



The Future of Carbon Markets

Presentation to the World Coal Institute
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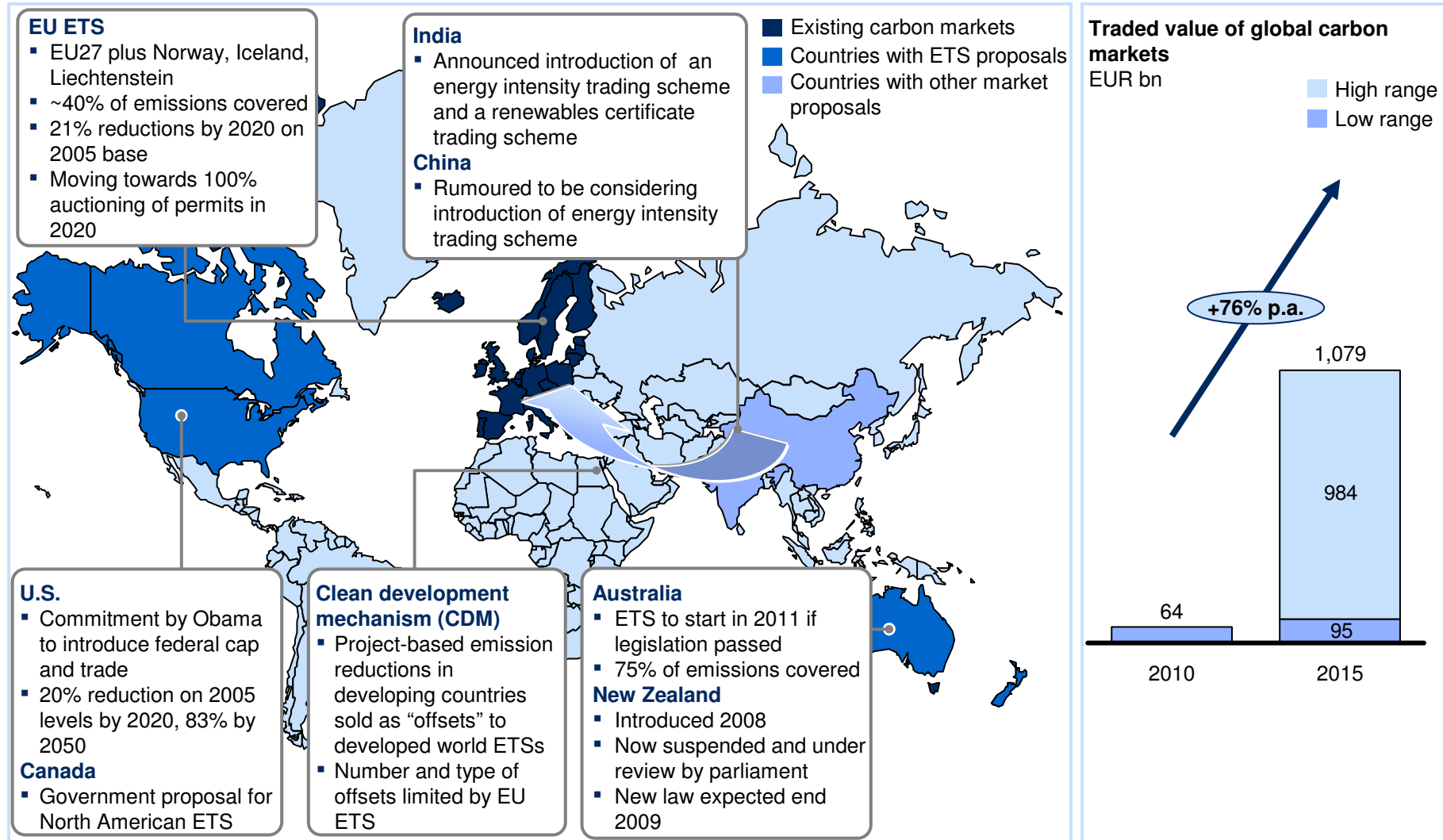
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Executive summary

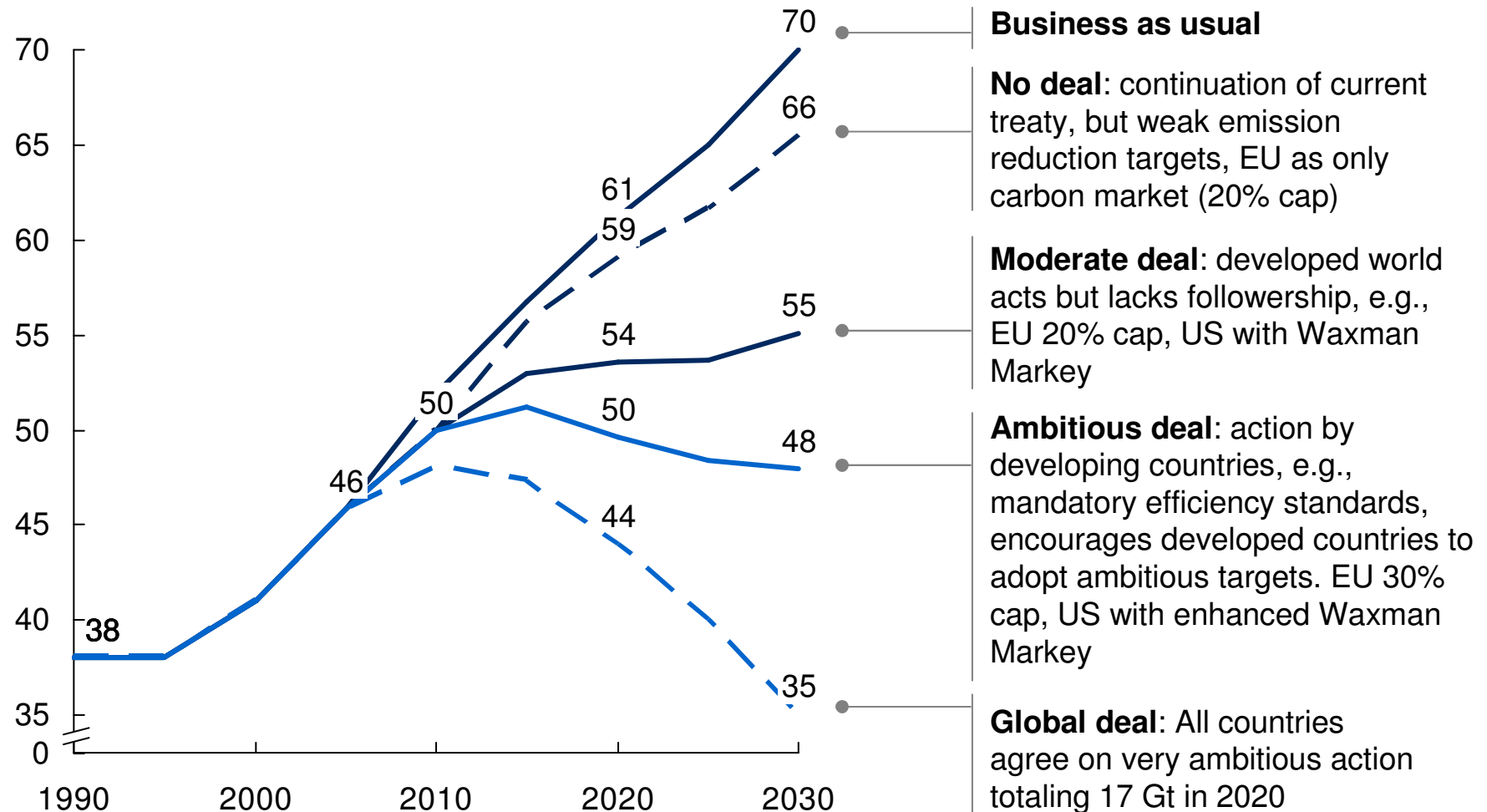
- Carbon markets could experience dramatic growth in coming years, but **carbon prices are driven largely by the outcome of the global deal and are therefore highly uncertain**
- **In the short term, carbon prices disadvantage coal by driving coal-to-gas shift in power.** Further coal-to-gas shift could be motivated by transport abatement which reduces oil demand, potentially lowering the oil price and with it, the gas price. Pricing of fugitive methane emissions would further decrease coal demand, but potentially increase profit for some producers.
- **In the long term, demand for coal is at risk of being stranded between two extremes of possible carbon market outcomes:** a weak deal and low carbon price may drive only a modest drop in coal demand; a strong deal, high carbon price and support for CCS could boost coal demand; Anything in-between could lead to substantial decline.

