

EU industrial competitiveness: measures to address power sourcing costs whilst fostering decarbonisation

Executive Summary
May 2026



Context and objectives: IDDRI, Agora Energiewende & Agora Industry aim to inform the EU debate on possible measures to support industrial competitiveness and decarbonisation

Study context

- The 2021-2022 European energy crisis substantially worsened the historical energy cost gap for industrials located in Europe compared to other major trading partners such as the US and China.
- The policy objective to preserve industrial competitiveness led many European countries to implement a range of uncoordinated measures to reduce energy costs for some industrial sectors.
- The European Commission (EC) recently put in place the Clean Industrial State Aid Framework (CISAF), in order to provide guidelines for Member States to support the decarbonisation and competitiveness of industry. The EC also plans to strengthen the Innovation Fund and create an Industrial Decarbonisation Bank.
- Understanding how energy cost differences affect the competitiveness of different industrial sectors in the context of decarbonisation is key to assessing potential gaps in the current policy toolbox and defining a more structured and coordinated framework.

Key questions for the study

1

How do energy prices affect the competitiveness of different industrial sectors and decarbonisation incentives?

2

What are the main reasons for the competitiveness gap between the EU, Chinese and American industries, and what factors contribute the most?

3

What measures are or could be implemented to address issues of energy cost competitiveness in the context of decarbonisation?

Our Mandate: Provide economic evidence regarding energy cost competitiveness and decarbonisation for different industrial sectors and map the current policy toolbox

The study is structured around 3 workstreams addressing the three sets of questions:

- 1 Develop a framework using relevant criteria to assess the degree of exposure of different industrial sectors to competitiveness issues in relation to energy costs.**
- 2 Compare unit production costs for 5 industrial sectors in the US, China and selected EU countries and analyse competitiveness issues related to energy costs as well as other factors affecting competitiveness.**
- 3 Analyse the existing policy toolbox in Europe to address energy cost issues affecting the competitiveness of industrial sectors, identify gaps and possible improvements to the current approach to address competitiveness and decarbonisation issues.**

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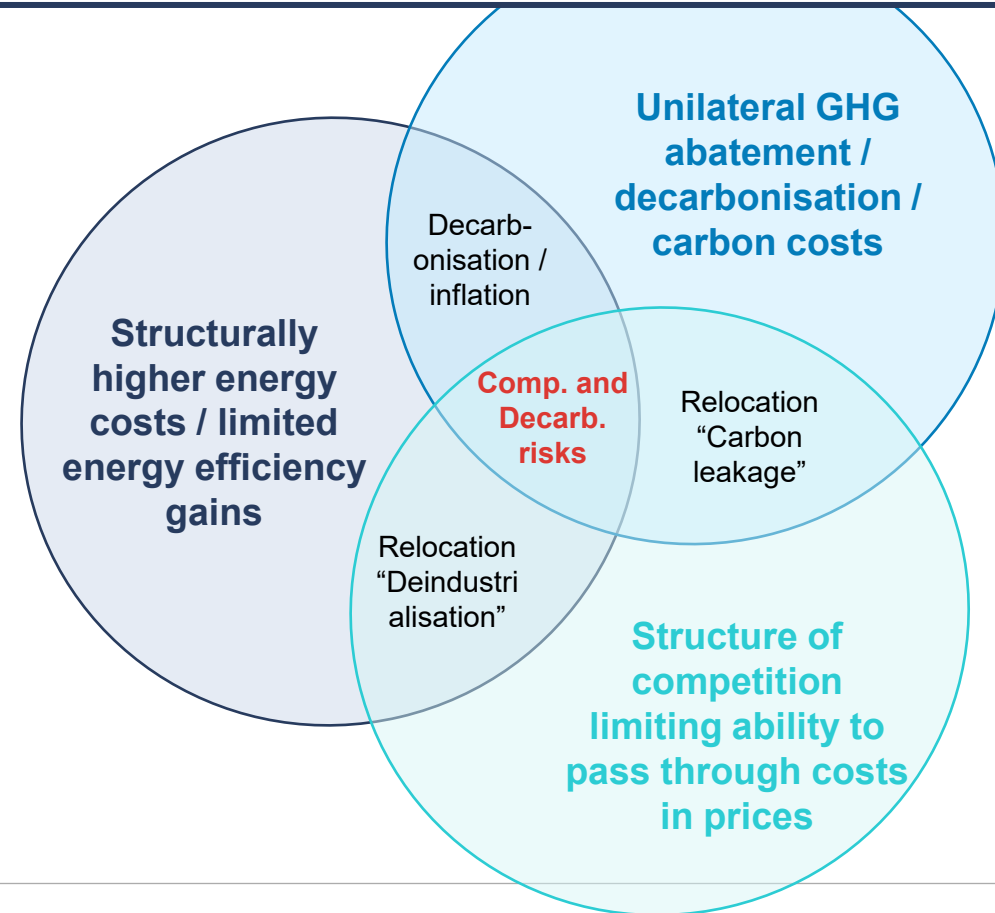
Workstream 1: Development of a framework to assess the degree of exposure of different industrial sectors to energy costs affecting competitiveness and decarbonisation

The assessment of a given industrial sector's energy cost exposure relies on three sets of criteria:

- The share of energy purchase costs in relation to profits or production costs at firm level within the sector, which depends on the energy needs of the firms and prices of energy vectors;
- Whether there is an available technology to decarbonise and the extent of the change in production costs resulting from a decarbonisation investment, or whether the sector remains exposed to carbon prices;
- How the structure of competition and demand in the market allows for price increases for goods produced in the sector.

Indicators to qualify and quantify a sector's exposure to energy competitiveness and decarbonisation issues should capture the different drivers above.

We identify three sets of criteria to assess exposure to energy costs affecting competitiveness and decarbonisation



1

Methodology (1/2): Identification of 8 indicators to quantify the exposure of EU industrial sectors to energy costs (based on available data at EU level)

- We selected the indicators listed below for their relevance with regards to industry vulnerability to energy and electricity costs and decarbonisation issues.
- The ability to pass through variations in costs is key to defining actual exposure of a sector – this is captured partially through the Trade intensity indicator (see next slide).
- Other criteria were discussed, notably geographical concentration, more granular local differences in processes and economics, etc. and could be introduced to refine the analysis.

Indicators analysed and their relevance

| <u>Indicator</u> | <u>Relevance</u> |
|--|---|
| Trade intensity | Measures intensity of international competition in the market and inability to pass through higher energy or carbon costs |
| Current energy intensity | Measures vulnerability of industrial processes energy cost variations |
| Current electricity intensity | Measures vulnerability of current selected processes to electricity cost variations |
| Electricity intensity post decarbonisation | Measures vulnerability of selected processes following decarbonisation / electrification investments to electricity cost variations |
| Flexibility potential post decarbonisation | Indicates ability to respond to short-term power price signals and generate extra revenues when electrified |
| Technological readiness to decarbonise | Indicates timeline for decarbonisation and need for public support |
| Decarbonisation CAPEX cost gap ratio | Indicates how upfront investment can hamper switch to electrified / decarbonised solutions |
| Decarbonisation OPEX cost gap ratio | Indicates how variable energy costs can hamper a switch to electrified / decarbonised solutions |

1

Methodology (2/2): Quantification of the above indicators for 16 industrial applications – example of trade intensity

- A sector's trade intensity measures its exposure to international trade and the associated competitive pressure. Based on the EC carbon leakage framework:
 - A trade intensity of **above 10%** implies that the (sub)sector is exposed to competition in international markets.
 - A trade intensity of **above 25%** indicates that the (sub)sector has very limited ability to pass on costs to final consumers without losing significant market share in favour of its foreign competitors.^[1]

| Sector | Industrial application | NACE 2 | Trade intensity |
|------------------------------|--|------------------|-----------------|
| Chemicals and petrochemicals | Steam cracking for olefines (ethylene) | 20.14 | 49% |
| | Low-temperature chemical steam supply | 20.2 → 20.5 & 21 | 55% |
| | Ammonia production | 20.15 | 32% |
| Iron and steel | Primary steel smelting | 24.1 | 26% |
| | Secondary steel smelting | 24.1 | 26% |
| | Post-production heating | 24.2 | 49% |
| Aluminium | Primary aluminium smelting | 24.42 | 35% |
| | Secondary aluminium smelting | 24.42 | 35% |
| | Alumina digestion | 24.42 | 35% |
| Glass | Container glass melting | 23.11 | 24% |
| | Flat glass melting | 23.13 | 25% |
| Cement | Cement clinker burning | 23.51 | 10% |
| Paper and pulp | Steam generation for paper drying | 17 | 22% |
| Food and beverages | Milk powder production steam supply | 10 & 11 | 17% |
| Data centres | Data storage / AI computation | 63.1 | Not applicable |
| Battery | Cell manufacturing | 27.2 | 61% |

Source: Compass Lexecon analysis based on EU's Carbon Leakage Regulation

Note: [1] Trade intensity is calculated as the sum of imports and exports divided by the sum of turnover and imports for each sub-sector to which the given application belongs. Trade intensity thresholds are taken from the EU ETS carbon leakage mitigation in Phase 2 of the EU ETS that provided more granularity ([here](#)). Current Trade intensity threshold to determine carbon leakage in EU ETS Phase IV is 20%.

1 **Proposed framework based on 5 dimensions combining different indicators to assess sectoral exposure to energy costs affecting competitiveness and decarbonisation**

Electrification cost gap
High upfront or operational costs hinder a fuel switch

Defining criteria

- OPEX gap ratio >1.2
- CAPEX gap ratio >2
- Trade intensity > 25%

Power costs exposure
Dependent on electricity, but limited ability to pass power costs through

Defining criteria

- Already electrified
- (Hyper) electro-intensive today
- Trade intensity > 25%

Flexibility potential
Can leverage flexibility to improve costs and thereby competitiveness

Defining criteria

- Direct electrification available
- Medium to high flexibility potential in core processes

Reliance on H2 or syn-gas
High process temperatures or low tech readiness level require an alternative to direct electrification

Defining criteria

- No direct electrification by 2035
- Hybrid solutions available (syn. gas + electricity) or indirect elec. (H₂)

Industry characteristics
From the quantitative analysis performed on 16 industrial applications, we identify:

- Four key characteristics related to electricity and
- One additional dimension capturing wider constraints to industry competitiveness (assessed in Section 2)

Non-energy issues should also be considered to get the full picture of competitiveness issues

Non-energy issues
Other barriers hindering competitiveness

Defining criteria

- Raw material supply bottlenecks
- Infrastructure bottlenecks
- Global overcapacity
- Other market disruption














2 Workstream 2: Analysis of EU competitiveness gaps and decarbonisation incentives in 5 industrial sectors compared to the US and China

5 industrial applications were selected to analyse the extent of the competitiveness difference between jurisdictions, both for the incumbent and decarbonised industrial processes.

- The relevant EU countries for the industrial case studies were selected based on their relevance for the sector in terms of production size or innovation.

