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UKRAINIAN CLIMATE OFFICE

A framework for green reconstruction

Toward EU-readiness of Ukraine's carbon pricing

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Ukraine faces a significant challenge of reconstructing its energy and industrial sectors, which the World Bank estimates will cost US $115 billion over the next decade. This reconstruction effort is compounded by the need for a transformation toward a modern green asset base to thrive in a rapidly decarbonizing global economy. Carbon pricing will be important in guiding reconstruction investments to sustainable and future-proof assets and technologies. As Ukraine aims to join the European Union (EU), it should determine, negotiate, and communicate a credible convergence path toward integration into the EU Emissions Trading System (EU ETS), while Carbon Border Adjustment Mechanisms (CBAMs) – in particular, the EU CBAM – will provide additional incentives to decarbonize in the short term.

Deloitte Germany in cooperation with Deloitte France is providing its knowledge for the pivotal challenge of facilitating Ukraine's green construction in collaboration with GIZ, which is implementing the "Capacities for Climate Action" (C4CA) project, and the Ukrainian Climate Office, commissioned by the German Federal Ministry for Economic Affairs and Climate Action (BMWK) under the International Climate Initiative (IKI) and co-financed by the European Union.

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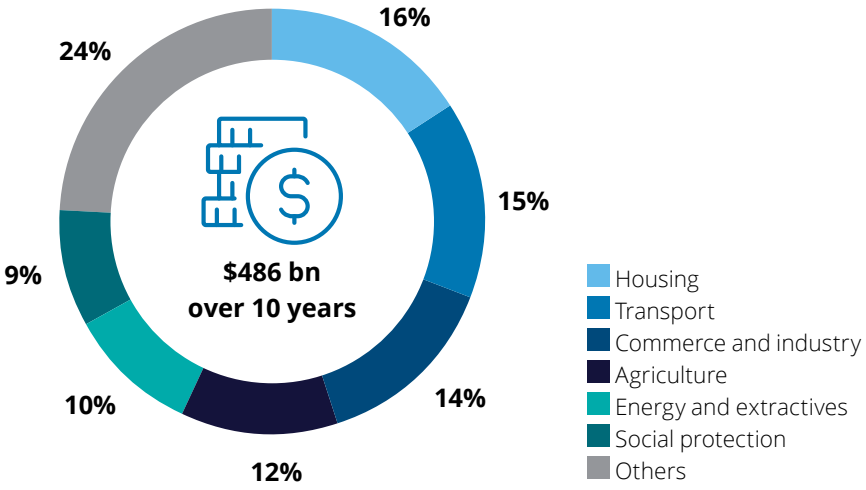
Green reconstruction in the energy and industry sectors

Due to the widespread destruction caused by the war, Ukraine and its international partners face the daunting task of rebuilding the country. While estimates of the costs of reconstruction vary and critically depend on the future course of the war, a report jointly published by the World Bank, the Government of Ukraine, the United Nations and the European Commission in February of 2024 estimated that the total cost of reconstructing Ukraine would amount to approximately US $486 billion over the next 10 years (see Figure 1).[1]

Fig. 1 – Total estimated recovery and reconstruction needs by sector



Source: The World Bank

The energy and industry sectors of Ukraine have been subject to substantial destruction. In the summer of 2024, interviews conducted by Deloitte with stakeholders based in Ukraine indicated that large shares of thermal power plant (TPP) and hydro power plant (HPP) generation capacity were estimated to be fully destroyed or seriously damaged. With the Zaporizhzhia nuclear power plant (NPP), over 40% of nuclear-powered generation capacity is currently under Russian occupation, as are some of the best renewable generation sites in the east and south of Ukraine. Significant parts of Ukraine's heavy industrial capacity have also been destroyed or are occupied, including the Azovstal and Ilyich Iron and Steel Works in Mariupol, a major coke plant in Avdiivka, and multiple mining towns predominantly in the Donetsk region.

Alongside the reconstruction challenge, Ukraine faces a significant green transformation challenge and opportunity. The capital stock of Ukraine's pre-war industrial and energy sectors was highly energy-inefficient and dependent on fossil fuels, resulting in economy-wide carbon intensity of GDP 4.5 times higher than the global average and more than 8 times higher than the average in the European OECD countries in 2020.[2] Reconstructing Ukraine's economy with more efficient fossil-based technologies may address short-term needs but will put Ukraine's medium- and long-term objectives at significant risk. In a rapidly decarbonizing world, Ukraine needs a modern industrial and energy asset base, low-carbon technologies and renewable energy to maintain and increase access to and competitiveness on the world market in general and in the EU in particular.

Fossil-based products are facing shrinking global markets and potential additional costs on export markets from instruments such as the EU Carbon Border Adjustment Mechanism (CBAM). As Ukraine's western trade partners transform their own asset bases, rebuilding with fossil-based technologies that have long amortization periods could leave the country with stranded assets. Therefore, a successfully reconstructed Ukraine will likely look different from pre-war Ukraine. While green reconstruction will favor international capital market access, improve energy efficiency and resilience, and generate cost savings from renewable energies in the long run, it requires higher upfront investment costs. The World Bank has estimated the cost of green reconstruction of the energy and industrial sectors ("energy and extractives", "commerce and industry", i.e., including mining and the private services sector) at US $115 bn over the next ten years.[3]

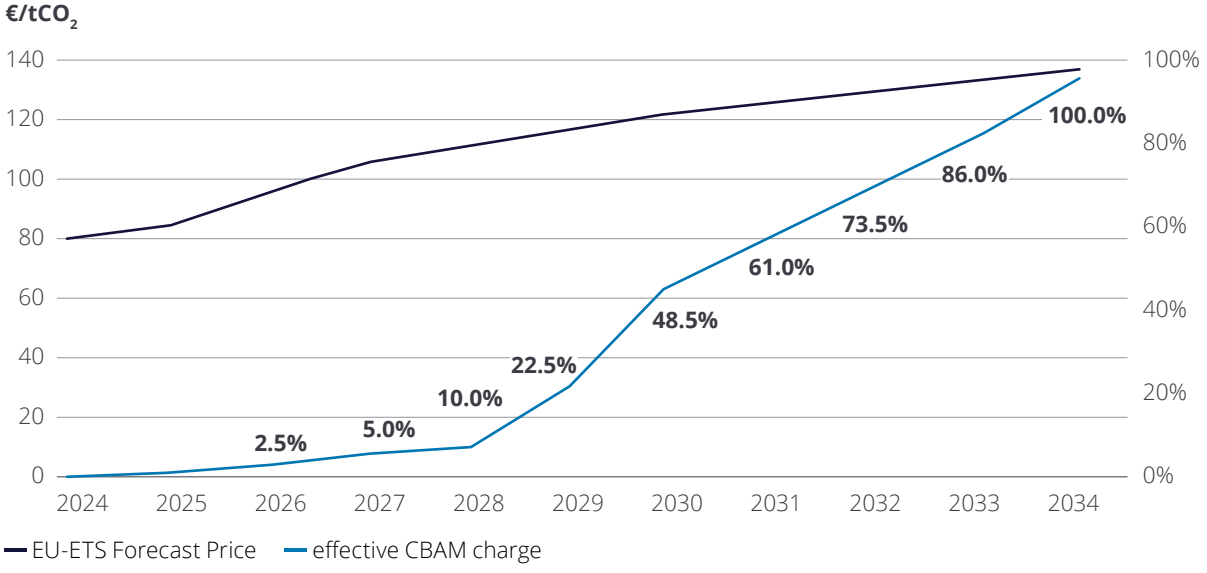
Ukraine's EU perspective implies carbon pricing is an instrument to incentivize green investment

To achieve green reconstruction, policies are required to help guide public and private investors toward green rather than fossil assets. Reconstruction funding from donor institutions through concessional finance and other support measures is likely to face increasing pressure in terms of alignment with climate objectives[4]; but the specific conditions and their consistency of application are not yet clear. In addition, private investments may also be financed from other sources. Hence, a lead instrument in the overall policy architecture is required to help ensure consistent incentives for green investments.

