Oregon
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# AGENDA

**Title:** Direct Use Fuels and Industry Working Group – Oregon Energy Strategy

**Date:** August 6, 2024, 9 – 11 am

**Objectives:**
The purpose of this Working Group is to:

- Understand foundational data sources that will inform the energy strategy and ask clarifying questions.
- Provide expertise and feedback on key assumptions related to direct use fuels and industry.
- Discuss "what if" questions and priorities for a scenario analysis that can help illuminate trade-offs of different clean energy pathways.
- Foster transparency in the Energy Strategy technical analysis through information sharing on the scope, data sources, and development process of the modeling tools.

**Direct Use Fuels and Industry Working Group Members:**

| | |
|---|---|
| Oregon State University Industrial Assessment Center | Karl Haapala |
| NW Natural | Matthew Doyle |
| Cascade Natural Gas | Eric Wood |
| Coalition of Communities of Color | Nikita Daryanani |
| Energy Trust of Oregon | Adam Shick |
| Food Northwest | Pam Barrow |
| Oregon Fuels Association | Mike Freese |
| Amazon | Courtney Lee |
| Prosper Portland | Katherine Krajnak |
| Renewable Hydrogen Alliance | Rebecca Smith |
| Coalition for RNG | Sam Lehr |
| Green Energy Institute | Carra Sahler |
| Climate Solutions | Claire Prihoda |
| Portland General Electric | Lee Archer |
| Northwest Energy Efficiency Alliance | Susan Hermenet |
| Umatilla Electric Cooperative | Alec Shebiel |
| Oregon Environmental Council | Nora Apter |
| Oregon Citizens' Utility Board | John Garrett |
| Northwest Energy Coalition | Will Gehkre |
| Oregon Department of Environmental Quality | Bill Brady |
| Oregon Business and Industry | Sharla Moffett |
| Oregon Business for Climate | Tim Miller |
| Business Oregon | Valerie Egon |

**Agenda**

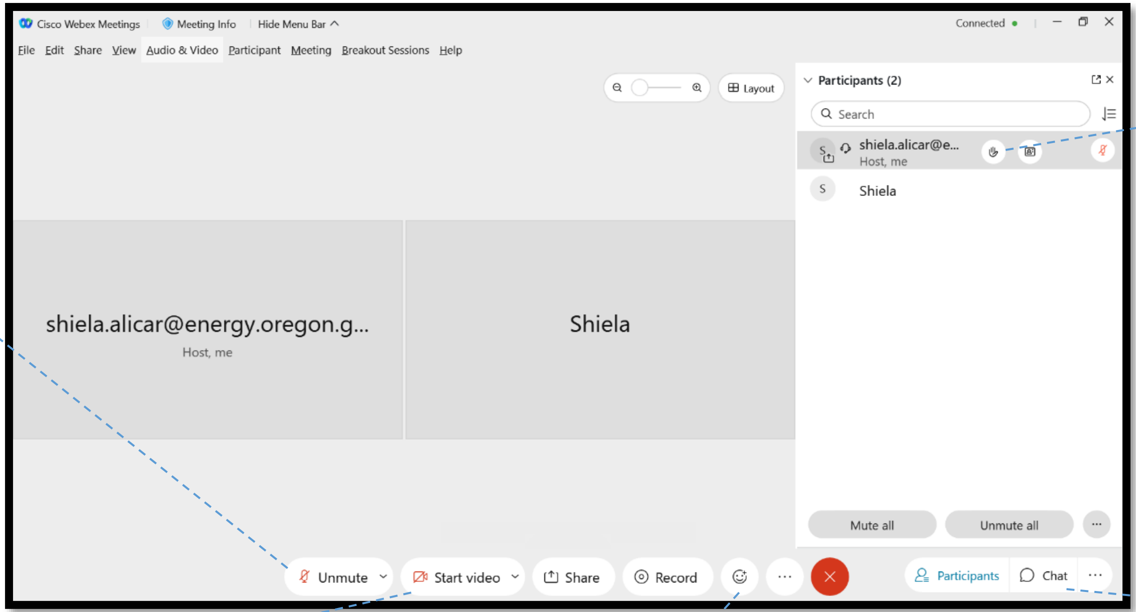
| Topic | Who | Time |
|---|---|---|
| Welcome and Introductions | Michael Freels, ODOE | 10 min |
| Setting the Stage | Michael Freels, ODOE | 10 min |
| How direct use fuels and industry are considered in the Oregon Energy Strategy reference scenario | Jeremy Hargreaves, Evolved Energy Research | 15 min |
| Guided discussion on the reference scenario:<br>• What are your thoughts/reactions to the starting point assumptions presented here?<br>• Is there anything in the assumptions or modeling that you would like to understand more? | Michael Freels, ODOE<br>Jeremy Hargreaves, Evolved Energy Research | 40 min |
| Guided discussion on alternative scenarios/levers:<br>• What are your Direct Use Fuels and Industry priorities and how might they be reflected in a scenario analysis? | Michael Freels, ODOE<br>Jeremy Hargreaves, Evolved Energy Research | 40 min |
| Wrap up and Next Steps | Michael Freels, ODOE | 5 min |

# Oregon Department of **ENERGY**

**Oregon Energy Strategy**
Direct Use Fuels and Industry Working Group

Tom Elliott and Michael Freels
August 6, 2024

# USING WEBEX

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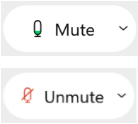


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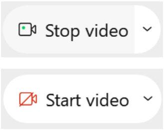
## Video Options

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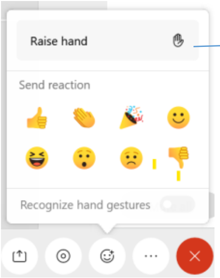
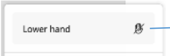
## Reactions



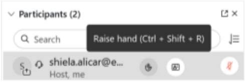

*Click to Raise your hand.*


*Click on Lower hand when you are done.*

## Second Raise Hand Option

*You can also click on the hand next to your name in the Participant list to raise your hand.*

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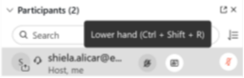
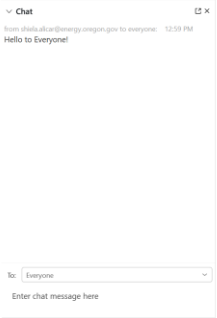
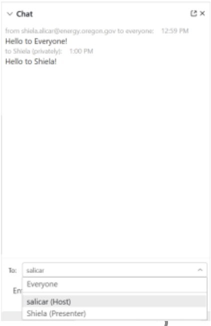



## Chat




*You can chat to Everyone in the meeting.*




*You can send a private message to the Host or Presenter (or all Panelists when there is a Panel).*

# PURPOSE OF THIS WORKING GROUP

- Understand foundational data sources expected to inform starting point for analysis and ask clarifying questions.

- Provide expertise and feedback on key assumptions related to direct use fuels and industry technologies out to 2050.

- Discuss "what if" questions to inform scenarios that can help understand trade-offs of different clean energy pathways.

*Note: focus is on the modeling; discussion of policy recommendations will take place in early 2025.*

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# AGENDA

| | | |
|---|---|---|
| **9:00 – 9:10** | Welcome and Introductions | Tom Elliott, Energy Policy Team Lead |
| **9:10 – 9:20** | Setting the Stage | Michael Freels, Energy Policy Team Lead |
| **9:20 – 9:35** | How direct use fuels and industry are considered in the Oregon Energy Strategy reference scenario | Jeremy Hargreaves, Evolved Energy Research |
| **9:35 – 10:15** | Discussion of reference scenario data and assumptions | Michael Freels & Tom Elliott, ODOE<br>Jeremy Hargreaves, Evolved Energy Research |
| **10:15 – 10:55** | Discussion of alternative scenarios | |
| **10:55 – 11:00** | Wrap up and Next Steps | Tom Elliott, Energy Policy Team Lead |

*Note: ODOE will open the floor for comments and questions from observers if time permits. Comments and questions can be submitted to: https://odoe.powerappsportals.us/en-US/energy-strategy/*

# WORKING GROUP ROSTER

| ORGANIZATION | NAME |
|---|---|
| Oregon State University Industrial Assessment Center | Karl Haapala |
| NW Natural | Matthew Doyle |
| Cascade Natural Gas | Eric Wood |
| Energy Trust of Oregon | Adam Shick |
| Food Northwest | Pam Barrow |
| Oregon Fuels Association | Mike Freese |
| Amazon | Courtney Lee |
| Prosper Portland | Katherine Krajnak |
| Renewable Hydrogen Alliance/Transformist Consulting | Rebecca Smith |
| Coalition for RNG | Sam Lehr |
| Green Energy Institute (Lewis and Clark) | Carra Sahler |
| Climate Solutions | Claire Prihoda |
| Portland General Electric | Lee Archer |
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| Northwest Energy Coalition | Will Gehkre |
| Oregon Business and Industry | Sharla Moffett |
| Oregon Business for Climate | Tim Miller |
| Business Oregon | Valerie Egon |
| DEQ | Bill Brady |

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# INTRODUCTIONS

- Please share the following with the group via chat:
  - name
  - affiliation
  - geographic location you represent
  - what are you doing for fun this summer?

