Power of Place – West
Technical Briefings

The Nature Conservancy

SEPTEMBER 26 & 28, 2022

Purpose of Today's Briefing

- The Nature Conservancy
    - Climate Program
- Power of Place Project
    - Background
    - Power of Place-West
    - Questions and Answers
- Policy Recommendations
- Wrap-Up

About The Nature Conservancy

- The Nature Conservancy (TNC) is a global environmental nonprofit working to create a world where people and nature can thrive.
- The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends.
- TNC priorities are:

TACKLE CLIMATE CHANGE

PROTECT LAND & WATER

PROVIDE FOOD & WATER SUSTAINABLY

BUILD HEALTHY CITIES

The Nature Conservancy

Jennifer Morris | Chief Executive Officer

www.nature.org

North America Climate Mitigation Program

U.S. Climate Action

Natural Climate Solutions

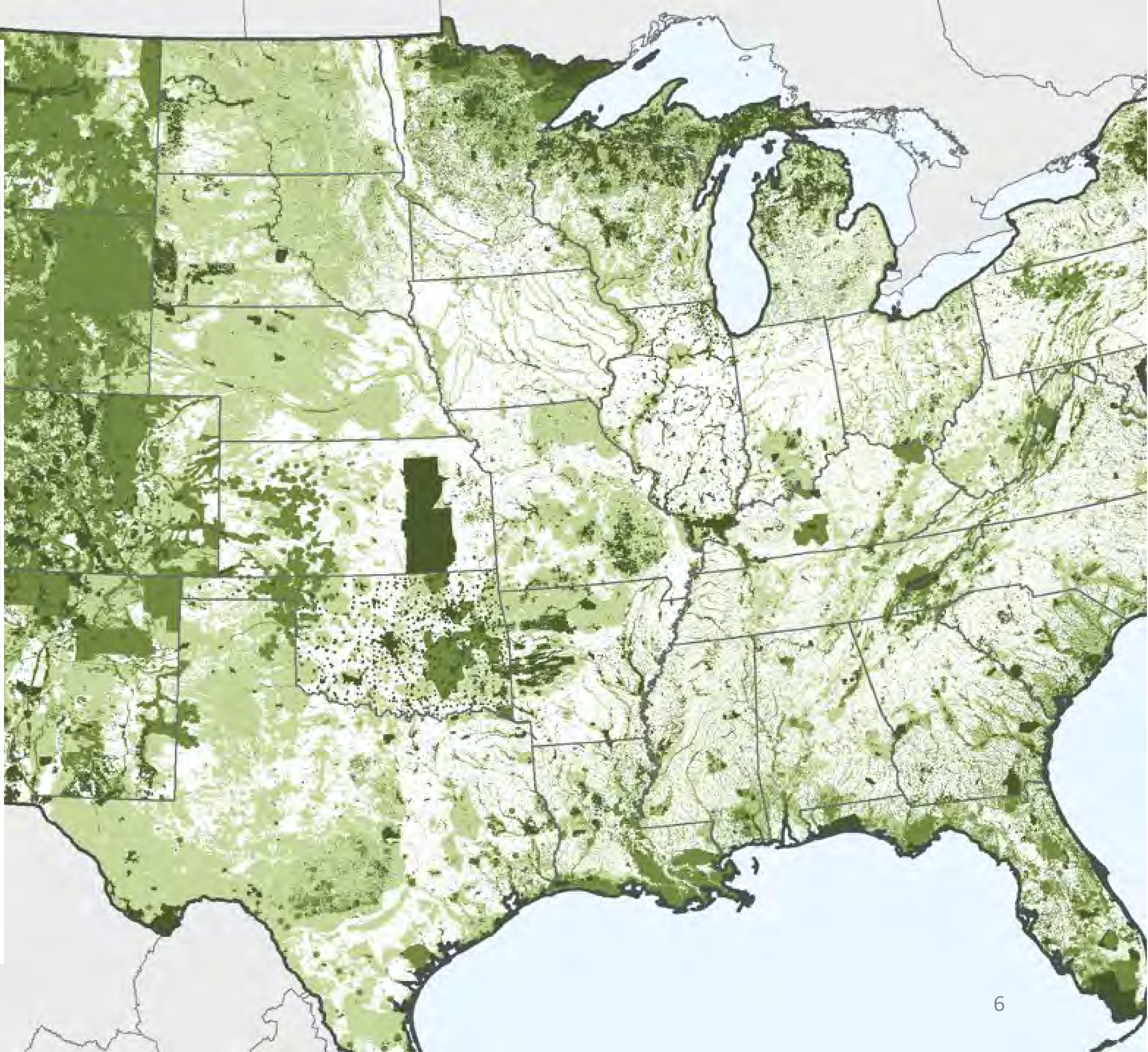
Renewable Energy Deployment

SUPERCHARGING THE CLEAN ENERGY TRANSITION

Federal Investment	IRA - $369 billion
	IIJA - $120 billion
State Commitments	15 states with net zero commitments
	Major investments (CA $54B)
Corporate Commitments	Nearly 50% of wind and solar purchases in 2021

Power of Place

Decarbonization pathways informed by a national environmental data set.



Power of Place Project Team Introductions

Project Roles

Jason Albritton
Power of Place
Project Sponsor

Jessica Wilkinson
Power of Place
Project Director

Nicole Hill
Power of Place West
Project Director

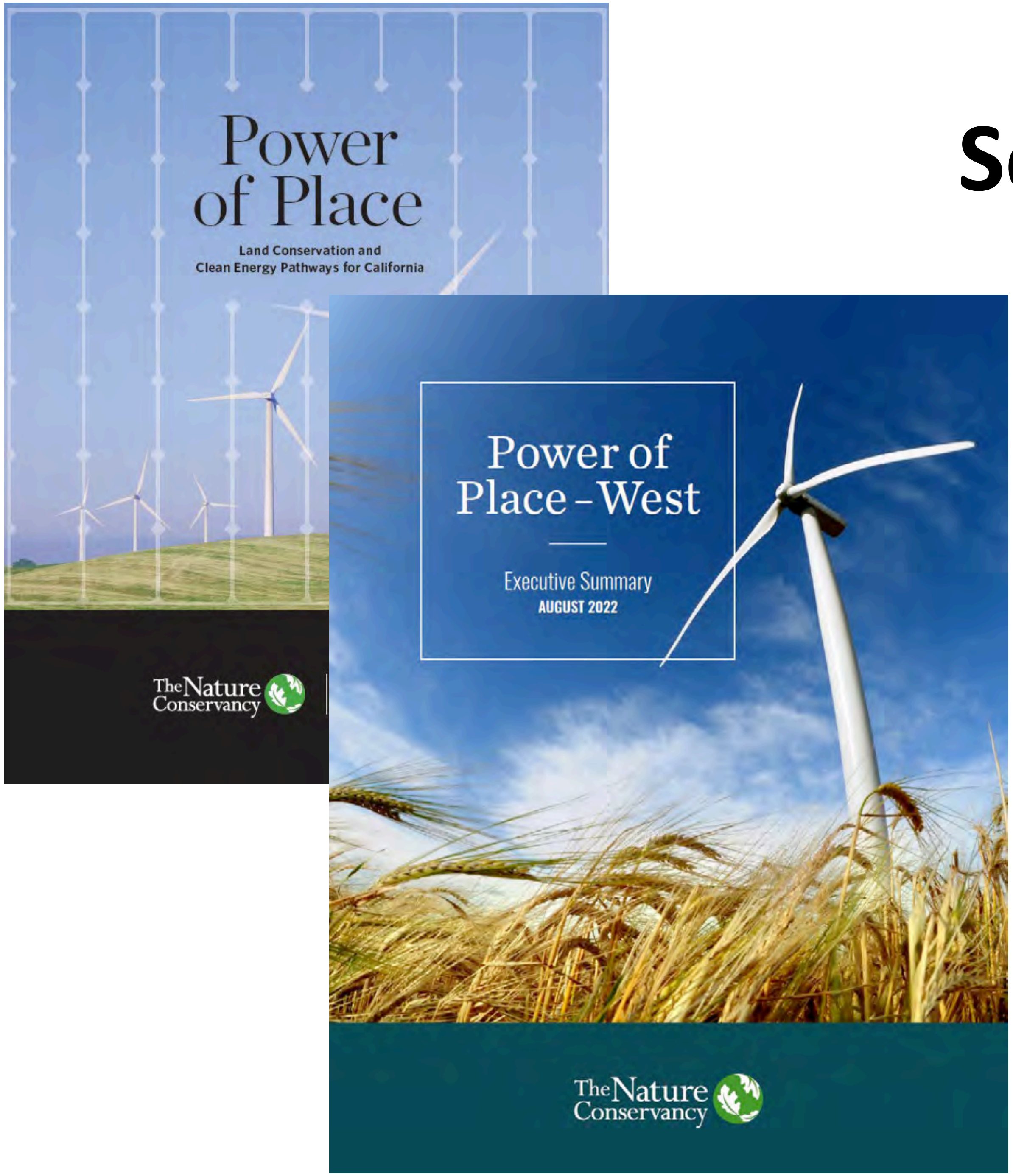
Nels Johnson
Power of Place
Science and
Technical Lead

Ryan Jones
Evolved Energy
Research

Emily Leslie
Montara Mountain
Energy

Dr. Grace Wu
UC Santa Barbara

Scaling Up Power of Place



- California only - 2015
- California and supply from western interconnect - 2019
- **Western U.S. (11 states) - August 2022**
- Nationwide (lower 48) - January 2023

Power of Place - West

Grace Wu, Ryan Jones, Emily Leslie, James H Williams, Andrew Pascale, Erica Brand, Sophie Parker, Brian Cohen, Joseph Fargione, Julia Prochnik, Maya Batres, Mary Gleason, Michael Schindel, Charlotte Stanley, Benjamin Sleeter

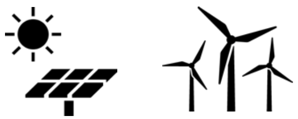
Multiple collaborators from the various organizations: UC Santa Barbara, Evolved Energy, Montara Mountain Energy, University of San Francisco, University of Queensland, JASenergies, USGS

Results and methods presented will be published in a forthcoming academic, peer reviewed paper

- Geographic Scope
- Modeling Context

Research questions

In scenarios that achieve **net zero** economy-wide emissions by 2050 for the **11 western US states**, how do natural and agricultural land protections and energy pathway assumptions affect...



- The total renewable potential and **land/ocean use requirements**?

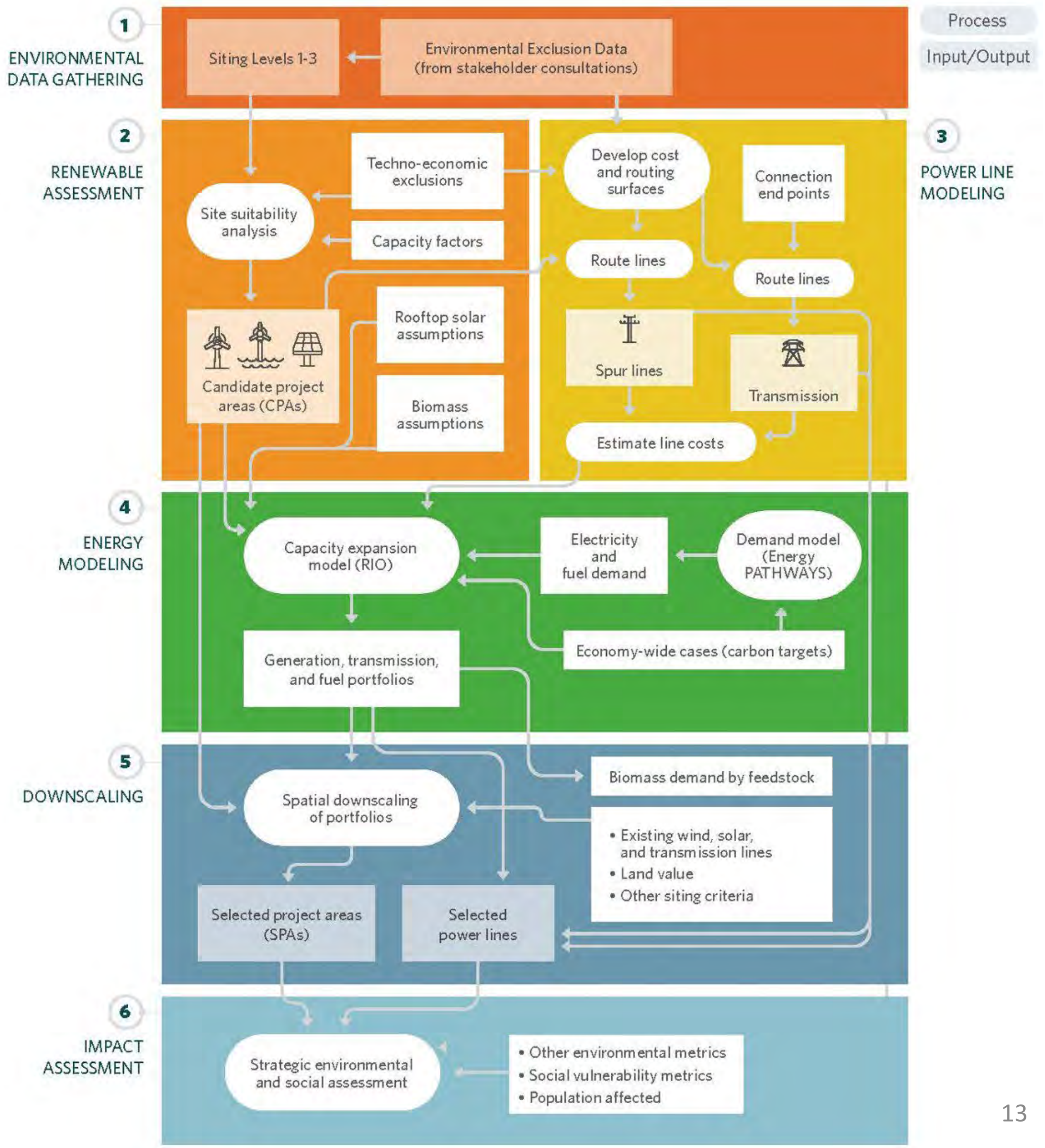
- **Optimal technology** investments?

- Total electricity **system costs**?

- **Environmental and social impacts** due to project development?

