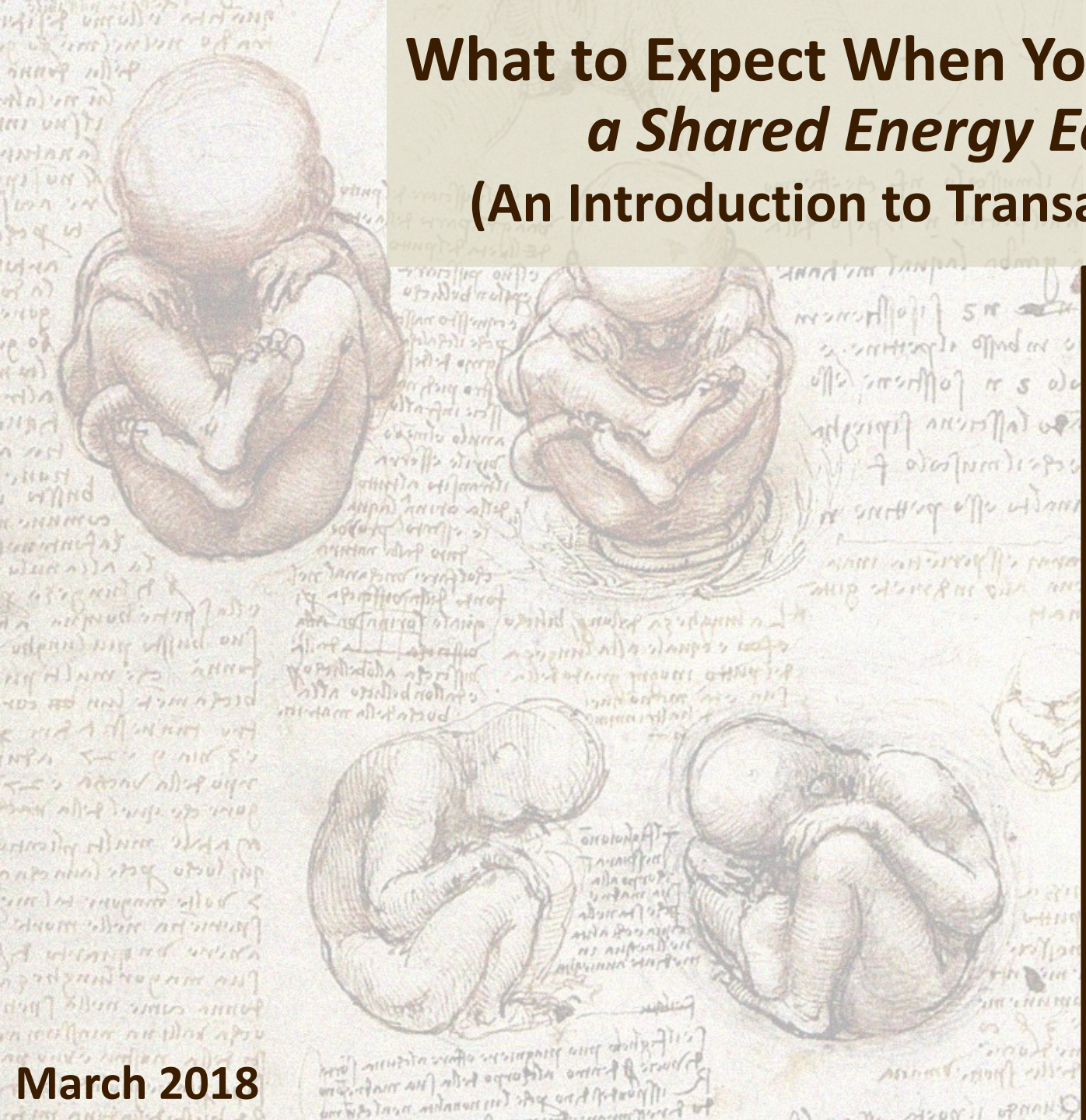
# What to Expect When You're Expecting *a Shared Energy Economy*

## (An Introduction to Transactive Energy)



**Joshua Binus**
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- Background
- End-Use Consumers
- Electric Utilities
- Society
- Conclusions

**March 2018**

# Background: Transactive Energy 101

- The most profound changes in the electric power industry stem from the ongoing digitization of industrialized society.
- The development of a shared energy economy is directly linked to the adoption of enabling technologies—most notably distributed energy resources (DERs).
- Transactive energy involves value-driven exchanges between any/all parties interested in buying and/or selling electricity.
- Early pilots and demonstrations have been steadily demonstrating the efficacy of transactive energy systems and approaches.

## Definitions of Transactive Energy

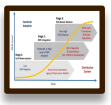
"A system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter."

— GridWise Architecture Council

"Transactive energy engages customers and suppliers as participants in decentralized markets for energy transactions that strive towards the three goals of economic efficiency, reliability, and environmental enhancement."