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# CLEAN ENERGY TRANSITION INSTITUTE TEAM

## Project Management

- Overall Project Manager: Eileen V. Quigley, CETI
- Technical Project Manager: Ruby Moore-Bloom, CETI

## Technical Modeling

- Technical Project Lead: Jeremy Hargreaves, Evolved
- Technical Advisors: Elaine Hart, Moment Energy Insights; Amy Wagner, Evolved
- Technical Project Support: Ryan Jones and Gabe Kwok, Evolved
- Health Impacts Lead: Jamil Farbes, Evolved

## Equity Support

- Equity Advisor: Angela Long, Rockcress Consulting
- Equity Advisory & Data Analyst: Mariah Caballero, CETI

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# Setting the Stage

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# WORKING GROUP MEETING #1 CHECK IN

*Do you have any clarifying questions from the first working group meeting?*

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# WHERE WE ARE IN THE PROCESS

**Technical approach**

(July – Dec 2024)

- Listening sessions
- Working Groups
- Advisory Group
- Inter-Agency Group
- Tribal Consultation
- EJ & Equity Engagement
- Webinars (bookends)

Present draft model results → Public written feedback

**Policy recommendations**

(winter/spring 2025)

- Listening sessions
- Working Groups (may be different)
- Advisory Group
- Inter-Agency Group
- Tribal Consultation
- EJ & Equity Engagement
- Webinars (bookends)

Present draft policy recommendations → Public written feedback

**Final Report**

(summer/fall 2025 – due by Nov 1, 2025)

- Drafting
- Present draft report → public written feedback
- Finalize
- Publication & outreach

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# SCOPE OF THE ENERGY STRATEGY

In identifying pathways to meeting the state's energy policy objectives, the state energy strategy must take into account, at a minimum:

- State Energy demand and trends
- Energy resources and tech choices considering costs, EE, feasibility & availability
- Existing & potential incentives to support EE
- Energy generation, transmission, distribution infrastructure
- Emerging tech & investment opportunities
- Environmental justice
- Community benefits
- Land use considerations
- Energy burden & affordability
- Economic and employment impacts
- Energy security and impacts of broader markets
- Energy resilience
- Community energy resilience

# ENERGY POLICY OBJECTIVES

| Economy-wide | Electricity (IOUs*) | Natural gas, liquid fuels, propane |
|---|---|---|
| • EO 20-04<br>• 80% GHG reduction by 2050 | • HB 2021<br>• 100% clean by 2040<br><br>*HB 2021 applies to the large IOUs, PacifiCorp and Portland General Electric Company, as well as to electricity service suppliers. | • Climate Protection Program<br>• 90% GHG reduction by 2050 |

Policies driving and shaping compliance pathways:
Clean Fuels Program, Advanced Clean Cars II, Advanced Clean Trucks, Building Codes, Appliance Standards, and many more….

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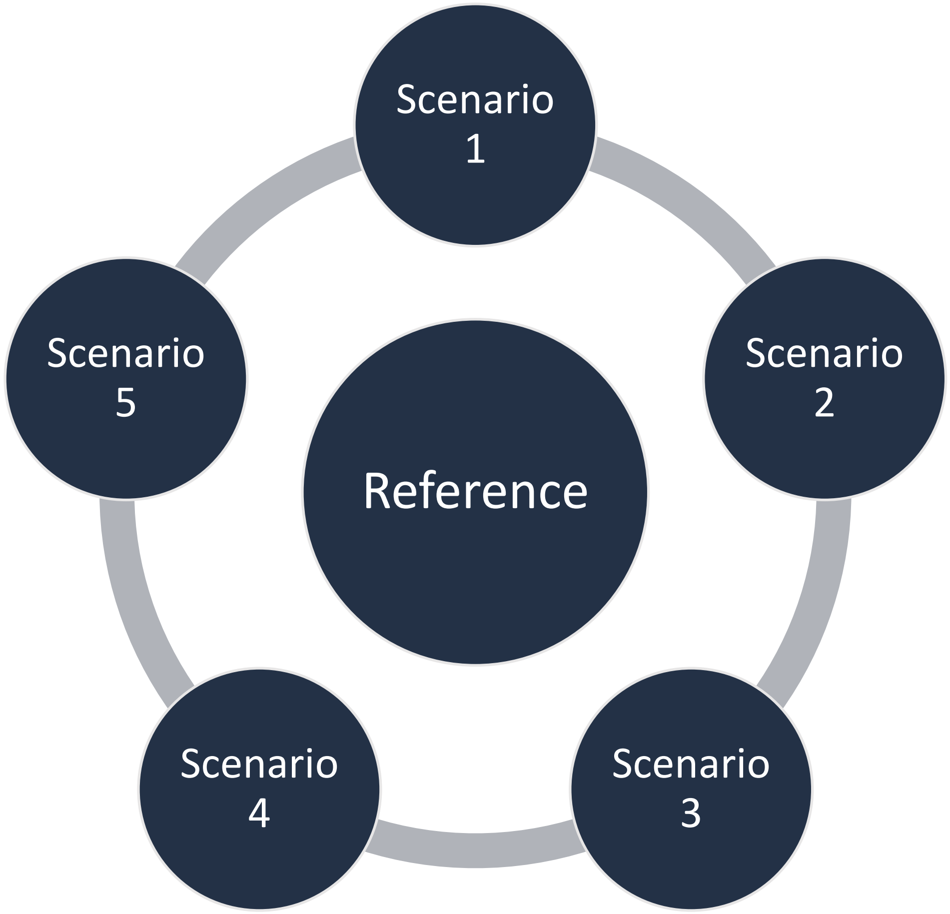
# SUMMARY OF MODELING APPROACH




**Reference**: Combination of a set of reasonable assumptions demonstrating alignment with state energy goals to 2050

**Scenarios 1-5**: Test alternative pathways to uncover differences and trade-offs with reference pathway
*(What if there is more or less transmission? What if heat pump or electric vehicle adoption is slower than expected? etc.)*

