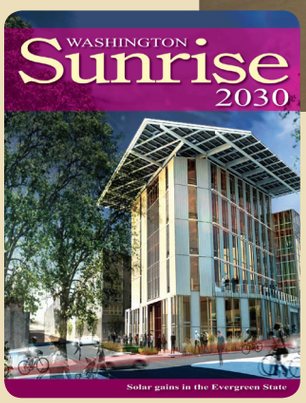
WASHINGTON Sunrise 2030

Solar gains in the Evergreen State

FACT
On sunny days, Bavaria (with a solar resource comparable to Western Washington), gets 20 percent of its electricity from the sun.



On the cover

The Bullitt Foundation is spearheading a visionary effort to develop the Cascadia Center for Sustainable Design and Construction in Seattle's Central Area. The Center will be one of the nation's first mid-rise commercial buildings to achieve "living building" status.

Washington Sunrise is powered by:

- Shoreline Community College
- Puget Sound Energy
- Seattle City Light
- Silicon Energy
- Solar Washington
- Seattle AIA
- Northwest Seed
- Power Trip Energy
- NW Wind and Solar
- ENXCO
- Clean Energy Tech Center
- Washington State Department of Commerce

Shoreline
COMMUNITY COLLEGE

Shoreline Community College provides equal opportunity in education and employment and does not discriminate on the basis of race, sex, age, color, religion, national origin, marital status, gender, sexual orientation or disability.

Principle investigator
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- Stuart Frothingham
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- Geoffrey Hoefer
- Gale Breikreutz

Production
- Jim Hills
- Grace Schulz

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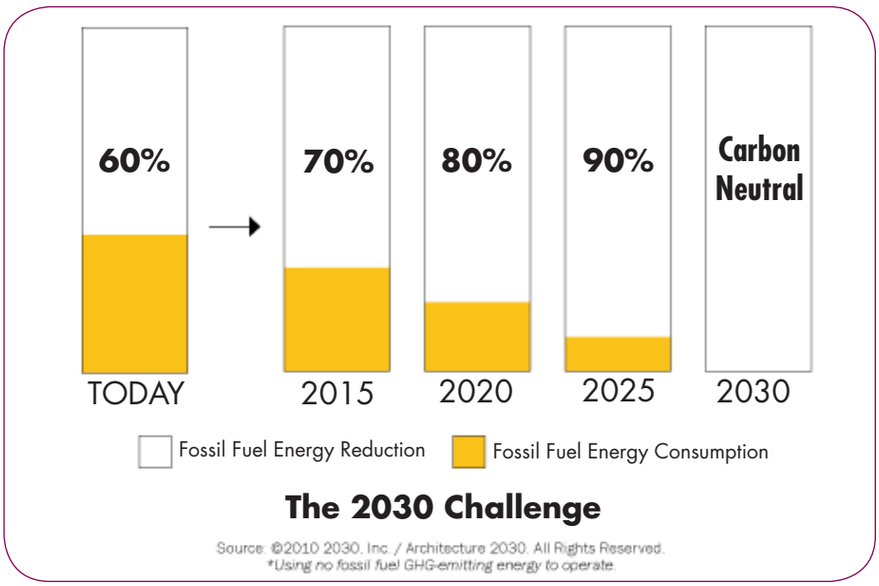

Energy efficient buildings aren't just a good idea

In Washington, its the law

Washington Sunrise 2030 shows that our state can extend this challenge to transportation and achieve a truly renewable energy economy by 2030.

On Friday, May 8, 2009 Washington Gov. Chris Gregoire signed the Efficiency First Bill, which sets the goal of carbon neutrality for all new public and private new buildings and major restorations by 2031. The 2030 Challenge takes Washington's built environment all the way to carbon neutrality in a series of benchmarked ssteps

According to the 2030 Challenge Buildings are the major source of global demand for energy and materials that produce by-product greenhouse gases (GHG). Slowing the growth rate of GHG emissions and then reversing it is the key to addressing climate change and keeping global average temperature below 2°C above pre-industrial levels.

In Washington our buildings are cleaner than most because owe have hydropower resources. But, this means our CO2 footprint from transportation is a larger part of the energy mix than elsewhere, hence:

Washington Sunrise 2030 shows that our state can extend this challenge to transportation and achieve a truly renewable energy economy by2030.

ADOPTER architecture 2030 CHALLENGE

INTRODUCTION

Washington Sunrise 2030: Mapping the path toward a carbon-neutral state

Washington Sunrise 2030 is a provocative seachart to a possible energy future for Washington.

Unlike many of the studies examined in this document, Washington Sunrise 2030 is not confined to a narrowly defined set of objectives. The Northwest Power Plan is limited to electrical conservation and renewable issues in the Pacific Northwest. The Governor's Clean Energy Council's work is limited to actions necessary to grow a particular market sector. The Pacific Northwest National Laboratory's work on energy storage fails to draw on Washington's Department of Ecology study of low carbon fuels. Which, in turn, fails to examine in depth the impacts on electricity markets that are implicit in a massive transition to electric vehicles.

This meta-study examines our energy demands, needs, capabilities and opportunities. It is addressed to our policymakers, utilities, the design/build communities, environmentalists, farmers, industrialists, businesses and local governments, in short, to all of Washington's stakeholders. It began as a project of students in the Shoreline Community College Clean Energy Technology Program and with a commitment to advancing the American Institute of Architect's 2030 Challenge.

Washington's energy economy is foremost a product of the Columbia River, its tributaries, and the rivers of the Cascades and the Olympics. The rivers of the Northwest give Washington a unique vantage point. As a state, we have an opportunity via our hydrological wealth that can lead to an abundant renewable energy economy, rich in wild salmon, irrigated cropland, recreation, transportation options, economic well-being and family-wage jobs. This path requires respect and judicious use of our rivers' resources. Washington must assert its rightful role in how the river is managed. We share our stewardship of the rivers with others in our watershed.

THESIS

Washington, with its unique weather patterns, hydro-based energy economy, and diverse resource portfolio is capable of achieving a carbon-neutral, renewable-energy economy by 2030.

SUMMARY OF FINDINGS

Three keys to achieving the Washington Sunrise 2030 goals are:

1. Establishing a single state level agency to coordinate and lead the mosaic of Washington's stakeholders
2. Developing pumped storage capacity combined with advanced battery storage
3. Accelerating the transition to non-fossil fuel transportation systems

Washington Sunrise 2030 examines the recent work by the Northwest Power Planning Council, the state Department of Commerce, Pacific Northwest National Laboratories, Bonneville Power Administration, the regional utilities, The Northwest Energy Coalition, Climate Solutions, The Winrock Foundation, and others. Much in-depth analysis has been accomplished for our region and state. Washington Sunrise 2030 builds on that past work. The task at hand is one of integration and focusing on indigenous resources

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These documents create a seachart to an achievable energy future for Washington and its residents. Findings are drawn principally from the aforementioned works. We have simply arranged the pieces into a picture of what the near future can be, given wise and active leadership, carefully crafted public policy, a commitment from our utilities, state and local governments, our industries, and our residents.

Throughout Washington Sunrise 2030, the reader will find key "Findings." These findings are observations drawn from reading the attributed works and recommendations for action.

Following the Washington Sunrise 2030 recommendations will revitalize Washington's economy, create new opportunities, industries, and family wage jobs distributed throughout the state.

Here are some of the main points you'll find in this report:

- There are far more affordable renewable energy resources and conservation opportunities available in Washington than will be required for the foreseeable future. Even if the region is forced to breach the lower four Snake River dams, accelerate the shutdown of the Centralia coal plant, and does not re-license the Columbia Generation Station, there are still enough from renewable sources to meet all our needs.
- If we are to reach carbon neutrality and address increased air pollution from transportation, we must aggressively pursue electrification of light duty vehicles.
- Wind and solar will emerge as the least-cost unsubsidized options within this decade.
- Washington will transition from a centralized transmission grid to an inverted grid structure. A growing portion of of power generation will be located along the distribution lines while transmission assets will become a web moving power in multiple directions.
- Technologically, we are prepared for the challenge and we begin this task with a technological edge that will put Washington in a leadership position.
- Washington can meet and exceed the AIA 2030 Challenge, now mandated in our building codes, but only if we develop the workforce and make local investments.
- The primary guide is the Sixth Northwest Power Plan, but it must be adapted to Washington's unique needs and resources and informed by work of the States Clean Energy Strategies study and the Northwest Energy Coalition's Bright Future report among the many works already in place.
- Our state's definition of "least-cost planning' must be expanded to account for the local economic benefits of both conservation and generation decisions accruing to those impacted by least-cost planning.

Our state's definition of "least-cost planning' must be expanded to account for the local economic benefits of both conservation and generation decisions accruing to those impacted by least-cost planning.

INTRODUCTION

Smart grid or energy web?
Tomorrow is already here

Just as the personal computer and the Internet emerged as highly disruptive technologies, permanently shifting the landscape of nearly all aspects of our culture, another rapidly maturing intersect of equal import is emerging, this time the locus is energy.

- The cost of photovoltaics are nearing the cost of coal and will achieve parity by 2015-20.
- Home energy-management systems are maturing rapidly and moving to market.
- Plug-in electric vehicles are being introduced by major manufacturers.
- Low energy-use homes are now required by the Washington state energy code.
- Utilities are exploring the "smart-grid."

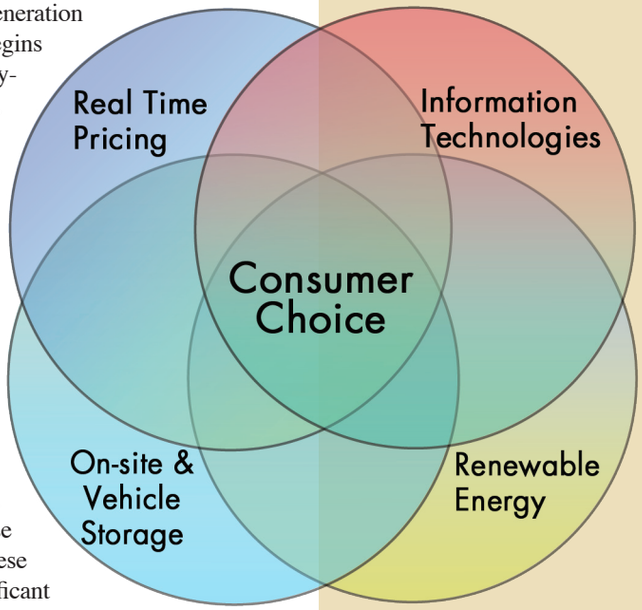
These are occurring today, weaving themselves into an interactive energy web. This web is restructuring energy use, transportation, and the built environment. The Northwest power system is adapting to the active interplay between demand and production, consumer, and generator.

The traditional hierarchical relationship between utility and consumer is being pushed aside. Consumer choice is disrupting the once-monopoly of energy generation as homes, businesses, and vehicles become renewable energy generators and storage systems linked by emerging information technologies to existing utility networks and transmission systems.

