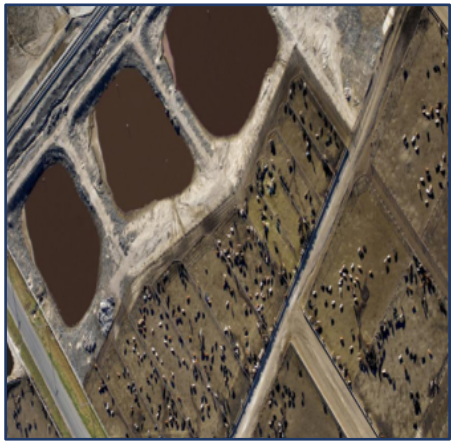
Investing in Oregon's Fuel Resiliency

Barriers to Biomethane



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Keep fighting the good fight.

-Michael S. Graham

EXECUTIVE SUMMARY

Biomethane is a fascinating resource. The saying *poop to power* is all-encompassing in that biomethane is a resource which turns a waste into a resource. It is putting our waste to work. There is a myrid of economic resiliency benefits from producing domestic fuel sources, air quality improvements from offsetting diesel fuel use, and environmental benefits from managing wastes and methane more effectively. If there are so many intrinsic values associated with biomethane, why has our society not invested in it as a fuel alterantive? This report investigates the many barriers facing the biomethane industry in the State of Oregon by talking to those who work with biomethane every day. Through interviews with on-the-ground stakeholders, as well as short post-interview surveys, the research produced findings in the broad categories of economics, regualtion complexity, and education and information. Policy recommendations were produced in response to these findings and are intended to be used by any and all entities in Oregon political process with the goal of encouraging the biomethane sector within the State of Oregon.

INTRODUCTION

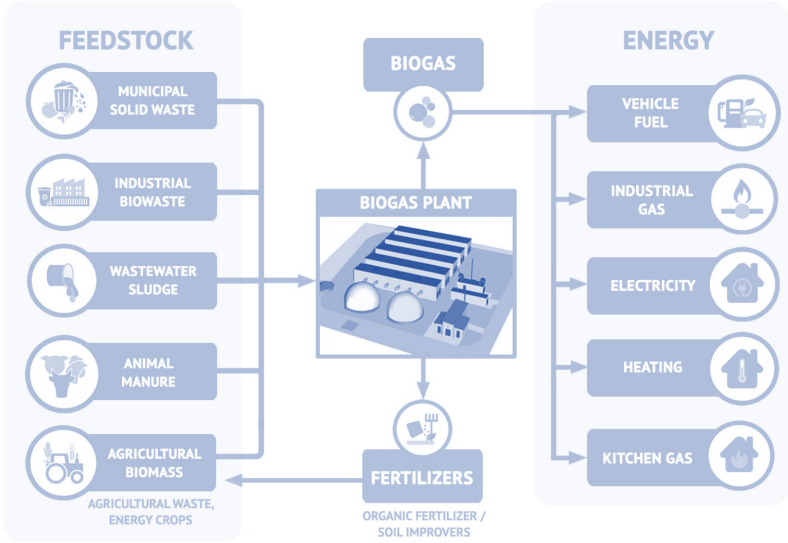
Wastes are conveniently located all around us. Our farms produce it, our homes discard it, our businesses, industries, institutions and the sort desire to rid themselves of it. But what if what we were discarding perfectly-good renewable energy? The energy we need to provide stability to our economies, improve our airsheds and rein in rampant global warming. There is value in our garbage, be they residues, manures, and even scraps of food. It is a renewable energy source which is produced from putting Oregon's waste to work.

PUTTING WASTE TO WORK

Biomethane is the product of refining biogas – a substance produced from the decomposition of organic wastes in the absence of oxygen, known as anaerobic decomposition. Sources for biogas and biomethane production include wastewater treatment plants, landfills, and digesters utilizing animal manures or food waste. These are known as *fuel pathways*, and depending upon the pathway, the biomethane will have a variable carbon intensity – the amount of carbon produced over the lifecycle of the fuel.

The components of biogas consist primarily of methane and carbon dioxide, as well as a small quantity of contaminants ranging from siloxanes, to sulfur, and water vapor. The process of producing biogas dates back to the 10th century when the Assyrians used it to heat bath water.[i] Today the low heating content of biogas lends itself to process heat applications, electricity generation, or combined heat and power operations. However, by removing carbon dioxide, sulfur, nitrogen and other trace contaminants it can be refined into nearly-pure methane. This is known as biomethane and is interchangeable with fossil natural gas once upgraded to pipeline-quality gas, allowing the fuel to be used in standard applications ranging from power plant turbines to vehicle internal combustion engines, fuel cells and your humble range.

FIGURE 1. BIOGAS PRODUCTION PATHWAYS & USES.



SOURCE: 1. "BIOGTS BIOGAS PLANT – THE FUTURE OF BIOGAS PRODUCTION." BIOGTS.

Expansion in the United States is slow for biogas, and biomethane especially. The American Biogas Council (2014) states Europe currently operates over 10,000 digesters producing biogas, while the United States operates over 2,000 sites. There is federal incentive for biofuel production through the Renewable Fuel Standard, created under the Energy Security Act of 2007 (U.S. EPA). However, more powerful policy

is being developed at the state level. California features a modest biogas and biomethane industry after its passage of Assembly Bills 1900[ii] and 2196[iii] in 2012. Today, Oregon is only the second state in the U.S. to feature legislation centered on biogas and biomethane with the passage of SB 334.[iv] Forward-thinking states such as Oregon and California see the potential to lead the nation in biomethane production, practice, and policy and work to mitigate harmful greenhouse gas emissions while developing a low-carbon renewable fuel sector. But what are the barriers preventing such a green fuel from growing in Oregon?

BENEFITS OF BIOMETHANE

Biomethane is widely viewed as a low-carbon fuel and therefore one of many tools in the world's fight against anthropogenic climate change.[1] The following section details the state of biomethane within the State of Oregon and discusses carbon pricing schemes, their impacts on biomethane.

ECONOMIC RESILIENCE

Biomethane offers economic benefits in the form of job creation, fuel price insulation from market volatility and natural disaster resiliency. Job creation from biomethane plants is modest but impactful especially in rural communities. A joint report by the Climate Trust and the Energy Trust of Oregon estimated 300 permanent full-time jobs could be created through realization of Oregon's biogas and biomethane potential. The report also cited a German study which determined 1,750 biogas plants were built between 2004 and 2010, creating 21,660 jobs at a rate of 12.4 new jobs per plant.[v] Many jobs can be located near feedstock production points in rural communities, such as those with access to agricultural and forest residues. There are many benefits to increasing economic development in rural communities, such as increased wages and the relinking of rural and urban communities.[vi] Oregonians across all communities would benefit from clean energy jobs and the associated fuel price stability.

