THE OREGON BUSINESS PLAN ENERGY DISCUSSION PAPER

For Discussion at the 7th Annual Leadership Summit

SUMMARY

As initial steps to create and implement a comprehensive energy policy for Oregon, the Oregon Business Plan recommends the following:

1. **Create the Oregon Energy Council, as suggested by the Governor, to make recommendations on energy policy for the state.**
2. **Accelerate energy efficiency initiatives for both commercial and residential retrofits, as well as identify opportunities to make energy generation, transmission, and delivery more efficient. This provides the lowest cost way to reduce greenhouse gas emissions.**
3. **Diversify Oregon's natural gas supply sources by encouraging access to additional supplies through the development of additional pipeline capacity and LNG importation facilities.**
4. **Expand the region's electric transmission system to integrate increasing amounts of wind power and other renewable energy (solar, geothermal and biomass) and maintain system reliability.**
5. **Maintain and enhance Oregon's existing hydropower resources so that they can be used to meet electric demand and assist with integrating intermittent wind resources into the power grid.**
6. **Accelerate adoption of electric cars and natural gas vehicles through demonstration projects and tax credits.**
7. **Craft state and federal carbon reduction policies to insure traded-sector industry health.**

The Oregon Business Plan proposes to add energy policy as a new initiative for 2009. During the upcoming year, we seek to engage business leaders from a variety of sectors to work with elected officials and other interested groups to develop strategies to achieve the very ambitious goals laid out by Governor Kulongoski and the Legislature.

The Oregon Business Plan believes Oregon should aspire to:

1. Provide affordable (competitive) and reliable electricity and natural gas to the industrial, commercial and residential sectors.
2. Substantially reduce greenhouse gas emissions and dependence on oil.
3. Spark innovative products, services, and investment in infrastructure to help achieve the above goals and generate new jobs, economic growth and additional export income.

The Business Plan's aspirations on energy cannot be achieved without concerted, thoughtful action. Focusing only on reducing greenhouse gas emissions, without carefully considering the impacts on existing business, could cause energy prices to become uncompetitive and unreliable. This would expose Oregon to the risk of severe economic disruption and displacement. On the other hand, if we develop a balanced energy policy based on practical strategies focused on energy efficiency, we have the opportunity to provide global leadership on one of the most important issues facing our planet -- and from that leadership we can generate new jobs and economic wellbeing for Oregonians.

This paper provides background on the energy challenges we face. It does not have the answers. At the Energy Summit this past August Governor Kulongoski called for a State Energy Policy to be developed. This would require careful study of the issue to identify comprehensive plans. We support this idea.

Oregon has already taken a number of actions on energy:

- Renewable portfolio standards
- Business Energy Tax Credit
- Public Purpose Charge
- Energy Trust of Oregon
- Improved commercial and residential building codes
- Established aggressive greenhouse gas (GHG) reduction goals

Six opportunities deserve immediate attention in 2009:

1. **Accelerate Energy efficiency Initiatives** for both commercial and residential retrofits as well as identify efficiencies in energy generation, transmission, and delivery. This provides the lowest cost way to reduce greenhouse gas emissions.
2. **Diversify Oregon's natural gas supply sources** by encouraging access to additional supplies through the development of additional pipeline capacity and LNG importation facilities.
3. **Expand the region's electric transmission system** to integrate increasing amounts of wind power and other renewable and low-carbon energy resources.
4. **Maintain and enhance Oregon's** existing hydropower resources so that they can be used to meet electric demand and assist with integrating intermittent wind resources into the power grid.
5. **Accelerate adoption of electric cars and natural gas vehicles** through demonstration projects and tax credits.
6. **Craft carbon reduction initiatives with an eye toward traded-sector industry health. Business leaders should engage with policy-makers to help craft proposals that support the state's traded-sector economic strategy.**

The Business Plan proposes that business and public leaders join together and work on these opportunities in 2009, understanding that additional actions will be developed by the newly created Governor's Energy Policy Council.

As policy-makers contemplate cap and trade, carbon emissions regulations, carbon taxes and other mechanisms to reduce GHG emissions, it is important that we implement strategies that make sense for Oregon's unique traded sector economy. A coalition of stakeholders, including the Global Warming Commission and several statewide business associations has sponsored an economic study of the Western Climate Initiative proposal. The report from this study should be completed by early January.

We hope that this report will contribute **to** constructive public policy discussion, recognizing that additional research will likely need to be done. Carbon regulation is new territory for both our state and federal law makers, and the more information that is shared and dialogue that takes place the more likely we are to get it right.

Oregon's Current Energy Policy

On October 27th 2008 Governor Kulongoski released a climate change proposal for Oregon. This document describes a proposed legislative agenda designed to implement a widespread strategy across the Oregon economy to GHG emissions and achieve the State's goals for future GHG emission reductions. The proposed Oregon strategy would encourage new renewable energy and widespread energy efficiency programs that will include new building

codes, zero emission buildings and electric vehicles. The goal is to establish Oregon as a leader in GHG reduction actions.

The Governor's proposed climate change proposal would, if implemented, reduce GHG emissions through increased energy efficiency, additional incentives for installing new renewable energy supplies and sustainable transportation. In releasing this proposal the Governor said, "We have reached another historic moment in our understanding of the environment – and the economy, the unregulated and unmitigated emission of CO2 and other greenhouse gases into the atmosphere is changing our climate, threatening our ecology, keeping us dependent on foreign sources of energy, and – if nothing is done – is a missed opportunity to reinvent our national and state economies."

In 2007 Oregon passed House Bill 3543 which undertakes a number of actions to reduce GHG emissions. The bill established GHG reduction goals that call for the reduction of GHG emissions to begin in 2010 and by 2020 achieve a total emission level for GHG in Oregon that is 10% less than the amount emitted in 1990. House Bill 3543 sets further reduction targets for GHG emissions to 75% below 1990 levels by 2050.

These are very aggressive goals for controlling GHG emissions and they have stimulated considerable discussion and debate about how best to reach them without significantly altering Oregon's competitiveness for business or causing large economic disruptions. As a first step in moving Oregon toward the goals of HB 3543 the Governor proposed developing net-zero energy use building codes, expanding the Business Energy Tax Credit to include new more efficient vehicles, development of energy performance certificates for homebuyers and a regional cap and trade program to reduce GHG emissions.

In this paper the Oregon Business Plan provides a context on Oregon's energy use in the major sectors of electric power, natural gas and transportation. These three sectors account for the majority of GHG emissions in the state and offer the opportunity to reduce future emissions though changes implemented in the coming years.

Oregon Energy Vision

Through a combination of legislation and policy proposals like the recently released Governor's Climate Change Proposal, Oregon is beginning the conversation that will create a new State Energy Policy. Oregon needs a clear coherent energy policy in order to achieve even a small portion of these aggressive goals. The policy tools that have been discussed include a legislated cap and trade market for carbon emissions, a program for constructing "net zero" emission buildings, expanded incentives for development of new renewable resources, and increased Business Energy Tax Credits to encourage increased efficiency and renewable investments by Oregon's businesses. These actions need to be analytically evaluated with respect to their effects on achieving the GHG emissions goals both in the short- and long-run.

In addition the Governor is also proposing to encourage sustainable transportation in a way that is consistent with the Governor's transportation initiative. The concept of sustainable transportation seeks to increase use of low carbon fuels, reduce vehicle miles driven and increase use of electric vehicles & plug-in hybrids to reduce GHG emissions from the transportation sector and to reduce dependence on foreign sources of oil.

Population is the Key Energy Driver

Oregon's Office of Economic Analysis prepares the population forecast for Oregon shown in Figure 1. The population forecast for Oregon is that the state will continue to be an attractive place for people to live and work. By 2025 Oregon's population is projected to reach 4.5 million people. This projected growth rate adds approximately 1 million new people to Oregon every 20 years. As the population grows there will also be greater demand for energy in all forms along with increased economic growth and job creation. These are good for the Oregon's economy but will put additional stress on energy supply sectors that are simultaneously being asked to increase supplies, reduce costs, maintain reliability and reduce GHG emissions.

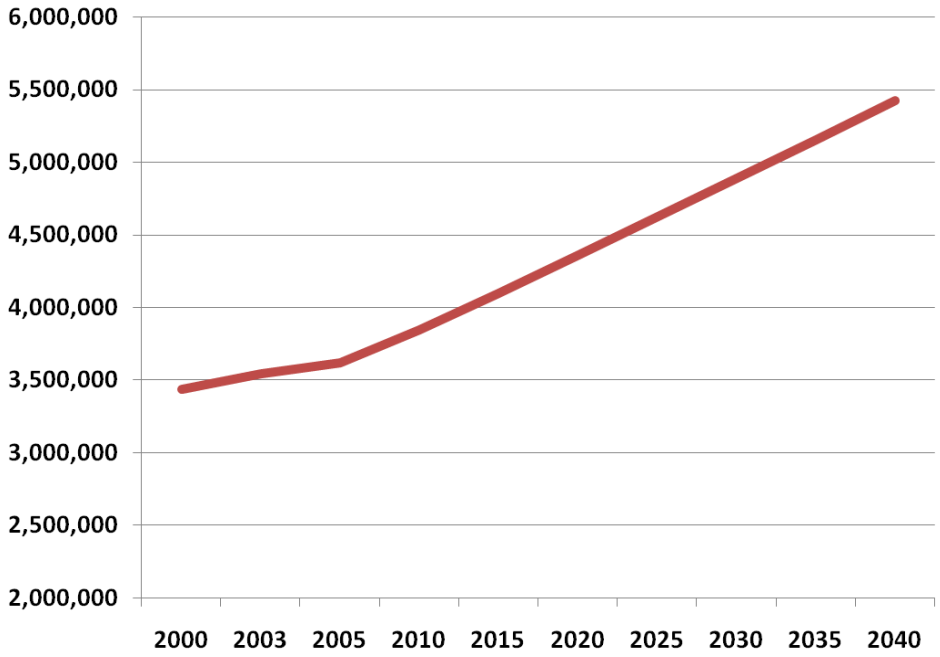


Figure 1 – Population Forecast for Oregon from Oregon's Office of Economic Analysis

In response to this large amount of growth Oregon must become more energy efficient in how it consumes energy services. For consumers and business alike, energy is not the ultimate goal because it is the services (heating, cooling, lighting, motive forces through motors, etc) provided by energy consumption that are needed by both consumers and business. Oregon's challenge is to continue to provide the energy services that society demands at reasonable prices as population and economic activity grow.

