

Transmission Line Ratings and the Evolving Resource Mix

FERC Technical Conference in AD19-15
September 10, 2019

Rob Gramlich

For AWEA, ACORE, WATT, ACEG, and AEE



Grid
Strategies LLC

Who We Are

- **Working for Advanced Transmission Technologies**
 - Ampacimon, Lindsey, LineVision, Smart Wires, WindSim, NewGrid
- **American Wind Energy Association**
- **American Council on Renewable Energy**
- **Americans for a Clean Energy Grid**
- **Advanced Energy Economy**



Transmission Congestion Costs Rising (Again)

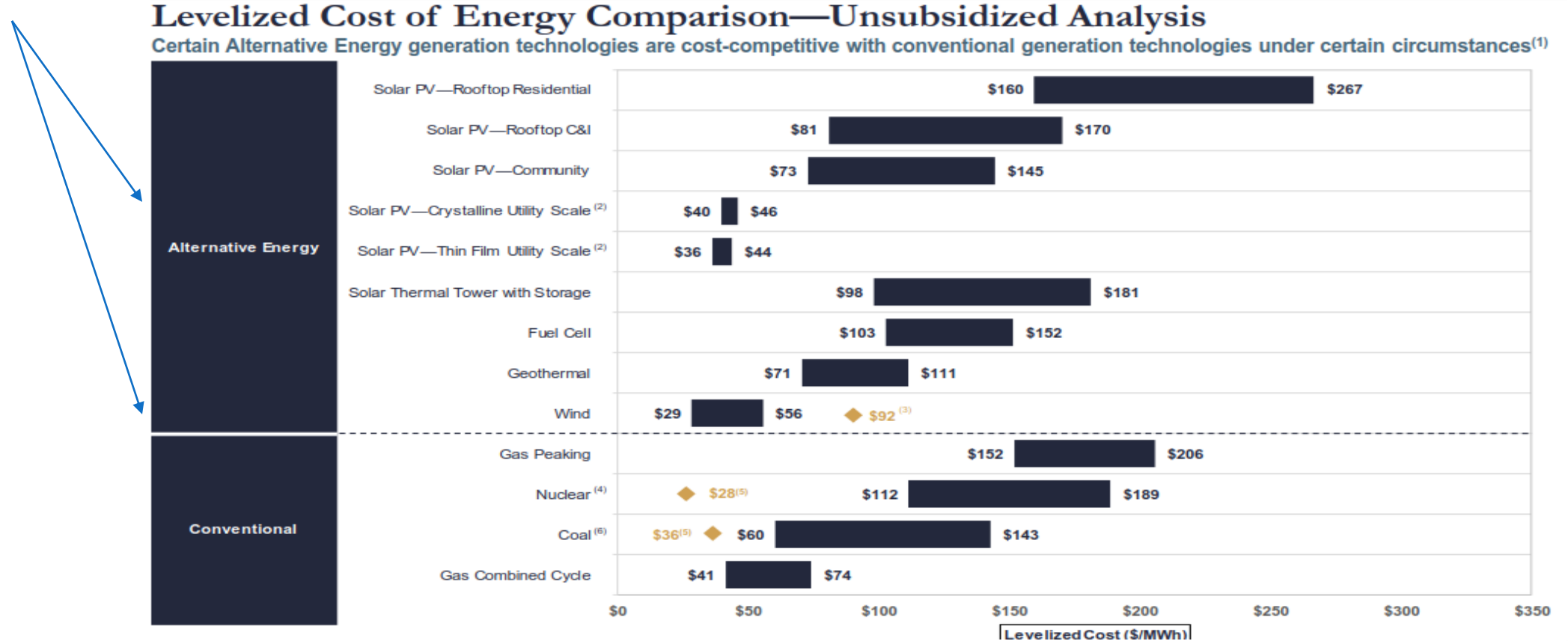
Transmission Congestion Costs (\$ millions) for RTOs from 2016-2018

RTO	2016	2017	2018
ERCOT	497	976	1,260
ISO-NE	38.9	41.4	64.5
MISO	1,400	1,500	1,400
NYISO	529	481	596
PJM	1,023.7	697.6	1,310
SPP	273.7	405.3	380.9
Total	3,762.3	4,101.3	5,011.3



