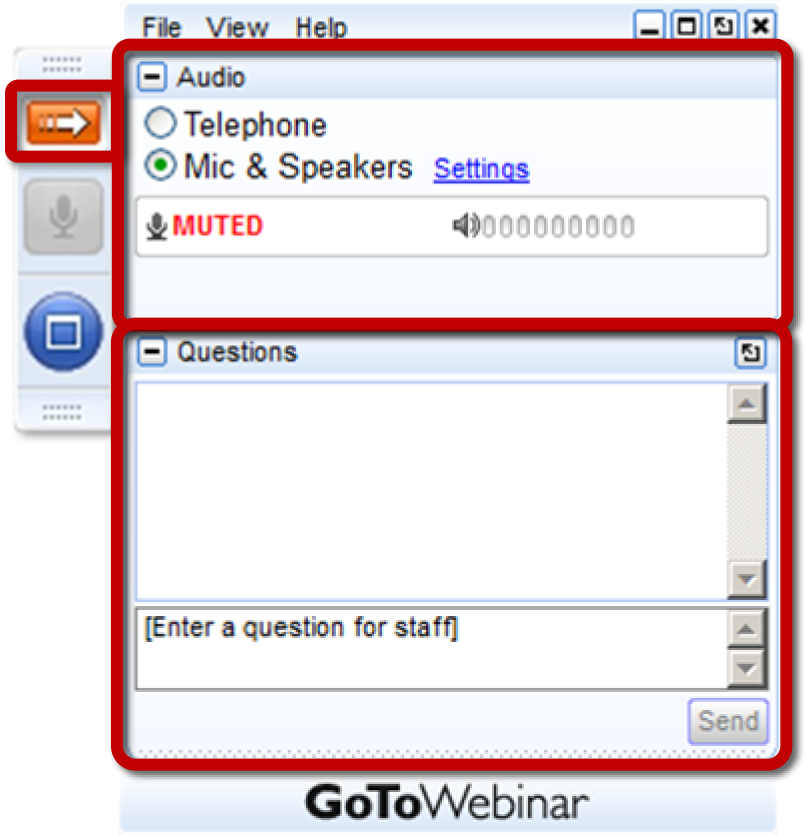
The LA100 Study:
Lessons for State 100% Clean Energy Planning

August 25, 2021

100% CLEAN ENERGY COLLABORATIVE

CleanEnergy States Alliance

Webinar Logistics



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100% Clean Energy Collaborative

100% CLEAN ENERGY COLLABORATIVE

Assists states and other entities that have 100% clean energy goals (or are considering adopting such a goal) by providing knowledge-sharing activities and analysis so that they can address program challenges and opportunities.

The 100% Clean Energy Collaborative is managed by the Clean Energy States Alliance in partnership with the US Climate Alliance.

Clean Energy States Alliance

In partnership with

UNITED STATES CLIMATE ALLIANCE

NEW: Guide to 100% Clean Energy States

The Guide includes information about the goals, timelines, legislation, and plans of 18 states, plus the District of Columbia and Puerto Rico, that have adopted 100% clean electricity goals. It is divided into five parts:

1) Table of 100% Clean Energy States
2) Map and Timelines of 100% Clean Energy States
3) Summaries of State 100% Clean Energy Plans
4) Visual Comparison of State 100% Clean Energy Plans
5) State Legislation, Plans, Reports, and Other Documents

Explore the guide at www.cesa.org/projects/100-clean-energy-collaborative/guide

Clean Energy States Alliance

UNITED STATES CLIMATE ALLIANCE

Webinar Speakers

Jacquelin Cochran
Director, Grid Planning and Analysis Center, NREL

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Warren Leon
Executive Director, Clean Energy States Alliance (moderator)

Clean Energy States Alliance

The Los Angeles 100% Renewable Energy Study

LA100 and Implications for Other Locations

Jaquelin Cochran, Ph.D.

CRES

July 27, 2021

Los Angeles Department of Water & Power | NREL Transforming ENERGY

Los Angeles Department of Water and Power (LADWP)

L.A.'s Current Power Grid

7,880 MW of Generation Capacity
Peak Load: 6,502 MW (Aug. 31, 2017)
4 million residents

LA100 Advisory Group

Provided Input and Review Throughout the Study

Representatives:

- Environmental groups
- Neighborhood councils
- Academia
- Key customers
- City government
- Business and workforce groups
- Utilities

Scenarios

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

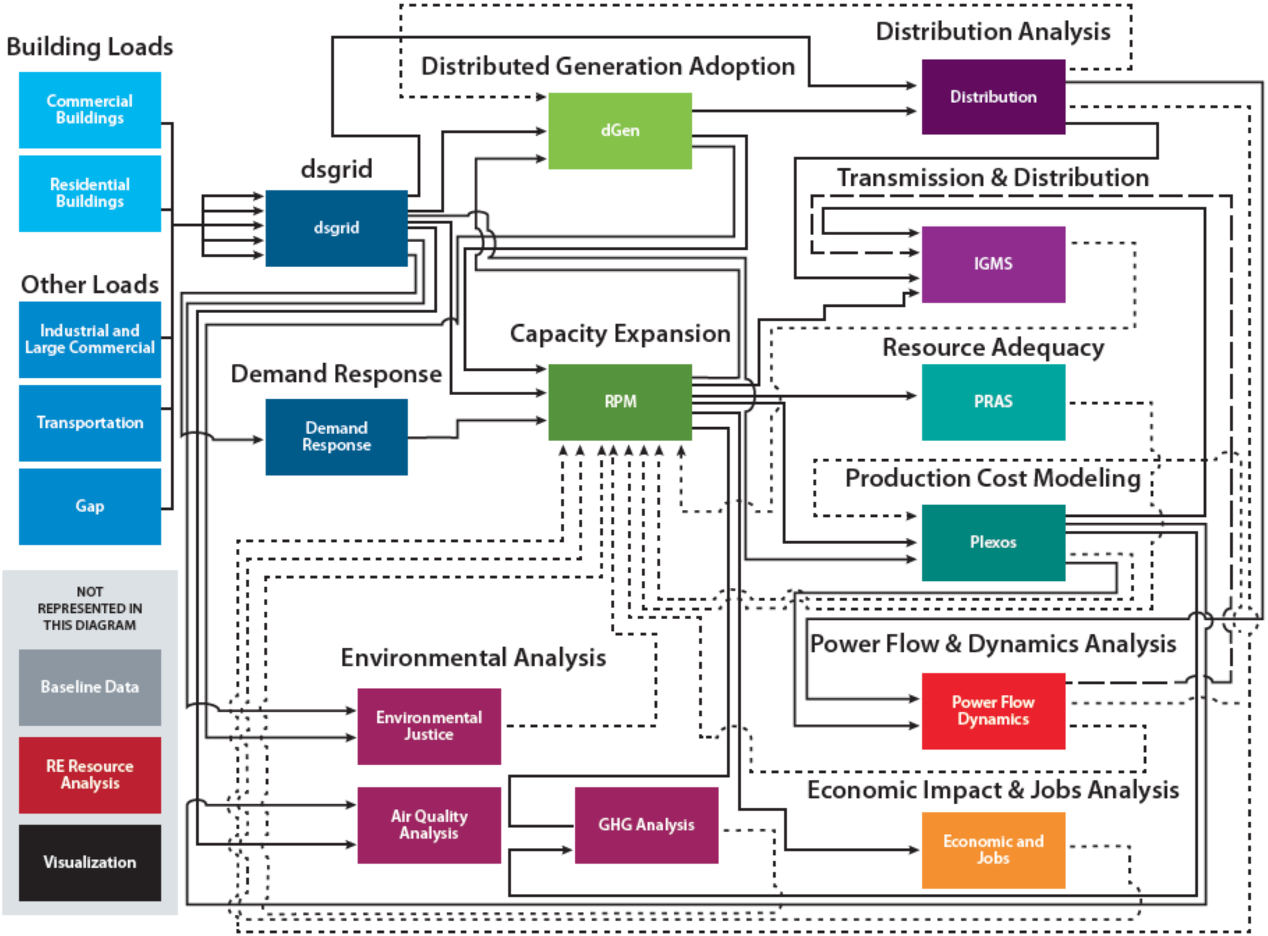
- 100% clean energy by **2045**
- Only scenario that builds new transmission corridors
- No natural gas or nuclear generation