Carbon markets could experience dramatic growth in the developed and potentially developing world under proposed regulation



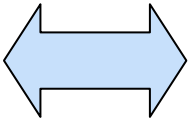
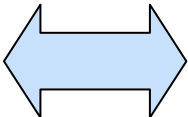
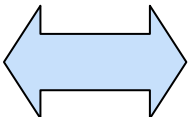
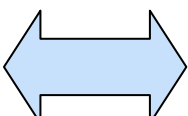
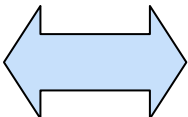
But a wide range of potential global deal outcomes need to be considered when assessing the outlook for carbon markets

Global emissions impact of carbon markets (excluding potential non-market approaches), Gt CO₂e



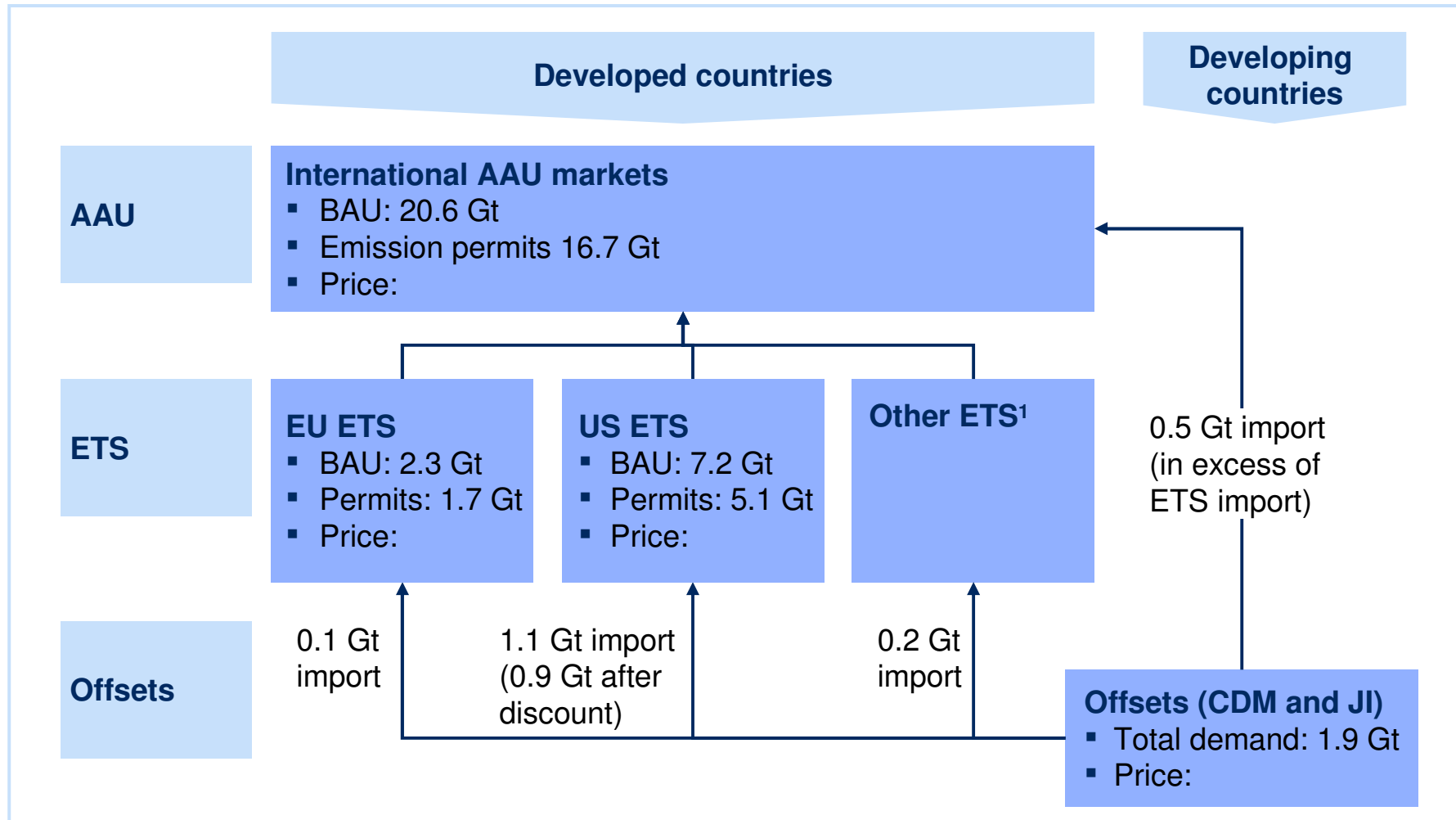
Carbon prices will also be driven by a number of other factors

NOT EXHAUSTIVE

	<u>Low carbon prices if...</u>		<u>High carbon prices if...</u>
Energy prices	<ul style="list-style-type: none"> Persistent high prices for oil and gas, making energy efficiency more attractive and driving renewables penetration 		<ul style="list-style-type: none"> Low energy prices, increasing the cost and decreasing the penetration of energy efficiency and renewables
Economic growth	<ul style="list-style-type: none"> Low economic growth, reducing BAU emissions and demand for abatement; Also reduces cost of capital making abatement investments cheaper 		<ul style="list-style-type: none"> High growth, making additional, more expensive abatement necessary on the margin High growth boosts cost of capital
Technological progress	<ul style="list-style-type: none"> Broad set of abatement levers viable at low cost e.g., CCS Some breakthrough technologies e.g., dramatically improved battery technology 		<ul style="list-style-type: none"> Many proposed abatement technologies never materialise Low learning rates on renewables keeps prices high
Policy effectiveness	<ul style="list-style-type: none"> Effective policy developed to deliver full technical abatement potential, in particular, for energy efficiency and forestry 		<ul style="list-style-type: none"> Limited progress on effectiveness of energy efficiency and forestry policy
Carbon market design	<ul style="list-style-type: none"> Strong market linkages Banking and borrowing allowed; long time horizons Price ceilings applied 		<ul style="list-style-type: none"> Markets evolve independently with short time horizons Price floors applied

McKinsey has developed a carbon markets model that solves for carbon prices under a given global deal scenario

