FLEXIBILITY, TRANSPARENCY, FUELS & THE FUTURE

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NATIONAL ELECTRICITY TRENDS

- Total U.S. electricity generation across all sectors to average 11.3 GWh per day in 2018.
- Highest level of generation since 2010.
- Natural gas generation up significantly over the past decade, rising from 24% of total U.S. generation in 2010 to nearly 32% last year.
- Coal supplied 30% of U.S. generation in 2017, compared with nearly 45% in 2010.

NATIONAL ELECTRICITY TRENDS

- Nuclear share of generation was 20% in 2017; forecast as slightly less than 20% in 2018 and in 2019.
- Non-hydropower renewables provided slightly less than 10% of electricity generation in 2017 and are expected to provide more than 10% in 2018 and nearly 11% in 2019.

NATIONAL ELECTRICITY TRENDS

- Power plant operators added 5 GW of new natural gas-fired generating capacity during the first four months of 2018,
- An additional 15 GW scheduled to come online through the end of 2018.
- Additions represent largest annual increase in natural gas capacity since 2004.

NATIONAL ELECTRICITY TRENDS

- FERC 2018 Infrastructure Report as interpreted by Utility Dive July 8, 2018.
- “Despite renewables gains, gas leads new U.S. generation”
- “FERC’s infrastructure report illustrates that gas and coal are large and entrenched.”
- “While new gas plants are increasingly threatened by renewables and energy storage … a broader view shows plants are still going strong and the decline of natural gas may be overstated.”

ELECTRICITY DEMAND SNAPSHOT

- In 2017, coal and nuclear generation over half of PJM's installed generation capacity (33% coal, 19% nuclear, 21% natural gas).
- What about Summer 2018 heat waves and Bomb Cyclone?

ELECTRIFICATION

- National Renewable Energy Lab (NREL) ongoing “Electrification Futures Study”; Multi-Year research examining impacts of widespread electrification across U.S. economy
- Medium and high scenarios:
  - By 2050, 20 percent increase in U.S. electricity consumption
  - By 2050, 38 percent increase in U.S. electricity consumption
  - High scenario = 1.6 percent annual growth rate, or 80 terawatt-hours.
- Why? Electric Vehicles. Less so? Buildings and Industrial Sector.

STORAGE BY THE NUMBERS

- EIA “Energy Storage Overview” presented June 5, 2018
- At end of 2017, U.S. had 664 MW of power and 742 MWh of energy in operational large-scale battery capacity.
- Audience participation - how much electricity does U.S. consume annually?

STORAGE BY THE NUMBERS

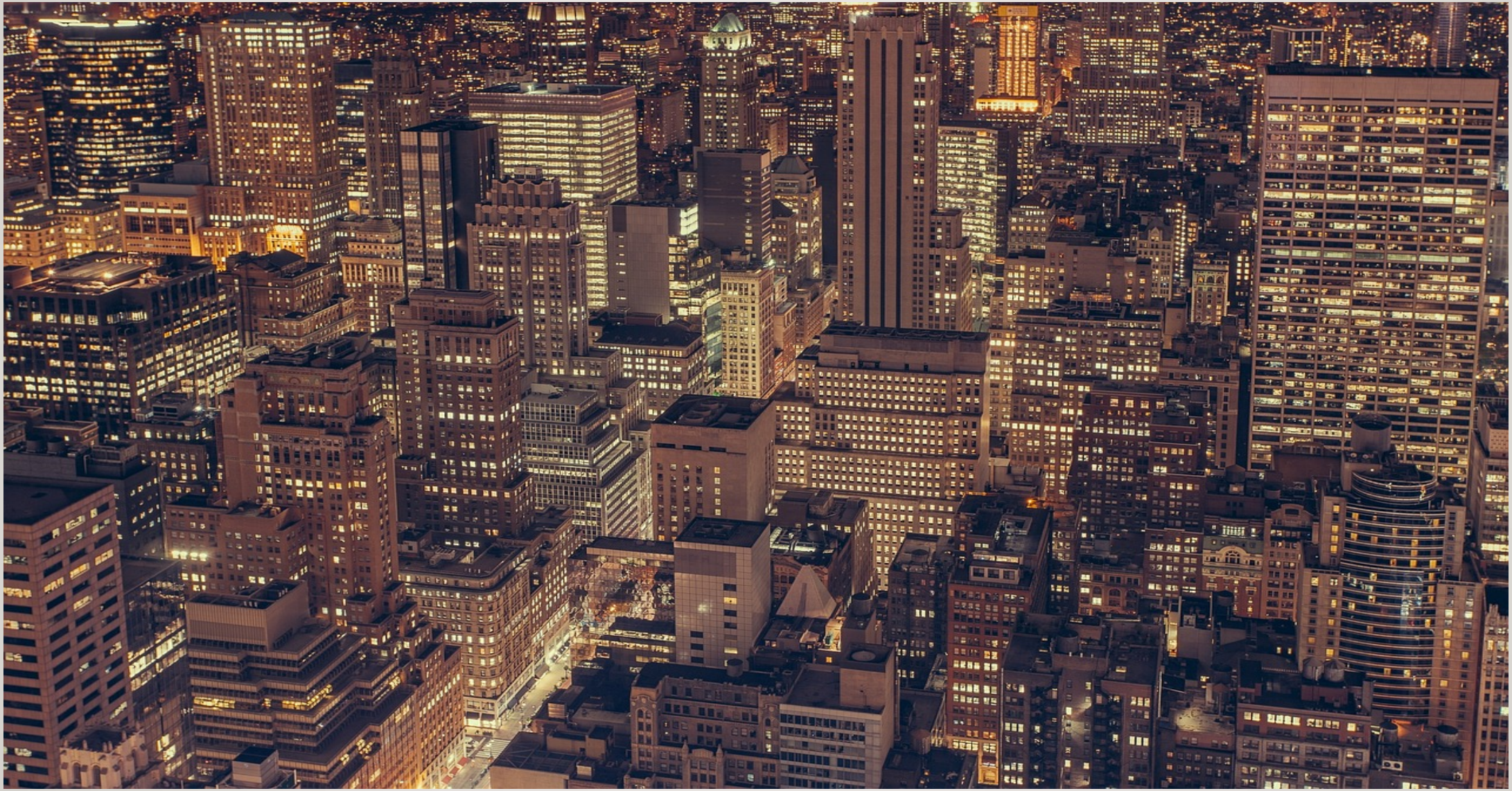
- Total U.S. electricity generation across all sectors to average 11.3 GWh per day in 2018.
- 2016 – natural gas generation alone was 512,000 MW of nameplate capacity.
- What has to be solved to make storage truly a “gamechanger”?
  - Rules – state regulators still developing ideas, only a handful of states have mature programs.

STORAGE – CHALLENGES TO SOLVE

- Costs and Battery Life – longer life = higher costs, but can recognize economies of scale with larger arrays.
- 2016 Lazard study - Average unsubsidized levelized costs of storage for lithium ion batteries $414/MWh, keeping in mind that the average retail price of electricity in the United States is $120/MWh.
- Siting and permits – can be very difficult for less expensive pumped hydro storage. Projects aren't sailing through DOI/BLM.

STORAGE – CHALLENGES TO SOLVE

- Asst. Sec. DOE Bruce Walker at SEARUC - $30 million pilot project on batteries > 10 hour life.
- Components – minerals owned by other countries. NETL publications, research.
- Customization – software connectors between battery and energy source are very specific to site and function.

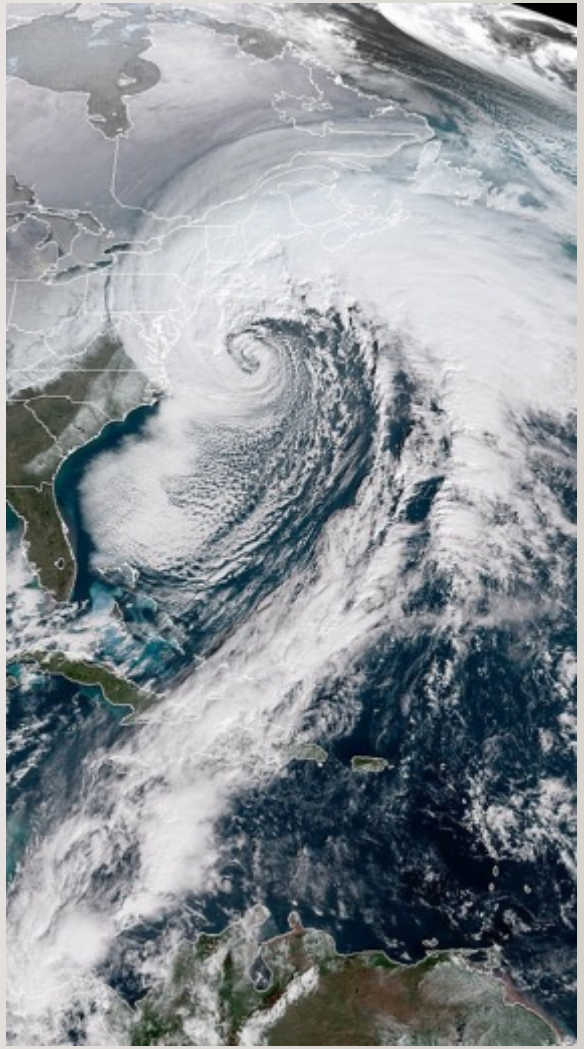


STORAGE IN THE BIG APPLE

- June 2018 N.Y. state releases updated draft energy storage roadmap.
- 2025 target of 1,500 MW. Currently 95 percent of NY state storage is 2 pumped hydro facilities.
- Talk of NY PSC setting 3 GW target by 2030.
- Challenges?
  - Permitting, especially indoor siting in congested areas.

Part 1: Energy Resilience

Recent Weather Events and Summer Projections Make it Clear that Grid Resilience is Enhanced by Coal & Impaired by Non-Dispatchables (Wind)

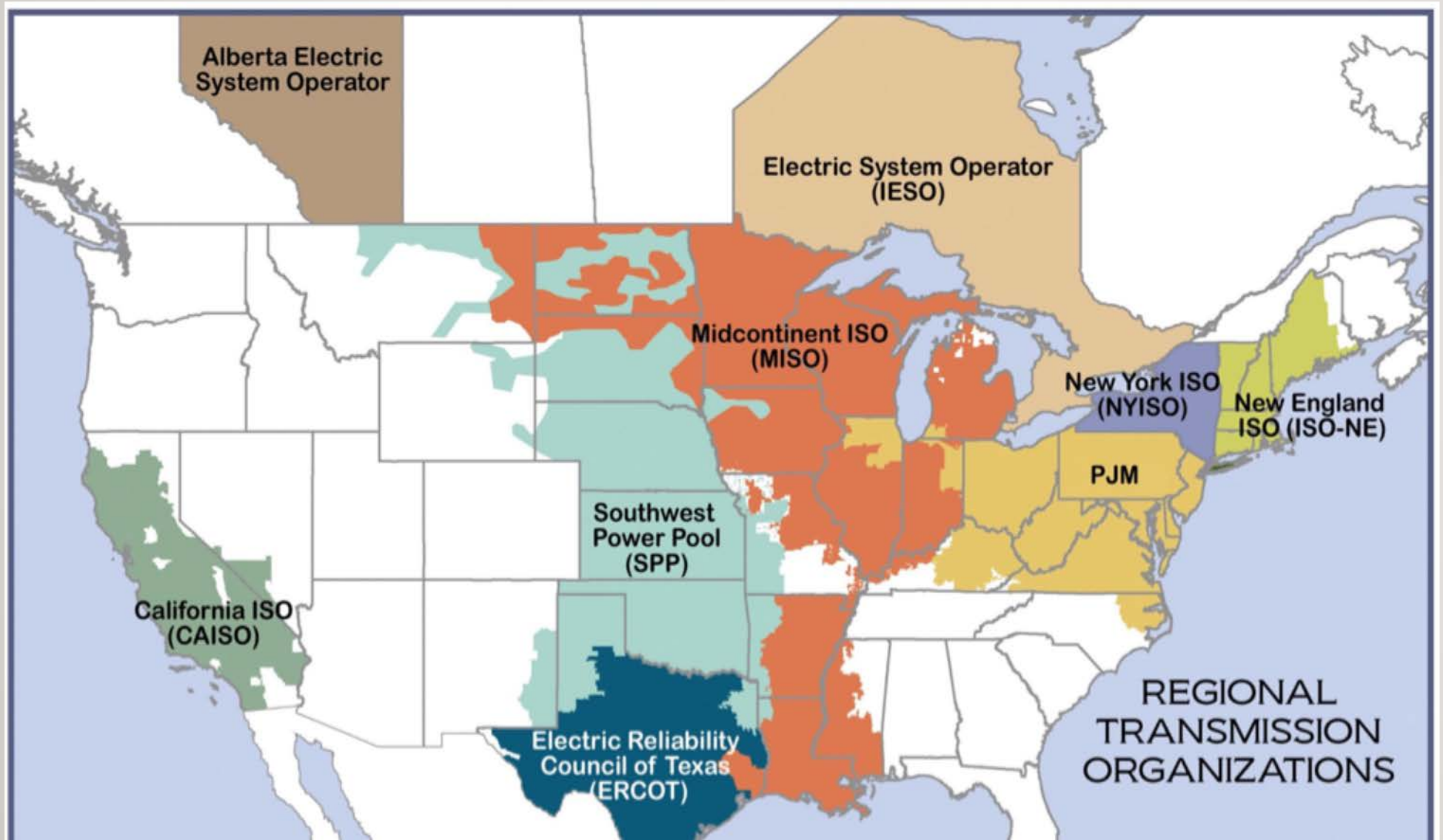


1. Data Shows Energy Resilience of Coal (and Penalty of Wind) across 6 RTOs Impacted by the January 2018 “Bomb Cyclone.”

2. Biggest renewable market experiment (Texas) now facing extremely thin reserve margins and risks of price escalation after a modest reduction in coal baseload capacity.

