



EESI
Environmental and
Energy Study Institute

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CONGRESSIONAL BRIEFING

Towards the Energy System of Tomorrow
***Briefing Series: Modernizing the U.S. Energy System:
Opportunities, Challenges, and the Path Forward***

Friday, June 04, 2021

About EESI...



NON-PROFIT

Founded in 1984 by a bipartisan Congressional caucus as an independent (i.e., not federally-funded) non-profit organization



NON-PARTISAN

Source of non-partisan information on environmental, energy, and climate policies



DIRECT ASSISTANCE

In addition to a full portfolio of federal policy work, EESI provides direct assistance to utilities to develop “on-bill financing” programs



SUSTAINABLE SOCIETIES

Focused on win-win solutions to make our energy, buildings, and transportation sectors sustainable, resilient, and more equitable

...About EESI



Top-Rated Nonprofit - 4 Star Charity

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Ideas. Insights. Sustainable Solutions.

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Trump Administration Budget Proposal
Terrible for Climate

Briefings | March 20, 2020
Financing Climate Mitigation and Resilience: Lessons from Hawaii

Briefings | March 18, 2020
Biogas: Driving the U.S. Circular Economy

Briefings | March 13, 2020
Coastal Resilience in the Southeast

Briefings | February 24, 2020
A Security Threat Profile of Global Climate Change

Briefings | February 20, 2020
2020 Sustainable Energy in America Factbook

White Papers | February 19, 2020
Fact Sheet: Federal Resources for Nature-Based Solutions to Climate Change

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HILL BRIEFINGS

Video recordings and written summaries of Congressional briefings



CLIMATE CHANGE SOLUTIONS

Bi-weekly newsletter with all you need to know including a legislation tracker



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FACT SHEETS

Timely, science-based coverage of climate and clean energy topics

Modernizing the U.S. Energy System: Opportunities, Challenges, and the Path Forward



-  **June 04--Towards the Energy System of Tomorrow**
-  **June 11--Modernizing America's Transmission Network**
-  **June 18--Leveraging Grid Edge Integration for Resilience & Decarbonization**