2020 snapshot, Moderate deal scenario

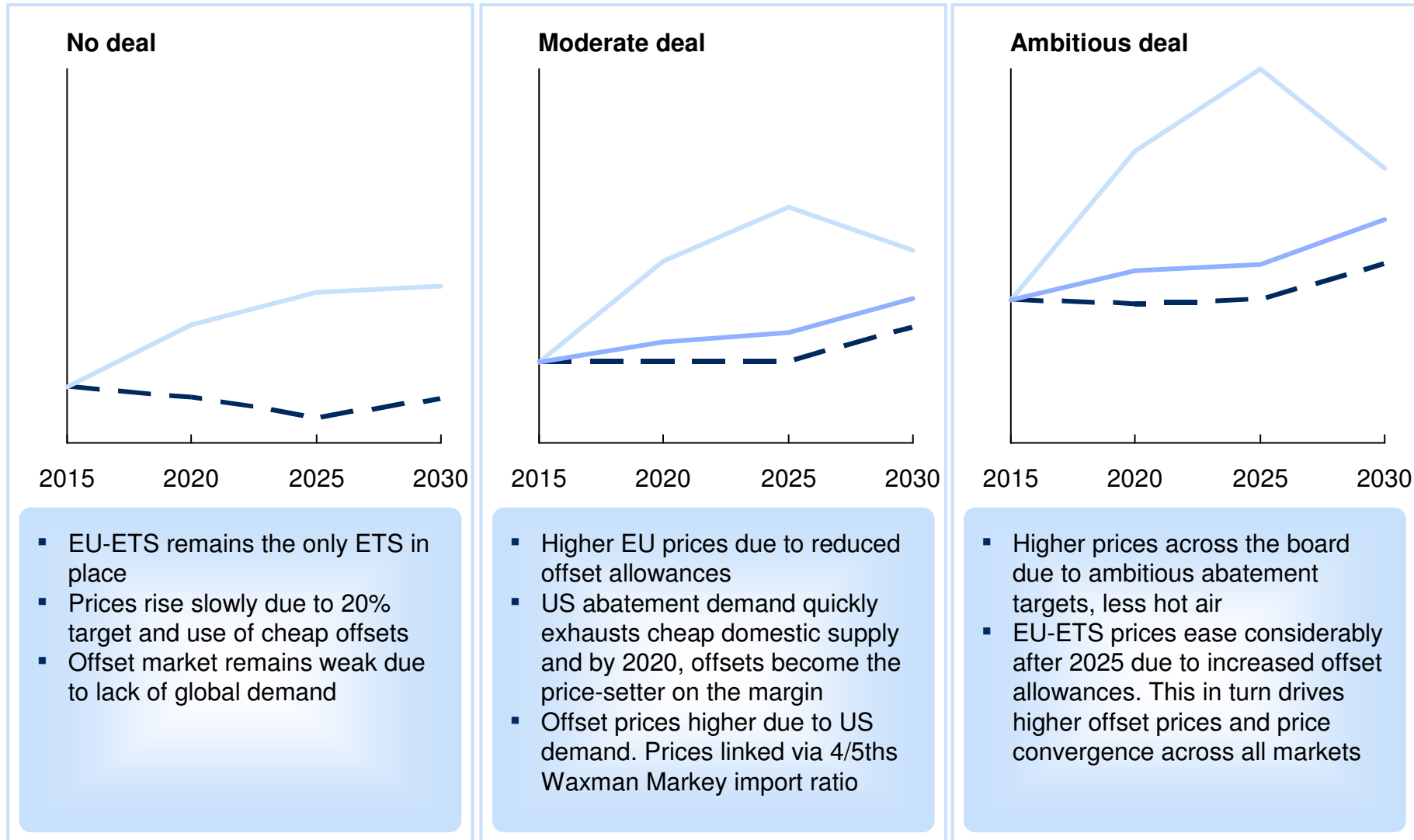


1 Australia and Canada

We forecast a rise in EU-ETS prices through 2025, but the outcome is highly sensitive to the global deal scenario

Carbon prices, EUR/t CO₂e

— EU ETS
— US ETS
- - - Offset



- EU-ETS remains the only ETS in place
- Prices rise slowly due to 20% target and use of cheap offsets
- Offset market remains weak due to lack of global demand

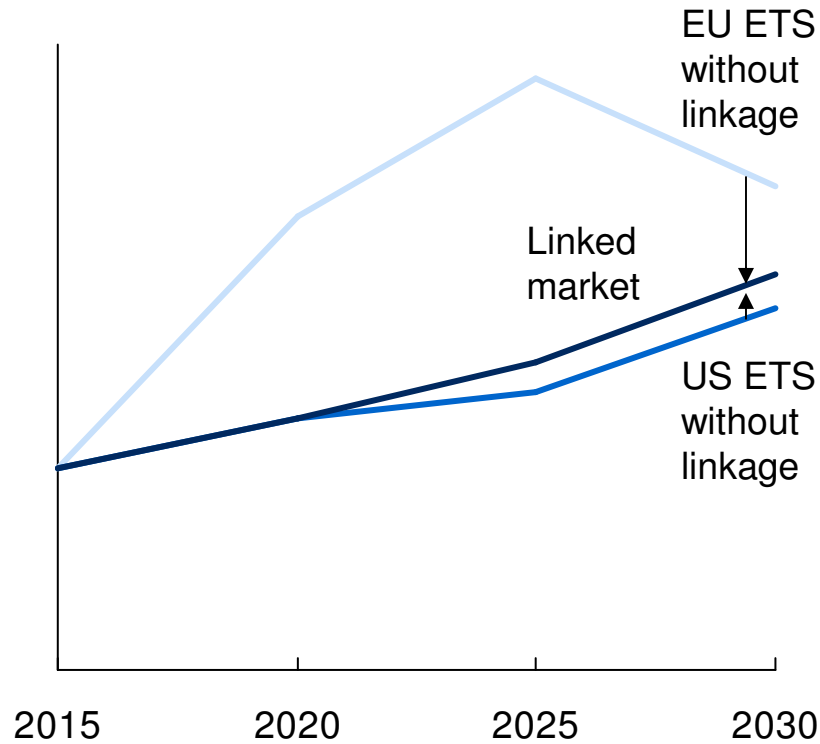
- Higher EU prices due to reduced offset allowances
- US abatement demand quickly exhausts cheap domestic supply and by 2020, offsets become the price-setter on the margin
- Offset prices higher due to US demand. Prices linked via 4/5ths Waxman Markey import ratio

- Higher prices across the board due to ambitious abatement targets, less hot air
- EU-ETS prices ease considerably after 2025 due to increased offset allowances. This in turn drives higher offset prices and price convergence across all markets