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

Unprecedented Model Resolution and Integration



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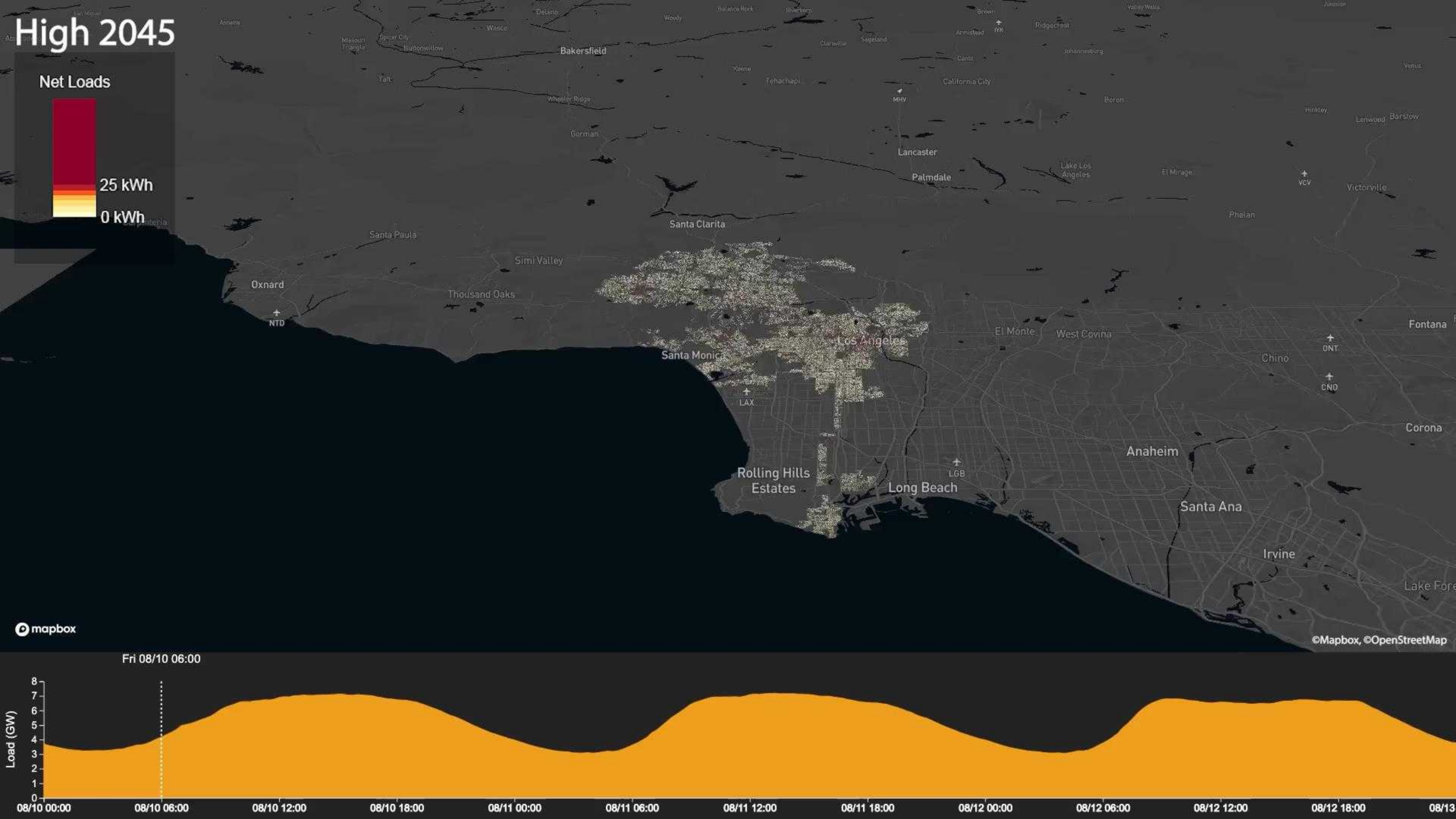
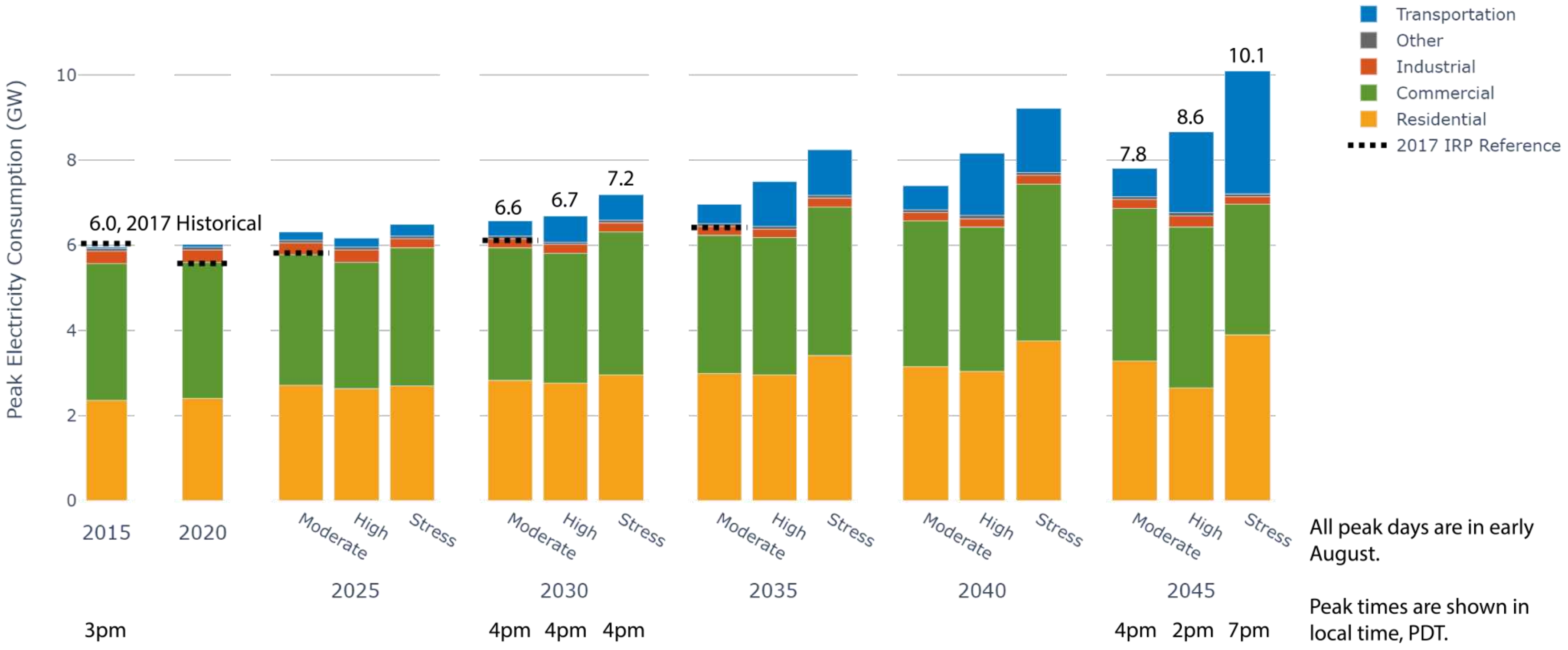

High 2045
Net Loads
25 kWh
0 kWh
Bakersfield
Tehachapi
California City
Lancaster
Palmdale
Santa Clarita
Santa Paula
Simi Valley
Oxnard
Thousand Oaks
Santa Monica
Los Angeles
El Monte
West Covina
Fontana
Chino
Corona
Anaheim
Santa Ana
Irvine
Long Beach
Rolling Hills Estates
Victorville
Phelan
LAX
LGB
ONT
mapbox
©Mapbox, ©OpenStreetMap
Fri 08/10 06:00
Load (GW)
8
7
6
5
4
3
2
1
0
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

Results

Growth in customer demand for electricity

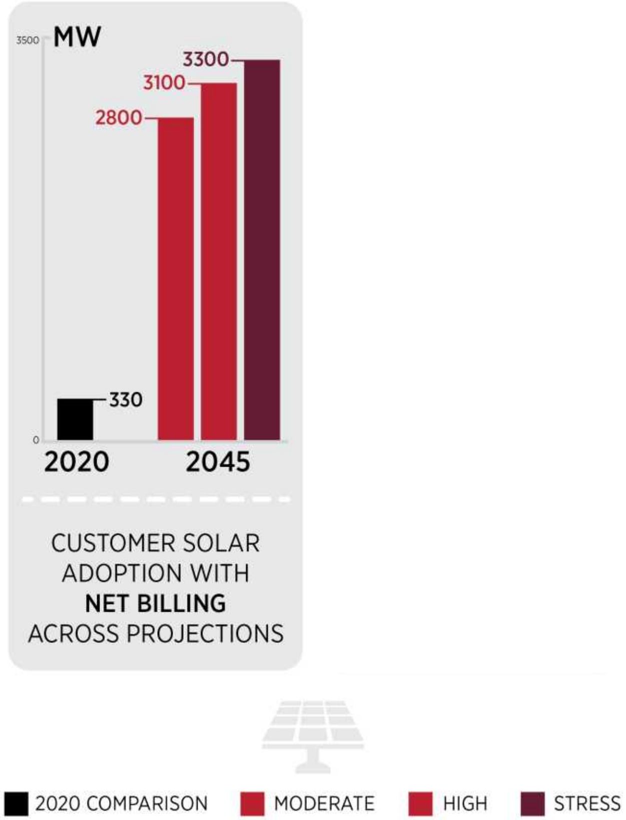


All peak days are in early August.

