Oregon Energy Strategy
Low-Carbon Fuels Policy Working Group

Meeting 2

Feb 19, 2025, 9:00-12:00

Post-Meeting Notes

Meeting Summary

Michael Freels (ODOE) presented on four key findings of the energy pathways modeling to inform the policy discussions of the Low-Carbon Fuels Policy Working Group (PWG). These findings pertain to low-carbon fuels, dispatchable capacity, electrification, and declining fuel demand. Michael and Jessica Reichers (ODOE) moderated digital whiteboard exercises for PWG members to brainstorm barriers and issues related to the four key findings and pathways presented by the modeling. ODOE is reviewing the discussions and brainstormed materials from the PWG to prepare for Meeting 3 of the Low-Carbon Fuels PWG, which focus on discussing existing Oregon policies related to the issues and barriers brainstormed in this Meeting 2 and on considering findings from the air quality and Energy Wallet analyses relevant to this PWG.

In-Meeting Notes

Participants

ODOE	Oregon Agencies	PWG Members
Michael Freels	Bill Peters, DEQ	Rebecca Smith, RHA
Hugh Arceneaux	John Tokarczyk, ODF	Devin McGreal, CNGC
Edith Bayer	Matt Steele, DEQ	Antonio Machado, WSPA
Joni Sliger	Morgan B Schafer, DEQ	Pam Neild, BPS
Joshua Price	Nicole Singh, DEQ	Brittany Park, NWN
Jessica Reichers		Carra Sahler, GEI
Lauren Rosenstein		Cassandra Jackson
Mary Kopriva		Cory-Ann Wind
Jillian DiMedio		Dave Vant Hof
Alan Zelenka		John Garrett, CUB
Amy Schlusser		John Plaza, SkyNRG
Anne Thrall-Nash		Michael Graham, Clean Cities
Rob Del Mar		Sam Wade, Coalition for RNG
		Sharla Moffett, Oregon Business and Industry
		Tim Miller, Oregon Business for Climate
		Tom Pardee, Avista

Introduction

- Michael Freels (ODOE) introduced ODOE staff and pointed Policy Working Group (PWG) members to Joshua Price for technical assistance. Michael also stated that this and other public meetings are recorded
- Michael introduced WebEx functionality and stated that ODOE's public comment portal for the Energy Strategy remains open
- Michael asked that PWG members introduce themselves in the chat

PWG Plan and process:

- Michael went over meeting structure for Low Carbon Fuels PWG, with four meetings planned to cover low carbon pathways, barriers, strategies, and policy actions sequentially
- Modeling office hours; Michael stated that office hours are scheduled for additional modeling questions. Michael asked that, to the extent they have modeling questions during policy discussions, PWG members frame them in a policy context.
- Michael highlighted 3/12 upcoming meeting to present complementary analyses results
- Michael went over the agenda for this meeting, with time dedicated to discussing barriers relevant to low-carbon fuels, dispatchable capacity, and electrification
- Jessica Reichers (ODOE) explained that she would be acting as facilitator for the present call and the group agreements of the PWG, asking that PWG members hold space for differing perspectives.
- Jessica reviewed guidance for the meeting, explaining how various factors should inform policy discussions. Jessica asked that PWG members speak up when they notice disagreement with other raised perspectives

Key findings

- Michael presented on four key findings from the modeling for the low-carbon fuels PWG.[1]
- Key findings include
  - 1. Low-Carbon Fuels: Low-carbon fuels are an increasing proportion of Oregon's energy supply across all scenarios.
  - 2. Dispatchable Capacity: More capacity from low-carbon fuel gas plants is needed to support the growing electric grid.
  - 3. Electrification: Electrification is more cost effective than adopting low-carbon fuels in many applications.
  - 4. Declining Fuel Demand: Fuel demand declines but fuel remains a significant component of Oregon's Energy System across all scenarios.

Key Finding 1

- Low-carbon fuels:
  - All scenarios modeled show an increase low-carbon fuel consumption through 2050
    - David Van't Hof asked: Does the modeling break out what the LCF are used for?

