Power and Renewables

Presentation

Harvard Electric Policy Group

Subsidies in Electricity Markets: Tilting at Windmills?

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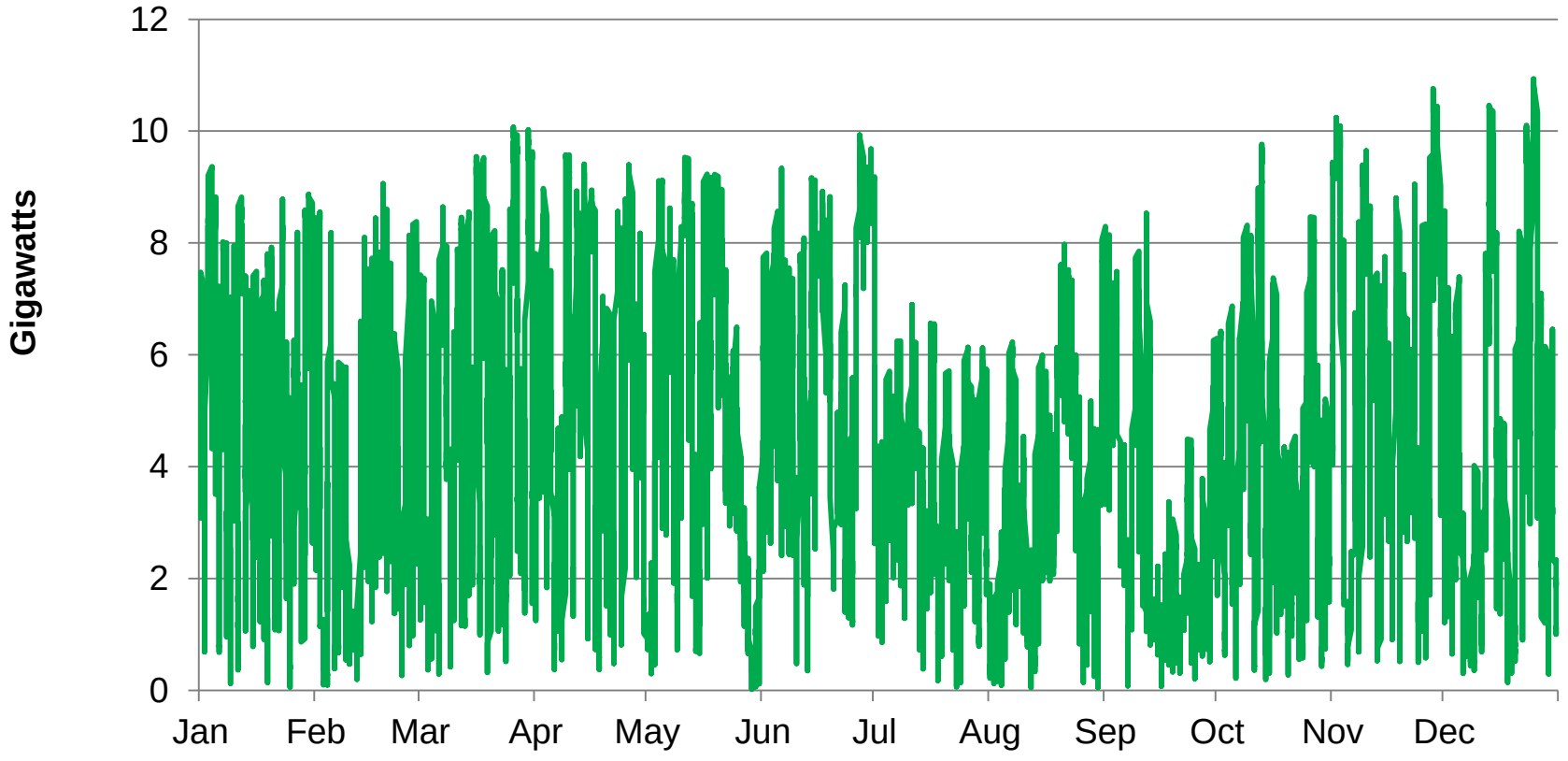
Subsidies in Electricity Markets: Tilting at Windmills?

- **Subsidies are complex --** one sort or another pervade electricity markets, including $23/MWh Production Tax Credits (PTCs) for wind output, renewable energy credits RECs (derived from generation share mandates), net metering at full retail prices, solar investment tax credits, Zero Emission Credits, and flexible capacity payments. Some market interventions are incorrectly tagged as subsidies (capacity markets or Operating Reserve Demand Curves), not all subsidies skew market outcomes (sunk nuclear R&D subsidy), and different subsidies skew market results in different ways.
- **Wind PTCs are one of the largest and most influential subsidies shaping electricity market outcomes --** shifting as much as 50 percent of wind power supply costs to tax expenditures and currently creating a short run marginal generating opportunity cost of a negative 23 $(2016)/MWh. Although a phase out is underway by 2019, the PTC is grandfathered for the first 10 years of the operating life of wind projects installed prior to PTC expiration dates and thus, will impact markets for more than a decade to come.
- **Wind subsidies skew competitive market outcomes --** by suppressing energy market-clearing prices, disproportionally penalizing investments in generating efficiency, and frequently subverting the original intent of the subsidies while generating arguments for offsetting market interventions.
- **ERCOT provides a concrete example --** market conditions in 2014 indicate significant distortions with demand and supply in long run balance that will likely increase in the years to come.