Power of Place West Methods

Spatial planning framework/ methodology

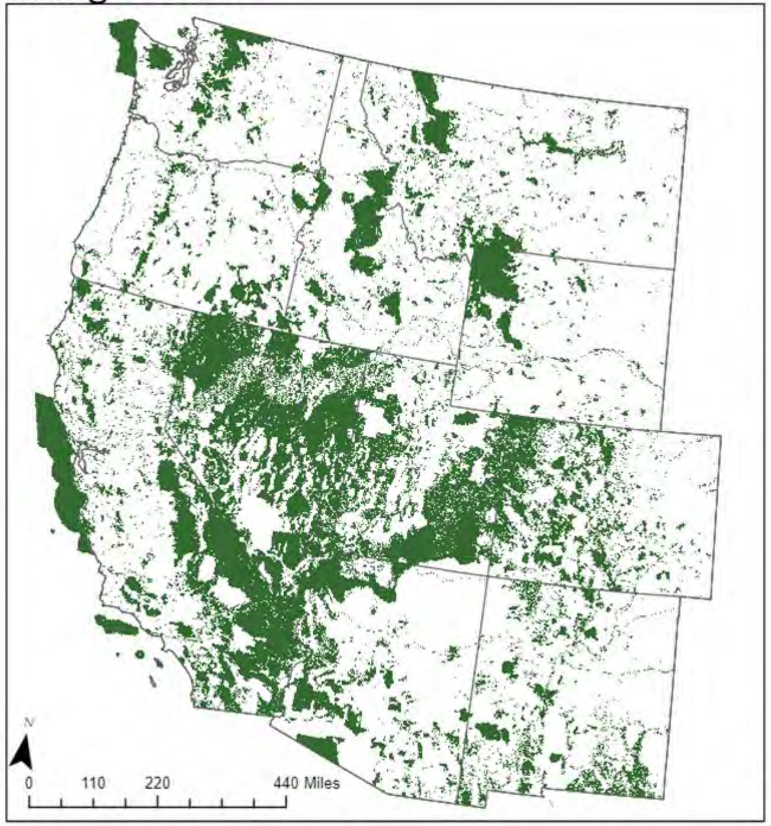


Siting Levels

Categories of Exclusion	Definition of Category for wind and solar	Examples	Biomass
Level 1	**Legally protected:** Areas with existing legal restrictions	National Wildlife Refuges, National Parks, Marine Sanctuaries, Military Training Areas	All feedstocks included, but exclude potential supply from conservation reserve program land
Level 2	**Administratively protected: Level 1** + areas with existing administrative and legal designations where state or federal law requires consultation or review and lands owned by non-governmental organizations (NGOs) on which there are conservation restrictions.	Critical Habitat for Threatened or Endangered Species, Sage Grouse Priority Habitat Management Areas, vernal pools and wetlands, tribal lands	No net expansion of land for purpose-grown herbaceous biomass crops. Specifically, land available for herbaceous biomass crops (miscanthus and switchgrass) is limited to the share of land currently cultivated for corn that is eventually consumed as corn ethanol, which is phased out in all net zero scenarios by 2050.
Level 3	**High conservation value: Level 2** + areas with high conservation value as determined through multi-state or ecoregional analysis (e.g., state, federal, academic, NGO) and lands with social, economic, or cultural value.	Prime Farmland, Important Bird Areas, big game priority habitat and corridors, TNC Ecologically Core Areas, “Resilient and Connected Network”	Same as Level 2

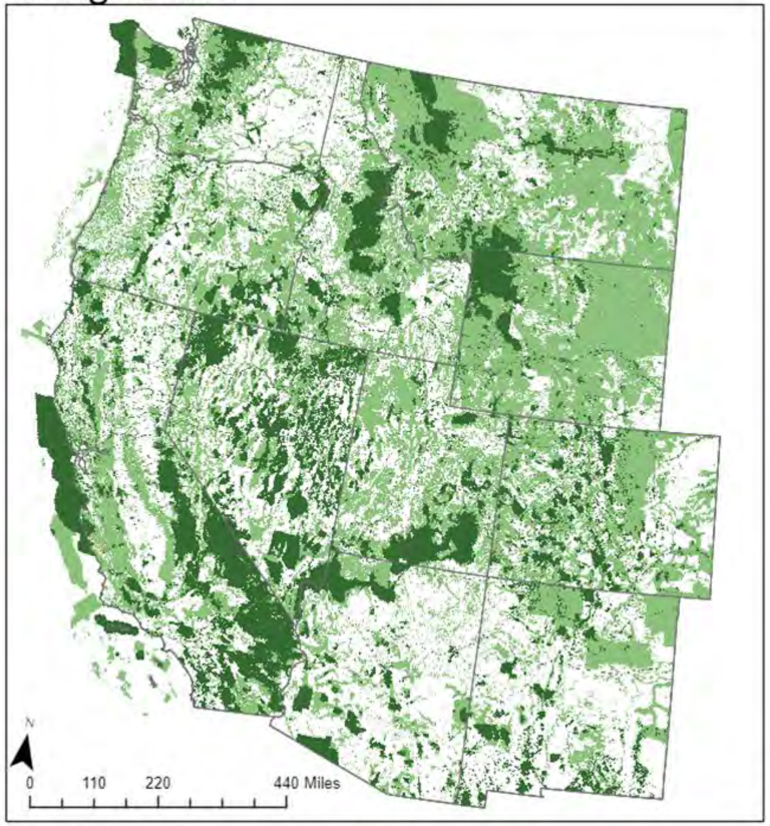
Siting Levels

Siting Level 1



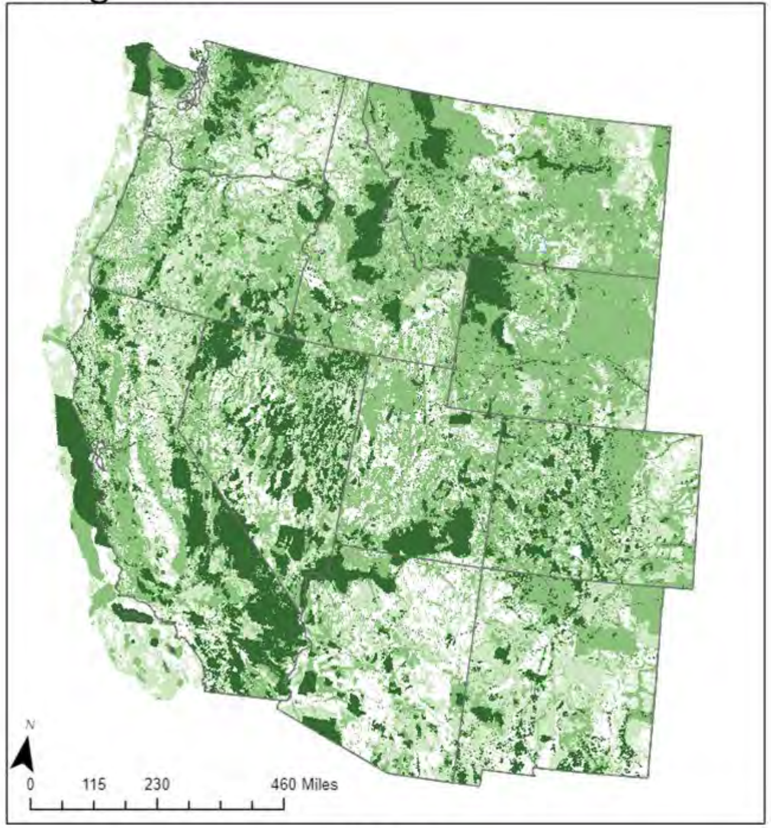
Excludes Category 1

Siting Level 2



Excludes Category 1, 2

Siting Level 3



Excludes Category 1, 2, 3

Resource Potential Characterization

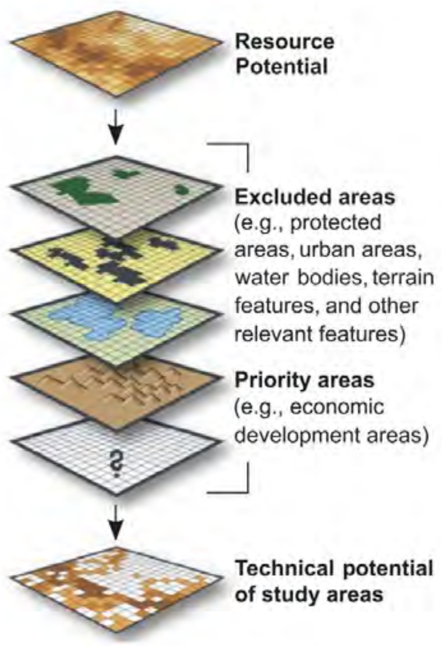
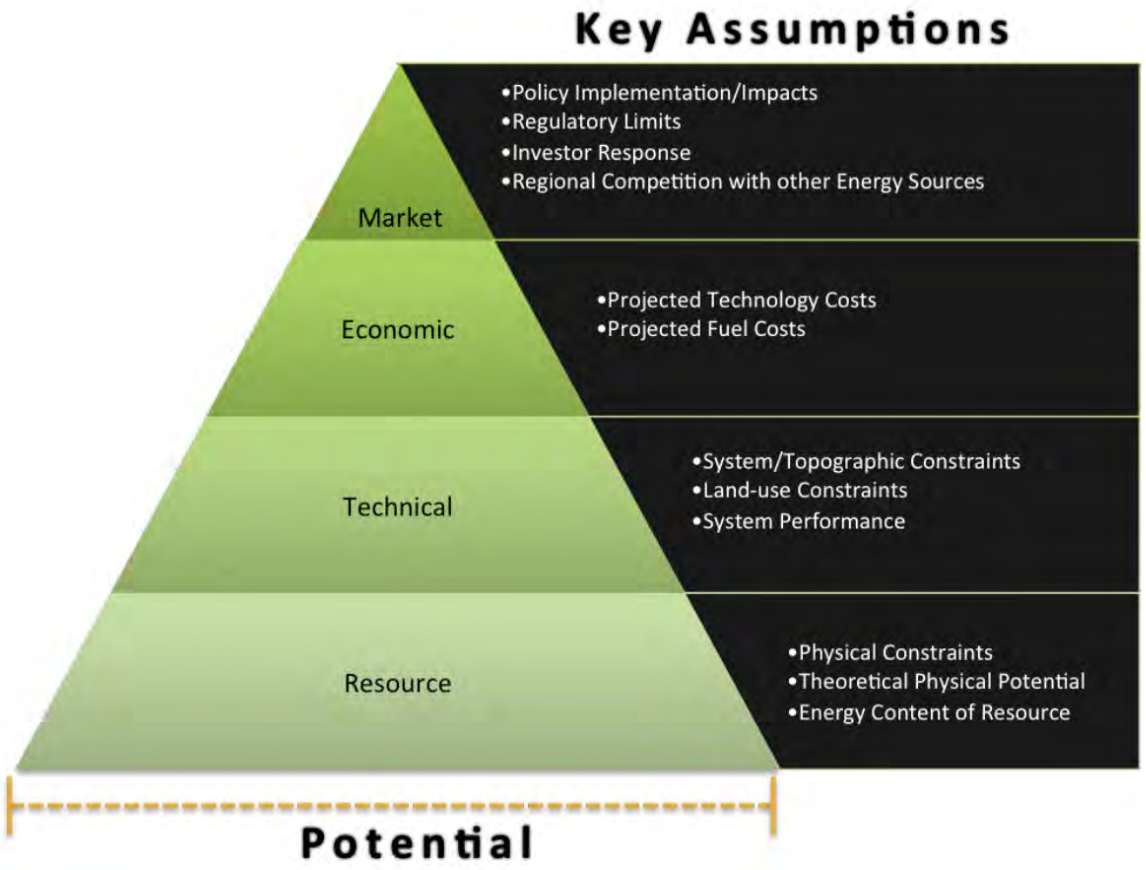


Figure 3. Process of screening resource potential to calculate the technical potential of study areas.
Adapted from Lopez (2016)



https://greeningthegrid.org/Renewable-Energy-Zones-Toolkit

Transmission Routing and Costing Multipliers

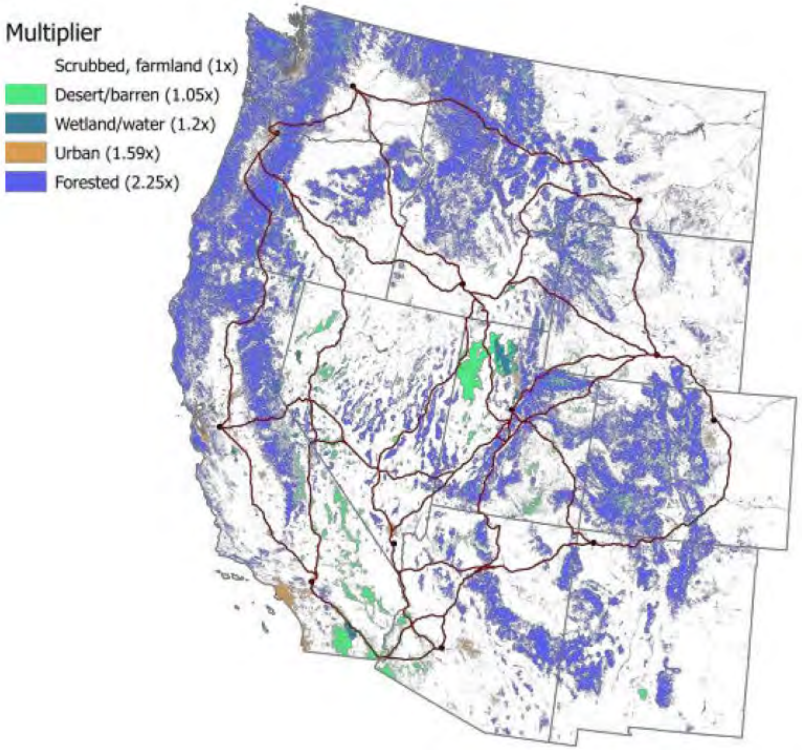


Fig. S7. Least cost path model results showing selected cost surface mutlipliers and new 500 kV transmission lines.

Table S7. Transmission routing multipliers

Multiplier	GIS layer	Use	Criteria	Value[1]
Terrain	MRLCD (30)	routing	Forested	2.25
Terrain	MRLCD (30)	routing	Urban	1.59
Terrain	MRLCD (30)	routing	Wetlands (and water)[5]	1.20
Terrain	MRLCD (30)	routing	Desert/barren	1.05
Terrain	MRLCD (30)	routing	Scrubbed/Farmland/(& other)[5]	1.00
Slope	USGS (31)	routing	mountain (greater than 4 degrees)	1.75
Slope	USGS (31)	routing	rolling hills (between 1 and 4 degrees)	1.40
Slope	USGS (31)	routing	flat (less than 1 degree)	1.00
Environmental Risk	The Nature Conservancy	routing	Category 1	100 (TNC)[3]
Environmental Risk	The Nature Conservancy	routing	Category 2	20 (TNC)
Environmental Risk	The Nature Conservancy	routing	Category 3	15 (TNC)
Environmental Risk	The Nature Conservancy	routing	No Category	1 (TNC)
Airports and Runways	EZMT [ref] [ref]	routing	$<$ 5km from either	100 (32)
Existing ROW	HILFD (28)	routing	New builds + in existing ROW	9 (TNC)[7]
Existing ROW	HILFD (28)	routing	Co-locate + outside existing ROW $>=$ 230 kV	9 (TNC)[7]
Existing ROW	HILFD (28)	routing	230 kV reconductor + outside existing ROW = 230 kV	2.22[9]
Existing ROW	HILFD (28)	routing	345 kV reconductor + outside existing ROW = 345 kV	1.82[9]
Existing ROW	HILFD (28)	routing	500 kV reconductor + outside existing ROW = 500 kV	1.54[9]
Tower structure	Population Density, USDOT (33)	both	230 kV + population density $>$ 100 people/square mile	1.1
Tower structure	Population Density, USDOT (33)	both	345 kV + population density $>$ 100 people/square mile	1.3
Tower structure	Population Density, USDOT (33)	both	500 kV + population density $>$ 100 people/square mile	1.5
Wildfire risk	Risk to Potential Structures in USDA Forest Service (34)	both	risk scaled[6]	1 to 5 (TNC)[2]
AFUDC and overhead	continental US	costing	All	1.175
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Forested	2.25
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Mountain	1.75
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Urban	1.59
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Rolling hills	1.40
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Wetland (& water)[5]	1.20
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Desert/barren land	1.05
B&V Terrain/Slope	USGS (31) MRLCD (30)	costing	Scrubbed/Farmland/(& other)[5]	1.00
Environmental Risk	The Nature Conservancy	costing	Category 1	1.2 (TNC)[4]
Environmental Risk	The Nature Conservancy	costing	Category 2	1.1 (TNC)[8](35)
Environmental Risk	The Nature Conservancy	costing	Category 3	1.05 (TNC)[8](35)
Environmental Risk	The Nature Conservancy	costing	No Category	1 (TNC) (35)