We define and compute the following:

- Competitiveness gap:** difference in total costs of production for various processes between regions;
- Decarbonisation cost gap:** difference in total costs of production between fossil and low-carbon processes, within a given region.

| Application | Relevant region | | |
|-----------------------------------|--|--|---|
| | EU  | US  | China  |
| Primary aluminium production |   | Kentucky | Inner Mongolia |
| Primary steel production |   SE3 | Indiana | Hebei |
| Steam supply for low T° chemicals |   | Texas | Shandong |
| Paper drying |   ITN | Georgia | Shandong |
| Battery cell manufacturing |   | Michigan | Henan |

2 Methodology: The extent of the cost-competitiveness gap and the role of energy costs are assessed using a bottom–up model of total production costs, today and projected in 2035

- We based the calculations of our bottom-up cost models on publicly available sources for each cost component and validated the key assumptions and results through interviews with industry stakeholders. The scope of the different cost components in 2024 and 2035 is explained below:

Cost components differentiated across time

| 2024 |
|--|
| Energy costs <ul style="list-style-type: none"> Gross prices for industrials (procurement costs, network charges, levies and taxes) based on reference sources Network and tax/levy rebates in EU Indirect CO₂ cost compensation in relevant EU MS (emission costs from power generation) |
| Carbon costs <ul style="list-style-type: none"> EU ETS 1 costs (scope 1): 65 EUR/t^[1] Free allowances for relevant industries No emission costs in China and US |

| 2035 |
|---|
| Energy costs <ul style="list-style-type: none"> Gross prices for industrials (procurement costs, network charges, levies and taxes) based on reference sources Network and tax/levy rebates in EU |
| Carbon costs <ul style="list-style-type: none"> Full EU ETS 1 costs (Scope1): 130 EUR/t^{**} Chinese emission costs for industrials (scope1): 20 EUR/t CBAM: Direct (scope 1) / indirect (scope 2) for China and US |
| Flexibility revenues <ul style="list-style-type: none"> For EU countries, flexibility revenues from on-site battery on electrified processes |

+ Flexibility revenues from battery

+ Cost components assumed constant across time

| Constant over time | | |
|---|--|--|
| CAPEX^[3] Asset investment costs, integration costs, per t of final output, non-differentiated across regions, no subsidies | Non-energy OPEX Differentiated across regions (EU, US and China) | Transport costs Costs to ship to the EU per ton of final output |
| Labour costs Differentiated across regions (EU, US and China) | Financing costs Differentiated across regions (EU, US and China) | Raw material costs (Raw material costs per ton of final output, differentiated per region) |

2

Methodology: For the 2035 analysis, CBAM costs are assumed to be added to production costs in the USA and China for both scope 1 and 2; conversely, the current indirect CO₂ cost compensation for EU production costs is phased out

Our assumptions for the modelling of CBAM costs

$$\begin{aligned}
 & \text{Scope 1} \\
 & = ((EU \text{ domestic } CO_2 \text{ price}) \\
 & \quad - (Foreign \text{ } CO_2 \text{ price})) \\
 & \times \text{installation emission factor}
 \end{aligned}
 +
 \begin{aligned}
 & \text{Scope 2} \\
 & = EU \text{ domestic } CO_2 \text{ price} \\
 & \times \text{Foreign average power} \\
 & \quad \text{emission factor} \\
 & \times \text{installation power factor}
 \end{aligned}$$

Direct emission (scope 1): CBAM is mainly driven by carbon cost differences

- To calculate the difference in regional carbon costs by 2035 we rely on the assumption set in line with WEO24 STEPS (EU: 130 €/tCO₂, CN: 20 €/tCO₂ and US: 0 €/tCO₂)
- Installation-specific power factors are based on our bottom-up cost model assumptions

Indirect emissions (scope 2): we assume average foreign power factors

- We rely on the IEA WEO24 STEPS scenario assumption of decreasing emissions in industrialised power systems of around 30% until 2035
- Installation-specific power factors are based on our bottom-up cost model assumptions and represents electricity needs of the imported product

Our assumptions reflect the theoretical impacts of the CBAM Regulation Delegated acts published in December 2025:

- **The use of default values for calculating CBAM duties is disincentivised (mark-ups)**
 - We assume actual embedded emissions are the basis for CBAM duty calculations
- **Embedded scope 2 emissions are determined using average CO₂ emission factor of power generation**
 - We replicate that methodology for CBAM costs on scope 2 emissions
- **An extension of CBAM to downstream products and additional measures will be implemented to avoid circumvention**
 - We assume CBAM applies to all embedded emissions in imported goods

Sources: CL analysis based on EC (2025) Report on the application of the regulation on CBAM ([available here](#))

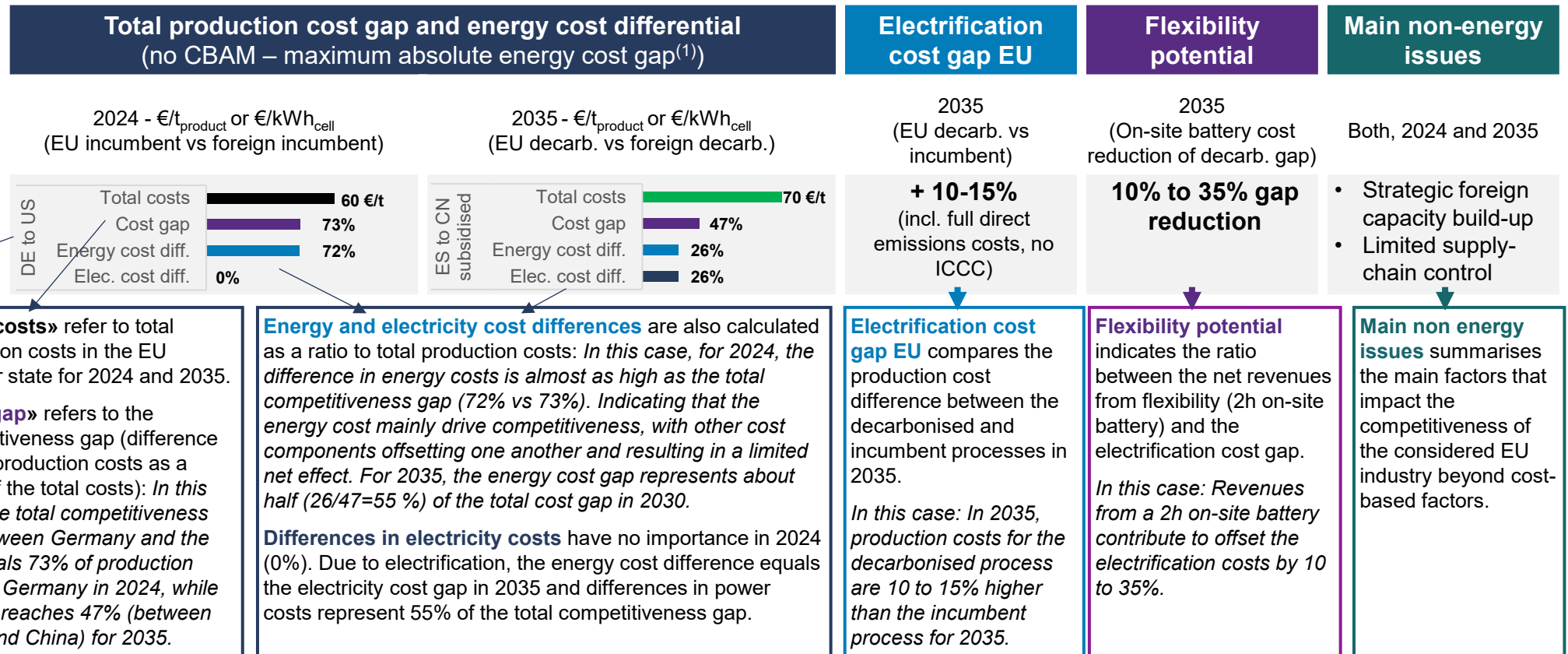
2 Findings (1/3): Industrial sectors are diversely affected by energy costs, and power costs in particular, resulting in competitiveness gaps of varying magnitude

- Differences in energy costs and power costs are only one factor among many others (e.g. labour, raw material and financing costs) that can explain the total competitiveness gap for different industrial sectors. The figures on the following slide provide a summary of the main results of the case studies, regarding both the total competitiveness gap and the relative weight of energy and power cost differences.






NB: These figures are calculated by comparing the case studies with the highest absolute gap in energy costs, to provide an illustration of the “upper bound” regarding the weight of energy costs in the total competitiveness gap. Detailed results, including calculations for other cost factors can be found in the case studies section of the full study.

How to read the results

Steam supply for low T° chemicals



2 Findings (2/3): Industrial sectors are diversely affected by energy costs, and power costs in particular, resulting in competitiveness gaps of varying magnitude

| | Total production cost gap and energy cost differential (no CBAM – maximum absolute energy cost gap ⁽¹⁾) | Electrification cost gap EU | Flexibility potential | Main non-energy issues | |
|---|---|--|---|---|---|
| | 2024 - €/t _{product} or €/kWh _{cell} (EU incumbent vs foreign incumbent) | 2035 - €/t _{product} or €/kWh _{cell} (EU decarb. vs foreign decarb.) | 2035 (EU decarb. vs incumbent) | 2035 (On-site battery cost reduction of decarb. gap) | |
|  Primary aluminium production | <p>GR to CN subsidised</p> <p>Total costs: 2220 €/t</p> <p>Cost gap: 29%</p> <p>Energy cost diff.: 10%</p> <p>Elec. cost diff.: 13%</p> | <p>GR to CN subsidised</p> <p>Total costs: 2415 €/t</p> <p>Cost gap: 39%</p> <p>Energy cost diff.: 13%</p> <p>Elec. cost diff.: 13%</p> | - 5% (incl. full direct emissions costs, no ICC) | 50% to 105% cost improvement (2) (on top of cost advantage) | <ul style="list-style-type: none"> Raw materials Direct emission costs |
|  Primary steel production | <p>SE to US</p> <p>Total costs: 575 €/t</p> <p>Cost gap: 8%</p> <p>Energy cost diff.: 7%</p> <p>Elec. cost diff.: -0.3%</p> | <p>DE to CN subsidised</p> <p>Total costs: 870 €/t</p> <p>Cost gap: 27%</p> <p>Energy cost diff.: 18%</p> <p>Elec. cost diff.: 4% (+ 12% indirect⁽²⁾)</p> | + 10-15% (incl. full direct emissions costs, no ICC) | 2% to 7% gap reduction | <ul style="list-style-type: none"> Raw materials Overcapacity |
|  Steam supply for low T° chemicals | <p>DE to US</p> <p>Total costs: 60 €/t</p> <p>Cost gap: 73%</p> <p>Energy cost diff.: 72%</p> <p>Elec. cost diff.: 0%</p> | <p>ES to CN subsidised</p> <p>Total costs: 70 €/t</p> <p>Cost gap: 47%</p> <p>Energy cost diff.: 30%</p> <p>Elec. cost diff.: 26%</p> | + 10-15% (incl. full direct emissions costs, no ICC) | 10% to 35% gap reduction | <ul style="list-style-type: none"> Strategic foreign capacity build-up Limited supply-chain control |
|  Paper drying | <p>PL to US</p> <p>Total costs: 410 €/t</p> <p>Cost gap: 16%</p> <p>Energy cost diff.: 27%</p> <p>Elec. cost diff.: 0%</p> | <p>IT to CN subsidised</p> <p>Total costs: 330 €/t</p> <p>Cost gap: 44%</p> <p>Energy cost diff.: 19%</p> <p>Elec. cost diff.: 19%</p> | - 20% (incl. full direct emissions costs, no ICC) | 5% to 15% cost improvement (2) (on top of cost advantage) | <ul style="list-style-type: none"> Raw materials Net EU export Shifting demand structure |
|  Battery cell manufacturing | <p>PL to US</p> <p>Total costs: 135 €/kWh</p> <p>Cost gap: 32%</p> <p>Energy cost diff.: 3%</p> <p>Elec. cost diff.: 1%</p> | <p>IT to CN subsidised</p> <p>Total costs: 130 €/kWh</p> <p>Cost gap: 30%</p> <p>Energy cost diff.: 1%</p> <p>Elec. cost diff.: 1%</p> | Similar costs (incl. full direct emissions costs, no ICC) | 1% to 8% gap reduction | <ul style="list-style-type: none"> Foreign tech. leadership Foreign supply-chain control |

