Achieving Net-Zero Emissions in the Northwest

Yale Carbon Containment Lab

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Agenda

- Clean Energy Transition Institute
- Net-Zero Northwest
  - Key Findings
  - Emissions
  - Clean Fuels
  - Top-level Takeaways
- Questions and Answers

Clean Energy Transition Institute

- **What We Are:** Independent, nonpartisan Northwest research and analysis nonprofit organization
- **Our Mission:** Accelerate an equitable clean energy transition in the Northwest
- **Our Role**:
  - Provide unbiased research and analytics
  - Offer an information clearinghouse for policymakers
  - Convene diverse stakeholders

Net-Zero Northwest

Net-Zero Northwest Overview

- Up-to-date deep decarbonization pathways analysis for the Northwest to achieve net-zero emissions by 2050
  - Focus is what must happen in the region to accelerate the clean energy transition equitably from now until 2030-35
  - Incorporates the Inflation Reduction Act
- Health metrics on reduced air pollution/particulate matter due to decreased smokestack and tailpipe emissions
- Workforce analysis of the jobs lost or gained as the region transitions to net-zero emissions

Modeled a Core Case with 22 "What if" Scenarios

- Core Case—Relatively unconstrained technology availability in state and out of state
  - Infrastructure investments can be freely located according to lowest cost for the West
- Aggressive electrification and efficiency
- No measures taken to reduce service demands
  - Conservative, can we decarbonize even without behavior changes?
- Other scenarios change something about the Core Case
  - Unlikely that everything in the Core Case is achievable given siting and permitting, regional coordination, and other factors

What Did We Want to Know? (1)

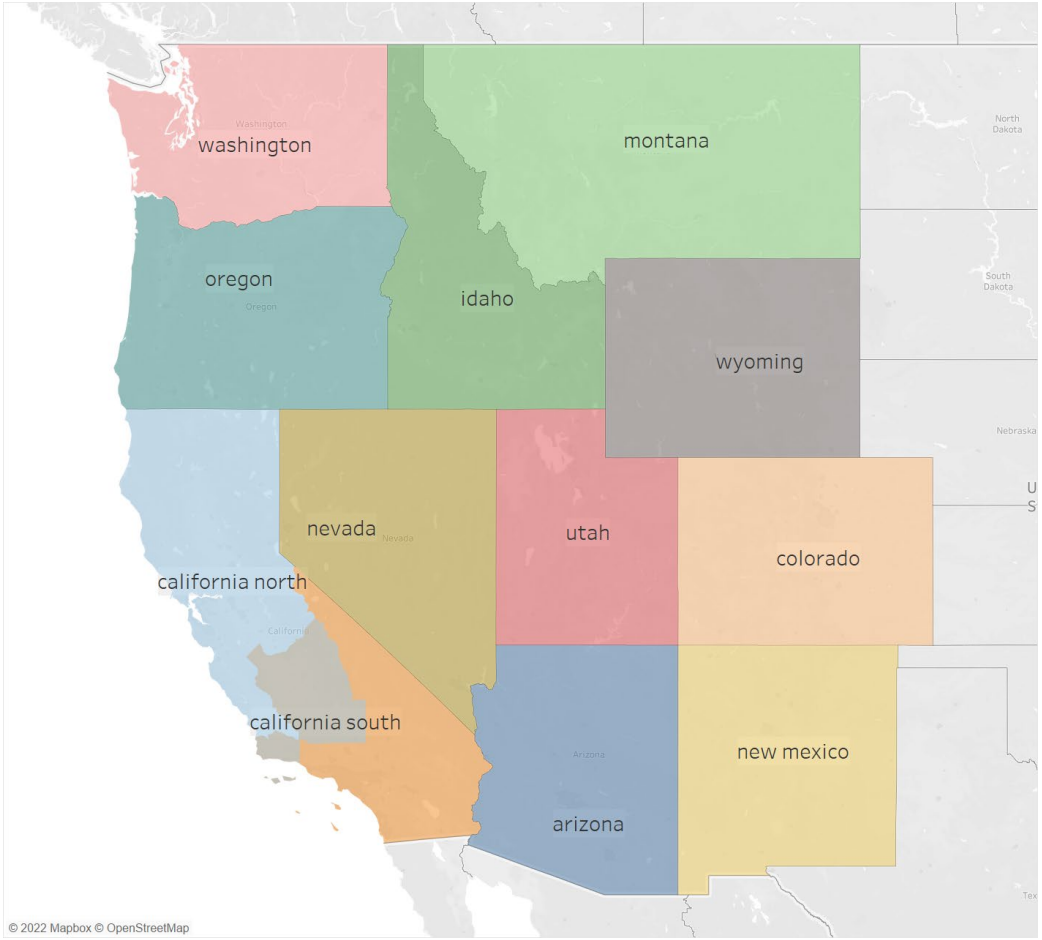
- How would the Northwest energy system change to achieve net-zero emissions by 2050?
- What is the impact of accelerated or constrained transmission expansion across the Western grid?
- How does retaining gas compare with electrification as a decarbonization strategy in buildings?
- What role can distributed energy resources and demand response play in decarbonization?

What Did We Want to Know? (2)

- How does the pace of transportation electrification impact the cost of decarbonization?
- What are the tradeoffs between clean fuels, including biofuels and synthetic fuels/hydrogen?
- How do investments in Northwest and Oregon energy resources change with an Oregon offshore wind target?
- What is the impact on health metrics if decarbonization reduces criteria pollutants?