Insulation from fuel prices helps ensure economic stability, especially for industries within the State which rely on healthy margins in transportation operations. Oregon currently possesses only a minor natural gas production site and no petroleum production sites. Because of this, the State is subjected to market fluctuations in fuel prices. Diesel prices alone crippled Oregon fleets over a 20-month period between Fall 2009 and Spring 2011 when prices soared from $2.63 to $4.06 per gallon.[vii] Total theoretical estimates conclude biomethane could offset about three percent of total natural gas demand in the United States.[viii, ix] Oregon's biomethane potential could be higher, around five to ten percent of total natural gas demand, due to its robust agricultural and food processing sectors. This translates into a higher percentage offset of imported fossil fuels. There are added natural disaster resiliency benefits to producing domestic sources of energy.

[1] Anthropogenic Climate Change – refers to the warming of the planet due to emissions of greenhouse gases such as carbon dioxide and methane.

Resiliency planning in Oregon states a need to build resilience into critical energy infrastructure. A presentation by the Oregon Department of Energy and Oregon Department of Geology and Mineral Industries pointed to the vulnerabilities in Oregon's reliance on electricity and imported fuel supplies during a Cascadia Subduction Zone earthquake.[x] The presentation cited a need to build resiliency into these systems. Investment in biomethane production projects could alleviate some stress on emergency response teams as biomethane systems can continue to produce and store local sources of fuel, and electricity in certain applications, when the greater electrical grid is jeopardized by a natural disaster.

AIR QUALITY IMPROVEMENT

Biomethane can offer social benefits when offsetting diesel as a transportation fuel. Offsetting diesel consumption with biomethane consumption in vehicles can provide air quality improvements. Combustion of diesel fuel in particular emits nitrogen oxide, sulfur oxide, carbon monoxide and particulate matter. Avoiding particulate matter emissions is particularly advantageous as the ODEQ and The International Association for Research on Cancer labeled particulate matter 2.5mm a human carcinogen in 2012 and linked diesel engine exhaust to increased risk of lung cancer. ODEQ attributes the pollutant to major health issues such as aggravated asthma, heart and lung disease, cancer, and premature death. The resulting costs from treatment for illness, hospitalizations, lost work days and premature death issues was estimated at a loss of $1.6 billion to the Oregon economy.[xi]

When used as compressed natural gas in vehicles, biomethane can prevent up to 80% of nitrogen emissions while its emissions of particulate matter are virtually nonexistent.[xii] This also provides maintenance savings for fleet operators as they no longer need costly and heavy pollution control devices on their vehicles.

ENVIRONMENTAL ENHANCEMENT

Oregon cares about mitigating its carbon footprint and creating a resilient economy. In 2007 The Beaver State set a 2020 goal to decrease greenhouse gas levels by 10% below 1990.[xiii] The State is currently not on track to meet this goal.

"Oregon's emissions had been declining or holding relatively steady through 2014 but recorded a non-trivial increase between 2014 and 2015. The majority of this increase (60%) was due to increased emissions from the transportation sector, specifically the use of gasoline and diesel. The reversal of the recent trend in emissions declines, both in the transportation sector and statewide, likely means that Oregon will not meet its 2020 emission reduction goal." [xiv]

In 2017 the 79th Oregon Legislature Assembly passed Senate Bill 334 tasking the Oregon Department of Energy (ODOE) to identify, inventory and estimate the potential of State biomethane resources and their ability to reduce greenhouse gas emissions from stationary and transportation sources. One study found biomethane in Oregon can reduce greenhouse emissions enough to meet 5% of the State's 2020 goals.[xv] Given biomethane's low carbon intensities it is clear biomethane could play a role helping rein in the State's greenhouse gas emissions and meet part of its 2020 goals.

Other environmental benefits from biomethane are produced from incentivizing better waste management practices. This is particularly true in the agricultural sector for animal manures, where nutrient management improvements at confined animal feed operations (CAFOs) leads to improved surface and ground water resources.[xvi] There is a substantial methane reduction potential available coupled with improving manure resources management. "The U.S. has the highest methane emissions from manure management of any country — twice as much as second and third place, India and China, respectively".[xvii] Increasing the value of methane capture techniques through encouragement of the biomethane industry could help to reduce methane emission in Oregon.

FIGURE 2. UNCOVERED MANURE LAGOON.

SOURCE: 2. SIMET, ANNA. "BIOGAS ADVANCES IN THE US @BIOMASSMAGAZINE."

CLIMATE & CARBON

Oregon and California have both developed policies which apply prices to carbon with the overarching goal of reducing greenhouse gas emissions. However, California has surpassed Oregon in implementing a carbon pricing scheme after passage of Assembly Bill 32, the California Global Warming Solutions Act of 2006.[xviii] The Assembly Bill required the state to reduce its greenhouse gas emissions to 1990 levels by 2020. This was accomplished at a minimum through adoption of their carbon Cap and Trade, regulation that establishes a system of market-based declining annual aggregate emission limits for sources or categories of sources which emit greenhouse gas emissions.[xix] Of these market-based declining annual aggregate emission limits are the California Cap and Trade and the Low Carbon Fuel Standard. Currently, Cap and Trade carbon credits are priced at $15.10 per metric tonne of carbon dioxide or carbon dioxide equivalent as of March of 2018 and focuses on reducing stationary emission sources.[xx] On the other hand, the Low Carbon Fuel Standard focuses on reducing transportation emission sources and offers credits trading at an average of $134.69 during the 2018 May report for April trading activities. "The LCFS is a cornerstone policy for transportation sector reductions needed to meet Governor Jerry Brown's aggressive 2030 GHG target," and allows the market to provide solutions which are the most economical solution per their desired application.[xxi] Credit generation through this program has grown substantially from 2015 to 2016, from 5.5 million total credits to 6.1 million total credits.