Wind in Texas

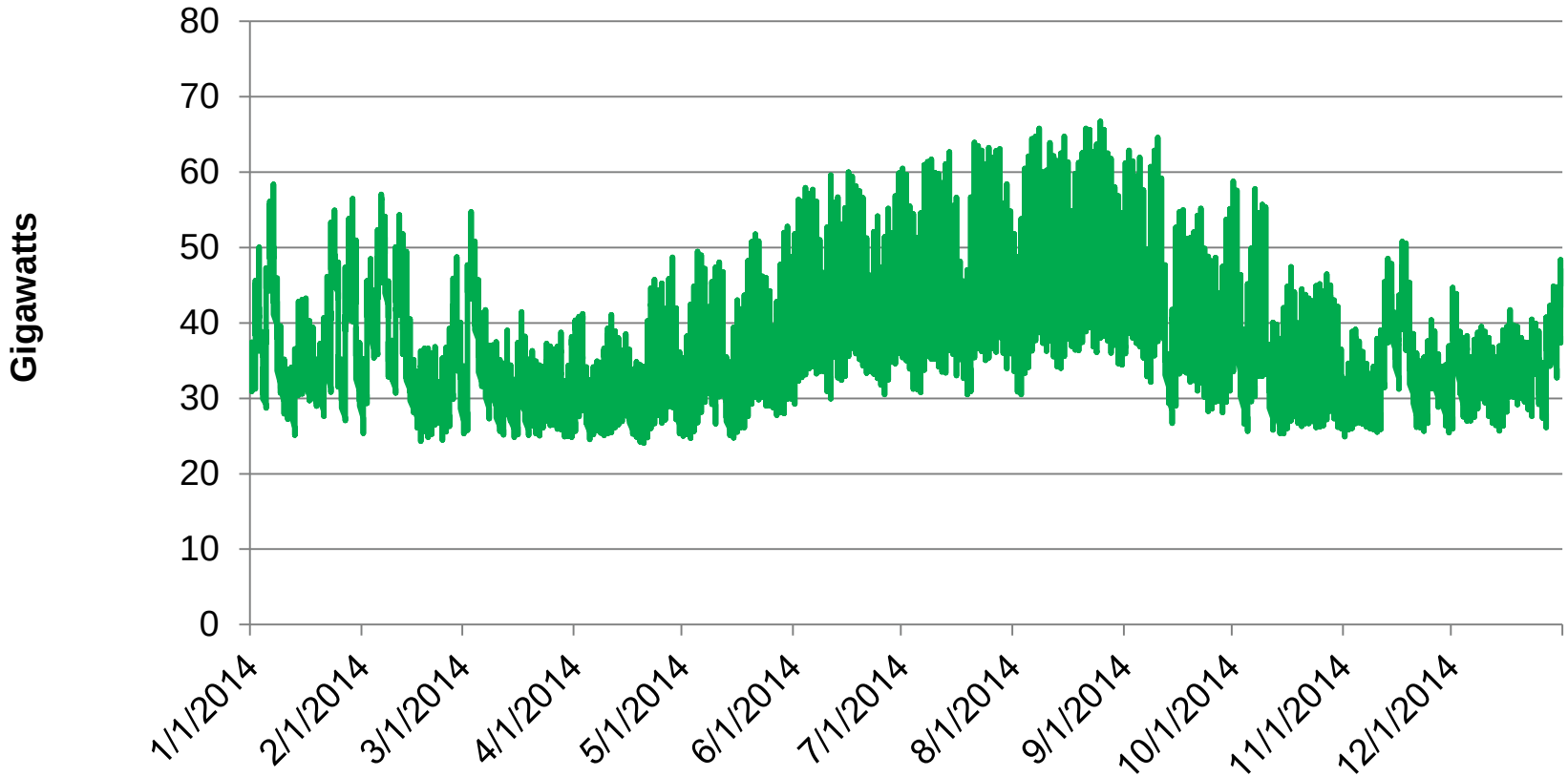
ERCOT wind pattern, 2014



Source: IHS, ABB Velocity Suite