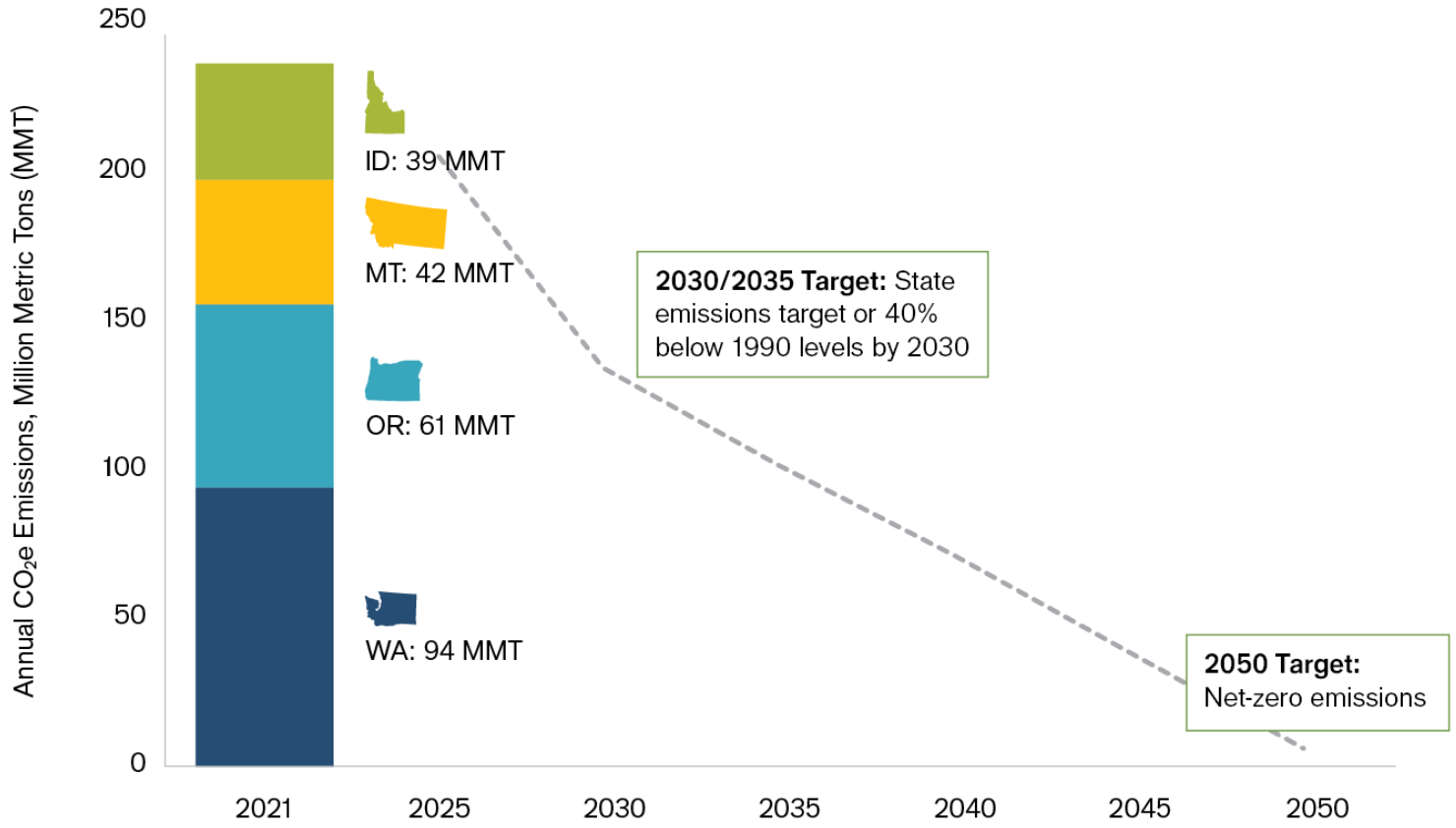
Model Geography-11 Western States

- We model the states in the Western United States with California represented as two zones and the rest of the US as a single zone
- Contextualizes the decisions made in Northwest operating as part of a larger energy system
  - Competition for fuels including biomass, renewables, and hydrogen derived from renewables
  - Balances the electricity system over a large and diverse region – assumes single balancing authority
  - Captures transmission line and pipeline flow and build constraints
  - Resource, load, and temporal diversity contribute to economy and region-wide least cost strategy to reach net-zero



Net-Zero Northwest Emissions Target

Where Do We Start From in the Northwest?



Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report*, June 2023.

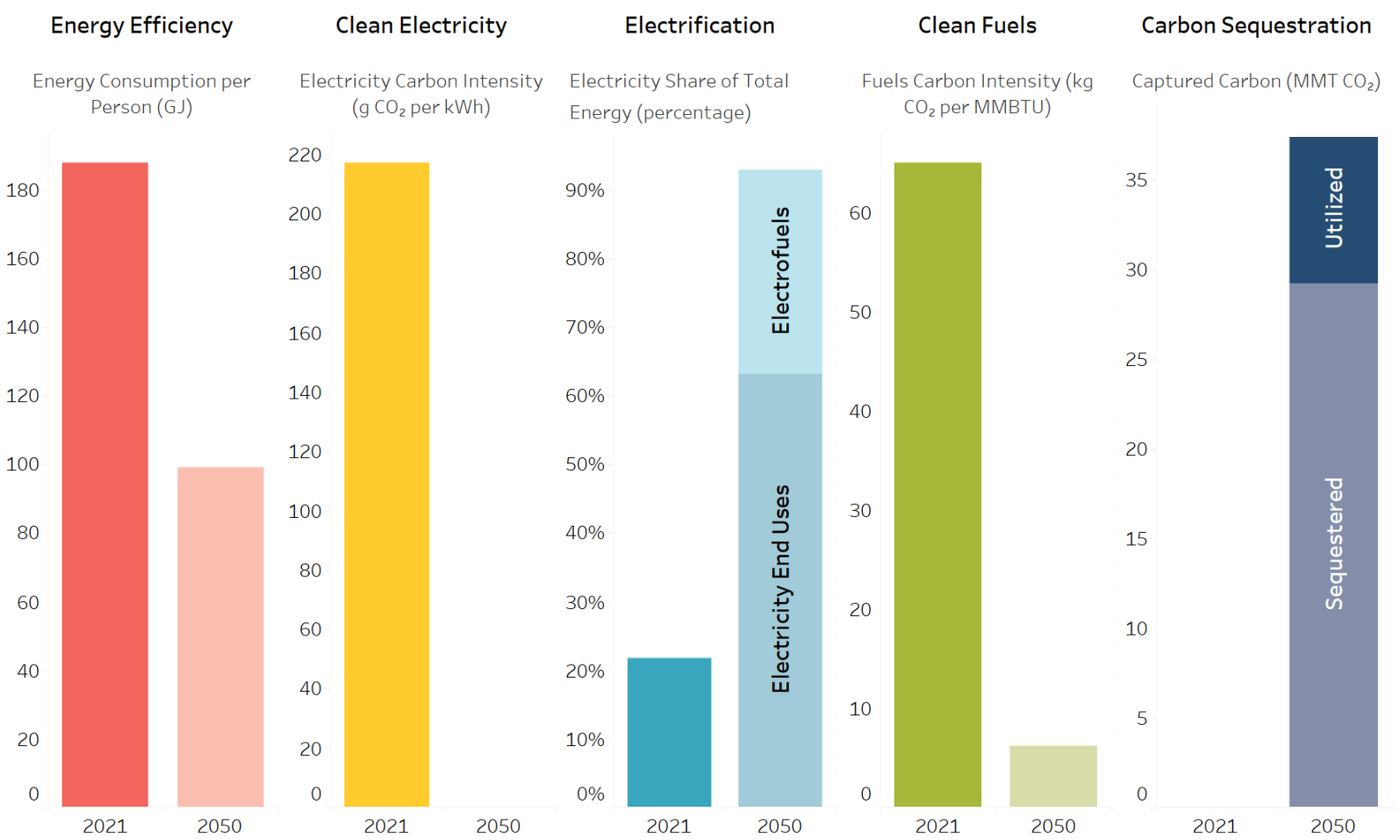
What Did We Learn?

