

Agenda Item A

April 15th Meeting Notes

Oregon Low Carbon Fuel Advisory Committee



State of Oregon
Department of
Environmental
Quality

Attendance

Advisory committee members and alternates

Mark Reeve, Chair - Reeve Kearns, PC
Emily Ackland - Association of Oregon Counties
Sam Hartsfield - Port of Portland
Ian Hill - Sequential Biofuels
Frank Holmes - Western States Petroleum Association
Michael Johns - Lane County Dept. of Public Works
Christine Kelly - Oregon State University
Mark Kendall - Oregon Environmental Council
Dan Kirschner - Northwest Gas Association
Geoff McPherson - Citizen
Matt Michel - Canby Utility
Harrison Pettit - ZeaChem
Joshua Proudfoot - Good Company
Marcy Putman - Labor Union - IBEW
John Rakowitz - Association of General Contractors
Danelle Romain - Oregon Petroleum Association
Jennifer Shmikler - Farm Bureau

Others in attendance

Megan Boutwell - Stillwater Associates LLC
Chris Butler - Clean Energy
Mike Cleary - NREL
Todd Campbell - Clean Energy
Carrie Ann Capp - ODEQ
David Collier - ODEQ
Clark Cooney - Oregon Department of Agriculture
John Courtis - California Air Resources Board
Mike Dewey - Waste Management
Brian Doherty - Miller Nash/WSPA
Angus Duncan - Global Warming Commission
Maury Galbraith - OPUC
Jana Gastellum - Oregon Environmental Council
Andy Ginsburg - ODEQ
Margi Lifsey - ODOT
Sue Langston - ODEQ
Dave Nordberg - ODEQ
Brett Rude - Washington Department of Ecology
Bob Saunders - Washington Department of Ecology
Matt Tracy - Metro
Rick Wallace - Oregon Department of Energy

Note: Where responses to questions or comments came from persons other than DEQ staff, the source is noted in parentheses, for example, *Response (CARB)*.

Agenda Item A, Announcements:

The purpose of the meeting was to provide the advisory committee with information on alternative fuel commercialization status and potential use for generating compliance scenarios for low carbon transportation fuels, which will inform the economic analyses of costs associated with the compliance scenarios, economic impact, and feasibility. DEQ is requesting any additional information that members of the committee can provide to inform the agency's decisions.

The project schedule has been extended from an end date of 2020 to 2022, to preserve that 10-year phase in period that the bill anticipates, to account for DEQ's rulemaking process and public outreach efforts that will ensue.

DEQ will present the carbon intensity of Oregon's fuels to the Advisory Committee. Individuals interested in the details of what goes into the GREET model to calculate the carbon intensity of low

carbon fuels are encouraged to attend an informational workshop to be held at DEQ headquarters on May 27, 2010.

Comment: I would be interested in hearing from the fuel suppliers about the decision to move the date to 2022. That means that there has to be a larger reduction in gross terms, because you have growth for two more years if you are going to reduce it to 2010 levels. Therefore, it will have an impact on the programs. **Comment:** It sounds to me like it should be a whole committee discussion. **Response: (DEQ)** *We could discuss that more later, but the concept is that once you achieve your 10% below 2010 levels by 2022. All we are doing is moving it back two years. It is just a matter of having the same 10 year period to phase it and not phasing it in within 8 years given that our rule will be delayed a couple of years.* **Comment:** I understand what you are saying, but I would appreciate a discussion at a future meeting.

Agenda Item B – Biomass and Fuels Assessment

Sue Langston of DEQ provided an overview of the current federal renewable fuel standard 2, the required volumes of advanced biofuels and presented highlights of the biomass and fuels assessments compiled by DEQ staff. The federal renewable fuel standard 2 is currently in effect and being enforced through renewable identification numbers.

The Biomass Assessment summarizes existing studies on available and potentially available biomass in Oregon, such as from waste and dedicated biofuel crops. No study covers all the sources of waste biomass available in Oregon. There are several sources of waste biomass in Oregon, although there are competing uses for some biomass. Washington State has a comprehensive, recent study on waste biomass availability, and estimates that enough biomass could be made available to produce nearly 50% the state's transportation fuel needs.

The fuels assessment includes a source description of the technology, a discussion on the commercialization status in either the fuels or vehicles, production volumes for Oregon and elsewhere. The assessment also includes discussion about the barriers and infrastructure issues associated with low carbon fuels, a summary of known trends, and preliminary estimates of low carbon fuel use in Oregon for 2022. Sue Langston provided a brief review of Table 1 from the fuels assessment to give the advisory committee information about the types, production volumes and commercialization status of various types of low carbon fuels. Sue also reviewed Table 2 of the fuels assessment, and asked the committee to provide feedback on the low, moderate and high (but feasible) estimates of potential fuel volumes provided. Points raised during and after the presentation included:

- Are EPA's RFS2 biofuel goals based on an assessment of bio-feedstocks such as biomass waste or biofuels crops? **Response: (DEQ)** *Yes, They have a whole chapter on biofuels feedstocks available nationwide (Chapter 1.2 of EPA's RFS2 Regulatory Impact Analysis).*
- If Oregon does have its share of biofuels under the RFS2, then what percentage of the low carbon fuel standard requirement does that meet? Could this be put into a table with projected consumption of gasoline and diesel? **Response: (DEQ)** *In other states (Washington, California and the Northeast/Mid-Atlantic states), the RFS2 biofuels are expected to meet 1/3 of the low carbon fuel standard. DEQ intends to calculate that for Oregon as well, and expects the results to be similar.*

