

Forming Expectations about Price Formation

Travis Kavulla
Regulatory Majordomo, NRG Energy
Dec. 12, 2019

Harvard Electricity Policy Group
Somewhere Outside Tucson, Arizona

SAFE HARBOR:

This communication contains forward-looking statements that may state NRG's or its management's intentions, beliefs, expectations or predictions for the future. Such forward-looking statements are subject to certain risks, uncertainties and assumptions, and typically can be identified by the use of words such as "will," "expect," "estimate," "anticipate," "forecast," "plan," "believe" and similar terms. Although NRG believes that its expectations are reasonable, it can give no assurance that these expectations will prove to have been correct, and actual results may vary materially. Factors that could cause actual results to differ from those implied by the forward-looking statements in this communication are set forth in the Company's most recent Annual Report on Form 10-K, quarterly and other periodic reports, current reports and other filings with the Securities and Exchange Commission at www.sec.gov. NRG undertakes no obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise, except as required by law.

Please note: If you invest in NRG, you are taking a risk based on our projections – so if you don't like that, consider investing in a regulated utility where the risk of these projections is shifted to captive customers.

DIVERSITY



Approximately
35
generating assets
in 8 states



Approximately
3.7 Million
customers

STABILITY



Fortune
500
company



Over
\$9 Billion
in revenue

SUSTAINABILITY



50%
carbon emissions
reductions by 2025*



net-zero
carbon emissions
reduction by 2050*

*Using 2014 as a baseline

STRENGTH



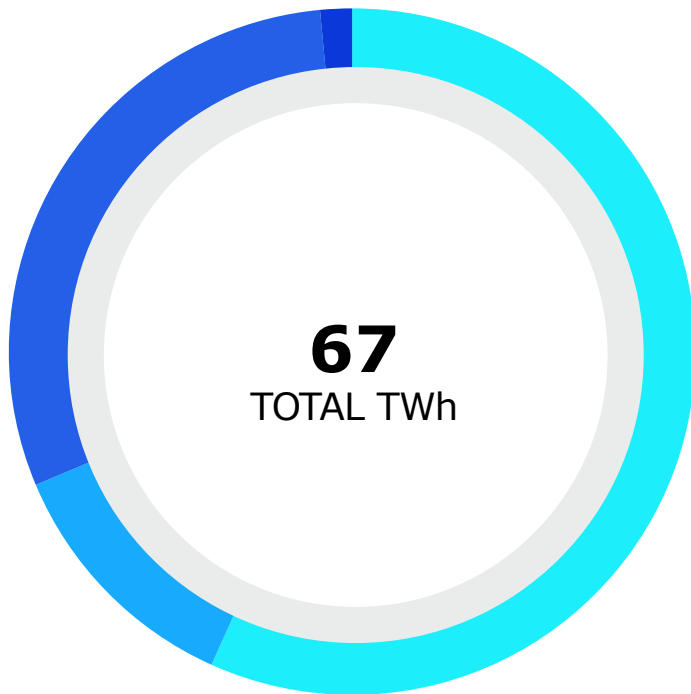
Over
4,500
full-time employees

SAFETY



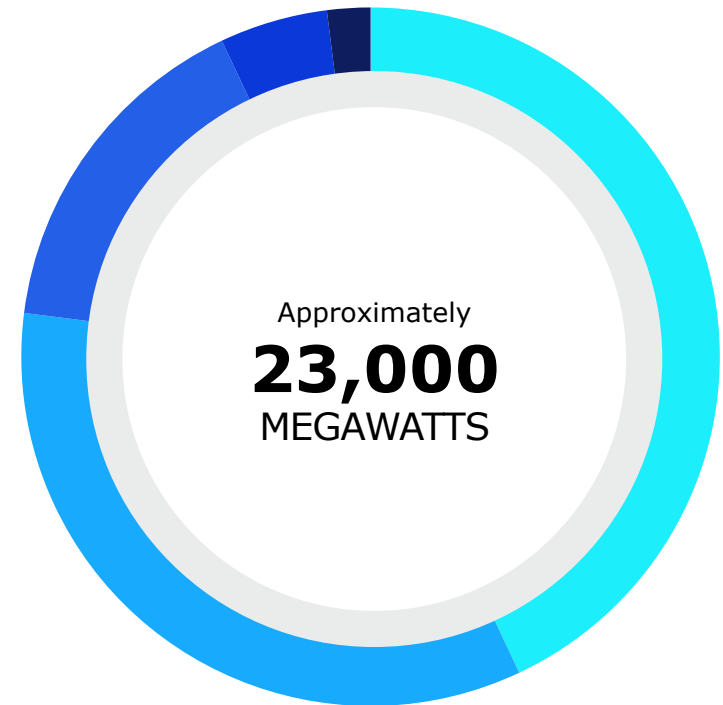
7 facilities
With VPP Star rating

RETAIL LOAD 2018 TWh Sold



■ 38 TWh Texas Mass ■ 8 TWh Northeast Mass
■ 20 TWh Texas C&I ■ 1 TWh Northeast C&I