2 Findings (3/3): The implementation of CBAM can reduce the cost-competitiveness gap in 2035

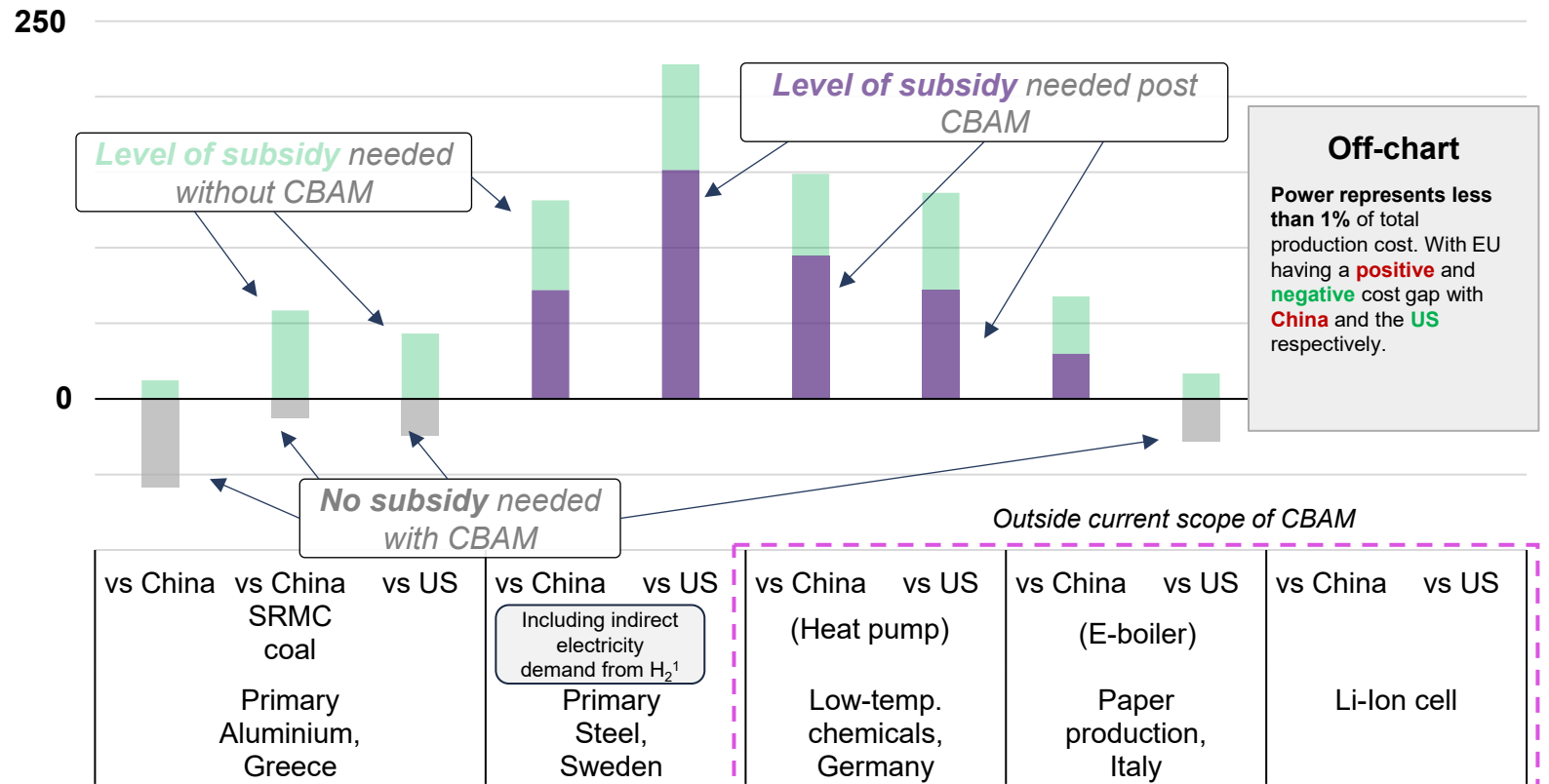
The cost-competitiveness gap in 2035 varies across industries.

Effective implementation of CBAM on scope 1 & 2 (see calculation rules [here](#)) could be a powerful tool to limit the potential need for public support.

- Green bars reflect a scenario where CBAM is not in place and there is no ICCC in the EU.
- Purple bars represent a scenario where CBAM covers scope 1 and 2 for all EU ETS sectors – with this, the most competitive US and Chinese process is usually fossil-based.
- Differences in results steam supply for low-temp. chemicals versus paper production illustrate how similar T° requirements can translate into different support needs due to energy needs of different technologies.

Therefore, a uniform power price support instrument may not reflect the differentiated cost exposure across industrial sectors.

Theoretical power price subsidy needed for decarbonised EU industrial applications to breakeven with US and Chinese most competitive production routes in 2035, €/MWh



Disclaimer: "Most competitive" foreign production route result in the highest boundary for theoretical support levels and can be the fossil-based process in some sectors.

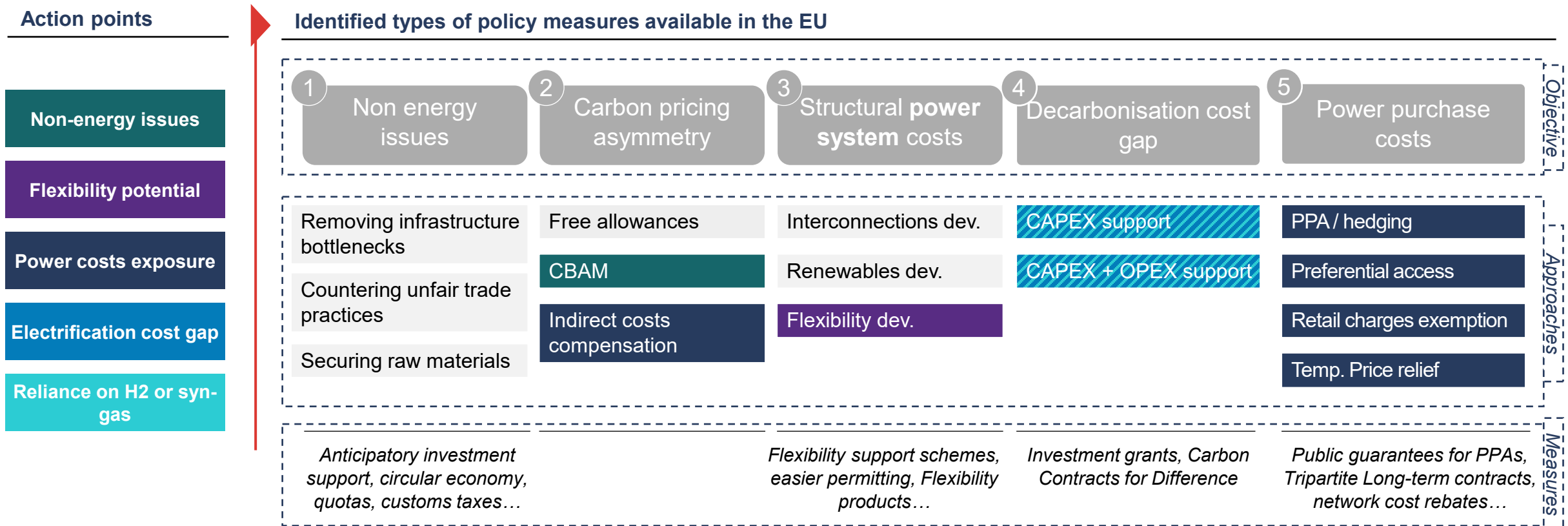
2 Possible solutions: Identification of a set of principles to coordinate support measures based on the assessment of production cost competitiveness and non-energy issues

| | |
|--|--|
| <p>Power cost exposure <i>Dependent on electricity, but limited ability to pass power costs through</i></p> | <ul style="list-style-type: none"> Addressing power sourcing cost exposure is not a silver bullet as levels of subsidies can exceed power purchase costs. Differences in labour costs and financing costs, especially with China, explain large shares of the total production cost differences with the EU. |
| <p>Electrification cost gap <i>High upfront or operational costs hinder a fuel switch</i></p> | <ul style="list-style-type: none"> Direct and indirect electrification solutions can face profitability issues both in terms of CAPEX and OPEX. By 2035, some electrified processes have lower OPEX than fossil-based processes such as steam supply for milk powder, low T° chemicals and paper drying using heat pumps or e-boilers. The decarbonisation cost gap in this case can be addressed with a one-off investment aid only. Other applications have comparably higher OPEX than investment costs and would require de-risking and stabilising power purchase costs. |
| <p>Reliance on H2 or syn-gas <i>High process temperature or low tech-readiness level require an alternative to direct electrification</i></p> | <ul style="list-style-type: none"> Given the likely OPEX gap for industries using indirect electrification, coordination and least-cost development of the H2 value chain are key prerequisites of their competitive decarbonisation. |
| <p>Flexibility potential <i>Can leverage flexibility to improve costs and thereby competitiveness</i></p> | <ul style="list-style-type: none"> Industries with interruptible processes, or where storage can be economically installed on site, can bridge part of the cost-competitiveness gap by monetising their flexibility in power markets. Measures supporting the development of flexible capacities would address both the competitiveness of electricity supply and power system flexibility needs. |
| <p>Non-energy issues <i>Other barriers hindering competitiveness</i></p> | <ul style="list-style-type: none"> Where total production costs are similar (e.g., Chinese aluminium), competitiveness issues arise from structural overcapacity and associated unfair practices more than from energy costs. CBAM protection on direct emissions could be effective for some sectors, on the condition that circumvention is prevented and some of the implementation issues are addressed. |

Coordinating both energy cost competitiveness measures and decarbonisation incentives is required to provide efficient support to industrial sectors / products at risk. In addition, a concept of criticality could be introduced to identify projects / products / sectors where the net benefit of the public support is positive because of their positive spillover effects in the wider value chain, justifying structural / enduring support.

3 Workstream 3: Analysis of the current policy approaches to address issues of competitiveness and decarbonisation and identification of gaps and possible improvements

- Currently, the EU has a patchwork of support measures to address industrial competitiveness issues which can be grouped into 5 categories displayed below.
- We analyse the current policy framework and other potential forms of support to address the different dimensions of the competitiveness and decarbonisation issues identified in WP1. We focus on measures for ETS costs, flexibility valuation, and measures to offset the remaining competitiveness gap.



3 Methodology: Analysis of possible measures from the toolbox in terms of impact on competitiveness, timeframe and potential design issues

- We use the following framework to assess the pros and cons of potential support measures on the achievement of the policy objectives:



Impact on
competitiveness and
/ or decarbonisation

- How does the measure contribute to **competitiveness / decarbonisation** objectives?
- What is the extent of power (or other) cost **reductions achieved** by the measure (if publicly available)?
- Does the measure improve short-term or long-term **predictability** of energy (or other) costs for eligible industrials?
- Does the measure maintain or increase incentives to develop industrial demand **flexibility**?

E.g., measures that fix cost components for industrials, such as carbon costs



Timeframe
of support

- Does the measure provide **immediate relief**, or does it aim at **delayed structural impacts**?
- Is the support provided as: (1) a **one-off** (1 year), (2) **temporary** (< 5 years), or (3) **long-term** (> 5 years)? What explicit or implicit conditions would lead to a withdrawal or phase out of the measure (i.e., “objective reached”)?

