

IHS ENERGY

IHS Materials for presentation at National Association of Manufacturers webcast

EPA Clean Power Plan: Potential market impacts

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Kristian Bodek, Director, North American Power, 617 866 5185

Kristian.Bodek@ihf.com



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IHS Clean Power Plan (CPP) research agenda

- **IHS reference case (December, 2015).** A specially constructed case designed to reflect the likely evolution of the US power sector under current market and policy conditions, excluding the effects of federal CO₂ policy
- **State gap analysis (December, 2015).** State CO₂ emission rate and emissions trajectory under the IHS reference case versus its CPP goals. Also quantifies the changes required to close the anticipated 2030 compliance gap if a state were to go it alone and whether it would prefer rate or mass goals
- **Policy compliance analysis.** Compliance cases to assess the policy's potential impact across energy sectors, including power, renewables, natural gas, and coal, assuming interstate trading
 - National-level mass trading (April, 2016)
 - National-level rate trading (April, 2016)
 - Hybrid (June, 2016)

Reference case is designed to reflect the likely evolution of the US power sector under current market and policy conditions

Summary of IHS reference case for the contiguous United States

	Units	Reference
Power demand growth (compound annual average), 2014–30	%	1.4%
Coal-fired capacity retirements, 2015–30	GW	63
Nonhydro renewable capacity additions, 2015–30	GW	154
Natural gas-fired capacity additions, 2015–30	GW	167
Average power sector natural gas consumption, 2022–30	Bcf/d	39
Average Henry Hub natural gas price, 2022–30	2014 \$/MMBtu	3.57
Annual average power sector coal consumption, 2022–30	MMst	730
Power sector CO ₂ emissions, 2030	MMst	2,285
Power sector CO ₂ emissions in 2030 relative to 2005	%	-14%

Source: IHS

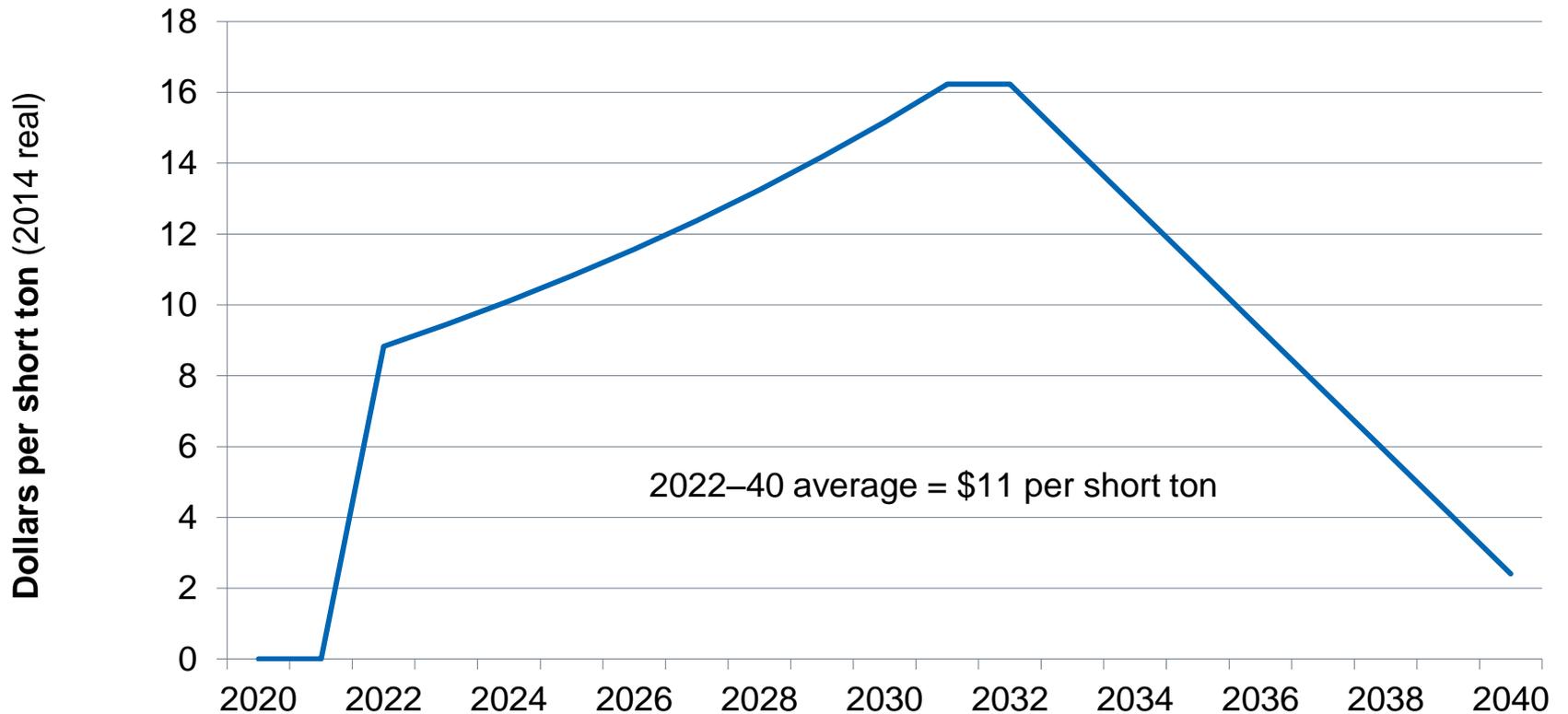
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Power and fuel market impacts explored in IHS policy compliance analysis