GENERATION CAPACITY By fuel type – North American Portfolio



■ 43% Natural Gas ■ 34% Coal ■ 16% Oil ■ 5% Nuclear ■ 2% Renewables

- **Holy moly, this actually works**
- Supply faces a strong incentive to be available when needed.
 - 44% of RT energy market revenue in a 6-month period, March to August 2019, comes from a single 5-day stretch (Aug. 12-16)
- Load faces a strong incentive to cover its position through self-supply or third-party commercial arrangement
 - IMM estimates that only ~10-20% of load is “unhedged” to real-time price.
 - That estimate does not reflect retailers’ assumption of price risk for their customers’ load (who are mostly on fixed-price contracts). Actual unhedged load on a combined wholesale/retail basis is much lower still.
 - Those retailers (e.g., Griddy) with truly unhedged customers got angry calls & lost market share! Turns out customers have a mind of their own and don’t require a paternalistic government to speak for them!

- **Demand flexibility**
 - Larger, more sophisticated C&I customers select index pricing products because they are comfortable with the risk/volatility.
 - The competitive retail market is enabling growth in demand response products. ERCOT reported 1.2 million customers on price responsive products (TOU, DR) in 2018.
- **Supply procurement**
 - Appropriate new capital investment is encouraged. NRG signed 1,400 MWs of 10-year solar PPAs this summer based on tradeable & estimated forward prices.

ERCOT: A renewables bonanza?



Solar	Dec CDR	2020	2021	2022	2023	2024
	Operating	2,169	2,169	2,169	2,169	2,169
	Planned	1,569	7,941	9,469	9,469	9,469
	Total	3,738	10,110	11,638	11,638	11,638
	May CDR	2020	2021	2022	2023	2024
	Operating	1,861	1,861	1,861	1,861	1,861
	Planned	3,069	6,660	7,118	7,118	7,118
	Total	4,930	8,521	8,979	8,979	8,979
	Delta	2020	2021	2022	2023	2024
	Operating	309	309	309	309	309
	Planned	(1,500)	1,281	2,351	2,351	2,351
	Total	(1,192)	1,589	2,660	2,660	2,660
Wind	Dec CDR	2020	2021	2022	2023	2024
	Operating	22,783	22,738	22,738	22,738	22,738
	Planned	5,590	12,095	13,822	14,326	14,326
	Total	28,373	34,833	36,560	37,064	37,064
	May CDR	2020	2021	2022	2023	2024
	Operating	22,047	22,066	22,066	22,066	22,066
	Planned	7,457	13,398	13,956	13,956	13,956
	Total	29,504	35,464	36,022	36,022	36,022
	Delta	2020	2021	2022	2023	2024
	Operating	736	672	672	672	672
	Planned	(1,867)	(1,303)	(133)	370	370
	Total	(1,131)	(631)	538	1,042	1,042

- The authors of *Priorities for the Evolution of an Energy-Only Electricity Market* (May 2017) should take a bow!
- As should the regulators who agreed to adopt its most important recommendations in a two-phase implementation (March 2019, March 2020).
- The ERCOT market stands as a major accomplishment for those who want to see competitive markets survive.





NEWS
RELEASE

FOR IMMEDIATE RELEASE

PJM Files Reserve Pricing Reforms for the Future of a Flexible, Reliable Power System
Proposal Before FERC Seeks Proper Pricing for Valuable Reserves

(Valley Forge, Pa.– March 29, 2019) – PJM Interconnection today proposed energy and reserve market reforms to fairly value the crucial energy reserves that support a reliable electrical grid with the flexibility required for the continued evolution of the resource mix in the nation's largest bulk power system.