Key Net-Zero Northwest Themes

- Energy efficiency, clean electricity, electrification, clean fuels, and capturing carbon are the key strategies to achieve net-zero emissions
- The region is poised to lead in clean fuels development
- Siting and permitting will shape the Northwest's new energy map
- Federal funding is boosting nascent clean energy technologies
- Reducing tailpipe and smokestack emissions brings health and economic co-benefits

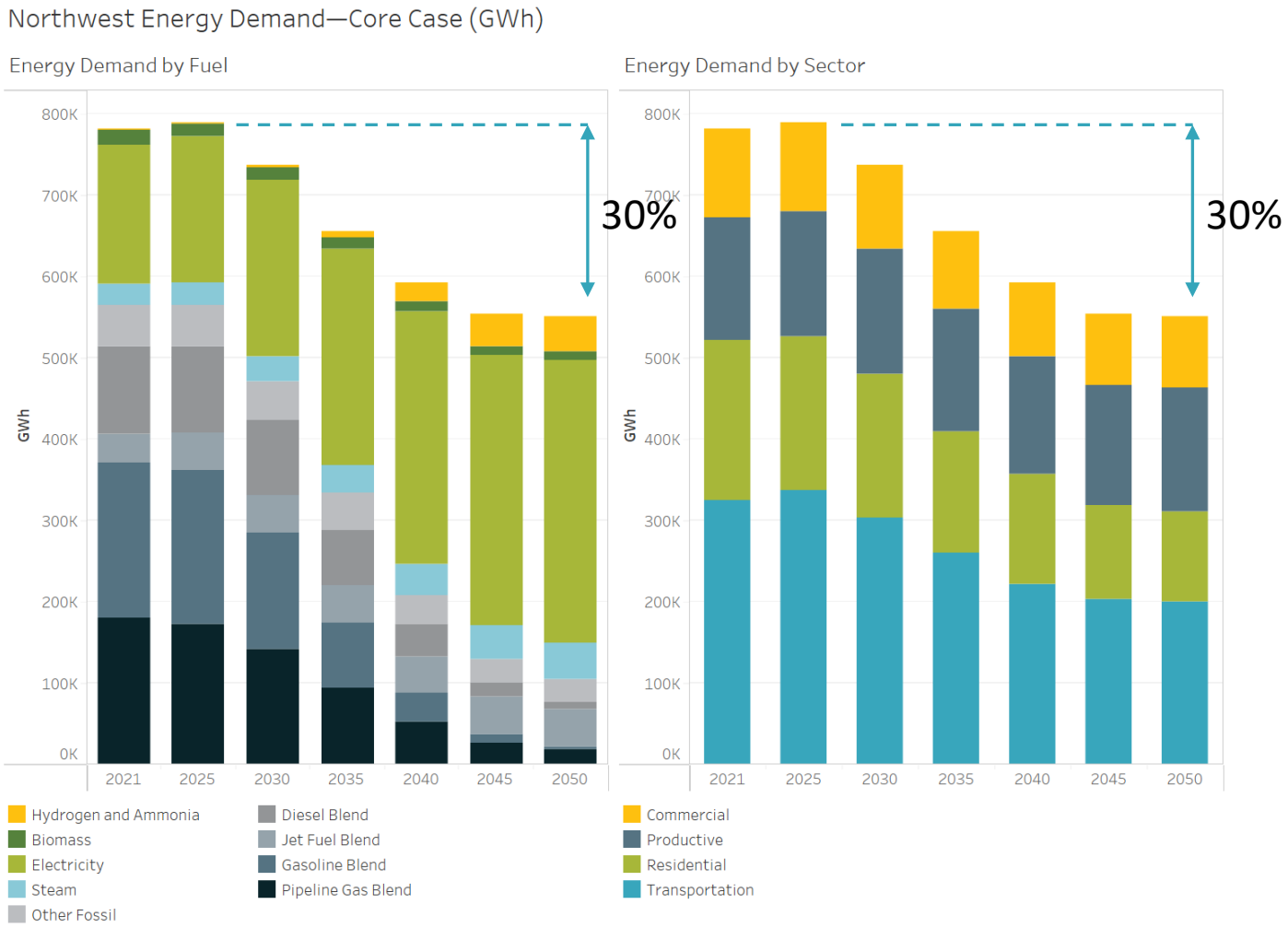
Five Pillars of Decarbonization

Five Decarbonization Pillars in the Northwest, 2021 to 2050



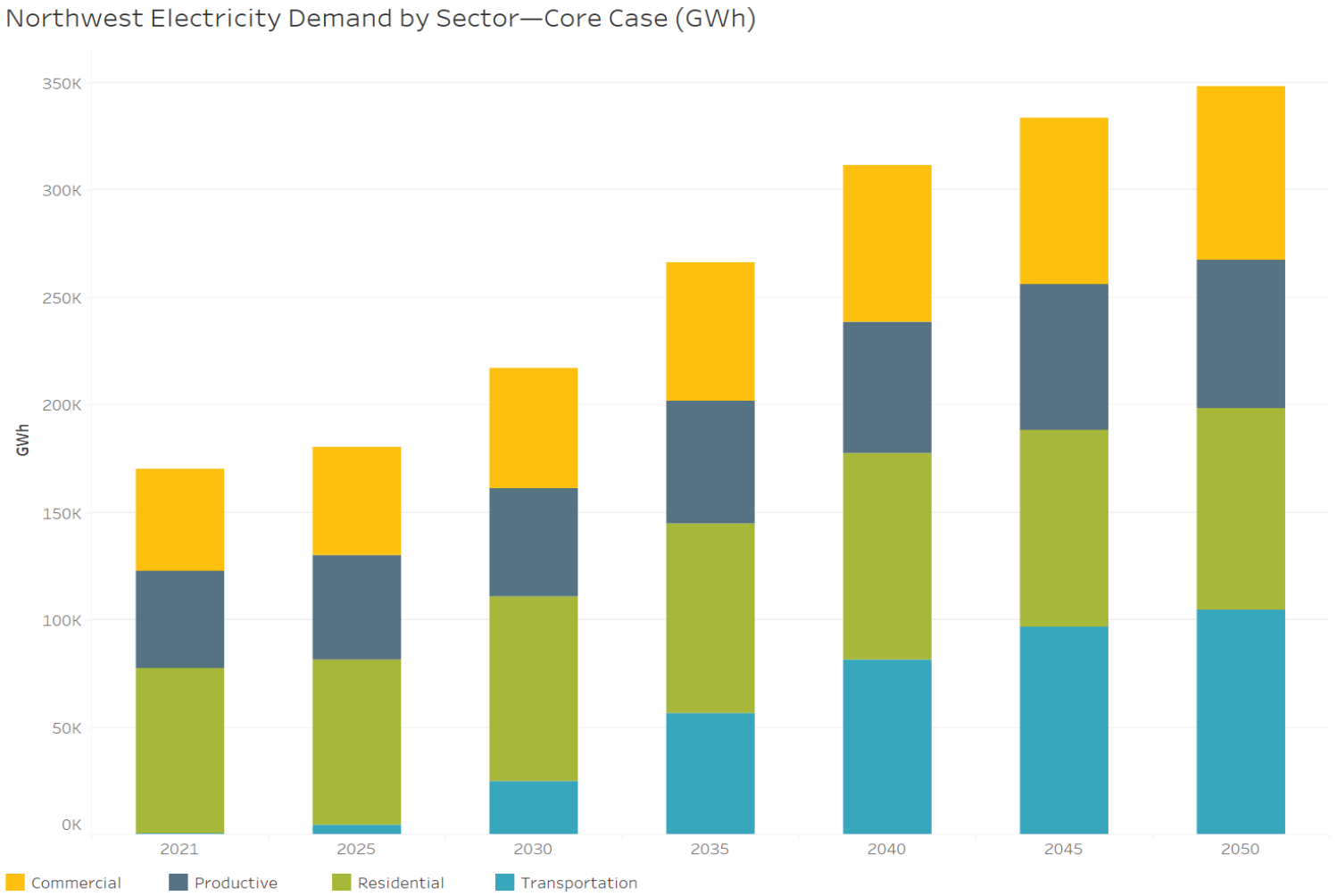
Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report*, June 2023, p. 5.

Efficiency and electrification drive down total energy demand through 2050



Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023, p. 27-28.