[1] These key findings are available in greater detail at https://www.oregon.gov/energy/Data-and-Reports/Documents/OES-Low-Carbon-Fuels-Key-Findings.pdf.

- Michael went over slide showing direct use fuels in differing end uses; the model shows a significant decline in fuel use in commercial and residential buildings, but the industrial and agricultural sectors retain most of their fuel use and transition to a variety of low carbon fuels. The retention of fuel-use in these sectors is driven by the feasibility of electrifying end-uses
- Relatively few low-carbon fuels were selected to be produced in Oregon; the modeling showed increasing imports of e-fuels in Oregon
- Oregon low-fuel consumption; Michael showed that low-carbon fuel consumptions is increasing
- Categories of low-carbon fuels include:
  - Blended fuels: fuels that are added to petroleum fuels to reduce emissions like ethanol or biodiesel
  - Zero-carbon tailpipe fuels which may have upstream emissions; hydrogen, for example
  - Renewable fuels, lower carbon versions of current fuel like renewable diesel or gasoline
- Oregon Low-carbon fuel production
  - Michael explained that Oregon produces in-state biodiesel and ethanol, but has not seen significant growth in in-state production; there is opportunity for renewable natural gas, methane captured from agricultural or municipal waste and wastewater, refined, stored, and then used as a natural ga
- National biofuel production
  - Michael showed a slide indicating increased biodiesel production in the last few years. Michael stated that California and Washington have plants and that biodiesel can serve as a drop-in low-carbon fuel replacement for currently used fuels. Michael stated that there is high demand but limited supply for biodiesel in Oregon.
- Hydrogen production
  - Michael stated that there is a planned PNWH2 hub, a collaboration between WA, ID, and OR following federal funding; planned for h2 pipelines, electrolysis, and other. These are expected to accelerate h2 production in Oregon

Key challenges

- Jessica described challenges identified by Oregon, including:
  - There are many options for low-carbon fuels, each with benefits and challenges.
  - The timing for electrification of end uses like vehicles will have implications for what low-carbon fuels are needed and when.
  - How do we determine the best low-carbon fuel options and what to invest in.

- Jessica asked if PWG members had questions on modeling results or key challenges
  - Brian Adams, PPGA; q on modeling. Modeling appears to determine that h2 the solution of choice for clean fuels; wonders why h2 has been elected as a solution versus alternatives
    - Jessica; ODOE did not select h2 as a solution but it was found by the model as the least cost solution, but there is uncertainty to this finding. Would like to

focus policy discussion around barriers/challenges to relying on h2, such as those Brian alludes do in his question.

- Sharla Moffett, appreciates Michael's response; wants to understand what kind of investment are being contemplated by the state towards low-carbon fuels
  - Michael says current meeting objective is to identify barriers to realizing modeled pathways; later meetings can focus on policy recommendations/proposal
- Dave Van't Hof; thinks an issue with the modeling is a lack of available data and a tendency to select a single option, such as h2, as opposed to an all-of-the-above solution. Dave states that a slide presented on fuel production in Oregon as flat-lining or barely increasing line is unrealistic. Dave also thinks the Strategy needs to focus on what actions need to be taken in the interim, towards 2030 and 2035 goals, rather than towards 2050
  - Michael agrees that the modeling has limitations and that part of the Phase 2 policy discussions will be addressing areas where the modeling does not provide full context

Key Finding 1: Whiteboard Activity

- Michael went over instructions for a Miro whiteboard brainstorming activity.[2]
- The PWG brainstormed issues and barriers related to reducing fuel demand under categories of consumer behavior, cost/affordability, infrastructure, and supply.
- Jessica Reichers moderated a discussion of items raised in the brainstorming activity.
  - Cost as a supply barrier
    - Antonio Machado, Western States Petroleum Association:
      - When identifying barriers; as other states increase demand for low-carbon fuels, Oregon will face challenges importing low-carbon fuels because of low production in Oregon. This will increase costs for LC fuels. Interstate competition
    - Michael Graham via chat; a barrier to relying on higher ethanol blends is that vehicles cannot use them
    - Tim Miller; when considering interstate competition, why not think of this as a market generally, where increased demand would lead to increased supply? Wonders if Antonio is emphasizing that in-state supply is vital for in-state costs
    - Antonio; fossil fuels are more abundant but raw materials for LC fuels is more constrained because of material inputs and capital infrastructure.
    - Antonio is also concerned about international market barriers and tariffs impacting which resources are affordable/feasible
    - Michael Graham; thinks state-level credit prices impact renewable diesel market. So, states with highest credit prices affect where renewable diesel goes; if WA has a stronger credit price, what happens to Oregon's supply?