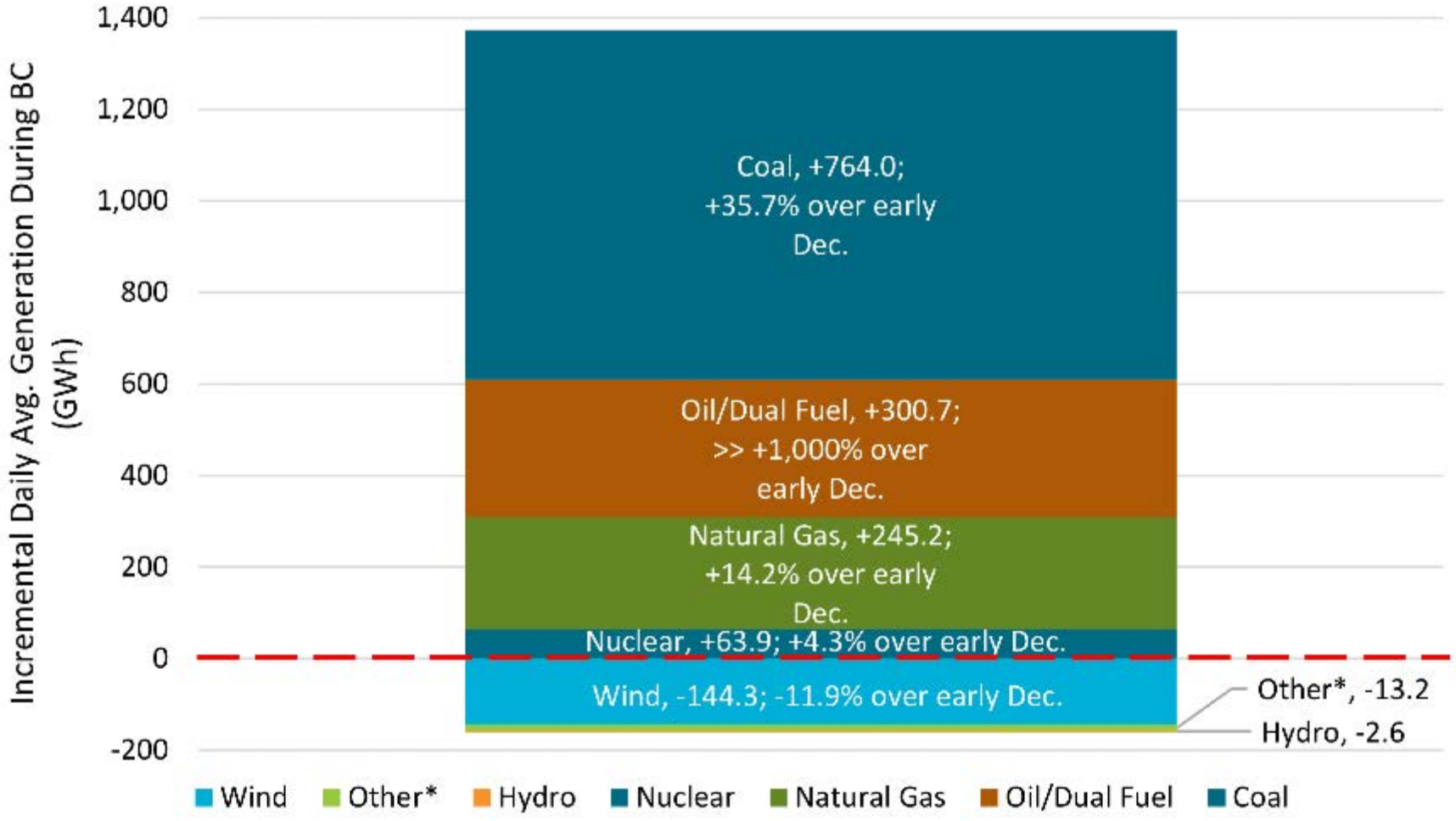
Bomb Cyclone Case Study

6 Regional Transmission Operators (RTOs) Impacted



DOE/NETL (right): "Without available capacity from partially utilized coal units, PJM would have experienced shortfalls leading to interconnect-wide blackouts"

Exhibit ES-1. Fuel based generation resilience during the Bomb Cyclone, six ISOs



* 'Other' includes misc. categories, including other, refuse, solar, diesel, and multiple fuels

PJM Bomb Cycle Case Study in Energy Resilience (continued)

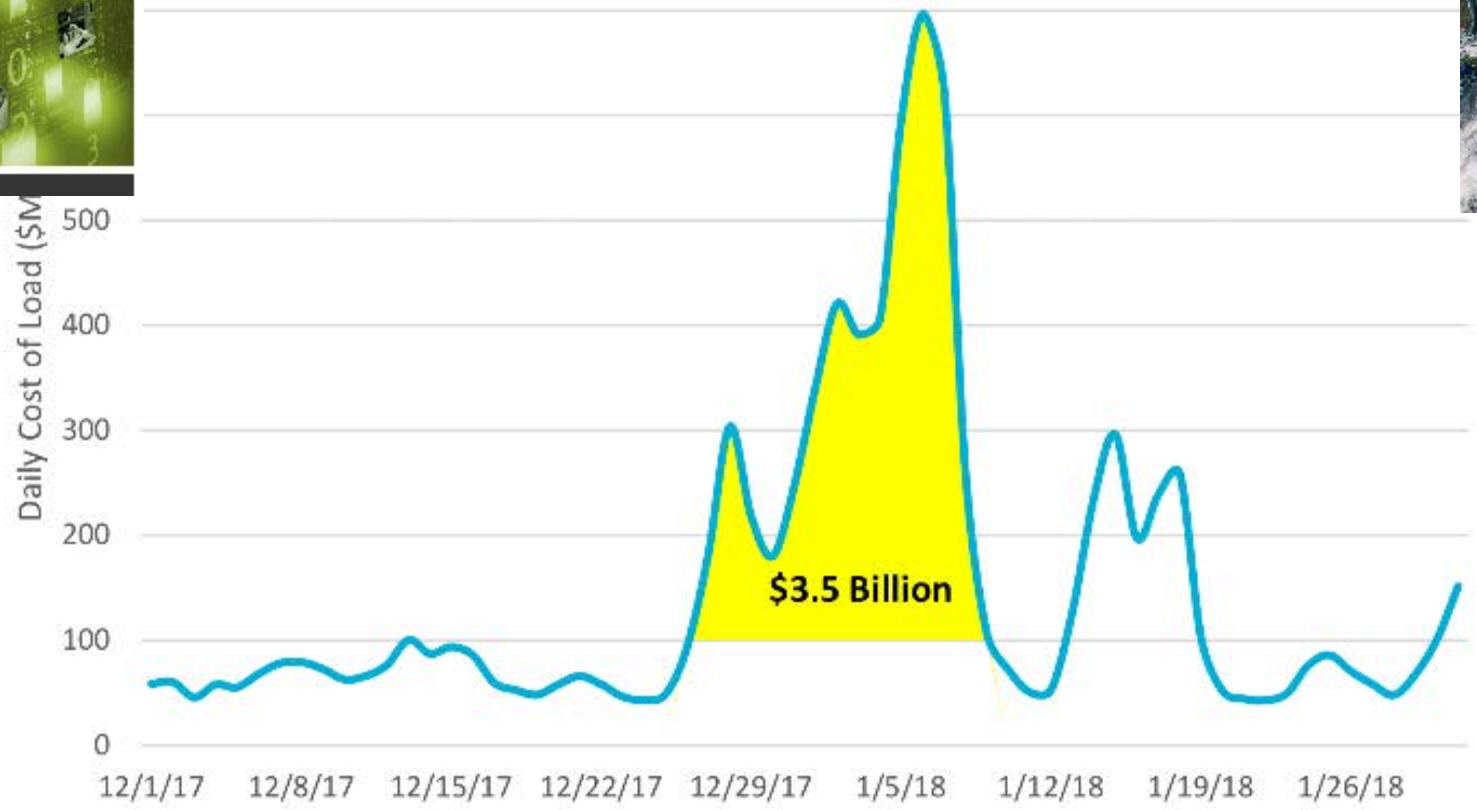
FACTS ARE STUBBORN THINGS

Average Daily GWh

Fuel	12/1-12/26	12/27-1/8	Positive Delta Total	Percentage Change	Share of Positive Increase
Coal	746	1,113	367	49%	73%
Gas	607	619	12	2%	2%
Renewables	127	122	-5	-4%	-
Nuclear	846	851	5	1%	1%
Oil	6	117	112	1994%	22%
Multiple fuels	2	10	8	383%	2%
Total	**2,334**	**2,832**	**504**	**21.6%**	**100%**

Source: DOE/NETL 2018

Exhibit 1-13. Notional resilience value[o]