Peak times are shown in local time, PDT.

By 2045 rooftop solar would be an economic choice for nearly all households and businesses

Adoption would occur on 22%   38% of all existing single-family homes, up from 6% in 2020



In all scenarios, wind and solar provide 69%–87% of future electricity demand.

The pathways diverge going from 90% to 100% renewables.

This last 10% is what is needed for reliability during periods of very low wind and solar, extremely high demand, and unplanned events like transmission outages.

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

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

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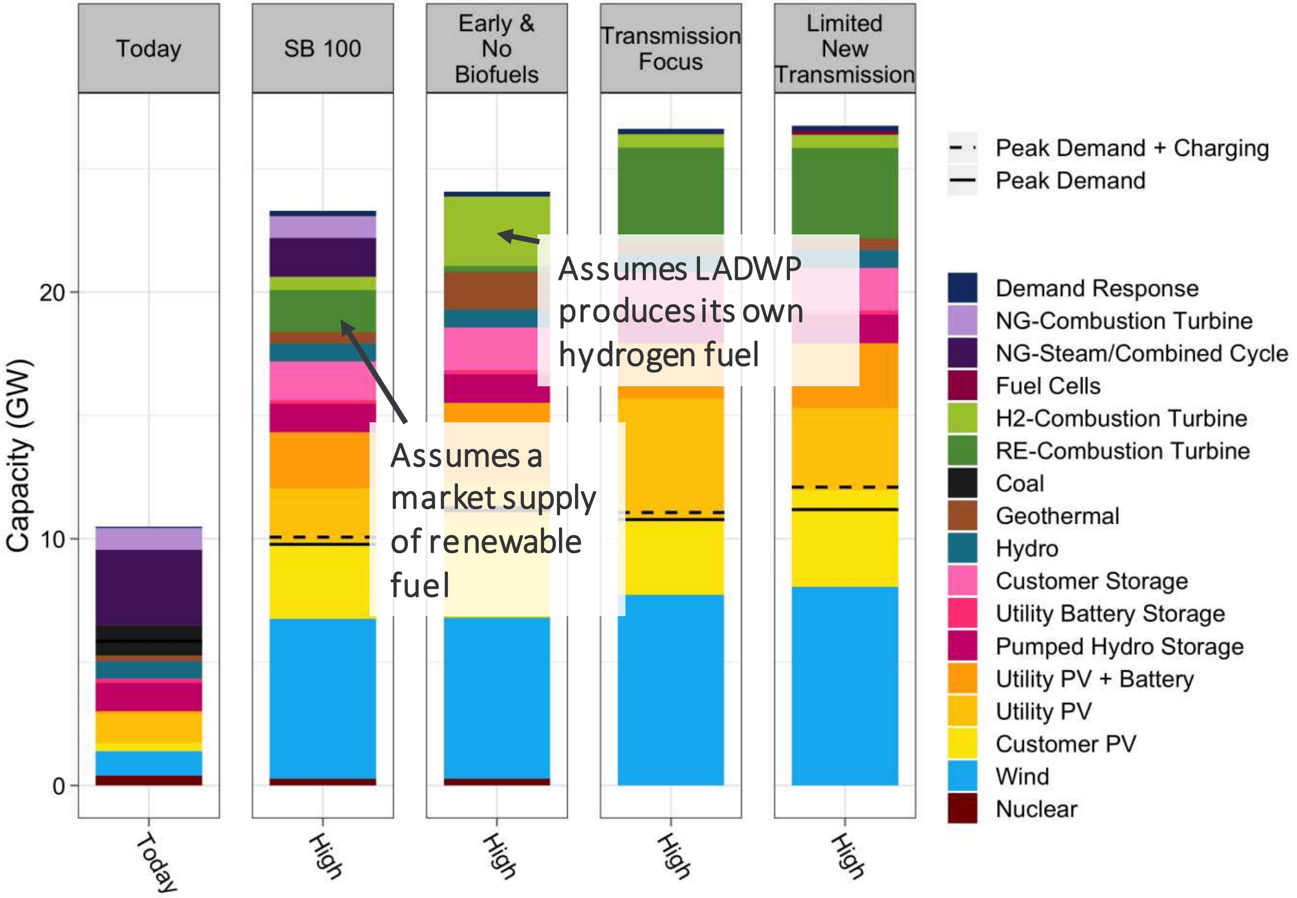

How do we get to the 100% RE target?

Example scenario:

2035 target, no biofuels

Early & No Biofuels Scenario High Electrification: 2020

Customer Rooftop Solar

340 MW

Renewable Energy (utility scale)

Solar + Battery: 90 MW
Solar: 1,200 MW
Wind: 1,000 MW
Geothermal: 230 MW

Storage (including coupled with solar)

1,300 MW

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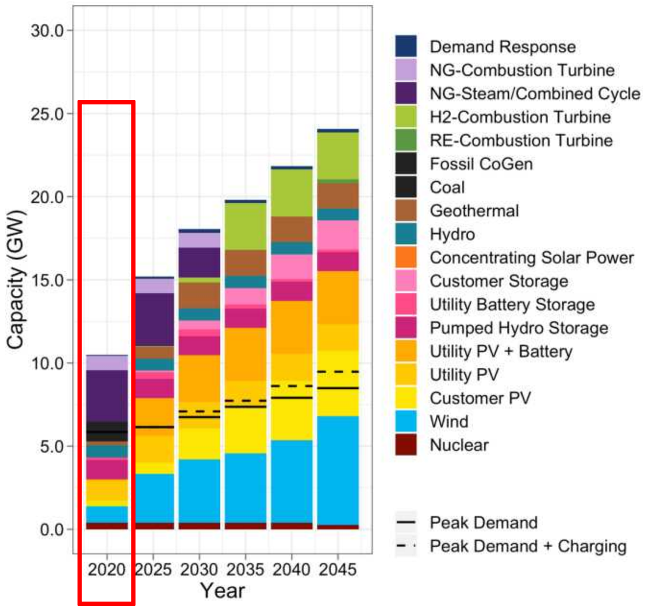

C e n ner Gener tion

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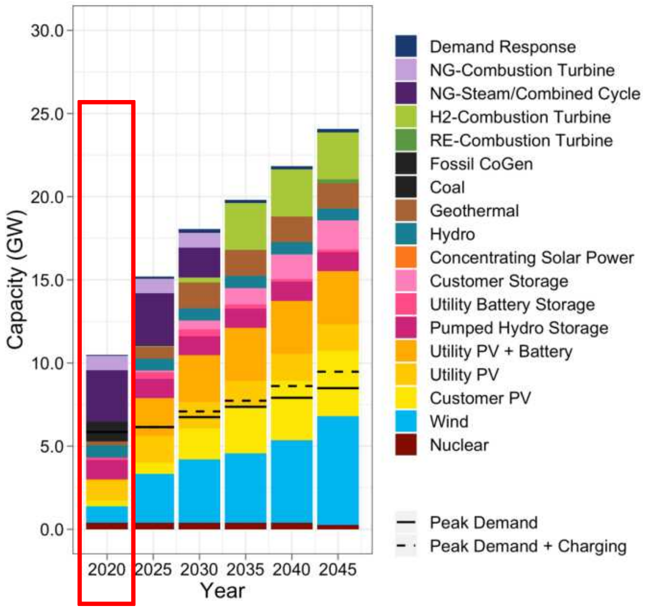

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Early & No Biofuels Scenario   High Electrification: 2020

