NREL's 100% Clean Electricity by 2035 Study

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Paul Denholm

Photo from iStock-1137734382

What this study is and why it's needed…

Our transition to a 100% clean electricity system requires widespread, rapid change

- We need to understand drivers of uncertainty, potential tradeoffs, and least-regrets pathways
- Power sector decarbonization is a pillar towards economy-wide decarbonization.

Given our rapidly changing energy environment, this study examined *four core 100% scenarios* along with *142 additional sensitivities* to capture future uncertainties related to technology cost, performance, and availability

- Further analysis is required, in addition to the development of new data and capabilities
- A single study won't be able to answer all the questions, nor will it be able to capture all possible variables.

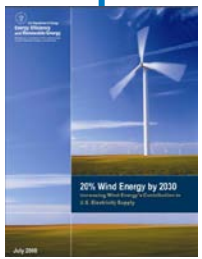
Study's scenarios and results are building blocks for a broad range of decarbonization efforts from the U.S. Department of Energy

More than a decade of visionary power sector and renewable integration analyses

2008

Now

20% Wind by 2030 (2008)



Western Wind & Solar Integration Study (WWSIS) 1 (2010)

Eastern Wind Integration & Transmission (2010)

RE Futures (2012)

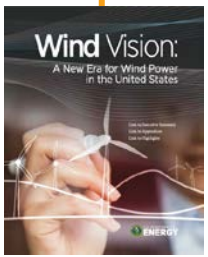
SunShot Vision (2012)

WWSIS 2 (2013)

WWSIS 3 (2014)

Standard Scenarios (2015 –)

Wind Vision (2015)



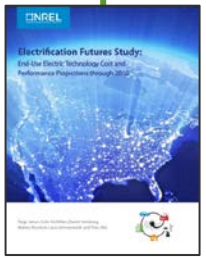
ERGIS (2016)

On the Path to SunShot (2016)

Hydropower Vision (2016)

Greening the Grid (2017)

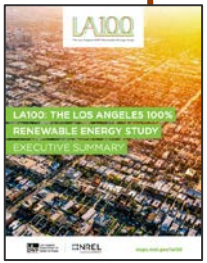
Electrification Futures Study (2017 – 2021)



Geothermal Vision (2019)

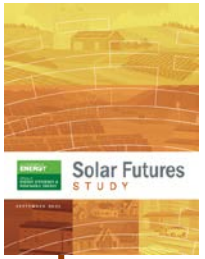
NARIS (2021)

LA100 (2021)



Storage Futures Study (2021 – 2022)

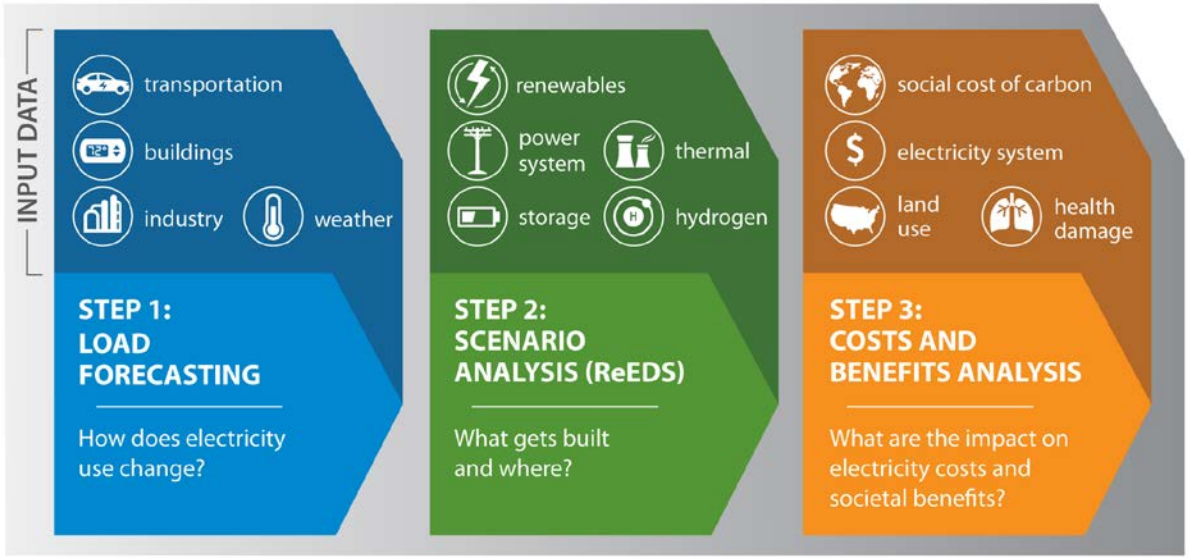
Solar Futures Study (2021)



