Oregon
Tina Kotek, Governor

OREGON DEPARTMENT OF ENERGY

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AGENDA

Title: Transportation Working Group – Oregon Energy Strategy

Date: August 8, 2024, 9 – 11 am

Meeting Link: See Webex Link sent through e-mail

Objectives:
The purpose of this Working Group is to:

- Understand foundational data sources for the reference scenario and ask clarifying questions.
- Provide expertise and feedback on key assumptions related to transportation in the reference scenario out to 2050.
- Discuss "what if" questions to inform additional scenarios that can help illuminate trade-offs of different clean energy pathways.

Transportation Working Group Members:

City of Portland	Ingrid Fish Pam Neild
Citizen's Utility Board	John Garrett
Clean Fuels Alliance	Cory Ann Wind
Climate Solutions	Brett Morgan
Columbia Willamette Clean Cities	Michael Graham
Eugene Water & Electric Board	Juan Serpa Munoz Billy Curtiss
IBEW Local 48	Marshall McGrady
NW Energy Coalition	Alma Pinto
Oregon Department of Environmental Quality	Rachel Sakata Bill Peters
Oregon Department of Land Conservation and Development	Cody Meyer
Oregon Department of Transportation	Sylvan Hoover
Oregon Fuels Association	Danelle Romain Mike Freese
Oregon Transit Association	Derek Hofbauer
Oregon Trucking Association	Jana Jarvis
Pacific Power	Kate Hawley
Port of Portland	Lewis Lem
Portland Bureau of Transportation	Hannah Morrison
Portland General Electric	Greg Alderson
Renewable Hydrogen Alliance	Rebecca Smith Erin Childs

TriMet	Kyle Whatley
Verde	Indi Namkoong
Western State Petroleum Alliance	Antonio Machado
Wy'East	Robert Wallace

Agenda:

9:00 – 9:10	Welcome and Introductions	Jillian DiMedio, ODOE
9:10 – 9:20	Setting the Stage	Jillian DiMedio, ODOE
9:20 – 9:35	How transportation is considered in the Oregon Energy Strategy reference scenario	Jeremy Hargreaves, Evolved Energy Research
9:35 – 10:15	Discussion of reference scenario data and assumptions	Jillian DiMedio, ODOE Jeremy Hargreaves, Evolved Energy Research
10:15 – 10:50	Discussion of alternative scenarios	
10:50 – 11:00	Wrap up and Next Steps	Jillian DiMedio, ODOE

Note: ODOE will open the floor for comments and questions from observers if time permits. Comments and questions can also be submitted to energy.strategy@energy.oregon.gov.

Oregon Department of **ENERGY**

Oregon Energy Strategy
Transportation Working Group

Jillian DiMedio
August 8, 2024

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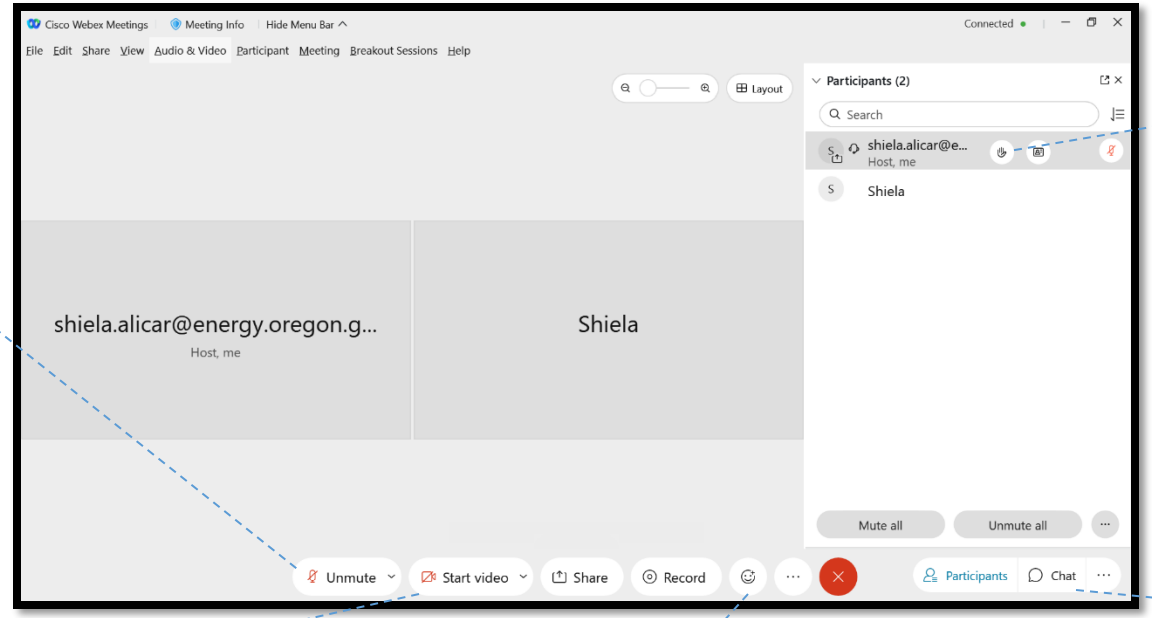
USING WEBEX

Audio Options

Mute — *Microphone On*

Unmute — *Microphone Off*



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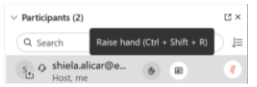

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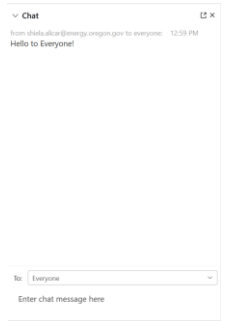
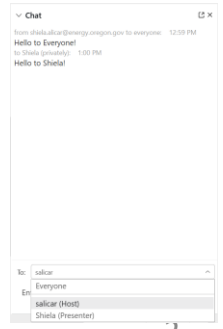
Chat



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).



