GRAND UNIFICATION: INTEGRATING THE DISTRIBUTION AND TRANSMISSION SYSTEMS

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ITINERARY

- Open networks
- Historical perspective and new drivers
- T-D integration principles
- Priority areas for T-D integration

OPEN NETWORKS

Open Networks

Britain's energy landscape is changing, and new smart technologies are changing the way we interact with the energy system. Our Open Networks project is transforming the way our energy networks operate.

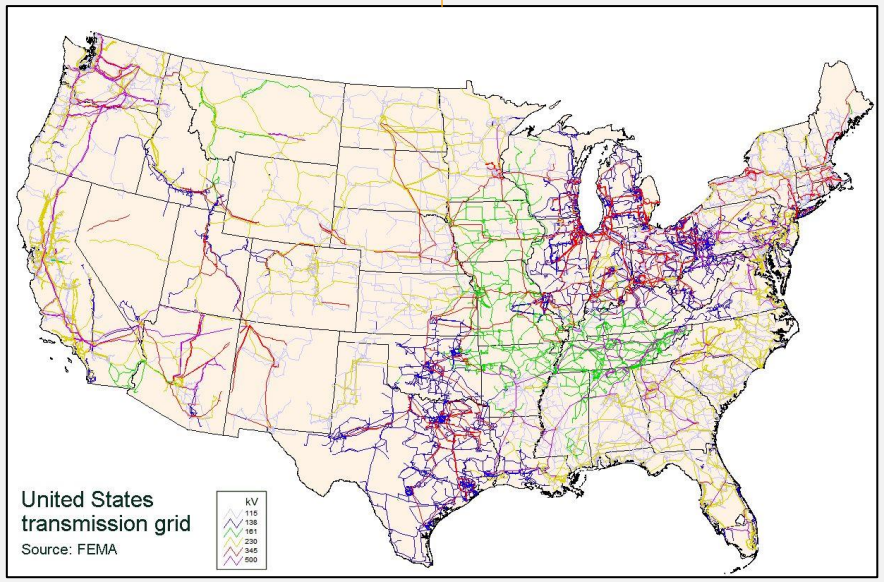
What would an open networks concept look like in the U.S.?

Source: https://www.energynetworks.org/creating-tomorrows-networks/open-networks/

LOCALIZATION | | REGIONALIZATION

Localization:
Siting of resources closer to loads

Regionalization:
Greater physical and institutional interconnectedness of electricity systems

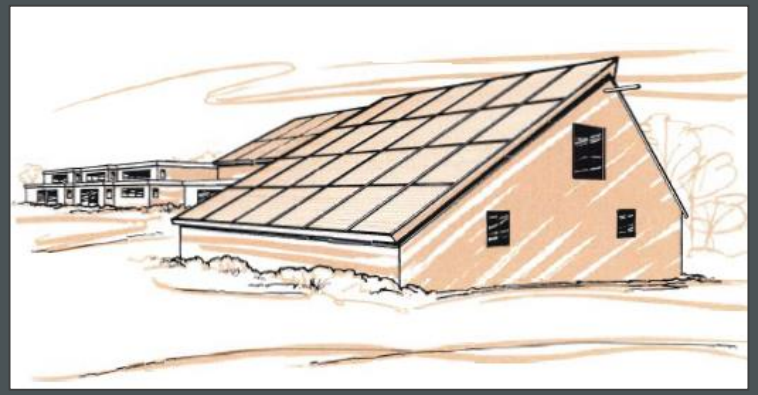


A (VERY) BRIEF HISTORICAL DETOUR

1920s-1970s

Electric utilities and large power plants come to dominate U.S. electricity systems; greater regional interconnection but power exchange among utilities is limited in scale and scope

A (VERY) BRIEF HISTORICAL DETOUR



1970s-1980s

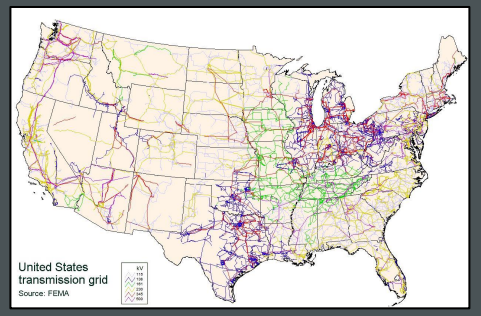
Oil crises and macroeconomic instability challenge traditional utility model; federal and state governments response with PURPA and emergence of utility DSM programs

A (VERY) BRIEF HISTORICAL DETOUR

1990s-2000s

FERC Order 888 opens access to transmission systems, ISO/RTO markets take shape and mature, but regionalization is limited in scope; limited changes on the demand side of markets