Oregon seeks to meet the energy needs of a growing population through increased energy efficiency while at the same time reducing use of energy sources that produce GHG emissions. This is a formidable challenge that presents numerous problems for Oregon's political leadership and energy companies. The challenge is not achievable without significant investment in new technologies and recognition of the inherent economic and environmental impacts from shifting energy supply sources.

Oregon's Energy Use

The Oregon Department of Energy prepares a State Energy Plan every two years. The Oregon Energy Plan for the period 2007 2009 presented the energy sources used by

Oregonians during 2003. This is shown in Figure 2 where "petrol" refers to petroleum based liquid fuels.

Figure 2 illustrates that the majority of energy consumed in Oregon is for transportation fuels which represent 40 percent of the total. Electricity is the second biggest energy consuming sector with natural gas a close third. Since 2003 there has been substantial development of wind power in eastern Oregon. However it is difficult to identify where this renewable energy is going to be consumed because much of it was developed by independent power producers that are capable of selling the output of their wind farms anywhere in the western U.S. In fact, there have been a number of press reports that some of the renewable energy generated in Oregon wind farms is currently being exported to California.

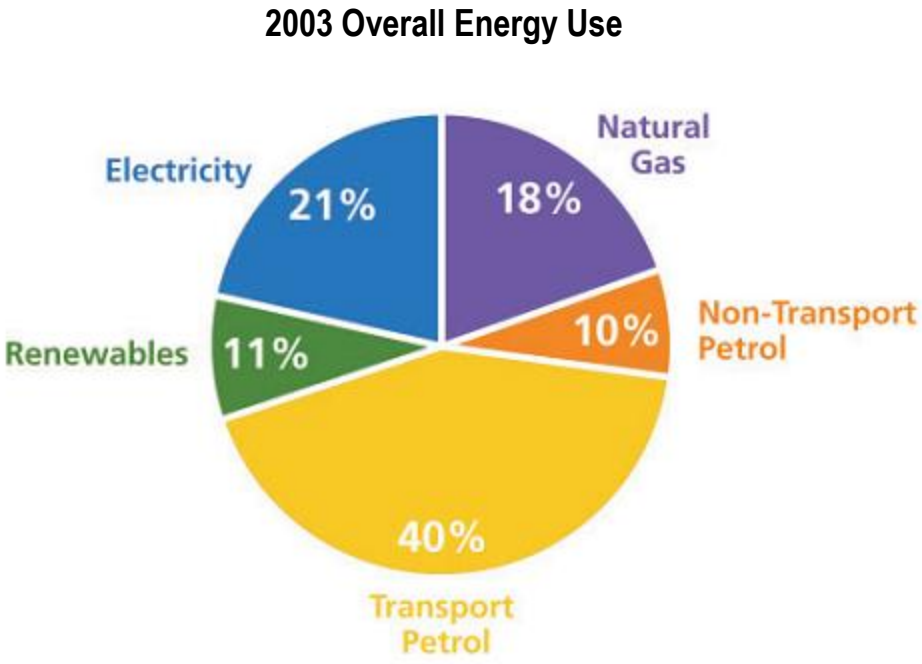


Figure 2 – Oregon Department of Energy, Oregon Energy Plan 2007 -2009

Oregon's Fuels for Electricity

The Oregon Energy Plan also presents the fuels used by Oregon utilities to produce electric power for Oregon consumers. The fuel mix for serving Oregon customers is shown in Figure 3. This figure shows that the Oregon Department of Energy estimates that electric power is almost equal parts hydropower and coal, with natural gas and nuclear representing 10 percent and 3 percent respectively. The nuclear energy that is serving Oregon customers is coming to Oregon through Bonneville Power Administration (BPA) power sold to public utilities in Oregon.

The information shown in the Oregon Energy Plan is for 2005 so it does not show the rapid increase in wind power production in the last few years and the growth in wind power is currently projected to continue for at least the next several years. At this point most of Oregon's wind is being integrated into the power system by BPA using the flexibility of the region's hydropower system. In both Washington and Oregon BPA is currently integrating

1489 MW of wind power generation. This is projected to grow to 3000 MW by the end of next year and to more than 6000 MW by 2013. The rapid rate of wind development is currently stressing BPA's ability to integrate such a large amount of intermittent resources into the federal hydropower system. How best to integrate the intermittent generation of such a large wind fleet is currently under study. However, as the amount of wind power increases and the flexibility of hydropower generation is continuing to be reduced due to increasing fish constraints, it may be necessary to increasingly integrate wind power using the operation of thermal resources. This would increase GHG emissions.

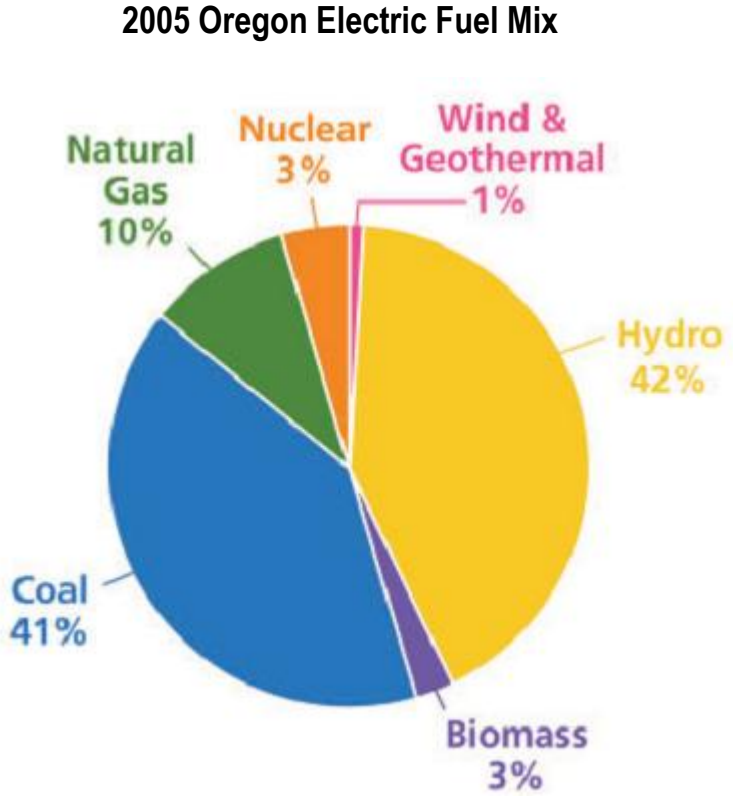


Figure 3 – Oregon Department of Energy, Oregon Energy Plan

US & Northwest Electric Power Mix

Figure 4 shows an estimate of the electric power resources serving customers in the Pacific Northwest in 2008. This chart was prepared by the Northwest Power and Conservation Council (Council) and shows that hydropower continues to be the dominate source of electric power supplying the region's customers. This Figure also shows that natural gas and coal provide 24 percent and 19 percent respectively with nuclear, wind, biomass and oil providing much lesser amounts.

This figure shows why the Northwest has a much lower footprint for GHG emissions from the electric power sector than either the west coast or the nation as a whole. The region's system of dams provides large amounts of renewable hydropower without GHG emissions. In this way it provides the region with a significant head start at efforts to reduce GHG emissions. However, the figure also shows that it will be difficult to reduce GHG emissions

from the electric power sector without replacing coal fired resources with either natural gas or some other base load resource such as geothermal or nuclear. Any of these strategies will be extremely costly and require a serious commitment by both government and industry.

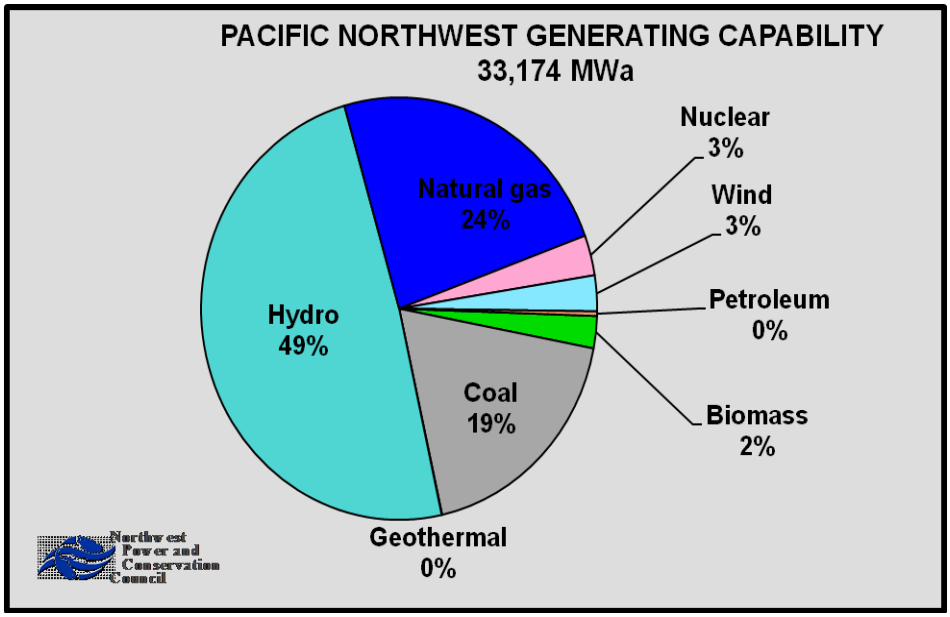


Figure 4 – Electric Power Supplies for the Pacific Northwest 2008 – Northwest Power and Conservation Council.

Figure 5 shows a similar analysis for the United States as a whole. This shows that for the nation the dominant electric power source is coal with significant but lesser amounts provided by natural gas and nuclear.

