California Local Solar Roadmap:

Why Sustainable Growth in Local Solar Can Save California Ratepayers Over $120 Billion

Summary Results
July 2021

Expert Panel Available to Answer Your Questions

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Conventional Thinking

- Large central power plants are the most cost-effective option for California's energy future because of economies of scale
- Utility scale is cheapest, fastest way to meet California's clean energy goals
- Local solar + storage is too expensive and isn't fair and beneficial to all Californians

Paradigm Shift

- New and better models challenge conventional thinking
- Local solar and storage is *more* cost effective, not less
- Scaling local solar and storage in addition to utility scale renewables leads to greater ratepayer savings
- California was right to invest in distributed energy, should stay the course and expand

What Did We Do?

Using the most advanced modeling in the world, we asked ourselves the question:

If California sustains market growth for rooftop solar and enables a market for distributed storage and community solar, do the financial and other benefits outweigh costs?

What Did We Find?

If California grows local solar to 65 GW by 2050 and pairs it with distributed storage, all California ratepayers….

Save **$120 billion** over an all-utility scale future

Grow distributed storage by over **60 GW**

Avoid more **carbon dioxide** emissions

Create over **374,000** more jobs

WIS:dom®-P: Total System Planning Tool

- **WIS:dom-P is a state-of-the-art, fully combined capacity expansion and production cost model**, developed to process vast volumes of data. It was developed by Dr. Christopher Clack and his team at Vibrant Clean Energy. For more information visit: https://www.vibrantcleanenergy.com/.

- **It simultaneously co-optimizes for: (1) Capacity expansion requirements (generation, storage, transmission, and demand-side resources); and (2) Dispatch requirements (production costs, power flow, reserves, ramping and reliability).**

- **WIS:dom-P is a total system planning tool** that provides:

1. **MORE & BETTER DATA PROCESSING**

2. **TOTAL SYSTEM PLANNING COORDINATION**

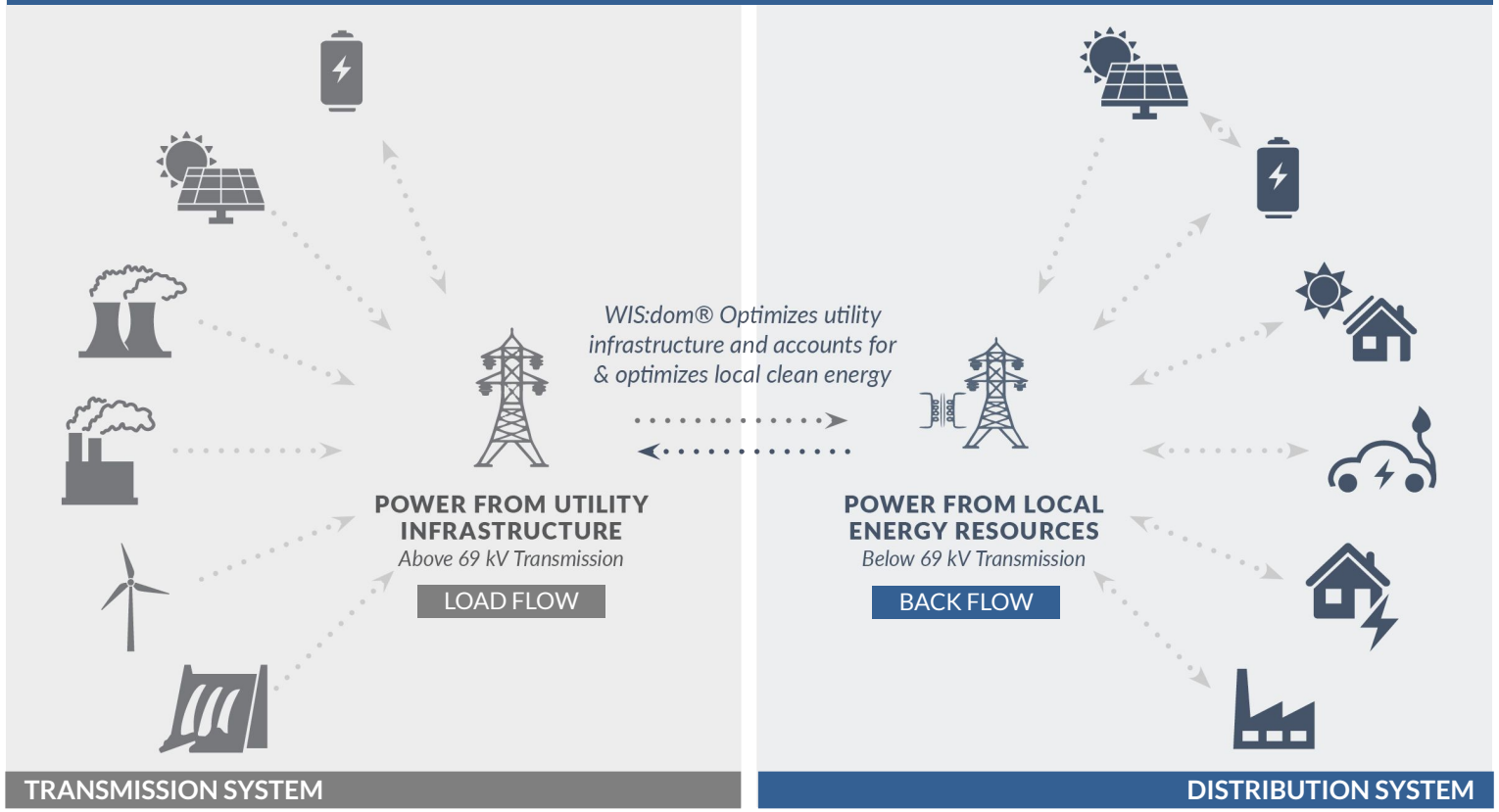
3. **LOCAL CLEAN ENERGY INTEGRATION & OPTIMIZATION**

- **Effectively a more detailed utility cost model**. WIS:dom-P approaches utility system planning just as legacy models have done for decades but the new power of high resolution, big data, and assessment of local solar and storage benefits reveals new insights into system solutions.

What Is Integrating and Optimizing DER?

- WIS:dom-P co-optimizes and coordinates the utility-scale electricity grid (left) with the distribution grid (right) to find the overall least system cost.
- **Co-optimize and coordinate means** it considers distribution infrastructure requirements and determines when leveraging local solar + storage to serve local load and/or reduce peak load, could lessen the need for some distribution infrastructure and forego additional utility-scale generation and transmission buildout.
- When you optimize and integrate resources on both sides of the grid, you shift the paradigm and all kinds of savings and benefits become possible.

WIS:dom optimizes utility infrastructure (left) and integrates all resource options including local energy produced on the distribution grid (right)



What Did We Ask the Model to Measure?

Utility Scale Only

100% CLEAN BY 2050
+
ECONOMY-WIDE ELECTRIFICATION
+
OUTDATED MODEL
+
NO LOCAL SOLAR

Model assumes zero additional growth of local solar and storage and only considers and weighs cost impacts from a central transmission-level grid perspective. Changes to, and upgrade costs for, the distribution infrastructure are not considered, they are merely additional costs computed after a solution is found.

Local Solar + Storage Future

100% CLEAN BY 2050
+
ECONOMY-WIDE ELECTRIFICATION
+
NEW MODEL
+
LOCAL SOLAR + STORAGE FUTURE

The model considers distribution infrastructure requirements and determines that leveraging local solar + storage deployment to serve local load and/or reduce peak load, could lessen the need for some of the distribution infrastructure as well as forgoing additional utility-scale generation and transmission buildout.

What Is Local Solar and Why Model Sustainable Growth?

- **LOCAL SOLAR + STORAGE** are distributed solar generation and storage technologies that provide electric services to the grid. Technologies include rooftop and community solar and distributed battery storage.

- **BENEFITS OF LOCAL SOLAR INCLUDE** direct and indirect benefits such as reduced grid costs (as demonstrated in this report), lower energy bills, local job creation and economic impact, a more just and equitable electric grid, increased grid resiliency, and more innovation due to competition.

- **WHY DID WE SET TARGETS?** We know the indirect benefits of local solar are massive, but utilities claim it shifts costs to other customers. We wanted to know if this was true when you use new models that examine the total systems costs and benefits of these resources.

ROOFTOP SOLAR

Drawing on CEC modeling to meet state's climate goals.