Demand in Texas

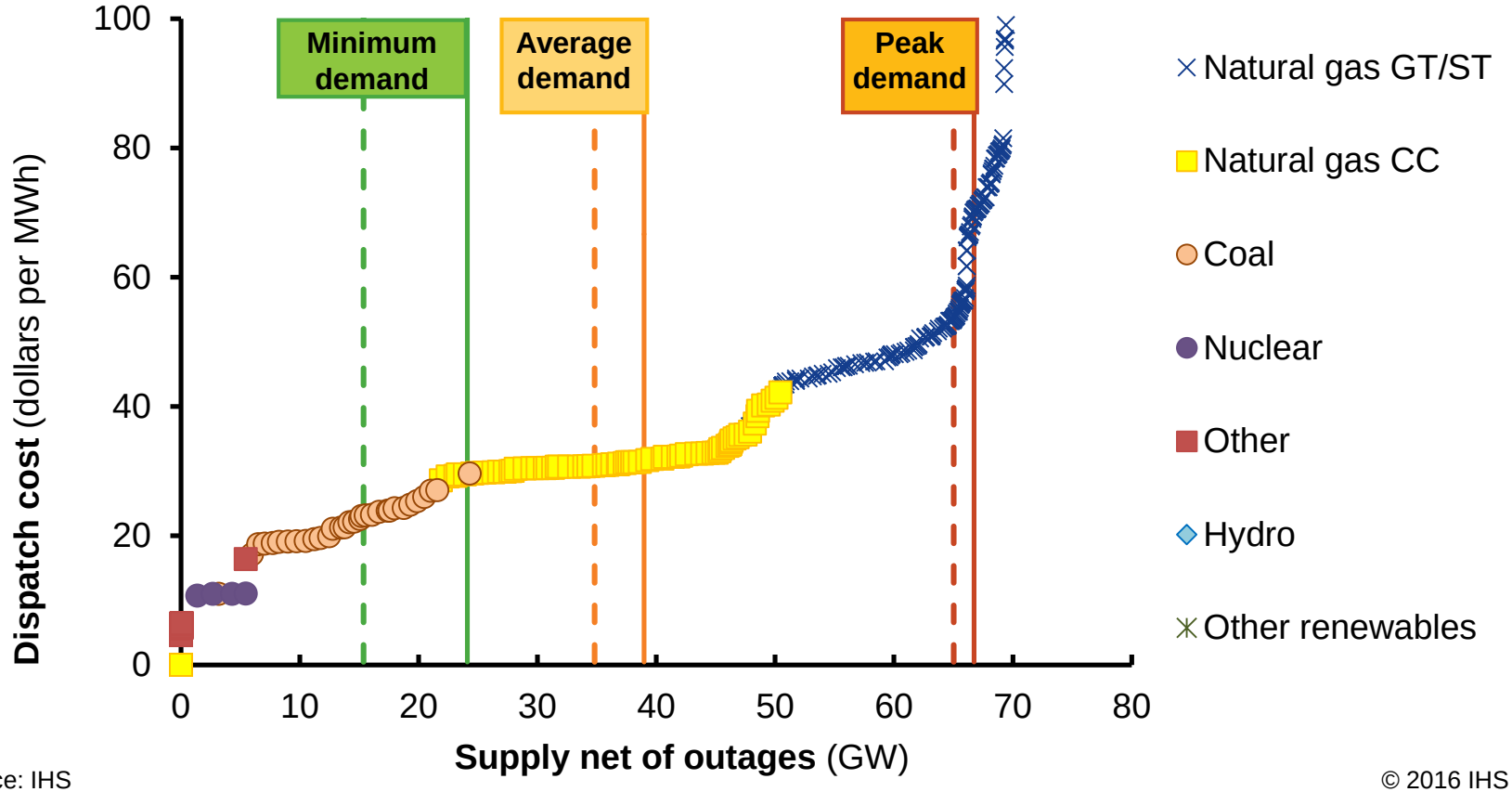
Texas hourly aggregate consumer demand, 2014



