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Tina Kotek, Governor

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OREGON ENERGY STRATEGY

PHASE 1 INTERIM COMMENT RESPONSE DOCUMENT

This Phase 1 Interim Comment Response Document is a compilation of public feedback received between July 31 and December 18, 2024 on the Oregon Energy Strategy, along with Oregon Department of Energy responses for how the feedback was considered by ODOE or how it informed the project.

Phase 1 focused on developing technical modeling and complementary analyses to support Phase 2 policy discussions in 2025. ODOE solicited feedback throughout Phase 1 to inform the key data and assumptions applied in the Reference Scenario, the selection of Alternative Scenarios, and the design of the complementary analyses. This Phase 1 Interim Comment Response Document reflects feedback received via the public comment portal, by email, during meetings of the Oregon Energy Strategy Advisory Group and focus-area Working Groups, and during the two public listening sessions held on July 31, 2024.

This document reflects final responses on the technical modeling efforts concluded in Phase 1 and provides clarification and transparency regarding the technical modeling. It also reflects and responds to questions and comments regarding other aspects of the development of the Energy Strategy and is intended to help guide stakeholders' engagement in the next Phases of the Strategy development. ODOE and stakeholders may rely on this document as a resource when preparing future updates to the Strategy.

All public comments received through December 18, 2025 are included. ODOE's responses to feedback are mostly included; ODOE is awaiting final confirmation from its modeling expert for some comments regarding the energy pathways modeling and for the complementary analyses. ODOE will publish a final Phase 1 Comment Response Document when responses to all comments are available.

A Table of Contents is provided below – the document is primarily organized to reflect the organization of the Draft Reference Scenario, Draft Alternative Scenarios, and Complementary Analyses documents that were released in Phase 1 for public comment, with additional sections provided for comments pertaining to the Strategy development process generally or other Phases of the Energy Strategy's development. ODOE responses are in *italics.*

The Oregon Department of Energy invites additional written feedback through the Energy Strategy comment portal.

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TABLE 1: ACRONYMS AND ABBREVIATIONS

Abbreviation	Term
2021 Plan	2021 Northwest Power Plan
ACF	California Advanced Clean Fleets
AG	Advisory Group
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
ATB	NREL Annual Technology Baseline
AWHI	Advanced Water Heating Initiative
BESS	Battery energy storage systems
BEV	Battery electric vehicle
BIAs	Biologically Important Areas
BOEM	Bureau of Ocean Energy Management
BTM	Behind-the-meter[1]
CBSA	Commercial Building Stock Assessment
CCS	Carbon capture and sequestration
CO_2	Carbon dioxide
COU	Consumer-owned utility
CPUC	California Public Utilities Commission
CRD	Comment Response Document
CRITFC	Columbia River Inter-Tribal Fish Commission
CWA	Clean Water Act
DER	Distributed energy resource
DLR	Dynamic line rating
DR	Demand reduction
EGS	Enhanced geothermal systems
EIA	Energy Information Administration
Energy Vision	Columbia River Inter-Tribal Fish Commission's Energy Vision for the Columbia River Basin
EP model	EnergyPATHWAYS model
ESA	Endangered Species Act
EV	Electric vehicle
FCEV	Fuel cell electric vehicle
GET	Grid-enhancing technology
GHG	Greenhouse gas
GW	Gigawatt
HB	House Bill
HD	Heavy-duty
HDVs	Heavy-duty vehicles
HVAC	Heating, ventilation, and air conditioning
ICCT	International Council on Clean Transportation
IOU	Investor-owned utility
IRA	Inflation Reduction Act
IRP	Integrated Resource Plan

[1] Meaning on the customer's side of the utility meter.

LDVs	Light-duty vehicles
LS	Listening session
LSRD	Lower Snake River dams
MD	Medium-duty
MDVs	Medium-duty vehicles
MW	Megawatt
NEEA	Northwest Energy Efficiency Alliance
NOx	Oxides of nitrogen
NREL	National Renewable Energy Laboratory
NWPCC	Northwest Power & Conservation Council
NZNW	Clean Energy Transition Institute's Net-Zero Northwest study
ODOE	Oregon Department of Energy
OPUC	Oregon Public Utility Commission
ORESA	Oregon Renewable Energy Siting Assessment
OSW	Offshore wind
PNNL	Pacific Northwest National Laboratory
PoP - West	The Nature Conservancy (TNC) Power of Place – West study
PREPP	Pacific Northwest Regional Planning Project
RBSA	Residential Building Stock Assessment
RBSA	Resilient Columbia Basin Agreement
RIO model	Regional Investment and Operations model
SMR	Small modular reactor
TENs	Thermal Energy Networks
The CPP	Climate Protection Program
The Energy Strategy, the Strategy	Oregon Energy Strategy
US DOE	United States Department of Energy
V2G	Vehicle-to-grid
VMT	Vehicle miles traveled
WG	Focus-area Working Group
ZEV	Zero-emission vehicle

TABLE 2: KEY TERMINOLOGY[2]

Term	Definition
Phase 1	The period of Oregon Energy Strategy development focused on technical analyses and fact-finding to support and inform exploration of pathways to achieving the state's energy policy objectives.
Phase 2	The period of Oregon Energy Strategy development focused on discussing policy gaps and opportunities to inform policy recommendations.
Phase 3	The period of Oregon Energy Strategy development focused on drafting the Oregon Energy Strategy Report.
Complementary analyses	Technical analyses beyond the energy pathways modeling that ODOE will provide to support Phase 2 policy discussions. The complementary analyses include an Energy Wallet analysis, Air Quality modeling, geospatial mapping, and employment impacts, and are intended to provide additional context on energy burden, affordability, health impacts, community well-being, and economic vulnerabilities.
Energy pathways modeling	A planning tool that calculates energy needed to power an economy while meeting policy targets, such as a greenhouse gas emissions target, and the least-cost way to meet those energy needs with efficiency, clean electricity, electrification, clean fuels, and carbon sequestration. Refer to the CETI-OES Team's Technical Approach Document for additional description of their energy pathways modeling process.
Reference Scenario	The energy pathways modeling tool applies a core set of assumptions and data to create a Reference Scenario that presents a least-cost pathway to achieving Oregon energy policy objectives. This Scenario has been selected to strike a balance of "aggressive but achievable" assumptions that, based on numerous sources, are likely to yield the lowest-cost pathway to meet Oregon policy objectives and energy needs. However, many risks and uncertainties remain, and there is no one "correct" solution for the full combination of technologies and measures needed to meet our goals. To more fully inform the evaluation of pathways and policies, the Reference Scenario is compared to several Alternative Scenarios.
Alternative Scenarios	Variations on the Reference Scenario. Each Alternative Scenario changes a key area of uncertainty compared to the Reference, framed as "What if" questions. (For example, What if it takes longer to build transmission?) By comparing modeling outputs between the Reference and Alternative Scenarios, energy pathways modeling helps to inform decisions by better understanding the effects of the "What if" scenarios on the mix of technologies and resources needed to meet Oregon's energy policy objectives.
Focus-area Working Group	A topic-focused stakeholder group convened by ODOE to provide specific input and feedback to inform the modeling and technical analysis.
Advisory Group	A stakeholder group convened by ODOE to provide a diverse range of perspectives for the development of a comprehensive and well-informed Oregon Energy Strategy. For more information, refer to the AG Charter.
Evolved	Evolved Energy Research.

[2] These terms are provided as a guide to readers using this document. For further explanation of the terms pertaining to CETI-OES' technical modeling, refer to the Technical Approach Document.

CETI-OES Team	The Clean Energy Transition Institute (CETI)-Oregon Energy Strategy Team includes CETI, Evolved Energy Research, Sylvan Energy Analytics, and Rockcress Consulting. ODOE contracted with the CETI to perform technical modeling in support of the Oregon Energy Strategy. The technical modeling is based on Evolved's proprietary modeling software.

TABLE 3: LIST OF PUBLIC COMMENTERS[3]

Commenter	Commenter Type
1000 Friends of Oregon	WG participant
Amazon Web Services	AG member
Better Energy LLC	Clean energy organization
BlueGreen Alliance	WG participant
Business Oregon	State agency
Cascade Natural Gas Corporation	Natural gas utility
City of Portland Bureau of Planning and Sustainability	Municipal government
Columbia-Willamette Clean Cities	WG participant
Climate Solutions	Clean energy organization, AG member, WG participant
Coalition of Communities of Color	WG participant
CoEnergy Propane, LLC	AG member
Columbia River Inter-Tribal Fish Commission (CRITFC)	Tribal organization
Columbia Riverkeeper	Environmental organization, WG participant
Community Energy Project	Clean energy organization
Confederated Tribes of the Umatilla Indian Reservation (CTUIR)	Tribal organization, AG member
Oregon Citizens' Utility Board (CUB)	Energy advocacy organization, AG member, WG participant
D. Meisenhelter	Individual commenter
D. Miller	Individual commenter
Daimler	AG member
Department of Land Conservation and Development	State agency
E. Strid	Individual commenter
Earth Advantage	WG participant
Energy Trust of Oregon	Clean energy organization
Eugene Water and Electric Board (EWEB)	Utility, AG member, WG participant
EV4/EV Global	Electric vehicle charging company
Food Northwest	Industry association, WG participant
G. Boulanger	Individual commenter
International Brotherhood of Electrical Workers	WG participant
J. Belcher	Individual commenter
J. Hammarlund	AG member
Kalmiopsis Audubon Society	Environmental organization, WG participant
Klamath & Lake Community Action Services (KLCAS)	Tribal organization, WG participant
Latino Founders	AG member
League of Oregon Cities	WG participant
LineVision, Inc.	Company
M. Totey	Individual commenter
Mark Healy	WG participant
Martha Dibblee	WG participant
Mobilizing Climate Action Together	Environmental organization

[3] Commenters are generally referred to as AG members or WG participants if their input was received in either of those forums; other commenter types are used for feedback received through written submissions.

Modern Hydrogen	Hydrogen company
Monmouth Power & Light	WG participant
N. Mandell	Individual commenter
NewSun Energy	WG participant
Northwest Energy Efficiency Alliance	Clean energy organization
NW Energy Coalition	Clean energy organization
NW Natural	Natural gas utility; AG member; WG participant
Oregon Association of Conservation Districts	AG member
Oregon Department of Environmental Quality	State agency
Oregon Municipal Electric Utilities Association	Utilities Organization
Oregon Business and Industry	WG participant
Oregon Coast Energy Alliance Network	Energy organization
Oregon Department of Agriculture	State agency
Oregon Department of Forestry	State agency
Oregon Department of State Lands	State agency
Oregon Physicians for Social Responsibility	Professional association
Oregon Rural Action	WG participant
Oregon Rural Electric Cooperative Association	Utilities organization
Oregon Solar + Storage Industries Association	Clean energy organization
Oregon Trucking Association	AG member
Pacific Ocean Energy Trust	Clean energy organization
Pacific Power	Utility
PacifiCorp	WG participant
PAE	WG participant
Portland General Electric (PGE)	Utility, WG participant
Port of Portland	AG member; WG participant
Public Power Council (PPC)	Utilities organization, AG member
QB Fabrication and Welding	AG member
R. Wallace, Wy'East Resource Conservation and Development / Port of The Dalles / Dufur School District	WG participant
Renewable Hydrogen Alliance (RHA)	Hydrogen trade association; AG member; WG participant
Renewable Northwest	Clean energy organization
Resource Innovations	WG participant
RNG Coalition	WG participant
Rogue Climate	WG participant
Skip Technology Inc.	WG participant
Sol Coast Consulting & Design	AG member, WG participant
Spark Northwest	Clean energy organization, WG participant
SunPower	WG participant
Sunstone Energy	WG participant
The Home Performance Guild of Oregon	WG participant
The Nature Conservancy (TNC)	Environmental organization, AG member, WG participant
Timothy McMahon, Stoel Rives LLP	AG member

TriMet	WG participant
V. Graham	Individual commenter
Verde	WG participant
Wallowa County	WG participant

COMMENT SUMMARIES AND RESPONSES

1. General Comments on the Oregon Energy Strategy

Several commenters — including Advisory Group members, an environmental organization, a utilities organization, a clean energy organization, a hydrogen trade association, and a utility — generally expressed appreciation for ODOE's work, stakeholder opportunities to participate, and for the development of the Energy Strategy as a whole.[4] The clean energy organization expressed general approval for the conduct of Phase 1 of the Strategy development.[5]

A listening session participant expressed disappointment with an earlier Ten-Year Energy Action Plan drafted for Oregon. The participant asked how the Energy Strategy would be different and more successful than the Ten-Year Energy Action Plan.[6]

> *The Oregon Energy Strategy is identifying pathways and policy/program recommendations to achieve Oregon energy objectives and be developed with robust stakeholder engagement; the Strategy is essentially different than the Ten-Year plan because of its stakeholder engagement and relationship to existing state goals.*

Project Timeline and Stakeholder Engagement

An environmental organization stated that the comment period and stakeholder engagement process for the Reference Scenario assumptions were too short and requested that ODOE continue to accept and incorporate feedback.[7] An environmental organization commented that the comment periods and schedule for WG meetings have been compressed, recommending that the Energy Strategy drafting process be slowed down to foster improved stakeholder participation.[8] A utilities organization agreed, stating that the written Draft Reference Scenario explanation should have provided links and further substantiation for the data sources included.[9] Another utilities organization agreed that the stakeholder engagement process has been rushed and stated that too much time was committed to explain the modeling process and engage with a broad array of stakeholders rather than soliciting input from experts.[10] A focus-area Working Group participant expressed appreciation for revisiting how the energy pathways modeling is intended to work, stating that additional explanation clarified how the modeling would be useful for policymaking.[11] An AG member stated that providing transparency as to the purpose and input sought for specific meetings, as well as clarifying future opportunities for input, would help alleviate some of the pressure imposed by the Strategy development timeline.[12]

An AG member asked if comments on the Reference Scenario would be made publicly available for review.[13] A few WG members also asked that ODOE publish a list of WG and AG participants and a description of the role of the WGs.[14]

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[4] AG 8.14.24 meeting, J. Basofin, Climate Solutions; M. Moerlins, NW Natural; J. Hill-Hart, CUB; Kalmiopsis Audubon Society; OMEU; Renewable Northwest; RHA; Pacific Power; City of Portland Bureau of Planning and Sustainability.
[5] Renewable Northwest.
[6] Listening Session 7.31.24 evening.
[7] Climate Solutions.
[8] Columbia Riverkeeper.
[9] OMEU.
[10] Oregon Rural Electric Cooperative Association.
[11] Environmental Justice and Equity WG 8.16.24 meeting, Sarah Wochele, CUB.
[12] AG 8.14.24 meeting, Laura Tabor, TNC.
[13] AG 8.14.24 meeting.
[14] WG 7.30.24 meeting.

ODOE has taken comments on the project timeline into consideration in extending Phase 1 comment periods and in planning of Phase 2, adding an additional WG meeting for Phase 2 policy discussions. ODOE is also keeping the comment portal open during Phase 2 policy discussions and encourages stakeholders to provide written feedback. Although the Energy Strategy has a statutory deadline of November 1, 2025, limiting ODOE flexibility to extend the project timeline, ODOE will consider these comments when planning for future updates to the Energy Strategy.

ODOE also appreciates the feedback regarding AG and WG expectations and requests for feedback. ODOE has shared plans for Phase 2 WG meetings and the feedback ODOE will seek from those meetings. ODOE will also publish WG membership lists and will continue to publish public comments on the Energy Strategy page.

A utilities organization stated that the formation of Phase 1 WGs was democratic but potentially led to an unbalanced representation of perspectives. With respect to Phase 2 Policy Working Groups, the commenter expressed a preference for allowing interested stakeholders to opt-in to participate rather than ODOE attempting to balance the WGs through member selection. The commenter expressed confidence in ODOE's ability to facilitate fair and equitable participation in WG meetings.[15] Conversely, an individual commenter expressed concern that one WG meeting spent an outsized amount of time focusing on an industry representative's perspective.[16] A natural gas utility requested to be appointed as an AG member, stating that they would bring perspective as serving rural and lower income gas users,[17] and an LS respondent generally recommended that the Strategy coordinate with natural gas utilities to promote effective end uses and minimize climate impacts.[18] A couple of AG members asked about how WGs would be formed for Phase 2 policy discussions, one asking if AG members could recommend WG members and another if ODOE would provide a form for stakeholders to express interest in serving on WGs.[19] An AG member recommended that ODOE consider federal stakeholder engagement processes, like those of the Northwest Power and Conservation Council, to inform Energy Strategy development.[20]

As with the formation of Working Groups for Phase 1, ODOE considers it important to ensure a balance of perspectives. Because Phase 2 policy discussions focus on policy dialogue rather than inputs into the model and technical analysis, ODOE formed new groups fit for that purpose. ODOE is committed to ensuring that the Strategy reflects balanced, diverse Oregon perspectives and encourages all stakeholders to provide written comments on the Phase 2 policy discussions and draft recommendations.

Policy and Resource Recommendations

An electric vehicle charging company commented that the only viable basis for an Oregon Energy Strategy to succeed is to promote solar and hydrogen technology for light- and heavy-duty vehicles, respectively. The commenter also wrote that HB 3630 requires the Strategy to minimize toxicity as a primary goal.[21]

A Tribal organization commented that energy developments in the Pacific Northwest have come at the price of ecosystems, Tribal resources, economies, and cultural practices and urged that the Energy

[15] OMEU.
[16] E. Strid.
[17] Cascade Natural Gas Corporation.
[18] Listening Session 7.31.24 morning.
[19] AG 11.20.24 meeting, Jeff Hammarlund; Laura Tabor, TNC.
[20] AG 8.14.24 meeting, Scott Simms, PPC.
[21] EV4/EV Global.

Strategy provide for the protection and enhancement of Tribal treaty-secured resources, especially Columbia Basin salmon. To this end, the commenter emphasized that the Strategy focus on renewable resources in combination with increased storage, reductions in peak demand, and increased energy efficiency.[22] An environmental organization agreed that the Energy Strategy should aim to reverse environmental degradation caused by energy development to the Columbia Basin[23] and a hydrogen company urged that the Strategy focus on renewable development to further state economic and climate objectives. The commenter recommended methane pyrolysis as a promising technology.[24] An energy organization urged that the Strategy prioritize decarbonization and grid resilience while planning for increasing extreme weather events.[25] An individual commenter urged that the Strategy recommend improvements to energy efficiency and demand reduction, and especially that the Strategy consider limiting the development of data centers in Oregon.[26] A WG participant commented that there is an environmental justice element to data center buildout and load growth, where expansion of these facilities will lead to winners and losers. The commenter requested that the Strategy consider prioritizing space for load growth expansion on the basis of energy needs, existing uses, natural resource impacts, and environmental justice and equity considerations.[27] An LS participant expressed interest that the Strategy explore decarbonizing concrete production.[28] Additionally, an AG member advised that the Strategy should keep consumer costs and potential cost savings in mind while planning for resilience benefits.[29]

> *ODOE appreciates stakeholders' feedback on their priorities for the Energy Strategy and promising technologies. ODOE will take this feedback into account, along with the technical analyses and Phase 2 policy discussions, in drafting Energy Strategy recommendations. In addition to stakeholder feedback, ODOE will rely on the Phase 1 technical analyses and HB 3630 Section 2(3) factors in drafting Energy Strategy recommendations.*

A clean energy organization recommended that ODOE rely on the Oregon Clean Tech Task Force report to identify policies to realize Oregon's energy objectives.[30] An environmental organization recommended that ODOE rely on the Columbia River Inter-Tribal Fish Commission's Energy Vision for the Columbia River Basin in the Energy Strategy.[31]

> *ODOE appreciates the references provided by commenters. ODOE will ensure that Energy Strategy recommendations do not conflict with Oregon Clean Tech Task Force recommendations and will review other state policy recommendations to inform Phase 2 policy discussions. The Energy Strategy must be informed by, among other things, energy-related studies and data analysis. As part this, ODOE is considering the CRITFC Energy Vision to inform the Energy Strategy.*

An AG member commented with the expectation that the Oregon Energy Strategy should focus initially on high-level issues before getting more granular and that the Strategy would require long-term commitment and flexibility to respond to changing conditions while targeting goals in 2030 and

[22] Columbia River Inter-Tribal Fish Commission.
[23] Columbia Riverkeeper.
[24] Modern Hydrogen.
[25] Oregon Coast Energy Alliance Network.
[26] V. Graham.
[27] Land Use and Natural Resources WG 8.12.24, Ann Vileisis, Kalmiopsis Audubon Society.
[28] Listening Session 7.31.24 morning.
[29] AG 8.14.24 meeting, Ivy Quach, QB Fabrication and Welding.
[30] Renewable Northwest (Alternative Scenarios Comment).
[31] Columbia Riverkeeper.

beyond.[32] A WG participant requested that the Strategy's recommendations be action- rather than goal-oriented, stating that action-oriented recommendations are necessary to quickly implementing and affecting policy.[33] Responding to discussions around realistic, achievable, and aggressive elements of the Strategy, a couple of AG member recommended that the Strategy be "detailed and specific" so as to recommend bold policy actions in a realistic and achievable way.[34]

The modeling is structured to inform and enable robust policy discussions occurring in Phase 2. ODOE anticipates revisiting the Energy Strategy over time, consistent with HB 3630, which calls on ODOE to periodically update the Oregon Energy Strategy to reflect current information, data analysis, and state energy policy objectives.