— Transactive Energy Association

DEF

TE Activity

Image/Data Source: Ed Cazalet, Paul De Martini, Jeffrey Price, Eric Woychick, and John Caldwell, *Transactive Energy Models*, Prepared by NIST Transactive Energy Challenge: Business and Regulatory Models Working Group, Sept. 2016.

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Image/Data Source: Google images

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**Distributed Computing**

Hawaiian Electric Company [e] enphase ENERGY

**Data Analytics & Machine Learning**


**Mass Machine Learning**

DEF | TE Activity

Image/Data Source: Google images

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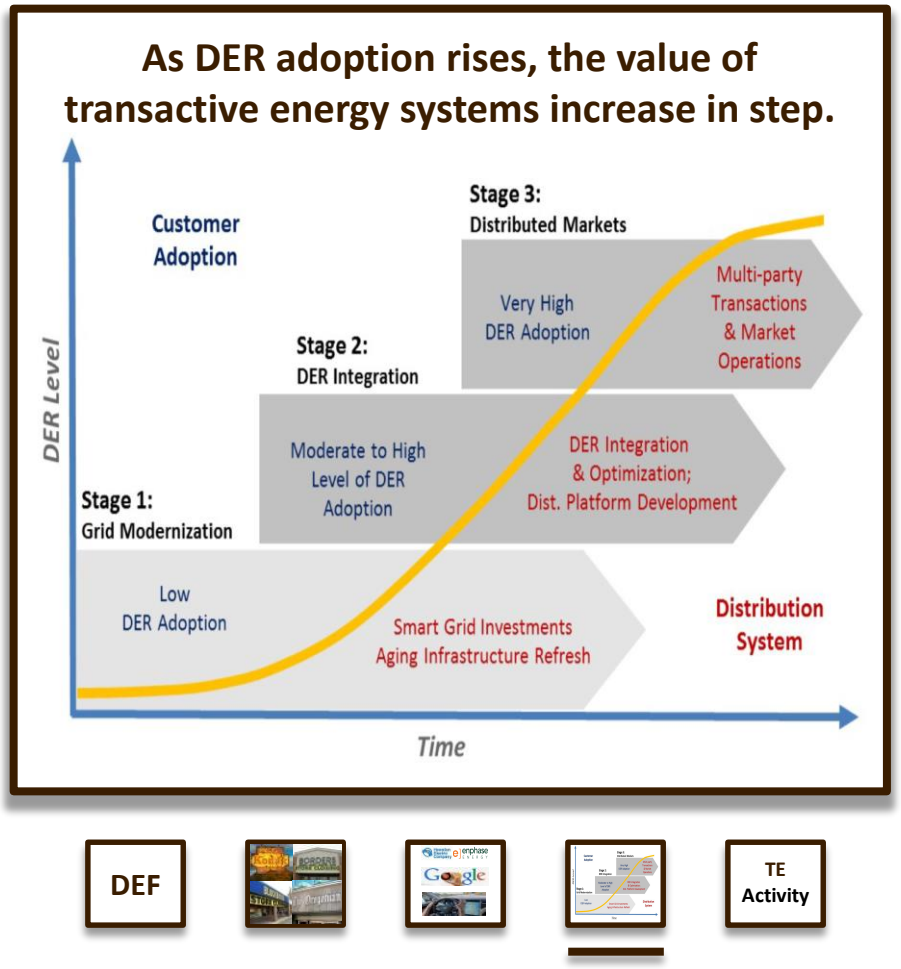


Image/Data Source: Paul De Martini and Lorenzo Kristov, Distribution Systems in a High Distributed Energy Resources Future: Planning, Market Design, Operation and Oversight, Ernest Orlando Lawrence Berkeley National Laboratory, Oct. 2015, p. 8.

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**Transactive Energy Activity**