CDR Reserve Margin Comparison

Reserve Margins	Version	2020	2021	2022	2023	2024
	Dec 2019 CDR	10.6%	18.2%	17.3%	15.2%	12.9%
	May 2019 CDR	10.5%	15.2%	13.0%	10.3%	7.8%
	Delta	0.2%	3.0%	4.3%	4.9%	5.1%
	CDR Reserve Margin Comparison (excluding renew contribution change)					
	Version	2020	2021	2022	2023	2024
	Dec 2019 CDR	9.1%	16.2%	15.2%	13.1%	10.9%
	May 2019 CDR	10.5%	15.2%	13.0%	10.3%	7.8%
	Delta	-1.3%	1.0%	2.2%	2.8%	3.1%

Even if one assumes that projections of renewable build are over-optimistic, by 2021's CODs, reserve margins see an uptick.

So what about 2020?

- Environmental law vs. scarcity
 - Texas CEQ “Notice of Enforcement Discretion”
- Transmission ratemaking vs. energy pricing
 - 4-CP, and peak load vs. peak net load
- CDR projections vs. reality
- Will a CREZ 2.0 be needed to make this all work?

“Reliability Through Markets”: A Great ERCOT Slogan...



...Which is actually CAISO's! (Several re-brands ago)



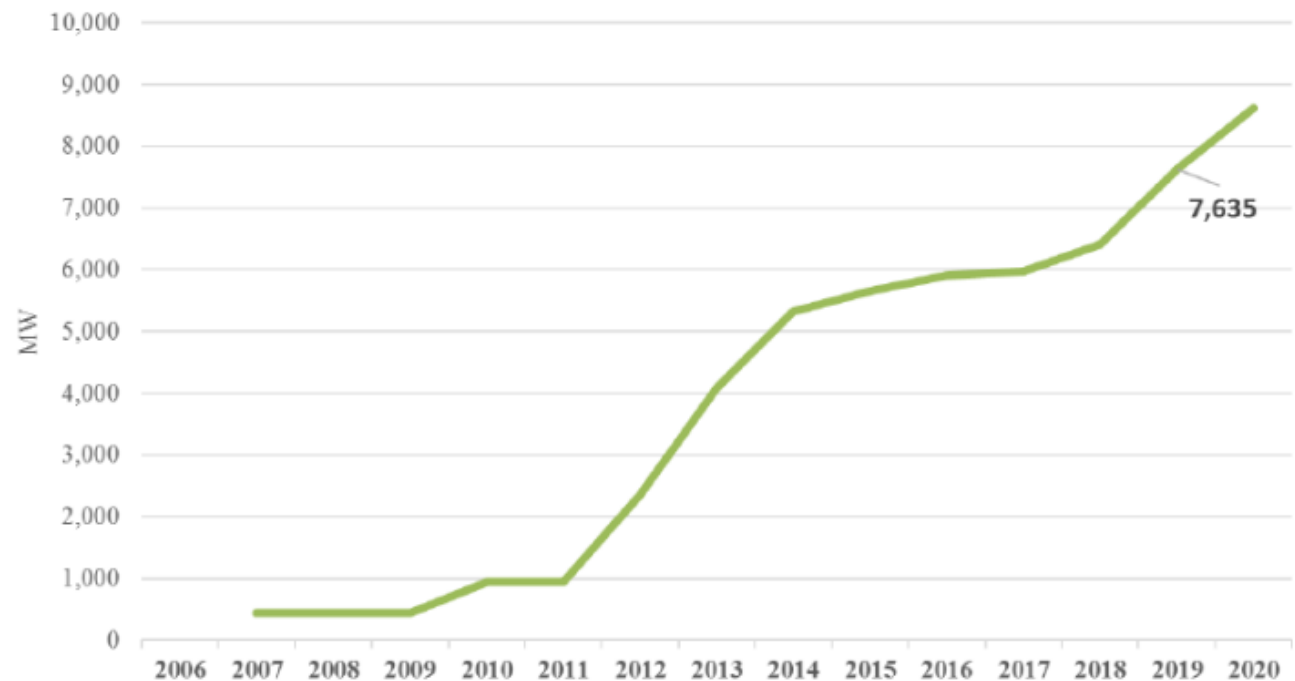
- Beth Garza asks in her slides: “Did market participants effectively manage their price exposure?” in relation to ERCOT’s summer
 - The beauty of ERCOT is that the people who care the most about the answer to this question are market participants
 - But in California, government still “owns” this question
- California:
 - doesn’t have a full competitive retail market to pass off the business & risk of hedging
 - has IOUs who are largely financially indifferent as to whether they’re making good/bad bets on energy supply
 - have local-government-sponsored CCAs that are making bets—but with other people’s money, and with an eye toward beating the IOU “price to compare,” not necessarily on medium/long-term viable hedging practices