Real-time pricing

Variable rates, even negative rates, will encourage consumers to become micro-producers for an increasing portion of their power demand. The current rapid decrease in solar costs and other decentralized renewable energy technologies are leading to homes becoming smart micro-power generation plants. Consumer needs will be managed in accordance with available information technologies used to access utility databases and short term weather information.

And, as the first generation of plug in vehicles begins the initial battery-replacement cycle, local energy storage will emerge as an affordable option. According to the Electric Power Research Institute, automotive lithium-ion batteries will still have 70 percent capacity at time of replacement, plenty of storage in a non-mobile application. Washington Sunrise 2030 anticipates these batteries to a significant market factor in the next decade, with availability increasing thereafter. Planning now to integrate these technologies into the emerging energy web will bring flexible, distributed storage strategies to the distribution system, easing pressures on the already overburdened transmission system.



Distributed storage at a consumer level also greatly enhances our energy security. With locally available generation and storage, homes become "safe havens" in earthquakes, floods or even during acts of terrorism.

19 years to adapt...

Between now and 2030, Washington State is predicted to see growth in many areas of its population and economy, according to the state Office of Financial Management, the U.S. Census Bureau, and other sources. However, population and economic growth don't have to also mean increased energy use. With stewardship and technological advances, it is probable that Washingtonians will actually reduce per capita use.

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Despite the oft-cited driver of increasing energy demand, population growth, the Pacific Northwest, the U.S, and many other nations are demonstrating that energy use is not rigidly linked to population growth or economic expansion.

In its annual publication, "The Electric Energy Picture in the Pacific Northwest," Bonneville Power Administration (BPA) plots Gross National Product vs. per capita energy consumption for 14 nations, including the U.S.

According to a past director of BPA, "Bonneville had been in a 'period of delusions. ' " Indeed, without the terminated WPPSS nuclear reactors, without the two other projects placed in mothballs soon afterward, and without four more reactors later canceled by private utilities, the Pacific Northwest spent the 1980s coping with an electricity surplus, not a shortage.

Economic factors may also not directly correlate to increased energy consumption. Energy use in the Pacific Northwest is almost twice as high as Sweden's while income levels were nearly the same. Many of our past projections that treated population and the economy as the primary drivers of energy demands have proven to be misguided.

Washington State already has many carbon-free, renewable energy resources that produce more than enough energy for the state; it is just a matter of effectively and exclusively using these resources.

New base-load power plants, or an extension of the life spans of the existing ones, would endanger the development of renewable energies, and would not constitute a bridge to the energy supply system of the future.

Base-Load Generation?

Neither conservation nor renewables reduce base-load generation. As an example, adding compact fluorescents to the energy mix in a utility service territory where coal is operated to provide base load, that base load is not reduced, just the load following generation.

According to German Advisory Council on the Environment (SRU):

"More responsible power trading and 'smart' power grids are an important prerequisite for the integration of the fluctuating renewable energy from the wind and the sun."

"In a supply strategy based on coal power plants (with or without carbon capture and storage strategies) and nuclear power plants, the share of regenerative energy sources must be strictly limited if these base-load power plants are to be economically and rationally run. New base-load power plants, or an extension of the life spans of the existing ones, would endanger the development of renewable energies, and would not constitute a bridge to the energy supply system of the future.

"...although nuclear power plants could ... throttle their capacity – for example in case of a storm which causes high wind energy feed-in (or high water flows on the Columbia, as seen in the spring of 2011), but only down to 50-60 percent of their installed capacity. After that, they would have to be shut off completely; otherwise an oversupply of power would occur. Such oversupplies already occur today, and ever more frequently. This results in negative prices for electricity on the electric power exchange. The producers actually pay the buyers to take their power, and pass on the additional costs to consumers."

A renewable resource colony for LA?

Snohomish PUD reports in their 2010 IRP:

"Negative prices in the wholesale energy markets are another consequence of the increasing amount of installed wind capacity. Negative prices occurred in the Northwest wholesale power market in spring of 2008 and again in 2010 when transmission lines to California were fully loaded and, because of spring runoff conditions, BPA could not decrease generation on the federal base system.

"With more power in the region than Snohomish County PUD needed to serve customer demands, market prices dropped below zero as wind owners sought out and paid entities with storage options to take their energy. Production tax credits and RECs are created only when energy is generated. As a result, market prices could go as low as negative $30 per MWh before economics will cause wind owners to curtail output. These conditions aligned for only a few hours in 2008 and 2010. As the number of installed wind projects grows in the Northwest, negative prices for power can be expected to become more frequent."

According to Pacific Northwest Utility Coordinating Council :

"...The large electrical giant to our south, California, is in the process of significantly increasing their Renewable

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Portfolio Standard targets. In so doing, California will put additional pressure on development of wind power in the Northwest to help meet these requirements. The (Sixth Northwest Power Plan) needs to account for the likelihood that some of the Northwest renewable resource will be developed to meet out-of-region requirements. As this occurs, California may acquire some of the most cost-effective wind power sites. This will leave the region with higher cost and poorer performing wind resources than assumed in the Draft."

"The Plan needs to clearly identify that operating 8,000 MW of wind will require integration strategies that will go beyond those currently identified."

"The Draft does a good job of articulating the challenges of integrating large amounts of variable output wind resources. The region's utilities are currently experiencing some of these problems with only about 3,000 MW of wind power operating. The Draft indicates that to meet the state renewable resource requirements, the region's utilities will acquire about 5,400 MW of additional wind resources for a total of over 8,000 MW operating in the region to meet Northwest requirements. This will take the Northwest power system into uncharted territory and will require new integration strategies."

Jobs: The future belongs to distributed solar ...

A recent meta-study conducted by the Energy and Resources Group, at the Haas School of Business, University of California and sited in Northwest Energy Coalition's "Bright Future" concludes that in the energy sector, distributed solar will provide more jobs per megawatt hour installed than any other energy technology including conservation and efficiency. The renewable energy and low carbon sectors generate more jobs per unit of energy delivered than the fossil fuel-based sector.

Among the common RPS technologies, solar photovoltaics (PV) creates the most jobs per unit of electricity output. Energy efficiency and renewable energy can contribute to much lower CO2 emissions and significant job creation. Cutting the annual rate of increase in electricity generation in half and targeting a 30 percent RPS in 2030 each generates about 2 million job-years through 2030.

The fossil record: Coal on the way out

Washington's fossil fuel use is very different than the rest of the nation. We rely on the Columbia River for most of our energy. The only coal burned in the state is imported coal used at Centralia, a merchant plant selling power to out of state consumers. The Centralia plant is scheduled to be converted to natural gas by 2025. But natural gas is only cleaner than coal by 50 percent and the Centrailia plant contributes nothing to Washington's energy needs

A portion of Puget Sound Energy's power comes from a Boardman, Ore., coal plant that is slated for closure. Boardman is Oregon's largest stationary source of greenhouse gases and a big contributor to haze and acid rain the Columbia River Gorge. Portland General Electric and environmental groups have agreed to settle a lawsuit over emissions at the plant, Oregon's only coal-fired power plant; a deal that helps ensure the plant's early closure by the end of 2020. If approved in U.S. District Court, the deal provides a court-enforceable order to shutter the plant in nine years.

"For the first time, we will no longer have to rely on PGE's gentleman's promise" to close the plant early, said Lauren Goldberg, a staff attorney with Columbia Riverkeeper.

According to a 2011 study by the National Academy of Sciences, fossil fuels are directly responsible for more than $120 billion in direct health costs per year in the U.S. While there is little coal use in Washington, neighboring states still produce electricity with coal, and some Washington utilities import that power.

Colstrip, a coal plant in Montana has 2,094 MW of generation capacity with Puget Sound Energy using roughly a third of that output. Portland General Electric gets about 12 percent of its generation from Colstrip. Avista, the Spokane-based utility serving Eastern Washington and Northern Idaho, gets about 13 percent of its load from Colstrip

PacifiCorp, which uses 148 MW from Colstrip, does business in Oregon, Washington and Idaho as Pacific Power and Rocky Mountain Power. However, Pacific Power is a national leader in developing renewable energy, with a target of

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... fossil fuels are directly responsible for more than $120 billion in direct health costs per year in the U.S.

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adding 2,000 megawatts from new renewable sources by 2013.

Pacific Power also promotes renewable energy to its customers through its voluntary Blue SkySM program, which provides a simple and convenient way for customers to support additional renewable energy and provides funding for smaller scale community renewable energy projects. More than 37,000 Pacific Power customers currently participate. In 2007, federal agencies named Blue Sky the national green power program of the year. Blue Sky has consistently ranked among the top five renewable energy programs by the U.S. Department of Energy's National Renewable Energy Laboratory.

Natural Gas: A leak in state's energy economy

Natural gas is not produced in Washington, nor in any of the adjacent states. Most natural gas used in Washington is imported from Canada where traditional supplies are nearly depleted. Future gas supplies will be derived by the controversial process known as fracking.

In evaluating the role of natural gas in Washington's future, Washington Sunrise finds that utilities and energy planners must consider that while natural gas is about 1/3 lower in CO2 productions, it is still more polluting than any of the renewables.

And, natural gas prices continue to rise. According to Washington's Utilities and Transportation Commission:

"There are multiple factors involved in explaining why costs have risen so quickly over previous decades:

"Cost of natural gas used as a fuel for power plants has impacted prices over the past five to six years. However, more recently these fuel costs have actually declined to levels last seen in the early part of this decade.

"Increasing demand. While the recession has moderated demand growth somewhat, demand is still projected to increase by a consistent 1.5 percent or more over the next decade. Utilities are required to build resources to meet long term demand needs, not short-term variations. Washington State's population has increased by approximately 100,000 each year which increases demand on the grid.

"Increased demand requires utilities to spend more money for new capacity. Currently, utilities are in need of greater investment to increase capacity. The generation and distribution systems require investment, while increased global demand for construction materials to build new power plants increases capital investment costs. Increased global demand has caused an increase in the cost for raw material (i.e., concrete, steel, copper, etc.). The cost for these materials has grown explosively in the last six years. Prices increased at 10 to 15 times the rate of general inflation. Therefore, building new electricity infrastructure is more expensive. After the commodity bubble burst in the fall of 2008 prices fell but are now on the rise again.

"Green Power/renewable energy puts a slight upward pressure on electric rates. Utilities cannot always buy the cheapest power, and renewable policies create a "sellers' market" for renewable power development or renewable generation equipment which drives up the cost utilities must pay.

"Aging workforces are causing critical skills to become scarce. There are not as many trained electrical workers projected to be in the workforce. This will increase demand for these workers which may drive up wages for critical skills.

"Aging infrastructure (i.e., power plants, distribution lines, and transmission lines) is related to need for increasing capacity. Old facilities need to be replaced and the cost of doing so is driven up by the cost of raw construction materials.