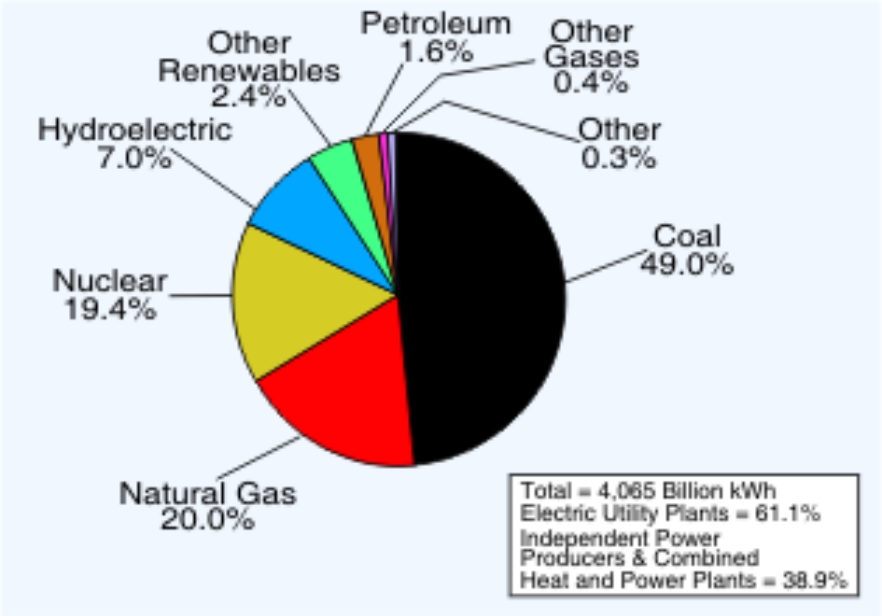
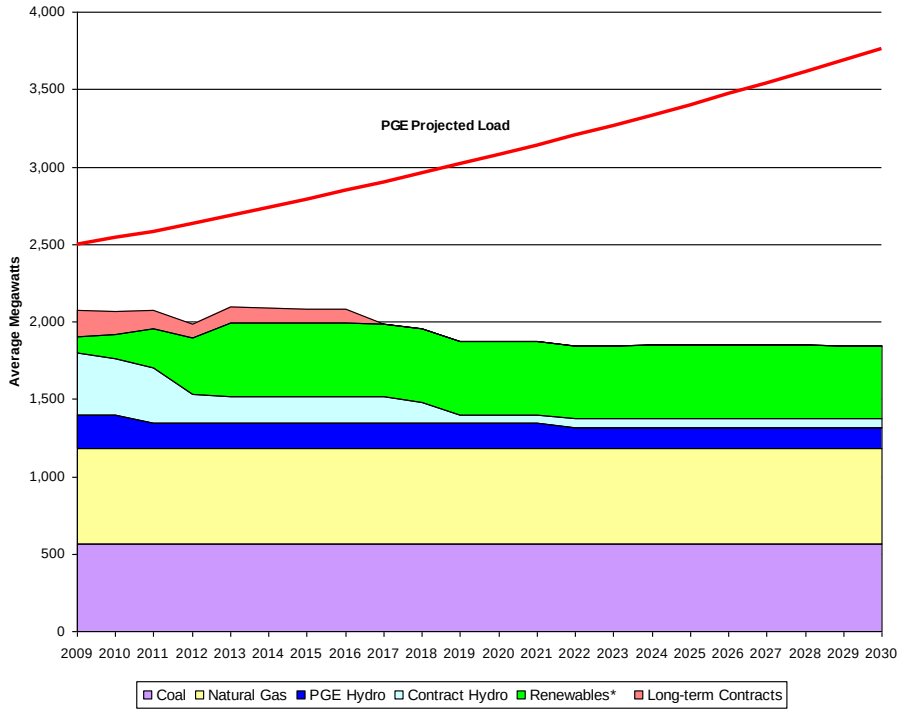


Figure 5 – U.S. Source of Electric Power

Electric Power Challenge Facing Oregon

Oregon's major utilities prepare integrated resource plans (IRP) that are designed to identify future demands for electric power and the alternatives for meeting these demands at the lowest practical costs with the least environmental impact. Portland General Electric has recently prepared its IRP and submitted it to the Oregon Public Utility Commission for review. Figure 6 shows the planning challenges PGE faces over the next 20 years. This graph shows PGE's projected load growth in the red line. Below the expected demand are PGE's current resources which include new renewables required to meet Oregon's renewable portfolio standard and current long term contracts for both hydropower and thermal resources. The base-load resources shown in PGE's portfolio are hydropower, natural gas and coal-fired power plants. The figure shows that PGE needs to find approximately an additional 2000 MWa of electric power generation or efficiency improvements in order to maintain a reliable power system by 2030.

Figure 6 –



Portland General Electric Load-Resource Gap

Portland General Electric's energy generating resources in 2008 are shown in Figure 7. This figure shows that PGE's resource portfolio is 41 percent natural gas-fired generation with almost equal shares of hydropower and coal-fired generation. Long-term power supply contracts makes up 10 percent of the portfolio with new renewables (wind) providing 4 percent of PGE's generation. Wind's share of PGE's portfolio is increasing as development continues at Biglow Canyon Wind Farm in Sherman County, Oregon.

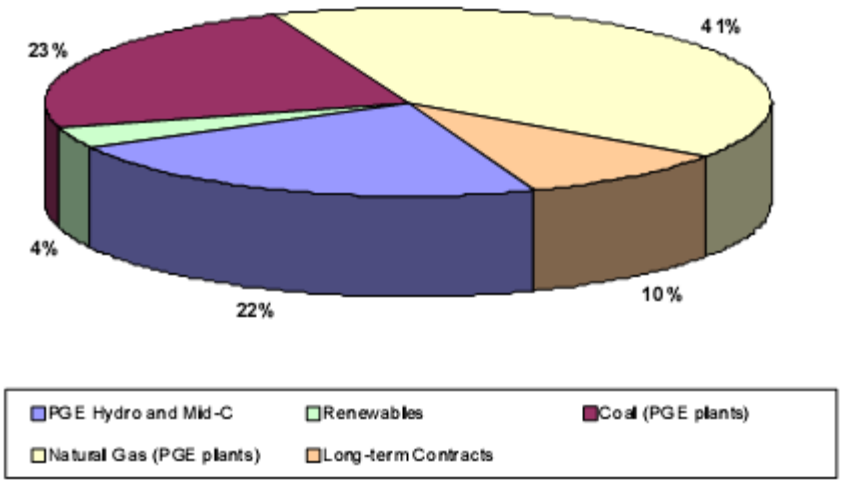


Figure 7 – Portland General Electric's 2008 Resources

PacifiCorp's planning is more complex because it serves customers in six states. The estimates of PacifiCorp's energy demand are shown in Figure 8. This shows in green that Oregon's share of PacifiCorp's total demand remains a significant component of the total demand for electric power.

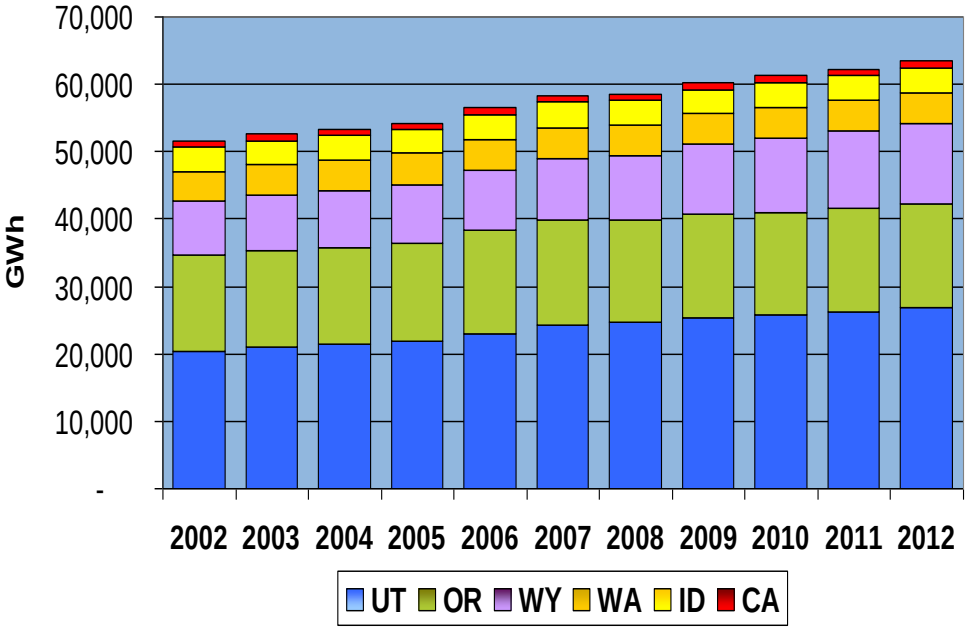


Figure 8 – PacifiCorp Electric Power Demand Forecast

Similar to PGE, PacifiCorp faces a future with significant energy deficits. PacifiCorp's deficit increases to over 3000 MW by 2016, see Figure 9.