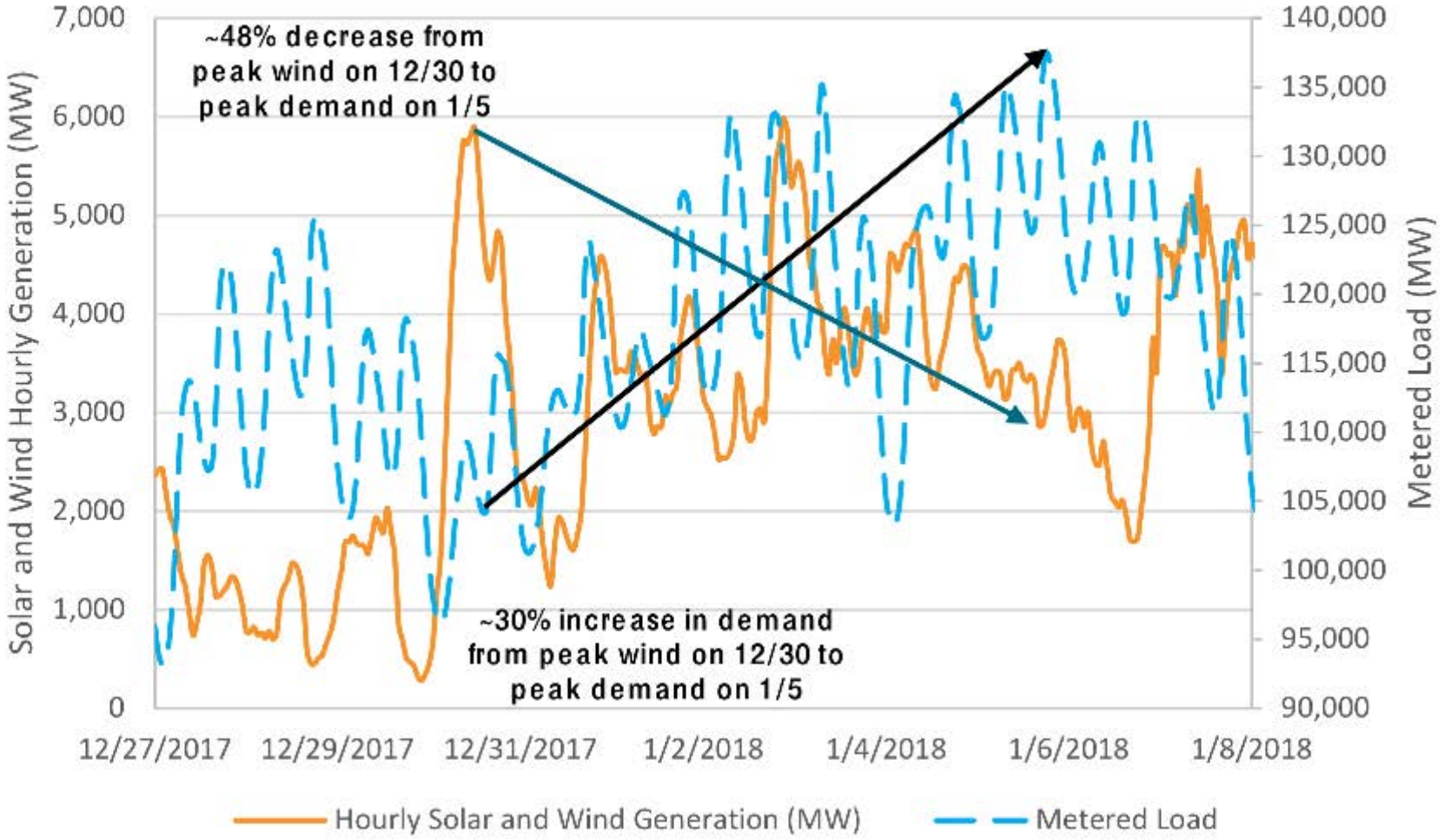


In the case of PJM, it can also be shown that the demand could not have been met without coal. At peak demand, January 5, 2018, natural gas prices exceeded $95/MMBtu in eastern PJM. Had coal been removed, a 9-18 GW capacity shortfall would have developed, depending on assumed imports and generation outages, leading to system collapse (Exhibit 1-14).

And How Much are They Helping When it Matters Most?

DOE/NETL: "*Intermittent generating sources experienced a significant decline nearly inverse to growth in demand. . . PJM saw decreased output from solar and wind resource [which] essentially imparted a resilience penalty to the system. . .*"

Exhibit 1-12. PJM solar and wind generation performance during the Bomb Cyclone



PART 2: The Need for Transparency

URGENCY OF THE TRANSPARENCY PROBLEM

1. Markets depend on consumers knowing the true & total cost of what they are buying.
2. Claims of “Grid Parity” and “100% Renewable” mislead consumers & policymakers.
3. Assumed benefits of electric grid de-carbonization must be put in context so consumers & policymakers are better informed.

How Electric Markets are not Transparent

1. Subsidies hidden from consumers in our ST/FED tax bills.
2. All fuels receive subsidies but massive disparity in ROI ($/MW).
3. Direct/Indirect Subsidies Distorting Markets (hiding costs):
   - Multi-billion dollar transmission projects socialized across entire markets.
   - Growing costs for ancillary services (to balance wind & solar).
   - Stranded costs of prematurely retired units (driven by market distortions

Price of Renewables - Hidden in our Tax Bills (not shown on utility bills)

DOE (2018):

Table 3-5. Fiscal Year 2013 Electricity Production Subsidies and Support[177]

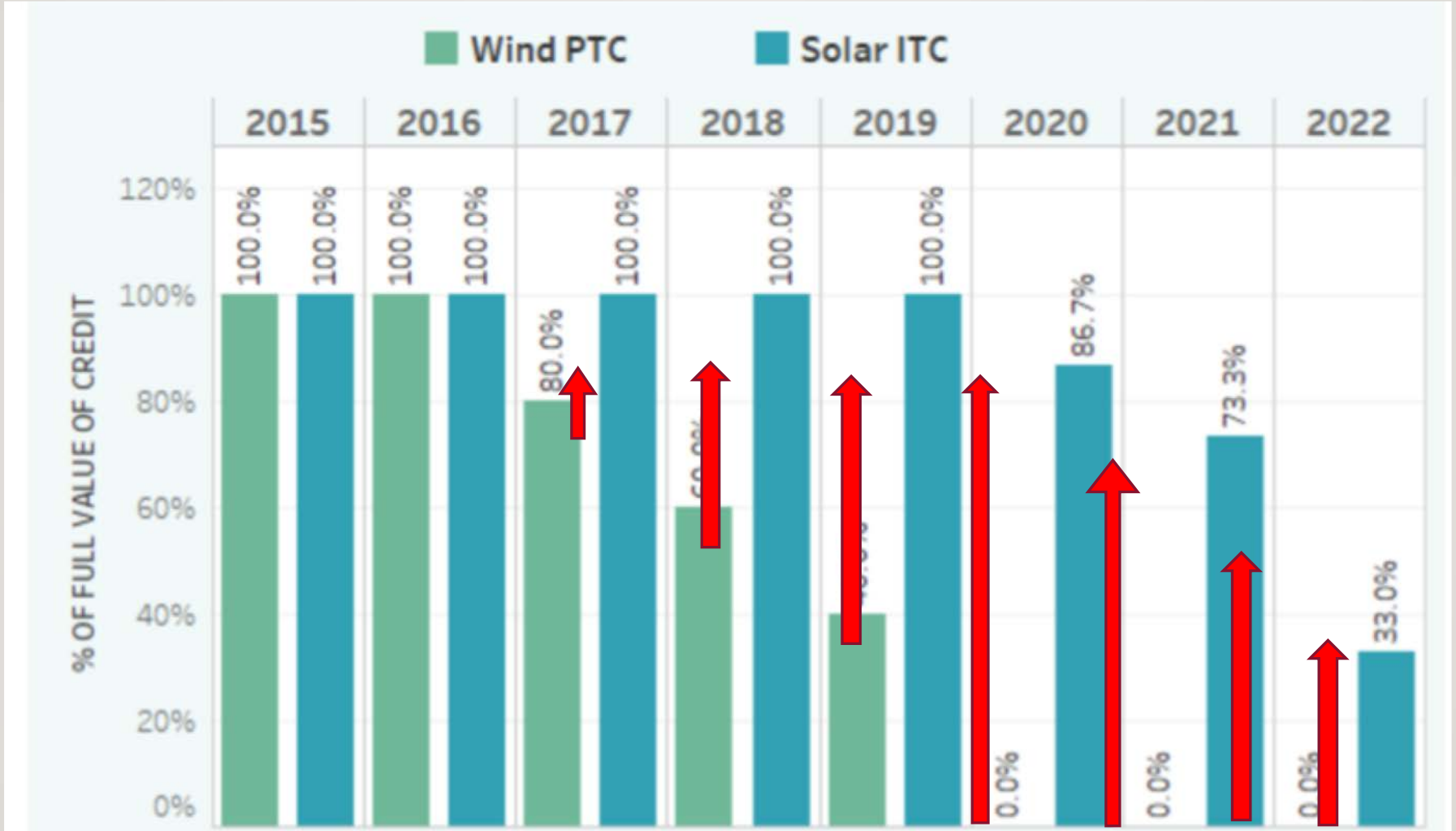
Beneficiary	Direct Expenditures	Tax Expenditures	Research and Development	Federal and RUS Electricity	Total	Share of Total Subsidies and Support
Renewables	7,408	3,373	722	176	11678	72%
Biomass	62	9	47	-	118	1%
Geothermal	221	22	2	-	245	2%
Hydropower	194	17	10	171	392	2%
Solar	2,448	1,712	234	-	4393	27%
Wind	4,274	1,614	49	-	5936	37%

JCT (2017):

Federal Tax Expenditures for Wind (2016-2020)	Federal Tax Expenditures for Solar (2016-2020)
23,700,000,000.00	12,300,000,000.00

Sources: EIA Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2016 (Table 1) (April 2018); DOE Grid Study (Table 3-5)(2017); JT. COMM. ON TAXATION 2016 REPORT.

SUBSIDY PHASE-OUT HAS A LONG TAIL



- PTC guidance with 4-year safe harbor will delay the impact of the wind phase-out.
- Extent to which wind companies will use reduced value PTC is unclear.
- Section 48 ITC continues permanently at 10%, while Section 25 (residential) phases out.
- Treasury is still working on the ITC guidance.

Massive Disparity in ROI for Direct Federal Subsidies ($/MW)

CONGRESSIONAL RESEARCH SERVICE SUBSIDY CALCULATOR:

WIND & SOLAR > OIL, GAS & COAL COMBINED

(YET, 24X LESS ENERGY)

SOLAR=182X (WIND = 68X) WHAT NUCLEAR RECEIVES

(ON AN ENERGY EQUIVALENT BASIS)

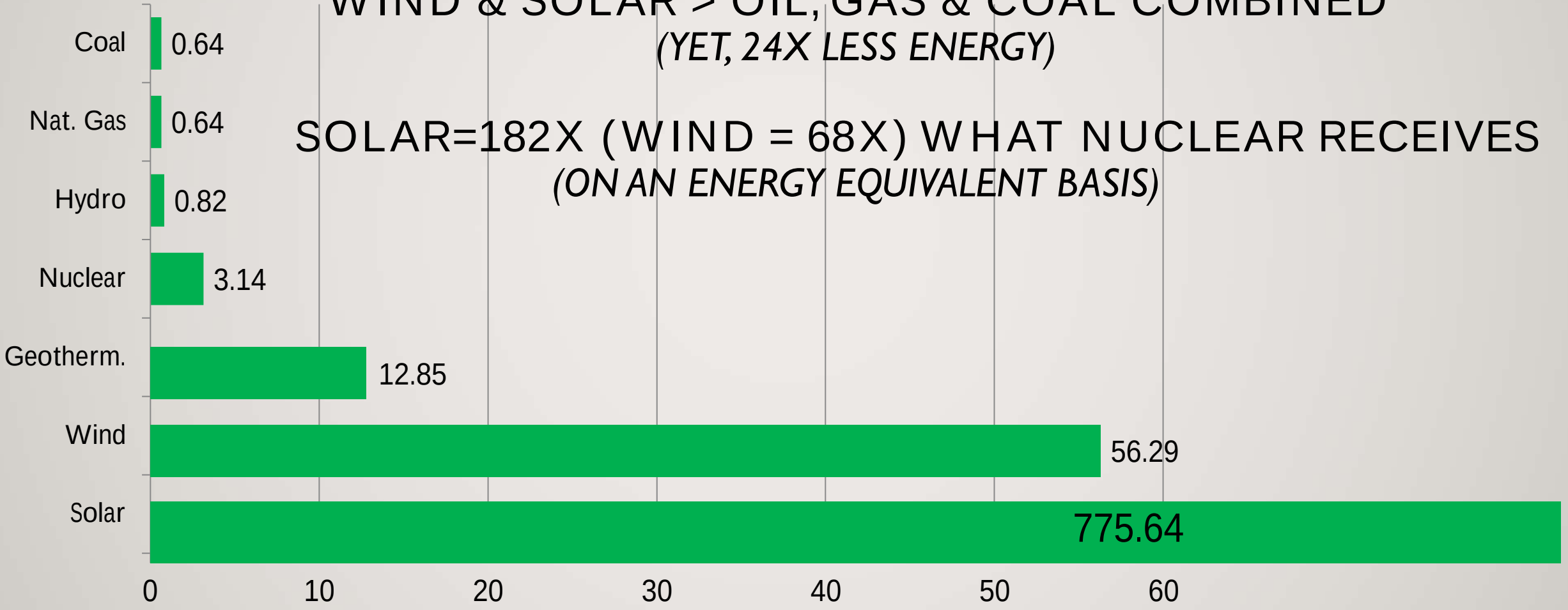


Chart Source: U.S. DOE, 2011; Institute for Energy Research, 2011 (an update of this information is critically needed).