Distributed Wind Energy Futures Study (2022)

- Study used ReEDS to find the least-cost option to maintain safe and reliable power during all hours of the year.

- The scenarios:
  - Achieve 100% clean electricity under accelerated demand electrification
  - Reduce economywide, energy-related emissions by 62% in 2035 relative to 2005 levels.



Scenarios developed prior to the Inflation Reduction Act (IRA)

Figure from NREL

Methodology

NREL developed **four core supply-side scenarios (along with 142 additional sensitivities)** representing a range of possible pathways to a net-zero power grid by 2035—from the most to the least optimistic availability and costs of technologies.

Multiple pathways to a net-zero grid in the U.S. by 2035

produce *significant benefits exceeding the costs*

Photo from iStock-1137734382

Key Findings

The study shows there are *multiple pathways* to **100% clean electricity by 2035** that would produce significant benefits exceeding the additional power system costs.

Key Findings

- **Technology deployment must rapidly scale up**
  - 4x the current annual deployment levels for wind and solar
  - Growth of emerging clean energy and storage technologies.
- **Total transmission capacity must grow significantly**
  - Up to 3x today's capacity, or between 1,400 and 10,100 miles of new high-capacity lines per year starting in 2026.
- **The climate and health benefits of decarbonization *offset the costs*, saving:**
  - 130,000 lives and $390–$400 billion in avoided mortality costs
  - $1.2 trillion in avoided damages from climate change
  - $920 billion to $1.2 trillion in overall net benefits to society.