Economy-wide Energy Modeling Framework - Tools

	ENERGY PATHWAYS	RIO
Description	Scenario analysis tool that is used to develop economy-wide energy demand scenarios	Optimization tool to develop portfolios of low-carbon technology deployment for electricity generation and balancing, alternative fuel production, and direct air capture
Application	EnergyPATHWAYS (EP) scenario design produces parameters for RIO's supply-side optimization: • Demand for fuels (electricity, pipeline gas, diesel, etc.) over time • Emissions caps by year • Hourly electricity load shape	RIO returns optimized supply-side decisions to EP for cost and emissions accounting: • Electricity sector portfolios, including renewable mix, energy storage capacity & duration, capacity for reliability, transmission investments, etc. • Biomass allocation across fuels

Power of Place – West Scenarios

Siting Levels

	Scenario	1	2	3
Core scenarios	Reference	x		
	High Electrification	**x**	**x**	**x**
	Slow Electrification	x	x	x
	No fossil fuels (100% RE)	**x**	**x**	**x**
Sensitivities	Electricity only reference	x	x	x
	Electricity only high electrification	x	x	x
	Biomass contraction			x
	Renewables constrained			x
	In-state preference			x

Increasing Environmental Exclusions →

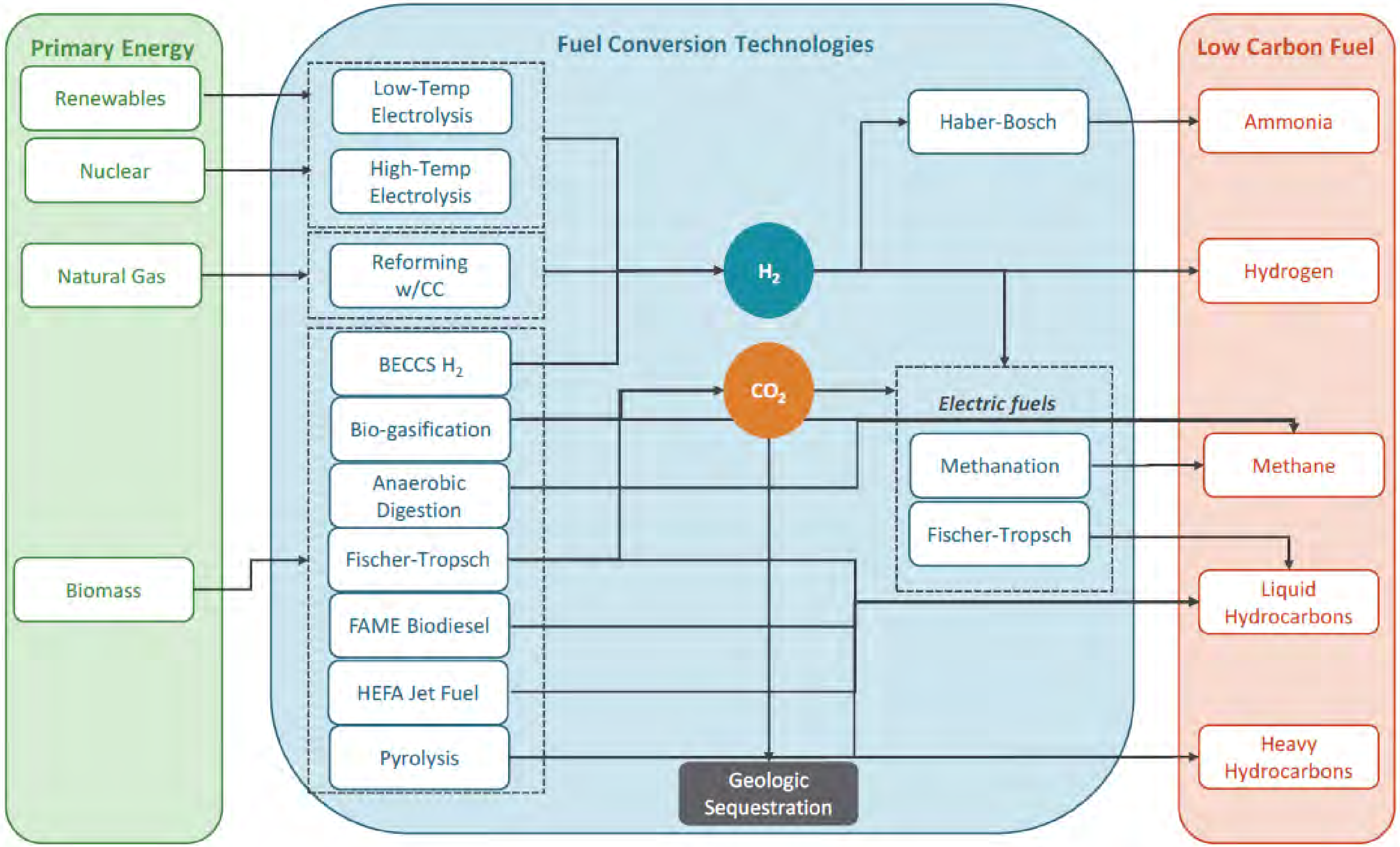
Wide set of technologies options represented

215 Demand-Side Technologies

Electricity Technologies:

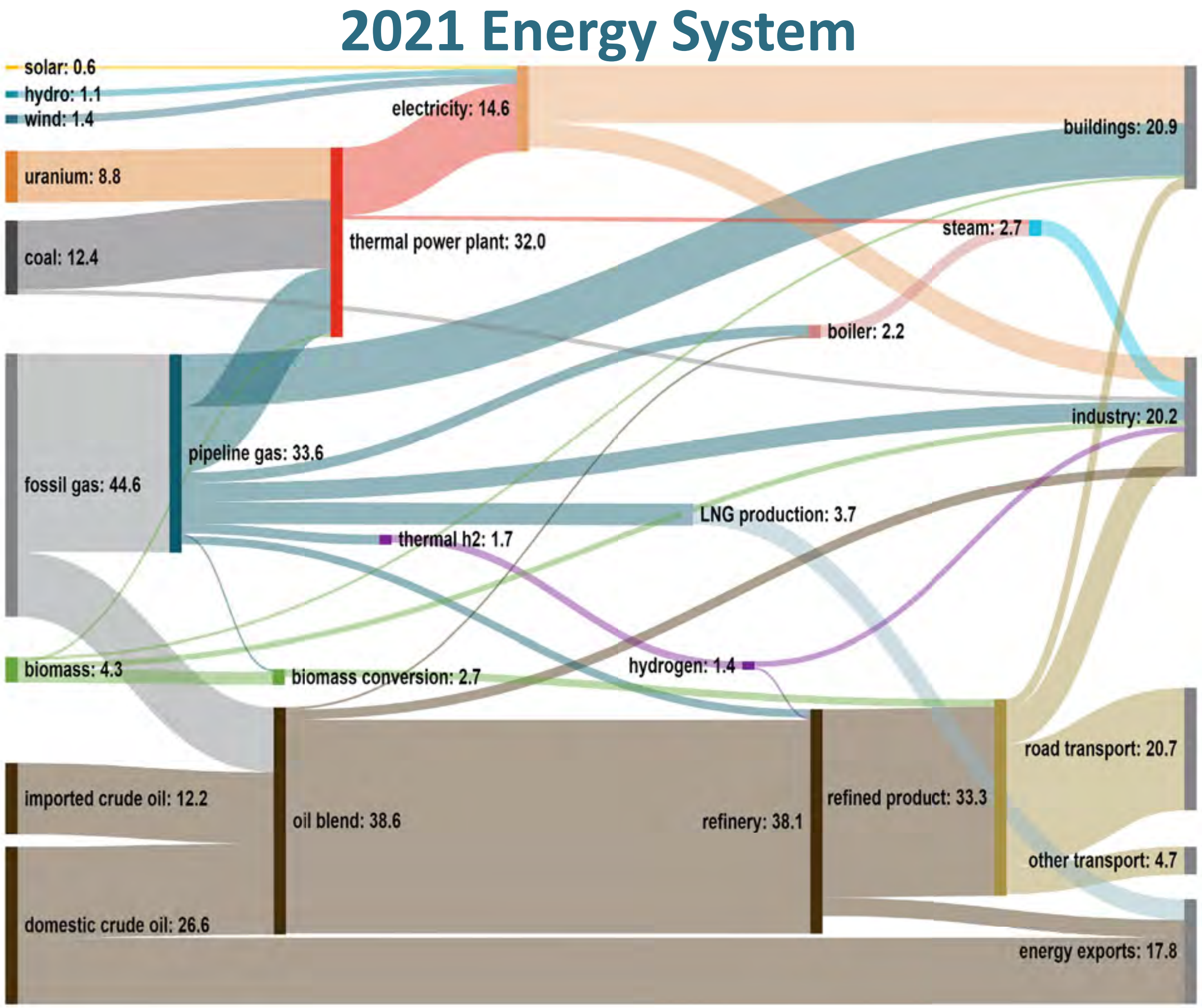
- Rooftop solar, urban infill, ground-mounted
- Onshore wind, offshore wind
- Nuclear, Gas CCGT w/CC, Biomass w/CC
- Gas CCGT & CT
- Geothermal
- Electricity Storage
- Flexible load

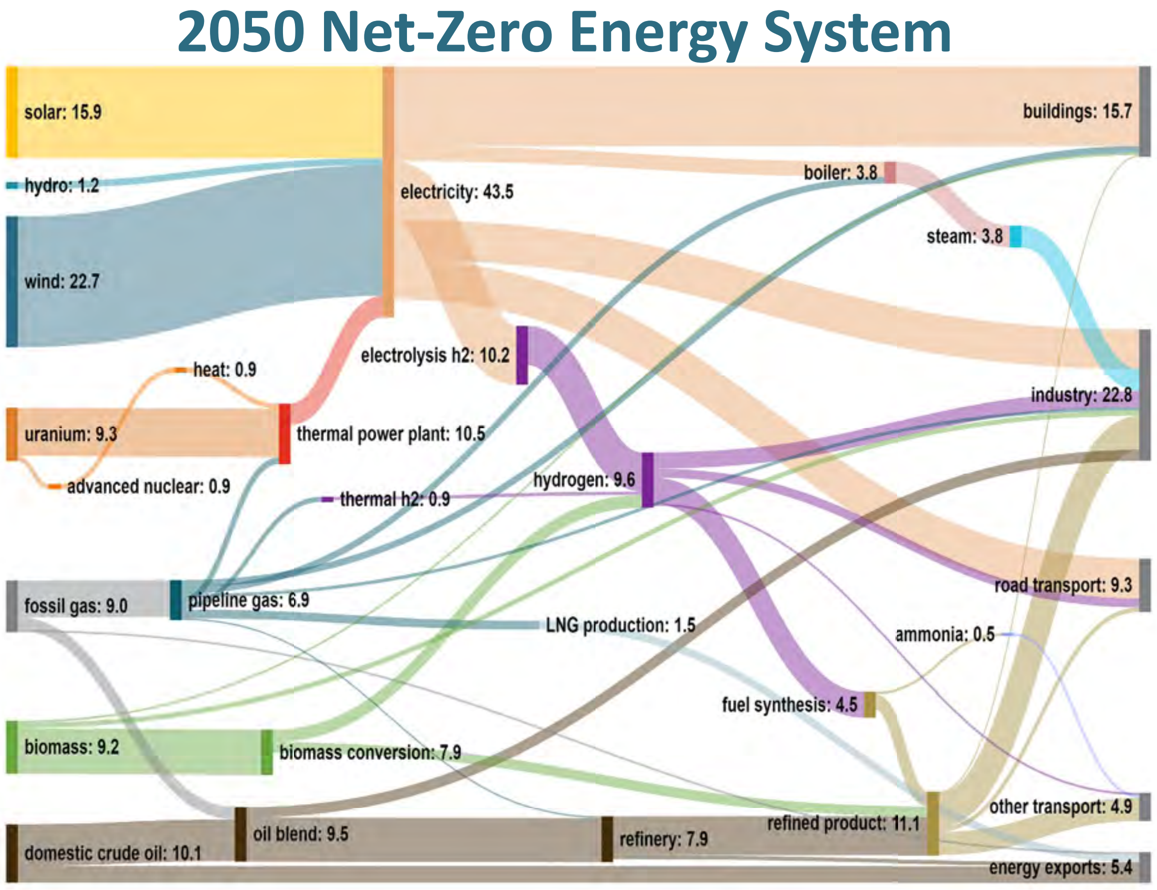
Fuel Technologies



Envisioning a decarbonized energy system for the U.S.

Sankey diagrams (EJ)