[2] The whiteboard is archived and available for viewing at Low Carbon Fuels PWG Meeting 2-19 - Miro. The final whiteboard results are also transcribed below.

Key finding 2: Firm dispatchable resources needed to supply electricity grid

- Michael explained that the model chose to build new, small, clean-fuel burning plants for system reliability purposes. The model examined a scenario when constructing these plants would not be viable, finding that such a scenario would increase system costs.
- Jessica went over key challenges related to this finding;
  - There are limited resources producing biogas and hydrogen today.
  - There is a great deal of economic and technological uncertainty around the development of clean hydrogen and biogas resources and infrastructure.
  - Siting new electricity generation plants will be challenging.
- Carra Sahler question; how did the modeling consider storage?
  - Edith; the model found that batteries are only cost-effective to invest in batteries if they're run often. Gas plants are cost-effective because they're inexpensive to build but expensive to run, based on fuel costs. As long as they don't need to run often, these gas plants are a more economic choice than batteries.
  - Carra; did the modeling include costs to build these new thermal plants?
  - Michael: yes. The modeling called for retaining a majority of existing gas plants and building additional, small plants for reliability needs.
- David Vant Hof; there are both short and long-term energy needs
- Tim Miller question; the Alternative Scenario with less buildout of short-term gas plants called for more renewable energy generation in order to produce hydrogen, correct? Wonders if the model has comprehensively addressed uncertainty and infrastructure costs associated with hydrogen
  - Michael: Yes; the hydrogen cost curves were based on NREL data and includes infrastructure costs. However, ODOE recognizes that there is uncertainty associated with hydrogen cost projections
  - Sharla Moffett and Michael Graham likewise expressed concern that the modeling addressed the infrastructure and permitting costs associated with hydrogen development

Key Finding 2: Whiteboard Activity

- Jessica Reichers moderated review of brainstorming activity. Jessica reflected that PWG members have raised questions on data and cost inputs to the modeling. Jessica asks if a deeper dive should be done to highlight what costs are more or less certain and whether there's opportunity to supplement the modeling data
  - Brittany Park recommends that the Strategy promote policies that provide flexibility to address this cost uncertainty, such as setting goals and allowing the market to solve for developing conditions
  - Bryan; we should consider solutions in this PWG that were not fully reflected in the modeling, AG discussions, especially with respect to alternatives to hydrogen. Expressed concern that the modeling was biased towards hydrogen.
  - Brittany Park; price and cost uncertainty is a barrier for utilities wanting to make investments

- Rebecca, RHA; understanding that process is focused on identifying barriers and tradeoffs. How should tradeoffs be incorporated in the strategy that the modeling couldn't address?
- Jessica; agrees, says considerations around energy resiliency, environmental effects, other factors should be taken into account to supplement the model's cost-optimized findings
- John Plaza; thinks mapping the value of renewable natural gas (RNG) as a short-term resource and feedstock for transportation fuels is missing. Both renewable diesel and sustainable aviation fuel are able to be made in significant volumes from RNG. Thinks RNG is low a hanging fruit opportunity that's already in existence under the Washington Cleanfield standard and that incentives like those in California for increased anaerobic digestion RNG production should be explored.
- Sam Wade: RNG is challenging because it creates methane reductions in the waste sector and agriculture and uses that methane for a variety of end-uses; there's a challenge in this in determining which sectors incentivize or pay for RNG production. Believes that in the near term the focus should be on just achieving the methane reductions and getting the gas in the pipeline, and then you can shift the gas toward the hard to electrify sectors over time; those hardest to electrify sectors may be trucking or aviation or something else.