Webcasts and written summaries available at www.eesi.org

Audio-only excerpts released via The Climate Conversation podcast

Fact sheets, fact sheets, web articles, and web articles

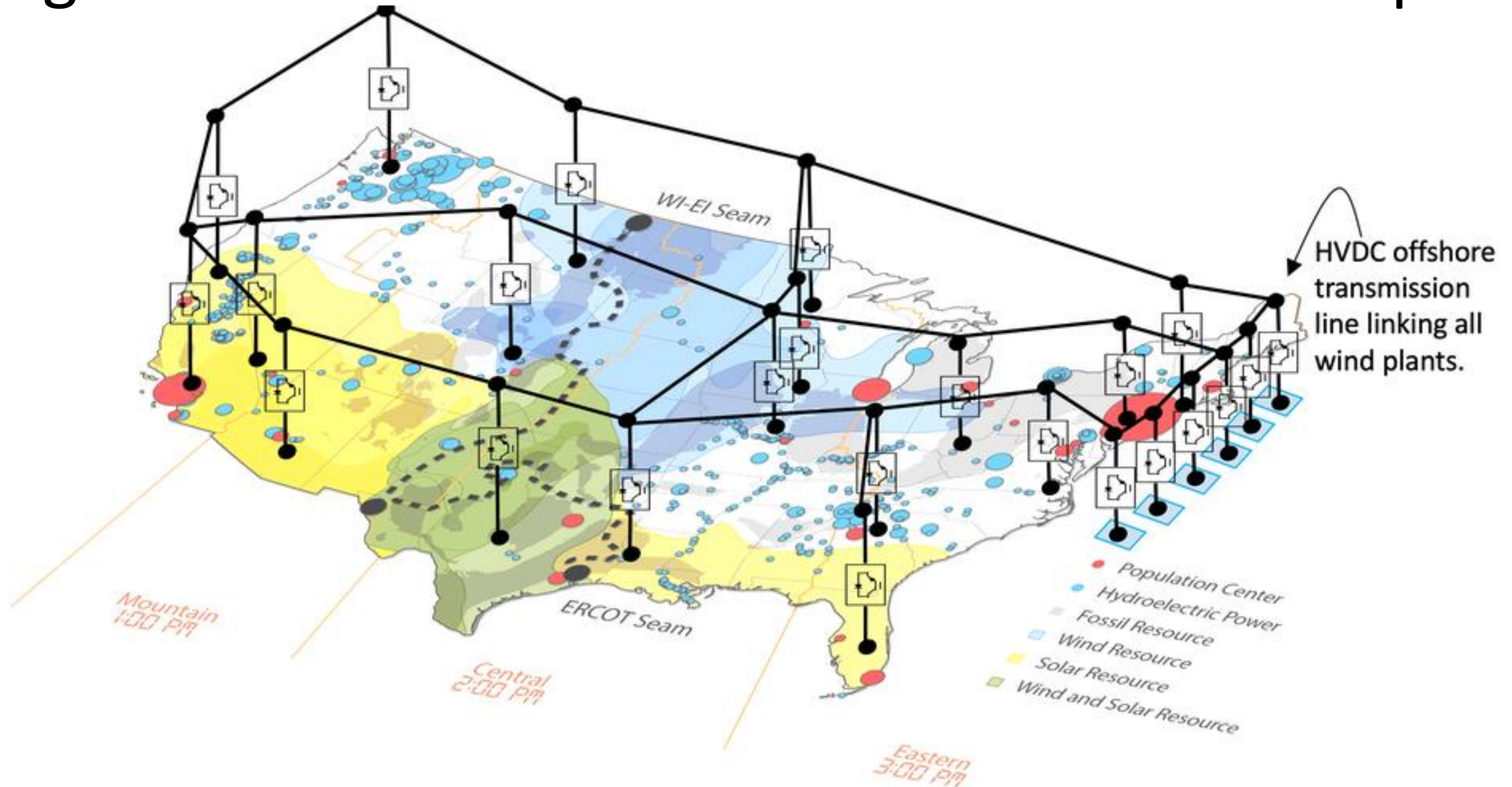
Towards the Energy System of Tomorrow

Environmental and Energy Study Institute

June 4, 2021

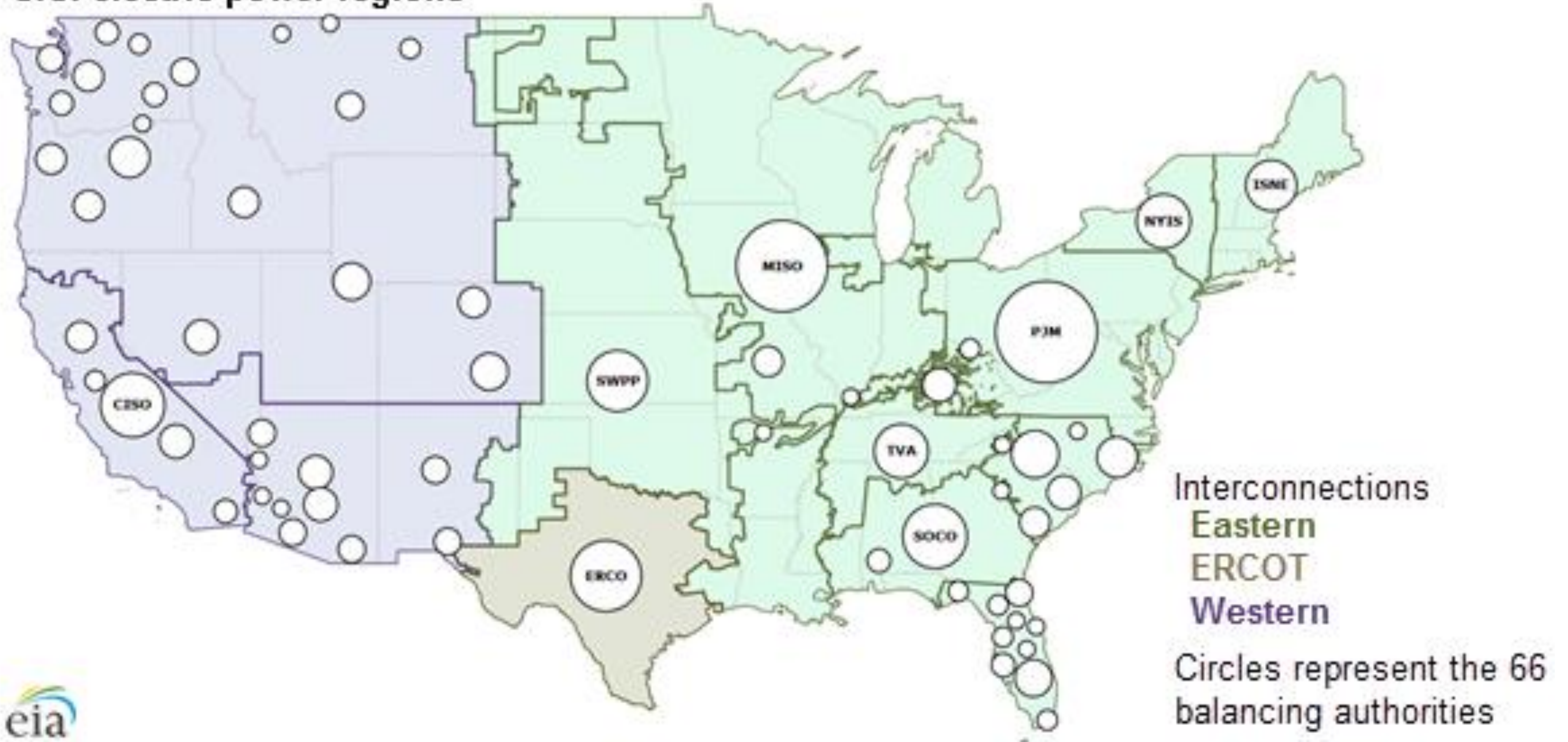
Jennifer Chen, ReGrid

Regional solutions: economies of scale and scope

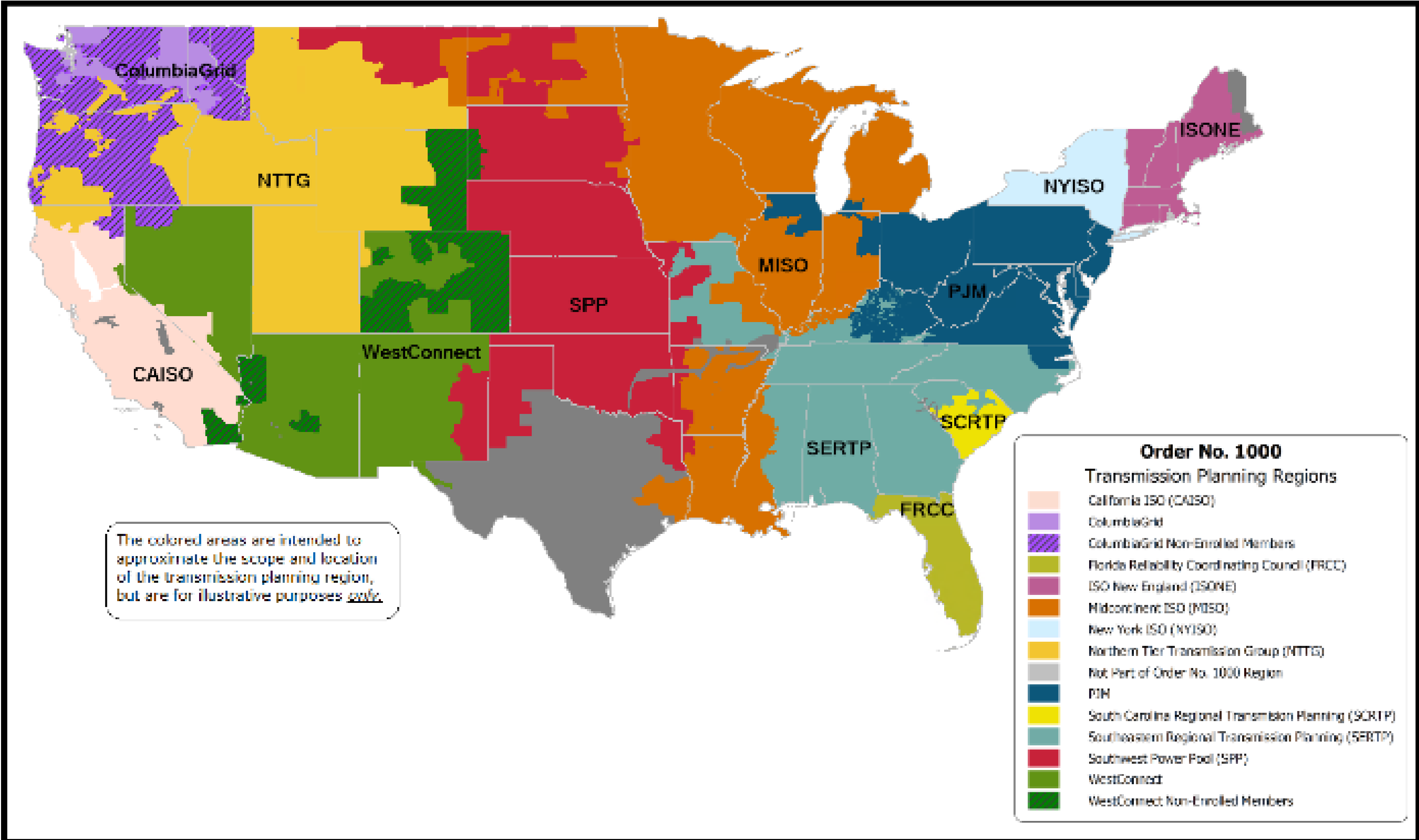


Fragmented electricity trade

U.S. electric power regions



Fragmented transmission planning



Electricity customers can offer key solutions

- Customer devices will scale up with electrification
 - D-system must be able to manage higher amounts of smaller, distributed resources discharging and storing electricity
- EVs, HVAC systems, etc. on the D-system can help balance electricity supply and demand
 - Help integrate wind/solar and maintain reliability at least-cost
 - FERC allowing DR, storage, DERs to participate in wholesale electricity markets helps optimize use of these resources
 - Need T&D coordination, accurate prices, better forecasting

How can Congress help?

- Market / transmission expansion and grid-edge issues highlight importance of federal, state and local authorities collaborating—need forums to work out solutions
 - Ask FERC/DOE to convene states, local authorities, stakeholders to develop coherent, equitable, implementable large-scale backbone transmission plan
 - Fund and provide technical assistance to states to study the benefits of market and transmission expansion, and improve D-system to accommodate DER proliferation and participation in markets
 - Fund DOE to improve open-source mapping tools to identify transmission corridors that optimize efficiency, equity, and avoid environmentally sensitive and cultural heritage sites while maximizing existing rights of ways
- Reduce costs of efficiently sharing resources
 - Fund DOE to develop common open-source energy market trading platform to optimize trades across borders
- Align incentives with policy goals
 - Direct FERC to require utilities to trade electricity and share resources as part of an independently operated market to minimize overcharging customers
 - Enable DOE to investigate setting standards to encourage greater efficiency for the transmission system

Thank you!

