



Accelerating Clean Energy @Scale

Place-Based Solutions

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Public Private Partnerships
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IAEE Webinar, June 28, 2021

NREL at a Glance

2900

Employees,
postdoctoral
researchers,
interns, visiting
professionals



World-class
facilities, renowned
technology experts

nearly
900

Partnerships
with industry,
academia, and
government

\$500
million

**Annual
Budget**

\$1.2B
annually

**National
economic
impact**

Core Innovations for Our Energy Economy

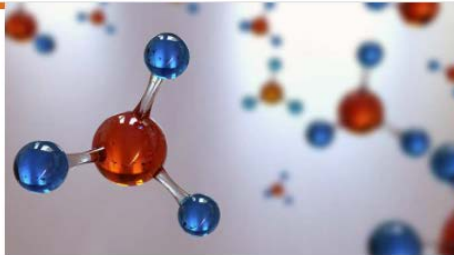
Integrated Energy Pathways

Modernizes our grid to support a broad selection of generation types, encourages consumer participation, and expands our options for transportation electrification



Electrons to Molecules

Uses renewable, affordable electricity to convert low-energy molecules—such as water and carbon dioxide—to generate higher-value, higher-energy chemicals, fuels, and materials



Circular Economy for Energy Materials

Reduces waste and preserves resources by designing materials and products with reuse, recycling, and upcycling in mind from the start

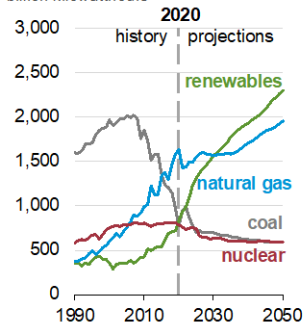


The U.S. Energy Mix is Changing

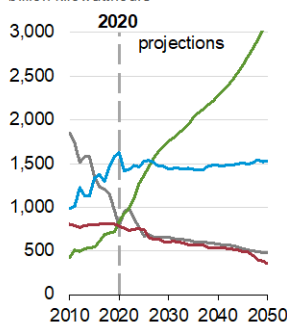
U.S. electricity generation levels from selected fuels and renewable sources

U.S. electricity generation, AEO2021 renewables cost cases

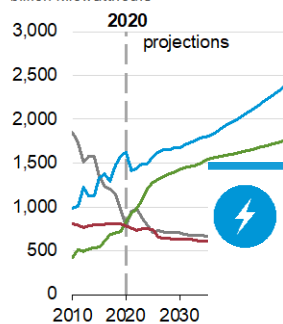
Reference case
billion kilowatthours



Low Renewables Cost case
billion kilowatthours



High Renewables Cost case
billion kilowatthours



Note: Renewables category includes electricity generation from wind, solar, hydroelectric, geothermal, wood, and other biomass

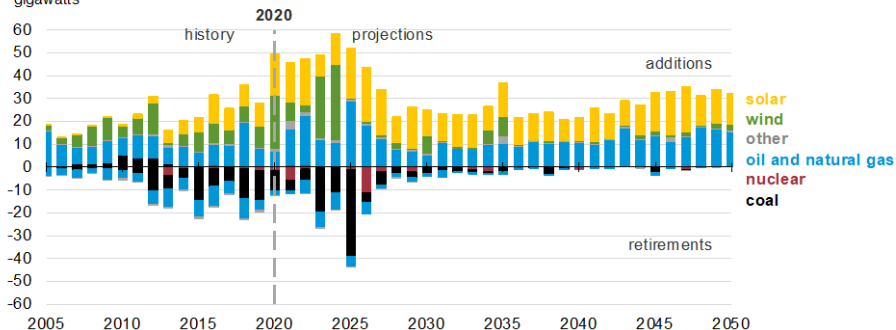
Source: U.S. Energy Information Administration, *Annual Energy Outlook 2021* (AEO2021)

www

U.S. retiring and new generating capacity

Annual electricity generating capacity additions and retirements

AEO2021 Reference case
gigawatts



Source: Form EIA-860M, *Monthly Update to the Annual Electric Generator Report*, July 2020



Translating community energy ambitions into actions

Clean Energy Transition Implementation Plan



**Stakeholder
Engagement**



**Analytic Insights,
Models, Tools,
and Datasets**



**Solutions and
Technologies**



**Action Plans and
Implementation**



**Community-
Driven National
Impact**

Businesses and communities are pursuing ambitious clean energy initiatives to mitigate environmental and economic risks and address system inequities.

