PV and Storage, Late Spring 2022

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1. Introduction

So far, so good in limiting each of these papers to a single post. The last paper (described and linked below) in April, was rather long, but I was able to keep it to a reasonable length for a single post.

PV and Storage, Spring, 2022: *The Technology & Business (Section 2) part of this paper updated to latest photovoltaic (PV) cell/module technologies, a possible revival of concentrated solar power from NREL, and possible extension of PV project lifetimes. As usual, the last part of this paper (section 3) covered recent large (100 MW per technology) PV and/or storage projects in the U.S.*

https://energycentral.com/c/cp/pv-and-storage-spring-2022

Section 2 of this post will present a roadmap to decarbonization composed by a major California Utility and others. Section 3 will present major PV and/or storage projects in the U.S. that were announced recently.

2. Technology & Business

Immediately below is the Executive Summary of a document from SDGE and others. I'm including this in my PV and Storage report for several reasons: (1) it has excellent graphics (one of which is the main image for this post), (2) it largely agrees with my views, and (3) even though California Independent System Operator et al runs frequent models of our future, this document presents this in a format that more readable.

2.1. The Path to Net Zero: A Decarbonization Roadmap

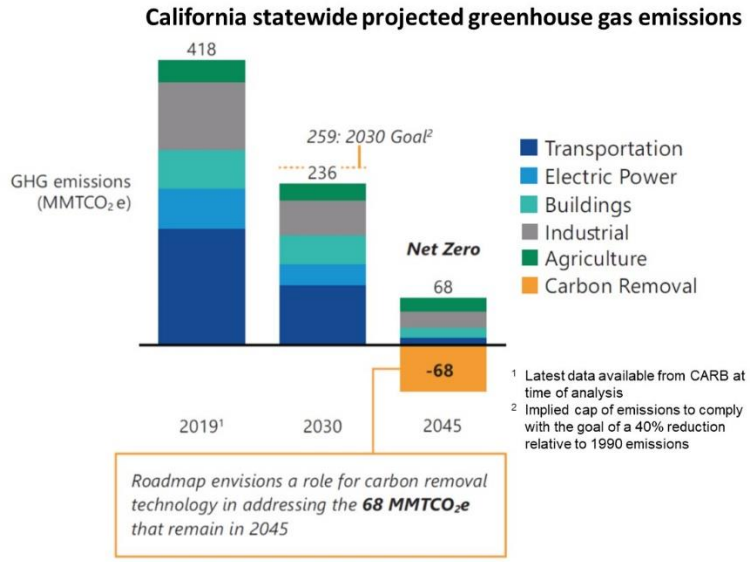
California has set ambitious climate goals by adopting into law Senate Bill (SB) 100, which requires 100% zero-carbon energy by 2045, and is committed to achieving a just and equitable energy transition on its path to carbon neutrality (Net Zero).[1] *The state must undertake a significant transformation and decarbonize at 4.5 times the pace it has over the past decade to achieve carbon neutrality by 2045 and help mitigate the negative impacts of climate change. California already serves as a global sustainability leader. Given its decarbonization experience, innovative spirit and commitment to equity, its carbon neutrality goal presents California with an opportunity to demonstrate how a major economy can decarbonize in a reliable, affordable and equitable way.*[2]

The Path to Net Zero: A Decarbonization Roadmap for California (Roadmap) examines the implications of this transition for the state and the region San Diego Gas & Electric (SDG&E) serves. It also includes SDG&E's recommendation for California to achieve carbon neutrality, and is the first publicly available analysis to use the industry standard

[1] SB 100 requires that 100% of retail sales of electricity in California be served by eligible renewable energy resources and zero-carbon resources by 2045. See https://www.energy.ca.gov/sb100

[2] SDG&E, Boston Consulting Group, Black & Veatch & David G. Victor, "The Path to Net Zero, A Decarbonization Roadmap for California," April 2022, https://www.sdge.com/netzero

for electric reliability and industry modeling software in modeling how to decarbonize California by 2045. See the figure below.



