

Meeting the Challenge of Our Time

Pathways to a Clean Energy

Future for the Northwest

An Economy Wide Deep Decarbonization Pathways Study • 2019



Cascadia Conversation Agenda | 12.18.2019

- Clean Energy Transition Institute
- Deep Decarbonization Pathways Study
- Key Findings
- Implementation Opportunities and Challenges
 - Building Integration with the Grid
 - Grid-Scale Storage
 - Transportation Electrification
 - Jet Fuel & Marine Fuel



Clean Energy Transition Institute

Independent, nonpartisan Northwest research and analysis nonprofit organization with a mission to accelerate the transition to a clean energy economy. Provide information and convene stakeholders.

- Identifying deep decarbonization strategies
- Analytics, data, best practices
- Nonpartisan information clearinghouse
- Convenings to facilitate solutions



Why a Northwest Deep Decarbonization Study?

Common set of assumptions to inform decisions about how the clean energy transition could unfold over the coming decades

- Unbiased, analytical baseline for the region
- Variety of pathways to lower carbon emissions
- Surface trade-offs, challenges, and practical implications of achieving mid-century targets
- Broaden conversations about actions needed



Key Study Questions Posed

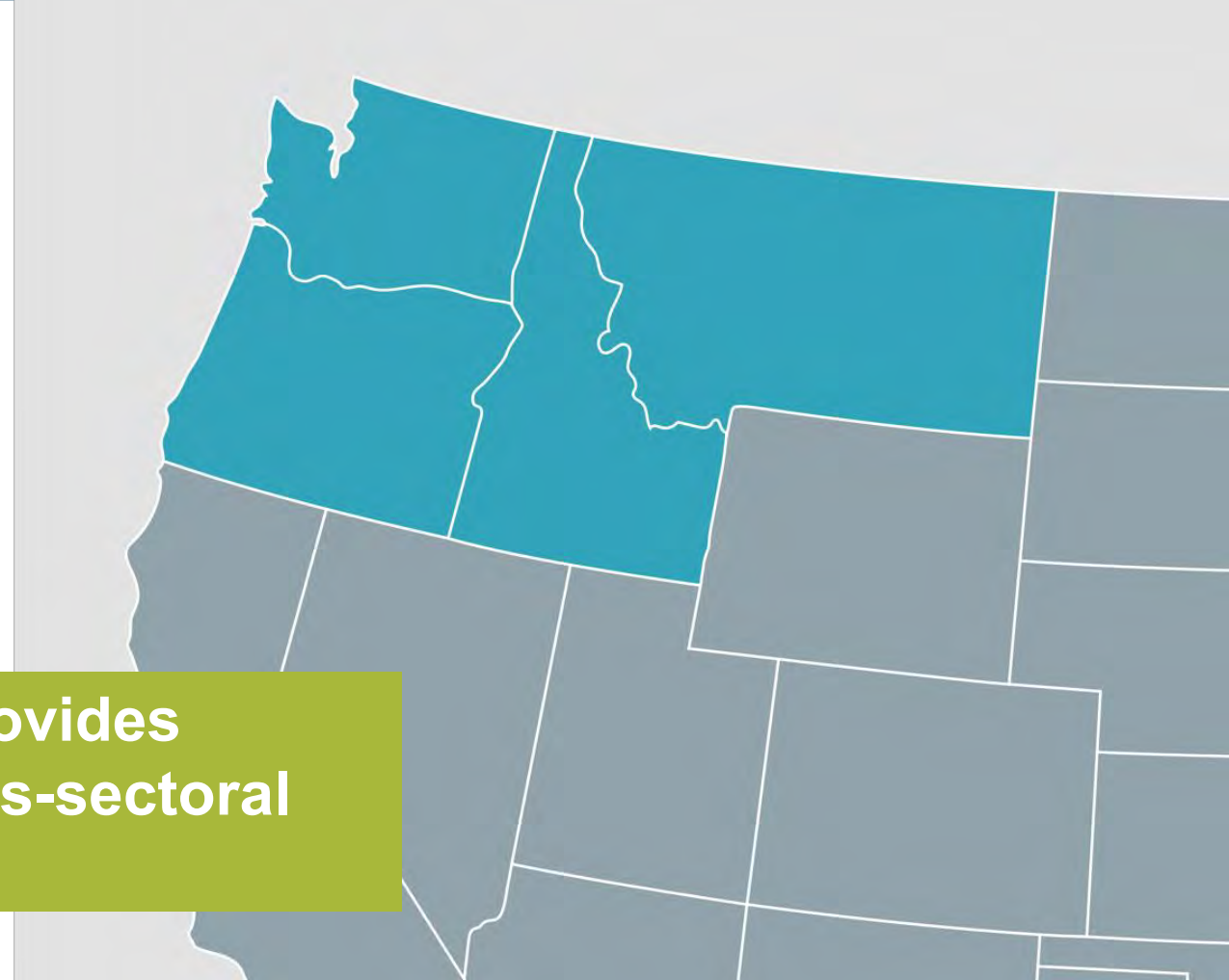
- **How does the energy sector need to transform** in the most technologically and economically efficient way?
- **How does electricity generation need to be decarbonized** to achieve economy-wide carbon reduction goals?
- **What if we can't** achieve high electrification rates?
- **What is the most cost-effective use** for biomass? What if biomass estimates are wrong?
- **What would increased electricity grid transmission** between the NW and CA yield?



Scope: Northwest Regional Energy Sector

- **Scope:** WA, OR, ID, MT
- **All Energy Sectors Represented:**
 - Residential and commercial buildings
 - Industry
 - Transportation
 - Electricity generation

Evaluating holistically provides
an understanding of cross-sectoral
impacts and trade-offs