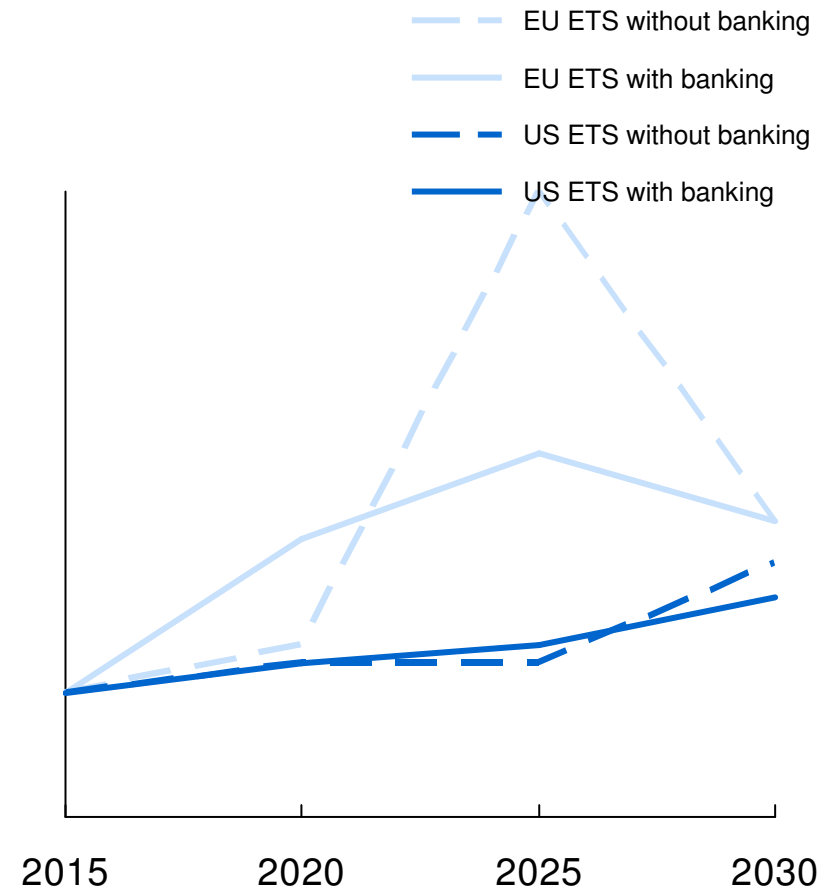
The model also allows the impact of carbon market architecture to be understood