"Climate change may be a driving factor in the future. If a carbon dioxide emissions cost is established, it will impact costs to the customers. The cost of any taxes, replacement costs of low-cost fossil fuel with new and less carbon intensive fuel, and more expensive new plants will be reflected in utility rates.

"Conservation programs are not a cost free resource. If the cost of other resources goes up, the amount of cost-effective conservation goes up and the amount of conservation dollars utilities collect in consumer rates goes up. This rate increase will be mitigated through building codes such as our new 2030 Challenge compliant codes and emerging appliance efficiency standards."

Washington is very dependent of fossil fuels in the transportation sector. To make significant headway in reducing fossil fuel impacts, transportation sector fuel use must be aggressively addressed.

INTRODUCTION

Finding the Missing Megawatts: Pumped Storage and Advanced Batteries, Not Imported Natural Gas

Public discussion on interactions between the Columbia River system and wind projects have largely focused on wind projects as suffering from intermittent generation.

This notion is somewhat misleading, as the Columbia over multiple years demonstrates larger fluctuations than most wind projects. Hydro, wind, solar, all fluctuate seasonally. Fluctuations of the Columbia system can be as much as 75 percent year to year, with wind fluctuating 45 percent on an annual basis yet demonstrates significant hourly fluctuations.

Regional solar can fluctuate 700 percent, yet solar fluctuations track very close to air conditioning demand. As our region's average temperatures increase from climate change, air conditioning loads can be expected to increase.

If Washington is to make a successful transformation to renewables, their variable nature must be addressed. Currently, Washington is under threat of becoming a resource colony, with local resources purchased by out-of-state investors who sell to out-of-state utilities.

Regional Assessment for the Northwest Power Pool

While it is important to note that the Pacific Northwest National Laboratory (PNNL) study is regional in nature, and not Washington specific, it is probable that any action taken on energy storage strategies will be of a regional nature, as Bonneville Power is one of the few organizations in the northwest positioned to provide renewable load leveling. Any successful renewable energy strategy for Washington must address the intermittency of wind, solar and the Columbia River. The PNNL study examines a wide range of storage options and enumerates their costs, opportunities, and risks.

"The study estimated the total balancing requirements for the Northwest Power Pool (NWPP) for a scenario of 14.4 GW of wind energy in the 2019 time horizon. ... The results of this study estimated a total balancing requirement of approximately 4 GW of inc. capacity and about 3.6 GW of dec. capacity, using the BPA's customary 99.5% probability bound... "

"A life-cycle cost analysis was performed that sought the cost optimal technology investment to meet the total intra-hour balancing requirements of a 50-year lifetime. Considered were capital, O&M costs, as well as fuel prices and typical prices for criteria emissions. The CO2 emissions were valued at a cost of $45/ton CO2. Assumed was that all of the estimated balancing requirements will be met with new investments."

"Significant emphasis was placed on reviewing the literature regarding the characterization of storage option for grid applications, and on choosing plausible and defensible cost performance characteristic of the technologies under considerations. Sodium sulphur (NaS) and lithium-ion (Li-ion) batteries, pumped-hydro energy storage, as well as demand response (DR) strategies, and conventional combustion turbine were considered in the analysis. This study revealed several insights into the technology ranking under life-cycle cost optimality."

"First, the reference technology (combustion turbines) is not the least expensive option. Both batteries types were comparatively less expensive. The following ranking (least cost to highest cost) was established for the base cases:

1. NaS only,
2. NaS + DR,
3. NaS + pumped-hydro with many mode changes,
4. Li- ion+DR,
5. NaS+pumped-hydro with many mode changes+DR.

Combustion turbines are not the least expensive option.

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The most costly cases were pumped-hydro with 2 mode changes and demand response alone.

"The design of how pumped-hydro system is operated is critical for the overall size and, thus has direct impact on the lifecycle cost. For the 2-mode-change per day operation, the power rating must be doubled the size compared to the multiple-mode-change design. When only changing the mode twice a day, the machine must provide the full increment-to-decrement swing (inc./dec swing) in one single mode (pumping or generating). However, if the machine remains unconstrained in the number of mode changes a day, the full inc/dec swing (from maximum generation to full load pumping) can be utilized. The 4- minute delay between modes, in which the machine is neither pumping nor generating, necessitates other resources to substitute (back-up resource). The size of the back-up is considerable for the multiple-mode- change operation and relatively small when the pumped-hydro system changes modes only twice a day. Both the oversizing as well as the back-up resource requirements drive up the total life-cycle cost of pumped-hydro system when compared to a battery system.

"Demand-response strategies by itself appears costly. The reason for this result follows a similar logic as for the 2-mode-change pumped-hydro storage. Unlike battery energy storage, which can be a load and a generator at times, DR must be large in capacity to perform the balancing only in the load mode. Thus, the total capacity size tends to be larger than the rate capacity of a battery. The size of the DR capacity (number homes) is determined by the lowest load condition just meeting the balancing requirement leaving a lot of capacity under-utilized for the

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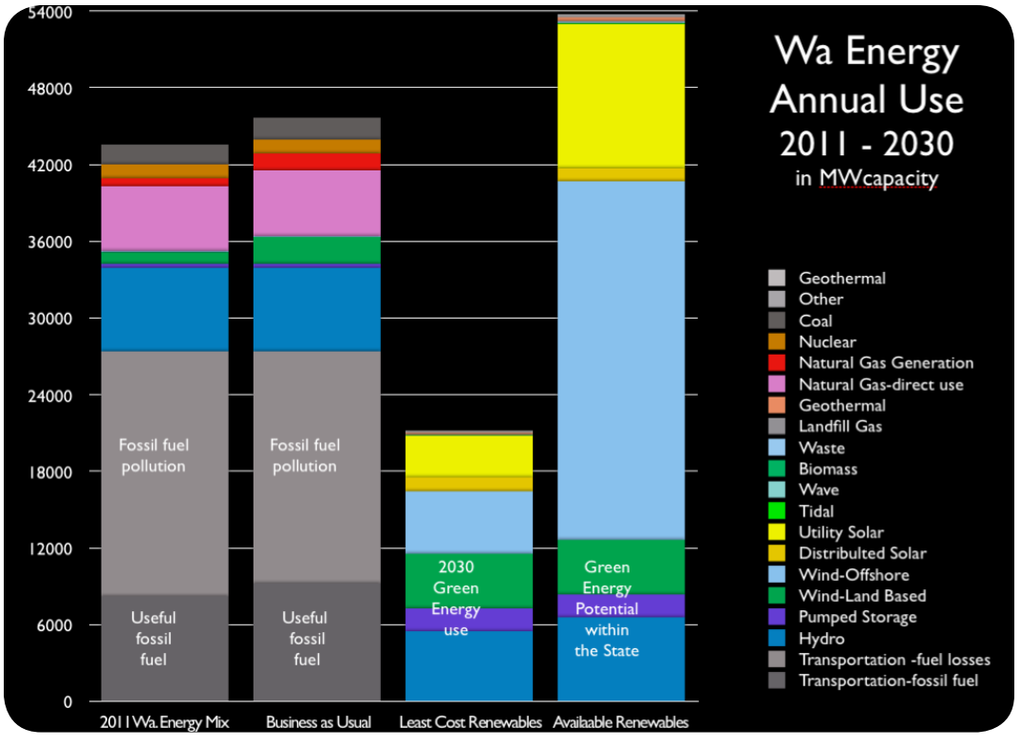
Pumped storage is an established commercially mature technology.

Passive Haus:
Get to 2030 the German Way

"A Passive House is a very well-insulated, virtually air-tight building that is primarily heated by passive solar gain and by internal gains from people, electrical equipment, etc. Energy losses are minimized. Any remaining heat demand is provided by an extremely small source. Avoidance of heat gain through shading and window orientation also helps to limit any cooling load, which is similarly minimized. An energy recovery ventilator provides a constant, balanced fresh air supply. The result is an impressive system that not only saves up to 90 percent of space heating costs, but also provides a uniquely terrific indoor air quality."

- http://www.passivehouse.us/passiveHouse/PassiveHouseInfo.html

INTRODUCTION



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remainder of the day. The most advantageous load profile for providing balancing services would be a flat profile achieving maximal utilization of the demand response resource. Because of a typical residential load shape, meeting all balancing requirements with demand response is unlikely to be economical. However, some DR capacity can reduce the energy requirements of the battery. There is an interesting trade-off between DR power capacity and the storage energy capacity when combining storage and demand response. Interesting shifts are seen in the optimal battery size as one adds demand response resource to the technology mix."

"The results clearly indicate that energy storage and particularly the electro-chemical storage technology are likely to compete with conventional combustion turbine technologies with and without accounting for the emission externalities. Energy arbitrage opportunities may not be the key driver for large deployment of energy storage, at least not in the near-term (2019 timeframe). Placement aspects appear very important for the economics of energy storage, giving electro-chemical storage devices an advantage over pumped-hydro system by not being constrained to a particular geographic topology and hydrological system. However there are other values that large scale energy storage may provide, that are difficult to model, which may support the economics. Grid flexibility for transmission outage management is likely to be improved with energy storage. Further studies with a particular focus on transmission system impacts are necessary to better reveal these values."

Given that this PNNL document accurately characterizes the range of options, It would appear that power planners in the Northwest have a range of options, with conventional pumped storage and combustion turbines being among the least preferred. However further expansion of Grand Coulee's potential and development of some currently planned pumped storage should remain an option.

> … pumped storage can also provide capacity, frequency regulation, voltage and reactive support, load- following, and longer-term shaping of energy from variable-output resources without the fuel consumption, carbon dioxide production, and other environmental impacts associated with thermal generation.

INTRODUCTION

In 1986, Washington walked away from a leadership role in wind power.

Which way was the wind blowing in 1980?

Least-cost planning may not always assure the best economic choice. In 1977, Boeing won a contract for the design, fabrication, construction, installation and testing of several 2.5-MW wind turbine models. The dedication ceremony for the first three turbines was held on April 17, 1980, at Goodnoe Hills.

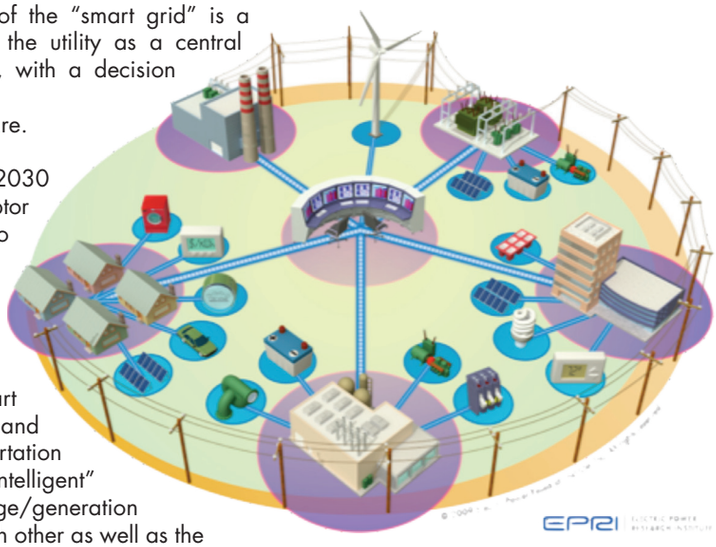
Bonneville Power Administration bought the generated electricity of the turbines and integrated it into the regional power grid. Goodnoe Hills was the first wind farm in the world. It sucessfully demonstrated the technical viability of megawatt scale wind energy. Wind farming was born in Washington.