Key Finding 3: Electrification is more cost effective than adopting low-carbon fuels in many applications

- Michael presented on the modeling findings regarding electrification for end-uses that currently use fuels; the model calls to fully electrify the light duty fleet and much of the medium and heavy duty vehicle fleet by 2050, with low carbon fuels supporting aviation, rail, maritime, and all conventional vehicles that remain in the vehicle stock through 2050 across all sectors
- The modeling examined an Alternative Scenario that would delay electrification and found that doing so would increase system costs for Oregonians
- The modeling also called for increased electrification in buildings and reliance on electric heat pumps for heating and cooling
- Key challenges for Key Finding 3 include:
    - Fuel providers would be operating in an environment with declining fossil fuel demand.
    - Costs to maintain existing fuel systems would be supported by fewer customers/ratepayers, with potential implications for consumer costs.
    - Existing fuel infrastructure, such as gas stations, underground storage tanks, fuel depots, and pipelines could be at risk of becoming stranded assets.

Key Finding 3: Whiteboard Activity

- Jessica Reichers moderated a discussion of the brainstorming activity
    - Workforce
        - John Plaza emphasized that workforce development is a need for all aspects of the clean energy transition, especially in Eastern Oregon

        - Michael Graham emphasizes importance of right-to-work,, the ability to repair equipment, especially in rural communities that may have limited access to licensed or centralized repair enterprises
    - Bryan Adams: for the propane industry, providing for the transition to rely on renewable feedstocks is an unmet need; instead, discussion talks too much of migrating away from currently-used fuels entirely. Providing certainty for Oregon farmers that a market will be available for feedstock to produce renewable hydrogen would be valuable, especially for crops suited for this purpose such as Camelina Sativa.
        - Jessica Reichers expresses appreciation for Bryan's comment and notes that more renewable propane is being produced in Oregon based on recent data
    - John Garrett; from CUB's perspective and consumer protection, there is more certainty around producing proven, renewable scale electricity versus uncertainty around renewable fuels. With distribution infrastructure, investments for direct fuel distribution last 50+ years, so it would be risky for ratepayers to make 50-year investments in direct fuel use, relative to electrification. John Garrett thinks, from residential ratepayer side, the least-cost, least-risk solution is electrification
        - Bryan Adams states that his organization has ongoing conversations with their customers as to how to future-proof new homes and constructions. Bryan recommended that energy wallet modeling effort reach out to direct-use fuel providers for data.
        - Jessica asks where propane serves; Bryan, rural areas where natural gas isn't available
        - Michael Graham, Clean Cities; for purposes of electrification, current policy framework doesn't support piecemeal steps towards decarbonization; thinks policies should be directed towards supporting more stepwise improvements
        - Michael Graham also stated that challenge of increased electricity demand from vehicle electrification has not yet been grappled with by many stakeholders because other barriers, such as vehicle range and cost, are more immediate

Key Finding 4: Demand declines but fuels remain a significant component of Oregon's Energy System in all scenarios

- Michael presented on 2022 transportation fuels used in Oregon; Michael also looked at 2023 renewable diesel production as growing to now exceeding biodiesel production
- Michael presented data on direct use fuels in Oregon in 2022
- Michael explains that population growth has historically led to related direct use fuel consumption

Key Finding 4: Whiteboard Activity

- Michael emphasized that it'll be valuable to focus on near-term barriers and policies in the context of the Energy Strategy, especially because of the uncertainty facing low-carbon fuels in the longer term
- Brittany Park reiterates that the biggest barrier Northwest Natural faces is cost-uncertainty and uncertainty regarding policy in the future to support investments