Growing Need for Transmission Delivery Capacity

- Renewables are now the low-cost energy sources

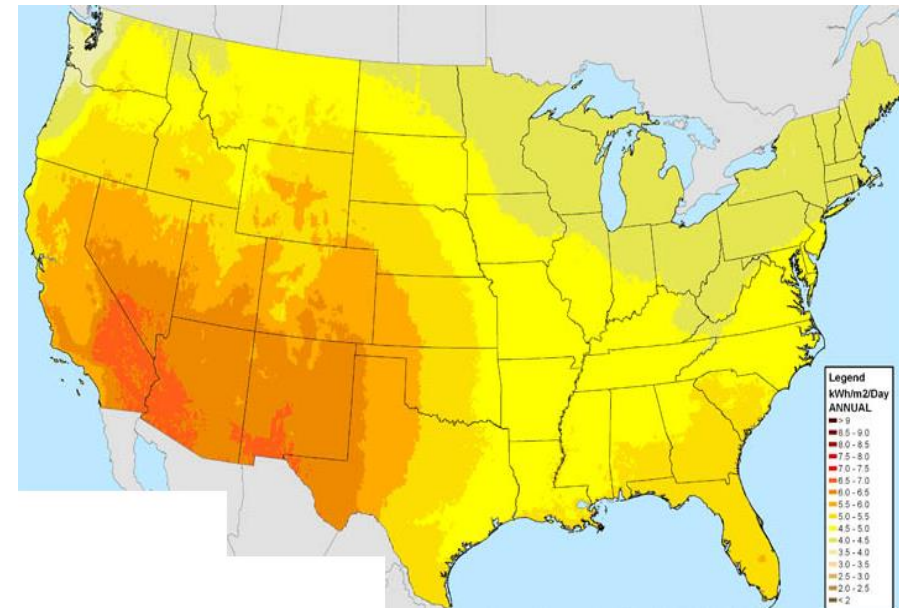
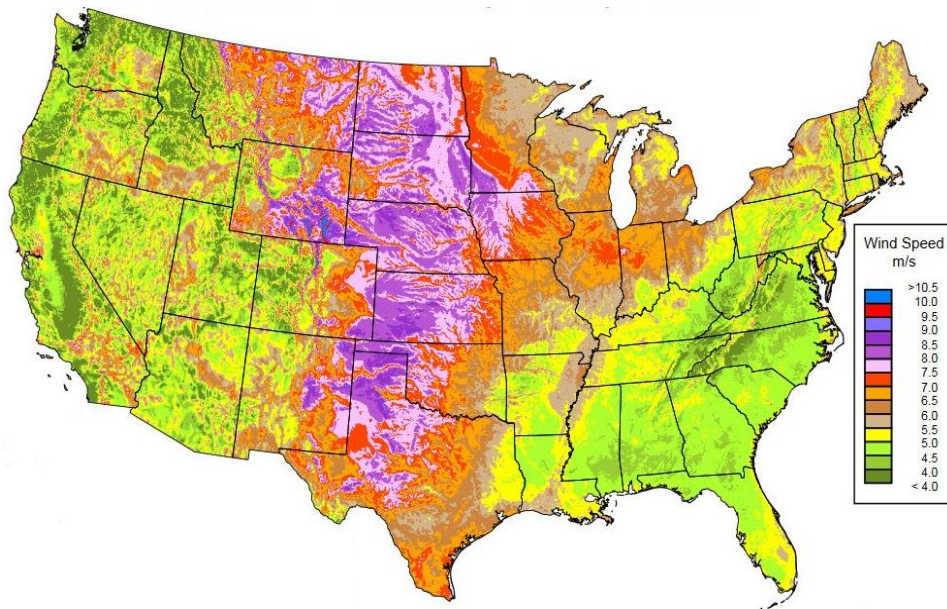


Source: Lazard <https://www.lazard.com/media/450773/lazards-levelized-cost-of-energy-version-120-vfinal.pdf>



Growing Need for Transmission Delivery Capacity

- Best wind and solar far from load
- 188 GW of solar and 180 GW of wind projects in interconnection queues at end of '17



