Capturing technological disruptions and behavioral change in long-term energy scenarios

IRENA LTES Forum
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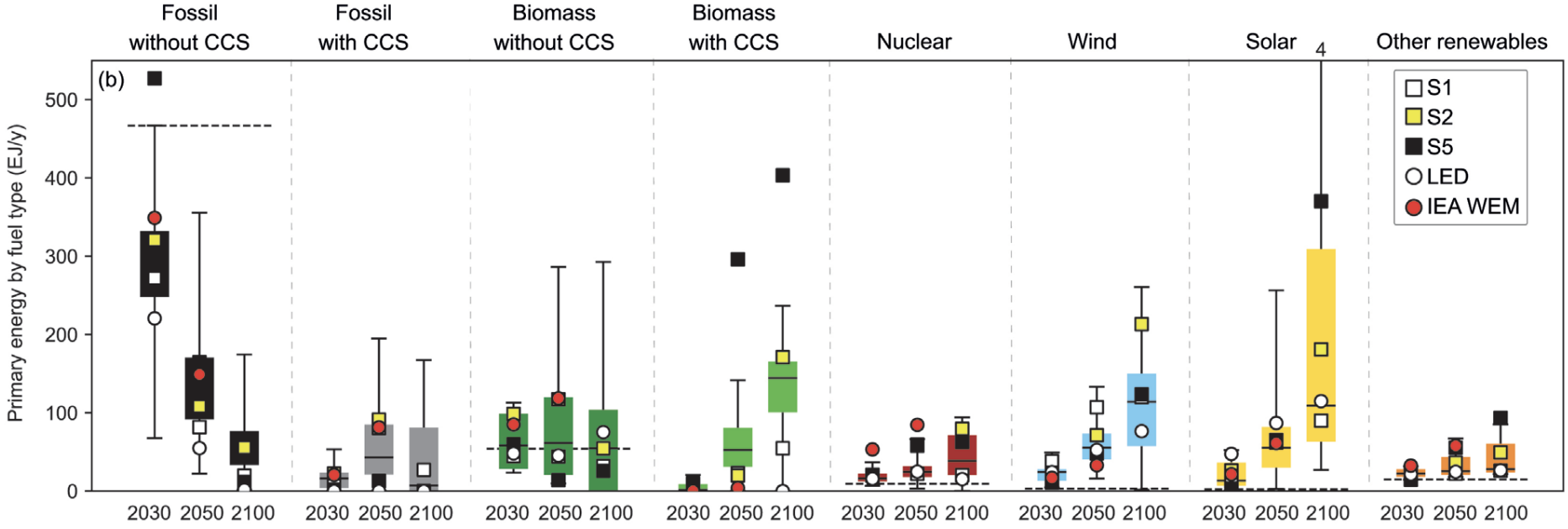
June 2021