Carbon prices, EUR/t CO₂e, Moderate deal scenario

Linkage between markets causes prices to converge



Banking and borrowing smoothes carbon prices over time

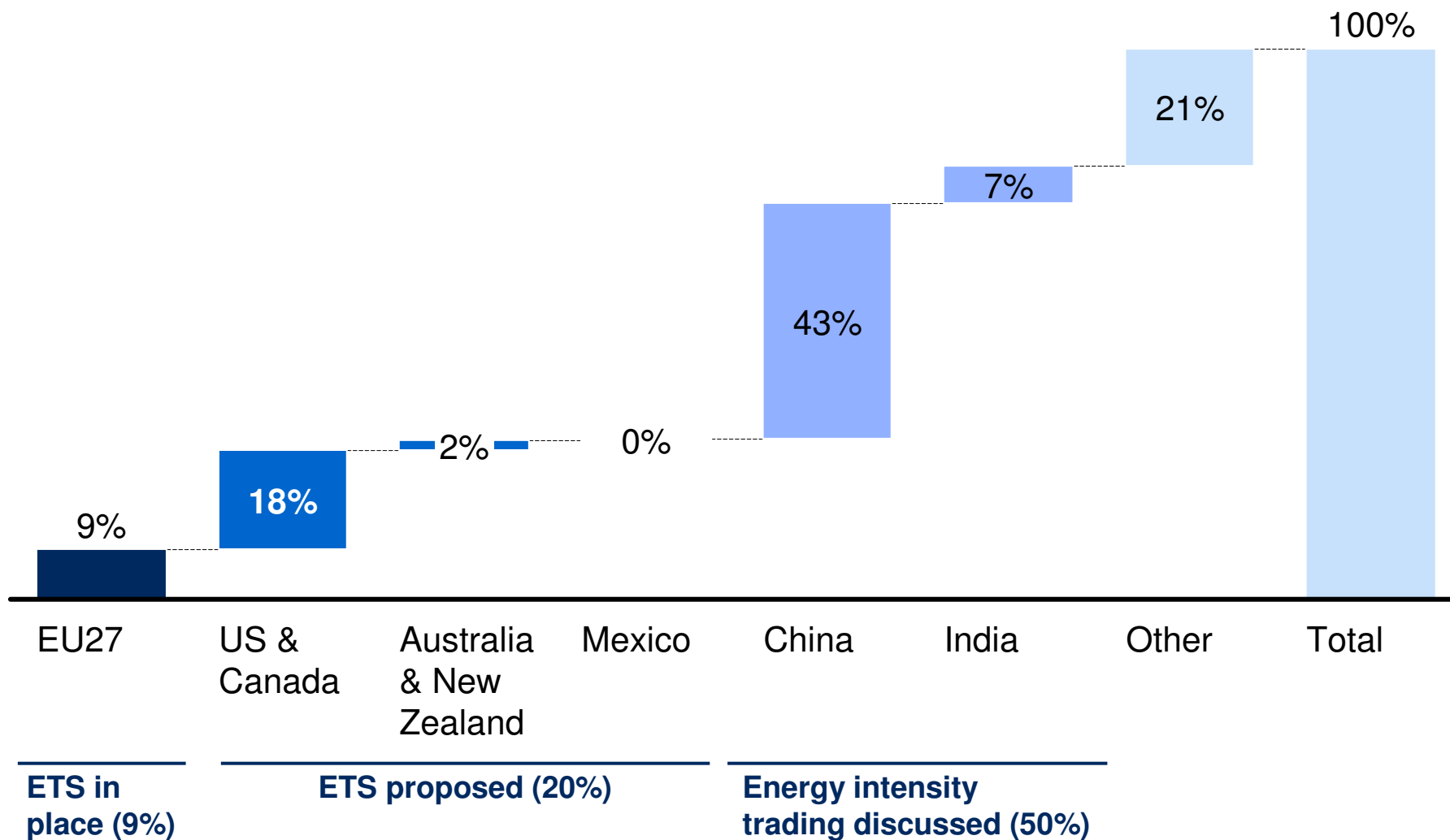


Carbon markets affect the coal industry in four main ways

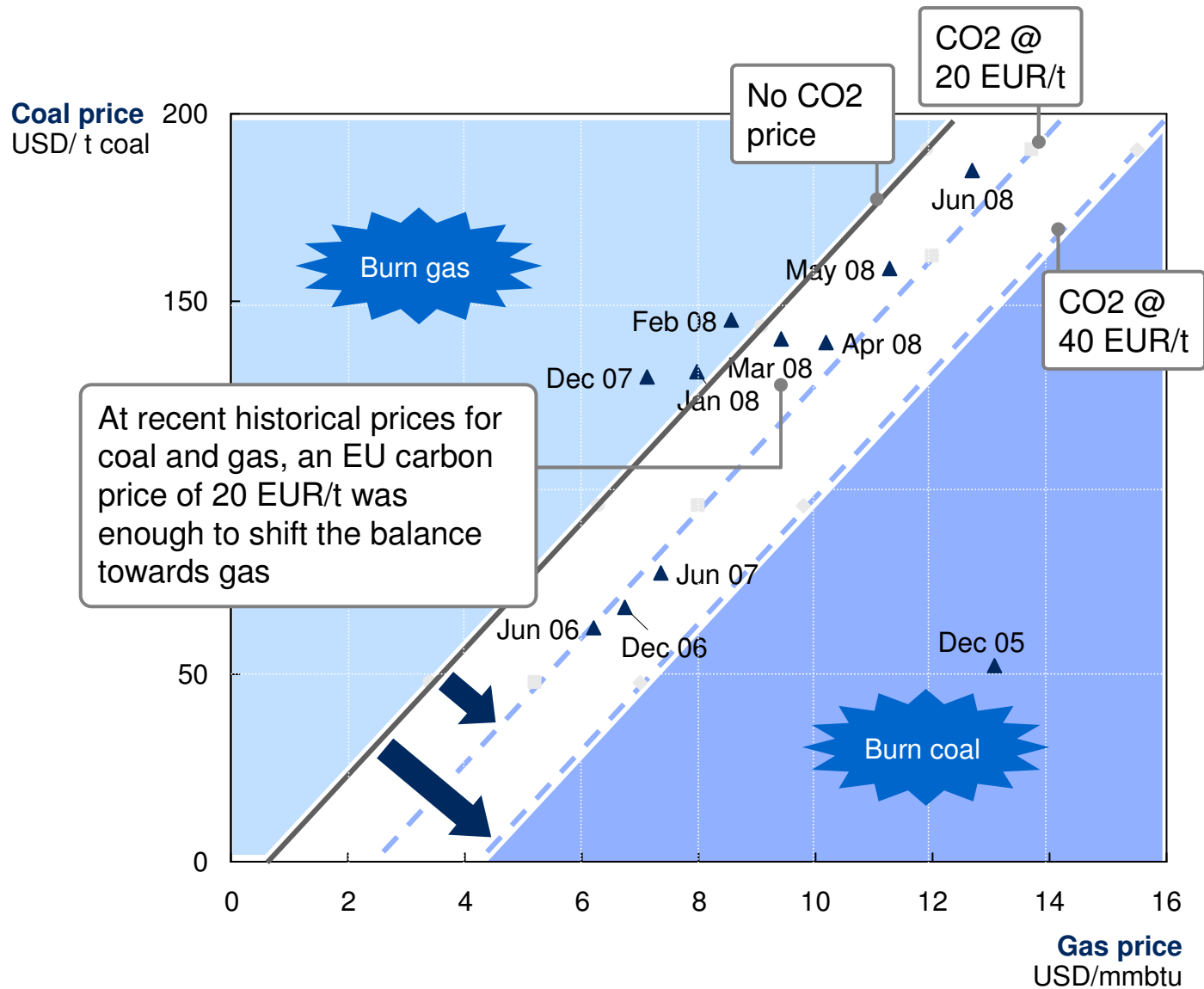
- 1 Carbon pricing in the power sector makes coal more expensive relative to gas and other low-carbon technologies, driving down demand
- 2 After 2020, CCS could potentially boost demand for coal if supported by a sufficiently high carbon price
- 3 Carbon regulation could impact other energy prices such as oil, indirectly affecting demand for coal in power through the oil-gas price linkage
- 4 Potential pricing of fugitive methane emissions would change the merit order of the coal industry and have an asymmetric impact of profitability

1 Less than a third of global coal consumption will fall within current and proposed ETS schemes

Share of global coal consumption



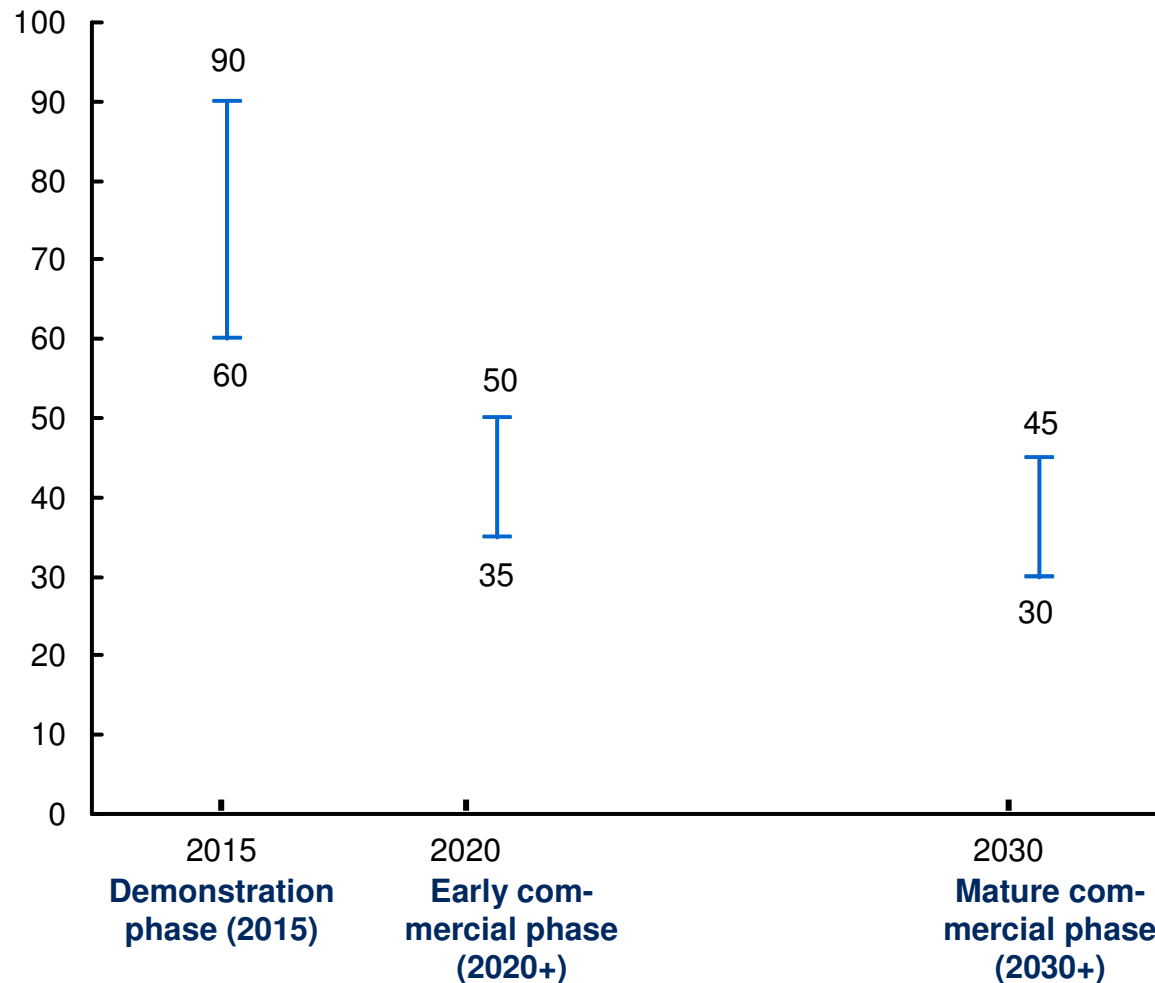
1 But within affected markets, carbon pricing even at recent levels can drive significant coal to gas shift in power sector



② Longer term, CCS could become economically viable but will require additional regulatory support beyond a carbon price