- Cory-Ann Wind; it's difficult to capture uncertainties between global, national, and state-wide policies; thinks there's enough technology, feedstock, and infrastructure, but the biggest question mark is market certainty. Example; renewable liquid propane gas versus, renewable gasoline, diesel, etc; which should be produced? With so many options, what is being selected for production? Is it renewable aviation fuel? It can depend on tax credits and political factors. Cory-Ann worries that no one state or policy could address this uncertainty
- Jessica asks if there are areas that need further study
- Cory-Ann thinks policies complementary to clean fuels program, or expanding the clean fuels program beyond transportation, could be helpful, because of the outsized role the clean fuels program has on promoting low-carbon fuels production. Doesn't think the Washington Clean fuels program is the only viable way forward
- Jessica asks what are barriers to bringing renewable diesel into Oregon;
    - There's competition for renewable diesel in WA and CA; what are barriers to OR being competitive in that market?
    - Cory-Ann says market for renewable diesel could become saturated; thinks electrification in California then could lead to those facilities providing fuel for Oregon or to producing SAF. Cory-Ann thinks similarly for WA facilities, but that Midwest/Gulf Coast areas produce fuels for the west
- Antonio Machado
    - Refineries are expensive and difficult to permit; its more viable for some refineries to exit the market rather than produce renewable fuels.
    - No infrastructure can transfer fuels from Midwest to West; there's no incentive to transport
    - Wants to be clear about ramifications of policy and how they could affect current capital
    - Antonio thinks in-state capacity is valuable in face of market uncertainty
- Brittany Park
    - The supply of RNG is abundant; the main barrier is policy, regulatory prices, and regulatory certainty

Next Steps

- March 14 meeting agenda will be to:
    - Share information from other PWGs
    - Go over complementary analyses
    - Discuss existing Oregon policies
    - Review issues and barriers
    - Brainstorm potential policy solutions
- Michael invited PWG members to email further thoughts to him or submit through public comment portal

    - Asked that PWG members consider existing barriers and needed policy in advance of next meeting
- Michael shared the public comment portal and thanked the PWG members for their participation

Virtual Meeting Chat

Unfortunately, the chat data from this meeting did not save properly and is not available.

Miro Whiteboard

Below is a transcription of the feedback received on in the 2/19/25 Miro Whiteboarding activity. The whiteboard is also available for review at: [Low Carbon Fuels PWG Meeting 2-19 - Miro]

Whiteboard Q1

Question 1: Demand Declines *What are the primary issues or barriers to reducing fuel demand?*	
Consumer Behavior • For EVs to become a viable solution for rural Oregon, significant increases in EV infrastructure are needed. Almost no EV infrastructure is outside of the major urban centers of the state. This will prevent wide spread adoption with consumers outside in rural Oregon • I don't think that fuel demand will decrease, before any true transition there will be an increase before there is a decrease if fuel demand was to decrease there would not be an incentive to produce and we would see plants shutting down and find a true lack of fuels to support a transition • In order to decrease demand, energy must first be readily available to everyone. Otherwise, there will not be an equitable approach to energy distribution • confidence in electric vehicles including getting to cost parity and intercity charging • Behavior change is long, slow, and expensive and typically isn't well funded. • lack of availability and reliability in rural areas • and is often word of mouth--folks rely on their neighbors, relatives and friends • Investment costs compared to existing use • lack of resources to support energy efficiency/building electrification in COU territory • Transit availability, frequency, and walkability of cities	***Cost/Affordability*** • IOUs focused on investments that provide ratebase • Dedicated clean energy production that is allocated to EV/transportation use - keeps cost down and prevents Tech from taking all the clean energy produced in the state • Constant changes to policies, such as incentives, driving cost fluctuations • multi-state IOU used to delivering ee using its own teams • Providing more certainty for rate recovery to utilities and other entities willing to invest in renewables. • Upfront costs of vehicles and infrastructure for EVs • uncertainty around federal policy supporting EE and DER • Public charging costs are increasing; Utility rate increases jeopardize the economic value proposition of EVs, especially for MD/HDs
Infrastructure • Charging availability, especially in lower-income communities where investment is lacking • Policy issue of what to do with all the out-dated infrastructure as we transition off. May need public funding for some decommissioning as companies	***Supply*** • Timely adjustments to the OR LCFS so credit prices don't collapse with increasing supplies of low carbon fuels. This has been a significant issue for CA and is hindering investment due to volatility of credit prices.