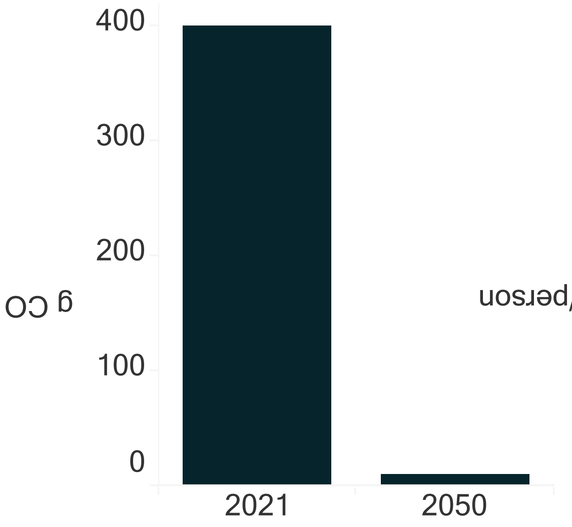
Source: ADP2022 Central Case

Economy-wide Energy Modeling Framework – Four Pillars

U.S. Benchmarks

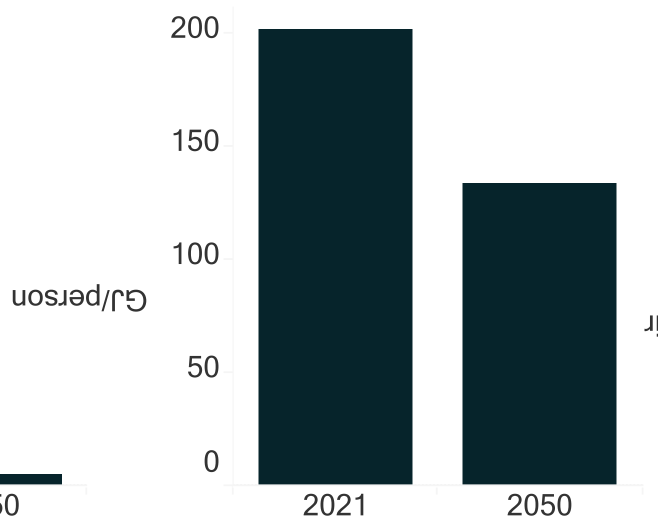
Electricity Decarbonization

95% reduction in emissions intensity



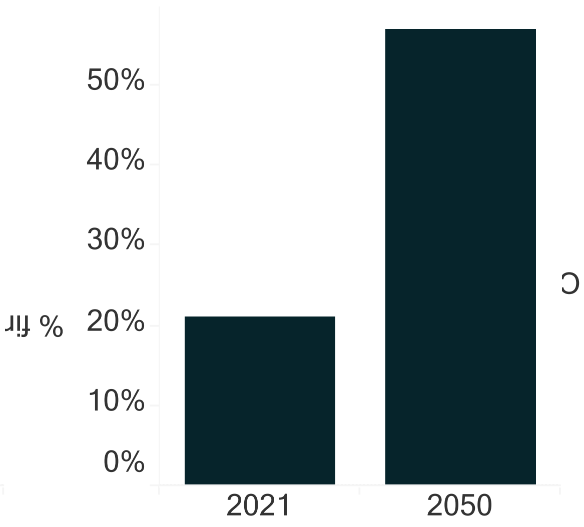
Energy Efficiency

40% reduction in per-capita final energy demand



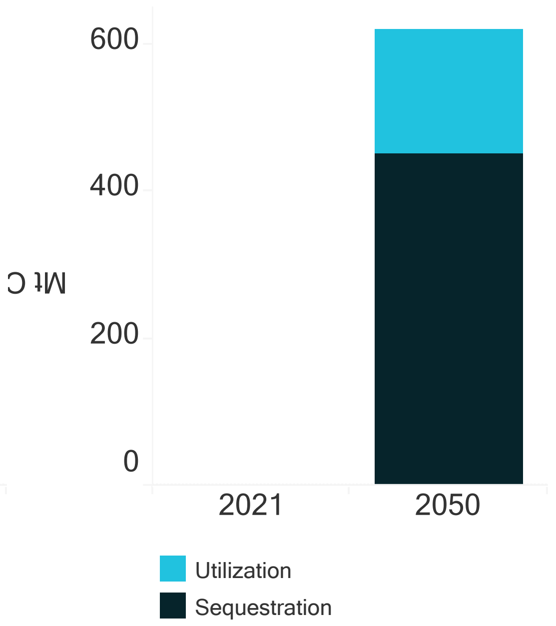
Electrification

300% increase in share of energy from electricity



Carbon Capture

600 MMT+ carbon capture and use/storage



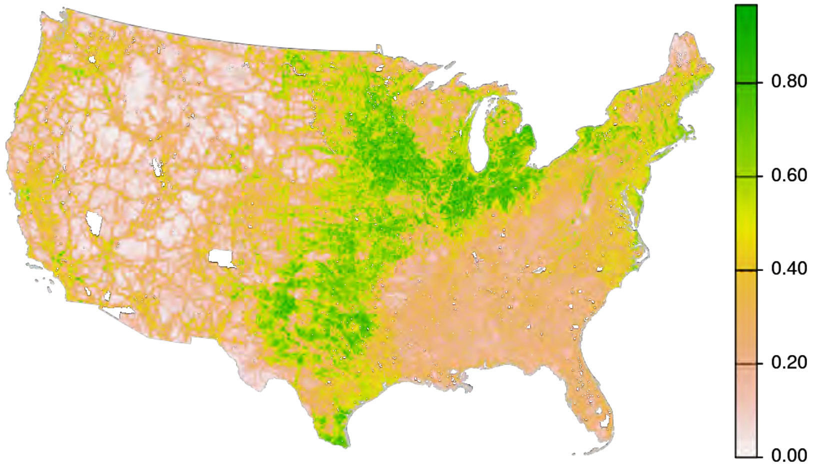
Haley, B., Jones, R.A., Williams, J.H., Kwok, G., Farbes, J., Hargreaves, J., Pickrell, K., Bentz, D., Waddell, A., Leslie, E., Annual Decarbonization Perspective: Carbon Neutral Pathways for the United States 2022. Evolved Energy Research, 2022.

Downscaling

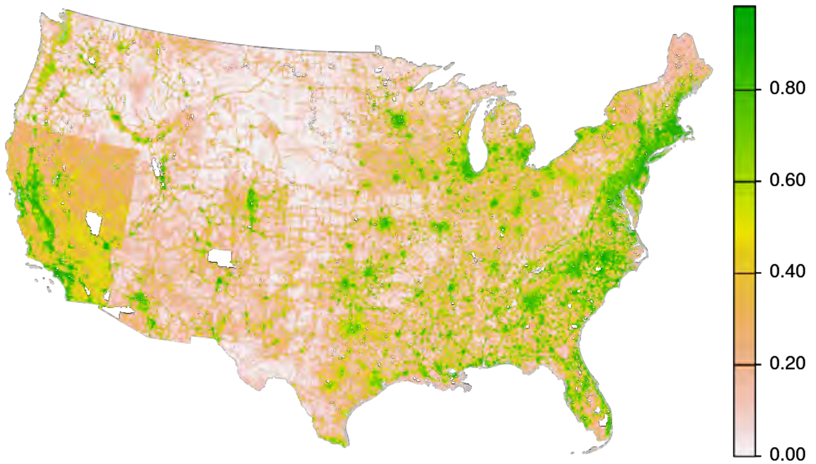
Empirical approach for predicting most suitable new locations for wind and solar development

1. Environmental exclusion categories (environmental sensitivity)
2. Land acquisition cost
3. Population density
4. Distance to roads
5. Distance to substation
6. Distance to transmission
7. Slope
8. Capacity factor (i.e., resource quality)
9. Renewable Portfolio Standards

Random forest prediction surfaces



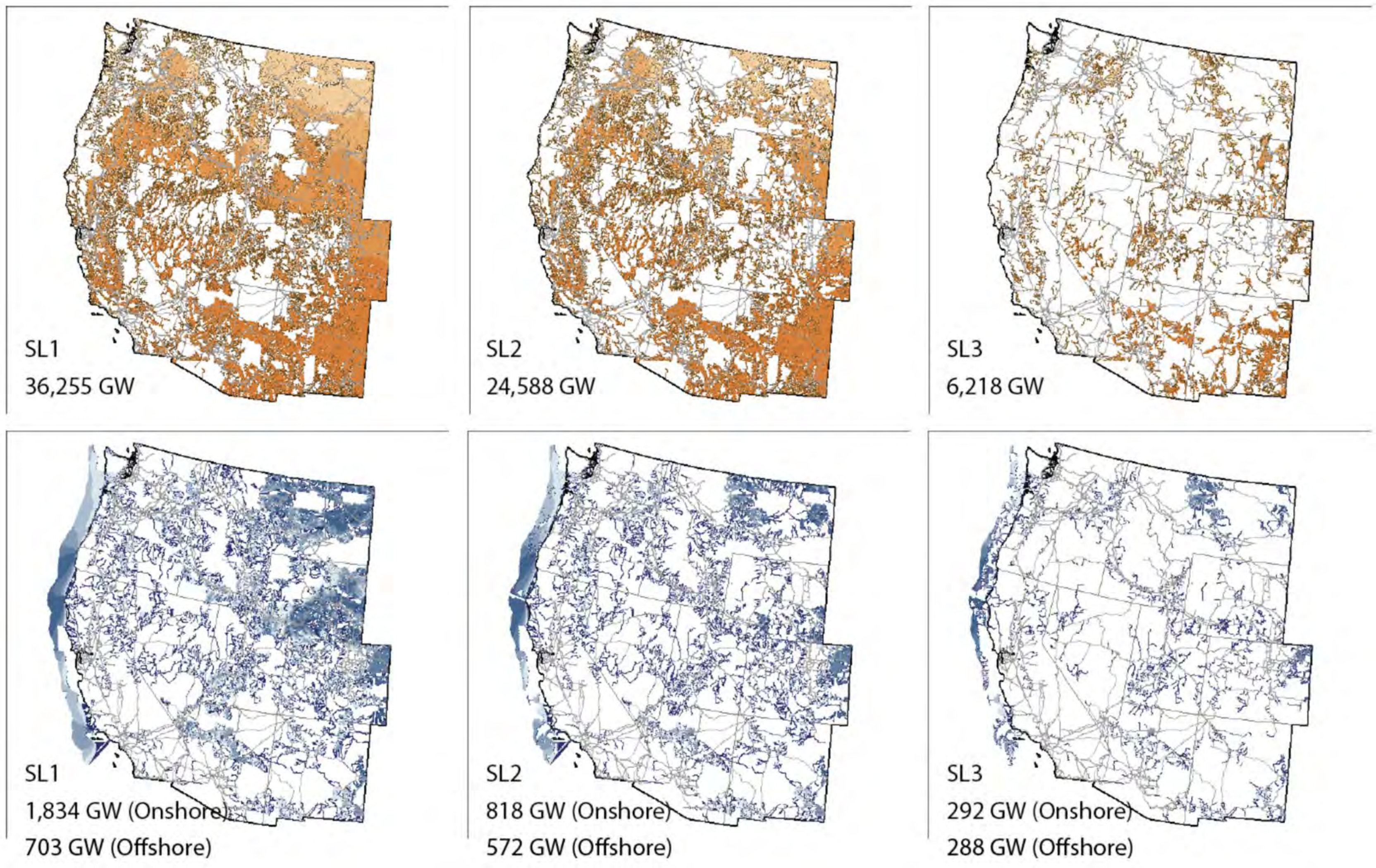
Onshore wind



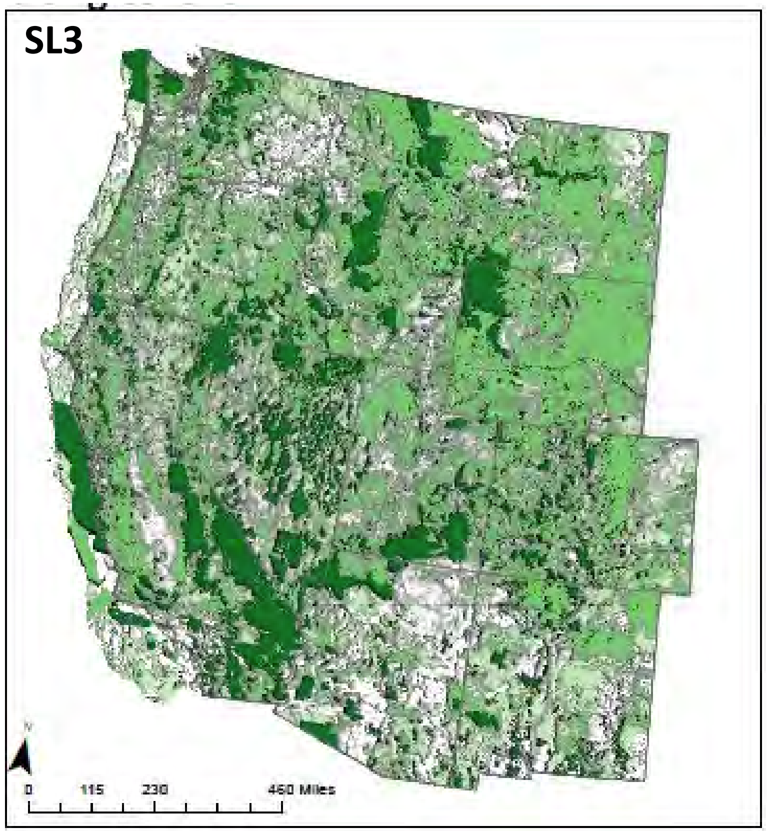
Questions on Methodology?

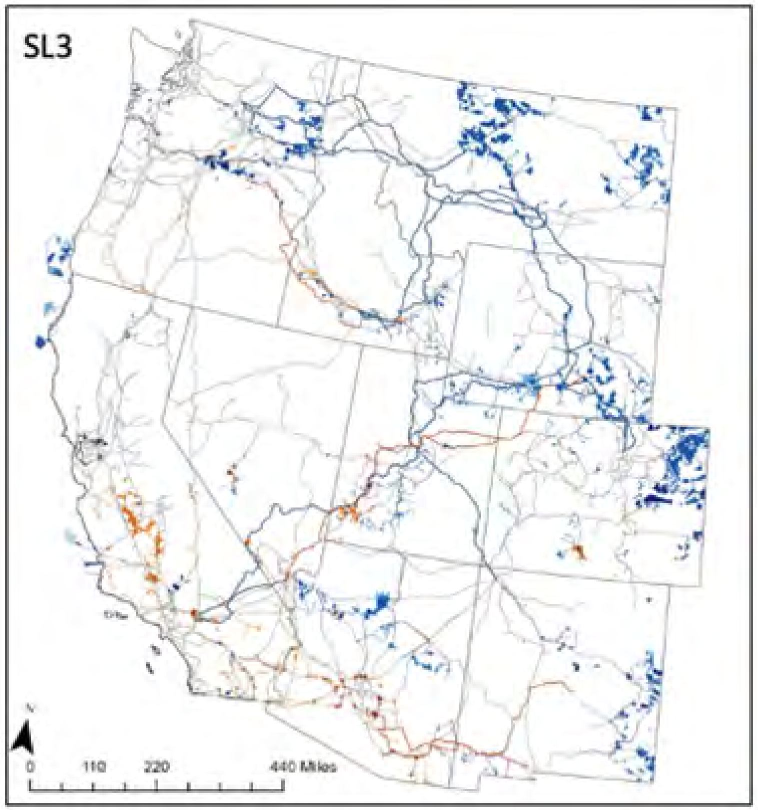
Power of Place West
Key Results

The amount of suitable land is many times the amount needed for 2050 decarbonization.

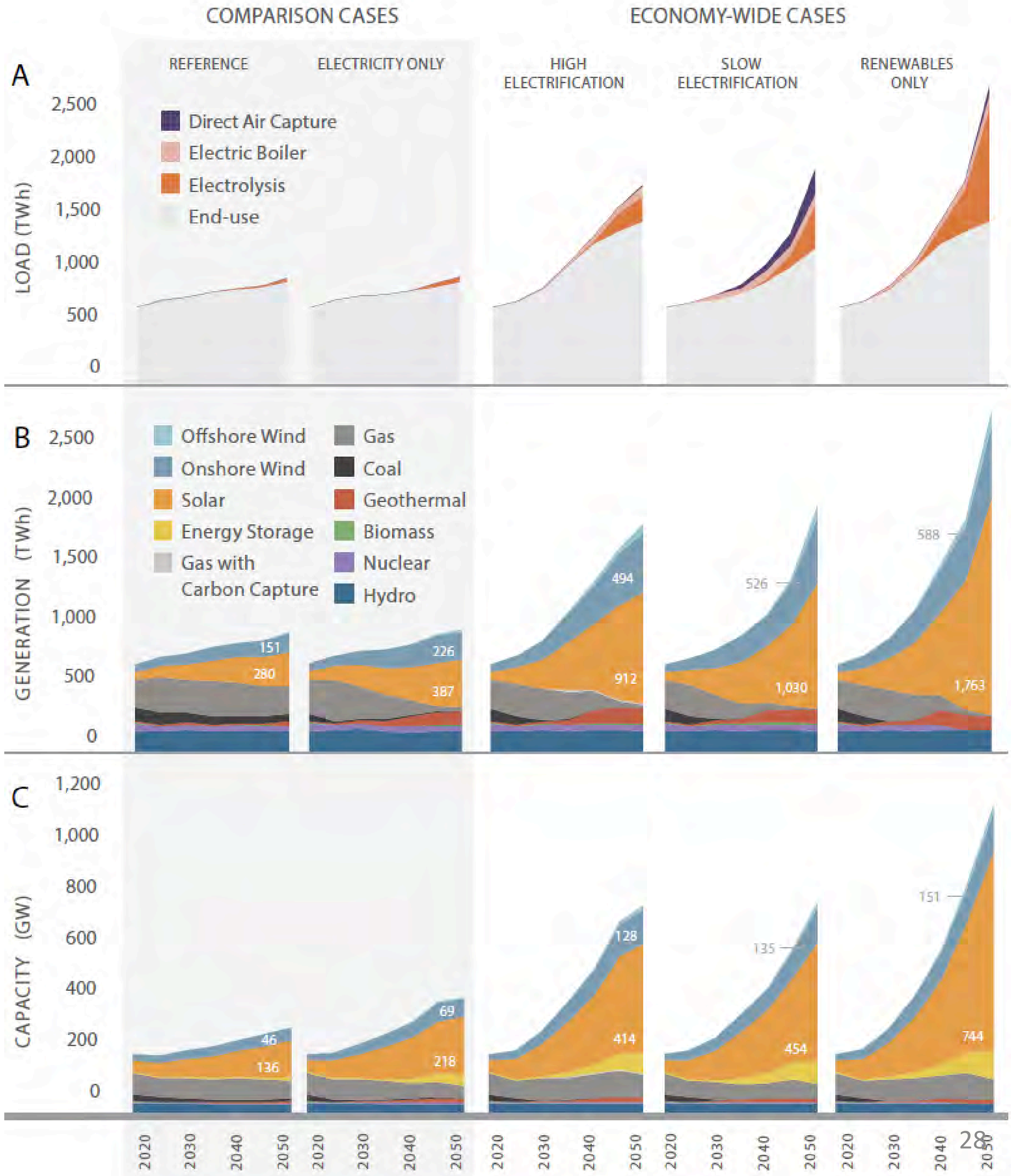


We can achieve economy-wide net-zero greenhouse gas emissions reductions across the West while avoiding the most sensitive natural and working lands.