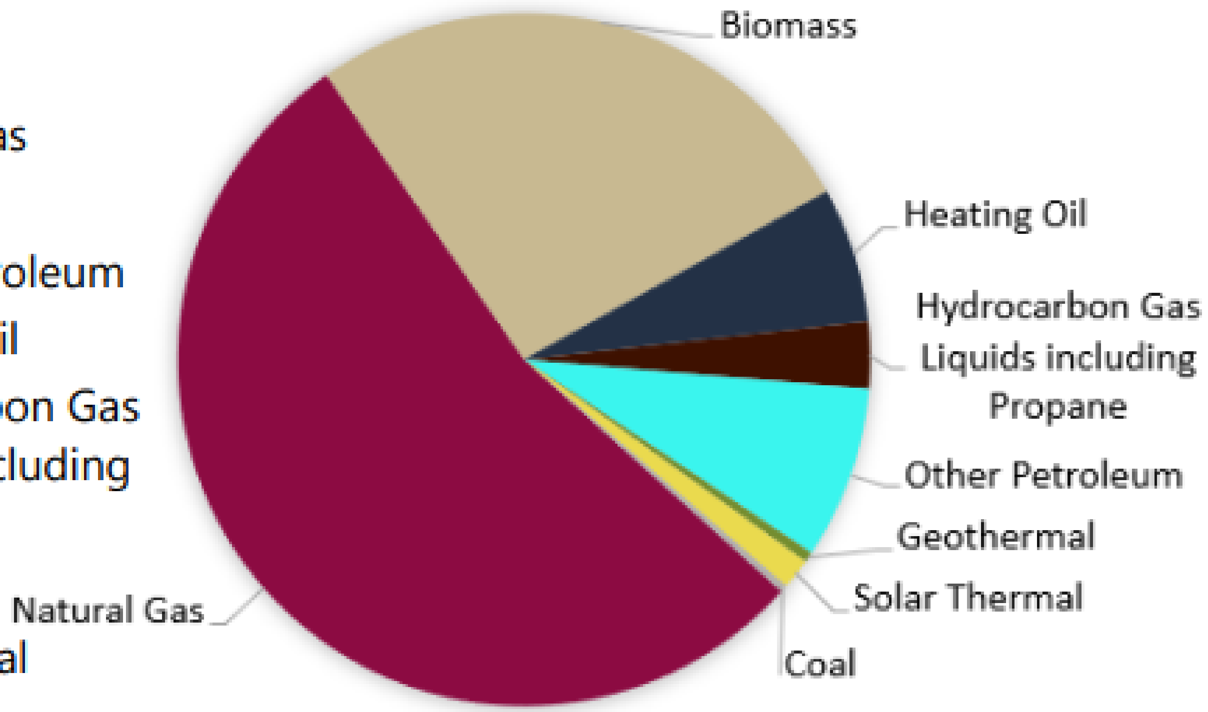
# OREGON'S ENERGY LANDSCAPE

## Direct Use Fuels

26.0%

**of Oregon's 2020 energy consumption**

- **53.7%** Natural Gas
- **26.6%** Biomass
- **8.1%** Other Petroleum
- **6.3%** Heating Oil
- **3.1%** Hydrocarbon Gas Liquids Including Propane
- **0.3%** Coal
- **0.5%** Geothermal




*Source: 2022 Biennial Energy Report. All data is for 2020.*

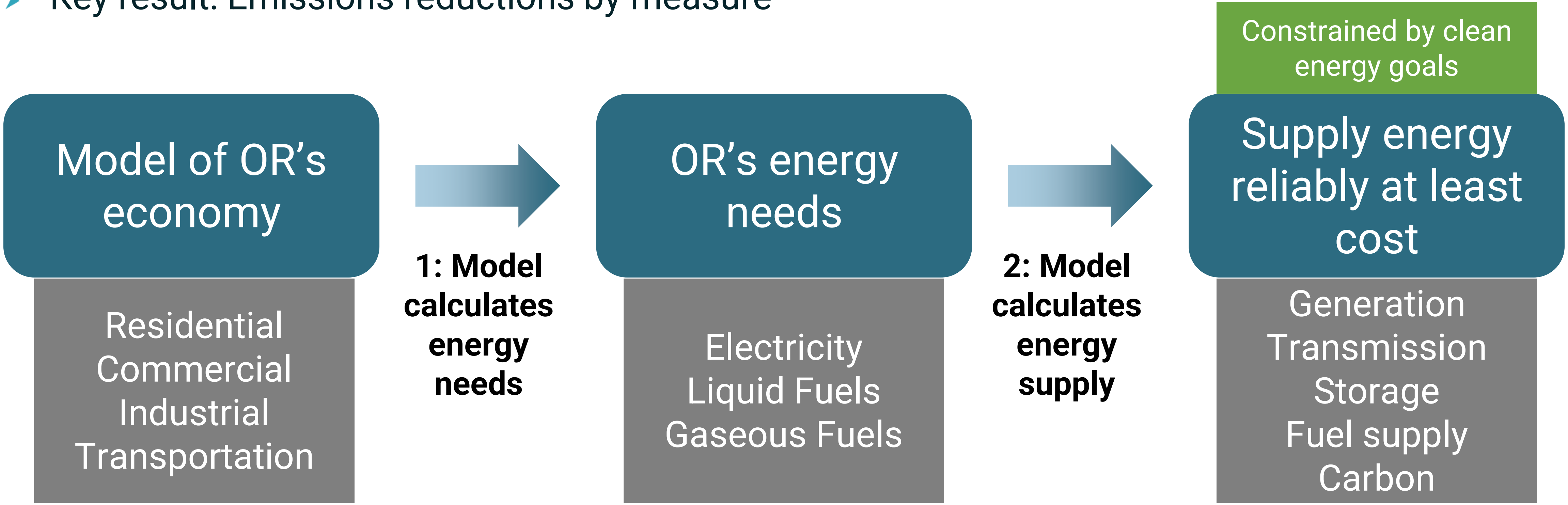
# How direct use fuels and industry are considered in the Oregon Energy Strategy reference scenario

# Oregon Energy Strategy Technical Consulting



# High Level Description of Modeling Approach

- Model calculates the energy needed to power OR’s economy, and the least-cost way to provide that energy under clean electricity and emissions goals
- Key result: Emissions reductions by measure

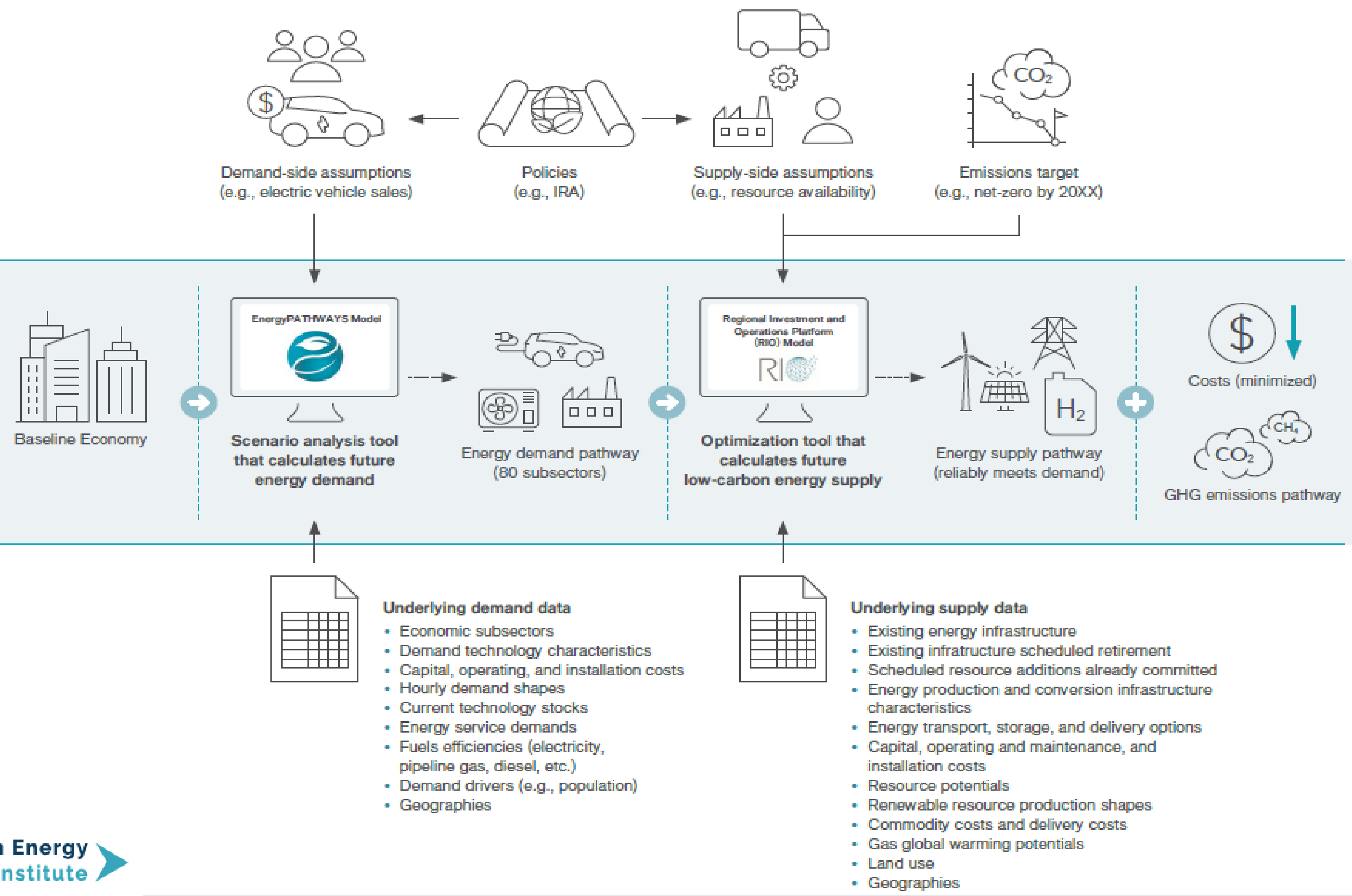


# Economy-Wide Energy Modeling

**Scenario Assumptions**
Model incorporates assumptions about demand-side uses, clean energy policies and incentives, and supply-side resources.