Oregon does not possess a Cap and Trade or equivalent program but has instituted a similar low carbon fuels program known as the Clean Fuels Standard. Around one-third of the State's greenhouse gas emissions originate from the transportation sector.[xxii] In order to reduce emissions, the 2009 Oregon Legislature passed House Bill 2186 authorizing the

Oregon Environmental Quality Commission to reduce the average carbon intensity of the State's transportation energy by 10 percent over 10 years, and in 2015 the Oregon Legislature passed Senate Bill 324 allowing the Department of Environmental Quality to implement the Clean Fuels Program in 2016.[xxiii]

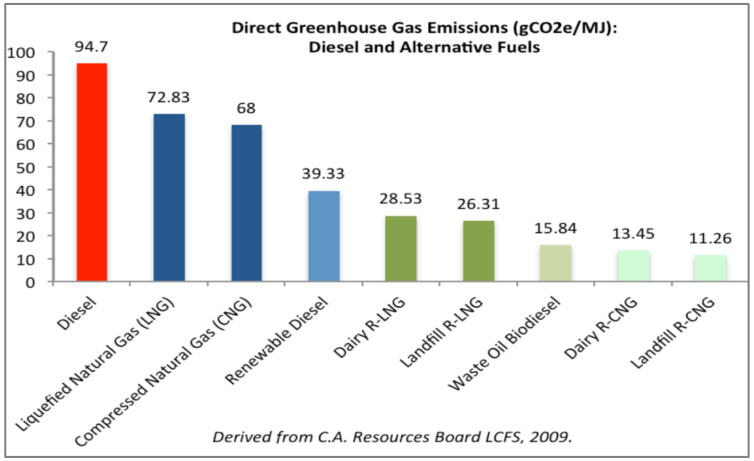
The Oregon Clean Fuel Standard sets carbon intensity standards for traditional and alternative fuels. When the carbon intensity standards are exceeded by a regulated party, such as a fuel distributor or retailer, a deficit is generated. When the carbon intensity of a fuel is lower than the standard for the specific fuel, a credit is created. Credits currently are available for purchase by the obligated parties for $56.14 as of March of 2018. It is important to support the Oregon Clean Fuels Standard so the market may mature and increase in value.

Climate Benefits of Biomethane

Biomethane is a low carbon fuel due to its low well-to-wheels lifecycle carbon intensity; an analysis process which examines a fuel's carbon emissions from its feedstock sources, production process, transportation process and method of consumption. An Energy Vision & CALSTART fact sheet lists biomethane as the lowest of any vehicle fuel that is commercially available today.[xxiv] Biomethane production incentivizes the capture of fugitive methane sources, or methane emissions that would otherwise enter the atmosphere and contribute to global warming. This is particularly beneficial as methane is 25 times more effective than carbon dioxide at trapping heat in our atmosphere, pound for pound on a 100-year basis.[xxv] Some of the largest sources of methane in the United States are coincidentally some of the best sources for biomethane production.

Landfills and manure management are the second and fourth-largest sources of methane in the United States, respectively, according to the U.S. Environmental Protection Agency (EPA).[xxvi] These sources represent a large biomethane potential for many states such as Oregon and California and can produce substantial reductions in carbon dioxide when used as a transportation fuel. California's Air Resources Board analyzed a dairy manure biomethane project and calculated a negative carbon intensity value due to the difference between preventing and capturing and utilizing the fugitive methane emissions from manure lagoons.[xxvii]

FIGURE 3. FUEL PATHWAY CARBON INTENSITIES



SOURCE: 3. CARLIFORNIA AIR RESOURCES BOARD LCFS, 2009.

There is a low standard for manure management and methane is typically not regulated nor captured. However, the current value of preventing methane emissions from dairy manure and using it as a transportation fuel is lucrative under the California and Oregon low carbon fuel programs. However, the transportation programs do not disincentivize fossil fuel use and

only incentivize low carbon alternative fuel use. It is important to appropriately price carbon-intensive fossil fuels in order to transition to a future fueled by lower-carbon alternative.

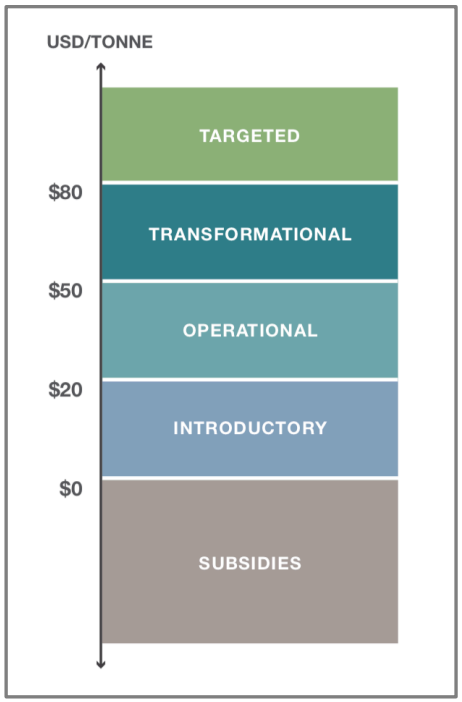
Carbon Pricing

Carbon credits at certain market price points create economic arguments for consumers to use biomethane in their transportation functions. A price on carbon increases the cost of fossil fuels and encourages adoption of lower-carbon alternatives such as biomethane. However, this transition happens at different rates that can impact our progress in meeting global temperature goals of below 2°C. A CDP and We Mean Business report on carbon pricing pathways details carbon pricing pathways that help to meet global temperature goals. "Carbon pricing is a key policy instrument to ensure global temperatures do not rise more than 2°C" and involves the "widespread adoption of effective carbon pricing policies".[xxviii] The graphic is from the report and details the different levels at which transformational shifts are undertaken in the economy in order to avoid paying for carbon-intensive technologies.

The carbon price at different levels will affect the intensity and frequency of transformation in the market. There is a need to lower carbon dioxide levels south of 400 parts-per-million carbon dioxide.[xxix] Sweetening the economic argument for alternative fuels such as biomethane through disincentivizing fossil fuels guides society towards lower-carbon options.

Adoption of such fuels helps to ensure we meet a global temperature goal of 2°C. Unfortunately, there is little persuasion to do so at $20 per metric tonne of carbon dioxide. However, economic shifts occur when carbon prices push north of $50, with transformational economic shifts being made at carbon prices above $80 per tonne.[xxx] Due to the low cost of diesel, gasoline and natural gas, lower-carbon fuels such as biomethane will continue to be priced out of the market without more aggressive carbon pricing mechanisms. A visualization of this process is shown to the right with Figure 1 – Carbon Pricing Bands. Definitions of these terms are available on the following page.

FIGURE 4. CARBON PRICING BANDS.



SOURCE: 4. WE MEAN BUSINESS, & CDP. (2015). CARBON PRICING PATHWAYS: NAVIGATING THE PATH TO 2°C.

FIGURE 5. DEFINTIONS OF CARBON PRICING BANDS.

SUBSIDIES: Fossil fuel subsidies lower the actual cost of carbon and make low carbon technologies relatively more expensive. This negative price on carbon is one way that governments boost fossil fuel consumption and render low carbon alternatives economically less viable.