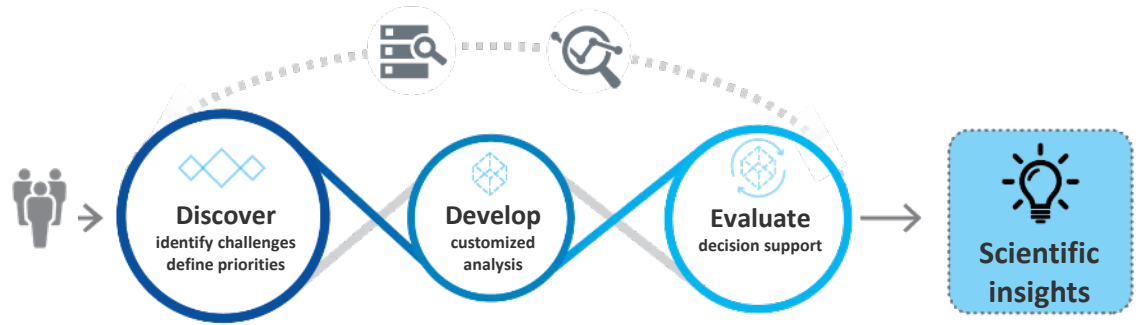


LA100 team at Pine Tree Wind and Solar Farm, California

To move from **ambitions to actions**, communities often need **in-depth energy-sector expertise and insight**.

As a U.S. Department of Energy (DOE) research lab, **NREL offers unbiased, best-in-class analysis and modeling capabilities** supported by a foundation of more than **40 years of scientific and applied research, technology expertise, and partnerships**.

ACES provides customized, holistic modeling and analysis to support strategy development with communities and partners.



To address communities' unique energy-system goals and diverse stakeholder priorities, data-driven, technically sound, actionable insights include:

- Partnership opportunities
- Investment strategies
- Technology possibilities/scenarios
- Energy equity considerations
- Illustration of trade-offs.



State of Alaska



Republic of Palau



Office of Indian Energy

U.S. DEPARTMENT OF ENERGY



Office of ENERGY EFFICIENCY & RENEWABLE ENERGY



Federated States of Micronesia

Los Angeles

Navajo Nation

Greensburg, KS

Akwesasne Nation

Hurricane Sandy recovery



Republic of the Marshall Islands



American Samoa

Commonwealth of the Northern Mariana Islands

State of Hawaii



INSTITUTE FOR Sustainable Communities

Puerto Rico

U.S. Virgin Islands



NREL's decades of experience span a variety of sponsors and over 2,000 communities, utilities, and businesses.

Example: Supporting resilience in vulnerable communities



Community priorities

Remote, island, and islanded community energy and infrastructure challenges, values, and goals



Partnership approach

Deep energy-sector experience, expertise of the national labs + local, trusted stakeholder organizations




Energy assessment and planning

Provide resources and on-the-ground support



Resilient energy systems

Knowledge sharing → lessons learned, use cases → identified responsive technology needs