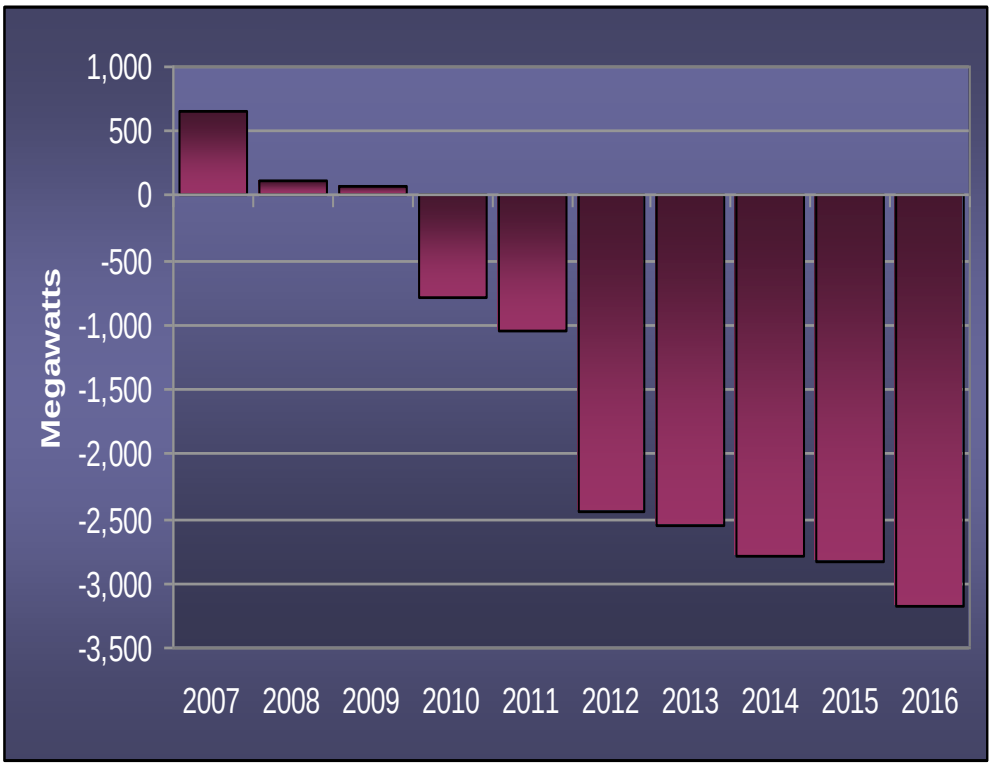


Figure 9 – PacifiCorp's Forecast of Electric Power Deficits

Figure 10 illustrates PacifiCorp's energy resource mix in 2007. This figure shows that 64.8 percent of PacifiCorp's total energy is provided by coal-fired power plants. Hydropower provides 9.6 percent of total energy, 8.5 percent from combined cycle gas-fired power plants and 8.7 percent from power purchased from others.

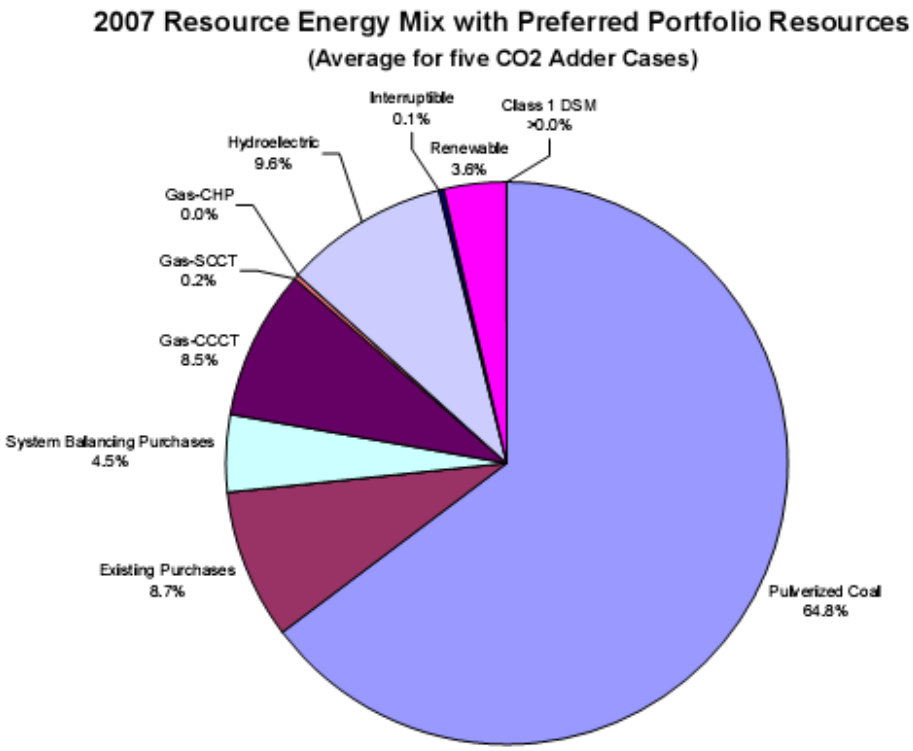


Figure 10 – PacifiCorp's 2008 Energy Resources

The projections of large and growing deficits present a paradox for Oregon's two largest utilities. That paradox is how to best reduce CO2 emissions from electric power generated to meet the growing electric power demands of Oregon customers without causing large rate increases or degrading system reliability. The planning challenges for Oregon's electric utilities are further complicated by the rapidly reducing number of alternative power supplies that are acceptable to policy leaders, regulators and utility investors. Currently, the only viable, large scale resource alternatives that utilities in Oregon can use to meet growing customer demands are energy efficiency, wind generation and natural gas-fired generation.

Energy efficiency is obviously a critically important resource for Oregon. It can avoid the need for developing additional power plants and it is far lower cost than the other alternatives. This is the reason that utilities are planning on increasing energy efficiency programs beyond what is currently possible under the Oregon Public Purpose Charge through energy efficiency tariffs authorized under SB 838 enacted in 2007.

Wind power is an effective renewable resource but, as previously discussed, its intermittent generation profile prohibits it from meeting instantaneous customer demand. When a customer turns on a light there must be a power plant capable of generating the amount of power required to light the bulb. This is an absolute physical requirement in order to maintain a reliable power system. Because it's not possible to control the wind, other power plants must take up the swings in wind generation and provide energy to meet customer demands when the wind is not blowing. Wind generation is increasing rapidly in Oregon. However this is putting integration of this renewable power source as a critical issue that must be resolved in order for wind power to most effectively reduce GHG emissions.

Finally, the generating resource of choice to meet future load growth is natural gas-fired power plants. These can be configured to meet both energy demands and peak loads. When built in a combined cycle configuration the efficiency of converting natural gas to electric energy is maximized. Combined cycle power plants also produce the lowest CO2 emissions of all thermal power plants. However, natural gas is also used in many of Oregon's homes, businesses and industries and projected growth in the demand for natural gas continues and is discuss later in this paper.

Northwest's Electric Power System's Carbon Footprint

The Northwest Power and Conservation Council (Council) conducted an analysis of the Pacific Northwest electric power system's carbon emissions. This analysis provides a solid analytic foundation for policy discussions about how best to control carbon emissions in the future. The study began with the Council's current Electric Power Plan for the region. The resources that the Council's Plan called for the region's utilities to develop in the future are shown in Figure 11. This figure shows the large amount of wind that the Council expects utilities to construct, a significant amount of new natural gas-fired generation and a substantial acquisition of energy efficiency.

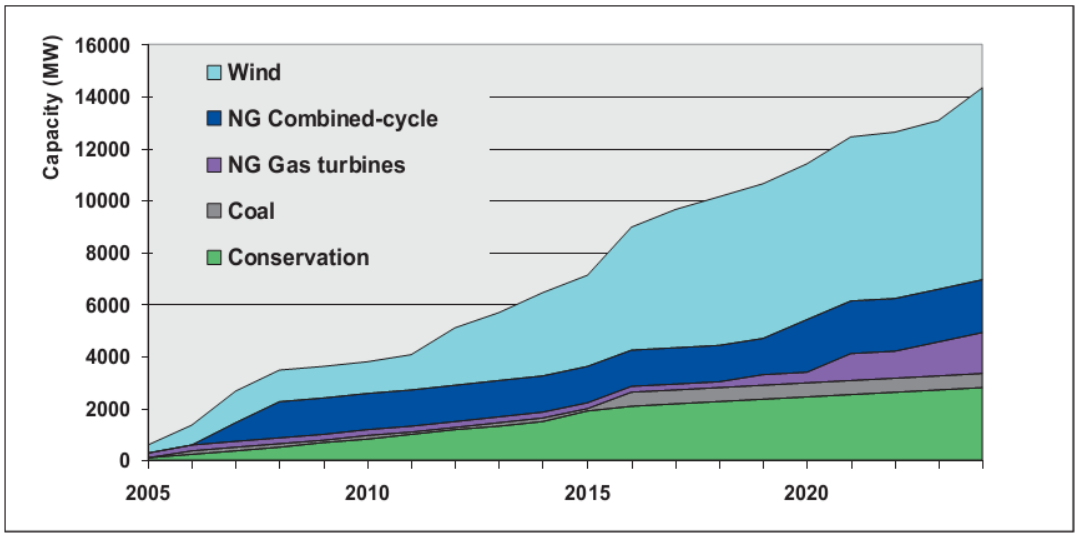


Figure 11 – Northwest Power and Conservation Council Resources in Power Plan

The Council then estimated the historical and future total production of carbon dioxide (CO2). The historical CO2 production before 2005 is shown in Figure 12. The variability in the rate of CO2 production historically is caused by uncertainty with the amount of runoff of water through the region's hydropower system. With increased runoff the hydropower system can produce more carbon free energy and this displaces the operation of thermal power plants. This results in reductions in CO2 emission in good water years and conversely increases in CO2 emissions inr bad water years when less hydropower generation is available.

Figure 12 also shows the Council's projection of the future carbon emissions assuming that the Council's Power Plan is implemented and that the region experiences average water conditions. This figure also assumes that the capability of the exiting hydropower system is

maintained into the future and that future reductions in hydropower generation for fish or other reasons does not occur.