INTRODUCTORY: Prices up to $20. Most systems begin in this band, enabling businesses to adapt. Governments give clarity about future policy direction and collect revenue.

OPERATIONAL: Price range $20 to $50. In this band, carbon prices start to drive economic transformation, enabling structural changes like a wholesale switch from coal- to gas-generated electricity. Carbon taxes and cap-and-trade systems start to generate significant income.

TRANSFORMATIONAL: Price range $50 to $80. Schemes in this band have secured a low carbon future beyond coal. For example, renewables are likely to be the most attractive investment, replacing gas.

TARGETED: Prices above $80. In limited circumstances, this band may support specific policy objectives such as eliminating certain fuel sources.

SOURCE: 5. WE MEAN BUSINESS, & CDP. (2015). CARBON PRICING PATHWAYS: NAVIGATING THE PATH TO 2°C.

BARRIERS TO BIOMETHANE

There are many barriers to increasing production, utilization and overall adoption of biomethane. Most broad is the idea of risk. A recent study found "…issues which increase project costs and/or create uncertainty or risk" are the major factors preventing adoption of biomethane production in Oregon.[xxxi] One such risk is the capital intensity of biomethane production.

Biomethane requires large amounts of capital and low amounts of manpower. Capital intensity is driven by several factors: the costs to develop a project and the costs to produce biomethane. A UC Davis report found the costs associated with developing biomethane projects stemmed primarily from the technologies needed for cleaning and upgrading the biogas to pipeline quality specifications. [xxxii] Moreover, the same UC Davis report stated the high costs needed for cleaning and upgrading correlated directly with the energy content requirements for injecting the biomethane into the pipeline. [xxxiii] The pipeline specifications are set by utilities and their public utility commissions. This was apparent in a Nicholas Institute (2014) report which contended that the cost of the equipment and the low return on investment for businesses is to blame for poor adoption of biomethane. These issues are compounded by a lack of policy incentives.

A different study reported a lack of incentives for biomethane production as a transportation fuel. It found standards may often "include incentives supporting production of [biomethane] for electricity generation [while not supporting] production of [biomethane] for vehicle fuel use". [xxxiv] The literature showed there are few policy incentives available for encouraging biomethane. An Energy Vision analysis found a major barrier was a lack of state-level mechanisms such as feed-in tariffs. Feed-in tariffs are useful tools in assuring the value of biomethane being injected into the pipeline.[xxxv] Moreover, it is commonly accepted that natural gas prices will not drive biogas production, and that added GHG restrictions will help with but not cure barriers facing the biomethane market.[xxxvi] The same Energy Vision report stated limited access to the vehicle market hampers industry growth. The transportation fuel market provides biofuel producers with credit program opportunities to offset the high cost of production.[xxxvii]

Overall, the literature found barriers to biomethane include high costs for development and production as well as market barriers from the low cost of natural gas and limited access to vehicle fuel markets. While pipeline specifications are a barrier, these can met through technology as long as costs can be offset through financing or policy incentives.

NEED FOR RESEARCH

The literature mentions several barriers spanning multiple categories. These include economic categories of cost, financing, and market pressures as well as those surrounding navigating regulating bodies and lacking information and education resources. While literature succeeds at identifying barriers which *may* plague the industry there is little information about the issues facing those involved in biomethane projects. Moreover, there is no information about what is impacting "on-the-ground" biomethane stakeholders in the State of Oregon and what is needed to alleviate the pressure facing these key biomethane proponents. The State's Policy Advisory Group works well to identify high-level issues facing the industry as reported from the perspective of high-level personnel who work around biogas and biomethane.

It is imperative that research be conducted to assess barriers facing those working with biogas and biomethane. These are Oregon's "on-the-ground" stakeholders whose livelihood relies upon the success of biogas and, in the future, biomethane. Using this lens, the researcher posed the question: what are the barriers to increasing the utilization of biomethane within the State of Oregon?

METHODOLOGY

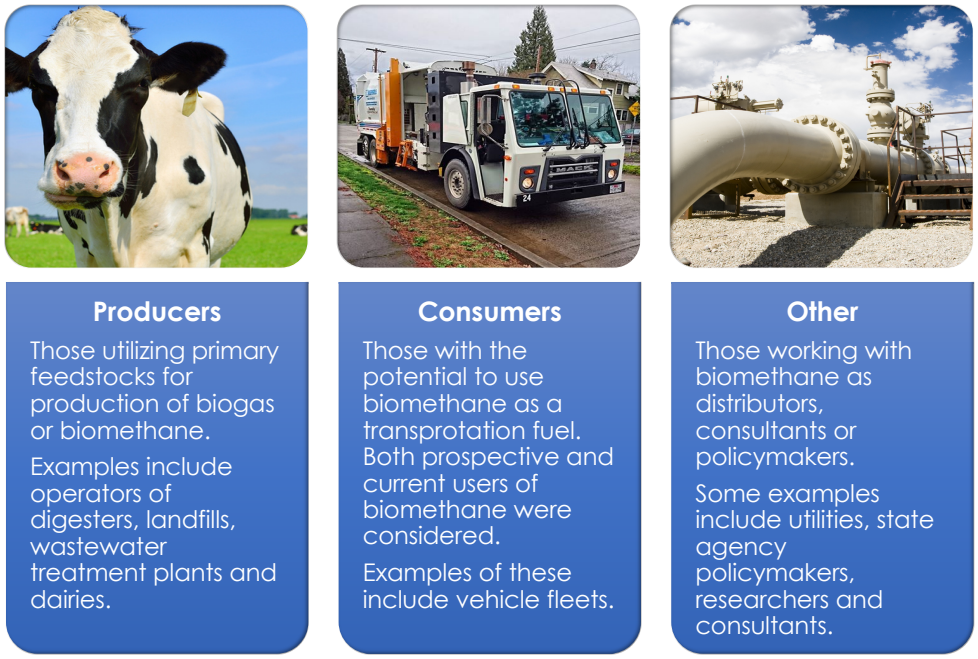
This section describes the research methods used in answering the research question: what are the barriers to catalyzing the utilization of biomethane within the State of Oregon? Methods included interviews with on-the-ground biomethane stakeholders as well as a brief post-interview barrier survey.

INTERVIEWS

The research population included 10 adult industry experts selected from private and public organizations involved with biogas and/or biomethane within the State of Oregon. Participants were located through communication with research chair personnel, policy staff at the Oregon Department of Energy and through cold calls by the researcher. The target population included stakeholders involved in some facet of biogas or biomethane. Stakeholder classes are described in Figure 6 below.