Transform hundreds of energy systems for local and national impact

Empower communities with codeveloped investment-ready actionable options

Customize tools, unlock local expertise-driven insights

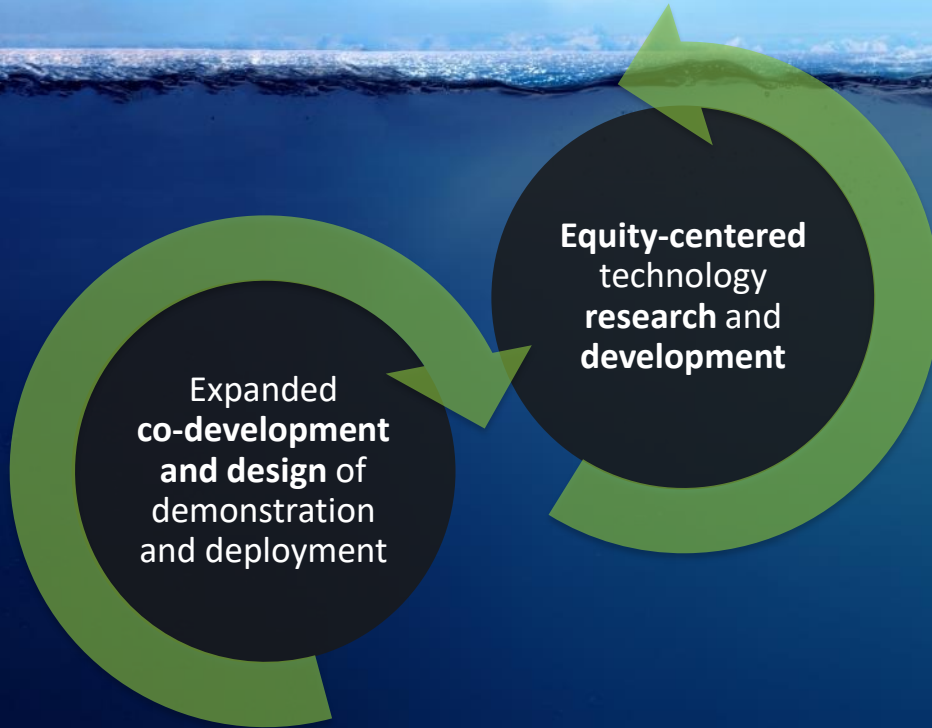
Convene local partners and national investors

An American flag is planted in a field of tall grass. The sun is setting behind the flag, creating a bright glow and casting long shadows. The sky is filled with dramatic, dark clouds, with some light breaking through near the horizon. The overall mood is patriotic and hopeful.

Rapid, widespread transition to clean, affordable,
equitable, secure, and resilient energy systems

Building on a history of place-based engagement

Expand local empowerment to meet national goals



Community-driven climate justice solutions

Newtok,
Alaska



Impacts of climate change

Traditionally nomadic people settled in erosion zone by U.S. government
Now falling into ocean, sinking into permafrost, flooded with sewage



Community decision to relocate to Mertarvik

“Place to get water”
High ground, clean water, rich resources; allows Yup'ik people to continue subsistence life



Co-developed sustainable solutions

Culturally appropriate homes modeled to use 50% less energy than regional average
Homes maintain healthy air through ventilation and mechanical systems
Efficient energy systems and infrastructure



Workforce development, implementation support

Trained local crews to build homes at new site
Constructed homes, school, evacuation center

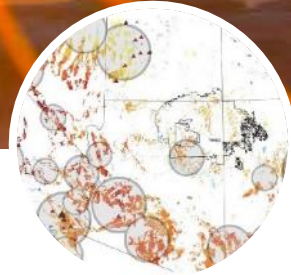
Community-centered clean energy opportunities in coal transition

**Navajo Nation,
Arizona**



Navajo Generating Station (NGS)

Largest coal-fired power plant in western U.S. built in 1970s to provide bulk power to Central Arizona Project (CAP)



Transitional glidepaths

Analytic consideration of multiple stakeholder priorities in secure, affordable renewable energy futures



Co-developed solutions

Agricultural water production and storage using wind and solar power



Transitional workforce considerations

Analysis with a focus on community priorities and coal transition employment opportunities