- Several biomass studies are ongoing. Energy Trust of Oregon is completing a more comprehensive analysis of biomass resources. The Department of Energy, Agriculture and Forestry are collaborating to quantify available biomass.
- When will the economic analysis consider this and other elements? **Response: (DEQ)** *We will talk about compliance scenarios and input assumptions for the economic analysis in June. [Please note that the schedule has changed since the April 15 meeting]*
- Are we going to do an economic analysis on biomass availability to show us what is possible, or are we just going to do a technical analysis? It seems to me that an economic analysis would be very helpful, for example for grass seed straw. There is a lot exported to Japan and other places for animal feed, bedding, etcetera, so we would be competing with that economically. **Response: (DEQ)** *We need to look at that. I know in California's economic analysis, they did look at the cost of feedstock and that certainly is something we will look at.*
- Lane Counsel of Governments is studying diverting grass straw from other markets. There is a large portion which doesn't have feed or other value. Annual rye, for example, is not in demand from the Asian market. The material is being restrained from being burned. They are having storage difficulty in most of the Willamette Valley, which is driving the price down. The market is highly volatile, anywhere from \$12 to \$45 per ton. You may have to do a study that looks at projecting the cost out into uncertain market demand conditions.
- Some portion of material is going to Asia as raw boiler fuel. We probably can do something here with it and compete on price.
- On liquefied natural gas (LNG) use in the compliance scenarios: I think not including LNG is unreasonable given the trajectory of growth and the fact that the technology is heavily commercialized for medium to heavy vehicles in particular. It is probably reasonable to include zero in the low compliance scenario, but given the trajectory of growth in transportation LNG use and the fact that the technology is well commercialized for medium and heavy-duty uses, it is unreasonable to count zero LNG contributing to compliance across all of the scenarios. Therefore, I think we should reconsider that and include a scenario with a high LNG estimate, and potentially a moderate as well.
- This is based on EPA and (California's) analysis, both of which are in a dynamic process, which means that things are continually changing.
- Some of these minimums and maximums would be competing for the same feedstock. **Response: (DEQ)** *That would be taken into account as the compliance scenarios are developed.*
- The high case is understated because it assumes that all 50 states are competing for low carbon fuels. The high case should assume that we would have more biofuels than we produce in Oregon.
- If you look at California's analysis, we are not going to get to where we need to get on the low carbon fuel penetration with our existing fleets. So it is relying on high infiltration, whether it is E15 or flex fuel vehicles or more compressed natural gas cars. The actual infrastructure is not there. If we really want this thing to work, we are going to have to address the vehicle side of the equation, in terms of supply. I do not know how to do it, but that point should be made.

A discussion followed on the impact of using various biofuels in equipment and vehicles.

- I would assume that all these biofuels would have specifications that need to be met as opposed to mandates for blending. Again, this is a market performance-based system. If something is not meeting the specification, someone else is going to jump in with a better fuel that is meeting the specification. I think those are issues and we need to make sure the specifications are there that meet off-road or customer requirement conditions.
- What do you do when you are in the middle of a job and the equipment is not working? For this to work, it has to work in individual pieces of equipment. And in much of Eastern Oregon, the equipment operates differently.
- In Eastern Oregon, I have heard a lot about gelling problems they had with 2% biodiesel that we had last winter. The fuel was separating and the biofuel was going to the bottom of the tank.
- Minnesota is not having the same problems and they have been using biodiesel for about five years. The problems Eastern Oregon is having are rampant to the point that in February the Legislature passed a bill that suspends the 2% mandate next winter so that we can look at this problem and see what it is. So it is very real and I'm not sure the existing literature is going to shed a whole lot of light on this. It is a huge problem.
- Minnesota has been the poster child of this. They had the first biodiesel mandate and, of course, it gets cold in Minnesota.
- The low carbon fuel standard is different from any type of particular blending mandate. The low carbon fuel standard can be met with no biodiesel whatsoever.
- Oregon Department of Agriculture did a great job of studying that issue. The problems have been blown up compared to what actually happened. We have lots of history in Oregon of much higher blends than 2% operating fine in cold weather snaps. Oregon Department of Agriculture did a really good job of testing fuel and seeing what was actually happening out there. One of the primary principles behind having a low carbon fuel standard and not a renewable fuel standard is that we are not saying that you have to burn 10% biodiesel whether you like it or not. At some point, the committee should be able to get to the point that we do not have to keep saying that repeatedly, and we can move past that. We are trying to create a scenario to achieve our carbon reduction goals while letting the market figure out how to make that happen and it can happen many different ways.
- The people (in Eastern Oregon having gelling problems) that you brought up earlier - were they using any anti-gel agents in their fuels? **Response: (Russell)** *They were using additives and they were not blending #1 with #2. We have traditionally dealt with the gelling of diesel, which will gel in cold temperatures. We have gone to above ground storage tanks in Oregon to reduce the ground water contamination and the fuel is more susceptible to temperature variations. Businesses with below ground tanks had no problems. The trucking companies with above ground tanks had huge problems.*
- I want to encourage us to move on, off of this topic, because it has perennially come up and we have identified that in Minnesota they do not have this problem. It is clearly just a performance specification and storage standard issue, and I think it distracts us from the discussion of the giant list of fuels assessment we have on the agenda. It continues to come up so I believe it is a legitimate concern, but I do not believe this is the forum for us to be trying to find a solution to

the ASTM specifications and additive specifications that are required. I would encourage someone to come forward with the specifications that are effective and working in Minnesota.