Stakeholder classes were used when developing the interview guide so as to garner the best perspective on barriers while minimizing leading questions, intrusion of the researcher's biases, and simple yes or no answers while also maximizing liberal and detailed responses by the interviewees. The guide featured stakeholder-specific questions since different stakeholder classes were hypothesized to dwell upon different barrier classes. The research population is preferable because it represents on-the-ground producers and consumers as well as those working on projects involving biogas or biomethane. Participants provided a unique perspective on barriers to current or future projects based upon their experience working in the biogas industry or on biomethane projects.

Figure 6. Interview Stakeholder Classes



Three interview guides were developed and contained eight to ten questions depending upon the stakeholder class being interviewed. Interviews were conducted either over the phone or in-person depending upon geography and time constraints. Convenience for the interviewee was always the priority when scheduling interviews. Interviews generally lasted around an hour with only a few lasting an hour and a half or slightly longer due generally to stakeholder enthusiasm.

Interviews were conducted using a written script. However, the script was used more as a guide and would transition into casual conversations as this was the preferred method in order to garner the most organic perspective possible. Interview responses were entered into an Excel table and categorized based upon their broad barrier categories of finance, market, technology, policy, regulation, education/information and miscellaneous.

POST-INTERVIEW BARRIER SURVEY

In addition to interviews, a post-interview survey was conducted in order to understand perspectives on specific barriers. It was important to distribute the survey after the interview so as to reduce interview response biases. The survey is anonymous and was tabulated by adding all responses.

A catalog of barriers was constructed in order to comprehend all potential barriers to biomethane. Literature was reviewed to develop a list of over 130 barriers which were not unique to Oregon but applicable to biogas and biomethane. Biogas was included since it is the raw material from which biomethane is refined. These resources were categorized by their area of impact: policy, regulatory, infrastructure, information/education, financial, or market.

- ***Policy:*** a barrier which is created by a lack of government policy, such as incentives or renewable portfolio standards.
- ***Regulatory:*** a barrier which is created by an excess of government regulations such as air quality permits, gas injection standards or building permits.
- ***Infrastructure:*** a barrier which is created by the lack of infrastructure, such as lack of pipeline injection points.
- ***Information/Education:*** a barrier which is created from a lack of education or information, such as perception of risk due to misinformation or poor public perception of biogas or biomethane.
- ***Financial:*** a barrier which is created by excessive costs of materials and/or equipment or issues associated with procuring financing, such as the cost of clean-up and upgrading technology or the inability to obtain financing from a traditional credit institution.
- ***Market***: a barrier which is created by market forces, such as low compressed natural gas demand due to a lack of compressed natural gas demand or the low cost of fossil natural gas due to a national glut of fossil natural gas.

The catalog was reduced to around 40 barriers based upon their importance. The list was further reduced to 18 barriers to create the post-interview barrier survey. These barriers were not specific to Oregon and were gleaned from an extensive literature review. Participants were asked to rank the individual barriers from 1 to 3, with three being considered a major barrier and 1 being considered a minor barrier. The results were tabulated anonymously in an Excel table. Response rankings were summed and divided by the 30 – the highest total possible for a barrier. Barriers were then ranked based upon this calculated integer, with the highest integers being classified as the most important.

FINDINGS

This section details the findings from the interviews with biogas and biomethane stakeholders as well as their post-interview barrier surveys.

PROJECT MOTIVATION

All stakeholders were asked about what motivated their utilization of biogas, biomethane, or compressed natural gas depending upon their stakeholder class. For instance, consumers of biomethane do not consume biogas and therefore were asked what motivated their consumption of compressed natural gas. The most noteworthy responses from this question encompassed three primary areas: economics, sustainability, and waste management.

Seen within these broad categories were several common sub categories. Many responded their motivation arose from economic rationales, such as the reduced costs of operation, or increased revenue from new products. Other motivating factors include sustainability benefits of reducing carbon footprints and meeting climate goals. Waste management industry stakeholders commented on the odor control benefits of biogas utilization and the resulting reduction in fines from air quality regulators. It seems there is an eagerness to invest in projects, but economic and political drive are missing.

POST-INTERVIEW BARRIER SURVEY

The barrier survey indicated the most impactful barriers embraced economic categories. The top four barriers comprised at least 70% or more of barrier responses and are displayed below in no particular order:

1) **Cost**
   - Infrastructure costs, such as cleaning and upgrading technologies, compression equipment, vehicle conversion kits, vehicle tank and certification costs
   - A lack of incentives for biomethane systems as resiliency infrastructure. Incentives need not be monetary.
2) **Market**
   - The cost to produce biomethane at certain scales when considering the cost of fossil natural gas.
   - The low cost of fossil natural gas and the relatively higher cost of biomethane.

Post-interview barrier survey responses show a need to mitigate the economic barriers associated with increased utilization of biomethane within Oregon.

INTERVIEW RESPONSES

Detailed below are the biomethane stakeholder responses on barriers facing their utilization of biomethane or improvement of biogas to biomethane. Interviews with biomethane stakeholders provided perspectives of on-the-ground stakeholders. Producers, consumers, utilities, consultants, and policymakers offered their opinions on what motivates them to utilize biogas and what prevents or would prevent them from improving their biogas to biomethane. Findings from these interviews indicated there are many categories of barriers such as cost, financing, market, regulatory, and information and education.

ECONOMIC – CAPITAL INTENSITY & COSTS OF BIOMETHANE INDUSTRY	
Due to…	**Barrier Snapshot**
Early Stage of Market	– Early stage of the market is not a major cause of cost concerns. Biomethane technologies are the major cost for projects and are mature technologies in Europe.
Challenges Related to Scale	– Scale plays a large role due to the clean-up and upgrading requirements for biogas and the amount of biogas being considered for purification to biomethane standards. Larger operations however can benefit from economies of scale. Other considerations include the source of the biomethane. Landfills, for example, produce a gas which requires additional clean-up steps.
Absence of Sufficient Policy Support	– Insufficient policy plays a major role in mitigating cost concerns for biomethane stakeholders.
Absence of Sufficient Policy Support Certainty	– Certainty surrounding policy for mitigating costs for biomethane stakeholders likely hinders basic interest in biomethane utilization projects.

Interview respondents cited many economic barriers when considering improving biogas to biomethane, developing new biomethane projects and converting or purchasing compressed natural gas vehicles for consumption of biomethane. Barriers for this section are comprised of cost, financing, and market segments.

Many of the interviewees agree it is cost-prohibitive to utilize biomethane. Interviewees indicated the major costs for biomethane utilization are in the clean-up and upgrading technology used to refine biogas to biomethane. Stakeholders listed other costly infrastructure needs such as the cost of compressors, storage tanks, pipeline segments, and compressed natural gas vehicle conversion kits. There are major cost concerns with many vital pieces of biomethane utilization equipment. The capital cost for biomethane interviewees is a major barrier preventing development of biomethane production projects in particular.

