

ESIG Fall Technical Workshop



San Diego, CA
October 23-26, 2023

ESIG Disclaimer & Antitrust Compliance Guidelines



Disclaimer: Any information presented at the Energy Systems Integration Group (ESIG) Technical Workshops or User Group meetings is for informational purposes only. ESIG accepts no responsibility for the accuracy of such presentations, or for your reliance on any information contained within the content available through such forums. Discussions represent a wide range of views and interests of the participating individuals and organizations. Statements made during discussions do not necessarily reflect those of ESIG.

Antitrust Guidelines: It is ESIG's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. The antitrust laws make it important that event participants avoid discussion of topics that could result in charges of anti-competitive behavior, including: restraint of trade and conspiracies to monopolize, unfair or deceptive business acts or practices, price discrimination, division of markets, allocation of production, imposition of boycotts, exclusive dealing arrangements, and any other activity that unreasonably restrains competition.

For additional guidelines, [please click here](#).

ESIG Non-Discrimination / Anti-Harassment



The Energy Systems Integration Group (ESIG) **does not tolerate** discrimination or harassment, which can take many forms, by its staff, members, meeting attendees, guests or other participants in any ESIG activities.

ESIG does not and shall not discriminate on the basis of race, color, religion (creed), gender expression, age, national origin (ancestry), disability, marital status, sexual orientation, or military status, in any of its activities or operations. These activities include, but are not limited to, hiring and firing of staff, selection of volunteers and vendors, and provisions of services. We are committed to providing an inclusive and welcoming environment for all members of our staff, clients, volunteers, subcontractors, vendors and clients.

Harassment is any verbal remark, physical advance or visual display that makes another feel intimidated, offended or belittled. Harassment can be sexual or non-sexual in nature. Sexual harassment may include unwanted advances, inappropriate sexual jokes, sexually suggestive comments, touching, requests for sexual favors or inappropriate comments about another's appearance. Non-sexual harassment may include offensive comments, jokes or pictures related to race, religion, ethnicity, gender, age or any other protected characteristic. To keep harassment out of ESIG's environment, all comments and actions must always be appropriate and respectful.

Workshop Agenda Overview



Monday am

- Tutorial I: HVDC Transmission
- Tutorial II: High Fidelity IBR Generic Model Development and Validation for Planning,

Monday pm

- Introduction and Keynote Comments
- Opening Plenary Session: Grid Enhancing Technologies
- Session 2: IBR and GFM Studies and Tools
- Board Meeting & Dinner 6:00 – 8:30 pm

Tuesday am

- Session 3: Building Sector Decarbonization in Energy Systems Modeling
- Session 4: Grid Code Interconnection Requirements Assessment

Workshop Agenda Overview



Tuesday pm

- Session 5: Transmission and Interconnection
- Session 6: GFM Developments
- Networking Reception 6:30 – 8:00 pm

Wednesday am

- Session 7: Market Topics
- Session 8: Transmission – From DER to HVDC

Wednesday pm

- Session 9: Power Systems Planning and Operations
- Session 10: Closing Plenary - Planning Implications with Large Loads
- Advisory Council Meeting & Dinner 6:00 – 8:30 pm