As many other studies have highlighted, electricity is expected to play a central role in decarbonization. But there are also critical roles for other forms of clean energy, including renewable natural gas and hydrogen. While the Roadmap recognizes uncertainties that require new, flexible approaches to technology and policy, it also highlights areas where the priorities are clear. These include the need to expand electrification and supplies of solar and wind power, invest in a diverse set of electric generation resources that will help ensure the electric grid is reliable and lastly, to provide much larger volumes of clean fuels.

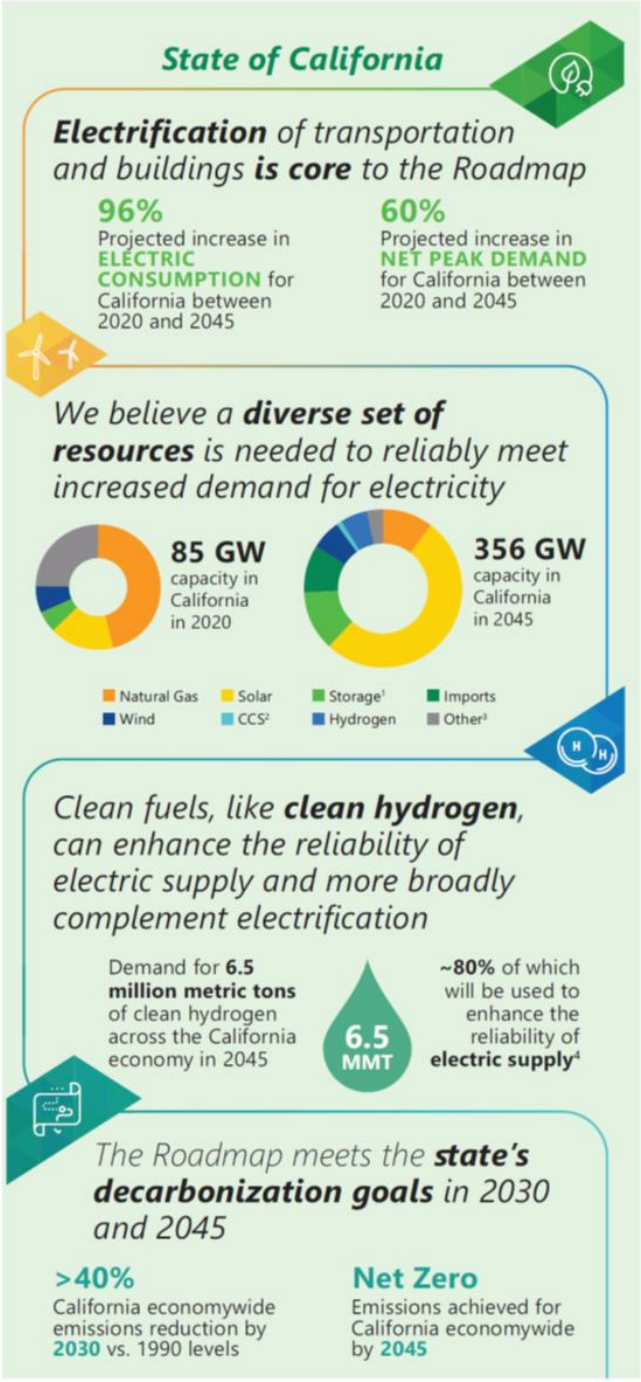
Electrification is central to decarbonizing the transportation and building sectors under the Roadmap. It is estimated that electric generation capacity will need to increase to 356 gigawatts (GW) by 2045 in California to meet this increasing demand for clean electricity, approximately four times the capacity that existed in 2020. The Roadmap foresees in-state solar and wind generation providing the bulk of this capacity.