**Distribution/Transmission Operations Support**

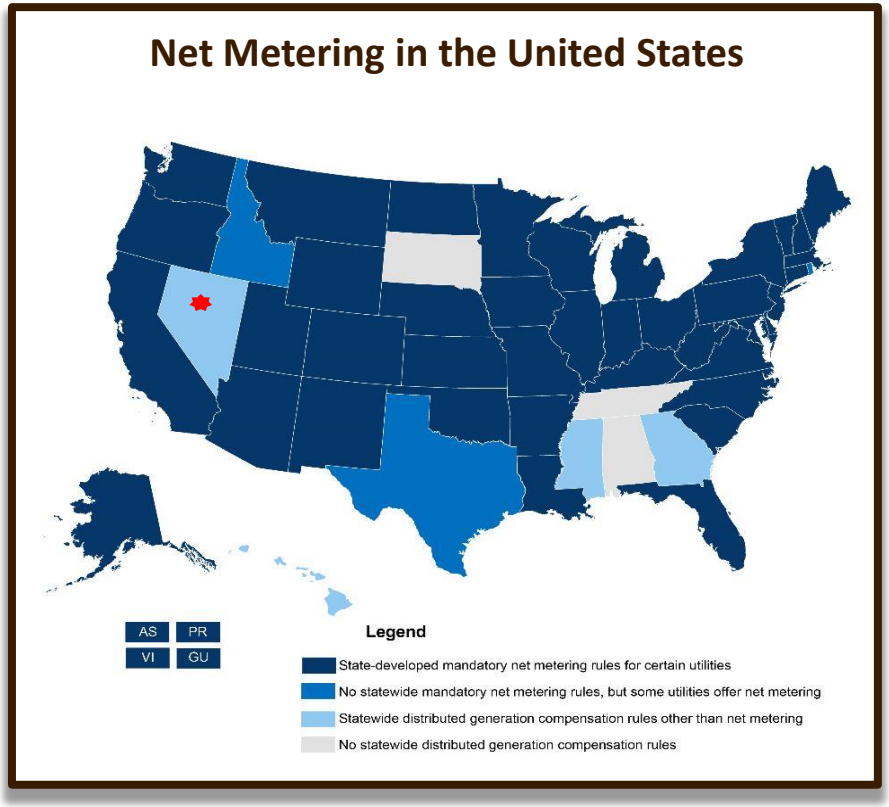
- Olympic Peninsula (PNNL, BPA, IBM)
- Pacific Northwest Smart Grid Demonstration Project (PNNL, BPA, and NW utilities)
- AEP gridSMART Demonstration Project (PNNL, AEP)
- Powermatcher Suite (Flexiblepower Alliance Network)
- Southern California Edison/TEMIX

**Peer-to-Peer**

- Sonnen Community
- Brooklyn Microgrid (LO3, Siemens)
- Vattenfall + 22 European energy traders


Image/Data Source: Joshua Binus, Sample compilation drawn from multiple sources.

# Consumer demand for enabling technologies has, by and large, been supported by local, state, and federal policies.




- **Solar PV** → Renewable Portfolio Standards, Net Energy Metering, incentives
- **Battery storage** → Self-supply, demand response, demand charge avoidance, and mandates
- **Electric Vehicles** → Emissions reduction targets, incentives
- **Microgrids** → Resiliency and peer-to-peer transactions

Image/Data Source: Mark Muro, "Rooftop solar: Net metering is a net benefit," *Brookings*, May 23, 2016, http://www.brookings.edu/research/papers/2016/05/23-rooftop-solar-net-metering-muro-saha (last accessed on 6-28-16).

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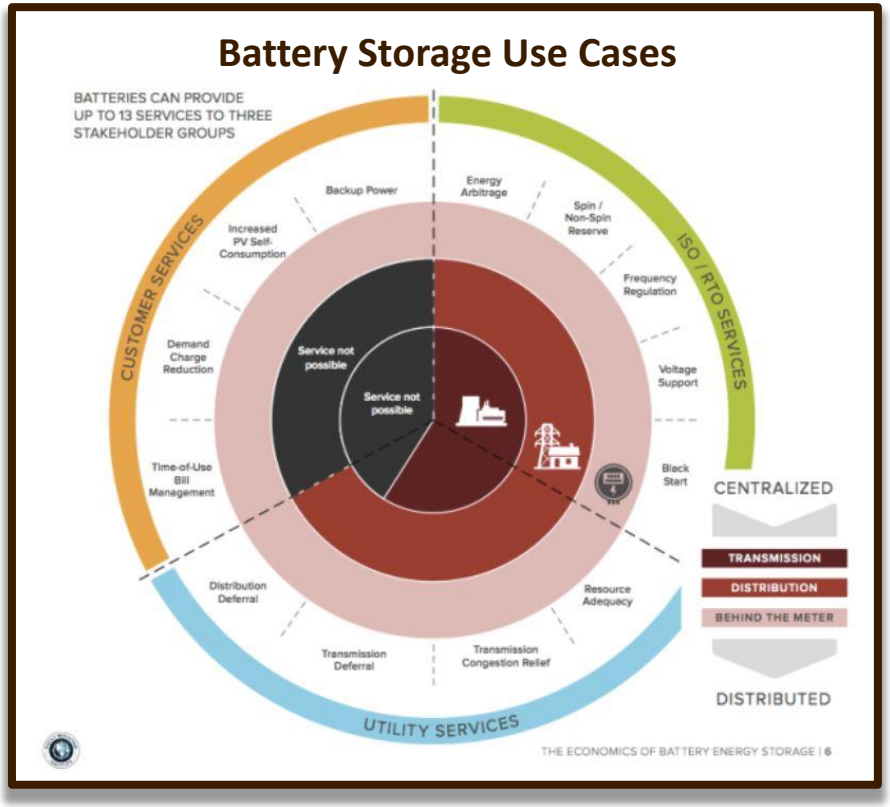






- **Solar PV** → Renewable Portfolio Standards, Net Energy Metering, and incentives
- **Battery storage** → Self-supply, demand response, demand charge avoidance, dynamic rates, and mandates
- **Electric Vehicles** → Emissions reduction targets, electrification efforts, incentives
- **Microgrids** → Resiliency and peer-to-peer transactions

Image/Data Source: David Shadle, "Energy storage: Are we there yet?" *T&D World Magazine*, June 13, 2016, http://tdworld.com/commentaries/energy-storage-are-we-there-yet (last accessed on 6-27-16).