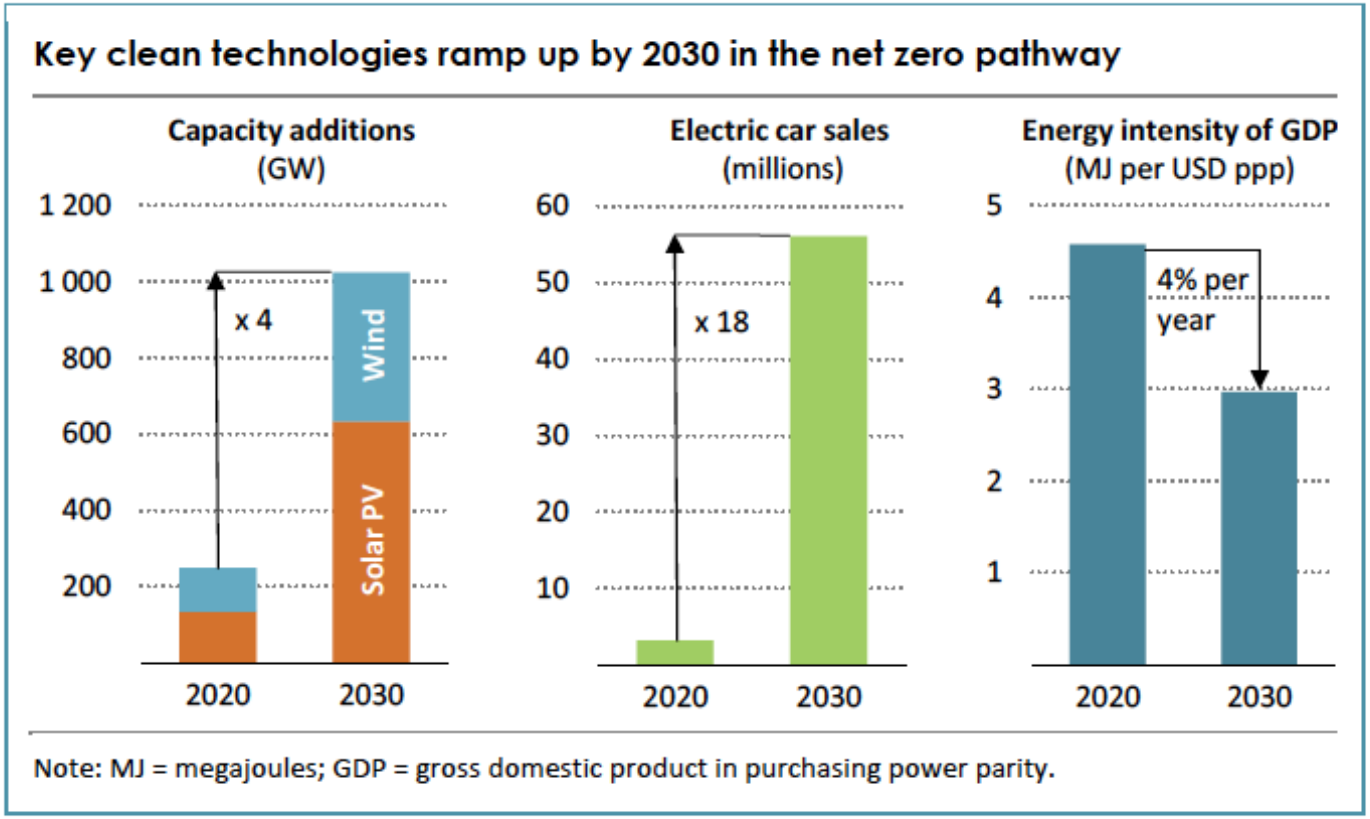
Breadth of technologies



Primary energy supply relative ranges for pathways limiting warming to 1.5°C with no or limited overshoot

Source: IPCC SR15 report.

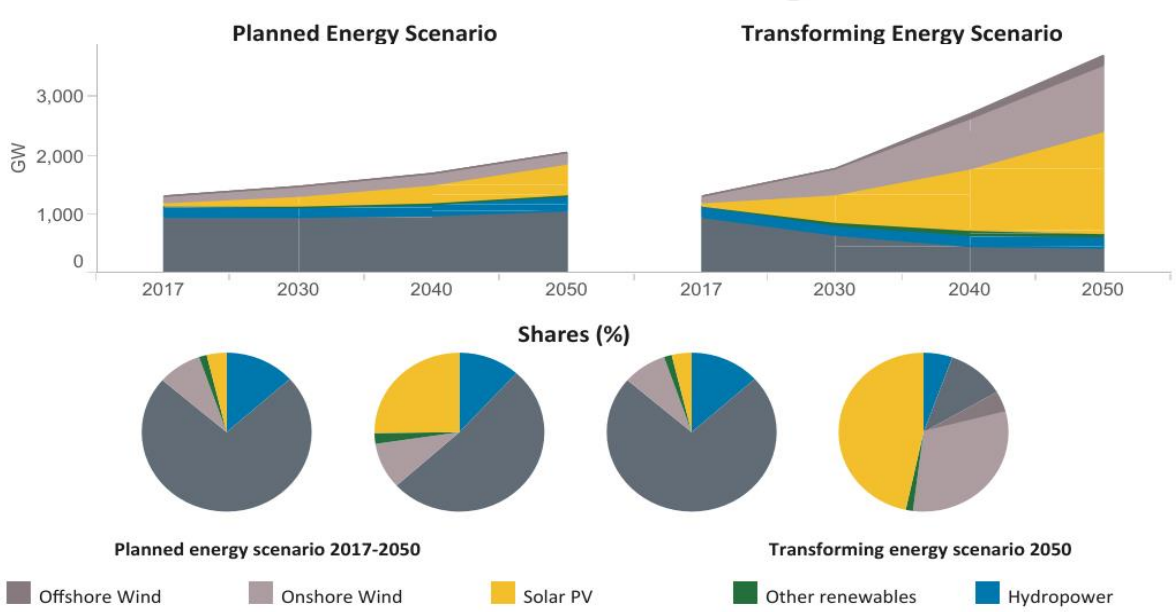
Net Zero by 2050 – A Roadmap for the Global Energy Sector