ECONOMIC – OBTAINING FINANCING	
Due to…	**Barrier Snapshot**
Early Stage of Market	– A major source of financing issues is attributable to the early stage of the market.
Challenges Related to Scale	– Scale can influence the Return on Investment for a project due to economies of scale but is not a major causation.
Absence of Sufficient Policy Support	– Insufficient policy severely hinders the immature biomethane market. Policy intervention is needed to shore up the market's financing options until the market matures.
Absence of Sufficient Policy Support Certainty	– Certainty of policy is not as much of a barrier as is insufficient policy support.

Stakeholders responded that obtaining financing is a major barrier to increasing biomethane utilization within the State. The producer stakeholder category in particular responded it was difficult to obtain financing from traditional credit sources such as banks and credit unions. Some respondents indicated financing entities were hesitant to lend to biomethane projects due to perceived risks including insufficient contracts for feedstock procurement and biomethane consumption. This barrier is particularly serious when coupled with the capital-intensive nature of biomethane projects.

ECONOMIC – MARKET	
Due to…	**Barrier Snapshot**
Early Stage of Market	– The early stage of the market is not to blame for the low-cost of fossil natural gas but is a major factor in the lack of compressed natural gas vehicle consumption. Early stage of the carbon market, or lack thereof, is another factor in devaluation of biomethane.
Challenges Related to Scale	– Scale is a big factor in producing a lower-cost fuel, due to economies of scale, but is not the primary issue at hand.
Absence of Sufficient Policy Support	– Better policy is desperately needed to increase the value of biomethane so it is cost-competitive with fossil natural gas and/or policy to incentivize vehicle consumption of biomethane.
Absence of Sufficient Policy Support Certainty	– The uncertainty surrounding support of new policy and certain credit markets drives uncertainty for biomethane stakeholders, such as fleet operators switching to compressed natural gas with certainty of fueling infrastructure investment.

LACK OF BIOMETHANE PRODUCTION INCENTIVES

Stakeholders commented on a lack of biomethane production incentives which would make biomethane cost-competitive with fossil natural gas supplies. This could be accomplished through offsetting production costs or increasing biomethane's value. Responses surrounded a lack of monetary support to begin projects, upgrade projects, or encourage projects overall for both production and consumption of biomethane.

Some interview responses considered a lack of incentivization at the local government level to be a major barrier. One interviewee, a refuse hauler, lamented there were *increased* taxes due to their investment in biomethane fueling infrastructure for their garbage truck fleet. The company recently invested in a biomethane compression fueling system which was taxed by the local county in the form of an increase in property taxes. The refuse hauler was dissuaded by the lack of environmental and social attribute consideration on behalf of the county government and recently considered reverting to diesel-fueled refuse trucks, which cost less to purchase in the short term, do not necessitate investments in new fueling infrastructure but cost more over their life time, pollute the local air shed and emit a greater amount of climate-warming greenhouse gases. Additionally, the company had considered switching to biomethane for its fuel of choice. The local municipality recently invested in a biomethane project and would have provided a local source for the refuse hauler's compressed biomethane fleet. This is in-part due to undervaluing the environmental benefits of biomethane.

Stakeholders also indicated a lack of environmental incentives. Namely, this surrounds environmental attributes and their monetization. Many interviewees understood the sustainability attributes of biomethane but commented on the lack of value surrounding the attributes. This facet is troubling as biomethane is capital intensive and costs more to produce than fossil natural gas.

Lack of Biomethane Demand Incentives

Interview responses indicated concern with a lack of available fueling infrastructure for compressed natural gas vehicles, and therefore compressed biomethane vehicles. There is additional concern regarding vehicle conversion costs, such as tanks and certifications. Furthermore, stakeholders indicated issues regarding maintenance bay conversion costs. These issues are problematic if the State wishes to incentivize local use of biomethane so Clean Fuel Standard Program credits can be sold and used within the State. It should be reiterated that biomethane nets the most value for producers and consumers when used as a transportation fuel under the current credit market systems.

Credit Market Stability

Some interviewees expressed concerns with credit markets for biomethane. This included competition from less expensive natural gas as well as a lack of demand for compressed natural gas vehicles. The producer stakeholder category expressed the most concerns with market barriers. All interviewees familiar with the transportation sector incentives expressed concerns with the stability of these markets. These included the Low Carbon Fuel Standard in California, the Clean Fuels Standard in Oregon and the U.S. EPA's Renewable Fuel Standard's RIN. Stakeholders expressed the most fear for credit value volatility surrounding the longevity of the Renewable Fuel Standard's RIN program after 2022.

Regulatory – Navigation and Limitations of State Statutes	
Due to…	**Barrier Snapshot**
Early Stage of Market	– The barrier is present due to the early stage of the market and little knowledge surrounding impacts of regulatory statute and regulatory agency navigation.
Challenges Related to Scale	– There are significant challenges related to scale, such as resources required to navigate regulatory agencies or operate without benefits created through statute changes.
Absence of Sufficient Policy Support	– Regulatory agency navigation will not become easier and certain statutes will not change without policy.
Absence of Sufficient Policy Support *Certainty*	– Certainty of policy support is necessary to navigate regulatory agencies and correct certain states and assist biomethane stakeholders.

NAVIGATING REGULATING AGENCIES

Production stakeholders indicated project development is complicated due to the number of regulatory agencies required for project approval. A proposed landfill biomethane project in Oregon indicated in their interview there were at-minimum three state agencies requiring permitting, in addition to the five other stakeholders including the local distribution company (gas utility), vehicle compressed natural gas consumers, local city government, local county government, and the local general public. The project manager stated their desire to consolidate, at minimum, the government entities in some manner.

LIMITATIONS OF OREGON PUBLIC UTILITIES COMMISSION REGULATIONS

The same landfill biomethane project indicated the issue associated with statute in the Oregon Public Utilities Commission (OPUC). Statute states utilities in the State must procure the least-cost resource if rate-payer capital investments are to be made. Therefore, under the OPUC, utilities such as those owning the potential landfill biomethane project cannot make a ratepayer-funded capital investment due to the increased cost to produce and utilize biomethane[xxxviii]. This is the case in Oregon and is indicated to be inhibiting utilities' investment in biomethane projects which may provide local benefits.