Video Options

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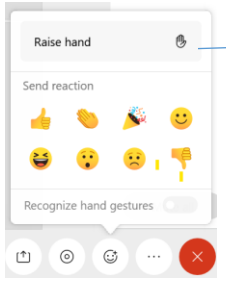
Reactions



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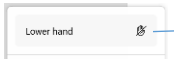

Click on Lower hand when you are done.

PURPOSE OF THIS WORKING GROUP

- Understand foundational data sources expected to inform starting point for technical analysis and ask clarifying questions.
- Provide expertise and feedback on key assumptions related to transportation.
- Discuss “what if” questions and priorities that may inform scenarios to better 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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WORKING GROUP ROSTER

ORGANIZATION	NAME
City of Portland	Ingrid Fish, Pam Neild
Citizen's Utility Board	John Garrett
Clean Fuels Alliance	Cory Ann Wind
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INTRODUCTIONS

- Please share the following with the group **via chat**:
  - Name
  - Affiliation
  - Geographic location you represent
  - What is your favorite type of transportation and why?

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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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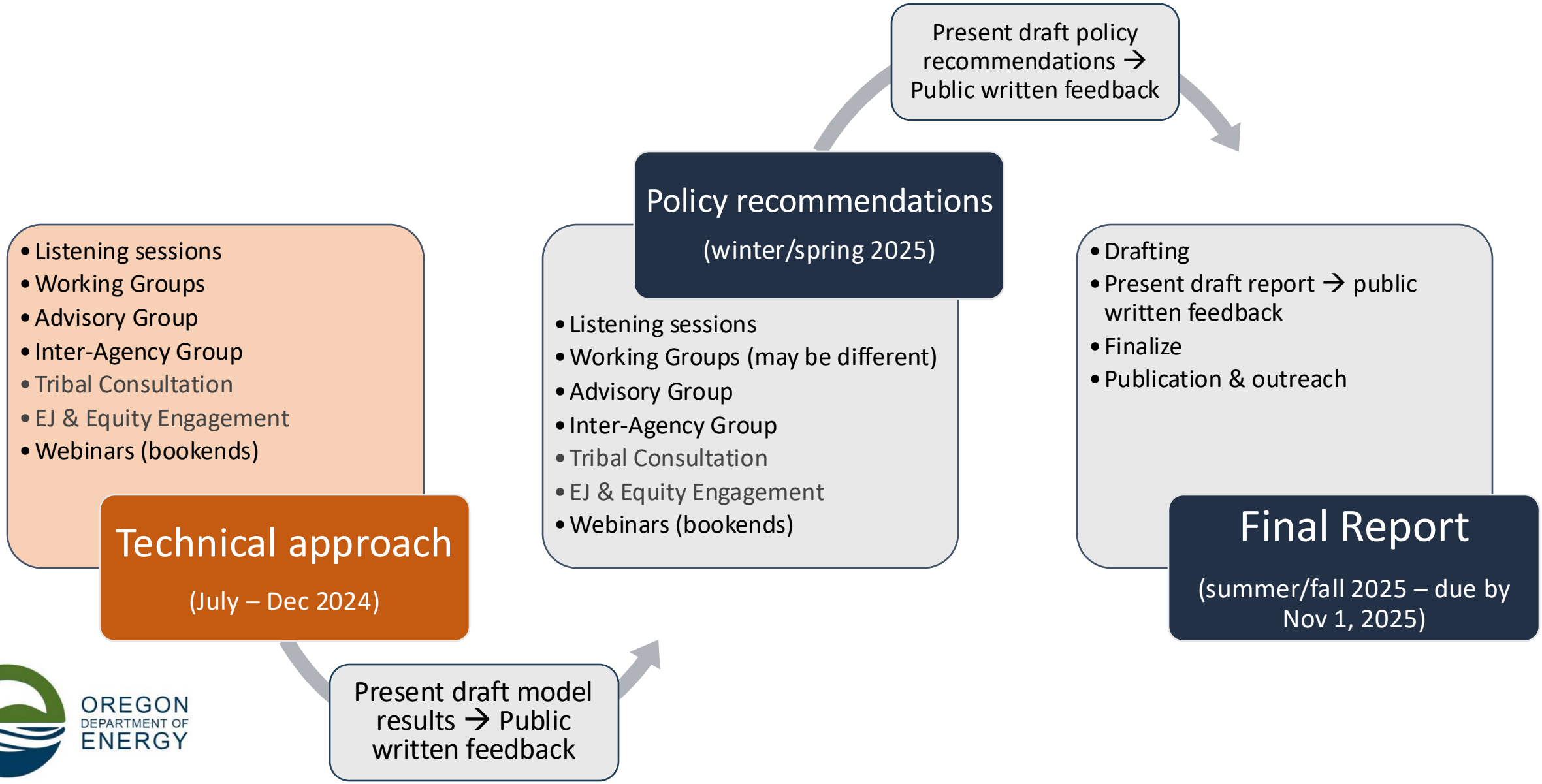
WHERE WE ARE IN THE PROCESS