**Energy Modeling**
Evolved Energy Research uses two models to calculate the least-cost way to provide energy under an emission target: Energy Pathways for demand and RIO for supply.

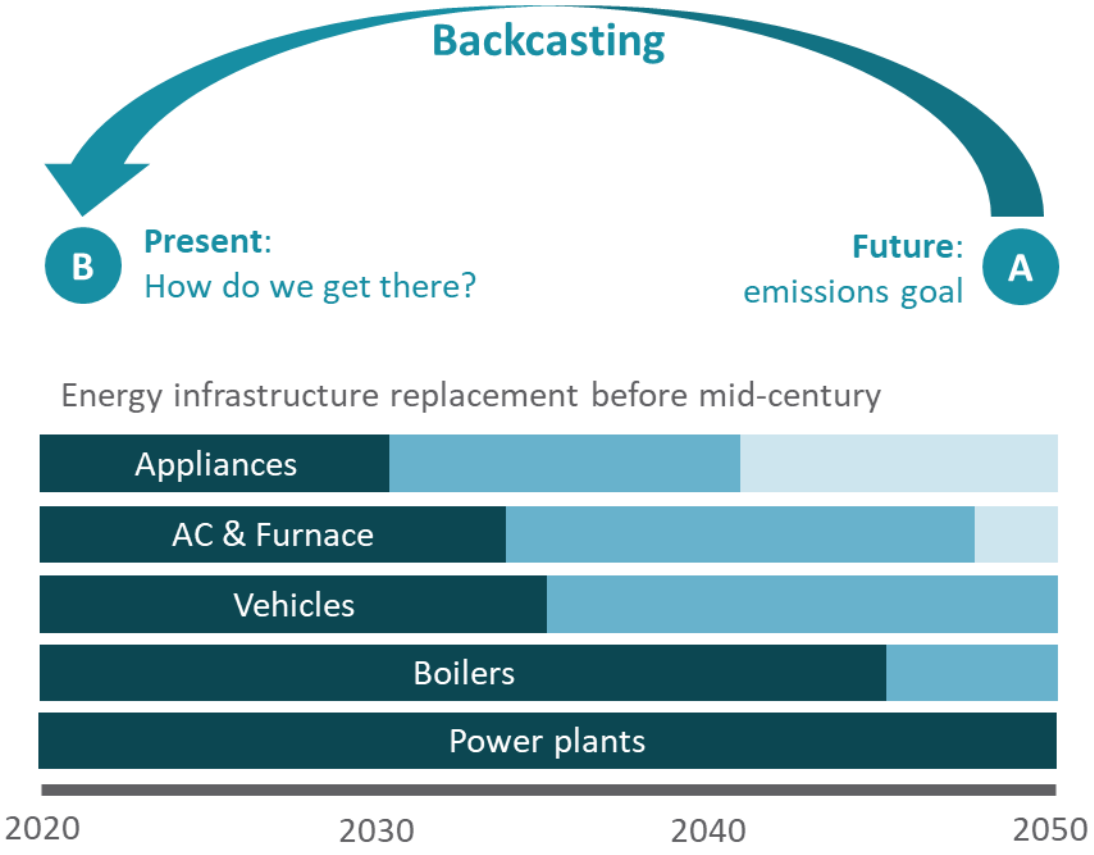
**Best Available Data**
Model incorporates relevant and up-to-date energy data from reputable sources, substituted with local data where possible.




EVOLVED ENERGY RESEARCH
Clean Energy Transition Institute

# Forecasting vs. Backcasting

- **Forecasting**: project changes based on expected customer behavior given incentives/technology
  - e.g result of current policy
- **Backcasting**: start with an end-point and work backwards to infer customer adoption over time
  - What is the best path to be on?
  - Target for future policymaking: Where is current policy falling short?
  - All options available in the long term



# End-Use Sectors Modeled

- Approximately 80 demand sub-sectors represented
- Evolution of fuel demand by sector based on technology adoption
- The major energy consuming sub-sectors are listed below:

**Key energy-consuming subsectors:**

**Residential Sector**
- Air-conditioning
- Space heating
- Water heating
- Lighting
- Cooking
- Dishwashing
- Freezing
- Refrigeration
- Clothes washing
- Clothes drying

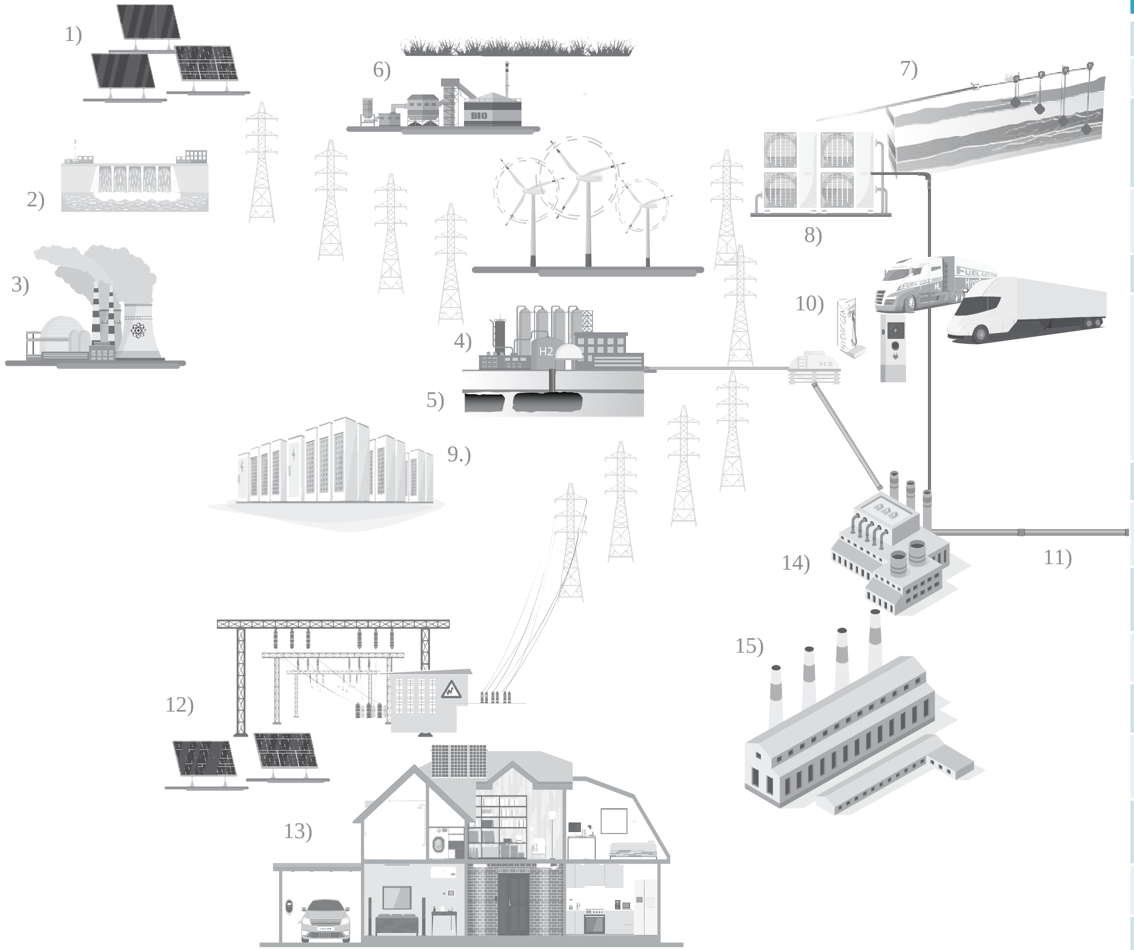
**Commercial Sector**
- Air-conditioning
- Space heating
- Water heating
- Ventilation
- Lighting
- Cooking
- Refrigeration