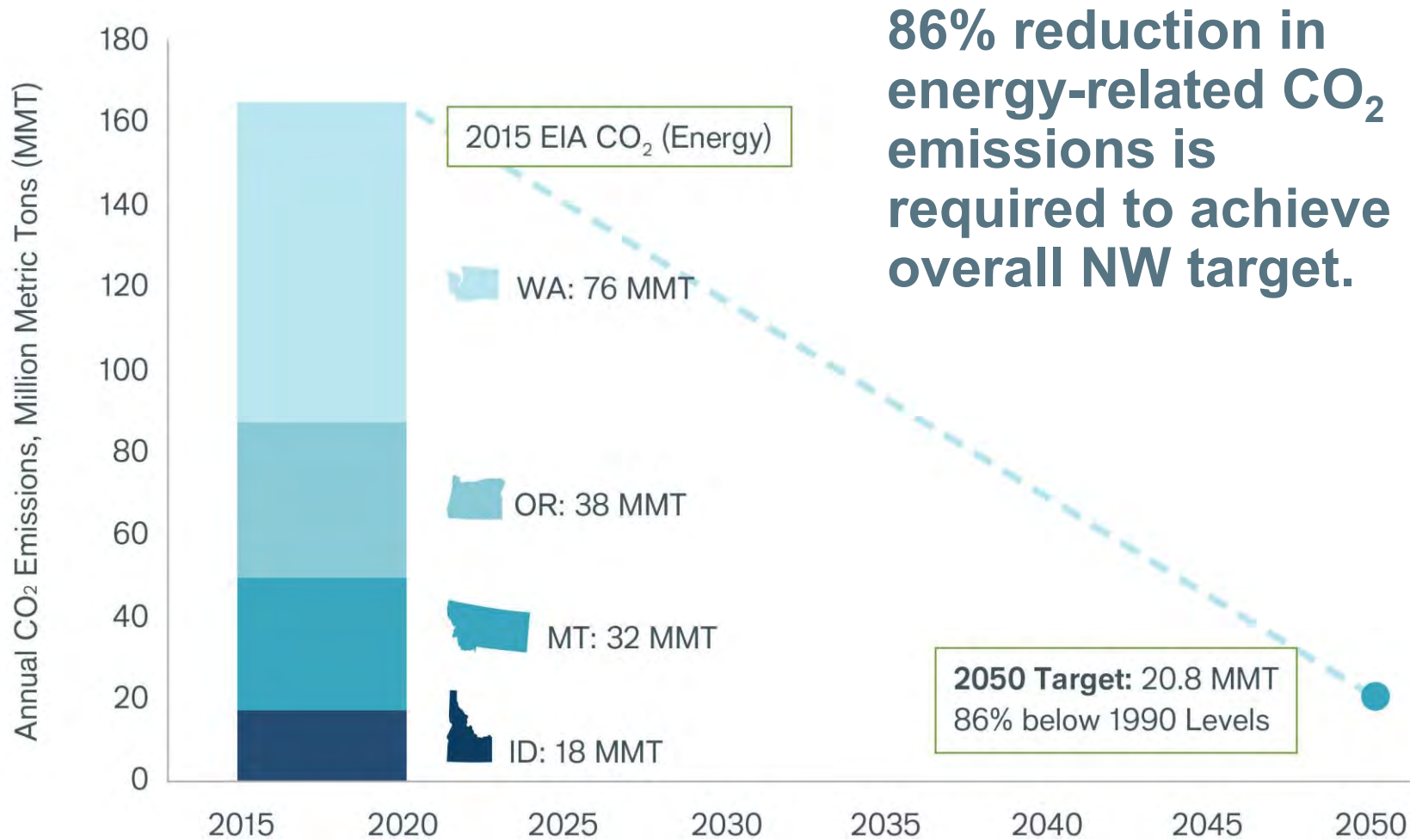
Study Emissions Target

86% reduction in energy-related CO₂ below 1990 levels by 2050

- Applied to each Northwest state independently
- Consistent with economy-wide reduction of 80% below 1990 levels by 2050
- Allows for reductions below 80% for non-energy CO₂ and non-CO₂ GHG emissions, where mitigation feasibility is less understood relative to energy