- Allowance / emission reduction credit price
- Coal plant retirements
- Natural gas plant additions
- Wind and solar PV plant additions
- Impact on power demand
- Natural gas demand and price
- Coal demand and price
- Power prices (wholesale and capacity)
- CO₂ emissions

Mass trading: CO₂ allowance price projection

Mass trading policy compliance analysis CO₂ allowance price, 2020–40

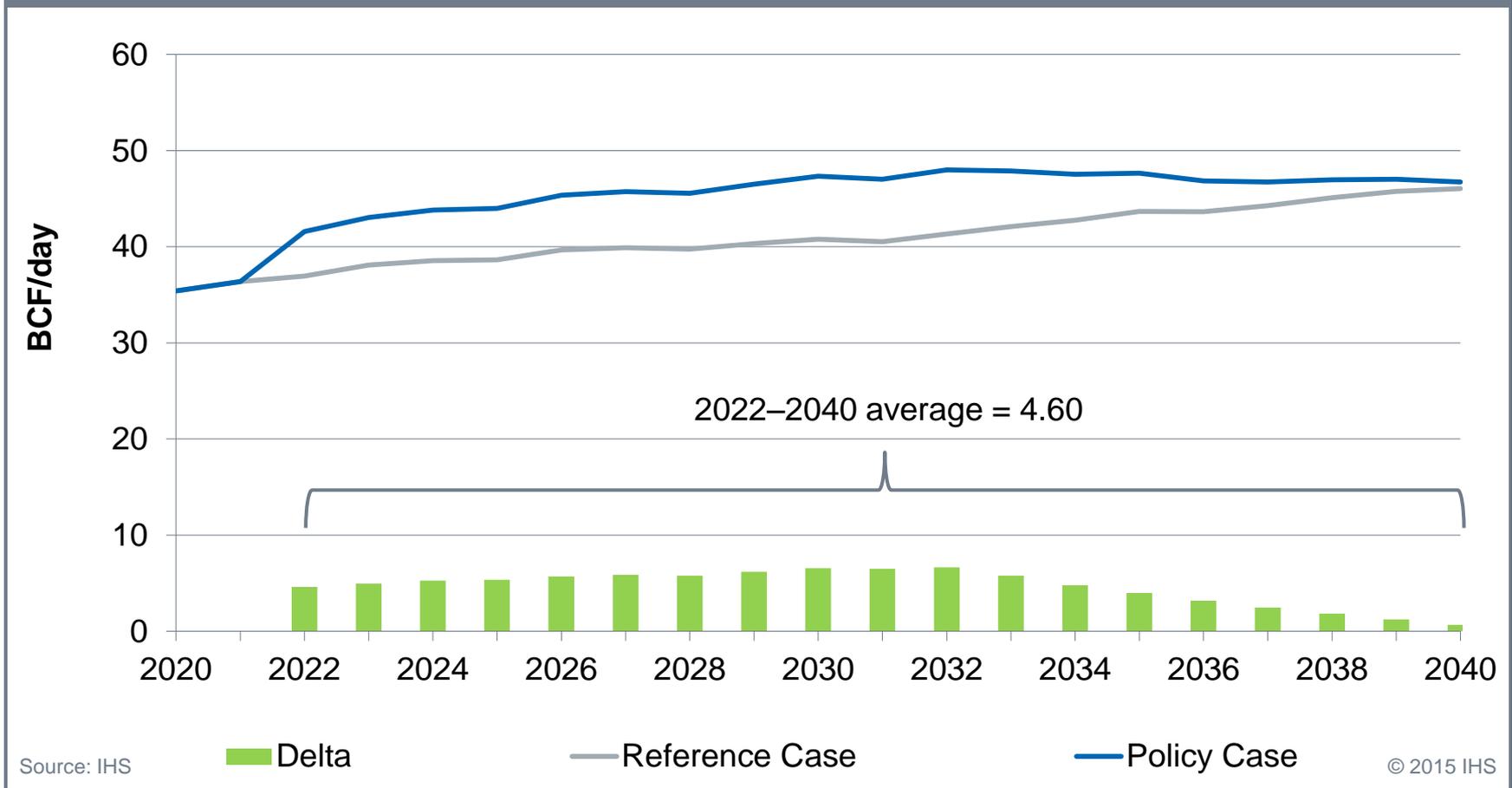


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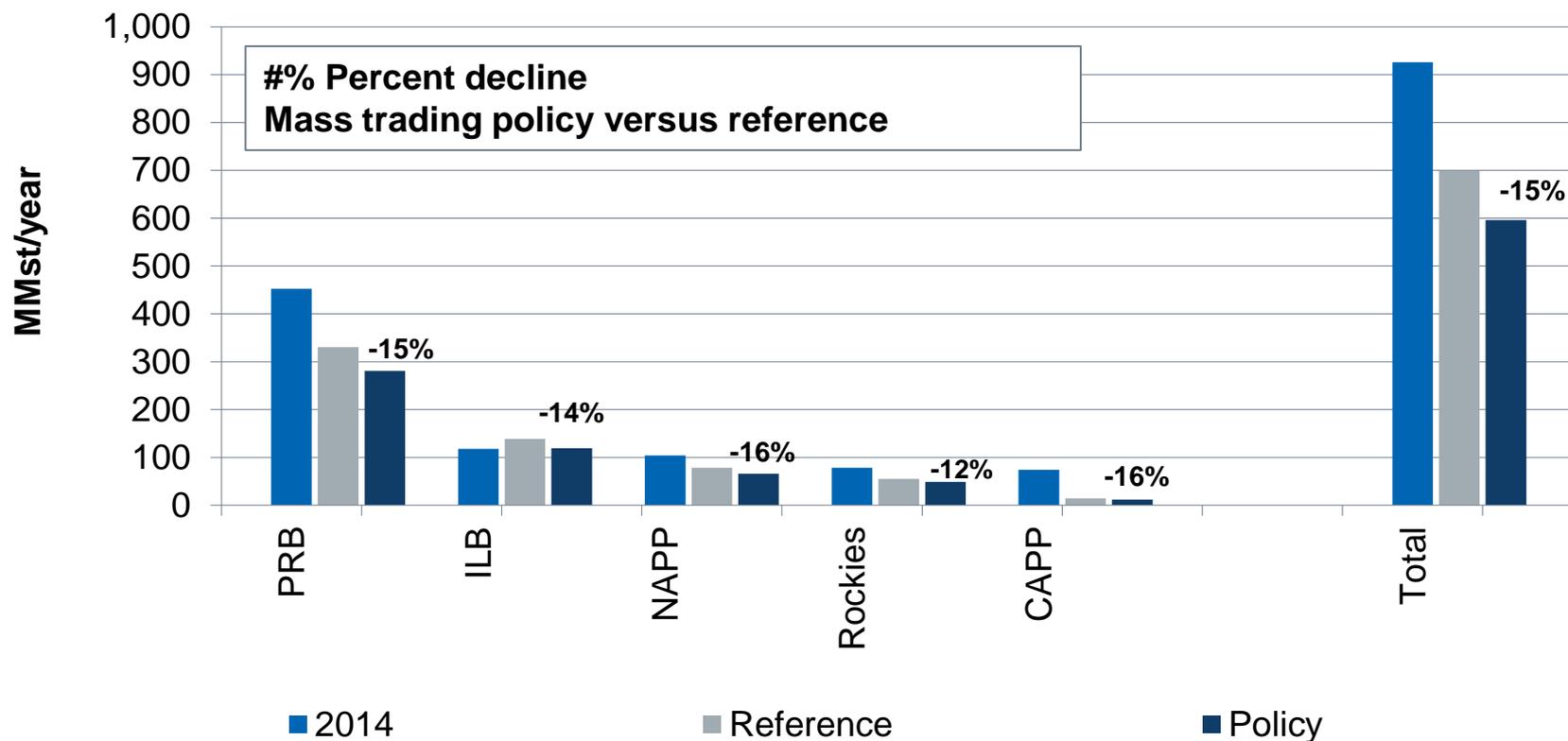
Mass trading: power sector natural gas consumption