A (VERY) BRIEF HISTORICAL DETOUR

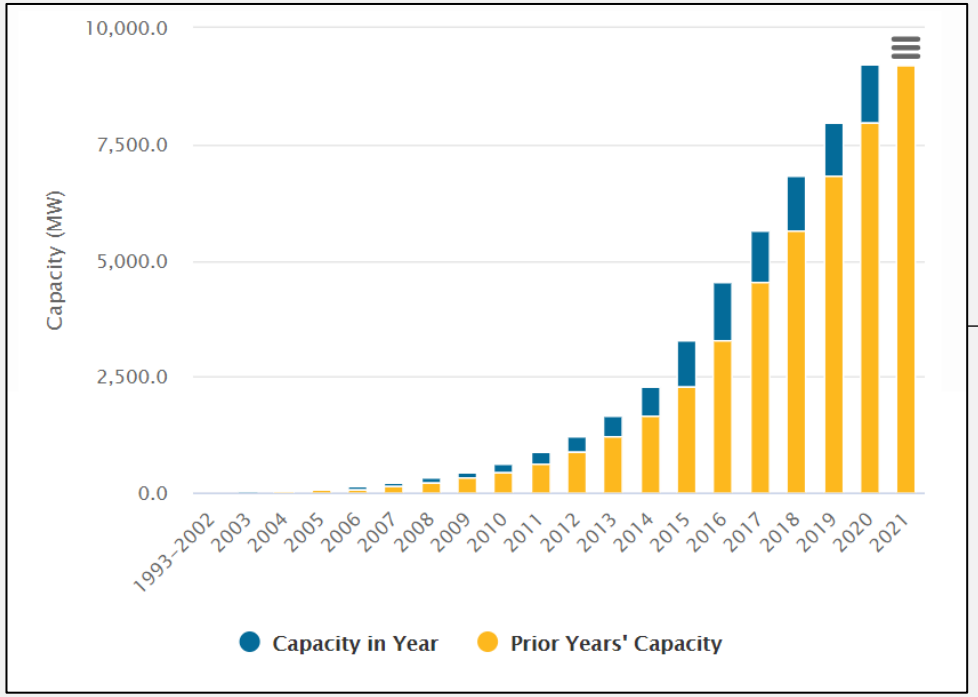


2010s

Rapid distributed PV growth in several states, growing interest in DER; development of SPP markets and WEIM, expansion of RTO markets

INTEGRATING THE DISTRIBUTION AND TRANSMISSION SYSTEMS

California solar DG capacity, 1993-2020



The Western EIM, circa early 2021

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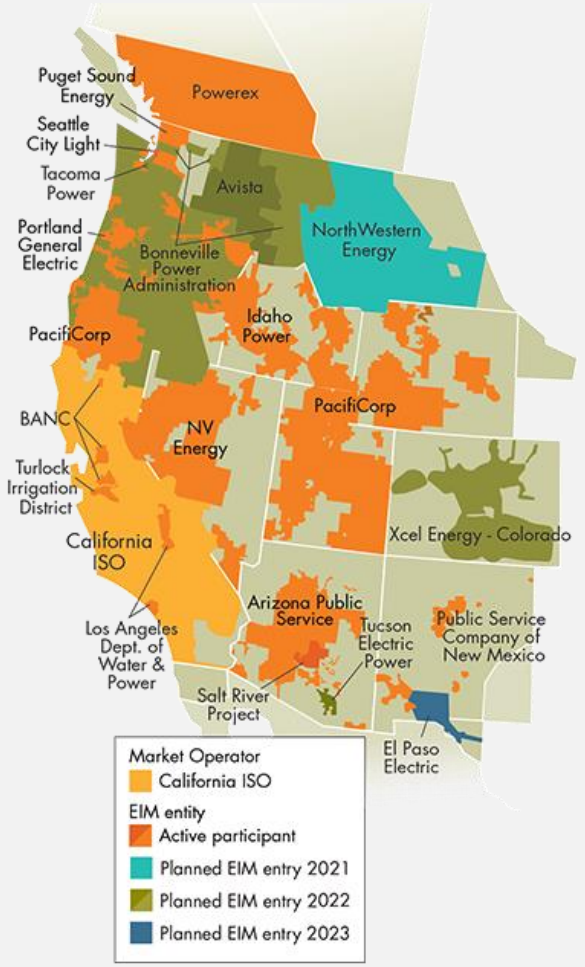
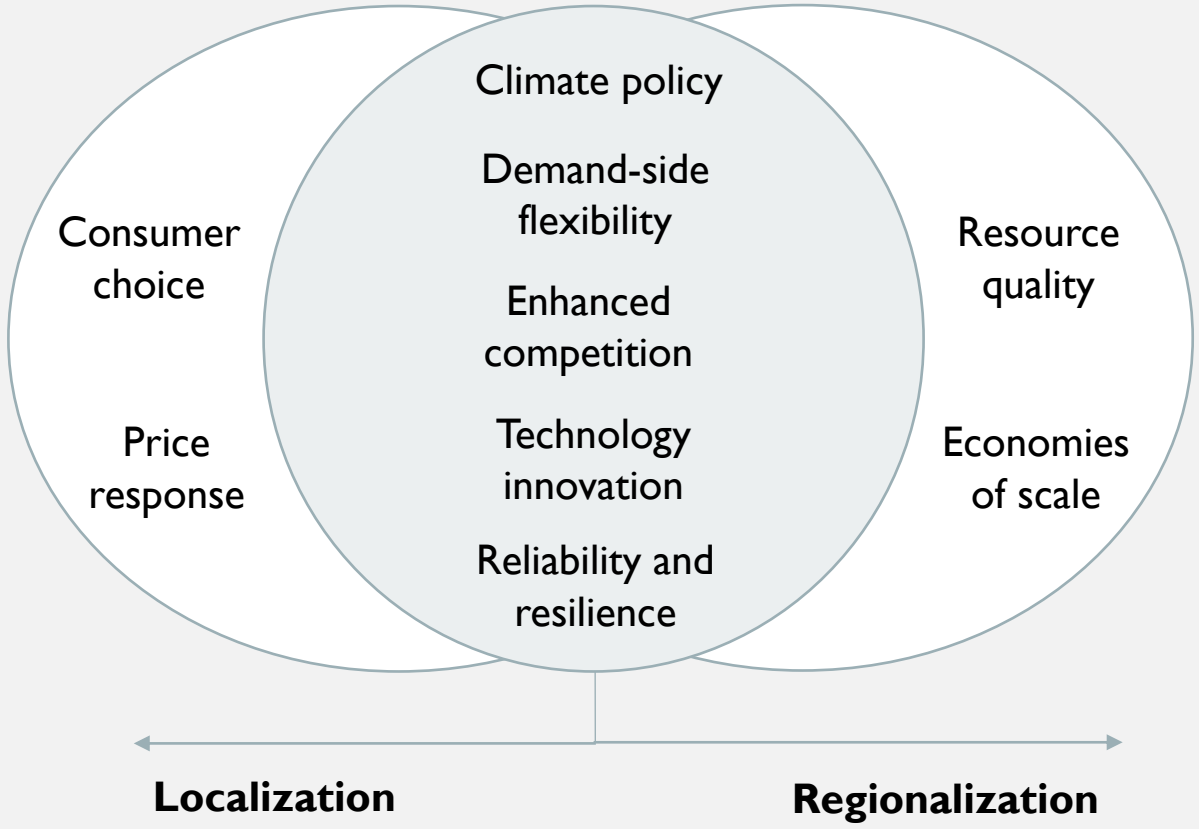