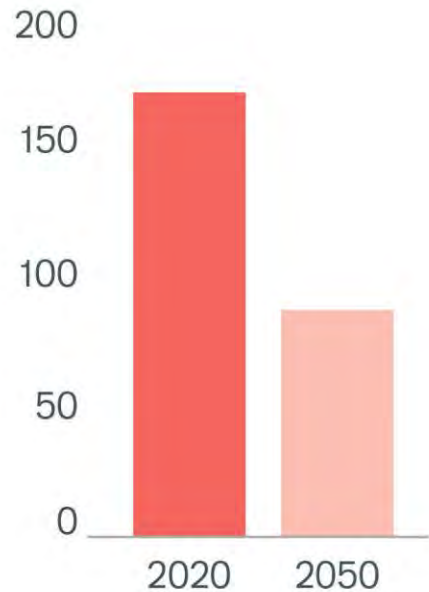
Northwest Deep Decarbonization Target



Five Decarbonization Strategies Deployed

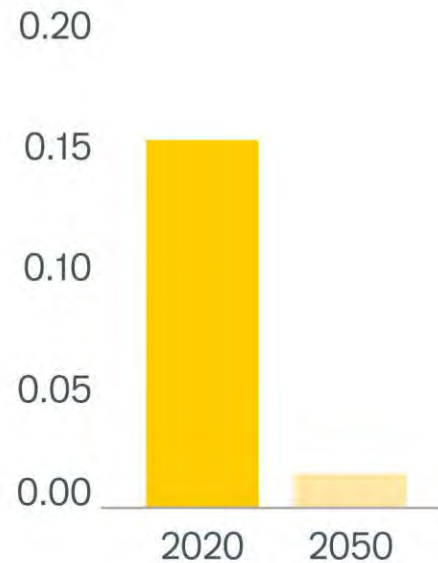
Efficiency

Per capita decreases 50%



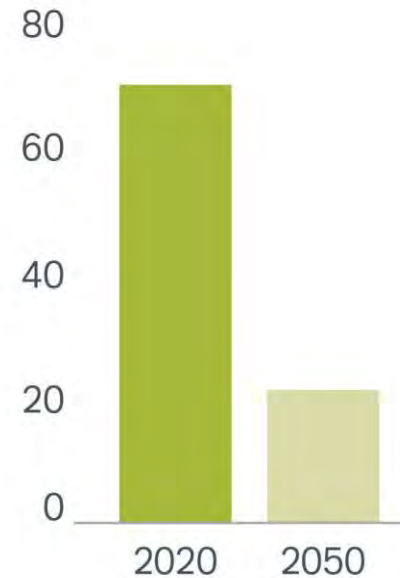
Clean Electricity

96% Clean by 2050



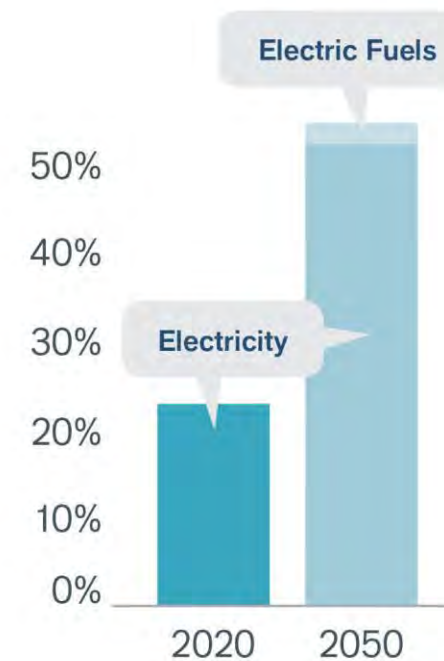
Low Carbon Fuels

70% decrease



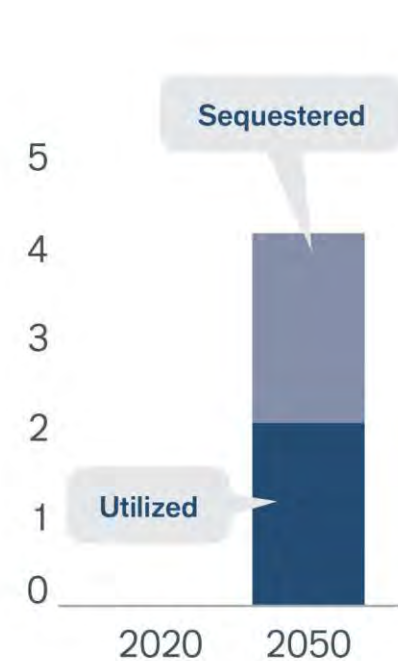
Electrification

Doubles from 23% to 55%

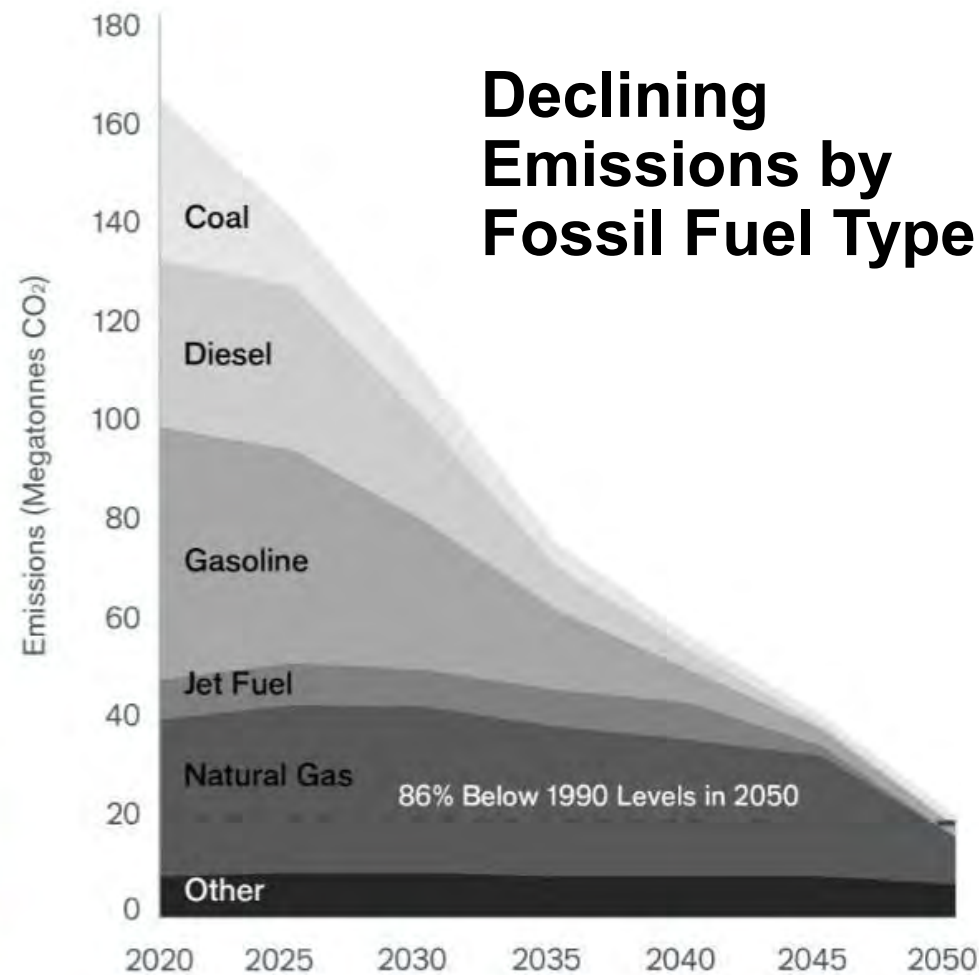
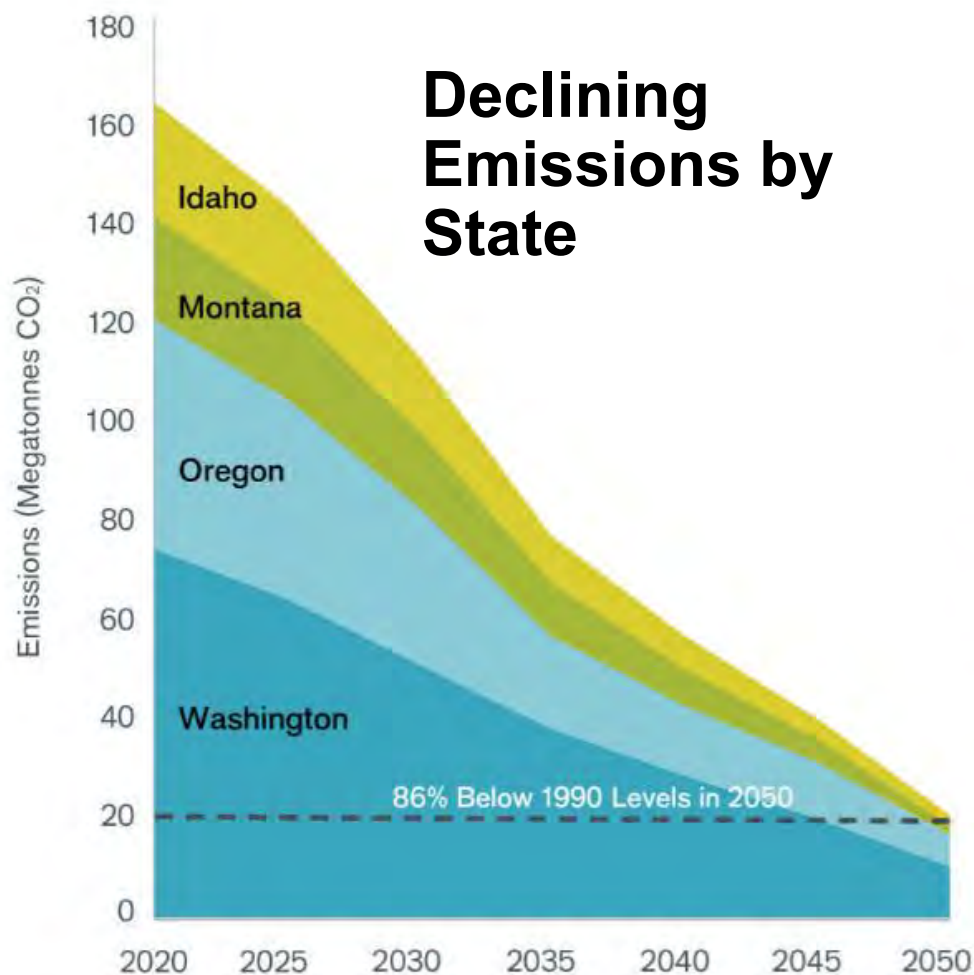