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ReGrid

Renewable Reliable Reimagined



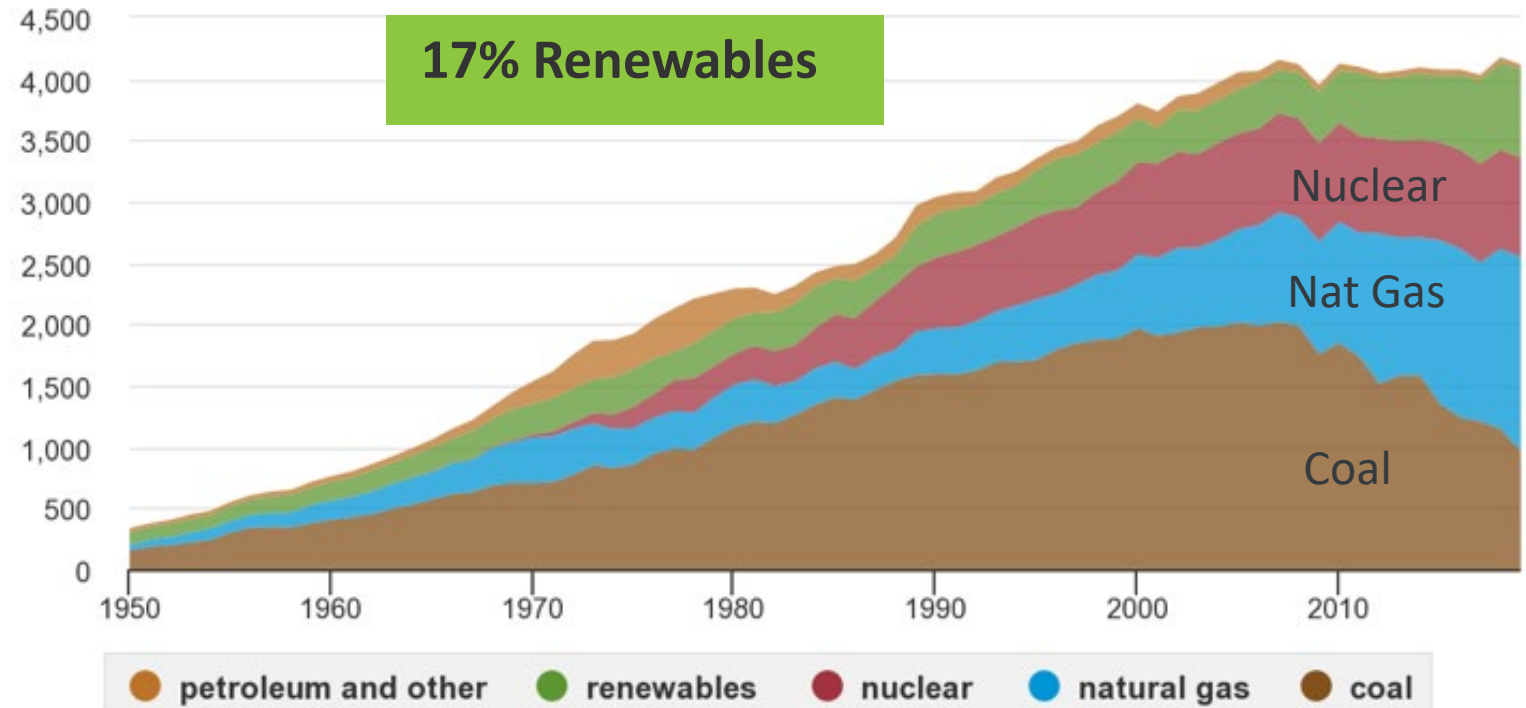
Towards the Energy System of Tomorrow
EESI Panel

Juan Torres
Associate Laboratory Director
Energy Systems Integration

The US Energy Supply is Shifting

U.S. electricity generation by major energy source, 1950-2019

billion kilowatthours



Note: Electricity generation from utility-scale facilities.



Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, March 2020 and *Electric Power Monthly*, February 2020, preliminary data for 2019