YEAR	MEGAWATTS PER YEAR
2022-2026	1,150
2026-2029	1,072
2030-2050	1,000

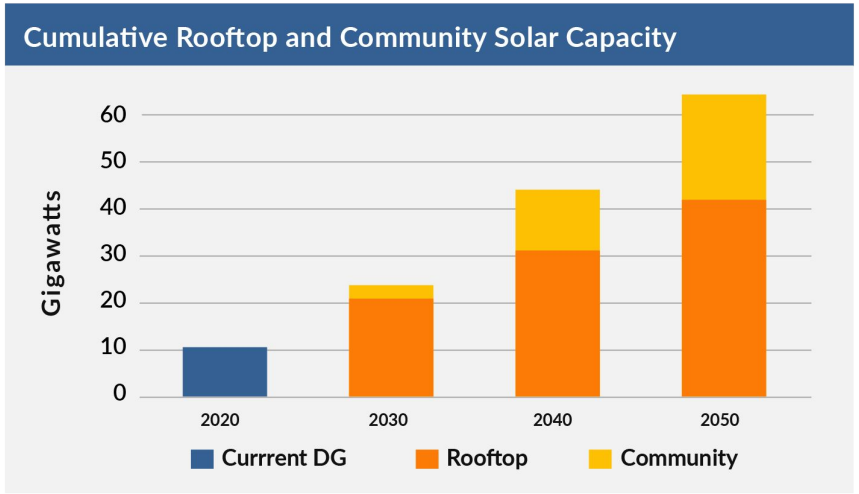
COMMUNITY SOLAR

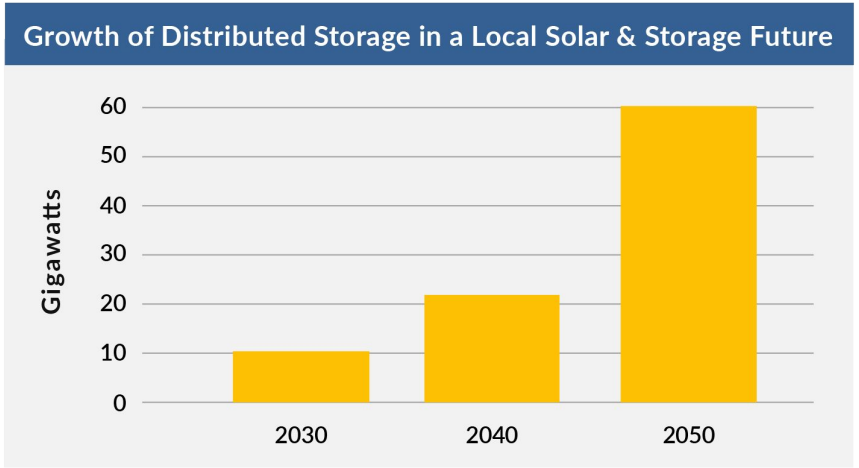
Modeled to balance DG capacity to ensure local solar access for all Californians.

YEAR	MEGAWATTS PER YEAR
2024-2025	250
2027-2030	500
2031-2050	1,000

Local Solar + Storage Capacity Key Takeaways

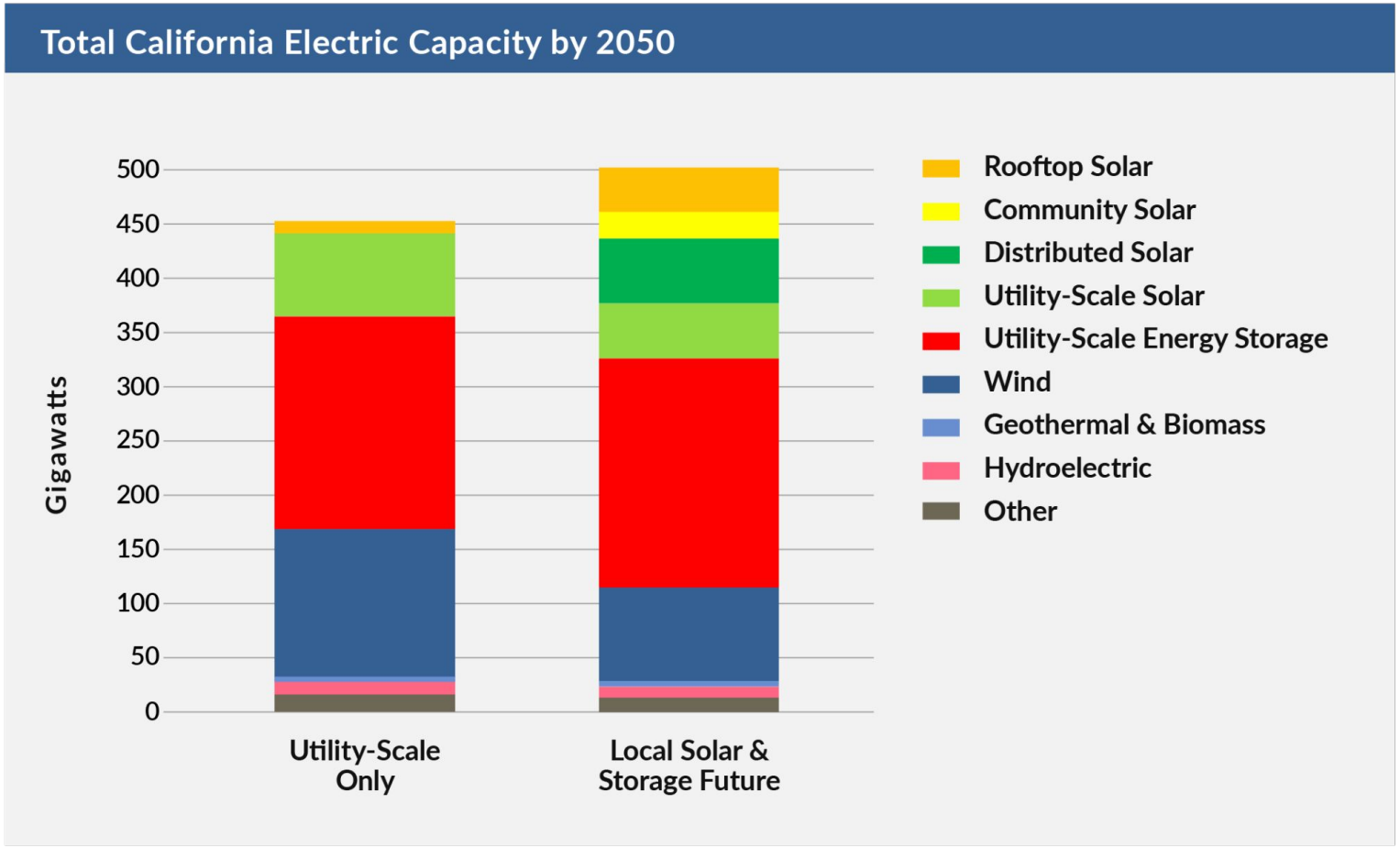
- The model was asked to create sustainable growth of local solar (over 65 GW of community and behind-the-meter solar by 2050)
- As a result the model deployed 60 GW of distributed storage
- Together the build out of local solar + storage enabled future savings, optimized local resources, and supported deployment of large scale renewables to meet future goals.