2. Reference Scenario and General Modeling Comments

2.1. General Comments on the Reference Scenario and Modeling

Reference Scenario Drafting Process

An electric vehicle charging company commented that the proposed modeling process is biased towards the interests of the fossil fuel industry because of its least-cost approach to identifying energy pathways; the commenter stated that a "best-value" approach with greater emphasis on non-economic benefits would better match the "optimized pathways" language from HB 3630. The commenter urged that the Strategy move faster to identify energy solutions in response to the climate emergency and recommended that ODOE shift funding and efforts from the state-wide modeling and Strategy effort to help counties develop energy resilience plans.[35] A WG participant also asked if the modeling would optimize for factors other than cost[36] and other WG participants asked that the Strategy consider how different power options could, for example, mitigate energy outages in communities under dire weather conditions such as wildfires or winter storms.[37]

Evolved Energy Research's modeling provides least-cost optimized pathways subject to constraints pertaining to Oregon decarbonization and climate goals, energy reliability requirements, and energy demand. The modeling will be supplemented by complementary analyses on air quality, consumer cost impacts, and employment impacts to help inform stakeholder policy discussions in Phase 2. Please refer to the CETI-OES Team's Technical Approach Document for more detail on the energy pathways modeling.

Modeling Software and Inputs

An energy organization expressed general support for the key data and assumptions provided in the draft Reference Scenario.[38]

An energy advocacy organization stated that the Reference and Alternative Scenarios published by ODOE are supported by inadequate information and support to inform public comment.[39] An environmental organization agreed that ODOE should release "data sheets, a complete list of

[32] AG 8.14.24 meeting, Ivy Quach, QB Fabrication and Welding.
[33] Land Use and Natural Resources WG 8.12.24, A. Kreiner, OACD.
[34] AG 8.14.24 meeting, Aaron Orlowski Eugene Water and Electric Board; Joshua Basofin, Climate Solutions.
[35] EV4/EV Global.
[36] Environmental Justice and Equity WG 8.16.24, Jess Grady-Benson, Rogue Climate; John Seng, Spark NW.
[37] Environmental Justice and Equity WG 8.16.24, NWEC.
[38] NW Energy Coalition.
[39] CUB.

technologies, and relative performance measures." [40] An AG member asked if the Strategy and modeling would be able to take into account forthcoming data that would be released later in the Strategy drafting process.[41] A couple of environmental organizations generally recommended that ODOE identify additional data for:

- Energy Service Demand projections, including data sources and methodology;
- Existing and New technology options with cost and performance data, and constraints (growth rates, resource limits, market share constraints, etc.), categorized by sector and energy service;
- Existing and new energy resource supply options, cost curves and resource projections for all fossil, renewable and imported resource options;
- Existing and projected load duration curves for electricity demands;
- Methodology and assumptions (e.g., reserve margin) for determining peak loads (and capacity needs); and
- Discount rates.[42]

One of the commenters also requested that ODOE provide more clarity as to how existing and emerging technologies are treated differently by the modeling.[43] Likewise, another environmental organization requested that, to assist in commenter review, ODOE provide cost and performance specifics for the technologies modeled, including how these factors may change over time. In particular, the commenter expressed interest in reviewing data details on supply technology types and energy generation options; as an example, the commenter requested that ODOE clarify whether solar photovoltaics include residential rooftops, commercial rooftops, community solar, and utility-scale solar. Further feedback included general support for the assumptions published by ODOE and the CETI-ODOE team's receptiveness to commenter input on Oregon-specific data sources.[44]

As part of the final Technical Report, the CETI-OES Team will deliver a full list of data and assumptions used in Evolved's modeling, which includes information about technologies included—both existing and emerging — as well as cost curves.

Evolved's modeling does not use energy service demand projections. Instead, Evolved uses a model to simulate a detailed bottom-up representation of all energy-consuming technologies in Oregon (e.g., number of water heaters, air conditioning units, gasoline vehicles, electric vehicles, etc.) and how they will change over time based on sales assumptions. The model develops a comprehensive picture of electricity and fuel demands across 80 subsectors of the economy, resulting in a picture of energy demands across the economy by subsector and year. In addition to utility-scale solar, Evolved Energy Research's modeling includes rooftop solar from the NWPCC 2024 solar rooftop projections, as well as community-based renewable energy targets for PacifiCorp and PGE (a minimum of 10 percent of renewable electricity generation coming from systems that are 20 MW or smaller; current program capacity (from the Oregon Community Solar Program) is fully constructed.

It will not be possible to incorporate forthcoming data released later during the Strategy development process in the modeling, but ODOE will update the Energy Strategy in the future and may be able to use updated data at that point.

[40] Climate Solutions.
[41] AG 8.14.24 meeting, Jeff Hammarlund.
[42] Climate Solutions; Mobilizing Climate Action Together.
[43] Climate Solutions.
[44] Mobilizing Climate Action Together.

An environmental organization also requested that ODOE publish further detail on Evolved's EnergyPATHWAYs and Regional Investment and Operations models, specifically:

- The time-steps used for each model and how they relate to one another (i.e., whether the EP model provides 5-year time steps and RIO uses hourly time steps);
- How hourly demand shapes are determined for the EP model;

  The EP model simulates a detailed bottom-up representation of all energy-consuming technologies (e.g., number of water heaters, air conditioning units, gasoline vehicles, electric vehicles etc.) and how they will change over time based on sales assumptions. The EP model develops a comprehensive picture of electricity and fuel demands across 80 subsectors of the economy. Sales assumptions of demand-side technologies can be specified by year or follow S-curve adoption logic that simulates market emergence, market growth, and market maturity. Sales assumption development considers other studies done in the state and region on technology adoption, input from ODOE and public participants, and the CETI-OES Team's experience looking at sales targets that would achieve clean energy and emissions targets in Oregon and other regions.

- Whether the EP model requires iteration to meet GHG targets and if so, how is that performed;
- Whether the CETI-OES Team will release data templates, preferably structured by resource options and individual demand sector to facilitate expert review

  ODOE has published modeling assumptions and sources for the Reference and Alternative Scenarios. The CETI-OES Team will also deliver a list of assumptions and data sources used in the energy pathways modeling, including data and assumptions about resource options and demand subsectors, in the final Technical Report.

- How the EP model handles the timing of demand devices and what options are available for DR technologies;

  Demand response includes the following:
  - *Households: space heating, cooling, water heating, electric vehicles, customer side batteries if they are participating*
  - *Commercial: space heating, water heating, cooling, smart buildings*
  - *Industrial: dual fuel boilers, thermal energy storage, process flexibility, heating, cooling*

  Flexible load parameters:
  - *Space heating loads can be delayed or advanced by 1 hour*
  - *Water heating loads can be delayed or advanced by up to 2 hours*
  - *Air conditioning can be delayed or advanced by 1 hour*
  - *Residential vehicle charging can be delayed by up to 8 hours*
  - *Commercial vehicle charging can be delayed by up to 3 hours*

- Whether the model can provide "technology characterization" for emerging technologies in commercial operation, and;
- How the modeling accounts for learning curve impacts to technology costs.[45]

[45] Mobilizing Climate Action Together.

The technology costs are not dynamic in the model (e.g., costs do not decrease when more heat pumps are built). Instead, the model includes forecasted cost declines based on publicly available analysis such as the National Renewable Energy Laboratory (NREL) Annual Technology Baseline.

A WG participant asked how the model accounts for consumer purchasing behavior, such as how income might affect mini split heat pumps versus ducted heat pumps installation or how EV charging infrastructure might affect regional EV uptake.[46] A WG member asked if the modeling would use PLEXOS, Aurora, or another modeling software.[47]

Evolved's modeling starts with a demand-side simulation model – the EP model, a detailed bottom-up representation of all energy-consuming technologies in Oregon and how they will change over time based on sales assumptions. Evolved's supply-side RIO model optimizes supply-side investment and operational decisions to serve the energy demands simulated in the EP model reliably. The CETI-OES Team's Technical Approach document at pp.10-13 describes how the EP and RIO models work together to identify optimized pathways and the types of data inputs that inform those models.

Consumer behavior is based on data and assumptions identified and developed in consultation with participants throughout the Phase 1 engagement process. The energy modeling does not differentiate consumer purchasing behavior by income or other characteristics.

An AG member asked what the definition of "benefits" is under the Strategy and urged that co-benefits not be distinguished or treated as distinct from benefits generally. The AG member stated that doing so devalues these benefits and spoke to the importance of non-economic benefits, such as heat-pump buildout helping avoid mortalities during heatwaves.[48]

ODOE recognizes the point and importance of non-energy benefits and is conducting complementary analysis to deepen the understanding of the effects of different pathways on Oregonians. As part of this, ODOE is working with its consultants to develop specific analyses to consider effects of the model results on equity, environmental justice, jobs, and air quality and health. In the case of the COBRA tool being used to evaluate air quality and public health impacts, the term co-benefits is part of the title of the tool (the Co-benefits Risk Assessment screening tool). In Phase 2, these analyses will be used to inform a discussion on how to shape equitable policies that account for energy and non-energy costs and benefits for different households and communities across the state.

Consideration for IRPs

A couple of clean energy organizations urged that ODOE only consider acknowledged Integrated Resource Plans in Strategy modeling.[49] A utility asked whether the modeling, when relying on IRPs for near-term investments and operations, would take into account proxy resources identified in IRPs and transmission selected in IRPs — even if that transmission is expected to be online before 2035 (when the modelling proposed to assume new transmission could come online).[50] A clean energy organization urged that the modeling and Strategy provide actionable pathways to Oregon energy goals where IRPs

[46] Environmental Justice and Equity WG 8.16.24, Mark Healy.
[47] WG 7.23.24 meeting.
[48] AG 10.17.24 meeting, Charity Fain, Community Energy Project.
[49] Climate Solutions; Oregon Coast Energy Alliance Network.
[50] Pacific Power.

and IOU Clean Energy Plans have failed to do so.[51] An AG member expressed general concern that IRPs are insufficiently transparent and cautioned against overreliance on IRPs to inform strategy modeling.[52]

> *The energy pathways modeling was informed by IRPs and IRP updates, including IRP data to inform updates to Oregon interties with data from utility IRPs. Energy pathways modeling differs from IRPs and is more suitable for identifying actionable pathways for Oregon energy objectives because of its backcasting approach, which identifies least-cost pathways to pre-defined policy goals and energy needs, in contrast to IRPs' focus on forecasting demand and providing least-cost, least-risk means for a utility to meet that demand. Refer to the CETI-OES Team's Technical Approach Document for more information on energy pathways modeling. The only transmission line determined to be far enough along to include before 2035 that impacts Oregon's transmission capacity to other states is the Boardman- to-Hemingway line, which is assumed to come online in 2030.*

State Policy Objectives as Modeling Constraints

A hydrogen trade association expressed support for the energy pathways and backcasting modeling approach as the best means of informing a strategy to realize Oregon's energy objectives.[53]

A natural gas utility commented that modeling assumptions should be realistic rather than aspirational and consider current energy goal trajectories, market baseline estimates and anticipated trajectories, factors such as equipment affordability, market adaptation, and individual consumer actions.[54] Another natural gas utility agreed that the modeling should reflect current baselines[55] and added that the modeling should use a range of possible energy outages – including correlated failures, climate impacts on renewable resources (including hydro), and the increasing frequency of extreme weather events like wildfires – instead of a fixed outage rate.[56] Similarly, a utilities organization stated that the Reference Scenario assumptions should be more feasible than aggressive, with Alternative Scenarios testing more ambitious assumptions, referring generally to California energy policy as unrealistic and co-occurring with elevated blackout risks in the state. The commenter also stated that the modeling must factor in affordability, reliability, equity, and the promotion of economic growth.[57] A clean energy organization also urged that the modeling inputs and constraints reflect Oregon realistically and focus on physical and technical constraints of the infrastructure and natural resource availability to and in Oregon.[58]

> *The Reference Scenario does not represent new policy positions of ODOE or the state out to 2050. However, the Reference Scenario and Alternative Scenarios must be ambitious, as they serve to explore pathways to meet Oregon's ambitious climate and energy objectives. The Reference Scenario incorporates demand-side assumptions that are based on a key finding that appears consistently throughout numerous studies already done on decarbonization trajectories: that aggressive but achievable energy efficiency and electrification are key to a least-cost path to meet economy-wide energy and climate goals. With feedback from the WGs, the Reference Scenario inputs and assumptions were improved upon with the intent to incorporate Oregon-specific data and assumptions where feasible. With feedback from WGs, the Reference Scenario's*

[51] Oregon Solar + Storage Industries Association.
[52] Electricity Generation Technologies WG 8.5.24, Shannon Souza, Sol Coast Consulting & Design.
[53] RHA (Alternative Scenarios Comment).
[54] Cascade Natural Gas Corporation.
[55] NW Natural.
[56] NW Natural.
[57] OMEU.
[58] Oregon Solar + Storage Industries Association.

inputs and assumptions were further adjusted to incorporate stakeholder perspectives and expertise.

The point of this approach is not to prove any one scenario "right." Rather, the value comes from the comparison between different pathways and the Reference Scenario. Each Alternative Scenario asks a "what if" question that represents a significant change to a key variable from the Reference Scenario. Each variable is carefully selected, with public input, to test some of the real-world uncertainties we face. For example, what if transmission is constrained, or what if electrification of vehicles is slower than expected?

Each scenario represents a scope and scale of change that we are not fully on track to meet today, and serves to inform policy discussions. The comparison between scenarios will help understand and navigate uncertainty and risk by demonstrating the effects of different pathways on things like: overall system cost, what gets built where, land use impacts, affordability, jobs, and public health. These results will help inform policy analysis and recommendations to advance our state toward achieving a reliable, affordable, and clean energy system in line with our state's policies.

A couple of energy organizations recommended that Oregon not assume that other states will meet their climate goals[59] and a WG participant agreed, stating that California is significantly behind pace on several of their state goals.[60]

The modeling is grounded in Oregon's established energy policies. The analysis must model the competition for resources, resource and load diversity, policies in other states, and resource potentials inside and outside of Oregon to understand the challenges of decarbonizing the state's economy alongside meeting broader decarbonization and energy goals in the West.

A WG participant requested that ODOE provide a list of the applicable policies and laws that are being constrained for or otherwise included in the modeling. The commenter expressed concern that DER, Public Utility Regulatory Policies Act, and HB 2021 policies of promoting zero-emission electricity and workforce equity be included. The commenter also stated that HB 2021 and HB 3630 were authored by the same legislator and thus that the intent of the Oregon Energy Strategy should be read to include HB 2021 in Oregon state energy objectives.[61] An energy organization stated that the Energy Strategy should include additional elements from HB 2021, including Section 2.(2) goals regarding job creation, workforce equity, and energy resilience. The commenter expressed doubt that the proposed modeling approach can fully capture the resilience and economic benefits of DERs and other renewables, especially with respect to the near-term benefits of DER buildout;[62] an AG member and LS respondent agreed that distributed storage and generation resources offer resilience benefits that should be appreciated by the Strategy.[63] A utility recommended that the modeling assumptions be clarified to reflect, under ORS 469A.410 and HB 2021, an emissions reduction standard of 100 percent by 2040 rather than a 100 percent clean energy portfolio standard, as well as interim emission reduction goals

[59] Oregon Coast Energy Alliance Network; Oregon Solar + Storage Industries Association.
[60] WG 8.22.24 meeting, Jake Stephens, NewSun Energy.
[61] Transmission and Distribution WG 8.14.24, Jake Stephens, NewSun Energy.
[62] Oregon Coast Energy Alliance Network.
[63] AG 10.17.24 meeting, Juan Barraza; Listening Session 7.31.24 morning.

for 2030 and 2035.[64] A utilities organization asked how the modeling would differentiate COUs from IOUs, reasoning that COUs are not subject to HB 2021 because of their current energy portfolios.[65]

> *The modeling incorporates Oregon's clean electricity policy, HB 2021, which applies to electricity service suppliers and two of the state's investor-owned utilities, PacifiCorp and Portland General Electric, representing approximately 62.2 percent of Oregon retail electricity sales. HB 2021's goals are: 80 percent electricity emissions reductions below baseline (2010-2012) by 2030, zero emission retail electricity sales by 2040.*
>
> *The decision to incorporate HB 2021 has not changed from Evolved's starting point assumptions, but the approach of how to apply HB 2021 goals in the modeling has gone through significant refinement with the ODOE team to align with state policy as it applies to IOUs and COUs.*
>
> *In addition to HB 2021, the model must solve to meet Oregon's other anchor climate and clean energy goals: Executive Order 20-04 (80 percent economy-wide reduction in greenhouse gas emissions by 2050); and the Climate Protection Program (90 percent reduction in greenhouse gas emissions from fuels by 2050). This is a requirement of HB 3630, which directs ODOE to develop the energy strategy and identify pathways to achieving the state's energy policy objectives.*
>
> *There are additional policies pertaining to specific subsectors, such as HB 2531 for 100% LED sales by 2025, that will be listed in the final data source list provided in the final Technical Report.*

A WG participant asked how the modeling accounts for the needs of different policy objectives, e.g., how electricity generation technology needs might vary if targeting a 2030 versus a 2040 goal.[66]

> *Evolved's modeling provides outputs in 5-year increments. The modeling is constrained to meet Oregon energy objectives in all applicable years and to minimize costs through 2050.*

A utilities organization asked how the modeling would incorporate statutorily authorized "reliability pauses" for IOUs, stating that these should be modeled as a barrier to 100 percent clean electricity by 2050.[67]

A clean energy organization provided a number of Oregon energy and climate authorities, including many chapters of the Oregon revised statutes and Executive Order 20-04, that they recommended to include in the model, as well as a number of BPA Comprehensive Interconnection Feasibility Studies.[68]

Climate Protection Program (CPP)

An environmental organization asked if supply-side assumptions for alternative clean fuel investment for the CPP would be based on current or draft CPP rules.[69] A natural gas utility asserted that any modeling efforts that would include CPP rules would be premature because of a recent invalidation of CPP rules by the Oregon State Court of Appeals.[70] A utilities organization commented that CPP goals will be impeded by practical difficulties and a regulatory provision allowing DEQ to recommend changes to CPP goals if retail customer rates increase or are projected to increase significantly due to local distribution

[64] Pacific Power.
[65] OMEU.
[66] Electricity Generation Technologies WG 8.5.2024, David Van't Hof, Climate Solutions.
[67] OMEU.
[68] Oregon Solar + Storage Industries Association.
[69] The Nature Conservancy.
[70] Cascade Natural Gas Corporation.

companies' costs of compliance.[71] An industry association asked whether the Reference Scenario would use an emission goal of 80 percent below 1990 levels or, per CPP regulations, 90 percent below 1990 levels. The commenters recommended using the latter.[72]

On Nov. 21, 2024, the new CPP rule was adopted per Administrative Order No. DEQ-18-2024. Evolved made minor adjustments to the model to incorporate the new CPP rule into the modeling and ensure that standards of 50 percent fossil fuels emissions reduction by 2035 and 90 percent reductions by 2050 were met by all scenarios.

An environmental organization recommended that ODOE publish the following modeling outputs:

- Total Discounted System Cost;
- Cumulative (and by period) GHG Emissions to meet Targets;
- Resource utilization levels and marginal costs, if constrained;
- Technology results;
- Level of new capacity installed by sector and type, end use, mode, etc.;
- Annual investments in new capacity;
- Annual fixed and variable operating and fuel costs;
- Annual and season/time-of-day (for power plants) utilization;
- Marginal cost, if constrained;
- Energy consumed by each technology (sector);
- Marginal prices for all energy carriers (by season/time-of-day for electricity); and
- Emission level by resource/sector/technology for each period, and marginal costs in target years.[73]

The final Technical Report will include: the cumulative net present value cost difference between each Alternative Scenario and the Reference Scenario, with net present value costs calculated with a 3 percent societal discount rate; cumulative (and by period) GHG Emissions to meet Oregon energy objectives; electricity generating capacity by technology, as well as electricity demand by end use and sector (residential, commercial, productive, transportation); and emissions by greenhouse gas and by sector for each 5-year timestep.

The environmental organization also requested clarification on how the modeling results would be used to inform economic, environmental justice and equity, consumer energy cost, and energy resilience considerations.[74]

The modeling results will serve as inputs for subsequent technical analyses, including a jobs study, consumer Energy Wallet analysis, and air quality modeling. The complementary analyses have been discussed with the Environmental Justice and Equity WG, as well as the AG, to ensure that they can help illuminate economic, environmental justice, equity, and consumer energy cost considerations for Phase 2 policy discussions.