DRIVERS OF LOCALIZATION AND REGIONALIZATION



A USEFUL LENS ON T-D INTEGRATION

Where should we site energy storage?

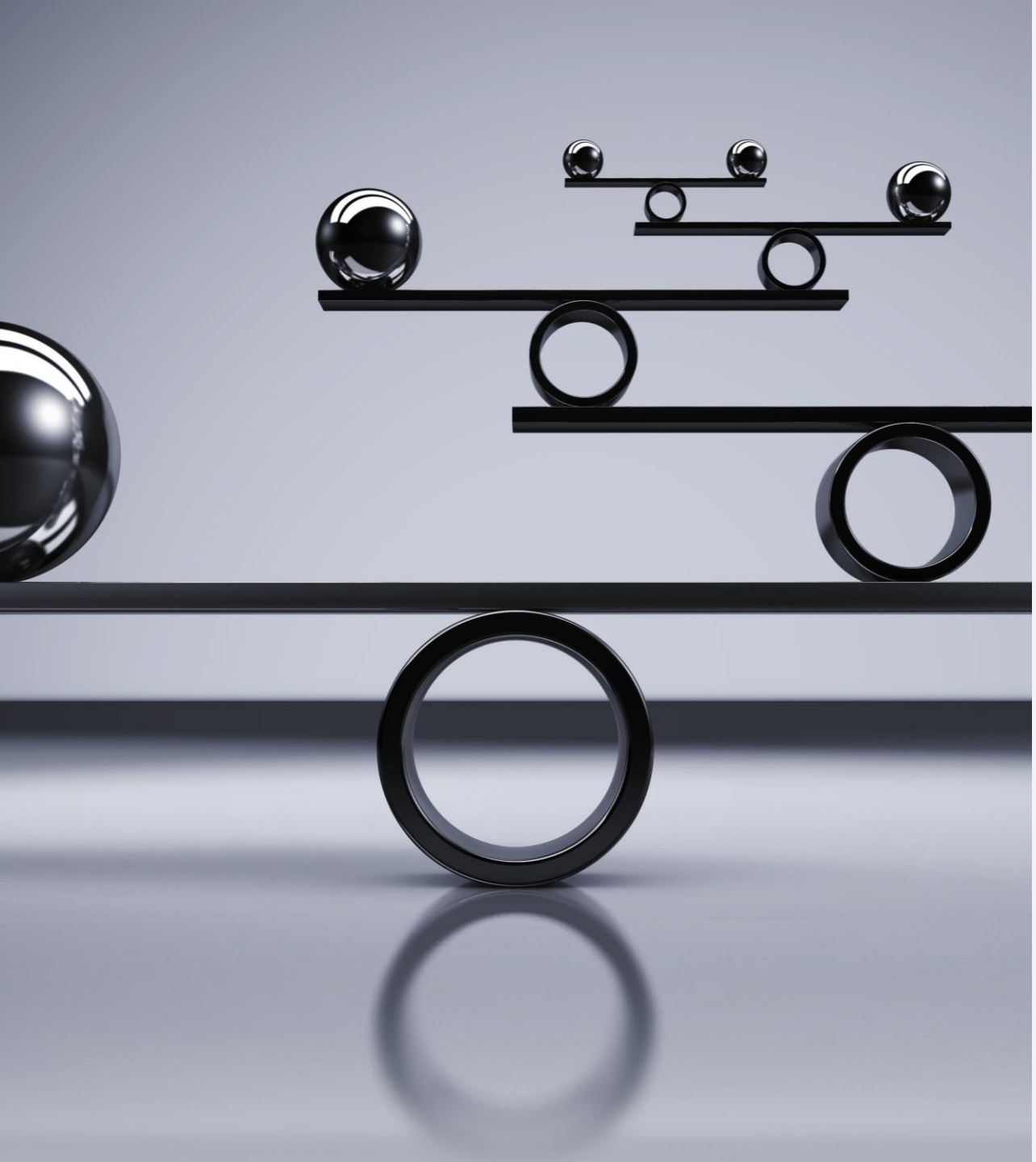
Behind the meter

Distribution

Sub-transmission

Transmission

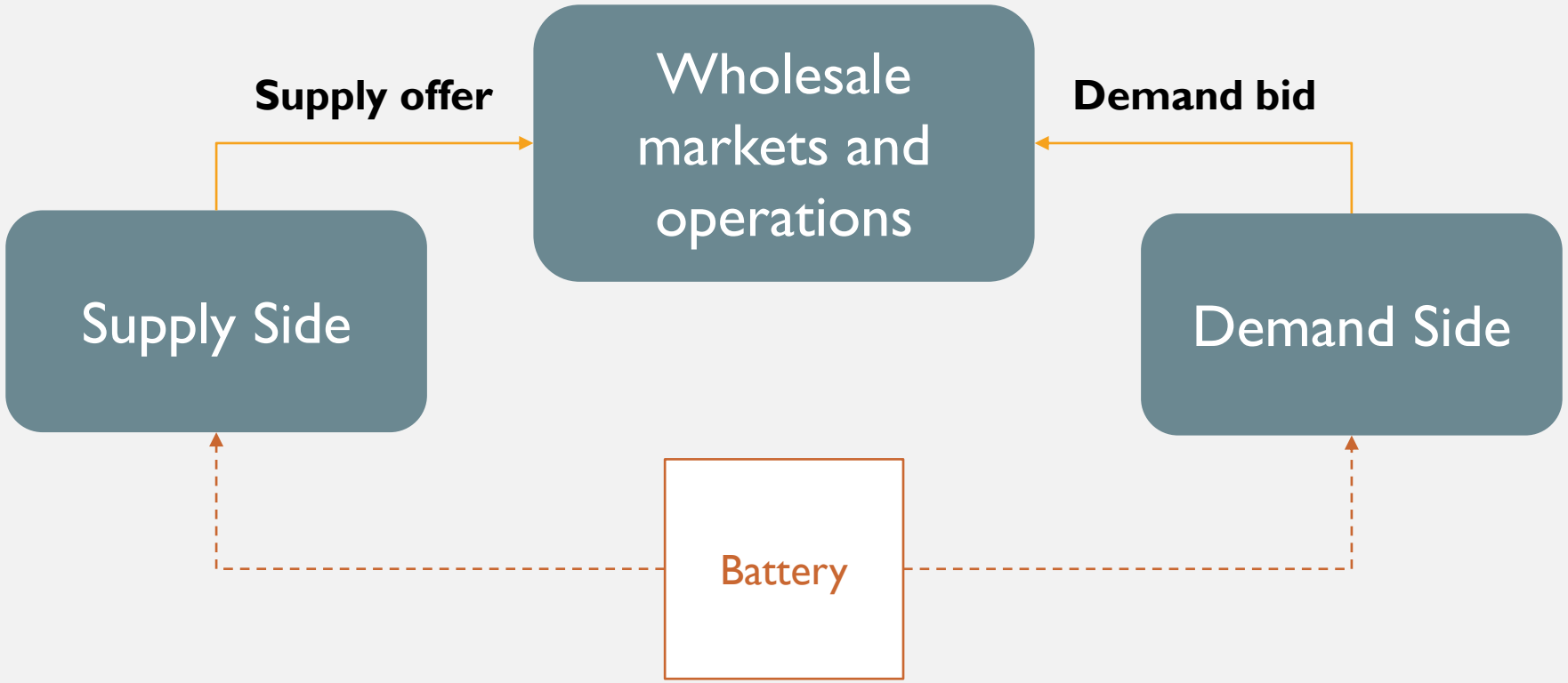
Generation facility



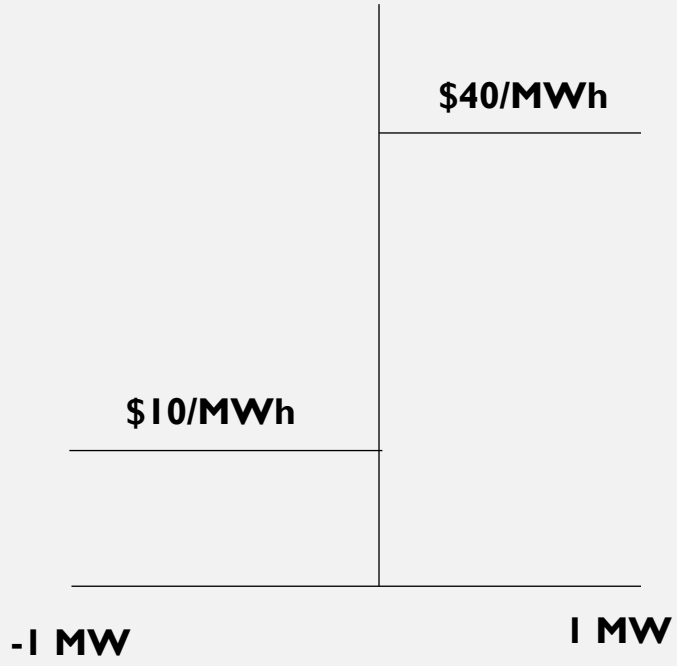
FOUR INTEGRATION PRINCIPLES

- **Equivalent access and value** — resource owners should locate resources where, and operate them how, they have the most value
- **Regulatory equivalence** — regulatory treatment of resources connecting to the transmission or distribution systems should not unduly affect resource siting
- **Planning convergence** — through transparency and coordination, investment planning for distribution and transmission systems should produce consistent results
- **Autonomy** — consumers and producers should be able to choose how they buy and sell power