E.g., measures that provide a one-off investment grant, or long-term subsidised contracts



Implementation and
design issues, incl.
potential distortions

- What features of the measures can **limit risks / expenses** borne by the State budget?
- What features of the measure **limit energy market distortions** within / across Member States or industrial sectors?

E.g., measures that include dynamic components that evolve with market conditions

3 Findings (1/2): Identified issues and best practice policies to enhance the EU framework to address energy cost competitiveness and decarbonisation issues by type of measures

| | Measures reviewed | Main identified issues | Best design principles |
|---------------------|---|---|---|
| Power cost exposure | PPAs and hedging tools | <ul style="list-style-type: none"> PPA development has been tackled with uncoordinated levels of interventions among MSs | <ul style="list-style-type: none"> Cumulation of PPA and decarbonisation support schemes Shorter RES-E support mechanisms |
| | Preferential access to low carbon electricity | <ul style="list-style-type: none"> Various initiatives among Member States, with complex and diverging designs Timeframes can be too short | <ul style="list-style-type: none"> Use of CfDs to maintain exposure of upstream and downstream beneficiaries to market signals Participation of downstream beneficiaries in low-carbon production capacity development |
| | Levies and taxes exemptions | <ul style="list-style-type: none"> Not in place in all MSs Strength and scope of exemption vary widely between MSs | <ul style="list-style-type: none"> Inability to pass through costs as a condition for eligibility Wide scope of levies and taxes increase exempted amounts Predictability through transfer to State budget |
| | Network cost rebates | <ul style="list-style-type: none"> Not in place in all MSs Widely varying eligibility rules Trend towards eligibility depending on flexibility potential | <ul style="list-style-type: none"> Cost-reflectivity principle Inability to pass through costs as a condition for eligibility Eligibility of both baseload and flexible consumption in line with cost reflectivity |
| | CISAF's temporary price relief | <ul style="list-style-type: none"> No actual implementation yet, unclear detailed application Calibration of relief based on one-size-fits-all | <ul style="list-style-type: none"> Match timeframe for relief with issue targeted |
| | Indirect CO2 costs compensation | <ul style="list-style-type: none"> Not in place in all MSs Large budgetary impact Outdated eligibility thresholds and list of beneficiaries Unclear framework post 2030 | <ul style="list-style-type: none"> Inability to pass through costs as a condition for eligibility |

Abbreviations: PPA...Power Purchase Agreement, MS...Member State (EU), RES-E...Renewable Energy Source (for electricity), CfD...Contract for Difference

3 Findings (2/2): Identified issues and best practice policies to enhance the EU framework to address energy cost competitiveness and decarbonisation issues by type of measures

| | Measures reviewed | Identified issues | Best design principles |
|---------------------------|--|---|--|
| Electrification cost gap | <ul style="list-style-type: none"> MS-level CAPEX grants | <ul style="list-style-type: none"> Renewal / periodicity of schemes unclear Can be insufficient if infrastructure and other constraints prevent implementation | <ul style="list-style-type: none"> Calibrate to offset the CAPEX gap between incumbent and decarbonised processes Competitive bidding to maximise the efficiency of public spending |
| | <ul style="list-style-type: none"> EU-level CAPEX grants | <ul style="list-style-type: none"> Oversubscribed (requests exceed budget) Long timelines / complex tools to navigate | <ul style="list-style-type: none"> Competitive bidding (<i>ibid</i>) |
| Reliance on H2 or syn-gas | <ul style="list-style-type: none"> Important Projects of Common European Interest (IPCEI) | <ul style="list-style-type: none"> Scope too narrow (except battery manuf.): focus is on the (upstream) H2 value chain | <ul style="list-style-type: none"> Competitive bidding (<i>ibid</i>) |
| | <ul style="list-style-type: none"> CAPEX + OPEX support (such as Carbon Contracts for Difference - CCfDs) | <ul style="list-style-type: none"> Requires long-term and large-scale budget commitment from Member State Schemes can be overly complex by design | <ul style="list-style-type: none"> Dynamic components to keep some market exposure and avoid over/under funding Competitive bidding (<i>ibid</i>) |
| Flexibility potential | <ul style="list-style-type: none"> Flexibility market design | <ul style="list-style-type: none"> Industrial flexibility can be under-valued / implicitly valued in some markets | <ul style="list-style-type: none"> Remove hurdles to explicit industrial flexibility participation in different markets Ensure markets and products reflect the full value of flexibility for the power system |
| | <ul style="list-style-type: none"> Flexibility contracting | <ul style="list-style-type: none"> Framework is relatively new (esp. under CISAF) so implementation remains sparse | <ul style="list-style-type: none"> Competitive bidding (<i>ibid</i>) Coordination / optimisation of flexible and firm capacity procurement mechanisms |
| Non-energy issues | <ul style="list-style-type: none"> CBAM | <ul style="list-style-type: none"> Product scope / rules leave room for circumvention Lack of exports provision affects the competitiveness of EU manufacturers in foreign markets Timeline / scope uncertainties impact linked measures | <ul style="list-style-type: none"> Need watertight CBAM rules and a review of the product and emissions scope Introduce (non-) monetary export rebates Clarify all uncertainties |

Abbreviations: CCfD...Carbon Contract for Difference

3 Key findings: Potential approaches to enhance the current EU framework to address energy cost competitiveness and decarbonisation issues

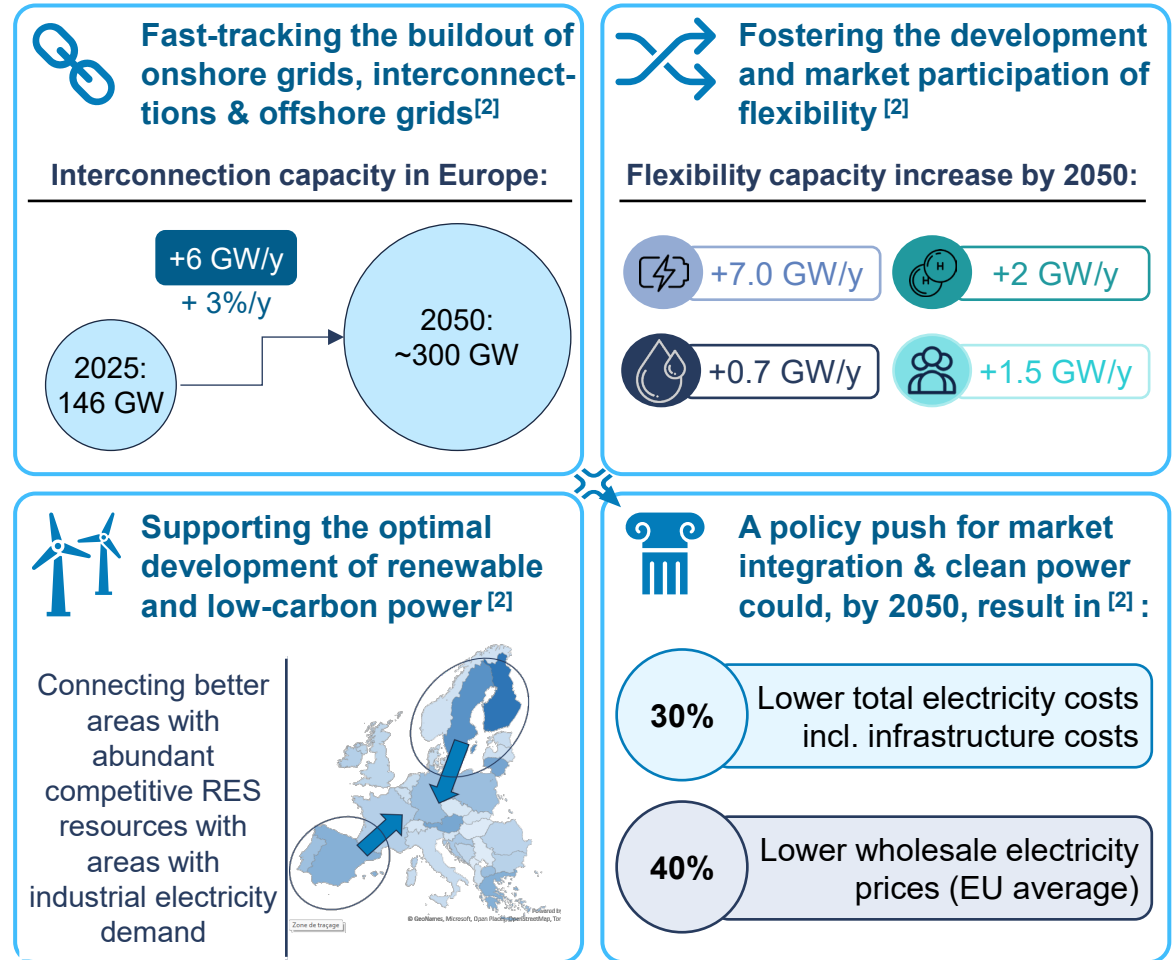
- 1 Structural measures to foster a least-cost electricity system are the foundation on which to build efficient and targeted support
- 2 Eligibility for energy cost compensation should be based on a set of objective and measurable criteria
- 3 Further coordination at the EU level could focus on harmonization of measures based on best practices and addressing overlaps between instruments
- 4 A holistic framework is needed to address energy and non-energy issues affecting competitiveness and decarbonisation and refine the policy toolbox
- 5 The level of energy cost support could be better calibrated for the different sectors using an analysis of the total production cost gap and the relative importance of energy costs
- 6 The choice of measures bears implications for the States' budgets and required EU funds
- 7 The criticality of a sector / site could be used to define a more targeted support framework but would require a definition and identification of such sites at EU level
- 8 Measures addressing issues materialising over different time frames are needed; in particular the visibility on the post-2030 framework remains limited and must be improved

3 (1/8) Structural measures to foster a least-cost electricity system are the foundation on which to build efficient and targeted support

Ensuring a least-cost decarbonisation and operation of the power system is the key prerequisite to minimising the need for targeted electricity cost support (for both direct and indirect electrification).