The jobs study will generate employment estimates based on investments in the energy sectors from Evolved's modeling (buildings, electricity, fuels, transportation). The Energy Wallet analysis will examine how energy consumption and associated costs change over time as usage shifts between petroleum, electricity, natural gas, and other fuels. The Energy Wallet analysis is based

[71] Oregon Municipal Electric Utilities Association.
[72] Food Northwest.
[73] Mobilizing Climate Action Together.
[74] Mobilizing Climate Action Together.

on the cost of delivering energy to customers, using results from the energy pathways modeling and calculated by applying percentage changes in the cost of serving customer energy needs to present-day energy bills. The air quality modeling will use the Environmental Protection Agency Co-Benefits Risk Assessment (COBRA) model to determine benefits of reduced pollutant emissions—as shown in the energy modeling results—on public health outcomes.

Carbon Capture and Sequestration

A hydrogen company asked that ODOE clarify if restrictions on carbon capture and sequestration (CCS) apply only to geological sequestration or also to aboveground permanent sequestration and technologies like methane pyrolysis of biogenic methane.[75] A natural gas utility recommended removing Reference Scenario restrictions on CCS, commenting that CCS is supported by federal law.[76]

In response to comments and an evaluation of existing policy, CCS has been included as a technology option in the model. Biological sequestration, however, is not an option in the model.

Carbon Offsets

An environmental organization asked if the modeling would target a "true net-zero" emissions goal or allow for carbon offsets. The commenter stated that carbon offsets can burden communities.[77]

Markets

An environmental organization asked if the modeling would account for expanding regional day-ahead and other energy markets.[78] An energy organization asked if the modeling would assume the presence of a single market and/or a regional transmission organization (RTO).[79]

Energy pathways models are not electricity market models. Electricity sector dispatch is based on least-cost operations and investments in the physical electricity system and does not consider contracts, day-ahead or hour-ahead bids and bidding behavior, tariffs, or other market structures. It is therefore complementary to, and does not replace, short-term market modeling.

Load Growth

Several commenters expressed concern with how the Strategy would address data center load growth. An environmental organization asked how the Reference Scenario would consider data center load growth;[80] they and an individual commenter expressed interest in the Strategy examining a policy to limit data center and other high-load industry buildout.[81] A couple of WG participants and an environmental organization stated that data centers and associated load growth is one Oregon's most significant energy challenges and should be explored in the modeling.[82] An AG member and trade association asked if ODOE considered other approaches for modeling data center load growth, such as incorporating the Pacific Northwest Utilities Conference Committee's 2024 Northwest Regional Forecast.[83] The AG member clarified that they do not object to relying on NWPCC's data center load

[75] Modern Hydrogen.
[76] NW Natural.
[77] Columbia Riverkeeper.
[78] Columbia Riverkeeper.
[79] Renewable Northwest.
[80] Columbia Riverkeeper.
[81] Columbia Riverkeeper; D. Miller.
[82] Kalmiopsis Audubon Society; Electricity Generation Technologies WG 8.5.24, David Van't Hof; Tim Hemstreet, PacifiCorp.
[83] Food Northwest; AG 9.9.24 meeting, Nate Hill, AWS.

growth modeling but expressed support for using NWPCC's mid-higher projection rather than their base case.[84] A utilities organization cited the NWPCC report as indicating that its projected base- and mid-cases for load growth have roughly equal likelihood of occurrence and recommended that ODOE rely on the mid-case to better reflect BPA's interconnection queue, PNUCC 2024 forecasts, and CHIPS Act investments.[85] An AG member asked if Evolved had verified that NWPCC projections accurately reflect individual data center load growth projections for PAC, PGE, and BPA territories[86] and a WG member asked if the modeling would consider industry projections and BPA load requests.[87] A utility also asked if the modeling would supplement NWPCC data with utilities' expected data center load growth based on IRP data.[88]

> *ODOE agrees that it is important to provide for load growth in the modeling. ODOE discussed using PNUCC's modeling approach with Evolved and determined that NWPCC's tech load forecasts fit best with Evolved's energy pathways modeling. ODOE presented the Council's data center forecast from pg. 15 of the Pacific Northwest Power Supply Adequacy Assessment for 2029 to the Electricity Generation Technologies WG and the AG for input. The Council told ODOE that they built this tech load forecast based on forecasts from each utility. In response to commenter feedback, ODOE adopted the tech load growth forecast from the "mid-higher case" in the NWPCC Pacific Northwest Power Supply Adequacy Assessment for 2029 through 2030. After 2030, tech load is assumed to continue to grow at a rate of 1.5 percent per year through 2050, based on a review of available data.*

A utilities organization asked how the model could provide for load growth resulting from electrification and economic development in COU territories.[89]

> *Evolved's modeling is generally statewide and does not look at the granularity of a particular utility or type of utility by organizational structure. Where feasible and appropriate, Evolved's modeling considers the percentage of load served by one group of providers versus another; for example, the model will consider the percentage of load served by entities subject to HB 2021 and does not assume that all electricity providers are subject to HB 2021's clean energy goals. Further, Evolved modeled Oregon as two zones – East and West – and some data inputs and outputs will be differentiated by zone.*

Climate Change Impacts

A couple of individual commenters, a natural gas utility, and couple of energy organizations recommended that the modeling account for climate change impacts to the energy system, including increased extreme weather events, high temperatures, and wildfires.[90]

> *The model factors in climate impacts for hydro by using NWPCC data. Evolved's model includes low, medium, and high hydro years along with the frequency with which those occur, but the model does not produce results that would show what the energy system would look like in a low vs. medium vs. high hydro year. The low hydro years drive the upper end of capacity needed because there must be reliability on the system even in those low years, whereas the more*

[84] AG 9.9.24 meeting, Nate Hill, AWS.
[85] OMEU.
[86] AG 9.9.24 meeting, Joshua Basofin, Climate Solutions.
[87] WG 8.22.24 meeting, Jake Stephens, NewSun Energy.
[88] Pacific Power.
[89] OMEU.
[90] J. Krauel; D. Meisenhelter; Oregon Solar + Storage Industries Association; Oregon Coast Energy Alliance Network; NW Natural.

frequent medium years define the average system's operating costs. The model also includes variations in heat pump efficiencies by climate zones. However, the modeling does not address extreme weather risks insofar as they may affect the need for grid-hardening investments. Demand side projections, which are based on Evolved's Annual Energy Outlook, further build changing heating degree days and cooling degree days into their service demand projections.

Environmental Justice and Equity

A WG participant requested that the Strategy consider whether modeled energy pathways would increase energy burdens on low- or moderate-income or environmental justice households.[91] An AG member also emphasized the importance of ensuring that an environmental justice lens be applied for all subjects covered by the WGs.[92]

The modeling outputs will be used to inform a consumer Energy Wallet analysis and Phase 2 policy discussions. Refer to the CETI-OES Team's Technical Approach Document for more information on the Energy Wallet analysis.

ODOE agrees that it is important to ensure that environmental justice and equity considerations are included for all topics considered in the development of the Strategy. ODOE has provided for additional Environmental Justice and Equity WG meetings during Phase 1 in recognition of the scope of this effort and will continue to engage with stakeholders and the Environmental Justice and Equity WG to review all topics addressed in Phase 2 policy discussions.

2.2. Comments on Modeling Assumptions and Approaches

2.2.1. Buildings

A utilities organization requested that the spelling of Northeast Energy Efficiency Alliance (NEEA) be corrected to North*west* Energy Efficiency Alliance.[93]

ODOE appreciates this comment and has corrected this drafting.

A clean energy organization generally asked for transparency regarding the modeling's treatment of dual fuel electric and gas boilers in buildings and what applications the model would consider for their use.[94]

Heat Pump Sales Assumptions, Electrification, and Other Building Efficiency Measures

A clean energy organization wrote that the draft assumptions regarding heat pump sales are too high for residential uses by 2040, for commercial uses by 2045, for residential and small commercial water heating by 2045, and for new appliance sales by 2035; the commenter recommended assumptions of 80, 60, 75, and 80 percent, respectively, as more reasonable. The commenter reasoned that, for residential heat pump sales, there are economic barriers to replacing heating, ventilation, and air conditioning systems with heat pumps. The commenter also stated that barriers to electrifying some commercial buildings warrant using a 60 percent assumption and that technical constraints facing heat pump water heaters limit the suitability of this technology for applications outside of garages or basements. The commenter stated that building electrification goals would also be difficult for small commercial restaurants and if the assumption accounts for gas fireplaces. The commenter added that

[91] Energy Efficiency and Load Flexibility WG, 8.2.24.
[92] AG 8.14.24 meeting, Jeff Hammarlund.
[93] Northwest Energy Efficiency Alliance.
[94] Climate Solutions.

attempts to require appliance electrification, including a Berkeley gas appliance ban, have not been successful.[95] A WG participant agreed that residential water heater assumptions should be less ambitious than those used for space heating, stating that water heat pump installation is problematic for utilities for a variety of reasons.[96]

A utilities organization generally agreed that proposed heat pump sales assumptions and cooking electrification goals are overly ambitious[97] and a natural gas utility agreed, requesting that ODOE poll consumers to establish an assumption for 2030 heat pump sales. The commenter added that natural gas appliances provide resilience benefits and questioned the proposed sales assumption as lacking a source.[98] A utilities organization stated that the proposed assumption is too ambitious because BPA heat pump incentives only apply to low-income customers, recommending that a DEQ assumption of 90 percent by 2040 be adopted. The commenter also stated that the proposed electrification assumption is dependent on the availability of incentives and asked if the assumption factors in BPA and Energy Trust incentives.[99] A WG attendee stated that, in their experience, electric heat pumps have not been reliable or efficient in Eastern Oregon.[100]

A natural gas utility urged ODOE to ensure that heat pump modeling accounts for ductless heat pump installation reliance on electric resistance heat (cadet-style) during winter months and to include gas heat pump adoption in some of the modeling scenarios.[101]

Conversely, a clean energy organization stated that heat pump sales would accelerate faster than proposed in the draft assumptions and recommended that ODOE consider Advanced Water Heater Initiative goals and research to support an ambitious assumption.[102] Likewise, a WG participant stated that federal water heating standards will require heat pumps for storage water heaters above 30 gallons.[103] A WG participant provided data they work on with BPA regarding regional heat pump sales, stating that a 65 percent sales by 2030 is achievable and possibly conservative.[104]

> *ODOE appreciates commenters' feedback. The Reference Scenario is intended to be aggressive but achievable; based on the feedback provided by commenters ODOE made several changes to the key assumptions for buildings, such as a smoother transition to heat pump sales in 2040, including hybrid heat pumps in sales assumptions, and providing for non-heat-pump electric technologies in large commercial water heating. Please refer to the modeling scenarios and assumptions for further details.*
>
> *Additionally, the modeling accounts for variances in heat pump efficiency in different climates. ODOE encourages WG members to raise issues around resilience and the efficacy of policies promoting heat pump sales or electrification during Phase 2 policy discussions.*

[95] Energy Trust.
[96] Energy Efficiency and Load Flexibility WG, 8.2.24, Wade Carey, Monmouth Power.
[97] Northwest Energy Efficiency Alliance.
[98] NW Natural.
[99] Oregon Municipal Electric Utilities Association.
[100] Buildings WG 8.14.24, Bryan Adams, CoEnergy Propane, LLC.
[101] NW Natural.
[102] NW Energy Coalition.
[103] Energy Efficiency and Load Flexibility WG, 8.2.24, Jeff Mitchell, Resource Innovations.
[104] Buildings WG 8.14.24, Ryan Brown, NEEA.

A WG participant also asked if there would be community education programs to facilitate uptake in heat pump installation.[105]

ODOE is interested in input as to how best to communicate Energy Strategy findings to stakeholders' communities going forward.

A couple of commenters asked if the modeling would account for specific heating technologies. A WG participant also asked if the modeling would consider solar thermal systems and instahots for water heaters,[106] and another WG participant asked if the modeling would account for variable speed heat pumps and resulting efficiency gains.[107]

For comments pertaining to ground-source heat pumps, networked geothermal systems, and heat reclamation, refer to section 2.2.6: Electricity Generation Technologies.

NWPCC Plan and Other Sources

A clean energy organization commented that ODOE should coordinate with NWPCC to inform assumptions regarding building stock, lighting, appliance, and end user behavior.[108] A WG member recommended that ODOE rely on U.S. Department of Energy Home Energy data and Air-Conditioning, Heating, and Refrigeration Institute HVAC sales data to inform modeling efforts.[109] A WG member also recommended a study with regionally specific analysis of space heating appliances[110] and a utility recommended that ODOE consider Energy Burden Assessments from NW Natural, Pacific Power, and PGE to examine electrification trends.[111] A municipal government stated that they were drafting a cost and market impact analysis related to new construction electrification, carbon standards, and temperature standards and offered to share the work upon its completion.[112]

ODOE is not proposing to use any specific data from the NWPCC 2021 Plan but did engage extensively with NWPCC staff during the development of modeling data and assumptions. Evolved Energy Research is relying on NEEA's Residential Building Stock Assessment and Commercial Building Stock Assessment for all building characteristic data.

Weatherization and Building Stock

A WG member recommended that the modeling assumptions make distinctions between new and current building stock and that commercial building types be further broken down;[113] likewise, an AG member asked generally how new buildings will be accounted for in the modeling.[114] Another WG member asked whether multifamily housing is considered residential or commercial in the modeling.[115]

[105] Environmental Justice and Equity 8.16.24 WG meeting, Greer Klepacki.
[106] Energy Efficiency and Load Flexibility WG, 8.2.24.
[107] Buildings WG 8.14.24, Ryan Brown, NEEA.
[108] NW Energy Coalition.
[109] Buildings WG 8.14.24, David Heslam, Earth Advantage.
[110] Direct Use Fuels WG 8.6.24, John Garrett, CUB, recommending Lauren Ross et al., Analysis of Electric and Gas Decarbonization Options for Homes and Apartments, American Council for an Energy-Efficient Economy, at 37-38 (September 2022).
[111] NW Natural.
[112] City of Portland Bureau of Planning and Sustainability.
[113] Buildings WG 8.14.24, Forest Tanier-Gesner, PAE.
[114] AG 10.17.24 meeting, Andrea Kreiner, OACD.
[115] WG 8.22.2024 meeting, Dirk Larson, The Home Performance Guild of Oregon.

A utilities organization also asked whether the proposed weatherization assumption accounts for buildings requiring other structural improvements and deferred maintenance and expressed concern that the proposed weatherization assumption of 80 percent might disadvantage under-resourced communities and households with high needs.[116] A natural gas utility commented that an assumption of 95 percent weatherized buildings may be overly ambitious and recommended that ODOE consult with community action agencies on this subject;[117] conversely, a WG participant wondered if, especially for residential buildings, most potential weatherization efficiency gains have already been realized. The WG participant recommended reviewing BPA and Energy Trust building stock assessments on this subject.[118]

A WG member asked whether the 20 percent energy savings assumed for weatherization reflects whole building energy or just heating and cooling energy use. The WG member stated that 10 percent seems more reasonable if the latter is true.[119]

A WG participant asked if weatherization goals include all homes and commercial buildings or just low-income households; the commenter also asked what a service delivery vehicle for low-income household weatherization might be.[120] Another WG participant asked how the modeling would account for mobile homes.[121]

> *The weatherization levels include households from all income brackets. Multifamily buildings are considered in the residential sector in Evolved's modeling. Mobile homes are included in the building stock on the whole, but results will not be broken out for mobile homes specifically.*
>
> *Based on feedback and Oregon specific data, renovation rates are now included in the model and replace the originally proposed weatherization assumptions. Evolved's modeling assumed 3,500 whole-home retrofits a year based on a 2020 Oregon Housing & Community Services Department Low Income Weatherization Program study; this assumption pertains to the number of homes served with deep weatherization retrofits for homes older than 1990. ODOE subject matter experts and other stakeholders suggested replacing Evolved's default national data for existing building conditions (the Energy Information Administration's Residential and Commercial Energy Consumption Survey) with region-specific data from the Northwest Energy Efficiency Alliance's Residential Building Stock Assessment and Commercial Building Stock Assessment. The CETI and Evolved teams agreed and converted the NEEA data into a format that can be used in the modeling. Energy use in all sectors, including in buildings, is benchmarked against the EIA State Energy Data System data in the first modeled year to ensure that the existing system is accurately represented.*

Other Efficiency Improvements

A natural gas utility recommended that ODOE consider other building strategies to promote energy efficiency, including heat recovery, advanced HVAC controls, and dedicated outside air systems.[122] A WG member agreed that efficiency measures such as improved insulation should be considered as

[116] Northwest Energy Efficiency Alliance.
[117] NW Natural.
[118] Energy Efficiency and Load Flexibility WG, 8.2.24, Wade Carey, Monmouth Power.
[119] Buildings WG 8.14.2024, Forest Tanier-Gesner, PAE.
[120] Environmental Justice and Equity WG 8.16.24.
[121] Environmental Justice and Equity WG 8.16.24.
[122] NW Natural.

alternatives to heat pump sales,[123] and another WG member asked if the modeling accounts for general year-on-year technological improvements other than for heat pump adoption.[124]

Evolved's modeling incorporates some technology-specific improvements based on publicly available data. The modeling also incorporates assumptions about weatherization (whole-home retrofits, which include improved insulation). The modeling does not account for building design and passive heating and cooling because of building design's relatively low impact on energy efficiency; ODOE welcomes input on how building design efficiency could be reflected in future modeling efforts.

Refer to section 2.2.5, Energy Efficiency and Load Flexibility, below, for more comments on energy efficiency.

Other Questions

WG meeting participants also raised additional questions, including:

- Does the modeling account for varying levels of greenhouse gas impacts from heat pumps based on their refrigerant usage?[125]
- Does the modeling account for households that rely on woodburning heating? Will it account for air quality impacts associated with woodburning?[126]

2.2.2. Industry

General Support for Draft Industrial Processes and Industry Electrification Assumptions

A clean energy organization generally supported the proposed industrial processes and industry electrification assumptions as reasonable[127] and a WG participant cited an Efficiency Vermont study in stating that initial annual energy reductions could be more ambitious.[128] A food trade organization commented that the proposed assumptions for industry process improvement and electrification of refrigeration and machine drives are reasonable. The commenter agreed with using a simple annual improvement for industrial processes, reasoning that there is insufficient data to support a more precise, technology-specific approach.[129] A hydrogen company requested that ODOE clarify if the 100 percent electrification assumption for industrial heat by 2050 refers to space heat, process heat, or both.[130]

While industrial sectors will improve their efficiencies at varying rates, there is a lack of data on predicted process efficiencies of each industrial sector. ODOE, in consultation with the CETI-OES Team, elected to assign a value of one percent improvement for all sectors instead of determining an efficiency improvement for each low process heat application; for example, computer and electronics products are assumed to be 100 percent electrified by 2050. Industrial HVAC loads are

[123] Buildings WG 8.14.24, Ryan Brown, NEEA.
[124] Buildings WG 8.14.24, Fred Heutte NWEC
[125] Buildings WG 8.14.24, Forest Tanier-Gesner, PAE.
[126] Buildings WG 8.14.24, David Heslam, Earth Advantage.
[127] Energy Trust.
[128] Direct Use Fuels WG 8.6.24, Karl Haapala.
[129] Food Northwest.
[130] Modern Hydrogen.

assumed to be 75 percent electrified by 2050. High heat applications are assumed to be 50 percent hydrogen/biogas or another low-carbon fuel by 2050.

Criticisms and Suggestions to Amend Industrial Processes and Industry Electrification Assumptions

A food trade organization recommended that electrification assumption figures of 50 percent of integrated steam production in food manufacturing by 2045 be used rather than 80 percent, and that 75 percent of industrial HVAC loads by 2050 be used rather than 90 percent, reasoning that the latter suggestion would be consistent with Washington State Energy Strategy goals. The commenter cited a US DOE study as demonstrating that low margins in the food industry delay electrification efforts.[131] A hydrogen trade association stated that hydrogen could play a significant role in industrial boilers and furnaces and requested that ODOE substantiate electrification assumptions for integrated steam production.[132] A natural gas utility expressed general caution regarding building electrification assumptions in the draft Reference Scenario and recommended that ODOE consult with NEEA and Energy Trust of Oregon on their plans and modeling regarding equipment availability and market transformation.[133]

Staff reviewed the US DOE study and Washington State Energy Strategy and modified the integrated steam production assumption to 50 percent electrified by 2045 and industrial HVAC loads to 75 percent electrified by 2050. We agree that hydrogen, biogas, and other low-carbon fuels may play a role in powering furnaces, boilers, and steam production as low-carbon fuels are blended into existing natural gas pipelines or used directly in these applications through various technologies. For example, the model will be able to invest in dual fuel electric and gas boilers as well as hydrogen boilers and we look forward to evaluating the model results with public partners.

Other Comments on Industry Assumptions and Modeling

A natural gas utilities company recommended that ODOE use a Computable General Equilibrium (CGE) model for the Strategy, reasoning that CGE models are standard for analyses of industries that are not directly regulated and that CGE models capture price changes and substitution effects between production, consumption, and trade.[134]

A CGE model can be used to evaluate the economic impacts of energy policies and would be an interesting tool to incorporate into future versions of Oregon's Energy Strategy. Staff elected to use Evolved's decarbonization pathways modeling because it identifies the interdependencies, efficiencies, and trade-offs to consider when pursuing deep decarbonization by evaluating technologies, existing policies, and the economic effects of accelerating the clean energy transition. Our intention is to provide policymakers and the public with guidance on what developments may be needed to achieve decarbonization goals.

