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Integrating a carbon floor price in the policy mix for Germany's coal phase-out

Study conducted on behalf of WWF Germany

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Carbon pricing in Germany
Some background

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- **Germany has a long tradition of target-driven policies.**
  - the outcome is mixed
  - the country is going to miss its 2020 GHG emission reduction targets (40%), partly due to its high-carbon electricity exports
  - this and the need to comply with the 2030 target has triggered heated debates which will lead to action (whatever it will be)
- **Coal phase-out is eventually on the political agenda**
  - first attempts in 2014 which led to decommissioning of 2.7 GW lignite power plants (with high compensations)
  - end date for coal-based electricity generation is explicitly mentioned in the coalition treaty – without being specific on the date and the trajectory (will be topic of a coal commission)
- **Carbon pricing raised a lot of attention during the last months**
  - often mentioned in early drafts of (many) documents, never survived (explicitly) in the final versions
  - overall inconsistent (implicit/explicit) carbon pricing is realized widely

Carbon pricing in Germany
Some background

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- **Key legal constraints need to be considered**
  - no window of opportunity for the next 5 years at the EU level
  - auction reserve prices are not possible due to EU legislation
  - recent ruling of the Constitutional Court (on the nuclear fuel tax) has far-reaching consequences for carbon pricing: CO_2 taxes as input taxes are no longer possible
  - the way out: flexible/floating energy taxation for power generation
- **Key political constraints need to be considered**
  - compensation of indirect CO_2 costs
  - British floor price mechanisms as a blueprint
- **Consequence**
  - the (original) British model will be the reference model
  - how to coordinate this cross-border (convergence or CDN model)?

Carbon floor price for electricity sector
Background on instruments (1)

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- **Reform of taxes, levies and surcharges is on political agenda (for many reasons)**
- **Also in this context: increasing interest in carbon pricing approaches (for different / all sectors) – for many good reasons**
- **EU ETS – the key carbon pricing approach for electricity sector will recover only very slowly from surplus crisis after measures taken on structural reform**
  - Up to second half of the 2020s: price around / below 10 €/EUA
  - No / only insufficient contribution to necessary quick GHG emission reductions in power plant sector
- **In electricity sector with strong cross-border integration, a number of interactions arise from carbon pricing:**
  - Climate-policy and distribution effects of unilateral approaches can prove problematic (relevant for all countries with ambitious climate protection strategies, e.g. DE, FR, NL)
  - Cross-border activities of carbon pricing are (very) advantageous and on political agenda.

Carbon floor price for electricity sector
Background on instruments (2)

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- **Broad portfolio of instruments is available for substantial (and relatively short-term) GHG emission reductions in electricity sector**
  - capacity management (e.g. security standby reserve),
  - operating restrictions (e.g. emission performance *standards*)
  - selective pricing instruments (e.g. special levy on coal)
  - carbon pricing (national floor prices, general floor prices in EU ETS, floor prices for regions within Europe)
- **Different instruments have different ramifications:**
  - GHG emission reductions (overall, in different countries)
  - costs and distribution mechanisms (electricity prices, compensations)
  - security of supply
  - balance of electricity imports and exports
- **Reminder: With the current reform of EU ETS, additionality of GHG emission reductions is ensured (market stability reserve, cancellation mechanisms and their interactions).**

Carbon floor price for electricity sector
Objective of analyses

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- **Numerical analysis of different aspects of carbon floor pricing options for electricity sector**
  - for Germany alone
  - an integrated regional approach: Germany, France, Belgium, the Netherlands, Luxembourg, Austria, Denmark
  - various price levels analysed in each case
- **Comparison with effects that have dominated discussion of instruments in Germany to date**
  - policy-induced shutdown of coal-fired power plants
  - different variants
- **Comparison with effects of combination strategies**
  - different levels of carbon floor prices
  - policy-induced shutdown of power plants in different variants

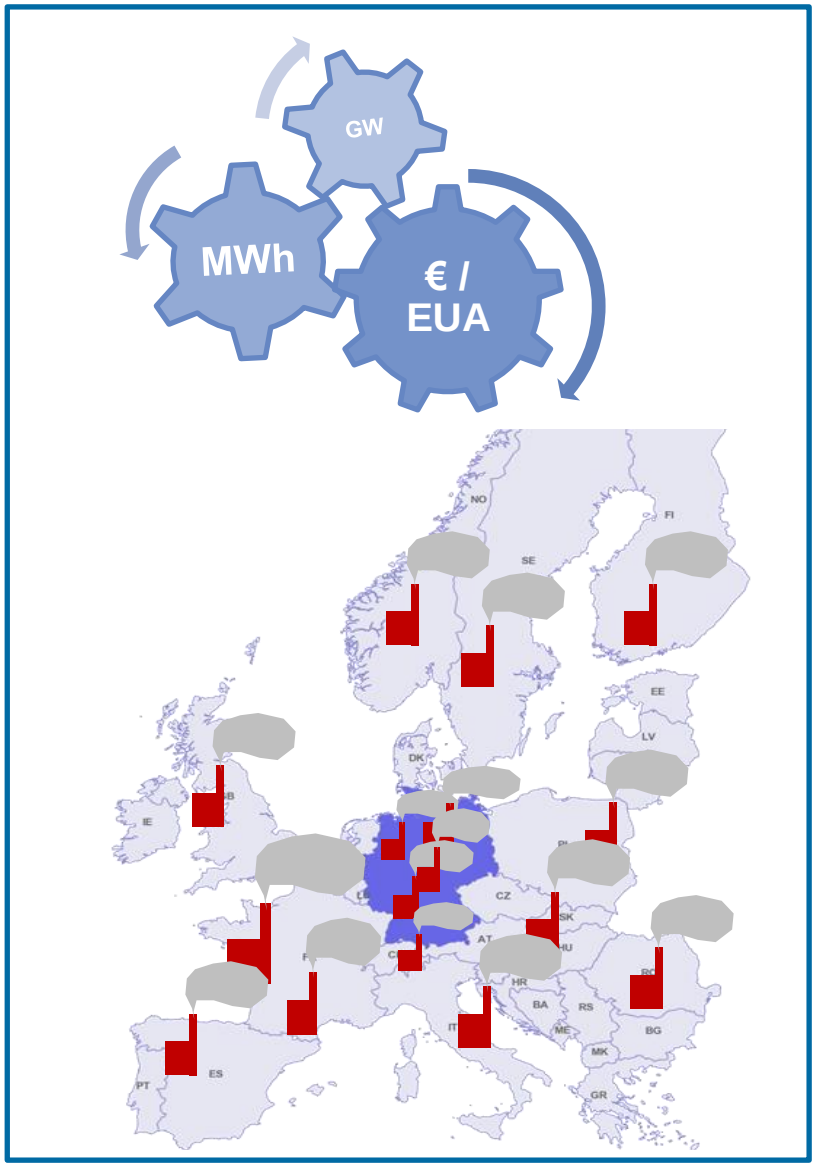
Methodology and scenarios

Methodology

- **Hour-by-hour *dispatch modelling* using electricity market model "PowerFlex Europe"**

- ***Shutdown of power plant units* endogenous to the model for the case that electricity revenues are not sufficient to cover fixed operating costs (personnel, maintenance and service, revisions) in the long term**

