

HELGA Analysis of the Jacobson Plan for California

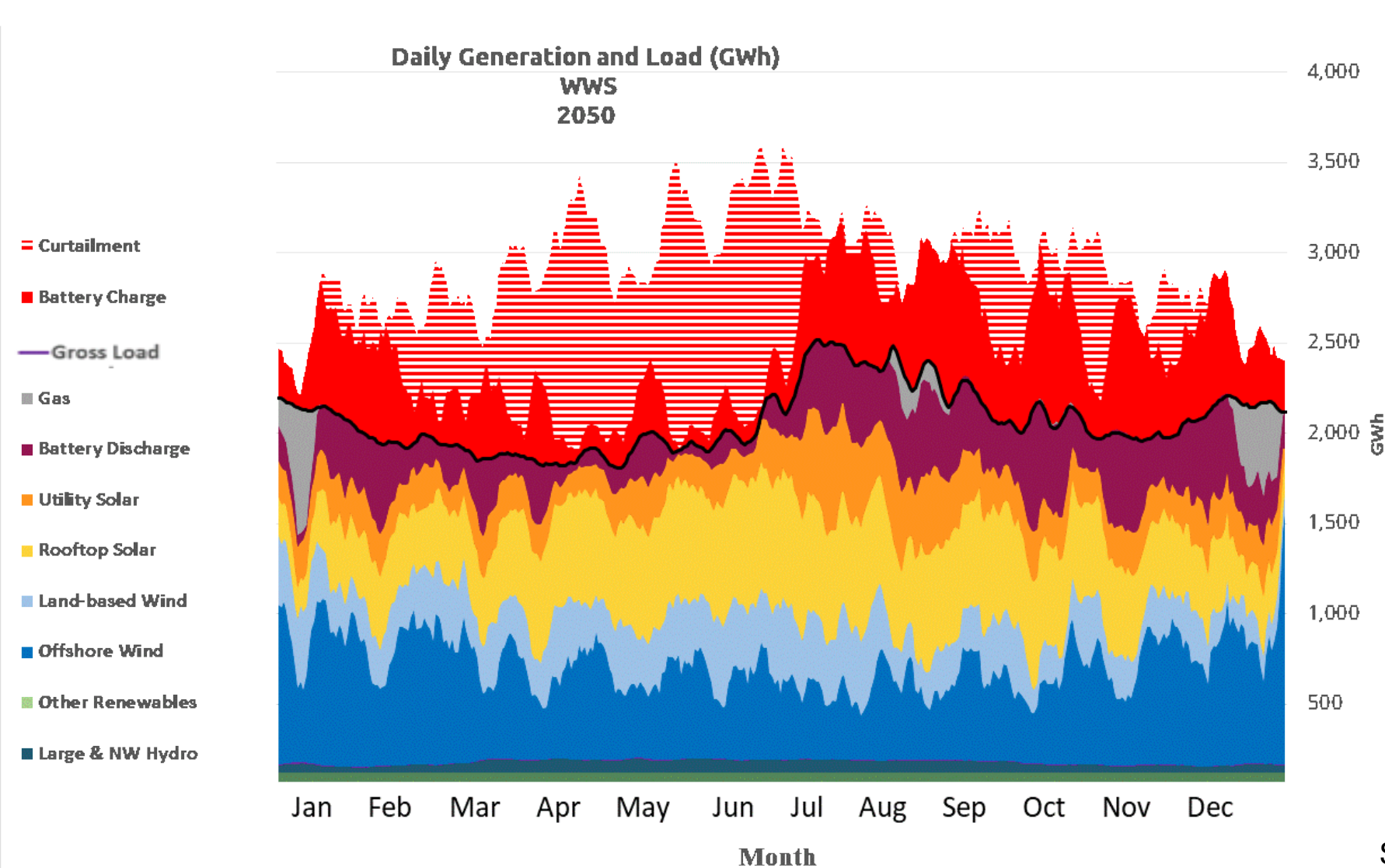
Prepared by Leonard Rodberg, PhD (lrodberg@gmail.com)

Mark Jacobson of Stanford University and his colleagues have attempted to [show](#) that electric grids powered only by solar, wind, and hydropower – what they call WWS, or wind, water, and sun – can provide all the energy we need in a completely electrified economy. Ten years ago, a number of analysts provided a comprehensive critique of this claim in the [Proceedings of the National Academy of Science](#). [Others](#) have provided solid critiques. A new tool, the to as the Hourly ELeetric Grid Analysis of HELGA model provides a straightforward vehicle for testing this claim. It performs an hour-by-hour analysis of the supply and demand of electricity for a defined area, and we have applied it to the Jacobson scenario.

We entered the source capacities in Jacobson's WWS [scenario](#) for California into HELGA and used the weather pattern for 2023 to evaluate the hourly contributions of solar and wind power. We set the average electric demand at 88.2 GW (this is how Jacobson et al describe the load in 2050 when all energy uses are electrified).

We found that at least 80 GW of gas generation has to be available to avoid repeated blackouts. The daily graph for the year 2050 shows several periods throughout the year when the renewables fail to meet the load. In fact, as the table shows, there are 52 days significant amounts of gas have to be burned to avoid system failure.

California's Grid According to Mark Jacobson



Generation and Cost Summary		WWS	Year 2050	
	Capacity (MW)	Generation (GWh/yr)	Capacity Factor (%)	% Total Load
Non-dispatchable*				
Existing Nuclear	-	-	0.0%	0.0%
New Nuclear	0	0	0.0%	0.0%
Large & NW Hydro	11,300	20,118	20.3%	2.6%
Other Renewables	6,000	14,622	27.8%	1.9%
Rooftop Solar	91,600	183,160	22.8%	23.6%
Utility Solar	125,000	178,568	16.3%	23.0%
Land-based Wind	44,300	124,105	32.0%	16.0%
Offshore Wind	64,420	233,699	41.4%	30.1%
Total	342,620	754,271	25.1%	97.1%

Dispatchable				
	Capacity (MW)	Generation (GWh/yr)	Capacity Factor (%)	% Total Load
Battery Discharge	507,000	111,131	2.5%	14.3%
Flex Nuclear	0	0	0.0%	0.0%
Gas	80,000	20,609	2.9%	2.7%
Hydrogen Turbine	0	0	0.0%	0.0%
Gas CT	0	0	0.0%	0.0%
Steam Plants	0	0	0.0%	0.0%
Total	587,000	20,609	0.4%	2.7%

Total In-State Generation				
	Capacity (MW)	Generation (GWh/yr)	Capacity Factor (%)	% Total Load
Total	929,620	774,880	9.5%	99.8%

Regional Purchases		Generation (GWh/yr)	% Total Load
Imports		1,525	0.2%

Total Load (GWh/yr)		776,405
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* Battery charging included in solar and wind generation.

Days Gas Burned	52
Days Batteries Discharged	337
Days Batteries Not Fully Charged	181

Source: HELGA 9/25/2025