Ukraine's aspiration for EU membership implies adopting carbon pricing as a primary instrument to incentivize green investment. As part of the EU accession process, Ukraine must implement relevant EU legislation, including the EU ETS – a cap and trade system to price greenhouse gas emissions into the energy, industry, aviation and maritime sectors.[5] Hence, Ukraine should establish and communicate a concrete path for implementation of an EU ETS-aligned system in the country. It will help anchor investors' expectations, and in turn guide their decisions in favor of green versus fossil investments. This especially requires setting a credible price path for emission allowances to develop stable business cases.

In the near term, the EU Carbon Border Adjustment Mechanism (EU CBAM) serves as an incentive to fast-track domestic carbon pricing in Ukraine. The EU CBAM is a levy on certain categories of fossil-based imports (electricity, cement, iron and steel, aluminum, fertilizers, and hydrogen under the current regulation) into the EU from third countries. This mechanism is designed to tackle carbon leakage from the EU ETS to countries with no or lower carbon pricing than in the EU, such as Ukraine. From the perspective of Ukraine, the CBAM will gradually charge the gap between a proportion of the EU ETS price (or "effective CBAM charge") and a Ukrainian carbon price on the embodied carbon content of relevant Ukrainian exports from 2026 onwards. Rapidly implementing an EU-compliant domestic carbon pricing mechanism with an increasing price path would facilitate limiting or altogether avoiding CBAM payments by Ukrainian companies into European fiscal coffers, and additionally generate revenues for the Ukrainian budget.

Fig. 2 – EU ETS prices, phase-in of effective CBAM charge



Source: Umwelt Bundesamt[6], European Commission[7]

In theory, Ukraine has the option to apply for two exemptions from the CBAM: the exemption due to exceptional circumstances (Article 30.7) and the electricity sector exemption (Article 2.7). However, both come with their own requirements, as discussed in Box 1.

Ukraine has already taken its first steps toward carbon pricing. A carbon tax on emissions in the energy, industry, and building sectors has been in place since 2010[9], albeit with a current carbon price of below €1 per ton of CO_2 equivalent (€/tCO_2eq) – a significantly lower price than the EU ETS[10] and using a different method of calculating taxable emissions. In addition, the country has already committed to prepare to join the EU ETS since signing the EU Association Agreement in 2014.[11] Ukraine is a member of the Energy Community (EnC), an international organization that unites the EU with neighboring and candidate countries to harmonize energy-related policies. The EnC is currently discussing a proposal to implement a regional ETS to converge with the EU ETS. In 2019, the implementation of the EU ETS methodology for monitoring, reporting, and verifying (MRV) ETS-relevant emissions was passed by the Verkhovna Rada of Ukraine as the "MRV law".[12] Furthermore, the current draft of the National Energy and Climate Plan for 2025-2030 (NECP) envisages that the framework conditions for the UA ETS will "gradually approach the EU ETS".[9] However, the relevant policy scenario of the NECP forecasts a revision of the rate and tax base that would result in a UA ETS price of €16/tCO_2 by 2035 and €100/tCO_2 by 2050 – substantially lower than would be required to integrate with the future EU ETS price level.

Investors require confidence regarding future carbon prices. Political efforts so far have focused on the necessary technical prerequisites for setting up an ETS-compatible system in Ukraine. Industry and policy specialists conceded in stakeholder interviews that MRV, the essential base of the ETS, will still require several years for a sufficiently reliable technical implementation to serve as the base of actual carbon pricing. There is limited bottom-up (installation-level) data at present to set the number (cap) of emission allowances for a Ukrainian ETS (UA ETS), especially in the context of the ongoing war. In addition, the price difference between current carbon prices in Ukraine and the expected EU carbon prices in 2030 – the informally discussed date of EU accession expected for Ukraine based on stakeholder interviews – would require a very steeply increasing price curve that could excessively burden Ukraine's already weakened industrial base. This gap between technical prerequisites and price expectations needs to be closed.

Other policy instruments may play a crucial role for green investment, provided that a carbon price establishes the foundation. Subsidies and direct regulation of construction investments may also help to guide green investments and will in any case be needed for hard-to-abate sectors. However, given the scale and complexity of the required reconstruction, these instruments might struggle to provide consistent incentives across the economy in the absence of a carbon price signal to deter competing fossil-based technologies. With a carbon price as a foundation, high-carbon investments become less attractive than green ones.[13]

Box 1:
Potential CBAM exemptions for Ukraine

Exceptional circumstances
Article 30.7 of the CBAM regulation states that provisional measures could be applied to address exceptional circumstances where an "unforeseeable, exceptional and unprovoked event has occurred that is outside the control of one or more third countries subject to the CBAM, and that event has destructive consequences on the economic and industrial infrastructure of such country". However, pursuing this pathway is considered hazardous by interviewed stakeholders given the risks and uncertainties regarding the specific timing and outcome of a potential exemption. A negative negotiation outcome could cause abrupt cost increases for industry if countervailing measures were not undertaken simultaneously. Furthermore, it could make EU accession more difficult if carbon pricing readiness is delayed.

Electricity sector
In addition, Ukraine can apply for the electricity sector exemption in the case of power market coupling with the EU (Article 2.7), under a restrictive set of conditions. These include agreement on applying EU law and regulation in the field of electricity, submission of a roadmap with a detailed timeline of climate framework legislation aligned with EU climate law and the implementation of a Ukrainian ETS (UA ETS) with a carbon price equivalence on electricity[i] to the EU ETS by 2030, and an effective system to prevent indirect import of electricity into the EU. Ukraine still requires significant progress in each of the above areas except the first to reach compliance[ii]. However, compliance is crucial; CBAM charges on electricity exports to the EU would be incompatible with the envisaged market coupling of Ukraine with the EU electricity market.

Source: EU CBAM regulation[8]

[i] The definition of price equivalence is yet to be determined at the time of writing, but could include measures such as carbon tax top-ups, PPP and exchange rate calibration, and a lower effective price through additional free allocations.
[ii] The first condition is fulfilled as a contracting party to the Energy Community.

Objectives in designing a carbon pricing trajectory

Ukraine should devise, negotiate, and communicate a roadmap for the convergence of its carbon pricing solution with the EU ETS to guide green investments with carbon price expectations, including short-term and long-term considerations:

Short term objectives:

Facilitating economic recovery: Carbon pricing should not overburden the existing industrial and energy sector assets and actors, which are already heavily strained by the economic impact of war.