**Industrial Sector**
- Boilers
- Process heat
- Space heating
- Curing
- Drying
- Machine drives
- Additional subsectors (e.g., machinery, cement)

**Transportation Sector**
- Light-duty autos
- Light-duty trucks
- Medium-duty vehicles
- Heavy-duty vehicles
- Transit buses
- Aviation
- Marine vessels

Source: CETI, NWDDP, 2019

# Economy-Wide Optimization Scope



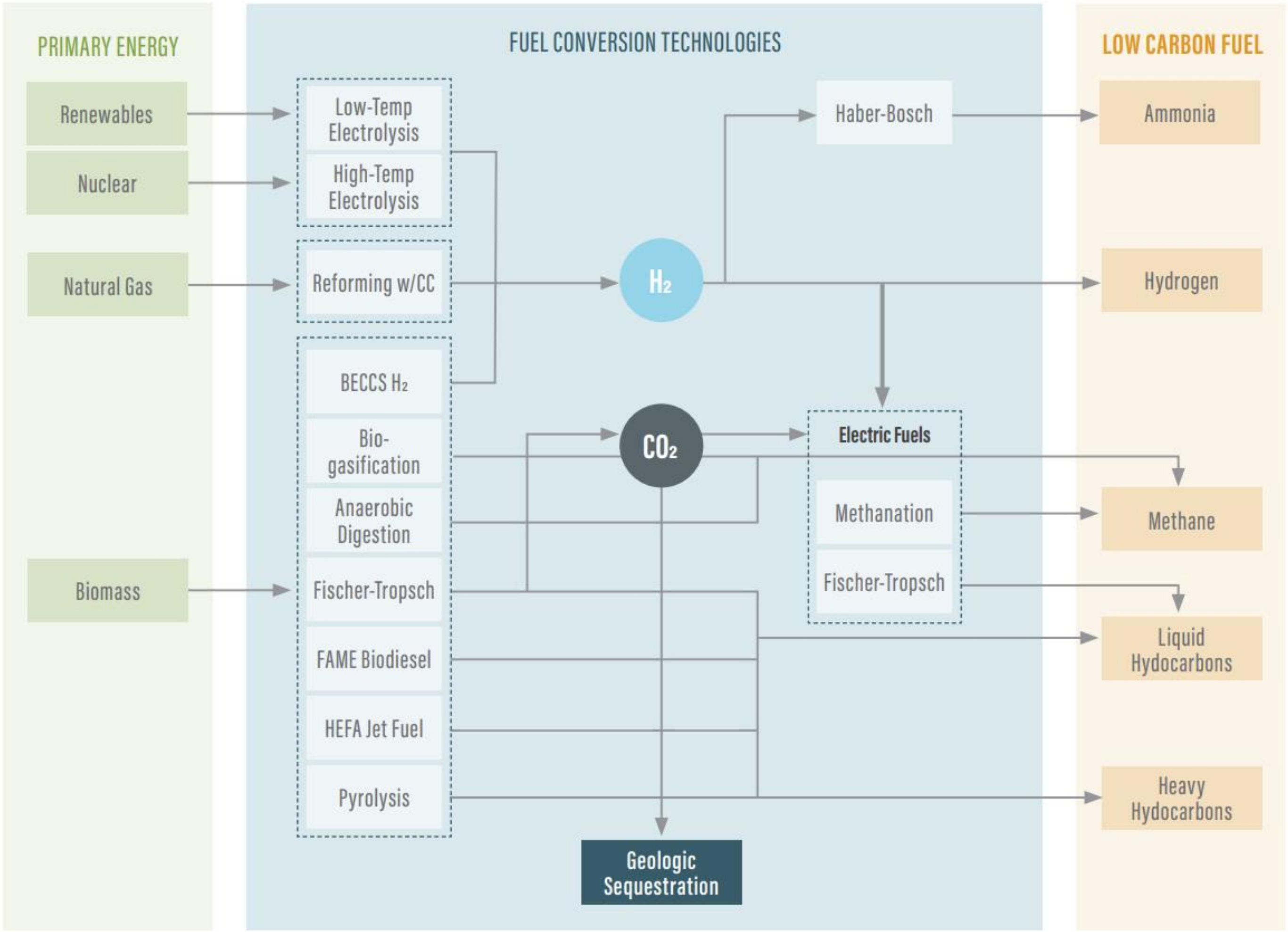

| | Resource Categories | Examples |
|---|---|---|
| 1. | Utility-Scale Renewables | Solar PV, Onshore Wind, Offshore Wind, Geothermal |
| 2. | Dispatchable Hydroelectric | Reservoir hydro, On-Stream Pumped Hydro |
| 3. | Thermal Power Plants | Gas CT, Gas CCGT, Coal, Coal w/CC, Gas w/;CC, Gas w/CC (Allam), SMR, Gen IV nuclear, Biomass, Biomass w/CC, Biomass w/CC (Allam), Gas and Coal CC retrofits |
| 4. | Hydrogen Production | Electrolysis, BECCS H2, SMR, SMR w/CC, High-Temp Electrolysis, ATR w/CC |
| 5. | Hydrogen Storage | Aboveground tanks, underground pipes, salt cavern storage |
| 6. | Biomass/Biomass Conversion | Biomass supply curves including existing woody and waste resources, new woody/herbaceous/waste resources, corn ethanol land displacement, anaerobic digestion feedstocks (LFG, water resource recovery facilities, food waste, animal manure). Conversion technologies including Fischer-Tropsch, pyrolysis, BECCS H2, cellulosic ethanol, corn ethanol, and biochar. |
| 7. | Geologic Sequestration | EOR, onshore saline, offshore saline |
| 8. | Direct Air Capture | DAC for synthetic hydrocarbon production (e-fuels), DAC for geologic sequestration |
| 9. | Electricity Storage | Li-Ion, Flow batteries, long duration energy storage (LDES), pumped hydro, thermal storage |
| 10. | Zero Emission Vehicles | Light-duty, medium-duty, heavy-duty, and bus vehicle types |
| 11. | Pipelines | Ammonia, hydrogen, $CO_2$ |
| 12. | Electric T&D Infrastructure | Distribution upgrades, generator interties, existing corridor upgrades, new AC and DC corridors |
| 13. | Distributed Energy Resources | Flexible end-use loads (EVS, water heating, space heating, air conditioning, appliance loads) |
| 14. | Zero-Carbon Fuel Synthesis | Ammonia, synthetic hydrocarbons (refined and unrefined), methanol |
| 15. | Industrial Decarbonization solutions | Industrial carbon capture, solar thermal heat, dual-fuel boilers, hydrogen |

# Sector Coupling: Challenges and opportunities

- Economy-wide approach needed to plan for electricity and clean fuels growth and operations when targeting Oregon's emissions targets
  - What are the regional implications of fuel and electric sector coupling?
  - Future-proof investments and manage risk by understanding new opportunities and speed of change
- Make decisions in an economy-wide, temporal, and spatial context
  - Explore the tradeoffs between strategies that incorporate load growth, clean fuels, carbon management, electrification opportunities, and new industry
  - Chicken and egg: What comes first, what are the barriers to development, where should near-term efforts be focused?
  - Whack-a-mole: Doing less in one part of the economy requires more in another, understand cost and feasibility consequences of decision making