Low-Income Energy Affordability Data (LEAD) Tool

<https://www.energy.gov/eere/slsc/maps/lead-tool>



Discover

Details about states and communities



Modify

Inputs to match user needs



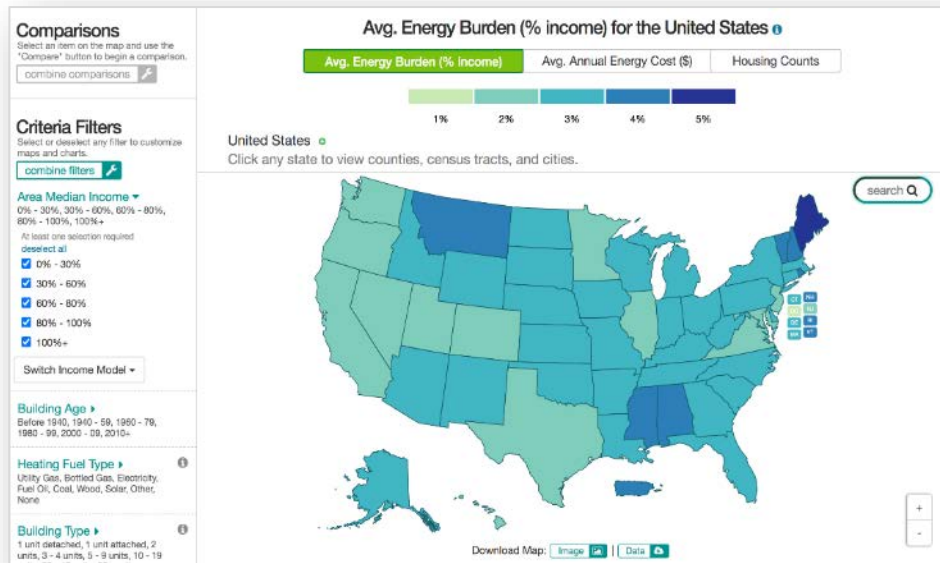
Understand

Low-income housing energy characteristics



Create

Energy strategies and programs



Impacts

- Cited in NJ bill to establish Office of Clean Energy Equity
- Used by WA State Dept of Commerce's energy assistance program
- Several successful case studies using LEAD (NY and KY)

Future Work

- In partnership with Office of Indian Energy to add tribal areas to LEAD
- Continual data updates (every two years)



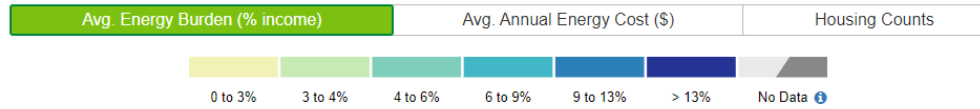
Place-Based Equity Mapping



Low-Income Energy Affordability Data (LEAD) Tool

Data (housing only) comes from the U.S. Census Bureau's American Community Survey 2018 Public Use Microdata Samples.

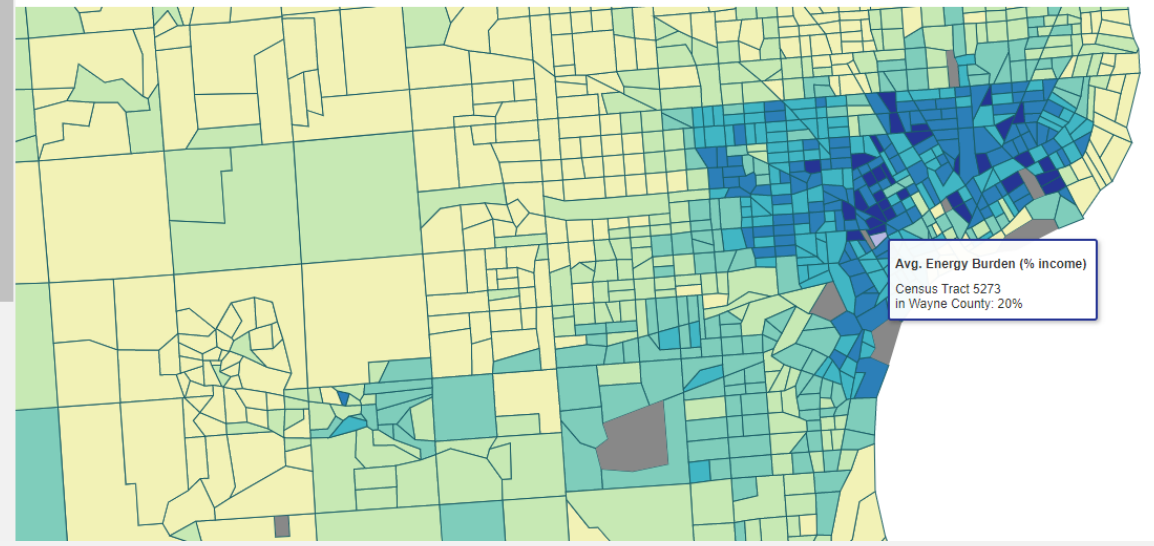
Avg. Energy Burden (% income) for Census Tracts in Michigan



United States > Michigan > Census Tracts

(View Counties View Cities)
Avg. Energy Burden (% income) for Michigan: 3%

Show borders: Tribal Areas* Counties None
* Tribal area borders may extend across multiple states.



New Features!