Potential measures to foster a least-cost electricity system include:

- **Fast-tracking the buildout of the transmission and distribution networks:** this includes the development of “transmission corridors” with accelerated buildout of interconnection and offshore grids through, e.g., reforming regulatory frameworks for TSOs including remuneration for anticipatory investments, enhancing the PCI framework with more coordinated planning, costs sharing, and financing, addressing permitting issues, and defining offshore grid regulatory frameworks.
- **Supporting optimal RES-E development:** supporting the optimal development of RES-E and low-carbon power across Europe through increased EU-level coordination, planning, and support approaches.
- **Ensuring efficient and timely development and market participation of low-carbon flexible capacities:** this entails e.g. implementing the Electricity Directive's provision for demand response participation in markets, reflecting system needs and implicit value of flexibility in market products, and setting up long-term derisking frameworks for all flexible assets



3 (2/8) Eligibility for energy cost compensation should be based on a set of objective and measurable criteria

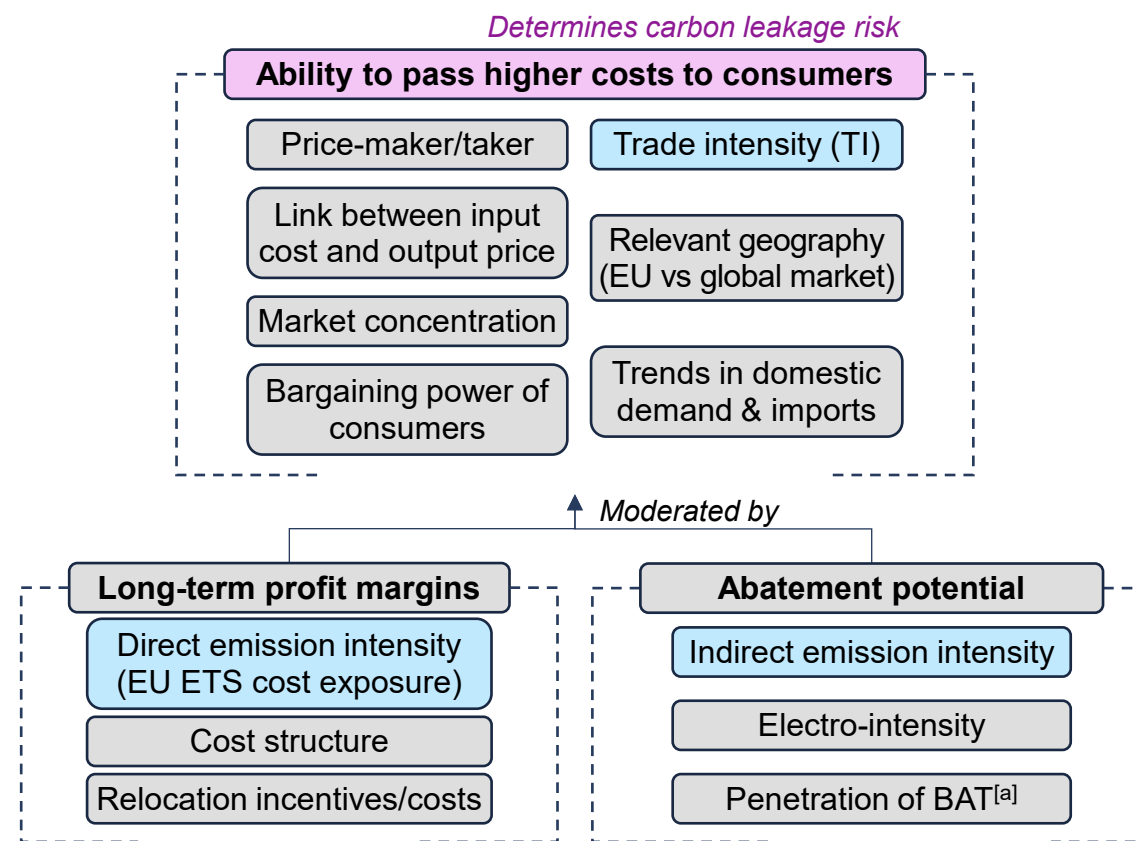
The ability to pass additional / higher costs through to consumers determines broad exposure to energy cost competitiveness issues:

- The economic framework to define eligibility is being used today in carbon cost pass through analyses to identify sectors' exposure to carbon leakage risks
- An extension of this economic framework to define eligibility for energy cost compensation could enhance the targeting of aid / support and integrate the twin goals of competitiveness and decarbonisation

Although the existing carbon leakage framework is a stepping stone, the Trade intensity indicator may not be sufficient to accurately capture industrial sectors' exposure to power costs and competitiveness issues.

- Fast changing market conditions could require regular updates of indicators defining list of eligible sectors / products
- Likewise, a more granular view could better capture product level complexities
- The carbon leakage framework could be expanded to, e.g.:^{[1],[2]}
 - Include more market structure inputs into the ability to pass costs indicator
 - Include other inputs key to profit margins and abatement potential

The ability to pass higher costs through to consumers is already considered in the current carbon leakage risk mitigation framework



3 (3/8) Further coordination at the EU level could focus on harmonization of measures based on best practices and addressing overlaps between instruments

Non-cumulation criteria generally apply to State aid measures.

- Network cost rebates may or may not constitute State aid^[1]
- Likewise, non-selective (i.e., no preferential rate) low taxation on energy goods may not constitute State aid^[1]
- EU funding generally prevents double subsidisation by default
- Lastly, some of the long-term supply contract arrangements may blur the line between market instrument and aid

Uncoordinated cumulation rules could put into question the proportionality or necessity of some State aid tools.

This would depend on the specific case:

- Case A: the rules seem to consider overlaps correctly
- Case B: if electricity supply is mostly based on low-carbon baseload fixed-price contracts, then the relevance of setting indirect carbon cost compensation may be questioned
- Case C: non-cumulation is in line with temporality of tools: CISAF is for temporary issues, CCfD is long-term/structural

➤ Given the fast-evolving nature of the support landscape, a comprehensive review of cumulation rules could help identify overlaps creating issues.

Illustration – potential overlaps on power purchasing costs

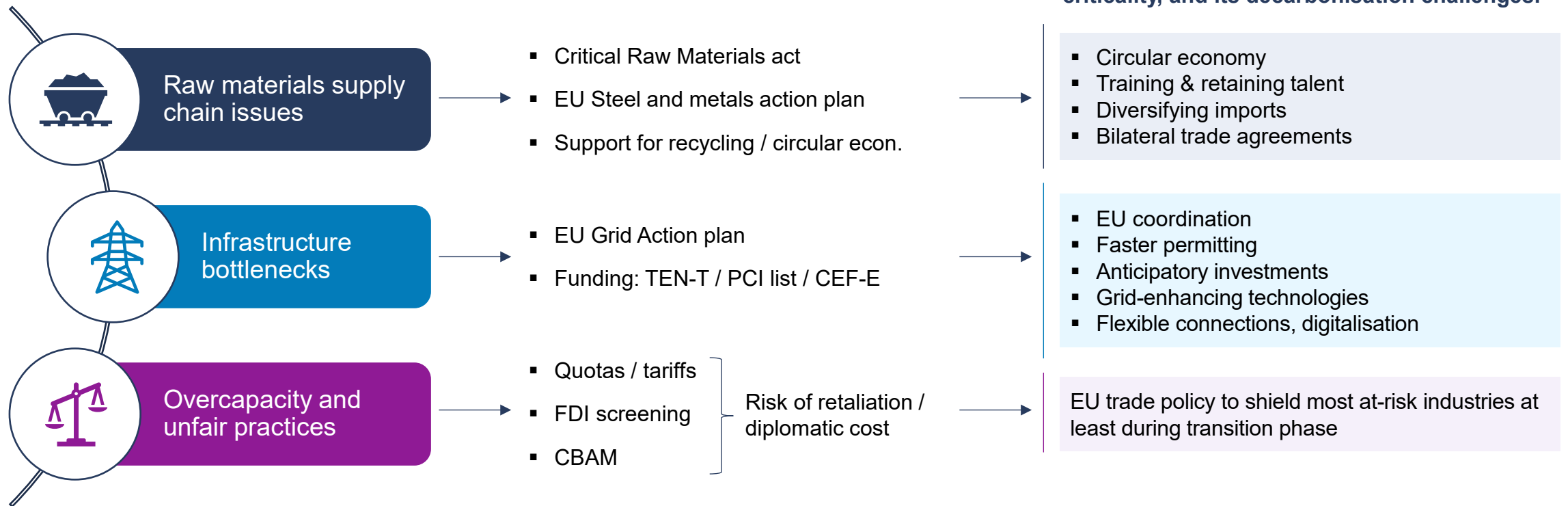
| | |
|--|---|
| <p>Case A: Indirect CO2 cost compensation (ICCC)^[2] + CISAF 4.5 (temporary power price relief)^[3]</p> | <ul style="list-style-type: none"> • CISAF rules: ‘When cumulated with [ICCC], the combined aid amount may not exceed the highest amount applicable under any of the two guidelines’ • CISAF aid intensity is typically lower than ICCC ➤ In practice, CISAF and ICCC are mutually exclusive |
| <p>Case B: Indirect CO2 cost compensation (ICCC)^[2] + Energy Release 2.0 (36-month €65/MWh supply contract, Italy)^[4]</p> | <ul style="list-style-type: none"> • Industrials receive power via Energy Release 2.0 at a fixed price (currently €65/MWh) for 36 months ➤ They remain eligible for ICCC, whose rules state: <ul style="list-style-type: none"> – The emissions factor (i.e., aid intensity) is the same for all power supply sources (grid, contracts, self consumption) – ICCC is cumulable with other State aid, incl. aid on the same costs up to the max. aid intensity • However, the use of ICCC may be disproportionate <ul style="list-style-type: none"> – ICCC aims to compensate for the pass through of the EU ETS into power purchasing costs – This pass through could be limited / minimal in the Energy Release 2.0’s fixed-price contract (depends on the price) |
| <p>Case C: CISAF 4.5 (temporary power price relief)^[3] + Germany CCfD^[5]</p> | <ul style="list-style-type: none"> • CISAF tolerates cumulation up to the highest of the 2 intensities • The German CCfD allows cumulation^[5], but any aid received is deducted from CCfD payments, and audits are performed ➤ Thus, CISAF and the German CCfD are mutually exclusive |

3 (4/8) A holistic framework is needed to address energy and non-energy issues affecting competitiveness and decarbonization and refine the policy toolbox

Other types of measures beyond power price subsidies are needed to address the wide range of issues affecting the competitiveness of the EU industry

The current EU policy framework provides for a range of possible approaches to support specific sectors that could be better coordinated

A holistic and sector-specific analysis is needed to target better the policy measures and level of support provided depending on the specificities of the sector, its competitive situation and criticality, and its decarbonisation challenges.



3 (5/8) The level of energy cost support could be better calibrated for the different sectors using an analysis of the total production cost gap and the relative importance of energy costs

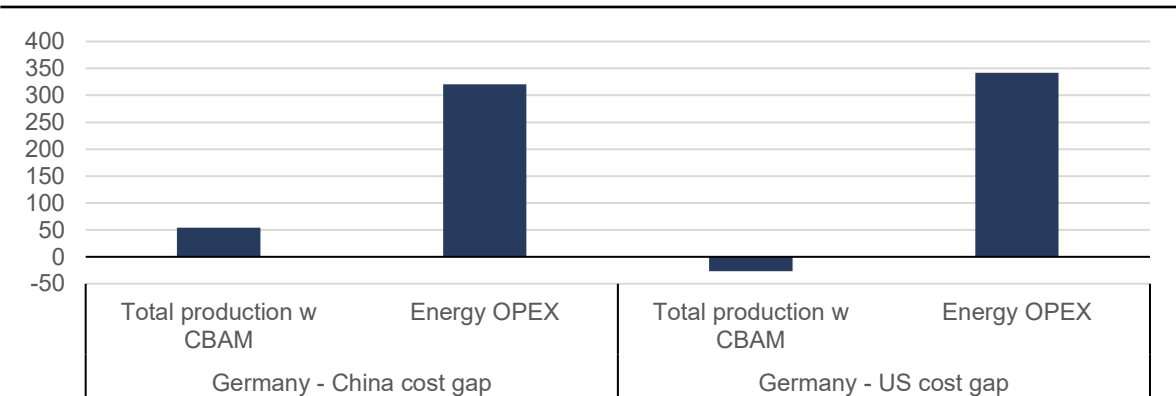
The proportionality of State aid is usually assessed through a funding gap analysis.

- Such funding gap analyses for support for decarbonisation could consider the cost gap with foreign countries and the relative importance of energy costs, in order to:
- Calibrate the proportionate support level; and
- Identify the optimal mix of measures between energy cost support and measures targeted at other issues affecting competitiveness.