- **2020 used as time horizon in the analysis (by way of example)**



Model analyses: Scenarios considered

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- **Reference**
  - 5.6 € / t CO_2
- **Carbon floor price in Germany**
  - 15 € / t CO_2 (i.e. 9.4 € / t CO_2 plus the reference amount)
  - 25 € / t CO_2 (i.e. 19.4 € / t CO_2 plus the reference amount)
  - 35 € / t CO_2 (i.e. 29.4 € / t CO_2 plus the reference amount)
- **Carbon floor price in regional market**
  - Germany, France, Belgium, the Netherlands, Luxembourg, Austria, Denmark
- **Policy-induced shutdown of power plants**
  - Shutdown of 7 GW lignite power plants (discussed in CDU-FDP-Green coalition negotiations)
  - Shutdown of all power plant units that entered operation before 1990 (8.4 GW lignite and 11 GW hard coal) based on the study “Future electricity system – Coal phase-out by 2035”
- **Corresponding combinations**

CO_2 effects beyond the fuel switch

Contribution margins as criterion for shutdown decisions

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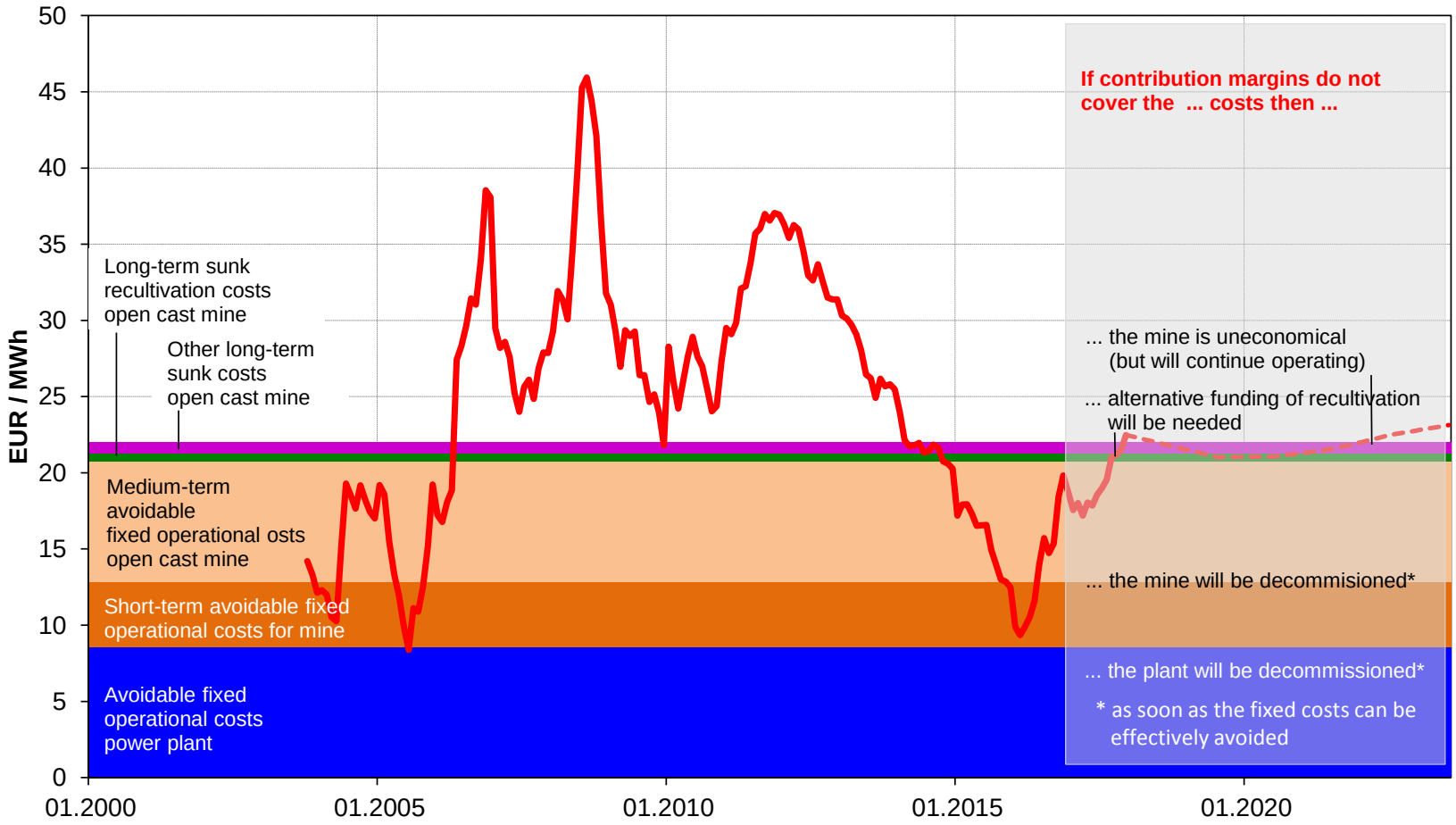


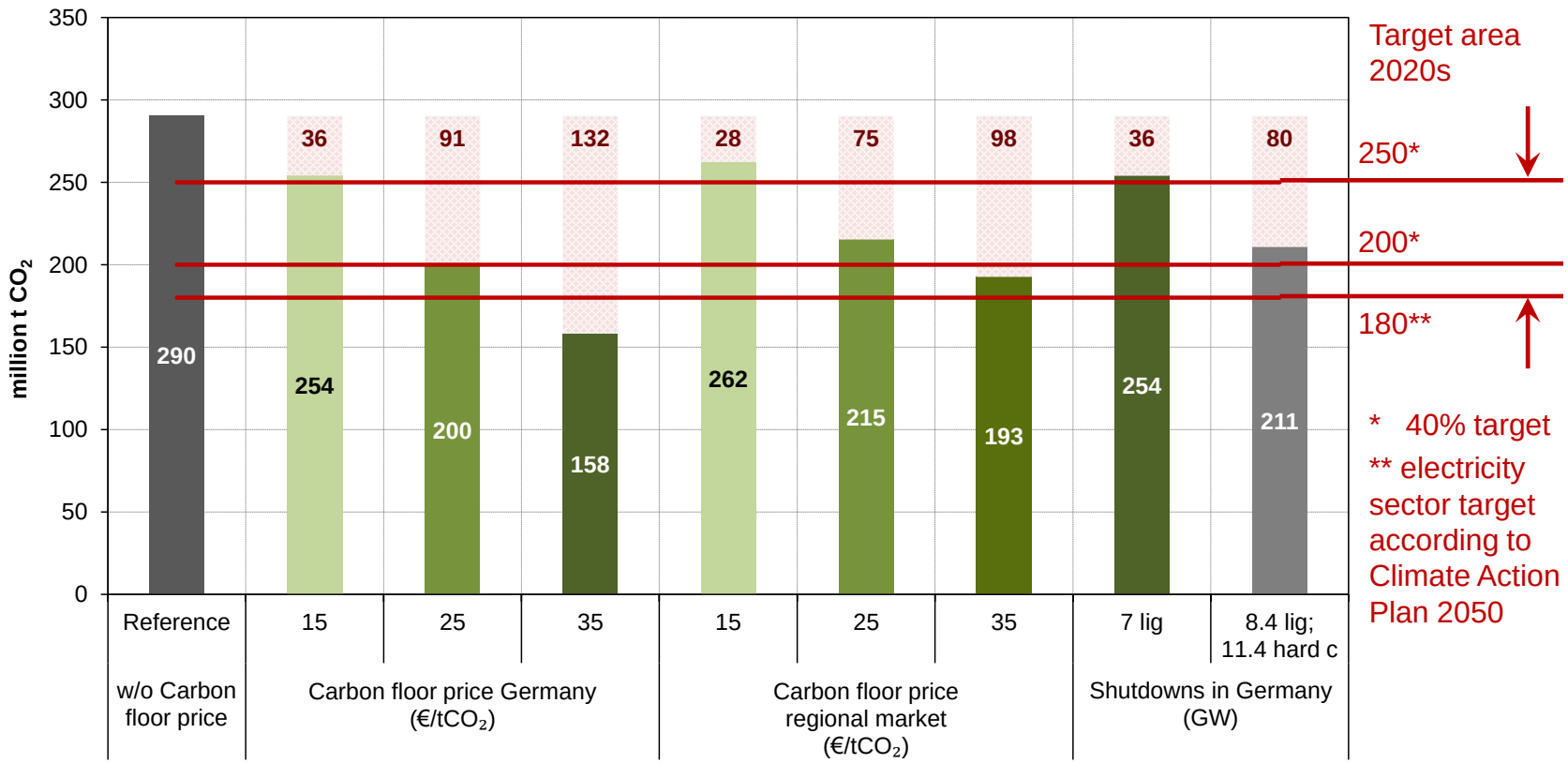
→ CO_2 prices have significant effects on contribution margins of lignite power plants and open-cast mines under current conditions.

