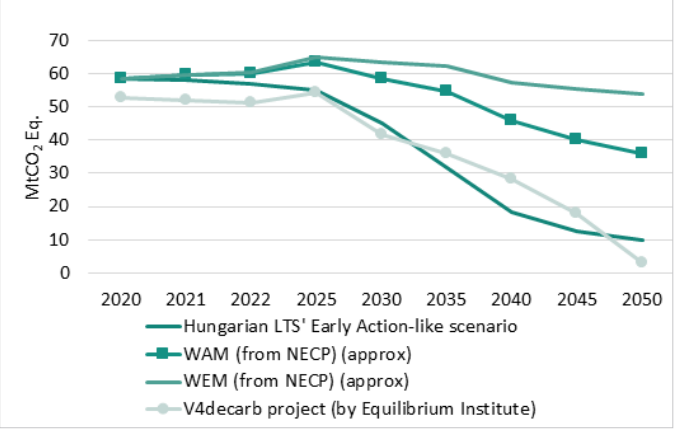
5. Roadmap's scenario description

Roadmap's scenario description

The emission target assumptions used in our modelling are based on EU policy targets. The overall 2030 emission target (as defined in Fit for 55 and RePower EU) is 55% reduction of all emissions compared to 1990, while for companies included in the ETS system -62 percent compared to base year of 2005. The EU's approach is significantly more ambitious than currently available Hungarian national strategies. For instance, the current Hungarian NECP – even with additional measures – aims a reduction of 36 $MtCO_2$ equivalent by 2050 compared to the emission levels from 2015 of 53.3 Mt CO_2 eq. This is far from the net zero targeted at the EU level. The Hungarian Long-term Strategy (LTS) is the only available document that aims for a net zero emission by 2050, mostly building on energy and production efficiency, with a slight contribution of carbon capture and storage (CCS) activities, while energy sector becomes a net absorber of emissions (ie. negative emissions).

Our approach was to start from the most commonly cited national strategy with continuous amendment to it in order to aim for the most ambitious measures to achieve net zero by 2050. Our choice fell on the National Energy and Climate Plan (NECP), with a scenario building on additional measures compared to current ones. One has to note that the gap in the NECP for 2030 between the existing measures scenario (WEM) and the more ambitious, additional measure scenario (WAM) is small, just 5 Mt CO_2 eq. (8 percent). The WAM version served as our starting point for the scenario building.

Figure 6: Hungarian emission paths under different policy documents (hereinafter referred as scenarios)



Source: Climact Pathway Explorer 2050 and Equilibrium Institute.

After assessing a number of scenario building and modelling possibilities, we opted for the Pathway Explorer 2050 model by Climact.[38] The most important feature of this model is that it gives a flexible and built-in solution to handle policy scenarios, while using a multisectoral approach. The model also encompasses the effect of change in consumer behavior, production structures and emission absorbing. The tool also differentiates ETS from non-ETS emissions. The weakness of this model is that it is just partly dynamic (there is no macro module available), while there is no cost-optimization either.[39] All in all, the tool can be considered as a way to project current stance rather than forecast the future. The model addresses CO_2, CH_4 and N_2O only, thus total emissions registered under the CRF, the UNFCCC system are slightly higher (~4 percent). The current gap (data for 2021) between the Pathway and Eurostat air emission accounts is 10 percent.

Industry data is more or less in line with ETS and Eurostat air emission accounts, however we have witnessed a very important difference for the steel industry. Official data (EU transaction log and Eurostat air emission accounts) pictures steel to emit around 1 Mt CO_2 eq./year, while Pathway's input shows an emission figure exceeding 3 Mt CO_2 eq. To handle this data issue, we decided to lower all model outcomes (CAPEX and OPEX costs and CCS) proportionally. This is an important modification to the framework, only partially compatible with the model.[40]

Perhaps the most important limitation of the model is that it was designed on a European level, meaning there is no room to account for national and plant specific attributes. Nevertheless, all the listed shortcomings are comfortably mitigated by the strengths of the framework, while computation output comparability can also be ensured between countries.

Compared to other existing net zero pathways, our modified NECP-WAM path is more "bottom-heavy", because measures kick in mostly from the second part of the forecast horizon. We have modified the baseline scenario (NECP – WAM) on the following major points to reach net zero.[41] Our scenario was run in mid-March 2023 (except for ammonia, which was missing in the first run and had to be imputed from a later run in mid-April).

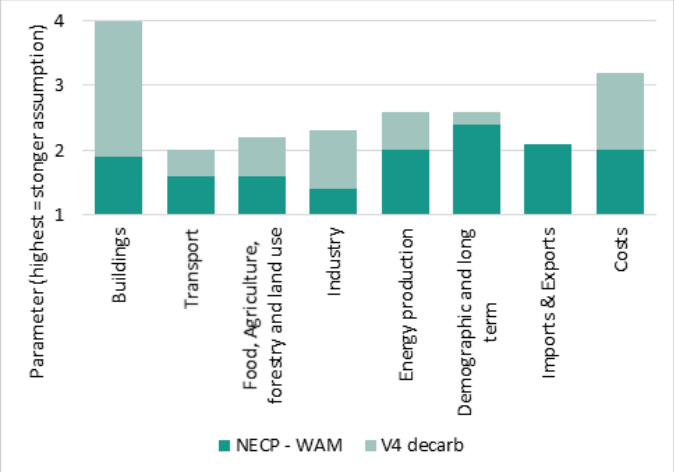
38 https://pathwaysexplorer.climact.com/dashboard?region=HU

39 The modell uses a multisectoral approach, but does not encompass a general equilbirum framework.

40 Even though we set the demand for Steel to be exogenous in the model, there is still an important share of not accounted CO_2 due to this data issue. In practice this means we have subtracted emissions (and cost) from the model, but the original calculation accounted for an additional 3 Mt of CO_2 either stored or used. It is unclear to what extent this modification affects total (national) industry CAPEX and OPEX.

41

Figure 7: Model scenario assumptions to reach net zero by 2050 (highest number represent a stronger assumption: more contribution to reduce emissions thus higher costs)



Source: Equilibrium Institute based on Pathway Explorer 2050.

The largest parametered upside deviation from NECP-WAM is at buildings mostly because in our view, building envelopes, low-carb heating solutions and appliances efficiency must be substantially better upgraded than what the current WAM scenario suggests. This also includes green gas, liquids.

We were also substantially more hawkish with energy costs, since both the WAM scenario and the Pathway model were created well before the energy crisis starting in 2021/2022. The costs under the Pathway model refer to energy, while technology costs are not available to be customized in the current version of the model.

Industry was the third most important area where we were stricter on our parameters compared to the NECP - WAM. First, we optimistically assumed an eco-friendlier B2C behavior, with a substantial increase in the lifetime of household appliances as well as a reduction of packaging used. We have modified the originally exogenous assumption on industries targeting mostly domestic markets (based on data from the Hungarian Statistical Office) and we linked production to internal demand in the case of cement and chemicals (consumption, investments), but not in the case of steel, as this one is more export oriented than the two others.[42] The linking for cement and chemicals was done in order to create a better connection between sectors to make the model more dynamic. We have been stricter on the material efficiency than the WAM scenario, with a higher recycled production share and a substantial increase in energy efficiency. **The biggest difference to WAM however is the assumption of the use of CCS technologies. We have significantly raised the CCS parameters** (in comparison to WAM) and not only for our target industries, but for all manufacturing activities (although our focus industries are by far the largest emitters of CO_2 within manufacturing). This was needed to approach our net zero target. **We have also modified the production technology assumptions for our focus industries to be more ambitious** (except for ammonia and chlorine, where this option was not available in the model).