Carbon Capture

1/2 fuel; 1/2 sequestered

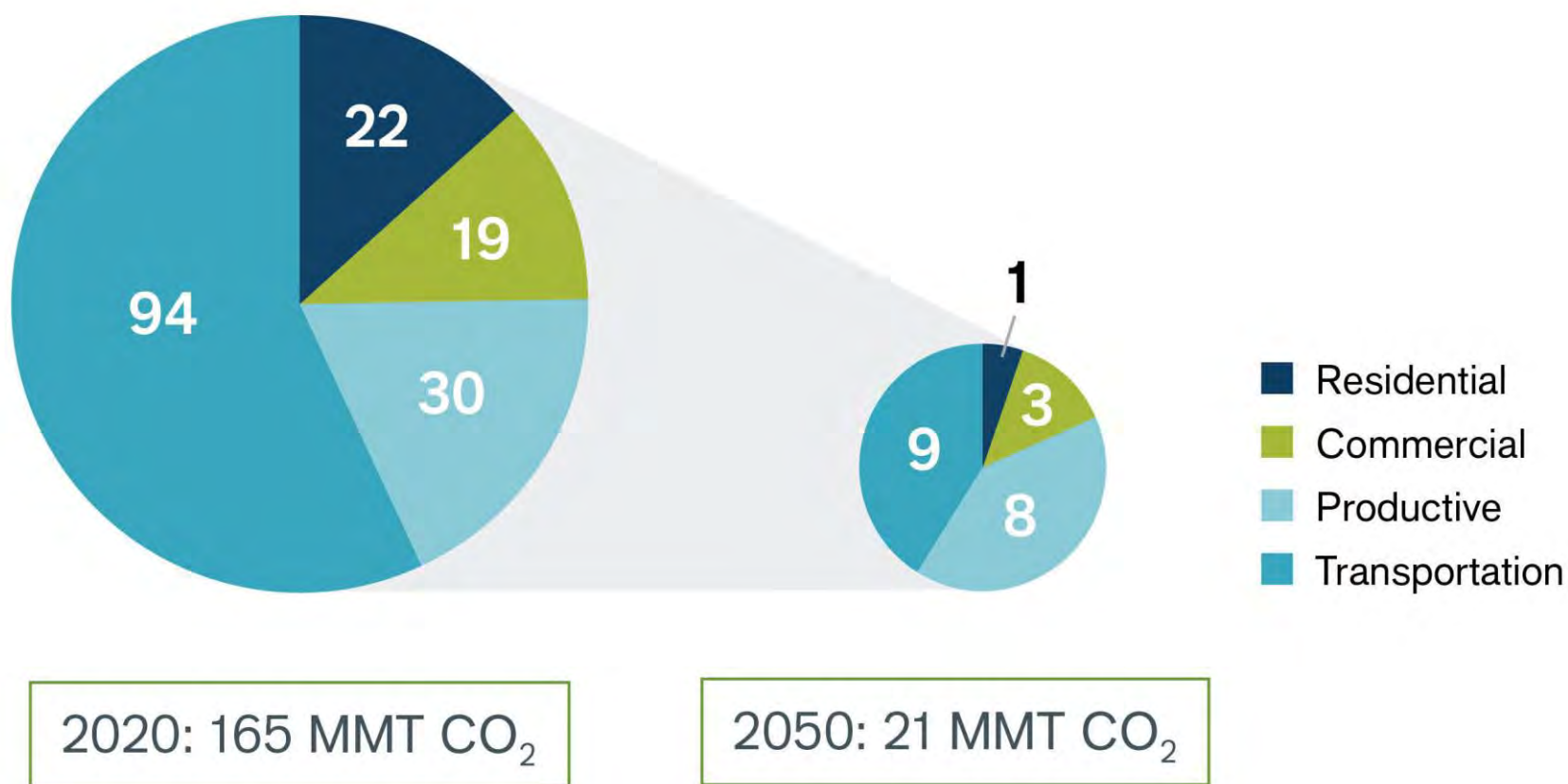


CO₂ Emissions Decrease by State & Fossil Fuel Type



NW CO₂ Emissions Decrease by Sector

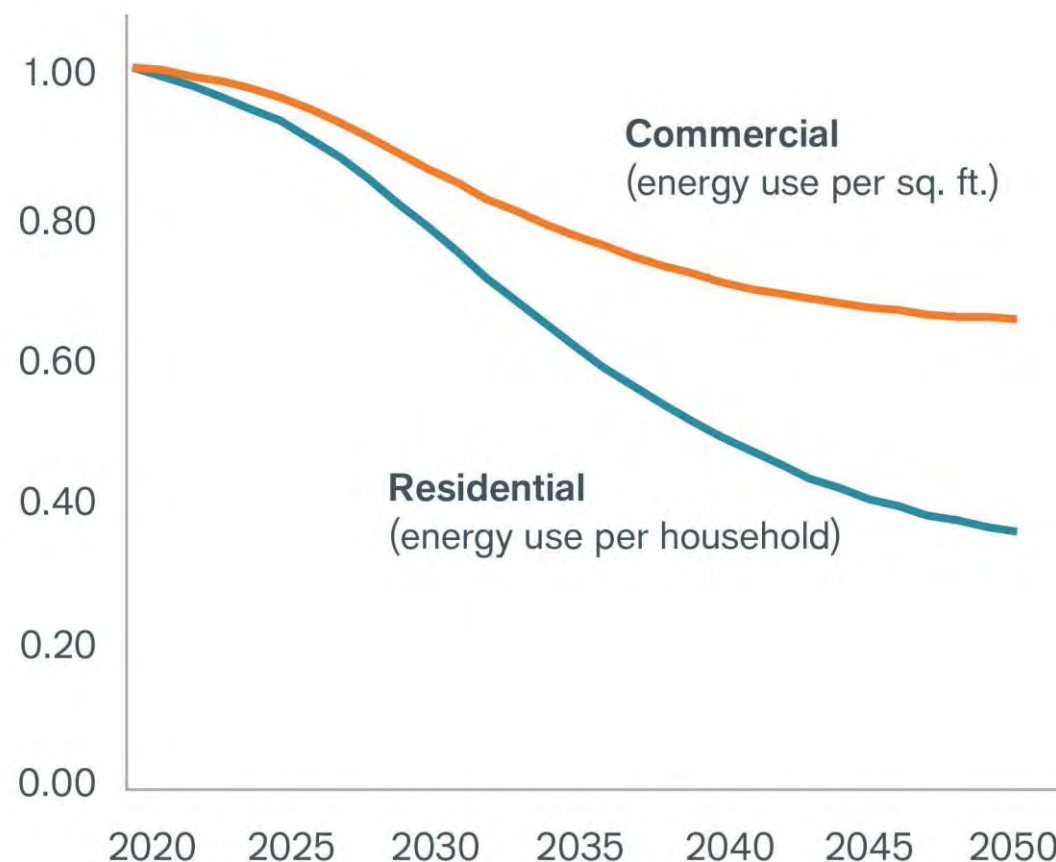
All sectors contribute to reduction in Northwest CO₂ emissions, with