Workshop Agenda Overview



Thursday – Working Groups and Task Forces – Members Only

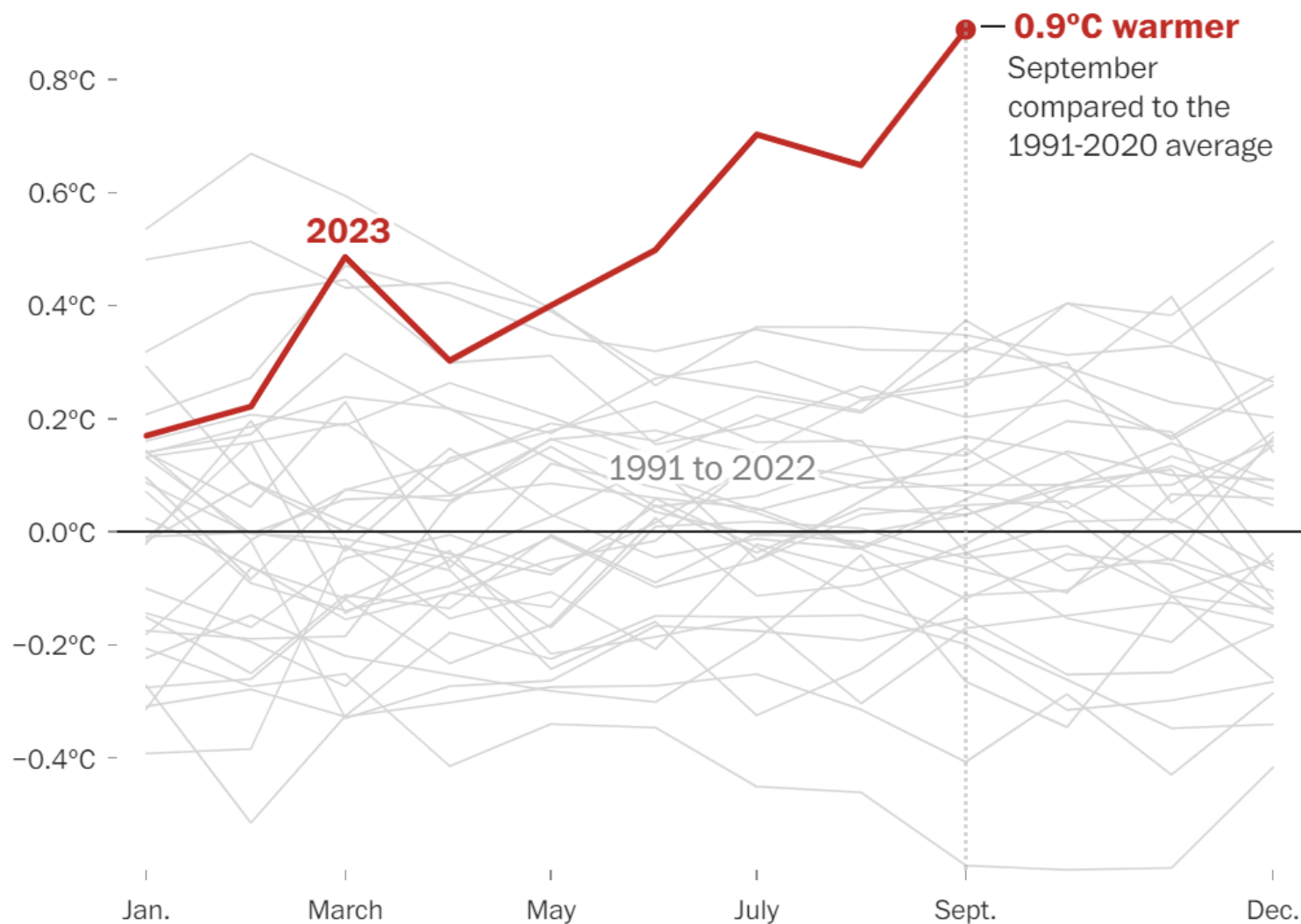
Thursday am

- Reliability Working Group
- System Planning Working Group
- Research & Education Working Group

Thursday pm

- Joint SPWG/DERWG Task Force on Long-term Load Forecasting
- System Operation & Market Design Working Group
- DER Working Group

“September Shattered Global Heat Record”



- “Absolutely gobsmackingly bananas”
- “Extraordinary”
- “We’ve never seen a record smashed by anything close to this margin.”
- “Copernicus estimates annual average temperatures this year are expected to end up about 1.4 degrees Celsius (2.5 degrees Fahrenheit) above preindustrial levels.”

Do You Ever Have That Feeling?



"Maybe if I unplug it and plug it in again, it'll fix this mess."

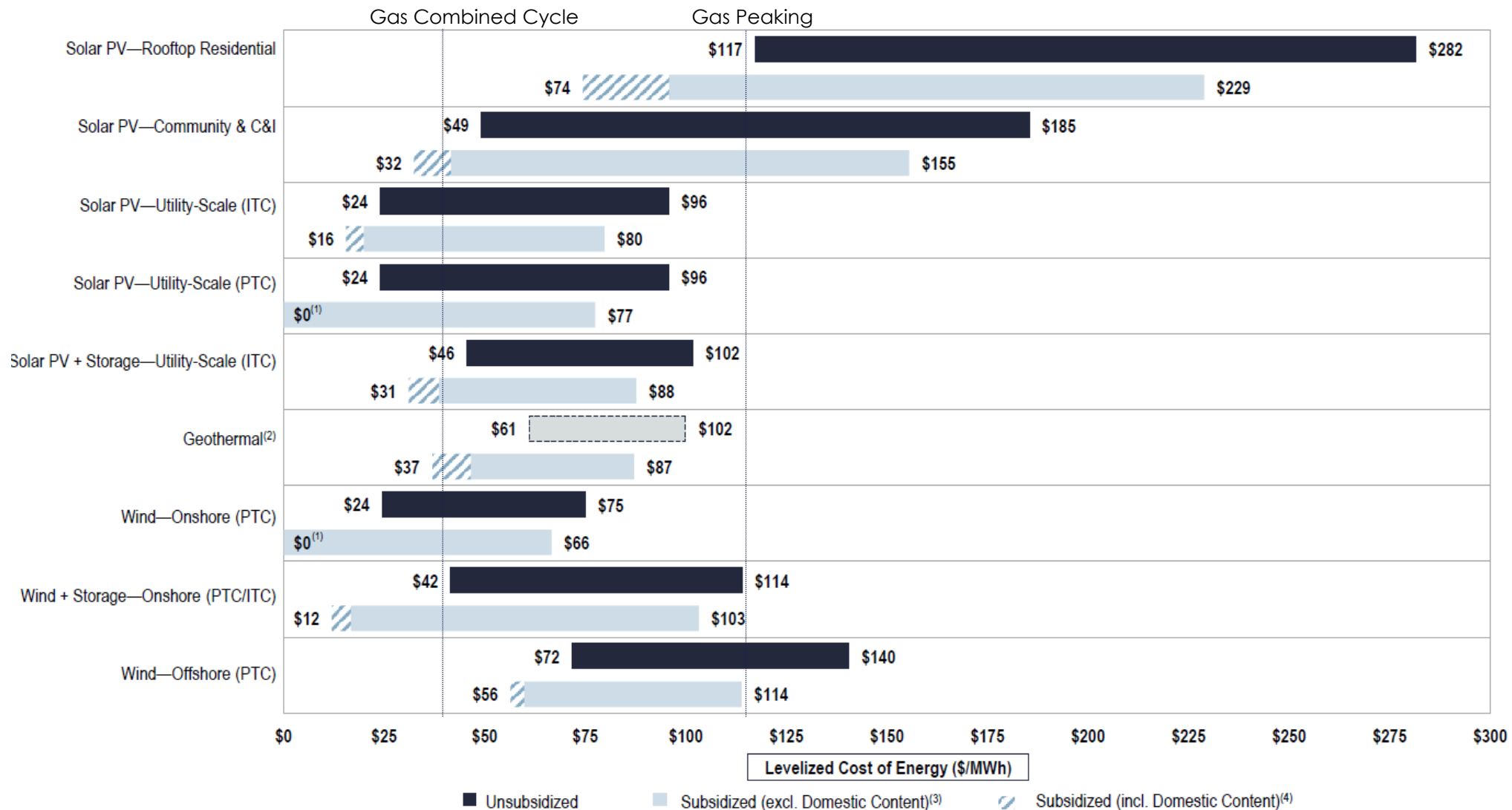
CartoonStock.com

What Did They Say at NARUC Last Year (Nov 17, '22)