2.2.3. Transportation

General Transportation Modeling Questions and Comments

Several LS participants expressed enthusiasm for policies that would reduce transportation system reliance on fossil fuels as a way to: reduce noise; promote air quality and health benefits, especially for

[131] Food Northwest.
[132] RHA.
[133] Cascade Natural Gas Corporation.
[134] NW Natural.

children; reduce suburban sprawl and food deserts; expand bicycle-use, electric bicycle- and scooter-use; and increase urban walkability, along with related health and environmental benefits. A participant also expressed enthusiasm for Climate-Friendly and Equitable Communities policies as a means to improve the transportation sector. However, other LS participants urged that transportation goals be realistic, especially for rural areas, and consider electrification, transmission, and other infrastructure constraints, as well as how to support rural communities through changes to transportation infrastructure.[135]

A WG participant asked if Evolved's modeling would account for regional variations in fuel prices.[136]

> *Yes; fuel supply and price forecasting are derived from the following sources: Energy Information Administration (EIA) Annual Energy Outlook, NW Power and Conservation Council's Fuels Advisory Committee natural gas price forecast and the U.S. Department of Energy Billion Ton Report. The modeling also accounts for costs associated with each element of supply chains for fuel production.*

A WG participant generally commented that ODOE should consider a scenario where the transportation sector is less responsible for meeting economy-wide Oregon emission reduction goals.[137] Another WG participant asked if the modeling would consider a scenario with substantial build-outs of public transit;[138] a LS participant also expressed interest in policies to promote effective and equitable public transit.[139] A WG participant commented that the modeling should build for a means to provide low-carbon fuels to legacy vehicles, such as biofuels.[140]

> *ODOE examined a Delayed Transportation Electrification scenario to test the impacts of constraining changes to the transportation sector on Oregon energy pathways. No alternative is being proposed that specifically examines public transit build-outs, but the Reference Scenario tested the effects of VMT reduction through a VMT sensitivity analysis. While the VMT reduction built into the model cannot be attributed to any particular strategy—nor are there associated costs included for VMT reduction measures— increased public transit infrastructure is one strategy for achieving VMT reductions. The High DER and Limited Transmission Scenario will also include a VMT sensitivity, to better understand the impact of VMT on transmission needs.*
>
> *Evolved's modeling allows for biofuels to meet legacy vehicle fuel needs. The modeling is based on US DOE's Billion-Ton Report and University of Washington data on forest and cellulosic biomass sources. ODOE welcomes more recent and localized data to inform future modeling efforts.*
>
> *For more comments on Delayed Transportation Electrification Scenario and Alternative Scenarios generally, refer to Section 3 below.*

MDV and HDV Sales Shares – Post 2035

A utility company stated that electric vehicle sales trends are slowing and recommended that ODOE consider a scenario that reflects constrained EV sales. The commenter also requested that ZEV sales assumptions be broken down into BEVs and PHEVs and generally that ODOE clarify how to interpret the

[135] Listening Session 7.31.24 morning and evening.
[136] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[137] Transportation WG 8.8.24, Cory-Ann Wind, Clean Fuels Alliance America.
[138] WG 7.30.24 meeting.
[139] Listening Session 7.31.24 morning.
[140] Electricity Generation Technologies WG 8.5.24, Dave Van't Hof, Climate Solutions.

two MDV rows.[141] A utilities organization generally requested that ODOE provide detail as to current consumer behavior and what changes would be necessary to achieve 100 percent electric vehicle sales by 2035. The commenter also opposed a 100 percent zero-emissions vehicle sales assumption for Class 2b-8 vehicle sales by 2040 or California Advanced Clean Fleets goals, reasoning that non-electric vehicles are important to restoring service during an electrical outage.[142] A couple of WG participants agreed that resiliency should be considered in evaluating alternative fuels for HDVs[143] and transit fleets.[144] The latter WG participant recommended ODOE consider policies similar to a California policy of providing transit vehicles priority access to power in emergency situations.[145]

> *With respect to transit fleet resilience, the modeling applied a reliability standard for the system that requires a level of reliability no lower than that of today. Overall, however, resilience topics will be an important element of Phase 2 policy discussions.*

A utilities organization also opposed assuming 100 percent BEV sales for school buses as unrealistic, citing a news article as raising safety, reliability, and cost concerns regarding BEV school buses.[146] A hydrogen trade association commented that it did not object to proposed BEV and FCEV sales assumptions for transit buses, but stated that these sales shares may change over time. The commenter reasoned that BEV buses are currently less expensive but face range and charging limitations, whereas FCEVs are more expensive but face no charging limitations while performing better in cold weather. The trade association cited several of their members as stating that FCEVs would be superior in their fleet operations. The commenter stated that the same tradeoffs between charging needs and cost do not support the proposed heavy-duty vehicle sales share assumptions between FCEVs and BEVs. The commenter cited a UCLA and a UC Davis study as indicating that FCEV infrastructure in California may expand and hydrogen hub development as a means for supporting FCEV infrastructure build-out.[147]

A WG participant commented that technological limitations are a barrier to implementing policies such as the Advanced Clean Trucks Rule in Oregon. The commenter stated that FCEV trucks are a year out from availability and expensive and that, as a result of range limitations, it would take four BEV trucks to match the productivity of three diesel-fuel trucks. The commenter recommended that biodiesel trucks be considered as a means to achieve Oregon energy objectives.[148] Another WG participant agreed that supply chain issues should be considered for transit fleets, stating that there currently is only one company manufacturing hydrogen buses.[149]

Conversely, a WG participant cited a Rocky Mountain Institute study as showing that 57 percent of MD and HD trucks in Oregon could be electrified, based on current routes and telemetric data. The commenter added that the study showed that providing power for this 57 percent of MD and HD trucks would reflect a net increase of 3 percent power demand in Oregon. The commenter stated that policies to, for instance, facilitate fleet access to fast charging stations would greatly facilitate BEV truck adoption.[150]

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[141] Pacific Power.
[142] Oregon Municipal Electric Utilities Association.
[143] Transportation WG 8.8.24, Juan J. Serpa Muñoz, EWEB.
[144] Transportation WG 8.8.24, Kyle Whatley, TriMet.
[145] Transportation WG 8.8.24, Kyle Whatley, TriMet.
[146] Oregon Municipal Electric Utilities Association.
[147] Transportation WG 8.8.24, Robert Wallace, WyEast.
[148] Transportation WG 8.8.24, Jana Jarvis, Oregon Trucking Association.
[149] Transportation WG 8.8.24, Kyle Whatley, TriMet.
[150] Transportation WG 8.8.24, Brett Morgan, Climate Solutions.

A hydrogen trade association requested that ODOE engage with truck fleet operators to explore this issue more fully[151] and a WG participant recommended that ODOE consult with Daimler.[152] The WG participant stated that industry is more likely to assume 80 percent FCEV adoption and 20 percent BEV adoption rather than the inverse.[153]

> *In response to stakeholder feedback, ODOE and the CETI-OES Team have revised the Reference Scenario assumptions to provide for a greater share of long-haul FCEV sales (35 percent, versus the 25 percent originally proposed) relative to BEV sales (65 percent, versus the 75 percent originally proposed).*
>
> *The CETI-OES Team has also updated its school bus stocks data with DEQ stocks by county.*

A WG participant stated that, to clarify, the Advanced Clean Fleets Rule does not set a sales objective but instead requires fleets to phase out internal combustion engines vehicles.[154] Another WG participant commented that the Advanced Clean Fleets Rule is undergoing litigation and may not be appropriate to build into the model.[155] A WG participant asked if Evolved's modeling would account for public transit fleet policies, such as the Innovative Clean Transit rule and School Bus Replacement Program in California. The commenter recommended a database from the American Public Transit Association to inform transit energy modeling.[156]

> *The modeling only includes specific policies currently adopted in Oregon. However, in some cases, where these policies end or plateau prior to 2050, a projection of continued technology adoption beyond the existing policy goals is assumed. Advanced Clean Fleets is not included as an assumption for Oregon but is included in the modeling of vehicle sales for California. Vehicle sales modeling is based on International Council on Clean Transportation forecasts and includes Inflation Reduction Act incentives, Advanced Clean Cars I and II, and Advanced Clean Trucks (ACT) regulations, as well as continued zero emission vehicle adoption beyond ACT's 2035 objectives. The modeling also included a sensitivity that explored the impact of no ACT targets while still meeting 100% ZEV sales by 2050.*

Additionally, a clean energy organization commented that they would expect a higher uptake of managed charging in commercial than residential fleets, reasoning that commercial fleet managers would have greater incentives to adopt managed charging.[157]

> *The model considers that commercial vehicles have less flexibility than passenger vehicles in terms of managed charging times due to required duty cycles.*

Other Vehicles

A hydrogen trade association requested that ODOE clarify how the model will address off-road vehicles and port ground equipment like forklifts, stating that companies like Amazon have begun using

[151] Transportation WG 8.8.24, Robert Wallace, WyEast.
[152] Transportation WG 8.8.24, Jana Jarvis, Oregon Trucking Association.
[153] RHA.
[154] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[155] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[156] Transportation WG 8.8.24, Kyle Whatley, TriMet.
[157] Energy Trust.

hydrogen vehicles in these situations.[158] A WG participant also asked how the modeling accounts for construction and farm equipment.[159]

Farm and industrial vehicles are included in industrial transportation demand, which is modeled with an assumption of 20 percent of industrial vehicles switching to hydrogen fuel by 2050.

Maritime and Rail Shipping Assumptions

A WG participant generally expressed support for assuming a twofold cost increase for electric and hydrogen versions of rail, aviation, and marine equipment.[160] The WG participant also asked if the modeling would consider Class II and switching railroads, stating that intrastate lines may be easier to address through policy than interstate lines.[161] Another WG participant urged ODOE to include Class I lines in modeling as the type of line that consumes the majority of fuel.[162] A WG participant asked if the modeling includes both oceangoing vessels and harbor craft.[163]

The maritime demand subsectors include: domestic shipping (i.e., Harborcraft), international shipping (i.e., Oceangoing), and recreational boats.

Vehicle Miles Traveled (VMT) Assumptions

A WG participant requested that ODOE be clear going forward when referring to VMT per capita or VMT overall, as the case may be.[164] A couple other WG participants opposed including a 20 percent reduction in VMT as a Reference Scenario assumption, reasoning that such an assumption is aspirational and raises issues regarding funding for road maintenance.[165] Another WG participant stated that VMT reductions are unlikely in rural Oregon because no fundamental changes are predicted for rural transportation. The commenter expressed concern that the modeling accurately account for the cost impacts of rural drivers switching to low-carbon fuels or EVs while maintaining flat VMT.[166] An LS participant asked if promoting work-from-home business models and locally-sourced agriculture would be ways to realizing VMT reduction goals.[167]

ODOE agrees with the perspective that rural VMT is not likely to be reduced easily; the modeling would only provide for VMT changes on a state-wide basis. Evolved's modeling provided for a 20 percent reduction in VMT on a per capita basis by 2050, in line with Oregon's Transportation Plan and stakeholder feedback.

Transportation Infrastructure

A utilities organization stated that modeling should account for related charging infrastructure and electrical load impacts associated with vehicle electrification assumptions, stating that power transformers are particularly difficult to source.[168] A WG participant agreed with the importance of considering charging infrastructure needs, stating, as an illustration, that a 5 MW electric truck charging

[158] RHA.
[159] Transportation WG 8.8.24, Robert Wallace, WyEast.
[160] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[161] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[162] Transportation WG 8.8.24, Cory-Ann Wind, Clean Fuels Alliance America.
[163] Transportation WG 8.8.24, Kyle Whatley, TriMet.
[164] Transportation WG 8.8.24, Lewis Lem, Port of Portland.
[165] Land Use and Natural Resources WG 8.12.24, Mike Totey – OHA, Michael Eng, Wallowa County.
[166] Environmental Justice and Equity WG 8.16.24, Kaleb Lay, Oregon Rural Action.
[167] Listening Session 7.31.24 evening.
[168] Oregon Municipal Electric Utilities Association.

station is able to charge three trucks at a time[169] and another WP participant urged that the modeling consider energy system resilience, capacity constraints, and distribution needs when considering vehicle electrification.[170]

A WG participant asked if the modeling would account for vehicle-to-grid (V2G) technology and smart charging to adjust for low energy-demand timeframes, adding that the Oregon Transportation Electrification Plans for PGE and PAC currently plan for smart charging but only look into V2G for the future.[171]

> *Evolved modeling assumes limited managed charging in 2025 that increases to ultimately account for two-thirds of the residential vehicle fleet and one-third of the commercial vehicle fleet by 2030. V2G technology adoption is assumed to be 26 percent for residential EVs and school buses by 2050. These assumptions are reduced in the Limited Demand-Response Alternative and increased in the High DER and Limited Transmission Alternative. The modeling bases EV charging infrastructure buildout on the National Renewable Energy Laboratory's Electrification Futures Study.*

A couple of LS participants expressed interest that the Strategy balance gas taxes in response to increased EV uptake.[172]

> *Policy implications for increased EV uptake will be considered in Phase 2.*

Other Hydrogen Comments

A WG participant asked whether and how renewable natural gas is incorporated as a potential feed stock for low-carbon hydrogen production. The commenter also asked how infrastructure costs are factored into clean fuels modeling.[173]

> *The model can select biogas as a feedstock to hydrogen production through steam methane reforming, though it is not normally the most economical use of biogas.*
>
> *Hydrogen production facilities that use natural gas or biogas as a feedstock may need to incorporate carbon capture to reduce production emissions, which can significantly add to the cost. These fuels can be used directly or blended into natural gas pipes. Biogas produced and used today and in the modeling in the near term is largely dependent on anaerobic digestion sources. The availability of thermal gasification technologies will provide a greater availability of biogas and make it a more economical option which the model may incorporate in the coming decades.*
>
> *With respect to clean fuels modeling, the model accounts for capital infrastructure and operating costs for delivery, storage, and fuel conversion; for instance, the cost of storing liquid or gaseous hydrogen is accounted for in the model and is costly so investments in this infrastructure may be limited.*

A WG participant asked if the modeling would consider a recent Washington Department of Commerce hydrogen study, especially in relation to maritime shipping assumptions.[174]

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[169] Transportation WG 8.8.24, Jana Jarvis, Oregon Trucking Association.
[170] Transportation WG 8.8.24, Juan J Serpa Muñoz, EWEB.
[171] Transportation WG 8.8.24, John Garrett, CUB.
[172] Listening Session 7.31.24 morning, evening.
[173] Transportation WG 8.8.24, Michael Graham, Clean Cities.
[174] Transportation WG 8.8.24, Rebecca Smith, RHA.

The CETI-OES Team considered the Washington Department of Commerce's MD and HD truck assumptions when establishing those used in this modeling, but they are not identical. The modeling does assume the same assumptions in relation to maritime shipping.

A WG participant asked if the modeling accounts for internal-combustion hydrogen engines.[175]

Evolved modeling only accounts for hydrogen FCEVs.

2.2.4. Direct Use Fuels

A clean energy organization requested that any modeling of direct-use fuels include their associated emissions. The commenter also asked whether the modeling would examine the electrification of sectors that might otherwise be served by liquid fuels.[176] A professional association generally urged that the Oregon Energy Strategy not plan for reliance on natural gas, biofuels, or, for most applications, hydrogen.[177]

The greenhouse gas emissions of direct use fuels are incorporated into the modeling, and reduction of emissions from this sector will be important to meeting state decarbonization goals. Hydrogen and other low-carbon fuel options are alternatives for the model to select for a variety of applications. Applications that are more economical to electrify will be less likely to be selected by the model to use low-carbon fuels. Industrial high heat applications, heavy duty transportation, or other hard to electrify applications are more likely to see hydrogen or other low-carbon fuel adoption. The energy modeling identifies least-cost pathways to meeting Oregon energy transition goals. Staff and public partners will need to balance the results with maintaining safety, resilience, equity, and affordability within Oregon.

Industrial End-Uses and Direct Use Fuels.

A couple of WG participants expressed concern that industrial electrification of end uses assumptions are overly ambitious.[178] Another WG participant asked whether hydrogen was considered as an alternative, low-emission fuel for industrial end-uses[179] and an environmental organization generally asked what kinds of alternative fuels will be considered in Evolved's modeling.[180]

Industrial electrification assumptions were determined using existing studies and industry recommendations. Achieving state decarbonization goals will require significant market and industry change across all energy sectors. High-heat industries, such as bulk chemicals, are difficult to electrify and are treated as options for hydrogen demand in the modeling. The modeling also assumes that 20 percent of industrial vehicles will rely on hydrogen by 2050. Low-carbon fuels such as biogas, ammonia, sustainable aviation fuels, synthetic methane, and other biofuels will all be considered in the model.

A WG participant asked if Evolved modeling considers Pacific Northwest National Laboratory modeling work or relies on data from Washington State University and Oregon State.[181]

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[175] Transportation WG 8.8.24, Brett Morgan, Climate Solutions.
[176] Renewable Northwest (Alternative Scenarios Comments).
[177] Oregon Physicians for Social Responsibility.
[178] Direct Use Fuels WG 8.6.24, Sharla Moffett, Oregon Business and Industry; Michael Meyers, NW Natural.
[179] Direct Use Fuels WG 8.6.24, Rebecca Smith, RHA.
[180] Columbia Riverkeeper.
[181] Direct Use Fuels WG 8.6.24, Lee Archer, PGE.

Evolved modeling incorporates data from a variety of government, utility, and industry data sets to determine costs, energy demand and supply, the availability of technologies, and much more. For example, the model incorporates biomass feedstock data from Washington State University.

For additional comments on energy for industrial end-uses, refer to Section 2.2.3, above.

Natural Gas

An environmental organization asked if the modeling would account for methane leaks when considering natural gas pipeline infrastructure;[182] a LS participant expressed excitement that the Energy Strategy could help eliminate methane and pipeline leaks.[183] Multiple LS participants expressed enthusiasm for phasing out the reliance of natural gas and producing a Strategy that accounts for natural gas health impacts,[184] while other LS participants generally expressed concern for limiting natural gas use, especially for home heating and as a replacement for kerosene heating.[185] A WG participant stated that Greenhouse Gas Reporting Program data tracks methane emissions from transmission pipelines and compressors in-state and that the Clean Fuels Program carbon intensity values for fossil methane used in vehicles include all methane emissions.[186]

The EnergyPATHWAYS model is a comprehensive energy accounting and analysis framework specifically designed to examine large-scale energy system transformations. It accounts for the costs and emissions associated with producing, transforming, delivering, and consuming energy in an economy. The model does consider the full carbon intensity of natural gas drilling/capturing and pipeline leakage. The Environmental Protection Agency has developed supply curves of measures to reduce non-CO_2 (carbon dioxide) and non-energy emissions, e.g. reducing methane (CH_4) leakage, reducing fluorinated gases (f-gases) in industrial processes and products, and reducing nitrous oxide (N_2O) from soil management. The model optimizes these measures against energy emissions reduction measures.

A WG participant asked how the modeling would account for renewable natural gas and renewable methane, providing a study by ICF on the subject.[187] An LS participant generally asked how Oregon could implement an orderly shutdown of the "methane grid."[188]

A natural gas utility generally asked what assumptions are being relied upon for natural gas efficiency, stating that natural gas heat pump technology, as used in Canada, should improve gas efficiency for later dates in the modeling.[189]

Natural gas applications in space and water heating are assumed to improve in efficiency over time with the turnover of existing appliance stock and the market availability of new natural gas technologies such as hybrid or natural gas heat pumps and boilers. Enhancements in building shells, industrial processes, and other technologies should also support reductions in fuel demand over time and are incorporated into the model.

[182] Columbia Riverkeeper.
[183] Listening Session 7.31.24 morning.
[184] Listening Session 7.31.24 morning.
[185] Listening Session 7.31.24 evening.
[186] WG 8.22.24 meeting.
[187] Direct Use Fuels WG 8.6.24, Sam Lehr, RNG Coalition.
[188] Listening Session 7.31.24 morning.
[189] NW Natural.

Biomass, Biogas, and Biofuels

A WG participant asked if the modeling would take into account or vary the carbon intensity of biofuels[190] and an environmental organization recommended that the actual emissions from use of biofuels be modeled.[191] An environmental organization asked if the modeling would include biomass as an energy source and, if so, air quality impacts associated with biomass-based generation.[192] The commenter also asked if the modeling would include biogas facilities and, if so, air quality impacts associated with biogas production.[193] A natural gas utility questioned why industries, such as the paper and pulp industry, are not being considered in the direct use fuels and industry sections[194] and a WG participant also asked that beets be included as a feedstock for biofuel.[195]

All of Oregon's industries are considered in the model including the paper and pulp industry, even if they were not explicitly mentioned in the WGs.

