

A photograph of several wind turbines in a green field under a blue sky with scattered clouds. The sun is low on the horizon, creating a warm glow. The turbines are dark against the sky, and their blades are slightly blurred, suggesting they are in motion.

Analysis of an EU-wide Carbon Price Support

Impact on CO₂ emissions, cost efficiency and rents

Dr. Harald Hecking, Dr. Jürgen Kruse, Frank Obermüller
ewi Energy Research & Scenarios gGmbH | Cologne, January 2017

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Summary

Main results: Effects of a Carbon Price Support on the EU electricity market between 2017 and 2025

- 1. An EU-wide Carbon Price Support (CPS) will avoid up to 943 million tons CO₂ in the EU or rather 105 million tons per annum at average. Germany's CO₂ reduction will sum up to 249 million tons.
- 2. In 2017, electricity generation from coal and lignite will decrease at the rate of 28% in the EU and 20% in Germany and will be replaced mainly by natural gas. European gas demand will therefore increase by approx. 25 bcm, or 5.5%., per annum.
- 3. A CPS causes approx. 23 billion euros of additional costs for the EU, which is, set in relation to electricity demand, equivalent to an additional 0.08 ct/kWh_{el}. Additional costs in Germany will amount to 1.5 billion euros or 0.03 ct/kWh_{el}. Italy bears the highest costs and will have to pay 4 billion euros additionally while France profits with 2.3 billion euros.
- 4. A CPS is cost-efficient: no other instrument avoids the same amount of additional CO₂ at a lower costs. The average price for CO₂ abatement is approx. 24 EUR/tCO₂.
- 5. A CPS increases the German wholesale electricity price by 8-11 EUR/MWh.
- 6. European electricity suppliers (in particular operators of renewable energy and nuclear power plants) generate additional revenues of approx. 61 billion euros. Operators of lignite and hard-coal power plants face losses of approx. 24 billion euros. European electricity consumers face extra costs of approx. 170 billion euros.
- 7. Additional revenues of roughly 87 billion euros generated by certificates as well as additional revenues generated by power plant operators could be utilized to compensate partially for the added financial burden.



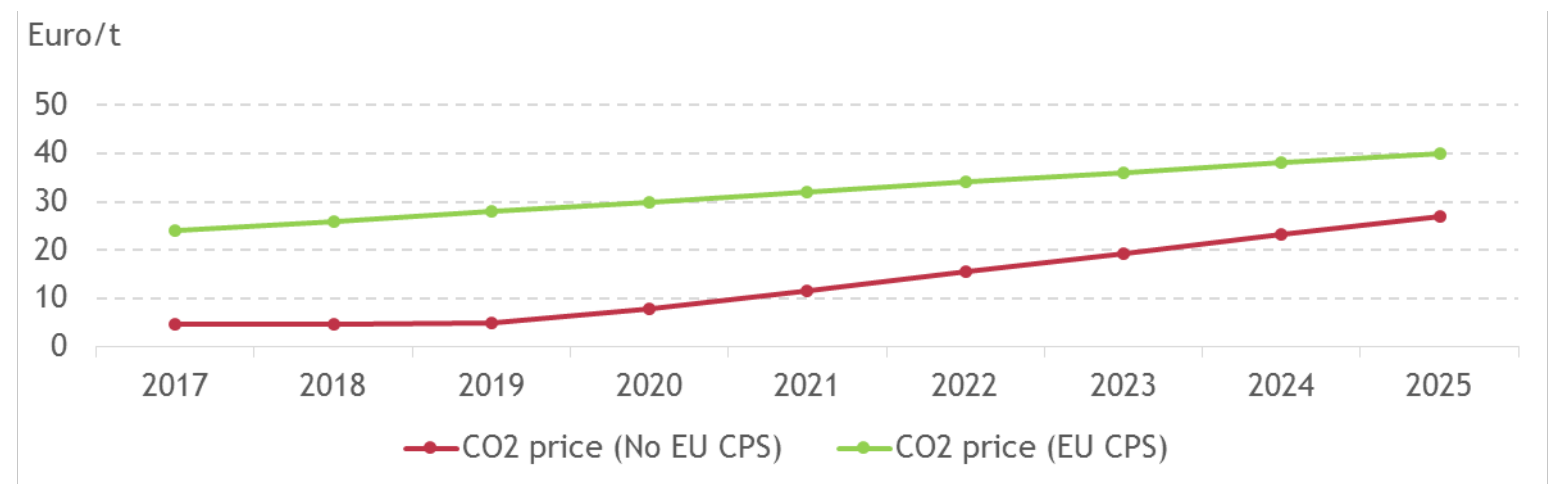
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Background, motivation, methodology