exit markets. What to do with old gas stations -- and envir remediation. • Infrastructure costs. specifically in rural areas • Charging at work lacking • If you disregard the oil and gas industry now and make it impossible for them to do business they will go to another more frielndly place and will benefit other states than the west coast • concerned about gas station franchises (many small businesses) and their futures • TE charging will largely rely on private charging companies; uptime and repairs may be problematic and undermine trust	• Supply would decrease with lower demand, at this point there is a potential to lose refineries in the west coast and that would hurt demand and definitely increase costs
Other *No stickies added*	

Whiteboard Q2

Question 2: Low Carbon Fuel Development ***What are the primary issues or barriers to increasing low carbon fuel demand and production?***	
Supply	***Demand***
• No existing fueling network for some fuels, like H2 • for low carbon fuels, the more demand from other states the less availability. • State carbon emission policy are too narrow/ prescriptive - focusing on specific methods for decarbonization rather than setting goal-oriented or performance-based targets. This limits innovation and adaptability to market changes. • Need more instat production of low carbon fuels • Short-term policy changes (ie, tax credits) impact business decisions to invest in production capacity or allocate supply to Oregon • Existing Infrastrucutre, • SAF supply and specific SAF policies needed to supply aviation • Power generation and transmission costs/availability for creation of H2 • Cost • There are many options for low-carbon fuels, each with benefits and challenges.	• Meeting the education needed for adoption among business, consumers, etc. -- COST and resources for providing that education • Hand-holding for folks (business, other) as they deal with decisions and adoption issues • Availability of vehicles • Hard to decarbonize sectors such as aviation and heave trucking • Cost of new vehicles for EV/FCEV • Competition from other sectors such SAF v. RD for vehicles • Need more policies shifting use to low carbon fuels such as City of Portland fuel policy • My energy advocacy is focused on the residential building sector. It's uncertain that direct fuel use, through natural gas utilities, will be competitive with electric options. This makes long-term investments in gas distribution system infrastructure today, risky. There is kind of a fork in the road, where some level of commitment to gas or electric long-term investment is needed. Making long-term investments in gas and electric distribution infrastructure simultaneously, without knowing direct fuels will be affordable/available, puts too much burden on ratepayers. • Creating models and decision tools for folks to understand whether to electrify or adopt a LCF solution

Feedstock	***Cost/Affordability***
• Over the long term, competition for very low CI biofuel • RNG: many feedstocks in Oregon are not economical to develop due to infrastructure gaps, such as dairy manure being plentiful in Tillamook Co. but no natural gas pipeline infrastructure exists for interconnection. This contrasts to CA where pipeline infrastructure is widespread and dairy RNG development is more similarly more widespread. • Competition for fuels among different end uses - RNG and H2 for NG utilities as opposed to transportation. • Uses of RNG beyond direct fuel and/or electricity production	• Clarity around Oregon's desire to incur costs through programs such as SB 98 and how those costs will be evaluated for prudence • Addressing the upfront cost of new technologies even if they save money in the long term • Cost Constraints in policies enabling and encouraging low carbon fuel utilization • Cost of transition – ie. RNG is very high cost for fleet, where RD is drop in with existing equip. • Providing more certainty for rate recovery to utilities and other entities willing to invest in renewables. • H2 infrastructure is incredibly important to understand and quantify as a transportation fuel. No existing infrastructure is present for transportation and storage of H2. This is a massive barrier to H2 as a fuel source • Funding Incentives
Other	
• Having objective facts available for policy makers (versus just info coming from competing solutions) as they make decisions • Opportunities to decrease overall consumption of fuel, like public transportation, should be higher priority	