Minimizing CBAM payments: As CBAM payments would flow out of Ukraine, it would be preferable to keep them in Ukraine through a domestic carbon price to generate revenues. The latter could then be used to support the decarbonization of carbon-intensive activities (e.g., energy and industry), thus softening the effective fiscal burden, which would not be possible under the CBAM.

Long term objectives:

Incentivizing investments in green reconstruction: The resulting expected price path for carbon emissions should be sufficient to efficiently guide reconstruction investments toward green technologies wherever feasible.

Facilitating EU accession: Ukraine should be on track for implementation of EU climate policies to facilitate and accelerate EU accession.

Further considerations:

Technical feasibility: EU-compatible implementation of carbon pricing needs to be feasible for businesses and public institutions such as with regard to MRV implementation, setting an emissions cap and establishing a trading platform.

Further commitments: In addition, Ukraine should consider the impact its carbon pricing choices will have on further commitments. As a member of the Energy Community, a domestically geared solution may conflict with a potential Energy Community regional ETS implementation. Moreover, preserving the coupling of Ukraine's electricity system with the EU grid requires Ukraine to get its electricity sector exempted from the CBAM, which, in turn, is conditional on Ukraine establishing an ETS by 2030.[14]

There are various ways to design the UA ETS but not all are aligned with Ukraine's objectives, and some could create serious roadblocks to EU accession. Box 2 discusses the main decision space of Ukraine, i.e., the dimensions over which it has control.

In the following two chapters, the cost impact of two carbon pricing policy scenarios on the Ukrainian economy is analyzed to help Ukraine determine which scenario may be best to pursue to develop its own carbon pricing and convergence with the EU ETS.

The design of the carbon pricing instrument will affect Ukraine's economic future.

Box 2:
UA ETS decision space

Ukraine's decision space regarding its own ETS can be contextualized by comparing and contrasting to the full EU ETS it will eventually integrate with, and the different levers under its control until then. These levers relate to the dimensions of sectoral scope, price ambition and timing.

Dimension 1: Sectoral scope
Ukraine has the option to apply the UA ETS to a limited number of sectors to help mitigate the effects on vulnerable industries. However, adopting the full EU ETS scope would lay the foundation to better accommodate EU integration in future. Adopting tailored sectoral coverage would imply an economically less efficient decarbonization pathway as carbon prices would differ widely between industry sectors. It would also cause integration challenges with the EU ETS as some (covered) sectors would be much closer to EU ETS integration than (non-covered) others.

Dimension 2: Price ambition
The UA ETS could target the same market price as the EU ETS, albeit with a lower effective price (the real cost burden). A lower market price would likely be problematic for EU ETS integration, while a lower effective price could be implemented more easily.

A lower effective price could be achieved – in whole or for targeted sectors – through the distribution of free emissions allowances. Free allowances could be disbursed in several ways, including following the EU approach or Ukraine having its own higher level of free allowances. Although Ukraine implementing different free allowance rules should not be problematic for EU ETS integration from a technical point of view, the suitable number of free allocations should be carefully considered. It would likely require substantial negotiations because it would distort prices within the EU and create a precedent. The availability of accurate installation-level emissions data could be also a constraint.

For higher price certainty towards EU integration, a carbon tax could be used as a top-up instrument for allowance prices.

Dimension 3: Timing
Ukraine has discretion over the timing of the UA ETS introduction until future integration with the EU ETS.

However, if investors do not get the signal to factor in extra (carbon) costs in future, they might require more subsidies and allowances over the medium in high-carbon assets once policy ambition increases suddenly. A later introduction could also increase the required steepness of price increases presuming Ukraine joins the EU ETS.

A ramp-up period for the price level or price corridor – where the price level increases to a pre-determined fixed level or range each year – would set expectations and allow time for investors and industry to adjust their behavior.

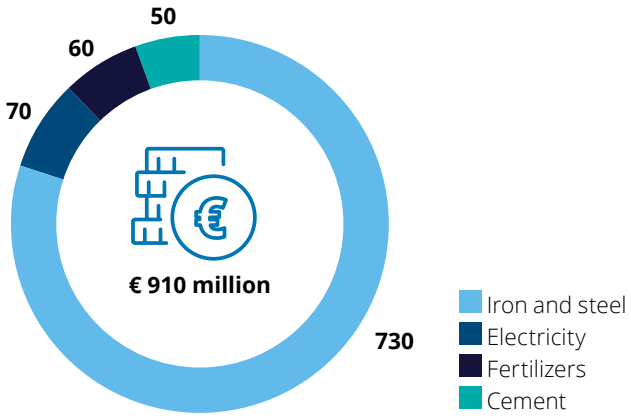
How large would Ukraine's CBAM payment obligation be without domestic carbon pricing?

In the hypothetical case that Ukraine does not implement an ETS, importers of Ukrainian products will face rising CBAM payment obligations from 2026 onwards. The impact on export competitiveness and the tax transfer could encourage Ukraine to implement a minimum level of carbon pricing to help reduce payments to the EU and instead collect and use the corresponding fiscal revenues. This framing, currently subject to debate, notably ignores the two most important reasons for carbon pricing in Ukraine: guiding reconstruction investments toward green technologies and ensuring readiness for EU accession.

CBAM payments cover the imports of fossil-intensive goods into the EU, charging their embodied carbon content at an effective EU carbon price (approximated as the EU ETS price adjusted according to the phase-out trajectory of free allowances).[15] The assessment relies on pre-war emission intensities and Ukrainian exports to the EU (see Appendix for further details), considering a €50/tCO_2 effective price designed to be representative of the 2030 horizon.[iii] It therefore provides an upper bound estimate of CBAM payments, assuming full reconstruction of the pre-war economy (i.e., a return to previous production levels and technologies and no redirection of exports to other markets).

Based on a return to the pre-war economy, total annual payments on Ukrainian goods imported into the EU could become significant by 2030, reaching almost to €1 billion (in 2021 prices) for an effective carbon price of €50/tCO_2 – about 0.5% of Ukraine's pre-war GDP. In terms of sectoral burden, iron and steel would account for around 80% of total CBAM payments (approx. €730 million), followed by electricity (about 8%, or €70 million) and fertilizers and cement (7% and 5%, respectively, or €60 million and €50 million, see Figure 3). It is worth restating that our estimate is likely to be an upper bound of the CBAM impact on Ukraine, insofar as it relies on a pre-war economy assumption (motivated by the limitations in data availability) while a significant proportion of heavy industry (e.g., steel production) has either been destroyed or is now located in occupied territories (e.g., Donbas).

Fig. 3 – Annual gross financial CBAM burden for Ukraine with a €50/tCO_2 effective carbon price (representative of the 2030 horizon) and assuming full reconstruction of the pre-war economy, in € million



Source: Deloitte computations are based on 2021 trade data (Eurostat[16]) and emission intensities (Bank of Finland[17], Joint Research Centre (JRC)[18, 19]), focusing on direct emissions and on the assumption that Ukraine will recover economic activity similar to its pre-war level (trade and emission intensity levels).

[iii] An effective carbon price of €50/tCO_2 is considered, designed to be representative of the 2030 horizon assuming an EU ETS price slightly above €100/tCO_2, and a share of free allowances slightly below 50% for CBAM goods. The current domestic carbon tax of less than €1/tCO_2 in Ukraine is ignored, assumed to remain flat and negligible.