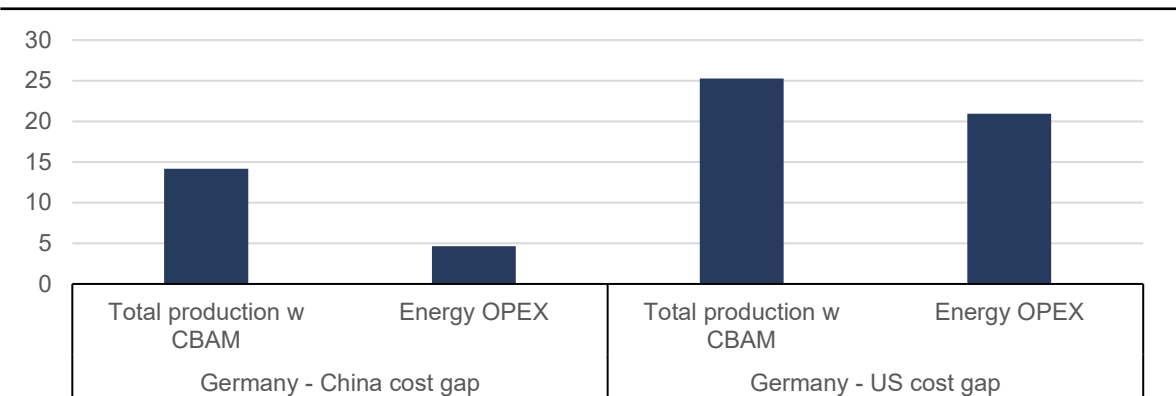
Proportionate energy cost support levels could be differentiated depending on the sectors :

- Case A – e.g. primary steel in 2035:
 - Total cost gap < energy cost gap
 - Here, energy cost support should only offset the difference in production costs, not the difference in energy costs
 - Case B – e.g. Steam supply for low T° chemicals in 2035:
 - Total cost gap > energy cost gap
 - Here, energy cost support should only offset the difference in energy costs, and other support is mandated
- **Energy cost competitiveness support measures may not be a silver bullet to offset the overall competitiveness gap.**

Primary steel total production and energy opex cost gaps in 2035, €₂₀₂₄/t_{steel}



Steam supply for low-temperature chemicals total production and energy opex cost gaps in 2035, €₂₀₂₄/t_{steam}



Source: CL analysis based on bottom-up costs models, various sources (see Annex)

Notes: Germany uses the decarbonized processes (H₂-DRI-EAF for primary steel and a heat pump for steam generation) while US and China use the incumbent process (BF-BOF (retrofit) for primary steel and a NG boiler for steam generation). In 2035, we assume that CBAM applies to actual embedded emissions in scope 1 for foreign products, and Indirect CO₂ cost compensation has been phased out.

Abbreviations: CBAM... carbon Border Adjustment Mechanism, OPEX... Operational expenditures

3 (6/8) The choice of measures bears implications for the States' budgets and required EU funds

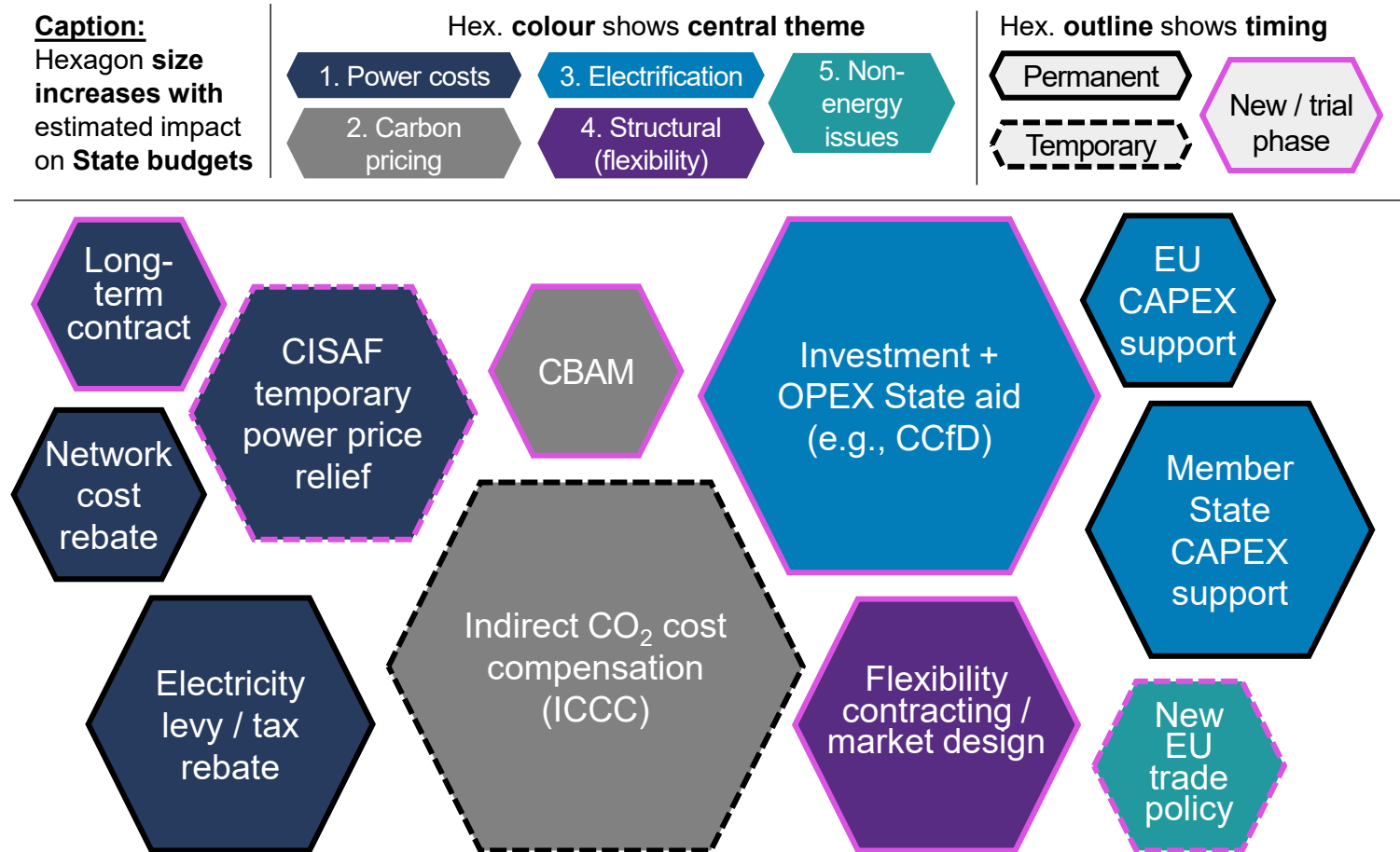
Different measures affect States' budgets differently, from large out-of-pocket support like CCfDs to EU-only funding (e.g., IF calls).

This could potentially create disparities in the types and levels of support across MS:

- Larger or wealthier MS can and tend to^[1] spend more on State aid, and thus may opt to deploy:
 - Direct electricity subsidies, like ICCC or CISAF temporary price relief
 - Comprehensive long-term fuel switch aid, such as CCfDs
- Other MS may not be able to support industrial competitiveness at the same rates, and may opt for:
 - De-risking measures
 - Measures with clawbacks
 - Public-private financing
 - Relying on EU grants / funds

➤ This reinforces the need to monitor and control state aid measures across Europe to avoid distortions.

Clusters of key support measures in place for EU industries (illustrative, non-exhaustive)



3 (7/8) The criticality of a sector / site could be used to define a more targeted support framework but would require a definition and identification of such sites at EU level

The concept of “criticality” of an industrial sector is not precisely defined but could provide a tool to target support to sites that condition the economic viability of sectors.

The criticality of a sector / site could be assessed across multiple dimensions, including:

- Relevance for strategic autonomy and the risk of losing the last remaining production capacity
- Importance as a precursor / input for strategic sectors, both current (defence, health, energy) and emerging (AI)
- Economic and industrial contribution at the EU, national, and local levels
- Vulnerabilities of processes, regions, or value chains in which the product / application plays a key role
- Etc ...

The definition of ‘criticality’ should reflect the specific characteristics and challenges of the industry and its broader relevance for the EU economy and sovereignty, enabling the effective identification of sites that may require targeted policy interventions and support measures.

Overview of current definitions of criticality used at EU or national level

| | | |
|----|----------------------------|--|
| EU | Critical Raw Materials Act | “Critical raw materials are of <u>high economic importance</u> for Europe while being also highly vulnerable to <u>supply disruptions</u> ” |
| EU | Critical Medicine Act | “A critical medicine is identified by combining two criteria: the <u>seriousness of the disease it targets</u> and the <u>availability of suitable alternative medicines</u> ” |
| UK | Criticality Assessment | “raw materials that are crucial for the economic <u>prosperity, national security</u> and ongoing <u>technological development</u> of the UK, but have a significant risk of <u>supply disruption</u> ” |
| NL | Vital Assessment | “The assessment of whether a process or service is vital is made by the responsible ministry. This involves analysing whether <u>disruption, failure, or manipulation</u> of a process or service could have such serious consequences that they could harm <u>national security</u> ” |

3 (8/8) Measures addressing issues materialising over different time frames are needed; in particular the visibility on the post-2030 framework remains limited and must be improved

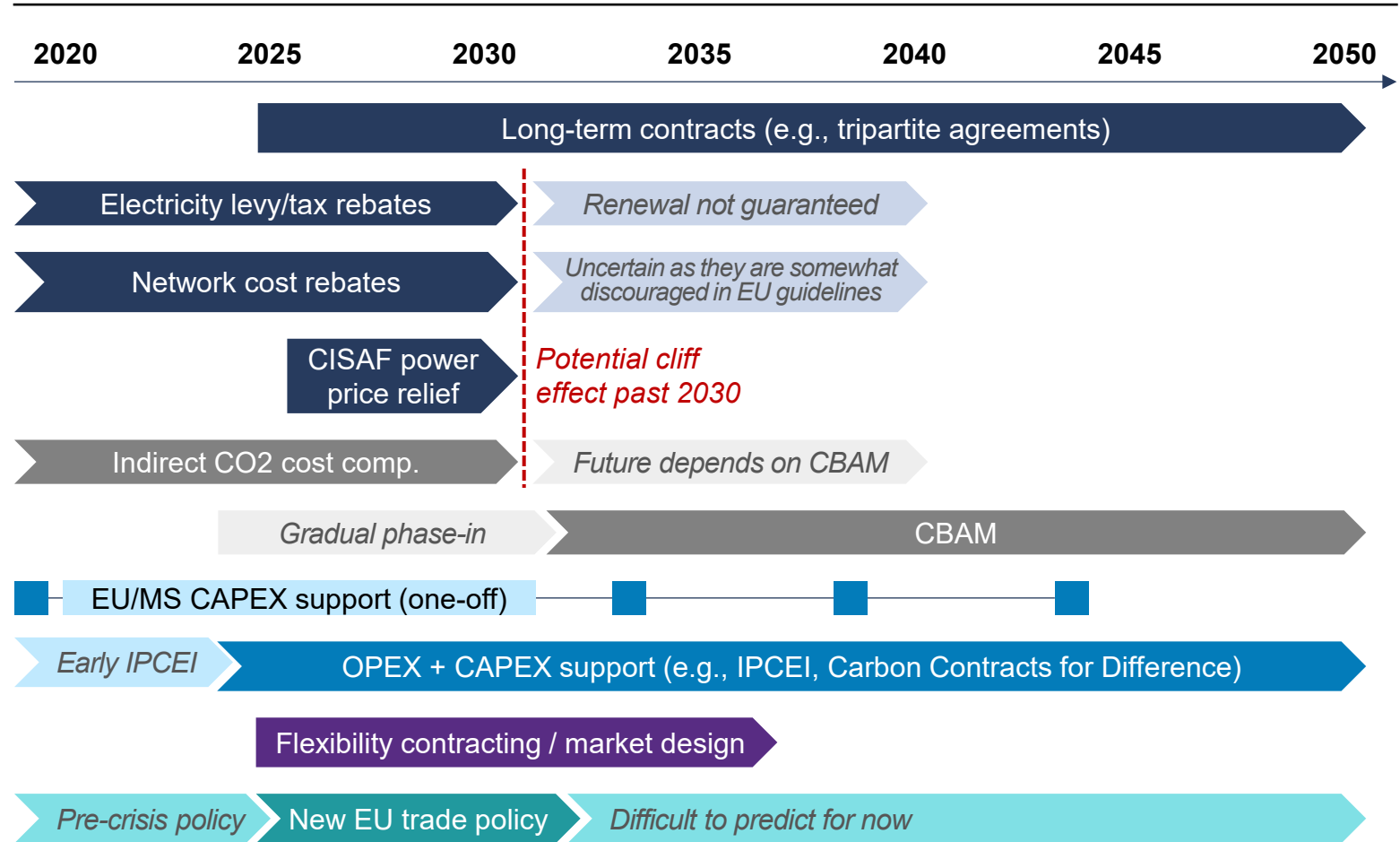
EU interventions span across different time frames corresponding to the issue they seek to address:

- One-off investment support using tenders should be favoured when feasible
- Temporary or short-term measures (≤ 5 years, e.g., CISAF temp. price relief) should be deployed to tackle transitory issues or market shocks / idiosyncratic situations^[1]
- Enduring / long-term instruments (> 5 years, CCfDs, network cost rebates, etc) should be used to resolve structural challenges^[2]

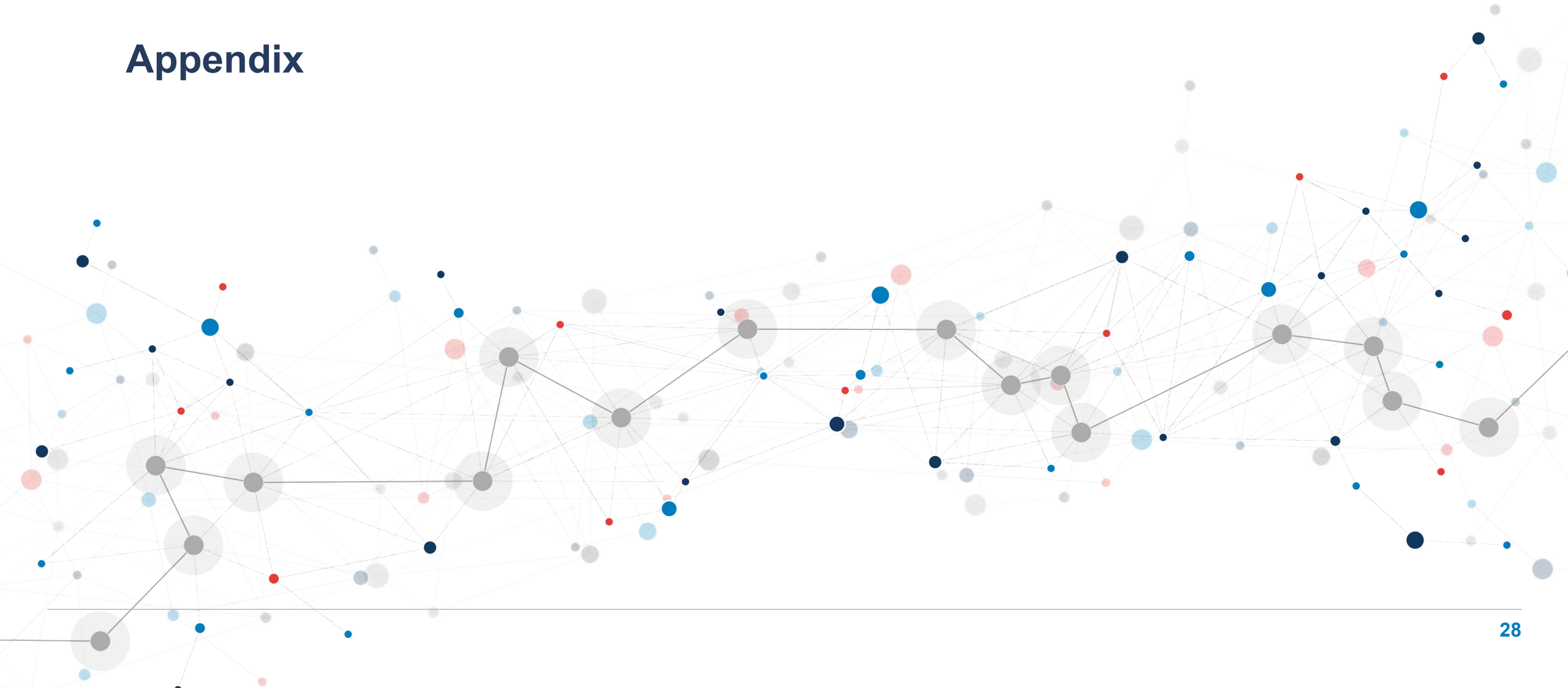
However, the current EU policy toolbox lacks predictability in the long term (e.g., on duration of support), esp. post 2030:

- Some schemes like ICCC or RES levy reductions are due to expire by around 2030; renewal is likely yet needs confirmation
- Similarly, clarity on CBAM should be provided in 2026 with the CBAM and ETS review to prepare the next phase of decarbonisation

Overview of the temporality of the measures of the toolbox and the challenges they address^[3]



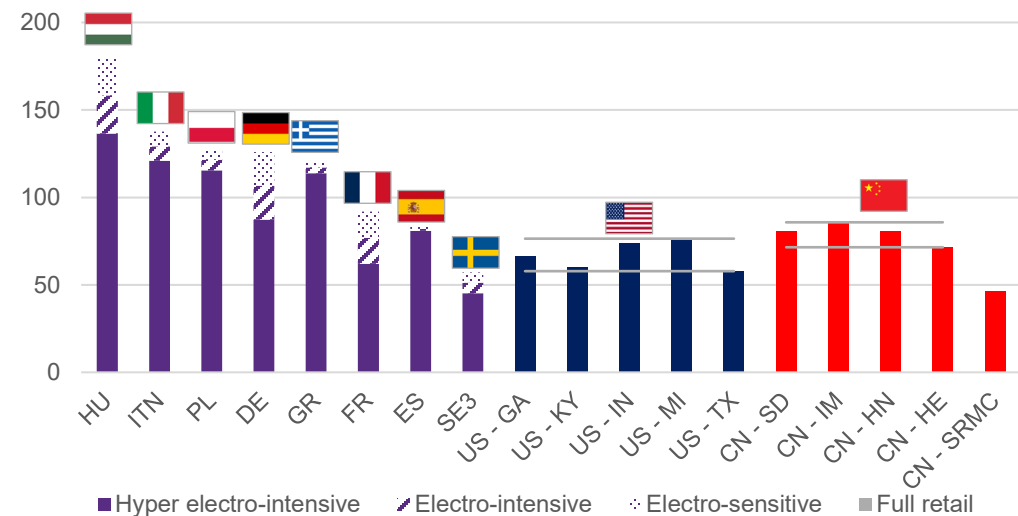
Appendix



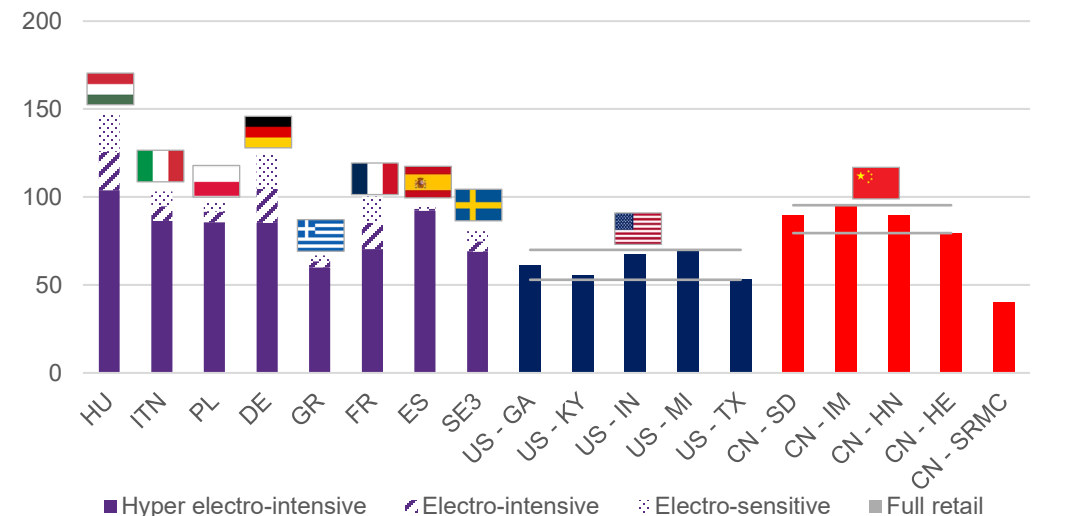
Power – Retail prices vary according to the electro intensity of the processes and are based on reference sources

- Retail price assumptions:** industrial retail prices are differentiated between hyper electro-intensive, electro-intensive and electro-sensitive. Final retail rates include procurement costs, network costs as well as taxes levies and fees in Europe. For the US and China, we show relevant industrial retail rates which are equivalent to electro-sensitive rates in Europe.
 - For 2024, we rely on publicly available statistics.
 - For 2025 price assumptions for the EU rely on CL scenario modelling for IDDRI-Agora with main inputs from TYNDP24 and WEO24, US prices are based on the projections of industrial retail prices made by the EIA 2025 Energy Annual outlook and Chinese projections are based on AFRY projections.
- Additional sensitivity China:** Historically, the Chinese government has subsidised coal-fired power generation, and some industrial facilities operate on-site coal plants. To reflect this, a Chinese “coal SRMC” sensitivity is included, assuming industrial users receive electricity at short-run marginal cost.

Industrial electricity retail price assumptions, 2024, €₂₀₂₄/MWh



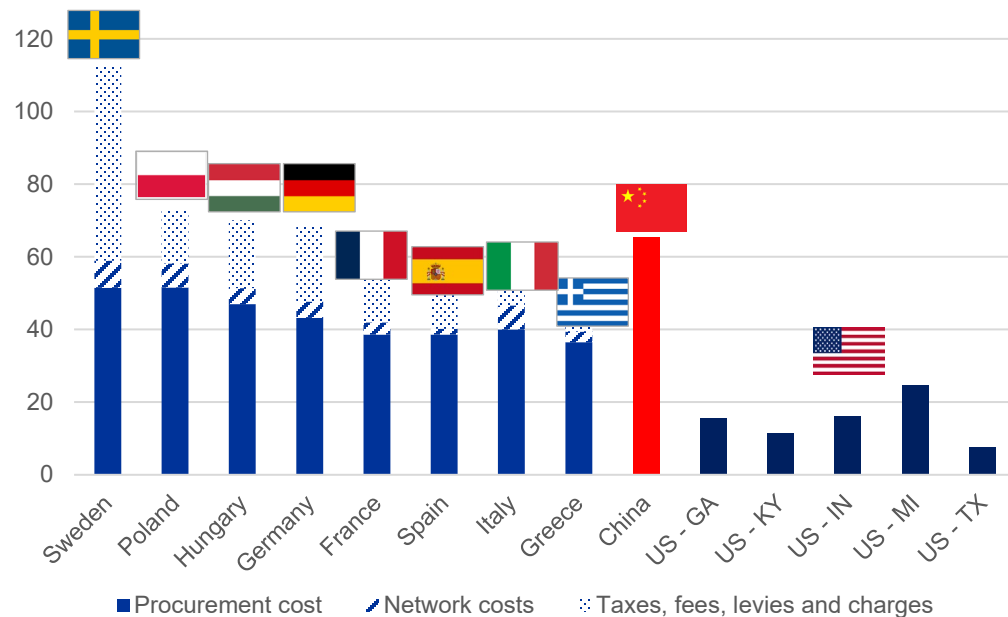
Industrial electricity retail price assumptions, 2025, €₂₀₂₄/MWh