Source: IHS, ABB Velocity Suite

ERCOT supply stack without renewables

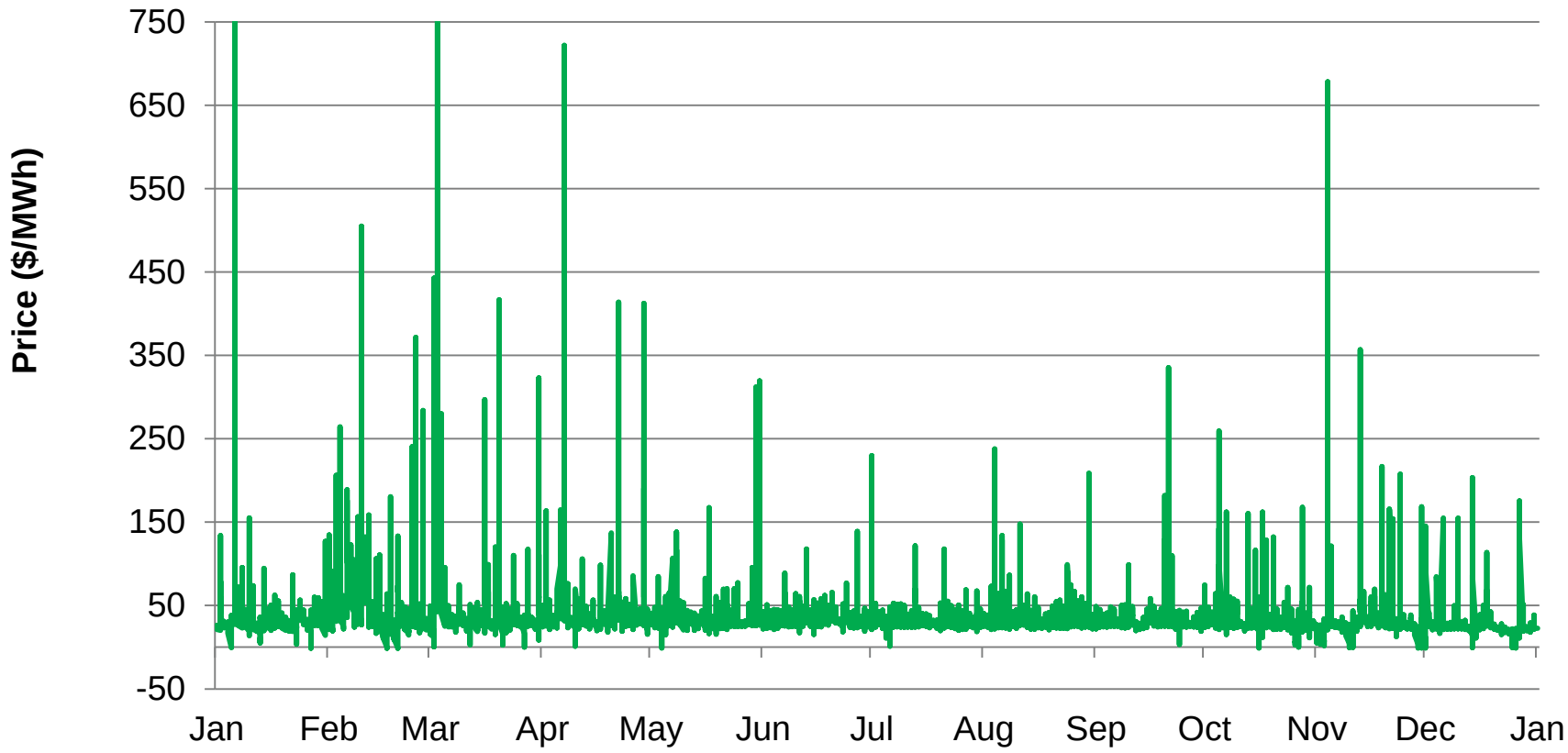
ERCOT electric demand supply curve, 2014



Source: IHS

Wholesale power prices in ERCOT, 2014

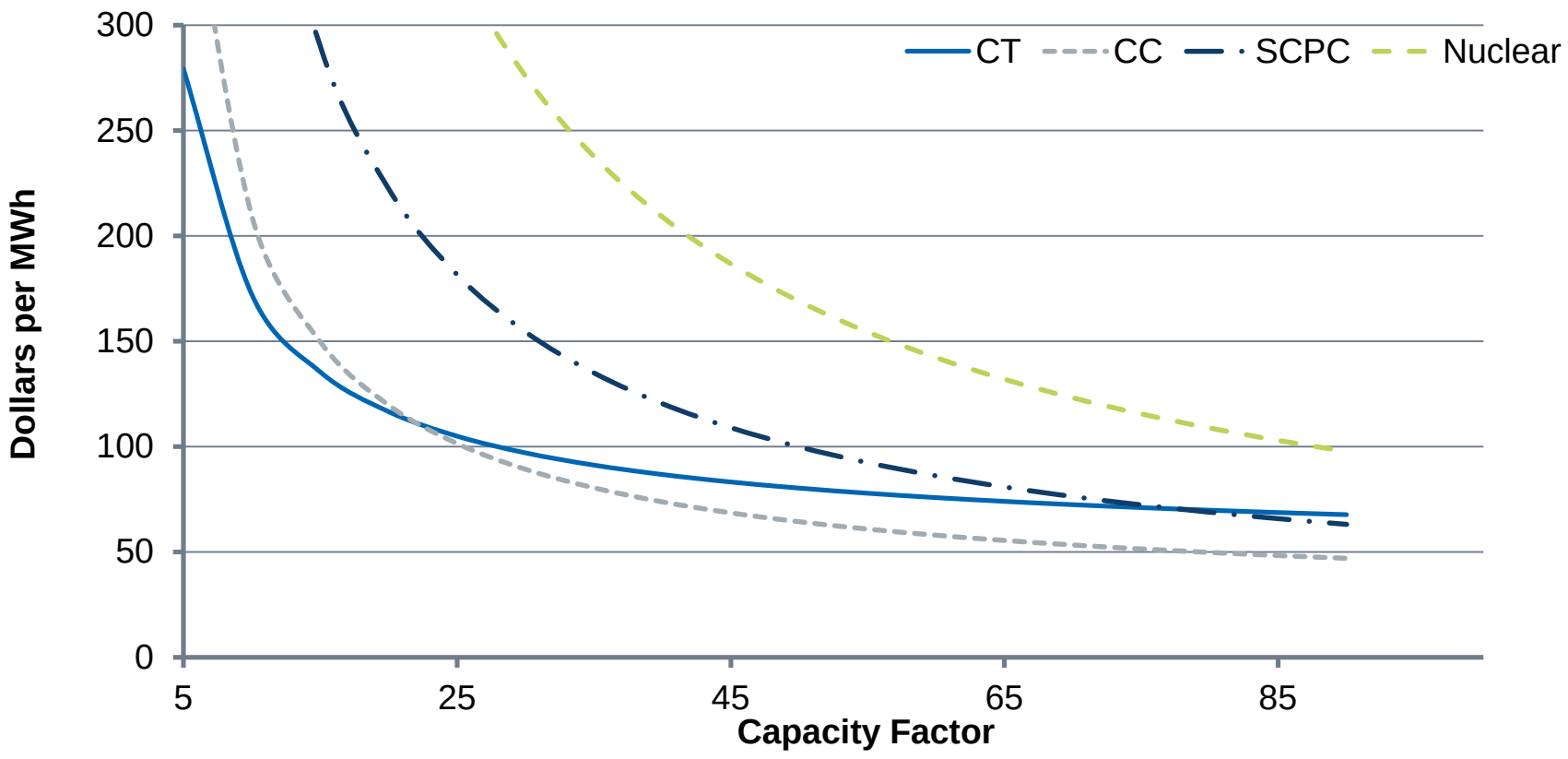
ERCOT 2014: $36/MWh average price, 44 hours of negative prices