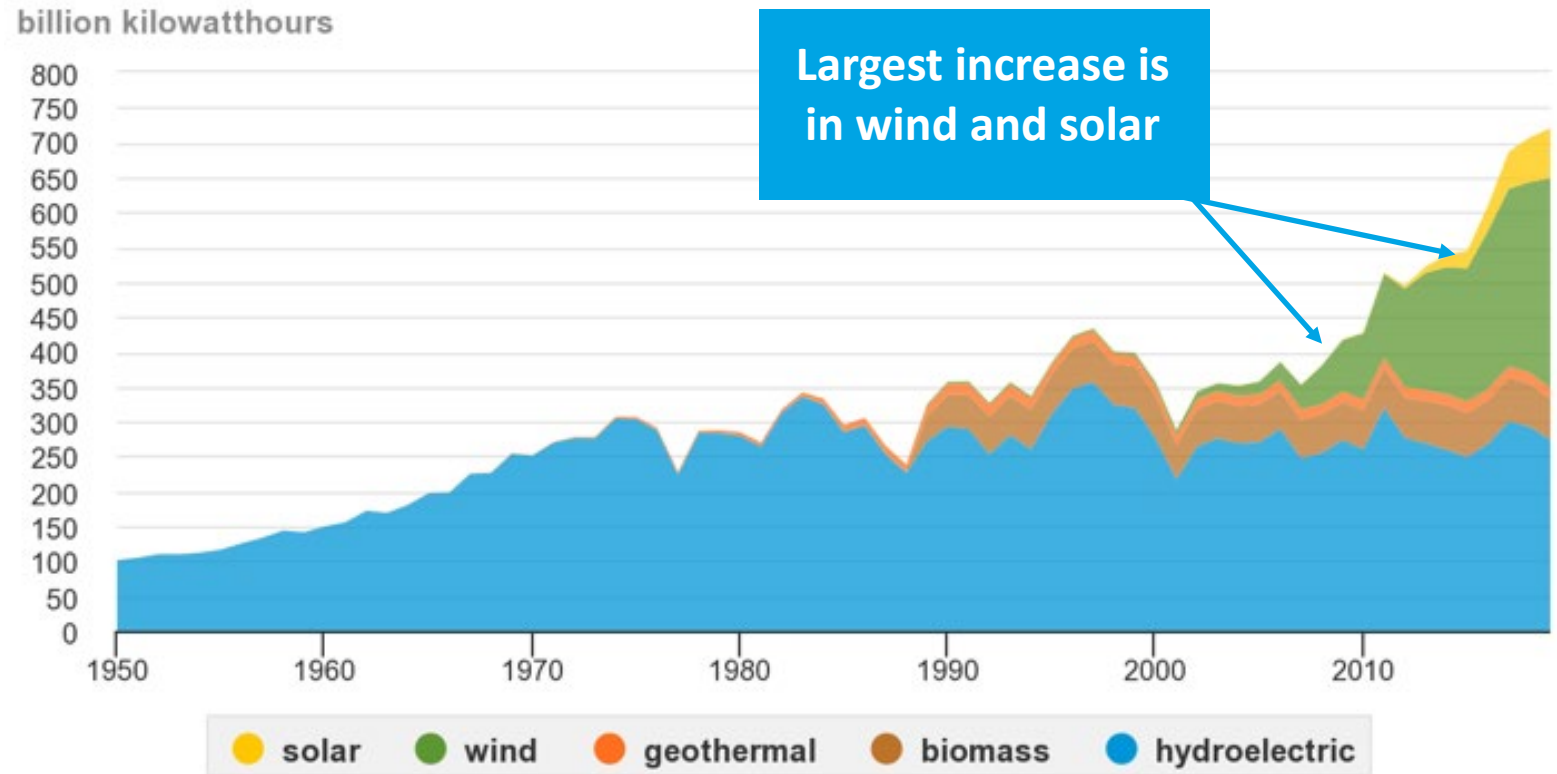
The US Energy Supply is Shifting

Renewable Energy

In 2019, 17% of annual electricity was from renewable sources.