decreases ranging from 95 to 73%.



Buildings: Deep Efficiency & Electrification

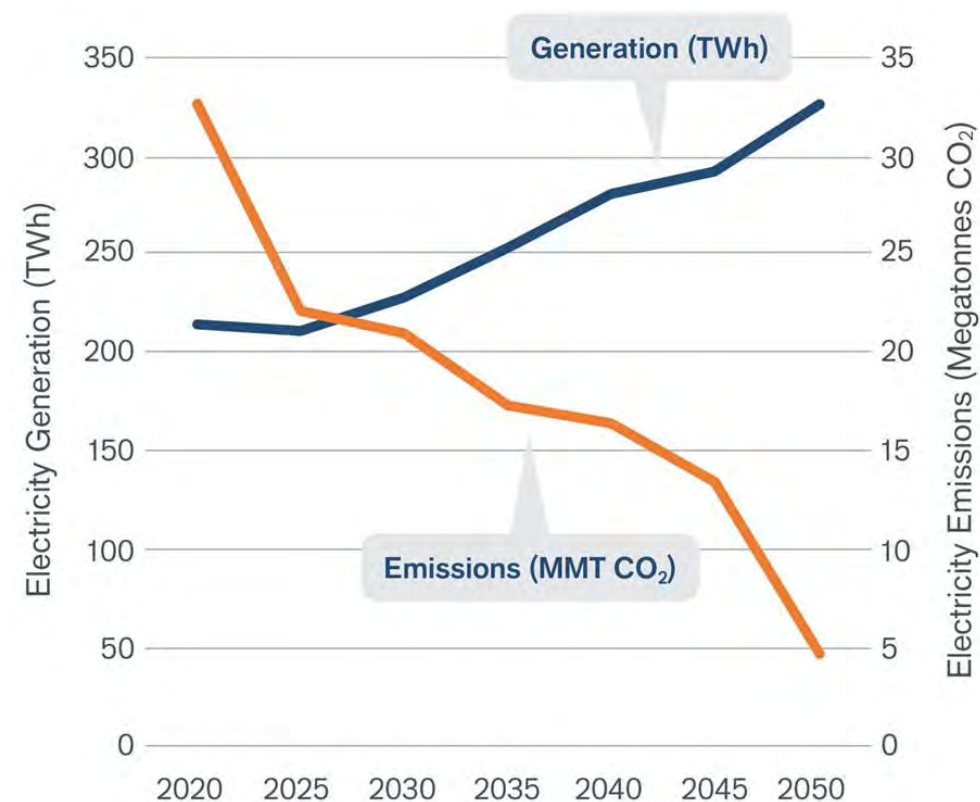
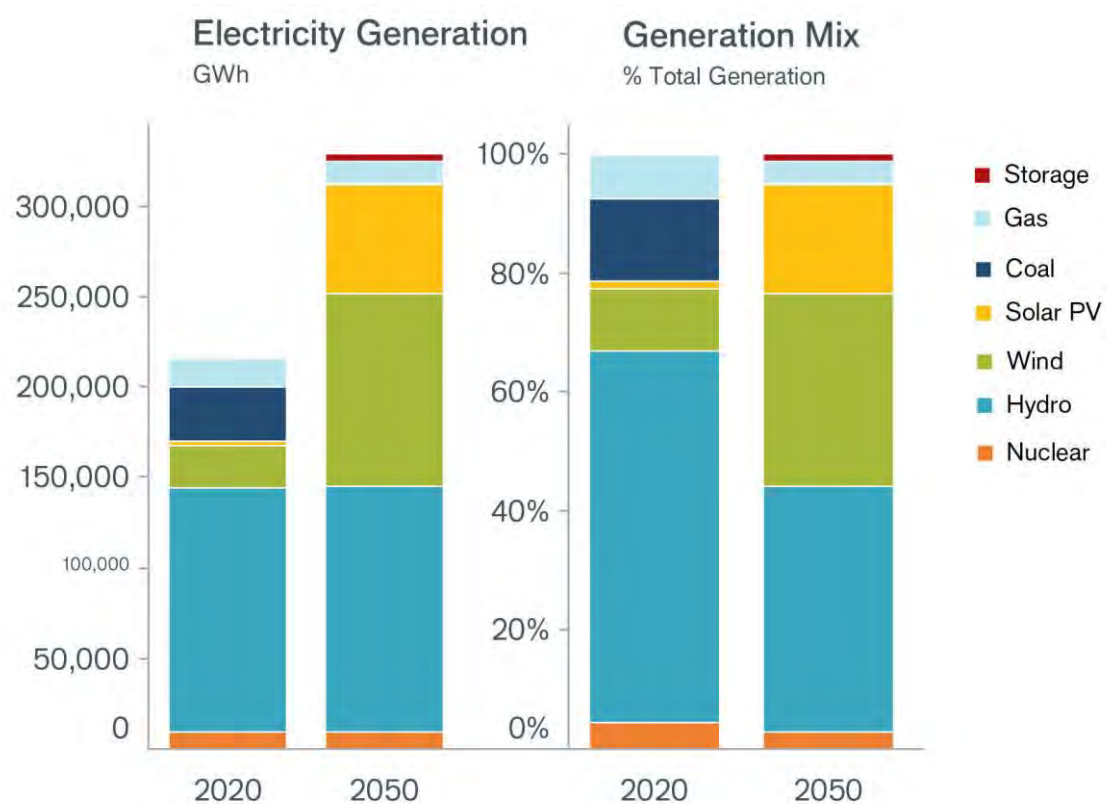
- Building energy intensity declines by 30% for commercial and 60% for residential sector from 2020 to 2050