Background and motivation: Current thoughts on introducing a CPS

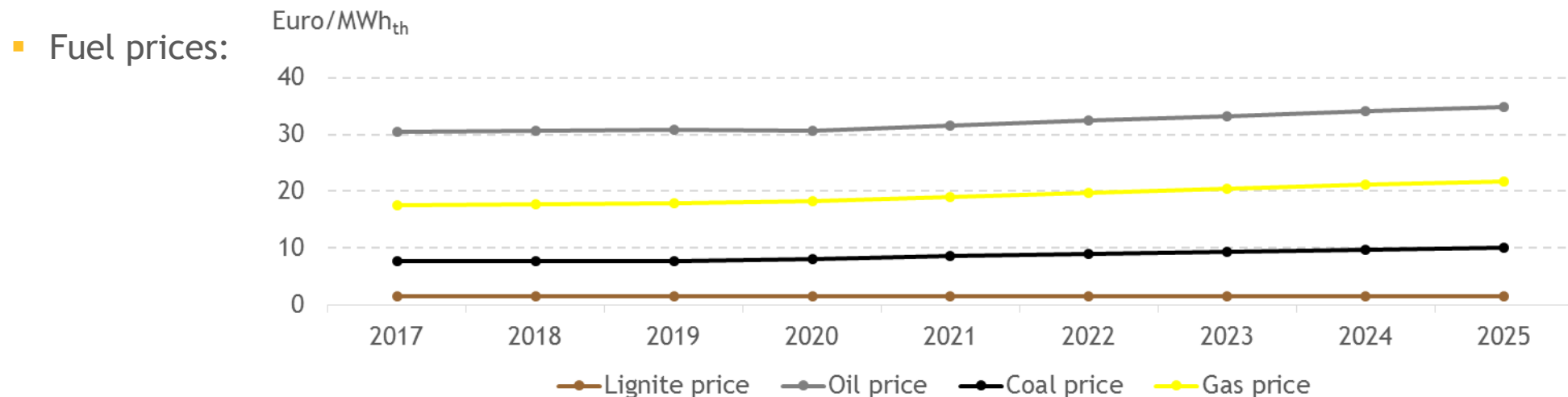
- In its Climate Action Plan, the German government has proclaimed its intention to realize measures that strengthen incentives within the EU-ETS.
- During the negotiations for the Climate Action Plan in October/November 2016, a CPS was being discussed but not embedded in its final version.
- France has discussed to introduce a CPS for CO₂ emissions from domestic power plants and later expand this instrument to other European countries or EU-wide. France has envisaged an initial price of 30 EUR/tCO₂ in 2020 up to 50 EUR/tCO₂ in 2030.


- The study analyzes the economic effects of a technology-neutral CPS.
- The analysis scrutinizes a „non cap-neutral“ CPS:
 - Cap-neutral: The abatement of CO₂ emissions by a CPS enables to first postpone and perpetuate emissions and later reduce them.
 - Non cap-neutral: As a result of a CPS, avoided CO₂ emissions will not be available in the future but will be removed from certificate trading. Postponement and perpetuation of CO₂ emissions will be a consequence as well as reduction of long-term CO₂ emissions at the same time.
- The effects of a CPS will be calculated on the basis of a comparison of two scenarios:
 - An EU-wide technology-neutral CPS - *EU Carbon Price Support (EU CPS)* -, following the price level of the French proposal; in comparison with
 - a reference scenario (No EU CPS)
- The following effects are being analyzed:
 - CO₂ reduction
 - Additional costs and revenues
 - Winners and losers by power plant type and country



ewi Methodology, modelling and assumptions

- The analysis is based on ewi's European electricity market model DIMENSION:
 - Period: 2017-25, analyzed countries: EU-28 + Switzerland + Norway - Cyprus - Malta (simplified: „EU“)
- Electricity demand:
 - Germany: Scenario framework 2025 of the network development plan 2015
 - Remaining EU: ENTSO-E Scenario Outlook & Adequacy Forecast 2015 and EU Energy Trends to 2050 of the EU-Commission
- RES-E development:
 - Germany: Goals of the Federal Government (Renewable Energy Law)
 - Remaining EU: Endogenous; with minimal development being equivalent to ENTSO-E Scenario Outlook & Adequacy Forecast 2015