Following our amendments to the NECP – WAM scenario, industry's contribution to overall CO_2 abatement turned out to be considerably larger. In fact, a positive contribution at a value of 7 percent came up as a result of the simulation, while WAM was going completely in the other direction, with the overall increase in industry emissions (notably due to an unambitious investment path). Industry is thus the main component that explains the gap between the original NECP – WAM set in the Pathway Explorer and our custom scenario (see figure 4). The model acceptably met our target of net zero emission by 2050, with only a marginal 2.7 Mt of net emission in 2050. This can be abated with further measures (for instance in transports).

Technology shifts implied in our scenario analysis are much more ambitious than current industry plans. Since there are no industry public plans for CO_2 abatement, we have interviewed our project's Task Force members in order to contrast the model's technology shift assumptions with the current Hungarian stance. **Our general take-away was that industry players do not fully consider large investments for technology shifts yet as they do not see a reliable market environment even with the current technologies and standards in place (especially in Steel and Cement) or are on a careful planning phase (Chemicals).** A more detailed assessment follows:

- **CHEMICAL INDUSTRY:** there are known technology upgrades on the table, these are possibly being considered, however there has not been any public plan rolled out yet by the biggest industry players. Work is in progress between national chemical associations to model possible pathways to decarbonization, however this project is confidential. An expert has provided us with the information that even within this top-down organized, large scale project data availability is scarce, due to the fact that companies regard these modelling inputs as trade secrets.

- **CEMENT INDUSTRY:** all 3 major plants are running on dry-kiln technology. The Pathway model suggests a partial shift towards geopolymers and other technologies, however these expenditures represent only a smaller fraction compared to the sum to be spent on the upgrading of the dry-kiln technology (about 70% in the total cement industry CAPEX would be spent on dry-kiln). CCS/CSU options are available, but this would require a shift away from the current CEM I standards towards higher standards (an intervention from the state or the EU to demand more eco-friendly cements). Here, the further usage of solar energy, the reduction of the clinker factor, waste to energy and possibly partial use of industrial waste as raw material remain on the agenda.

42 We have done so for cement, lime, ammonia, paper and wood processing (production).

- **STEEL INDUSTRY:** Pathway model assumptions over CAPEX are centered around the currently used Blast furnace technology (used by the main plant Dunaferr), while a smaller fraction is attributed to scrap electric arc furnace (used by Ózdi Acélművek). Novel technologies to be considered here are HIsarna and Hydrogen DRI, however these are not suitable for the current plants. For instance, in order to use a direct reduction technology such as HIsarna, the whole Dunaferr plant would need to be rebuilt from scratch. This is not a financially sound option. Moreover, Dunaferr faces serious competition from the wider region (including neighboring countries) which questions the overall rentability of any investment in the plant (especially considering the unavailability of labor force and raw material). The best CCS/CSU technologies are not yet available in Hungary; thus a proper cost assessment is not possible at this point.

6. Investment needs

Investment needs

Our empirical approach to cost assessment comprises 2 stages:

01 Research in the relevant literature for unit cost / abated CO_2 equivalent: we have received unit cost data from Climact with an important disclaimer that cost assumptions would need to be reconsidered in the near future. Stemming from this, we have searched recent literature and ongoing project (public finance) descriptions to get an idea of how realistic Pathway unit costs were. Most of the literature[43] showed lower unit costs, however these might not be relevant for many reasons, the most important being that each project is very different cost-wise. Some determining factors include but are not limited to:

a) **GEOGRAPHICAL FACTORS:** carbon storage costs vary significantly depending on the location of the project. For instance, landlocked countries might face higher costs compared to countries with access to offshore storage opportunities.

b) **USE OF THE CAPTURED CO_2:** the solution with the highest costs is the one using only storage, mostly because its limited capacities. A more cost-effective solution is the transportation and usage of CO_2. The most cost-efficient solution for the abated CO_2 is the use on site of the carbon captured. In Hungary, carbon storage facilities are theoretically available, however these are currently used for natural gas storage and the Government's recent statements have indicated that gas usage will remain an incremental part of the Hungarian energy system. Transport facilities would probably need serious investment as well as the establishment of end-to-end connections. We do not have information on the possibilities of the use-on-site options. The most probable outcome is a transport and use (CCUS) scenario because plants usually emit more CO_2 that they could use on site.

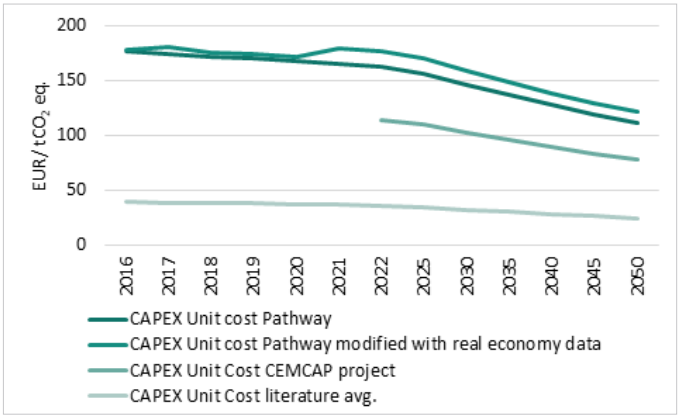
c) **CAPTURE LEVEL:** the amount of CO_2 captured can also vary based on different technological factors.

02 Amendments to Pathway Explorer CAPEX

CAPEX unit costs modified with real economy data: we have changed the unit costs with official machinery fixed capital formation data from Eurostat National Accounts. This was needed in our view because Pathway unit costs are somewhat outdated (from 2015) and gaining data from national accounts was the easiest way of updating the figures in the model. The modification resulted in a higher CAPEX than the Pathway model output, however the difference was not large (8-10 percent higher costs after the update, see fig. 8).

For our CAPEX unit cost estimations, we opted to choose the unit cost in the Pathway but modified with national accounts data (see above). We selected Pathway for many reasons. First, because costs can significantly vary based on the after-use of the abated CO_2, it is better to stick with established model assumptions, rather than setting up a partial framework. Second, Pathway unit costs were the highest of all sources considered here, which gives a better approximation of the maximum incurring costs. Knowing the upper end of the cost incurrences is more beneficial to policy also because there can be many indirect costs not considered in the models (e. g. administrative costs, red tape etc.). Third, we believe that large scale realization is costlier than costs estimated in case studies, which pencils a conservative approach towards unit costs in general. For instance, the CEMCAP project assessed a Belgian factory with offshore access. Because Hungary is landlocked, costs should be probably higher than in Belgium.

Figure 8: CAPEX unit cost paths for CO_2 abatement in the Cement industry



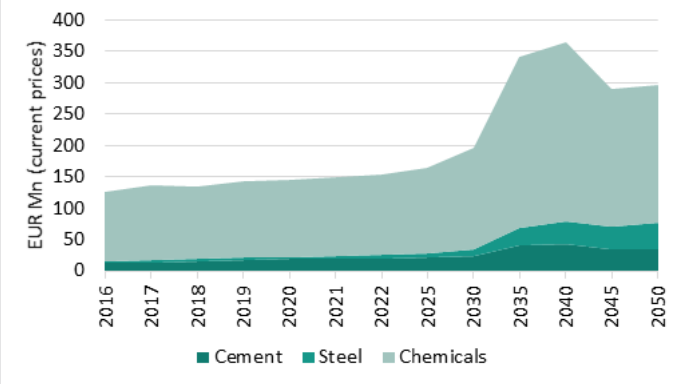
Source: various sources. For the sources other than the Pathway model, we assumed the starting point difference is unchanged for the total length of the forecast horizon.

