Materials will be available at: www.eesi.org/060421grid
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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
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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

HVDC offshore transmission line linking all wind plants.
Fragmented electricity trade
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
The US Energy Supply is Shifting

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

billion kilowatthours

17% Renewables

- Nuclear
- Nat Gas
- Coal
- Petroleum and other
- Renewables
- Nuclear
- Natural gas
- Coal

Note: Electricity generation from utility-scale facilities.
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

Largest increase is in wind and solar

Note: Electricity generation from utility-scale facilities. Hydroelectric is conventional hydropower.
Vehicle electrification dominates incremental growth in annual consumption

2050 U.S. electricity consumption increases
- **Medium** +932 TWh (20%)
- **High** +1,782 TWh (38%)

https://www.nrel.gov/analysis/electrification-futures.html
The Grid of the Past

[Diagram showing the flow from Generation to Transmission, then to Distribution, and finally to Load.]
The Grid is Changing
**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

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**Power Electronics-Based Energy System Operating with Less Inertia**

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*DOE 2050 Projections 1TW of Wind and PV*
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

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

- Natural Disasters
- Space Weather

Physical Threats

- Physical Threats

Electromagnetic Pulse

Human Threats

- Cyber Threats
Thank You

www.nrel.gov
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Please take 2 minutes to let us know at:
www.eesi.org/survey

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