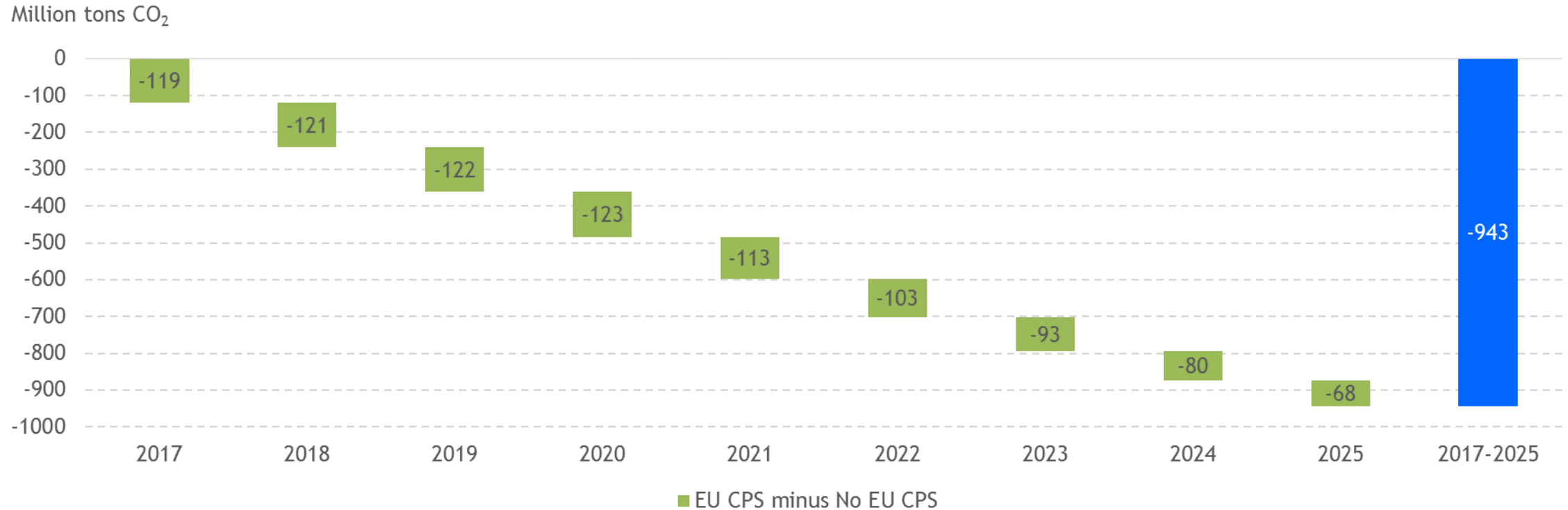




2 CO₂ abatement

A Carbon Price Support will avoid up to 943 million tons CO₂ in the EU from 2017 to 2025.

Effects of CPS on yearly CO₂ emissions in the European electricity sector



- Reduction of EU CO₂ emissions 2017-25:
 - Cumulated 943 million tons of CO₂
 - Annual reduction fluctuates within the range of 68-123 million tons of CO₂

More than 55% of the entire abatement of emissions 2017-25 will be achieved by 4 countries: DE, CZ, PL and NL.

Effects of a CPS on countrywise CO₂ emissions in the electricity sector, 2017-25 cumulated



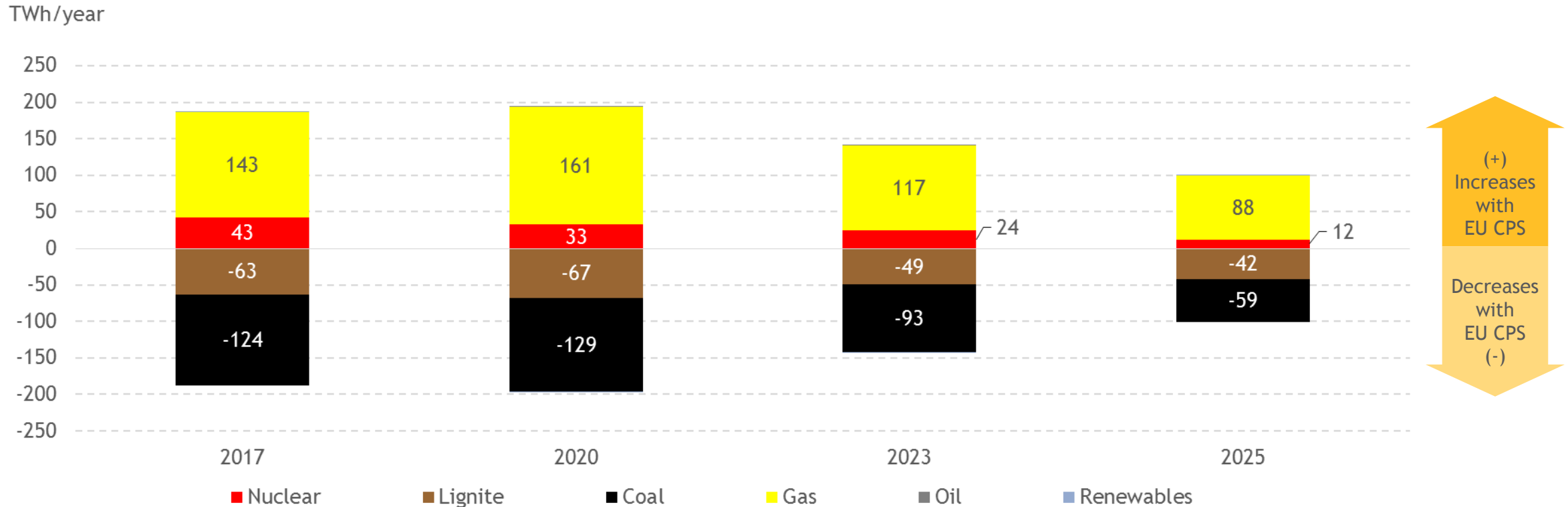
- Individual countries' share in the entire reduction 2017-25:
- Germany 26%
 - Czechia 11%
 - Poland 10%
 - Netherlands 9%
 - France 5%

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Effects on the EU electricity market

Share of gas and nuclear in power generation increases at the expense of hard-coal and lignite.