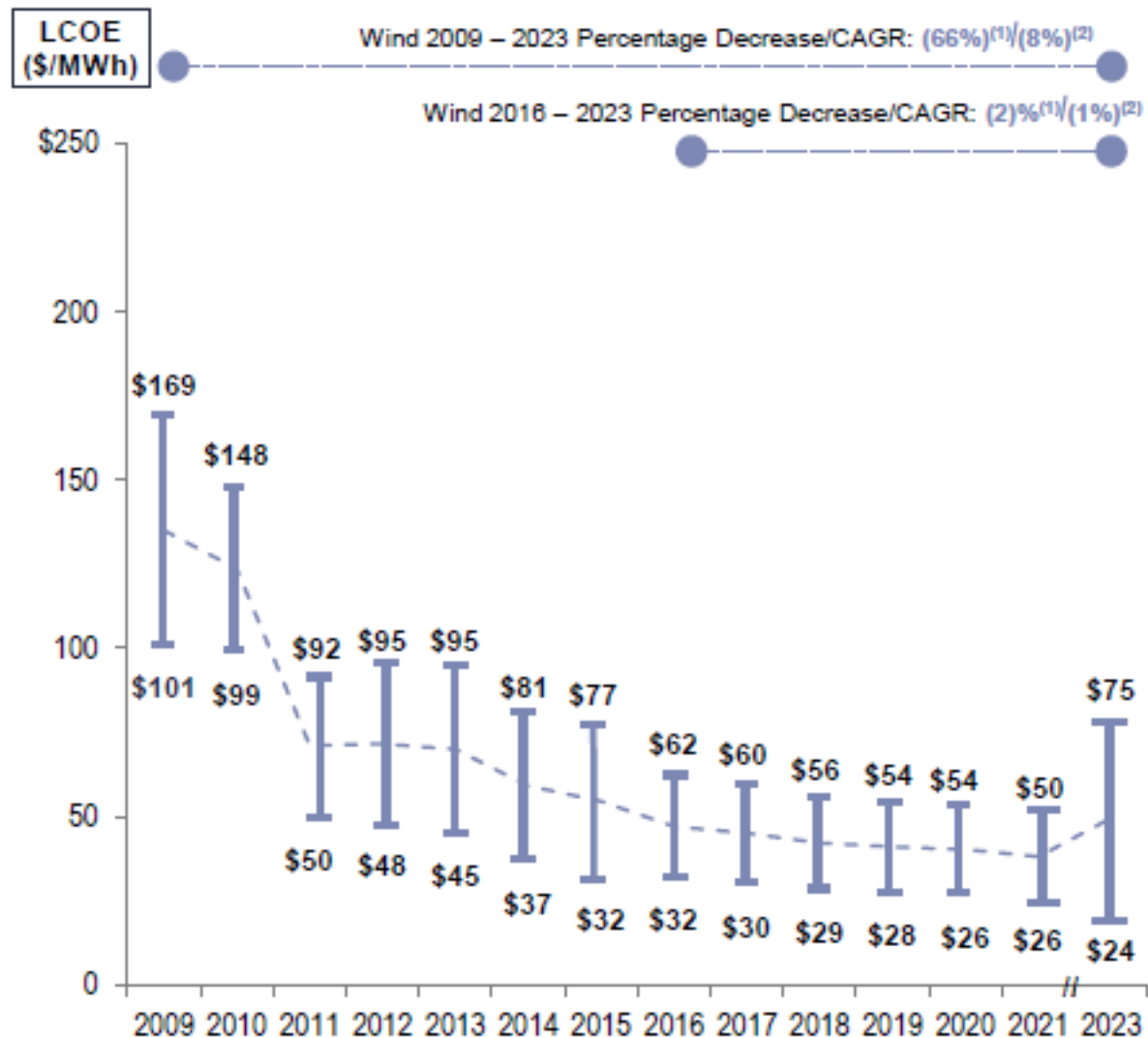
- The **Inflation Reduction Act** will upend key tenets of utility resource planning, including the need for bottom-up forecasting to account for a pending surge in electric vehicle and building load, according to panelists at a National Association of Regulatory Utility Commissioners (NARUC) meeting on Nov 17, 2022.
- Wind and solar paired with battery storage is in the \$20/MWh to \$30/MWh range, making them competitive with natural gas-fired generation, said Matt Pawlowski, NextEra Energy Resources executive director of business management and regulatory affairs.
- Later this decade, **with the IRA, NextEra expects wind coupled with a 4-hour battery system will cost \$14/MWh to \$21/MWh**, according to a Nov. 4 company presentation. **Solar with batteries will cost \$17/MWh to \$24/MWh, the company estimates.**
- **An existing natural gas-fired power plant will cost \$35/MWh to \$47/MWh to operate, assuming gas is in the \$4/million British thermal units to \$5/MMBtu range**, according to NextEra.
- **“We have a once-in-a-lifetime set of incentives that are on the table. The biggest risk for ratepayers would be a failure to capitalize on that right now,”** said Walsh, DOE OGC.