Other Direct Use Fuels Comments

A hydrogen company commented that the sentence beginning "Clean Fuel Standard" in the Draft Reference Scenario appears incomplete.[196]

The statement "Clean Fuel Standard incorporated" wasn't an unfinished sentence, it was meant to convey that the standard was considered when evaluating alternative clean fuel supply and pricing.

A WG participant expressed concern that the modeling build for sufficient electrical energy storage to match the storage capacity of direct use fuels, especially insofar as such storage is necessary to provide for system resilience in winter.[197] An LS participant stated that diesel fuel is essential as a backup energy source for distributed wastewater and water pumps needs because, they stated, solar is not a viable resource in winter.[198]

Energy pathways modeling approximates reliability needs, including rules of thumb for capacity needs and energy-limited resources that include generator and transmission outage rates, load forecast error, availability of renewable resources, and energy storage contributions. Reliability requirements in the model adapt in each model year to account for the quantity and location of renewable resources built by the model, the size and flexibility of load, and the type of transmission and generation resources constructed.

A WG participant asked if the modeling would account for workforce needs to support and maintain direct-use fuels infrastructure development.[199]

Evolved's energy pathways modeling does not project job impacts, but the modeling outputs will be used to inform a forthcoming employment analysis.

[190] WG 7.30.24 meeting.
[191] The Nature Conservancy.
[192] Columbia Riverkeeper.
[193] Columbia Riverkeeper.
[194] NW Natural.
[195] Electricity Generation Technologies WG 8.5.24, Martha Dibblee.
[196] Modern Hydrogen.
[197] Direct Use Fuels WG 8.6.24, John Garrett, CUB.
[198] Listening Session 7.31.24 morning.
[199] Direct Use Fuels WG 8.6.24, Valerie Egon, Business Oregon.

A WG participant asked if emerging technologies without good data on the levelized cost of energy for that technology would be included in the Reference Scenario.[200]

No; the Reference Scenario only considers technologies for which there is publicly available data.

Other Hydrogen Comments

A natural gas utility recommended that ODOE consider low-carbon energy available from Canada via pipeline, stating that BC Hydrogen and Alberta Hydrogen have data available on this subject. The commenter also stated that high volumes of synthetic methane produced from green hydrogen or excess CO_2 may become available but that, together with hydrogen, ODOE should explore storage buildout to support use of these resources, such as repurposing natural gas facilities in Mist, Oregon to this end.[201] A hydrogen trade association agreed that the model should incorporate and explain natural gas, renewable natural gas, and hydrogen imports from British Columbia and Alberta.[202] A WG participant also expressed interest in exploring possible hydrogen sources from Canada and information from the Washington Department of Commerce on this subject.[203]

A WG participant asked if the modeling assumes the Pacific Northwest Hydrogen Hub will be constructed as designed.[204]

The modeling builds for hydrogen economically, taking into account Internal Revenue Code (IRC) 45V tax credits. The model does not explicitly build in the construction of the Hydrogen Hub.

Several commenters, including an environmental organization, a hydrogen company, and a WG participant, provided questions and comments regarding the modeling's treatment of hydrogen, including:

- How the modeling would address the levelized cost of hydrogen, especially in relation to 45V tax credits;[205]
- How the modeling differentiates hydrogen transportation and production point (at customer site versus remote);[206]
- Asking whether the scenarios explored will include hydrogen as an electricity generating resource and, if so, does the modeling include hydrogen blending with methane gas[207];
- Stating that hydrogen generated from methane and blended into gas should not be considered "clean" under any circumstances[208];
- Asking if the modeling would only consider "green" hydrogen[209] and reserve its use for the most difficult to electrify sectors[210];
- How the modeling would calculate emissions resulting from the transport of hydrogen;[211]

[200] WG 8.22.24 meeting.
[201] NW Natural.
[202] RHA.
[203] Direct Use Fuels WG 8.6.24, Rebecca Smith, RHA.
[204] Direct Use Fuels WG 8.6.24, Lee Archer, PGE.
[205] RHA.
[206] RHA.
[207] Columbia Riverkeeper.
[208] J. Krauel.
[209] AG 10.17.24 meeting, Jeff Hammarlund.
[210] Columbia Riverkeeper.
[211] RHA.

- Would the model build for gasification of biomass to support green hydrogen?[212]
- Stating that only "green" hydrogen should be considered by the Strategy[213] and that the Strategy must provide definitions prohibiting carbon emissions for "green," "clean," or "renewable" direct use fuels[214];
- Whether the modeling treats green hydrogen as an emerging technology and, if so, how;
- If "green" hydrogen refers simply to low-carbon-intensity hydrogen or hydrogen produced via electrolysis[215];
- If the modeling would consider hydrogen as an electricity generating resource at peaker plants[216];
- How the modeling accounts for nitrogen oxide (NOx) emissions from using hydrogen in peaker plants;[217]
- How the modeling would treat hydrogen blending[218]; and
- If the modeling would consider declining water supply as a factor in selecting for hydrogen electrolysis.[219]

Hydrogen production is optimized by the model based on economic factors as well as the emissions constraints built in, based on Oregon climate policy. While there are no requirements that the model only choose clean hydrogen, the emissions constraints in place due to Oregon climate policy in conjunction with higher incentives for clean hydrogen are likely to result in hydrogen that has a low carbon intensity. The modeling builds out each of the steps necessary for producing, transporting, and storing hydrogen. The most significant factor affecting hydrogen buildout is the cost of electrolyzers and the 45V tax credit. Constructing additional storage for hydrogen is likely to be prohibitively expensive in the modeling, and so hydrogen is likely to be built by the model as a direct-use, liquid fuel. After the November 2024 national election, questions arose about the future of the IRA incentives. ODOE has decided not to assume changes in federal support for hydrogen or other technologies in the modeling, as it is too early to predict where changes may occur. To the extent that any changes occur during Phase 2, they can be incorporated into the policy discussions.

Modeling assumptions are that natural gas (methane) used in buildings can be blended with hydrogen up to a 20 percent by volume blend of hydrogen gas. The same is true in electricity generation, where gas generators can receive a blend of fossil and decarbonized methane with up to a 20 percent by volume fraction of hydrogen gas. Up to 100 percent clean hydrogen can be delivered to hydrogen generators through new infrastructure, the costs of which would be accounted for by the modeling.

In the model, NOx production from peaker plants using blended hydrogen and gas inputs will be the same as a peaker plant burning 100 percent fossil gas.

A hydrogen trade association recommended that the modeling include the following assumptions and allowance regarding hydrogen:

[212] AG 10.17.24 meeting, Shannon Souza, Sol Coast Consulting & Design.
[213] D. Meisenhelter.
[214] N. Mandell; D. Meisenhelter.
[215] Modern Hydrogen.
[216] WG 8.22.24 meeting.
[217] WG 7.30.24 meeting.
[218] WG 8.22.24 meeting.
[219] Columbia Riverkeeper.

- For hydrogen production, the model should include methane pyrolysis and solid oxide electrolysis;
- For hydrogen storage, underground silo storage and underground hard rock caverns should be added;
- For geologic sequestration, include onshore rock formations;
- Long-duration energy storage options should include hydrogen and compressed air energy storage; and
- Hydrogen can be selected for industrial and transportation end-uses.[220]

2.2.5. Energy Efficiency and Load Flexibility

An LS participant indicated that energy efficiency policies explore least-cost solutions and consider differences in resources between small COUs and larger utilities; other LS participants generally expressed interest in energy efficiency as a means to realizing Oregon energy policy objectives.[221] An LS participant stated that they would like the Strategy to explore what the most efficient household looks like – for example, whether or not they would rely on solar panels, be entirely electrified, or reflect other characteristics.[222] A utility asked if energy efficiency assumptions are based on utilities' Conservation Potential Assessments.[223] An environmental organization asked whether the modeling would consider energy efficiency improvements, citing the Columbia River Inter-Tribal Fish Commission Energy Plan as indicating that efficiency improvements are a fish-friendly policy and represent an environmental justice opportunity.[224] An energy organization agreed that energy efficiency should be promoted by the Strategy and treated as a combined resource from residential, business, government and community energy use.[225]

> *Energy efficiency assumptions are inputs into the model across sectors and technologies, including improvements to industrial processes, heating technology, lighting, and building weatherization. The approach to energy efficiency inputs in the Reference Scenario is to establish "aggressive but achievable" levels of energy efficiency and electrification, based on a literature review that includes utility programs and potentials studies, available data from regional organizations, and decarbonization studies. The levels of efficiency in the Reference Scenario will be compared to an Alternative Scenario with lower levels of energy efficiency.*

Energy Efficiency Appliances

A clean energy organization recommended disaggregating electric residential and commercial appliance installations by end use. The commenter reasoned that, for example, there is great potential for grid-managed heat pump water heaters market saturation before 2050, but that this might require a strategy of customer incentives that would differ from strategies necessary to promote other end-uses. The commenter recommended that ODOE consult with NEEA, NWPCC, utilities, AWHI, equipment suppliers, and aggregators to refine saturation curves in the modeling.[226]

Demand Reduction and Flexible Load

[220] RHA.
[221] Listening Session 7.31.24 morning and evening.
[222] Listening Session 7.31.24 evening.
[223] Pacific Power.
[224] Columbia Riverkeeper.
[225] NW Energy Coalition.
[226] NW Energy Coalition.

A clean energy organization commented that a NEEA load flexibility effort, along with potential for grid-managed water heating and other flexible demand work, could save hundreds of megawatts in Oregon.[227] A couple of AG members asked if the modeling would consider DR uptake in California and the Southwest to inform Oregon predictions.[228] A WG participant added that, while current DR participation trends are low, interest is increasing, especially in the Midwest. The commenter added that NWPCC modeling suggests higher volatility in future energy prices and increased consumer DR and battery adoption in response.[229] A WG participant also generally asked about the modeling's uptake of demand responsive controls and extent of complimentary storage in buildings,[230] and another WG participant asked if DR technologies are broken down or treated as a single input.[231] A clean energy organization expressed concern with linear forecasting of DR uptake in households, stating that PGE efforts have only led to minor DR uptake and recommending that ODOE consider PNUCC information on DR.[232]

> *DR technologies are treated as a single input but broken into the heating service demand and the cooling service demand. The CETI-OES Team initially assumed a 10 percent participation rate in buildings for heating and cooling technologies in demand response programs and, based on building shell inertia, an advance or delay of up to one hour. DR assumptions have been updated to provide for 50 percent of homes and commercial buildings with demand response capability participating in some form of firm demand response program by 2050 for heating, water heating, and air conditioning, with linear growth from 0 percent in 2025. As with assumptions for energy efficiency, assumptions for demand response are based on a literature review of existing programs, potentials studies, and decarbonization studies.*

Other Comments

A WG participant stated that private companies are working on non-lithium battery storage technologies that could be promising for later years in the modeling. The commenter stated that they rely on NREL and EIA but that forecasts based on these data sets have, historically, been inaccurate. The commenter asked if the modeling weighs data sources differently based on their quality.[233] Additionally, the commenter asked that the modeling account for technological advancement, such as what impact drastic price shifts in battery and hydrogen technology would have on the Oregon energy system.[234] The commenter and another WG participant also commented that consumer interest in home batteries to complement solar systems or provide for EV charging is low, largely as a result of cost considerations and nonresponsive rate structures or policies to support involvement in a DR program.[235] An LS participant stated that incentives to promote utility buy-back of locally-generated resources would be a valuable component of the Energy Strategy.[236]

2.2.6. Electricity Generation Technologies

Considerations for Electricity Generation Generally: Modeling Approach and Energy Sources

[227] NW Energy Coalition.
[228] AG 9.9.24 meeting, Scott Simms, PPC; Ivy Quach QB Fabrication and Welding.
[229] Energy Efficiency and Load Flexibility WG 8.2.24, David Clement.
[230] Buildings WG 8.14.24.
[231] Energy Efficiency and Load Flexibility WG 8.2.24.
[232] Northwest Energy Efficiency Alliance.
[233] Energy Efficiency and Load Flexibility WG 8.2.24, Brennan Gartner, Skip Technology Inc.
[234] Listening Session 7.31.24 morning; Brennan Gartner.
[235] Environmental Justice and Equity WG 8.27.24; Brennan Gartner, Skip Technology Inc; Patrick Sterns, SunPower.
[236] Listening Session 7.31.24 morning.

A number of LS participants expressed interest that the Energy Strategy's approach to electricity consider consumer and infrastructure costs.[237] An environmental organization and an individual commenter commented that the modeling should provide a lifecycle analysis for different energy opportunities[238] and an LS participant asked if the modeling accounts for scope-three lifecycle emissions, such as those resulting from battery manufacture.[239]

The energy model does not site electricity generation at a specific location. Instead, capacity for electricity generation is based on the total availability of land—relying on The Nature Conservancy's Power of Place-West study—and the economics of building the infrastructure and operating the facility. Administratively and government-protected lands as well as certain identified habitats and resources adopted from the Power of Place-West Study were used as land-use constraints. Modeling results of the amount of electricity generating capacity will be presented for the two Oregon zones represented in the model – East and West.

The model has a macro level view of land use and natural resources and is limited in how it can account for a variety of crosscutting cutting issues such as equity, environmental justice, resilience, safety, and the full life cycle impact of each energy technology choice. Phase 2 Policy Working Groups will provide an opportunity to review modeling results, further evaluate potential effects on these areas of consideration, and add even greater depth to the analysis and potential policy actions we may consider for the state.

A clean energy organization expressed opposition to any inclusion of coal, gas, and nuclear in the Energy Strategy as contrary to state energy goals. The commenter recommended that utility-scale Battery Energy Storage Systems be considered along with electricity generating resources as a means of realizing GHG reduction and system resilience goals.[240] An individual commenter and a professional association agreed that the Strategy should call for reducing electricity generation from coal, gas, and nuclear facilities.[241] An individual commenter agreed, stressing that failing to plan for a draw-down of fossil fuel infrastructure may result in companies abandoning sites and burdening local communities with remediation. The commenter emphasized that this poses an environmental justice and equity concern.[242]

BESS is an option that the model can select. Coal, gas, and nuclear are described separately below.

Two clean energy organizations commented that the modeling should consider the grid, economic, and resilience values of rooftop, community, commercial, and utility scale renewables,[243] and a WG participant recommended that low-carbon generation technologies be compared on the basis of their impacts to water resources, mining, air quality, jobs, energy resilience, and habitat, in addition to economic considerations.[244] A utilities organization stated that increased heat and smoke resulting from climate change may negatively impact solar, wind, and battery performance, recommending that the Strategy take this dynamic into account.[245]

[237] Listening Session 7.31.24 morning.
[238] Kalmiopsis Audubon Society; V. Graham.
[239] Listening session 7.31.24 evening.
[240] Renewable Northwest.
[241] D. Meisenhelter; Oregon Physicians for Social Responsibility.
[242] N. Mandell.
[243] Oregon Coast Energy Alliance Network; Oregon Solar + Storage Industries Association.
[244] Environmental Justice and Equity WG 8.16.22 meeting, Jess Grady-Benson, Rogue Climate.
[245] Oregon Municipal Electric Utilities Association.

The model has a macro level view of energy generation technologies and is limited in how it can account for a variety of crosscutting issues such as equity, environmental justice, resilience, safety, and the full life cycle impact of each energy technology choice. The Policy Working Groups will provide an opportunity to review modeling results, further evaluate potential effects on these areas of consideration, and add even greater depth to the analysis and potential policy actions we may consider for the state.

Natural Gas

A utilities organization recommended that, despite limitations in HB 2021, ODOE examine a scenario that builds natural gas peaker plants to provide for energy resilience.[246]

The modeling aims to be consistent with existing state policies. Thus, natural gas is an electricity generation technology option that the model may select to meet modeled electricity demand, but the model cannot select to build and site new natural gas facilities with an installed capacity of 25 MW or higher in Oregon unless it incorporates carbon capture and storage at the site making it a non-emitting electricity generation option. The modeling does allow building new clean gas – e.g., hydrogen or biogas – generation facilities. Ultimately, the modeling considers economy-wide carbon emissions and seeks the overall least cost supply portfolio that complies with Oregon energy objectives.

Geothermal Energy

A natural gas utility stated that limited data is available to support future technologies to be considered by the modeling, such as low and high temperature heat for industry, and technologies without levelized cost data should not be considered by the modeling. The commenter added that the model should consider ground-source heat pumps and networked geothermal systems as technologies that could replace neighborhood centralized systems.[247] Another natural gas utility agreed that geothermal energy and networked geothermal should be considered by the Strategy, stating that a Washington Thermal Energy Network law was passed to facilitate ground-source heat pump technology build out. The commenter added that TENs could include geothermal, wastewater/sewage generated thermal energy, thermal energy from abandoned coal mines, and waste heat reclamation from data centers.[248]

Conventional geothermal and enhanced geothermal are electricity generation technologies that the model may select to meet modeled electricity demand.

The default in Evolved's model was to include conventional geothermal plants, for which there is assumed potential in California but no Northwest representation due to lack of reliable data inputs. After conversation with ODOE and stakeholders, the CETI-OES Team decided to also include enhanced geothermal systems as an option on the supply side, using cost assumptions from the NREL Annual Technology Baseline advanced pricing and capped at 25% of Oregon's technical potential to avoid relying too heavily on the emerging technology.

Offshore Wind

A clean energy organization recommended that the Strategy consider offshore wind development, especially near the International Port of Coos Bay, to produce green hydrogen and provide clean energy

[246] Oregon Municipal Electric Utilities Association.
[247] NW Natural; Direct Use Fuels WG 8.6.24, Michael Meyers, NW Natural.
[248] Cascade Natural Gas Corporation.

and support maritime and land-based transportation.[249] An individual commenter urged that, when considering OSW, the modeling account for the conservation values of marine ecosystems and transmission concerns, stating that habitat impacts must be considered for a credible comparison of energy generation options.[250] An environmental organization agreed and expressed concern for selecting OSW under a scenario where land-use or natural resources constraints inhibit onshore renewable development.[251] An environmental organization commented that the lifecycle emissions of maintaining an offshore wind turbine situated in the North Pacific may, because of environmental hazards in the region, be greater than indicated in NREL data.[252] A WG participant asked if the modeling is targeting specific buildout goals for OSW or if the modeling allows for the construction of OSW without connections to the grid and another WG participant stated that Oregon state planning calls for 3 GW of OSW with integrated hydrogen production at the landing.[253]

Offshore wind is an electricity generation technology option that the model may select to meet modeled electricity demand. The modeling does not explicitly call for the construction of OSW in any quantity. The modeling can build for energy parks, where OSW would not be interconnected to the grid but would instead be used locally for the production of alternative liquid fuels or other purposes.

Biomass

An LS participant generally commented with the concern that biomass-based fuels are costly to produce and not produced from waste products; conversely, another LS participant expressed enthusiasm for biomass-based fuels as a way to bring value to agricultural or other waste.[254] A WG participant commented in the meeting that the Strategy should consider Oregon's timber basket and vast biomass potential for in-state production.[255] An environmental organization expressed caution with relying on the U.S. DOE's 2023 Billion-Ton Biomass as support for biomass fuel production in Oregon, stating that the study considered generating electricity from agricultural crops rather than timber. The commenter cautioned that the Strategy should be mindful of the relatively higher costs and environmental impacts of using timber for electricity generation compared to other renewable energy sources.[256]

The production and consumption of biofuels will produce GHG emissions in Oregon and these will be accounted for in the energy model. The Oregon Energy Strategy is focused on GHG emissions from energy activities in Oregon. GHG emissions from production of energy consumed in Oregon are tracked and accounted for in Oregon's GHG emissions totals and calculated reduction goals. Emissions are also tracked and accounted for in Oregon for biofuels that have land use change impacts (with associated emissions, for example dedicated energy crops such as corn). The modeling assumes that the supply chains for producing biomass are using clean energy.

A WG participant asked why, under CETI's Net-Zero Northwest study, relatively little biofuel was predicted and whether maritime and aerospace are included in overall clean fuels demand. The commenter recommended considering U.S. federal agency interest in biofuels, including that of US DOE

[249] Oregon Coast Energy Alliance Network.
[250] V. Graham.
[251] Kalmiopsis Audubon Society.
[252] Kalmiopsis Audubon Society.
[253] Electricity Generation Technologies WG 8.5.2024, Robert Westerman, International Brotherhood of Electrical Workers, Shannon Souza, Sol Coast Consulting & Design.
[254] Listening Session 7.31.24 morning.
[255] Electricity Generation Technologies WG 8.5.2024, Shannon Souza, Sol Coast Consulting & Design.
[256] Kalmiopsis Audubon Society.

and the Forest Service, and the fact of Oregon pelletizing local lumber waste for energy production purposes in Japan.[257]

Maritime and aerospace fuel demands are included in the modeling. The NZNW study predicted less biofuel use than other, earlier modeling because of the impact of IRC 45V and 45Q tax credits supporting hydrogen production and displacing biofuel use. The modeling includes these tax credits, as well. The modeling considers in-state and out-of-state production of biofuels.