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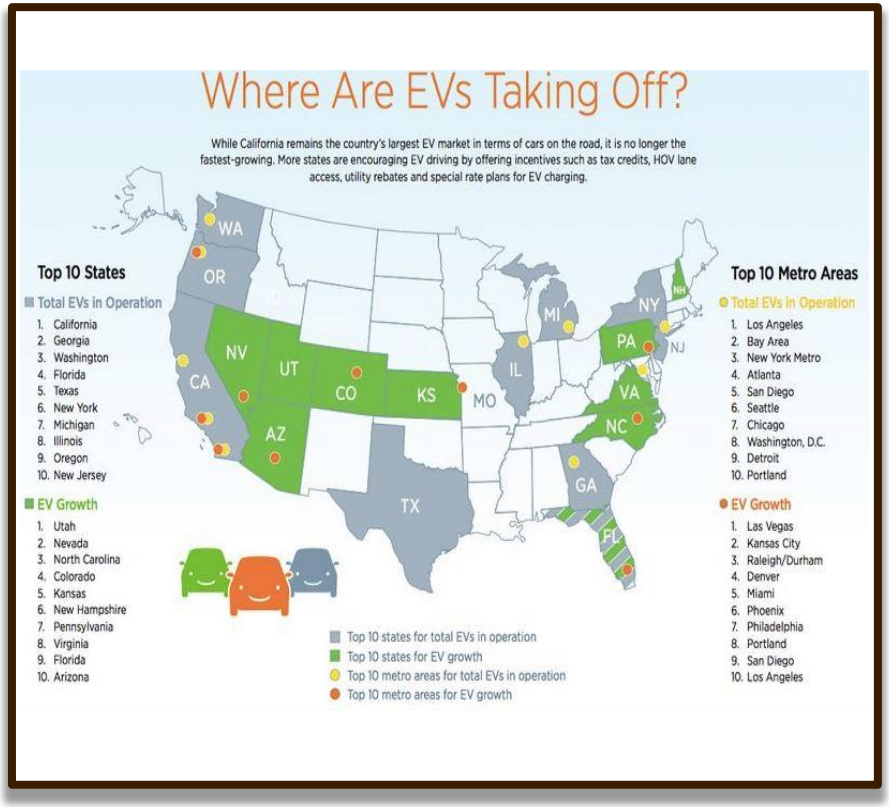


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Image/Data Source: Steven Loveday, "State-by-state breakdown of plug-in electric vehicle boom," *Inside Evs,* Jan. 27, 2017, http://insideevs.com/chargepoint-presents-state-breakdown-phev-vehicle-boom/ (last accessed on July 19, 2017).

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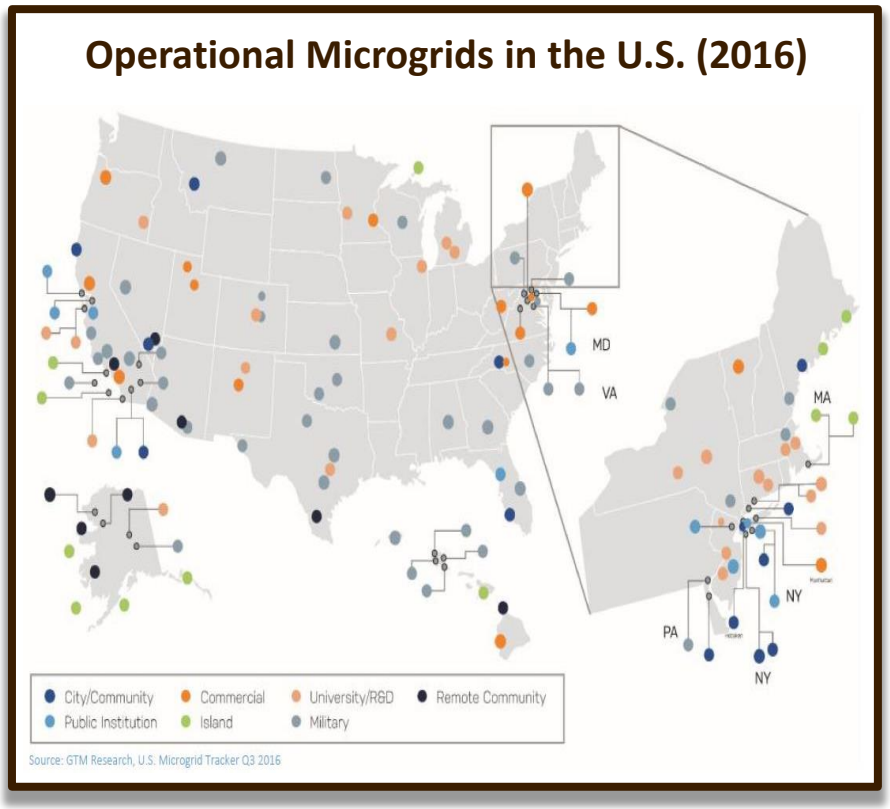