INDIRECT SUBSIDIES EXPLORED

CURRENT REGULATORY FRAMEWORKS HIDING COSTS:

- **TRANSMISSION**: Multi-billion renewable-driven transmission projects socialized across entire markets.
- **BACK-UP POWER:** Growing costs for ancillary services (to balance wind & solar) not factored into renewable pricing or interconnect charges.
- **REGULATED UTILITY STRANDED COSTS:** Stranded costs of prematurely retired units (driven by market distortions) born by customers in regulated markets (a cost that is absorbed by utilities in deregulated markets).
- **RESERVE MARGIN THINNING & PRICE ESCALATION:** Negative pricing and under-compensated baseload have driven retirements, discouraged investments in new baseload, and thinned reserves, which escalates prices

CASE STUDY – ERCOT:

WHAT MADE IT GREAT & WHAT WENT WRONG

- By providing a diverse, affordable, and reliable power supply, gas, coal, and nuclear have been the backbone of the Texas Miracle.
- Cost of transmission & ancillary services to connect & “balance” renewables are socialized to entire market & masked by low gas.
- The more our grid is exposed to large “swings” when the wind stops blowing, the more blackouts & price spikes are a risk.

CASE STUDY – ERCOT:

WHAT MADE IT GREAT & WHAT WENT WRONG

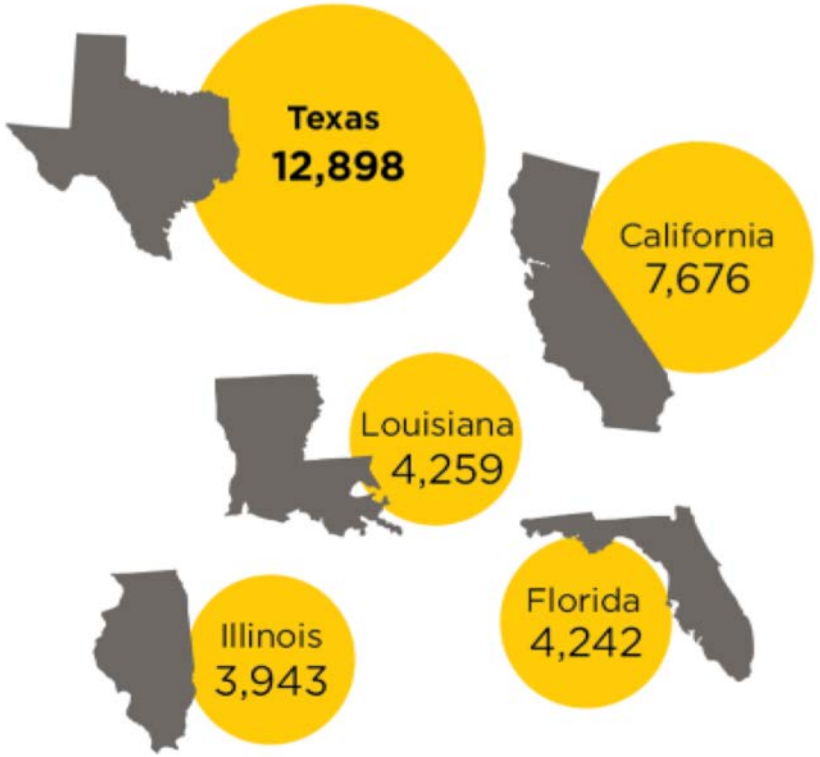
- Prolonged market distortions erode economics of baseload, drive retirements, & discourage investments in new baseload (even gas).
- Market distortions have thinned reserve margins and capacity builds (generator assets function as uncompensated insurance products).

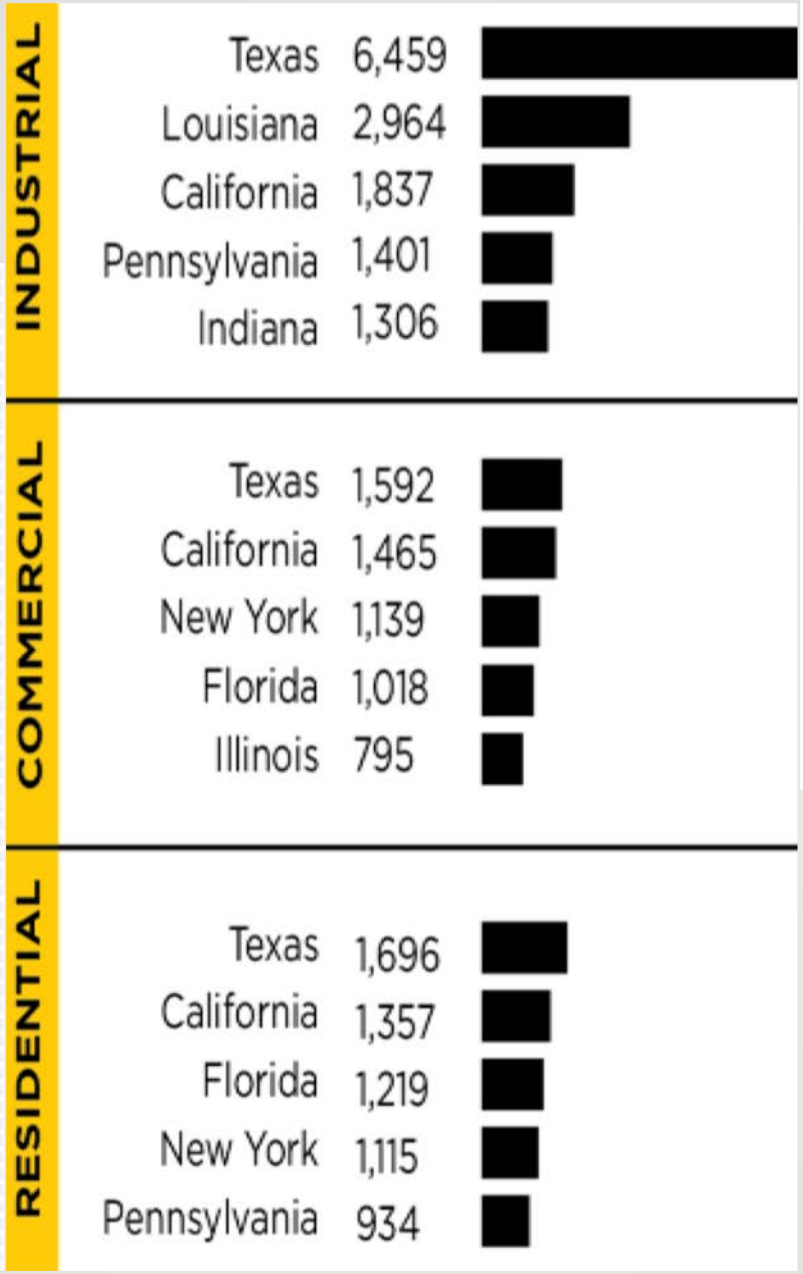
THE TEXAS POWER GRID

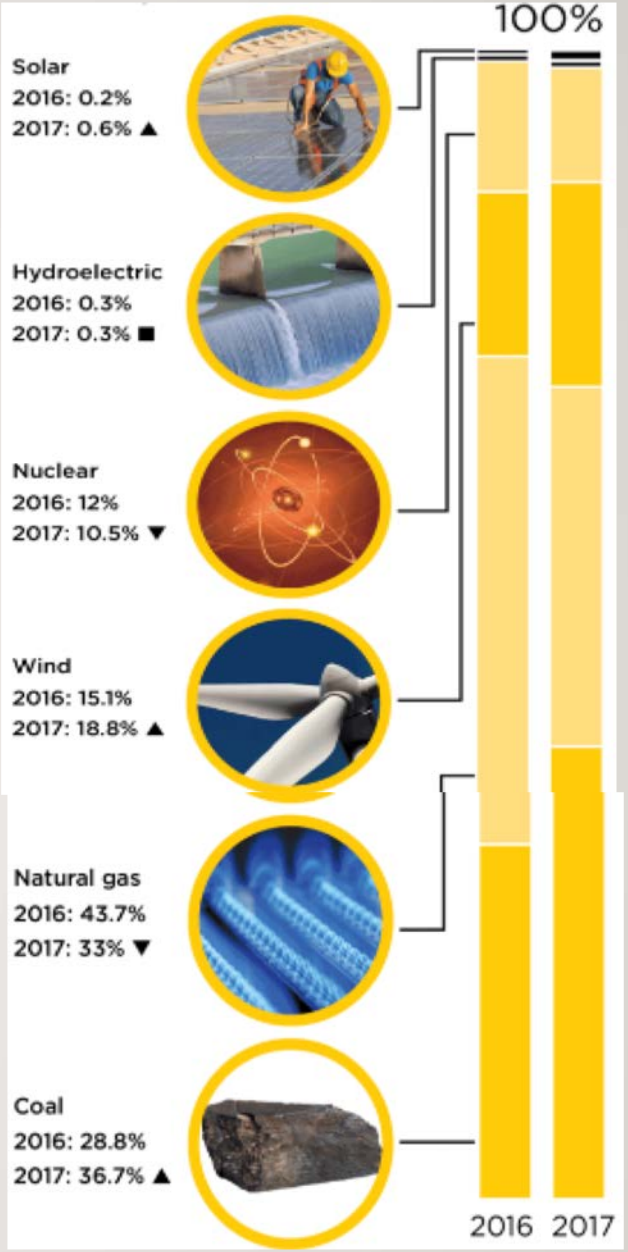
The nation's top energy consumer

Texans use 68 percent more energy than No. 2 California.