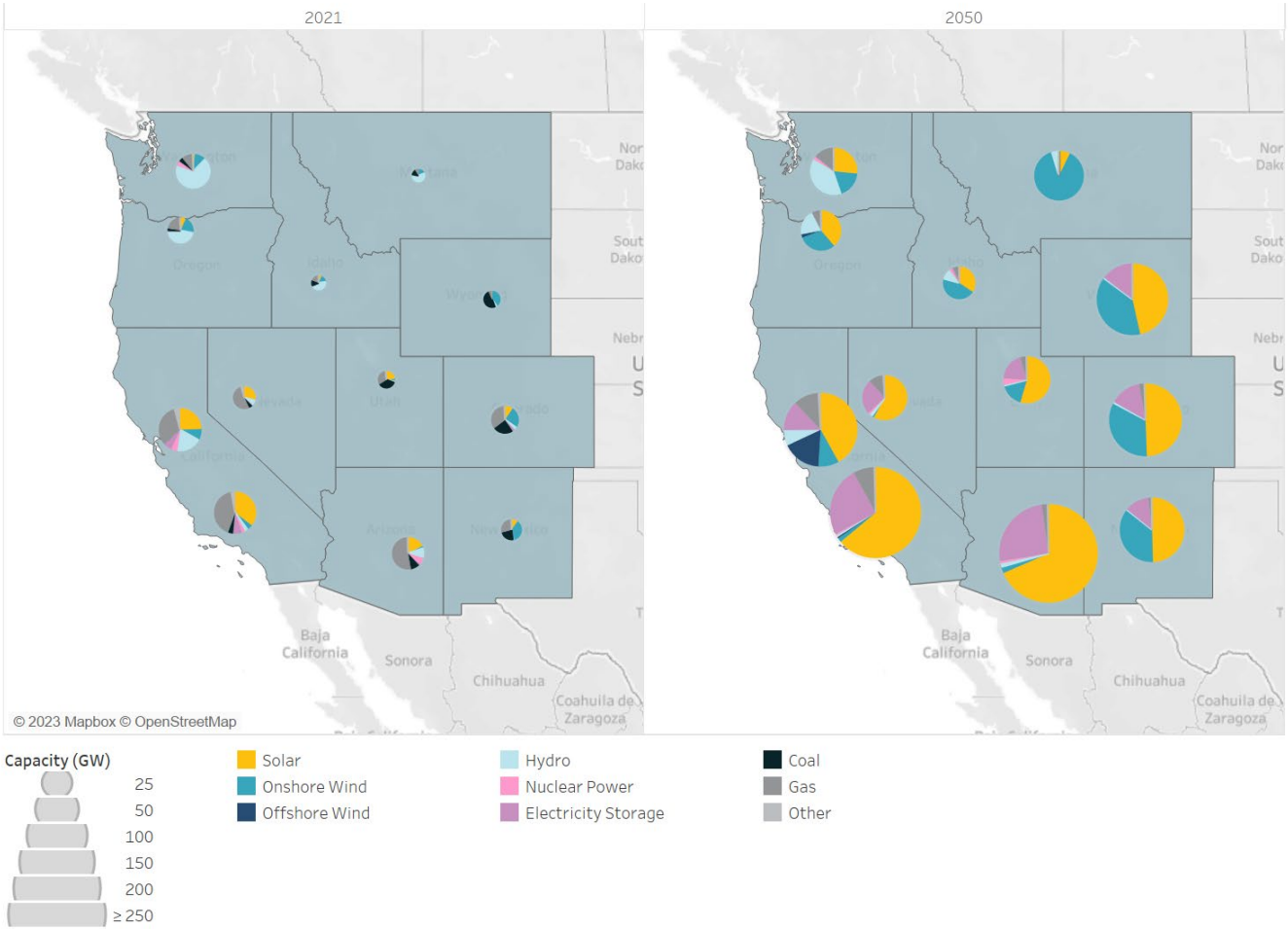
Electricity use more than doubles 2021-2050



Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023, p. 29.

Siting and permitting will shape the Northwest's future energy map

Electricity Generation Capacity Maps for the Western United States—Core Case (GW)



Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023, p. 39.

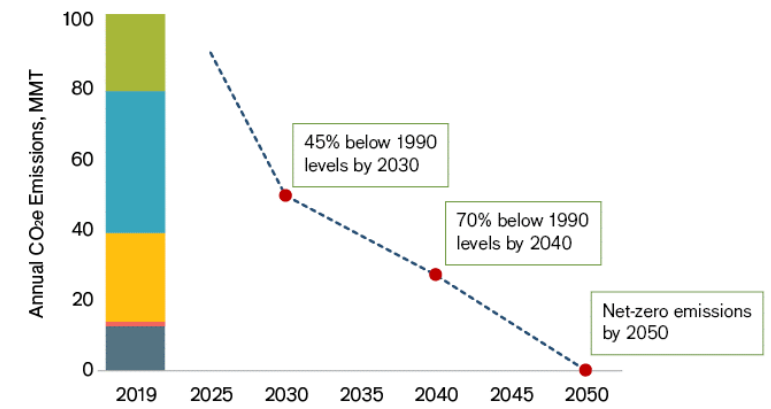
Reducing smokestack and tailpipe emissions brings health benefits

- Health benefits in the Northwest up to 33 avoided deaths per million people in 2030 and up to 40 avoided deaths per million people in 2050.
- Economy-wide savings up to $6.2 billion per year in 2030 and up to $8.9 billion per year in 2050.
- Some hard-to-remove pollutants will remain in 2050 despite achieving net-zero emissions, including $PM_{2.5}$ from wildfires, road dust, and agriculture

Emissions

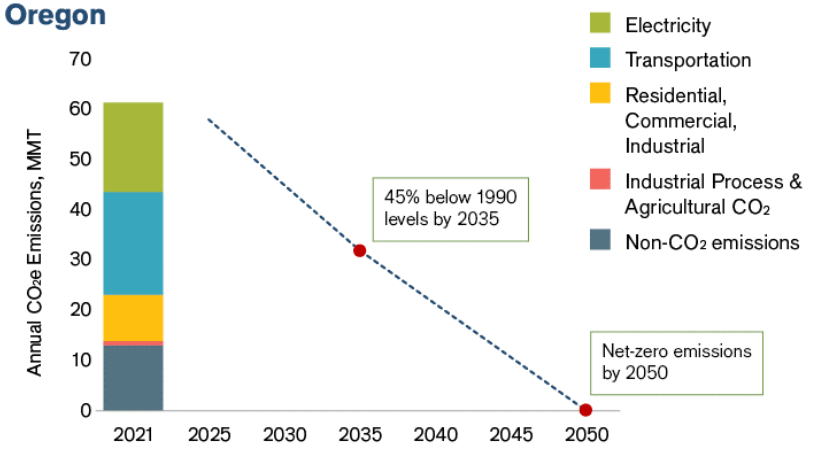
Emissions Profiles Differ in Northwest States

Washington



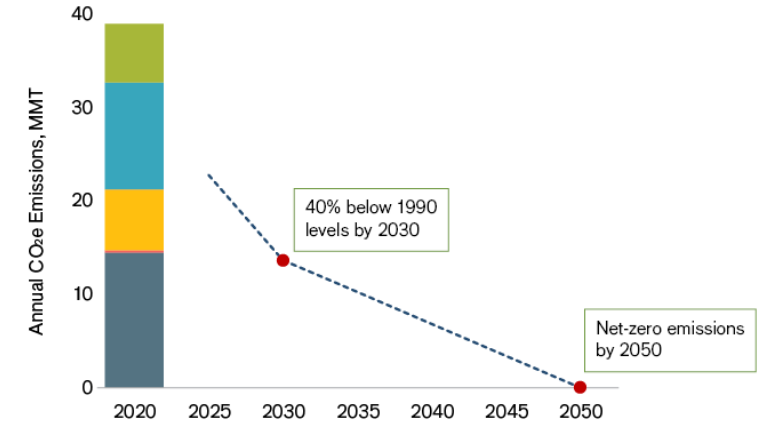
Note: Emission reduction targets set by Washington State Legislature.