Cost of CCS on new build coal, EUR/t CO₂e

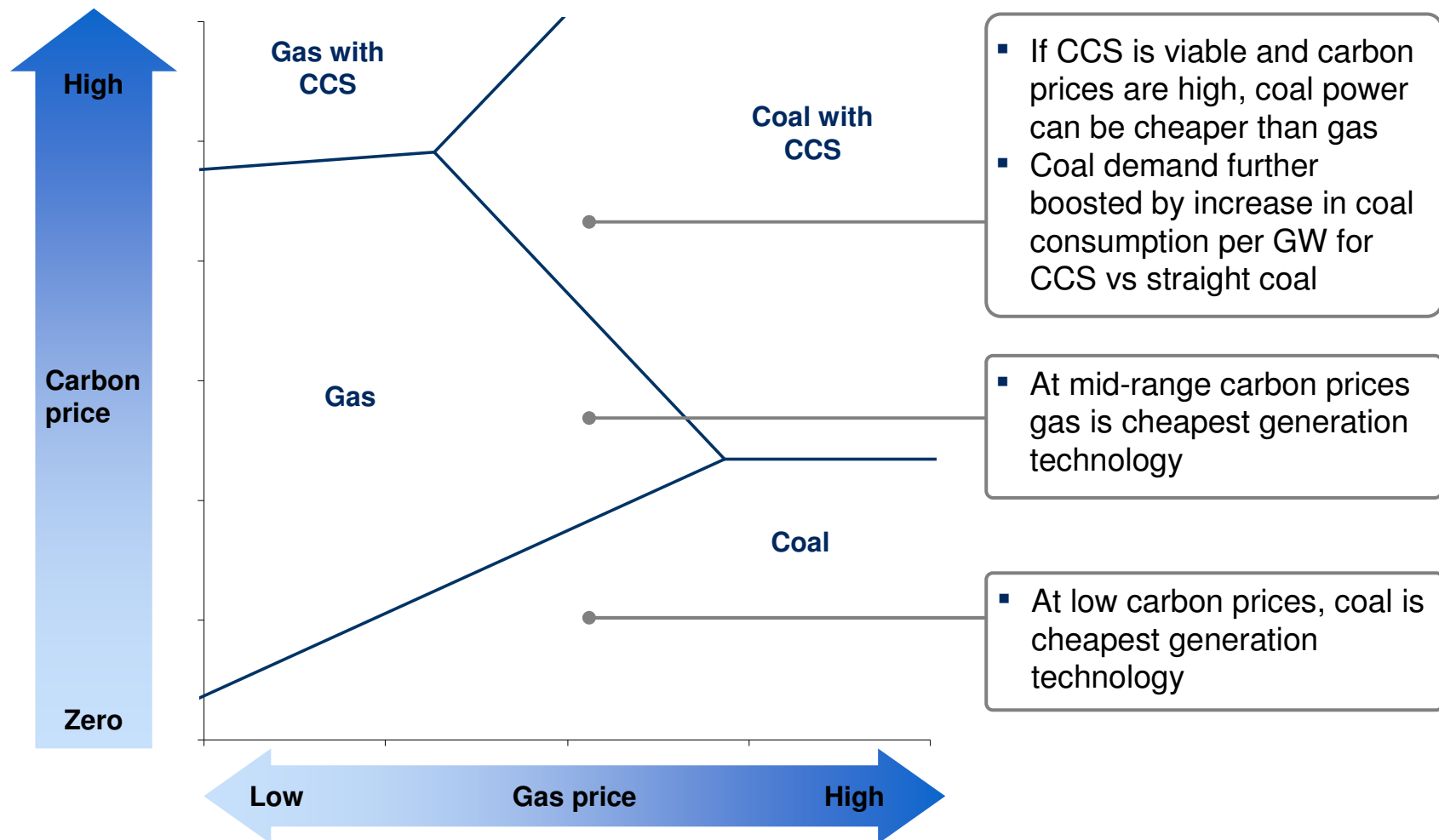
— Range of CCS cost forecasts



- Carbon price could be high enough to support CCS in EU from 2020; Unlikely in U.S. even in 2030
- In addition to a high carbon price, CCS would require additional policy support to overcome:
 - long-term regulatory and pricing risk in carbon markets
 - long-term risk of CO₂ leakage from reservoirs
 - amount of upfront capital investment required

② This could create a potential “no man’s land” where coal succeeds at high or low carbon prices, but suffers in-between

Cheapest power generation technology as a function of carbon price and gas price, 2030

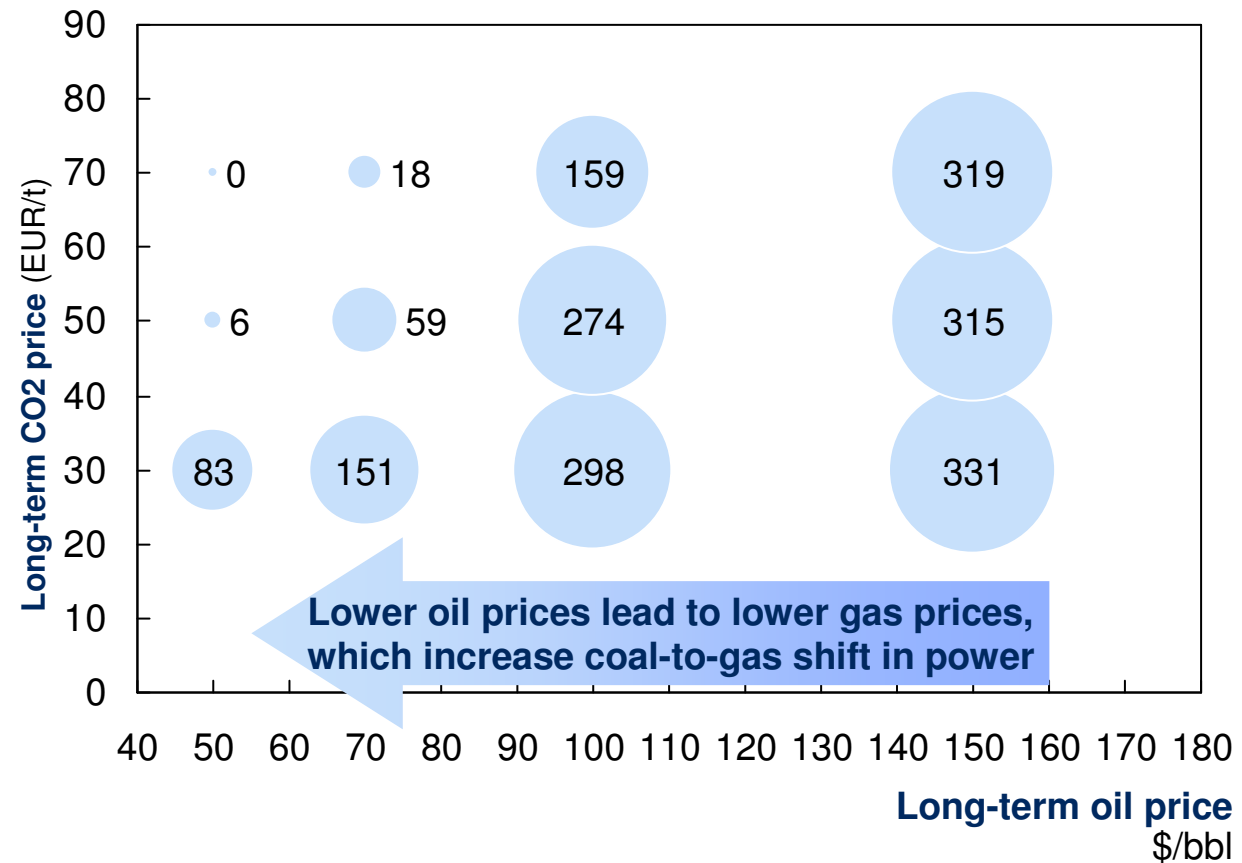


3 Carbon regulation could also impact coal indirectly if it depresses the price for oil via decreased demand

Bubble size is 2020 European seaborne energy coal demand, Mt

Main assumptions

- Assumed nuclear capacity in 2020 is 120 GW
- Assume that the gas-oil price linkage remains
- Long term coal price of \$75/ton
- Renewable share of generation mix stable at ~20% of total in 2020