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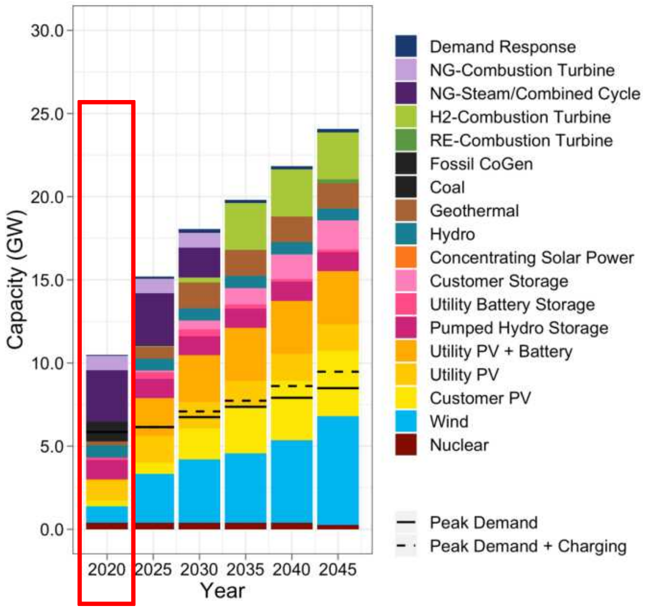

C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2025

Customer Rooftop Solar

690 MW (+350)

Renewable Energy (utility scale)

Storage (including coupled with solar)

1,700 MW (+400)

Solar + Battery: 2,300 MW (+2,200)
Solar: 1,600 MW (+400)
Wind: 2,900 MW (+1,900)
Geothermal: 690 MW (+460)

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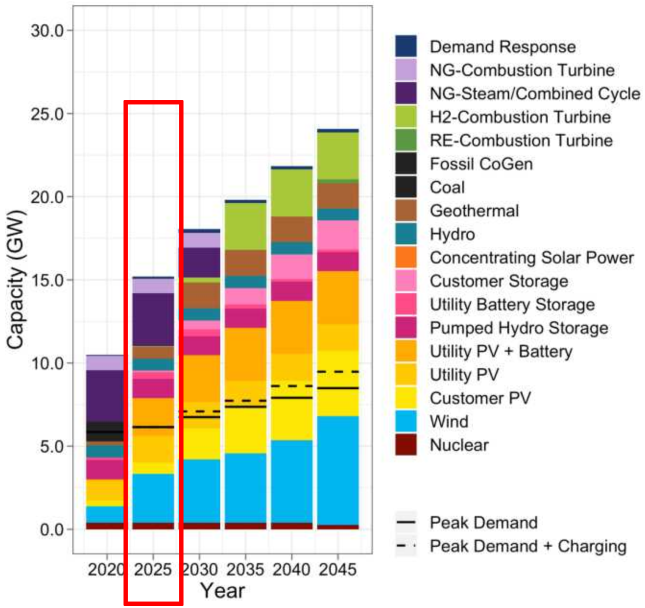

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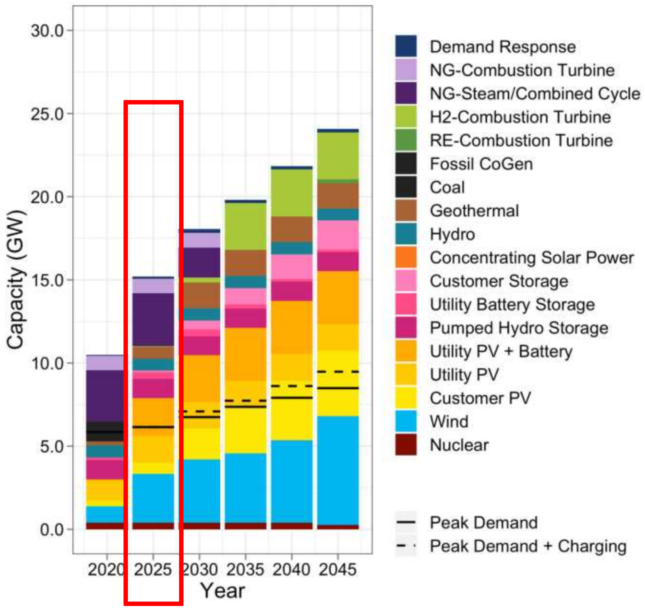

C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2025

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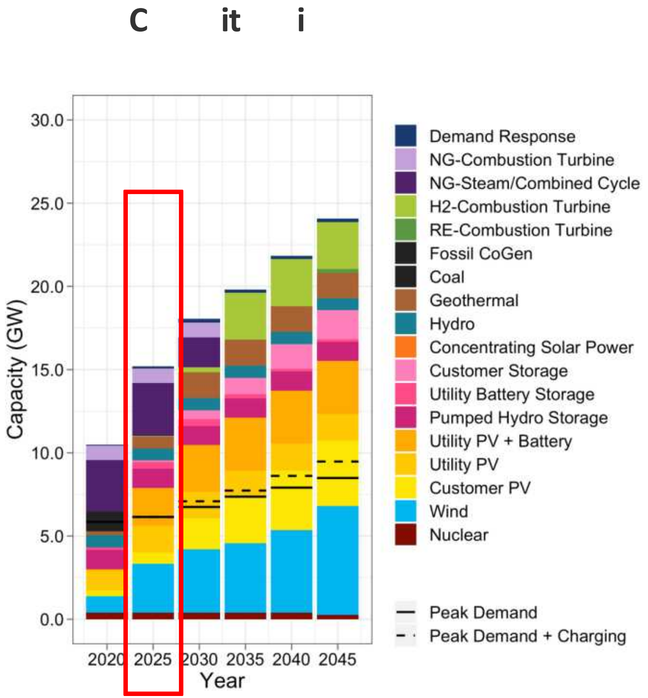
Geothermal: 690 MW (+460)



C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2030

Customer
Rooftop Solar

1,900 MW (+1,200)

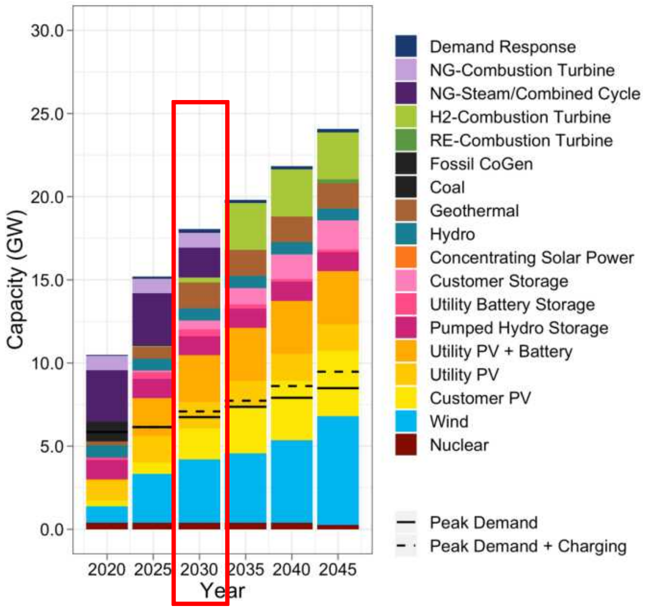
Renewable
Energy
(utility scale)

Storage
(including coupled
with solar)

2,100 MW (+400)

Solar + Battery: 2,800 MW (+500)
Solar: 1,600 MW (+0)
Wind: 3,800 MW (+900)
Geothermal: 1,600 MW (+900)

C it i



C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2030

Customer Rooftop Solar

1,900 MW (+1,200)

Renewable Energy (utility scale)

Storage (including coupled with solar)

2,100 MW (+400)

Solar + Battery: 2,800 MW (+500)
Solar: 1,600 MW (+0)
Wind: 3,800 MW (+900)
Geothermal: 1,600 MW (+900)

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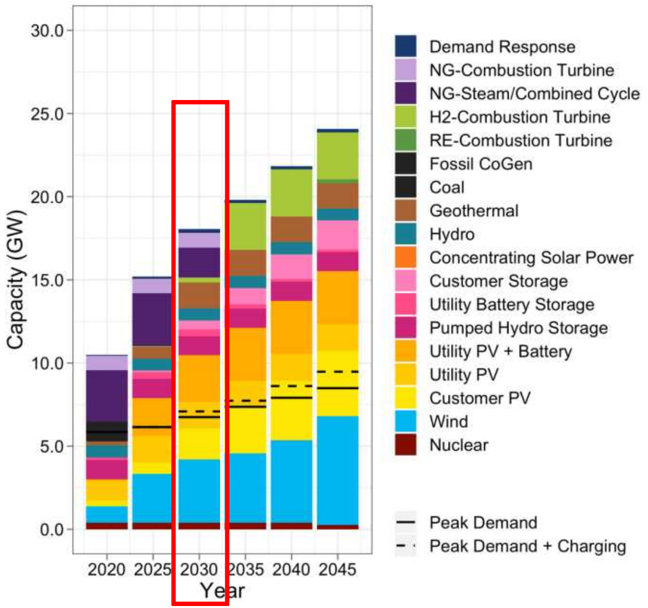