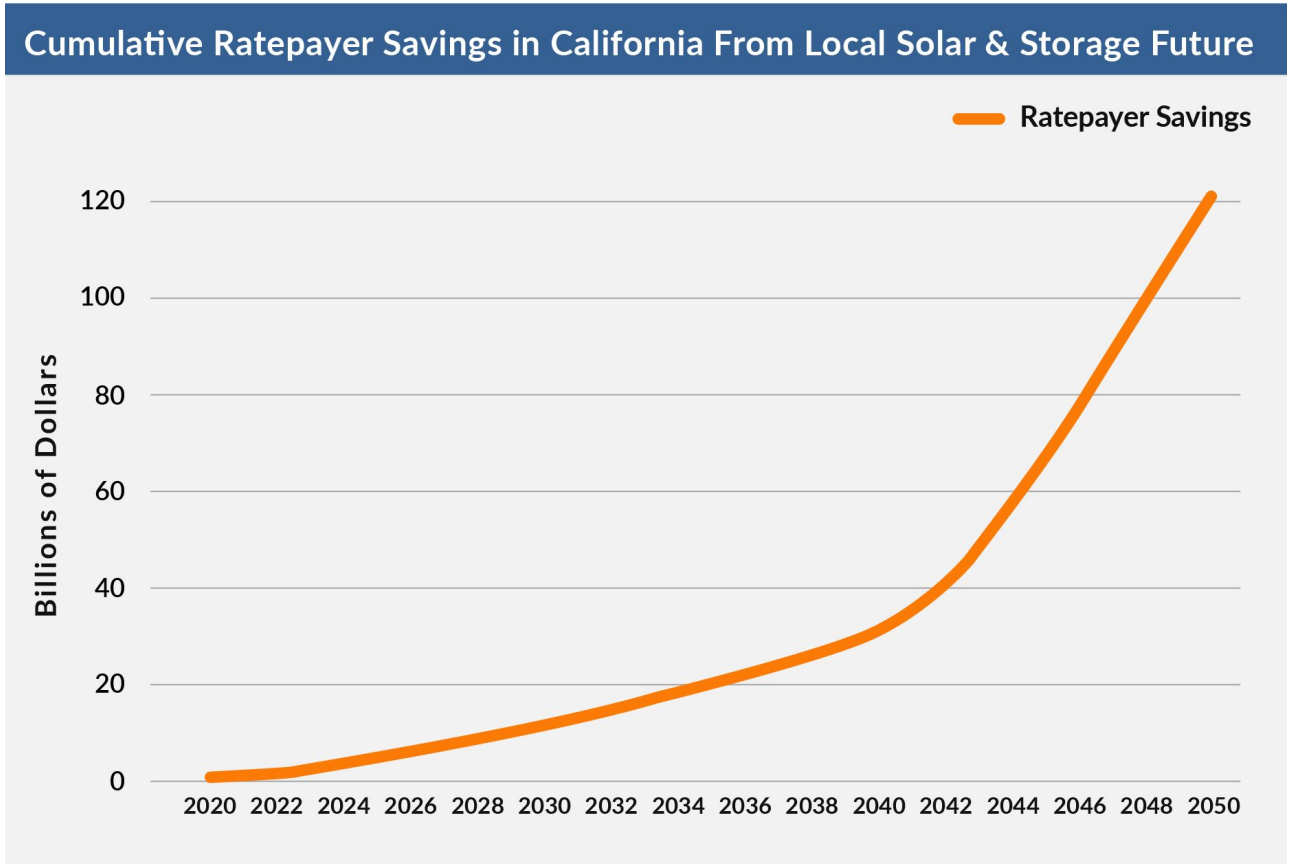
Total Capacity by 2050

- In addition to local solar + storage playing a major role, utility-scale solar and wind account for over 70% of capacity and generation needs. That's because when you retire firming capacity and peaker plants & have better control over demand, it allows the grid to focus on deploying the cheapest electrons, regardless of when or where power is produced.