Hydropower

A Tribal organization stated that the Strategy's modeling must reflect Endangered Species Act Biological Opinions and federal commitments to the Six Sovereigns, stating that ESA and Clean Water Act lawsuits in recent decades have restricted hydropower expansion to protect salmon and other wildlife. The commenter also cited federal commitments in the Resilient Columbia Basin Agreement to reduce hydropower reliance in recognition of the conservation concerns and likely climate impacts to the Columbia River. The commenter expressed support for the proposed reliance on NWPCC data, but urged that Strategy modeling ensure that minimum flow requirements are met. The Tribal organization also requested that ODOE confirm if the modeling incorporates federal government commitments to replace hydro reliance with new renewable capacity and provide for the management and restoration of Columbia River salmon populations. The commenter provided a list of applicable federal commitments to these ends, wrote that federal funding will provide 1,000-3,000 MW of additional clean energy generation capacity across the four CRITFC Tribes, and stated that PNNL is developing a model to inform the replacement of hydropower reliance with other renewable capacity. The commenter urged ODOE to treat Tribal energy contributions with the same weight as utility IRPs, requested that ODOE coordinate with PNNL on modeling efforts, and recommended that the Strategy consider the possibility of a decision to breach Lower Snake River dams. The Tribal organization also stated that hydropower operations have changed in recent years, with decreased capacity in the Spring, increased capacity in Summer compared to 2005.[258] A WG participant also asked if removal of the LSRD would be considered and if the modeling could allow for replacing that hydropower with other non-emitting sources, like SMRs.[259]

The CETI-OES Team has been in touch with CRITFC, PNNL, and NWPCC to evaluate available data on hydro system operations and climate-related changes, as well as capabilities of the model used for the Oregon Energy Strategy to incorporate this data. The timelines of the PNNL modeling for the Pacific Northwest Regional Energy Planning Project did not align with the timeline for Phase 1 modeling, and data were not available in a format that could be used by the model. The CETI-OES Team worked to incorporate the most recent data available and has updated hydro power data source through coordination with the NWPCC to use the simulated hourly hydro data from the NWPCC 2029 Adequacy Assessment Reference Scenario and climate scenarios projected through 2029. The model includes three climate scenarios and ten 8,760-hour simulations of hydro output per climate scenario. These incorporate climate impacts for 2029 but not further than that. Evolved and NWPCC collaborated to transform the data into a usable format by disaggregating by the zones that Evolved is modeling.

NWPCC's 2029 Reference Scenario uses updated GENESYS modeling that accounts for changes to hydro operations resulting from the Resilient Columbia Basin Agreement to the Lower Snake and

[257] Electricity Generation Technologies WG 8.5.2024, Shannon Souza, Sol Coast Consulting & Design.
[258] Columbia River Inter-Tribal Fish Commission.
[259] Land Use and Natural Resources WG 8.12.24, Nolan Pleše, LOC.

Lower Columbia projects. These changes are geared to increase spill for improved juvenile fish survival in the Lower Snake and Lower Columbia. For more information, refer to NWPCC's regional adequacy assessment for 2029.

An LS participant expressed interest in exploring the value of small-scale hydropower, such as using irrigation facilities as hydro opportunities, in the Strategy.[260]

The modeling identified small-scale hydropower buildout as a potential electricity generation resource.

Nuclear

An environmental organization asked whether the modeling would consider nuclear power construction outside of Oregon, and, if so, how. The commenter also cited an Institute for Energy Economics and Financial Analysis study as indicating that small modular reactors are not economical to construct and should not be considered an existing technology.[261] A utilities organization agreed that, as an emerging technology, SMRs should not be modeled in the Reference Scenario. However, the commenter recommended that SMRs be modeled in an alternative scenario, reasoning that SMRs are essential to economic growth in a constrained transmission scenario.[262] A WG participant agreed that the Strategy should explore relaxing policies against in-state siting of nuclear reactors and supported considering SMRs, especially as an energy source for data centers and communities facing energy transmission constraints. The commenter cited delays to the Boardman-to-Hemingway transmission line as rationale for allowing electricity generation buildout with less intensive transmission needs.[263] Similarly, a few LS participants expressed interest in examining nuclear energy generation in the Strategy.[264] Another WG participant cautioned that nuclear projects in the last several decades have taken decades to complete and gone significantly over budget,[265] and a professional association opposed allowing for the siting of nuclear power in Oregon as costly and unsafe.[266]

The modeling aims to be consistent with existing state policies. Thus, siting nuclear facilities in Oregon is not an option that the model may select to meet forecasted electricity demand, though the model may select the option of siting nuclear facilities in other states that are not restricted by existing policies. The modeling allowed for the selection of SMRs as a type of nuclear facility.

Distributed Energy Resources

An environmental organization asked if the modeling would consider rooftop solar, community solar and storage, and other distributed energy and if the modeling would account for related resilience and environmental justice benefits.[267] Another environmental organization asked that ODOE clarify how the modeling accounts for DER projects that are larger than rooftop installations but smaller than grid-scale.[268] A WG participant requested that the Strategy explore how constrained transmission might cause consumers to explore on-site generation and how energy policy might facilitate these efforts.[269] A

[260] Listening Session 7.31.24 evening.
[261] Columbia Riverkeeper.
[262] Oregon Municipal Electric Utilities Association.
[263] Electricity Generation Technologies WG 8.5.24, Martha Dibblee.
[264] Listening Session 7.31.24 morning.
[265] WG 8.22.24 meeting, Jake Stephens, NewSun Energy.
[266] Oregon Physicians for Social Responsibility.
[267] Kalmiopsis Audubon Society.
[268] The Nature Conservancy.
[269] Electricity Generation Technologies WG 8.5.2024, Brenda Montanez Barragan, NW Natural.

couple of WG participants generally asked how the modeling would account for DERs and, in particular, possible IOU opposition to DER buildout. One of the commenters described a net metering moratorium imposed by their utility in support of their question[270] and a few LS participants similarly expressed interest that the Strategy explore policies to insure that utilities' incentives and policies do not conflict with DER buildout.[271] A clean energy organization stated that the Reference Scenario is overly ambitious in assuming that out-of-state energy policies will be met and that this assumption leads to an understatement of the value of local renewable energy capacity.[272]

> *The model may select from electricity generation facilities of a variety of sizes, including community-based renewables, community solar, and rooftop solar.*
>
> *Community-based renewables: After conversations with ODOE and stakeholders about how to apply HB 2021, Evolved ensured that the modeling includes the community-based renewable energy goals for PacifiCorp and PGE as a minimum of 10 percent of renewable electricity generation coming from systems that are 20 MW or smaller. It is possible this statutory goal could be met in part with facilitates that generate electricity using biomass that also generate thermal energy for a secondary purpose. ODOE encourages stakeholders to consider this and other nuances of existing policy as part of the Phase 2 discussions.*
>
> *Community Solar: Conversations with ODOE subject matter experts helped the team determine how to treat community solar. The modeling assumes that current program capacity (from the Oregon Community Solar Program) is fully constructed.*
>
> *Rooftop Solar forecast: After discussion with ODOE and stakeholders, Evolved decided to use the rooftop solar projections from the NWPCC March 2024 Rooftop Solar Forecast.*
>
> *The model will control for reliability but may not capture all resilience and environmental justice benefits. Those aspects of development of different sizes may be discussed in Phase 2. Regarding rooftop solar, some amount of rooftop solar is input into the model, and the model may also select rooftop solar as an option to build to meet forecasted electricity demand. The input amount relies on data from the Northwest Power and Conservation Council's March 2024 rooftop solar projects. Any additional selected amount would not be based on economics to an individual consumer as the model considers the least-cost options for the system as a whole. Increased customer demand to pursue DERs may be discussed in Phase 2. ODOE encourages commenters to address policy-related questions in Phase 2.*

Hydrogen

A hydrogen trade organization recommended that the Strategy consider hydrogen combustion as a resource, both in 100 percent hydrogen turbines and in blends with natural gas.[273] The commenter asked if the modeling would allow for dual-fuel turbines and hydrogen turbines that require natural gas to start up or as a back-up resource under Oregon permitting constraints. The commenter also requested clarification as to whether the modeling would treat electrolyzers as a fixed load or a flexible load, recommending the latter.[274]

[270] WG 7.30.24 meeting; Environmental Justice WG 8.16.22 meeting, Robert Wallace, WyEast.
[271] Listening Session 7.31.24 morning.
[272] Oregon Solar + Storage Industries Association.
[273] RHA.
[274] RHA (Alternative Scenarios Comment).

The model does consider hydrogen combustion as a resource, in both 100 percent hydrogen turbines and in dual-fuel turbines. Whether the results see hydrogen used in this way will depend on whether it is selected for cost.

Electrolyzers that are built under the IRA (2032 and prior) can receive the IRC 45V Clean Hydrogen production tax credit, which is likely to incentivize those electrolyzers to operate at higher capacity factors, at least until the expiration of the tax credit.

2.2.7. Land Use and Natural Resources

Land Use Modeling Generally

A couple of WG members recommended that the Reference Scenario exclude land use policy constraints, reasoning that seeing the maximum availability for infrastructure siting absent land constraints will help inform policymaking.[275] A WG participant generally recommended adding assumptions for increasing permitting backlogs, especially at the Energy Facility Siting Council.[276]

ODOE Staff presented land use policy constraint filters including legally protected, administratively protected, and high conservation valued land based on The Nature Conservancy's PoP - West. Public partner feedback included recommendations to include all three of these categories of exclusion because the study found that even with these restrictions, Oregon could achieve its clean energy goals. These restrictions were also selected because they reflect the barriers to development seen today and may better align with existing state policies. Phase 2 policy discussions will provide an opportunity for stakeholders to review modeling results, add greater depth to Energy Strategy analysis, and discuss these topics in more detail.

The Nature Conservancy's Power of Place - West Study

An environmental organization supported a spatial planning approach based on the Nature Conservancy's PoP - West research.[277] The commenter and a couple of individual commenters also recommended, to protect natural resource and biodiversity, prioritizing brownfields or previously developed properties for energy projects.[278] The environmental organization observed that there is a data layer in the Oregon Renewable Energy Siting Assessment tool that identifies lands with human modification and recommended using this layer in modeling and in prioritizing land for new energy development. The commenter also expressed support for Level 3 PoP - West protections.[279] A clean energy organization supported restricting siting on the basis of PoP - West Level 1 and 2 layers and requested that the ODOE clarify if any other assumptions were applied regarding land use and natural resources.[280]

The environmental organization that drafted PoP - West commented to clarify that PoP - West should be construed not as a predictive model with prescriptive solutions, but rather as a tool to foster dialogue for renewable energy siting. The commenter recommended that PoP - West be supplemented with Oregon Department of Fish & Wildlife big game corridor and sage grouse maps,[281] and raised a concern

[275] WG 8.22.24 meeting, Amy Berg Pickett, Sunstone Energy, Jake Stephens, New Sun Energy.
[276] WG 7.27.24 meeting.
[277] Kalmiopsis Audubon Society.
[278] Kalmiopsis Audubon Society, V. Graham; D. Miller.
[279] Kalmiopsis Audubon Society.
[280] Renewable Northwest.
[281] The Nature Conservancy.

that PoP - West prime farmland restrictions may not fully reflect on-the-ground agricultural realities.[282] The environmental organization also stated that PoP - West could be improved to allow for more DER development in Western Oregon and requested that ODOE provide a crosswalk between ORESA and PoP - West data.[283] An AG member asked if the modeling would apply the same assumptions in its treatment of eastern and western Oregon. The commenter requested that ODOE announce any stakeholder engagement opportunities for discussing policy and modeling differences between eastern and western Oregon.[284]

> *The modeling relies on PoP - West as a framework for land use screens, which restrict the use of land for energy development (both energy resources and transmission) in the modeling. The Reference Scenario started by restricting the use of legally protected (PoP Level 1) and administratively protected areas (PoP Level 2) in Oregon. After reviewing initial results, Evolved recommended expanding the restriction to lands of high conservation value (PoP Level 3), and ODOE agreed with this approach. The model does not select specific sites for energy development; it instead provides an evaluation of the total amount of land that is available for development. ODOE's use of PoP - West inputs screened out lands such as designated wildlife corridors from the land available for development.*
>
> *Evolved's model has used the PoP - West land screens for past studies, but our starting point assumption was that we would consider refining or replacing the PoP - West study with the Oregon-specific ORESA tool. We discussed this option through internal ODOE meetings and two meetings with the Land Use and Natural Resources WG. Through the engagement, we heard about the importance of incorporating resource and land use screen data layers in the model to inform how much and what type of energy development may occur in Oregon, with reasonable land use assumptions for the Reference Scenario and further limits for an Alternative Scenario.*
>
> *Specifically, ODOE heard that the POP - West analysis was a good way to consider land use for these scenarios but that it could be improved if we could update it with more recent Oregon-specific data sets and more data about the marine environment. The CETI-OES Team worked to investigate how the existing PoP - West data sets could be enhanced with more information from the ORESA tool or other sources (e.g., OROWind Map).*
>
> *Ultimately, it was determined that it would take several steps that would exceed available time and resources, including, for example, obtaining the PoP - West layer-by-layer representations, which likely include layers that have already been combined in some cases and converted into rasters that would be difficult to un-do and then re-create. Therefore, the conclusion was that "tweaking" the PoP - West analysis was not an option at this time, but that it should be captured in the Energy Strategy report as a potential future opportunity with more time and resources.*

Tribal Lands and Culturally Significant Sites

An environmental organization requested clarification on what the modeling considers to be Tribal lands and urged that the definition be expanded to include culturally significant sites.[285] Another environmental organization stated that PoP - West fails to adequately consider cultural resources; as an example, the commenter referred to fisheries and suggested that a conflicts analysis would be important to evaluating this interest. The commenter stated that the legislative direction that DLCD

[282] AG 9.9.24 meeting, Laura Tabor, TNC.
[283] Land Use and Natural Resources WG 8.12.24, Laura Tabor, TNC.
[284] AG 9.9.24 meeting.
[285] Columbia Riverkeeper.

produce a Roadmap for Offshore Wind Energy in Oregon reflects legislative intent that cultural resources be prioritized and assessed in state energy planning. The commenter recommended that ODOE engage with other potentially interested parties regarding OWS and cultural resources, such as commercial fishers.[286] A WG participant agreed with the importance of consulting with Tribes on land use impacts outside of formal reservation borders.[287]

The energy pathways modeling does not site energy projects at specific locations; instead, the model sites based on the total availability of land and the economics of siting the infrastructure within a region. The model has a macro level view of land use and natural resource availability. Certain Tribal lands are restricted and considered protected from siting energy facilities, but the definition of Tribal lands is limited to reservations or lands protected by Tribal sovereignty. A mapping of culturally significant Tribal sites was not included in the land use restrictions but could be an area of policy improvement that could be addressed in the Policy Working Groups in 2025. ODOE staff will continue government-to-government communication with Tribal nations to ensure these views are accounted for in the report.

Seismic Risks

An environmental organization asked whether the model would account for seismic concerns by, for example, relying on Oregon Department of Geology and Mineral Industries data. The commenter stated that ORESA is inadequate to filter out sites where communities have identified risks, such as Port Westward.[288]

There is not enough granularity in the model to invest in grid-hardening types of investments to be more resistant against natural disasters, and these would come at additional costs: e.g., microgrids, undergrounding of transmission, and other measures for purposes other than serving existing load. Evolved's model does not factor in those costs unless they are baked into forecast costs for transmission.

One way to think about this is that these potential costs/measures would be the same across scenarios, since they are separate and address an issue other than load growth. Therefore, when comparing one scenario against another, hypothetical grid-hardening investment cost would net out, and the relative difference between scenarios would be the same as what the modeling results show.

Marine Ecosystems

An environmental organization generally stated that energy development has major water quality impacts and asked how the modeling would account for these.[289] Another environmental organization also stated that, to the extent the modeling relies on ORESA, it should integrate updated layers for marine mammal Biologically Important Areas and for seabird distributions. The commenter recommended reviewing DLCD's mapping tool, OROWIND, or relying on West Coast Wind Energy Areas as already identified by the Bureau of Ocean Energy Management. The environmental organization cautioned that the PoP - West study provides inadequate description of its methodology for evaluating marine ecosystems and that, overall, inadequate data is available on marine ecosystems.[290] The

[286] Kalmiopsis Audubon Society.
[287] WG 8.22.24 meeting, John Seng, Spark Northwest.
[288] Columbia Riverkeeper.
[289] Columbia Riverkeeper.
[290] Kalmiopsis Audubon Society.

environmental organization that drafted PoP - West recommended that PoP - West be supplemented with Department of Defense data and updated fisheries data to better reflect offshore ecosystems.[291] A WG participant stated that the water quality layer of PoP-West is helpful for identifying where large facility or gas siting may be constrained.[292]

The CETI-OES Team worked with ODOE to investigate how to enhance the existing PoP - West data sets with more information from the ORESA tool or other sources (e.g., OROWind Map). Ultimately, we determined it would take several steps that would exceed the timing and resource constraints of the modeling. Possible steps included, for example, obtaining the PoP layer-by-layer representations - which likely include layers that have already been combined in some cases and converted into rasters that would be difficult to un-do and then re-create. Therefore, we concluded that "tweaking" the PoP analysis was not an option at this time, but that these changes should be explored in future updates to the Energy Strategy.

Renewable Energy Siting and Agrivoltaics

A WG participant asked whether the modeling would consider possible increases in siting difficulty in later years of the modeling as ideal locations begin to be fully developed and public fatigue with development grows.[293] A clean energy organization agreed with WG discussions on diminishing suitable site availability for renewable power generation and stated that the Strategy should, based on recent solar energy density estimates and other sources, estimate land usage figures that would be necessary under the scenarios analyzed[294] recommending Berkeley lab research to support such figures.[295] Other WG participants agreed that the modeling should explore whether agrivoltaics could be sited on farmland, reasoning that this is an important policy question and that "high value farmland," as identified in Oregon law, reflects drastically different conditions.[296] A WG participant generally expressed interest in dual-use siting, such as developing solar along the Boardman-to-Hemingway line or implementing agrivoltaics.[297] An AG member emphasized the importance of balancing energy development with agriculture in Oregon and referred to the Pine Gate Renewables' Sunstone project in Morrow County as an example of solar development accompanied by agricultural mitigation measures.[298]

The model outputs will include the average number of acres used by different types of development overall. The modeling relies on ORESA to consider siting factors with some granularity, including the energy potential of a site and factors impacting the difficulty of regulatory permitting. The modeling does not have a direct input to factor in public fatigue regarding renewable energy siting. One of the alternative scenarios modeled, Scenario 4: Limited Utility-Scale Generation, limits the capacity of utility-scale wind, solar, and geothermal to 50% of what was found in the Reference Scenario. This scenario could represent challenges with permitting and siting new renewables.

Environmental Justice and Equity

[291] The Nature Conservancy.
[292] Land Use and Natural Resources WG 8.12.24, Dan Serres, Columbia Riverkeeper.
[293] Electricity Generation Technologies WG 8.5.24, Tim Hemstreet, PacifiCorp.
[294] Renewable Northwest.
[295] Renewable Northwest (Alternative Scenarios Comment).
[296] Land Use and Natural Resources WG 8.12.24, Michael Eng, Wallowa County; WG 8.22.24 meeting, Jake Stephens, NewSun Energy.
[297] Land Use and Natural Resources WG 8.12.24, Michael Eng, Wallowa County.
[298] Timothy McMahon, Stoel Rives LLP.

A couple of WG participants asked that renewable energy siting considerations include possible impacts to rural communities.[299] Another WG participant stated that failing to consider the general location of energy project developments would present an environmental justice concern.[300]

> *Evolved modeled Oregon as two zones – East and West. The potential available land that the models can draw from is developed from land-use layers and considerations about land that resources are located on. This potential has been screened for environmental and environmental justice concerns, so in that respect some environmental justice concerns are incorporated directly into the models. The models will not show where resources are located (by county or specific site). Modeling results will include the capacity of each resource in eastern and western Oregon. This information coupled with the types of land exclusions included in the modeling assumption will provide a basis for Phase 2 discussions on land use considerations.*

2.2.8. Transmission and Distribution

How Electric Transmission is Modeled

An environmental organization asked what the key data inputs for transmission capacity are.[301] A WG member urged that the modeling examine how to build transmission across the Cascades and to Portland, reasoning that Portland is an outsized source of energy demand in the state and faces unique transmission constraints. The commenter stated that there is substantial energy generation capacity west of the Cascades and south of Portland that could be utilized to respond to geographical transmission constraints. The commenter expressed interest in reviewing the modeling inputs for line- and path-ratings, stating that a WECC model includes these ratings and recommending that the model break down energy demand areas in Oregon into eight zones.[302] Another WG member asked if the modeling would be based on production cost model (PCM) dispatch, stating that, if so, it would naturally conflict with modeling to address current transmission capacity allocation methodologies.[303]

> *The model considers transmission constraints across two modeled zones. Evolved's starting point assumption was that we would model Oregon as one zone, like most other states in the model. During the initial review of the technical and data approach with ODOE. Evolved developed a representation of Oregon as two zones: Western and Eastern Oregon, roughly demarcated by the Cascades. The CETI team developed assumptions for the electricity transfer capacity between East and West Oregon based on publicly available BPA data of historical path flows.*

A clean energy organization recommended considering the development of the Cascade Renewable Transmission Project as a potential new transmission resource because of its potential to transfer 1100 MW of energy from eastern to western Oregon and its receipt of a WECC path rating.[304] A few AG members agreed that the modeling should consider merchant-built transmission such as the Cascade Project.[305] An AG member stated that the Bethel to Round-Butte reconductoring project has received

[299] Land Use and Natural Resources WG 8.12.24, Michael Eng, Wallowa County.
[300] WG 8.8.24 meeting.
[301] Mobilizing Climate Action Together.
[302] Transmission and Distribution WG 8.14.24, Jake Stephens, NewSun Energy.
[303] Electricity Generation Technologies WG 8.5.24.
[304] NW Energy Coalition.
[305] AG 9.9.24 meeting, Timothy McMahon, Stoel Rives LLP; Fred Heutte, NWEC.