→ The oft-mentioned "domino effects" can only arise if fixed operating costs of an open-cast mine can be lowered in their entirety and not modularly; this is not expected.

Results

Absolute GHG emissions and power plant shutdowns in DE

Carbon floor prices and policy-induced shutdowns

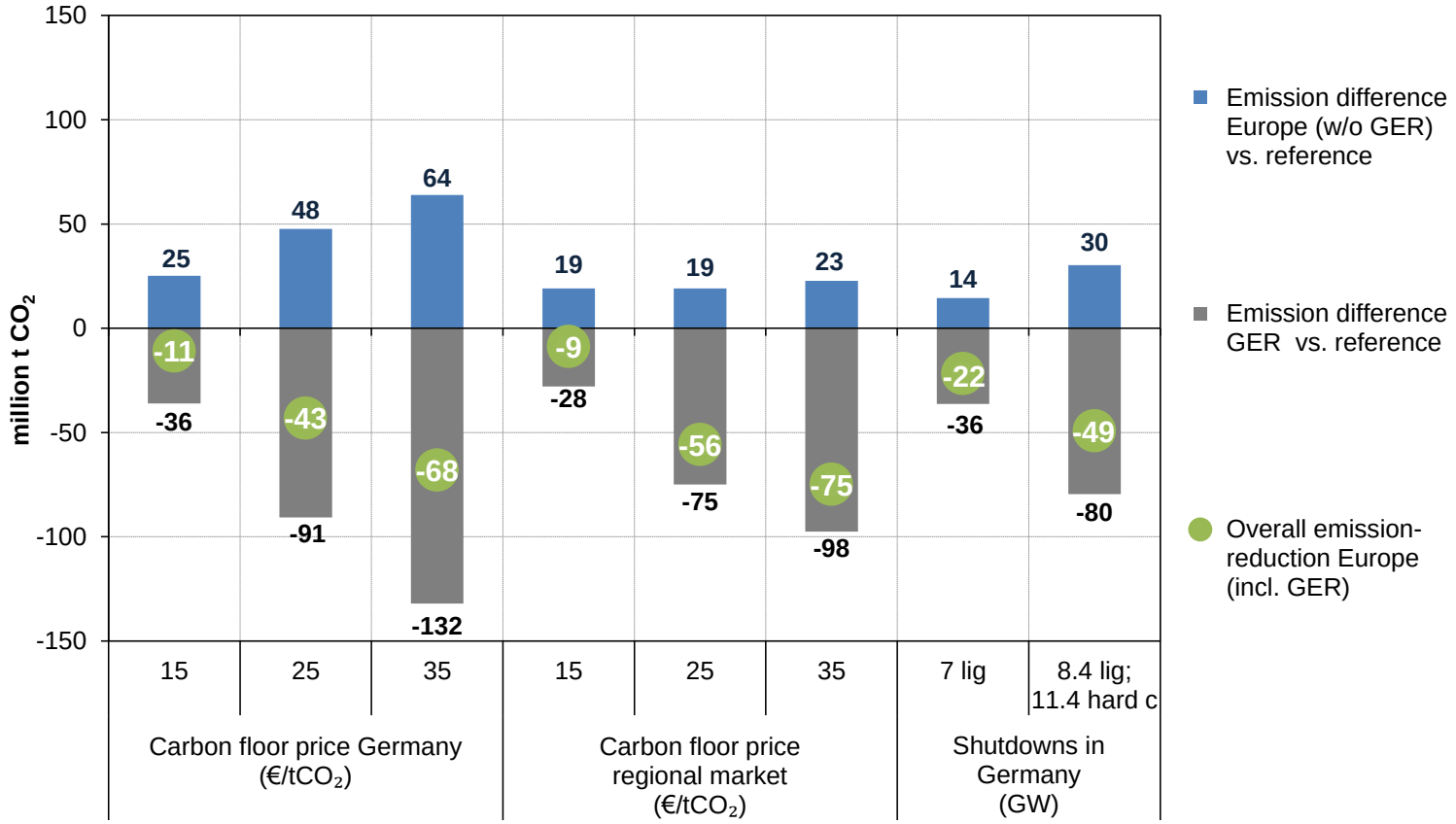


→ Possible for electricity sector to meet 40% reduction target with carbon prices of approx. 25 €/t CO_2 in DE and 30 €/t CO_2 in European regional market or via significant shutdowns of lignite (>8 GW) and hard coal (>11 GW)

→ Electricity sector target for 2030 of German Climate Action Plan 2050 is achievable with carbon prices above 30 € (unilaterally in DE) or from 35 € (regional market) or with shutdowns >>8 GW (lignite) and >>11 GW (hard coal)