LCOE Comparison – Sensitivity to Tax Credits



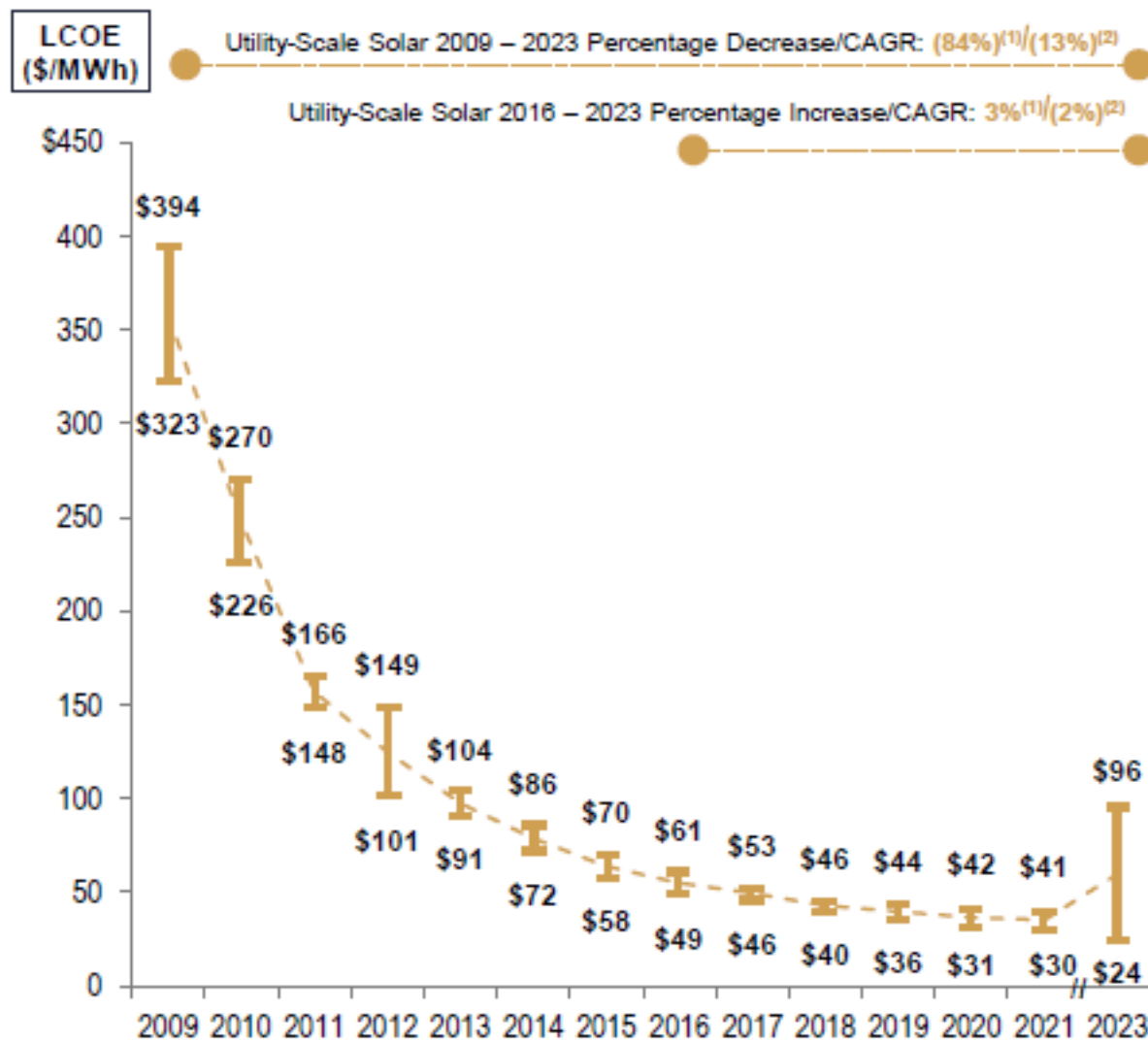
Source:
Lazard

Unsubsidized Wind LCOE Over Time



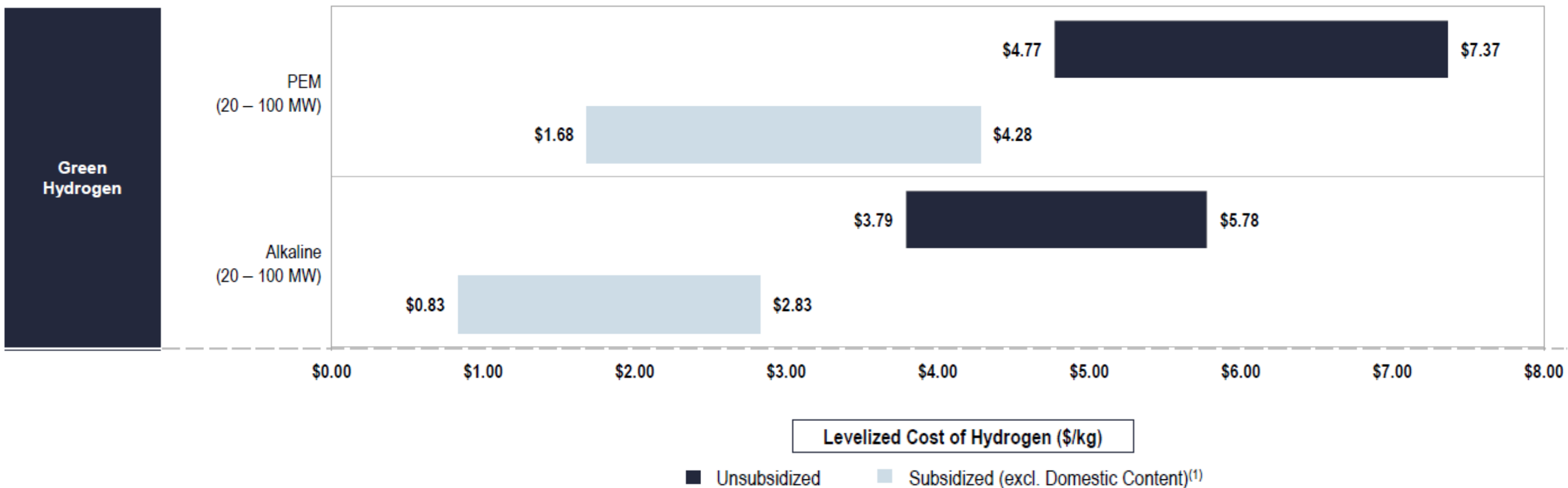
Source:
Lazard

Unsubsidized Solar LCOE Over Time



Source:
Lazard

LCOE of Hydrogen – Illustrative Results



Source:
Lazard

An Industry Maturing – Globally



- Global wind capacity end of 2022 (various): 950 GW
- Global PV capacity end of 2022 (various): 1100 GW
- US Renewable capacity end of 2022
 - Wind 130 GW
 - PV 110 GW
- Variously Estimated Global VG installations in 2023
 - Wind 100 GW
 - PV 250 - 300 GW