Source: IHS, ABB Velocity Suite

Comparing costs of dispatchable generation

Busbar Costs versus Capacity Factor



Source: IHS

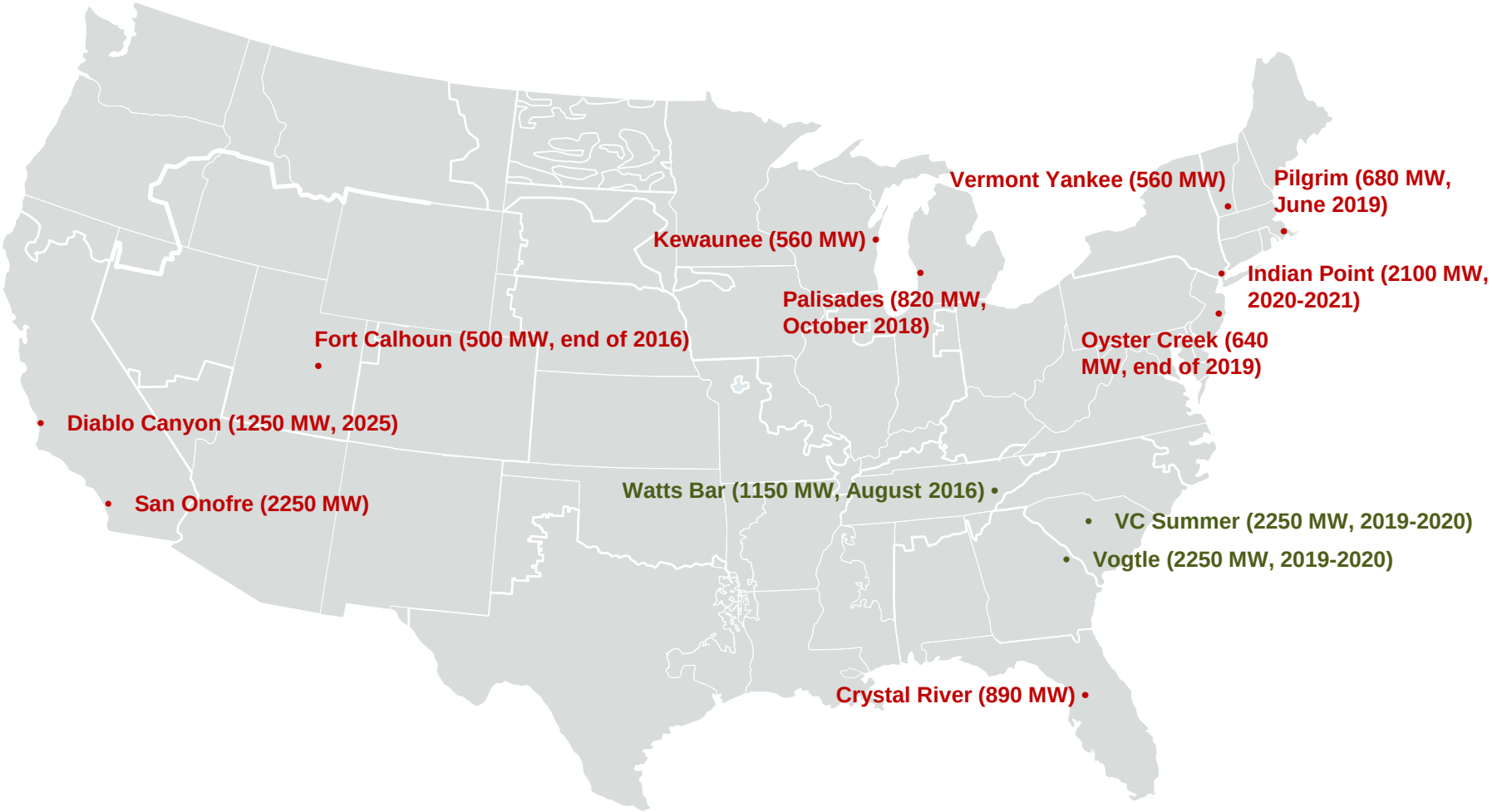
Cost profile of Texas new generation alternatives