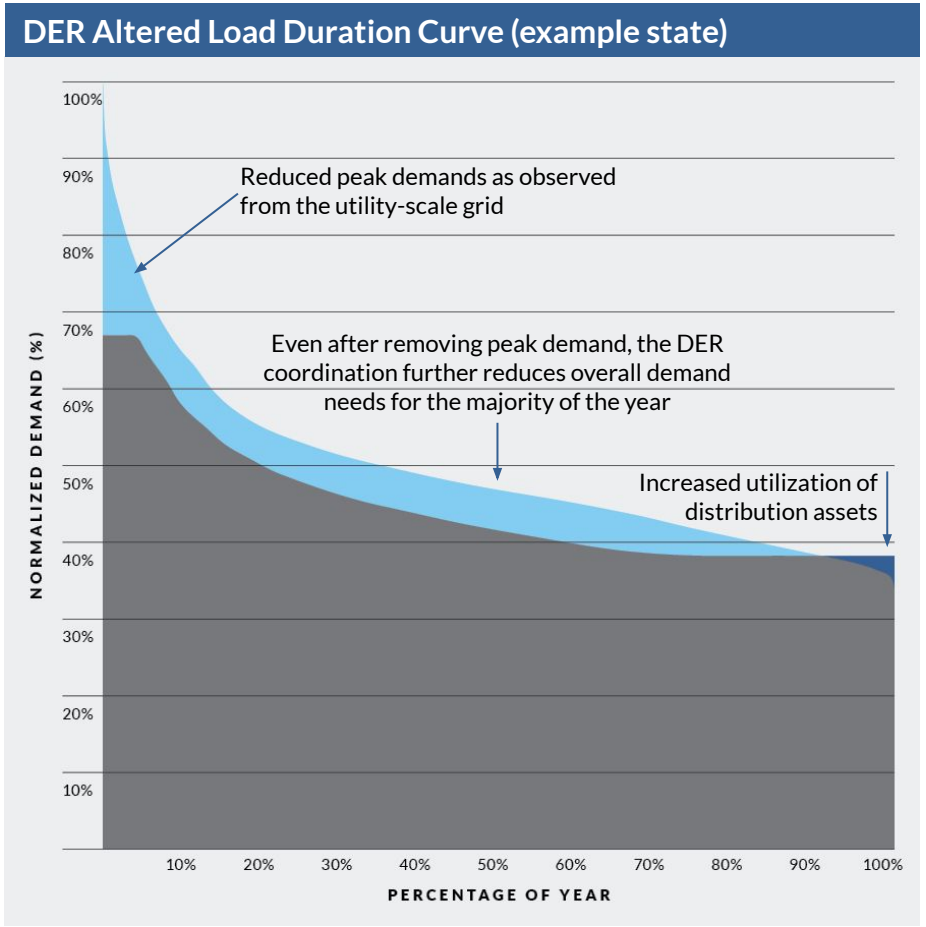
Sustainable Growth in Rooftop and Community Solar + Storage Saves CA Ratepayers $120.1 BN

- Initial investments in utility-scale and distribution level grid infrastructure and capacity drive huge long-term savings relative to traditional electricity grid system planning.
- When the system adds and optimizes local solar + storage, cumulative savings of over $120.1B are possible.
- The savings captured in this chart include only monetary grid costs and benefits, it doesn't include indirect societal benefits.
- This demonstrates that a clean electric grid that leverages expanded local solar + storage is less expensive than a grid with only utility scale generation.



Why Did WIS:dom Find Cost Savings?

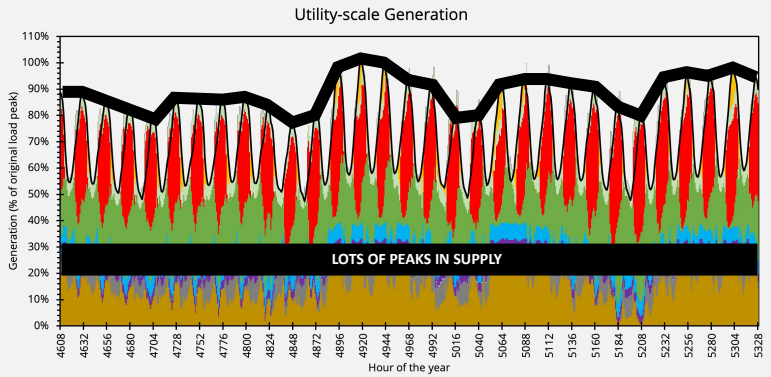
- Modeling that ENABLES COMMUNICATION between both sides of the grid (transmission & distribution) with WIS:dom demonstrates an ability for local solar and storage to reshape load, as observed from the utility-scale grid (i.e., above 69 kV).
  - One consequence of this co-optimizing and coordinating utility-scale with distributed-scale is the reduction of volatility in the demand as observed by the utility-scale grid.
  - A second consequence is a dramatic drop in the peak demand requirements as observed by the utility-scale grid — *~16% reduction in peak by 2050 attributed to local solar + storage in national modeling.*
- The result is that more local solar + storage reduces net demand and smooths overall demand to enable access to lowest cost utility-scale generation – more utility wind and solar and less fossil firming capacity.
- By permanently easing stress on system during critical peak hours and & reducing how much bulk-scale power is needed to serve the distribution grid, you don't have to overbuild the system with expensive peaker plants and firming capacity.