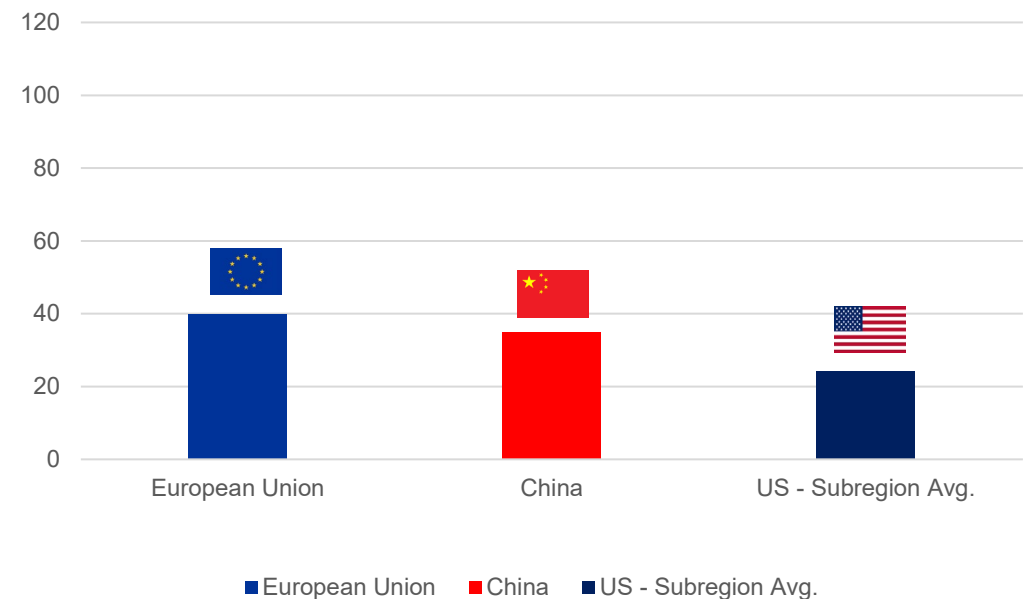
Natural gas – Current and projected prices for natural gas are taken from reference sources

- For 2024, we use Eurostat data, “gas price component for non-household users with a consumption between 100 000GJ and 999 999GJ per year”, the highest consumption band with data available for all countries in scope. US prices correspond to the 2024 average US Industrial price converted in EUR/MWh and Chinese prices are taken from IEA Q1 2023 Industry end-user prices for natural gas, which we have inflated using China 2024 Inflation consumer price of the World Bank.
- Industrial retail price calculations for 2035 are based on wholesale price projections from the World Energy Outlook 2024 for the EU and China. Industrial retail prices projections in the US are based on the EIA's 2025 Energy Annual Outlook.

Natural gas retail price assumptions, 2024, EUR/MWh



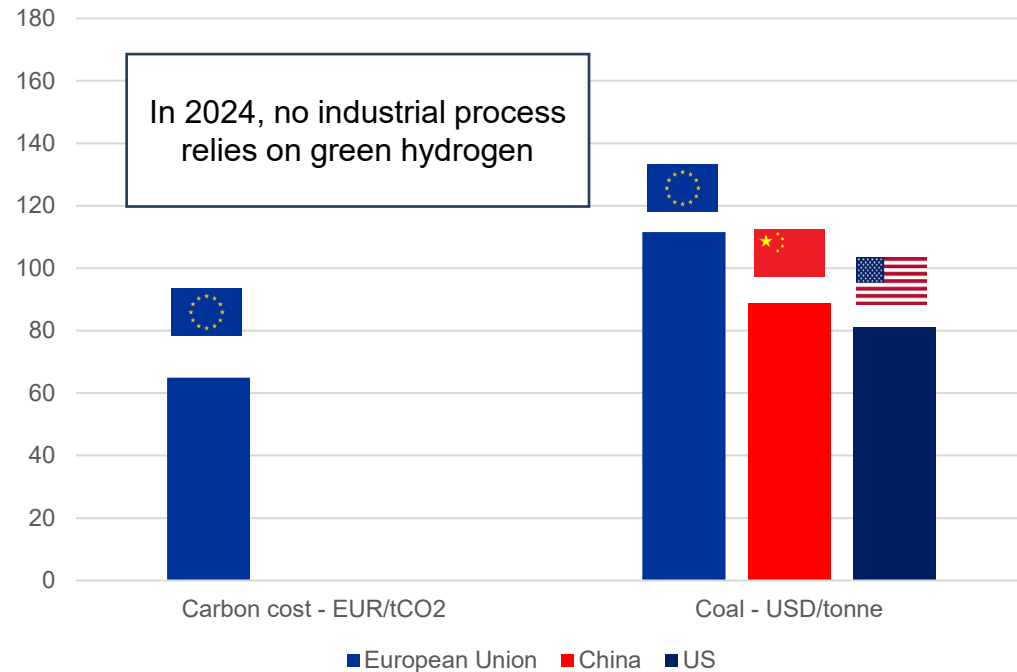
Natural gas retail price assumptions, 2035, EUR/MWh



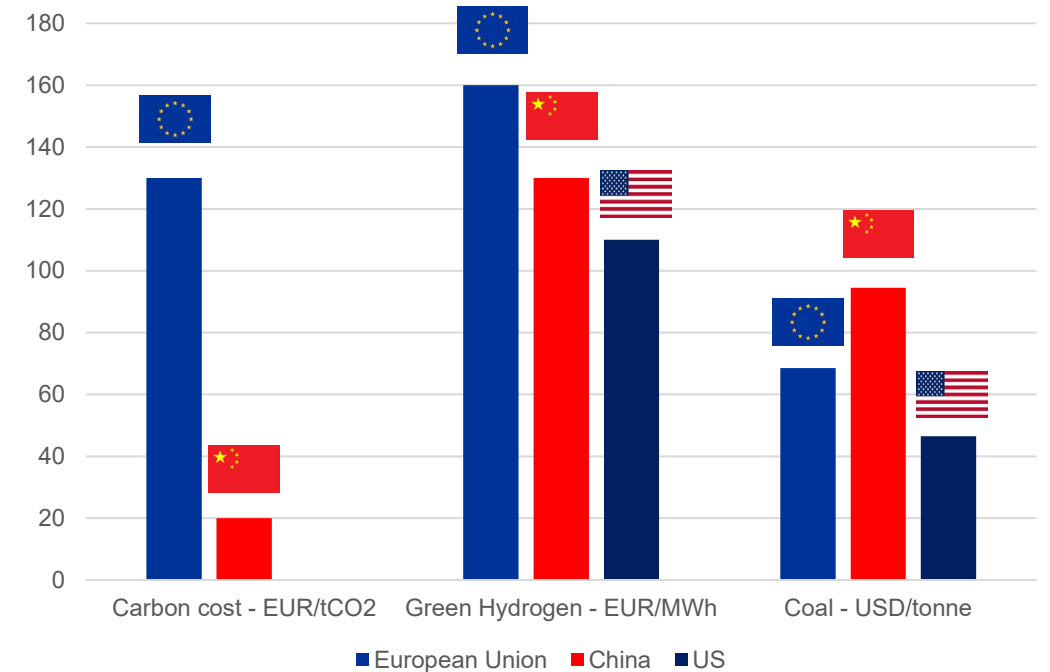
Other commodities – Current and projected prices for green hydrogen, CO2 prices, and coal are taken from reference sources

- **Coal:** For 2024 we rely on the average EU ETS allowance price and for coal we use Europe coal ARA CIF (Amsterdam-Rotterdam-Antwerpen), China Qinhuangdao yearly average spot prices, including cost and freight (CFR), and US Central Appalachian coal spot price index (FOB).
- **CO₂:** For 2024, EU ETS allowance price at 65 EUR/t (average yearly market price). For 2035, EUA price at 130 EUR/t (WEO24 STEPS); China's carbon pricing is applied to industrials at 20 EUR/t (WEO24). No carbon pricing in the US.
- **H₂:** prices taken from IEA 2024 Global Hydrogen Review.

Carbon cost and coal retail price assumptions, 2024, EUR/tCO2 and USD/tonne



Carbon cost, green H2 and coal retail price assumptions, 2035, EUR/tCO2, EUR/MWh and USD/tonne











ICCC – ICCC in 2024 for EU electricity costs is computed using emission factors published by the EC for the Default methodology

Based on the Indirect CO2 cost compensation State Aid Guidelines, we approximate the compensation using the following formula:

$$\begin{aligned} & \text{Power price reduction} \\ &= \text{aid intensity} \times \text{CO}_2 \text{ price} \\ & \quad \times \text{emission factor} \end{aligned}$$

The emission factors are based on:

- The default approach has been defined since the 2012 guidelines. With this approach, the emission factor is calculated centrally by the European Commission, based on public data, and reflects fossil fuel generation.
- The market-based approach, introduced in 2020, leaves the choice of the methodology to the Member States, it should be “based on a study of the CO2 content of the actual margin setting technology”.
- For 2024, we rely on the default approach and use emission factors as published by the commission (2021/C 528/01).
- For 2035, we perform a sensitivity considering the emission factor would decrease in line with past trends.

| | | Emission factor 2024 (tCO ₂ eq/MWh) As published |
|-------------|---|--|
| Methodology | | Default approach |
| France |  | 0.44 |
| Germany |  | 0.72 ¹ |
| Poland |  | 0.81 |
| Spain |  | 0.53 ² |
| Greece |  | 0.73 |
| Italy |  | 0.7 |
| Sweden |  | (No scheme) |
| Hungary |  | (No scheme) |

Free allowances – Free allowances for 2024 are calculated based on benchmarks published by the EC

Based on EU delegated regulation we estimate the free allocation of emission allowances. For simplicity, we do not account for the historic production level of the installation, and assume that each unit of product receives the benchmark free allowances:

$$\text{Free allocation} = \text{Product benchmark} \times \text{yearly reduction factor} \times \text{CO}_2 \text{ price}$$

- The product benchmark is based on publications EU Delegated Regulation 2019/331 between 2021 and 2030.
- The yearly reduction factor is based on the same publication and assumes the highest yearly reduction factor.
- Finally, we estimate the value of free allocations based on the average 2024 EUA price.
- In practice, the installation specific allocation of free allowances is also impacted by the historic production volumes. Decreasing production in one year would result in a reduction of allocation in the following years. We disregard this mechanic and assume that each unit of product receives the benchmark free allowances.

| | | Benchmarks 2024 (tCO ₂ _{eq} /t _{production}) As published | | |
|---------------------|----------------------------|--|------------------|-------------|
| Application | Process | Product benchmark | Reduction factor | 2024 |
| Primary aluminium | Smelter | 1.514 | 0.95 | 1.44 |
| Primary aluminium | Anodes | 0.324 | 0.95 | 0.31 |
| Primary aluminium | Total | | | 1.75 |
| Paper | Coated/uncoated fine paper | 0.318 | 0.95 | 0.30 |
| Primary steel - BOF | | 1.328 | 0.95 | 1.27 |
| Steam for low-temp. | Fuel benchmark | 56.1 | 0.95 | 0.14 |

Source: COMMISSION DELEGATED REGULATION (EU) 2019/331