Whiteboard Q3

Question 3: Dispatchable Resources to Support the Electric Grid *What are the primary issues or barriers to using fuel as a dispatchable resource for electricity generation?*	
Siting Facilities	***Cost***
• Transmission line infrastructure to support new siting facilities • Mobility of clean fuel inventory between siting facilities • integrating geothermal and TENs systems • Will the ZCF be produced on site or sited separately from existing gas plants • Environmentalists • footprint of these facilities and ability to permit and site • overuse of eastern resources for western benefit • H2 storage and pipeline infrastructure is extremely difficult infrastructure to permit. H2 production will most likely occur in eastern part of state. Yet it has to be transported and then stored in urban environments. Imagine the opposition that will occur with large H2 storage at PDX for example • Land use concerns - how up-to-date are the designations of "high-value farmland," are there places where we can colocate ag and clean energy production?	• Near term costs and availability of LC fuel types (relative availability of RNG and propane vs H2) • RNG feedstock development barrier: many feedstocks in Oregon are not economical to develop due to infrastructure gaps, such as dairy manure being plentiful in Tillamook Co. but no natural gas pipeline infrastructure exists for interconnection. This contrasts to CA where pipeline infrastructure is widespread and dairy RNG development is more similarly more widespread. • lack in duel system planning • Production of H2 using renewable energy requires consideration of 100% usage of electrolizer. Less than 100% usage of electrolizer leads to massive increases in H2 production due to capex • Cost of building out the infrastructure of moving H2 around as part of this solution (piping, trucking, liquifying?, etc.) - not sure this is all fully in the model • bill impacts to consumers

	• Clarity around Oregon's desire to incur costs through programs such as SB 98 and how those costs will be evaluated for prudence • Providing more certainty for rate recovery to utilities and other entities willing to invest in renewables. • Even if these infra costs are full in the model, what business model and policy / regulatory framework will they need, and will there be political will to support these? e.g. will we be creating new utilities? • funding incentives • Selection of LC fuel types in face of cost uncertainties • H2 production requires massive increases in cheap/firm/renewable energy to truly be low-carbon H2 • Costs associated with electric grid reliability and power outages • Land use concerns - how up-to-date are the designations of "high-value farmland," are there places where we can colocate ag and clean energy production? • There are limited resources producing biogas and hydrogen today. • efuels (co2 +h2) require significant increases in low cost/firm renewable energy. For example, 50mgy of efuels production requires 400+MW of firm renewable/clean energy that is priced at $40 MWh or less • Cost of keeping a plant available, secure, safe and ready if it's only running a few hours a year; the cost of those few Megawatt hours will be VERY high and would seem we'll see other solutions when we actually stare at those costs • energy burden to low income customers for these new resource aquisitions • distribution
Community and Environmental Impact • Potential lack of federal oversight of pipeline infrastructure • Wildfires. Many of the catastrophic wildfires in OR and CA were caused by electric transmission lines. What environmental considerations have been given to the impact associated with increasing electrification as it relates to wildfires. • Impact on wildlife habitat • unintended consequences--unexpected hydrogen leaks, NOx emissions, and costs to retrofit or build power plans/piping • Siting new electricity generation plants will be challenging.	***Other*** • Availability of zero carbon fuels - tied to cost but may be other issues likel siting etc • The barrier to RNG production in Oregon is access to pipeline infrastructure. • Storage. Where and at what cost could H2 be stored for dispatch-able use in OR is not clear to me. Also the feasibility of using what are currently natural gas storage sites for H2 at the same time is not clear to me. • Need better estimates of amount of ZCF needed to meet reliability needs in future • lack of regulatory oversight, treating all RNG (outside of LCFS) as zero carbon • statewide zero emission policy goals

• expansion of factory farms to produce RNG, impacting air and water quality • Risks of transporting/piping/storing these new fuels -- we've done a poor job of safely storing fuels so far (high seismic risk, close to populatino, etc.) • Power reliability in rural areas if electricity is the only power source. • concerns about hydrogen being "clean", ie. produced from extra renewable capacity instead of pushing increased thermal operations to meet existing energy needs • Great need for community engagement and education	• identification of value for built out infrastructure for solutions can provide peaking resources. • State carbon emission policy are too narrow/ prescriptive - focusing on specific methods for decarbonization rather than setting goal-oriented or performance-based targets. This limits innovation and adaptability to market changes. • using RNG for electricity production is one of the lowest cost benefit use cases for RNG. Especially when considering the higher value use cases of RNG as a feedstock for SAF or renewable diesel production