Oregon



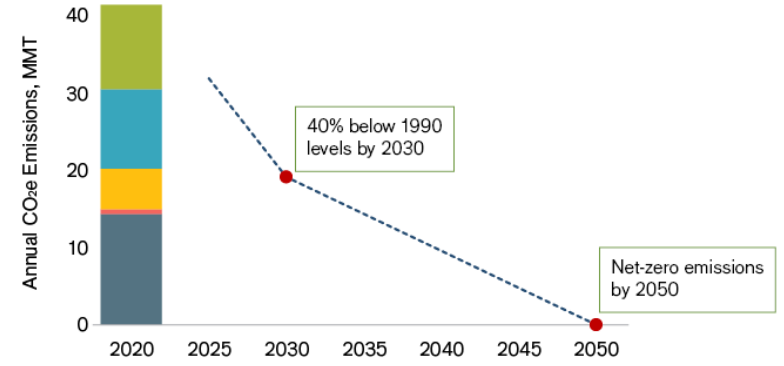
Note: 2035 emission reduction target set by Executive Order; straight-line interpolation to net-zero by 2050.

Idaho



Note: Lacking an Idaho emission reduction target, the NZNW model set targets at 40% below 1990 levels in 2030 and net-zero emissions in 2050. The emissions line starts below the top because 1990 levels were lower than inventory forecasts made for 2020 emissions.

Montana



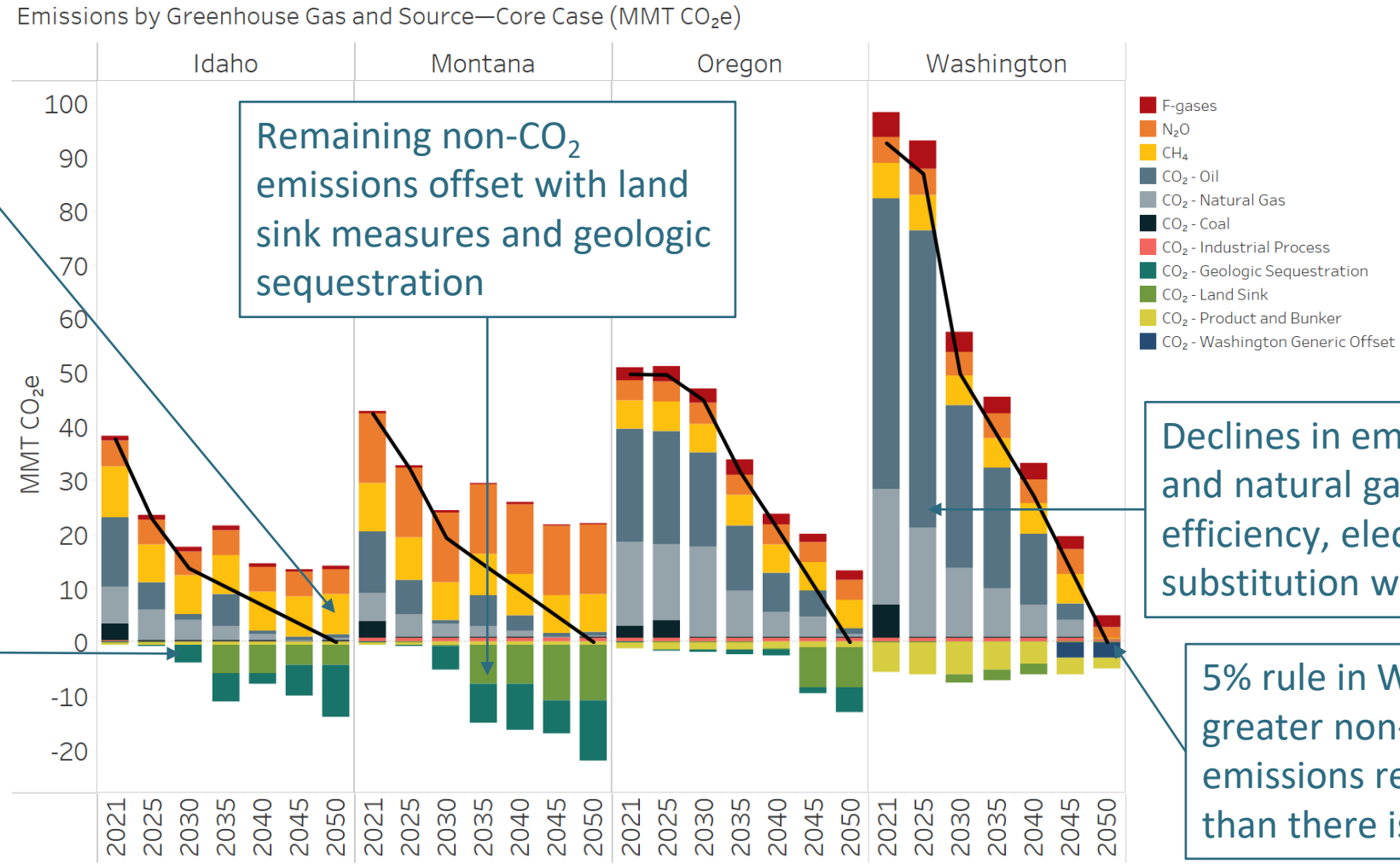
Note: Lacking a Montana emission reduction target, the NZNW model set targets at 40% below 1990 levels in 2030 and net-zero emissions in 2050. The emissions line starts below the top because 1990 levels were lower than the inventory forecasts made for 2020 emissions shown here.

Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023, p. 278.

Reaching emissions targets requires negative emissions technologies

N_2O and CH_4 from agriculture difficult to decarbonize and remain in the economy in 2050

States with large agricultural sectors require carbon sequestration and clean fuels to achieve 40% by 2030 targets set in this study



Remaining non-CO_2 emissions offset with land sink measures and geologic sequestration