C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2030

Customer Rooftop Solar

1,900 MW (+1,200)

Renewable Energy (utility scale)

Storage (including coupled with solar)

2,100 MW (+400)

Solar + Battery: 2,800 MW (+500)
Solar: 1,600 MW (+0)
Wind: 3,800 MW (+900)
Geothermal: 1,600 MW (+900)

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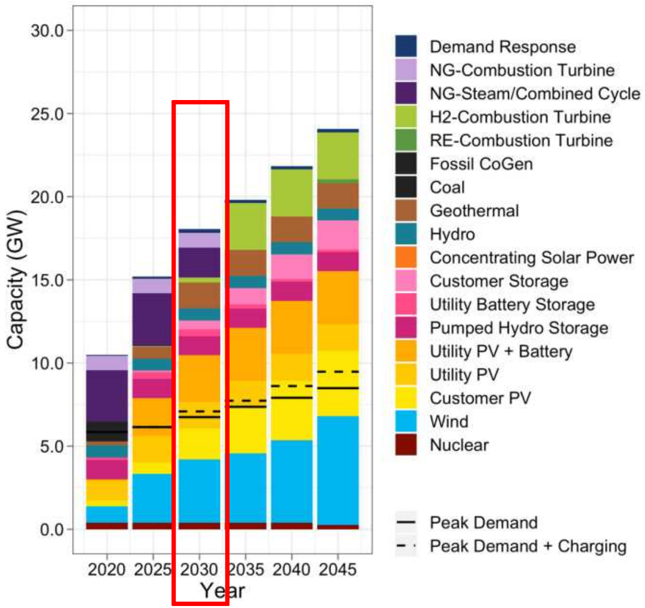


C e n ner Gener tion

Early & No Biofuels Scenario High Electrification: 2035

Customer Rooftop Solar

2,700 MW (+800)

Renewable Energy (utility scale)

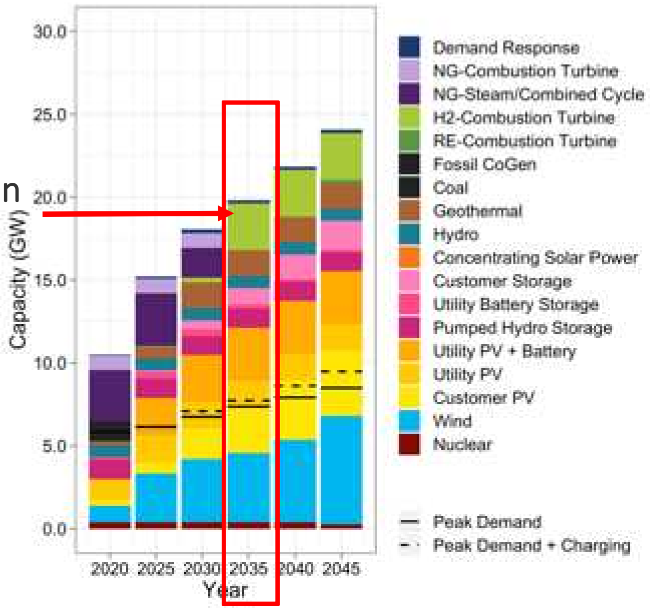
Storage (including coupled with solar)

2,400 MW (+300)

Hydrogen Combustion Turbines

+2,500 MW in LA

C it i



Solar + Battery: 3,200 MW (+400)

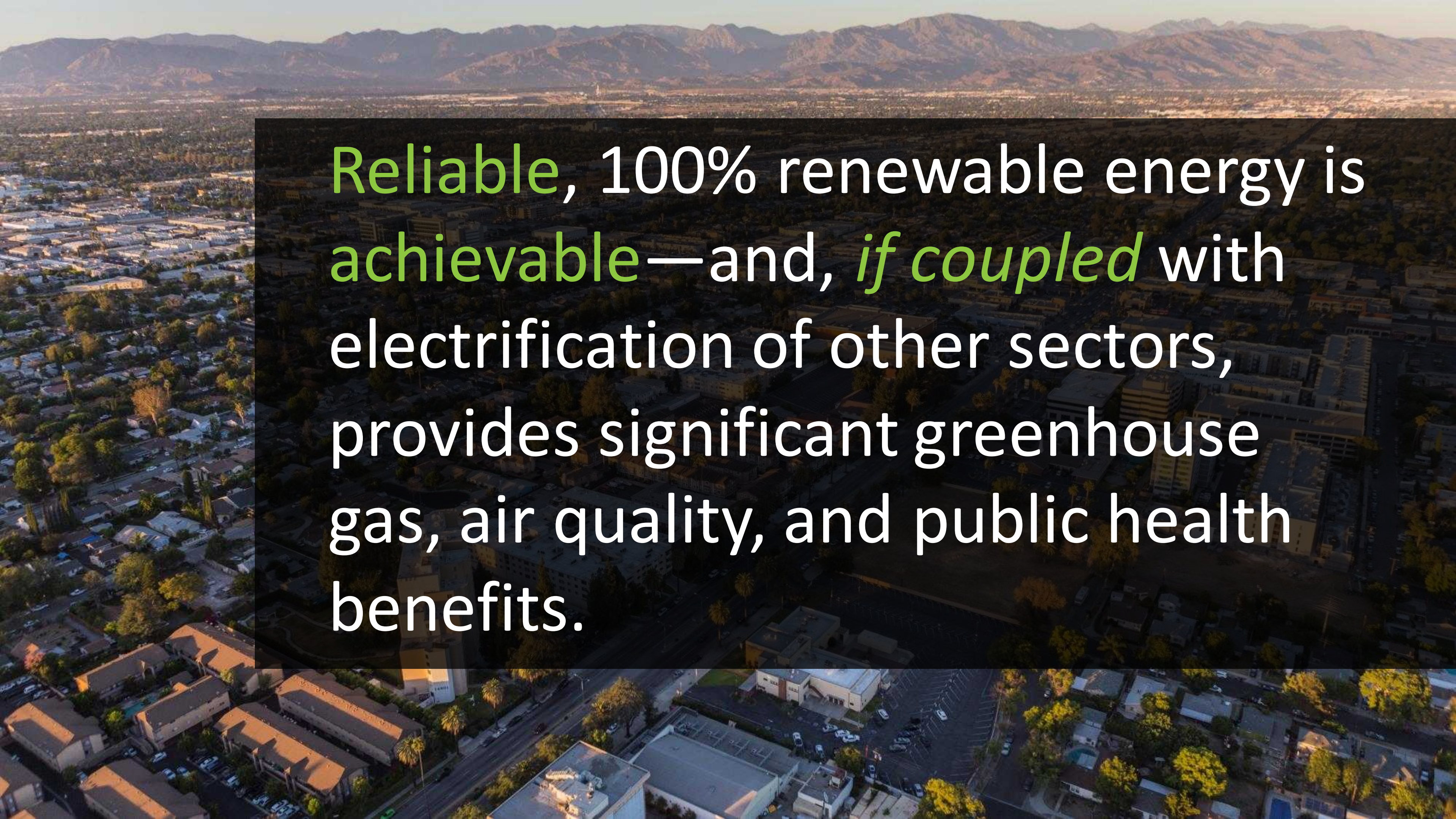
Solar: 1,600 MW (+0)

Wind : 4,200 MW (+400)

Geothermal: 1,600 MW (+0)

C e n ner Gener tion

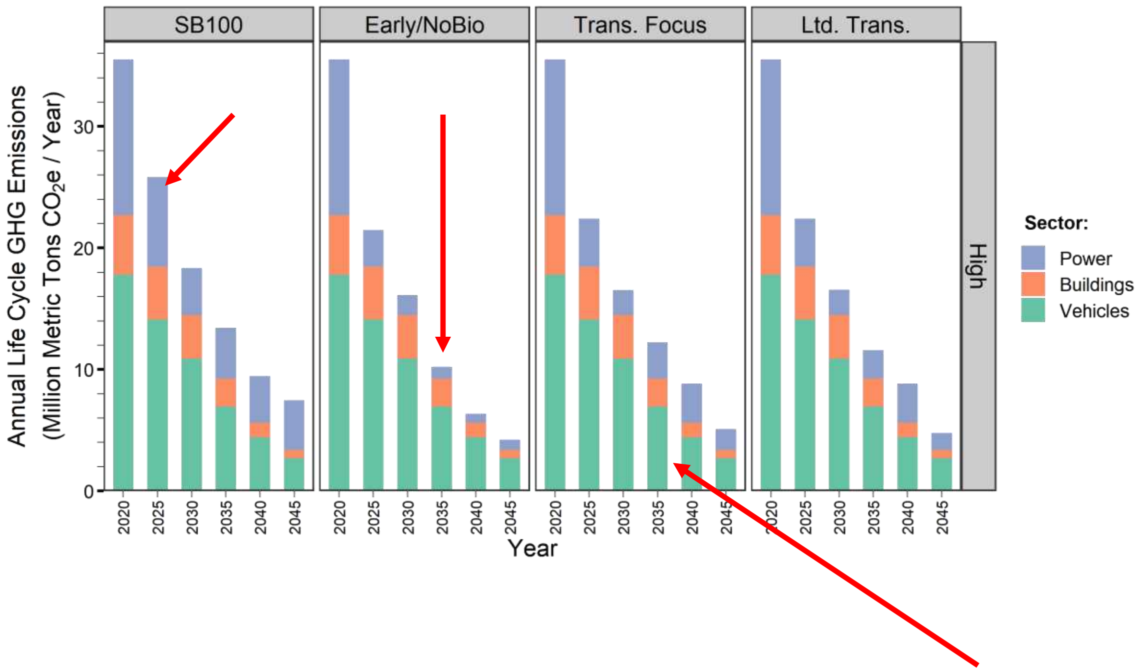
Identifying alternative options for firm, in-basin capacity likely represents the largest opportunity to reduce the costs of the transition and points to the highest priorities for R&D: hydrogen and extended demand response.