EQUIVALENT ACCESS AND VALUE



DEMAND-SIDE PARTICIPATION



ISO Supply Bid

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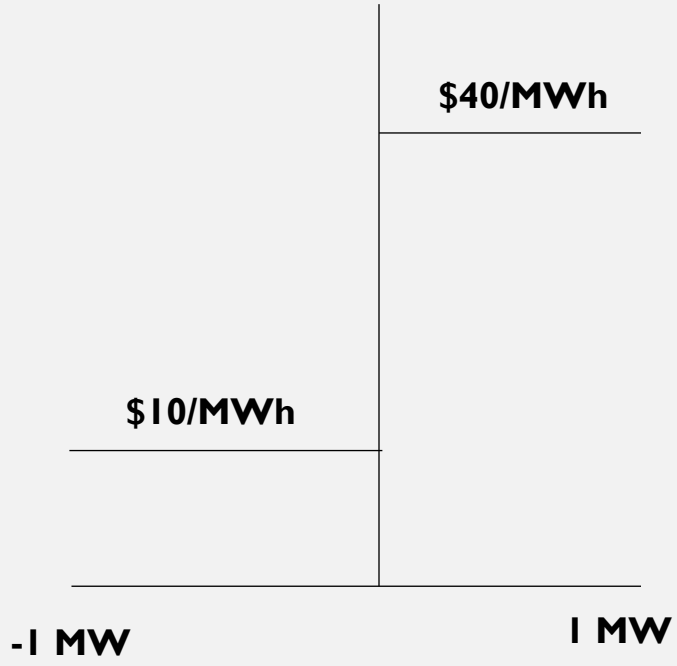

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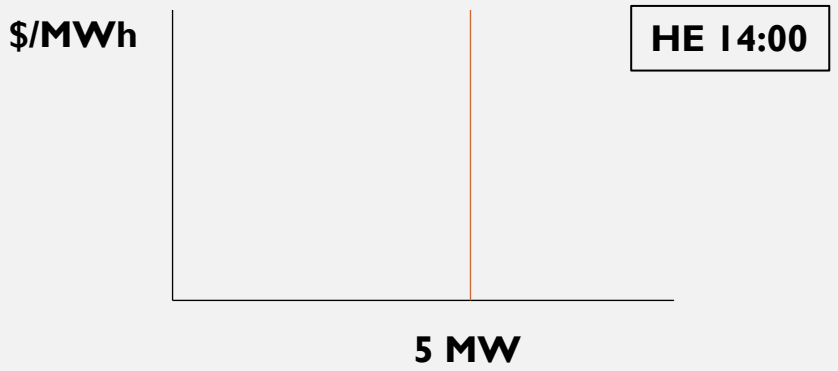
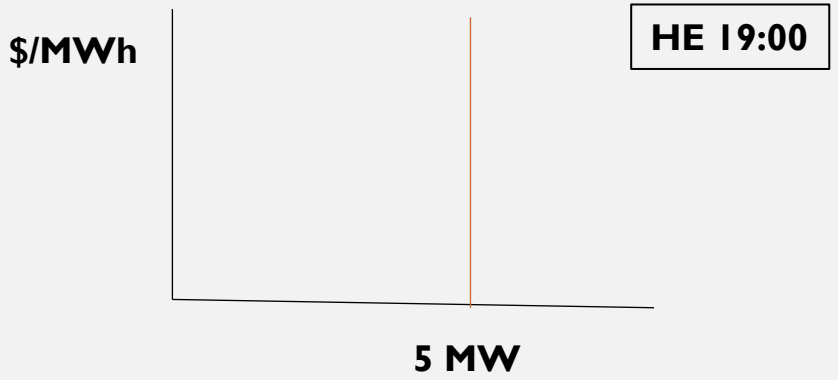
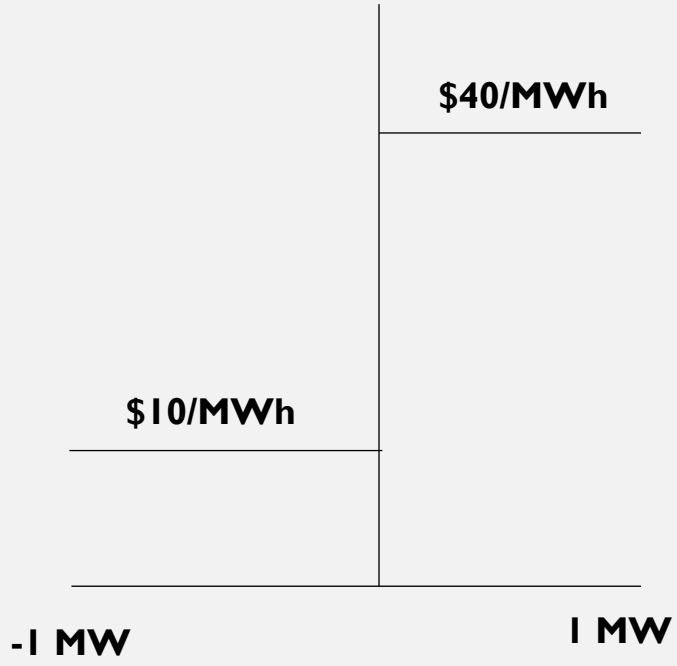