CBAM charges will be driven by the emission intensity of Ukrainian industries and their reliance on the EU market.

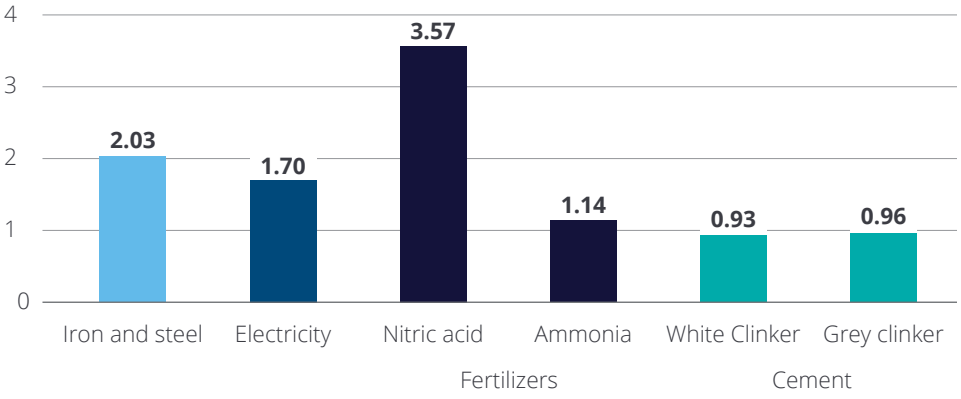
The pre-war emission intensity of the Ukrainian iron and steel industry was more than twice that of the EU (see Figure 4). Ukraine also appears to be much more carbon intensive than the EU as regards nitric acid manufacturing, and, to a lesser extent, electricity and ammonia. As the Ukrainian economy reduces its reliance on fossil fuels on the pathway to green reconstruction, the CBAM charge will automatically decrease as emission intensities decline.

The difference in emission intensity between the Ukrainian and EU economies translates into large CBAM costs given the increasing weight of the EU market in Ukrainian exports. More than 14% of Ukrainian basic metal production in value (including iron and steel products) used to be sent to the EU market in 2020, while over 5% of chemical production was exported to the EU.[20] Over the next few years, Ukraine could become even more integrated with the EU as part of the accession process, further increasing CBAM exposure.

In practice, the CBAM impact would likely be lower as rebuilding similar to the pre-war economy is likely not realistic. When derived from current data (2022 and 2023 average, see Appendix), the CBAM cost would be less than half the pre-war assessment, reflecting the sharp decline of exports – particularly in the iron and steel sector. Moreover, it is unlikely that steel, cement and electricity exports would fully recover to pre-war levels of production and exports, given the scale of destruction in these sectors and the domestic need for these goods for reconstruction. Furthermore, even a fossil-based reconstruction would likely incorporate more modern, energy-efficient and hence less emission-intensive technologies.

To help reduce CBAM payments, Ukraine could implement a domestic carbon trading system. This would imply that instead of fiscal payments to the EU, carbon revenues would flow into Ukraine's budget. It is important to keep in mind that this would not be the sole reason for setting up carbon pricing in Ukraine. The main reasons are to guide reconstruction investments toward green technologies and to ensure readiness for EU accession. In contrast to CBAM, this domestic carbon pricing would, however, affect the entire production of these sectors, not only EU exports. Hence, it is necessary to understand how much of a financial burden domestic carbon pricing would be for the Ukrainian electricity and industrial sectors.

Fig. 4 – Emission intensity of selected Ukrainian economic sectors compared to the EU



Source: Deloitte calculations based on JRC[18, 19] and International Energy Agency (IEA)[21] (electricity), direct and indirect emissions considered except for electricity.

Is quick convergence with the EU ETS feasible for Ukraine?

To assess the financial burden of a domestic carbon price on the Ukrainian economy, an ambitious policy scenario is considered in which Ukraine implements a domestic carbon price comparable to the EU ETS by 2030. A market price of €100/tCO_2 is assumed, applied to the electricity and heat generation sector and with a 50% rebate mechanism (e.g., free allowances) in the other sectors.[iv] This reflects a plausible carbon price equivalent designed to be compatible with EU ETS integration by 2030.

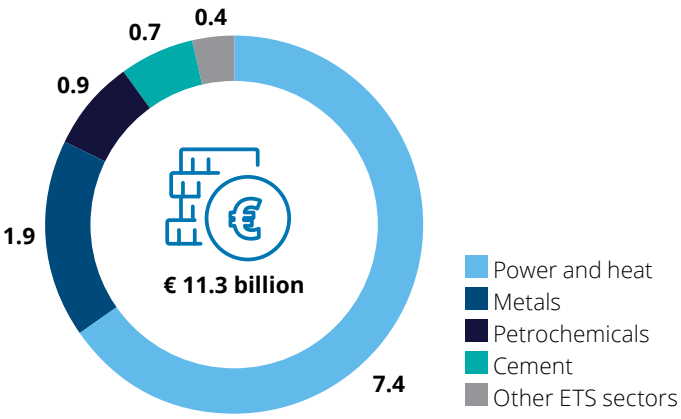
The impact of such a carbon price is computed by assuming full reconstruction of the pre-war Ukrainian economy based on 2021 production levels and emission intensities, as per the CBAM assessment (see Appendix for further details). The results should be treated with caution as an upper estimate, assuming that Ukraine's destroyed capacities are rebuilt exactly as they were before the war, despite the possible introduction of a carbon price providing clear incentives to replace them with low-carbon technologies – notwithstanding technological progress independently from carbon pricing incentives. The end of this section provides an account of these impacts to illustrate the sensitivity of our central estimate. Furthermore, the gross financial burden is computed, that is without factoring in the recycling of carbon price revenues (e.g., through tax cuts, direct investment subsidies, or compensatory mechanisms for vulnerable industries and households).

Based on a reconstruction of the pre-war economy, an upper estimate of the annual gross financial burden of ambitious carbon pricing in Ukraine would reach €11.3 billion (in 2021 prices, see Figure 5):

The electricity sector, which was highly fossil-intensive before the war, would make up about two-thirds of the costs.[vi] This estimate is subject to great uncertainty about the reconstruction choices to be made, especially for an energy system in which a coal phase-out was already underway before the war.

Carbon pricing convergence with the EU ETS by 2030 is likely to be costly for the Ukrainian economy. Based on the structure of the pre-war economy, the gross financial burden would equate to about 7% of Ukrainian pre-war GDP, a shock that is larger than the impact of the COVID-19 pandemic on the EU economy (a 5.6% GDP drop in 2020[22]). This level of climate-related effort is very high compared to that currently expected from EU Member-States: in 2022, EU ETS revenues represented less than 0.25% of EU GDP, and below 0.8% of Polish GDP.[vii]

Fig. 5 – Annual gross financial burden of a domestic carbon price comparable to that of the EU ETS by 2030 and assuming full reconstruction of the pre-war economy, in € billion



Source: Deloitte calculations based on the assumption that Ukraine will recover economic activity similar to its pre-war level (trade and emission intensity levels). Note that the sectors presented here differ from the CBAM, the latter mechanism being set on specific goods (e.g., electricity), while the EU ETS covers wider "sectors" including additional products or services (e.g., district heating).

[iv] The details of the Ukrainian carbon pricing mechanism are not explicitly modelled, notably whether it is a carbon tax or an ETS with a system of free allocations. Rather, the price level is assumed regardless of the pricing mechanism implemented.