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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
- Econ and employment impacts
- Energy security and impacts of broader markets
- Energy resilience
- Community energy resilience

ENERGY POLICY OBJECTIVES

Economy-wide

- EO 20-04
- 80% GHG reduction by 2050

Electricity (IOUs*)

- HB 2021
- 100% clean by 2040

*HB 2021 applies to the large IOUs, PacifiCorp and Portland General Electric Company, as well as to electricity service suppliers.

Natural gas, liquid fuels, propane

- Climate Protection Program
- 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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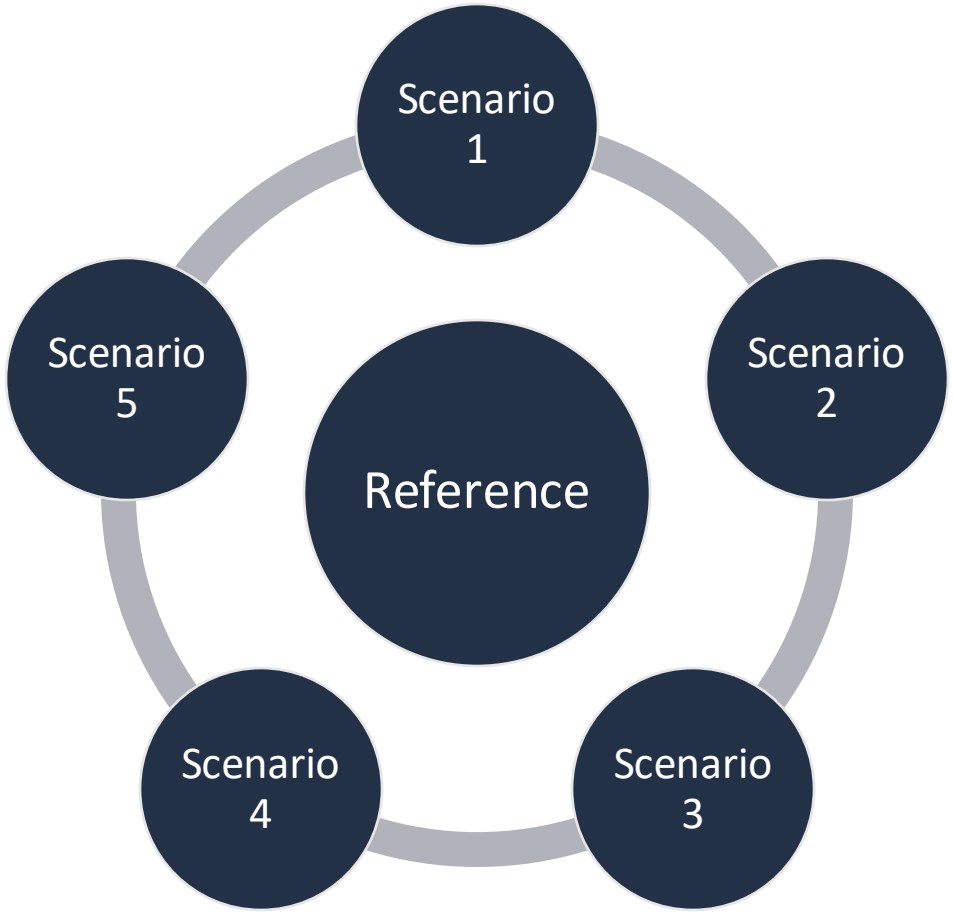
SUMMARY OF MODELING APPROACH



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.)

How transportation is considered in the Oregon Energy Strategy reference scenario