LIMITATIONS OF ENERGY TRUST OF OREGON REGULATIONS

A handful of stakeholders indicated the inability to secure forms of support from the Energy Trust of Oregon. This facet is due to State statute regulating the Energy Trust of Oregon to supporting renewable energy projects only where electricity is the end-use. Many consider the Energy Trust of Oregon's resources as vital in supporting energy efficiency and renewable energy projects throughout the State of Oregon, and especially renewable energy projects which are cost-prohibitive.

EDUCATION & INFORMATION	
Due to…	**Barrier Snapshot**
Early Stage of Market	– The barrier is the direct product of the early stage of the market, or is the cause of the early stage of the market. There is little knowledge surrounding biomethane and no State-provided information available for distribution to entities which are interested or should be interested in the resource.
Challenges Related to Scale	– There are no challenges related to scale aside from perhaps the lack of current projects within the State. However, this could be the product of the lack of information and education.
Absence of Sufficient Policy Support	– A direct product of a lack of policy directing the State to produce information and education resources surrounding biomethane.
Absence of Sufficient Policy Support Certainty	– Certainty of policy is not a major factor seeing as the state will produce some resources upon the fulfillment of goals outlined in Senate Bill 334.

Stakeholders indicated a lack of information and knowledge affected their ability to implement projects due to effects on local governments and the general public. Many interviewees agreed there is a lack of knowledge surrounding biomethane which hinders expansion of the resource's production and consumption.

PERCEPTION AND LACK OF INFORMATION SURROUNDING BIOMETHANE

Interviewees expressed concerns with public perception due to a lack of knowledge surrounding biomethane. This was apparent while interviewing a consultant for the Deschutes Brewing biogas project.

The intent of the Deschutes Brewery biogas project was to divert brewery waste intended for the municipal sewer system and redirect it into anaerobic digesters which would convert the waste material into usable electricity and heat. The project was advantageous for both the brewery, which according to the consultant is the largest brewery of its size not processing its own waste, and the municipality, which also according to the consultant was not prepared to handle large amounts of brewery waste and will require costly investments in sewer and processing infrastructure. The municipal wastewater plant originally taxed the brewery $200,000 in waste processing fees and recently increased the tax to $1.2 million per year. In the same two-week period (2016), the land application company, which was contracted to haul the high strength waste for spreading on agricultural land, notified Deschutes Brewery it no longer possessed the land capacity to handle the brewery's high-strength wastes. Therefore, the brewery investigated anaerobic digestion and biomethane as an alternative to the costly wastewater service fees and solid waste handling capacity limitations.

The brewer quickly encountered issues surrounding local government and public perception of biogas and biomethane systems. Deschutes Brewery launched a progressive information campaign to inform the Bend City Council and local landowners. Outreach included an open house for community leaders and entailed a barbecue where brewery staff dressed as mad scientists, each filling a unique role and informing attendees of different fun-facts surrounding biogas and biomethane. However, public sentiment of one prominent landowner, who claims P.F. Chang's will not allow the landowner to franchise, today still plagues the brewery's project. Other issues such as capital opportunity costs also tabled the project for the time being.

Interviews and survey responses show information is lacking in many stakeholder categories. For example, in some instances producers are unaware of biomethane and its benefits and do not feel comfortable making large investments. Insufficient information can also hurt opinions of local governments or the general public. Overall, a lack of information and education materials for access and distribution by stakeholders is a barrier to biomethane in the State of Oregon.

Overview of Barrier Findings

Listed below is a table with barriers identified in the findings. Color coding represents the relationship of a barrier to the factors detailed in the columns.

CATEGORY	**BARRIER CATEGORY**	***Due to…***			
		Early Stage of Market	**Challenges Related to Scale**	***Sufficient* Policy Support**	**Sufficient Policy Support *Certainty***
Economic	**Capital Intensity – Cost**				
Regulatory	**Obtaining Financing**				
Economic	**Market**				
Regulatory	**Regulatory Navigation & Limitations of State Statutes**				
Education & Information	**Education & Information**				

KEY	*Major*	*Moderate*	*Minor*

Conclusions & Policy Recommendations

Overall stakeholders indicated they are aware of the beneficial aspects of biomethane but are hesitant to invest in new production and consumption projects due to risk. These risks included those surrounding cost of project assets, financing security, market barriers for production and consumption, regulatory complexity and navigation, and insufficient information and education. It is imperative the State work to mitigate the risks related to the immaturity of the biomethane market, those related to scale, and insufficient policy support and certainty of support. It is important Oregon work to address the issues identified by stakeholder interviews and survey responses if the State wishes to capitalize upon the economic resiliency, public health and environmental benefits created through the production and utilization of the biomethane industry. The recommendations listed below were developed in consideration of the above findings with the intention of supporting the biomethane sector within the State of Oregon.

SOURCE: 6. STAHLBUSH ISLAND FARMS. CORVALLIS, OREGON.

POLICY RECOMMENDATIONS

This section highlights solutions proposed to address the barriers detailed in the findings section. These recommendations are focused on mitigating identified risks through State policy action.

CATEGORY	POLICY RECOMMENDATION	*Helps With…*		*Helps Provide…*	
		Early Stage of Market	**Challenges Related to Scale**	***Sufficient* Policy Support**	**Sufficient Policy Support *Certainty***
Regulatory	**Recommendation 6.1.1.** – *Oregon Public Utility Commission Statute Change*				
Regulatory	**Recommendation 6.1.2** – *Energy Trust of Oregon Statute Change*				
Finance	**Recommendation 6.1.3** – *Loan Program Creation*				
Finance	**Recommendation 6.1.4** – *Business Oregon Grant Inclusion*				
Incentive	**Recommendation 6.1.5** – *Biomethane Infrastructure Incentivization*				
Incentive	**Recommendation 6.1.6** – Biomethane – Fueled Vehicle *Incentivization*				
Regulatory	**Recommendation 6.1.7** – Oregon Clean Fuels Standard *Administrative Pathway Simplification*				
Education & Information	**Recommendation 6.1.8** – *Information Resource Production & Distribution*				

KEY	*Major*	*Moderate*	*Minor*	*Does Not Pertain*

1) PRODUCTION RECOMMENDATION – STATUTE CHANGE

The State could facilitate and encourage investment in capital-intensive alternative fuel infrastructure which produces triple-bottom-line benefits by allowing property tax benefits at the State and/or local government level. Applicable infrastructure investments could include but should not be limited to: storage tanks, compressors/fueling systems/fueling stations, clean-up and/or upgrading equipment.

2) PRODUCTION RECOMMENDATION – STATUTE CHANGE

The State should investigate changes to Oregon Public Utilities Commission statute barring utilities from making ratepayer-funded capital investments in biomethane production or distribution projects, such as and *limited to* gas clean-up and upgrading technologies, pipeline injection technologies, biomethane-specific fueling infrastructure, and biomethane storage infrastructure.