GHG emission reductions compared to reference in DE / Europe / overall

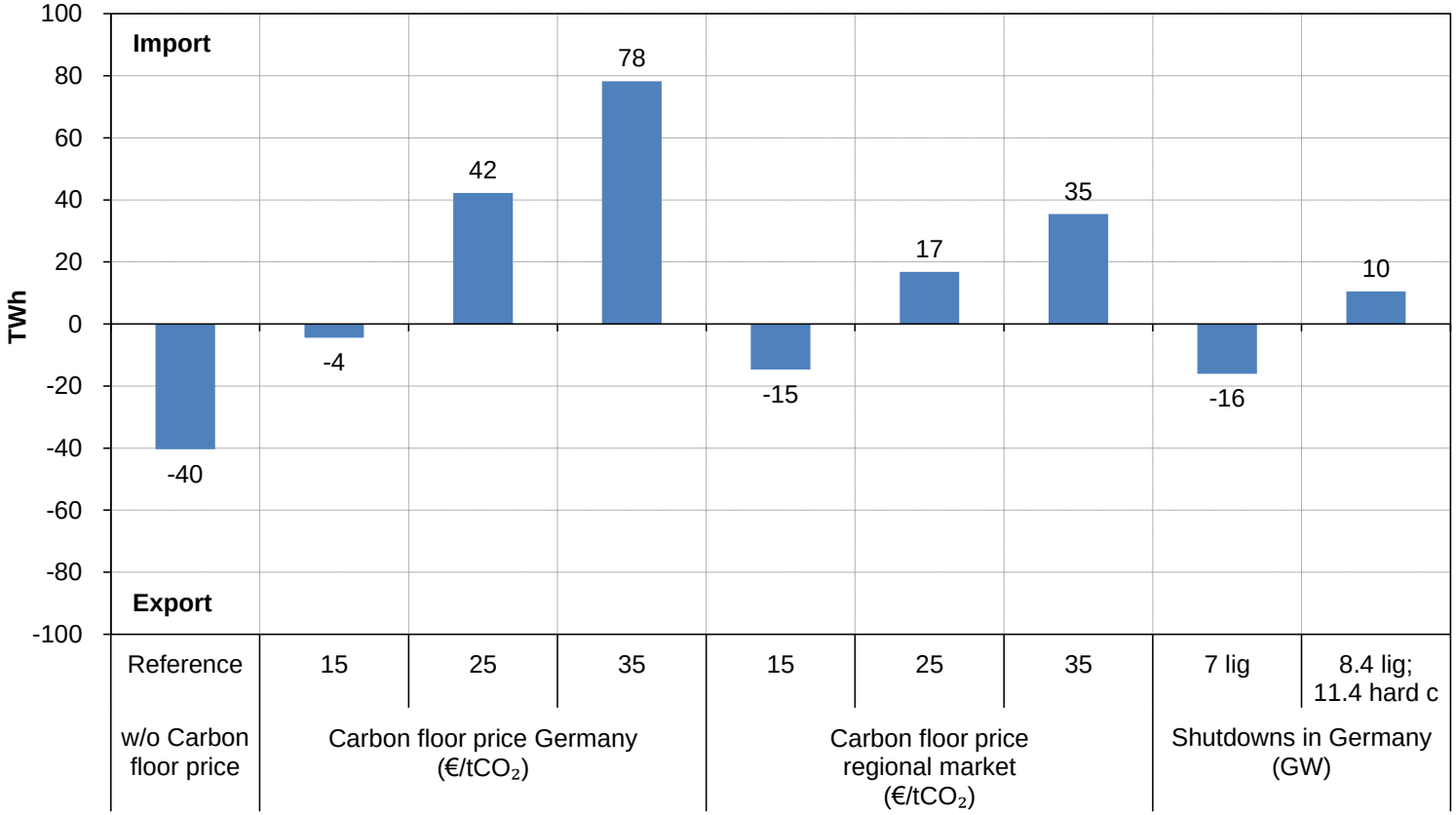
Carbon floor prices and policy-induced shutdowns



- → Carbon floor price only in DE has strongest GHG emission reduction in DE, but largest rebound effect in regional market (outside DE)
- → Carbon floor price above 15 €/t CO_2 in European regional market generates largest GHG emission reductions in regional market (incl. DE)
- → Policy-induced shutdowns of lignite >8 GW and of hard coal >11 GW bring about similar emission reductions as carbon floor prices of 25 €/t CO_2 (DE or regional market)

Electricity import-export balance

Carbon floor prices and policy-induced shutdowns



→ Carbon floor price in DE generates the strongest shift towards significant electricity imports

→ Carbon floor price of 15 to 25 €/t CO_2 in regional market balances German electricity imports

→ Policy-induced shutdowns bring about positive electricity exports or at most very low imports

→ Shutdowns decrease Germany's surplus electricity exports more slowly than carbon floor price

Installed power plant capacities (excl. new built)

Carbon floor prices and policy-induced shutdowns

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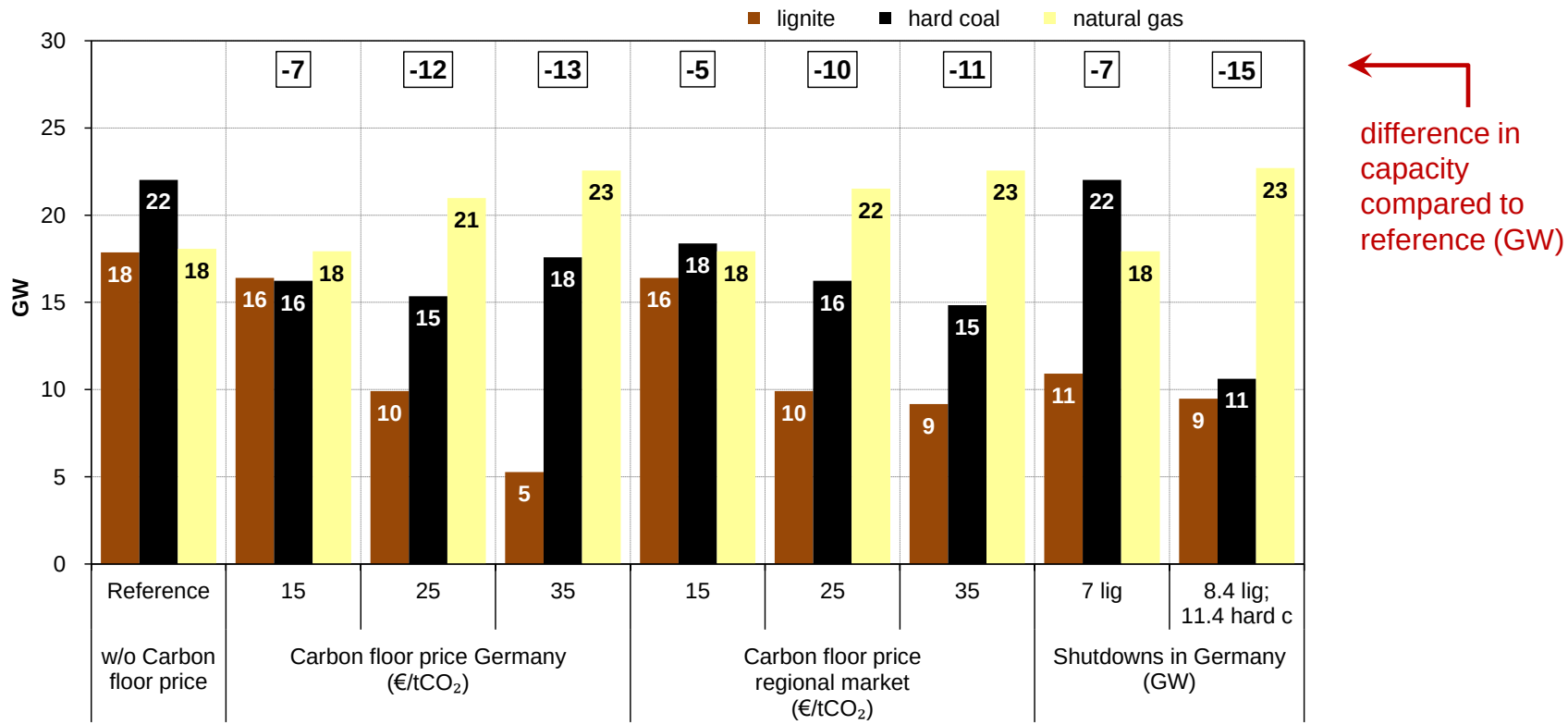