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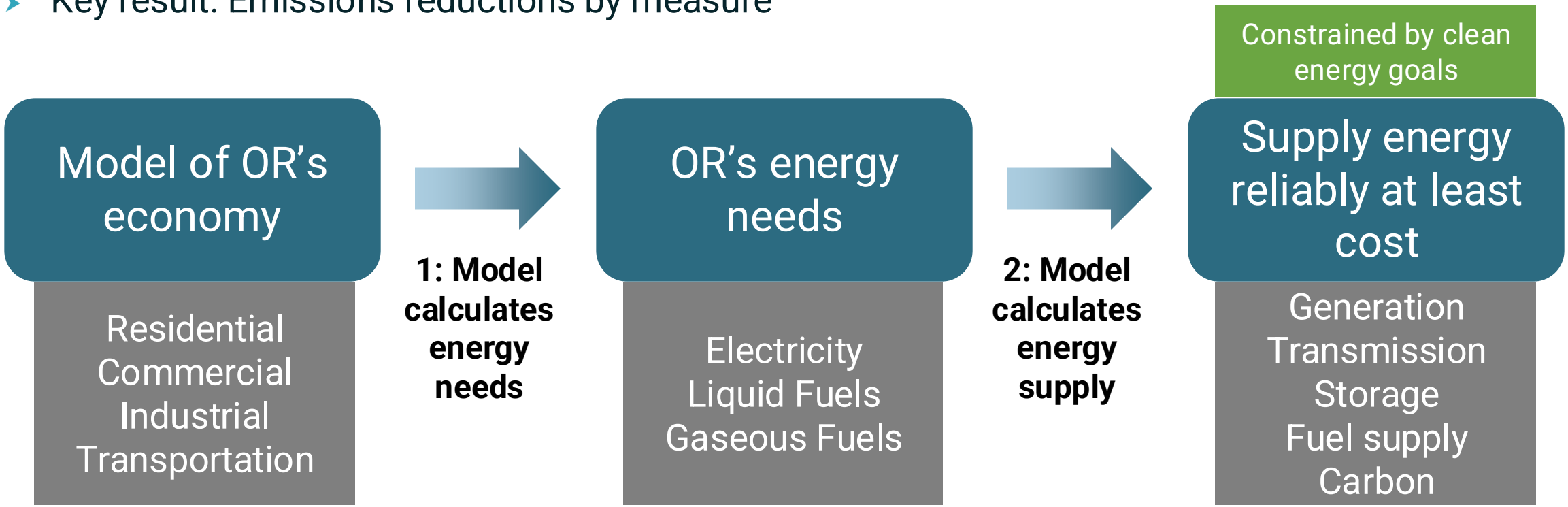
Oregon Energy Strategy Technical Consulting

High Level Description of Modeling Approach

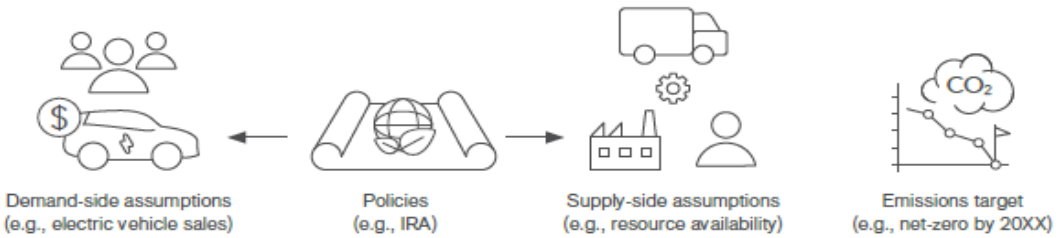
- Model calculates the energy needed to power OR's economy, and the least-cost way to provide that energy under clean electricity and emissions goals
- Key result: Emissions reductions by measure



Economy-Wide Energy Modeling

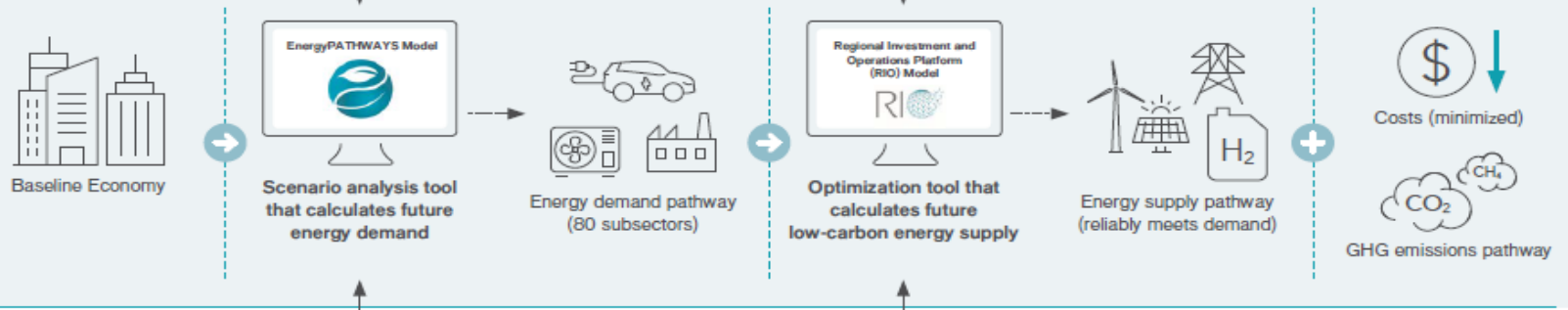
Scenario Assumptions

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.

Underlying demand data

- Economic subsectors
- Demand technology characteristics
- Capital, operating, and installation costs
- Hourly demand shapes
- Current technology stocks
- Energy service demands
- Fuels efficiencies (electricity, pipeline gas, diesel, etc.)
- Demand drivers (e.g., population)
- Geographies

Underlying supply data

- Existing energy infrastructure
- Existing infratructure scheduled retirement
- Scheduled resource additions already committed
- Energy production and conversion infrastructure characteristics
- Energy transport, storage, and delivery options
- Capital, operating and maintenance, and installation costs
- Resource potentials
- Renewable resource production shapes
- Commodity costs and delivery costs
- Gas global warming potentials
- Land use
- Geographies