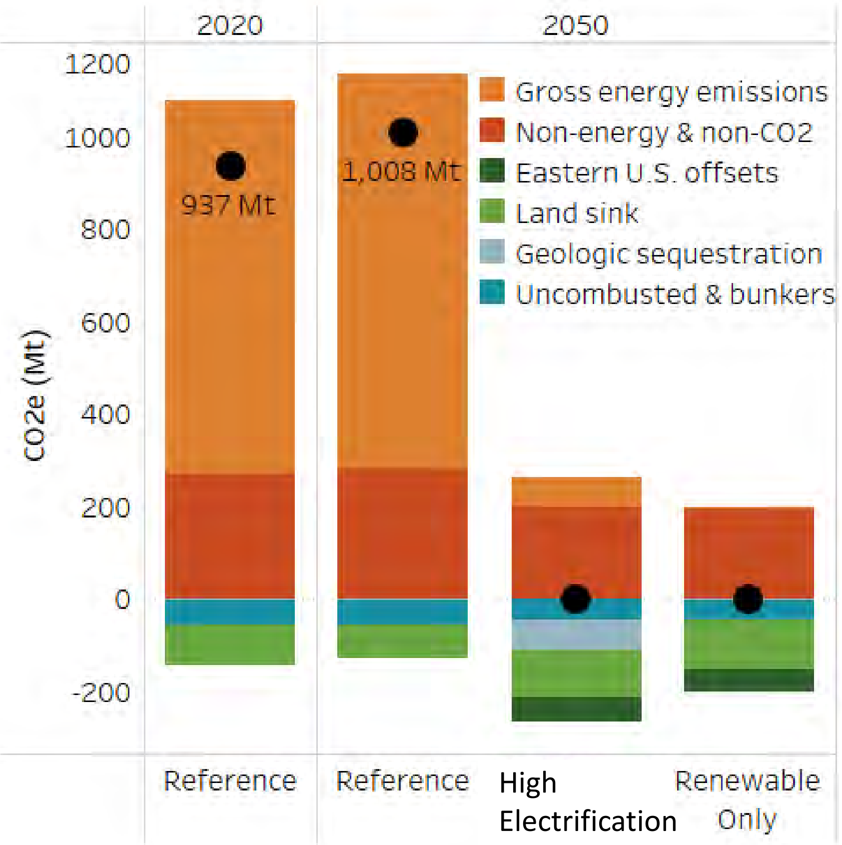


High Electrification results in the lowest new capacity additions by 2050

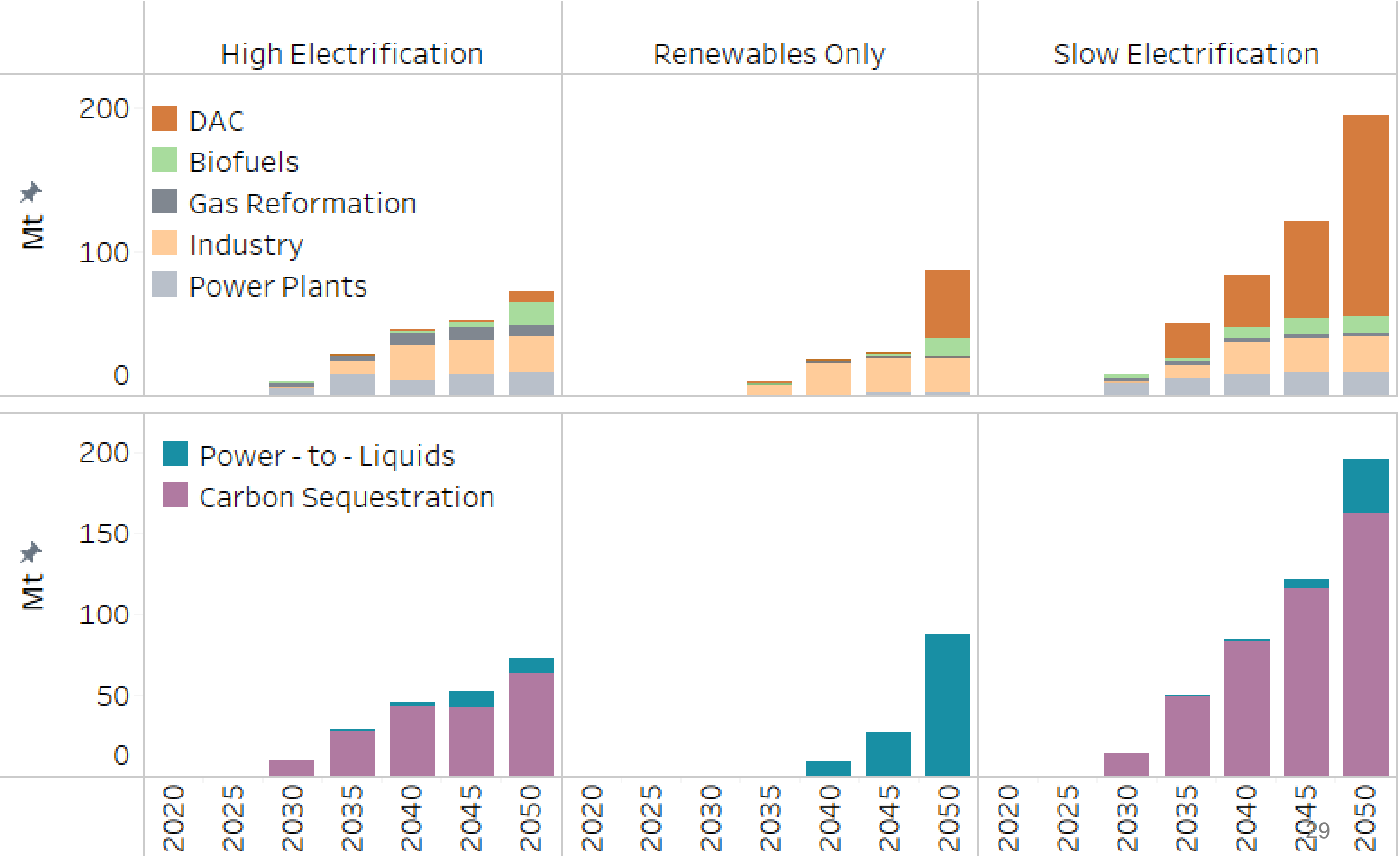


Capturing CO_2 is a necessary part of a net-zero pathway for the U.S. and the Western States. Captured CO_2 can be used as a feedstock to make fuels & materials, or it can be sequestered

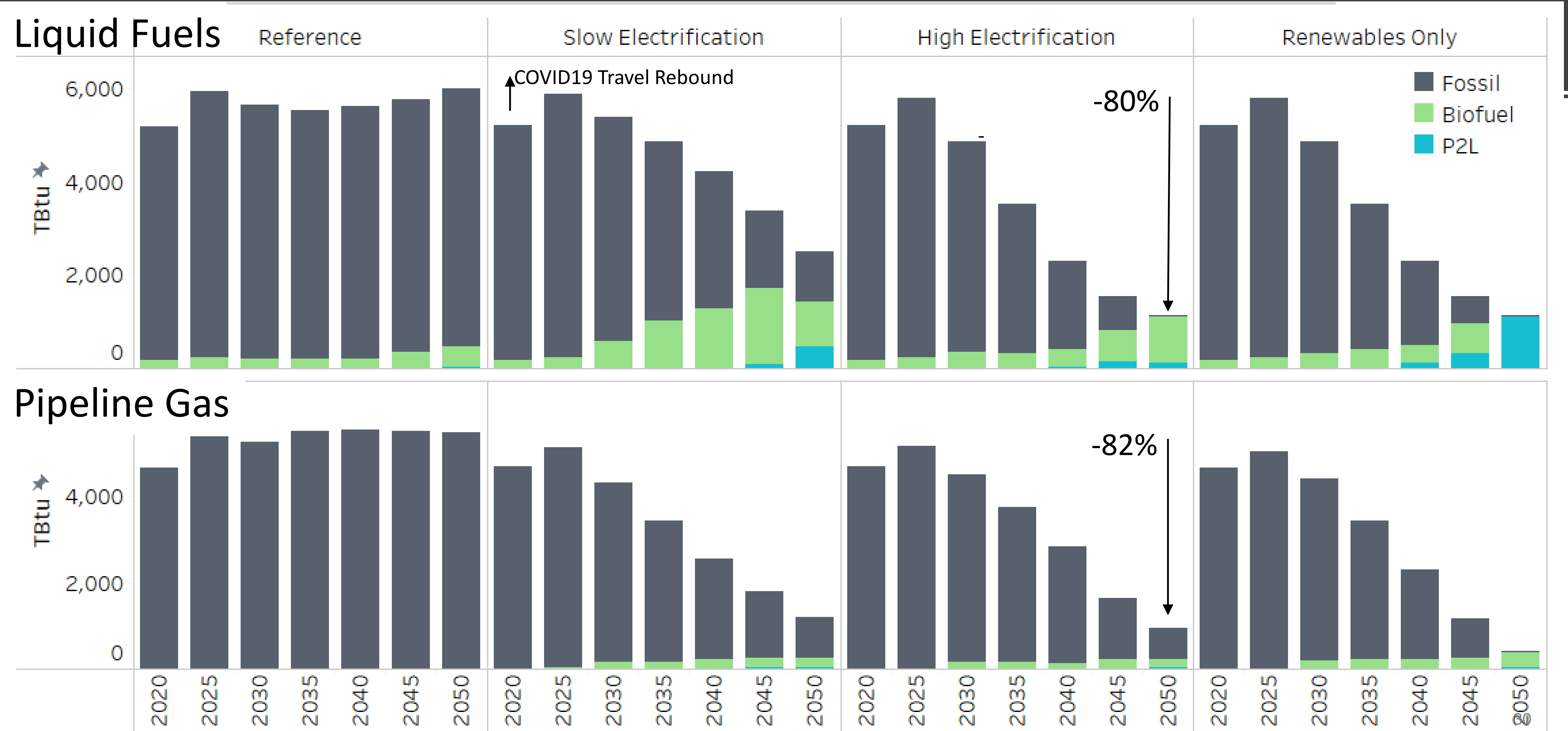
2050 Emissions Accounting



2050 Carbon Capture and Use

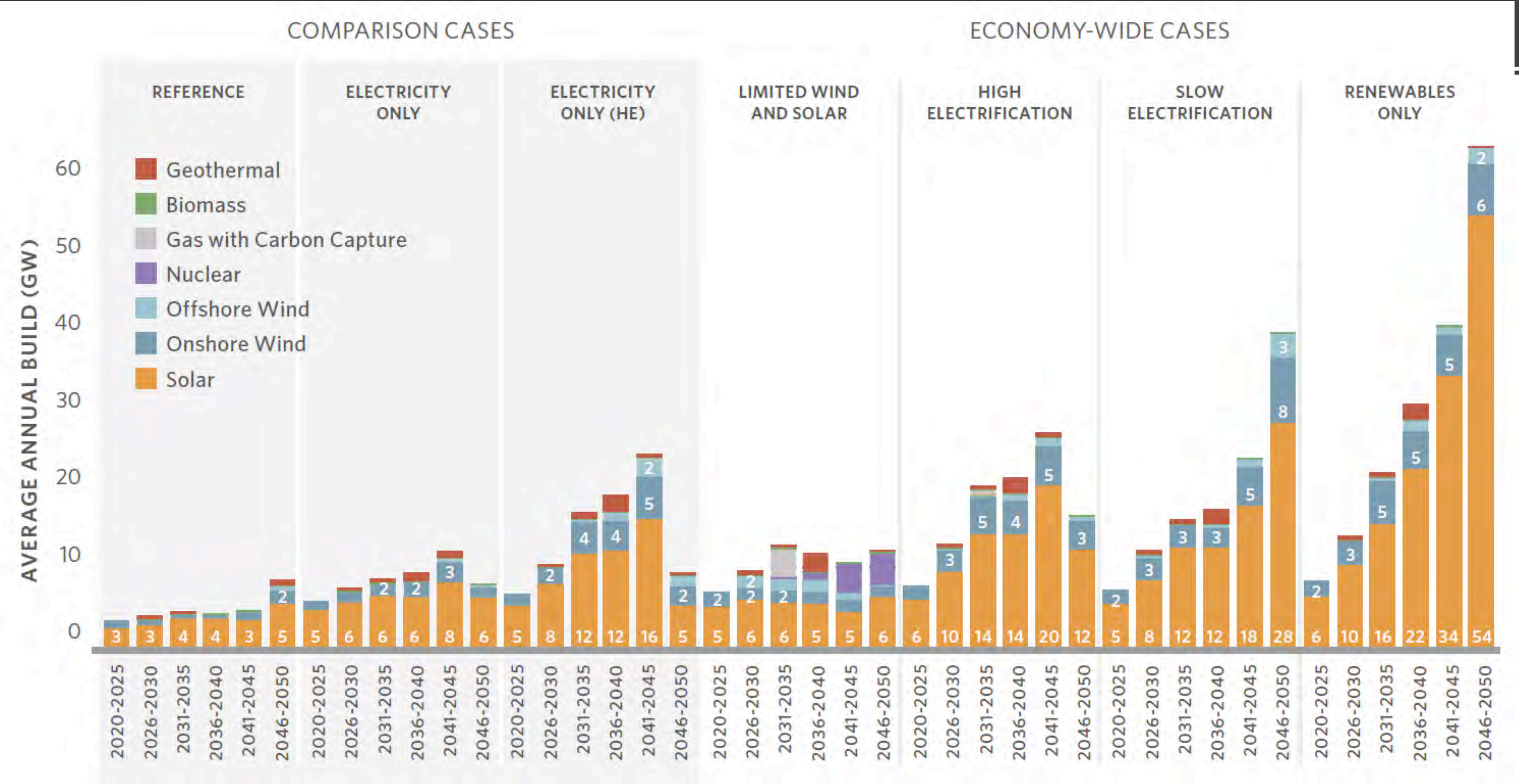


Combusted fuels decrease over 80% if high electrification can be achieved
Remaining liquid combustion primarily in aviation