Utilities should be required to facilitate interest from all biomethane producer or consumer parties. For instance, biomethane cooperative or aggregation projects wishing to inject gas into the pipeline. In this instance, utilities should encourage aggregation of smaller biogas producers and should facilitate and invest in infrastructure which allows for gas clean-up, upgrading, storage and pipeline injection for the multiple producers.

3) FINANCE RECOMMENDATION – LOAN PROGRAM

The State could consider financing low-interest and long-term loans for biomethane projects for the below project specifications. Gas production and risk levels could be considered through careful research by the Oregon Department of Energy. Additionally, the State could consider designating the Oregon Department of Energy as the facilitator of the loan program as this would replace the now-sunset Small-Scale Local Energy Loan Program

Project classes for loan application:

- Large (by gas production and risk level)
- Medium (by gas production and risk level)
- Small (by gas production and risk level)

4) FINANCE RECOMMENDATION – BUSINESS OREGON GRANT INCLUSION

The State could include biogas and biomethane projects as viable options in descriptions of several Business Oregon grants. The State could consider pursuing either this recommendation or the above recommendation; *Finance Recommendation – Loan Program*. The State could include certain biomethane investments under some of the following programs or opportunities:

LOANS & LOAN GUARANTEES

- **Oregon Business Development Fund** (OBDF) provides direct loans that leverage private capital and provides incentives for businesses to expand or locate in Oregon.
- **Oregon Capital Access Program** (CAP) provides a form of loan portfolio loss reserve so financial institutions may make business loans that carry higher than conventional risks while complying with federal and state banking regulations.
- **Oregon Industrial Development Bonds** (IDB) are available to manufacturing projects, exempt facilities and nonprofit organizations to provide access to capital primarily for value-added manufacturing.

OTHER TOOLS

- **Aggie Bonds** (Beginning and Expanding Farmer Loan Program) provides new farmers tax-exempt financing for capital purchases. The maximum Aggie Bond financing is $520,000. Aggie Bond financing can be used for:
  - Purchase of farm land
  - Costs of depreciable farm property. Financing of new depreciable property (such as construction of farm buildings and new equipment) is limited to $250,000. Financing of used depreciable farm property is limited to $62,500.

RURAL OPPORTUNITY INITIATIVE

- A strategy to unify and strengthen existing business development resources to build rural prosperity through capacity-building grants. The overarching goal is to position rural communities for success as they strengthen entrepreneurship-based economic development in their communities. Objectives to meet goals include:
  - Building longevity through strengthened partnerships;
  - Connecting local resources to one another and to a statewide network;
  - Proactively ensuring equitable participation for entrepreneurs and service providers of all backgrounds and demographics; and
  - Increasing entrepreneurism by elevating and making existing resources more accessible, and by filling gaps in local resources through available statewide resource partners.

PROPERTY TAX ABATEMENT

- **Enterprise Zones** – in exchange for investing and hiring in an enterprise zone, businesses receive exemption from local property taxes on new plant and equipment for at least three years (but up to five years) in the standard program. In addition, many zones can offer special incentives for investments in qualifying rural facilities or in electronic commerce operations.
- **Strategic Investment Program** – the Strategic Investment Program exempts a portion of very large capital investments from property taxes for 15 years. The program is available statewide.
- **Construction-in-Process** – unfinished facility improvements may be exempt from local property taxes for up to two years while under construction with April 1 filing each year. In an enterprise zone, most authorized businesses enjoy a somewhat broader tax abatement using a different form.
- **Food Processing Machinery and Equipment (M&E)** – for five years starting in or before 2020, newly operational M&E is exempt if certified by the Oregon Department of Agriculture, encompassing real or personal property used in the primary processing of many types of goods for human consumption with certain limitations. The processor also needs to file annually with the county assessor or Oregon Department of Revenue using an exemption claim form.
- **Oregon Investment Advantage** – this program helps businesses start or locate new types of operations in a number of Oregon counties by providing an income tax subtraction, potentially eliminating state income tax liability on new operations over several years after they begin.
- **Federal Opportunity Zone Program** – this new program is designed to incentivize investments in low-income communities in exchange for tax benefits.

5) PRODUCTION INCENTIVE RECOMMENDATION – BIOMETHANE INFRASTRUCTURE

The State should investigate changes to statute barring the Energy Trust of Oregon from providing resources, be they financial or informational in form, to energy products which produce or consume biomethane.

6) DEMAND INCENTIVE RECOMMENDATION – VEHICLE CONVERSION COSTS

The State could increase incentivization of compressed natural gas in certain vehicle classes other than light-duty through incentives such as grants, rebates and/or credits for the following:

- Vehicle conversions
- New compressed natural gas vehicles and/or components
- Maintenance facility infrastructure
- Technical training grants.

While fueling infrastructure across the state may be of concern, biomethane fits well with return-to-base fleets which do not require statewide fueling infrastructure but rather "base-related" infrastructure such as vehicle conversions, maintenance facilities and onsite compression and fueling infrastructure.

7) Regulatory Complexity Recommendation – Administrative Pathway Simplification

The Oregon Department of Environmental Quality could consider streamlining and simplifying the credit generation process under the Oregon Clean Fuels Program. Policy can designate a non-profit industry proponent of biomethane as an aggregator of all biomethane credits, such as that created for electric vehicles in the shape of Forth Mobility.

The State could also consider designating the Oregon Department of Energy as the liaison between biomethane producers and other government agencies/project entities and should consider designating and funding one full-time position within the Department of Energy which supports biomethane projects through coordination with other government agencies. Gas off-take agreements is not covered under this description and is left to gas producer to fulfill.

8) Education & Information Recommendation – Information Resource Production & Distribution

The State should authorize the Oregon Department of Energy to produce standard contract and other permitting paperwork which can be used by all biomethane stakeholders so there may be a uniform and safe system for contracts and applications to be created and executed. Standard contract forms should be created for both feedstock and gas off-take. These are optional and can be supplanted by privately-produced agreement forms. This recommendation is designed to set an industry standard for application, permitting, and contract agreements, forms and overall paperwork.

The State should consider development of standard information resources, such as but not limited to topics concerning biomethane benefits, production pathways, technical specifications and needs, and financing and funding information. This information is intended to be distributed to producer, consumer, utility, and local government stakeholders.

Materials distributed to local government stakeholders should also include biomethane resource potentials within their respective county(s). Resources should be made available to local government entities as public outreach materials, such as but not limited to information pamphlets, flyers, and/or brochures.

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