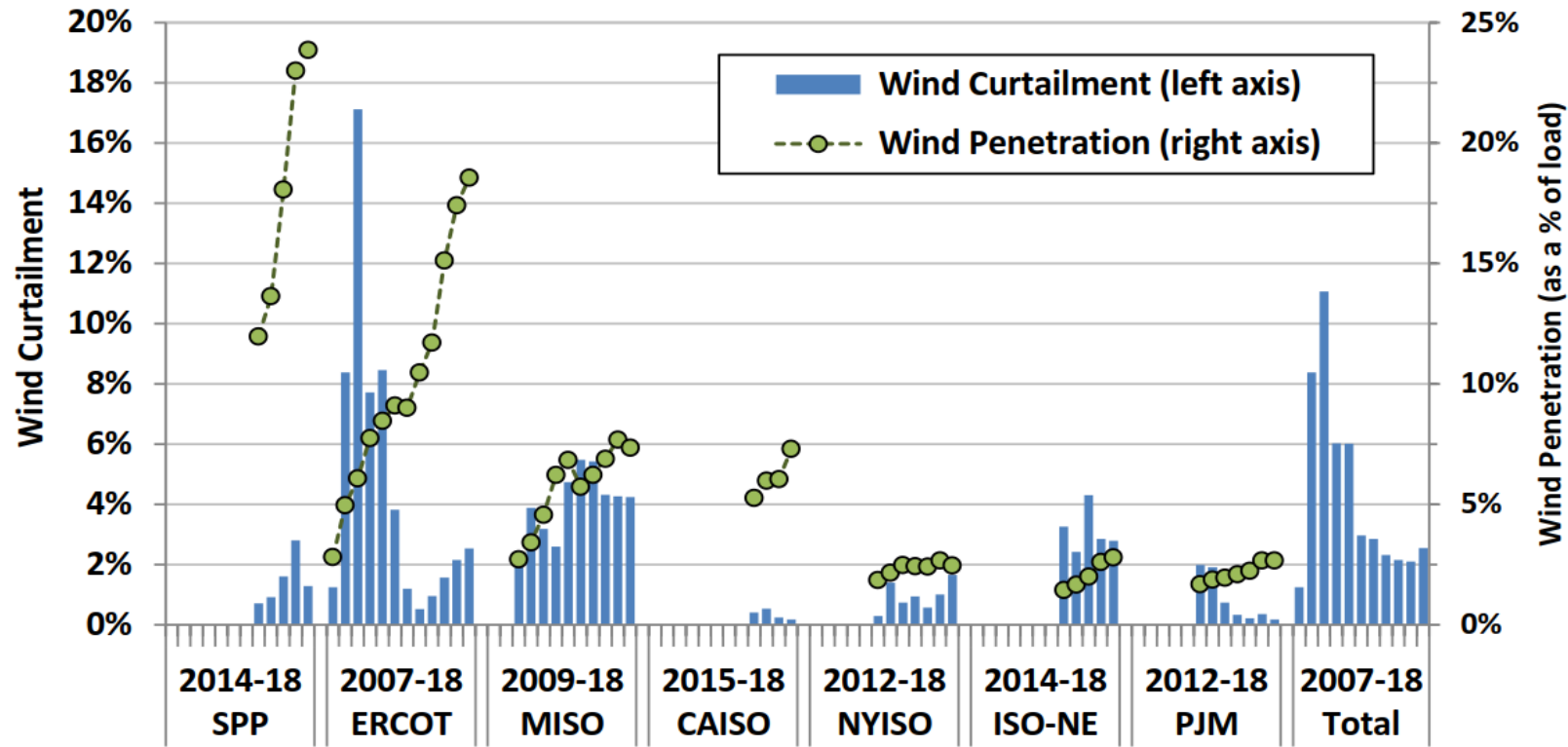
NREL Wind (left) and Solar (right) Resource Maps

<https://windexchange.energy.gov/maps-data/319> , https://www.nrel.gov/gis/images/map_pv_us_annual10km_dec2008.jpg



Growing Need for Transmission Delivery Capacity

- Generation curtailment likely to rise with little intra- or inter-regional transmission in present plans