Building Energy Intensity (2020=1.0)



Electricity: 96% Carbon Free

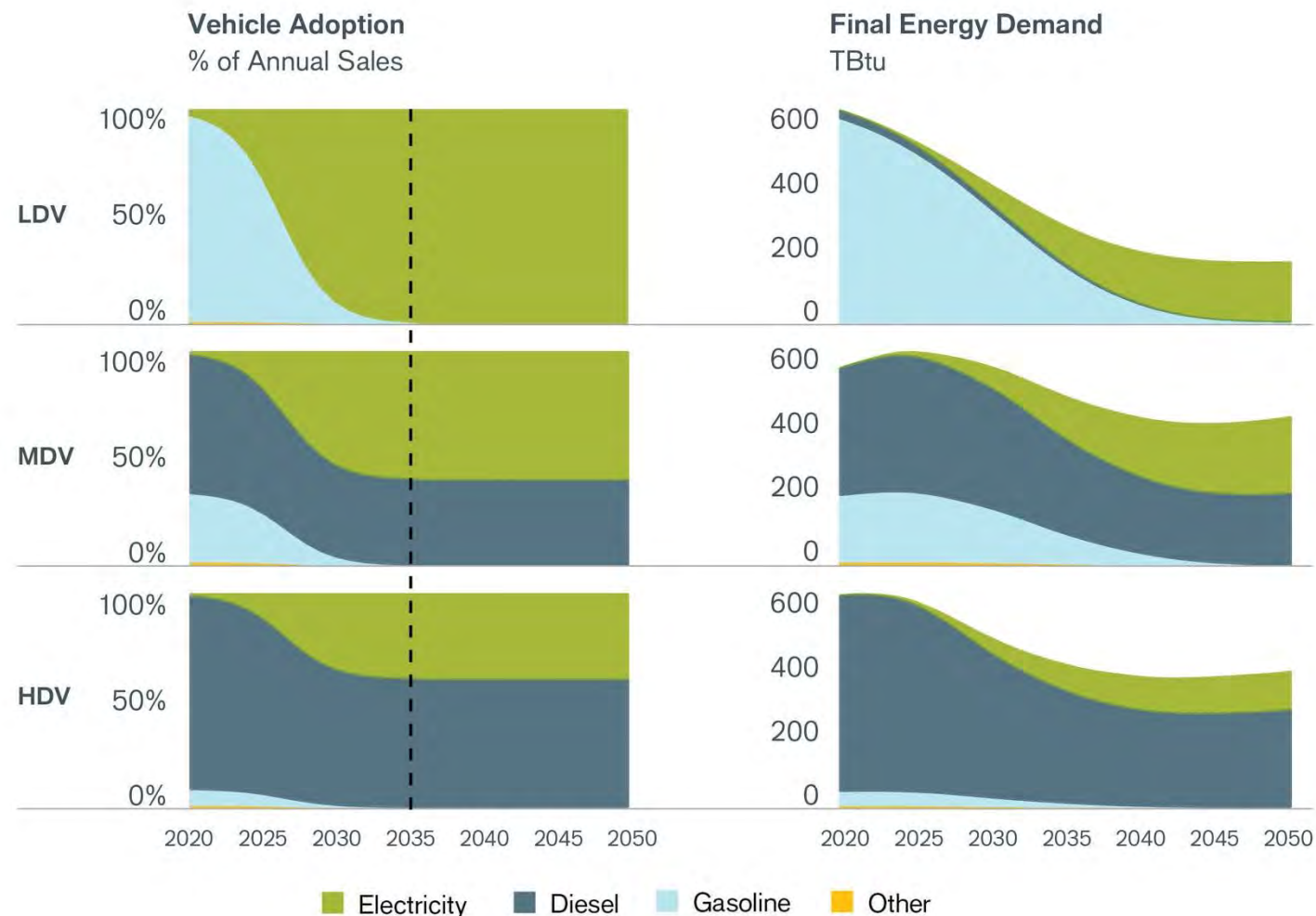
Generation increases 53%, with fossil fuel use at 4%, emissions decline by 86%.



Transportation: Massive Shift to Electric Vehicles

By 2050:

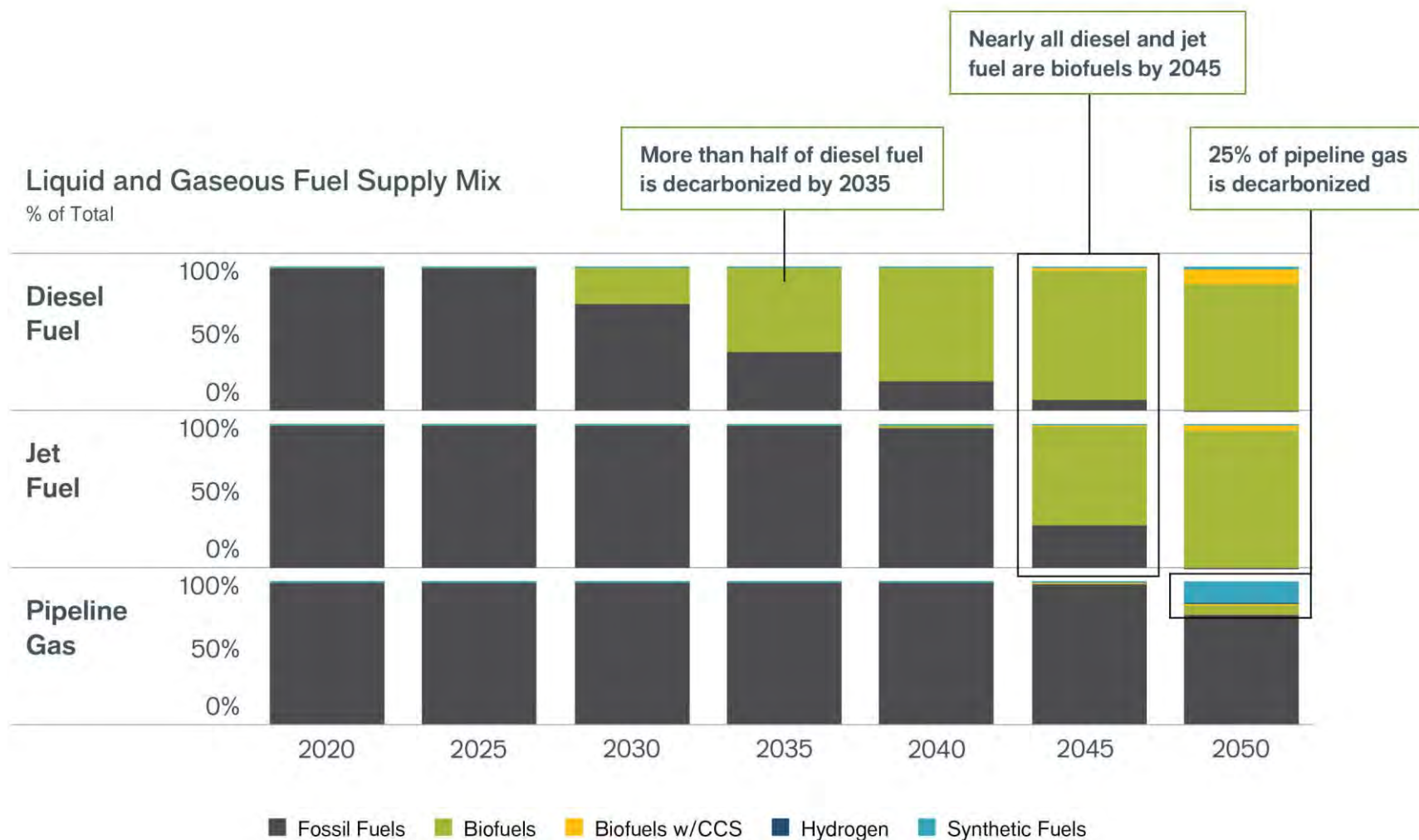
- Cars, SUVs, and light trucks fully electrified
- Medium and heavy-duty trucks partially electrified
- Results in a 60% reduction in final transportation sector energy demand from light, medium, and heavy-duty vehicles



Fuels: Decarbonized Diesel, Jet, and Pipeline Gas

By 2050:

- Diesel and jet fuel fully decarbonized, primarily using biofuels
- 25% of pipeline fuels partially decarbonized
- Synthetic fuels play a key role



Estimated Net Cost to Achieve Target Roughly 1% of GDP

- Cumulative costs of decarbonizing the energy system in the Central Case are 9.5% higher than the capital and operating expenses of the Business as Usual energy system
- Represents roughly 1% of region's GDP
- Does not include benefits from avoiding climate change, reducing air pollution, improved health



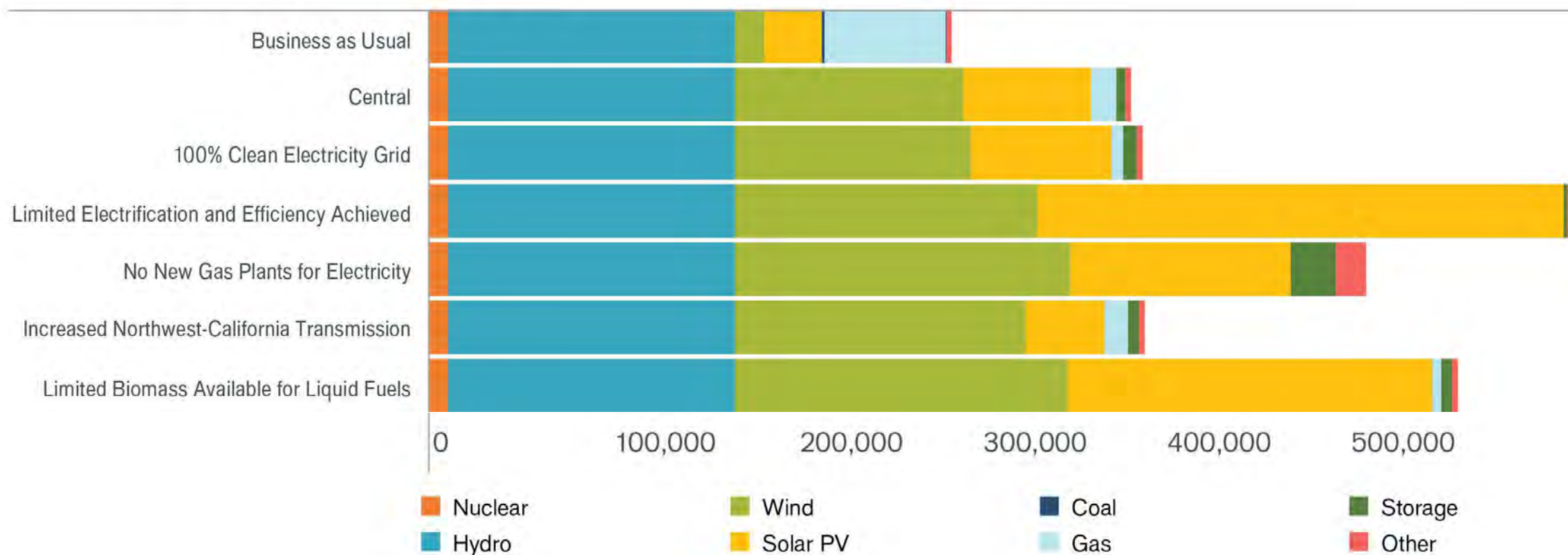
Alternative Pathway Results

-  **100% Clean Electricity Grid**
 - Easier with economy-wide approach; electric fuels achieves additional 4%
-  **Limited Electrification & Efficiency**
 - Enormous supply/cost implications; scale of facilities prohibitive; imports likely
-  **No New Gas Plants for Electricity**
 - More energy storage & renewables for reliability; approximately double the cost
-  **Limited Biomass for Liquid Fuels**
 - Similar energy system impacts to the No New Gas, though not as costly
-  **Increased NW-CA Transmission**
 - Saves \$11.1B; avoid development of low-quality renewables in CA & in NW