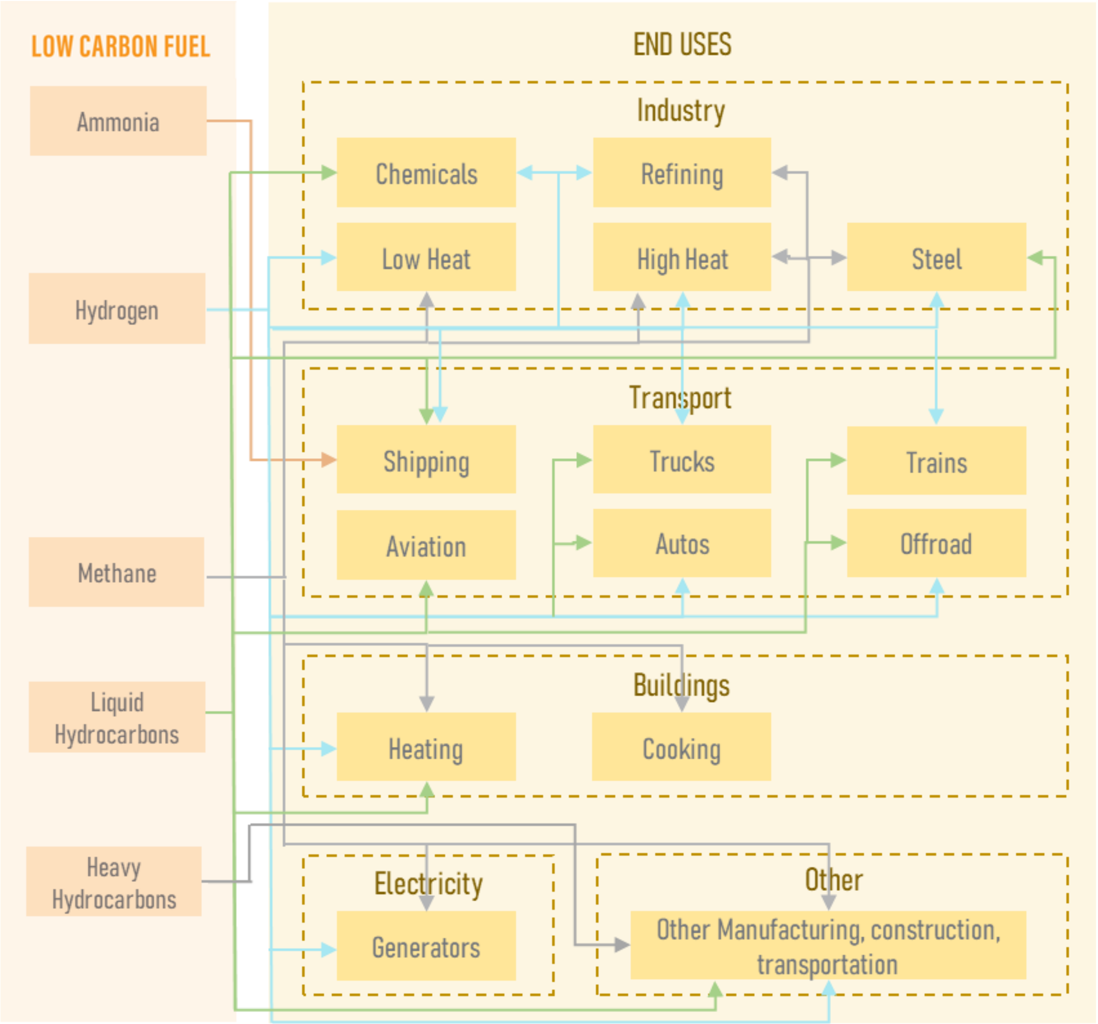
# Clean Fuels Supply

- Optimize capital investments and operations across all elements of clean fuel supply chains
  - Renewables/biomass
  - Transportation and storage
  - Conversion processes
- Scenarios used to constrain opportunities for clean fuels supply chains and electric sector development

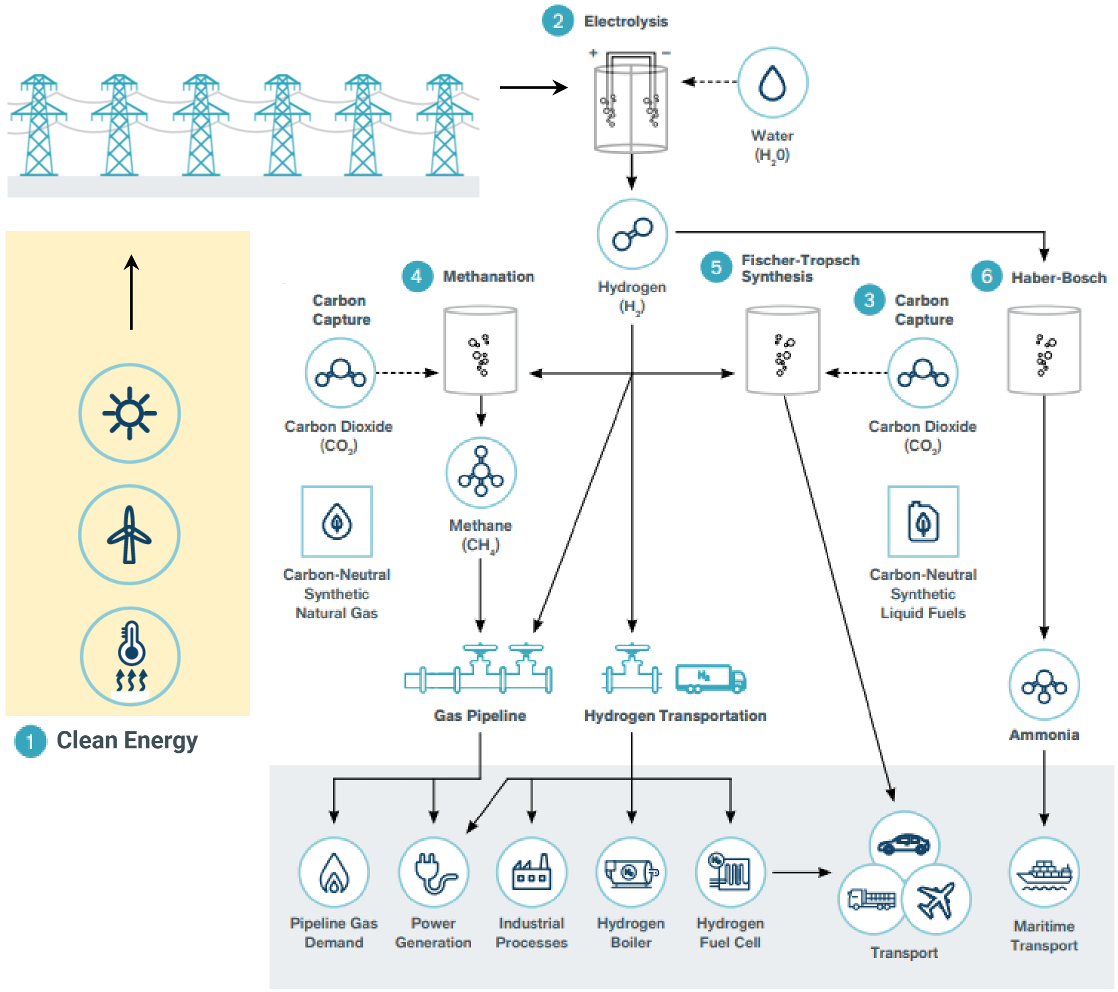


# Clean Fuels Demand

- Where are clean fuels used?
  - Replacing blue hydrogen with green
  - Drop in fuels: decarbonizing fuel blends
  - New markets for direct hydrogen use
  - New markets for ammonia
- Direct use of 100% hydrogen/ammonia blend in the economy defined with input assumptions
  - Fuel cells, 100% ammonia in maritime propulsion
- Share of clean fuels in fuel blends optimized by the model



# Supply Chain Example: Electrolytic Hydrogen




1 **Renewable Energy & Power Grid:** Clean electricity powered by sources such as solar, wind, and hydroelectricity supplies the power grid. Nuclear energy could also power high-temperature electrolysis.