LSE Tariff

DEMAND-SIDE PARTICIPATION



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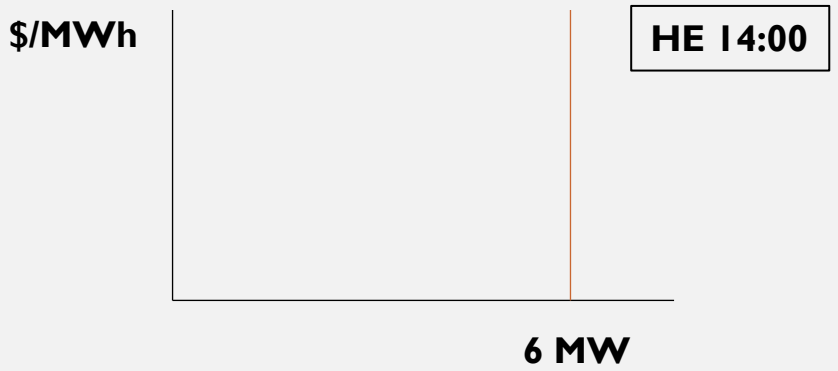

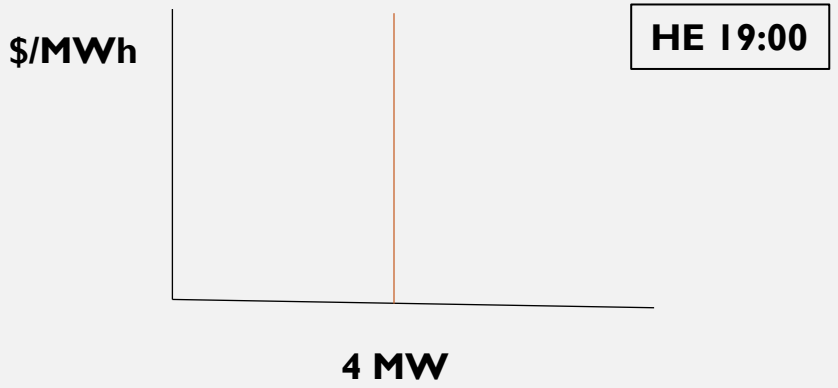

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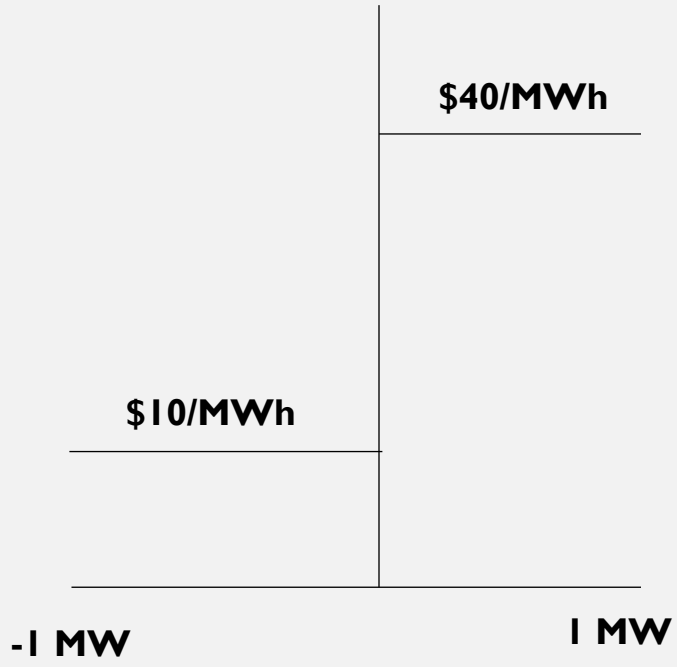

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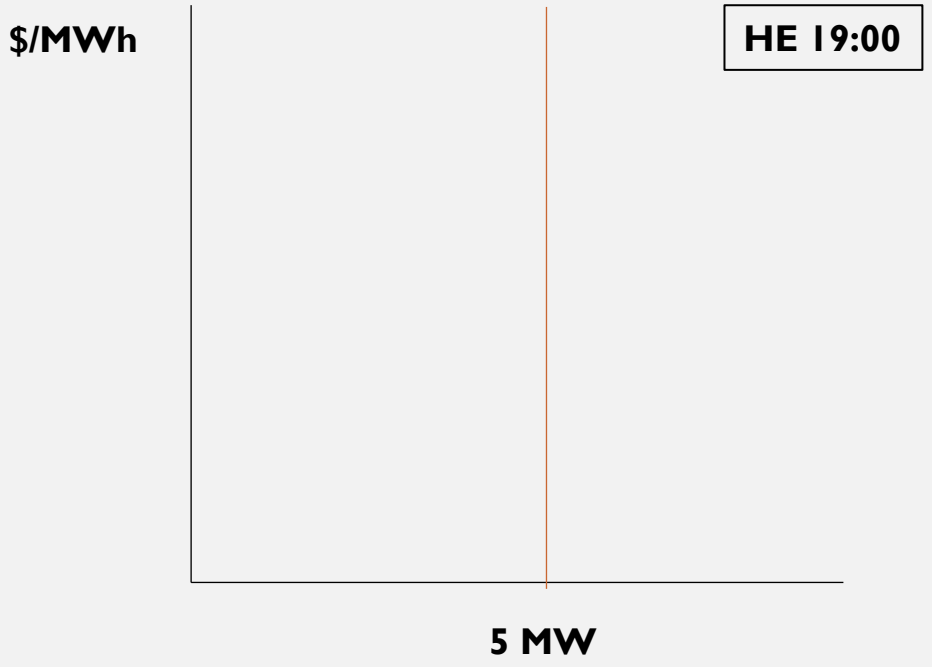