REMAP Scenario Example

Region
North America

Category
Electrical capacity

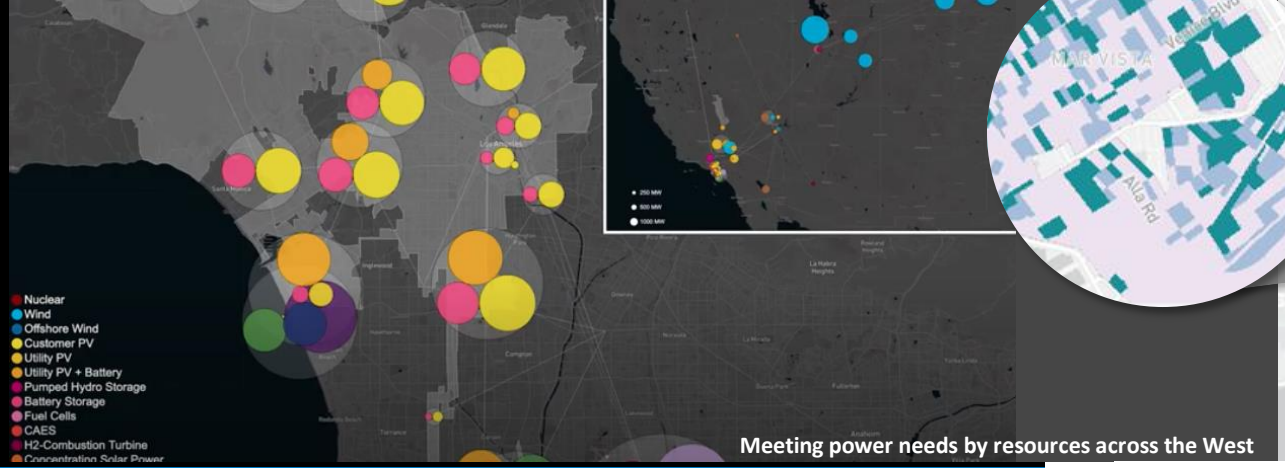


Source IRENA (2020), Global Renewables Outlook: Energy transformation 2050, International Renewable Energy Agency, Abu Dhabi
https://irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020.

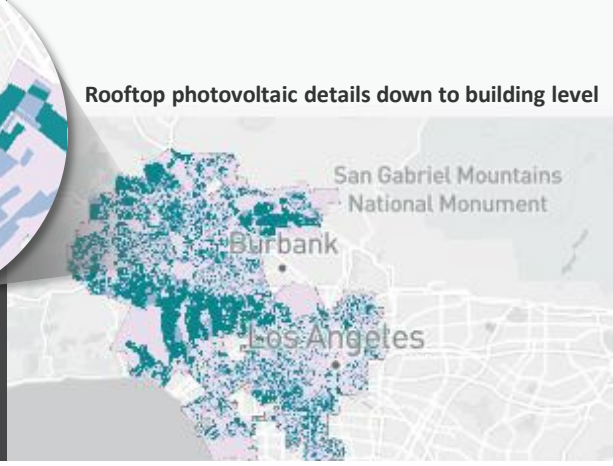
US Scenarios: Power Sector

Forward-looking scenarios of the U.S. power sector updated annually to support and inform energy analysis