Wind and solar are excellent resources for providing low-cost clean energy, but to help ensure reliability, the California electric system must also develop more flexible resources, such as energy storage and clean dispatchable generation.[3] This is especially important as the need for clean, reliable electricity increases from transportation and building electrification. We believe this will require installing 40 GW of new battery storage as well as 20 GW of dispatchable generation from 100% clean hydrogen generation by 2045.[4] Moreover, in addition to existing natural gas generation, we believe that 4 GW of electricity from natural gas with carbon capture and sequestration (CCS) will be needed to support reliability as the electric sector

[3] Clean dispatchable generation refers to resources that do not produce greenhouse gas (GHG) emissions and are available any time electricity is needed, in contrast to weather-dependent wind and solar generation. These attributes are necessary to help ensure a clean and reliable electric supply, and SDG&E recommends an inclusive approach as clean dispatchable technologies continue to develop.

[4] 100% clean hydrogen generation is a type of clean dispatchable resource that burns "green" hydrogen fuel produced using only renewable electricity via electrolysis.

decarbonizes. Combined, these flexible resources can provide clean electricity when the sun is not shining and the wind is not blowing and ensure that high electricity demand during the summer months can be reliably met.



Having clean dispatchable resources that can provide carbon-free electricity when needed will be critical to help ensure a clean, reliable electric supply for a decarbonized California. Developing the necessary technology and infrastructure to enable clean dispatchable resources will be a tremendous undertaking. For example, the California electric system currently has no electric generation from 100% clean hydrogen generation.[5]

As electricity consumption increases, additional electric infrastructure will be necessary for California to support decarbonization. This infrastructure will support reliability and allow California to access an estimated 34 GW of imported renewable power by 2045, which should enable the geographic diversification of renewable power and minimize the impact of localized weather events.

Resource diversity is essential to reliable, resilient and affordable decarbonization. The Roadmap calls for critical roles across the economy not only for clean electricity but also for clean fuels. In addition to supporting electric system reliability, clean fuels make it possible to decarbonize emissions from sources that cannot be easily electrified, such as heavy-duty trucks and many industrial processes. The Roadmap also requires the use of carbon removal technologies so that the GHG emissions that remain in 2045 and beyond can be removed and the goal of Net Zero achieved.

[5] See section 2 of "Reasonable Transition," this describes the path that generation currently fueled by natural gas will follow to 100% hydrogen, https://energycentral.com/c/gn/reasonable-transition

This Roadmap aims to provide what we believe is a reasonable and appropriate starting point for implementation and prioritization based on current knowledge, feasibility and market conditions. But the challenges, technologies and solutions associated with decarbonization are constantly evolving. The Roadmap will therefore need to be revisited as uncertainties are narrowed. For example, there are still unknowns about consumers' future adoption rate of electric vehicles (EV) and all-electric household appliances, as well as how the associated increase in electricity usage will impact the electric system. There are also uncertainties about the cost of decarbonization technologies. By pursuing multiple technological options for decarbonization, the Roadmap's diversified approach should provide California with the necessary flexibility to adapt its path to carbon neutrality. Done right, we believe the California clean energy system can be affordable to consumers. Indeed, our modeling projects that economy-wide decarbonization spending as a percent of California gross domestic product (GDP) decreases over time.

2.2. Regulatory & Political Support

Implementing the Roadmap will require regulatory and political support focused on four key considerations:

1. ***Maintaining affordability and enhancing equity.*** *Policymakers and regulators will need to manage cost and equity impacts by changing how electricity and gas are priced, particularly for average and lower-income households who carry a greater burden today. Achieving the state's goals will require contributions from all Californians and the equitable allocation of benefits and costs must be prioritized. Funding sources for state priorities should be reevaluated as well. For example, funding state-mandated public purpose programs from the state's budget instead of electric and gas bills should promote more equitable recovery of program costs. Additionally, the state should perform an immediate evaluation of all GHG reduction programs and policies to determine which deliver the greatest benefits relative to the cost, and then phase out ineffective programs.*

2. ***Prioritizing electric sector reliability.*** *Policymakers, regulators and electricity providers will need to do more long-term planning and develop updated tools to help ensure electric system reliability as the state decarbonizes. This will require a longer planning horizon, early approval of long-lead transmission projects, updated methods for assessing reliability and fair compensation for reliability services.*