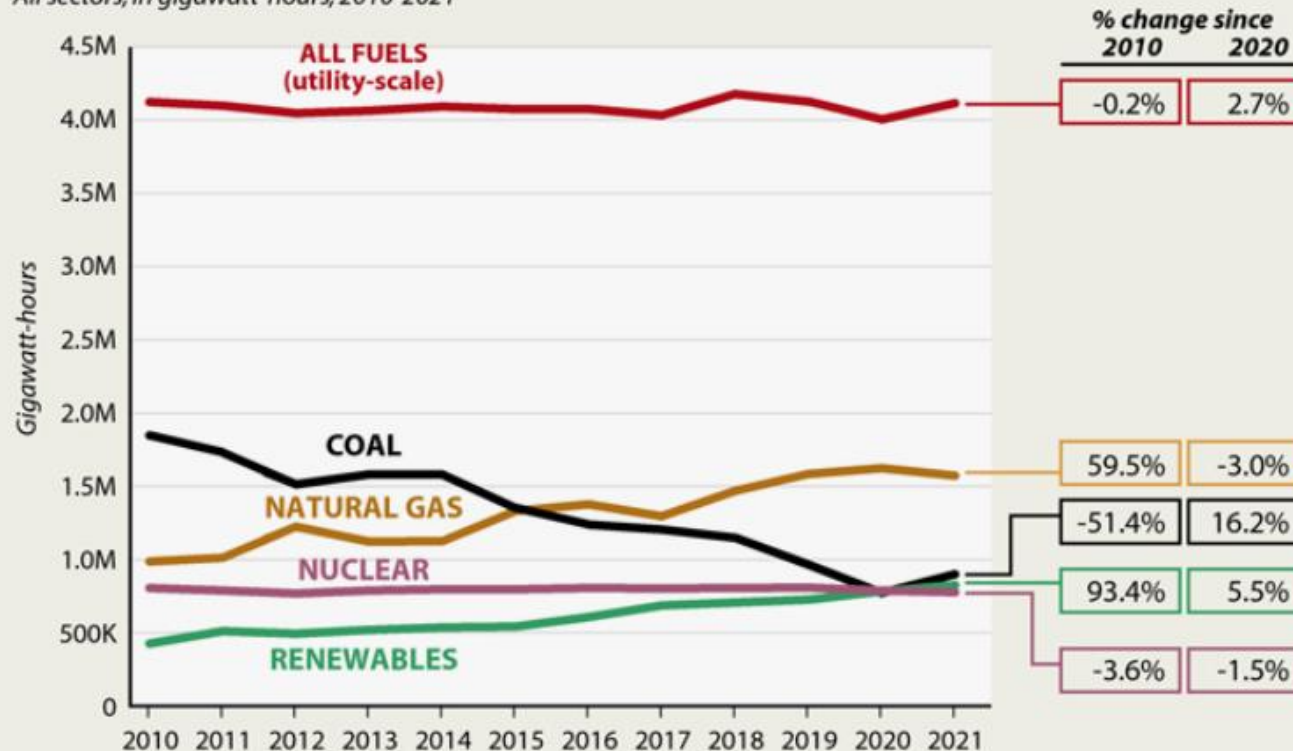
Still a Ways to Go in the US

Renewables, Coal on the Rise

Renewable energy gained ground in 2021, but it was still passed by coal, which had a comeback after a major decline in 2020. Natural gas and nuclear each lost ground.

U.S. NET POWER GENERATION

All sectors, in gigawatt-hours, 2010-2021



NOTE: Renewables includes the EIA categories of "conventional hydroelectric" and "other renewables."

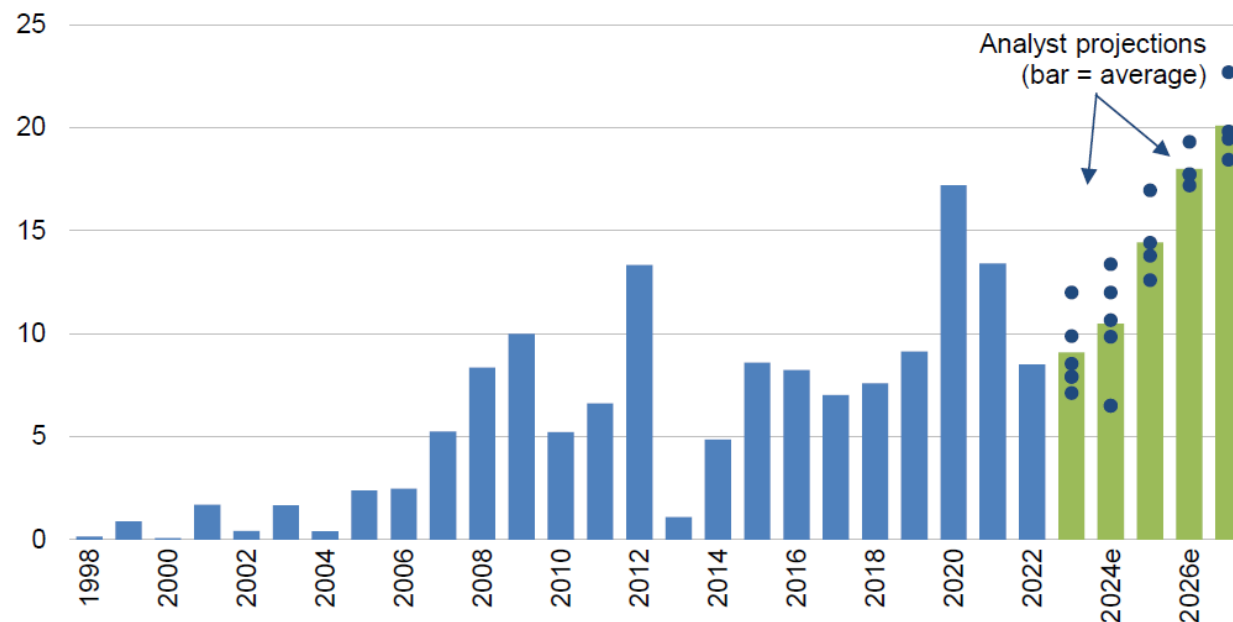
Outlook for Future US Wind Plant Installations