- I just want to emphasize that this is important and the full analysis that we need to make not be too narrow. The problem with the increase in biodiesel is an issue because it has to do with another rulemaking. We need to make sure that whatever analysis on this makes sure that we do not have many unintended consequences down the road.
- As we are planning something that is large and complicated and is based on assumptions, which affects how we assess if we will have future problems, there is a potential for real interruption of the ability to conduct business. I am suggesting in your compliance scenario that you have to consider those and allow for that. Not just specific to biofuel, but to all of them. **Response: (CARB)** *the use of biofuels was an important and critical issue in California. For one thing, all biodiesel is not the same. The properties and the quality control for some production facilities is not what it is supposed to be. A current study addresses these issues and determines exactly what specifications we are going to be able to enforce to avoid any problems. This is an issue that we need to pay a lot of attention to, because we do not want to have a problem with vehicles or equipment. Avoiding problems could require additional standards for fuel. We are looking at engines and emissions performance. Different types of biofuels might create some increase in emissions. Response: (DEQ)* *To acknowledge the validity of both sides of this discussion, I think we are saying that this is an important issue. With regard to our standard, there are a couple of ways we are handling the potential biofuels issue. One is the back-loaded phase-in-schedule. In 2022, we will need to be at full compliance and might have larger volumes of biofuels. The intervening time is enough time to study the quality control and put better practices into place. The statute requires the fuel specs, but it also requires us to defer the requirements if necessary to prevent disruptions of fuel supplies. HB 2186 puts mechanisms in place so that we can defer to the requirements for an additional year or two. Currently, we are trying to design five compliance scenarios. We have to assume in at least some of those scenarios that the problems are worked out and we can have higher levels of biofuels. We are evaluating a range of possible futures.*

BREAK

Agenda Item C, Advanced Bio Fuels

Mike Cleary, National Bio Energy Center Director, National Renewable Energy Laboratory

Mike Cleary presented a high-level look at the research being conducted at the National Renewable Energy Laboratory (NREL) with respect to the commercialization status of cellulosic ethanol production, with an emphasis on driving down the cost of biofuels. NREL has goals for reducing the cost of cellulosic ethanol production, and has met or exceeded all past cost reduction goals. They have reduced the cost of cellulosic ethanol production from \$6.47 in 2001 to \$1.90 in 2010, and hope to meet future goals as well. NREL is looking mostly at agricultural residue as a feedstock. Cleary also discussed testing of advanced biofuels for use in existing vehicles, and summarized existing Department of Energy projects and partnerships. Points raised during and after the presentation included:

- My friend is a rancher and he gets \$100 for his hay, so where are we in that scheme of things? **Response: (Cleary)** *We are presently scaling up. On our pretreatment, we building a new one-ton and 8 ton-plant. To put this into prospective, we are going to talk about pilot and*

commercial-scale projects. From our point of view, this is the first level at which people get realistic processing, engineering costs and using at least small-scale pieces of equipment that would be scaled up for commercial scale. For us commercial scale is about 2,000 tons a day of biomass and there are four demonstration plants that are in the 700 ton a day range that were funded in 2008 with targets of being operational in 2009.

- So output on that would be roughly 160 million gallons a year or 200 million? **Response:** *(Cleary) We would like to be at 100 million gallons of ethanol per ton, but we are really probably between 75 and 80. Two years ago, it was in the 40-50 range. And again, no matter how much biomass we make, we have to hold a reasonable fraction of that biomass sacrosanct for the manufacture of liquid transportation fuels. We can use electricity in many ways, but it is hard to make hydrocarbons from anything else.*
- I just wanted to frame the agricultural residue collection aggregation a bit. For a small scale commercial plant you are looking at say 20-25 million gallons, and that is what the early ones are being proposed at. You are talking about between 300,000 and 500,000 (gallons). This is by far the largest aggregation of agriculture biomass in the history of the country. So the reason that feedstock cost numbers are not firm is that no one has ever collected material at that level.
- When you were talking about going from the pilot to the commercial level, were you going to address the scale of problems for the reactors? **Response:** *(Cleary) In a new facility we are building for one ton a day, we are putting in two different pretreatment bioreactors and two new hydrolysis sub-purification systems. These are at a scale that is meaningful and therefore scalable.*

Lester Wybourny, Engineering Specialist, National Vehicle and Fuels Emissions Laboratory, Office of Transportation and Air Quality, Environmental Protection Agency

Lester Wybourny described the rulemaking for the Renewable Fuel Standard 2, the potential for use of flex fuel vehicles, and discussed commercialization status for advanced biofuels. Points raised during and after the presentation included:

- In terms of making a decision about the E15, do you have any idea what kind of timetable that EPA is on? **Response:** *(Wybourny) Well I expect that we will reach a decision sometime the summer of this year. EPA is doing additional vehicle fuels testing at NREL to support that decision. It is focused completely on transportation cars.*
- One of the benefits of the flexible fuel vehicle is that you do not have to blend all the way to E85. You can use 50% ethanol. Will there be changes in engine technology which would overcome some of the energy density penalties that you have with ethanol? I mean obviously all the (existing) engines were designed for gasoline and not for a higher-octane fuel. **Response:** *(Wybourny) The first question, let's say that instead of going all the way to E85, you go to something like E50. It may be the pricing of E50 could be closer to gasoline and it helps you in terms of pricing for a high price ethanol and E85. The challenge there is that then you need to have more vehicles using E50 to use up the ethanol. The second question: I am not a vehicle specialist so I cannot answer that.*
- Butanol is much more transparent than Ethanol. What is the legal ability to use Butanol as a fuel and what about the intellectual property for producing Butanol? **Response:** *(Wybourny) I know*

that companies are talking about actually taking existing corn ethanol plants and converting them over to Butanol.