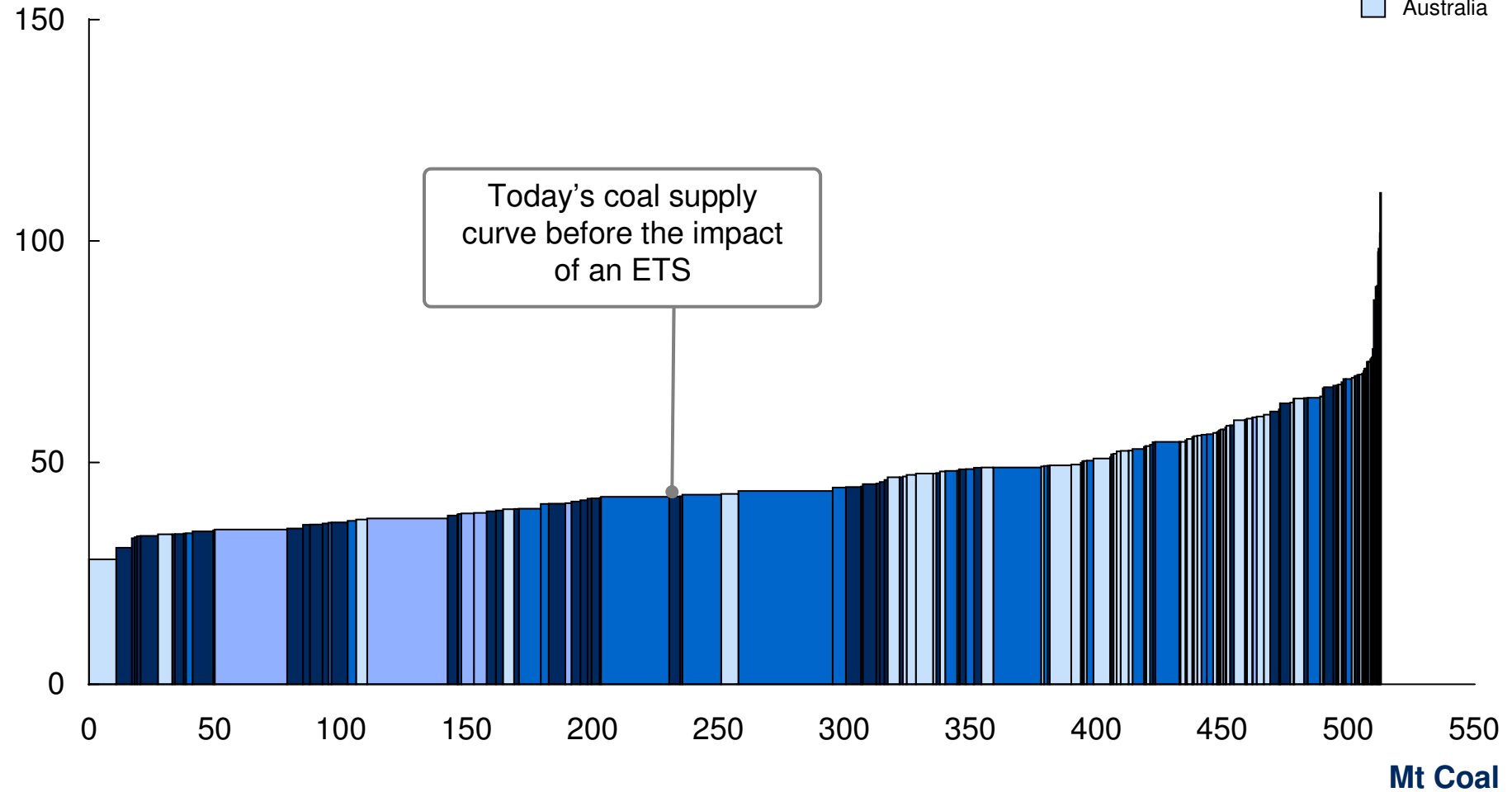


④ Where fugitive methane emissions in mining are covered by an ETS, cost may increase by up to 10% changing merit order