Source: LBNL
Wind
Technology
Market Report
2018

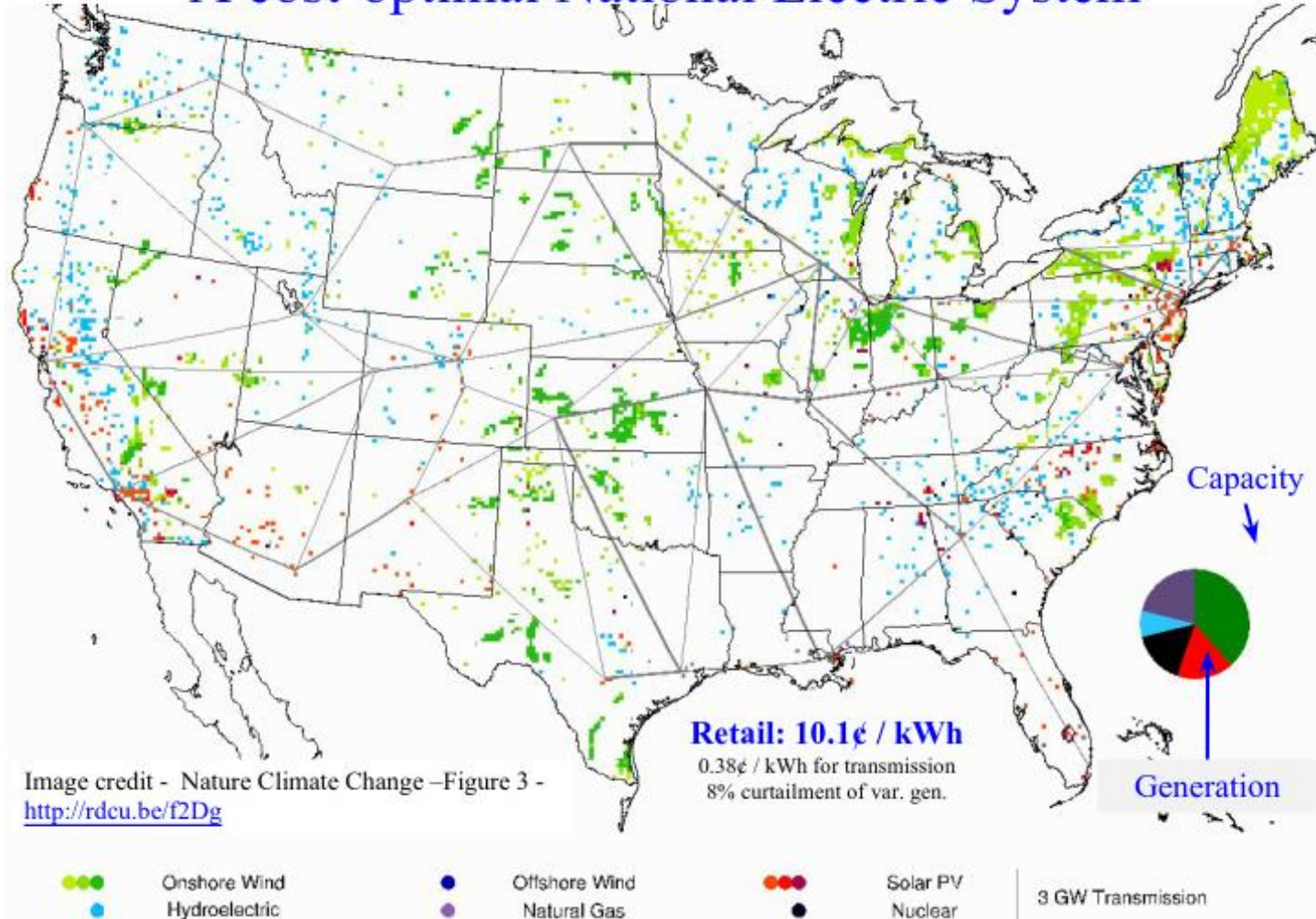
Notes: All curtailment percentages shown in the figure represent both forced and economic curtailment. PJM's 2012 curtailment estimate is for June through December only. For each year, the total reflects only those ISOs for which we have curtailment data.

Sources: ERCOT, MISO, CAISO, NYISO, PJM, ISO-NE, SPP



New Transmission is Part of the Solution

A cost-optimal National Electric System



Christopher Clack, VCE

...but major policy changes are needed, and it will take many years



Technologies to Use the Existing Grid More Efficiently

- **Power Flow Control**
 - Push and pull power, modular, scalable, movable
- **Topology Optimization**
 - Software to optimize transmission configurations to re-route flow
- **Storage as Transmission**
- **Dynamic Line Ratings**
 - Adjust path rating based on ambient conditions, allows capacity forecasting
- **Potentially others**



The Incentive Problem

Averch-Johnson Effect: the tendency of regulated companies to engage in excessive amounts of capital accumulation in order to expand the volume of their profits.

–Drs. Harvey Averch and Leland Johnson (1962).

“All regulation is incentive regulation.” – Dr. Alfred Kahn

“The managers of the network... were given incentives that would pay them more if congestion (and thus the cost of redispatch from cheap to expensive power plants) were diminished. This incentive led to low-cost investment that reduced congestion, to the benefit of electricity consumers.”

– Dr. Jean Tirole, [Economics for the Common Good](#)



Fed. Power Act Section 219b3

“encourage deployment of transmission technologies and other measures to increase the capacity and efficiency of existing transmission facilities and improve the operation of the facilities.”

--16 U.S.C. § 824s(b)(3).



An Incentive Proposal

- Utility earns share of savings
- Based on prospective congestion reduction (production cost savings)
- Size cap at \$25 million
- For hardware, software and associated protocols applied to existing transmission facilities that increase the network's operational transfer capacity.
- Time frames:
 - planning (years),
 - operations planning (months, weeks, days)
- Periodic review



More Transparent and Consistent Line Rating Methodologies

- Renewable energy developers consider line rating methodologies to be opaque and inconsistent
- FERC, NERC, and IEEE can potentially all play a role in standardizing and making more transparent line rating methodology