Since you last visited the LEAD Tool, we have added the following features:

- Search for states, counties, census tracts, and cities across the U.S.
- Combine comparisons into custom groups
- Tribal Area borders added to census tract maps

About & Methodology

Case Studies

Save

Comparisons

Select an item on the map and use the "Compare" button to begin a comparison.

combine comparisons

The United States

Criteria Filters

Select or deselect any filter to

Map EJ

Compare to US Compare to State

Category:

- Environmental Indicators
- Demographic Indicators
- EJ Indexes

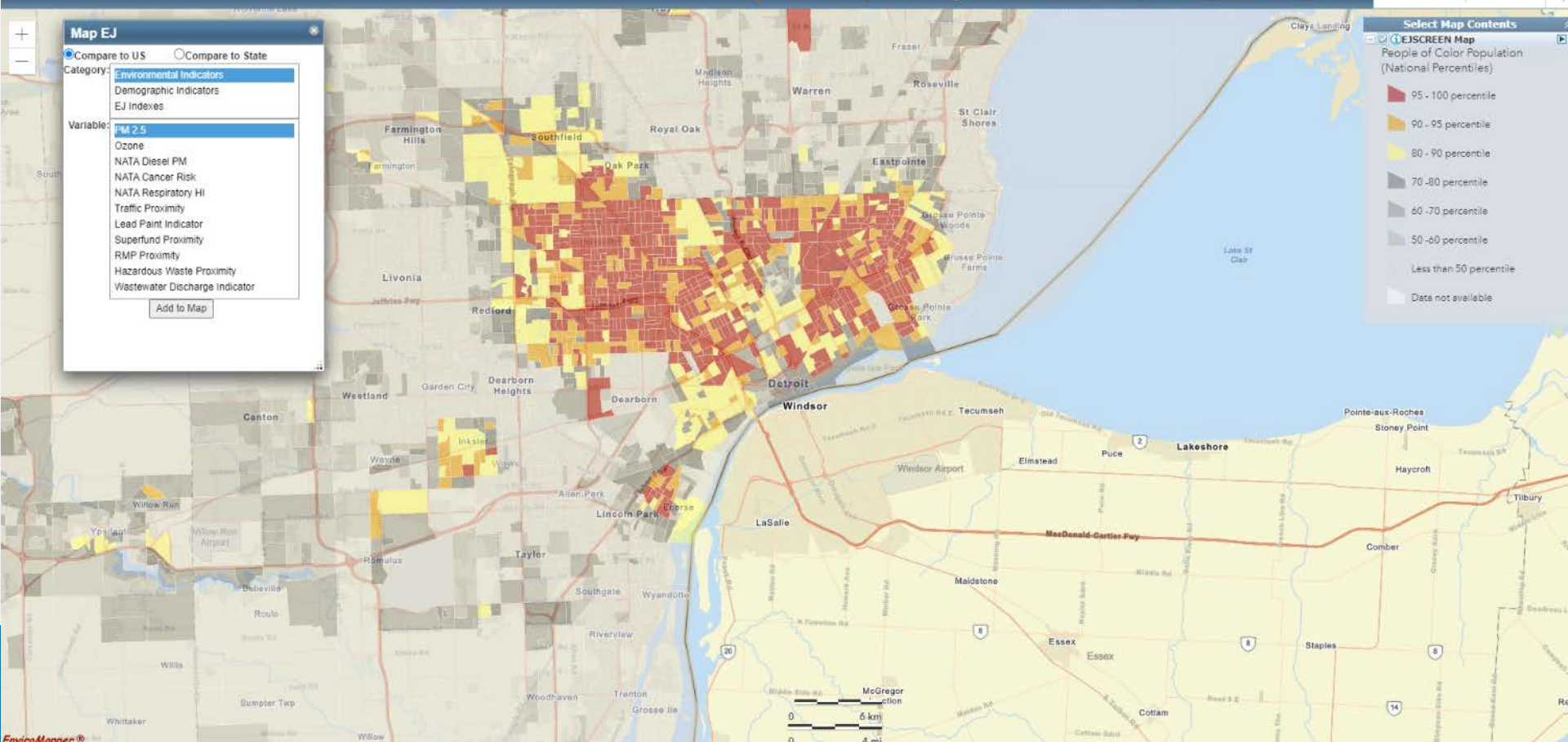
Variable:

- PM 2.5
- Ozone
- NATA Diesel PM
- NATA Cancer Risk
- NATA Respiratory HI
- Traffic Proximity
- Lead Paint Indicator
- Superfund Proximity
- RMP Proximity
- Hazardous Waste Proximity
- Wastewater Discharge Indicator

Add to Map

Select Map Contents

- EJSCREEN Map
- People of Color Population (National Percentiles)
 - 95 - 100 percentile
 - 90 - 95 percentile
 - 80 - 90 percentile
 - 70 - 80 percentile
 - 60 - 70 percentile
 - 50 - 60 percentile
 - Less than 50 percentile
 - Data not available



Prioritized equity and energy efficiency in 100% clean energy goal

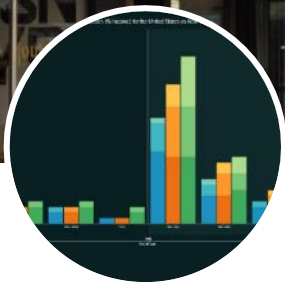
100% by 2050
Kingston,
New York



Disproportionate burden

Higher energy burden among low-income, owner-occupied households

43% of households pay more than 9% of annual income on utility bills



Savings

High savings potential in residential, commercial, and city buildings

Replacing boilers/ furnaces/ AC with heat pumps reduces building energy consumption by 50% (average)



Community center/ emergency shelter

Optimized photovoltaics (PV) + storage is cost effective



Tradeoffs

Natural gas costs < electricity; must electrify building end uses and transportation to meet goal

Older / tree-shaded residential buildings cannot achieve on-site net zero retrofits

Translated ambitious goals into actions



Prioritizing communities

Immediate beneficiaries of air quality improvement

Scenarios reflect range of diverse community objectives

Workforce development



Stakeholder engagement

Open, public meetings hosted by neighborhood organizations as well as LADWP



Documented, inclusive vision

Prioritizing and addressing public health, underserved communities, jobs, low rates, and more on the path to clean energy



Ensuring accessibility of results

Materials tailored for diverse audiences, including in Spanish



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

With community input, NREL looked at **four possible futures**



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

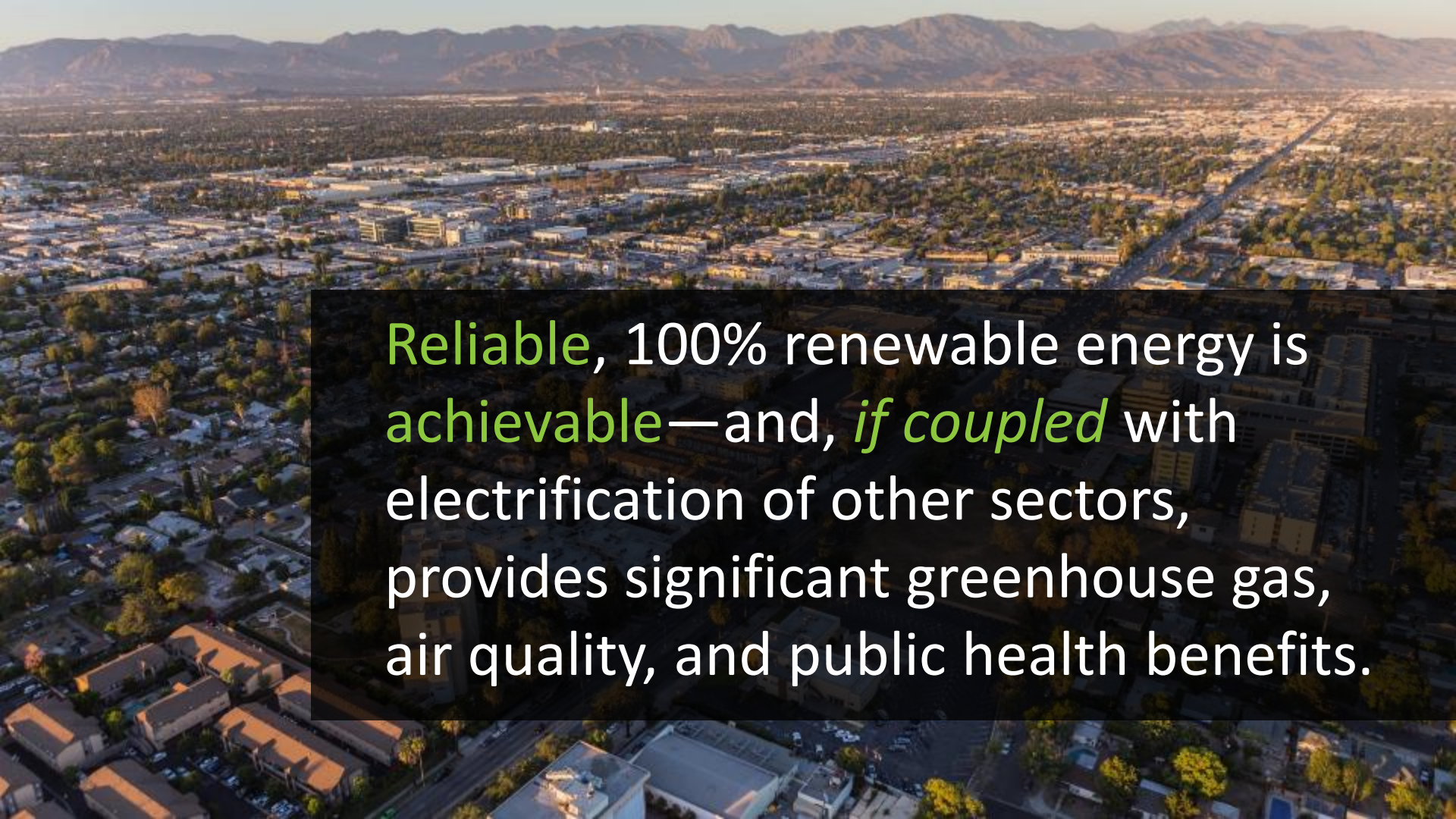
- 100% clean energy by **2045**
- Only scenario that does not allow upgrades to transmission beyond currently planned projects
- No natural gas or nuclear generation