nrel.gov/analysis/standard-scenarios.html



Meeting power needs by resources across the West

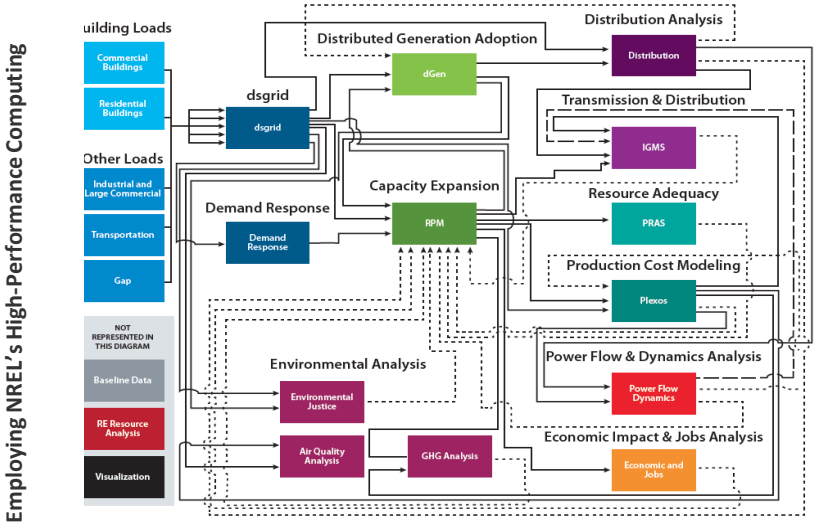


Rooftop photovoltaic details down to building level

LA100: Los Angeles 100% Renewable Energy Study

NREL is uncovering analytic insights at unprecedented scale

- **Infrastructure level insights to realize ambitious goals**
- **Critical roles of biofuels, or RE-fueled (e.g., RNG or H2) support seasonal storage & reliability**



= over 100 million simulations

LA100 Scenarios

Each Scenario Evaluated Under Different Customer Demand Projections (different levels of energy efficiency, electrification, and demand response)

- Moderate
- High
- Stress

SB100

Evaluated under Moderate, High, and Stress Load Electrification

- 100% clean energy by **2045**
- Only scenario with a target based on retail sales, not generation
- Only scenario that allows up to 10% of the target to be natural gas offset by renewable electricity credits
- Allows existing nuclear and upgrades to transmission

Early & No Biofuels

Evaluated under Moderate and High Load Electrification

- 100% clean energy by **2035**, 10 years sooner than other scenarios
- No natural gas generation or biofuels
- Allows existing nuclear and upgrades to transmission

Transmission Focus

Evaluated under Moderate and High Load Electrification

- 100% clean energy by **2045**
- Only scenario that builds new transmission corridors
- No natural gas or nuclear generation