DOE funding and is very likely to take place.[306] Another AG member recommended that ODOE coordinate with BPA to review the accuracy of how transmission is being modeled.[307]

> *CETI staff has carefully reviewed BPA transmission planning work to inform Evolved modeling and policy work going forward. ODOE has also met with BPA to discuss Energy Strategy modeling to ensure we are operating on the most up-to-date data on planned lines and path ratings and to confirm that none of the transmission assumptions applied in the Energy Strategy raise red flags.*

A clean energy organization recommended that transmission modeling measure lines by rated capacity rather than historical path flows, reasoning that recent trends in energy transmission are inconsistent with historical flow patterns.[308] A clean energy organization urged that the modeling consider transmission constraints sufficient to evaluate local energy generation and smart grids, stating that Integrated Resource or Clean Energy Plans are inadequate to support this analysis.[309] An individual commenter added that the modeling should examine microgrids and local storage as a means to foster energy resilience and alleviate transmission constraints, cautioning that reliance on past transmission data may be inadequate to consider developing, localized energy generation, and storage technologies. An AG member also asked how the modeling treats regional transmission construction.[310] A WG participant asked if the modeling might show load demand shifting to areas where energy is abundant rather than confronting transmission barriers.[311] A WG participant recommended that the Strategy consider encouraging Peoples Utility Districts for smaller communities, such as individual retirement communities, to mitigate transmission constraints.[312]

> *ODOE appreciates the input*. The modeling does include path ratings for lines as an input. Transmission is modeled between zones, with each state in the WECC representing a zone, as well as in two Oregon zones (East and West), and a two California zones (North and South). In this way it provides visibility into the need for transmission at a zonal level, without describing where within that zone the transmission will be built. The modeling considered a High Distributed Energy Resources plus Limited Transmission Scenario, as well as high level of demand response in the Reference Scenario compared to a Limited Demand Response Alternative Scenario. The comparison between scenarios will provide context to support policy discussions about the role of distributed solutions and microgrids. ODOE encourages commenters to address policy-related questions in Phase 2.

New Transmission Development Assumptions

A utility stated that it is planning for the construction of a 500 kV transmission line between southern, central, and northeastern Oregon with a planned in-service date of 2032. They recommended that the modeling account for the construction of this line beyond 2035 or explain why the modeling would account for some projected transmission projects but not others. The commenter stated that they would provide further data to support this assumption. Additionally, the commenter requested clarification as to whether the Reference Scenario will assume completion of PAC's Gateway South alone

[306] AG 9.9.24 meeting, Fred Heutte, NEWC.
[307] AG 9.9.24 meeting, Scott Simms, PPC.
[308] NW Energy Coalition.
[309] Oregon Coast Energy Alliance Network.
[310] AG 9.9.24 meeting, Laura Tabor, TNC.
[311] WG 8.22.24 meeting, Robert Wallace, WyEast.
[312] Electricity Generation Technologies WG 8.5.2024, Martha Dibblee.

or of the entire Energy Gateway set of projects.[313] An environmental organization generally expressed support for reconductoring and co-location as a means to quickly address transmission expansion needs.[314]

The model includes options to expand interzonal transmission connections through new greenfield lines, reconductoring, and co-location of lines. The model also includes constraints on timing for when it is possible to reconductor or build a new line.

In terms of new greenfield lines, the starting point assumption was that the model would not allow new transmission until 2035, except for certain priority transmission projects that are currently planned and/or under development. Through engagement with ODOE, the WGs, and the AG, the only transmission line determined to be far enough along to include before 2035 that affects Oregon's transmission capacity to other states is the Boardman-to-Hemingway line, which is assumed to come online in 2030. The model would still be able to expand the path from state to state (Oregon to Idaho, for example, without indicating a specific transmission line) when it is a cost-effective option.

Reconductoring and co-location of transmission lines is also not allowed in the model until 2035.

Distribution System Modeling

A clean energy organization generally stated that it is important to account for load growth when considering transmission and distribution system capacity.[315] A WG participant asked if the modeling would account for increased load on local distribution grids and substation transformers.[316]

The model does not have a detailed representation of distribution grids, but it does track the increase in distribution load with electrification. It uses regional average distribution costs to estimate the increase in costs associated with expansion of distribution infrastructure. These estimates are high level and better addressed through utility planning using detailed short-term distribution modeling. Refer to section 2.1 for more comments on load growth.

Grid-Enhancing Technologies

A company commented that Dynamic Line Ratings, a grid-enhancing technology (GET), is likely to be deployed in the coming years and should be reflected in the modeling. The commenter referenced Oregon utility and US DOE initiatives, as well as the Western Transmission Expansion Coalition (WestTEC) study, regarding GETs in support of their position.[317] A couple of clean energy organizations agreed that GETs and DLR should be considered by the modeling,[318] and an AG member requested clarification on how the modeling analyzes GETs.[319]

The model does not explicitly include grid-enhancing technologies. There are insufficient data and studies at this time to incorporate GETs into the model's interzonal path ratings. However, the path ratings themselves are reflective of the full set of technologies available. Therefore, if GETs are part of the system, they are included in that path rating. However, GETs are not a technology

[313] Pacific Power.
[314] The Nature Conservancy.
[315] Renewable Northwest.
[316] WG 8.22.24 meeting, Brent Bischoff.
[317] LineVision, Inc.
[318] NW Energy Coalition; Renewable Northwest.
[319] AG 9.9.24 meeting, Josh Basofin, Climate Solutions.

with an associated cost that can be selected in the model due to the lack of data available to characterize their impact on interzonal path ratings.

Cost Assumptions

A clean energy organization recommended relying on what the California Independent System Operator and Pacific Gas & Electric use as proxy values for wildfire costs.[320] A clean energy organization recommended that, to inform transmission cost assumptions, ODOE confer with Oregon utilities regarding their distribution resource plans.[321] A commenter stated that transmission and distribution costs may continue to grow and exceed the costs of residential- or commercial-scale solar power.[322]

A WG participant asked if the modeling would account for programmatic costs of transmission, such as National Fire Protection Association code applicability to hydrogen fueling stations, Society of Automotive Engineer fuel dispensing, and permitting processes.[323]

Transmission assumptions come from The Nature Conservancy's PoP - West study, which uses detailed GIS modeling to determine least-cost interstate transmission routes between existing substation endpoints. This data has been updated with analysis of planned lines under construction in Oregon and the region. Transmission options include reconductoring, colocation of new lines with existing lines, and greenfield transmission development of AC and DC transmission. The cost of building or expanding a given route includes existing capacity, reconductoring opportunities at different voltages, terrain, and sensitive land use areas.

Pipeline Infrastructure

A natural gas utility recommended that pipeline infrastructure assumptions allow for infrastructure development beyond operations and maintenance as the gas system adapts to using clean fuels,[324] and a hydrogen trade association similarly recommended that the model allow for the construction of hydrogen transportation infrastructure.[325]

An environmental organization generally stated that the modeling should account for cost impacts related to expanding liquid fuel versus electrification use and transmission capacity.[326] The commenter also asked if the modeling would account for costs to repurpose pipelines for alternative fuels.[327]

The model is based on physical infrastructure build and the cost and operations of that build. For example, the model includes infrastructure costs for every step of the hydrogen supply chain, including storage facilities, midstream infrastructure for conversion (methanation, Haber-Bosch, Fischer-Tropsch, etc.), and delivery of hydrogen or hydrogen-derived fuels. Codes and standards affecting the infrastructure in each of these steps are not explicit in the model but instead incorporated into the cost assumptions used in the model from public sources.

Fuels such as biogas and hydrogen can be blended into existing lines in small quantities but at larger scales do need dedicated lines for their distribution, and the model reflects those costs. Pipeline infrastructure built to expand natural gas is limited but the construction of pipes for the

[320] Renewable Northwest.
[321] NW Energy Coalition.
[322] E. Strid.
[323] Electricity Generation Technologies WG 8.5.2024.
[324] NW Natural.
[325] RHA.
[326] The Nature Conservancy.
[327] AG 9.9.24 meeting, Laura Tabor, TNC.

distribution of clean fuels is allowed in the model. Biogas and hydrogen can also be stored and used for electricity generation. The costs associated with electricity generation, transmission, and distribution would be attributed to this application of the fuel.

An AG member asked how the modeling would account for Gas Transmission Northwest pipeline expansion and possible resulting increases to Oregon gas consumption. The group member supported an assumption that the pipeline would increase gas consumption because of a current Cascade Natural gas agreement to purchase GTN gas.[328]

TC Energy's Gas Transmission Northwest Xpress pipeline capacity expansion project will increase the availability of natural gas in the region. The model considers regional gas supply on a region-wide basis and Oregon's access to the resource. Existing policies such as DEQ's Climate Protection Program will gradually limit the use of fossil fuels to meet Oregon demand. The model will not construct new natural gas pipeline infrastructure in Oregon but may select development of infrastructure for low-carbon fuels to meet demand. ODOE encourages commenters to address policy-related questions in Phase 2.

Other

A WG participant asked how the modeling accounts for energy loss via transmission.[329]

The modeling represents transmission losses through explicit zone-to-zone figures and, within zones, transmission losses are reflected through high-level averages.

An AG member asked if the modeling would only examine larger-scale transmission projects or also examine smaller projects and BPA work.[330]

The modeling is examining transmission build-out generally; it is not limited to large-scale projects.

An AG member asked why the modeling assumes no new transmission construction until 2035, stating that delays in transmission are likely to result in increased construction costs.[331]

At present, transmission projects face lengthy development timeframes for permitting, siting, and construction; given these constraints, the modeling generally assumes that future transmission development will only come online after 2035.

Two clean energy organizations stated that important transmission studies are likely to be published in the next year and encouraged ODOE to incorporate these studies to the extent feasible.[332]

ODOE appreciates the input. ODOE encourages commenters to address policy-related questions arising from forthcoming studies in Phase 2.

3. Alternative Scenario comments

3.1. General Comments on Draft Alternative Scenarios

[328] AG 10.17.24 meeting, Jeff Hammarlund.
[329] Transmission and Distribution WG 8.14.24, Shannon Souza, Sol Coast Consulting & Design.
[330] AG 9.9.24 meeting, Nate Hill, AWS.
[331] AG 10.17.24 meeting, Ivy Quach, QB Fabrication and Welding.
[332] NW Energy Coalition; Renewable Northwest.

An individual commenter generally stated that, for Alternative Scenarios, it would make more sense to consider additional delays and constraints rather than more optimistic alternatives.[333]

Extreme Weather Events

A utilities organization recommended that ODOE replace a draft Alternative Scenario with one that would examine increased extreme weather events and service disruptions. The commenter suggested that ODOE could also expand the Constrained Transmission Scenario to consider extreme weather events.[334]

3.2. Additional Proposed Alternative Scenarios

A natural gas utility expressed support for considering an Alternative Scenario to explore the effects of limiting natural gas in homes, supporting their recommendation with Deschutes County polling to indicate consumer interest in renewable natural gas, opposition to bans of natural gas, and support for renewable energy and energy efficiency incentives.[335] An energy organization recommended exploring Alternative Scenarios for increased renewable natural gas replacing natural gas utility loads.[336]

A Tribal organization recommended that the modeling consider a scenario to examine a low-peak, low-hydro reliance future consistent with *Energy Vision*'s call to reduce load-following ramping operations that are harmful to fish. The commenter also recommended exploring increased energy efficiency, increased demand-side energy management, accelerated solar resource buildout, and large-scale energy storage buildout. The commenter stated that relying on *Energy Vision* would produce a scenario protective of natural and cultural resources.[337] A WG member agreed that a scenario should consider removing LSRDs and construction non-emitting resources, such as SMRs, to replace LSRD power.[338]

A Tribal organization and an energy organization recommended exploring scenarios for increased energy efficiency.[339]

A Tribal organization and an energy organization recommended exploring scenarios for increased solar generation and storage buildout.[340]

An environmental organization recommended considering an Alternative Scenario to prioritize brownfields development and co-siting energy generation with industry and agriculture.[341]

An environmental organization recommended a scenario to constrain OSW development further than indicated by NREL data; a scenario that would consider Level 3 PoP - West land use constraints; and a scenario that examines faster decarbonization efforts.[342]

An energy organization recommended considering scenarios for slow electrification, fast electrification, "Distributed, Smart, and Resilient," and "Distributed, Smart, and Resilient with High Demand and Stretch Targets." The commenter provided a matrix indicating proposed variations in assumptions with each

[333] M. Totey.
[334] OMEU.
[335] Cascade Natural Gas Corporation.
[336] EnergyTrust.
[337] CRITFC.
[338] Land Use and Natural Resources WG 8.12.24, Nolan Plese, LOC.
[339] CRITFC; Energy Trust.
[340] CRITFC; Energy Trust.
[341] Kalmiopsis Audubon Society.
[342] Kalmiopsis Audubon Society.

scenario, with the latter two providing for GETs, expanded DERs construction, enhanced building energy efficiency, increased vehicle electrification and VMT reduction, methane gas decommissioning, and, in the last case, increased GDP projections.[343]

A hydrogen trade association recommended that the Strategy consider Alternative Scenarios similar to those modeled for the Washington Energy Strategy, including for tighter GHG and more flexible GHG requirements, and for lower and higher renewable energy development.[344]

An environmental organization recommended exploring a scenario to consider increased agricultural measures, for example nitrogen and manure management, that do not fit clearly into energy or sequestration portfolios.[345]

An AG member asked that a scenario consider the impacts of limiting Oregon's ability to import clean energy from out-of-state.[346] Another AG member asked that an Alternative Scenario not assume that Oregon participates in a regional energy market.[347]

A WG participant recommended examining a scenario that prioritizes Oregon workforce development and jobs impacts.[348] Other WG participants recommended exploring scenarios that generally considered affordability factors like increased cost of living, IOU arrears policies, and energy burdens.[349]

Several WG participants recommended examining a scenario where low-income households are able to access fully funded weatherization and the necessary pre-weatherization.[350]

> *ODOE appreciates stakeholders' feedback. Several of the recommendations raised above are addressed, in part, by the Alternative Scenarios selected by ODOE in consultation with the CETI-OES Team; the Limited Transmission Scenario will restrict Oregon's import of out-of-state energy, ODOE also selected a Limited Utility-Scale Electricity Generation in Oregon Scenario similar to the restricted renewable scenario, and incorporated Level 3 Pop - West siting restrictions into the Reference Scenario. These alternatives are described in the modeling assumptions and sources. The CETI-OES Team is also conducting complementary analyses, including an Energy Wallet analysis, to explore the customer cost impacts of the modeling scenarios.*

3.3. Comments on Alternative Scenarios

3.3.1. Alternative 1: Delayed Energy Efficiency and Building Electrification

An energy advocacy organization stated that the assumed commercial water heater adoption rates in the Reference and Alternative Scenarios appear low. The commenter also asked for sources to support the Industrial Processes and Electrification assumptions, stating that reductions in adoption rates in the Alternative Scenario seem more drastic than changes drafted for other Alternative Scenarios.[351]

> *The differences between all scenarios are intended to provide a useful perspective on how varying assumptions impact overall system costs. Considerations that have gone into defining the*

[343] Mobilizing Climate Action Together.
[344] RHA.
[345] The Nature Conservancy.
[346] Land Use and Natural Resources WG 8.12.24, Mike Totey.
[347] Land Use and Natural Resources WG 8.12.24, Lauren Link, TNC.
[348] Electricity Generation Technologies WG 8.5.24, Ranfis Villatoro, BlueGreen Alliance.
[349] Environmental Justice and Equity WG 8.27.24.
[350] Environmental Justice and Equity WG 8.27.24.
[351] CUB (Alternative Scenario Comment).

assumptions include ensuring that there is enough of a difference to provide insights, existing trends vs. future needs, and a review of developments in other places. The modeling is not meant to predict the future, but to provide insights into the costs and benefits of alternative futures as compared to each other to help inform policy discussions.

A clean energy organization recommended that ODOE consider an Alternative Scenario for expanded OSW buildout with modeling assumptions constructed to realize a full buildout of the Brookings Lease Area off the Oregon coast. The commenter recommended NREL and other data to support this proposed Alternative Scenario. Additionally, the commenter requested that ODOE explore enhanced modeling capabilities to co-optimize offshore wind generation sea space and supply chain constraints beyond Brookings.[352] An energy organization recommended that the modeling consider a scenario with increased GETs, environmentally responsible biomass gasification of products and byproducts, captured digestion of agricultural and municipal waste streams and, per a 2020 Local Solar Roadmap Whitepaper, a relaxed procurement restraints for solar construction in COU territories.[353] Conversely, an environmental organization stated that their research has shown relatively little variation in OSW buildout between scenarios and, in any event, that the modeling should avoid spatially identifying zones for OSW development in order to avoid conflict with an upcoming OSW Road Map.[354]

Offshore wind is a technology that competes alongside other generating technologies in the model. The study did not model a dedicated OSW scenario, but ODOE examined the alternative scenarios for their effects on OSW selection by the modeling. ODOE has taken all suggestions for alternative scenarios into consideration in working with the CETI-OES Team to define which scenarios will generate the greatest learning opportunities for Oregon.

3.3.2. Alternative 2: Delayed Transportation Electrification

An individual commenter shared an interest in seeing how much additional electricity generation would be needed to meet Oregon energy objectives.[355] An environmental organization expressed support for examining a lower electrification of transportation scenario, stating that, for example, grid upgrades would be needed to build out TriMet's battery electric bus operating and maintenance facilities, and these may encounter delays.[356]

An AG member asked why only medium- and heavy-duty vehicles are constrained under the alternative and how the modeling would examine interplay of electrification infrastructure and vehicle sales.[357]

The model assumes no light-duty constraints because Advanced Clean Cars II, which is existing policy, requires that all vehicle sales are 100 percent zero emission vehicles by 2035. Under the model, associated infrastructure needs to support electrification, including Advanced Clean Cars II and Advanced Clean Trucks, are assumed to be built out and the costs are considered. The model assumes vehicle turnover rates following assumed lifetimes between 12 and 18 years, based on type of vehicle, but ODOE is mindful of the possibility that drivers may delay replacing their vehicles as a response to vehicle electrification.

[352] Pacific Ocean Energy Trust
[353] Oregon Coast Energy Alliance Network.
[354] The Nature Conservancy.
[355] G. Boulanger.
[356] The Nature Conservancy.
[357] AG 10.17.24 meeting, Rakesh Aneja, Daimler.

3.3.3. Alternative 3: Limited Demand Response

A couple of WG participants and a clean energy organization supported using an alternative scenario to examine the impacts of energy efficiency, DERs, and load flexibility.[358]

An energy advocacy organization asked how assumptions for residential EV managed charging and DR household participation were determined. The commenter stated that the draft Alternative Scenario DR adoption rate changes seem more drastic than changes drafted for other Alternative Scenarios and asked if the residential EV managed charging assumption considered IOU transportation electrification plans.[359]

> *The differences between and among all scenarios are intended to provide a useful perspective on how varying assumptions impact overall system costs. The modeling is not meant to predict the future, but to provide insights into the costs and benefits of alternative futures as compared to each other to help inform policy discussions.*

3.3.4. Former Alternative 4: Constrained Transmission[360]

A company stated that an alternative scenario should consider expanded DLR adoption to provide an accurate depiction of Oregon energy transmission going forward. The commenter suggested adopting an assumption from an RMI study of applying "a conservative average of a 10 percent uprate from the static ratings to all overloaded lines in geographies with wind speeds of more than 3 feet per second."[361]

A natural gas utility and a couple of environmental organizations expressed support for exploring a constrained electricity transmission scenario.[362] A clean energy organization expressed support for including a constrained transmission scenario. The commenter also recommended considering forthcoming publications and announcements of planned transmission projects, including an October 17 Evolving Grid BPA presentation. The commenter also recommended that the Strategy consider policies to facilitate transmission and power generation permitting.[363] A utility agreed, supporting the consideration of a constrained transmission scenario to highlight the importance of improved transmission permitting policies.[364]

> *The modeling is not constrained to building transmission identified in assumptions for construction by 2035; this project (Boardman-to-Hemingway) is assumed to be completed by 2035, but the modeling may build for additional transmission.*
>
> *Former Alternative 4, Constrained Transmission has been replaced with a new Alternative, Limited Utility-Scale Electricity Generation in Oregon. New Alternative 5, High Distributed Energy Resources + Limited Transmission, examines the impacts of limiting transmission along with increase DER buildout. For more information on these Alternatives and why they were changed, refer to the modeling assumptions and sources section on Alternative Scenarios.*

[358] Spark Northwest; Environmental Justice and Equity WG 8.27.24; Nikita Daryanani, Coalition of Communities of Color; Sarah Wochele, CUB.
[359] CUB (Alternative Scenario Comment).
[360] *Alternative 4 is now Limited Utility-Scale Electricity Generation in Oregon. For more information on this Alternative and why it was changed, refer to the modeling assumptions and sources section on Alternative Scenarios.*
[361] LineVision, LLC (Alternative Scenarios Comment).
[362] Cascade Natural Gas Corporation; Mobilizing Climate Action Together; The Nature Conservancy.
[363] Renewable Northwest (Alternative Scenarios Comment.)
[364] PGE (Alternative Scenarios Comment).