Analysts project growing wind deployment, spurred by incentives in the Inflation Reduction Act (IRA)

- IRA extends PTC at full value for at least ten years for projects that meet wage & apprenticeship requirements
- Two 10% bonuses on top of PTC, for meeting domestic content requirements or for location in energy community
- Additional tax credits for domestic clean energy manufacturing, including for nacelles, blades & towers

Annual Capacity (GW)

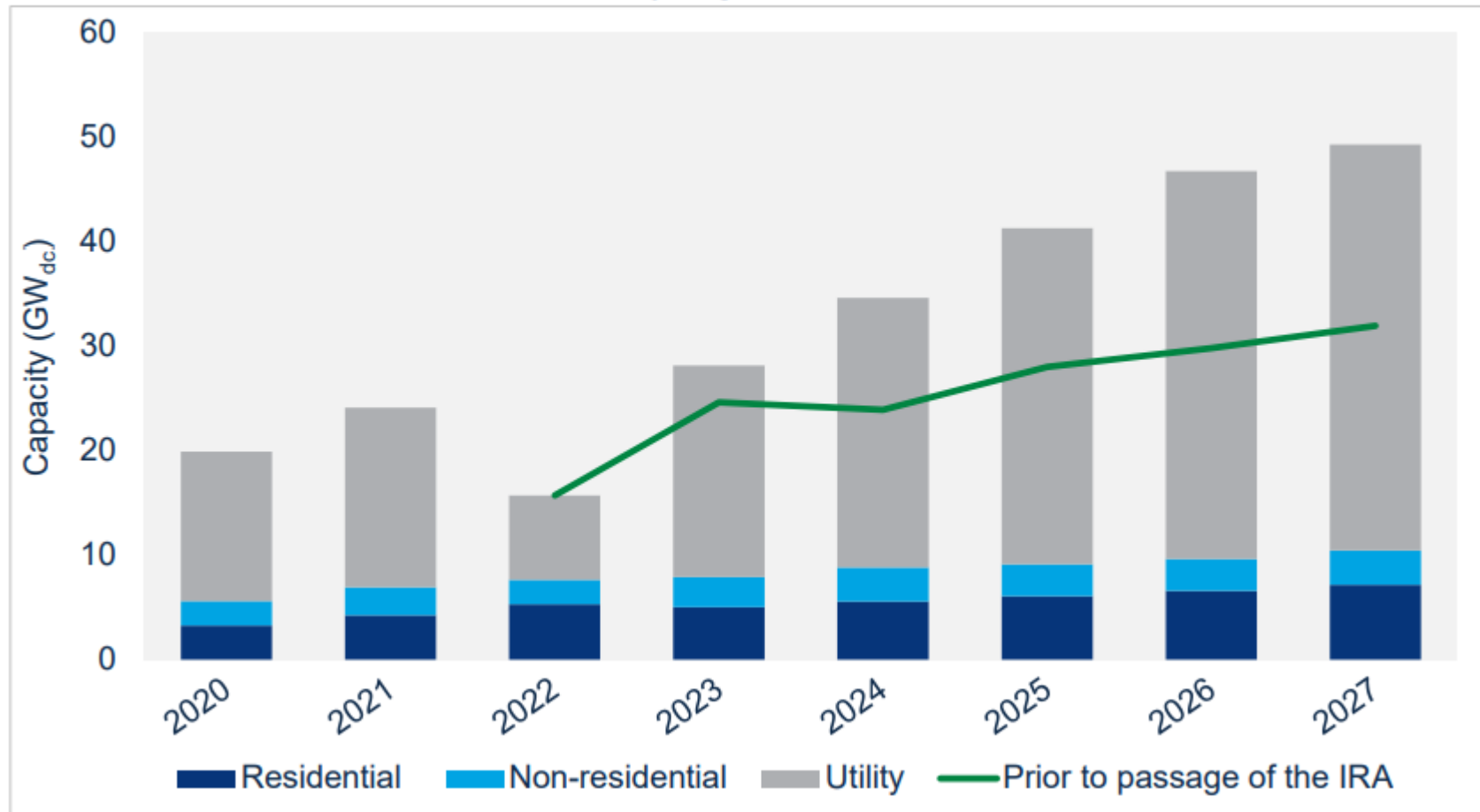


- Has resulted in both higher expectations for future capacity growth and a growing number of announcements for new, expanded, and re-opened manufacturing facilities
- Limited transmission, interconnection costs and timeframes, siting and permitting challenges, inflation and interest rates, and competition from solar may dampen growth