Total energy (trillion British thermal units) in 2015

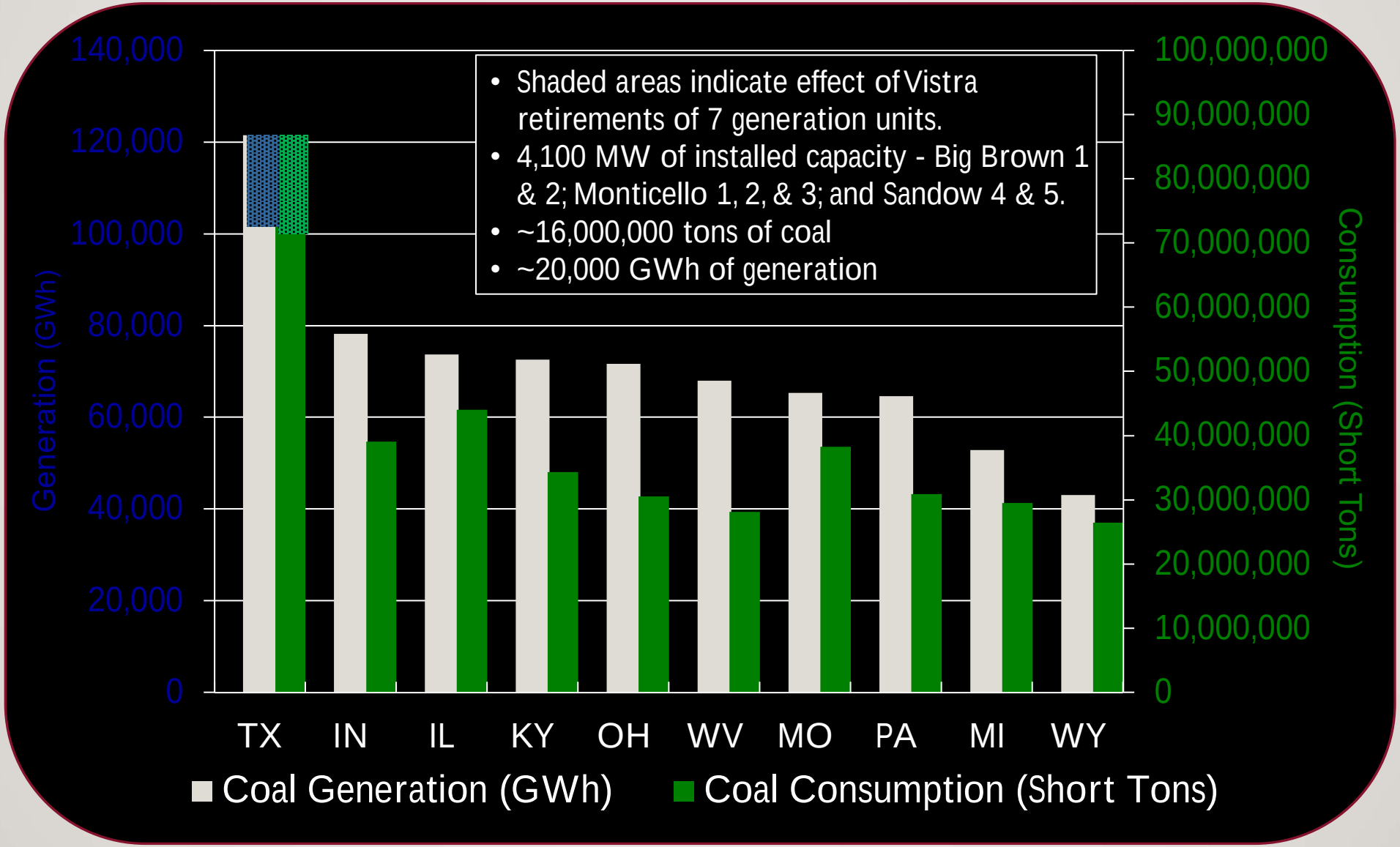




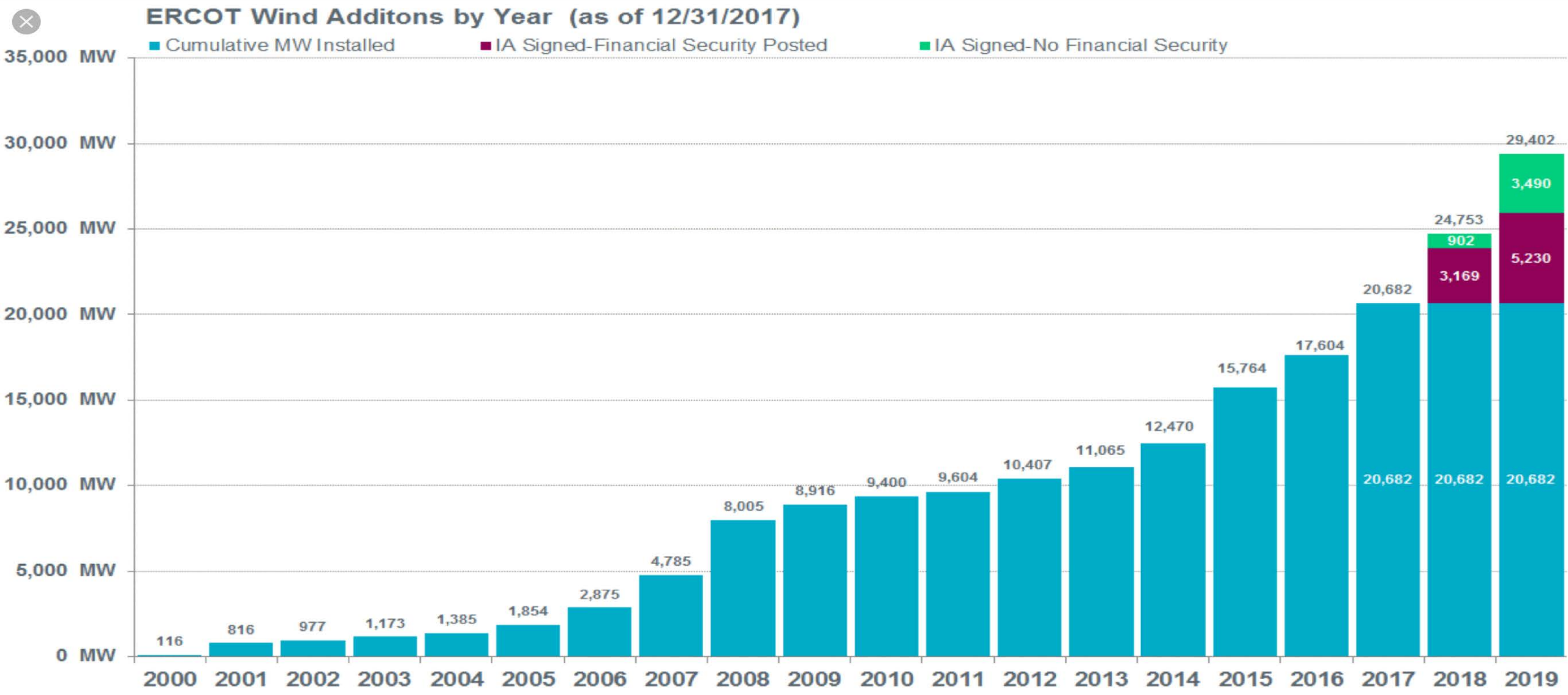


Source ***Dallas Morning News*****, 8/19/17**

Even with Recent Retirements, TEXAS USES MUCH MORE COAL THAN ANY STATE

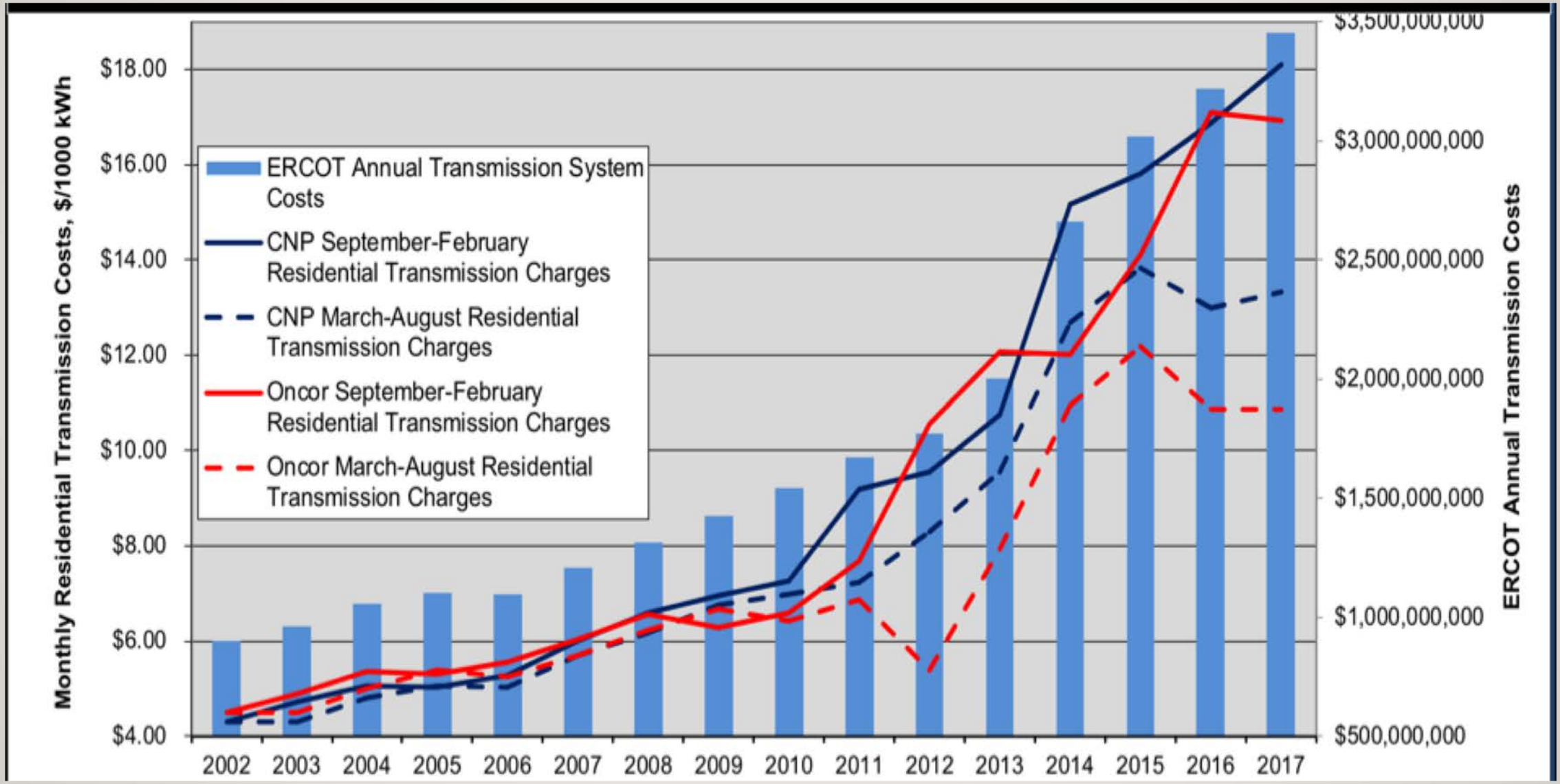


Source: EIA, State Historical Tables for 2015, Revised Nov. 2016; EIA-923 database (2015). Total coal generation and consumption for electric generation.



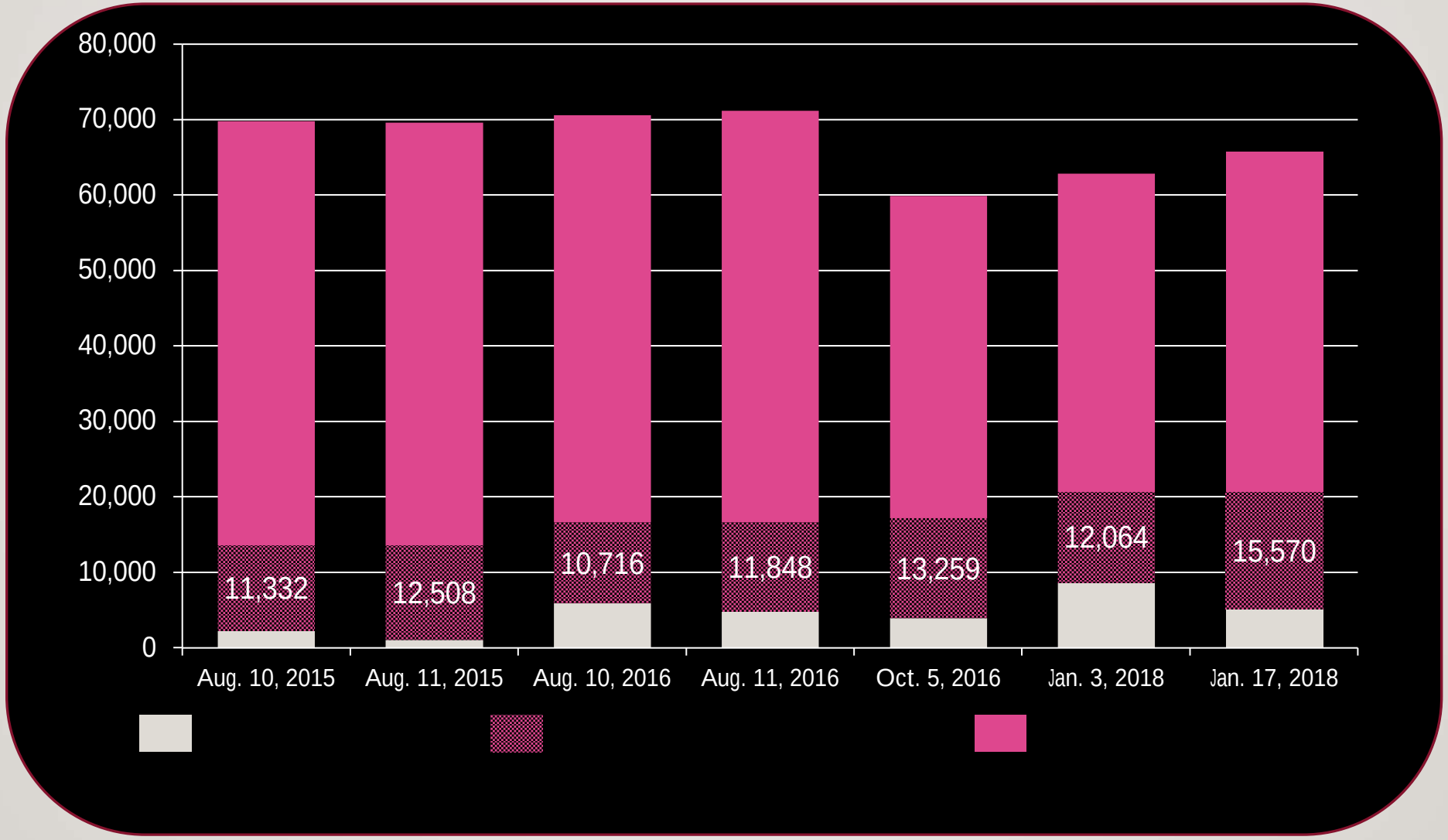
Notes:
- The data presented here is based upon the latest information provided to ERCOT by resource owners and developers and can change without notice.
- Installed capacities for the current year account for changes reported by the facility owners during the reporting month, and will be reflected in subsequent years' totals.
- Installed capacities include only wind facilities that have registered with ERCOT (Those larger than one megawatt and supply power to the ERCOT system.)
- This chart reports annual planned units with projected Commercial Operations Dates throughout the calendar year. In contrast, ERCOT's Capacity, Demand and Reserves (CDR) report shows planned capacity projected to be commercially available on or before the start of the Summer and Winter Peak Load seasons.
- Financial security posted for funding interconnection facilities does not include CREZ security deposits, which are refunded to the Interconnecting Entity when an IA is signed.