Cost and performance of Texas generation alternatives

	Coal	Nuclear	Gas CC	Gas CT	Wind	Solar
Capital cost ($/kW)	3550	7240	1380	800	1520	1780
Fixed O&M ($/kW-year)	40	109	13	9	36	20
Variable O&M ($/MWh)	5	2	4	5	0	0
Fuel cost ($/mmBTU)	1.75	0.7	4	4	0	0
Full load heat rate (BTU/kWh)	8,300	9,800	6,750	10,000	n/a	n/a
CO2 emission rate (lbs/kWh)	1.77	0	0.79	1.17	0	0

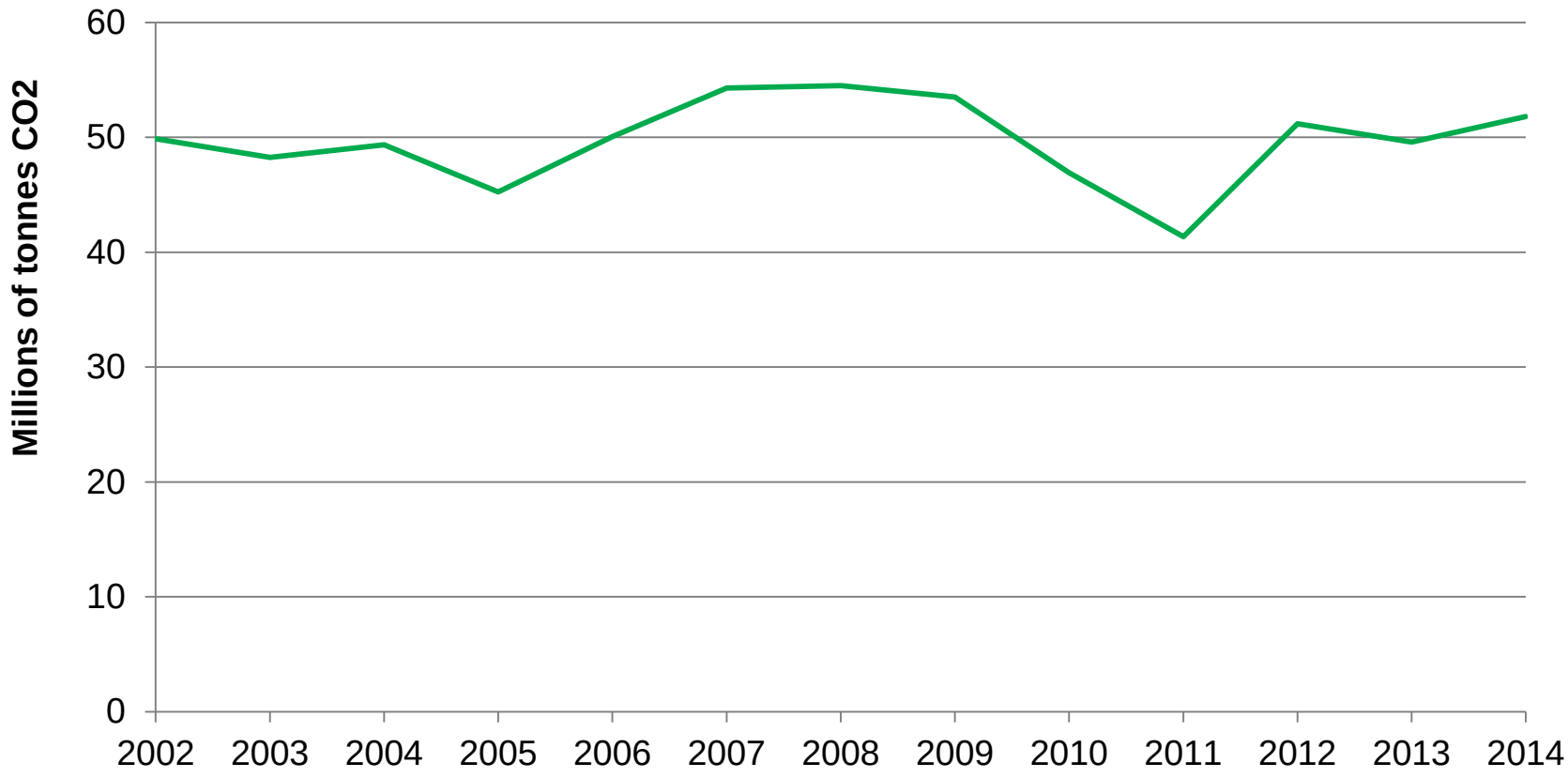
Source: IHS

Nuclear plant closures and construction since 2012



California in-state emissions

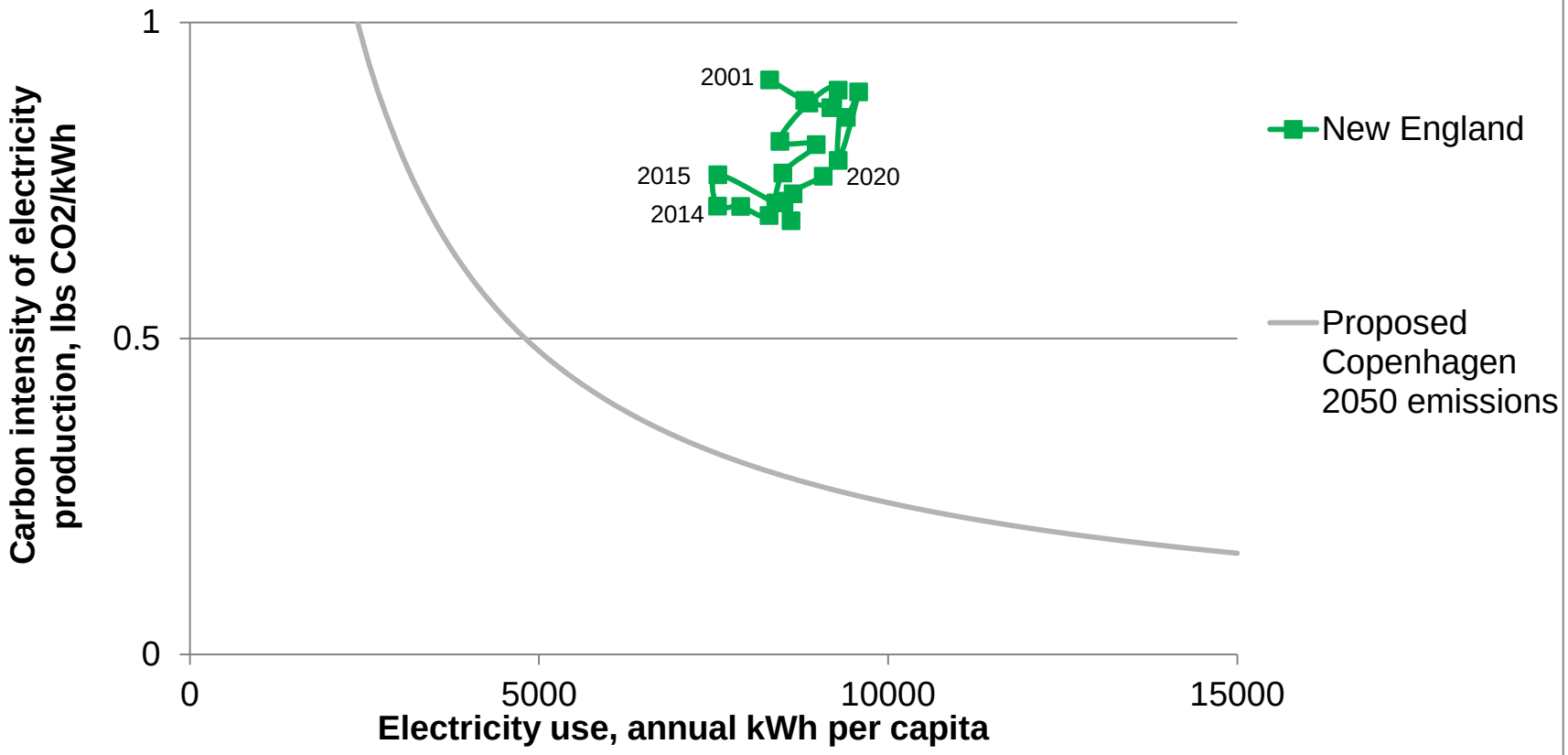
Emissions from California in-state generation, 2002-14