Each Scenario Evaluated Under Different Customer Demand Projections (different levels of energy efficiency, electrification, and demand response)


Moderate

High


Stress

An aerial photograph of a city, likely Phoenix, Arizona, showing a dense urban area with numerous buildings, streets, and green spaces. In the background, a range of mountains is visible under a clear sky. The lighting suggests it's either early morning or late afternoon, with long shadows and warm tones. A semi-transparent black box is overlaid on the lower right portion of the image, containing text.

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

An aerial photograph of a city. The foreground is filled with a dense residential neighborhood, showing various houses and apartment buildings with different roof colors and styles. In the background, a city skyline with several tall skyscrapers is visible against a clear blue sky with a few light clouds. A semi-transparent dark grey box is overlaid on the right side of the image, containing white text. The words "improving equity in participation and outcomes" are highlighted in a light green color.

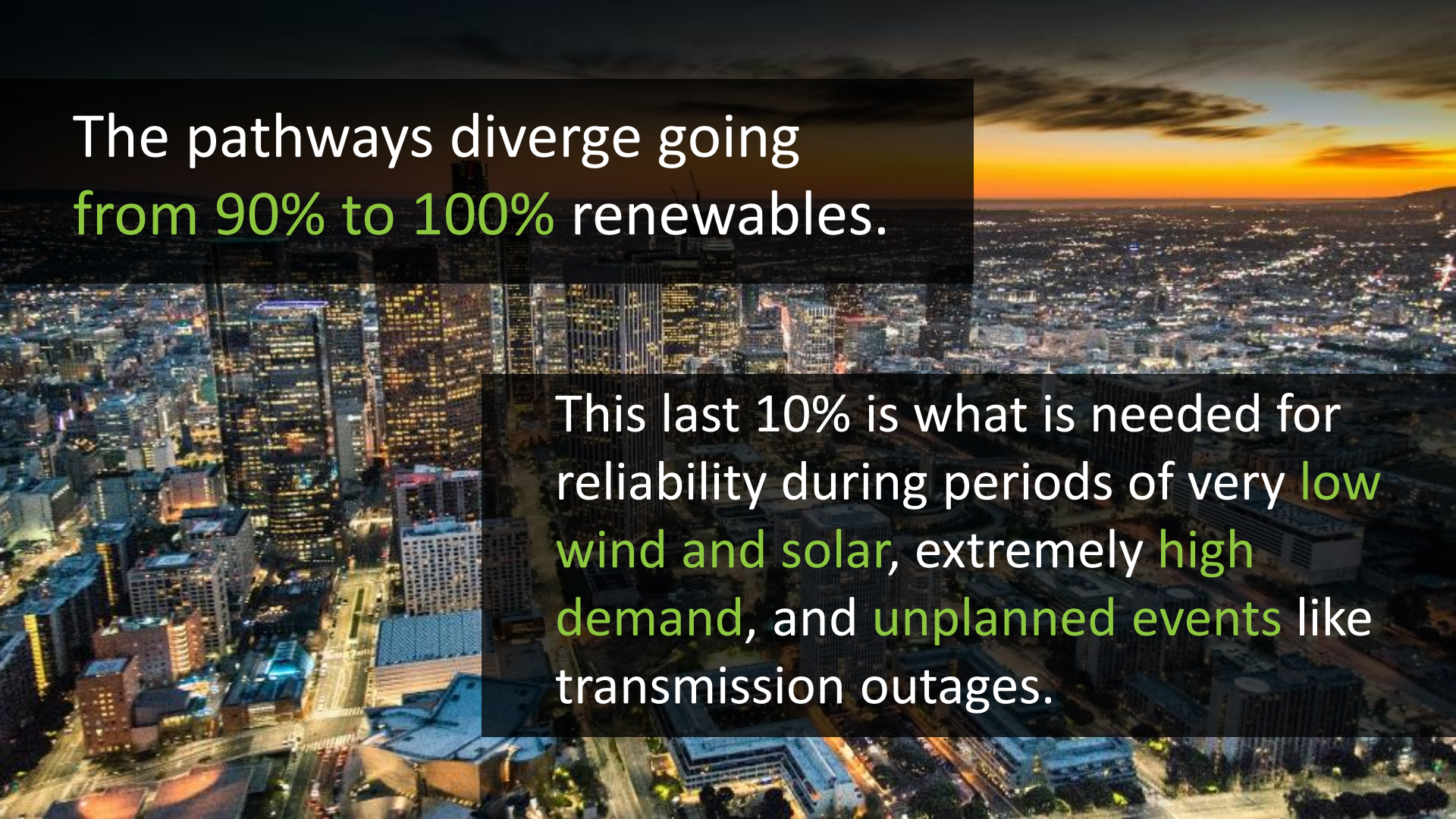
All communities will share in the benefits of the clean energy transition—but **improving equity in participation and outcomes** would require intentionally designed policies and programs.

A photograph of a running track with lane numbers 3 and 4 visible on the surface. The track is dark reddish-brown with white lane markings. The numbers 3 and 4 are painted in white on the track surface. A dark semi-transparent banner is overlaid on the top half of the image, containing white and green text.

LA can get started now, with many no-regrets options that achieve **significant emissions reduction** (76%–99%) **by 2030**.