→ Carbon floor price of up to approx. € 15 mainly reduces hard coal capacity compared to reference

→ … up to approx. 25 €/EUA mainly reduces lignite capacity; natural gas shutdowns are avoided

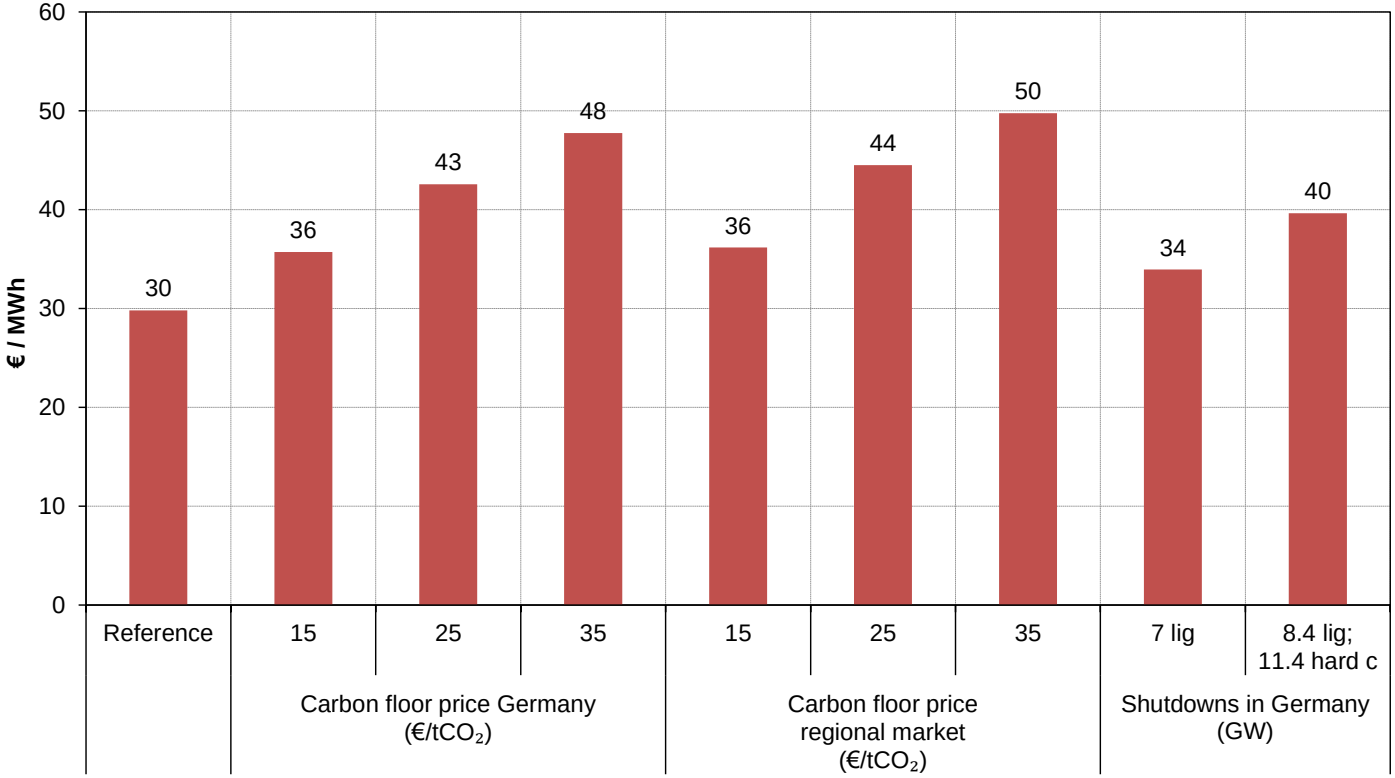
→ … up to approx. 35 €/EUA: carbon floor prices in DE / regional market have diff. effects on coal in DE

→ Policy-induced shutdowns of lignite alone avoid hard coal but not natural gas shutdowns

→ Lignite and hard coal shutdowns mean that natural gas shutdowns are avoided

Wholesale electricity prices

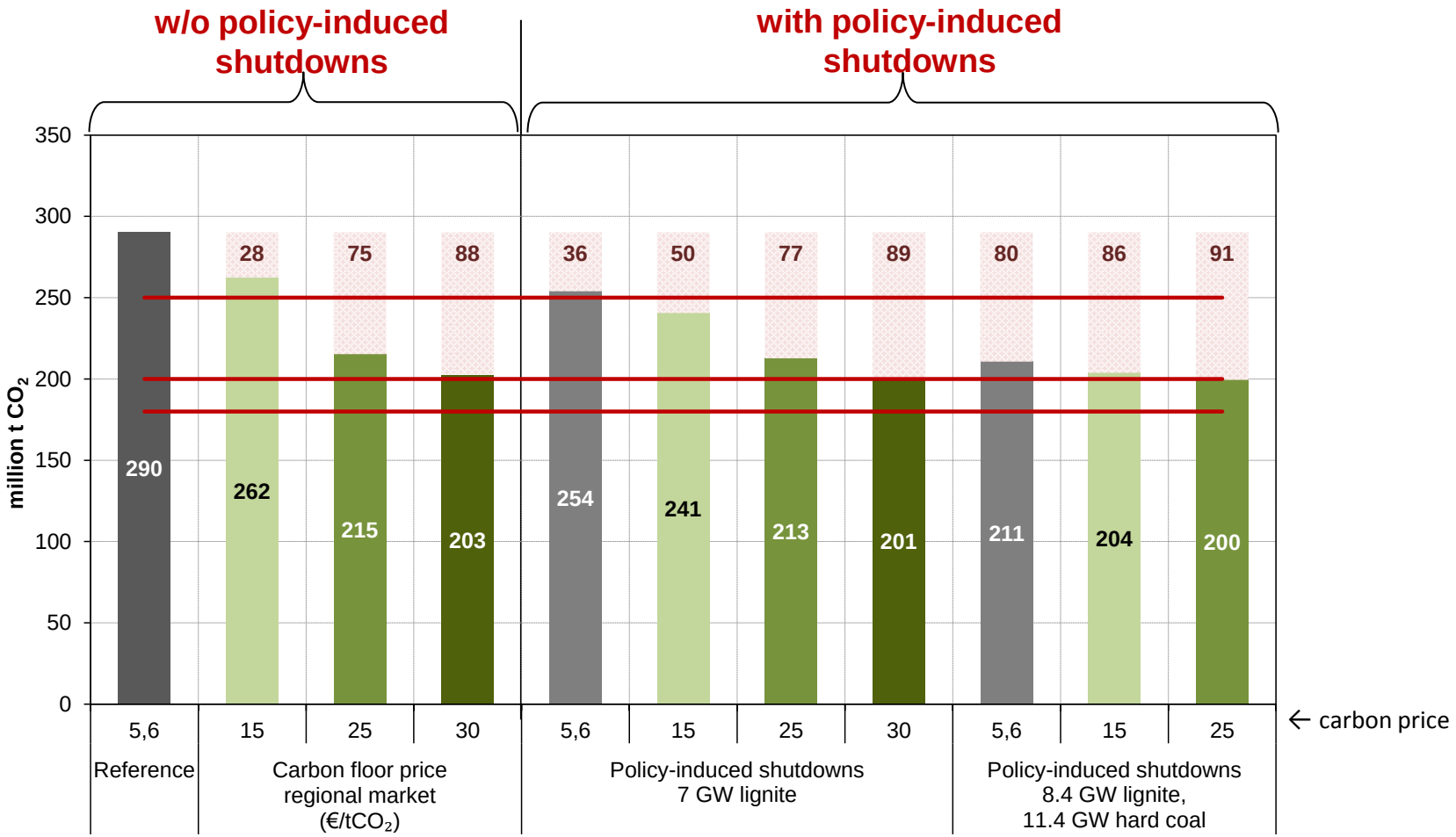
Carbon floor prices and policy-induced shutdowns