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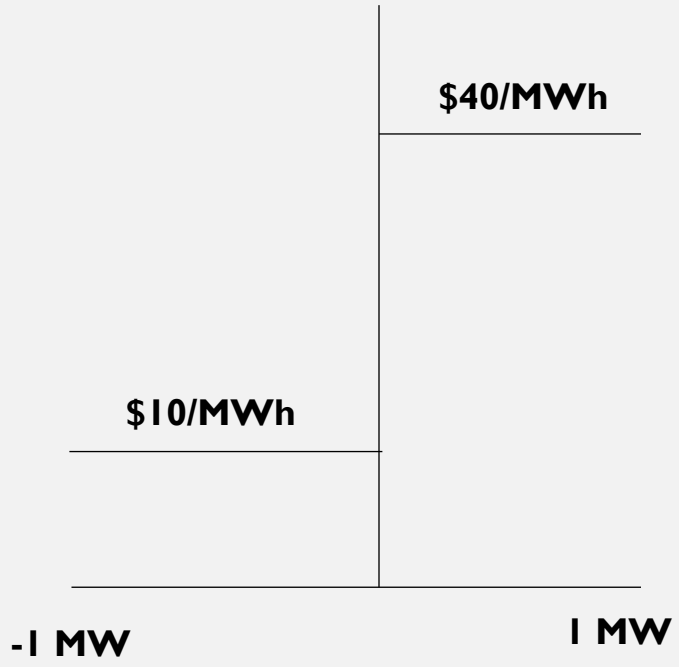

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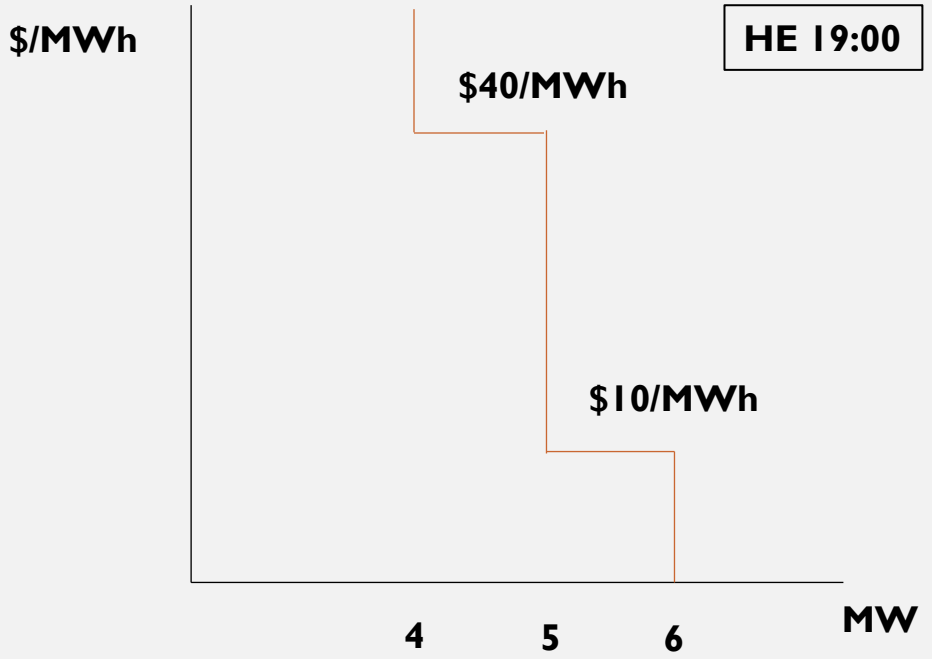
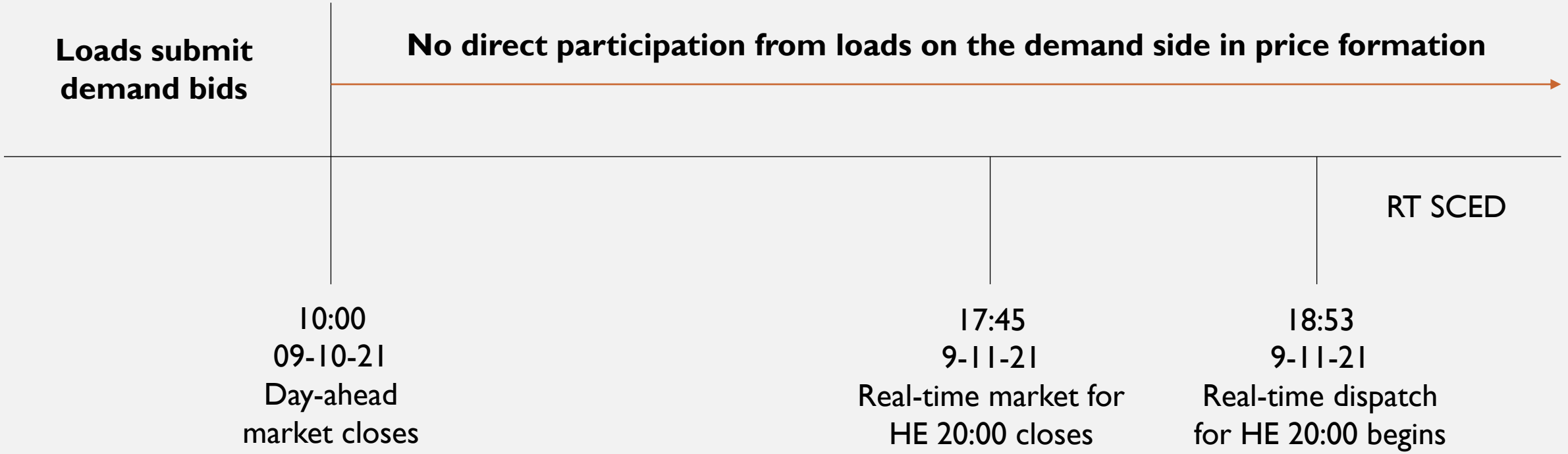