Whiteboard Q4

Question 4: Electrification ***What are the primary issues or barriers to electrifying applications and strategically using fuels?***	
Transportation	***Industry and Agriculture***
• Lack of grid capabilities • Realization that EV vehicles are not as green as they are considered given the great amount of CO2 needed to produce them and the impact to the environment caused by end of life cycle waste • the increasing costs of electricity and the pooor reliability specially considering weather related evenst or earthquakes • Maintenance costs and longevity of vehicles • unwillingness to recognize the value of EVs to resiliency--served as key resource in NC during flooding--making EVs a divisive issue instead of a real solution • Grid reliability • The demand for electricity from tech is creating an imbalance for efuels and H2 production. Transportation will never be able to complete with tech on pricing of MWh for clean/renewable energy. • Workforce development for training technicians to service EVs • Bumpy Middle Problem: LDV transition to EVs leaving drivers stranded with ICE vehicles that are worth less and cost more to fuel • Cost parity • federal policy changes now undermining EV expansion • Infrastructure for a smaller and smaller number of vehicles that use fuels; will hit tipping point where remaining folks just need to electrify • upfront cost and availability of EV platforms • slow manufacturing and delivery of EVs, especially medium and heavy duty trucks	• Mobility of product • aviation is not able to electrify in next 20-30 years based on best available EV technology. H2 is not a viable solution for aviation either. efuels is the best way to "electrify" aviation and it requires gigawatt scale of clean/renewable energy priced at $30 to $40 MWh based on current policies • Transporting fuels to hard-to-electrify applications after we begin to 'prune' the gas infrastructure (shut off/remove pipes) due to lack of customers and high cost of maintenance. • Ability to self-service EV equipment vs. existing equipment. I.E., right-to-work. • existing infrastructure is not well placed to serve the highest and best use of alternative fuels • Expiration of fuel.

Residential and Commercial	***Other***
• Retrofitting existing end uses is expensive, who would bear that cost or would it only be upon replacement? • lack of investments to support COUs investing in energy efficiency and electrification solutions • PGE is anticipating a DECLINE of FLATTENING in residential and commercial demand (due to DER) and is pursuing high load users that will impose higher costs on consumers if not limited by agency or legislature • Costs and Efficiencies • concerns about antitrust behavior by heat pump manufacturers and installers as they see that heat pumps are the solution sought by customers--jacking up prices • Customer and dealer awareness • Reliability concerns around home and business heating on a grid being strained by significant demand increase (data centers on top of natural growth) • gas utility misinformation when local governments adopt policies supporting residential electrification • Supporting the fewer remaining customers who will face higher costs; POLICY challenge of sharing that increasingly public cost of decarbonization. • Policies that only promote 100% electrification vs. piecemeal progress towards the end goal. For example, if you have an NG furnace and want to purchase a heat pump AC, you cannot receive an ETO incentive unless you also switch your NG furnace to an electric heat pump. • Single fuel gas utilities are reluctant to consider/ support electrification. It directly undercuts their business model, which is transporting direct fuels for residential and commercial building applications. • ETO fuel neutral policies is a barrier to customer and workforce development • Heat pump installation can co-necessitate expensive home insulation upgrades, inhibiting equitable utilization of heat pump incentives. • Misinformation about what heat pumps can do: "Whether or not you need a backup heat source for your heat pump will depend on the type of heat pump you purchase, your climate zone, and the design and efficiency of your home." • interesting. I think it's the opposite. Offering an AC incentive rather than recognizing the need to intervene for the benefit of emissions reductions AND grid	• Villifying the industries currently serving these markets vs. embracing them as key partners to help us transition to the new clean energy economy • Current business model / regulatory framework of gas utilities (ROI-focus) has them wanting to expand their systems -- hence making them push their current product, and thus act in ways that make them vilified by clean energy advocates; Need new regulatory framework so these actors can be fully motivated to be part of the solution. • Battery storage limitations • Increased subsidies available for existing fuel providers to convert to renewable feedstocks • electrification as a culture war tactic; let's focus on resiliency and adaptation...not to mention mitigation • bringing unions along to see the opportunities available to them...and then delivering on those benefits

reliability to replace the gas furnace with a heat pump that provides heating and cooling. • Heat pumps have to use back up fossil fuel below 38 F • Misinformation about the capabilities of electric heat pumps at cooler temperatures. • Electric IOU model that encourages rate basing investments (i.e. owning all of it), thereby raising costs of electricity	