3.3.5. Former Alternative 5: Constrained Utility-Scale Renewables[365]

An individual commenter requested that the modeling's categories of protected lands should be expanded to include lands that are well-documented as hazard zones, including tsunami, earthquake fault, and liquefaction soil zones. The commenter stated that this restriction is important to human safety and generally referred to local and state planning documents as treating the Cascadia Subduction Zone of North Portland and along the Columbia River as dangerous.[366] Another individual recommended that the Strategy restrict development in national forests, Bureau of Land Management or other public lands, Tribal lands, on rivers, or near other critical natural areas such as tsunami, CSZ or liquefaction zones,[367] and an individual recommended that ODOE consider an alternative scenario that would limit refinery construction to eastern Oregon in order to mitigate earthquake risks.[368]

Energy resilience and safety are critical components to Oregon's Energy Strategy, but the model is limited in how it can reflect their value; therefore, ODOE has reviewed the modeling results with these factors in mind and will be interested in further input on these topics through Phase 2 and the development of policy recommendations. The model does not select specific sites to locate facilities; it evaluates the availability of land for energy infrastructure across the state as a percentage of the whole.

ODOE published the Oregon Energy Security Plan in September 2024 and will continue to update and improve on this plan annually. The energy security plan is focused on the siting of existing infrastructure and supporting energy resilience, security, and education. Results of the Energy Security Plan will inform the Oregon Energy Strategy Final Report.

ODOE staff evaluated the potential of crafting Oregon-specific land screens but determined we had neither time nor budget to complete that task, so we used an existing data set, The Nature Conservancy's PoP - West study. The land use restrictions we used from the study include legally protected, administratively protected, and high conservation value lands including Tribal lands, prime farmland, and important ecological areas. Improving land using screening in marine areas, wetlands, and incorporating culturally significant areas present opportunities of potential improvement in a future version of the energy strategy.

Former Alternative 5, Constrained Utility-Scale Renewables has been replaced with a new Alternative High Distributed Energy Resources + Limited Transmission. A new Alternative, Limited Utility-Scale Electricity Generation in Oregon, examines the impacts of limiting utility-scale renewables development in Oregon but, instead of relying on a more restrictive siting layer as proposed in Former Alternative 5, imposes a general 50 percent reduction in grid-scale renewables as compared with the Reference Scenario. For more information on these Alternatives and why they were changed, refer to the modeling assumptions and sources section on Alternative Scenarios.

A clean energy organization expressed support for the Constrained Utility-Scale Renewables Alternative Scenario and recommended policies to alleviate renewables permitting constraints, including amending the land use planning system to acknowledge the value of renewable energy for Oregonians and Oregon's lands and resources. The commenter also supported adding land-use constraints in an

[365] *Alternative 5 is now High Distributed Energy Resources + Limited Transmission. For more information on this Alternative and why it was changed, refer to the modeling assumptions and sources section on Alternative Scenarios.*
[366] N. Mandell.
[367] D. Meisenhelter.
[368] Better Energy LLC.

alternative scenario but asked for clarification as to the definition of lands with social, economic, or cultural value.[369] An AG member also asked for a modeling's definition of prime farmland.[370]

Discussion of existing land use policies, constraints to siting renewable energy, and potential solutions are topics for the Energy Strategy Policy Working Groups in 2025. The land use constraint dataset that we used for the energy modeling is from the Nature Conservancy PoP - West study, which provides definitions of lands with social, economic, or cultural value that were identified using data sets for scenic byways, game species hunting areas, historic sites, and more. Prime farmland is defined based on soil characteristics such as moisture and temperature regimes, pH levels, and flood risk. The data set and definition is from the US Department of Agriculture 7 CFR 657.5.

3.3.6. Former Alternative 6: Higher Hydrogen Availability[371]

An environmental organization supported examining a scenario to limit hydrogen end-use market development or provide for more expensive hydrogen, reasoning that the Pacific Northwest currently has no green hydrogen production facilities and that other barriers to hydrogen marketability are likely.[372] A hydrogen trade association expressed support for considering a higher hydrogen availability scenario but wrote that ODOE provided insufficient detail to inform comments. The trade association requested that ODOE provide details on how the modeling addresses the Inflation Reduction Act hydrogen tax credits and calculates a levelized cost of hydrogen. The commenter requested the opportunity to provide further comment as additional details become available.[373]

Hydrogen is included as a direct fuel option and as an intermediary in clean fuel supply chains. Importantly, the model does not specify a particular cost per amount of hydrogen produced. Instead, there are costs associated with each element of the green electrolytic hydrogen supply chain, including renewable energy development, electrolyzers, the transportation and storage of hydrogen, etc. Investing in these options is in competition with other emissions reduction measures in the modeling. Based on the forecasted price of electrolyzers used in the modeling, hydrogen development would be an economic option earlier than is likely feasible based on how quickly the hydrogen market would need to ramp up. Therefore, Evolved applies a national constraint in the model for the rate at which electrolyzers can be built. This favors building electrolyzers in regions that are most economic, allocating finite resources that are limited by supply chain, labor, and other constraints.

The modeling incorporates the Inflation Reduction Act production tax credits for hydrogen. The modeling includes accounting mechanisms for tax code updates, such as hourly matching, additionality, and deliverability requirements for hydrogen producers to receive the full hydrogen production tax credit. Electrolyzers that are built under the IRA (2032 and prior) can receive the 45V Clean Hydrogen production tax credit, which is likely to incentivize those electrolyzers to operate at higher capacity factors, at least until the expiration of the tax credit.

An energy advocacy organization and an AG member asked why the Higher Hydrogen Availability scenario, in contrast to the other draft Alternatives, would relax constraints on the variable to be

[369] Renewable Northwest.
[370] AG 10.17.24 meeting, Andrea Kreiner, OACD.
[371] *Alternative 6 is now Alternative Flexible Resources For more information on this Alternative and why it was changed, refer to the modeling assumptions and sources section on Alternative Scenarios.*
[372] The Nature Conservancy.
[373] RHA (Alternative Scenarios Comment).

examined rather than tightening them.[374] The energy advocacy organization expressed concern that doing so may emphasize risks and uncertainties around electrification while minimizing those for hydrogen and liquid fuels. The commenter added that green and blue hydrogen adoption would require large infrastructure buildouts and associated costs.[375] A WG participant commented to express interest in modeling a higher hydrogen scenario but expressed caution that aggressive hydrogen assumptions should not be included in the Reference Scenario because of uncertainty around the technology.[376]

> *ODOE considered a draft Higher Hydrogen Availability Alternative Scenario on the basis that hydrogen is still an emerging resource and therefore warrants a more conservative approach in the Reference Scenario. In other cases, "aggressive but achievable" assumptions are built into the Reference Scenario, since unlike hydrogen, they apply technologies that are in place in Oregon and the region today. Ultimately, ODOE, in consultation with the CETI-OES team, elected to model a No Gas Alternative Scenario for Alternative 6. Please refer to the modeling assumptions and sources section on Alternative Scenarios for more description of this Alternative and why it was selected.*

3.3.7. Alternative 7: More Aggressive Greenhouse Gas Emissions Reductions

A clean energy organization generally expressed support for considering a More Aggressive Greenhouse Gas Emissions Reductions Scenario and for modeling net-zero emissions by a reasonable date, proposing 2050.[377] An AG member agreed, stating that the Strategy could consider relevant factors such as affordability and practicability while considering a more-ambitious scenario;[378] the member, another AG member, and several WG members urged that the Strategy and Oregon energy policy need to act quickly to address climate needs.[379] Another AG member supported the scenario, stating that Oregon Climate Action Commission modeling has shown more aggressive GHG reduction scenarios to have greater net benefits.[380] An AG member stated that an aggressive GHG reduction scenario could help identify barriers to decarbonization and help Oregon incorporate learnings from policy goals in California.[381]

A couple of AG members recommended postponing examination of a more aggressive GHG reduction alternative scenario to a future iteration of the Energy Strategy.[382] One of the AG members commented with the perspective that existing Oregon emissions reduction goals are already ambitious and best accommodate a common direction for the Energy Strategy.[383] Another AG member agreed that the Strategy should avoid focusing on an aggressive GHG reduction scenario because of state growth projections.[384] A WG member generally agreed that existing Oregon GHG goals are already ambitious.[385]

A survey of LS participants indicated a split of one, five, six, and 13 expressions from no, little, some, and strong interest in exploring a more ambitious GHG emissions reduction goal, respectively. Overall, more

[374] CUB; AG 10.17.24 meeting, Charity Fain, Community Energy Project.
[375] CUB.
[376] Transportation WG 8.8.24; Indi Namkoong, Verde.
[377] Renewable Northwest.
[378] AG 8.14.24 meeting, Charity Fain, Community Energy Project.
[379] AG 8.14.24 meeting, Charity Fain, Community Energy Project; Andrea Kreiner, OACD; WG 8.22.24 Carra Sahler; Jess Grady-Benson, Rogue Climate.
[380] AG 8.14.24 meeting, Laura Tabor, TNC.
[381] AG 8.14.24 meeting, Jeff Hammarlund.
[382] AG 8.14.24 meeting, Elaine Prause, Energy Trust of Oregon; Tucker Billman, ORECA; Shannon Souza, Sol Coast Consulting & Design.
[383] AG 8.14.24 meeting, Tucker Billman, ORECA.
[384] AG 8.14.24 meeting, Joshua Basofin, Climate Solutions.
[385] Direct Use Fuels WG 8.6.24, Sharla Moffett, Oregon Business and Industry.

participants expressed interest in exploring a more ambitious goal than were disinterested in doing so.[386]

Given the range of responses to this topic, ODOE decided against modeling a more ambitious greenhouse gas reduction goal. ODOE will consider exploring more ambitious GHG reduction objectives for updates to the Energy Strategy.

4. Comments on Complementary Analyses

General Comments on the Complementary Analyses

An energy advocacy group requested that ODOE extend the comment period to Monday, December 2, 2024. The commenter also asked that ODOE clarify whether, when responding to the request for feedback on geospatial mapping, that commenters should prioritize items listed in Appendix A or select a few, and, if so, how many.[387]

In response, ODOE extended the comment period from November 27 to noon, December 2, 2024.

Several WG members expressed general support for the CETI-OES' proposed approach for the complementary analyses and appreciation for ODOE and CETI-OES' incorporation of stakeholder feedback.[388]

A utilities organization recommended breaking out Energy Wallet, as well as Geospatial Mapping and Air Quality modeling, to examine IOU and COU territories distinctly. The commenter recommended this distinction because of:

- Differing economic circumstances between COU and IOU territories;
- Resource development impacts in COU territories leading to localized AQ impacts; and
- Differences in COU and IOU electricity generation technologies and associated carbon emissions.

The organization stated that, because of these circumstances, different policy approaches will be needed for COU and IOU territories and distinct technical analysis findings needed to support development of those policy approaches.[389]

Energy Wallet

A joint submission from a few energy advocacy organizations requested clarification as to how the energy pathways modeling and energy wallet analysis relate, and, specifically, whether the representative customer groups would be included as a modeling demand-side input, or how the model's "sectoral sub-groups" (e.g., residential heating, commercial lighting, personal transport) would be transposed onto the Energy Wallet customer groups. The commenter also asked if the customer groups would be the same for the modeling's eastern and western Oregon regions.[390]

An individual commenter, an energy advocacy organization, and a Tribal organization expressed support for analyzing the following groups in the energy wallet analysis: Homeowner,[391] High Priority Area

[386] Listening Session 7.31.24, morning and evening.
[387] CUB.
[388] Environmental Justice and Equity WG 12.18.24 meeting; Christina Zamora, KLCAS; Sarah Wochele, CUB; Lisa Arkin, Beyond Toxics.
[389] PPC.
[390] CUB, Community Energy Project, NW Energy Coalition.
[391] J. Belcher; KLCAS; Energy Trust of Oregon.

Homes,[392] and Weatherization;[393] two of the commenters organization also recommended Low-income Renter Multifamily,[394] Average Renter, [395] and the Tribal organization recommended Manufactured Homes,[396] while the energy advocacy organization recommended Rural Homes.[397] The energy advocacy organization stated that it selected the five customer groups as representing a broad portion of Oregon households and characteristics in common with the remaining four customer groups. The commenter cautioned, however, that the Energy Strategy not rely too heavily on the energy wallet analysis and, where appropriate, use the analysis as a basis for identifying further research needs. The commenter recommended that future research dig into "climate zone, current heating/cooling equipment efficiency and fuel type, household size and type (single family, multifamily, manufactured home), number of occupants, building age and weatherization, and occupant energy usage behaviors" as factors affecting consumer energy costs. The commenter expressed support for the proposed energy wallet analysis and Phase 2 workgroup design as a means for engaging stakeholders and addressing issues raised by the energy wallet analysis.[398]

A joint submission recommended that the selection of energy wallet customer groups balance diversity and specificity in order to reflect the experiences of as many Oregonians as possible. The commenter recommended Rural Manufactured/Mobile Homes, Willamette Valley Urban Single-Family Homeowners, Low-Income Renter Multifamily, Rural and Harsh Climates, and Tribal customer groups to capture groups' vulnerability to energy pricing changes, climate conditions, income, and increased fuel costs for reliance on wood- or kerosene-heating.[399]

A utility also provided input on how the energy wallet analysis should be used to support the Energy Strategy, stating that the analysis should: 1) identify households that should be provided assistance in the energy transition, and, to do so, should select customer groups that both reflect the largest number of Oregonians and that represent low-income and marginalized groups, and 2) identify housing types that, if promoted via public policy, can help minimize energy transition-related hardships. To the latter purpose, the commenter recommended that CETI include a customer group for new, multifamily housing.[400] An AG member also expressed interest in whether, and to what extent, High-Priority Area homes overlap with other customer groups.[401] Another AG member asked whether Tribal communities are reflected in Energy Wallet customer groups[402] and an AG member asked if and whether geospatial mapping efforts could help identify overlapping groups.[403]

The Tribal organization also requested clarification as to whether Rural Home, Coastal Home, High Priority Area Homes, and Weatherization customer groups are owner-occupied and whether duplexes and triplexes are considered Multifamily.[404]

A Tribal government recommended providing distinct customer groups for rural customers and remote customers, the latter of which are more dependent on conventional liquid fuels and travel more miles

[392] J. Belcher; KLCAS; Energy Trust of Oregon.
[393] J. Belcher; KLCAS.
[394] J. Belcher; Energy Trust of Oregon.
[395] J. Belcher; KLCAS; Energy Trust of Oregon.
[396] KLCAS.
[397] Energy Trust of Oregon.
[398] Energy Trust of Oregon.
[399] CUB, Community Energy Project, NW Energy Coalition.
[400] EWEB.
[401] AG 11.20.24 meeting, Laura Tabor, TNC.
[402] AG 11.20.24 meeting, Rebecca Smith, RHA.
[403] AG 11.20.24 meeting, Andrew Mulkey, 1000 Friends of Oregon.
[404] KLCAS.

for basic services. The commenter requested that a full analysis, including an Analysis of Variance, of all nine customer groups be provided to the AG.[405]

An AG member expressed concern that no representative customer group represents propane-using customers[406] and an AG member asked why the energy wallet analysis appears to assume that all single-family residential customers rely on natural gas.[407]

Energy Wallet: COUs and IOUs

A utilities organization urged that the Energy Wallet analysis should provide for distinct IOU and COU customers on the basis of:

- Lower income in COU-served regions;
- Lower energy costs provided by COUs; and
- The impact of COU governance structures on the energy costs;
- Differing needs for clean energy build-out; and
- The impacts of breaching LSRDs to COU customers.

The commenter also stated that more localized information is needed to reflect energy costs in Oregon because of differing costs and emissions for hydropower and how those factors impact IOUs and COUs differently.[408] An AG member generally agreed that IOU and COU impacts should be analyzed distinctly, also emphasizing the importance of considering Columbia and LSRD dams.[409]

A utility agreed that it would be helpful to examine energy wallet impacts to COU and IOU customers, agreeing that — because of the lack of a profit incentive for COUs and their reliance on hydropower — COUs provide lower costs with less emissions than IOUs. The utility reasoned that, because of these differences in structure, consumer costs, and emissions, the Energy Strategy may want to recommend replicating the COU model. The commenter provided a chart illustrating rate differences between COUs and IOUs to support their position.[410]

The utility recommended a few approaches to distinguish COU and IOU customer groups in the energy wallet methodology: including explicit COU and IOU customer groups; assuming that all groups are IOU customers and reducing expected costs by a percentage to reflect COU customers; and modeling each of the five selected groups as both a COU and an IOU customer.[411]

Air Quality Modeling

A Tribal government expressed general support for the proposed approach to Air Quality modeling.[412]

A WG participant asked if the Air Quality modeling would examine indoor air quality impacts, such as impacts from gas heating or cooking.

> *CETI-OES' Air Quality modeling is based on EPA's Co-benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) and is unable to model indoor air quality impacts. The*

[405] CTUIR.
[406] AG 11.20.24 meeting, Bryan Adams, CoEnergy Propane, LLC.
[407] AG 11.20.24 meeting, Charity Fain, Community Energy Project.
[408] OMEU.
[409] AG 11.20.24 meeting, Tucker Billman, ORECA.
[410] EWEB.
[411] EWEB.
[412] CTUIR.

energy pathways show changes in household technologies that may be used to qualitatively assess some indoor air quality impacts.

Geospatial Mapping

A few commenters, including a Tribal government and an individual commenter, expressed general support for the proposed approach to geospatial mapping.[413] A Tribal organization recommended adding Percent of Individuals Receiving Medicaid benefits and Percent of Individuals Receiving Social Security Disability Income as variables to be considered in geospatial mapping.[414] A joint submission recommended that geospatial mapping prioritize race, ethnicity, language, income, poverty, and education levels to provide an equity lens to geospatial mapping.[415]

An energy advocacy organization recommended that ODOE consider postponing the selection of geospatial mapping variables until stakeholders have had an opportunity to comment on the modeling, Energy Wallet, and Air Quality modeling analyses outputs, stating that discussion of these topics will help surface questions that geospatial mapping could help resolve. The commenter also recommended producing an interactive map on the basis of the modeling's final datasets to assist stakeholders in future work.[416]

An AG member asked if geospatial mapping data were available to analyze wildfire-related air quality impacts, reasoning that this information could be helpful in distinguishing where air-quality impacts result primarily from energy generation.[417]

5. General Comments on Phase 2

An AG member asked how ODOE would be incorporating stakeholder feedback in developing Energy Strategy recommendations, whether through feedback on the modeling results, voting on recommendations, or through the WGs. The AG member also asked how reliability would be factored into the selection of recommendations.[418]

ODOE will consider all input provided during Phases 1 and 2 in drafting recommendations for the Oregon Energy Strategy. This includes input from the Advisory Group, Working Groups, other state agencies, listening sessions, and written comments. These recommendations will be published for comment in June 2025 and finalized in response to commenter feedback for the November 1 Oregon Energy Strategy Report.

The energy pathways modeling approximates reliability needs, including rules of thumb for capacity needs and energy-limited resources that include generator and transmission outage rates, load forecast error, availability of renewable resources, and energy storage contributions. Reliability requirements in the model adapt in each model year to account for the quantity and location of renewable resources built by the model, the size and flexibility of load, and the type of transmission and generation resources constructed. Similarly, policy discussions will serve to advance options for realizing a reliable, affordable, and clean energy system that aligns with Oregon's energy policy objectives.

[413] CTUIR; J. Belcher.
[414] KLCAS.
[415] CUB, Community Energy Project, NW Energy Coalition.
[416] Energy Trust of Oregon.
[417] AG 11.20.24 meeting, Bryan Adams, CoEnergy Propane, LLC.
[418] AG 11.20.24, Jennifer Joly, OMEU.

An AG member asked if, in recognition of the recent federal election, space should be provided to consider how the change in administration may affect the Energy Strategy.[419]

Discussion of changing federal policies is within the scope of Phase 2 policy discussions and will inform the Energy Strategy.

[419] AG 11.20.24, Jenn Bies, Port of Portland.