- Can butanol legally be used as a transportation fuel? **Response: (Wybourny)** Yes. The problem is that butanol you can blend at the refinery, but you have to make sure you keep it segregated from the rest of the gasoline pool, because the rest of the gasoline pool is all blended with ethanol.
- The other thing I would add is it is that DuPont has a biobutanol project as well. The issue there is still the economics of being able to produce it in significant amounts. I feel comfortable that the economics are going to work out.
- Could you comment a little more on infrastructure issues and using E50 in the E85 vehicle? **Response: (Wybourny)** There are issues about trying to even use E85 because you have a fuel that is too low in Reid Vapor Pressure. One way forward is that you have butane at every terminal to blend that in. But then you force all of these terminals to have butane spears, which is a challenge in itself. The ASTM committee is likely to allow for lower blends of ethanol less than E85 so that you can meet the vehicle pressure minimums for the ASTM standard for E85. Now how would you use E85 at the pump? One way is that you could have E85 and then you could have the blending pump. You could blend the E85 with gasoline and have a mixture that is less than E85. I am not a distribution specialist. Our distribution person has looked at this a lot.
- Why aren't you testing off road equipment for E15? **Response: (Cleary)** Earlier than the year 2000, we have some concerns with using E15. We believe that the tier two vehicles were designed to be more able to adjust the blending ratio (with air) to accommodate a lower blend mixture than an E15 would present to the engine. With older cars, we would probably have to reserve gasoline pools so that they would be able to use something less than E15. They are flexible enough to handle E10. In most cases, they are not capable of using E15.
- If we do not make this change until we satisfy all of the non-road small engines, outboard motors, etc. we are letting the tail wag the dog. The huge amount of volume has got to go into transportation vehicles and my personal opinion is that it is time for the small internal combustion engine manufacturers to come into the 21ST century when it comes to being able to use other than true gasoline.
- I would actually agree with you on that statement. However, being on the front line of retailing fuel products, it would be tremendously helpful to have research that we can turn to. **Response: (Wybourny)** Clearly, there has to be some changes in the design, etc. to small internal combustion engines. They are way behind the curve compared to the vast amount of internal combustion engines used for transportation. If necessary, then one of those pumps will just have to be gasoline with no oxygenates in it and then I guess the marketplace will decide at that point.
- Currently in Oregon, E85 is actually priced on an energy equivalent basis at the pump. And you have a 42 cent a gallon state tax credit. The economics of it, for an individual consumer, is favorable. I would say that one of our barriers is the perception of ethanol and E85 in the marketplace, but also people buy flex-fuel vehicles (FFVs, which can run on gasoline or any blend of gasoline and ethanol up to E85) and have no idea that they have a FFV. We run into that all the time where we are telling people, you know you could be saving 90 cents a gallon right now because you have a FFV and they are completely surprised.

- There needs to be some work done by the EPA to accept butanol. As for somebody patenting the process, I think the answer is yes, they are.
- DEQ is considering not including algae fuel in the compliance scenarios, but EPA did have a number for algae in RFS2. How did you come up with that number and would you recommend that Oregon include a proportionate share as we move forward in looking at biodiesel as a future fuel for Oregon? **Response:** (Wybourny) *I really do not know what number we came up with for algae. We talked to individual algae companies and got some information from them. NREL did a study for us and they estimated, the energy needs, production volumes of different algae technologies, open pond, etc. and we assessed the life-cycle impact based on that.*
- If you were giving these talk four years from now how optimistic are you that cellulosic ethanol and diesel would be working? **Response:** (Wybourny) *Clearly, there is a tremendous amount of effort working on modifying the pathway and from there to drive that sugar into more hydrocarbon rich molecules. We could try manipulating the fatty acid pathway, again, starting from sugars. The issue is they are heading to Brazil to use sugar from sugar cane. So, I still believe the crux of the matter is, are those organisms productive enough in their synthetic capability, are they going to be able to handle and manage the a lot dirtier intermediate sugar that come from the production of the intermediate for liganocellulose. Therefore, I am confident, as I am a technologist myself, that they are going to be able to engineer these organisms and they are going to be able to meet some economic targets based on sugar. The real question is can use sugar derived from liganocellulose.*
- There are challenges to each of these technologies and just because you have developed a technology in the lab and demonstrated it in some sort of a simple pilot plant does not mean that it is going to work on full scale. It is a very challenging pathway for any of these technologies. I think it helps that DOE is funding to offset some of the capital costs and some of the development costs as well as the USDA's funding. We have the renewable fuel standard, which requires that that fuel is available and has to be used. I am very optimistic that we are going to see a lot of cellulosic biofuel being produced, but it is a slow start because there is a lot of development work that has to happen before you commercialize.

Agenda D- Electricity as a Transportation Fuel

Dave Nordberg discussed Oregon's low emission vehicle program and the minimum zero emission vehicles required by DEQ rules. Points raised during and after the presentation included:

- We have to disabuse ourselves of these zero emission vehicle annotation for electrics. They are relocated emission vehicles. Nighttime charging is not gas, it is coal.
- It is zero emission at the tailpipe, but in the lifecycle analysis it is not zero emission. There is an emission impact in generating additional electricity. **Response: (DEQ)** *When we are talking about other pollutants besides greenhouse gases, the location of the emission is critical. We tend to have issues with ozone in our urban areas. Therefore, when we say zero emission vehicles, we are primarily talking about tailpipe in terms of an ozone strategy. In terms of climate change, the lifecycle analysis will capture all of this. It will take into account the emissions from power plants and the efficiency of electric vehicles and see what the benefit is.*
- When will the economic analysis be able to look at those other benefits of local air shed?

- In the process of changing emissions from the power plant to the vehicle, you are gaining a larger efficiency in the process, by reducing the amount of power needed by a factor of three.
- Just a quick reference, how many cars are there in Oregon? **Response: (DEQ)** *Right now, in Oregon, we have 3.7 million cars. There are about 200,000 per year sold new. That has dropped off recently. It is quite a bit lower, but traditionally, we are looking at 200,000 vehicles per year.*
- How will these rules be enforced or implemented? **Response: (DEQ)** *These are rules that apply to the auto manufacturers and the number of vehicles that are delivered to Oregon for sale. They demonstrate compliance to us on an annual basis.*
- What happens if nobody buys one of these?
- Are you going to address how much capacity is going to be required for these charging stations? I would like to see some information on constraints on where we can generate capacity. **Response: (DEQ)** *I do not know if we have that quantified, but hopefully Maury will be able to address the capacity of the grid to accommodate electric vehicles. In May, we are going to be taking on these and issues related to the carbon intensity of electricity and who the opt-in parties will be.*