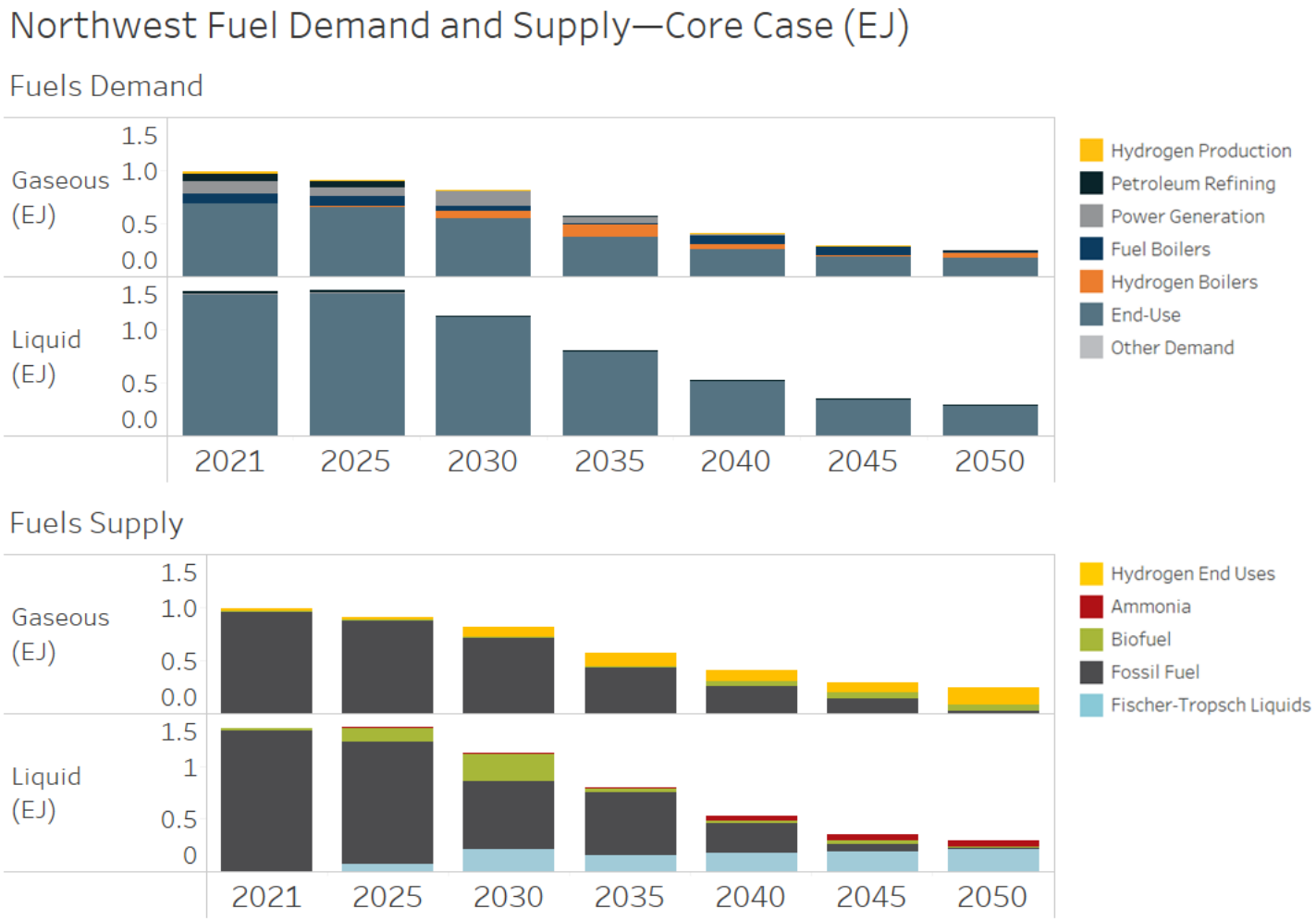
Declines in emissions from oil and natural gas driven by efficiency, electrification, and substitution with clean fuels

5% rule in WA requires greater non-CO_2 emissions reductions than there is potential

Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023. p. 50.