TRANSMISSION: Costs of Integrating Renewables



The Price of Non-Dispatchability

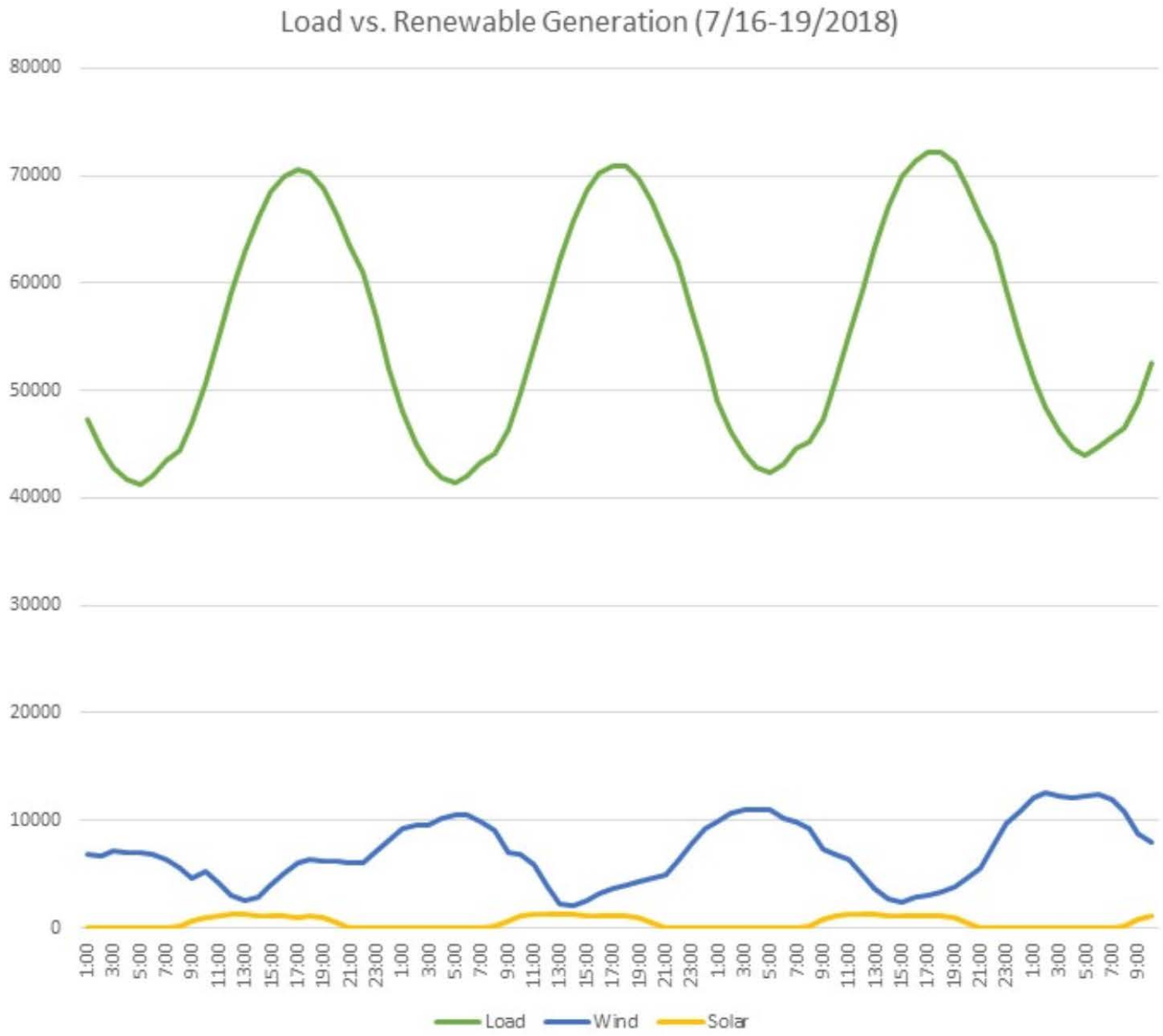
ERCOT - Exposure to the Wind "Swing"



Sources: ERCOT, Daily Wind Integration Reports; ERCOT Generation Interconnection Status Reports, August 2015, August 2016, and December 2017.

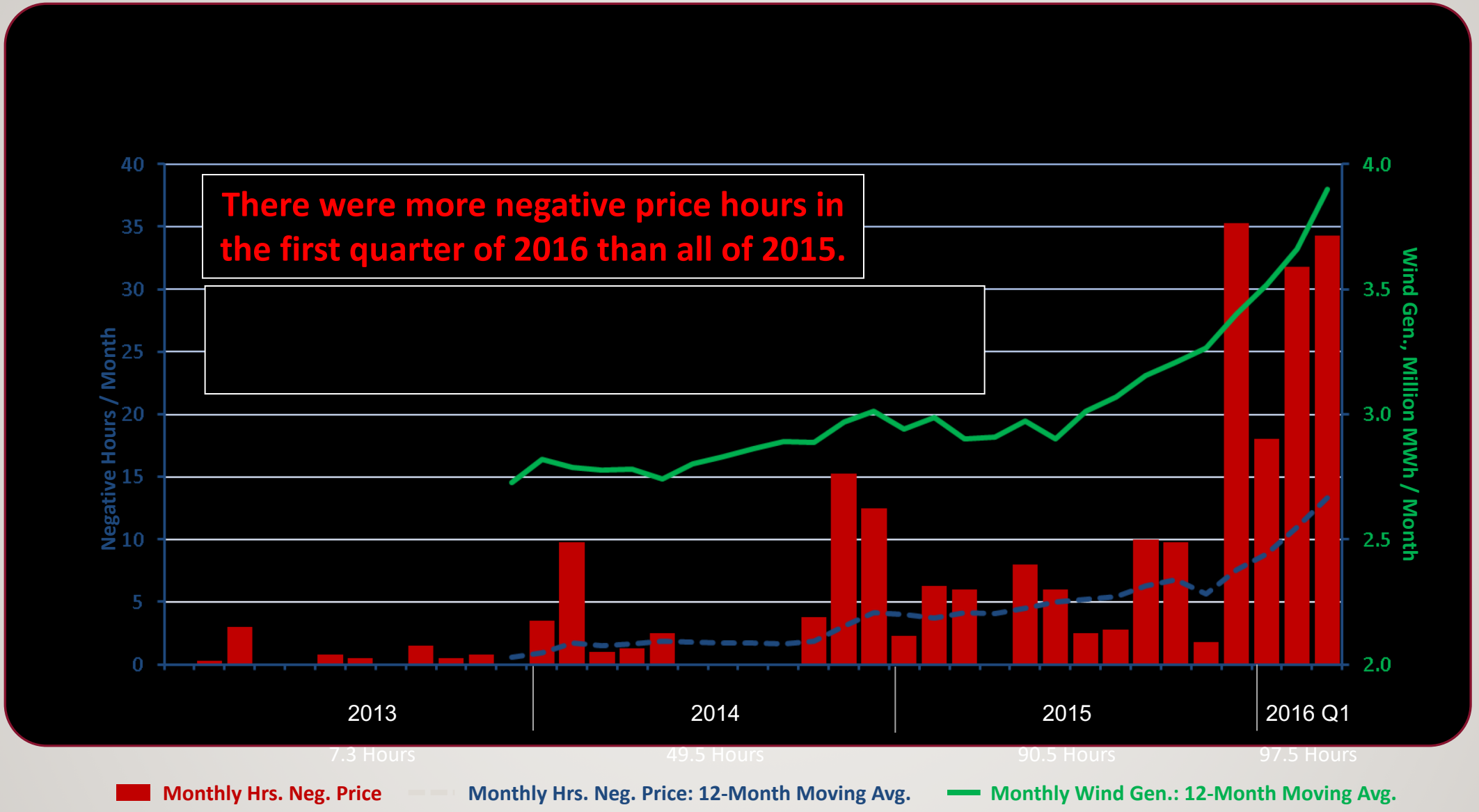
THIS WEEK AT PEAK

- New Record Consumption Every Day! (72-74 GW!)
- Gas, Nuke, and Coal Meeting the Challenge (69-71 GW)
- Wind No-Show & Solar (3-5 GW)