Source: IHS, CARB

The New England electricity carbon emissions boomerang

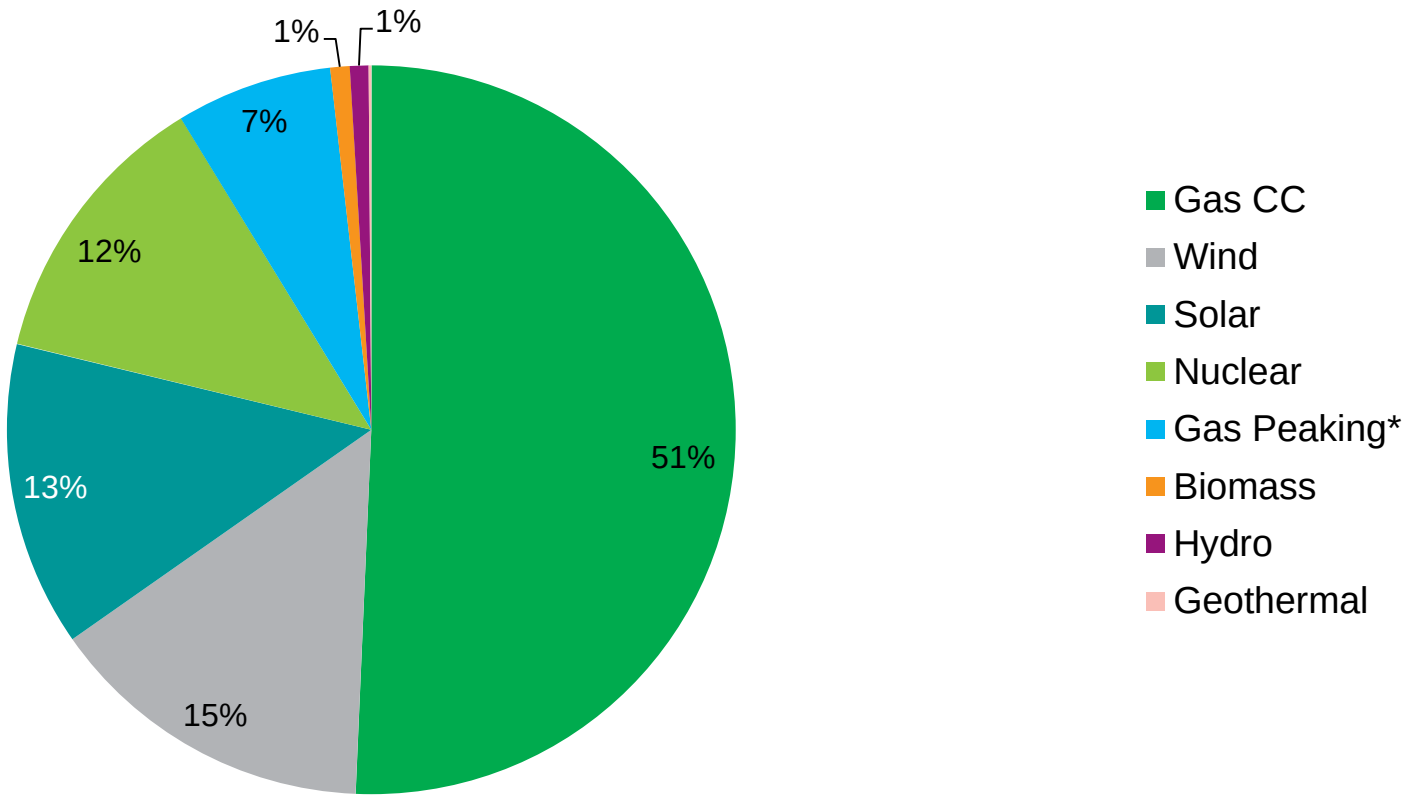
New England electricity carbon footprint, 2001-2020



Notes: Historical data from ISO-NE and EPA, projections from IHS
Source: IHS, ISO-NE, IEA, US EPA

US power plant construction, beginning of 2017

Generating capacity currently under construction: 44.9 GW



*Gas peaking includes both combustion turbines and internal combustion engines.
Source: IHS, SNL Financial

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Case study: a typical coal plant and a typical nuclear plant versus gas and renewables

Comparison of a typical coal plant and a typical nuclear plant against gas with 15% renewables

	Capacity (MW)	Capacity Factor	Levelized cost of electricity ($/MWh)	Generation (MWh)	Emissions Factor (lbs/MWh)	Emissions (tonnes)
Typical coal-fired power plant	1,000	59.8%	$44*	5,238,480	2,234	5,319,438
Typical nuclear power plant	1,600	91.6%	$39*	12,838,656	0	0
Total	**2,600**	**79%**	**$40.44**	**18,077,136**	**647.38**	**5,319,438**
20% wind	1,032	40%	$56	3,615,427	0	0
80% gas combined cycle	3,002	55%	$62	14,461,709	1,003	6,593,225
Total	**4,034**	**51%**	**$60.80**	**18,077,136**	**802.4**	**6,593,225**

*Costs are going-forward costs for existing coal and nuclear plants.
Delivered fuel costs: $0.70/mmBTU for uranium, $4.00/mmBTU for natural gas, $2.10/mmBTU for coal

Source: IHS

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