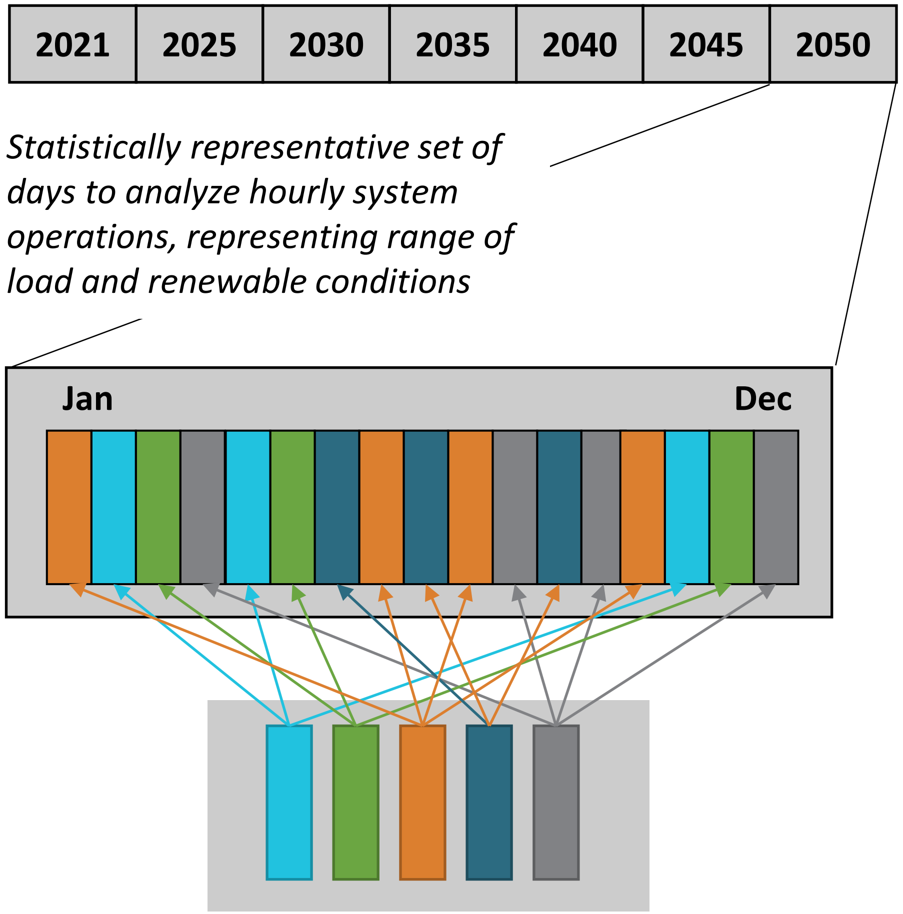


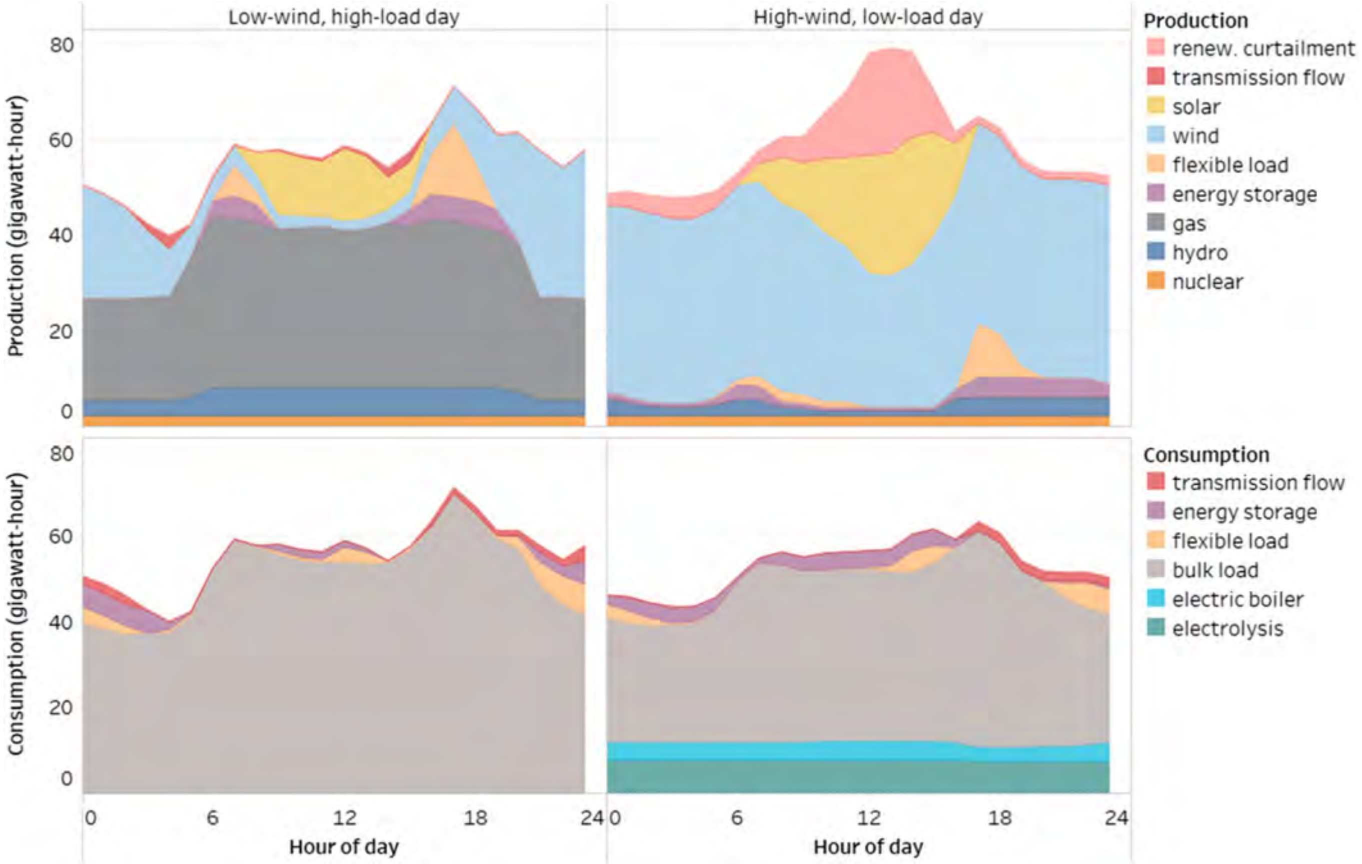
Note: Hydrocarbons used as feedstocks to asphalt or bulk chemicals not included

The annual wind and solar capacity build-rate will need to be 4-8x current rates by 2050



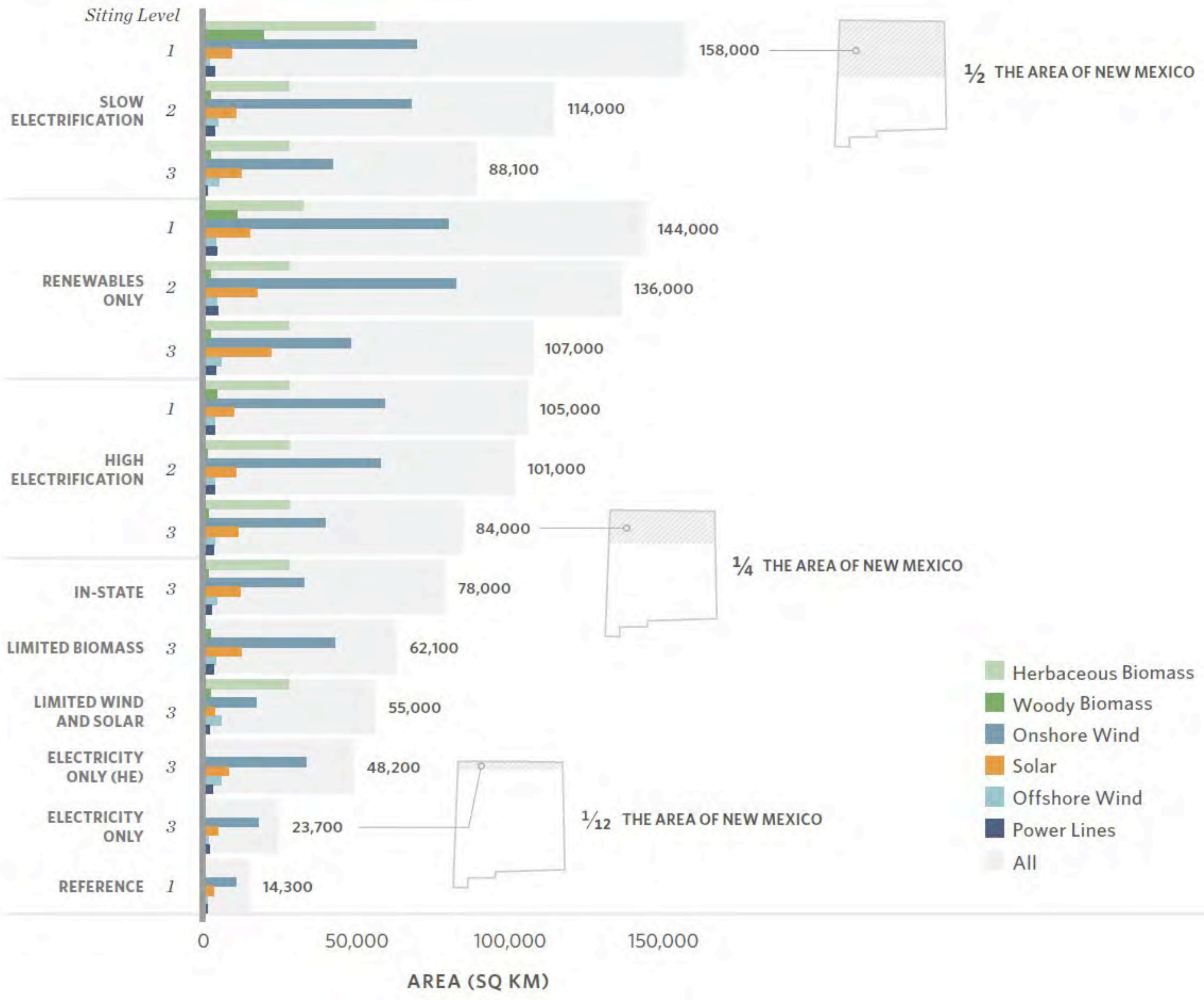
Significant Modeling Effort Went into Ensuring Modeled Systems Were Reliable





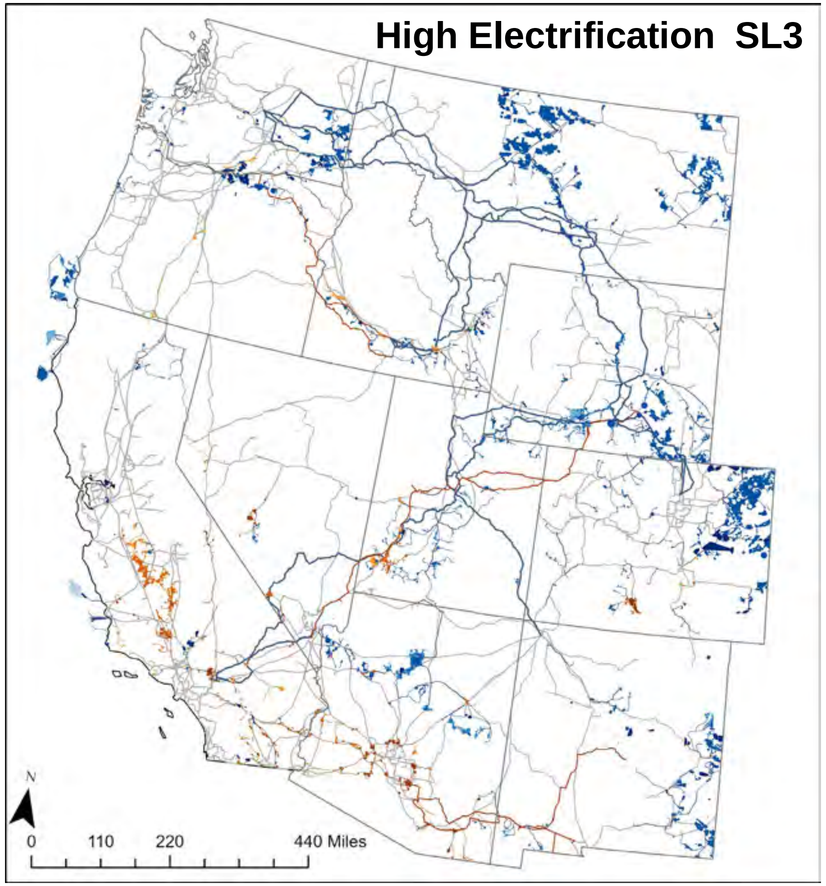
Williams et al, 2011
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020AV000284

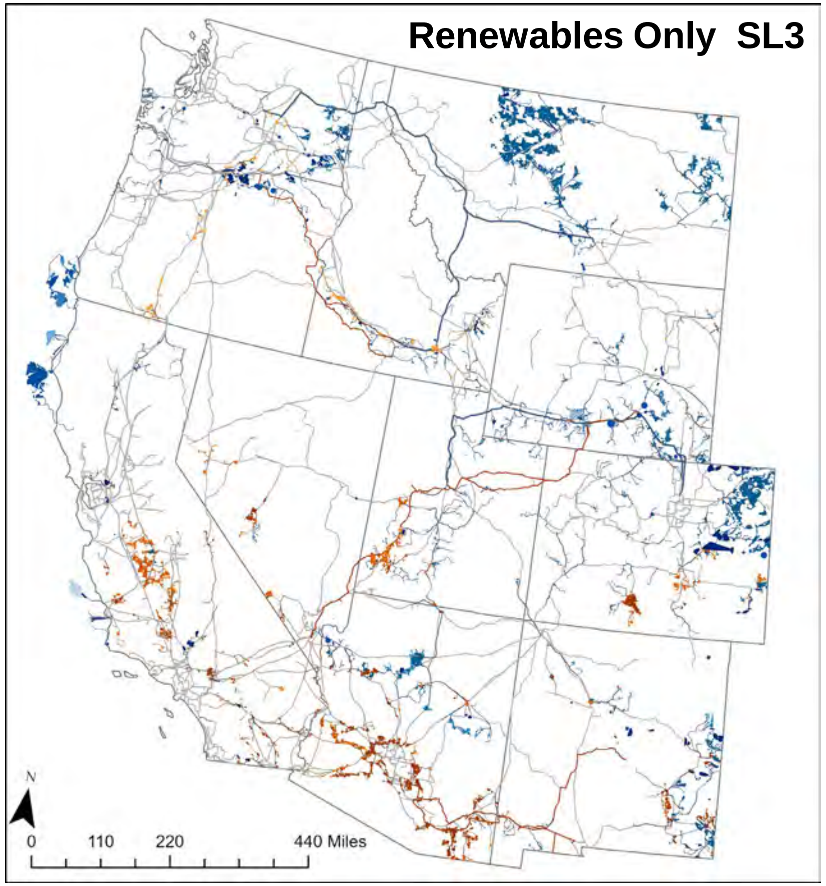
The "High Electrification" case, which utilizes electricity generation the most efficiently, had the lowest total land and ocean area requirements of the core scenarios



The "Renewables Only" wind & solar footprint is 25-30% higher than other scenarios