Reference and mass trading cases power sector natural gas consumption, 2020–40



Mass trading: power sector coal consumption

Power sector coal consumption by basin: 2014 and averaged over 2022–40 in the reference and mass trading cases



Source: IHS Energy

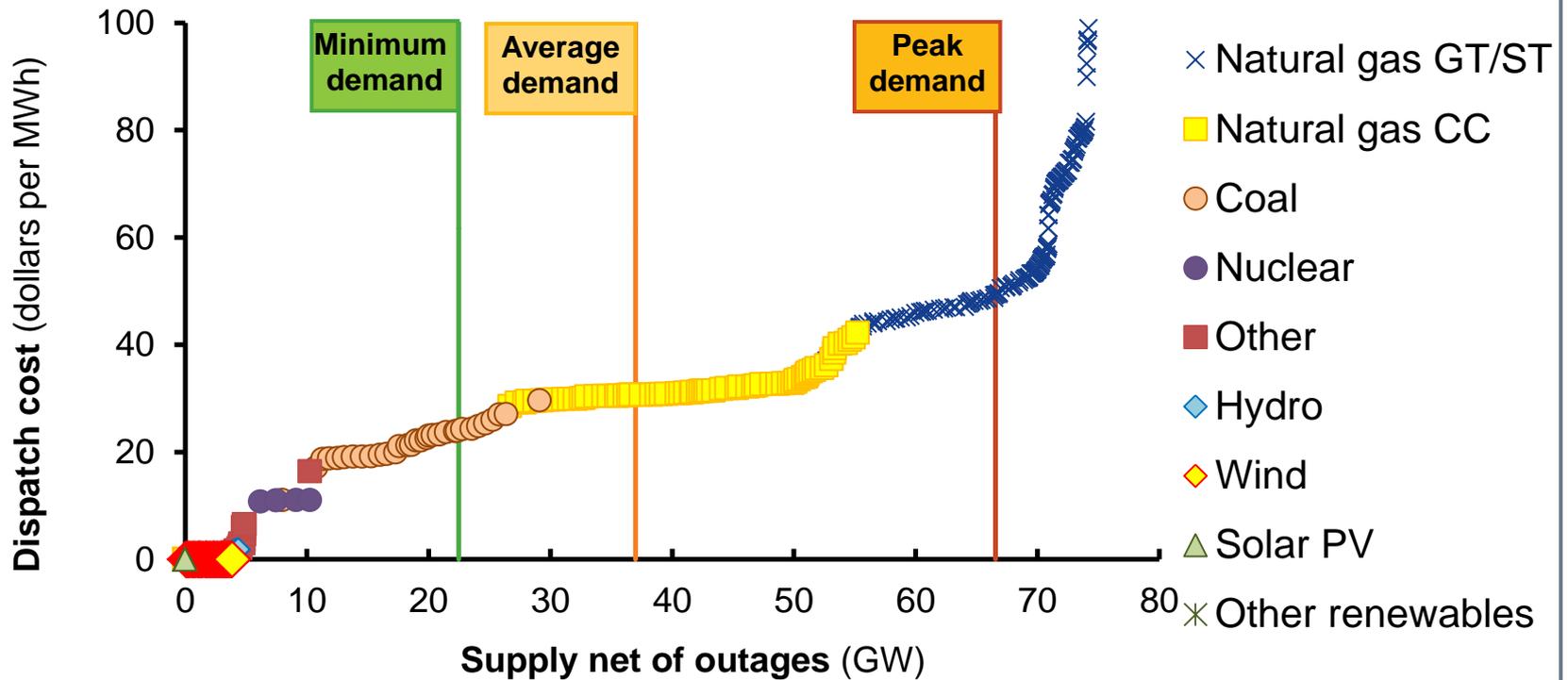
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Factors that drive the magnitude of the power and fuel market impacts across CPP compliance scenarios