- 7% Wind
- 7% Hydro
- 2% Solar
- 1% Biomass
- 0.5% Geothermal

U.S. electricity generation from renewable energy sources, 1950-2019

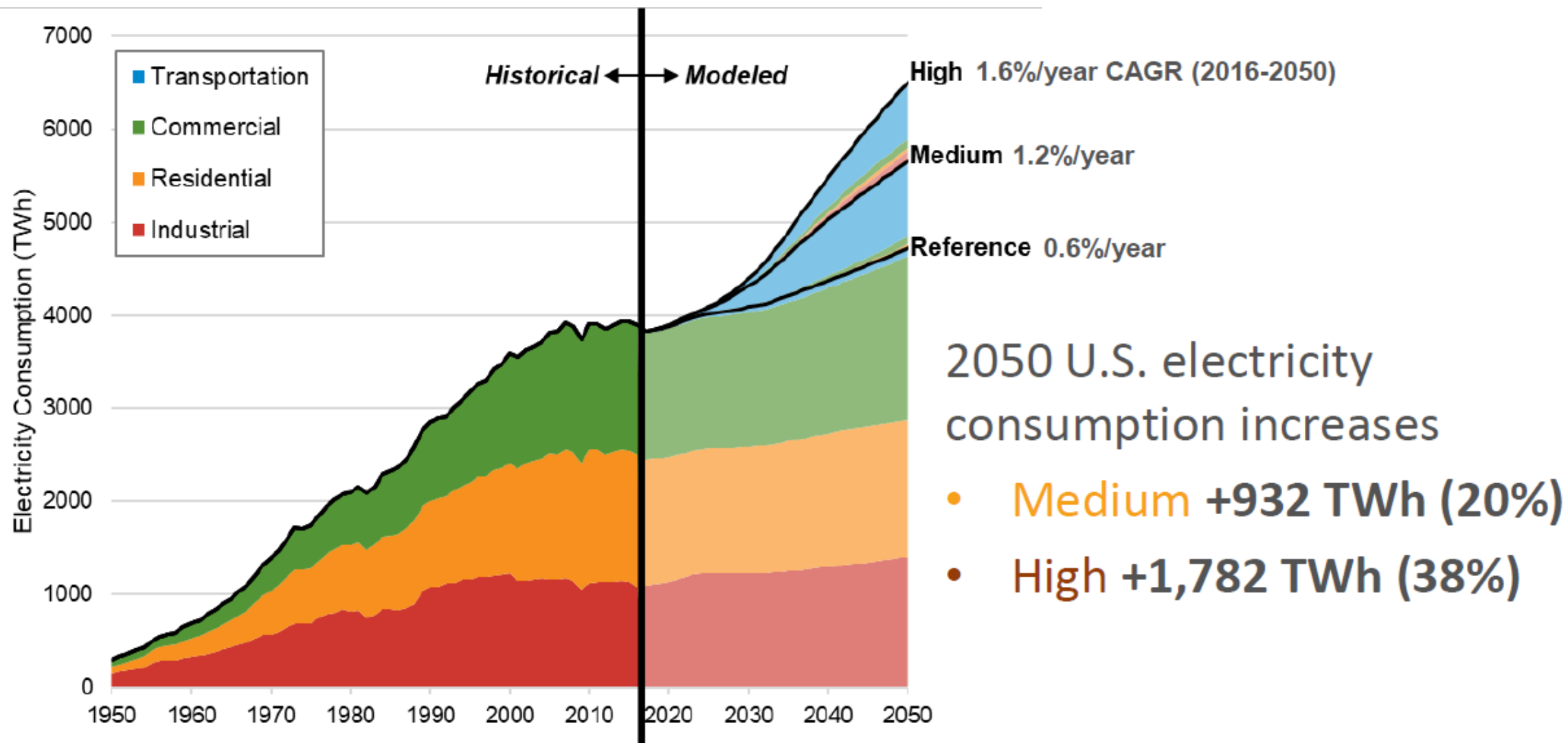


Note: Electricity generation from utility-scale facilities. Hydroelectric is conventional hydropower.