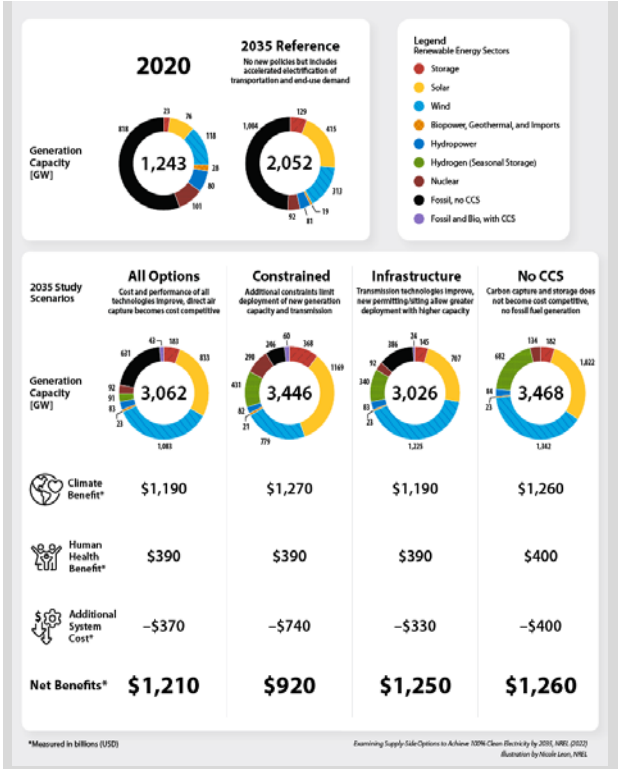
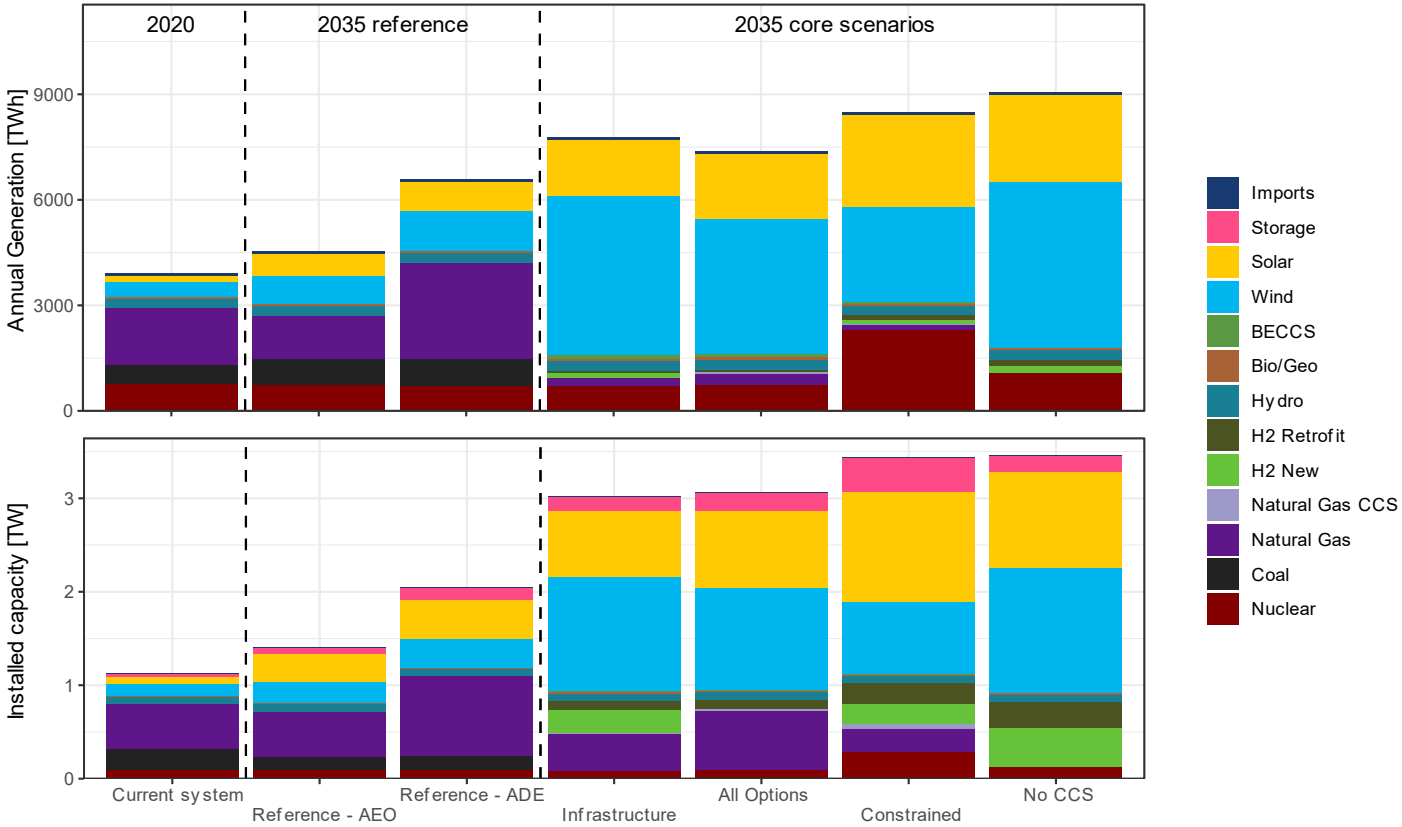