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Image/Data Source: GTM Research, *U.S. Microgrid Tracker Q3 2016.*

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**Regulators will continue to hear from consumers.**

Volunteers deliver comment cards to the PUC while students deliver testimony reminding the commissioners that they will inherit the future created by the decisions made in the present. Photo Credit: Gregory Monahan





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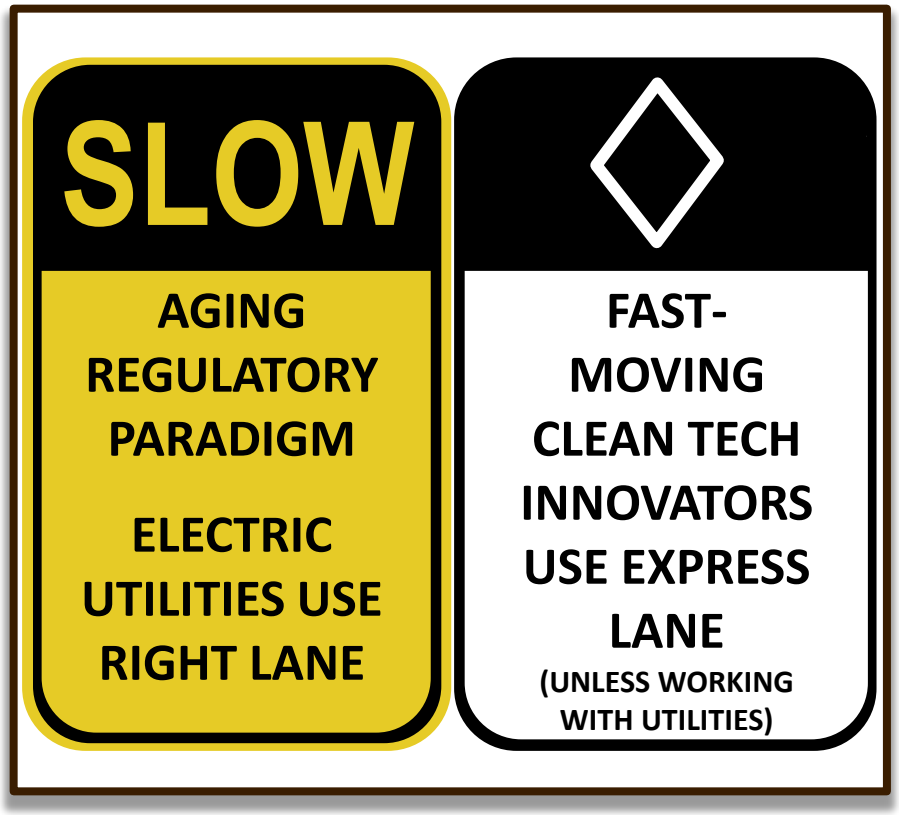
Image/Data Source: Oregon Sierra Club, "Coal to Clean, NOT Coal to Gas," *Oregon Sierra Club Blog,* June 12, 2017, https://orsierraclub.wordpress.com/2017/06/12/coal-to-clean-not-coal-to-gas/ (last accessed on March 7, 2018).

# Utilities are NOT in the driver's seat.

- The responsibility of maintaining reliability, combined with the need to maintain affordable rates, contributes to a slow-moving, conservative utility industry and regulatory environment.
- Utility business models based on volumetric sales of electricity have clearly been threatened.
- Some utilities and regulatory bodies have responded by actively trying to slow DER penetration—especially rooftop solar PV (e.g. NV Energy, Duke, Florida Power and Light, etc.).
- Forward-leaning utilities and regulators are looking at DERs for grid support and T&D infrastructure investment cost savings.




Image/Data Source: Signs made by Joshua Binus.