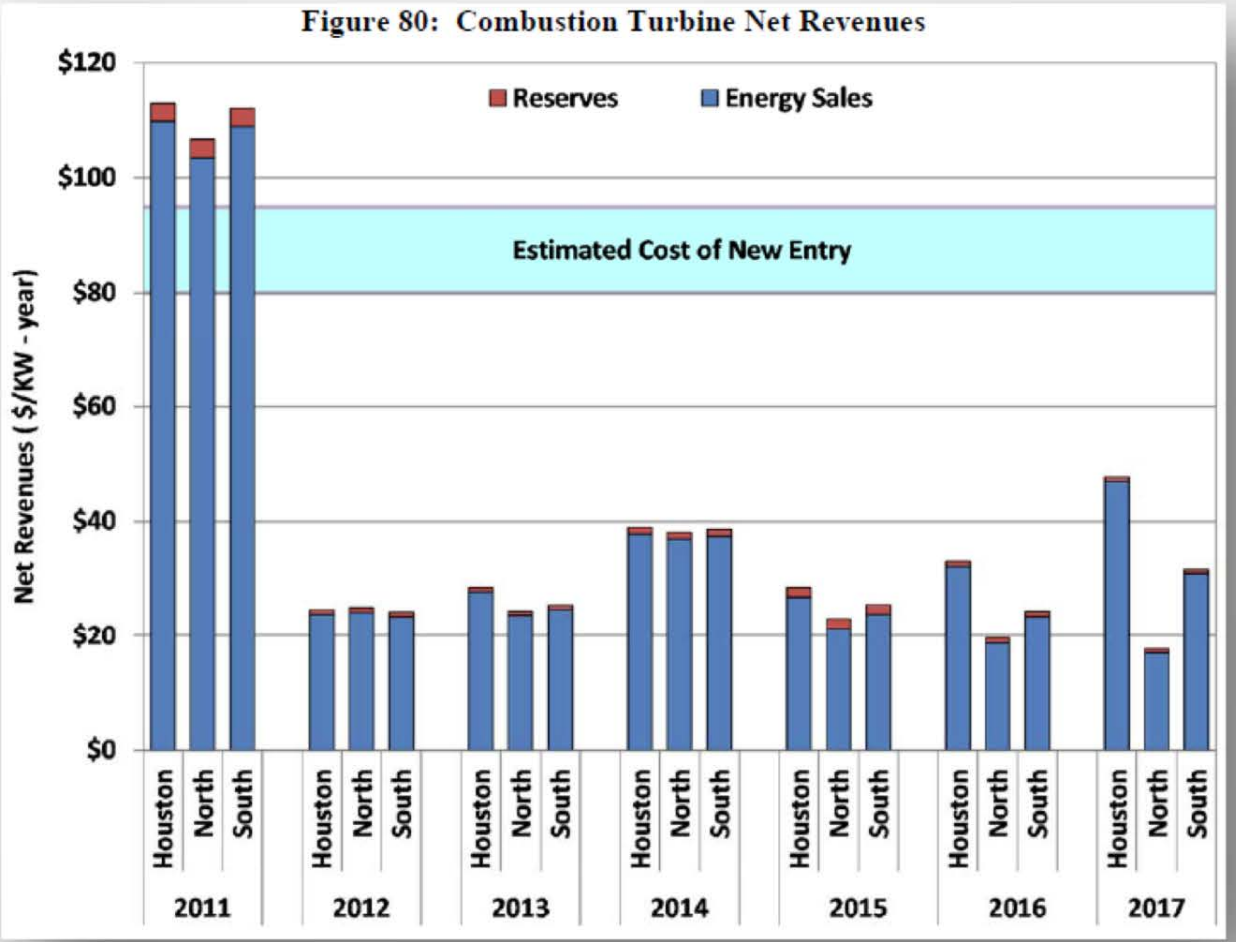
SUBSIDIES LEADING TO DISTORTION

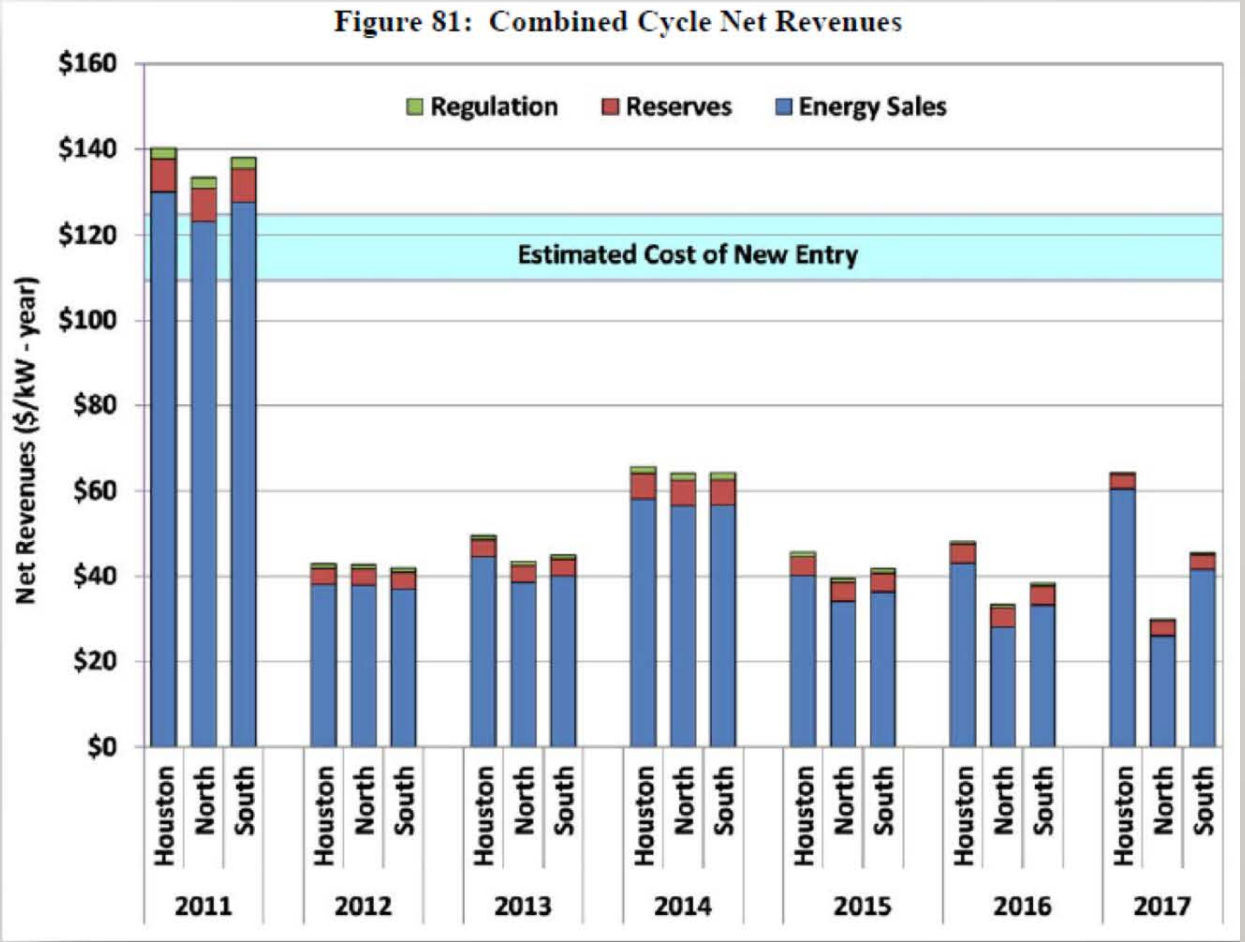
- Renewable Subsidies Have Distorted the Once-Idealized TX Market.
- The biggest source of distortion is NEGATIVE PRICING.
- “Negative Pricing” = When wholesale price of power actually is LESS THAN ZERO
  (i.e. generators have to pay to stay online and generating!)



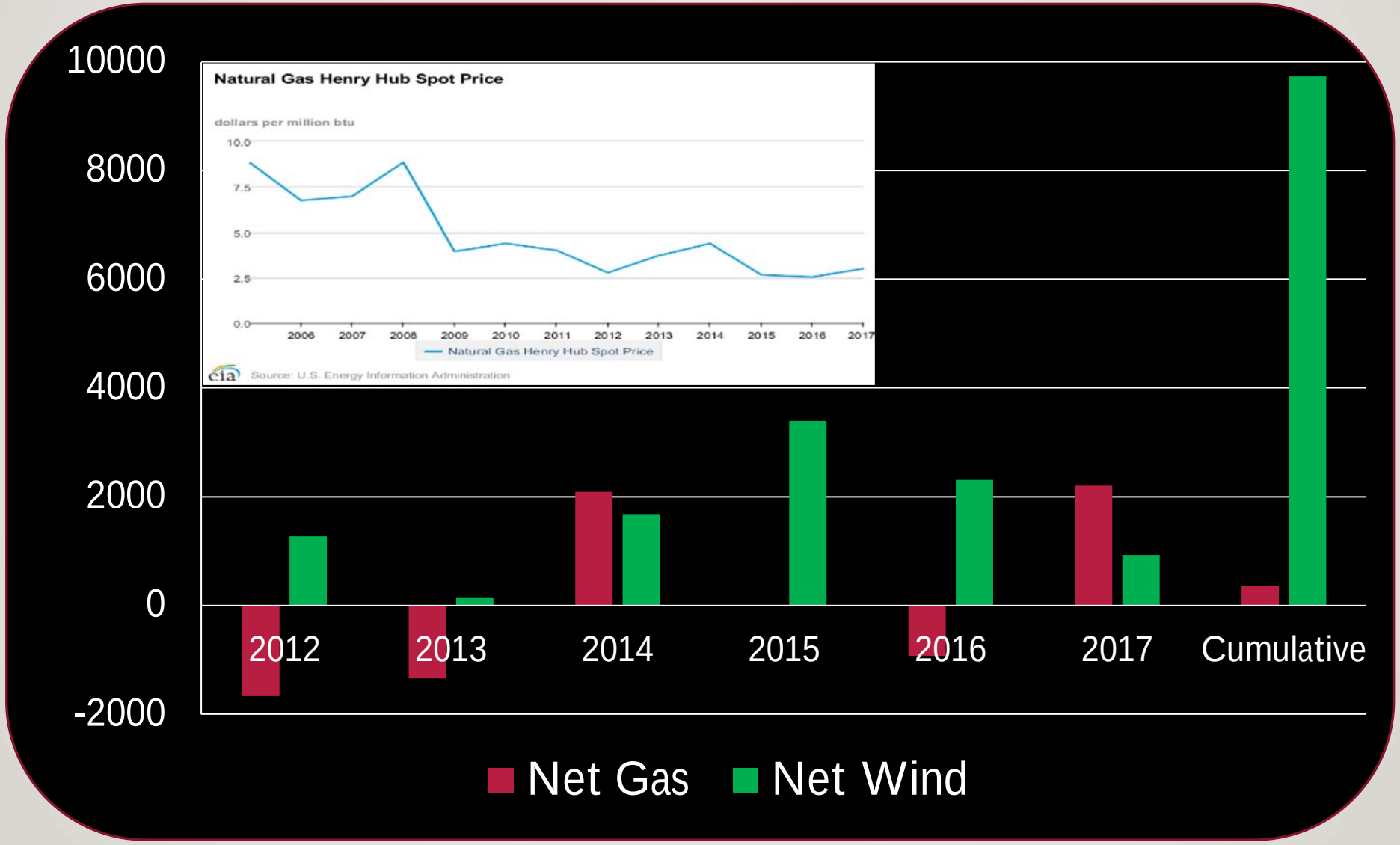
Note: Instances of negative pricing are based on occurrences in the ERCOT North Zone, a leading indicator of market-wide conditions.
Sources: ERCOT 15-Minute Settlement Data, North Zone, 2011-2016, sum of intervals in the month with negative settlement prices; 2011 – Mar. 2016 ERCOT Energy and Demand Reports; *ERCOT real time settlement data, north zone, 2015-2016

TEXAS INDEPENDENT MARKET MONITOR:
WHY GAS IS NOT GETTING BUILT



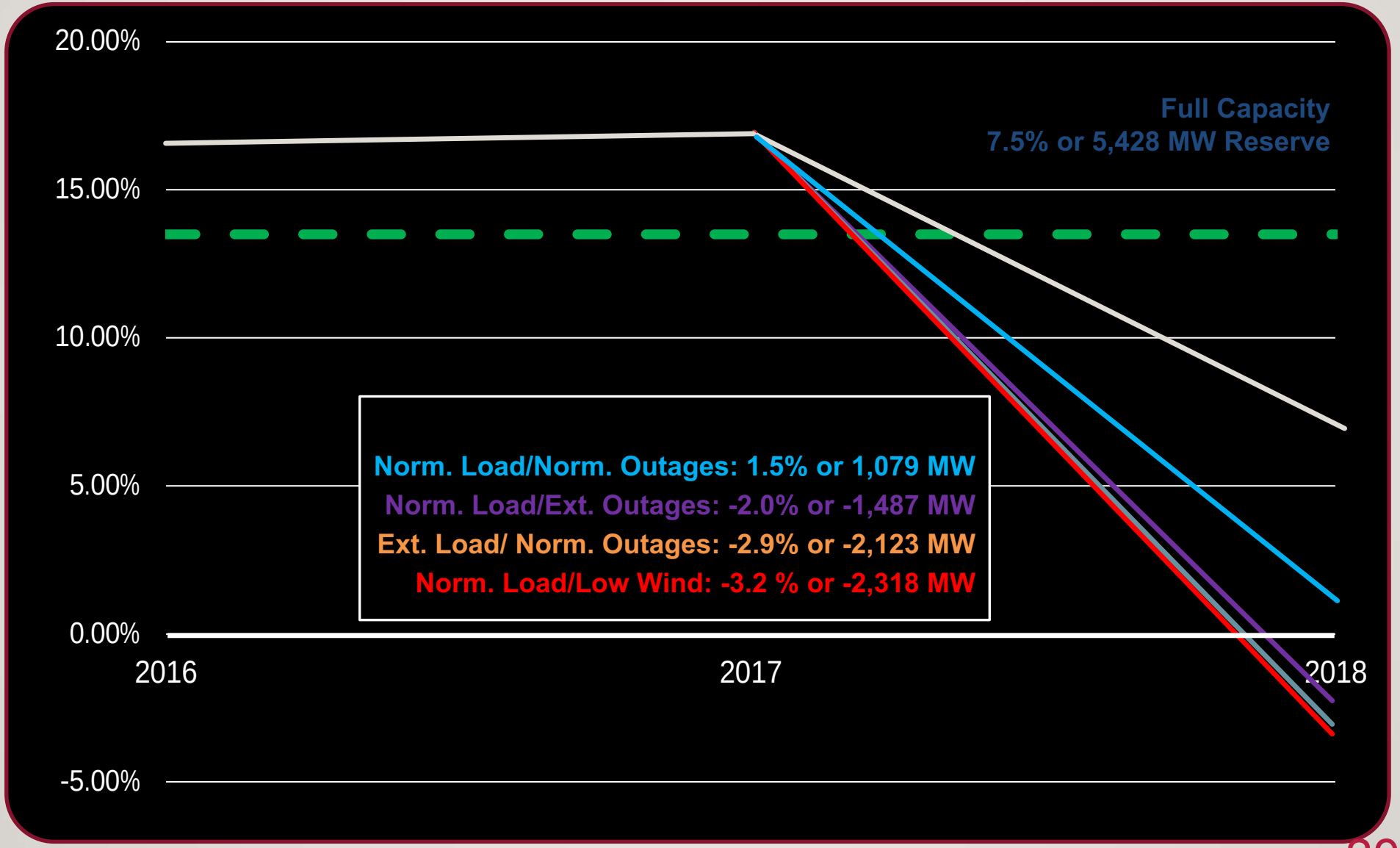


Texas Market Failing to Attract New Power Plants



Sources: EIA-860M, October 2017. Installed capacities. Includes Electric Utility, IPP CHP, and IPP Non-CHP units; excludes industrial and commercial gen.