- → Carbon floor prices in DE and in regional market have very similar effects on wholesale electricity price (35 €/t CO_2 instead of 5.6 €/EUA leads to increase of approx. 20 €/MWh)
- → Effects of policy-induced shutdowns on wholesale electricity price are very low (possible compensation payments and possibly higher scarcity prices: expected amount X €/MWh)
- → German EEG surcharge decreases when electricity prices increase -> decrease of approx. 50%
- → Power-intensive industries (within EU): enabling compensation of indirect CO_2 costs

GHG emissions / emission reductions of DE power plants

Carbon floor prices, policy-induced shutdowns and combinations



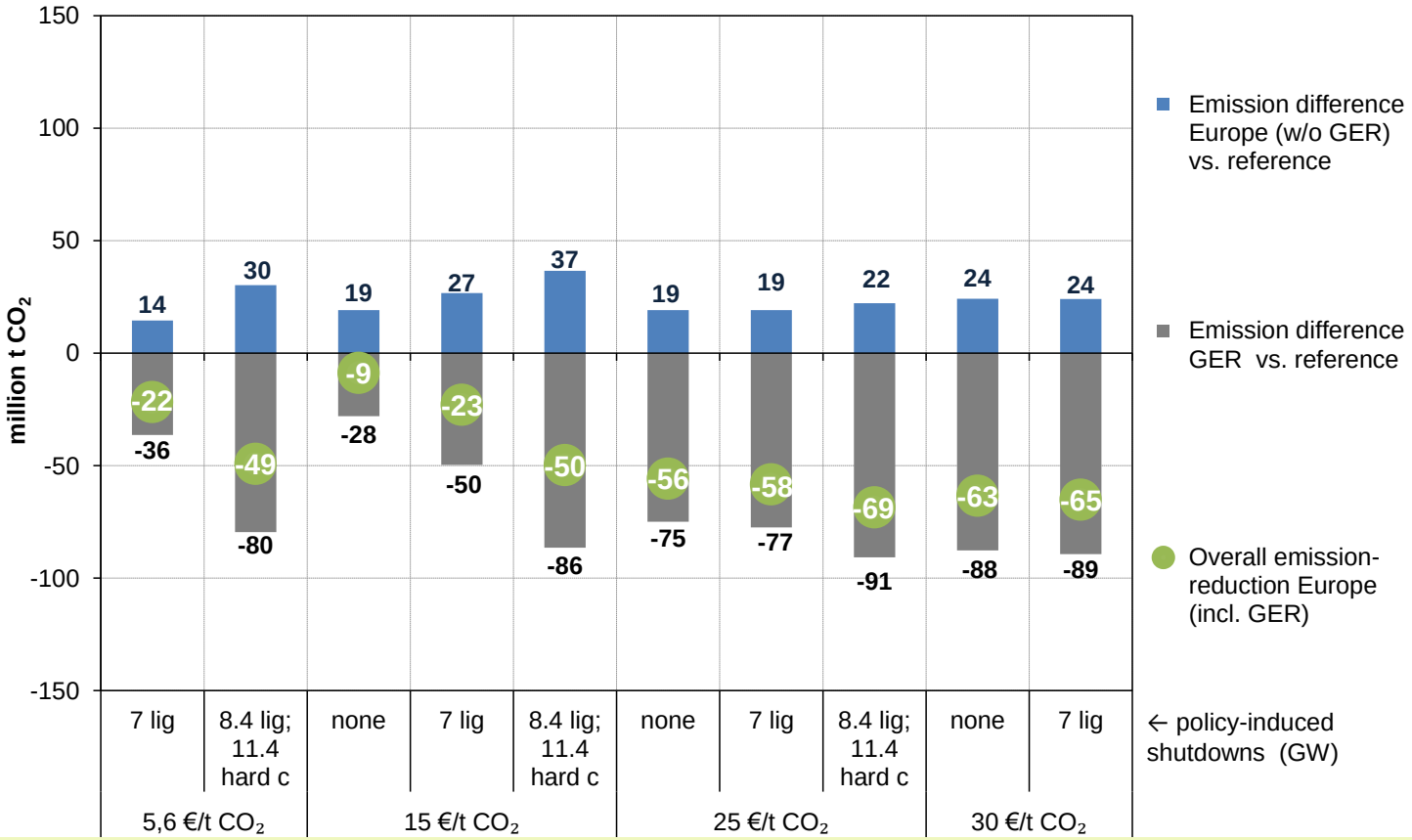
→ Combinations of policy-induced power plant shutdowns and carbon floor prices generate:

… relevant additional emission reductions if volume of shutdown is low (e.g. 7 GW lignite) and carbon prices (regional market) are approx. 15/20 €

… hardly any additional emission reductions if volume of policy-induced shutdowns is high

Emission reductions compared to reference in DE / Europe / overall

Carbon floor prices , policy-induced shutdowns and combinations



→ With carbon floor prices of 15 € (regional market) additional GHG emission reductions for DE and Europe result from policy-induced shutdowns of lignite and hard coal power plants in DE

→ With carbon floor prices of 25 € (regional market) additional GHG emission reductions for DE and Europe arise only through policy-induced shutdowns of hard coal power plants