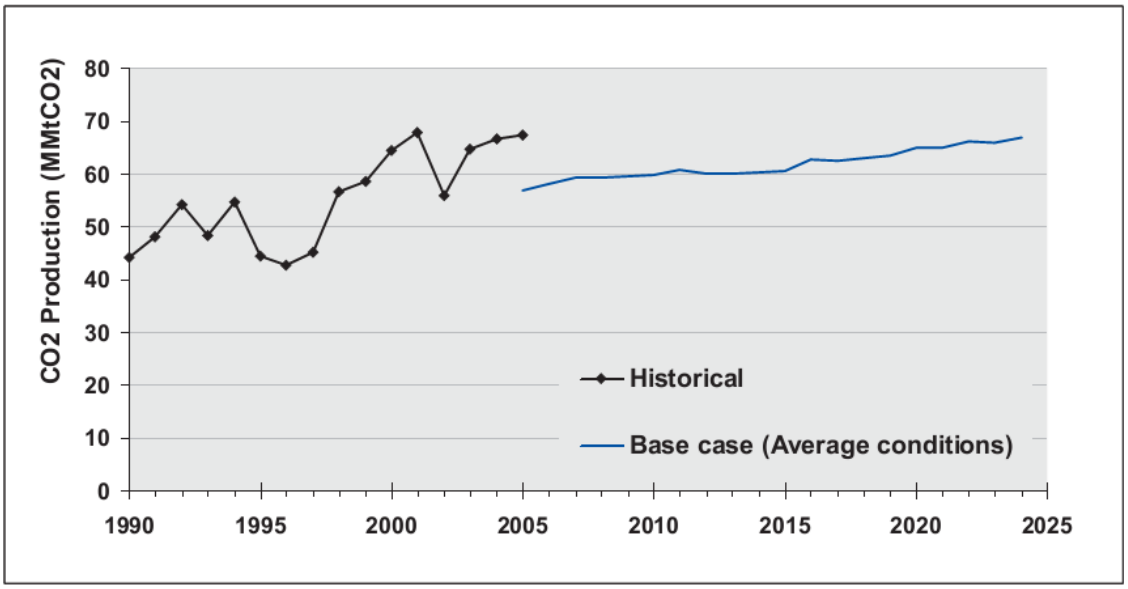


Figure 12 – Northwest Power and Conservation Council Carbon Emissions from the NW Electric Power System

The Council's analysis of regional carbon emissions shows that in 1990 the northwest electric power system emitted 44 million tons of CO2. However, by 2005 northwest CO2 emissions had grown to 57 million tons per year. This increase in regional carbon emissions was caused by three factors. First, electric power demand grew over the time period and utilities needed to acquire new power generating facilities to meet those demands. Second, PGE decided to shutdown down the Trojan nuclear plant in the early 1990s and this power was replaced with increased generation from fossil fueled power plants thus increasing carbon emissions. Finally, over the time period there have been continued reductions in hydropower production due to fish constraints. The constraints on hydropower production have reduced the amount of carbon-free hydropower that is available to meet electric demand. The lost hydropower was also replaced with increased generation from thermal power plants. These reductions in the capability of the hydropower system have also limited the ability of hydropower to integrate increasing amounts of wind power.

Figure 12 also predicts what is likely to happen to carbon emissions in the northwest if the Council's current Power Plan is implemented. The Council is in the process of updating its Plan but this will not be done until late 2009. However, if the Council's current Power Plan is implemented carbon emissions continue to increase to 67 million tons per year in 2024. This analysis shows that it will be tremendously difficult and expensive to achieve Oregon's carbon reduction goals in the future because to do so will require significant changes in not only the new resources acquired to meet the growing demand of Oregon customers but there will also have to be significant retirement of existing coal-fired power plants. The region's coal resources are relatively low cost providers of electric power and if they are replaced it will have to be with significantly more expensive sources of power that most likely rely on natural gas.

Yet the Pacific Northwest has the lowest carbon footprint for providing electric energy of any region of the country. This fact is shown in Figure 13 where the Northwest's carbon emissions measured in pounds of CO2 per megawatt-hour is 42 percent lower than the average emissions for the Western Energy Coordinating Council (WECC) and 61 percent lower than the U.S. average carbon emissions rate. The much lower rate of carbon emissions in the Northwest is due to our large concentration of renewable hydropower and the high level of energy efficiency implemented since the passage of the Northwest Power Act in 1980.

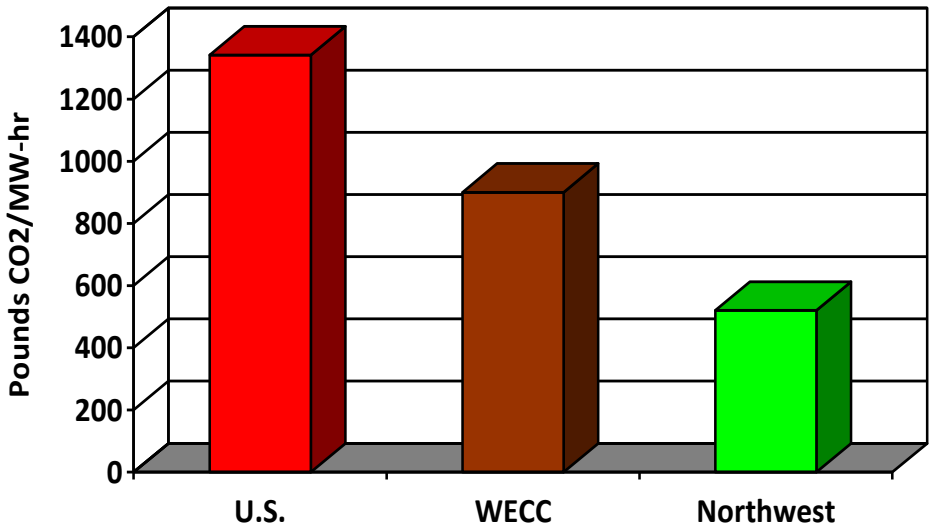


Figure 13 – Carbon Emission Rates for Electric Power Production

The advantage the Northwest now has in low carbon emissions can be maintained by continued implementation of all of the cost-effective energy efficiency possible. This will help to avoid development of new carbon emitting power resources. It will also be necessary to continue development of new renewable resources so that their output can be used to reduce the amount of natural gas needed to meet electric demand in Oregon. Finally, it will be critically important to maintain and enhance if possible, Oregon's existing hydropower resources so that they can be used to meet electric demand and assist with integrating intermittent wind resources into the power grid.

The Council's estimates of the available energy efficiency potential in the region from its current Regional Power Plan are shown in Figure 14. This figure illustrates that a little more than 3000 MWa of energy reduction potential is available at less than 7 cents/kwh and the total potential can almost reach 4000 MWa. This analysis is currently under review by the Council and new estimates will be available early in 2009.

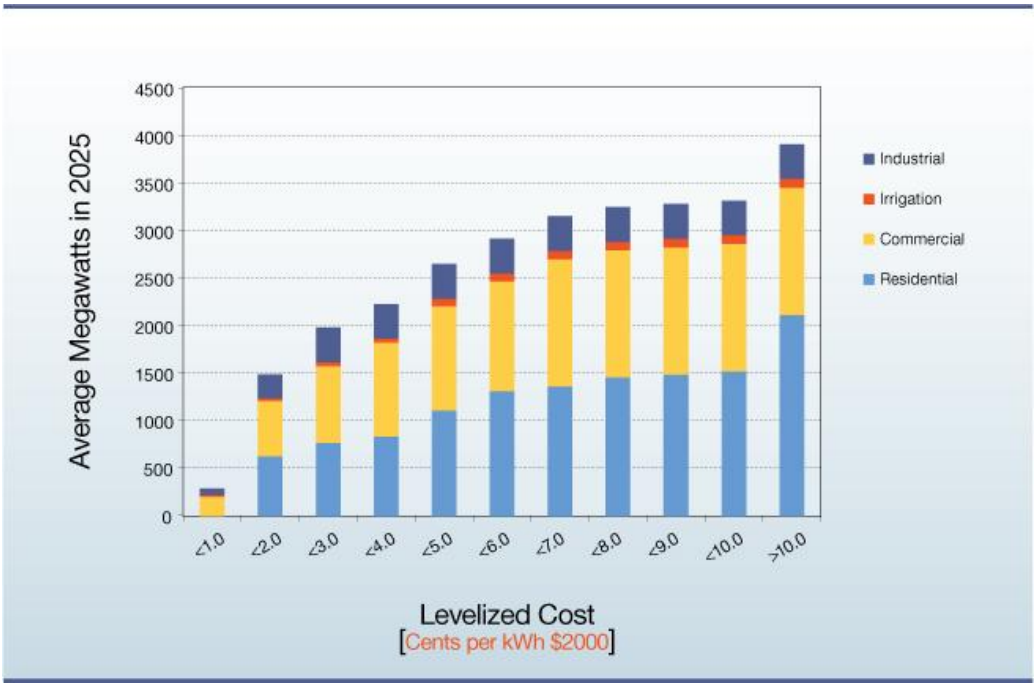


Figure 14 – Northwest Power and Conservation Council Energy Efficiency Supply Curve

The Council's analysis of the energy potential for the region was further confirmed by a national study by McKinsey, Figure 15. The objective of this study was to evaluate all opportunities for reducing carbon emissions in the U.S. The results show that energy efficiency needs to be "JOB 1" in order to reduce carbon emissions at the lowest practical cost. The large amount of energy efficiency found by McKinsey at negative costs (energy efficiency saves more in energy costs than it costs to install the improvement) could reduce national CO2 emissions by 1.4 gigatons per year.