LSE Demand Bid

DEMAND-SIDE PARTICIPATION IN REAL-TIME MARKETS



COMPENSATION FOR LOCAL VALUE

Transmission constraints lead to high capacity market prices for zone

Transmission segment is congested, high LMPs at node A

A

Load growth at T-D substation will trigger upgrades in the near-ish term

Battery

Battery discharges during distribution and transmission peaks; reduces energy (LMP) and zonal capacity charges, defers distribution investment

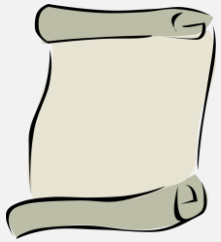
REGULATORY EQUIVALENCE

Distribution

- Distribution system should be expanded to accommodate all load, generation, and storage resources under normal operating conditions

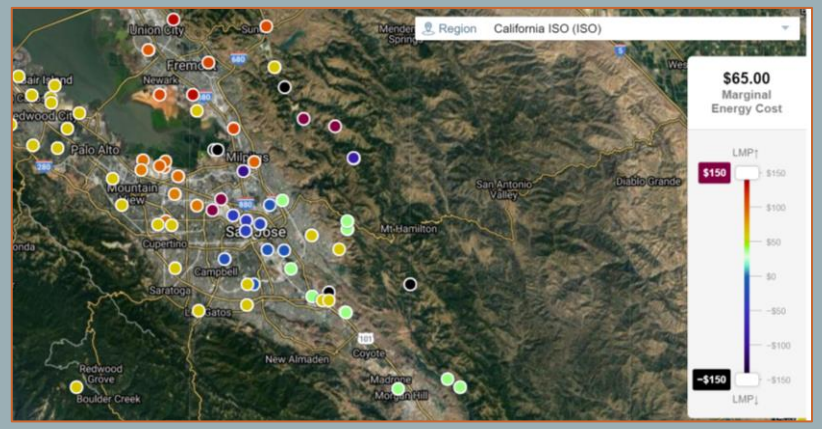
Transmission

- Resources can interconnect to the transmission system even if the transmission system cannot yet accommodate all of their output*; transmission system is expanded to meet reliability, economic, and public policy criteria



*** Historical note:** In 1998 ("New England Power Pool," Docket No. ER98-3853-000), FERC ruled that generators in New England should have the option to pay for re-dispatch rather than pay transmission expansion costs, and that designs for interconnection cost allocation and congestion management should be developed in tandem

NON-DISCRIMINATORY CURTAILMENT, DSOs, and OADTs



Transmission

- Open access transmission tariffs (OATTS)
- Functionally unbundled system operations
- Multi-criteria benefit-cost analysis
- Market-based congestion management

Distribution

Stage I

- Export limits

Stage II (Stage I+)

- Dynamic curtailment
- Functional unbundling with DSOs
- Open access distribution tariffs (OADTs)
- New approaches to evaluating distribution investments

Stage III (Stage II+)

- Market-based congestion management

PRIORITY AREAS FOR T-D INTEGRATION

- **Category 1: Nearer term, do it now**
  - Develop tariffs for "net injecting" customers that are tied to wholesale prices and include locational value
  - Create export limit (static curtailment) options for distributed generation and storage
  - Establish working group to address FERC-state jurisdictional issues
- **Category 2: Longer term, but start now**
  - Identify ways to enhance planning coordination between distribution utilities and ISOs
  - Create rules to govern dynamic curtailment and understand the possible functional responsibilities of DSOs
  - Develop pro forma open access distribution tariffs for different flavors of DSO
  - Establish new planning criteria for distribution systems
  - Revisit aggregated LMP settlement for loads
  - Explore more sophisticated market designs for demand bids

SUMMARY

- How can we make changes in regulation and markets that enable the distribution and transmission systems to function more like a single integrated system?
- Four principles:
  - Equivalent access and value
  - Regulatory equivalence
  - Planning convergence
  - Autonomy
- Priorities:
  - Do now – tariffs, export limits, jurisdiction working group
  - Start now – planning coordination, DSOs, OADTs, distribution planning criteria, market design