Effects of a CPS on gross electricity generation in the EU, 2017-25



Changes in gross electricity generation in the EU in the CPS scenario in 2020:

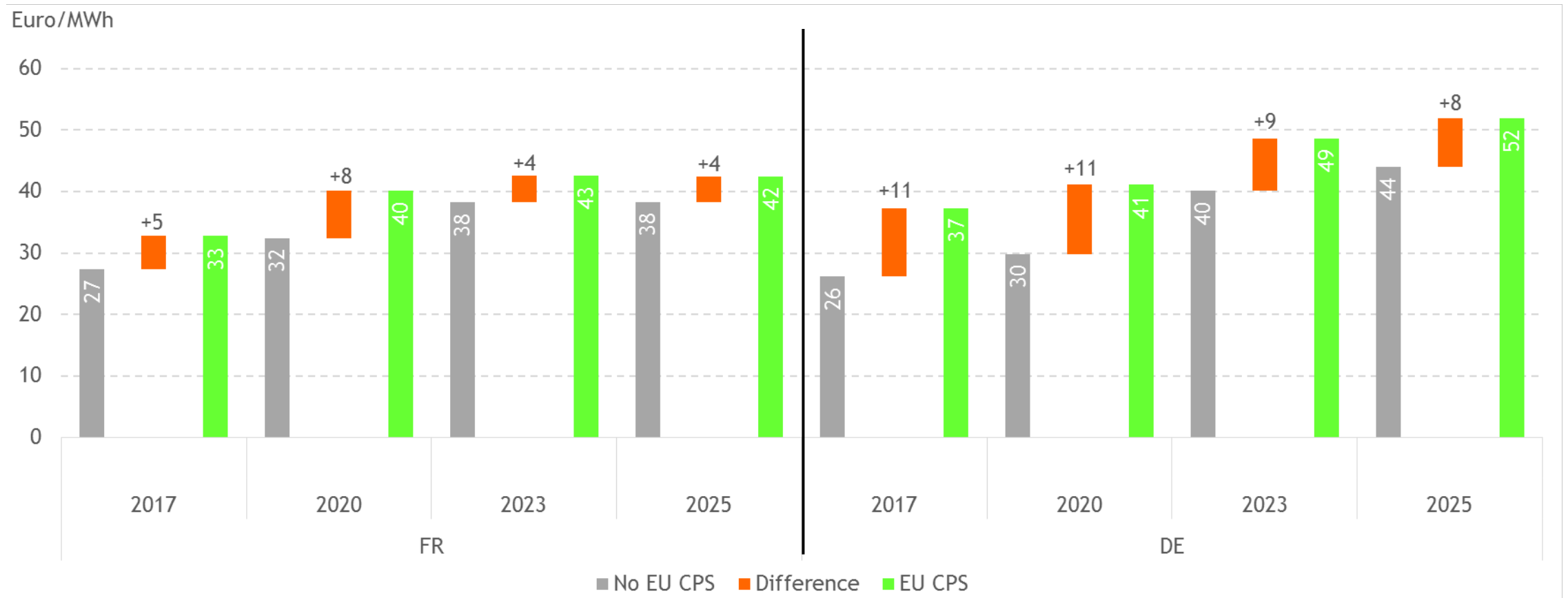
- gas (+161 TWh), nuclear (+33 TWh), hard-coal (-129 TWh), lignite (-67 TWh)

Changes in fuel consumption in the EU in the CPS scenario in 2020:

- gas (+25 bcm), hard-coal (-43 tons coal equivalent), lignite (-28 tons coal equivalent)

A CPS increases the wholesale electricity price - in Germany more than in France

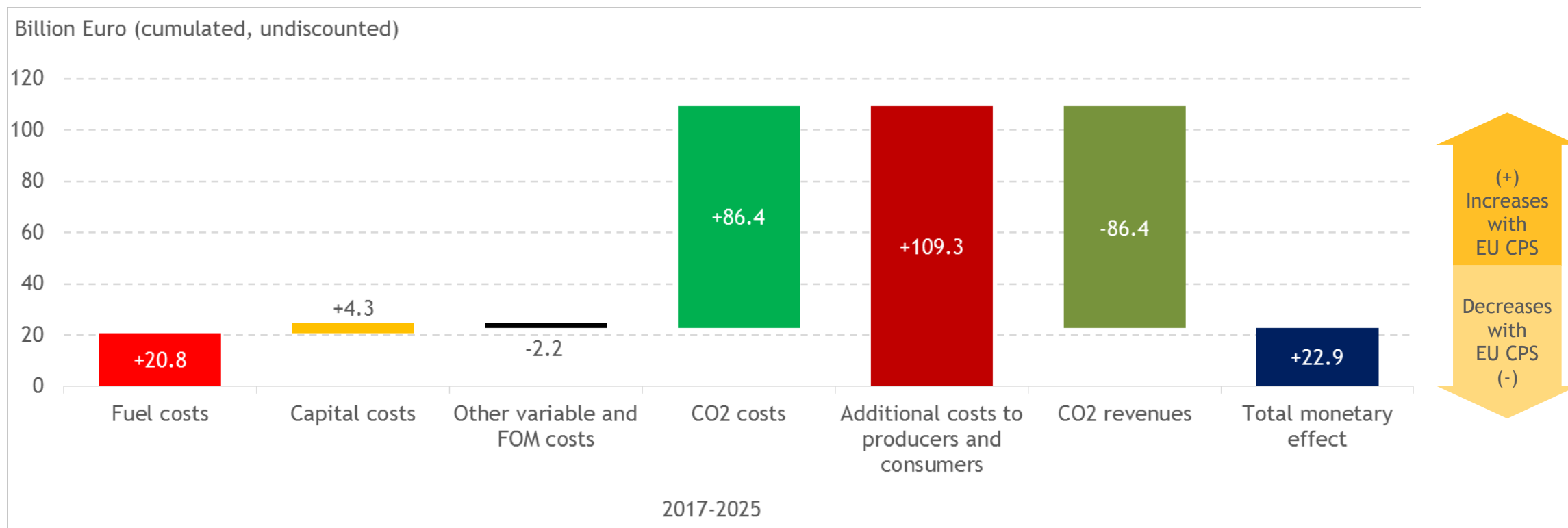
Effects of a CPS on the wholesale electricity price (annual average) in France and Germany, 2017-25