[v] Due to data availability limitations, our computation assumes a full reconstruction of the pre-war economy, hence providing a likely upper estimate of the carbon price impact for the UA economy.

[vi] As in the case of the EU ETS, it has been assumed that this sector did not benefit from any rebate (e.g., free allowances).

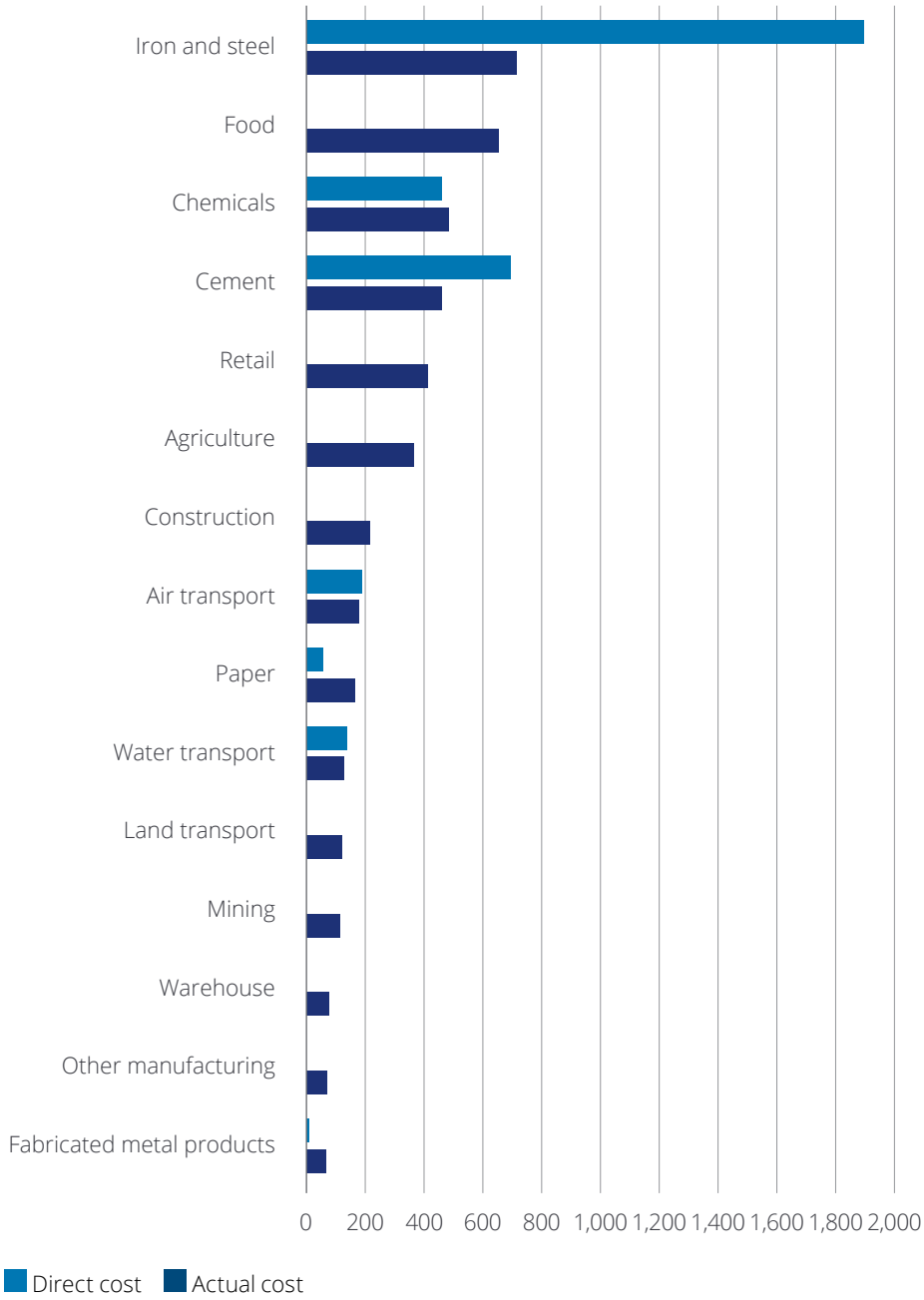
[vii] By 2022, the market price of emissions allowances in the EU was about €80/tCO_2 and free allowances represented about 40% of verified emissions, hence an effective ETS price of about €50/tCO_2. Source: Ember, Carbon price tracker. Other computations based on data from the EEA ETS data hub and Eurostat.

The direct costs of carbon pricing will likely be partially passed on to downstream sectors and consumers, affecting the whole economy.

Firms newly covered by carbon pricing could either absorb this additional burden (i.e., the direct cost) by reducing their margins, or, depending on their market conditions, transfer all or part of it to their customers through price increases. On the other hand, sectors that are not covered by the ETS may still be impacted by price increases from upstream sectors. Factoring in this pass-through mechanism along the value chain, the actual cost of carbon pricing is assessed in each sector based on the pre-war economic structure of Ukraine. The results reflect an estimate of carbon cost exposure, as the approach does not account for changes in consumption patterns resulting from price increases (e.g., demand reduction or substitution).

Figure 6 displays the direct and actual carbon costs incurred by Ukrainian sectors. Several emission-intensive sectors, such as the steel and cement industries, could benefit from pass-through effects and see their financial burden reduced by a third to a half. Conversely, sectors not covered by the carbon pricing mechanism could end up bearing a substantial burden, as costs would be passed through by their suppliers, particularly the electricity sector.[viii] For instance, this is the case for the food industry, the retail industry and agriculture. Final demand – including investment, household consumption and government spending – would bear around 40% of the carbon costs.[ix]

Fig. 6 – Direct and actual costs of a domestic carbon price comparable to that of the EU ETS by 2030 assuming



Source: Deloitte calculations based on the assumption that Ukraine will recover economic activity similar to its pre-war level (trade and emission intensity levels). Note that the pass-on rates are borrowed from the academic literature for each sector, including a full pass-on for the electricity and petroleum products sectors that are consequently not reported here. Also note that this figure adopts a more detailed sectoral decomposition than Figure 5.