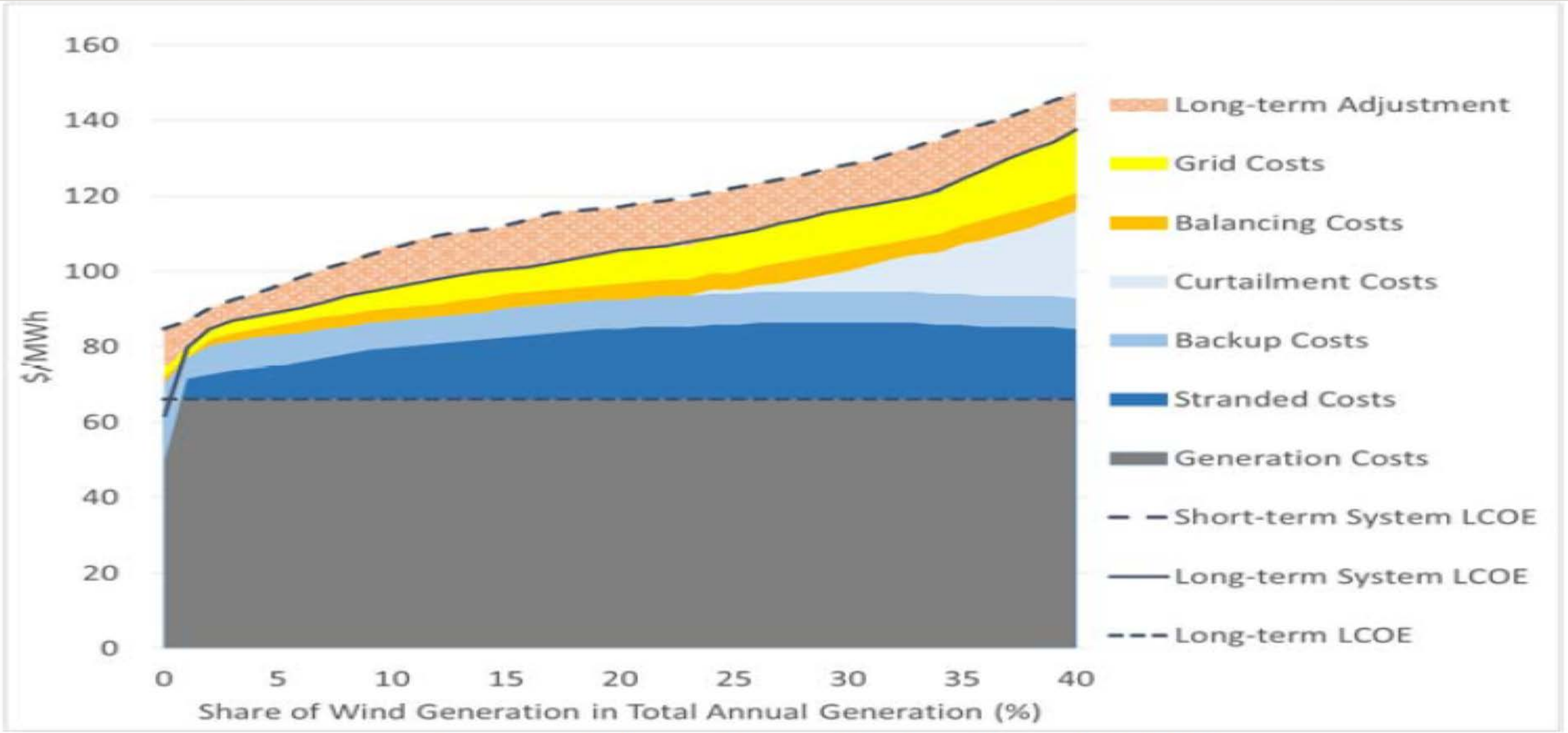
ERCOT SUMMER PROJECTIONS FOR RESERVES



Sources: ERCOT, Capacity, Demand and Reserves Reports, Winter Updates, 2007-2017; Seas. Assess. of Res. Adeq., May 2018.

Bureau of Economic Geology

Total Integration Cost of Renewables



Source: Adapted from Ueckerdt et al. (2013).

HOW TO FIX THE TRANSPARENCY ISSUE?

A Few Priorities

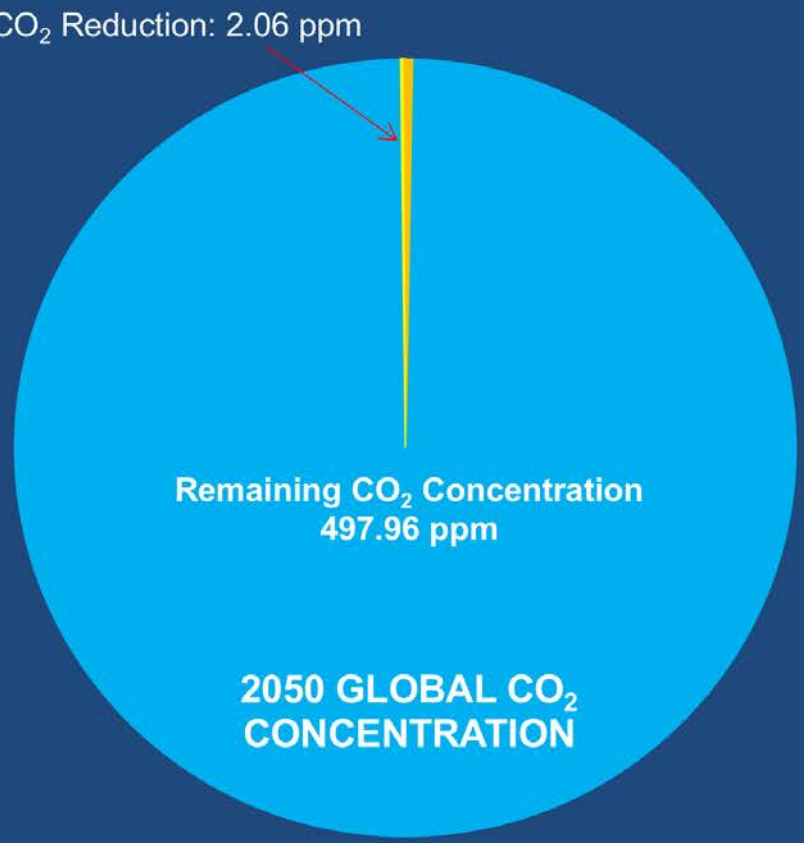
1. STATE Policymakers need to immediately implement measures to mitigate distortions & ensure that consumers know the true and total cost of each source of electricity.
2. FEDERAL Policymakers should never extend renewable subsidies again and should immediately close tax loopholes that are deceptively extending the PTC.
3. EDUCATION: Information campaigns are needed to improve transparency, explain land use implications of a renewable dominated grid, and put de-carbonization benefits in proper international context.

Domestic Decarbonization Will Not Move the Needle:

The World Needs our Technology, not our Ideology

CALCULATED CLIMATE BENEFITS OF TOTAL U.S. FOSSIL RETIREMENT:

- 0.4% reduction in CO_2 concentration
- Sea level rise reduced by less than 2/100th of an inch
- Global temperature reduced by 0.021° F
- In 2025, total annual US reductions will be offset by just more than 6 weeks of Chinese emissions



" Sources: "Climate Effects" of EPA's Final Clean Power Plan, ACCCE, August 2015 (Intergovernmental Panel on Climate Change (IPCC) projected concentrations of CO_2 in 2050 from 450 to 600 ppm); Statement of Karen Harbert, U.S. Chamber of Commerce, U.S. House of Representatives Comm. on Science, Space, & Technology, April 15, 2015; National Centers for Environmental Information, NOAA, Global Analysis – Annual 2014; U.S. Chamber of Commerce, Institute for 21st Century Energy, Coal-fired Power Plants Planned and Under Construction; EPA CPP RIA.

RESILIENCE DEBATE – WHY YOU SHOULD CARE

RESILIENCE BELTWAY DEBATE

- Why should you care?
- How did we get here?
- How will it end?

RESILIENCE DEBATE – HOW WE GOT HERE

- April 2017 - DOE Resilience report.
- Fall 2017 - DOE NOPR sent to FERC, asked FERC to consider a rule that would reward plants that kept 90 days of fuel on-site - lots of hullabaloo.
- PACE said "it's a conversation that needs to be kickstarted"
- "Nevertheless, as one of first acts as FERC Chairman, Kevin McIntyre led the Commission in a 5-0 decision rejecting the Department of Energy's Notice of Proposed Rulemaking (DOE NOPR).[6] In so doing, FERC reiterated its faith in the organized wholesale markets.[7]

RESILIENCE DEBATE – HOW WE GOT HERE

- Docket AD18-7 opened to take input on bulk power system resilience in regions operated by RTOs and ISOs.
- Ironically, last day of the “Bomb Cyclone” weather event, January 8 2018.
- “Voices form a cacophony, not a chorus” – Sidley Austin, June 2018 PowerMag.

RESILIENCE DEBATE – THE LEAKED MEMO

- Appears to be draft supporting an eventual DOE Order to keep coal and nuclear plants open.
- Kitchen sink approach.
- More hullaballoo over DOE invoking Secretary's authorities under the Defense Production Act of 1950, and
- Federal Power Act Section 202 (c) "authority to issue emergency orders due to shortages of electric energy, facilities, or fuel or other causes."

RESILIENCE BELTWAY DEBATE

- Trump Order to DOE June 1 2018 “President Trump directed Secretary of Energy Rick Perry to stop the closure of coal and nuclear plants, pushed offline by cheaper electricity from natural gas and renewables. And told Perry to “prepare immediate steps” to stop the plants from retiring
- Powelson FERC departure leaves 2-2.
- FERC Actions Later This Year?

STATE POLICIES TO WATCH

- Net Metering
- Gas Reserves
- Deregulation

NET METERING - CONNECTICUT

- 2018 bill replacing net metering
- “Revises net metering so Connecticut pays a more affordable rate per kilowatt-hour basis; ”
- Utilities tasked with developing new tariff-based renewable energy programs, so stay tuned.

NET METERING - MASSACHUSETTS

- Massachusetts approved new charges for new solar customers in January.
- At the same time, the state became first in the nation to apply demand charges to all residential net metering customers.
- Demand charges are determined by a customer's highest electricity usage over an entire monthly billing period.

NET METERING - MICHIGAN

- In late April, the Michigan Public Service Commission elected to replace net metering.
- Instead, solar customers will buy energy from the grid at the retail rate and compensated for energy they send to the grid at a significantly lower rate.
- That rate will be based on an estimate of how much the utility would otherwise pay to procure that power, an “avoided cost” calculation.
- Current net metering customers grandfathered 10 years.

BACK TO THE FUTURE - DEREGULATION

- Cropped up in Florida Fall 2017, **well-funded** push to use 2018 ballot to enshrine consumers' right to choose their retail electricity provider.
- Failed in Committee of the Constitution Revision Commission.
- Nevada - on November 2018 Ballot. www.noon3.com.
- Massachusetts Attorney General pursuing marketers for abusive tactics, has called for reversing consumer choice.

GAS RESERVES AND HEDGING

- Increased use of natural gas for power generation (even if percentages are level, overall demand will be up)
- Increased demand for U.S. gas in global markets (LNG exports thriving and will increase)
- Future uncertainty about domestic fracking regulations (even with studies showing safe for drinking water, what could future Congresses do?)
- Therefore, smart to continue allowing utility hedging programs (financial markets) and encourage innovative tactics for investment in physical reserves.

UPCOMING EVENTS

- July 31, 2018 - Roll-out of the *LIFE:POWERED* initiative.
- August 9 - PACE/Energy Fairness Workshop at ALEC (9:30 a.m.)
- August 15 - Public Forum in Georgetown, Texas to Discuss the Reasons "100% Renewable is not Doable."
- September 13 - Texas Public Policy Foundation Lunch Panel Discussion – A Closer Look at Wind Subsidies in Texas and Beyond.
- October – new PACE/Energy Fairness report State Solar Snapshots.

THANK YOU AND DISCUSSION

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