- Rate- versus mass-based compliance
- Market versus tailored mechanisms
- Degree of regionalization or model rule-based trading
- Allowance allocation methodology
- Existing versus new + existing
- Traditionally regulated versus restructured markets

At 2014 fuel price levels, coal and natural gas CC units are segregated along the ERCOT supply curve but in close competition

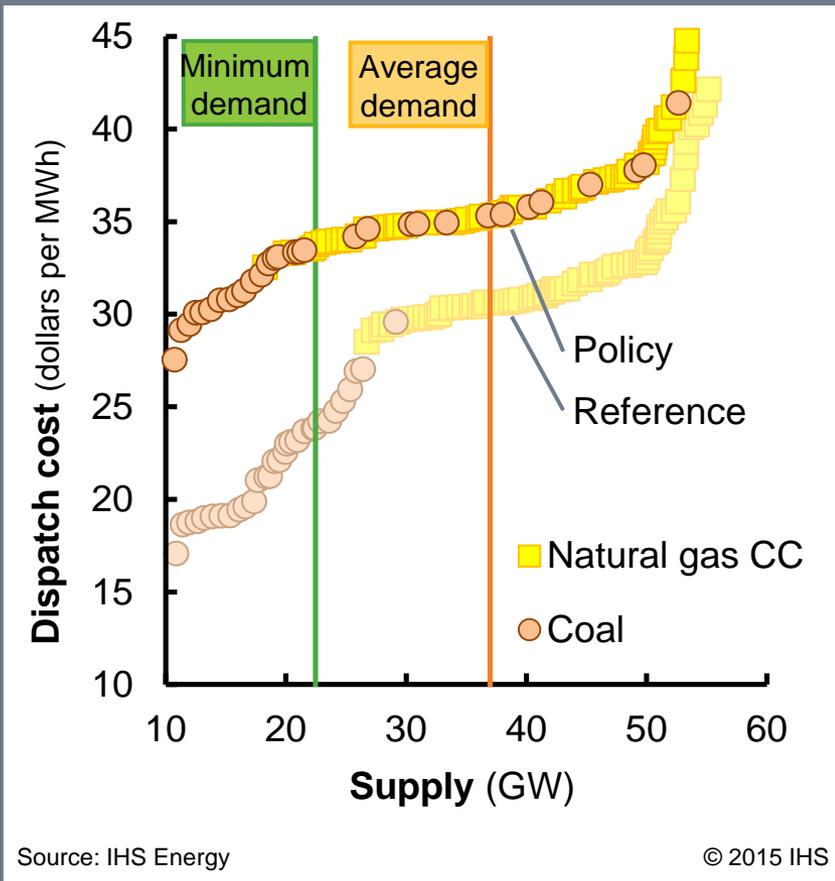
ERCOT power supply curve, 2014



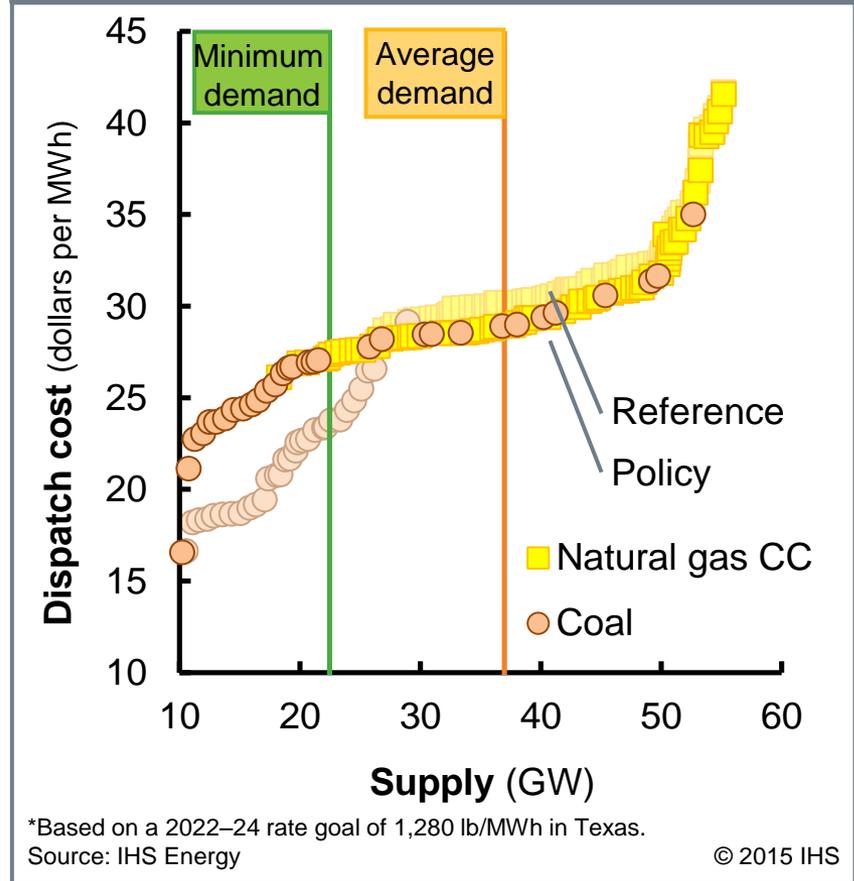
Key assumptions: Henry Hub gas price = \$4 per MMBtu; regional average coal price = \$1.7 per MMBtu

Mass and rate trading have different effects on power plant dispatch costs and thus wholesale power prices

Mass trading: Impact of a \$10 per short ton CO₂ price on a segment of the ERCOT supply curve.



Rate trading: Impact of a \$10 per short ton equivalent rate price on a segment of the ERCOT supply curve.*



Wholesale power price and capacity price impacts will vary between mass and rate trading

- Compliance via rate trading, versus mass trading, would reduce the impact on wholesale power prices
- Rate trading, however, is likely to have a relatively greater impact on capacity prices
 - CPP-driven coal retirements will accelerate the year in which power markets need new capacity to balance supply and demand and thus when capacity prices reflect the net cost of new entry
 - Under mass trading, new generators would recover more of their costs from the energy market and rely less on capacity payments
 - Under rate trading, new generators are required to rely more heavily on capacity payments to achieve revenue adequacy