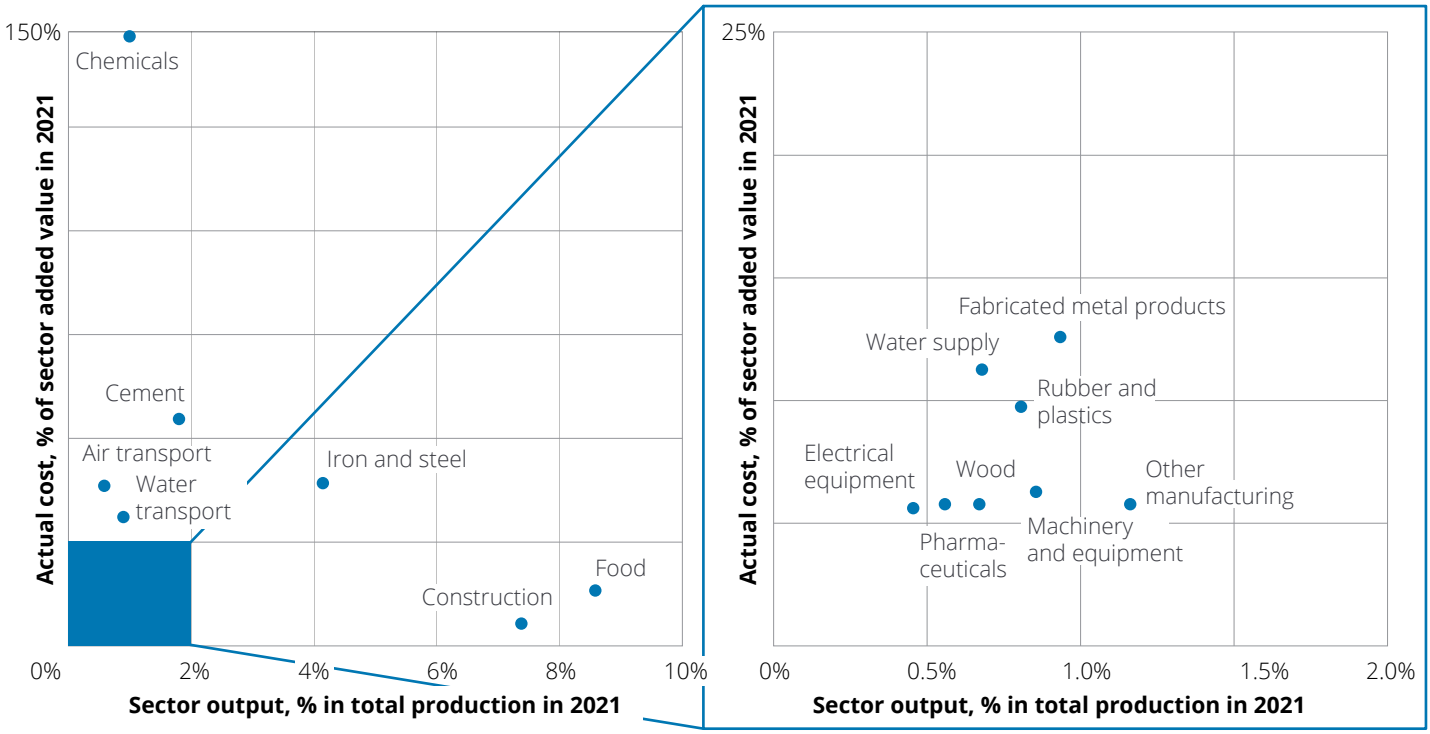
[viii] In line with the literature on European electricity markets, it is assumed that the extra cost of the electricity sector is entirely passed on to downstream consumers (industries and households). For instance, the food sector is not directly covered by the carbon price, but is penalized by the price increases of its suppliers including the power supply.

[ix] Less than 20% of the total cost would be borne by foreign actors through increases in the prices of Ukrainian exports.

Without specific compensation mechanisms, the actual costs of an ambitious carbon price for certain sectors would be particularly acute, with potential downside macroeconomic spillovers due to their weight in the Ukrainian economy (see Figure 7). The extra cost of an ambitious carbon pricing mechanism could reach up to 40% of the added value of the cement, iron and steel, and air transport sectors (and in excess of 100% for chemicals).

The macroeconomic impact could be significant, as some widely affected sectors have a significant weight in the Ukrainian economy and might cease to produce under such high cost increases. This could be the case for the iron and steel industry, which represents more than 4% of the total Ukrainian production value and supported up to 560,000 workers before the war (including the entire supply chain).[x]

Fig. 7 – Carbon pricing exposure of selected sectors under full reconstruction of the pre-war economy



Source: Deloitte calculations based on the assumption that Ukraine will recover economic activity similar to its pre-war level (trade and emission intensity levels). Note: the graph displays the share of the actual cost borne by selected Ukrainian sectors in their added value (vertical axis), against the share of each sector of total Ukrainian production (horizontal axis). Also note that this figure adopts a more detailed sectoral decomposition than Figure 5

[x] The pre-war estimate has been adjusted to account for changes in sector production assessed by United Nations Economic Commission for Europe (UNECE).

Green reconstruction could substantially lower the carbon price impact compared to the pre-war economic structure, thus aligning climate ambition and economic prosperity targets for the future of Ukraine.

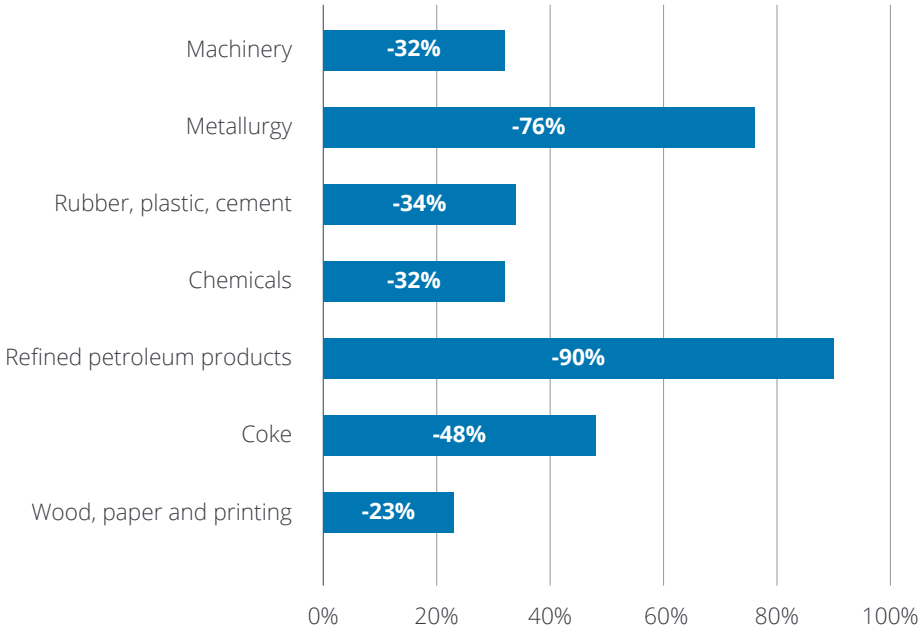
The annual gross financial burden of carbon pricing by 2030 would be about 40% lower (totaling approx. €7 billion) when accounting for the production drop in 2022 due to the ongoing war.[xi] The widespread destruction and territory losses deeply affected the economic structure; for example, metal industry production could have been up top 70% lower compared to 2021 levels (see Figure 8), resulting in a lower carbon burden.

As carbon pricing should guide reconstruction investments toward green technologies, the decarbonization of the Ukrainian economy could reduce the economic impact compared to the pre-war assessment. A case in point is the electricity sector, where generation capacities have been reported to be 60% lower than the pre-war situation in 2022. If half of Ukraine's pre-war electricity supply were to be produced using a generation mix close to that of the EU, the carbon price burden would be about 15% lower (approx. €1.5 billion) – or even more than a third lower if it were entirely produced by renewables (approx. €3 billion).

The fiscal revenues generated by carbon pricing could be recycled to affected sectors, for instance, through industry tax cuts or investment support. However, further analysis should be undertaken on green reconstruction trajectories given the carbon price trajectory, reconstruction needs and capacities to estimate the efficiency of different revenue recycling options.