2 **Electrolysis:** The process of using electricity, in this case carbon-free, to split water into hydrogen and oxygen.

3 **Carbon Capture:** Carbon dioxide is captured either through direct air capture powered by carbon-free electricity or from biorefineries, which convert biomass to biogas while capturing the carbon.

4 **Methanation:** Combines hydrogen with carbon dioxide to produce methane that can be injected into the gas pipeline as carbon-neutral synthetic gas.

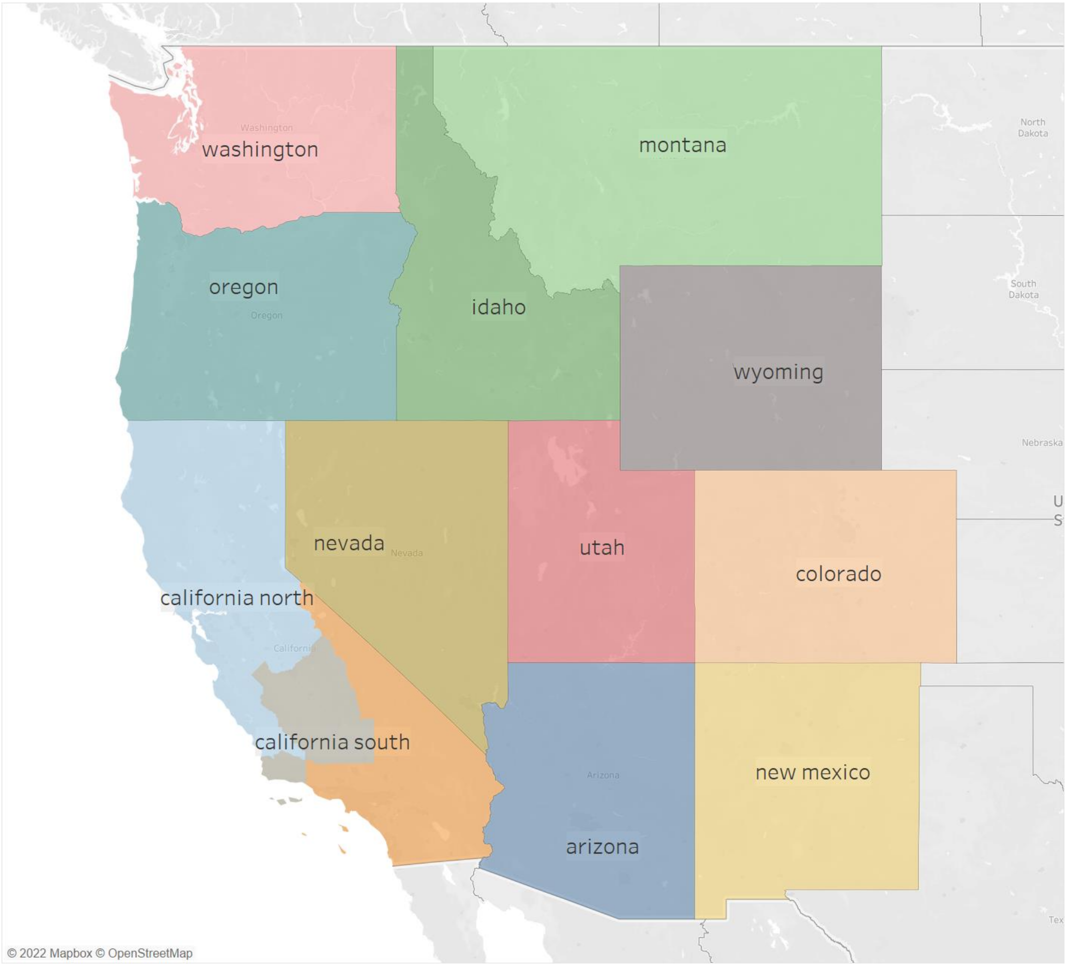
5 **Fischer-Tropsch Synthesis:** Chemical reactions that change a mixture of carbon dioxide gas and hydrogen gas into liquid hydrocarbons, such as gasoline or kerosene, that can be used for transportation.

6 **Haber-Bosch:** The primary method of producing ammonia from nitrogen and hydrogen. Today, ammonia is mainly used to make fertilizer, cleaning products, and plastics, but is also seen as a promising clean fuel for maritime transport.

Source: CETI, NZNW, 2023

# Model Geography

- Western United States with California represented as 2 zones and the rest of the US as a single zone
- Contextualizes the decisions made in Oregon 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
- Modeling 2 zones in Oregon to represent East-West Tx constraints



# Biomass Feedstocks: Billion Ton Study Update and LURA Model

- Billion Ton Study 2016 Update the default source of cost and potential data for biomass
  - https://www.energy.gov/eere/bioenergy/2016-billion-ton-report
  - Supply curve by state and year developed for the US, supporting modeling of a biomass and biofuels market
- Reviewed by WSU and Washington Department of Commerce during the Washington 2021 State Energy Strategy: A team at WSU updated estimates for woody biomass in the Northwest using the LURA model for this study
- Looking for sources of biomass potential that are Oregon specific that could improve upon these resources

# Reference scenario data and assumptions

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# FUEL DATA AND ASSUMPTIONS

| Input | Data Source or Assumption |
|---|---|
| Demand Side Assumptions | Modeled residential, commercial, and industrial demand end use using assumptions about sales shares in EnergyPATHWAYS |
| Supply Side Assumptions | Existing NG utility IRPs- Near-term investments and operations<br>Survey of peer reviewed and government agency sources of capital and operating costs and performance (ADP Technical Documentation 2023, p61) |
| Fuel supply and price forecasting | EIA Annual Energy Outlook<br>NW Power and Conservation Council's Fuels Advisory Committee natural gas price forecast<br>DOE Billion Ton Study |
| Alternative Clean Fuel investment | DEQ's Climate Protection Program |
| Alternative Clean Fuels | Biomass-derived fuels, hydrogen, and hydrogen-derived fuels qualify as clean (if green hydrogen used). Imported fuels are counted as zero emissions (credit for negative emissions from processes like BECCS are retained by producing state). Clean Fuel Standard incorporated |

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# KEY DATA SOURCES FOR EXISTING STOCKS

| Input | Data Source or Assumption |
|---|---|
| Building envelope | EIA Residential Energy Consumption Survey /EIA Annual Energy Outlook/Evolved analysis (still in discovery) |
| Residential space & water heating | NEEA Residential Building Stock Assessment |
| Commercial space & water heating | NEEA Commercial Building Stock Assessment |
| Cooking and other appliances | Residential: NEEA Residential Building Stock Assessment<br>Commercial: NEEA Commercial Building Stock Assessment |
| Technology stock replacement rate | Residential: EIA Residential Energy Consumption Survey and potentially local/regional data (still in discovery)<br>Commercial: EIA Annual Energy Outlook and Commercial Building Energy Consumption Survey and potentially local/regional data (still in discovery) |
| Data center load growth | Northwest Power and Conservation Council Forecast |

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# ENERGY EFFICIENCY IN BUILDINGS

| Input | Starting Point, informed by past Oregon studies |
|---|---|
| Building envelope | Weatherize 95% of existing commercial and residential home envelopes by 2040 (suggested starting point based on Oregon Climate Action Commission analysis*)<br>**Savings 10-20% household energy savings.** |
| EE Space heating (Residential and commercial) | Assume existing policies play out.<br>**What should we set as electric heat pump adoption goal out to 2050?** |
| EE Improvements to natural gas space heating | Gas spacing heating efficiency increases by vintage as technology improves and standards become tighter<br><br>Option for hybrid gas/electric heat pump systems; differentiated by climate zone |
| Residential Water Heaters | Assume existing policies play out.<br>**What should we set as electric heat pump adoption goal out to 2050?** |
| Commercial Water Heaters | Assume existing policies play out.<br>**What should we set as electric heat pump adoption goal out to 2050?** |
| Industrial process efficiency | **1% efficiency improvements per year across all sectors** |

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*Oregon Climate Action Roadmap to 2030, Roadmap to 2030 — Oregon Climate Action Commission

# INDUSTRIAL EFFICIENCY AND ELECTRIFICATION

| Input | Assumptions |
|---|---|
| Electrification | 100% of machine drives by 2035<br>100% of heat by 2050 in low temperature industries, including in Oregon’s largest industrials such as computer and electronics products<br>50% of heat in bulk chemicals production by 2050, 25% of heat in glass production<br>50% of integrated steam production, and 80% of integrated steam production in food manufacturing, by 2045<br>100% of refrigeration by 2040<br>90% of industrial HVAC loads across industrial subsectors<br>80% of industrial vehicles including in agriculture by 2050 |
| Switch to Hydrogen | 50% of heat in bulk chemicals (not a large industry in OR)<br>20% of construction energy demand<br>20% of industrial vehicles by 2050 |

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# INDUSTRIAL EFFICIENCY AND ELECTRIFICATION

| Input | Assumptions |
|---|---|
| Cement | Cement process is optimized in the model, including retrofits and new build rotary kilns to include direct separation, oxy-combustion, and biomass fuel |
| Thermal Energy Storage | Economic adoption modeled in industrial sector |
| Hybrid Boilers | Model can invest in dual fuel electric and gas boilers as well as hydrogen boilers |

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# DISCUSSION QUESTION

What should the model assume for the costs and availability of alternative fuel pathways?