Pennsylvania state profile

IHS reference case: Key statistics

Options	2012	2022	2030	2012-30 change
Affected coal (GW)	17	13	13	-5
Affected oil/gas steam (GW)	4	3	3	-1.6
Affected CCGT (GW)	10	10	10	-0.2
Affected steam/CCGT generation ratio (%)	64:36	56:44	58:42	-6:+6
Nuclear (GW)	10	10	10	+0.3
Wind (GW)	1	2	2	+1
Solar (GW)	0.2	0.6	0.9	+0.7
EE (% of 2012 sales)	1%	3%	7%	+6%

Source: IHS

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Independent options for achieving 2030 compliance

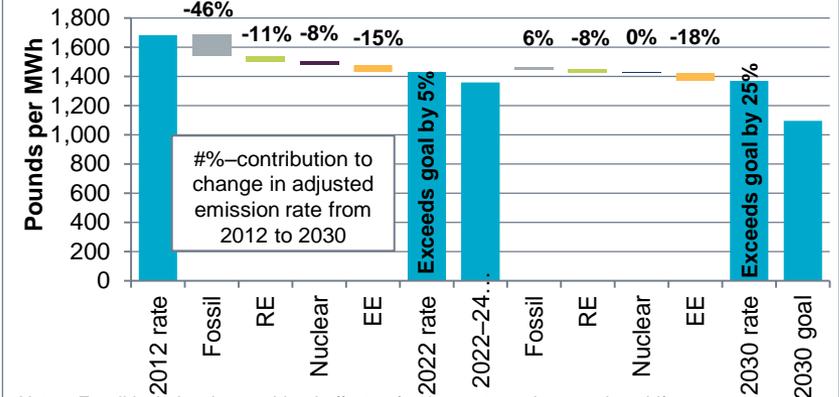
Options	IHS reference case, 2030	Change to meet:	
		Rate goal	Mass goal
Coal (GW)	13	-7	-2
Steam/CCGT generation ratio (%)	58:42	Not achievable	Not achievable
Nuclear (GW)	10	+2	+2
Wind (GW)	2	+4	+4
Solar (GW)	1	+12	+10
EE (% of 2012 sales)	7%	+19%	+9%

Notes: Each option represents a stand-alone measure that, incremental to IHS's reference case outlook for 2030, would enable a state to comply with its rate and mass goals.

Source: IHS

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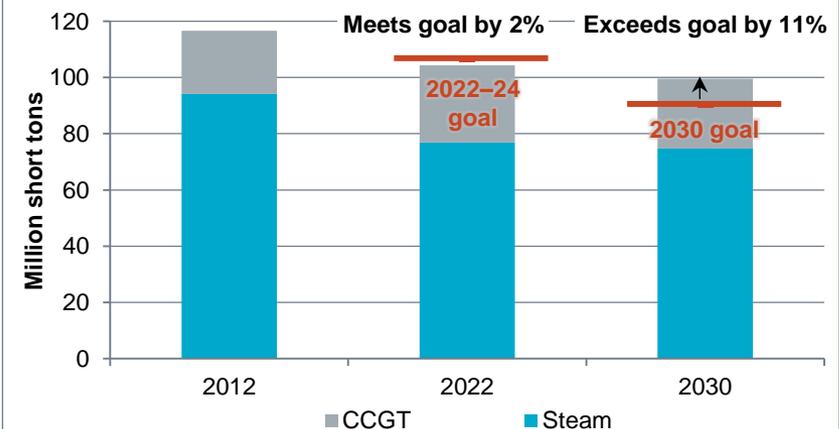
Rate goals versus IHS reference case adjusted CO₂ emission rates



Notes: Fossil includes the combined effects of retirements and generation shift.
Source: IHS

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Mass goal versus IHS reference case CO₂ emissions



Source: IHS

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Questions and answers

- **Kristian Bodek**, Director, North American Power

617 866 5185, Kristian.Bodek@ihs.com

- **Barclay Gibbs**, Senior Director, North American Power

202 481 7775, Barclay.Gibbs@ihs.com

- **Rita Beale**, Senior Director, Power, Gas, Coal & Renewables

202 481 9249, Rita.Beale@ihs.com

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