Reliable, 100% renewable energy is **achievable**—and, ***if coupled*** with electrification of other sectors, provides significant greenhouse gas, air quality, and public health benefits.

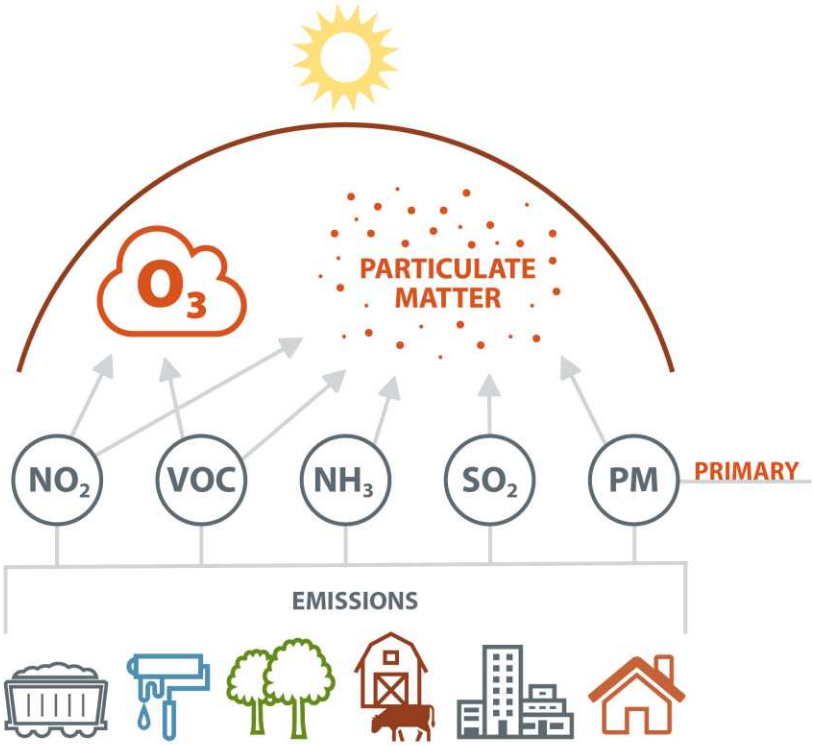
Life-Cycle Greenhouse Gas Emissions

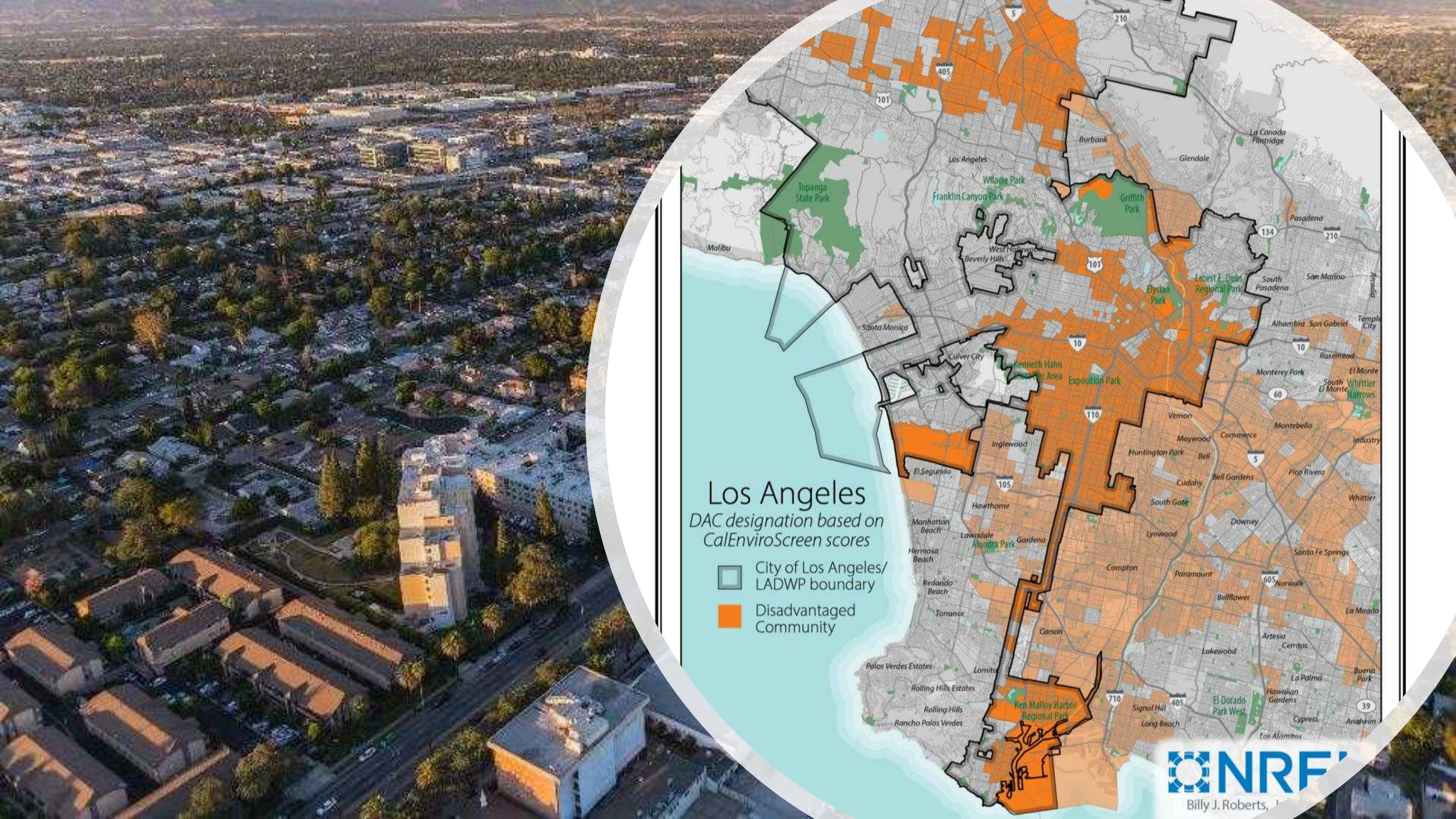
All Sectors



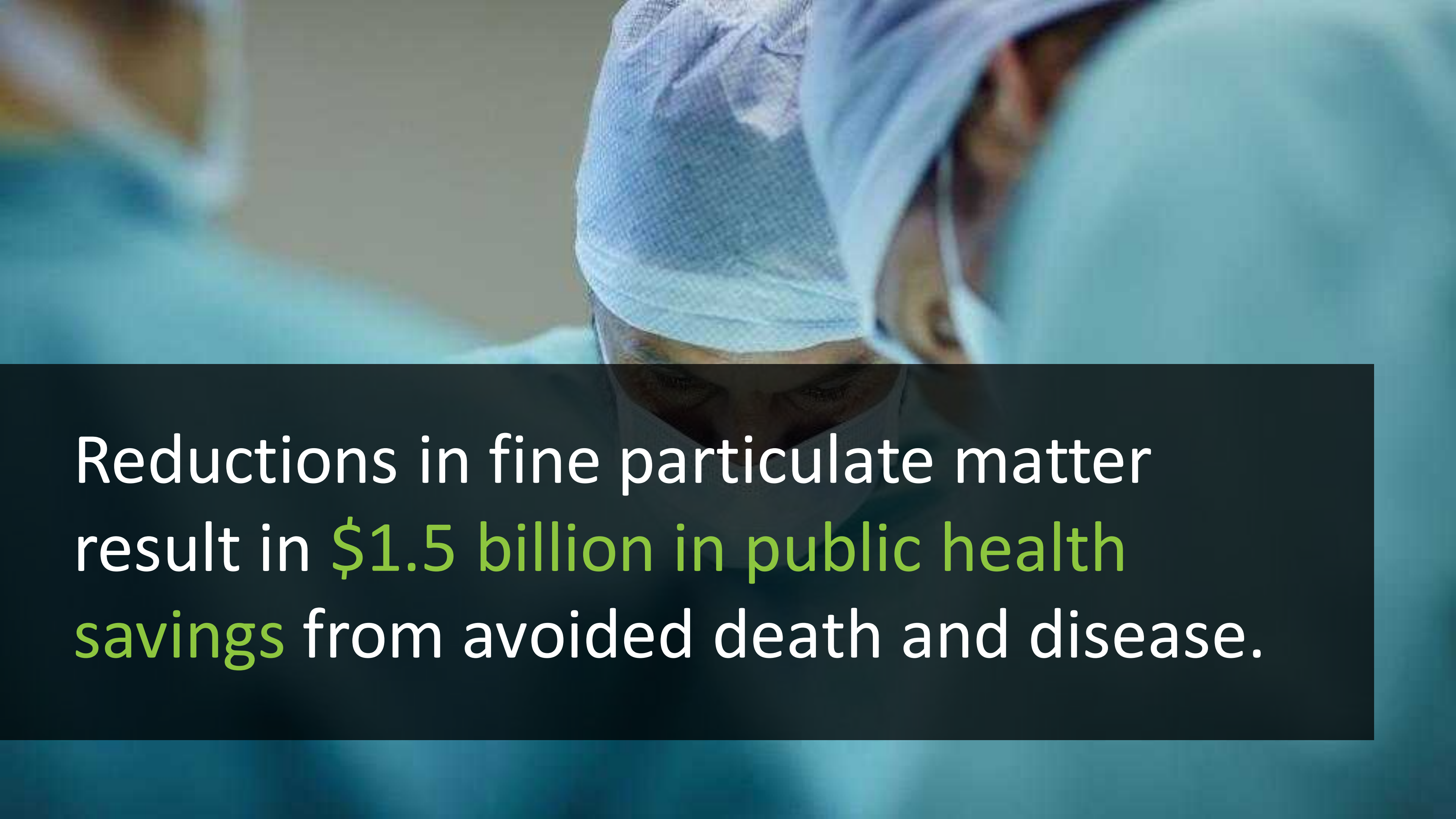
Two pollutants of concern

1. Fine particulate matter
2. Ozone

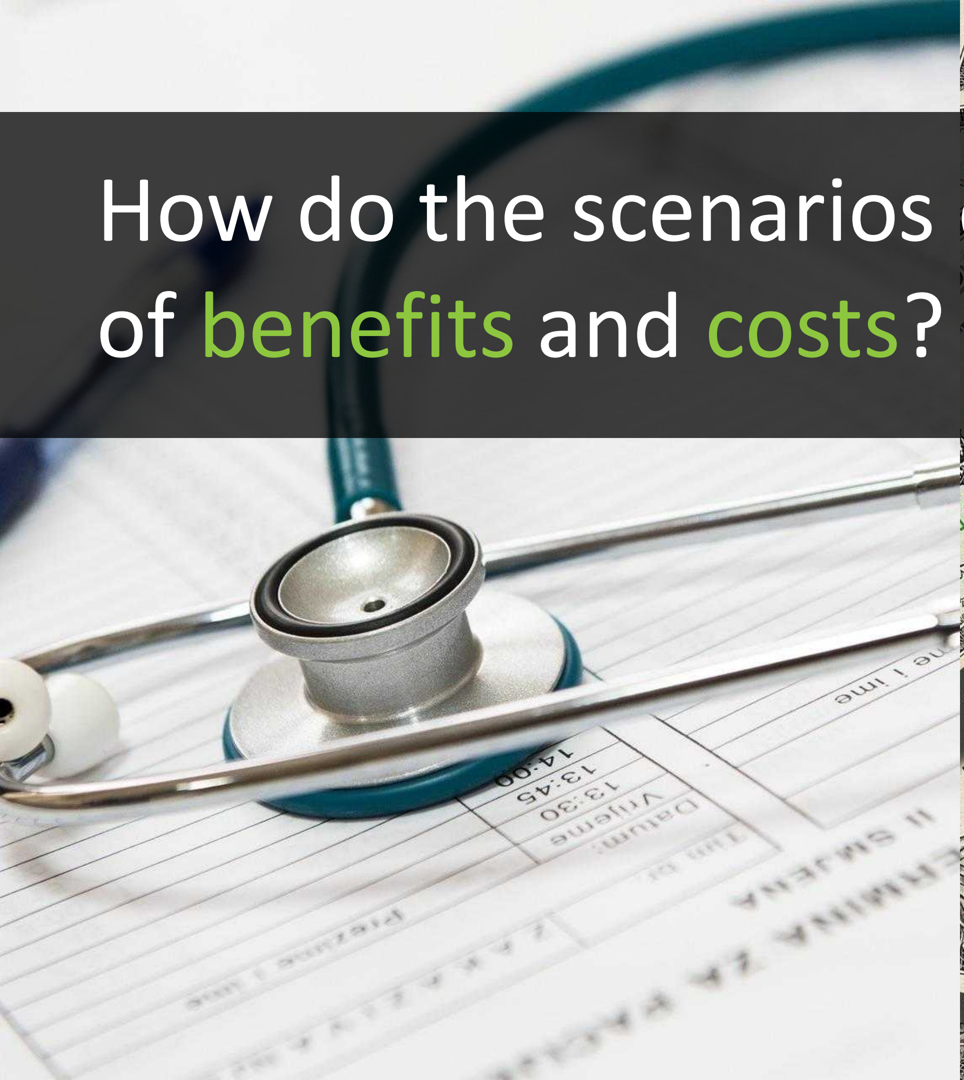




Los Angeles
DAC designation based on CalEnviroScreen scores
City of Los Angeles/ LADWP boundary
Disadvantaged Community
Topanga State Park
Malibu
Burbank
Los Angeles
Glendale
La Canada Flintridge
Wilacre Park
Franklin Canyon Park
Griffith Park
Pasadena
West Hollywood
Beverly Hills
Elysian Park
Ernest E. Debs Regional Park
South Pasadena
San Marino
Santa Monica
Alhambra
San Gabriel
Temple City
Culver City
Kenneth Hahn
Exposition Park
Rosemead
Monterey Park
El Monte
South El Monte
Whittier Narrows
Vernon
Montebello
Maywood
Commerce
Huntington Park
Bell
Industry
Inglewood
El Segundo
Bell Gardens
Pico Rivera
Cudahy
Hawthorne
South Gate
Whittier
Manhattan Beach
Downey
Lawndale
Alondra Park
Gardena
Lynwood
Hermosa Beach
Santa Fe Springs
Compton
Paramount
Redondo Beach
Norwalk
Bellflower
Torrance
La Mirada
Carson
Artesia
Cerritos
Lakewood
Palos Verdes Estates
Lomita
Rolling Hills Estates
La Palma
Buena Park
Hawaiian Gardens
Rolling Hills
Ken Malloy Harbor Regional Park
El Dorado Park West
Signal Hill
Rancho Palos Verdes
Long Beach
Cypress
Anaheim
Los Alamitos
NREL
Billy J. Roberts

All scenarios achieve 6%–8% reduction in concentrations of fine particulate matter.


Reductions in fine particulate matter result in $1.5 billion in public health savings from avoided death and disease.

How do the scenarios compare in terms of benefits and costs?



The combination of higher energy efficiency, electrification, and demand flexibility offers both greater benefits and reduced per-unit electricity costs compared to alternative scenarios.

Accelerating the target date to 2035 increases both the costs and benefits of the transition.

Technology restrictions result in higher costs when it comes to meeting the last 10%–20% of energy demand—but almost no additional regional air quality or health benefits.

While the transition to 100% renewables could create thousands of clean energy jobs annually, overall, the renewable energy investments alone are not anticipated to notably impact LA’s economy.