However, in 1986, the MOD-2 wind turbines were dismantled. In the last full year of operation, the output of the three turbines was 8,251 megawatt-hours. An excellent capacity factor. However, BPA had determined that they were not cost effective.

In 2008, EDF Energies Nouvelles, a French corporation, opened a wind farm on the same site with 47 RePower German-built 2.0 MW wind turbines. In 1986.,Washington walked away from a leadership role in wind power.

Cartesian" smart grid ... or a swarm of ants?

The typical portrayal of the "smart grid" is a utility-centric vision with the utility as a central manager of energy use, with a decision tree arranged in a hierarchical structure.



Washington Sunrise 2030 feels that the descriptor "smart grid" fails to capture the diverse nature of the emerging electrical system. Potentially disruptive technologies such as solar, wind, smart home technologies and electrification of transportation are producing an "intelligent" web of distributed storage/generation systems that "talk" to each other as well as the distribution/transmission systems.

This emerging intelligence may resemble that of an ant hill or termite mound than the current asymmetrical grid in which power decisions are centralized. (It is worth noting that termites can control the internal temperatures of their mounds to within 1/2 a degree C°) Under such a model, many issues affecting the aging power grid simply disappear.

POPULATION

Population growth:
The numbers don't add up to increased energy usage

Between now and 2030, Washington State is predicted to see growth in many areas of its population and economy, according to the state Office of Financial Management, the U.S. Census Bureau, and other sources. However, population and economic growth don't have to also mean increased energy use. With stewardship and technological advances, it is probable that Washingtonians will actually reduce per capita use.

Despite the oft-cited driver of increasing energy demand, population growth, the Pacific Northwest, the U.S, and many other nations are demonstrating that energy use is not rigidly linked to population growth or economic expansion.

In its annual publication, "The Electric Energy Picture in the Pacific Northwest," Bonneville Power Administration (BPA) plots Gross National Product vs. per capita energy consumption for 14 nations, including the U.S.

According to a past director of BPA, "Bonneville had been in a 'period of delusions. ' " Indeed, without the terminated WPPSS nuclear reactors, without the two other projects placed in mothballs soon afterward, and without four more reactors later canceled by private utilities, the Pacific Northwest spent the 1980s coping with an electricity surplus, not a shortage.

SUMMARY OF FINDINGS

- Using economic growth, energy use, and population to predict energy use is, at best, fraught with potential error.
- Washington can profit socially and economically in this unprecedented era of disruptive change.
- Just as the personal computer and the internet emerged as highly disruptive technologies, shifting permanently the landscape of computing, manufacturing, media, education, design, nearly all aspects of our culture, another rapidly maturing intersect of equal import is emerging, this time the locus is energy.
- Disparate technological and behavioral changes are coming together to create an interactive energy web that will restructure energy use, transportation, and the built environment . Those changes include:
  - The cost of photovoltaic-based energy production is nearing the cost of coal and will achieve parity by 2015-20.
  - Home energy management systems are maturing rapidly.
  - Major automobile manufacturers are introducing plug-in electric vehicles.
  - Low energy homes are now required by Washington State energy code.
  - Utilities are exploring the "smart-grid."

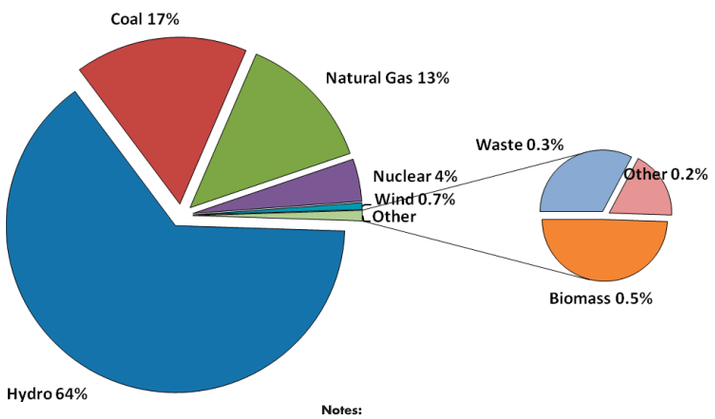
Economic factors may also not directly correlate to increased energy consumption.

See **GROWTH**, Page **16**

POPULATION

2009 Washington State Electric Utility Fuel Mix

Electricity Sales to Washington Customers by Fuel Source



Megawatt Hour Totals	
Hydro	57,214,771
Coal	14,672,973
Natural Gas	11,846,700
Nuclear	3,653,541
Wind	587,994
Other	899,562
Total	88,875,540

Notes:
The 'Washington Utility Fuel Mix' is the aggregate fuel mix of all Washington utilities including BPA direct sales to end users in the state of Washington.

Each fuel's Total megawatt hour (mWh) amount is the sum of that fuel's mWh amount from all Washington utilities including:
- claims on BPA power that is comprised of non-specific purchases of electricity by BPA
- claims on power generated by specific facilities
- claims on BPA power that is comprised of non-specific purchases of electricity by BPA

The category entitled "Other" consists of (mWh): Biomass 445,076 , Waste 296,180, Petroleum 94,360, Other Misc 28,650, Geothermal 19,237, Landfill Gases 16,058

-There were no claims or purchases for Solar.

-Category percentages are rounded upward resulting in a total of 100%.

Reported to utility customers in 2009, Produced by Washington Department of Community, Trade and Economic Development

GROWTH,

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Energy use in the Pacific Northwest is almost twice as high as Sweden's while income levels were nearly the same. Many of our past projections that treated population and the economy as the primary drivers of energy demands have proven to be misguided.

Washington State already has many carbon-free, renewable energy resources that produce more than enough energy for the state; it is just a matter of effectively and exclusively using these resources.

While Washington Sunrise 2030 shows that the relationship between population, economic development, and energy use is tenuous, it is also recognized as the common perception and is the basis for the "business as usual" projections in this report.

Washington Sunrise 2030 reflects a plausible future of Washington State's population and uses this as a baseline for energy conservation and demand calculations.

The state's population is expected to be of a different makeup in 2030 than it is today. Some of these changes will influence energy choices. The number of senior citizens and immigrants in Washington as well as rates for death, births, labor, housing and industry are expected to increase, as we reach 2030. Some populations are definitely going to increase, such as the number of retired baby-boomers. Other factors, like housing and birthrates, are much more variable.

The 2010 U.S. Census measured the state's population at 6,724,540 people. The state Office of Financial Management projects that the population in 2030 will be 8,385,714. The state Department of Transportation projects the population ranging from 8.6-8.3 million. While the actual population could be different, these projections reflect the best available data. Other potential influences will be addressed later.

The state unemployment rate currently

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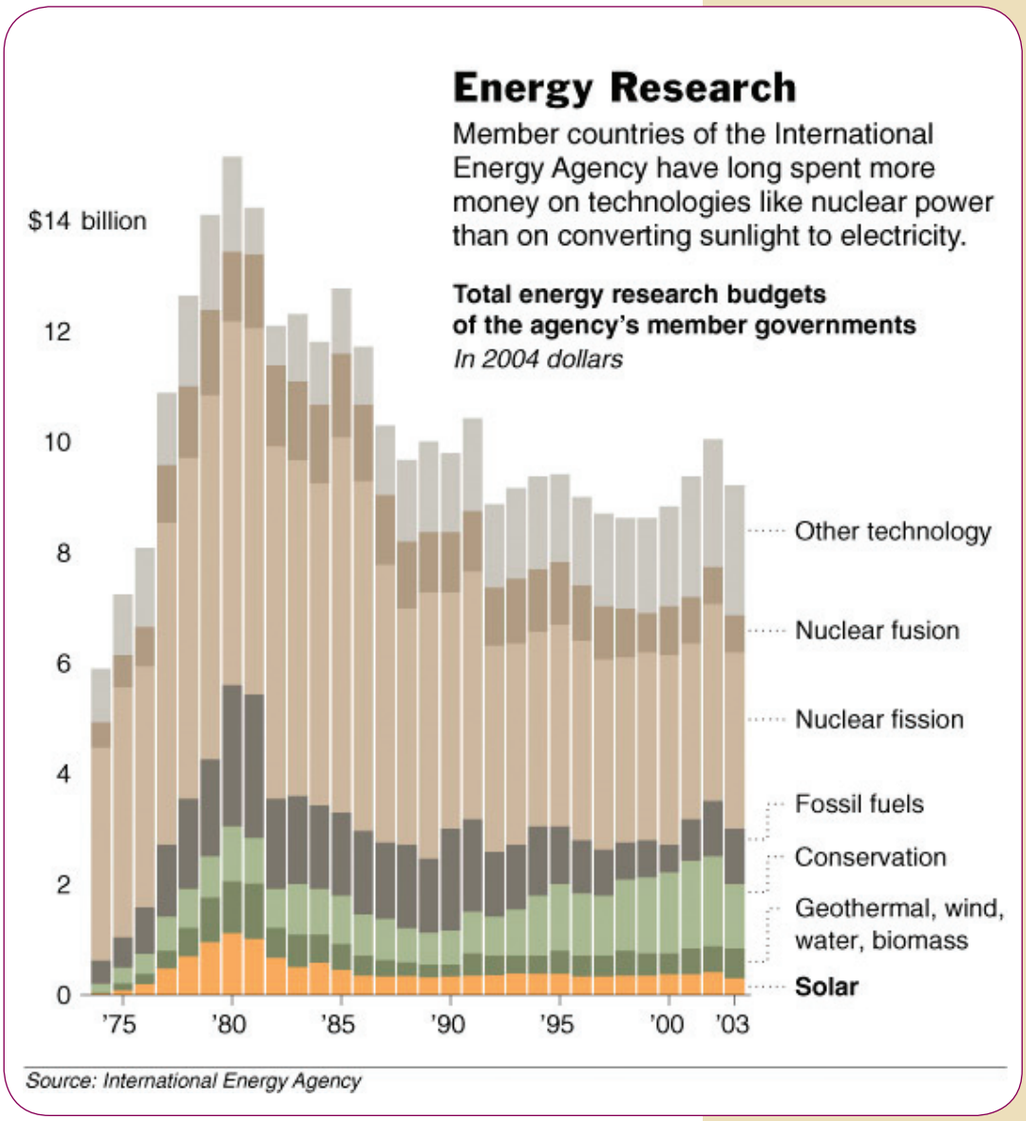
POPULATION

GROWTH,

From Page 16

stands at 9.9 percent, totaling 351,000 unemployed people. In 2030, the unemployment rate is predicted to be 4.7 percent , totaling 187,100 per-sons. The decrease in unemployment will largely be due to a smaller percentage of young working adults and an increase of jobs caring for the growing number of retired baby-boomers. Key industries are projected to be aerospace, retirement, and health care. however there are some uncertainties. However, Washington is also home to industries not invented 20 years ago so it is reasonable to assume the next 19 years could include more examples of innovative spirit as well as the sunsetting of mature industries. For example, the fishing industry in Washington is predicted to be hurt by environmental and resource management factors, slowing one of the State's oldest industries.