An aerial photograph of a city at sunset. The sky is a mix of orange, yellow, and dark blue. The city lights are visible, and a dark semi-transparent box is overlaid on the left side of the image, containing white and green text.

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

An aerial photograph of a city at sunset. The sky is a mix of orange, yellow, and dark blue. The city lights are visible, and a dark semi-transparent box is overlaid on the right side of the image, containing white and green text.

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.

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





How can **other communities** follow LA's lead?

Start deploying solar, wind, and batteries **now**; research longer-term solutions for the last 10%–20%

LA100 pioneers a **new, replicable** approach



Holistic in
scope



High in
detail



Prioritizes
reliability



Identifies **future**
R&D directions

Positioning us to address the clean
energy transition **nationwide**

An aerial photograph of Los Angeles, showing a mix of modern skyscrapers in the upper left and dense, older urban development in the rest of the frame. A semi-transparent dark box is overlaid on the top half of the image.

LA100 marks a shift toward centering
energy justice in the conversation

Prioritizing **community** objectives
Open, **public** meetings
Documented, **inclusive vision**
Ensuring **results are accessible** to all

LA100 Equity Strategies Study



Reliable, 100% renewable energy is achievable

All communities will share in the benefits of the clean energy transition



Improving equity in participation and outcomes requires intentionally designed policies and programs.



Focus

Procedural Justice
Recognition Justice
Distributional Justice

Thank you //
questions

www.nrel.gov

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