Installed capacities of power plants in DE

Carbon floor prices, policy-induced shutdowns and combinations

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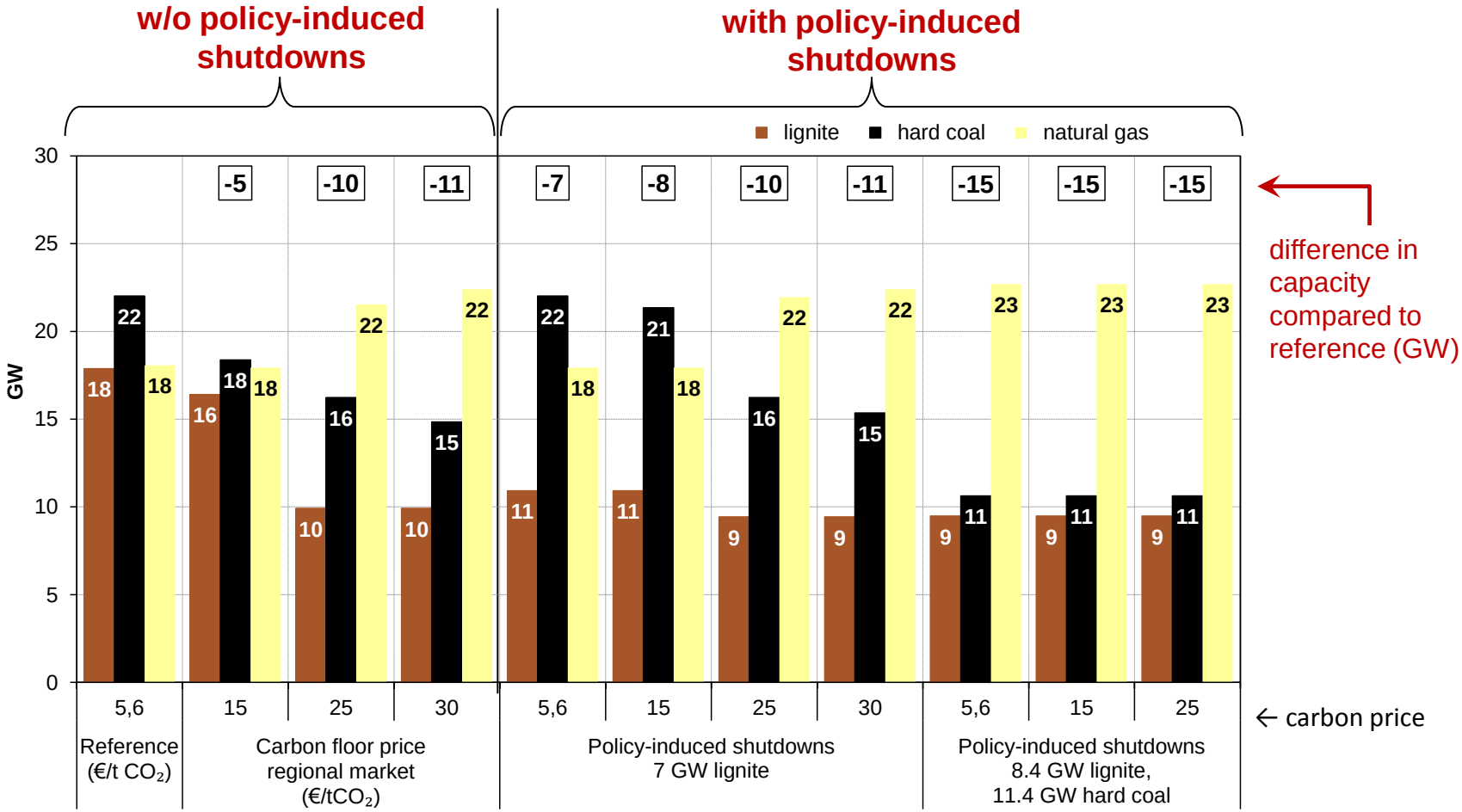


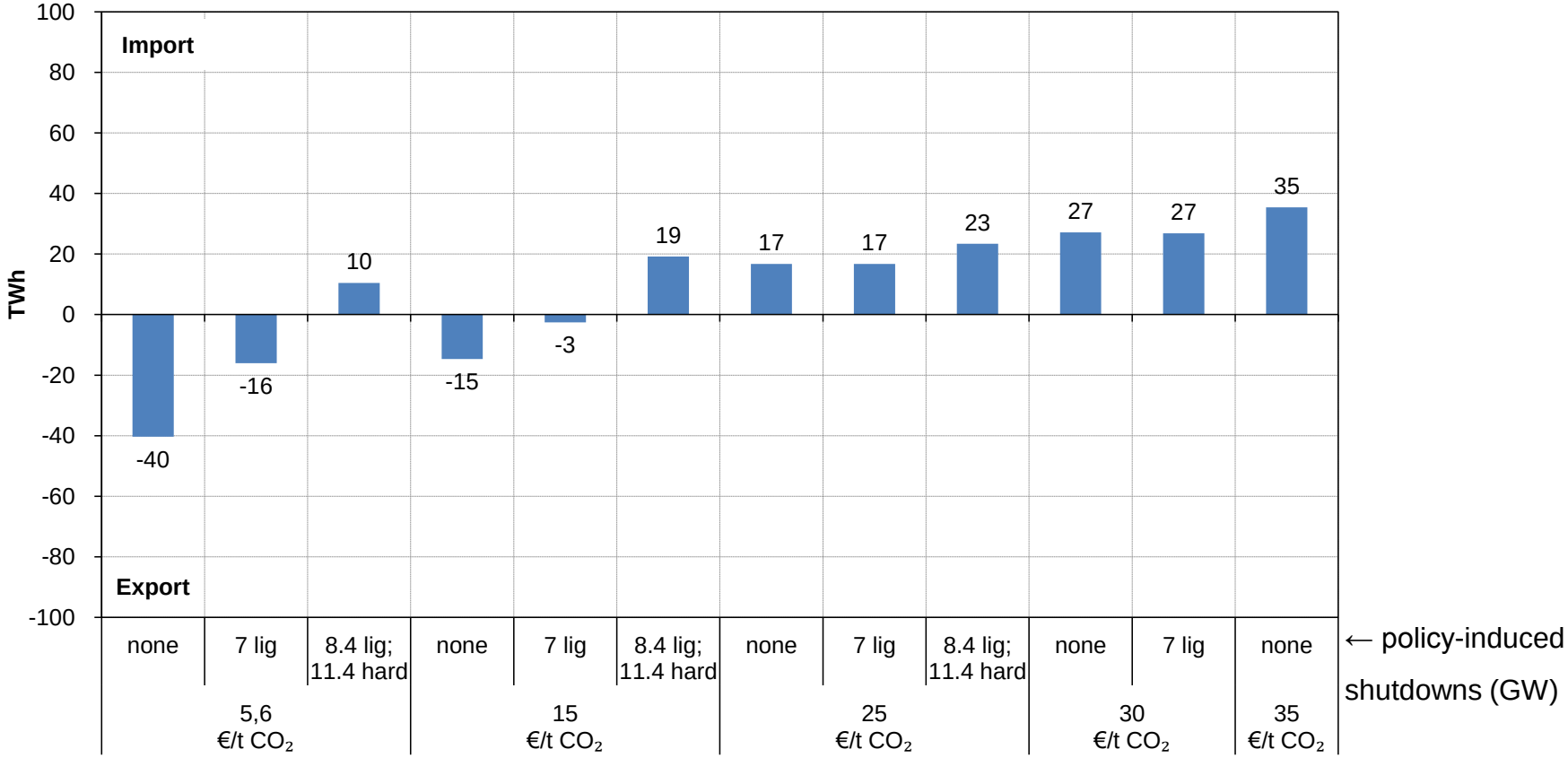
→ When policy-induced shutdowns of lignite power plants take place at same time:

… hard coal power plants are only shutdown when CO_2 prices (regional market) are approx. 25 €

… shutdowns of natural gas power plants are avoided when carbon floor prices (regional market) are approx. 25 €.