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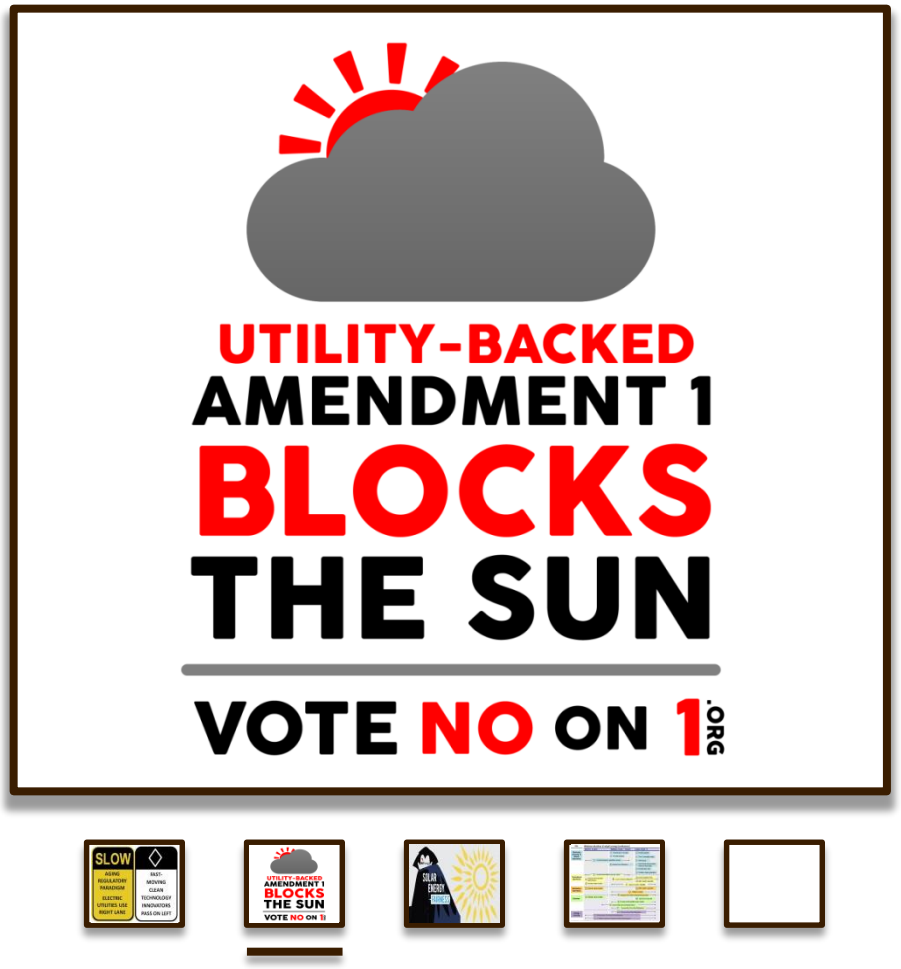


Image/Data Source: John Rogers, "4 Reasons to Vote NO on Florida's (Anti-) Solar Amendment 1," *Union of Concerned Scientists*, Nov. 4, 2016, http://blog.ucsusa.org/john-rogers/4-reasons-to-vote-no-on-floridas-anti-solar-amendment-1 (last accessed on July 19, 2017).

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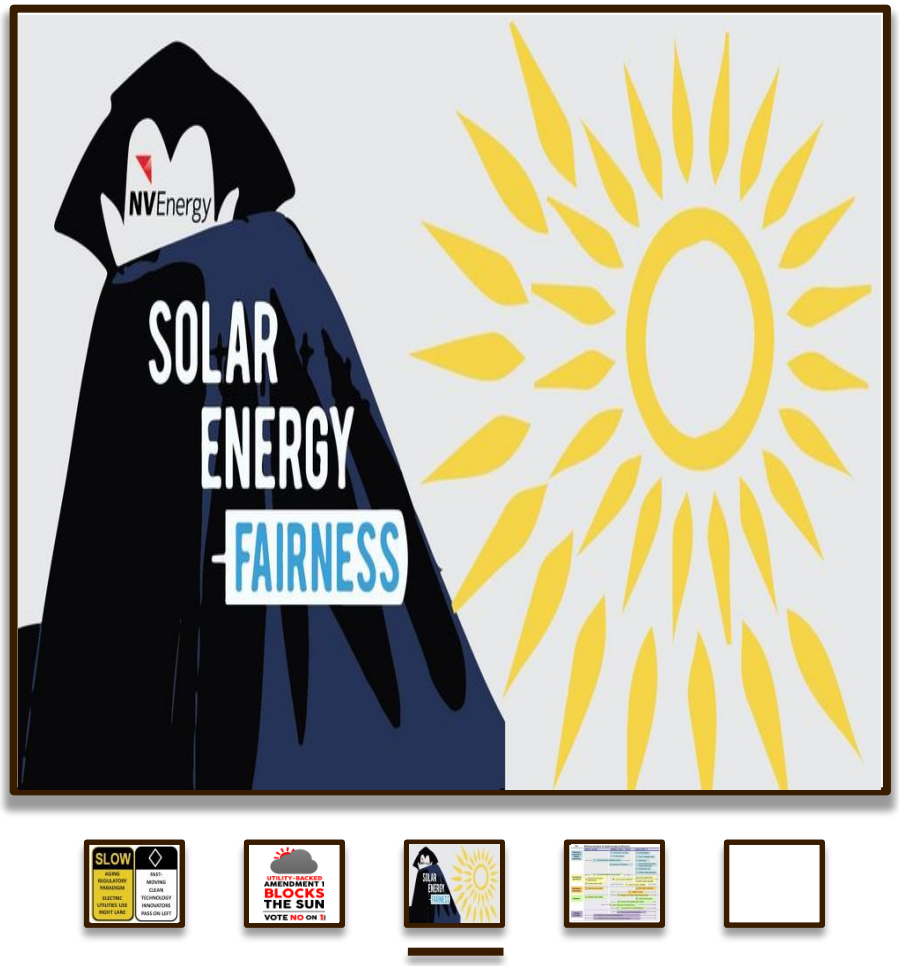





Image/Data Source: Guest Contributor, "Nevada utility continues rooftop solar war, opposes net metering," *Ecowatch*, July 28, 2016, https://www.ecowatch.com/nevada-utility-continues-rooftop-solar-war-opposes-net-metering-1948078069.html (last accessed on July 20, 2017).