Washington State's population is aging. By 2030, the retired population is projected to reach 1,675,800 people, representing 20 percent of the state's population. Today, the retired population is only 12.5 percent of the state's population. This will directly affect almost all aspects of the projected population, ranging from employment to housing and healthcare. The econ-omy in Washington is expected to revolve around the elderly far more in 2030 than it does to-day, with large job increases in nursing and retirement support. These retiring people will leave gaps in the workforce in areas like fabrication and health care.

In 2030, natural increase is expected to decline because death rates are expected to increase as a larger portion of Washington's population nears the U.S. projected life expectancy of 81 years. Birthrates are much harder to predict. The state Office of Financial Management predicts a slightly slowing birthrate by 2030, decreasing from 13.2 percent in 2009 to 12.33 percent in 2030.

The number of people immigrating to Washington is predicted to grow substantially by 2030. In 2010, the annual migration rate was about 24,100 people per year . The state Office of Fi-nancial Management projects the migration rate to peak in 2013 with 50,300 migrants per year and then returning to the historical average of 48,100 migrants per year. Some possible factors leading to an increase in migration are Washington's mild climate, the state's diverse

See GROWTH, Page 18

POPULATION

Active House - A Danish approach to 2030 goals

"The design, orientation and materials of an Active House are optimized to use as little energy as possible and to utilize renewable energy sources, thus making it CO2 neutral. All energy is produced from renew- able energy sources, either integrated into the building or taken from the nearby collective energy system and electricity grid.

Low energy consumption is reached through a holistic approach where orientation and design of the building ensures maximum use of the power of the sun. The use of high-performance products, intelligent control systems, dynamic façade and window solutions with optimized shading and screening will create a building that can be controlled according to the rhythm of the year and day.

The initial cost of an Active House can be higher than the cost of a conventional building because low energy consumption is attained by more energy efficient solutions and constructions (walls, roof, floors, windows, heating and ventilation system), and utilization of green technologies (solar panels, solar cells, heat pumps, etc.).

However, these added costs are offset by savings in primary energy, and by production of renewable energy. It is therefore important to calculate the total costs and savings during the design phase (construction costs) and the operation phase (running costs)…"

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natural resources, and it's comparably successful economy.

Today, we face some of the most uncertain living conditions since World War II. There are many forces that could impact the state's economic development and population composition.

Currently, the housing industry is not rebounding as expected and may foreclosure rates may worsen. Unemployment rates are some of the highest since the Great Depression and even experts are struggling to predict a recovery. Oil and other natural resources may have reached peak production rates, with prices likely to rise while forcing new adaptations. The recent Japanese tsunami is a reminder that natural forces are bigger than all of us.

While Washington Sunrise 2030 assumes population and economic growth, these are still only predictions. No matter which direction Washington State heads, cooperating and sharing with others to live more sustainably seems prudent.

Community wind blows cash in town on the coast

The Coastal Community Action Program (CCAP) of Aberdeen, Washington has brought community wind to life in the Greyland area on the Washington coast. They have recently completed a 6 megawatt (mW) wind development .

The original idea in 2000 was simple, maybe too simple: The intent was to place small-scale wind turbines on the houses of lower-income families to help them pay their energy bills.

But after 10 years of careful research, the project had morphed into a four-turbine wind system that can produce about 13.5 million kilowatt-hours of electrical energy annually. The income from this community-based project will be about $500,000 a year for 20 years. That revenue will fund CCAP's programs in Grays Harbor and Pacific counties.

The process of using combined tax credit programs is one of the many innovative hurdles that the CCAP had to negotiate. But the Community action agency pushed on through the acres of red tape and brought the project to fruition.

RENEWABLES

'Business as usual' won't bring jobs or save energy

If Washington residents choose to pursue a conservation/renewable energy strategy, and walk away from a "business as usual" approach, The state can reverse its historical energy growth patterns, expand employment opportunities, while producing a cleaner and more prosperous environment.

Washington Sunrise 2030 shows the way to a reduction in energy use of more than 40 percent. This surprising conclusion is drawn after examining all energy needs in the state. Most energy analyses have been restricted to one energy sector or another because state law has prohibited considering comparative fuel-source savings. By stepping around such arbitrary restrictions, Washington Sunrise 2030 finds the significant real-world opportunities in conservation and renewable energy sources.

Even with population increases and eliminating natural gas, coal and nuclear-based energy sources, and factoring in the potential removal of the four Lower Snake River dams plus a 20 percent additional load for electric transportation needs, Washington can meet its energy demands in 2030 via hydropower and new renewable resources – carbon neutral.

How is that possible?

Washington's 2011 total energy consumption is about 36,072 MWcf. The term MWcf, megawatt capacity factor, describes the actual energy derived annually from a particular resource, rather than using the nameplate rating.

The state's current installed nameplate capacity is just over 30,000 MW and produces just over 10,000 MWcf. Our 2009 population was 6,664,195 and we consumed 88,875,540 MWh (megawatt hours) of electricity. This resulted in

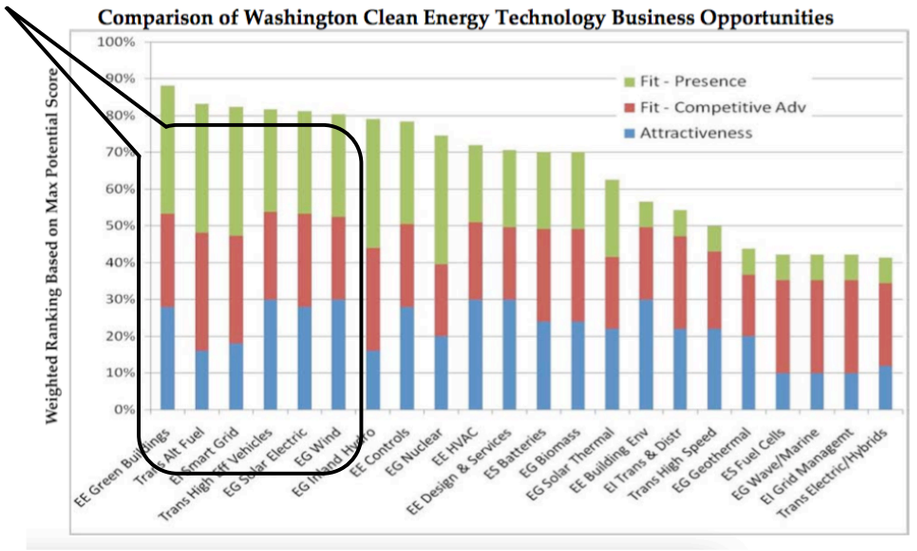
See **RENEWABLES**, Page **20**

Even with population increases and eliminating natural gas, coal and nuclear-based energy sources, and factoring in the potential removal of the four Lower Snake River dams plus a 20 percent additional load for electric transportation needs, Washington can meet its energy demands in 2030 via hydropower and new renewable resources – carbon neutral.

RENEWABLES

Top six

The six technologies rated highest in opportunity by the Washington Clean Energy Technology Council are identical to the technologies rated most beneficial by Washingtn Sunrise 2030.



RENEWABLES,

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a per capita energy usage of 13.3 MWh for 2009.

Washington Sunrise 2030 calculations use population expectations of 8,600,000 people. The resulted in a target demand of 114,692,000 MWh (at 13.3 MWh per person) which is similar to the Sixth Power Plan's projections.

Hydroelectric power is currently Washington's most abundant energy resource. In 2009, hydroelectricity provided 64 percent of our state's electrical energy and 18 percent of all the energy consumed when including transportation. With environmental protection organizations asking the courts to require breaching the lower Snake River dams, it seems prudent that Washington make provisions for a future without the energy provided by those dams.

Still, additional hydropower can be obtained via increased efficiencies and, more importantly, through expanded pumped storage augmented by advanced battery technology. Additional energy storage is critical to any comprehensive renewable energy strategy.

The Sixth Power Plan references 13 proposed pumped storage projects which could produce nearly 14,000 MW in Idaho, Oregon and Washington. A Foster Creek Conservation District study identifies three locations with a potential of 1,500 MWcf of pumped storage hydropower. We included this figure in our Washington State calculations. They represent less than 11 percent of the total MWcf noted in the Sixth Power Plan.

A portion of Washington's 2010 natural gas consumption, went toward generating electricity (613 MWcf) while the larger use (5124 MWcf) was heating, cooking and some transportation. Natural gas was initially converted into MW and then derated at 70 percent to establish the MWcf.

In 2010, Washington imported 141 million barrels of petroleum (7.75 billion gallons) for primarily transportation usage. This converts into 20,548 MWcf using a capacity factor based upon the typical fuel efficiency for vehicles of 14-26 percent. An average of 20 percent was used for Washington Sunrise 2030 calculations.

Transportation fuels were computed by identifying the number of barrels of petroleum used in Washington State in 2011 and identifying what percentage of this was waste product versus that which was used to produce useful energy

Distributed and utility solar are the two basic types of solar photovoltaics examined. It was calculated that 568 MWcf residential solar

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RENEWABLES

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From Page **20**

would be available at a market penetration rate of 18 percent per National Renewable Energy Laboratory (NREL) market estimates. An additional 15 percent was added assuming residents opt to power electric vehicles via their own available resources as prices continue to drop. There is an estimated 508 MWcf possible from commercial installations based upon data obtained from the Northwest Power and Conservation Council that they extracted from the CoStar database. This data set excluded schools and universities which could be substantial contributors. NREL suggests a commercial market penetration rate of 65 percent is reasonable and we added 25 percent to this figure for the potential to cover parking areas with solar.

In estimating utility solar, we arbitrarily chose to consider only one site, the 568 square miles of the Hanford Nuclear Reservation for illustrative purposes. It was estimated that a total of 11,251MWcf is potentially available. In this model, only 3,279 MWcf (29 percent) of this potential were assumed. In all probability, utility projects will be located according to the interests of the utility-scale project developers, rather than a massive plant at a single location.

Wind energy technology continues to expand in Washington. An estimated 4,250 MWcf of land-based and an estimated 28,198 MWcf of offshore wind potential exists in Washington waters. Our calculations use all of the land based wind and 17 percent (4,890 MWcf) of the offshore wind potential.