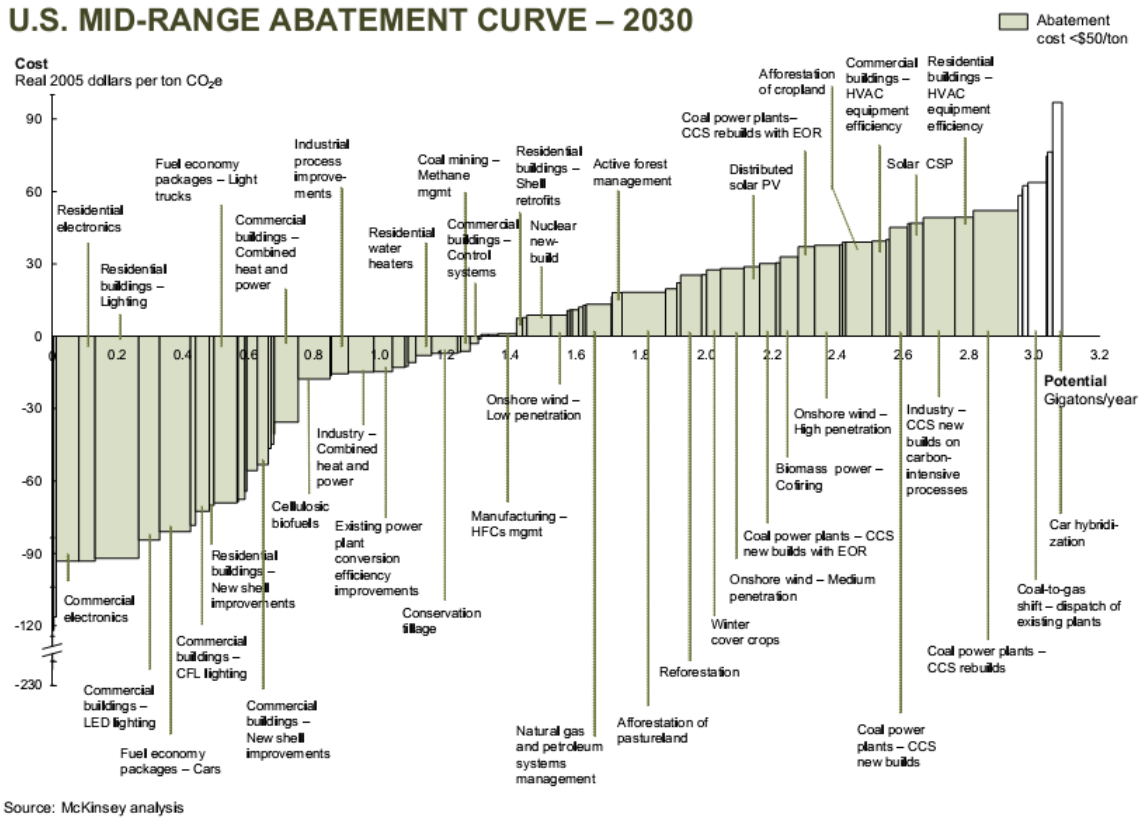


Figure 15 – National Carbon Dioxide Reduction Supply Curve - McKinsey

Based on extensive research and analysis conducted by the Council, utilities and government its is clear that energy efficiency is widely available, cost-effective and is the resource of choice to help meet future electric demands at the lowest possible cost and with the lowest possible carbon footprint. However, to significantly increase the rate of delivery of Oregon's energy efficiency resource will require significant innovation and in some cases a redesign of the current delivery mechanisms. A critical component is to develop a more effective financing mechanism due to the capital intensive nature of energy efficiency.

These supply curves for energy efficiency illustrate the importance of improving the efficiency of existing and new structures. A significant portion of these structural improvements involve installing new more efficient windows in Oregon homes and businesses. However, new windows are capital intensive and in order for consumers to install these measures they must have a reasonable payback period. Windows, like most energy efficiency measures, will require effective financial support mechanisms that will help to motivate consumers to stimulate the needed capital investment.

Oregon has initiated an effort to find creative ways to significantly enhance energy efficiency. The Energy Efficiency and Productivity Initiative (EEPI) was recently initiated with the following goals:

- Tie capital to end users of energy
- Increase the productivity of energy
- Accelerate retrofits of existing residential and commercial buildings

- Provide greater access to capital
- Equity, job creation and economic stimulus

EEPI will require legislation to change laws and regulations to facilitate implementation of the proposed redesign of energy efficiency delivery and financing mechanisms. However, EEPI is in large part an effort to harness capital from a variety of sources. In addition to EEPI there needs to be additional efforts to access the ability of Oregon's utilities to raise low-cost capital. Utility supported programs could provide large amounts of capital and use existing utility communications and billing with customers to accelerate the drive toward greater energy efficiency (e.g. on-the-bill-financing).

Energy efficiency in Oregon can help to avoid the need to acquire additional generation to meet our growing electric power needs. Increasing population, economic activity and the increasing electrification of our society presents significant challenges for maintaining the reliable low costs electric power system that Oregonian's currently enjoy. However, even the most aggressive energy efficiency program has not shown the ability to meet all projected load growth. This means that the amount of new generation needed can be reduced with increased energy efficiency but it cannot be eliminated.

Oregon also needs to work on enhancing the efficiency of current power generating resources and the delivery of that power to consumers. More efficient operation of existing resources can reduce both costs and emissions. This type of energy efficiency program focused on the existing power system should seek to effectively wring out every available cost-effective kilowatt-hour of energy.

Oregon will also need additional electric power system infrastructure to support growing electric demand and the unique requirements for integration of increasing amounts of intermittent renewable resources. This will require the development of new high voltage transmission lines with the inherent environmental and economic consequences. It will also require the development of necessary ancillary power services to support the integration of wind & solar so that overall power system reliability is maintained. Efforts are currently underway to make the existing electric power and transmission system more efficient at the delivery of power to end users. These efforts collectively come under the label "smart grid" because they are based on more effective design and operation of transmission systems based on advanced information and control systems.

Natural Gas Challenge Facing Oregon

Demand for natural gas is projected to nearly double in the next 20 years in the Pacific Northwest, Figure 16. This growth in natural gas usage is due to many factors. These include the increased use of natural gas for generating electric power, increasing use for residential, commercial and industrial heat and as a feedstock for chemical and fertilizer production.

However, natural gas has significantly lower carbon content than other fossil fuels such as coal. The Council estimates that a 400 MW coal plant will release about 3.0 million tons of CO2 per year while a 400 MW combined-cycle natural gas fired power plant only releases 1.2 million tons per year. This makes natural gas an attractive source of future electric power generation. Other types of electric generation that can provide similar electrical services as those provided by a natural gas-fired power plant are coal, nuclear and internal combustion engines. These alternative types of generation are either not economic, legally prohibited as

in the case of nuclear, or are politically unacceptable at this time in Oregon. For this reason, natural gas can help to bridge from conventional fossil fuels such as coal to an energy future that has less reliance on carbon based fuels. However this transition will take decades because the basic energy research and technology development needed to find suitable alternatives has not yet been conducted.

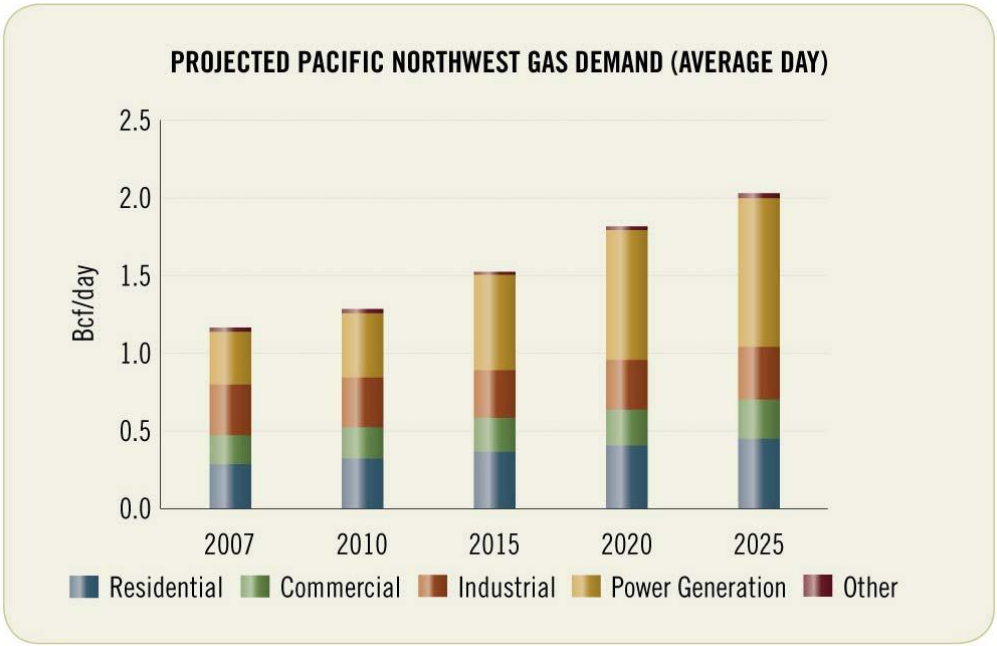


Figure 16 – Northwest Gas Association Forecast of Northwest Gas Demand

Oregon' sources of natural gas currently come from Canada and the Rocky Mountain States. In the future there may be another source of natural gas through liquefied natural gas (LNG) imported from outside Oregon and delivered through new terminals here in the state. Oregon is also very limited in the diversity of pipelines that deliver gas to Oregon consumers. This makes us dependant on a few long distance pipelines and market forces driven by the demands of other regions. For example, as shown in Figure 17, the development of additional pipeline capacity from Oregon's key supply basins in Canada and the Rockies to much larger natural gas demand centers in the east will further limit available supplies and add to price volatility.

The Portland Metro area is one of a very few large metropolitan areas in the country to rely on a single interstate pipeline. This creates a reliability risk that has concerned NW Natural for many years. An additional interstate pipeline from the east is essential to enhance Oregon's access to natural gas from Canada and the Rockies now and in the future by adding cost-competitive transportation capacity to the currently constrained capacity.