The total investment cost (CAPEX) to be spent between 2016 and 2050 for all 3 industries amounts to EUR 2.64 bn, which is approximately 1.6 percent of the current Hungarian GDP. The CAPEX split between our focus industries is very unequal, as chemical industry accounts for 78 percent of all CAPEX, while cement is responsible for 14 and steel for 8 percent of total CAPEX. Within the heterogenous chemical industry, olefin techs remain the most important area of investment (accounting for about one third of all chemical CAPEX).

43 Cement: Emanuelsson, Anna and Johnsson, Filip, The cost of CCS - a product chain analysis of the cement and pulp industries (August 15, 2022). ; Strunge, Till and Küng, Lukas and Renforth, Phil and Van der Spek, Mijndert, Marginal Cost Curves for Decarbonizing the European Cement Industry (October 25, 2022). ; Juliana Monteiro, Simon Roussanaly: CCUS scenarios for the cement industry: Is CO_2 utilization feasible?, Journal of CO_2 Utilization, Volume 61, 2022.

For all 3 industries: Leeson, N. Mac Dowell, N. Shah, C. Petit, P.S. Fennell: A Techno-economic analysis and systematic review of carbon capture and storage (CCS) applied to the iron and steel, cement, oil refining and pulp and paper industries, as well as other high purity sources, International Journal of Greenhouse Gas Control, Volume 61, 2017.

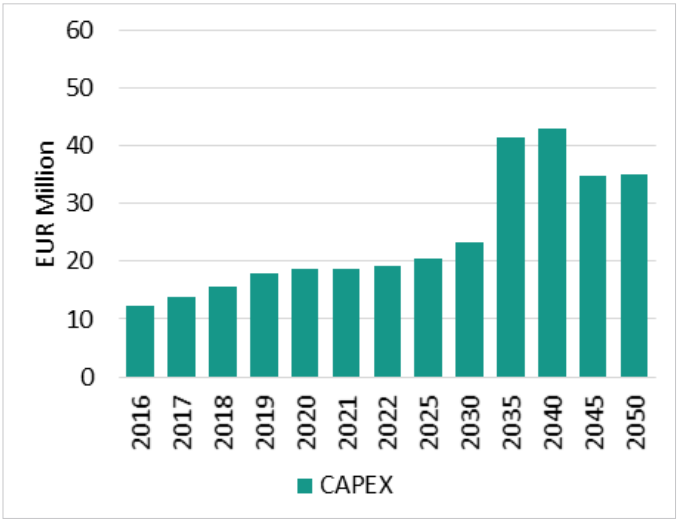
Figure 9: CAPEX financing needs by industry



Source: Equilibrium Institute based on Pathway Explorer model.

Cement industry's CAPEX would reach EUR 314 million. Most of the CAPEX happens after 2030, that is where the technology gets mature enough so that lower unit costs can spread faster among cement companies. The emission reduction is 1.9 Mt of CO_2 equivalent (in 2025 compared to 2022), while the emission in year 2050 is 0.1 Mt (all values are net values, taking into account CCS contribution).

Figure 10: Expenditures of CO_2 abatement in the Cement industry



Source: Equilibrium Institute based on Pathway Explorer model.

Steel industry's CAPEX sums up to EUR 186 Mn. It is important to emphasize once more that steel industry's current situation does not enable a timely assessment. Nevertheless, model output allocated most of the CAPEX to the currently dominant Blast-Furnace technology (used at Dunaferr).

Chemical industry's CAPEX sums up to EUR 2.1 bn.

7. Financing available

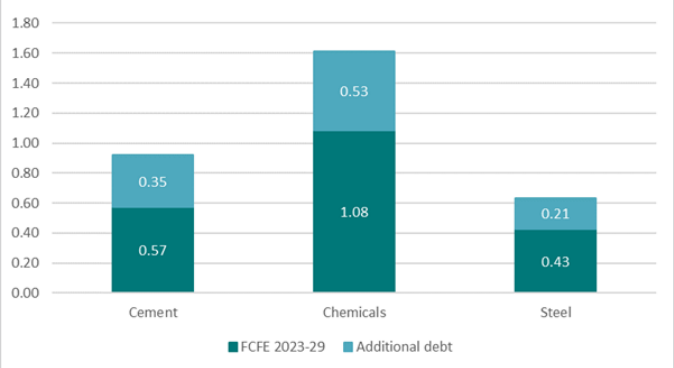
Financing available

7.1. PRIVATE RESOURCES

This sub-chapter addresses the capacity of hard-to-abate industries to finance investments, based on a combination of their estimated aggregated ability to generate free cash flow in 2023-2029 (i.e. until the last year before the roadmap´s 2030 target year) and their additional debt capacity. Financing capacity thus disregards any possible extra equity injections from their parent companies (or other related companies).

The private financing potential of the three sectors considered – taking into account the safe debt level – is estimated at EUR 3.17 billion over the period 2023-29, assuming zero dividend payments. Under a different actual dividend policy, the private financing potential would be significantly reduced.

Figure 11: Estimated private sources potentially available in 2023-29 (EUR bil.)



Source: Equilibrium Institute based on company and sector data

The free cash-flow estimates stem from the current economic position of the companies in the relevant sectors, their forecasted 2023-29 operating performance, usual investment policy and the related additional cash flows. The forecast method is developed by the ISFC (International Sustainable Finance Center) in this project. The forecasts consider, inter alia, the effects of recently increased energy and material input prices, decreasing volumes of free CO_2 emission allowances, expected CO_2 price growth, as well as current net debt levels.

The additional debt capacity equals the difference between the level of debt considered safe for mature industries and the actual debt level. The maximum safe debt level is estimated using a 3x multiple of EBITDA[44] and is checked also against its share of the total balance sheet, which should not exceed 50 percent.

It has to be noted that in all sectors, part of the pre-CAPEX free cash flow would be used for business-as-usual investments like replacement investments needed due to depreciation and other business-as-usual investments.

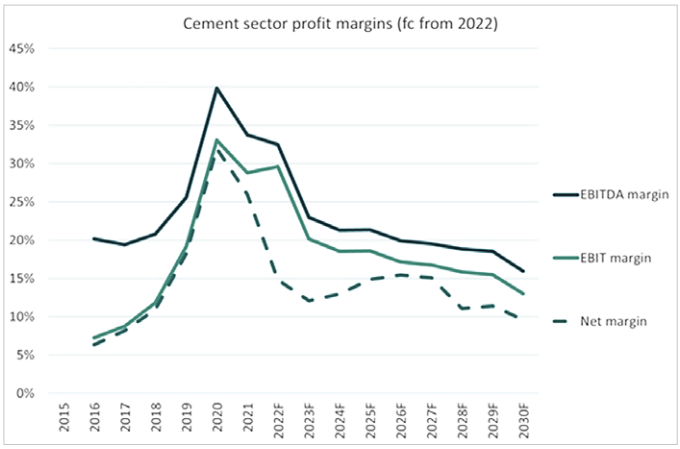
• 7.1.1 CEMENT SECTOR

The Cement sector financing capacity estimate combines financial forecasts of both major Hungarian cement producers, who dominate the market. These two companies – Duna-Dráva Cement and Lafarge Cement – together have 92% market share in the Hungarian cement market.