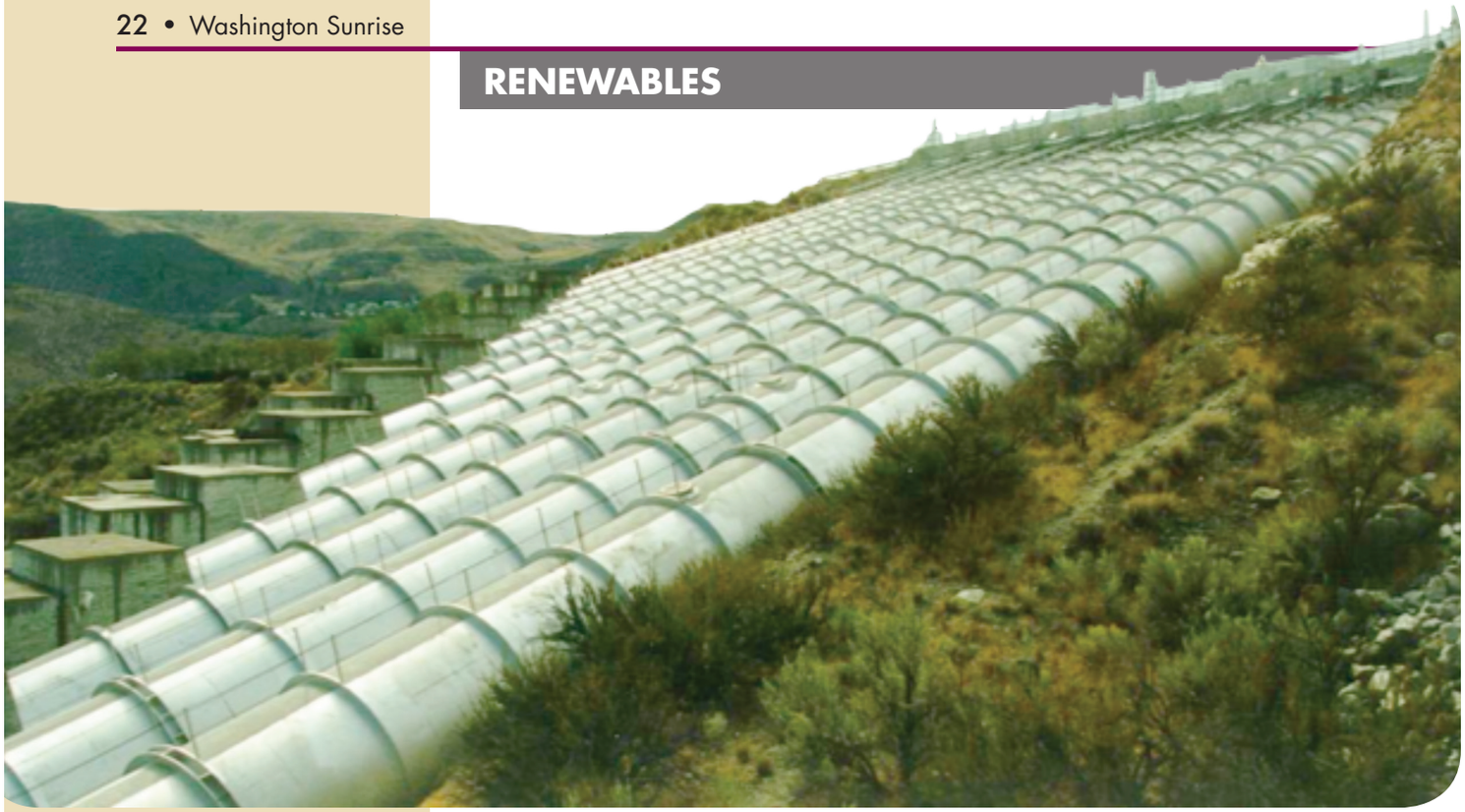
Geothermal energy technology is well-established in other areas, but immature in Washington where 300 MWcf is estimated to be available. Washington Sunrise 2030 assumes using 50 percent of this potential.

Hydrokinetic energy (wave and tidal) power are immature technologies with long-term potential. Due to the unlikelihood of substantial contributions by the year 2030, we do not list hydrokinetic projects as part of the 2030 Washington least-cost renewables mix. Given this, we only included a fraction of potential wave (0.5 percent) and tidal (10 percent) energy for a combined 114 aMW as a Washington renewables potential resource.

Even considering population increases, the elimination of natural gas (3,613 MW), coal (1251 MW) and nuclear based (1017 MW) energy sources, the potential removal of the four Lower Snake River dams (1022 aMW), and a 20 percent additional load for electric transportation needs (2,646 aMW), Washington can meet its 2030 energy demands via hydropower and new renewable resources.

Washington residents use 141 million barrels of oil per year. At $90 a barrel, that's $12.7 billion being pumped out of our economy, money that could be used for cleaner transportation technology.

RENEWABLES



The formula:

Pumped storage + advanced batteries = more than enough

According to the Sixth Northwest Power Plan:

"Pumped-storage hydropower is an established commercially mature technology.

"A typical project consists of an upper reservoir and a lower reservoir connected by a water transfer system with reversible pump-generators. Energy is stored by pumping water from the lower to the upper reservoir using the pump-generators in motor-pumping mode.

"Energy is recovered by discharging the stored water through the pump-generators operating as turbine-generator mode. Cycle efficiency ranges from 75 percent to 82 percent. Seventeen pumped-storage projects constituting more than 4,700 megawatts of capacity are installed in WECC. One project is located in the Northwest - the six-unit, 314 megawatt Grand Coulee pumped-generator at Banks Lake. This plant is primarily used for pumping water up to Banks Lake, the headworks of the Columbia Basin Irrigation System.

Most existing pumped-storage projects were designed to shift energy from nighttime low variable-cost thermal units to afternoon peak-load periods on a daily cycle.

However, pumped storage can also provide capacity, frequency regulation, voltage and reactive support, load- following, and longer-term shaping of energy from variable-output resources without the fuel consumption, carbon

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RENEWABLES

FORMULA,

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dioxide production, and other environmental impacts associated with thermal generation. Importantly for the Northwest, pumped storage could provide within-hour incremental and decremental response to wind ramping events.

Pumped-storage projects require suitable topography and geologic conditions for constructing upper and lower reservoirs at significantly different elevations within close proximity. Subsurface lower reservoirs are technically feasible, though much more expensive. A water supply is required for initial reservoir charge and makeup. Currently, 13 pumped storage projects ranging in size from 180 to 2,000 megawatts and totaling nearly 14,000 megawatts have been proposed in Idaho, Oregon, and Washington, suggesting no shortage of suitable sites. Construction costs are project-specific. Factors influencing cost include the availability of an existing water

RENEWABLES

Best-in-Class? Germany:
Renewable energy sources to contribute 217 TWh in 2020

By Paul Gipe

One of the world's largest banks has issued a report examining how to design feed-in tariffs for solar photovoltaics (solar PV) that ensure rapid development while minimizing cost to ratepayers.

Policymakers often erroneously believe that as more and more renewables are added to the system, the total cost of electricity increases. But the report concludes that increased renewable generation is driving down the cost of electricity. The merit-order effect, says Deutsche Bank, shows that purchasing renewable generation first reduces the size of the remaining demand, driving down wholesale prices.

"The German Feed-in Tariff for PV: Managing Volume Success with Price Response," is the Deutsche Bank report describing how to use price to control the volume of solar and limit its cost - a topic of continuing concern as solar generation grows rapidly. Two of the world's leading experts on feed-in tariff design, Wilson Rickerson and David Jacobs of Meister Consultants, contributed to the 36-page report for Deutsche Bank's Climate Change Advisers.

The report compares the explosive pace at which solar PV can be developed - and its resulting cost - to other renewable technologies, especially wind energy. The principle example used is Germany.

Deutsche Bank gives German renewable energy and climate policy high marks and rates Germany's feed-in tariffs as "Best-in-Class" for their success during the past decade.

Of major industrial nations, Germany has one of the world's highest concentrations of wind turbines, solar systems, and bio-gas power plants. The German program pays substantially less for solar PV generation than policies in the U.S., yet Germany installed seven times more capacity than the U.S. in 2010.

The report says that Germany's solar PV tariffs will remain a key contributor to driving solar PV prices down toward competitiveness with on-peak, fossil-fired generation. Germany will remain the world's largest market for solar PV through the decade, says Deutsche Bank, and the country's feed-in tariffs will eventually drive prices down to grid parity.

The German government is targeting annual installation of 3,500 MW of solar PV per year and by 2020 expects a total of nearly 52,000 MW will be installed. According to Germany's Renewable Energy Action Plan, solar PV will generate 41 TWh of electricity per year for as much as 7 percent of 2020 consumption.

Wind energy, says Deutsche Bank, will contribute 100 TWh or nearly half of the 217 TWh of renewable generation expected by 2020. Because policymakers want to limit the cost of solar PV development in absolute terms but also relative to other renewables, Deutsche Bank's report examines the role of program caps, and various triggers to reduce solar PV tariffs. The report is the most detailed discussion yet on how to design solar PV tariffs to maintain rapid growth while limiting program costs to ratepayers.

There are three possible triggers, says Deutsche Bank, for reducing solar PV tariffs:

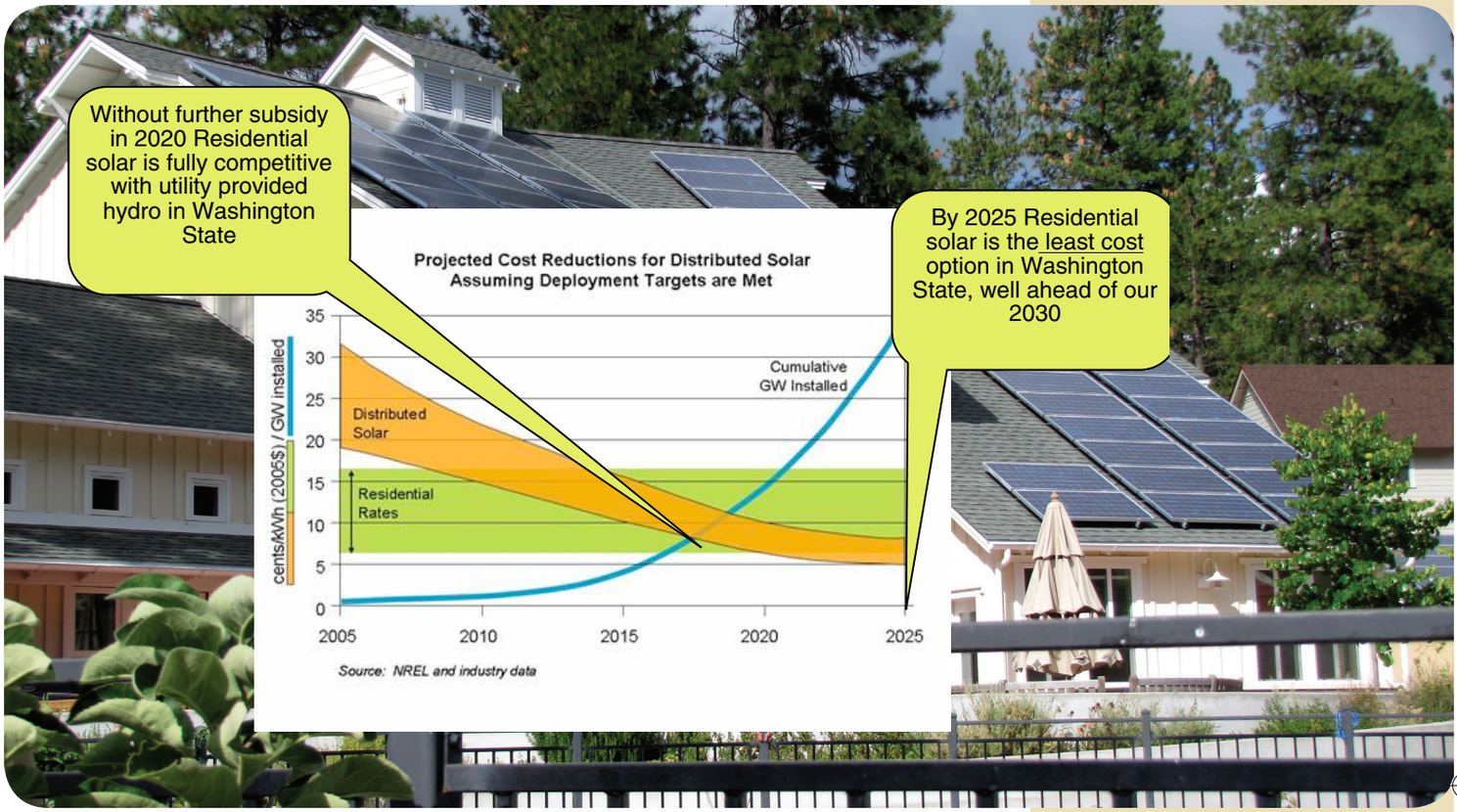
1. Time-based
2. Capacity- or generation-based
3. Cost-based

The report comes down on the side of time-based revisions, used in Ontario as well as Germany. Time-based triggers are more transparent and create the investment certainty for investors that Deutsche Bank values in well-designed programs.

Capacity-based or generation-based triggers, as is used in the California Solar Initiative, are less transparent, says Deutsche Bank, because participants can't always anticipate when the trigger will be reached.

Cost-based triggers are the least transparent because investors can't monitor progress. Program costs, or actual generation, can only be monitored after the fact.

RENEWABLES



Homeowner-produced solar power is all ready cheaper than City Light

And well before 2030, will become the least-cost option

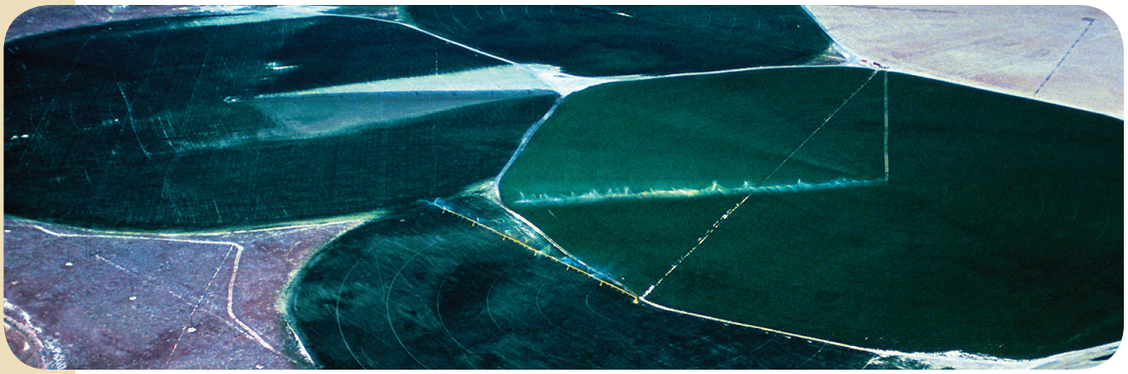
A 5 kW solar system in Seattle can be purchased at Costco for about $17,000.

It's a kit and designed for homeowner installation. After your 30 percent federal tax credit, that's an upfront cost of under $12,000. Over its 25 years-plus life, you can expect it to generate 125,000 kWh. At Seattle's current residential rates that's about $12,500.

The do-it-yourselfer comes out $500 ahead and that's not even counting the $6,750 state incentive that you would receive in the first nine years of operating the system.

That's a total return of $19,250. Seems that doing solar in Washington is a great way to put money in the bank. *(Of course we have ignored interest rates, inflation, and increasing cost of utility power, but clearly on simple payback, solar is already a lower cost option than many Washington utilities).*

RENEWABLES



Excerpted from:

"Effects of an increasing surplus of Energy Generating Capability in the Northwest"

DRAFT Northwest Power Planning Council Document 2011-01

"As of October 2010, ten preliminary permits had been issued by FERC for proposed pumped storage sites in the Northwest and four more preliminary permit requests were pending. None of the 14 proposed projects would pump directly from in-stream sources, so they would not directly reduce in-stream flows. One, the proposed Banks Lake project, however, would use Banks Lake as a lower reservoir and could indirectly augment withdrawal by increasing the effective upper reservoir capacity of the existing Keys pumped storage facility..."

"...The principal findings of this assessment are:

- *Developing resources to serve Northwest state RPS tends to increase the frequency of excess energy events until final RPS targets are met. After meeting the final targets, in the early to mid-2020s, the frequency of excess energy events is expected to slowly decline.*
- *Additional wind development for renewable energy credits is likely to increase the frequency of excess energy events.*
- *The probability of excess energy events increases during good water years and declines during poor water years. As demonstrated in June 2010, unusual runoff patterns can create excess energy conditions even in average water years.*
- *Current RPS targets and financial incentives tend to result in the growth rate of RPS-qualifying energy production exceeding load growth. Market prices are expected to be lower than they would be absent RPS resources, including the market value of non RPS- qualifying electricity.*
- *The average impact of lower market prices on the energy value of Northwest generating capacity will be moderate. The value of hydropower will be disproportionally reduced.*
- *Measures are available to reduce the frequency of excess energy events, to alleviate the economic and operational issues associated with excess energy events, to counter equity issues, and to use available low-cost, low-carbon energy more productively. Policy- related measures are generally low-cost and quickly effective, but may be politically difficult to implement. Structural measures tend to be capital-intensive, of limited effectiveness, and slow to implement."*

Editor's note:

Clearly, available pumped storage resources, combined with advanced battery storage is adequate to firm any renewables growth the state may experience.

RENEWABLES

I-937:
A baseline price for green energy produced at home

In 2006, Washington voters approved Initiative 937 requiring all electric utilities with more than 25,000 customers to carry out all cost-effective energy conservation measures and use certain eligible renewable resources to serve an increasing percentage of retail loads.

Initiative 937 requires these utilities to:

- Pursue all available conservation that is cost-effective, reliable and feasible;
- Evaluate the cost-effectiveness of conservation programs using methodologies consistent with those used by the Council;
- Beginning Jan. 1, 2010, and every two years thereafter, calculate and document the utility's 10-year conservation potential and biennial acquisition target;
- Use eligible renewable resources to serve 3 percent, 9 percent and 15 percent of utility loads by 2012, 2016 and 2020, respectively;
- As of Jan. 1, 2012, provide annual reports to the state on the utility's renewable resources and conservation achievements.

Utilities can be penalized for noncompliance. The penalty rate is $50 for every MWh by which a utility misses the mark. Given that a one kilowatt solar electric system can produce 1,000 kilowatt-hours, or one renewable energy credit (REC), per year for 20 years in the Puget Sound region. The renewable REC value to the utility ought have the value of at least the REC penalty. According to I-937, small scale projects can be double counted. The value to a utility of distributed solar is at least $2,000 per KW in avoided penalties.

RENEWABLES

No Northwest Coal?

"The state of Washington has bound itself by law to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020.

"Currently, the state is discussing the future of the Centralia coal-fired generation plant. The Boardman plant (located in Oregon) faces significant retrofit investments in order to comply with emission regulations, particularly with regard to mercury. Portland General Electric has agreed to shut down Boardman in 2020, though the regulatory process has not been completed.

"Though neither plant currently supplies power directly to PSE on a long-term contractual basis, if their operations were significantly curtailed or shut down, PSE and its customers would be affected by the resulting impacts on market prices and regional transmission reliability.

"To model the possibility that future regulatory policies could force the closure of the region's coal plants, PSE's analysis in this IRP includes a "No Northwest Coal" sensitivity in which the company also loses access to the Colstrip generating plant in Montana. ..."

From: PSE's 2011 Integrated Resource Plan

TRANSPORTATION

Transportation: 60% Problem - 70% Solution

Any careful discussion of transportation in Washington must recognize that the "Cascade Curtain" is not just a geographic and weather divide. The transportation requirements east of the mountains and in rural parts of western Washington are profoundly different than most of the Puget Sound Basin. Small eastern Washington communities tend to be far more walkable than many Puget Sound urban areas, but are typically poorly served by bus and rail systems. Automobile dependency results from greater commute distances. The Puget Sound corridor represents by far the largest population concentration therefore offering the lowest hanging fruit for reduction and/or elimination of fossil fuel use in the transportation mix within the state.

For decades, we have financed our transportation system by a combination of taxes and tolls. This has been a hit-or-miss proposition in many cases. We have planned out the scope and specifications of our highway systems in great detail but have not afforded the financing an equal effort.

One solution was offered in the "Traffic Choices Study" submitted by the Puget Sound Regional Council (PSRC). The main point of this study is to investigate an alternative method of financing the highway transportation system by charging users of the system variable fees (or tolls) depending on the amount of usage and the

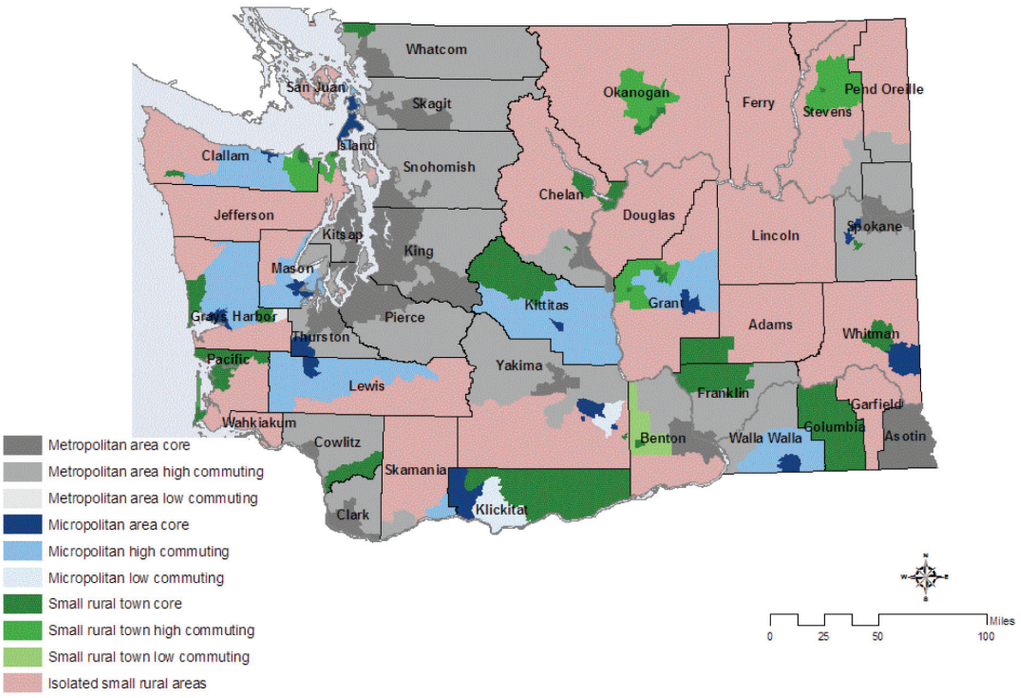
See **TRANSPORTATION**, Page **30**

Findings

Washington Sunrise projects that Washington will adopt electrified transportation well-ahead of the rest of the nation. Though aggressive action, 90 percent of our fleet can become a mix of all-electric, plug in hybrids, and bio-diesel.