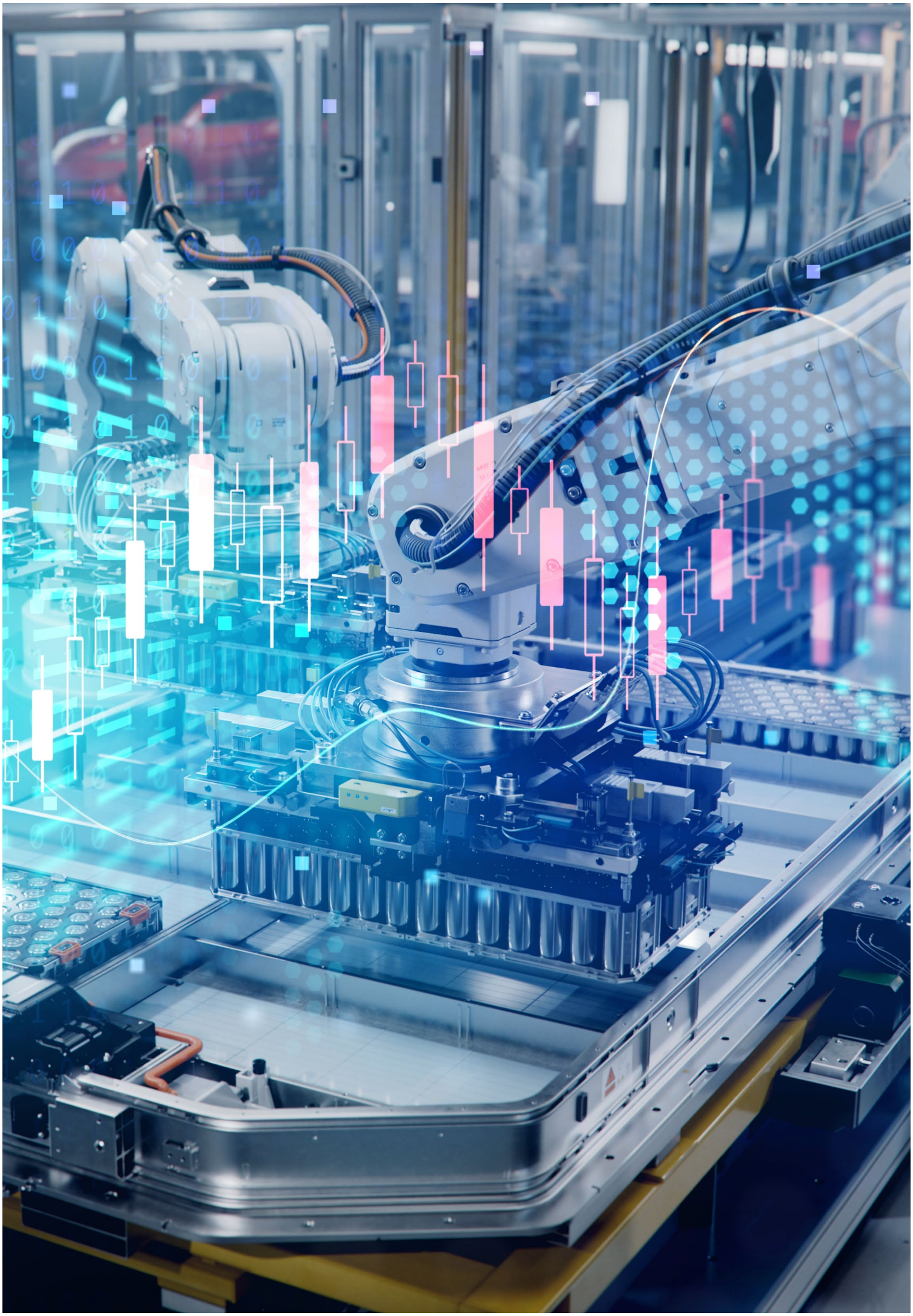
Overall, EU-level carbon pricing in Ukraine by 2030 appears to be highly ambitious from an economic perspective. Given that Ukraine can realistically only phase in carbon pricing materially after 2026, the described policy scenario would imply a very rapid increase in effective carbon prices and the payment burden on Ukrainian industry.

Fig. 8 – Change in production level for selected industrial sectors in 2022 compared to 2021



Source: United Nations Economic Commission for Europe (UNECE).[23]

[xi] The pre-war estimate has been adjusted to account for changes in sector production assessed by United Nations Economic Commission for Europe (UNECE).



Considerations for Ukraine's carbon pricing development

Investors need predictability in carbon pricing and stability in climate policies to plan investments in green reconstruction, and Ukraine should therefore determine and negotiate a substantive carbon pricing trajectory. First, Ukraine needs to determine its economic and strategic interests and what is achievable given the imperative of developing a decarbonized economy. This then needs to be negotiated with the EU to ensure the robustness and compatibility of the approach with EU accession.

Further economic modelling should be undertaken to assess how quickly Ukraine can realistically apply EU ETS carbon prices. In particular, energy system analysis needs to be carried out to get a better view of emission pathways from the energy and industrial sectors, accounting for reconstruction needs and various scenarios of recovery including policy options and the impact of carbon pricing on technological choices.

This analysis could be leveraged to identify a suitable convergence pathway to the EU ETS for Ukraine, for instance by negotiating a special regime of free allocations under the ETS. The standard case of EU accession has thus far been full compliance with the EU ETS rules at the moment of EU accession (e.g., Croatia in 2013). However, given its particular circumstances and the increasingly ambitious carbon price gap with the current EU ETS price level (compared to previous EU candidates), Ukraine will likely have room to negotiate on multiple dimensions, including later ETS integration, different sectoral scope, or compensation through EU funds. Free allocations appear to be the most attractive option for Ukraine. Negotiating a convergence path for a later phase-out of free ETS allocations in Ukraine would allow the country to participate in the EU ETS, applying the full market price at the margin, while reducing the income effect on Ukrainian industry. The interplay of such a special regime and the CBAM will have to be clarified.

Further considerations for implementation:

Carbon price instrument for the period until ETS integration: As highlighted in the literature[24], ensuring a predictable carbon price path for Ukraine would likely be difficult if installing a cap and trade system from the start, especially given the lack of data on current emissions. Hence, using a carbon tax based on the ETS MRV methodology could be considered and implemented as a top-up to the UA ETS price to ensure predictability and ambition.

Capacity building to prepare a sound MRV regime: For the eventual application of an ETS, total emission emissions allowances (i.e. the cap) need to be calculated using past emissions data. Such information does not currently exist. To help generate the data, a sound MRV is required, as is currently being contemplated as part of the roadmap toward implementation of the domestic ETS. The requirements in terms of capacity building should not be neglected and instead actively engaged as part of the recovery efforts.

In the short term, only the evolution of the conflict can determine the need to request a CBAM exemption. Should the CBAM burden prove economically too heavy to bear, Ukraine could request activation of the Article 30.7 "force majeure" clause that would provide provisional measures to address their exceptional circumstances. Despite it being de facto written with Ukraine's situation in mind, activation of this clause would require approval based on the EU Commission's proposal and is likely to be motivated only by an exceptional war-related effect assessed in due time.

Use of fiscal revenues: An explicit strategy on how to use the fiscal revenue from carbon pricing to compensate for the burden on consumers and to assist companies' decarbonization efforts should be an integral part of the carbon strategy from the outset to ensure its economic and political viability. Industry stakeholders from Ukraine have expressed limited trust in purely domestically controlled funds and support mechanisms, calling for increased cooperation with international stakeholders, especially the EU.