Art James, Oregon Department of Transportation

Art James described Oregon's electric vehicle initiatives, the transition in the market from low-speed, limited range neighborhood electric vehicles to a new generation of highway speed electric vehicles. He described types of charging infrastructure, barriers to electric vehicle use, and a transportation electrification grant, which will test electric vehicle use and charging infrastructure in Portland, Salem, Corvallis and Eugene. Points raised during and after the presentation included:

- How much would a Nissan Leaf and home charging station cost? **Response: (James)** *Nissan just announced pricing on that Leaf about two weeks ago and they are pricing it at \$32,000, pre-incentive. Participants in the transportation electrification grant have more costs defrayed.*
- What about cost of chargers? **Response: (James)** *They are approximately \$3,000 for a residential one. Public chargers are more. It has to do with power supply cost.*
- What about current battery life and recycling options? Also could you speak to the perception that these cars really will not have much appeal in rural communities? **Response: (James)** *Manufacturers tell us batteries will last ten years. At some point, the battery may be degraded by 15-20% and not an efficient battery for vehicles, but still has 80% of its capacity. Utility companies are looking at re-using batteries for backup storage or as a backup for server farms or large computer applications. It is not like the acid batteries where you have harmful chemicals. Appeal for rural area: nobody has announced plans yet to come out with an all-electric F-150 pickup truck that will go 500 miles. For compact driving these vehicles are enormously economic to operate, at about 1 ½ to 2 cents per mile in an electric car compared to 15 cents maybe in another vehicle. They are low maintenance.*
- Have you done an estimate for the gas taxes that will be avoided by using electric cars? **Response: (James)** *Obviously as an ODOT person, we want a gas tax. There has been a pilot study on the per mile charge which will be part of the conversation going forward. Charging stations are equipped with the technology to read miles.*

- What about cold weather performance of electric vehicles? **Response: (James)** *These vehicles have been tested in cold weather. Mitsubishi had no performance problem in Michigan in the middle of the winter. It does take a little longer to charge the battery in cold weather.*
- Since electric motors can generate a lot of torque that there is hope and promise for use in heavy duty applications. **Response: (James)** *Yes, they are available. You are right about torque.*
- There is actually an electrical application on air travel in of Los Angeles and Long Beach.

Maury Galbraith, Electric Rates and Planning Manager, Oregon Public Utility Commission

Maury Galbraith gave a quick overview of the role of public utility commission, informed the committee of a stimulus grant to figure out how to handle the influx of electric vehicles into the grid and a specific electric vehicle investigation that the PUC has opened up. Points raised during and after the presentation included:

- What issues that might arise from commercial establishments providing charging infrastructure for electric vehicles? Will they become utility providers under the regulation? And at what level will they charge an extra implement? **Response: (Galbraith)** *In general, there is a prohibition in this state on the resale of retail electricity. In other words, if you purchase power from Portland General Electric, say if you are a MacDonal's and you purchase power from Portland General Electric, there is a prohibition on you reselling that power to someone else. Now that statute does have a provision in it for electric vehicle charging and exempts electric vehicle charging stations from falling into the regulation of PUC. Other issues include off-peak charging incentives, metering issues, data collection issues, battery deployment, utility investment in batteries, and stranded cost issues. We are an economic regulatory agency who sets rates. We have a stimulus grant to hire some utility analysts to try and avoid becoming a bottleneck to doing these innovative things. We've got an investigation open and we would love your input on what issues need to be tackled.*
- To develop rates that encourage off-peak charging could be perverse based on the incentives and objectives we have here because of the mix of our nighttime fuel supply. Do you have any time of day related carbon analysis that has been done? Many base load power plants are coal. **Response: (Galbraith)** *That information could be gleaned from utility integrated resource plants. There is a perception out there that you need to distinguish between the generator that is on the margin and the generators that are just running around the clock. And your point is that there is a lot of coal fire generation that runs 24/7, that is just always running. But, if you are looking at what the marginal resource is, for the majority of the off-peak hours, it is still a gas-fire turbine. It does not mean that coal is not running. The coal is running, it is just not marginal. It is not what will be turned off next if you were to decrease that.*
- That cautions us about treating different fuels different ways, because the next new marginal kilowatt hours may be different than our base load characteristics of the carbon in our petroleum and so we want to make sure that we are not always looking to that next new marginal, but we are looking at the carbon contribution currently. **Response: (Galbraith)** *I think you want to look at carbon intensity at different times at different seasons of the year.*
- How much non-intermittent resource need to be added to support the intermittent, because that in some ways may represent future marginal supply. **Response: (Galbraith)** *It is an issue that has*

been under discussion for several years now and it will continue to be under discussion. So it really goes to how much flexibility, because what we are talking about here is being able to ramp generation up and down when the wind is either falling off or rising. We want to go in the opposite direction of the intermittent resource. How much flexible generation do we currently have and when might we run out and when we run out what do we want to add to get more. In my mind, those are the three questions and the answer to any of those questions is still unresolved. We really do not have a real clear sense as to how much current flexibility we have in the existing system. Bonneville has taken a look at it and said they are getting close to the point where they are going to run out on their system. But you need to remember that Bonneville has the vast majority of the wind on its balancing authority today. There are other balancing authorities in the Pacific Northwest that have not reached the level of wind penetration that Bonneville has. It is an open issue as to how much flexibility we currently have, how close we are to running out of it, and what we need to do to get more in the future.