- ➔ In Germany, a CPS increases the wholesale electricity price by 8-11 EUR/MWh
- ➔ Impact on the French wholesale electricity price is less severe with 5-8 EUR/MWh

A CPS leads to additional costs of 22.9 billion euros in the European electricity market in 2017-25.

Cost effects of a CPS on European producers and consumers, 2017-25 cumulated



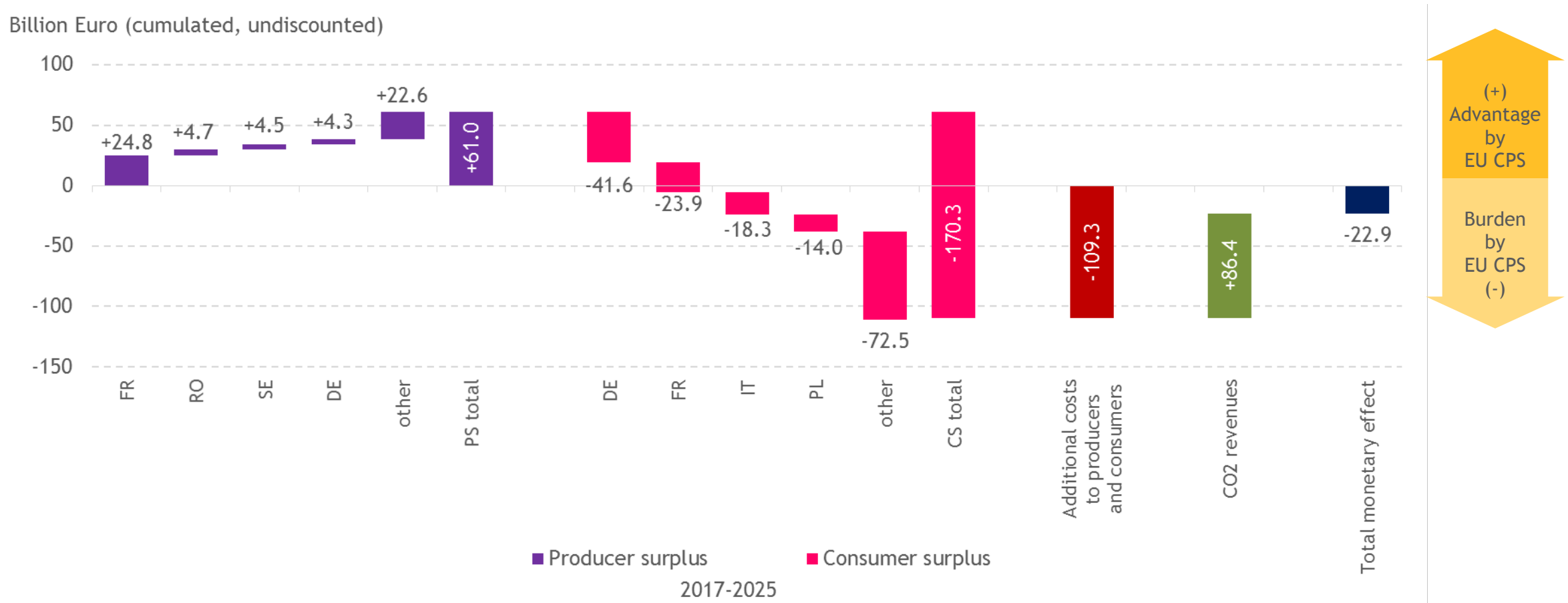
- ➔ Additional costs for European producers and consumers add up to 22.9 billion euros
- Increasing costs: Fuel prices (+20.8 billion euros), capital costs (+4.3 billion euros)
 - Decreasing costs: Other variable costs and fixed operating and maintenance costs (FOM) (-2.2 billion euros)
 - Higher CO₂ prices cause additional CO₂ costs for producers and consumers, but lead to additional revenues for the government. Those revenues could be utilized to compensate for the added financial burden.
 - An EU-wide CPS causes 22.9 billion euros of additional costs for the EU in 2017-25, which implies, set in relation to electricity demand, additional costs of 0.08 ct/kWh_{el} (or 0,4 ct/kWh respectively - taking into account CO₂ costs).



4 Winners and losers

European power plant operators are winners of a CPS, consumers pay for it. However: Great scope for distribution due to additional revenues from CO₂ certificates.