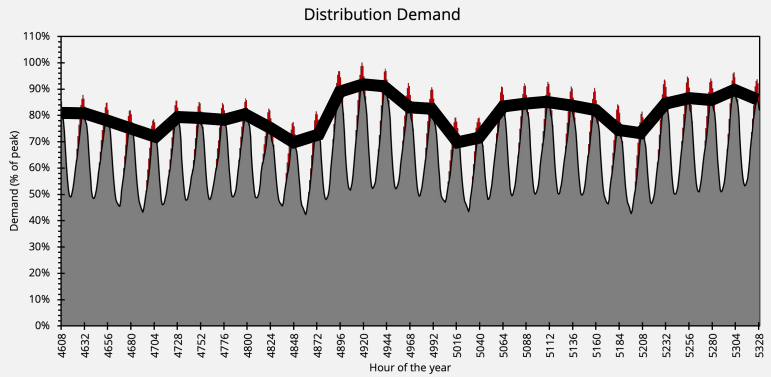


Eases Stress On The Bulk Power System

UTILITY-SCALE GENERATION ⟷ **DISTRIBUTION DEMAND**

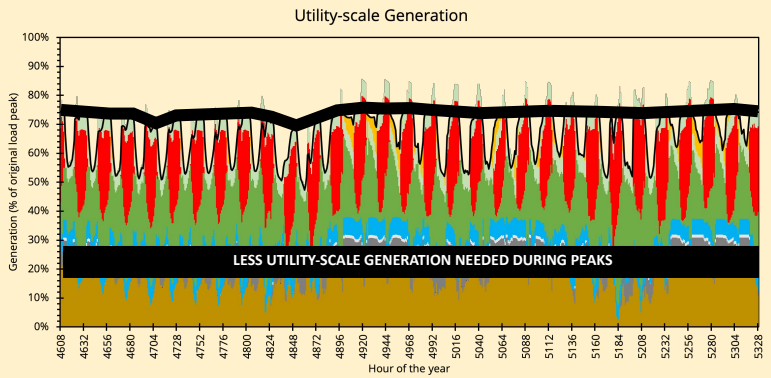
Utility-Scale Only
(summer month in sample state)

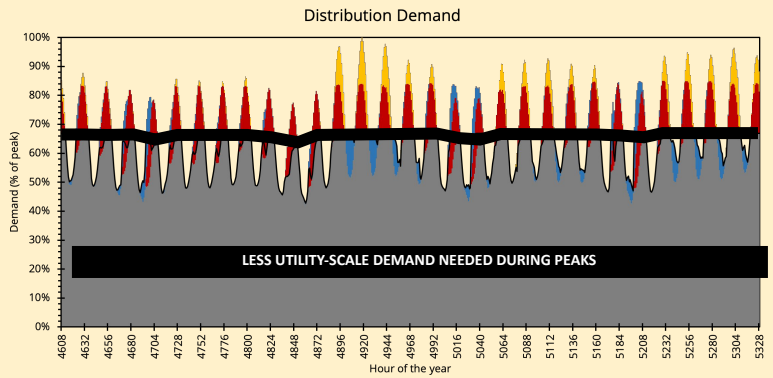




- Demand is sharp and spikey and supply ramps up and down to meet peaks
- More firming capacity and peaker plants are required to meet demand at times of the day when customers are using the most electricity
- Distributed solar + storage have minimal impacts on “shaping load” and meeting system needs

Local Solar & Storage
(summer month in sample state)