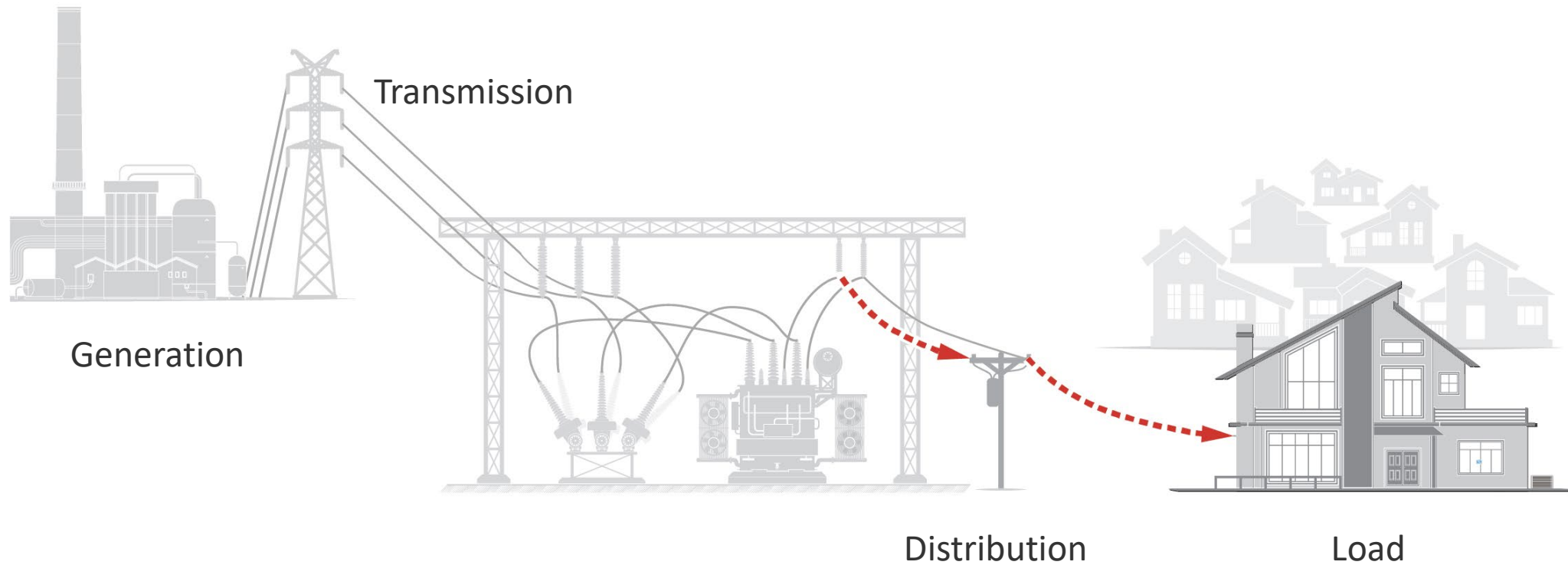


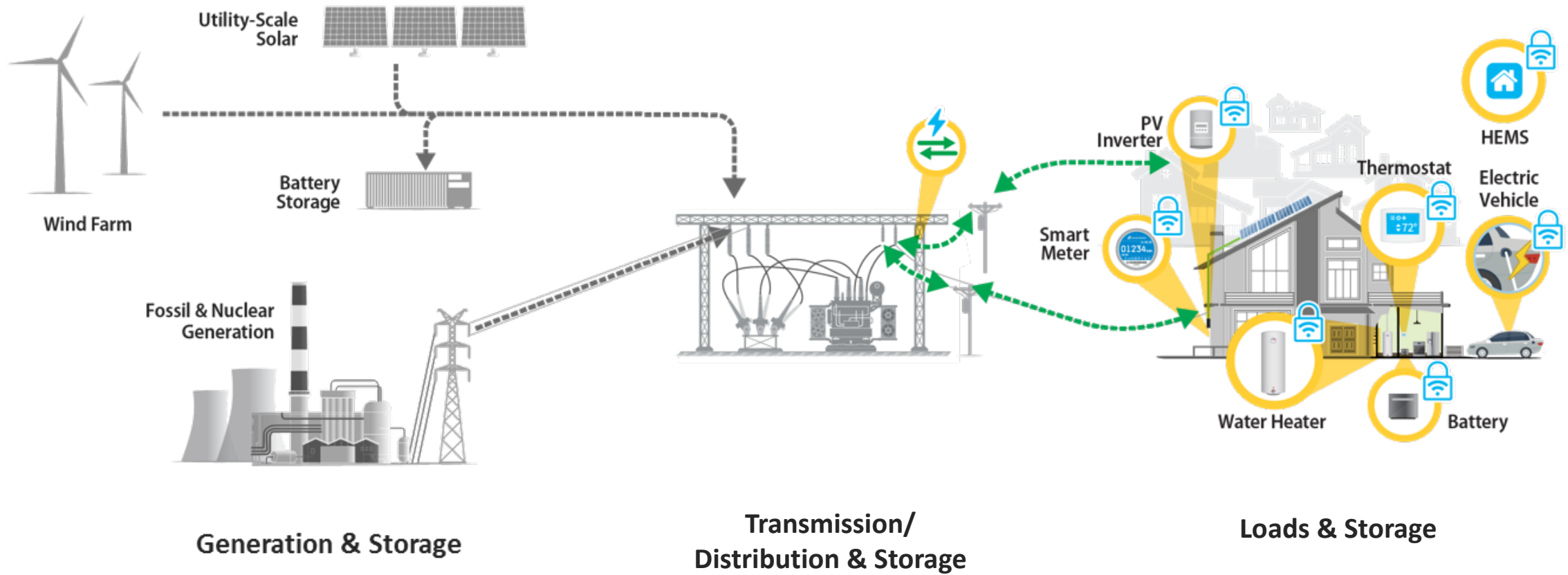
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 7.2a, March 2020 and *Electric Power Monthly*, February 2020, preliminary data for 2019

Vehicle electrification dominates incremental growth in annual consumption



The Grid of the Past





The Grid is Changing

Power Electronics-Based Energy System Operating with Less Inertia

Generation

- Solar PV, wind, microturbines, fuel cells use power electronics (PE) interfaces to connect to the grid
- Over 50% PE generation by 2050
- Other bulk source work synergistically

Storage

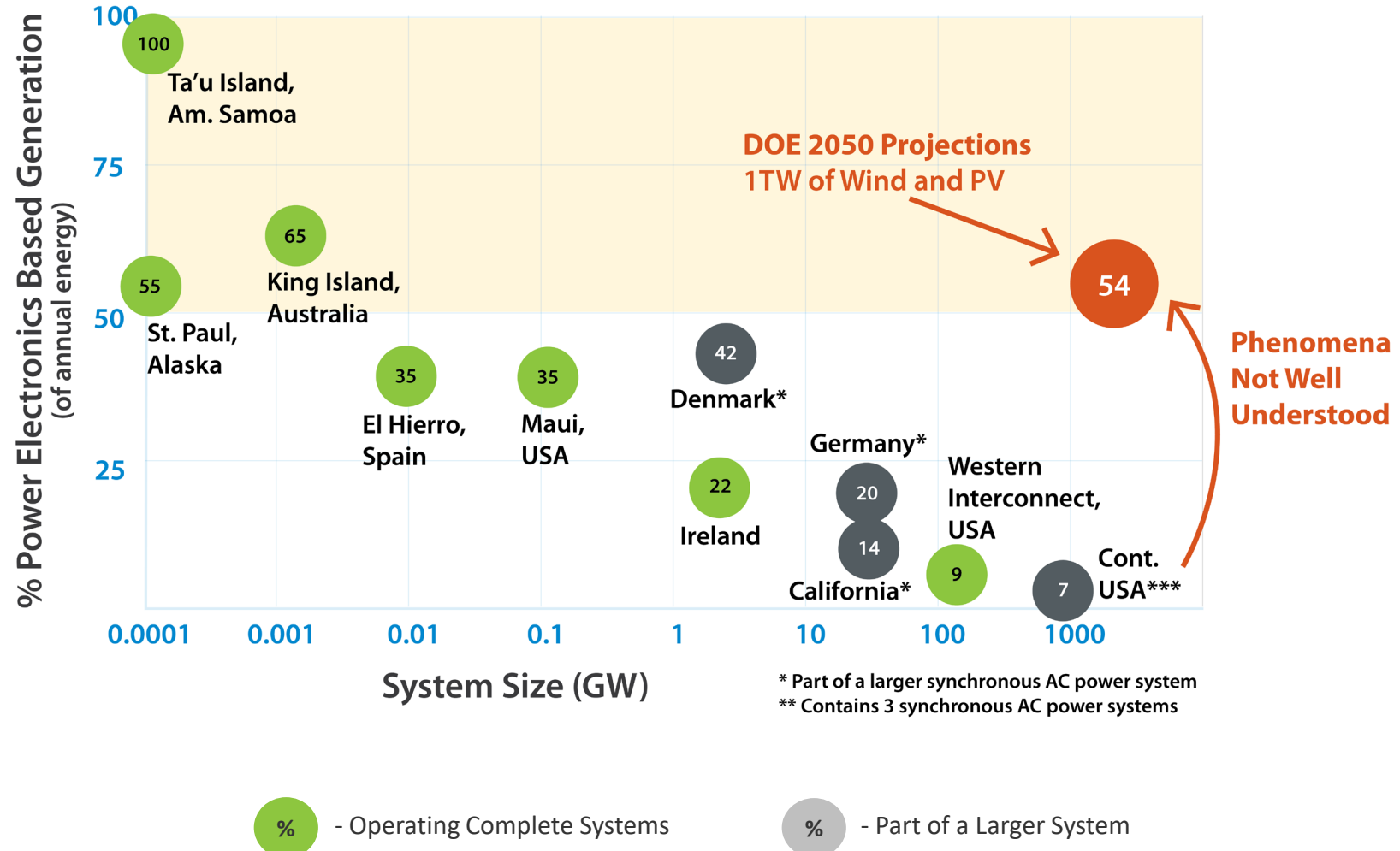
- Batteries use PE interfaces to connect to the grid
- Pumped hydro can add PE to increase controllability and provide grid services