Economic effects on consumers and power plant operators (measured in consumer and producer surplus), 2017-25 cumulated

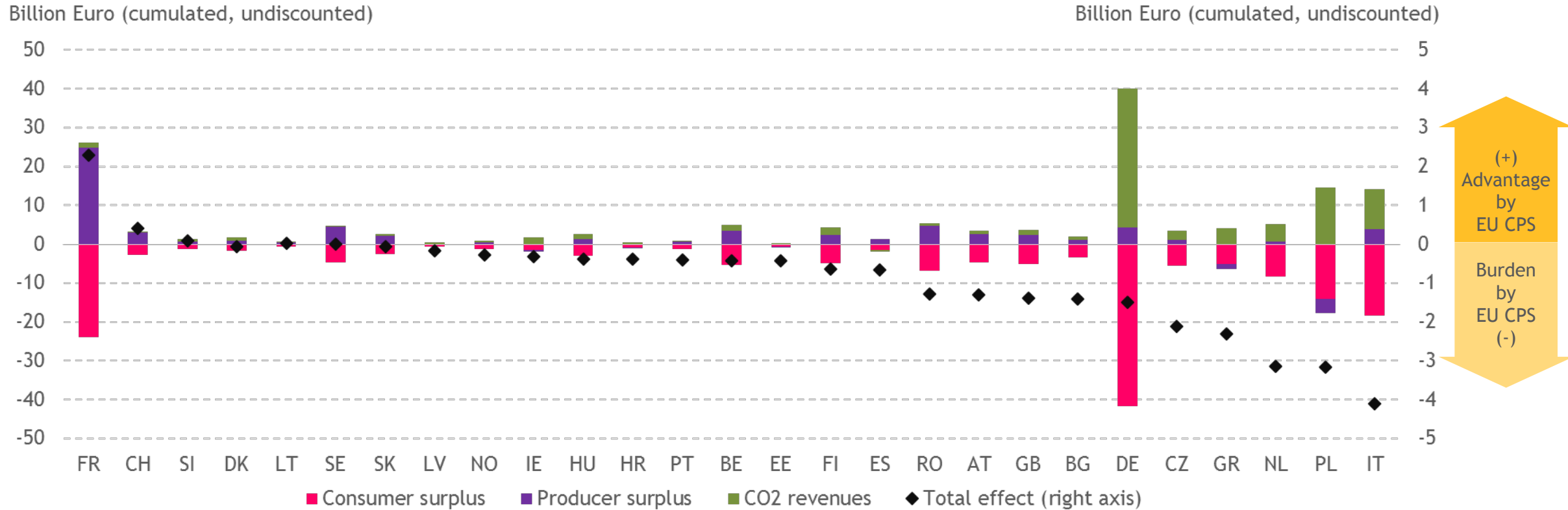


From 2017 to 2025 a CPS will lead to distributional effects between electricity producers and consumers:

- European electricity producers will benefit with 61 billion euros, in which power plant operators in France benefit the most
- European consumers will be financially burdened with 170.3 billion euros over this period of time
- A higher CO₂ price results in additional revenues of 86.4 billion euros from certificate trading which could be reallocated to consumers

5 countries benefit from a CPS, non of those will face added costs of more than 4.1 billion euros.

Economic effects of a CPS by country, 2017-25 cumulated

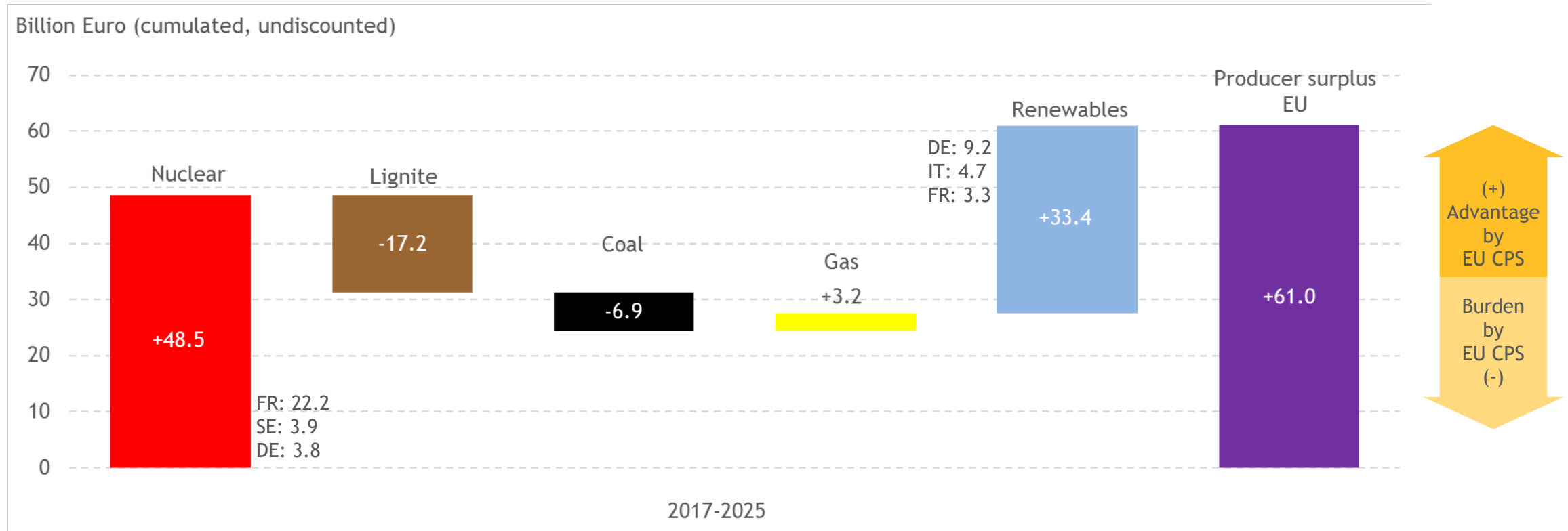


From 2017 to 2025 a CPS will lead to distributional effects among the considered countries:

- France benefits with added 2.3 billions euros, caused by large additional revenues generated by French nuclear power plants
- High additional costs for German consumers will be almost compensated by higher CO₂ revenues, total effect: -1.5 billion euros
- Italy bears the highest loss with approx. 4.1 billion euros
- Poland and the Netherlands will face a financial burden of 3.1 billion euros

A CPS favors nuclear power, renewables and natural gas, but penalizes hard-coal and lignite.

Economic effects of a CPS by power plant type in the EU (measured in supplier surplus), 2017-25 cumulated



From 2017 to 2025 distribution triggered by a CPS among power plant technologies:

- Losers: Operators of lignite power plants (-17.2 billion euros) and hard-coal power plants (-6.9 billion euros)
- Winners: Nuclear power plants (+48.5 billion euros), renewables (+33.4 billion euros) and gas power plants (+3.2 billion euros)

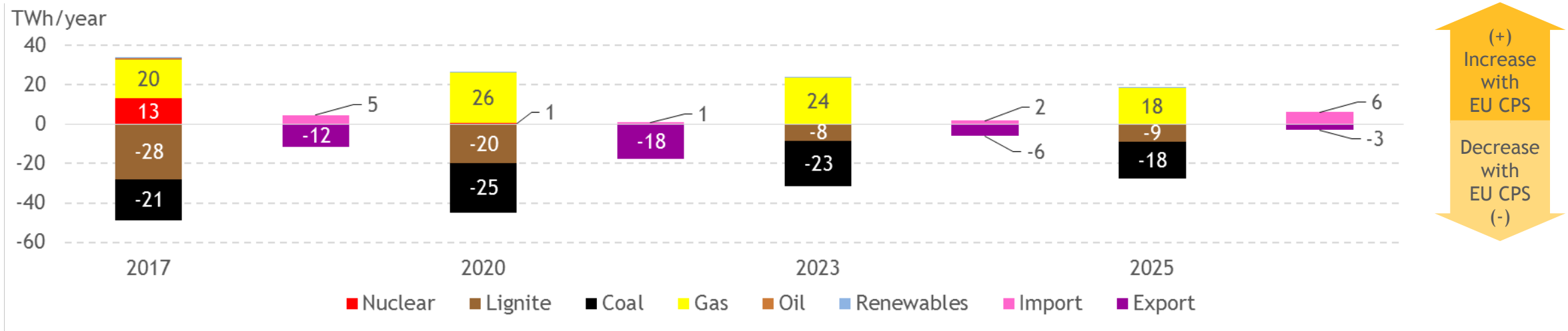


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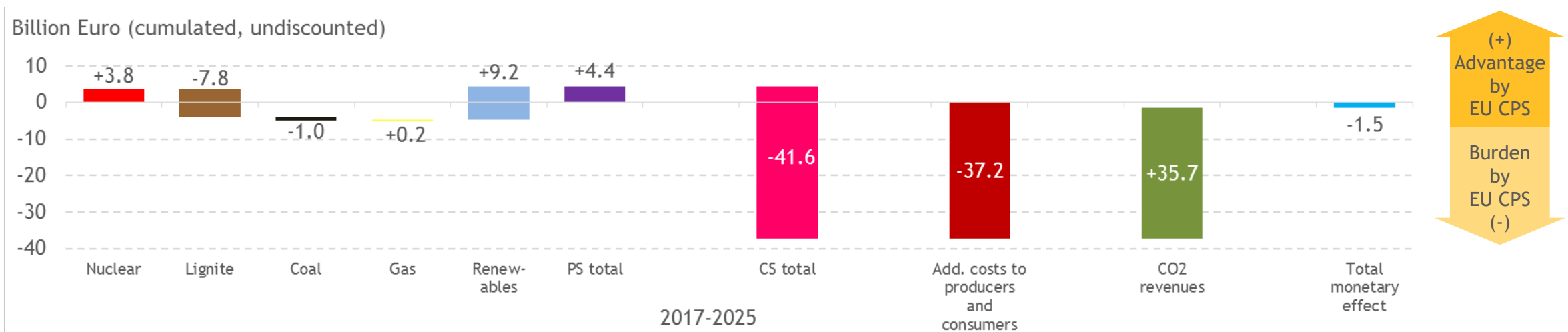
Germany and France in the spotlight

Germany: Coal electricity is highly regressive and will be replaced primarily by gas.