EVOLVED ENERGY RESEARCH

Clean Energy Transition Institute

Demand-Side Modeling

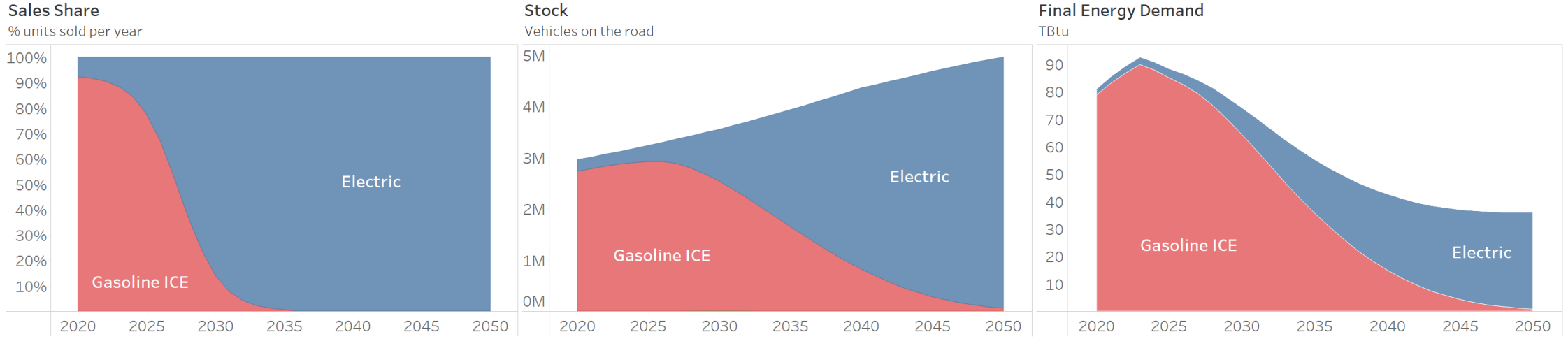
- Scenario-based, bottom-up energy model (not optimization-based)
- Characterizes rollover of stock over time
- Simulates the change in total energy demand and load shape for every end use

Illustration of model inputs and outputs for light-duty vehicles

Input: Consumer Adoption
EV sales are 100% of consumer adoption by 2035 and thereafter

Output: Vehicle Stock
Stocks turn-over as vehicles age and retire

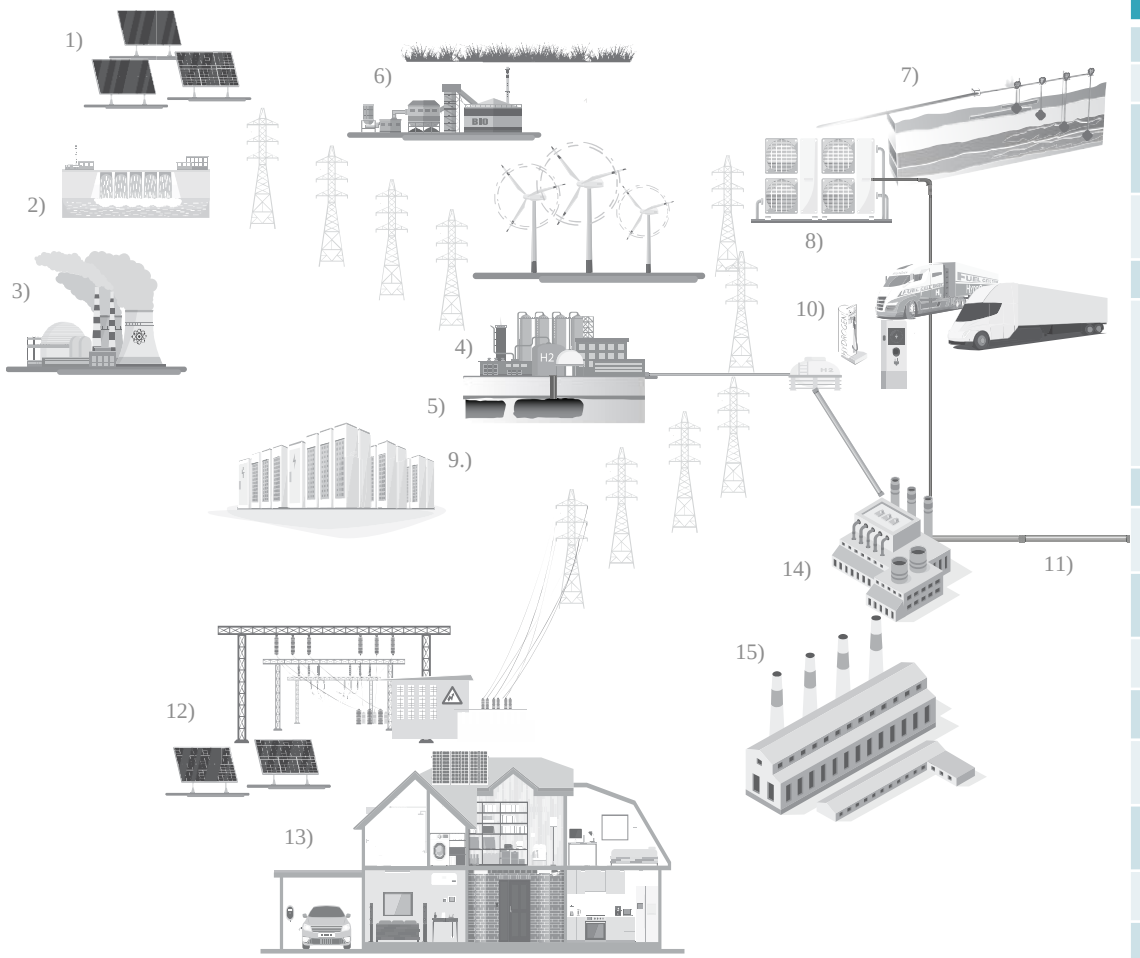
Output: Energy Demand
EV drive-train efficiency results in a drop in final-energy demand