Building Loads

- Over 60% of major home appliances expected to be PE-based by 2021
- Lighting switching to LEDs
- Variable speed drives for motors

Mobility

- EVs – 7 million by 2025
- MD/HD – Electrifying

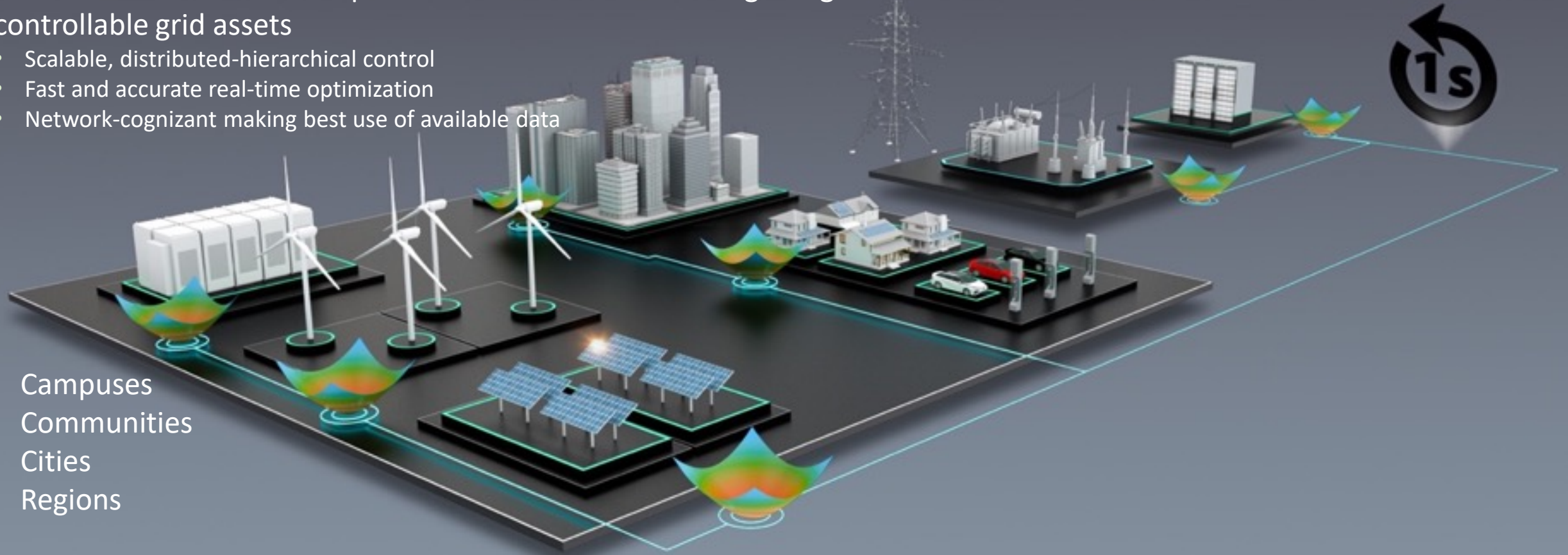


Advancements in AI and Autonomous Energy Systems (AES)

NREL's AES Research developed advanced controls for integrating hundreds of million controllable grid assets

- Scalable, distributed-hierarchical control
- Fast and accurate real-time optimization
- Network-cognizant making best use of available data

- Campuses
- Communities
- Cities
- Regions



Enabling large-scale deployment of distributed energy resources (EVs, Buildings, Generation) through advancements in optimization, control, data analytics, and complex system simulation



LA100

The Los Angeles 100% Renewable Energy Study

Detailed, ultrahigh resolution analysis evaluating a range of future scenarios to equip LA decisionmakers to understand:



What are the **pathways and costs to achieve a 100% renewable electricity supply** while electrifying key end uses and maintaining the current high degree of reliability?



What is the **impact on the environment**?



How might the **economy and rates** respond to such a change?

Sources of Energy System Disruption



Natural Disasters



Space Weather



Physical Threats



Electromagnetic
Pulse



Cyber Threats

Natural Hazards

Human Threats

Thank You

www.nrel.gov





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