Appendix

The future development of economic activity and technological choices in Ukraine remains highly uncertain due to the ongoing war in Ukraine and associated damages. In this context, the carbon pricing impact estimates provided in this report reflect an indicative exposure based on pre-war economic activity levels. In this objective, various approaches have been implemented and averaged to help compensate for limitations in data availability and provide the orders of magnitude communicated in the report.

A. Estimation of the direct economic exposure to CBAM

The impact associated with each CBAM good labelled *g* (see Appendix D for details on sectoral coverage) exported by Ukraine is derived using the following formula:

$$CBAM\ cost_g\ (€) = exports_{EU,g}\ (tons) \times emission\ intensity_g (t\ CO_2/tons) \times cost\ of\ emissions_{CBAM}\ (€/tCO_2).$$

$Exports_{EU,g}$ represent the Ukrainian exports to EU countries of $good_g$, for which data is collected from the Eurostat trade database[16] and IEA[33] (up to 2021) for the specific case of electricity.

The $emission\ intensity_g$ of good *g* is obtained by averaging the two following reference studies, considering direct emissions only:

- A Bank of Finland (BOFIT) policy brief[17] providing emission intensity coefficients for the case of Ukraine. For most goods, these coefficients reflect the average emission level of the worst-performing 10% of EU installations. In this context, the associated estimates should "be regarded as upper-end for the benchmark case".

- A report from the Joint Research Center (JRC)[18, 19] providing emission intensity coefficients at sub-product level (e.g., agglomerated iron ores, iron and non-alloy steel) that should be considered as the benchmark values for CBAM reporting (i.e., default values absent monitored data). For this study, these coefficients have been averaged to provide product-level indicators for cement, fertilizers and iron and steel, according to the share of each sub-product in exports to the EU (obtained from the UN Comtrade database[25]).

- For the specific case of electricity, the emission intensities are provided by the CBAM Transitional Registry and the Covenant of Mayors (based on the IPCC methodology).[26] They are consistent with a back-of-the-envelope computation obtained reporting Ukrainian power generation and associated emissions, as reported by the IEA.[33]

The $cost\ of\ emissions_{CBAM}$ represents the effective price of CO_2 considered in the policy scenario depicted in the report.

War impact: The central estimate is built on the assumption of a full reconstruction of the pre-war economy in Ukraine, factoring in 2021 data (listed in Table 1). To account for the war impact, the estimates have been recomputed based on 2021-2022 data (depending on availability) and averaged.

B. Estimation of the direct economic exposure to domestic carbon pricing

For each sector, *labelled s*, covered by the domestic carbon pricing mechanism replicating the scope of the EU ETS (see Appendix D for details on sectoral coverage), the impact associated is derived using the following formula:

$$UA\ carbon\ cost_s\ (€) = emissions_s\ (tCO_2) \times cost\ of\ emissions_{carbon\ price}\ (€/tCO_2)$$

where $emissions_s$ represents the carbon emissions from sector s and $cost\ of\ emissions_{carbon\ price}$ means the effective price of CO_2 considered in the policy scenario depicted in the report.

Unlike the CBAM, a domestic carbon price mechanism would affect the entire production associated with the covered installations. Two approaches are implemented to derive the related emissions:

- **Production-specific estimation:** When production-specific data is available for sector s, emissions associated with the main emitting products is derived from production quantities, $production_s$, and emission intensities, $emission\ intensity_s$, according to the following formula:

$$Emissions_s\ (tCO_2) = production_s\ (tons) \times emission\ intensity_s\ (tCO_2/tons)$$

Tab. 1 – Data sources used to derive production-specific emissions

Sector	Emission sources	
	Production	Emission intensity
Cement	Cemnet[27]	• BOFIT • JRC
Fertilizers	Center for Strategic and International Studies (CSIS)[28]	• BOFIT • JRC
	United Nations (national inventories)[29]	• BOFIT
Iron and steel	• United Nations (national inventories)[29] • Low carbon Ukraine report[30]	
Electricity	IEA[33]	

Note: BOFIT and JRC emission intensities refer to the Bank of Finland and Joint Research Center coefficients described in Appendix A.

- **Sector-wide estimation:** For each sector except power generation, sector-specific emissions are assessed for 2021 based on national emission inventories and sectoral sales. Total Ukrainian emissions provided by the OECD at a high-level sector aggregate (industry, transport)[31] for 2018 are split according to 45 industries (ISIC rev4 classification), based on Ukrainian sectoral production[20] and Polish emission intensities.[31] The obtained sector-specific emissions are then extrapolated until 2021, based on the evolution of total Ukrainian emissions (excluding LULUCF).

War impact: The central estimate is built on the assumption of a full reconstruction of the pre-war economy in Ukraine, factoring in 2021 data. To account for the war impact, the estimates have been recomputed based on 2021–2022 data (depending on availability) and averaged. In doing so, we assumed that the sectoral emission intensities remained unchanged and applied changes in production levels between 2021 and 2022 based on the literature.[23]

C. Estimation of the actual costs of UA ETS

When facing a new tax (direct cost), firms can either bear the additional cost by reducing their margins or increase their prices to pass on part of the burden to downstream sectors. Therefore, as all sectors are interconnected by consumption flows (input-output linkages), each sector's effective carbon pricing exposure (actual cost) results from (1) the ability of each sector to pass on (or not) some of its new costs to its customers, and (2) the emission costs passed on to the sector from upstream activities.

To compute the actual cost, we used the approach based on input-output methodologies and developed by Deloitte to assess the impact of carbon pricing in France.[32] To quantify the exposure of each sector to carbon pricing, this methodology accounts for the direct cost borne by sectors (see previous sections), the supply-chain structures (input-output linkages) and sector-specific pass-on rates.

More specifically, the following matrix equation yields the vector of actual cost, *UA carbon cost*^{Actual} (sectors staked in rows), obtained from the vector of direct costs, *UA Carbon Cost*^{Direct}:

$$UA\ carbon\ cost^{Actual} = (I - R) \times (I - A'R)^{-1} \times UA\ carbon\ cost^{Direct}$$

where $A' = \begin{bmatrix} t_1 x\, a_{1,1} & \cdots & t_n x\, a_{1,n} \\ \vdots & \ddots & \vdots \\ t_1 x\, a_{n,1} & \cdots & t_n x\, a_{n,n} \end{bmatrix}$, with $a_{i,j}$ the share of sector i in sector j's sales

and $R = \begin{bmatrix} t_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & t_n \end{bmatrix}$, with t_i the pass-on rate of sector i.

UA *carbon cost*^{Direct} is the direct tax emission cost faced by each sector (before pass-on mechanisms).

Sectoral pass-on rate coefficients are collected from the report[32], while inter-country input-output tables are made available by OECD until 2020.[20]

D. Sectoral coverage considered in the analysis

The following sectors are considered for the direct cost estimation:

CBAM: Cement, fertilizers, iron and steel, electricity.

Carbon pricing mechanism: Other non-metallic mineral products (cement), chemical and chemical products (fertilizers), basic metals (iron and steel), electricity, gas, steam and air conditioning supply (electricity), paper products and printing, coke and refined petroleum products, fabricated metal products, water transport, air transport.

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