- To put this in context, with 11,000 cars at 130-140 kilowatts a piece, if they were all charging at once that is 1.4 megawatts, that is a very, very small proportion of our average statewide connected load.
- One of the electric utilities about the effect on rate payers of added capacity in order to support the added load from electric vehicles. Specifically if imposing added load costs across from the base rate payers and whether that would be allowable and how that would be balanced and whether there would be rule changes? Is PUC was doing investigation into that issue and how to resolve it? **Response: (Galbraith)** *It sounds like you are referring to a provision in our statute that is called the Used and Useful provision that means the investments by the utility, if they are going to be recovered in rates, must be Used and Useful. There are two aspects to the Used and Useful situation. The traditional application of it in utility regulation is that at the end of the investment's life it comes out of rates when it has run its economic life and is no longer useful. I think the application of it in this case would be at the front end of the life, where the utilities make some initial up-front investment to kick start electric vehicle adoption. Get the charging stations out there, take care of the range anxiety and I think that people are wondering if the Used and Useful standard is going to be a barrier to doing that. In other words, if the stations are put in and you do not get a large adoption of electric vehicles and the utilities are trying to recover those costs, is that Used and Useful standard going to prevent that.*
- Utilities have an obligation to serve on a peak day because wind is an intermittent resource they have to back up every megawatt power of wind with something else. From a peak day perspective, wind delivers no energy from a planning perspective. I do not know if that is how every utility treats it, but that is one approach to the whole notion of how we back up these intermittent resources. To your question, what other resource is there scalable available to utility than natural gas? There is no nuclear, coal, and probably not much hydro. What are going to add for capacity? **Response: (Galbraith)** *I think you are correct that our options are becoming more and more limited on what we can add for capacity. I think that for the short term you are talking natural gas resources. There are other options out there. People are taking a close look at pump storage and other resources, but they have very long construction lead times. It is not something that you can bring on line the next two or three years, but more like 10, 12 or 13 years. On the other point about what for every megawatt hour of wind capacity that you have, you need to have a backup; I do not think it has to be megawatt for megawatt. It does not have to be equivalent, because there are some utilities that are currently surplus on capacity or they are already short.*

It is really the surplus sources that are the most interesting, because they are the ones that you don't have to add megawatt for megawatt. They already have a cushion in their system.

- Say demand could stay still for a minute. Adding wind does not demand more capacity. It is actually increasing capacity. What might have been base could go to firming up a renewable or an intermittent. If we can get a cap on that demand, then adding wind does not build to it. You are subtracting more than you are adding.

George Beard, Executive Leadership Institute, Office of Research and Sponsored Projects, Portland State University

George Beard presented considerations of drivers and barriers to electric vehicle adoption, presented a rough model for predicting adoption rates in Oregon through 2020, and included probable case and high-end estimates. In making the future electric vehicle adoption estimates, Beard considered technology adoption rates, intervening variables which might impact adoption of electric vehicles, recent public opinion research on how likely people are to purchase electric vehicles, population growth, vehicle replacement rates, and characteristics of Oregonians. Beard predicts somewhere between 240,000 and 288,000 electric vehicles by 2020. Points raised during and after the presentation included:

- How will you temper any of your estimations for computation between electric vehicles and hybrids, and what if people say they are very likely for my next car and, then they do not buy one? **Response: (Beard)** *It is a great question and Portland State in partnership with a number of folks is trying to understand the difference in the sociology, the anthropology of these cars. So if you turn around and you get a battery electric Nissan Leaf that goes 100 miles, it may not be ideal to then have to use an internal combustion engine to regenerate power to the battery, but it is a lot less worse than running 100% combustion. We do not know yet what the use cases are and how the market will respond, but we are simply trying to give our citizens choices and learn what makes sense. We are going to jump heavily into light duty urban freight mobility as well.*
- How collated is this to the uptake curve of hybrids? In Oregon's history, hasn't the hybrid market share satiated some of the enthusiasm for the electric vehicle? In addition, if we have a six-year turnover, aren't those people's appetite for next generation technology met? **Response: (Beard)** *I am going to qualify it by saying, I am only speculating here. But, because of the powers of natural selection, the early adopters who bought Prius in Portland and elsewhere in Oregon, we are beloved by Toyota. They think that Portland is the coolest place in North American. The Nissan people will turn around and say you know what in our polling we found out that there is a lot of motivation to go from a hybrid vehicle to a pure battery electric vehicle.*
- There is interest in electric vehicles in rural Oregon.
- DEQ did similar calculations as far as projecting high and low estimates. If we were to hit 20% new vehicle sales by 2022 and we went straight up from zero to 20% in these sales, I (Dave Nordberg) come out with a figure of about 129,000 vehicles on the road by 2022, which is not far off from his high estimates. On the low estimates, if we went to 5% of new vehicle sales by 2022 that would seem subjectively to what might be a conservative approach to a low number of electric vehicles. That is highly subjective.
- Just to let you know if you have input, DEQ would be happy to hear it. We are taking input on this issue until April 30th 2010, so email us or just call or however you want to communicate.