California's Energy Market(s)



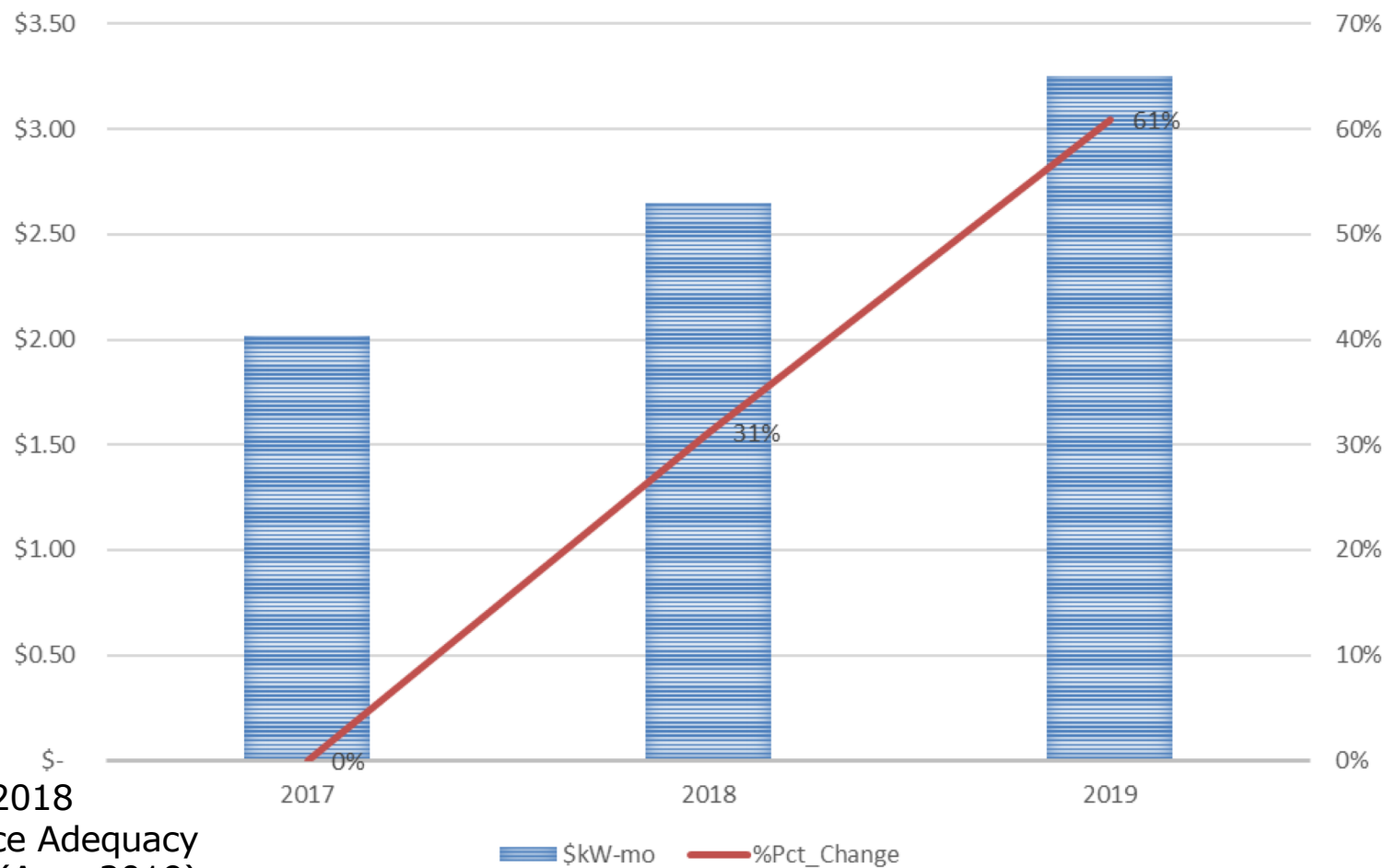
Market participants in California are increasingly unmoved by energy price signals – and look to RA contracts to make ends meet

CAM/CAM LIKE RESOURCE PROCUREMENT, 2007-2020 (AUG. VALUE)