Coal supply curve 2008

Operational cash cost
USD / tonne of coal

- Others
- Indonesia
- Colombia
- Australia

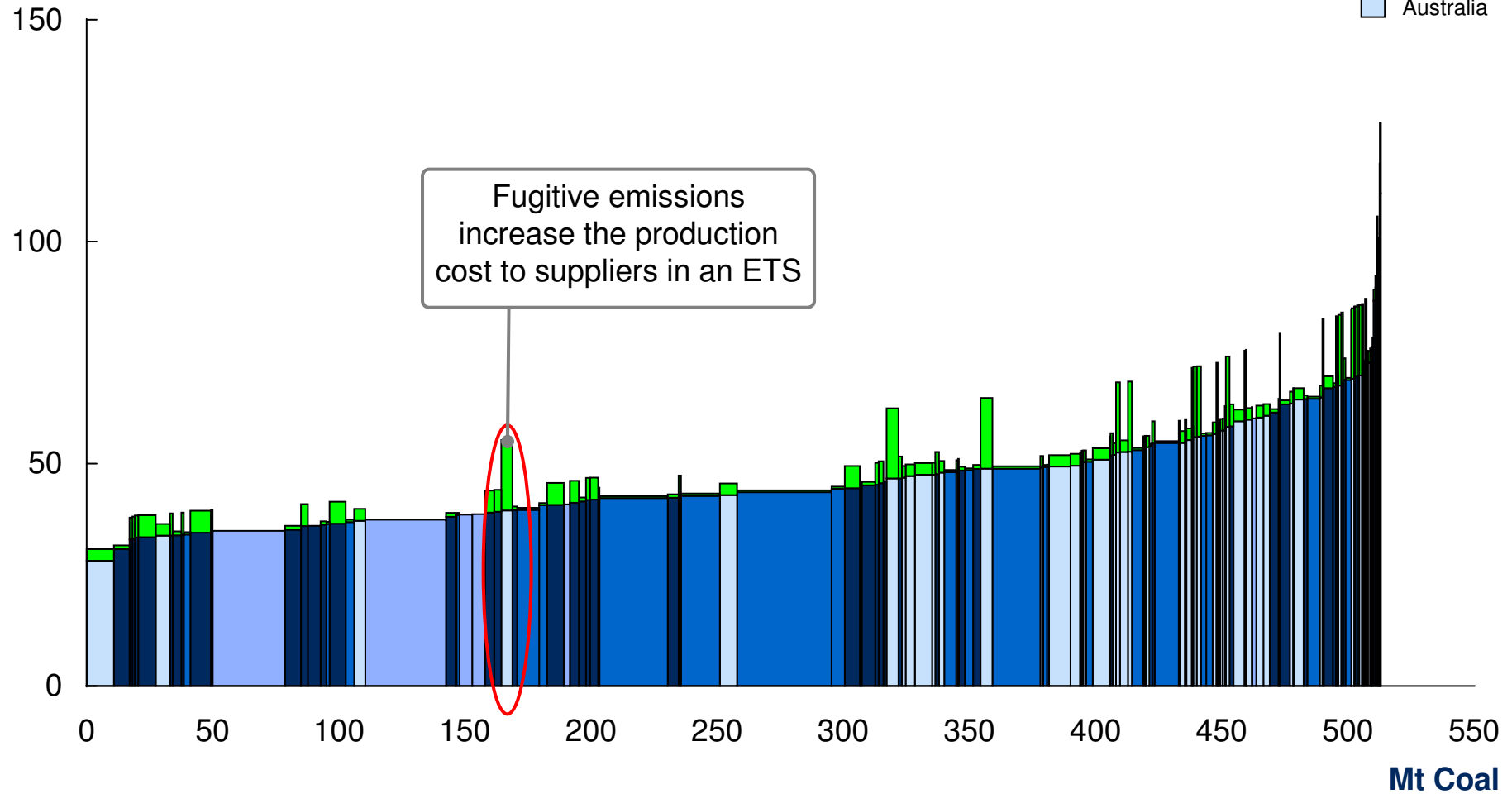


4 Where fugitive methane emissions in mining are covered by an ETS, cost may increase by up to 10% changing merit order

Coal supply curve 2008

Operational cash cost
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- CO2 cost
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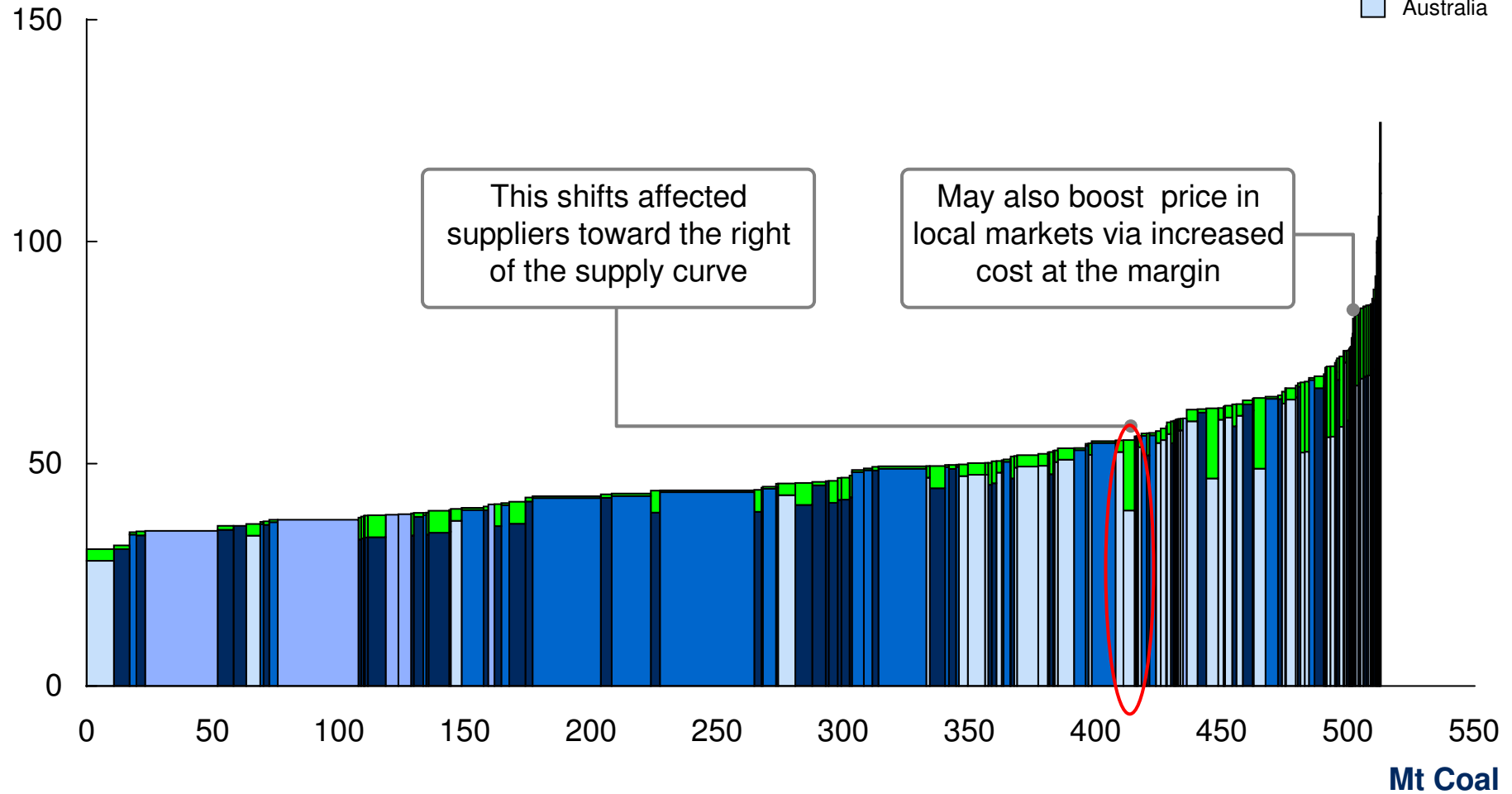


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The outlook for coal demand in the EU is weak unless CCS is viable long term and carbon prices are high

● Bubble size represents impact on coal demand*

Short term (2010-2020)

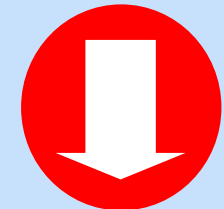
Long term (2020+)

Worst-case scenario for coal demand: 'The perfect storm'

- Ambitious or inefficient global deal leads to jump in carbon prices
- Rapid improvement in energy efficiency plus high renewable penetration reduces demand for fossil-fuel power
- Low oil/gas prices coupled with carbon price drive significant coal-to-gas shift



- CCS not viable, or does not get sufficient support to be implemented at scale
- Carbon prices increase, but not high enough to support CCS
- Further EE and renewables rollout supplemented by massive increase in nuclear



Best case scenario for coal demand

- Weak or delayed global deal keeps carbon prices low
- Proposed energy efficiency and renewables targets not met
- High gas prices limit further coal-to-gas shift
- Fugitive emissions stay out of ETS



- Ambitious global deal; Carbon prices > 45 EUR/t
- CCS takes off quickly with the benefit of additional policy support, increasing coal demand
- Significant electrification e.g., in transport, drives further power demand



* Describes the relative impact of carbon markets on coal demand, other things being equal. Other factors driving coal demand such as the LCP directive are not considered here

In light of the risks presented by carbon markets, coal producers need robust insight and strategy around three 'mission critical' areas

Actions required

Impact of carbon markets on the coal industry as a whole

- Develop and maintain long-term carbon price scenarios covering the full range of possible policy outcomes, as well as associated impact on coal demand
- Understand second-order effects between carbon, energy prices and power economics

Impact of carbon markets on own position on industry supply curve

- Understand impact of carbon markets and carbon pricing on future coal price in local market
- Develop strategy to protect margins and avoid moving down merit order. If decline inevitable, assess optimal exit strategy

Policy needed to protect the coal industry while reducing total emissions

- Support carbon market design that keeps carbon prices low in the short term, e.g., high offset allowances, borrowing
- Support mitigation measures in other sectors e.g., transport
- Lobby for financial support for CCS R&D and piloting
- Support an ambitious long-term global deal that will drive high carbon prices and protect viability of CCS