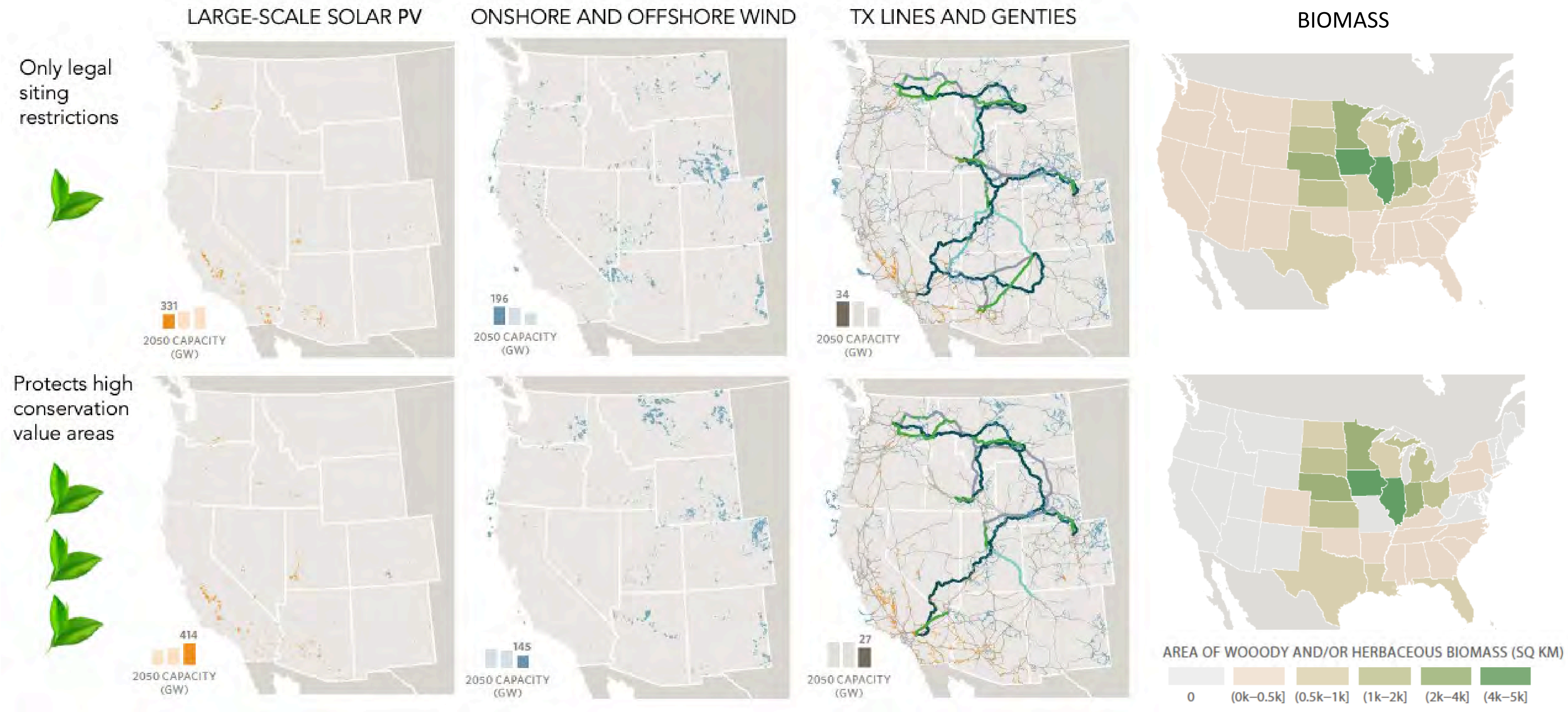
21M Acres



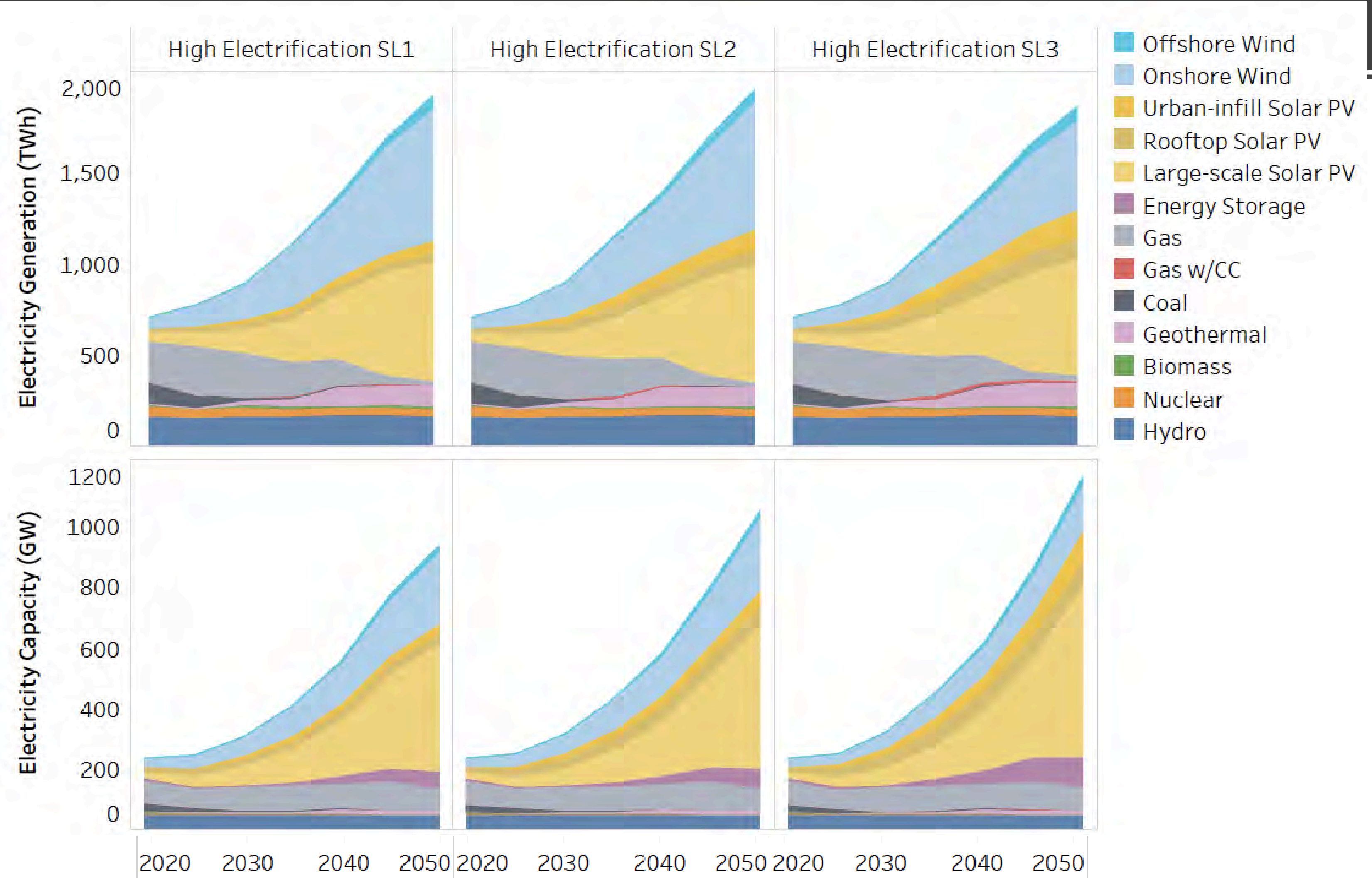


26M Acres

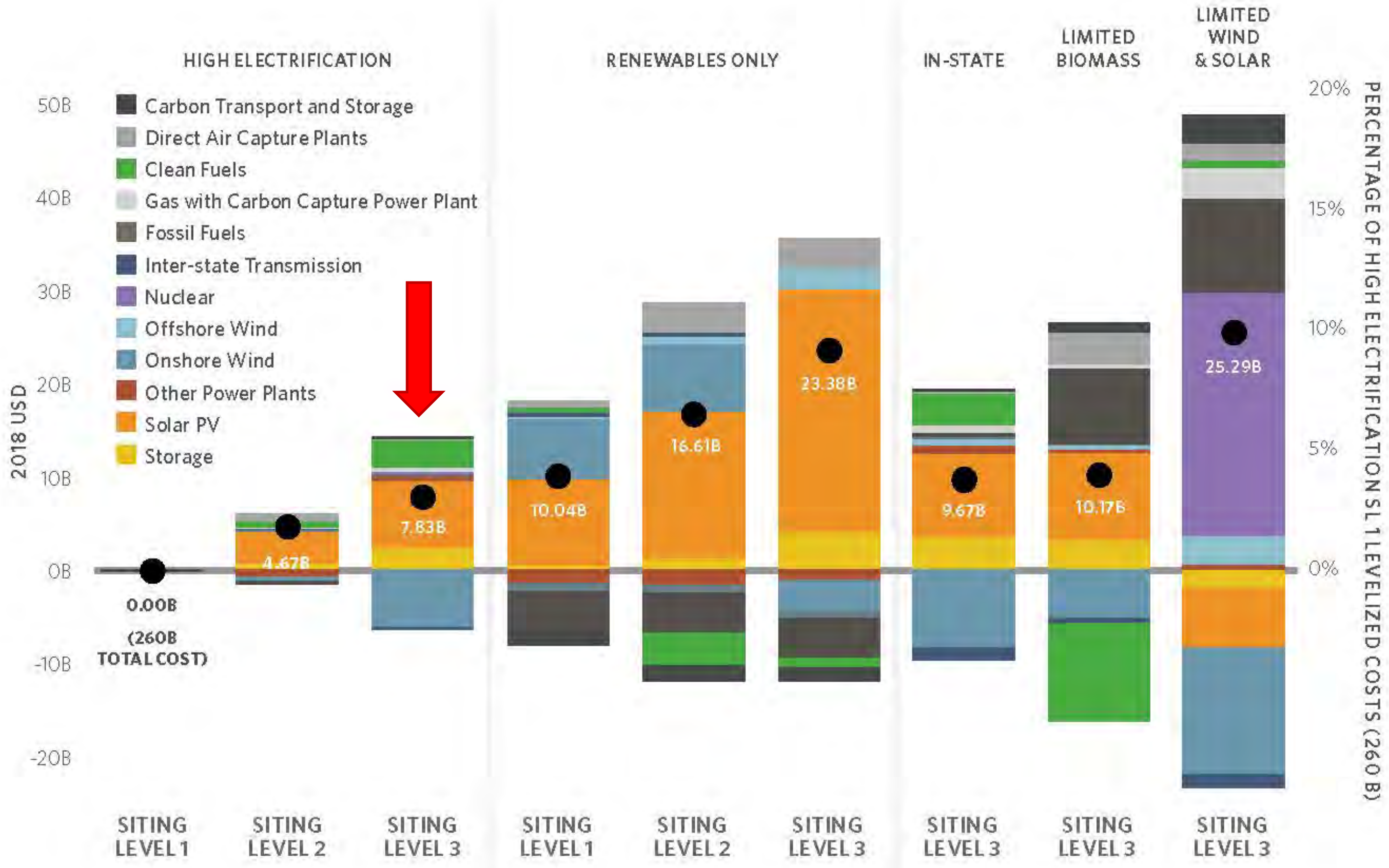
The spatial build-outs of onshore wind, offshore wind, solar PV, transmission and where biomass will be sourced differ in response to different levels of land/ocean use protections



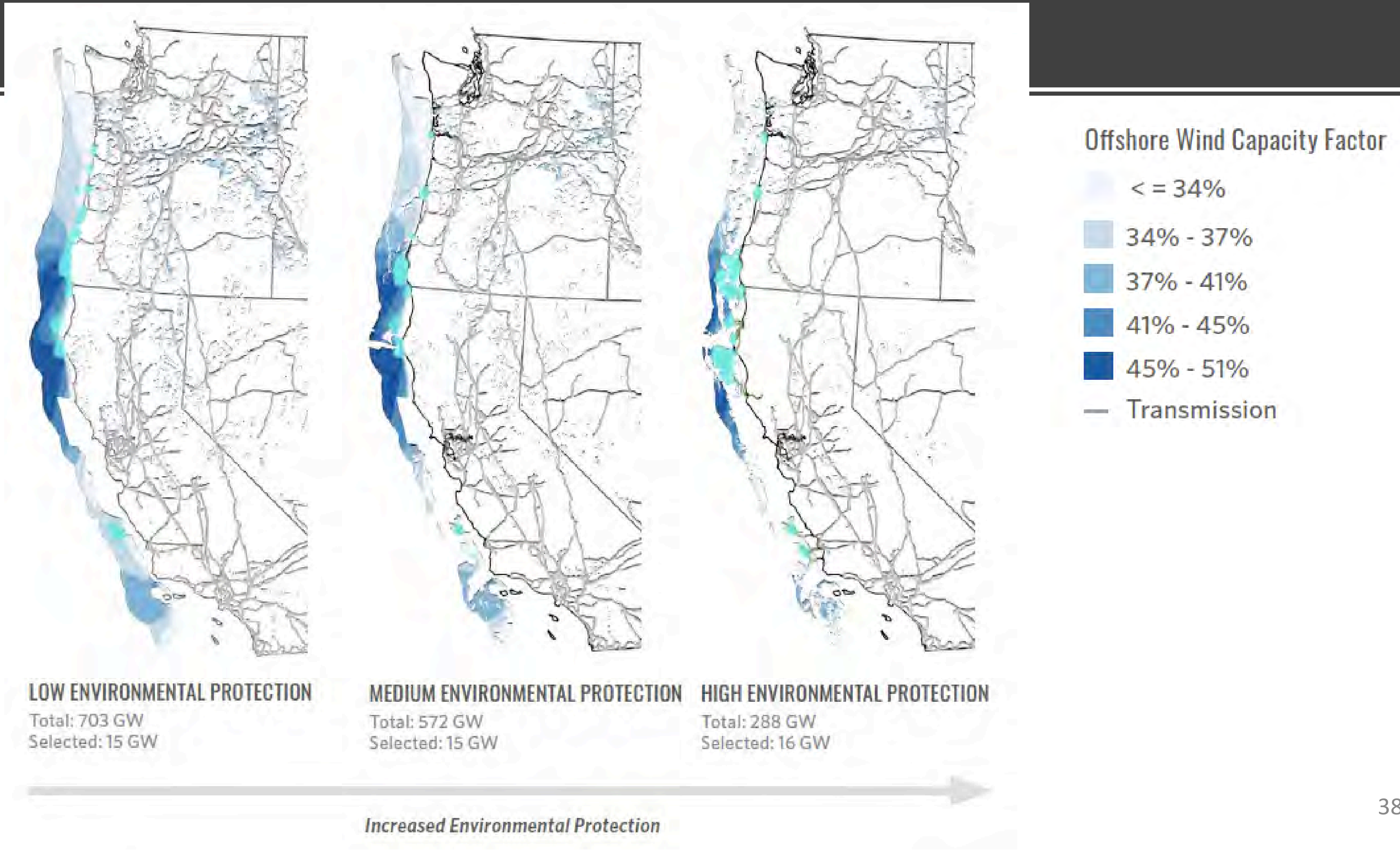
Meeting the net-zero target with stronger environmental protections did not significantly alter the share of different energy generation technologies



Impacts to sensitive natural and working lands can be avoided at minimal additional cost.