CPUC, 2018
Resource Adequacy
Report (Aug. 2019)

CA RESOURCE ADEQUACY 2017-2019

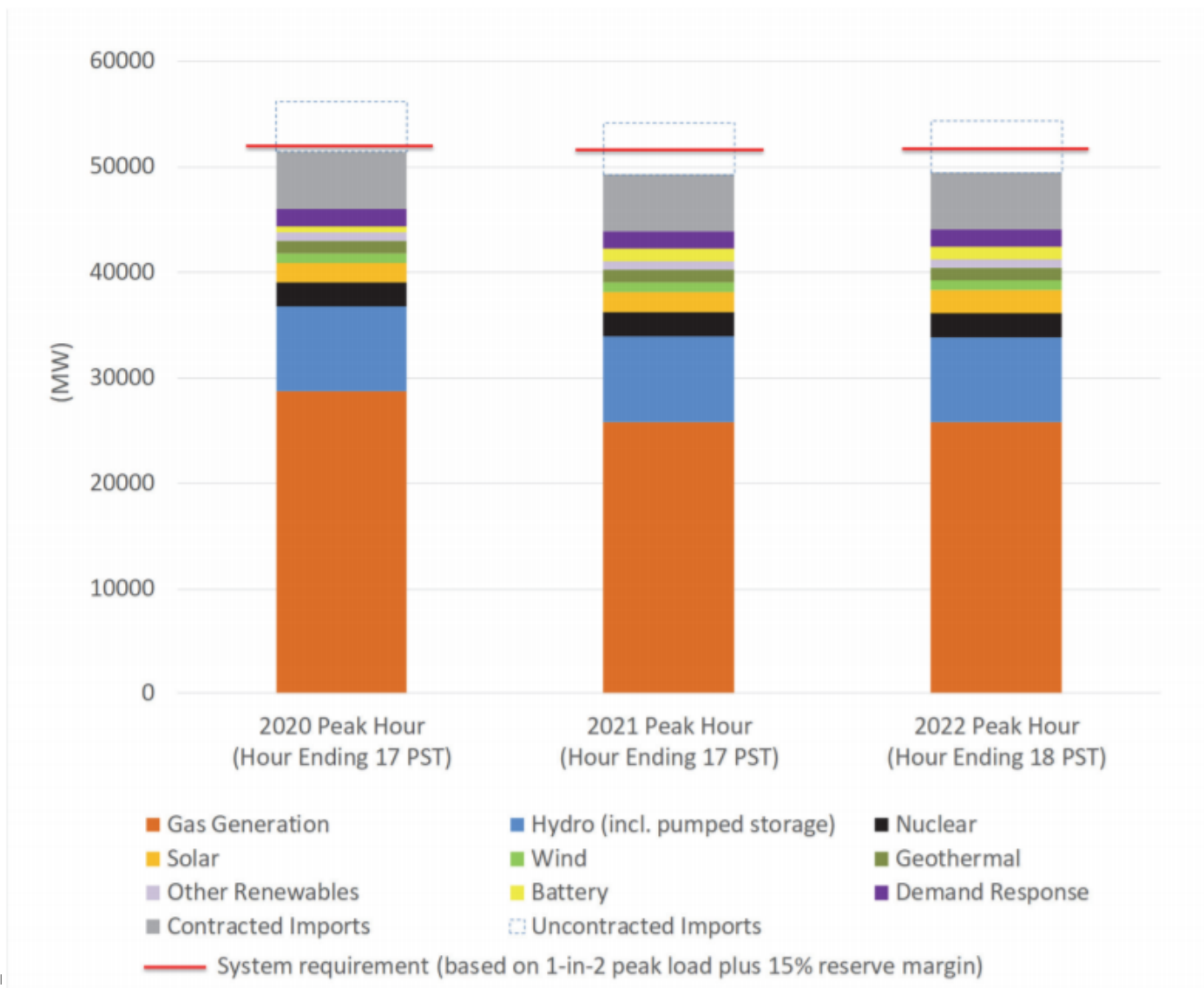


CPUC, 2018
Resource Adequacy
Report (Aug. 2019)

© 2019 NRG Energy, Inc. All rights reserved.

Coming Up Short?