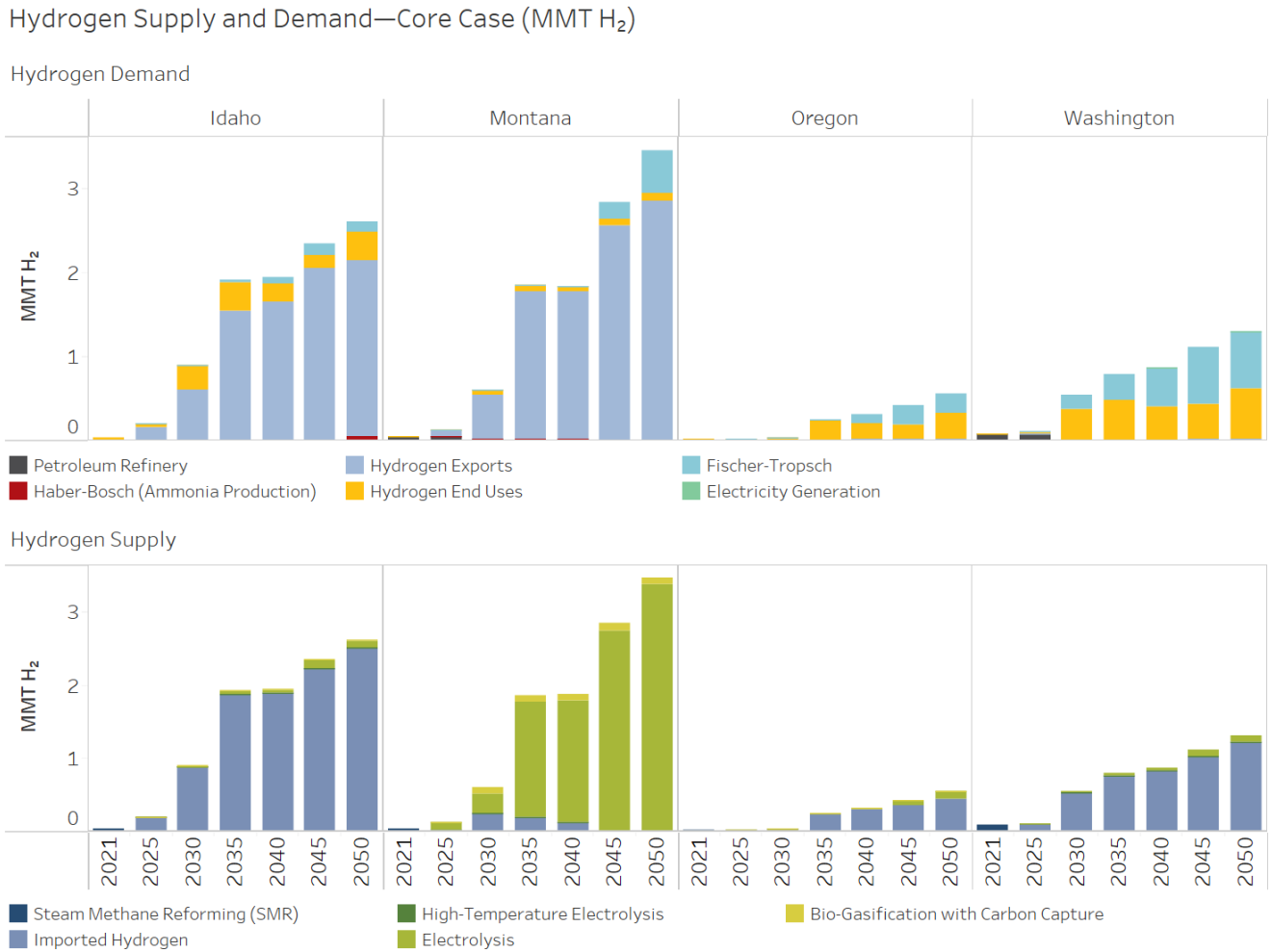
Clean Fuels

Northwest is poised to lead on decarbonizing clean fuels



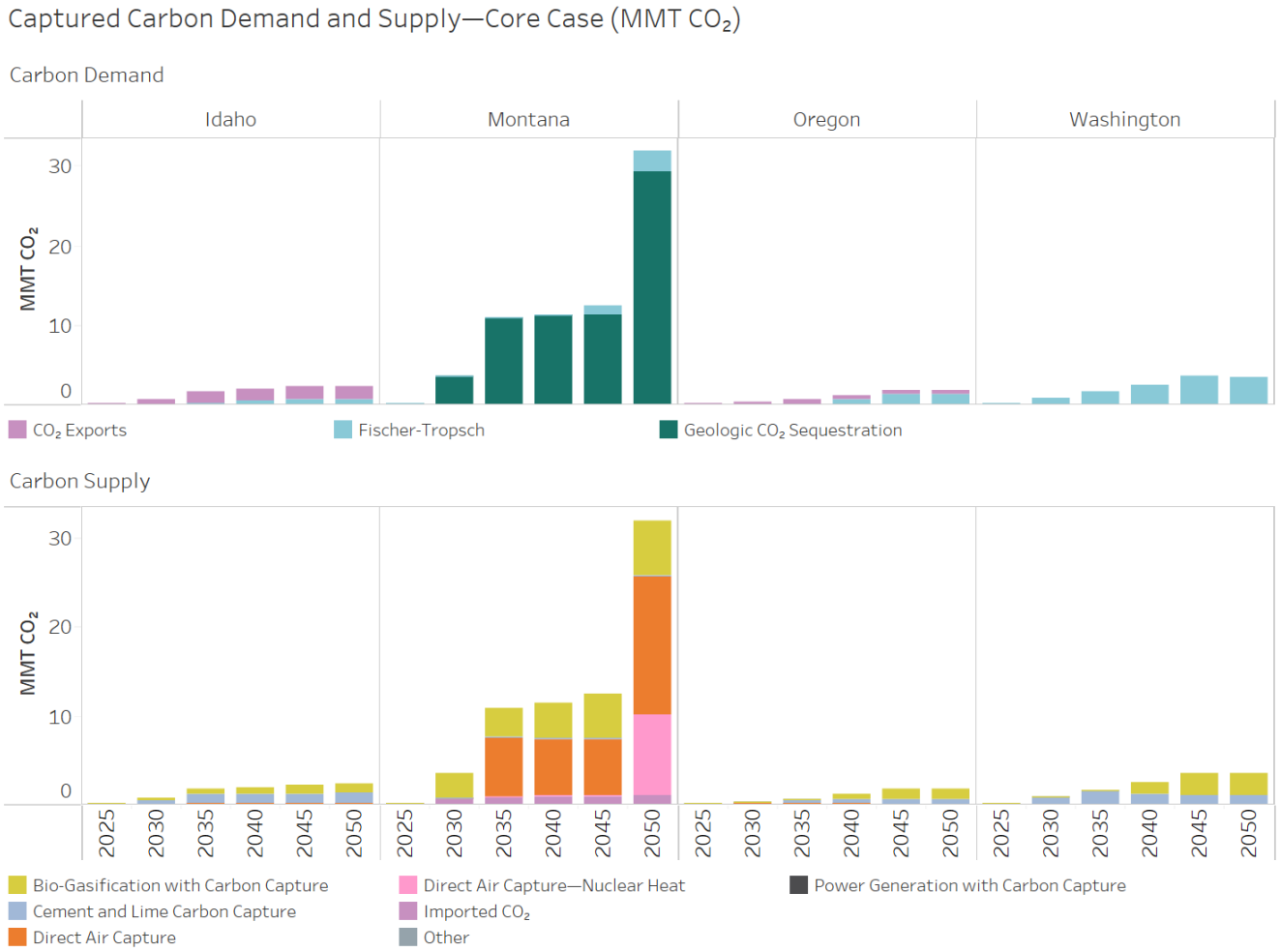
Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report*, June 2023, p. 45.

Hydrogen and Derived Products Economic by 2030



Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report*, June 2023, p. 46.

Capturing Carbon Critical to Developing Clean Fuels



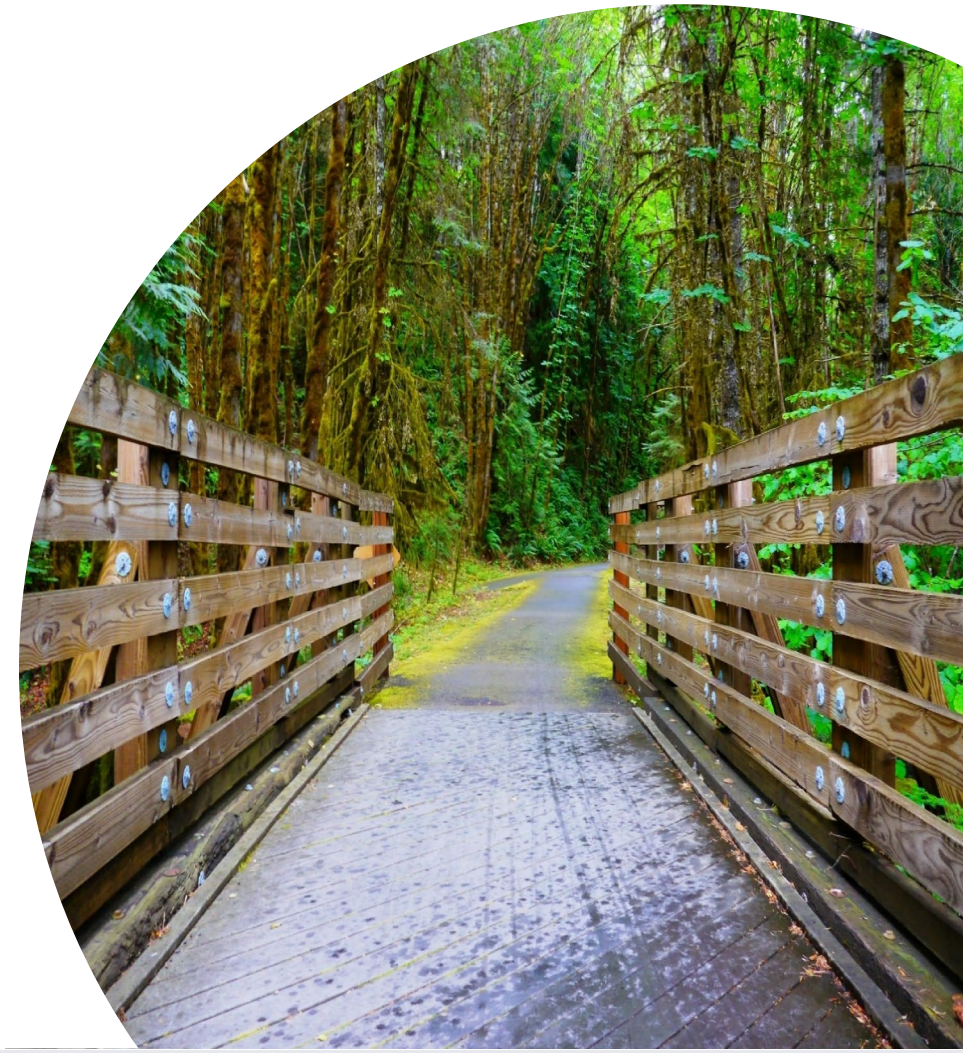
Source: Evolved Energy Research. *Net-Zero Northwest Energy Pathways Analysis Technical Report,* June 2023, p. 49.