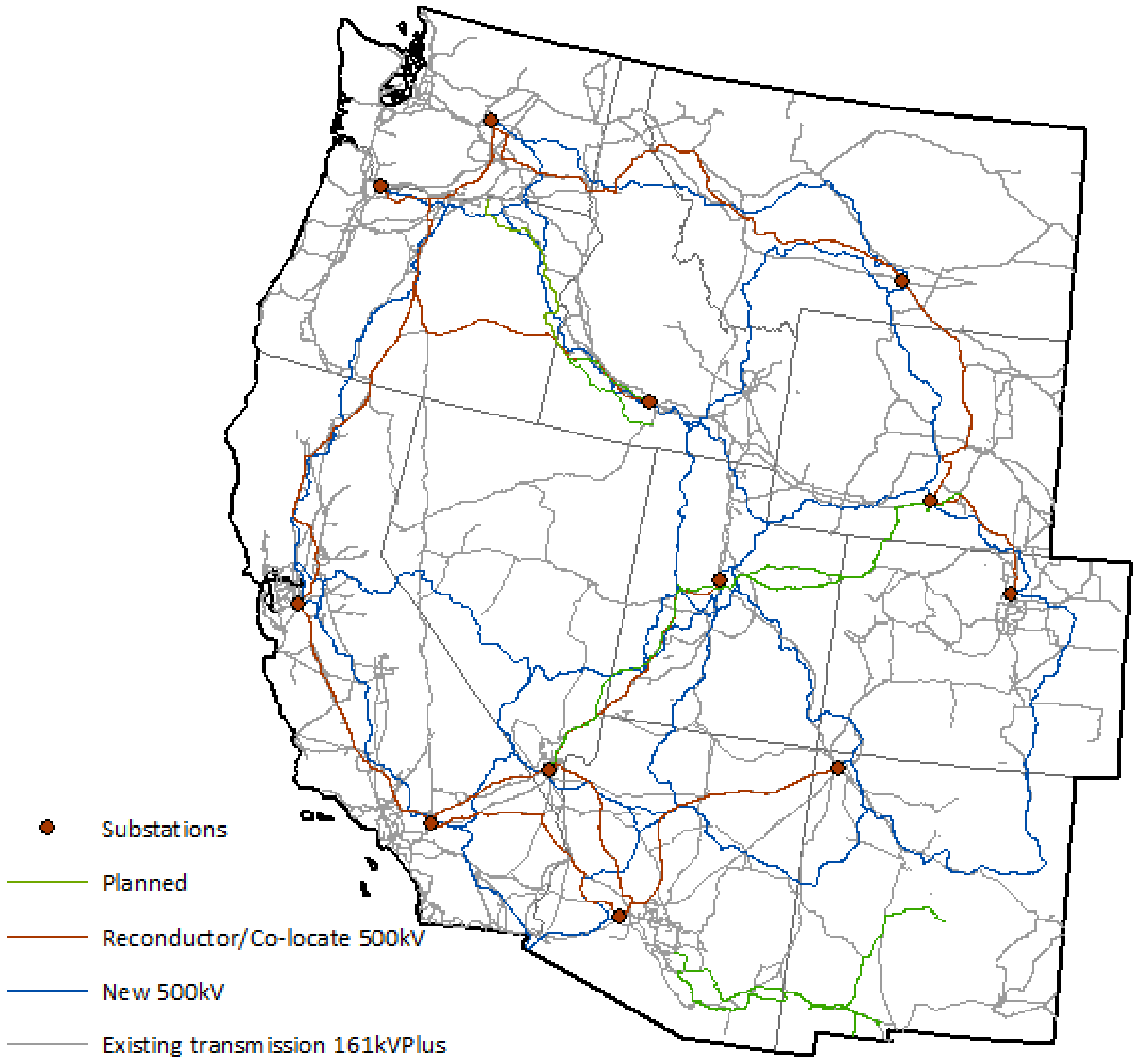


In the "high electrification" scenario, even with increasing environmental protection of ocean areas, the model only selects 15-16 GW of offshore wind.



High voltage interstate transmission capacity needs can be met through a combination of co-location, reconductoring, and strategically sited new transmission corridors.

Interstate Transmission	Length (miles)
Existing (>=230 kV)	86,323
Reconductor	4,093
Co-locate	2,638
New	6,259



Increased ecosystem protections reduce additional transmission capacity.

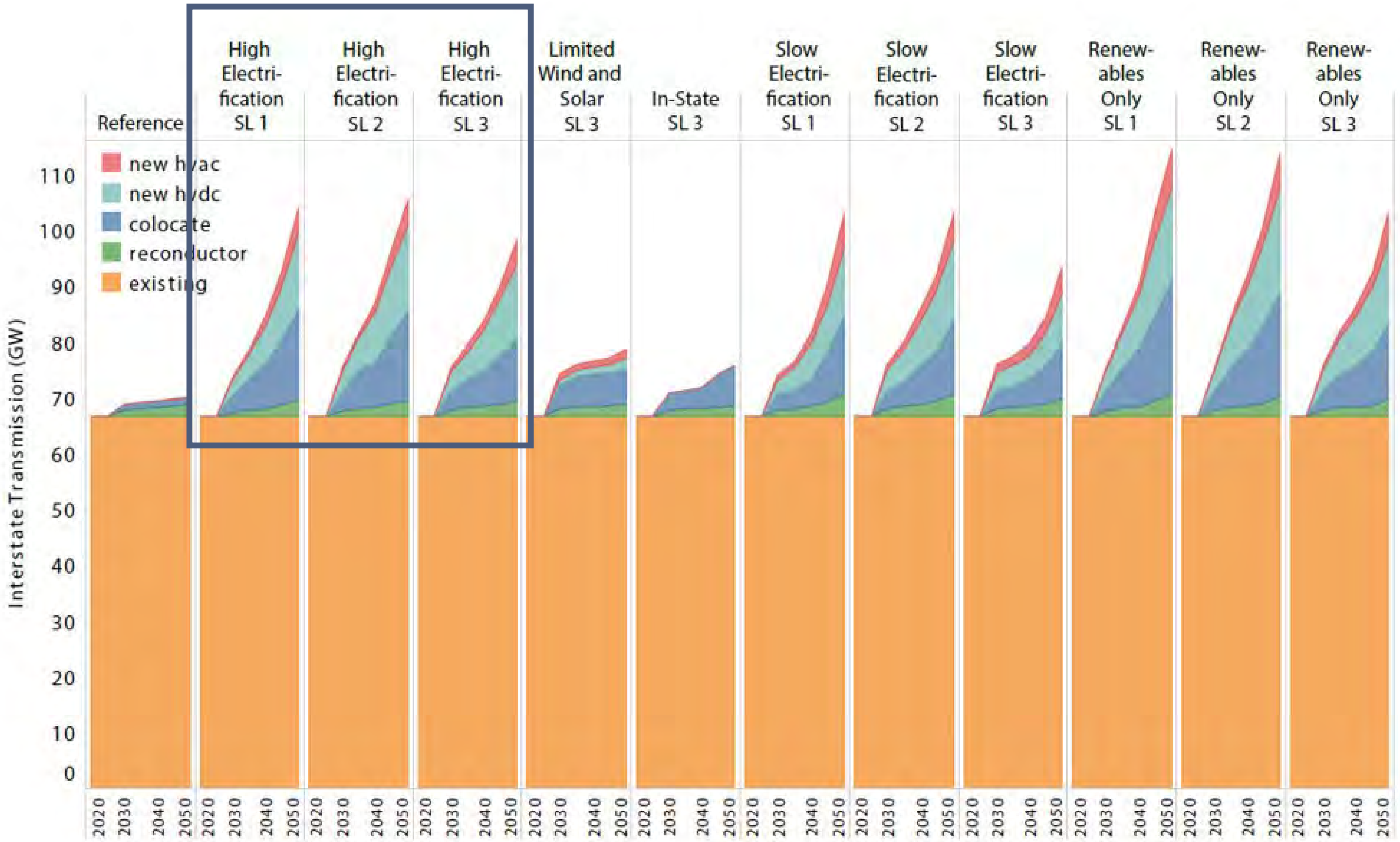
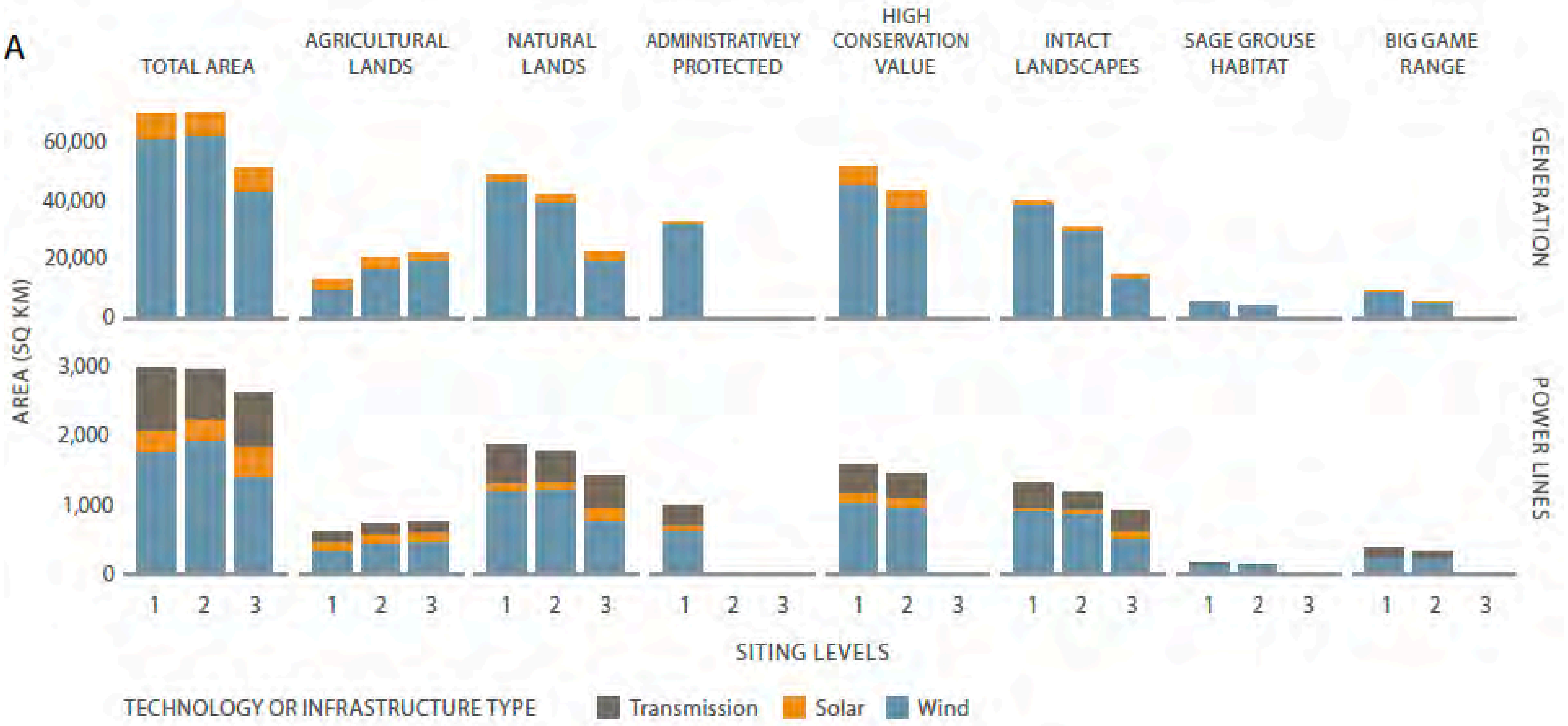
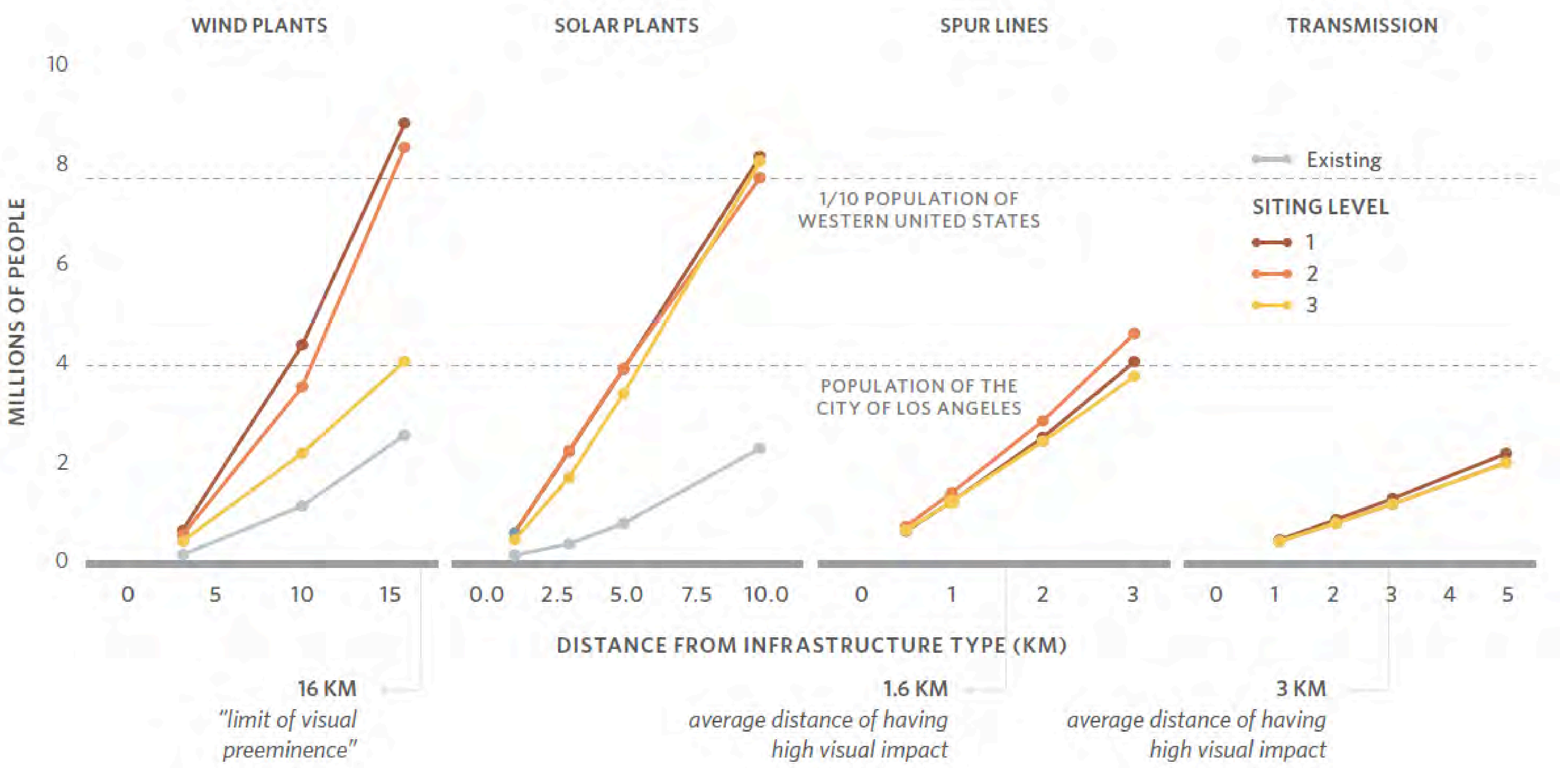


Fig. S19. Existing and new transmission capacity for the reference scenario and all decarbonization scenarios.

Environmental impacts may be significant in the absence of siting protections. More development will occur on agricultural lands with more siting protections



Many more communities (1 out of 10 people in the western US) will host new infrastructure projects. This decreases with increasing siting protections.



Questions on Results?

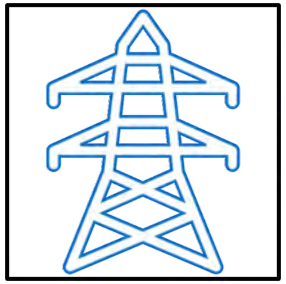
Power of Place West
Policy Recommendations

Policy Recommendations

- Improve energy *planning* to maximize community, conservation and economic benefits.

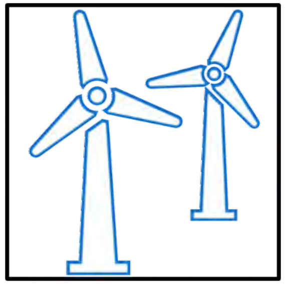
- Streamline review of projects in “Priority Renewable Energy Areas” by federal, state, and local governments (*permitting*).

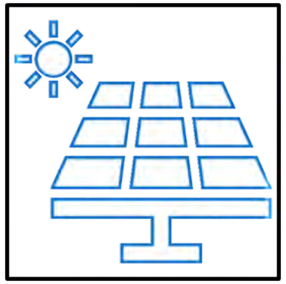
- Develop state and federal *mitigation* programs that require clean energy infrastructure to avoid, minimize, or offset impacts to wildlife, ecosystems, cultural resources, and iconic landscapes.



Planning

Permitting





Mitigation

Policy Recommendations

- Ensure energy siting on working lands benefits agricultural communities.

- Create a west-wide market that includes planning and coordination to develop the most cost-effective and reliable grid.

Working Lands

Markets

Questions?