Figure 1: 2020, 2021, 2022 System Resource Adequacy



CPUC, 2018
Resource Adequacy
Report (Aug. 2019)

- Parties have different, changing views of what “RA” is
 - When California began using ELCC, RA contribution of renewables dropped significantly.
 - Some other states continue to use simpler “exceedance” benchmarks for renewables.
 - Parties usually do not calculate RA as a function of a value of resources in relation to the regional interconnection – but often still as a standalone firm.
- The rise of *ad hoc* resource decisionmaking
 - California rescues its Once Through Cooling plants
 - Rules on RA imports to California tightening up
 - Coal plant closures—not clear that capacity is being considered in this context
- CAISO: More productization, rather than strict focus on energy – if successful, ultimately could create a more centralized, short-run market for RA-like things

- 1 in 4 Americans live in a jurisdiction that's declared a 100% clean-energy goal
- The ***implementation policies*** of ambitious state electricity standards are taking the form of government-led procurements
- These contracts:
 - Have long terms (usually ~20 years), insulating generators from market's churn
 - Are priced substantially above what the wholesale market would itself support (NJ's offshore wind Year 1 price = x3 wholesale price)
 - Are the result of processes that range from completely ad hoc (one-off proposals) to quasi-competitive (an RFP process to obtain the contract, but restricted to certain qualified technologies – rather than based on carbon emissions saved)
 - Have counterparties who are financially indifferent

Back to the Future: Regulatory ‘The Price is Right’ in New Jersey



2 OREC PURCHASE PRICE

The OREC Purchase Price was defined in the rules at N.J.A.C. 14:8-6.1 and 6.5.(a).12 as the price per OREC (megawatt hours (MWh)) paid for a Qualified Offshore Wind Project. Hence, the OREC Purchase Price reflects the all-in costs of the project, *i.e.*, the total project capital and operating costs offset by any state or Federal tax or production credits and other subsidies or grants. The OREC Purchase Price is fixed for the first 20 years of project operation and paid on a dollar per MWh for delivered energy. The rules at N.J.A.C. 14:8-6.5.(a).12.(iii) and (vii) required applicants submit an OREC Pricing Schedule with a fixed OREC price for each year of the proposed 20 year term of operation. The first year OREC price is typically the lowest price that may be subject to a rate of inflation over the life of the project. The levelized OREC Price, which reflects the rate of inflation, is the OREC Price used to evaluate projects on a competitive basis. LAI also evaluated the LNOC, which is the OREC Price less the expected value of energy, capacity and environmental attributes. The levelized net OREC Price represents the net price paid by ratepayers. It is expressed on a nominal dollar basis over the 20-year OREC term using a discount rate equal to 7%.

What is sold as a competitive process for large-scale renewable build-out... **is not.**

It's a return to "revenue requirement" regulation.

It's like old-school utility regulation – but with none of the transparency!

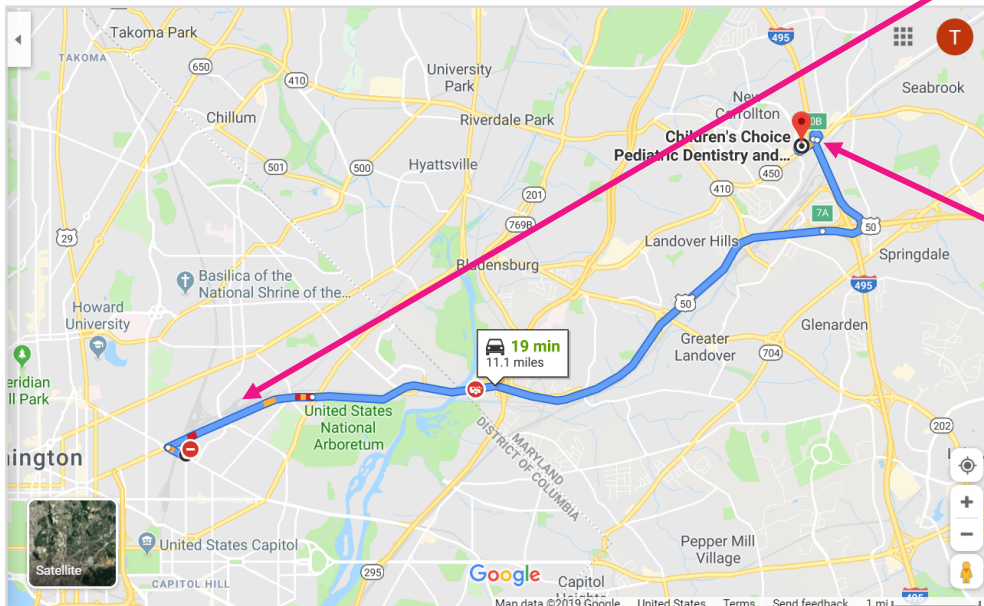
STATE OF NEW JERSEY BOARD OF PUBLIC UTILITIES

IN THE MATTER OF THE APPLICATION OF :
OCEAN WIND, LLC FOR APPROVAL AS A :
QUALIFIED OFFSHORE WIND PROJECT, : STATEMENT OF
PURSUANT TO N.J.S.A. 48:3-87.1 and N.J.A.C. :
14:8-6.1, et seq. :