The sector faces limited international competition as cement is not widely cross-border traded due to transport limitations and weight-to-value considerations. This should allow companies to maintain profitability in the coming years. At the same time, it is important to note that the mining tax extended in Hungary in 2022 severely affects cement companies. In our forecast, we anticipated its gradual phasing out[45].

Figure 12 also shows how profitability would be affected by a gradually reduced free quota allocation from 2026 (unless the local market allows compensation through price increases).

Figure 12: Cement sector margins forecast - without major decarbonization investments and gradually decreasing excess profit tax.



Source: companies annual reports, Equilibrium Institute calculations and forecast, based on ISFC methodology

The investment financing capacity in the sector in 2023-29 could reach EUR 0.92 billion (HUF 357 billion) at current prices. However, the above assumes zero profit distribution in the period. Both major cement producers had significant pay-out ratios in recent years, though. Roughly half of the total amount is thus a function of the companies´ dividend policy in the coming years.

See the Annex for the aggregate income statement and balance sheet forecasts of the cement sector until 2030 and selected key forecast assumptions.

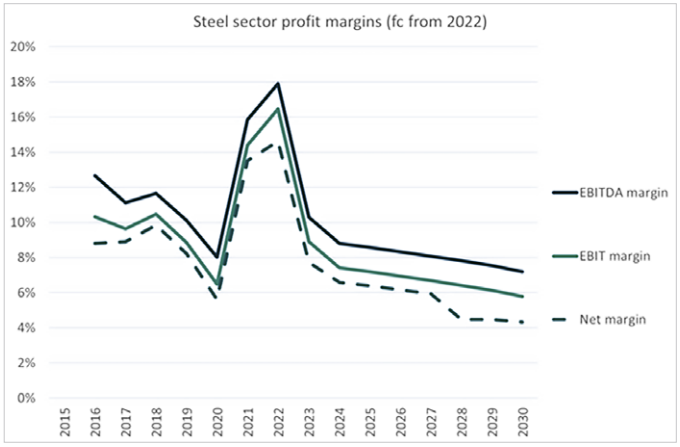
44 Earnings before interest, tax, depreciation and amortisation

45 https://www.globalcement.com/news/item/12689-hungarian-government-imposes-excess-profit-tax-on-building-materials

7.1.2. IRON & STEEL INDUSTRY

The steel market is highly internationalized, and manufacturers are exposed to competition from other regions due to the lower proportion of transportation costs in the final price. This and increased production capacity in China contributed to the weak financial results of Hungarian producers. In fact, the steel sector's financing capacity is based on the Ózdi Acélművek's finances. The situation of Dunaferr, once the largest steel producer, is in turmoil. There is a legal battle over ownership, and it has no agreed accounts from recent years. This market situation is expected to continue for at least the next few years. Figure 13 shows how profitability would be affected by a gradually reduced free allocation of emission allowances from 2026 onwards (unless the EU market allows compensation by increased prices).

Figure 13.: Steel sector margins forecast - without major decarbonization investments



Source: companies annual reports, Equilibrium Institute calculations and forecast, based on IFSC methodology

Given the lower margin of the sector, its investment financing capacity is limited. Despite its higher volume it is lower than it is in the cement industry: EUR 0.63 billion in 2023-29 at current prices. Zero profit distribution in the period and no extra equity injections from parent companies (or other related companies) are assumed.

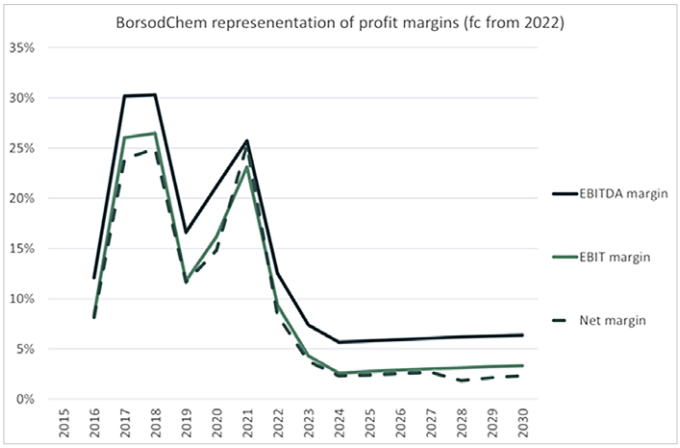
See the Annex for summary forecasts of the income statement and balance sheet of the steel sector up to 2030 and selected key forecast assumptions.

7.1.3. CHEMICAL INDUSTRY

The vast majority of companies active in the Hungarian chemical industry are subsidiaries, which do not publish detailed own accounts. The aggregated financials of the Hungarian chemical producers are modelled on the numbers of BorsodChem. BorsodChem represents a 32 percent market share in the industry, while Nitrogénművek Zrt and MOL Petrolkémia Zrt are other significant players with less transparent financials.

The chemical industry profit is volatile as the sector´s ability to pass on higher input costs (energy, materials) to consumers depends on the current market situation and demand. EBITDA margins of BorsodChem historically hovered around the range of 10-20 percent. The sector will also be affected by an increasing price in emission allowances, and gradually reduced free allocation from 2026 onward, though the chemical sector will be relatively less affected than the other two hard-to-abate industries given the smaller share allowances represent in the sector´s overall operating costs.

Figure 14: Chemical sector margins forecast - without major decarbonization investments



Source: BorsodChem annual reports, Equilibrium Institute calculations and forecast, based on IFSC methodology

Investment financing capacity in the sectors in 2023-29 could reach EUR 1.61 billion at current prices, assuming zero profit distribution in the period. The historical dividend policy of chemical producers has been cyclical, as has their profitability.

Summary forecast of the chemical sector´s income statement and balance sheet to 2030 and selected key forecast assumptions are presented in the Annex.

7.1.4. ADDITIONAL DEBT

With respect to debt financing, Hungarian enterprises – and not only in hard-to-abate sectors – traditionally rely on loans provided by banks at the local level or provided intra-group by parent companies. Bond financing is scarce in the corporate sector.

Corporate loans

The current loan-to-asset ratio is moderate in the three hard-to-abate sectors, the indicator reaches to digits numbers, and the combined additional debt capacity of the industries is estimated at EUR 1.1 bil., most of which in the chemicals industry, while in the steel industry it is limited due to the sector's inferior profitability.

Based on available reports, ESG-related lending of the banks (mostly supporting renewable energy sources and energy efficiency measures) can account already for up to 10-30 percent of some banks´ corporate investment loan portfolio, although classification and/or reporting may not be fully comparable between banks. The recently introduced EU taxonomy and mandatory reporting under

the Sustainable Finance Disclosure Regulation puts additional pressure on financial institutions to expand their sustainability-aligned financing. This, and the increased level of non-financial corporate reporting standardization introduced by the Corporate Sustainability Reporting Directive, is encouraging companies to embed sustainability into their business and, consequently, investments.

Green bonds

The green capital market is increasing in Hungary; however, its size is still relatively small. Based on data provided by the National Bank of Hungary, the stock of green instruments reached HUF 1200 billion (about EUR 3 billion), about 2 percent of the GDP. Most of the assets are sovereign issuance (more than two-thirds of the total), while private market activity is a magnitude smaller. Total wealth managed in ESG funds accounts for HUF 158 billion in 2021, which is 0.3 percent of the GDP. But there is no denying of the dynamism in the segment: ESG funds posted a whopping fivefold increase when compared to the previous year (2020).