3. ***Enabling deployment of decarbonization infrastructure.*** *California residents must adopt the use of significant numbers of electric vehicles and appliances to achieve state goals. Importantly, the electric system must be ready to provide clean and reliable electricity for these new uses. By clearing challenges to approving, siting, permitting and interconnecting necessary decarbonization infrastructure, policymakers and regulators can help pave the way for faster development and mobilization.*

4. ***Incentivizing innovation and adaptability.*** *Near-term investments in innovation are important to lower future costs and improve future performance of new technologies envisioned by the Roadmap, including clean dispatchable electric generation, clean fuels and carbon removal technologies such as direct air capture.*

3. Projects

The major projects (100 MW per technology, PV and/or storage) in the U.S. were identified.

Quinbrook Infrastructure Partners ('Quinbrook") and Primergy Solar ('Primergy"), announced today the final close of a monumental financing deal of $1.9 billion in debt and tax equity financing for the ***Gemini Solar + Storage project****. Gemini is a 690 MWac/966 MWdc solar PV and 380 MW/1,416 MWh battery storage project located in Clark County, Nevada, and is the largest single project of its kind to begin construction in the U.S.*

The Gemini project was developed by Primergy, a wholly owned portfolio company of Quinbrook. Once complete and operational in late 2023, Gemini will deliver renewable energy under a 25-year purchase agreement with NV Energy.

https://finance.yahoo.com/news/quinbrook-primergy-close-us-1-120000040.html?msclkid=473cd3b8c64011ecb57821e1a805edec

Two 100MW battery energy storage system (BESS) projects in Texas have been brought online by independent power producer (IPP) Broad Reach Power, for participation in the Electricity Reliability Council of Texas (ERCOT) market.

Both transmission-level systems are 100MW / 100MWh each, representing over US$100 million of investment. Located on greenfield sites in Texas' Mason County and Williamson County, they have the respective project names of ***North Fork and Bat Cave****.*

https://www.energy-storage.news/texas-broad-reach-power-brings-200mw-of-battery-storage-plants-online/?msclkid=2a06f7aac4b711ec84d2caa53ade55c6

Developer Open Road Renewables has proposed a battery energy storage system (BESS) in Indiana, US, which will total 131MW/524MW of storage, the company's President exclusively told Energy-storage.news.

The company has proposed the four-hour BESS project, called ***Monroe Power****, to adjoin a substation near the small town of Walkerton in Indiana's LaPorte County.*

Monroe Power LLC is the project development entity set up by Open Road Renewables for development of the project. A detailed project description document says the site will take between nine and 18 months to build, with interconnection approval by MISO expected in Spring 2023.

https://ieefa.org/developer-plans-131-megawatt-storage-system-for-indiana-grid/?msclkid=f6dd7c36c4b511ecb34a55f432e27aa1

The proposed ***Palomino Solar Energy Project*** *is a 200 MWAC solar photovoltaic facility located near Lynchburg in Highland County, Ohio.*

This project is being developed by Innergex Renewable Energy.

The study area is close to 3,000 acres, however the project would occupy closer to 1,400 acres. It will consist of ground-mounted solar panels to deliver electricity to the PJM regional power grid where corporate demand for solar energy is expected to increase by a factor of 14 by 2040.

The application for a Certificate of Environmental Compatibility and Public Need with the Ohio Power Siting Board ("OPSB") was filed in Q1 2022. As part of the permitting process, Public Information Meetings were held in March and June 2021 where we collected feedback from the community. Project construction is expected to start in the second half of 2023. Following a 12-14 month construction period, project commercial operations would commence by the end of 2024.

https://www.innergex.com/wp-content/uploads/2022/03/PALOMINO_HANDOUTS.pdf

Flint Grid, LLC (Flint Grid or Applicant) is proposing to construct the ***Flint Grid Energy Storage System****. (the Project). The Facility will be located on approximately 15 acres of private land along the south side of Jug Street Road in Jersey Township, Licking County, Ohio (Project Area). The proposed Facility is an up to 200 MW, 800 megawatt-hour (MWh), battery energy storage system.*

Final design will be completed prior to construction, as early as the fourth quarter of 2022. Construction is anticipated to begin shortly thereafter and be completed by the second quarter of 2024, at which point the Facility will be placed in service.