Public comment: Angus Duncan, Global Warming Commission

With regard to carbon content of those miles that are going to be driven by electric vehicles, even if it is plugged in at night and even if you did not assume that it was being met by the marginal gas instead of the coal. At some level we have to assume that there is going to be substantial electric vehicle market penetration and therefore needed additional base load. But pretty much every analysis that I have seen, government and interest group, has been pretty clear that if you plug your electric vehicle into a wall socket in your garage and it is fed with electricity from a pulverized coal plant, that you are still on a carbon basis but it is substantially less carbon intensive when you get in that car and drive it. Yes, you are technically driving coal generated electricity, but you are displacing another fossil fuel, another hydrocarbon, gasoline, and the efficiencies of a single large coal plant are so much greater even after allowing losses from transmitting from Wyoming to Portland, Oregon and putting it into an electric vehicle that there is a significant carbon savings to doing that, assuming the worst coal based resource case. And if we assume that increasingly as coal plants are retired and are replaced by base load gas plants that carbon benefit increases proportionately, so electric vehicles are a very significant carbon reduction mechanism even given the existing resource configuration in the country, let alone in the Pacific Northwest. Secondly this question of how intermittent resources interact with the system. Because there is a tendency to think one dimensionally, that if you put a wind project on the system and you have to have electricity when someone flicks the light that you need a dispatchable resource, gas or coal, immediately behind it and you have to match it megawatt for megawatt. If you really push it to the extreme and that back-up megawatt needs to either be running or it can be ramped up in seconds because the wind could die off in seconds. As a practical matter, that is just not how the system works. The system calculates its reserve obligations while looking at a whole range of resources, not just any one source and it also looks at the diversity among the resources. It looks at the consequences if one wind trimming was banned, which is 1-400 megawatt coal plant or 1-1,100 megawatt nuclear plant on an unscheduled outage. It has to calculate how much reserve is needed for a variety of different scenarios not just one involving wind and wind dropping off almost instantaneously. Even if we were looking at that, we would also have to look at the regional resource diversity underlying that wind resource. Because you can have the wind dying off in a project over here and the wind coming up on a project over there, you can decide if you are going to look at it on a seasonal basis, or an hourly basis or a minute-to-minute basis. We get different calculations in each one of those cases and I could really belabor this and get tedious, but I promise you I will not. The only other point that I wanted to make was that when we started the project that I am still involved in called The Regional Wind Integration Project, which is chaired by Bonneville and the power council. Pretty much all the utilities in the region participate in that and a few riff-raff members like me. We look at a number of different things. We looked at what the existing system would accommodate by way of new penetration, what kind of tweaks you could do to the systems to up that before you had to add any new resources whatsoever. In addition, then you looked at what the range of new resources might be, storage and demand side and generation that could add to the system flexibility. Long story short, I think Bonneville and the utilities were pretty nervous about anything assuming 10% wind penetration. The Bonneville system is already up between 15-20% and they are operating without having to add any new flexibility. They have tweaked the system. They have expanded some of the balance in authority in the connections that are compared to that. There is at least one study from the upper Midwest that suggests that you could get as much as 30-35% wind penetration

or wind and solar intermittent penetration before you had to start adding new reserve capacity. So there is a lot of flexibility still in the system and frankly, electric vehicles testing that system make me a lot less nervous that the potential that we will be shutting down a very substantial amount of the coal fuel in the next 20 years. One of the resources that we looked at in that integration project, and it is in the report, that is a potential significant contributor to adding flexibility into the system is plug-in electric hybrid vehicles. So, while they may test the demands and capacity back to the system, because of their storage capability, they may also add significant capacity to the system. And they may add at the wind, similar to that in Wyoming where it has to come over through wires, but right here in downtown Portland. So it's a more complicated subject than obviously you have time to get into here, but I think issues of electrical system capacity being able to accommodate even George's most ambitious projections is an issue that we have to deal with, but it is an eminently manageable issue at this stage.

Agenda E, Natural Gas as a Transportation Fuel

Todd Campbell, Director of Public Policy, Clean Energy Fuels

Todd Campbell discussed the benefits of an Oregon LCFS, the economics of natural gas compared to oil, and talked about the new discoveries of natural gas in North America, which have dramatically increased projections of available volumes. He described the wide variety and types of passenger, heavy, and medium duty applications that use either compressed natural gas or liquefied natural gas. He also described some projects producing very low carbon biogas from landfills. Points raised during and after the presentation included:

- Natural gas can be used as a transportation fuel or to make electricity for use in transportation. Which is more efficient? **Response: (Campbell)** *I think the most efficient use of natural gas would direct use application.*
- How much gas is currently available and how many natural gas vehicles would be available? **Response: (Campbell)** *Natural gas is distributed throughout the country. In 2008, we went from 120 years of proven reserves to about 200 years of proven reserve due to the efficiencies of being able to pull and extract that gas out of the shale.*
- Due to a new production technology that gave access to these vast reserves of shale, everything is on its head in our industry. We are not talking any longer about a resource that is in short supply, but rather one that is clearly abundant, clearly available, clearly domestic, and clearly North American produced.
- Can you retrofit a gasoline-burning engine to change over to compressed natural gas? **Response: (Campbell)** *You could, but you should use an EPA certified conversion.*
- Do you think that the public is going to spend \$2,000 on home based compressors? **Response: (Campbell)** *There is a \$2,000 incentive. I think as more policies are adopted and more of these are produced you will have some price relief.*
- What safety issues are there with natural gas used for transportation? **Response: (Campbell)** *Natural gas vehicles are very, very secure and safe. Every three years you have them inspected, because you are fueling with high-pressure systems.*
- Shelf gases might have indirect land use affects or impacts that have not been assessed on a carbon basis. In addition, water use has rarely been addressed. The other issue is if there is so

much shale around and it is \$6.00, how does that biomethane play practical if it takes \$8.00 to get it to market? **Response: (Campbell)** When you are talking about the contamination of aquifers it is not even at the same drilling level. The depth of what we are doing is vastly significant. You do not have that kind of cross contamination of water with shale exploration. There is water used, but the industry is reusing about 60-70%.

- If shale gas costs \$2.00 more to get it out of the ground, the assumption that the cost has no energy content to it, is curious. I just want to see the math. **Response: (Campbell)** I think that a fact that we have realized or recognized is so much gas that the price of the market went down to \$4.00 and could possibly go down to \$3.00. However, then the price will rise back up and you will see the race go and you will see the price go back down again.
- A headline in the Wall Street Journal about a week ago says that the EIA has not been collecting shale gas production data all that well and that the price of natural gas may be depressed because of that. We have two gas experts here. Is there a shale gas bubble that is about to burst here? Are we about to learn that the EIA has been dramatically over-estimating shale production and we are going from \$4.00 gas to \$6.00 gas in matter of weeks? We went down once. Are we going back up? **Response: (Campbell)** I think the EIA has been a horrible agency in terms of projections. I am not worried about one article or what the EIA thinks in terms of what this country has in terms of supply because if you look at what is being produced and the ability for us to deliver on that shale; I think that the data will show otherwise.
- Just to be clear, it was not the EIA that discovered the problem. These were Wall Street analysts who went to the EIA and said you are over-estimating shale gas. **Response: (Campbell)** I think it is important to understand that some of what dictates prices is the perception of how commodity is available for delivery in time and that is part of what EIA is talking about as revising those procedures for making those estimates. But probably a bigger part of what dictates commodity prices and indicates natural gas and others is what is actually available and that has not been changed based on EIA says was produced last month.
- Is there any way we can sense of a possible estimate for the year 2022, how many we might expect in the state? **Response: (Campbell)** I would be more than happy to provide those same principles to Oregon and show you the estimates.