Effects of a CPS on gross electricity generation in Germany, 2017-25

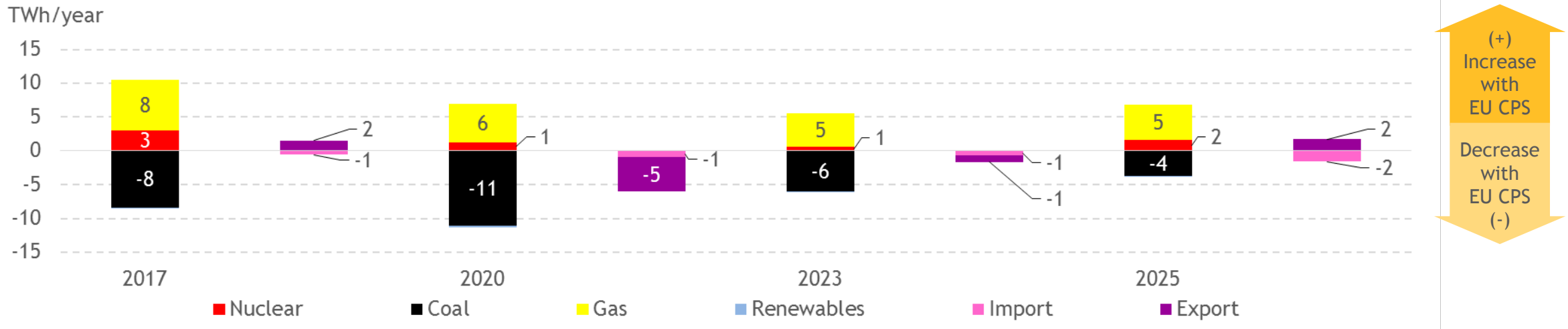


Economic effects on consumers and power plant operators by technology in Germany, 2017-25 cumulated

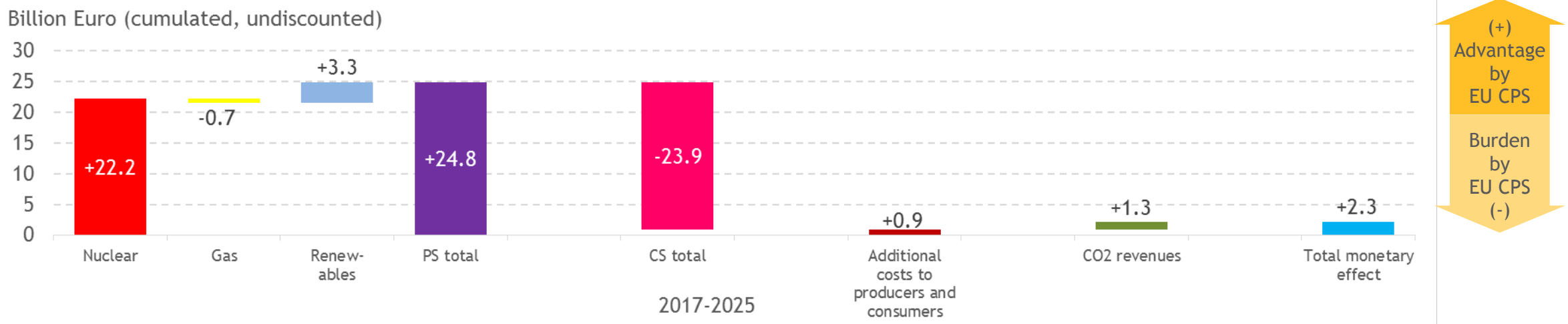



France: Operators of nuclear and renewable energy power plants benefit by a CPS, France benefits in total

Effects of a CPS on gross electricity generation in France, 2017-25



Economic effects on consumers and power plant operators by technology in France, 2017-25 cumulated





6 Qualitative discussion of a Carbon Price Support

Arguments for CPS

- High uncertainty regarding business-as-usual emissions (economic crises, policies to foster renewable energies, fuel prices, ...)
- Price peaks as a result of advanced decarbonization probable (low price elasticity of CO₂ abatement options)
- Reduction of price volatility and price peak liability
- Reduction of price uncertainty for investments in decarbonization technologies
- Reduction of risks and thus capital costs for decarbonization technologies
- Fewer national instruments to achieve national climate goals necessary
- If the EU wants to further reduce CO₂ in electricity generation, a CPS is relatively easy to implement
- Additional ambitions of individual countries will not be foiled by price cutting effects in the EU-ETS

Arguments against CPS

- Additional costs for consumers (e.g. industry, households) lead to effects on the economy as a whole that are not yet predictable
- Risk of carbon leakage in the industry
- Political intervention in the EU-ETS weakens long-term investment reliability
- Risk of arbitrary political changes of CPS in the future
- An EU-wide political realization is difficult due to large-scale distributional effects
- Compensation for distributional effects - e.g. by additional revenues of certificate trading - prone to lobbying

- A CPS is a **technology-neutral instrument** for cost-efficient CO₂ abatement
- A realization would have **immediate impacts** on the electricity market as well as direct CO₂ abatement effects
- Substantial **distributional effects** among countries, producers and among industrial and other consumers
- An EU-wide CPS is identical to **replacing the EU-ETS** by a carbon tax (provided that the CPS is higher than the market-price for certificates)
- A CPS that is **not applied EU-wide** - e.g. only in some countries - will only lead to reduction of emissions if certificates in the EU-ETS will be reduced accordingly

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ewi Energy Research & Scenarios gGmbH | January 9th 2017

presse@ewi.research-scenarios.de | +49 (0)221 - 27729 108

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