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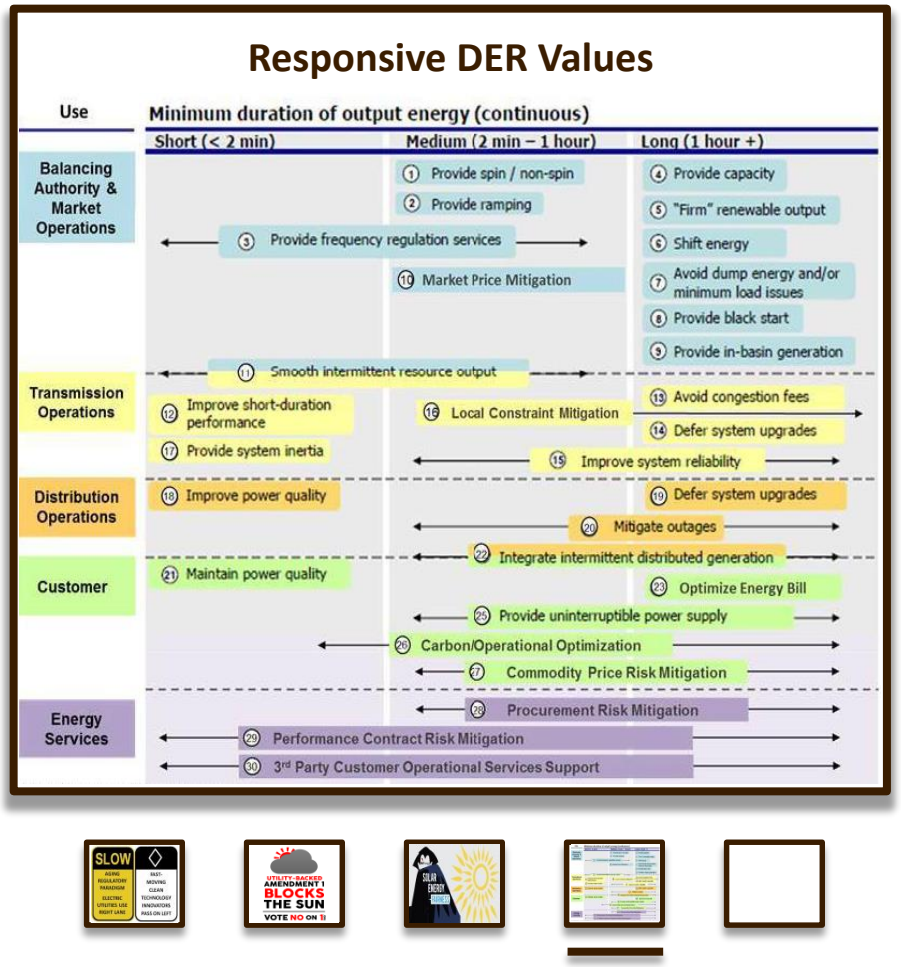
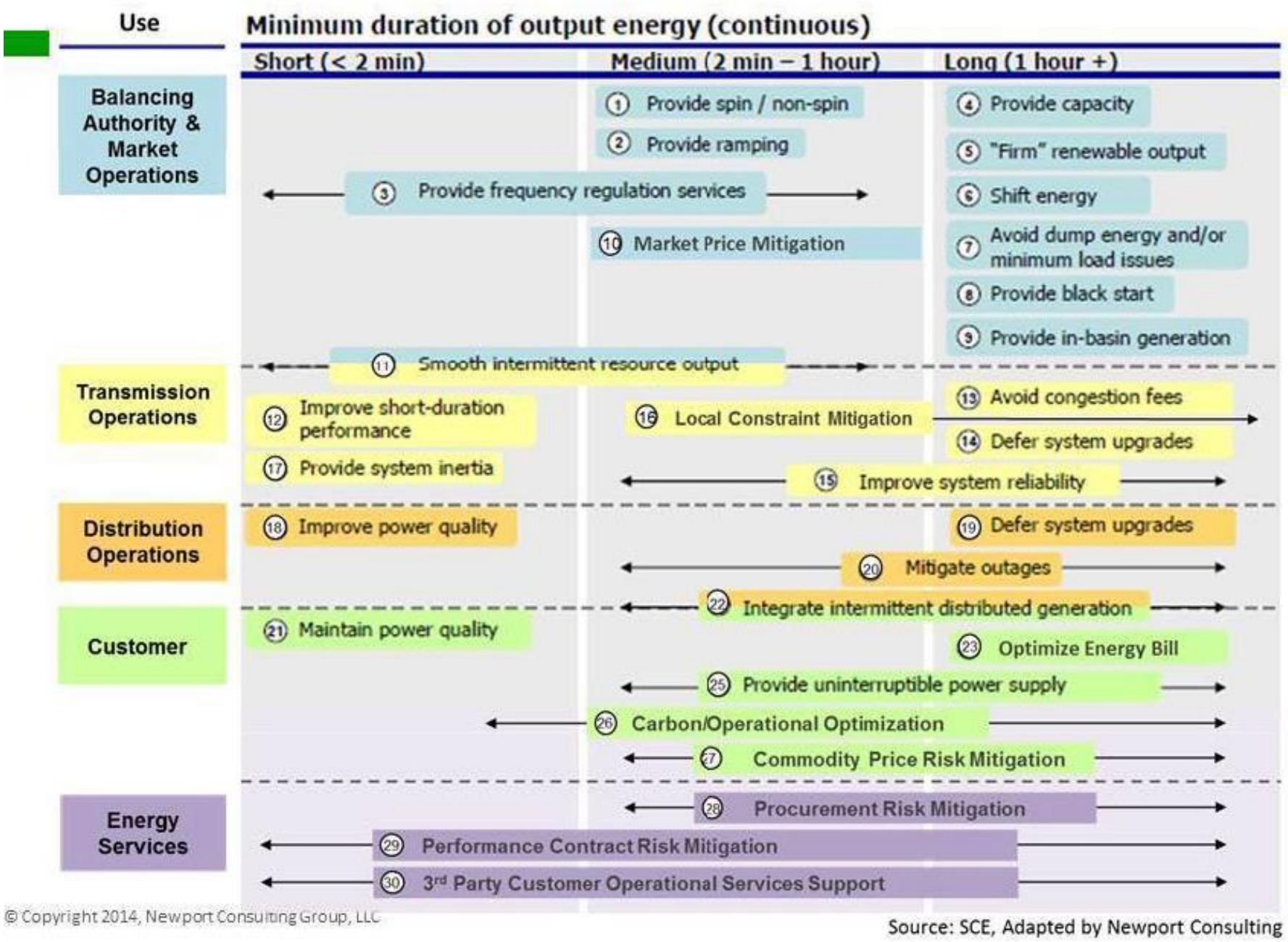