Agenda Item F - Sue Langston, Compliance Scenarios

Hydrogen: DEQ is considering not using any hydrogen in our compliance scenarios. What input does the advisory committee have?

Committee had no objections to leaving hydrogen out of the compliance scenarios.

Liquefied natural gas: In terms of putting together a compliance scenario, the question is: do we want to add one scenario that assumes optimistic incentives and projections for LNG?

There is real potential for LNG, especially for long haul trucks. What kind of incentives are available?

It is reasonable for Oregon to expect that there will be, that some contribution will be made, so in the moderate case I suggest that we add LNG.

Todd Campbell agreed to pull together estimates of use in Oregon for CNG and LNG.

Electric vehicles

- I would like to see that curve that was projected collated with the market implementation or adoption of hybrids in Oregon. The adoption rate of hybrids could indicate a likely adoption rate similar for an electric fleet.
- The high estimate ended up at about 5% of the fleet by 2022. How does that compare to what the Northeast states came up with for their high estimates? **Response: (DEQ)** *Theirs was actually a total of 8.8%, 4.4% of plug in hybrids and 4.4% of full battery electrics.*
- This projection from George Beard was conservative on electric vehicles. However, they are so low carbon it seems like we should have a case that is optimistic. In addition, I don't know whether the 5.5% is optimistic enough. California used then about 7-8% in some scenarios. They looked at low and high penetration scenarios.
- You wouldn't want to have a compliance scenario that assumed more of a fuel than you think could possibly be produced cause because it wouldn't be a realistic scenario. We are just trying to find how much of these different fuels, low, medium and high cases so that we can put together those different combinations in realistic compliance scenarios. We want to make sure they are all possible. You do not want to assume the high in every single scenario for the same fuel. This building block for compliance scenarios.
- We are looking at California and the Northeast who have not implemented yet and we are saying that their estimates are the best we have. We may have a couple of people that are qualified to talk about this stuff. And we are using that to build estimates. It seems like we ought to get some qualified techs that have some expertise in this area to develop this kind of data. It does not seem like this is a robust process.
- Nobody is going to know for sure how much of these fuels can be delivered, it depends on so many factors that cannot be forecasted. We are going to do an economic analysis on these five different scenarios. One is a high electric future. One is a more natural gas future and one is more of a biofuels future. We are seeing different ways of meeting this rule and then we will do an economic analysis and we will have a hired expert to do that analysis that will tell us what it would cost to deliver this. We just want to hand them five scenarios that are within the range of plausibility. Yes, we are going to be putting together five scenarios and they have a 10% reduction.
- **CARB:** If I may say, I think you have plenty of information to do an analysis of different types of scenarios that you are talking about. I think you are in good shape to put together realistic scenarios that might happen in 2020.
- I am more comfortable with numbers that we heard today. If we were going to pull from the Northeast or California then bring those numbers in here for comparison. I am more comfortable with going with what we heard today as far as that high estimate.
- I do not disagree with that perspective. It is just that these numbers from today are based on business as usual. We are adopting low carbon fuel standards based on a 10% reduction and that will provide an incentive that does not exist today. If it turns out that electric vehicles are the

cheapest way to meet the standard, use of them could increase beyond business as usual. If we are evaluating five different compliance scenarios, we are not determining what is going to happen. We are just saying, what would it cost if it went that way?

- It seems to me that there ought to be one scenario where you push electric as far as you can and see what happens. If 20% of the vehicles manufacturers are going to produce are electric, and that is without us having a low carbon fuel standard, we could predict higher numbers of electric vehicles. Although we do have a low emission vehicle requirement that is driving that as well.
- Car manufacturers move slowly as far as bringing production into line. A new vehicle takes eight years from design to production. Even if with a very sweet incentive, I think the manufacturers are still going to be slow to respond to this. So what is the balance with number of vehicles vs. the incentive? I would like us to stick with what we have seen and understand. In addition, if we are going to pull something out from the outside in then just show apples to apples.
- One of the five scenarios ought to push the envelope on electric beyond 5% electric vehicles.
- Well I thought the presentation today was sort of pushing the envelope.
- I am concerned about the push on the electric side under a low carbon fuel standard. If you want to have an electric car program, the most efficient way to do it is to have an electric car program.
- Instead of seeing five scenarios with one thing maxed out, I would like to see a scenario with moderate in it.
- I am comfortable with having a scenario that contemplates a more aggressive adoption of electric vehicles, as long as there is also a scenario that contemplates more aggressive adoption of CNG as well. All you are really doing is defining the jaws and then everything in between is what is really going to happen. Somewhere in between your lowest scenario and your highest scenario is where reality is going to hit.
- **CARB:** I would say that the objectives of the scenarios are twofold. The first is to say that the low carbon fuel standard is feasible. The second objective is to estimate cost. It is not to promote one technology vs. the other.
- That is the main point. We want to show a balance. We want to show what it would cost if we invest in that scenario. We just want to make sure all of those scenarios could possibly be implemented and to see what the contractor would assess the costs. In the end, we are not going to mandate any of those scenarios the market will determine it in the long run.
- The legislature may choose to adopt policies that spur one development and in order to ensure that a mandate is met, but that is not the problem.
- DEQ needs to show the logic behind how you reached the numbers in the five scenarios.