Scenario	Total Clean Energy (Renewable, Hydro, and Nuclear) Penetration Achieved 2035 vs. 2045	Present Value of Cumulative (2021–2045) Costs* at Alternative Discount Rates (Billion 2019$)	Cumulative (2020–2045) Life Cycle GHG Emissions, All Sectors (MMT CO_2e)	Reduction in Annual Life Cycle GHG Emissions in 2045 Compared to 2020, All Sectors	Cumulative (2021–2045) Monetized Emissions Costs of GHG Emissions at Discount Rates of 2.5% and 5% (Billion 2019$)	Annual Mean Value** of Avoided Health Impacts in 2045 Only (Undiscounted, 2019$) Compared to 2012	Average Annual Employment from LADWP Power-Sector Spending (2026–2045) by Location of Investment: In-basin, Out-of-basin, Total
SB100 MODERATE	90% / 90%	0%: $57B; 2.5%: $40B; 5.0%: $28B	570 MMT	54%	2.5%: $61B; 5.0%: $16B	$900M	In: 4,900; Out: 3,000; Total: 7,900
Early & No Biofuels MODERATE	100% / 100%	0%: $87B; 2.5%: $59B; 5.0%: $42B	510 MMT	61%	2.5%: $55B; 5.0%: $14B	Very similar results to SB100 – Moderate, likely***	In: 8,200; Out: 4,200; Total: 12,400
Transmission Focus MODERATE	90% / 100%	0%: $67B; 2.5%: $46B; 5.0%: $33B	540 MMT	59%	2.5%: $58B; 5.0%: $15B		In: 6,400; Out: 3,500; Total: 9,900
Limited New Transmission MODERATE	91% / 100%	0%: $62B; 2.5%: $43B; 5.0%: $31B	540 MMT	59%	2.5%: $59B; 5.0%: $15B		In: 6,700; Out: 3,000; Total: 9,700
SB100 HIGH	84% / 88%	0%: $61B; 2.5%: $42B; 5.0%: $30B	460 MMT	79%	2.5%: $50B; 5.0%: $13B	Very similar results to Early & No Biofuels – High, likely***	In: 5,500; Out: 3,500; Total: 9,000
Early & No Biofuels HIGH	100% / 100%	0%: $86B; 2.5%: $59B; 5.0%: $41B	390 MMT	88%	2.5%: $43B; 5.0%: $11B	$1,400M	In: 8,700; Out: 4,500; Total: 13,200
Transmission Focus HIGH	89% / 100%	0%: $72B; 2.5%: $49B; 5.0%: $35B	425 MMT	86%	2.5%: $46B; 5.0%: $12B		In: 7,200; Out: 4,300; Total: 11,500
Limited New Transmission HIGH	90% / 100%	0%: $67B; 2.5%: $46B; 5.0%: $33B	420 MMT	87%	2.5%: $46B; 5.0%: $12B		In: 7,600; Out: 3,900; Total: 11,500
SB100 STRESS	85% / 87%	0%: $69B; 2.5%: $47B; 5.0%: $34B	480 MMT	77%	2.5%: $53B; 5.0%: $14B		In: 6,500; Out: 3,700; Total: 10,200
Axis		$0 – $90B	0 – 600		$0 – $63B	$0 – $1,500M	0 – 15,000

*Costs, as measured in the study, represent costs of expanding and operating of the power system from 2021. Present values calculated with a discount rate of 0% are equivalent to an undiscounted value.
**95% confidence interval of values of avoided health impacts in 2045 compared to 2012 is SB100 – M is (-$480M–$3,000M) and of Early & No Biofuels – H is (-$470M–$4,400 M).
***Because the contribution to emissions reductions from the power sector is small (ranging from 0.8%–1% for NOx among LA100-evaluated reductions), it is reasonable to qualitatively estimate the results stated.

All communities will share in the benefits of the clean energy transition—but improving equity in participation and outcomes would require this to be integrated into the design of policies and programs.

The Los Angeles 100% Renewable Energy Study

LA100 Equity Strategies

THE CHALLENGE:

- How can Los Angeles ensure its transition to 100% clean energy with high levels of electrification improves energy justice?

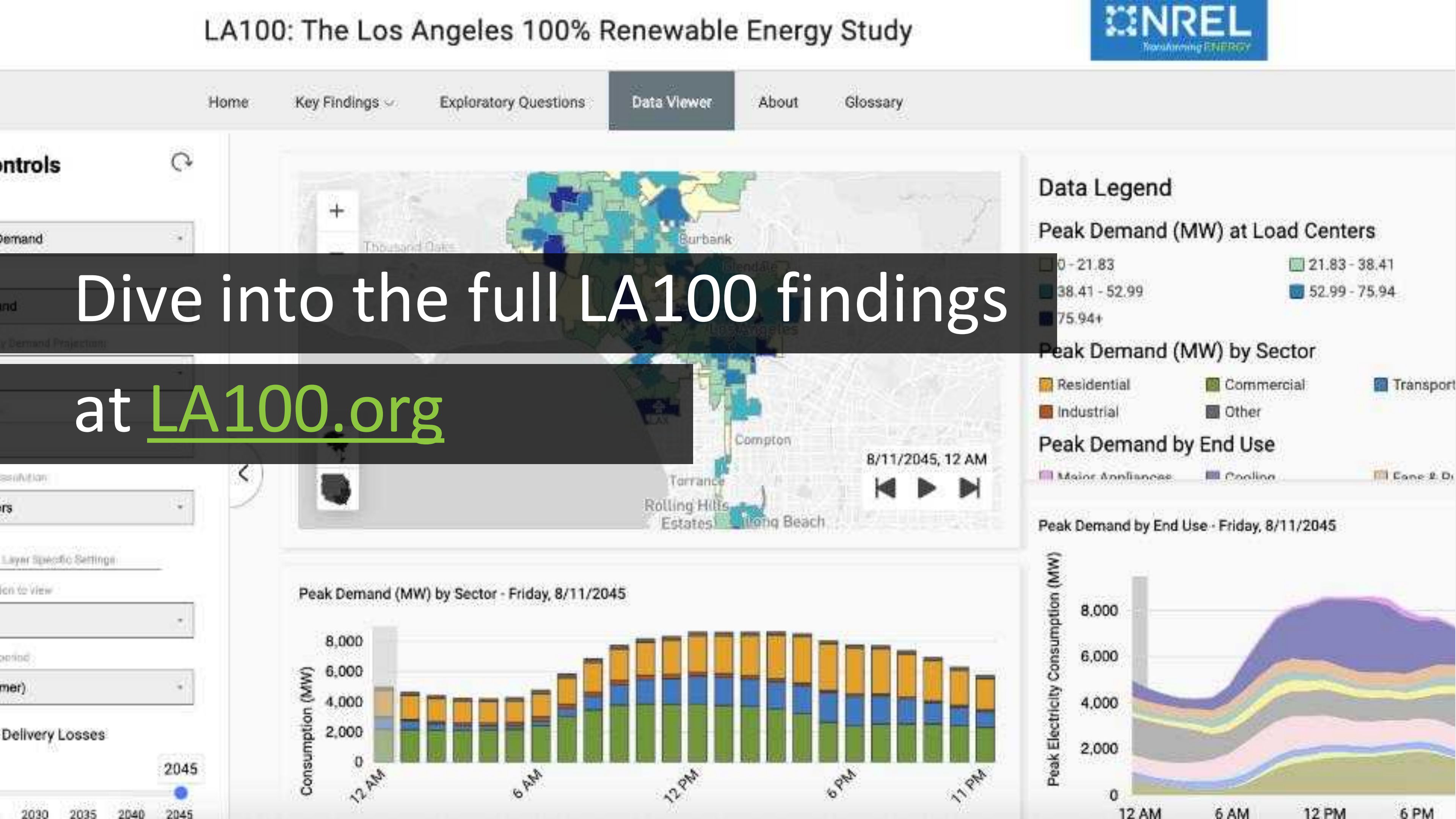
OUR SOLUTION:

- Prioritize energy justice outcomes based on community input
- Analyze clean-energy transition pathways that maximize energy justice outcomes for all communities in LA

POTENTIAL IMPACT:

- Improved understanding of factors contributing to energy inequities
- Implementation-ready strategies to address energy justice in LA
- Replicable approaches for incorporating energy justice in future research

LA can get started now, with many options that achieve significant reductions in greenhouse gas emissions (76%–99%) by 2030.



Dive into the full LA100 findings at [LA100.org](LA100.org)

Thank you for attending our webinar

Warren Leon
Executive Director
Clean Energy States Alliance
wleon@cleanegroup.org

Learn more about the **100% Clean Energy Collaborative** at
www.cesa.org/projects/100-clean-energy-collaborative

Upcoming Webinars

Energy Storage Policy Best Practices from New England
Thursday, August 26, 1-2pm ET

How Green is Blue Hydrogen?: Study Finds Hydrogen Produced with CCS Produces High Emissions
Tuesday, September 7, 1-2pm ET

Read more and register at: www.cesa.org/webinars