Electricity import-export balance

Carbon floor prices, policy-induced shutdowns and combinations

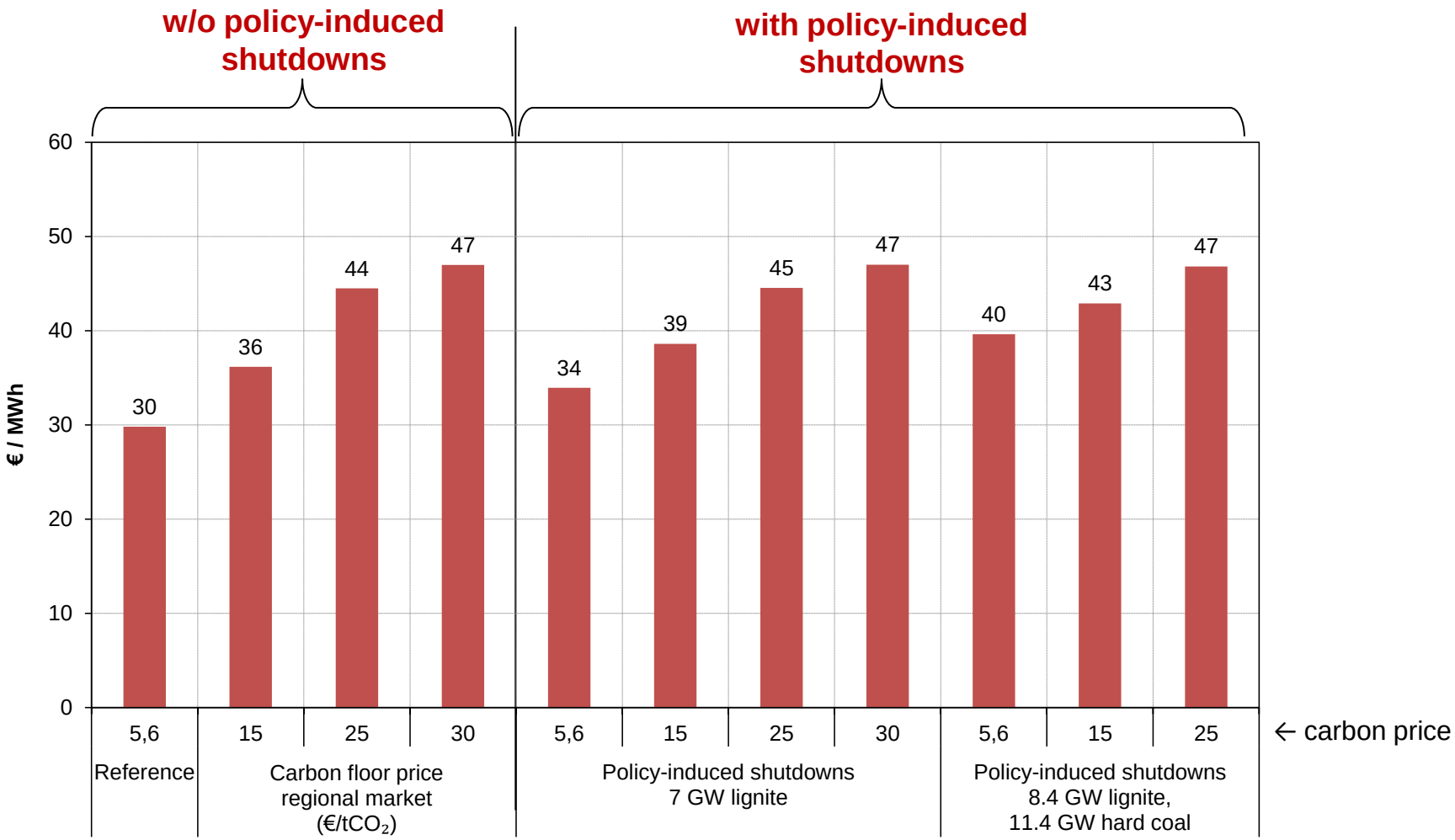


→ Higher carbon prices (also in regional market) lead to reduction of net electricity exports and to higher net electricity imports

→ Reminder: This only occurs if no new (natural gas) power plants are built in DE.

Wholesale electricity prices

Carbon floor prices, policy-induced shutdowns and combinations



→ Carbon prices dominate the electricity price effects on wholesale market

Conclusions

Summary
Emission reductions in Germany (1)

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- **Medium emission reduction targets for Germany would require carbon price levels of ~30-35 €/t CO_2**
- **The alternative would be forced the shut-down >50% of the coal fleet in the up-run to 2030 (ratio hard coal/lignite is important)**
- **Embarking on an ambitious emission reduction trajectory with carbon floor prices in the range of 15-20 €/t CO_2 would potentially require an hybrid approach**
  - (hybrid model of early shut-down with compensation and an increasing carbon price floor – which is important also to increase (dis)investor certainty)
- **It is completely unclear whether the coming government is willing to go for an carbon pricing approach (solely or in the framework of a hybrid approach)**
- **Enabling factors for the carbon floor price could be, however,**
  - the cost exposure of the electricity-intensive industries
  - the opportunities from cross-border cooperation (beyond the narrow energy & climate policy perspective)

Summary
Emission reductions in Europe

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- **Positive overall effect on GHG emission reductions**
  - In all scenarios considered, the emission reduction in Germany is substantially higher than the increase in emissions in its neighbouring countries
- **Rebound effects within Germany and abroad (= emission increase of the power plants that adopt electricity production of power plants with decreased production) can be effectively limited by carbon floor prices in regional market**
  - Carbon floor prices in regional market of approx. 25 €/t CO_2 substantially reduce the rebound effect in Germany as well as in European neighbouring countries
- **Higher emission reductions in combination of rather low carbon floor prices with power plant shutdowns**
  - With carbon prices of <25 €/EUA, higher GHG emission reductions are achieved through combination with policy-induced power plant shutdowns (in Germany).

Summary
Energy sector effects (1)

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- **Wholesale electricity prices**
  - Lower with policy-induced shutdowns than with carbon floor price
  - But policy-induced shutdowns can entail compensation payments (incl. scarcity prices but only when X €/MWh)
  - Effects for final energy users:
    - Approx. 50% of increase of wholesale electricity prices is absorbed via reduced EEG surcharge for final energy users that pay the (full) EEG surcharge
    - Effects for electricity-intensive industries that qualify, as before, for compensation of indirect CO_2 costs can be relieved via corresponding compensations (this essentially depends on legal design but is possible, see carbon floor price in UK)
    - Connection to other changes in tax, levy and surcharge systems (e.g. partial reduction of electricity tax) can likewise contribute to decrease of distribution effects.

Summary
Energy sector effects (2)

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- **Security of supply**
  - Extensive power plant shutdowns necessitate complementary measures to ensure security of supply: demand response, gas power plants, electricity storage if necessary.
- **Balance of electricity import and exports (for Germany)**
  - Carbon floor price tends to have larger effects on electricity import-export balances than policy-induced shutdowns of power plants (considered here)
  - With approx. 20 €/EUA in regional market, Germany's imports and exports are balanced; with higher carbon prices, there are net imports
    - The latter only occurs under the condition that no new gas-fired power plants are built in Germany, which could become necessary in any case with a view to security of supply
  - Reduced electricity exports from Germany increase production of hard coal (if carbon prices remain under approx. 20 €) and natural gas power plants in European neighbouring countries.

Thank you very much

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