Green assets' share from the total assets managed by investment funds is currently 1.8 percent. There is still a lot of ground to make up in this segment since from the 704 investment funds active in 2021 in Hungary, only 21 incorporate ESG aspects. It is hard to map a particular ESG spending goal as their focus areas are diverse. Putting the Hungarian situation in an international context, we can conclude that although the Czech Republic performs better in the issuance of green bonds, the Hungarian position among emerging market economies is good.

As of today, to our knowledge no financial tool has been used to reduce carbon emissions in industrial production. ESG projects are concentrated in four areas in Hungary: financial sector, energy & utilities, real estate, transportation, and mobility. Thus, industry is just indirectly affected by ESG through financial risk regulation by the MNB. "This for example includes the requirement for financial institutions on examining whether a financing project is environmentally sustainable and conducting a climate change and environmental risk assessment of customers before taking a risk. Assessing how climate and environmental risks affect a borrower's probability of default (PD) and average loss given default (LGD) is a particular challenge when assessing credit risk."[46]

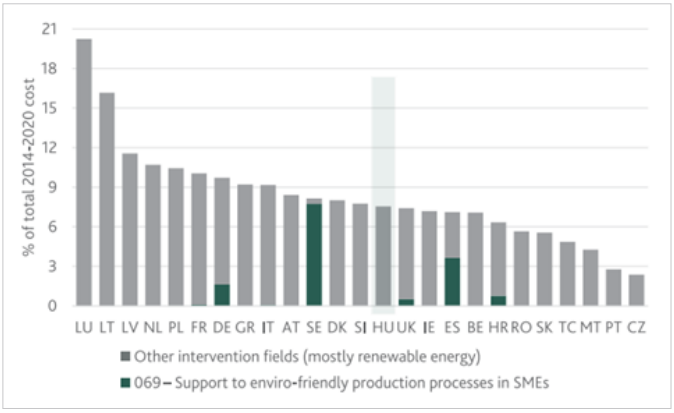
The future of the recently experienced dynamism in the Hungarian green capital market is somewhat in doubt because – as part of its tightening process on the monetary variables – the MNB stopped the Growth Bond Programme in 2021, but the capital requirements discount programme will remain in place until 2023.

7.2. PUBLIC RESOURCES

In the EU, funds from the Multiannual Financial Framework (MFF) or from the Innovation and Modernisation Funds are all available for heavy industry as well, but very important limitations persist for industrial decarbonization. European Investment and Structural funds are the deepest pockets of finance for decarbonization. However, the most popular item for state support, the "regional support" title is not available for companies in the steel sector for EU regulation reasons. Another current issue of regional support aid rules is the fact **that large companies are only eligible for support if the scope of outcome of the project mostly benefits SMEs.** Companies in scope for industrial decarbonization are exclusively large companies and their operations are not linked to SMEs. A third issue is that currently, member state financed decarbonization projects need to undergo Commission approval mechanism, however this is likely to change in the near future. Based on professional background information, **the European Commission is planning to amend the relevant legislation so that investment aid for environmental protection including decarbonization be compatible with internal market regulation, especially concerning state aid rules.** Despite the new 2023 European Commission state aid rules being more favorable for decarbonization, they will probably need to be reconsidered.

The **Economic Development and Innovation Operational Programme (EDIOP)** – which was the principal tool to finance company investments between 2014 and 2020 – mainly financed energy efficiency projects, but featured a programme called "Green national champions" too, with an allocation of HUF 9.8 billion (EUR 28 million, about 0.1 of total EU OP finance). The aim of this programme was to find SMEs that have an investment need to develop green innovations. The list of eligible activities did not feature any topic related to the reduction of process emissions. Not surprisingly, the 40 projects financed by the government did not feature any related low-carbon economy or Carbon Capture and Storage (CCS) related projects.

Figure 15: Funds allocated to process decarbonization in the period of 2014–2020



Source: European Commission (2021). Note: eligible costs to low-carbon economy thematical objective in the 2014–2020, in % of total allocations for the country.

46 FRR-okt-eng1.pdf (kpmg.com)

The new financing period will mainly follow the previous period's national financing logic, but this time will feature environment-friendly processes as supported activities. The new Economic Development and Innovation Operational Programme (EDIOP Plus) plans to spend EUR 166 million to enviro-friendly production processes in SMEs. This amount is 0.1 percent of the GDP and 1/5th of the target group's one year of investment. The fact that the new EDIOP does not feature any output indicator related to environmental goals indirectly projects that support for CCS and other decarbonization technologies may only be an auxiliary to the support of general fixed asset investments of SMEs. The few calls already available feature the Green national champions programme once more, with a budget three times higher than the previous one (HUF 30 billion). However, as its predecessor, the new Green champions programme will likely not support process emission reduction, but large companies are in the scope of the programme (with a lower support intensity than SMEs).

The Hungarian National Recovery and Resilience Plan (NRRP), approved by the Council of the EU in December 2022, amounts to €5 811 million in EU grants, which represents 4 percent of the country's GDP in 2019 and 0.8 percent of the entire Recovery and Resilience Facility (RRF). The Plan meets the climate (37 percent) and digital (20 percent) minimum investment targets of the RRF Regulation, with 48.1 percent of resources contributing to the green transition and 29.8 percent to the digital transformation. The disbursement of the allocation is planned in seven instalments, scheduled to be requested between summer 2023 and September 2026. **The NRRP roughly follows the logic of the operational programmes financed by the European Structural and Innovation Funds (ESIF), where the green targets are to be reached through the greening of energy and transport.** The plan refers only to the chemical sector in the green transition objective stating: "There is also a need to transform the chemical industry by increasing the spread of safe and sustainable chemical products and manufacturing processes. Increased investment and innovation capacity in the chemical industry to provide safe and sustainable chemicals will be vital to enable new solutions and support the green and digital transition of our economy and society. The strategy proposes a clear timetable and deadlines for transforming the industry with the aim of attracting investment in safe and sustainable products and production methods."[47]

In addition, for any payment to be made under the RRF, Hungary needs to meet all 27 milestones that it agreed with the Commission in relation to rule of law reforms under the plan.[48]

Unlike for the ESIF, centrally allocated state support programmes (Horizon 2020, Innovation Fund etc.) are not subject to state aid regulation. This means even steel activities are eligible for grants and there is no business size class restriction either. However, these funds do not represent an easy option either for the focus group companies for various reasons. First of all, for a country that is as highly financed from ESIF as Hungary (about 3-4 percent of GDP each year), competing for finance nationally is less burdensome than running against international counterparts. Another reason is that many companies in the focus group (included in the ETS) are mostly subsidiaries of foreign companies and for this reason the bulk of the R&D activity of the group is not in Hungary. Furthermore, Hungarian companies tend to be local, there are very few heavy industry entities that have their own R&D activity and are active internationally too.

Similarly to the use of other green finance sources, EU ETS revenues are allocated to energy efficiency and transport. According to Hungarian legislation, 100 percent of revenues from the auctioning of aviation allowances, and 50 percent of revenues from the auctioning of regular (EUA) allowances are used to help reaching climate goals. In the period 2015–2020 auctioning revenues were used via the Green Economy Financing Scheme, mainly for increasing the energy efficiency of buildings, the electrification of transport and for international climate financing. ETS revenues were not allocated for industrial decarbonization. The 2022 state budget proposal was planning to generate EUR 80 million from auctioning EUA-s (allowances) (this is less than 1 percent of the GDP).