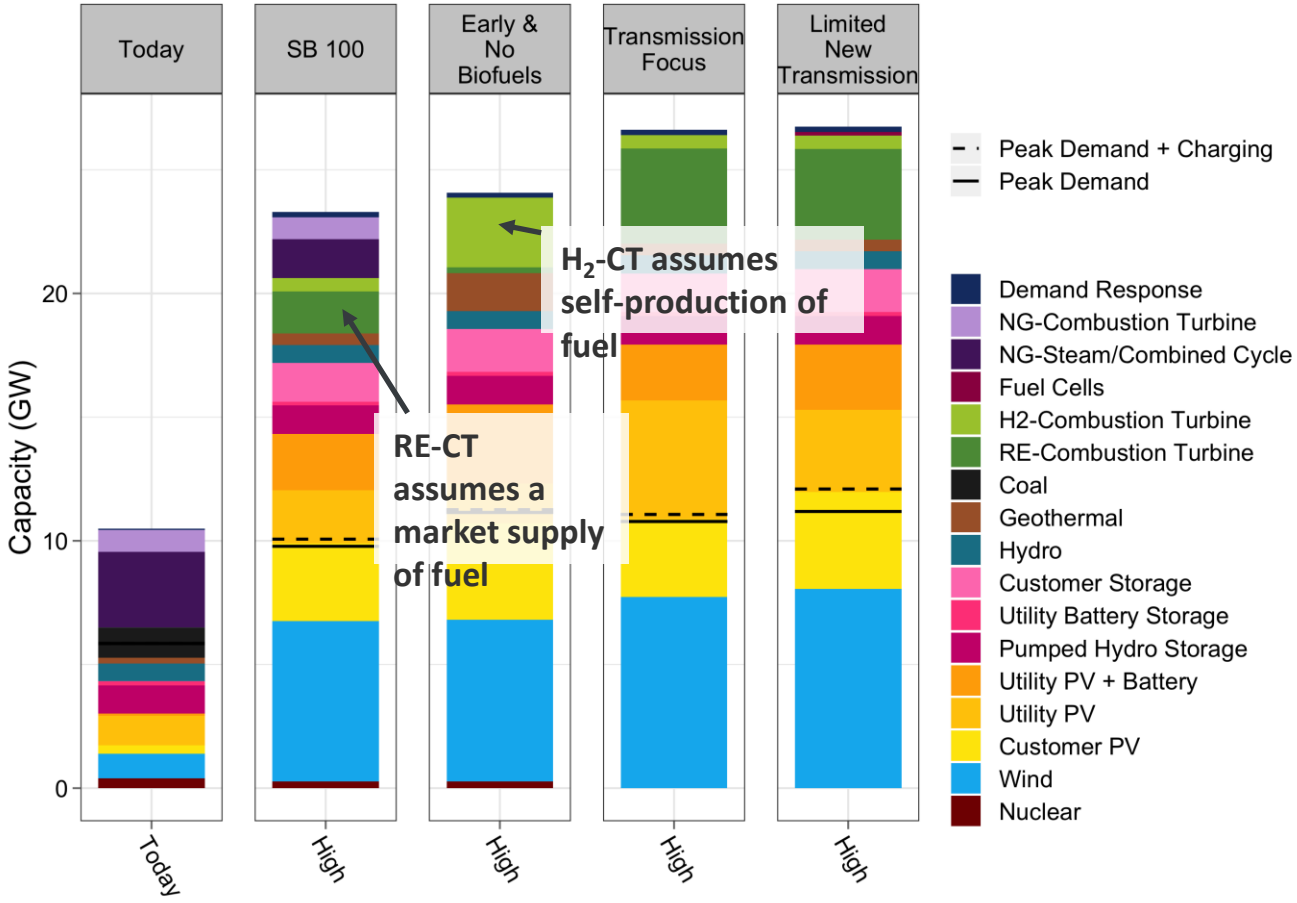
Limited New Transmission

Evaluated under Moderate and High Load Electrification

- 100% clean energy by **2045**
- Only scenario that does not allow upgrades to transmission beyond currently planned projects
- No natural gas or nuclear generation

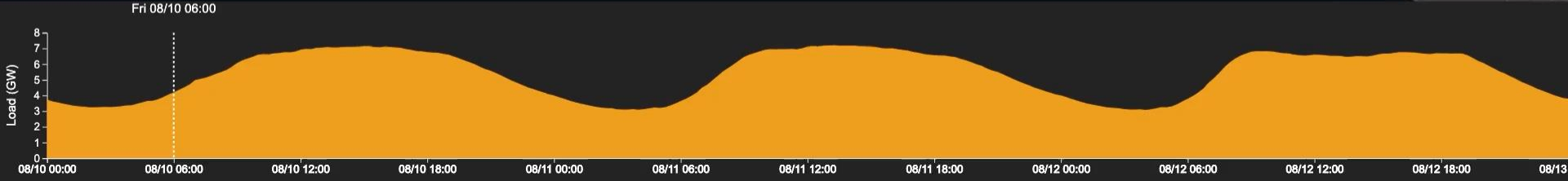
Meeting the last 10% on the road to 100% renewables

Producing hydrogen (rather than buying commercially available RE fuels) adds ~20% to cumulative costs



Capacity Mix in 2045 — High Load Scenarios, Compared to 2020


High 2045
Net Loads
25 kWh
0 kWh
Bakersfield
Santa Clarita
Lancaster
Palmdale
Oxnard
Simi Valley
Thousand Oaks
Santa Monica
Los Angeles
El Monte
West Covina
Chino
Fontana
Corona
Anaheim
Rolling Hills Estates
Long Beach
Santa Ana
Irvine
Victorville
California City
Tehachapi
Ridgecrest
Barstow
Palmdale
Lancaster
LAX
LGB
ONT
CNO
VCV
NTD
mapbox
©Mapbox, ©OpenStreetMap


Fri 08/10 06:00
Load (GW)
0
1
2
3
4
5
6
7
8
08/10 00:00
08/10 06:00
08/10 12:00
08/10 18:00
08/11 00:00
08/11 06:00
08/11 12:00
08/11 18:00
08/12 00:00
08/12 06:00
08/12 12:00
08/12 18:00
08/13

Implications for technology change

- Understanding commercial and near commercial technologies
- Characterizing precommercial technologies
- Understanding implications for behavior, institutional, policy and regulatory change
- Addressing Unknown Uknowns…

- Future casting….
  - Electrification
  - Multiday demand response
  - Storage, esp beyond batteries
  - H2
  - Renewable Natural Gas
  - P2X
  - ???

Evolving practices

- Ensemble approaches
- Robust Decision making
- Improved characterizations and incorporation into LTES models
- Transparency

www.nrel.gov