Illustration by Nicole Leon, NREL

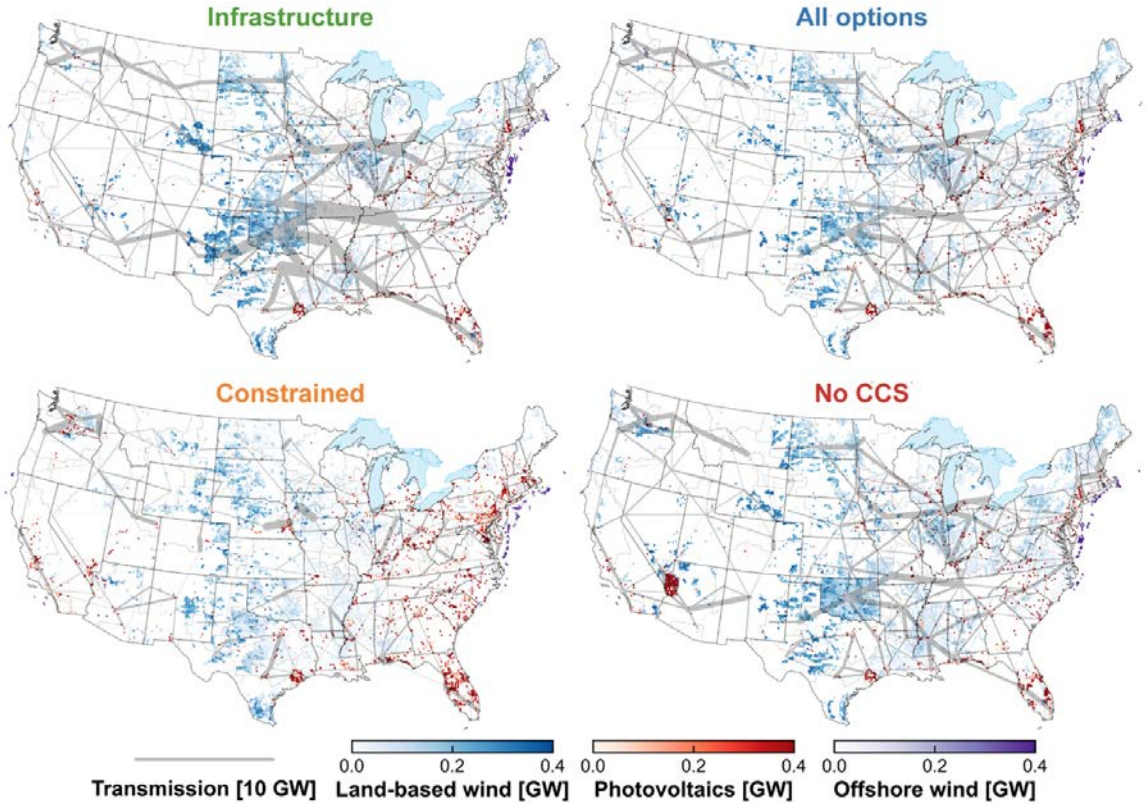
Technology deployment must rapidly scale up

Figure from NREL



Total transmission capacity must grow significantly

Figure from NREL



Four Key Challenges

A 100% clean electricity U.S. power system will require several key actions in the coming decade:

- **Dramatic acceleration** of electrification and increased efficiency
- **New energy infrastructure** installed rapidly throughout the country
- **Expanded clean technology** manufacturing and the supply chain
- **Continued research, development, demonstration, and deployment** to bring emerging technologies to the market.

Failing to achieve any of the key actions could increase the difficulty of realizing the scenarios outlined in the study.

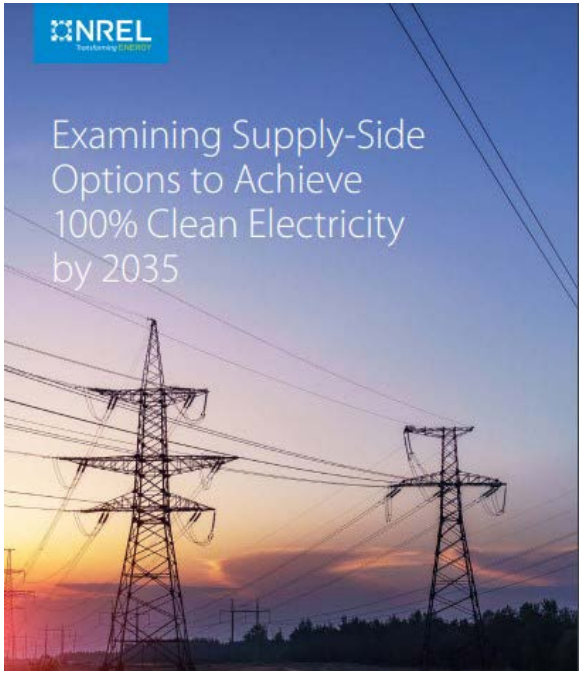


Image from Liz Craig, NREL

Read the full report at https://www.nrel.gov/docs/fy22osti/81644.pdf

Access the full report, data files, and the results infographic:

nrel.gov/analysis/100-percent-clean-electricity-by-2035-study.html.

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Thank You

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