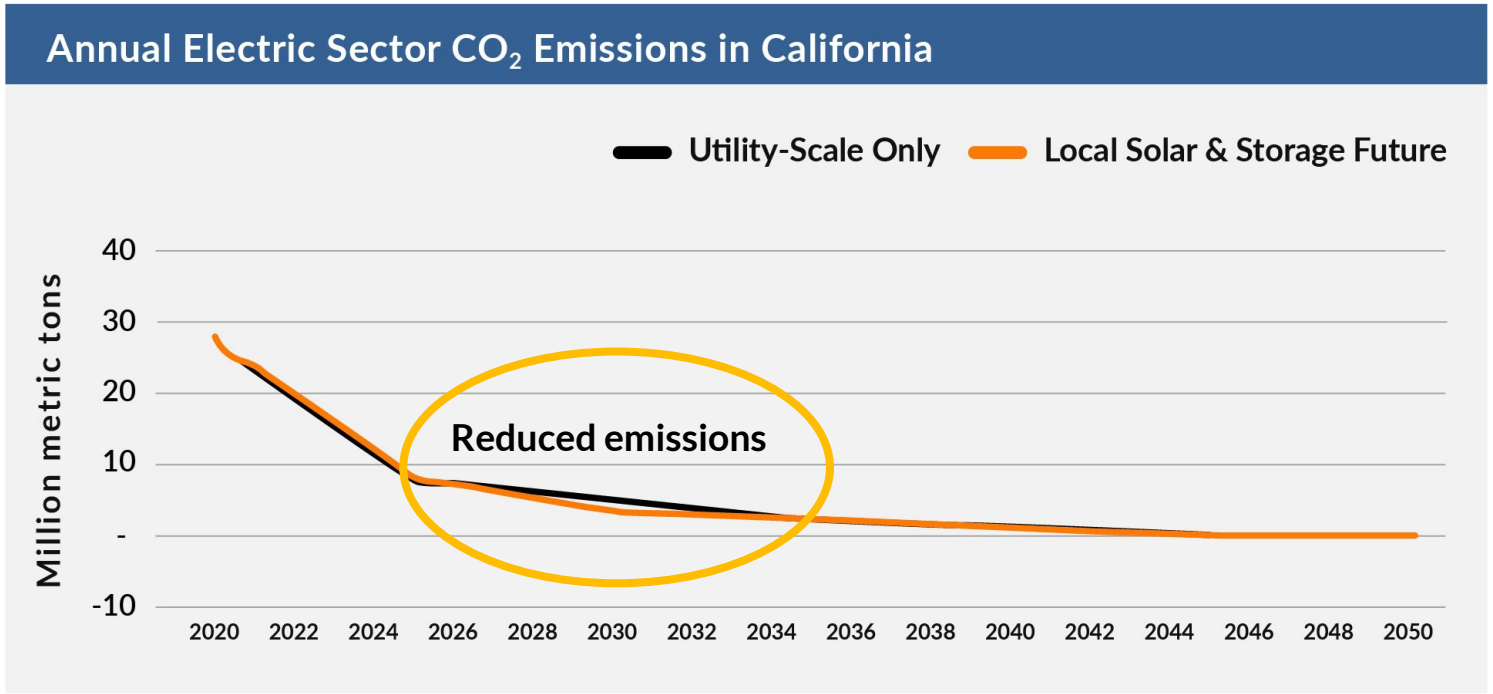




- Demand is smooth because local solar + storage can be deployed at peak times and reshapes load from the perspective of the utility grid (above 69kV)
- Permanently eases stress on system during critical peak hours & reduces how much bulk-scale power is needed to serve the distribution grid
- Less bulk power = less money on expensive peaker plants and firming capacity thus overbuilding the system

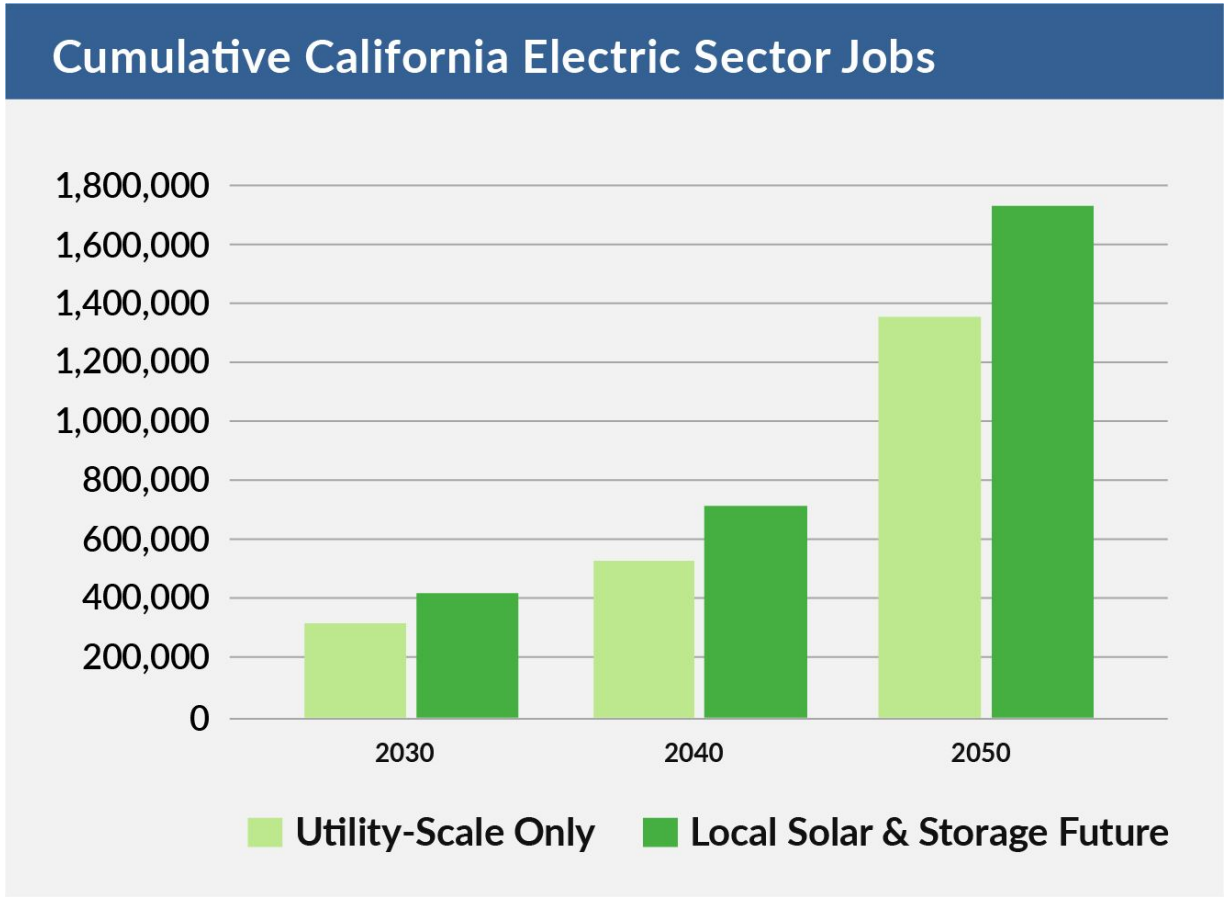
Sustained Investment in Local Solar Reduces Overall Carbon Dioxide Emissions