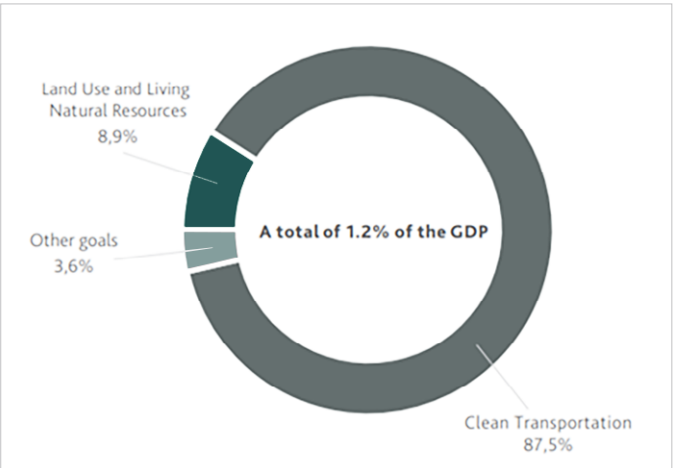
Activities of the central bank as regulatory authority with a green mandate

The Hungarian government took the first move toward encouraging green finance in June 2020, when it issued green government bonds, which raised cash for government initiatives relevant to Hungary's Clean Development Strategy's climate and environmental goals. Since then, a slew of new policies has been enacted to aid with the funding of green initiatives. The Green Bond Programme of 2020 amounted to HUF 718 billion in 2021, roughly 1.3 percent of the total gross central debt of the government (about two and half years of investment from the target group), while HUF 574 billion of projects have been selected by the state. The maturity of these issuances is 15 years for euro denominated bonds (75 percent of all green bonds). Eligible Green Expenditures included investment expenditures, intervention expenditures, tax expenditures and selected operating expenditures. To avoid double financing, companies already obtaining dedicated funding (e.g. a dedicated tax, proceeds from sale of EU ETS allowances or EU funding) have been excluded. **Allocation has been almost exclusively dominated by transportation projects.**

47 Hungarian National Recovery and Resilience Plan

48 https://www.europarl.europa.eu/thinktank/hu/document/EPRS_BRI(2023)747098

Figure 16: Projects financed by the Hungarian Green Bonds Programme



Source: Hungarian Debt Managing Authority report (2021).

Unfortunately, the Hungarian Green Bonds Programme's reception is ambiguous. Background expert information stated that most of the projects included in the Programme were already sanctioned to be financed prior to the start of the Green Bonds, which hurts the green credibility of the Programme. Also, the total sum of the Programme is far from being in line with the investment needs to reach the national green targets.

Tax credits on energy efficiency investments are in place since 2017, but process emission reductions are not supported under this scheme. The tax credit is financed in the Green Bond Programme. The main purpose of this measure is to boost the overall energy efficiency of the companies (including energy consumption, efficiency of buildings, transportation, and production). The tax allowance may be claimed up to 70 percent of the calculated corporate income tax, for a length of 6 years. The tax credits on investments in energy efficiency not claimed by the taxpayer in the corporate tax can also be claimed in the special tax of energy suppliers up to 50 percent of the calculated tax. In total, about 500 companies were eligible for the tax credit. Manufacturing industry as a whole received 38 percent of all tax relief in 2020, which is significantly higher than the industry's share in total tax base (24.8 percent). **Considering the hard-to-abate industries, non-mineral chemical manufacturing (including cement) and steel production received 9.4 percent of all tax allowances (0.3 percent of the GDP), however the projects financed through the instrument are not published.**

Blended finance

Blended finance is not directly available in Hungary, but since there is no dedicated scheme for industry decarbonization in any of the national development programmes, blended finance could be a relevant concept to foster decarbonization. Blended schemes are by nature similar to standard EU co-financed supports, in that EU schemes also incorporate a significant amount of private co-financing complementing state aid (which is the main idea behind blended finances too). We expect this form of finance to arise, but it is more likely to start with hydrogen focused projects, as these investments are preferred against direct decarbonization technologies.

8. Conclusions – policy and financing recommendations

Conclusions – policy and financing recommendations

Drawing conclusions on the decarbonization of heavy industries in Hungary is quite difficult nowadays, because of the special situation that developed in these sectors. In the steel industry, the financial state of the biggest actor, Dunaferr Ltd is making future planning impossible. For the cement industry, the special tax introduced in 2021 takes away all the profit from the companies present in Hungary, making the future of investments and any development rather unclear. The chemical industry is in a much better situation, although the ammonia-producer Nitrogénművek Ltd also had to face more serious financial challenges in the past years.

Keeping this in mind we developed policy proposals that could help both the decarbonization and the survival of these sectors.

Hungary's heavy industry is not in the focus of national decarbonization strategies for now.

A thorough industrial decarbonization strategy is lacking, especially process emissions are out of scope in major documents related to climate and energy policies. As one of the general barriers to industrial decarbonization is the lack of details, timing, and dedicated funding options for decarbonization, a strategy is needed that is then translated into action plans.

The actual work on the new National Energy and Climate Plan and the updated Energy Strategy present a window of opportunity to give momentum to the decarbonization of heavy industries.

Heavy industries are such special sectors that state aid is absolutely needed for decarbonization.

Carbon capture and storage and carbon capture and usage technologies cannot be developed and scaled up if there is no platform where policy actors and different economic/industrial actors can meet. **A platform on CCSU that meets regularly needs to be set up by the government. This must be followed by a CCSU strategy.**

The Hydrogen Strategy counts on the start of the use of hydrogen in the heavy industries mostly between 2030 and 2040. **The dates for hydrogen integration should be more ambitious** as like this, we are leaving the bulk of emission reduction to the last decade before 2050.

A common point for the 3 sectors is the lack of research and development into new, low-carbon or carbon-free technologies, as most of the R&D developments are carried out at the parent companies abroad, but R&D for the reduction of process emissions is not really in the focus of local companies either. **More funding must be made available for R&D and for pilot projects then scaling of the new technologies where possible.**

Both in the cement and in the steel sector there is a significant gap between the demand for and the supply of skilled workforce needed. **The educational and training system needs to be rethought in a way that solves this structural issue.**

The MNB's (the central bank's) green capital requirement programme was a forward-looking initiative, it **needs to be carried on**, as the green bond programme of the MNB can serve as a model in the region.

The greening of bank portfolios can be challenging, because banks may choose to divest from brown assets rather than cleaning them: this has to be closely followed by the government to see how private financing is adding to public finance, and investments must be channeled in the relevant sectors.

Auctioning revenues from the ETS should be fully dedicated to decarbonization and the financing of heavy industry decarbonization should also have its place on the agenda.

The mining fee introduced for the cement sector in 2021 must be lifted or transformed in some way to secure companies' own funding for investments in decarbonization.