Modeling Transition in Transportation

- Types of technology in transport from model inputs rather than solved directly – scenario representation of transportation transition
- Sales/Stock/Energy in on-road vehicles
  - Key input: Sales shares by year
- Energy demand by fuel blend in aviation/maritime/rail/industrial
  - Key input: Percent of gasoline, diesel, fuel oil, hydrogen, electricity etc.
- Sales shares driven by incentives and policy targets
  - Impact of incentives (e.g. IRA) – comes from studies of impacts
  - ACC II, ACT
  - State policy
- CFP and CPP compliance in modeling

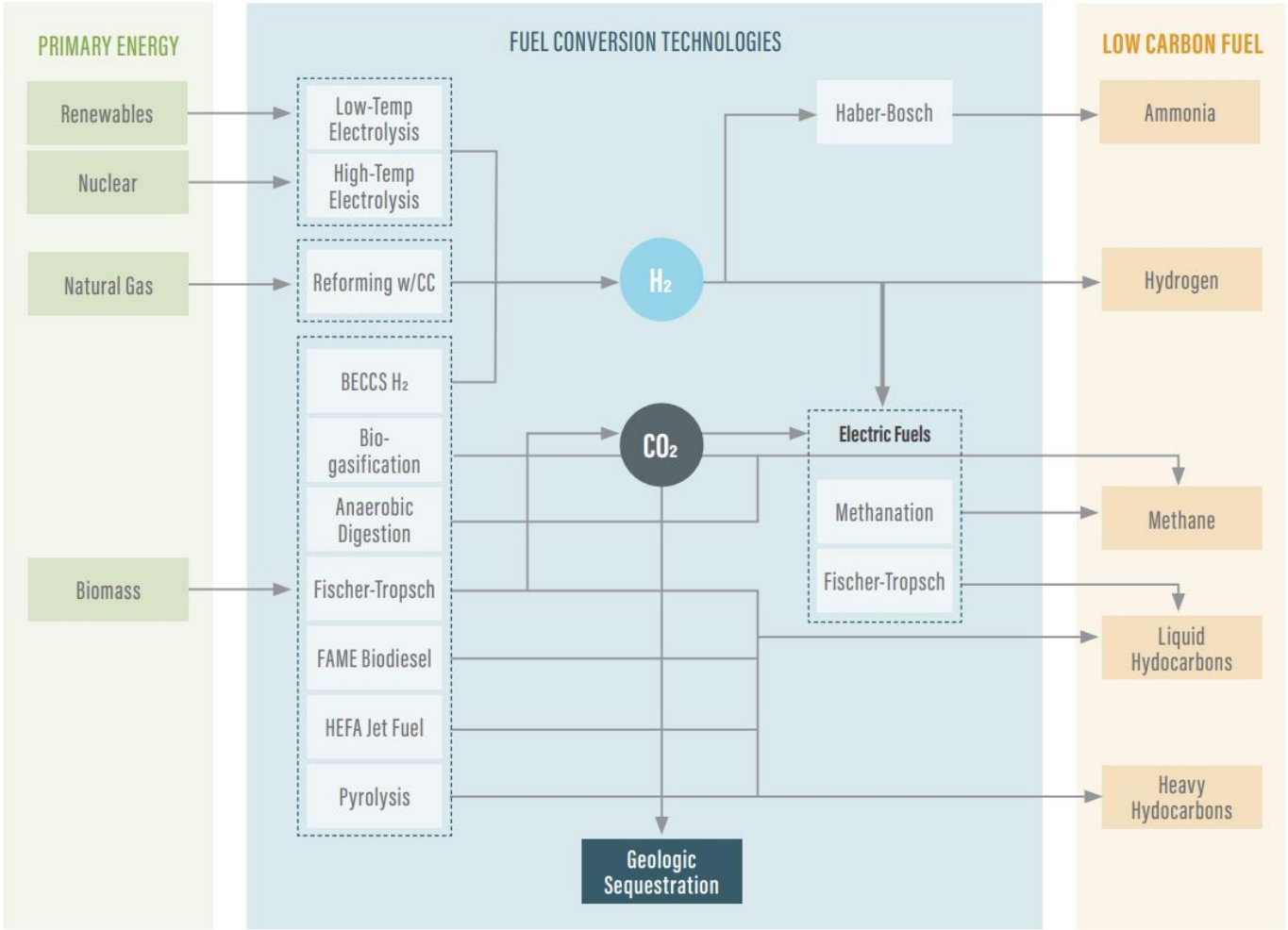
Economy-Wide Optimization Scope



	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

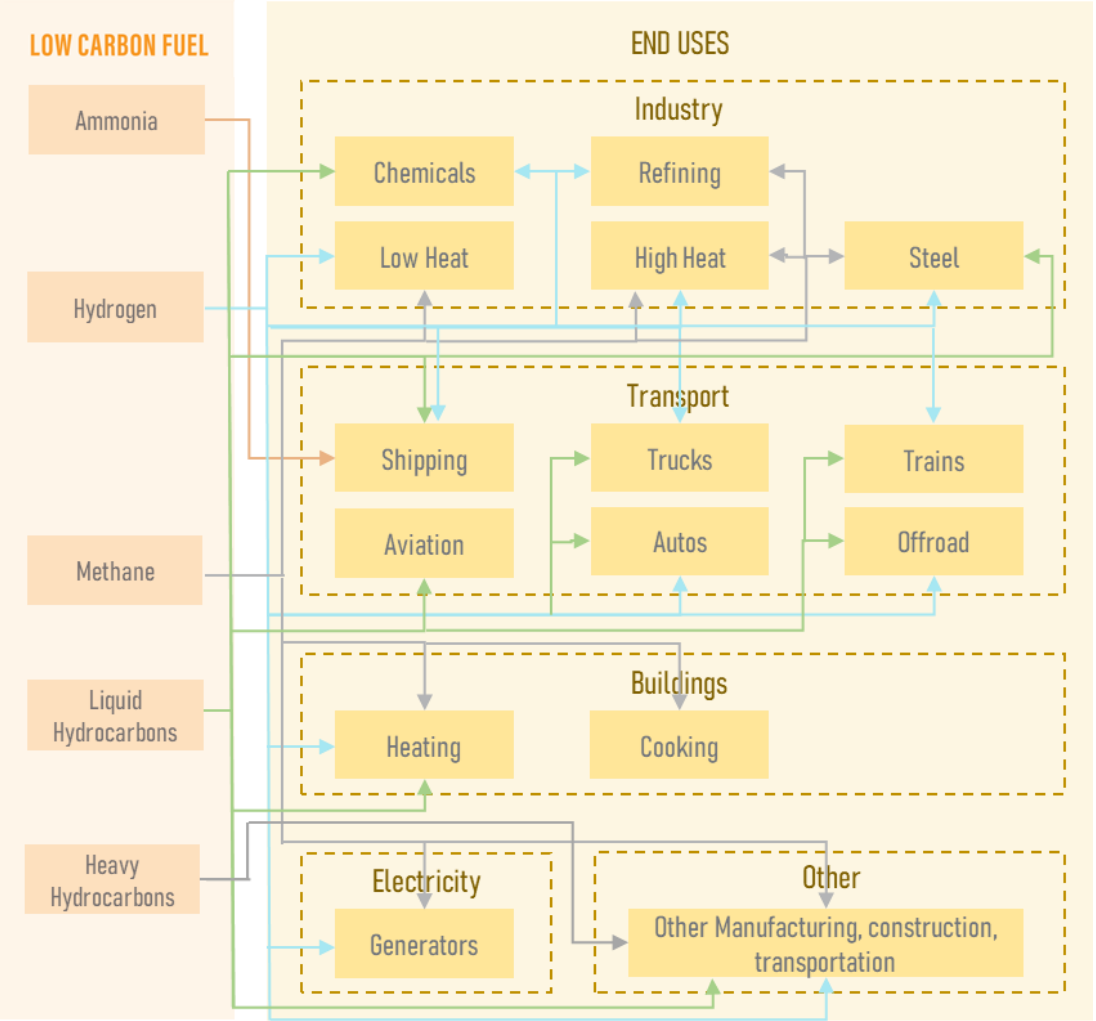
Clean Fuels Supply

- 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

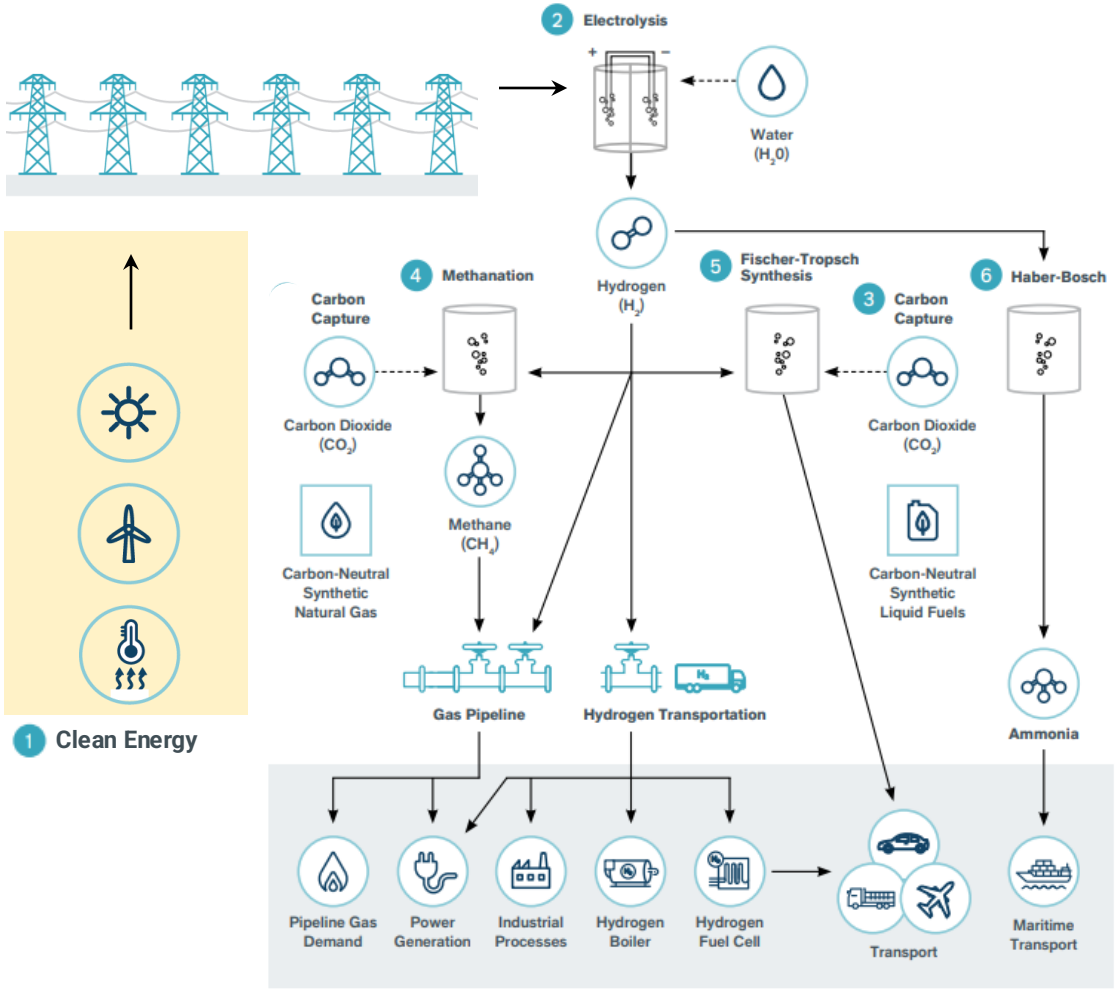


Clean Fuels Demand

- 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

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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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 *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)	Dept. of Environmental Quality / EPA MOVES (data comes from Highway Performance Monitoring System)
Fuel Economy	EPA MOVES, Historical average fuel economy by vintage and vehicle type

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STARTING POINT FOR FUTURE CONDITIONS

Model Input	Data Source / Existing Policy / Assumption Determining Future Conditions