- Compared to the base case, investing in local solar + storage early can save over 4.1 mmT of carbon dioxide emissions.
- Because local solar shapes load and reduces how much fossil fuel power is needed to serve the distribution grid, it leads to greater, and more immediate, emissions reductions.



Deploying More Local Solar Creates over 374,000 More Jobs by 2050

- Integrating, optimizing, and growing local solar + storage results in a total net increase in family-supporting jobs including over 100,000 more jobs by 2030 and over 374,000 more jobs by 2050.
  - This includes direct and indirect jobs but does not include induced jobs (e.g. the ripple effect of direct economic impacts).
  - Every county in California sees job growth in the Local Solar & Storage Future
- Local solar creates more jobs on a per MW basis compared to utility-scale electricity generation.
  - This is largely a result of more construction and operations jobs that result from distributed energy facilities.
  - Nationally, DPV has an average job/MW-ac ratio of 8.3 compared to UPV's job/MW-ac ratio of 3.3*.



*Based on WIS:dom modeling assumptions. Actual modeled ratios are state-specific and are tied to basic assumptions from NREL's JEDI and the IMPLAN modeling tools, adjusted further by actual jobs numbers provided in the Solar Foundation's annual solar jobs report.

Total Jobs by County in California

COUNTY	2030	2050
Alameda	3,540	39,151
Alpine	3	274
Amador	259	601
Butte	2,239	4,500
Calaveras	336	748
Colusa	53	6,248
Contra Costa	2,874	12,958
Del Norte	953	1,201
El Dorado	1034	2,728
Fresno	9,976	19,210
Glenn	60	6,802
Humboldt	255	7,583
Imperial	6,463	161,657
Inyo	2,018	60,344
Kern	64,521	137,643

COUNTY	2030	2050
Kings	1,992	3,348
Lake	143	1,760
Lassen	116	1,912
Los Angeles	57,906	260,662
Madera	709	2,142
Marin	523	3,057
Mariposa	124	1,561
Mendocino	1,111	5,992
Merced	3,128	5,766
Modoc	18	3,762
Mono	833	15,179
Monterey	11,213	20,513
Napa	305	1,612
Nevada	298	7,673
Orange	6,554	35,501

COUNTY	2030	2050
Placer	1,250	4,715
Plumas	516	2,393
Riverside	11,965	149,648
Sacramento	2,734	7,525
San Benito	3,831	4,373
San Bernardino	79,150	290,449
San Diego	8,159	59,688
San Francisco	1,531	9,368
San Joaquin	1,647	8,260
San Luis Obispo	8,882	90,826
San Mateo	1,908	8,874
Santa Barbara	40,574	47,443
Santa Clara	4,072	29,697
Santa Cruz	534	3,035
Shasta	2,185	16,496

COUNTY	2030	2050
Sierra	18	402
Siskiyou	149	3,506
Solano	3,915	7,858
Sonoma	1,043	5,643
Stanislaus	1,424	6,259
Sutter	254	1,090
Tehama	157	10,428
Trinity	156	276
Tulare	2,782	7,010
Tuolumne	1,013	1,506
Ventura	43,645	51,510
Yolo	609	6,548
Yuba	465	1,150

Recapping the Results

If California grows local solar to 65 GW by 2050 and pairs it with distributed storage, all California ratepayers….

Save **$120 billion** over an all-utility scale future

Grow distributed storage by over **60 GW**

Reduce carbon dioxide emissions overall

Create over **374,000** more jobs

Policymakers and Regulators Should Act Today

- **Establish and Maintain Clear and Consistent Policies to Scale Local Solar + Storage Today**
  - Grow behind-the-meter solar markets, with special focus to growth in communities of concern, via policies such as net energy metering and virtual net energy metering for apartments.
  - Continue growth of behind-the-meter energy storage via policies such as net energy metering along with consumer incentives, government purchasing programs, virtual power plant and grid modernization programs.
  - Lower the cost of solar & storage through streamlined permitting (e.g. SolarAPP) and reduced interconnection barriers.
  - Establish competitive community solar programs that can utilize distributed-energy storage, via an expansion of net energy metering and improvements to the Green Tariff Shared Renewables program.
- **Integrate and Optimize Local Solar + Storage into State Energy Planning**
  - Create new grid planning processes that require utilities to provide data that will help California unlock resource optimization
  - Use advanced modeling tools like WIS:dom-P in grid planning processes
  - Current pace of local solar + storage deployment is not sufficient to capture $ savings potential

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