- Alternative fuels depend on the cost of the supply chains to produce them:
  - cost of available biomass
  - cost of renewable energy
  - cost of fuels conversion such as with electrolysis, BECCS, pyrolysis, fisher tropsch, haber bosch etc., the
  - cost of fuel delivery, including if pipelines need to be constructed
  - value of incentives such as 45V and 45Q for hydrogen and carbon.

# DISCUSSION QUESTION

How should the model reflect potential technological opportunities such as advanced geothermal?

# What if…?

# Guided Discussion on Alternative Scenarios/Levers

- What if there is greater investment in energy efficiency?
- What if consumer behavior and cost slow electrification of space heating?
- What if NW production of an alternative fuel like hydrogen dramatically increases?
- What if Oregon established a more ambitious economy-wide GHG target?

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# Public Comment

# PUBLIC COMMENT

- We are interested in hearing your Energy Strategy interests, priorities, and expectations.
- Please raise your hand if you would like to ask a question or provide a comment.
- Please be brief as we want to hear from as many people as we can in the time available.

# Wrap up and Next Steps

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# OPPORTUNITIES FOR FURTHER ENGAGEMENT

## Provide Written Public Comment

- Written public comment can be submitted at: https://odoe.powerappsportals.us/en-US/energy-strategy/
- Written public comment is open until August 31

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Thank you

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# RESOURCES:

Project page: https://www.oregon.gov/energy/Data-and-Reports/Pages/Energy-Strategy.aspx

ODOE's website: www.oregon.gov/energy

Contact us: energy.strategy@energy.Oregon.gov

Public Comment Portal: https://odoe.powerappsportals.us/en-US/energy-strategy/

# STARTING POINT FOR EXISTING CONDITIONS

| Model Input | Data Source for Existing Conditions |
| --- | --- |
| Light-duty vehicles | OR Dept. of Transportation – Driver & Motor Vehicle division (DMV) Data |
| Medium- and heavy-duty vehicles | OR Dept. of Transportation – Combination of Commerce and Compliance Division (CCD) and DMV data (depending on vehicle weight<br>*Note: propose to use EPA MOVES if cannot obtain CCD data |
| Transit Buses | National Transit Database |
| School Buses | OR Dept. of Transportation – DMV Data |
| Fuels | OR Dept. of Environmental Quality Clean Fuels Program Data |
| Vehicle Miles Traveled (VMT) | EPA MOVES (data comes from Highway Performance Monitoring System) |
| Fuel Economy | Energy Information Administration Annual Energy Outlook Historical Average Fuel Economy by vintage and vehicle type |

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# STARTING POINT FOR EXISTING SYSTEM

| Data | Data source | Questions |
|---|---|---|
| Existing resource mix (utility-scale) | - All in-state resources plus out of state contribution over transmission<br>- Utility IRPs and CEPs<br>- PNUCC 2024 Regional Forecast?<br>- Jeremy to fill in main data sources | |
| Existing resource mix (distributed) | | |
| Utility-scale storage | | |
| Transmission system | X, Y, Z | |
| Energy Efficiency | | |
| Flexibility | | |

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# KEY ASSUMPTIONS

| Area | Assumptions | Questions |
|---|---|---|
| Reliability resource eligibility | - All in-state resources plus out of state contribution over transmission<br>- Tx import reliability contribution dynamic based on available resources | |
| Clean electricity resources modeled | Solar, wind, wave, tidal, ocean thermal, geothermal, advanced geothermal, offshore wind. Woody biomass, manure, small hydro. Clean fuels. Nuclear (outside of OR). | |
| Clean Fuels | Biomass-derived fuels, hydrogen, and hydrogen-derived fuels qualify as clean (if green hydrogen used). Imported fuels are counted as zero emissions (credit for negative emissions from processes like BECCS are retained by producing state). Clean Fuel Standard incorporated. | |
| Hydro system operations | Data source / key characteristics – Jeremy – this could go in the data slide up top, and then here we talk about anything that's up for discussion. | |
| Balancing across the WECC | Assume a single balancing authority | This could be controversial. Is there a way to factor in some inefficiencies to reflect the risk that will not have a seamless region with an RTO? And the reality that if we get there, it'll be down the road? |

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# RESOURCE COSTS & POTENTIALS

| Area | Assumption | Questions |
|---|---|---|
| Resource costs | - Jeremy | I suspect this will come up. Could go up top in data sources, or here if we think there are particular resources where this is up for bigger discussion. |
| Resource potentials | - ORESA resource potentials | |

# POLICY-DRIVEN ASSUMPTIONS

| Area | Assumption | Questions |
|---|---|---|
| Resource constraints | No nuclear or new natural gas sited in OR. | |
| CCS | Retrofits permitted, sequestration opportunities limited to saline aquifer formations using NETL supply curve with none in Oregon. Oregon can offset emissions with sequestration in other states. | |
| Inflation Reduction Act Incentives | Supply-side incentives included for hydrogen production, renewable electricity generation, battery storage, carbon sequestration, clean fuels, and nuclear | |
| HB 2021 | IOU Carbon Budgets are met under HB 2021. | |
| RPS – ORS 469A.052 and 055 | RPS requirements are met | |
| Community solar | Include mandated community solar capacity. | |

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# CLIMATE IMPACTS, RELIABILITY, RESILIENCE

| | Data source | Questions |
|---|---|---|
| Climate impacts on the power system | Historical weather and hydro years | |
| Hydro system variability | Low, average, and high hydro year (data source) | |
| Resilience | Are we doing anything to measure more extreme events than usual reliability analysis – like week-long heat dome + wildfires, etc.? | |
| | | |

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# OTHER QUESTIONS

| | | |
|---|---|---|
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| | | |

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# Implementation of Policy

- EO 20-04
  - 45% below 1990 levels by 2035, 80% below 1990 levels by 2050
  - Economy-wide emissions target implemented in the model
  - Includes all sources of emissions
- CPP
  - 50% reduction in fossil fuel emissions by 2035, 90% reduction in fossil fuel emissions by 2050 relative to 2017 to 2019 average (not including jet fuel or maritime fuel)
  - Not implemented in the model directly (check for compliance)
- HB 2021
  - 80%, 90%, 100% emissions free electricity by 2030, 2035, 2040, respectively. Baseline set by 2010,2011,2012 emissions average. Applies only to 60% of electricity generation
  - Implemented in the model as a converted clean electricity standard

Display Name
Claire Prihoda
Michael Meyers - NW Natural
Sarah Buchwalter, Portland General Electric
Adam Shick-Energy Trust
William Gehrke - NWEC
John Garrett
Spencer Moersfelder
Rebecca Smith for RHA
Toby Kinkaid
LEE ARCHER PGE
Valerie Egon, Business Oregon
McCammant
Karl Haapala
Sam Lehr
Tim Miller
Sharla Moffett
Maddy Do
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Eric Wood
Alex Houston, GEI
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Erin Childs RHA
Dan Kizer - NW Natural
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