Sources: ACP, independent analyst projections

Outlook for Future US Solar PV Installations

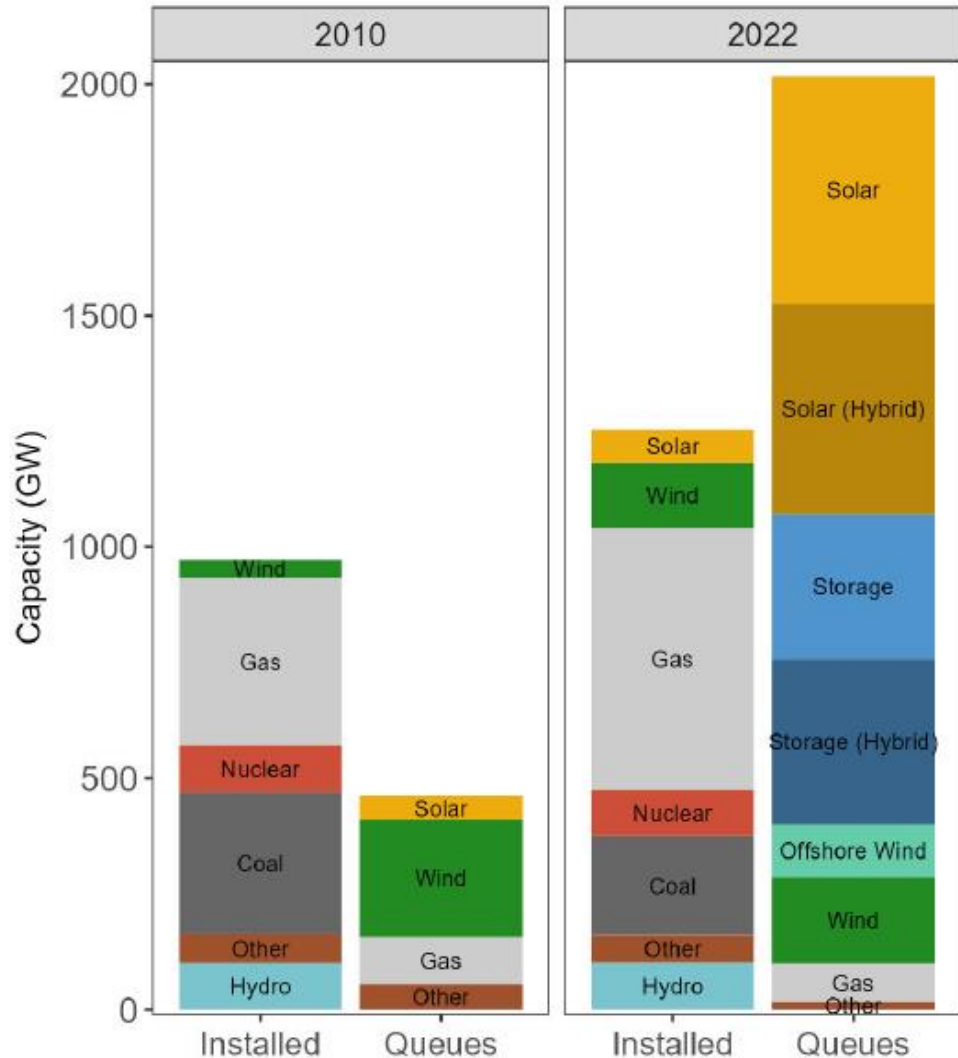
US solar PV installations and forecasts by segment, 2020-2027



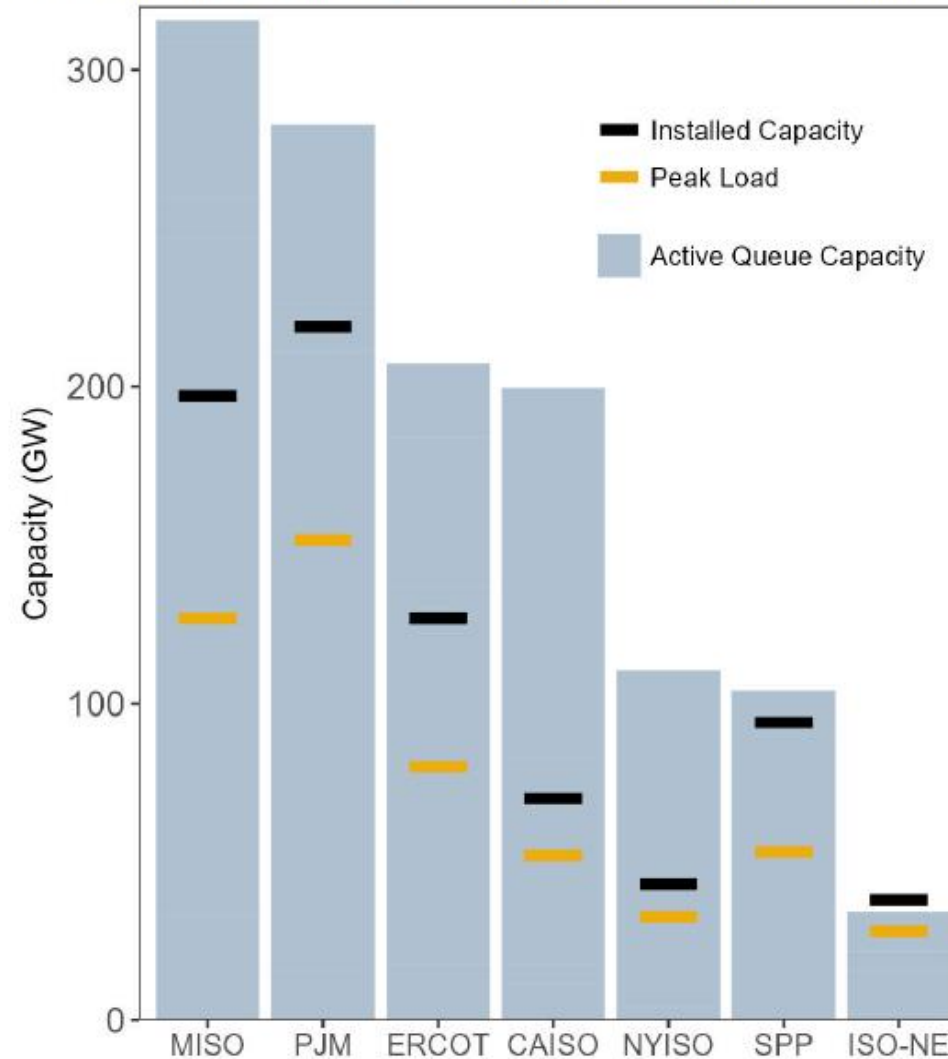
(Source: pv magazine - SEIA/Wood Mackenzie)