Flint Grid, LLC is an operating company of Able Grid Energy Solutions that was organized to own, plan, develop, sell, lease, and otherwise manage energy storage or renewable energy generation and transmission in Ohio. Able Grid, founded in 2017, develops, constructs, and operates battery energy storage systems from beginning to end.

Eolian, a portfolio company of Global Infrastructure Partners (GIP), in December, 2021 announced the acquisition of all remaining outstanding interests in joint venture development portfolios of energy storage projects managed by Able Grid Energy Solutions.

https://dis.puc.state.oh.us/ViewImage.aspx?CMID=A1001001A21L23B13314G00473

https://opsb.ohio.gov/cases/21-1061-el-bgn#:~:text=Flint%20Grid%20proposes%20to%20construct%20a%20200%20megawatt,Township%2C%20Licking%20County%20Ohio%20on%20approximately%2014.89%20acres.

https://ablegridenergy.com/

Note that the first two links above are alternatives.

The Tesla Megapack battery energy storage system at Moss Landing became fully energized and certified for market participation recently bringing 182.5-megawatts of stored energy capacity to the California power grid.

Pacific Gas and Electric Co. announced on Monday that ***Elkhorn Battery****, named for its location at its Moss Landing electric substation in Monterey County near Elkhorn Slough, has been commissioned after final testing. The battery energy storage system was energized and certified by the California Independent System Operator on April 7.*

The battery energy storage system has the capacity to store and dispatch up to 730 megawatt-hours of energy to the electrical grid at a maximum rate of 182.5 MW for up to four hours during periods of high demand.

https://www.msn.com/en-us/news/technology/tesla%20megapack%20battery%20energy%20storage%20system%20goes%20online%20in%20moss%20landing/ar-AAWlocu?msclkid=15fa121bc19911ec9425c6dc7973eabf

Cattlemen Solar Park *is a proposed 240 MW solar project located in the northeast corner of Milam County, Texas, approximately 70 miles northeast of Austin. Cattlemen II Solar Park is a proposed 150 MW solar project located approximately one half mile from the original Cattlemen I Solar Park site. The project areas would be located west of Baileyville, along FM 2027, and consist primarily of pastureland. The projects would be sited entirely on private land that would be leased from landowners who recognize the benefits of hosting a solar project. Lease payments would serve as a stable, weather-resistant cash crop that complements the area's agricultural economy. Cattlemen Solar could commence construction in 2022, which would enable full operations to be achieved in 2023. Cattlemen Solar II could commence construction in 2023, which would enable full operations to be achieved in 2024.*

https://www.edpr.com/north-america/cattlemen-solar-park?msclkid=46bb7efdcf2311ecbf1566d6704092f2

SOLV Energy has been contracted to provide EPC services for Doral Renewables' Mammoth North project, the first phase in a three-part, 1.3-GWAC solar development in Northwestern Indiana. The ***Mammoth North solar farm*** *specifically is expected to have a generation capacity of approximately 400 MWAC of energy, enough to power approximately 75,000 Midwestern households annually…*

Mammoth North has a power purchase agreement signed with AEP Energy Partners, a subsidiary of American Electric Power (AEP), one of the largest electric energy wholesale and retail suppliers in the U.S. The project is expected to begin operations in 2023.

https://www.solarpowerworldonline.com/2022/05/solv-energy-constructing-1st-phase-of-solar-project/

Consumers Energy today announced agreements to add 300 megawatts of clean energy – enough to power about 150,000 homes -- from two Michigan solar projects being developed in Genesee and Hillsdale counties.

Consumers Energy would purchase power from ***Confluence Solar*** *in Genesee County and* ***Heartwood Solar*** *in Hillsdale County. The agreements are being reviewed by the Michigan Public Service Commission.*

The new solar projects are each 150 megawatts and scheduled to begin operating by year-end 2024. Ranger Power will own and operate the sites.

https://finance.yahoo.com/news/consumers-energy-building-brighter-energy-100000392.html