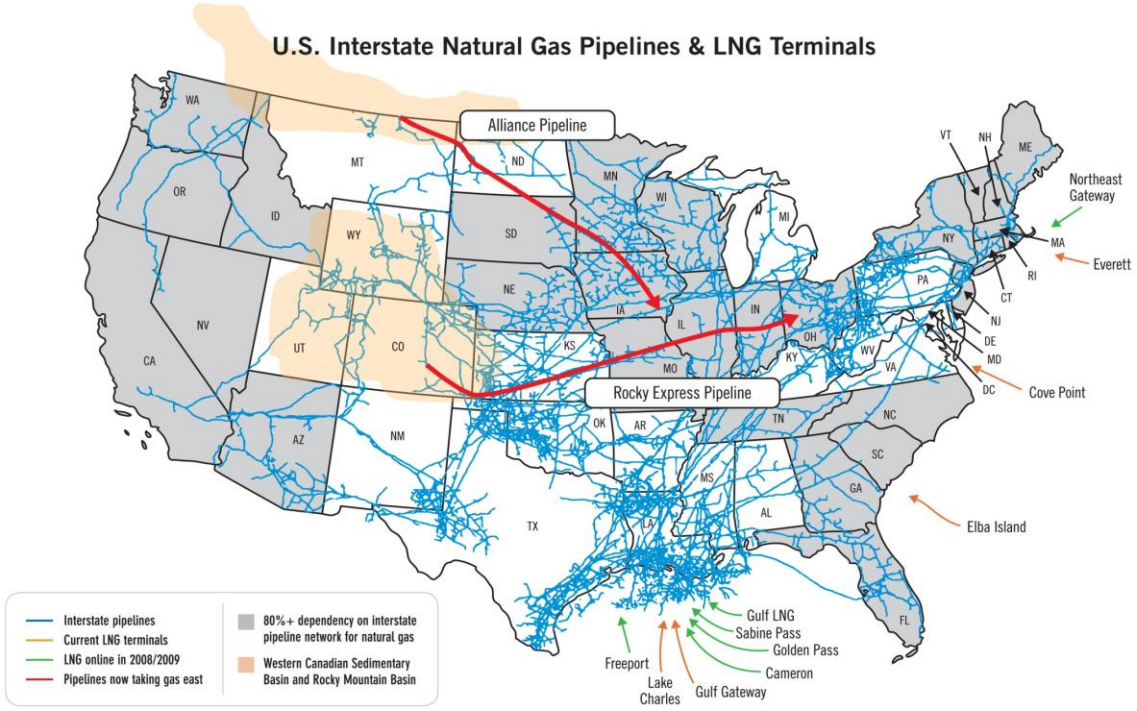
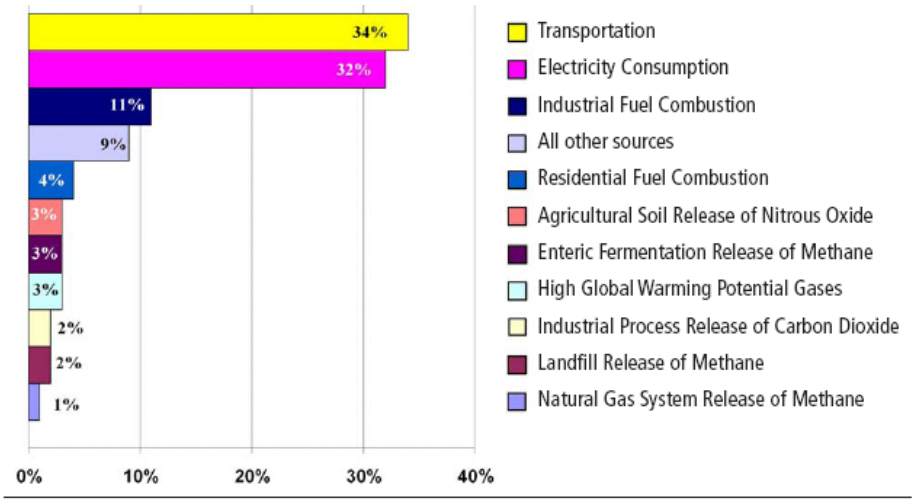


Figure 17 – U.S. Natural Gas Pipelines

Natural gas is the cleanest fossil fuel. As a result, natural gas can help Oregon to shift away from more carbon intensive fuels used for industrial, commercial, residential and transportation sectors. However, to be able to allow natural gas to bridge from were Oregon is to where we want to be with a significantly reduced level of carbon emissions, the natural gas supply and transportation infrastructure will need to be enhanced. This will require investing in improving Oregon's natural gas supply sources and the development of increased natural gas storage capability to buffer future price and supply risks. To diversify Oregon's supply sources of natural gas the state needs to encourage the development of LNG importation facilities.

Oregon's Transportation Sector

Transportation and direct use of petroleum represented 34% of Oregon's energy use in 2004, Figure 18. If efforts to control green house gases are to be successful there must be a comprehensive and systematically focused strategy to improve the transportation system in Oregon. One approach would be for Oregon to expand the use of natural gas as a transportation fuel. This can be accomplished by encouraging natural gas suppliers to participate in a demonstration project that uses natural gas in a variety of transportation vehicles. Tax incentives could be provided for purchase of natural gas fueled vehicles or through a demonstration project with state owned vehicles.



[12] "Carbon dioxide equivalent (CO_2e)" refers to a comparison of the radiative force of different greenhouse gases related to CO_2, based on their global warming potential. It is a way to compare all greenhouse gases on a uniform scale of how much CO_2 would be needed to have the same warming potential as other gases over the same timescale. Following U.S. Environmental Protection Agency (EPA) and international reporting protocols per the Second Assessment Report, methane is 21 times more powerful than CO_2 over 100 years and nitrous oxide is 310 times more powerful (newer IPCC GWPs are not used in this report).

Figure 18 – Major Sources of Greenhouse Gas Emissions in Oregon, 2004

There currently is a strong interest the development of compressed natural gas (CNG) facilities to serve high-use fleets including trash, transit, taxis and other centrally-fueled fleets because these types of vehicles are naturally suited to shifting to a more efficient fuel. In the discussion that follows on electric vehicles it should be noted that plug-in hybrids are not effective for application in heavy trucks and other larger vehicles. For these larger vehicles CNG can be an effective new fuel source. Natural gas and electric utilities are well-positioned to build the infrastructure for both CNG and electric vehicles because that infrastructure has a lot in common with standard utility investments: high fixed costs, capital intensive, long-term payback and public benefits.

A study conducted by M.I.T. evaluated the technological improvements possible in transportation vehicles by the year 2035. This study evaluated each of several vehicle types to determine their total GHG emissions taking into account the lifecycle of the fuel and materials used to construct and operate the vehicle. Figure 19, shows the results of the M.I.T. study and breaks down the GHG emissions into three components. The top bar is the well to tank emissions that are needed to extract, transport, refine and deliver the fuel to the vehicle. The middle bar is the GHG emissions from the tank to the wheels of the vehicle and the bottom bar is the GHG emissions from manufacturing the materials used in the vehicle.

The current estimate of GHG for today's vehicle is 277 grams of CO2/km. This estimate is for a conventional spark ignition engine (SIE). The study predicts that by 2035 the GHG emissions will drop to 178 grams CO2/km for the same SIE vehicle with similar performance characteristics. Also shown are the substantial GHG emission gains that can be achieved by hybrid electric vehicles (HEV) and plug-in hybrid vehicles (PHEV) over conventional spark ignition. These vehicles are more efficient at controlling GHG emissions than are the fuel cell vehicle (FCV) or the battery electric vehicle (BEV). All of these more advanced vehicle designs produce less GHG emissions over their lifecycle than either turbo charged or diesel vehicles.

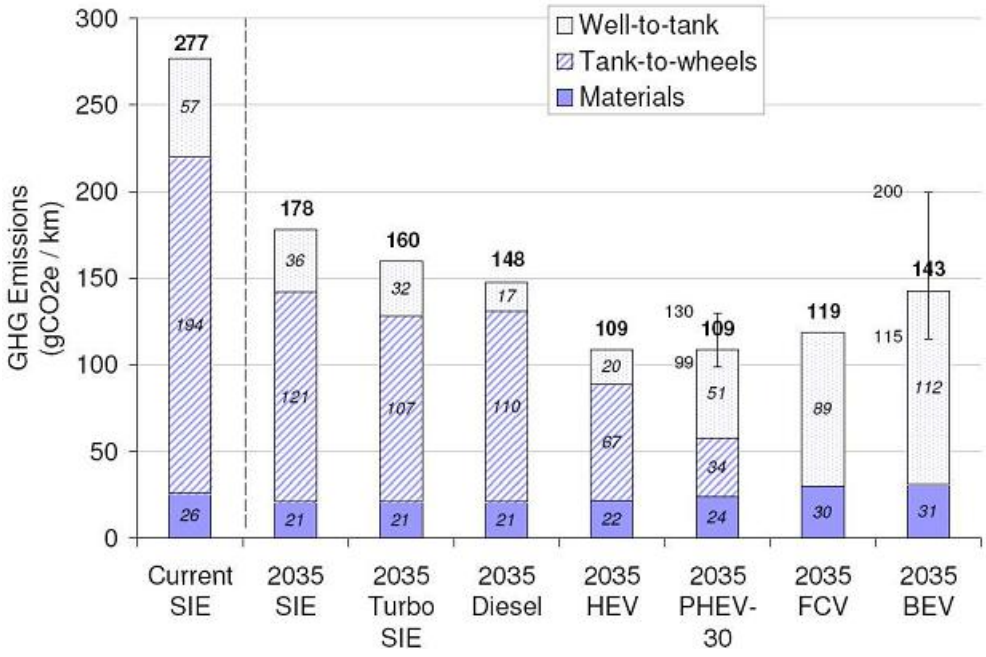


Figure 19 – M.I.T. Vehicle Lifecycle Greenhouse Gas Emissions

Oregon should design a program with the goal of promoting both electric and natural gas fueled vehicles. This will provide the initial infrastructure to support the next generation of efficient vehicle designs. Incentives to purchase either electric or natural gas fueled vehicles could be provided through the current tax incentive system that was used to encourage hybrid vehicles. In addition, the state should fund a demonstration project with state vehicles that will accelerate the shift away from conventional diesel to natural gas for state owned vehicles, buses and light trucks.

The state needs experience with plug-in hybrids. The current proposals to encourage purchase of plug-in hybrid vehicles should be continued. The effectiveness of hybrid vehicles at controlling GHG emissions as compared to plug-in hybrid vehicles indicates that the incentive to purchase these vehicles should be continued instead of terminated as is currently proposed. Finally, Oregon should promote changes in land use plans that will allow people to live close to work and be able to increasingly commute to work without use of a private vehicle.

Analysis of Plug-in Hybrids on Pacific Northwest Power System

The Northwest Power and Conservation Council conducted an analysis of the impacts that significant adoption of plug-in hybrid vehicles would have on the region's electric power system and GHG emissions. The Council's analysis used its models of the northwest power system to estimate what was likely to be the impact on power generation from the need to charge a fleet of plug-in hybrids primarily at night. Figure 20 shows the assumed market penetration rates that the Council used in its analysis. The scenarios assume a slow start for introduction of new plug-in hybrids that varies from about 25 percent penetration of new vehicle sales to over 60 percent penetration. The rate of adoption of each scenario varies but most achieve the maximum assumed penetration rate by about 2020.