Generating Capacity and Queues – Then and Now

Entire U.S. Installed Capacity vs. Active Queues



RTO Installed Capacity & Peak Load vs. Active Queues



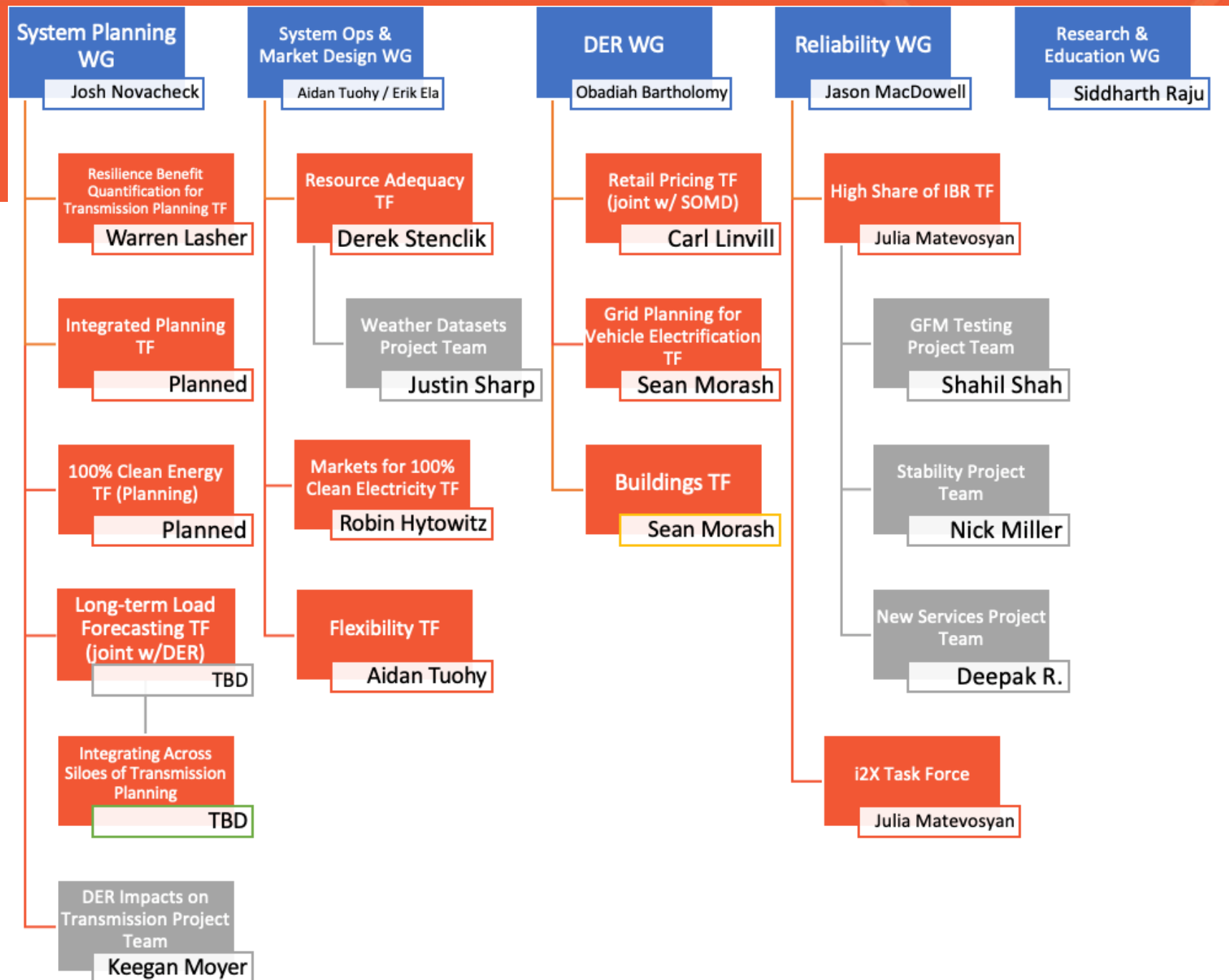
Source: Lawrence Berkeley National Laboratory

A Few Odds and Ends that Caught My Eye



- Tripling VPP capacity by 2030 could save \$10B, meet 20% peak demand; DOE
- 2 Tesla VPPs cleared to provide energy to ERCOT; Utility Dive
- Global energy transition investment must quadruple to \$5T/yr to meet climate targets; Utility Dive
- Hydrogen projects announced:
 - Hydrogen City in Texas – Elon Musk – 60 GW
 - Western Australia's Green Energy Hub – 50 GW
 - SVEVIND Energy and Kazakh Invest National Company – 45 GW - steppes of Kazakhstan
 - Global pipeline over 250 GW of green hydrogen
 - DOE awards \$7B for 7 hydrogen hubs
- EU to hold its first green hydrogen subsidy auction in December 2023; could fetch a “fixed premium” subsidy of up to Euro 4/kg; Hydrogen Insight
- *Reminder: DOE Hydrogen Shot seeks to reduce the cost of green hydrogen from \$5 to \$1 per kilogram (\$8/MMBTU) by 2030, competitive with fossil fuel sources of H2.*

Working Groups and Task Forces Structure



Users Groups Structure



Operations &
Maintenance

Ninotchka Bosworth & Stanton Peterson

Probabilistic Forecasts in
Planning & Operations

Nitika Mago

GETs

Ken Donohoo

Upcoming Meetings – 2024



2024 Spring Technical Workshop and Annual Meeting

March 25 – 28, 2024

Tucson, AZ

2024 Spring O&M User Group Meeting

April 16 – 18, 2024

Orlando, FL

2024 Meteorology and Markets Workshop

June 11 – 13, 2024

Salt Lake City, UT

2024 Fall Technical Workshop

October 21-24, 2024

Providence, Rhode Island

Onward and Upward

- Latest IEEE P&E magazine integration issue published July/Aug 2023
- A warm welcome to visitors from afar:

| | | |
|-----------|--------------|----------------|
| Australia | India | South Africa |
| Belgium | Japan | South Korea |
| Brazil | Kenya | Sweden |
| Canada | Mexico | United Kingdom |
| China | New Zealand | Vietnam |
| Denmark | Norway | Texas |
| Germany | Saudi Arabia | |



- Take the time to make some new friends!
- Looking forward to another great meeting!



THANK YOU

Charlie Smith
Executive Director
Charlie@esig.energy