Hungarian companies often have difficulties in submitting grant proposals, thus, they are unable to get funding from the **Modernisation Fund and the Innovation Fund**, the two main sources of financing that can be available for heavy industry decarbonization. **Actors of the sector could join forces and know-how to be more successful in securing grants on the one hand, on the other hand technical assistance for drafting proposals would be an asset welcomed by all.** At the moment, Hungary has no application to the Innovation Fund, which is a missed opportunity for financing heavy industry decarbonization, and **technical assistance of some kind should be organized to help companies.**

All in all, the decarbonization of the cement, steel and chemical sectors in Hungary is a challenging task and **most of the solutions are planned to be used after 2030. Nevertheless, if green financing, may it be public or private, added to technical assistance become more and more available** to the sectors' actors, **decarbonization** – and the related shift away from fossil fuel dependency – **will get closer to reality.**

Annex

Annex

Hard-to-abate industries simplified financial statements forecast until 2030

Cement sector simplified financial statements – forecast without major decarbonization investments and without profit distribution

Cement sector (MHUF)	2019	2020	2021	2022F	2023F	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2023/22
Sales	106,779	108,477	152,722	183,746	205,995	210,115	216,418	222,911	229,598	236,486	243,580	250,888	12%
EBITDA	27,318	43,230	51,566	59,638	47,271	44,747	46,223	44,428	44,857	44,527	45,170	39,997	-21%
Depreciation	6,873	7,387	7,603	5,249	5,701	5,815	5,990	6,170	6,355	7,026	7,438	7,375	9%
EBIT	20,445	35,843	43,963	54,390	41,570	38,931	40,233	38,259	38,502	37,500	37,732	32,622	-24%
Net profit	19,507	34,684	39,681	27,194	24,939	27,251	32,185	34,432	34,651	26,181	27,830	24,116	-8%
Assets	152,761	169,348	230,513	211,634	239,950	267,825	300,966	336,382	506,591	517,665	529,490	536,652	13%
Fixed assets	104,360	117,410	113,064	113,180	113,309	113,442	113,578	113,718	113,863	114,012	114,165	114,323	0%
Current assets	48,167	51,737	116,808	98,455	126,640	154,384	187,388	222,664	392,728	403,653	415,325	422,329	29%
Capital	152,761	169,348	230,513	211,634	239,950	267,825	300,966	336,382	506,591	517,665	529,490	536,652	13%
Equity	114,801	132,789	155,284	165,478	190,417	217,668	249,853	284,284	318,935	345,116	372,946	397,063	15%
Reserves	3,939	3,475	18,456	18,276	18,276	18,276	18,276	18,276	18,276	18,276	18,276	18,276	0%
Debt	17	99	27	27	27	27	27	27	134,571	118,420	101,340	83,277	0%
Current liabilities	18,556	15,978	30,339	27,854	31,230	31,855	32,810	33,795	34,808	35,853	36,928	38,036	12%
Other liabilities	22,495	19,453	48,795	46,130	49,506	50,131	51,086	52,071	53,084	54,129	55,204	56,312	
FCF (after DS)					31,957	33,336	38,587	41,026	41,443	17,506	18,652	13,906	
Capex	386	383	37	352	395	403	415	428	441	454	467	481	

Steel sector simplified financial statements – forecast based on Ózdi Acélművek Ltd data, without major decarbonization investments and without profit distribution

Ózdi Acélművek kft (MHUF)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Sales		92,237	132,163	175,830	170,285	142,815	238,314	288,297	322,557	329,008	337,234	345,664	354,306	363,164	372,243	381,549
EBITDA		11,683	14,686	20,481	17,207	11,454	37,809	51,583	33,156	28,971	28,904	28,795	28,651	28,443	28,094	27,477
Depreciation		2,166	1,957	2,096	2,145	2,187	3,498	4,108	4,463	4,552	4,689	4,829	4,974	5,123	5,277	5,435
EBIT		9,517	12,729	18,385	15,062	9,267	34,311	47,474	28,693	24,419	24,216	23,966	23,677	23,320	22,817	22,042
Net profit		8,124	11,782	17,291	14,000	8,010	32,225	42,176	24,929	21,704	21,521	21,296	21,036	16,225	16,628	16,454
Assets		79,011	87,240	102,306	111,859	118,184	151,675	199,140	227,508	249,859	272,206	294,348	396,066	403,599	411,006	417,679
Fixed assets		47,134	47,479	54,354	64,572	75,092	86,773	86,847	86,929	87,013	87,099	87,187	87,277	87,370	87,465	87,562
Current assets		31,804	39,725	47,808	47,286	43,051	64,895	112,293	140,579	162,847	185,107	207,162	308,789	316,229	323,541	330,117
Capital		79,011	87,240	102,306	111,859	118,184	151,675	199,140	227,508	249,859	272,206	294,348	396,066	403,599	411,006	417,679
Equity		32,879	42,388	59,084	75,123	82,820	118,336	160,512	185,441	207,145	228,666	249,962	270,998	287,223	303,851	320,305
Reserves		4,882	6,516	3,652	2,138	2,958	3,726	3,546	3,546	3,546	3,546	3,546	3,546	3,546	3,546	3,546
Debt		20,557	13,444	7,634	10,305	8,031	6,140	6,140	6,140	6,140	6,140	6,140	85,954	76,372	66,240	55,525
Current liabilities		20,693	24,892	31,936	24,293	24,375	23,473	28,942	32,381	33,029	33,854	34,701	35,568	36,457	37,369	38,303
FCF (after DS)	165,959								32,831	26,903	27,035	26,972	26,878	12,656	12,684	12,109
Capex					193	257	110	184	205	209	215	220	226	231	237	243

Chemical sector simplified financial statements – forecast based on BorsodChem Ltd data, without major decarbonization investments and without profit distribution

BorsodChem Zrt. (MHUF)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Sales		521,544	630,734	656,704	532,355	521,080	970,092	949,235	1,062,040	1,083,281	1,115,779	1,149,253	1,183,730	1,219,242	1,255,819	1,293,494
EBITDA		63,144	190,348	198,915	88,414	110,566	249,764	118,881	78,334	61,290	64,708	68,209	71,821	75,504	79,158	82,611
Depreciation		19,485	26,145	25,147	25,713	26,253	25,440	29,879	32,456	33,106	34,099	35,122	36,175	37,261	38,378	39,530
EBIT		43,659	164,203	173,767	62,701	84,314	224,324	89,002	45,877	28,185	30,609	33,087	35,645	38,244	40,779	43,082
Net profit		42,515	150,918	163,785	61,940	77,233	245,548	79,231	39,875	24,934	27,116	29,347	31,649	22,413	26,900	30,324
		0	0	0	0	0	0									
Assets		678,091	626,985	705,848	733,525	867,548	1,202,271	1,228,393	1,276,454	1,302,930	1,332,404	1,364,180	1,604,092	1,604,382	1,607,814	1,613,249
Fixed assets		319,832	438,553	457,917	487,169	598,916	663,760	663,834	663,916	664,000	664,086	664,175	664,267	664,361	664,458	664,559
Current assets		353,732	185,529	244,702	244,054	267,439	537,202	564,559	612,538	638,930	668,318	700,005	939,825	940,021	943,356	948,690
Capital		678,091	626,985	705,848	733,525	867,548	1,202,271	1,228,393	1,276,454	1,302,930	1,332,404	1,364,180	1,604,092	1,604,382	1,607,814	1,613,249
Equity		263,832	251,083	414,547	475,213	551,653	796,901	876,132	916,007	940,942	968,058	997,405	1,029,054	1,051,467	1,078,367	1,108,690
Reserves		132,558	185,270	218,873	181,530	249,369	273,857	273,677	273,677	273,677	273,677	273,677	273,677	273,677	273,677	273,677
Debt		232,478	174,798	55,248	61,024	47,547	9,701	9,701	9,701	9,701	9,701	9,701	215,462	190,761	164,640	137,017
Current liabilities		49,223	15,834	17,180	15,758	18,980	121,812	68,883	77,069	78,610	80,968	83,397	85,899	88,476	91,130	93,864
FCF (after DS)	420,257								80,518	59,581	63,574	66,897	70,326	37,550	41,811	44,964
Capex					193	257	110	184	205	209	216	222	229	236	243	250