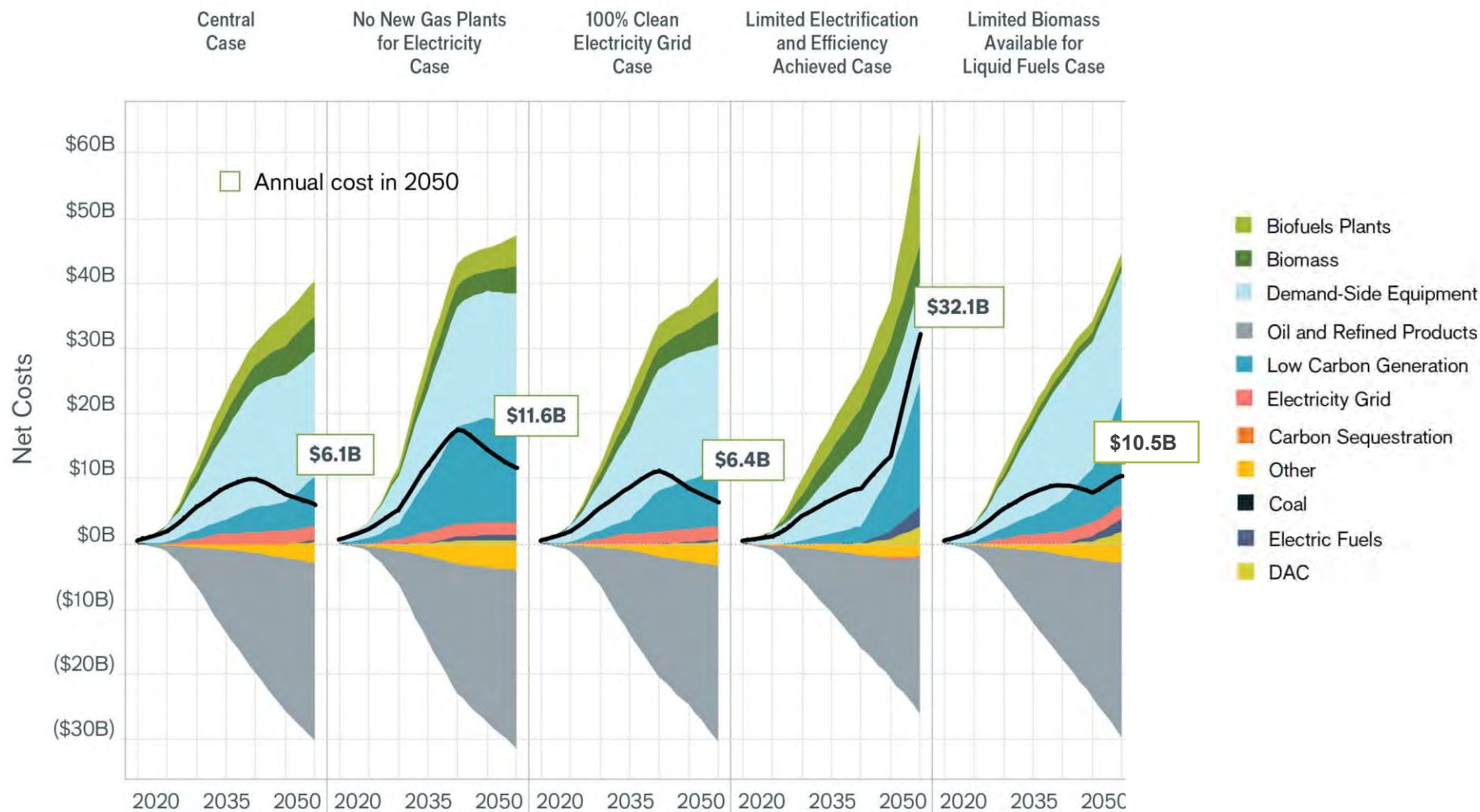
Electricity Resources All Cases in 2050

Electricity Generation by Resource Type (GWh)

2050



Annual Net Energy System Costs, Six Cases



Key Findings: Deep Decarbonization Achievable

- **Electricity** generation must be **~96% clean**
- **A highly efficient built environment** powered by clean electricity
- **Aggressive vehicle electrification** powered largely by clean electricity
- **Thermal generation (natural gas) important for reliability** but operates at low capacity factor in 2050
- **Significant cost savings** if the Northwest and California **grids are better integrated**
- **Biomass** allocated to replace jet and diesel fuel
- **Electric fuels** play an important role



Equity and Implementation Implications

- Deep Decarbonization Implementation Challenges:
 - Implementing widespread transportation electrification
 - Limiting natural gas in buildings, transport, and the grid
 - Achieving deep energy efficiency
 - Grid storage, grid readiness
 - Improving/expanding Northwest-California grid integration
 - Assessing actual biomass in the Northwest
 - Determining the role power-to-X, electrolysis, direct air capture in the Northwest
- Equity implications must be examined and addressed



Institute Next Steps

- **Additional Runs of the Model**
 - Run model with updated cost & technology data
 - Assumptions about hydroelectricity, nuclear availability, coal plant retirements, natural gas pricing and carbon intensity.
- **Develop Policy, Innovation, Investment & Equity Frameworks to Accelerate Deep Decarbonization**
 - Role of Natural Gas in Buildings, Transport, Grid
 - Transportation Electrification
 - Northwest-California Grid Integration
- **Project:** Building Decarbonization with an Equity Focus



CLEAN ENERGY TRANSITION INSTITUTE

partisan Northwest research and analysis nonprofit organization dedicated to **accelerating the clean energy transition in the Northwest.**

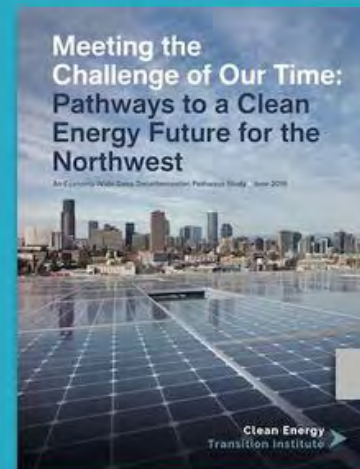
The Clean Energy Transition Institute's Role is to:

- Conduct Research and Analysis
- Serve as an Information Clearinghouse
- Provide Stakeholder Convening

FEATURED REPORT

Meeting the Challenge of Our Time: Pathways to a Clean Energy Future for the Northwest is the first economy-wide analysis to examine decarbonization pathways mapped to the Northwest's economic and institutional realities.

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