Image/Data Source: Stuart Johnston, "A platform for the household energy revolution," *Energy Networks Australia*, Apr. 20, 2017, http://www.energynetworks.com.au/news/energy-insider/platform-household-energy-revolution (last accessed on July 19, 2017).

# Responsive Distributed Energy Resource Values






Source: SCE, Adapted by Newport Consulting

# The development of a shared energy economy offers benefits to society. Many policy makers will take note.

**DER Installations are typically labor intensive.**




- Increased economic activity (and local job opportunities)
- Recirculation of currency in local areas (instead of sending money to out-of-state entities)
- Reduction of electric bills
- Islanding capability of some DER configurations offers end-users & communities the potential to avoid power loss during wider grid disruptions
- Some environmental burdens associated with electric power generation and transmission are diminished as demand is met more locally (often with renewables)
- Potential for positive rural-urban trading relationships that benefit both parties (similar to benefits associated with local food systems).

Image/Data Source: Walmart solar project, *SolarCity*, http://www.solarcity.com/commercial/commercial-solar-projects/walmart (last accessed July 21, 2017).

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Image/Data Source: Sustainable Connections, https://sustainableconnections.org/ (last accessed on July 21, 2017).

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# Super Storm Sandy Black Out in Lower Manhattan

NYUs Micro Grid around Washington Square Park Area

NEW YORK UNIVERSITY

VANDERWEIL POWER GROUP

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**Navajo Generating Station, largest coal plant in the American West**


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Image/Data Source: Bobby Magill, "The West's biggest coal plant may be about to shut down," *Grist,* Jan. 28, 2017, http://grist.org/article/the-wests-biggest-coal-plant-may-be-about-to-shut-down/(last accessed on July 21, 2017).

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**Commercial relationships between ruralites & urbanites contribute a counter narrative.**





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Image/Data Source: Jonathan Martin, "GOP property-tax plan will only widen the urban-rural divide," *The Seattle* Times, July 10, 2017, http://www.seattletimes.com/opinion/gop-property-tax-plan-will-only-widen-the-urban-rural-divide/(last accessed on July 21, 2017).

# Conclusions

- Consumers (across all sectors) are the driving force behind the movement toward a shared energy economy.
- The digitization of the electric power industry will likely have as much impact as it did for the telecom, banking, entertainment, and other industries.
- Utilities and regulators are not in control, but play a key role as shepherds of the grid's overall reliability.
- Regardless of the revenue impacts to electric utilities, industrial society is likely to embrace the movement toward a transactive/shared energy future due to the potential societal benefits perceived.
- While blockchain technology may certainly speed up the introduction and adoption of transactive energy products/platforms, it is, ultimately, only one component of a larger portfolio of tools (including both technologies and business/regulatory policies) needed to actualize a shared energy economy.