Geologic Sequestration

- Sequestration limited by sources of carbon and potential to sequester it
- Model permits states to count carbon sequestration that they pay for in other states toward own emissions offsets
- Modeled sequestration potential comes from National Energy Technology Laboratory (NETL)'s CO_2 Saline Storage Cost Model (potential to store CO_2 in saline aquifers)
  - Future studies may include potential for additional sites when more information is available

Carbon Management – Key Findings

- Carbon becomes a valuable commodity in a decarbonized energy system
  - Clean drop-in fuels production
  - Offsetting emissions
- Carbon demand increases in scenarios where fuels play a larger role, either because electrification is delayed or incomplete, or fossil fuel costs are low
- Delaying carbon management investments by electrifying end uses first lowers decarbonization costs



Top-Level Takeaways

Coordinated planning across the region needed to address transmission expansion issues

- Transmission has a long lead time, so planning must start now
  - Planning for integrated energy systems across geographies
  - Planning for sector coupling between electricity and fuels
- Transmission planning is time consuming with uncertain costs and feasibility
- In a pre-net-zero world, chicken-and-egg issue: Renewable developers needed transmission to connect to markets and transmission builders needed certainty that there were markets for renewables
  - Now no question that we need the resources to meet net-zero targets and energy demand
  - Need to get systems and process in place now

IRA incentives and electrification are major drivers of clean fuel trajectory

- IRA incentives for renewables, hydrogen production, and carbon utilization mean that hydrogen production is economic
  - Hydrogen production is relatively insensitive to the cost of electrolyzers due to generous IRA incentives
  - The economics of hydrogen reduce the amount of biomass use in the economy versus studies prior to IRA
- Clean fuel use in gasoline, diesel, and fuel oil depends on the rate of electrification of gas appliances in buildings
  - Lower rates of building electrification drive higher emissions in the residential and commercial sectors. This shifts greater emissions reductions into liquid fuels where more is replaced with clean alternatives

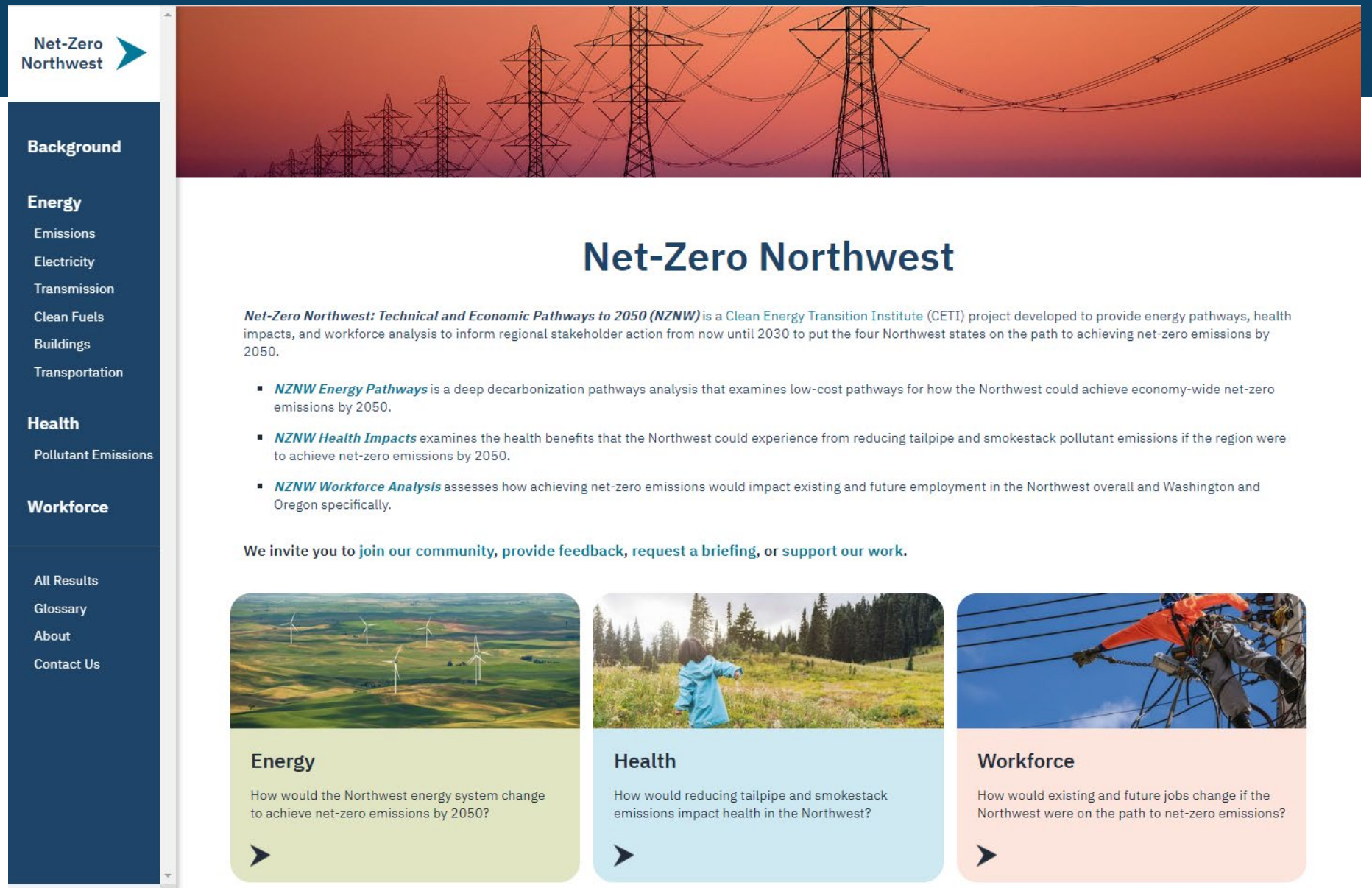
An equitable clean energy transition is not a given

- Least-cost modeling does not assess equity implications
- Co-benefits from reducing pollutant emissions and creating jobs
- How the costs of the transition are borne
- Siting and permitting challenges
- Intentional planning and authentic engagement required

Up Next: Workforce Analysis

Sign up to be notified of results
https://www.nznw.org/workforce

NZNW.ORG


Net-Zero Northwest
Background
Energy
Emissions
Electricity
Transmission
Clean Fuels
Buildings
Transportation
Health
Pollutant Emissions
Workforce
All Results
Glossary
About
Contact Us
Net-Zero Northwest
Net-Zero Northwest: Technical and Economic Pathways to 2050 (NZNW) is a Clean Energy Transition Institute (CETI) project developed to provide energy pathways, health impacts, and workforce analysis to inform regional stakeholder action from now until 2030 to put the four Northwest states on the path to achieving net-zero emissions by 2050.
NZNW Energy Pathways is a deep decarbonization pathways analysis that examines low-cost pathways for how the Northwest could achieve economy-wide net-zero emissions by 2050.
NZNW Health Impacts examines the health benefits that the Northwest could experience from reducing tailpipe and smokestack pollutant emissions if the region were to achieve net-zero emissions by 2050.
NZNW Workforce Analysis assesses how achieving net-zero emissions would impact existing and future employment in the Northwest overall and Washington and Oregon specifically.
We invite you to join our community, provide feedback, request a briefing, or support our work.
Energy
How would the Northwest energy system change to achieve net-zero emissions by 2050?
Health
How would reducing tailpipe and smokestack emissions impact health in the Northwest?
Workforce
How would existing and future jobs change if the Northwest were on the path to net-zero emissions?

Questions & Answers

Thank you very much

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