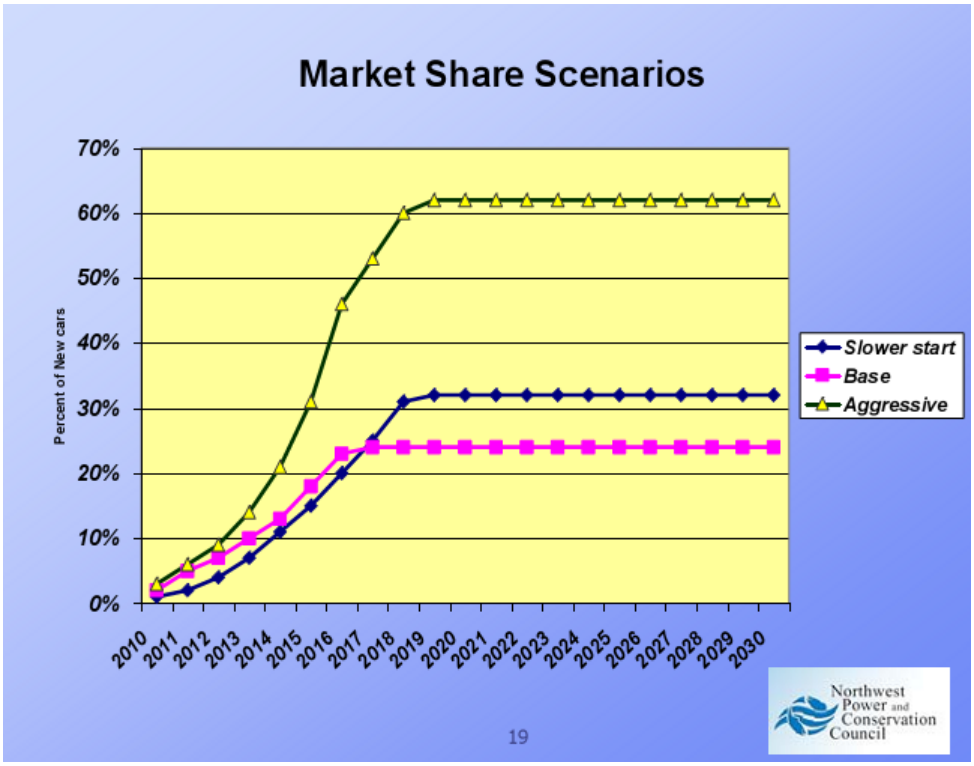


Figure 20 - Northwest Power and Conservation Council Market Share for Plug-in Hybrid Vehicles

Figure 21 illustrates the impacts on the regional power system of the three plug-in hybrid penetration scenarios. The impacts are rather modest and can easily be managed within the resource development needed to meet over all growth in demand for electricity. This analysis estimates that between 400 and 1000 MWa of additional power generation would be needed in the Pacific Northwest to support the assumed plug-in hybrid scenarios by the year 2030 but only 300 to 600 MWa would be needed by 2020.

The Council also estimated the reduction in CO2 that could be expected from the three plug-in hybrid scenarios. Figure 22 shows the CO2 reduction estimates ranged from 6 to 16 million metric tons by about 2030 depending on the penetration rates for plug-in vehicles assumed by the Council. The CO2 reductions are estimated to be more modest by 2020 with 3 to 6 million metric tons less emissions than would be the case if those same vehicles were conventional spark ignition. This is only a partial analysis of changes in CO2 emissions because the changes in electric power generation needed to recharge the plug-in hybrid vehicles were not included in Figure 22.

To estimate the changes in electric power generation required to recharge the plug-in hybrid vehicles the Council modeled the operation of the northwest power system in 2020. This analysis evaluated two cases. One case assumed the electric power system operated to meet regional electric demand with plug-in hybrids. The second case evaluated electric power operations without plug-in hybrid development. Due to the increase electric power required to recharge the plug-in vehicles, primarily at night, the Council's analysis showed an increase of 1.4 million tons of annual CO2 emissions from the power system.

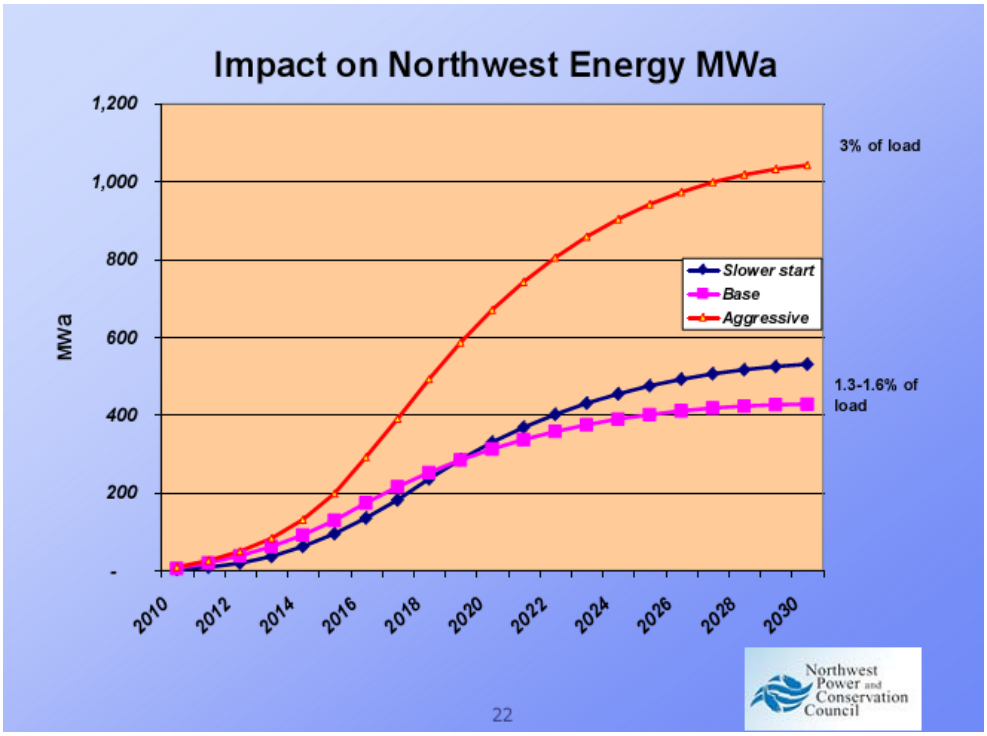


Figure 21 - Northwest Power and Conservation Council Market Power System Energy Demand for Plug-in Hybrid Vehicles

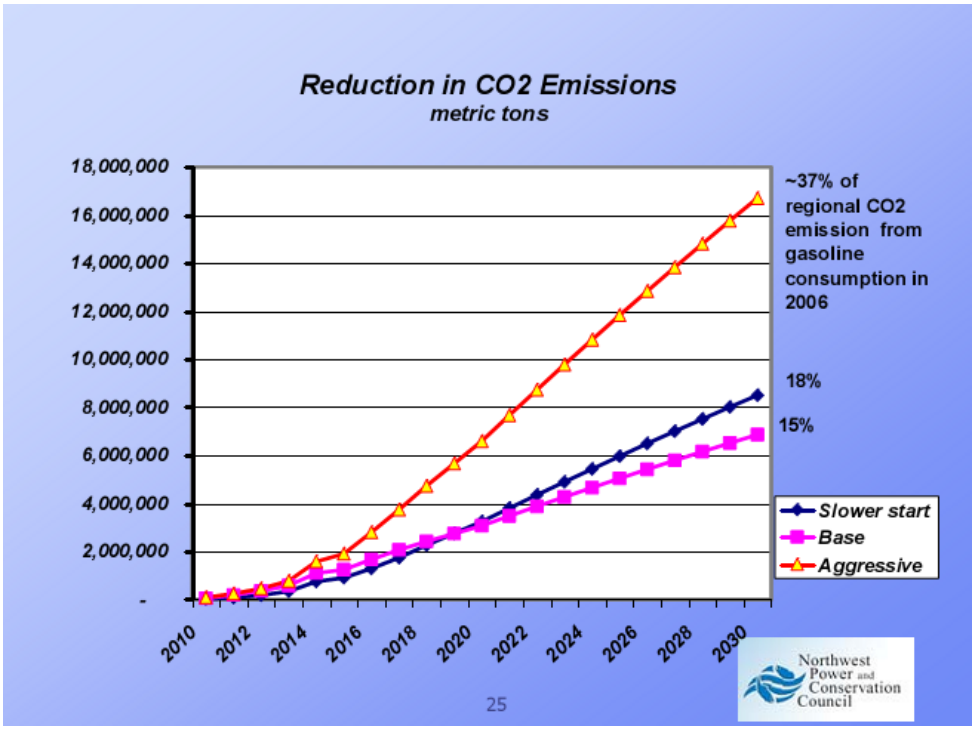


Figure 22 - Northwest Power and Conservation Council Reduced CO2 for Plug-in Hybrid Vehicles

The Council's analysis showed the approximately 3.0 million tons per year reduction in CO2 in the transportation sector in 2020 was somewhat offset by an increase in CO2 produced in the electric power sector of 1.4 million tons per year. The net savings from a medium level of penetration of plug-in hybrid vehicles in the region would be approximately 1.6 million tons of CO2 per year in 2020. This CO2 reduction can be expected to continue to increase after 2020 as more plug-in vehicles are placed in service. For comparison purposes, the Council's estimate of total CO2 production from the electric power sector in 2020 was shown in Figure 12 at more than 60 million tons per year.

Conclusions

The Business Plan's initial focus on energy serves to emphasize the serious energy challenges facing Oregon. It does not have all the answers. At the Energy Summit this past August Governor Kulongoski called for a State Energy Policy to be developed. The State's goals cannot be achieved without the development of thoughtful and balanced energy policies and strategies that are grounded in thorough technical and economic analysis. Oregon must strive to balance the joint goals of reduced greenhouse gas emissions while simultaneously enhancing Oregon's economic vitality and competitiveness.

Energy cost and reliability are critically important inputs to Oregon's economy and fundamental changes in our energy infrastructure must be carefully implemented to minimize impacts on existing businesses. To do otherwise could cause energy to become uncompetitive and unreliable and expose Oregon to economic disruption as businesses shift production out of Oregon. Tragically, this could lead to little change in greenhouse gas emissions as production is shifted to regions with less concern over greenhouse gases.

The Business Plan proposes that now is the time for Oregon to develop a balanced energy policy based on practical strategies focused on acquisition of cost-effective energy efficiency and renewable resources. Oregon has the opportunity to provide global leadership on one of the most important issues facing our planet -- and from that leadership we can generate new jobs and economic wellbeing for Oregonians.