[REDACTED], of full age, states:

1. I am the Senior Policy Advisor for Orsted North America Inc., the sole member of Ocean Wind, LLC ("Ocean Wind"), and I am authorized to make this Statement on behalf of Ocean Wind.

Absent a carbon price, it may be a reasonable “second-best” to pay a price premium for emissions-free energy – we even have a product for it: The REC.



SNL RECs Index

As of: 09/19/19

Product	Term	Price	Product	Term	Price
CA RPS-REC Bucket 3	2019	1.23	ME Class I	2019	1.63
CT Class I REC	2019	34.25	ME Class I	2020	2.88
CT Class I REC	2020	35.17	ME Class II	2019	0.88
CT Class II REC	2019	20.75	ME Class II	2020	0.95
CT Class II REC	2020	20.50	NH Class I	2019	33.13
CT Class III REC	2019	26.47	NH Class I	2020	33.67
CT Class III REC	2020	25.94	NH Class III	2019	41.75
DC Solar REC	2019	415.00	NH Class III	2020	35.00
DC Solar REC	2020	426.25	NJ Class I REC	2019	6.94
DC Tier I REC	2019	2.53	NJ Class I REC	2020	7.12
DE NEW REC	2019	7.18	NJ Class II REC	2019	4.13
MA APS	2019	16.00	NJ Class II REC	2020	5.13
MA APS	2020	17.81	NJ Solar REC	2019	233.42
MA Class I	2019	34.29	NJ Solar REC	2020	232.50
MA Class I	2020	35.21	OH In-State Solar	2019	7.13
MA Class II	2019	25.88	OH In-State Solar	2020	8.63
MA Class II	2020	25.88	OH Located REC	2019	5.49
MA Class II WTE	2019	10.63	OH Located REC	2020	5.83
MA Class II WTE	2020	14.81	PA Solar REC	2019	33.83
MA Solar I	2019	384.33	PA Solar REC	2020	42.83
MA Solar I	2020	360.00	PA Tier 1 REC	2019	6.82
MA Solar I	2021	343.50	PA Tier 1 REC	2020	7.06
MA Solar II	2019	313.67	PA Tier 2 REC	2019	0.48
MA Solar II	2020	293.75	PA Tier 2 REC	2020	0.56
MA Solar II	2021	273.83	RI Existing REC	2019	1.45
MD Solar	2019	59.83	RI NEW REC	2019	34.25
MD Solar	2020	61.17	RI NEW REC	2020	33.58
MD Tier I	2019	6.85	TX REC	2018	0.69
MD Tier I	2020	7.08	TX REC	2019	0.71

Data is compiled from a range of market indicatives and do not necessarily represent completed trades. CA RPS figures do not contain data from Evolution Markets.
 California prices are representative of the renewable and environmental attributes used for compliance purposes with the state's renewable portfolio standard. CA prices do not include the value of electricity
 Data for RECs index provided by:
 Evolution Markets: <http://new.evomarkets.com/>
 Tradition Financial Services: <http://www.tradition.com/>
 Karbone: <http://www.karbone.com/>
 Please contact data providers for more detailed or specific transaction data or REC markets not covered by SNL index.
 Source: S&P Global Market Intelligence

- NRG has endorsed Brattle's concept of a Forward Clean Energy Market – which clears “Clean Energy Credits” through forward auctions and thus can inform lower-priced offers into capacity markets (where they exist) and merchant entry into energy markets.
- If State RPSes/CESes are not rationalized, the nuance of price formation is going to be a footnote to a flood of state contracting activity (at least until states find that their preferred supply doesn't meet demand)
- A major, overlooked component is that the buyers *need to care* about cost – regulated utilities, default suppliers, and state entities don't (or at least not as much as those in a competitive market).
 - Put another way: Without retail choice, ERCOT's market design might not work