Bibliography

Bibliography

Bucsky, P. (13 January 2023). Az építőipar működését veszélyezteti a kormányzati cement ársapka. *G7*. https://g7.hu/vallalat/20230113/az-epitoipar-mukodeset-veszelyezteti-a-kormanyzati-cement-arsapka/

Bureau Veritas M&O. (n.d.). *Energy Taxation Directive (ETD).* Downloaded 21 June 2023. https://marine-offshore.bureauveritas.com/sustainability/fit-for-55/energy-taxation-directive

Climact. (n.d.). *2050 Pathways Explorer.* Downloaded 21 June 2023. https://pathwaysexplorer.climact.com/dashboard?region=HU

Council of the European Union. (15 March 2022). *Council agrees on the Carbon Border Adjustment Mechanism (CBAM).* https://www.consilium.europa.eu/en/press/press-releases/2022/03/15/carbon-border-adjustment-mechanism-cbam-council-agrees-its-negotiating-mandate/

Council of the European Union. (n.d.). *Fit for 55 - The EU's plan for a green transition - Consilium.* Downloaded 2023.06.21. https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

Council of the European Union. (4 October 2022). *REPowerEU: Council agrees its position.* https://www.consilium.europa.eu/en/press/press-releases/2022/10/04/repowereu-council-agrees-its-position/

Deloitte. (n.d.). *EU Carbon Border Adjustment Mechanism (CBAM).* Downloaded 21 June 2023. https://www2.deloitte.com/nl/nl/pages/tax/articles/eu-carbon-border-adjustment-mechanism-cbam.html

Emanuelsson, A., & Johnsson, F. (2022). The cost of CCS - a product chain analysis of the cement and pulp industries. In *Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) 23-24 Oct 2022*, Available at SSRN: https://ssrn.com/abstract=4280350 or http://dx.doi.org/10.2139/ssrn.4280350

Equilibrium Institute. (30 November 2022.) *Industrial Decarbonisation in Hungary.* https://v4decarb.org/publications/industrial-decarbonisation-in-hungary/

European Commission. (n.d.). *A European Green Deal.* Downloaded 2023. June 21. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

European Commission. (n.d.). *European green bond standard.* Downloaded 21 June 2023. https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/european-green-bond-standard_en

European Commission. (n.d.). *EU taxonomy for sustainable activities.* Downloaded 21 June 2023. https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en#documents

European Commission. (n.d.). *Key actions of the EU Hydrogen Strategy.* Downloaded 21 June 2023. https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen/key-actions-eu-hydrogen-strategy_en

European Commission. (30 November 2022). *Questions and answers: European Commission endorses Hungary's €5.8 billion recovery and resilience plan subject to meeting rule of law milestones.* https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_7274

European Commission. (n.d.). *Recovery and resilience plan for Hungary.* Downloaded 21 June 2023. https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/recovery-and-resilience-plan-hungary_en

European Commission. (n.d.). *Revision for phase 4 (2021-2030).* Downloaded 2023. June 21. https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/revision-phase-4-2021-2030_en

European Commission. (n.d.). *The Recovery and Resilience Facility.* Downloaded 21 June 2023. https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en

European Commission. (n.d.). *Summary of the Commission's assessment of the Hungarian Recovery and Resilience Plan.* https://commission.europa.eu/system/files/2022-12/HU%20RRP%20Summary.pdf

European Parliament. (18 December 2022). *Climate change: Deal on a more ambitious Emissions Trading System (ETS) | News | European Parliament.* https://www.europarl.europa.eu/news/en/press-room/20221212IPR64527/climate-change-deal-on-a-more-ambitious-emissions-trading-system-ets

European Parliament. (n.d.). *European Green Bond Standard: new measures to reduce green washing.* Downloaded 21 June 2023. https://www.europarl.europa.eu/news/en/press-room/20220516IPR29640/european-green-bond-standard-new-measures-to-reduce-green-washing

European Parliament. (20 April 2023). *Hungary's National Recovery and Resilience Plan: Latest state of play.* https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)747098

European Parliament. (n.d.). *Renewable energy.* Downloaded 21 June 2023. https://www.europarl.europa.eu/factsheets/en/sheet/70/megujulo-energia

Forbes. (31 January 2023). Kijött a rendelet: így dőlhet el a Dunaferr sorsa. *Forbes.* https://forbes.hu/uzlet/kormanyrendelet-mentes-dunaferr/?utm_source=hirstart&utm_medium=referral&utm_campaign=hiraggregator

Global Cement. (13 July 2021). *Hungarian government imposes excess profit tax on building materials.* https://www.globalcement.com/news/item/12689-hungarian-government-imposes-excess-profit-tax-on-building-materials

HVG. (31 January 2023). Kormányrendeletben dönthettek a Dunaferr sorsáról. *HVG.* https://hvg.hu/gazdasag/20230131_Dunaferr_kormanyrendelet_vesztesegesmukodes

Innovációs és Technológiai Minisztérium. (2 June 2021). *Magyarország Nemzeti Hidrogénstratégiája.* https://kormany.hu/dokumentumtar/magyarorszag-nemzeti-hidrogenstrategiaja

Koczóh, L. A. (25 January 2023). Javaslatcsomag a 2030-as klímacélok eléréséhez. *Green Policy Center.* https://www.greenpolicycenter.com/2023/01/25/a-mirror-projekt-kereteben-keszult-elemzesek-es-javaslatcsomagok-gyujtemenye/

Leeson, D., Mac Dowell, N., Shah, N., Petit, C., & Fennell P.S. (2017). A Techno-economic analysis and systematic review of carbon capture and storage (CCS) applied to the iron and steel, cement, oil refining and pulp and paper industries, as well as other high purity sources. *International Journal of Greenhouse Gas Control, 61*, 71-84. https://doi.org/10.1016/j.ijggc.2017.03.020

Mindekova, T. (2022). *Decarbonization of the Industrial Sector: Sustainable Finance as an Opportunity?* EUROPEUM Institute for European Policy. https://v4decarb.org/publications/industrial-decarbonisation-policies-in-the-eu/

Monteiro, J., & Roussanaly, S. (2022.) CCUS scenarios for the cement industry: Is CO_2 utilization feasible? *Journal of CO_2 Utilization, 61.* https://doi.org/10.1016/j.jcou.2022.102015

Nemzeti Alkalmazkodási Központ Főosztály. (n.d.). *The Second Climate Change Strategy of Hungary (NCCS-2).* Downloaded 21 June 2023. https://nakfo.mbfsz.gov.hu/en/node/365

Publyon. (7 October 2022). *REPowerEU: A boost for the European energy transition.* https://publyon.com/repowereu-a-boost-for-the-european-energy-transition/

Rugli, T. (1 February 2023). Orbán: a kormány kifizeti a Dunaferr dolgozóinak bérét a következő hat hónapban. *24.hu.* https://24.hu/belfold/2023/02/01/kormany-kifizeti-dunaferr-berek-orban-viktor/#

Strunge, T., Küng, L., Renforth, P., & Van der Spek, M. (2022). Marginal Cost Curves for Decarbonizing the European Cement Industry. In *Proceedings of the 16th Greenhouse Gas Control Technologies Conference (GHGT-16) 23-24 Oct 2022*, Available at SSRN: https://ssrn.com/abstract=4286149 or http://dx.doi.org/10.2139/ssrn.4286149

Vajda, P., Tóbiás, S. & Wiede, G. (2021). The MNB's new recommendation on taking, measuring and managing credit risk. *KPMG Financial Risk & Regulation News.* https://assets.kpmg.com/content/dam/kpmg/hu/pdf/FRR-okt-eng1.pdf