Light-duty vehicles	Advanced Clean Cars I / Advanced Clean Cars II International Council on Clean Transportation (ICCT) forecasts based on Inflation Reduction Act (IRA) incentives
Medium- and heavy-duty vehicles	Advanced Clean Trucks through 2035 ICCT forecasts based on IRA incentives Post 2035: ?
Transit Buses	?
School Buses	?
Fuels	Clean Fuels Program + Portland's Renewable Fuel Standard Targets
Vehicle Miles Traveled (VMT)	VMT per capita assumed to remain constant, reflecting historical trends since 1990
Fuel Economy	Light-duty: EPA SAFE 2022-2026, constant after 2026 Medium and heavy-duty: EPA Phase 3 standards through MY 2032; AEO projection after 2032 Buses: AEO projection of fuel economy Aviation: 15-20% efficiency gain through 2050, to reflect International Air Transport Association (IATA) Net Zero Roadmap

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ADDITIONAL DATA INPUTS / ASSUMPTIONS

Model Input	Data Source / Assumptions Determining Future Conditions
Vehicle costs	Light, Medium, and Heavy-Duty Vehicles: International Council on Clean Transportation Report: Analyzing the Impact of the IRA on EV Uptake in the U.S. Transit / School Buses: International Council on Clean Transportation Rail / Aviation / Maritime: Costs assumed to be same as fossil alternatives due to lack of data
Fuel costs	Annual Energy Outlook 2023 Oil and Gas Forecasts
Infrastructure costs	EV Charging: NREL Electrification Futures Study Hydrogen: U.S. Dept. of Energy Technical Targets for H2 Delivery
EV Charging Estimates	NREL Electrification Futures Study

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DISCUSSION QUESTION 1

What should the model assume for MHD vehicles post 2035?

Starting point:

Use sales target set by California's Advanced Clean Fleets regulation

- 100% ZEV sales by 2036 for all Class 2b-8 vehicles, including transit and school buses

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DISCUSSION QUESTION 2

Should we set targets for hydrogen in the transportation sector?

Starting Point:

- Long Haul and Transit: 80% electric, 20% H2 by 2040
- Rail: 20% electric, 70% H2 by 2050
- Maritime:
  - Domestic: 10% electric, 20% H2, 50% ammonia by 2050
  - International: 20% H2, 60% ammonia by 2050

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What if…?
Scenario Development

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Guided Discussion on Alternative Scenarios/Levers

What if the electrification of transportation happens slower than expected?

What if we reach or exceed VMT reduction goals of 20% per capita by 2050?

What if hydrogen end-use markets do not develop as quickly as anticipated? What if hydrogen is more expensive than anticipated?

What if larger quantities of primary fuels remain in use in transportation by 2050?

What if Oregon sets a more ambitious economy-wide GHG target?

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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

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/