- Metropoitan area fleets should adopt hybrids and all-electrics for and finance improvements to the transportation system by following the "Traffic Choices Study" by the Puget Sound Regional Council.
- Bio-diesel should be adopted for in-state, long-haul transportation fuels and commercial aircraft.
- Municipalities that use parking fees should eliminate such fees for plug in electric vehicles and/or develop pay as you go charging stations
- A secondary market for partially depleted automotive batteries will emerge for use in homes providing a growing option for energy storage
- We can move toward a light duty vehicle transportation fleet free of fossil-fuel dependency and relieve current traffic congestion.
- By 2030, careful transportation planning can reduce the number of private occupancy vehicle trips from its current levels, even as the population expands.
- As we reduce the frequency of private vehicle trips, automobiles can merge with the electric distribution system and become a part of a key element in an emerging localized renewable energy structure.
- We can move toward a more diverse mix of commuting options, including high speed bus, light rail, commuter train, and commute trip reduction.
- We can blend transit systems with walking and biking more effectively.

Figure 3: 2000 Census Tract Rural Urban Commuting Area (RUCA) Primary Codes for Washington State



TRANSPORTATION,

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time that the usage occurred.

This may sound similar to the Tacoma Narrows or Evergreen Point bridges' toll strategies, but is very different. While bridge tolls were enacted as a means to pay for construction and maintenance, the PSRC plan is a means of charging users according to use on all major arterials in the Puget Sound Metro area. The current financing strategy relies heavily on fuel tariffs and does nothing to regulate peak time usage.

Another difference in this system from the bridge-toll strategy is that it doesn't rely on expensive cameras or sensors in the roadway, but uses Global Positioning Satellite (GPS) technology to monitor usage. The cost of implementing this system would be in the GPS unit (already available in most smart phones) and a fee to a GPS service provider to monitor and report. A similar GPS system is used in the Netherlands and eight U.S. states are considering the concept.

There may be controversial aspects to such a system, but the benefits could be the answer to current and projected budget shortfalls while addressing traffic congestion problems. Fees could also be coupled to the efficiency of the vehicle, making low- and no-emission vehicles more economically attractive. Reducing fees at non-peak hours would help ease congestion and using mass transit would be free of tariffs.

This same concept could be incorporated into the commercial transportation market as well by rewarding businesses that utilize more efficient vehicles.

The potential ramifications of adopting this plan are nothing short of monumental. Rather than force behavioral changes with punitive legislation, the impetus would shift to incentives for voluntarily choosing more efficient means of transportation. Rather than expanding existing roadways, constructing new bridges, or digging tunnels under the cities, the reduction in traffic volumes would achieve the same results Privately

Options available now: Electric

The success of electric cars relies on one thing:

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TRANSPORTATION

A SIMPLE SOLUTION TO GETTING ABOUT IN URBAN AREAS

The City of Oslo offers rental bikes to residents and tourists alike. There are approximately 1,200 bikes to be found at racks around the city. Users register, pay a small annual fee then use your "smart card" to release a bike from the rack. Users must return the bike to a stand within three hours to make sure that there are bikes available. The bikes are regularly picked up, repaired, and redistributed around the city. The program is financed by advertising on the bikes.

TRANSPORTATION

IS THERE A DOLLARS AND CENTS JUSTIFICATION FOR BUYING A LEAF?

The Nissan Leaf will cost about $25,750. after the federal electric car tax credit The EPA estimates the average car is driven 15,000 miles per year. If a gallon of gasoline costs $3.20, and a kilowatt hour of electricity costs 11 cents, then driving the Leaf 15,000 miles for a year would cost $561. Assuming a vehicle life is 10 years or 150,000 miles, driving costs are about $5610. Ten years of Leaf ownership amounts to $30,910, not counting maintenance, insurance, etc. A Nissan Versa is about the size of a Leaf. MSR Price for a nice Versa is $16,800. According to the EPA the cost of driving the Versa 15,000 miles runs about $1,444 per year. 10 years of ownership of a Versa runs $31,240 (16,800 + 14,440), not counting maintenance, insurance, etc. So, ownership of the Leaf is $330 cheaper over 10 years than its gasoline cousin, the Versa.

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batteries.

As investments in battery technology increase, the products are improving and consumers will respond. A Seattle City Light study shows that, allowing for current technology and normal replacement habits, electric vehicles will have at least 49 percent market share in the Puget Sound region by 2029 and perhaps as much as 76 percent. With federal assistance, 2,500 charging stations are being installed in Western Washington to help promote and support electric vehicles.

Is there enough power available for all these electric cars? Studies show that 75 percent of the demand can be met using existing power infrastructure before considering the effect of photovoltaic charging options. And, electric vehicles can become part of the solution in respect to storage of excess grid electrical power.

Hybrid

Hybrid vehicles are offered by nearly all auto manufacturers. Plug-in, rechargeable hybrids (PHEV) are a recent development that increases the efficiency of the platform. This technology addresses the current shortcomings of all-electric vehicles and would be more effective in areas of lower traffic density and longer travel distances.

How much can be save using EVs or PHEVs in the electric only mode? Studies show that even at the highest rates in the U.S. (Hawaii @$0.27

See **TRANSPORTATION**, Page **34**

Currently Available Fuel-Efficient Vehicles (in U.S.)					
Name	Combined	Technology	Type	MSRP	Available
Nissan Leaf The top contender for first affordable mainstream all-electric car.	99 MPG	Electric	Sedan	$32,800	Now
Chevrolet Volt All-electric gas-free driving for 40-mile stretches.	60 MPG	Plug-in Hy-brid	Sedan	$40,000	Now
Toyota Prius The number-one selling hybrid car.	50 MPG	Hybrid	Sedan	$22,800	Now
Toyota Prius Plug-in Combines hybrid and plug-in	87 MPG	Plug-in Hybrid	Sedan	$32,760	Now
Honda Civic Hybrid Fuel efficiency, full-hybrid system, and a sleek design.	42 MPG	Hybrid	Sedan	$24,000	Now
Lexus CT 200h Lexus's first compact car, and the first compact hybrid sold by Toyota in the US	42 MPG	Hybrid	Sedan	$29,100	Now
Honda Insight The new Honda Insight combines practicality, affordability and top-of-the-charts fuel economy.	41 MPG	Hybrid	Sedan	$18,200	Now
Ford Fusion Hybrid A full-size sedan that achieves 41 mpg in the city.	39 MPG	Hybrid	Sedan	$28,800	Now
Lincoln MKZ Hybrid A luxury sedan with the technology underpinnings of the 41-mpg Fusion Hybrid.	39 MPG	Hybrid	Sedan	$34,300	Now
Hyundai Sonata Hybrid Hyundai's first hybrid offers average efficiency of 38 mpg, for thousands below the competition.	38 MPG	Hybrid	Sedan	$25,800	Now
Honda CR-Z Hybrid Can a hybrid compact car be sporty. and speedy? Honda tries	37 MPG	Hybrid	Coupe	$20,000	Now
Smart ForTwo The Smart ForTwo is cute and relatively fuel efficient.	36 MPG	Small Car	Coupe	$12,500	Now
Volkswagen Jetta TDI The Volkswagen Jetta TDI offers 140 horsepower, 42-mpg on the highway, and a wagon option.	36 MPG	Diesel	Sedan	$23,000	Now
Audi A3 TDI A step up from the Jetta TDI Sportwagen, without going as far as expensive clean diesels from Mercedes and BMW.	35 MPG	Diesel	Sedan	$28,100	Now
Volkswagen Golf TDI Practical sporty clean diesel. Excels in highway MPG.	35 MPG	Diesel	Sedan	$22,200	Now

This list is limited to vehicles currently available in the U.S. There are more vehicles in this category, only those vehicles with an efficiency of greater than 35MPG have been included due to space considerations. The complete list can be reviewed at the source: http://www.hybridcars.com/hybrid-cars-list

TRANSPORTATION

A CAR THAT GETS 10,382 MPG?

You might not want to travel to Yellowstone with your kids in this 10,382 mpg car, but with the equivalent of a liter of fuel, it could drive across America without stopping – if you could.

The world record of 3,836 kilometers on one liter of fuel was set five years ago at the 2005 Shell Eco Marathon. That record was smashed at this year's Eco Marathon by Team Polyjoule, a group of French students who drove their streamlined little hydrogen fuel cell-powered car 4,896 km on the same amount of fuel.

Besides its fuel efficiency, it's a beautifully designed vehicle, isn't it? Let's hope this kind of fuel efficiency trickles down to the rest of us before all the energy is used up.

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KWh) the cost would be half the cost of using gasoline at $3 per gallon. With current electric rates in the Northwest, the cost would be under 25 percent of the cost of gasoline. These kinds of economic incentives should have a significant impact on buying habits.

More Efficient Internal Combustion Engines

All manufacturers are offering a wider array of higher efficiency internal combustion engines (ICE) operating on both gasoline and diesel. While important advancements, they still rely on non-renewable energy sources and contribute greenhouse gas emissions.

TRANSPORTATION

Ford editorial sings praises of electric car, Information Technology

By Dan Roth
CNN Money

Ford Motor Company may be one of the world's oldest automakers, but that doesn't mean it's stuck in the past. William Clay Ford Jr., 54-year-old Executive Chairman of the Ford Board of Directors and great grandson of company founder Henry Ford, has penned a forward-looking editorial for Fortune that shows there are innovative ideas at Ford from the top down.

"For the first time in more than a century, some of the most fundamental and enduring elements of the automobile are being radically transformed," wrote Ford, who goes on to tout the up-coming all-electric Focus and PHEV and electric iterations of the C-MAX five-seater.

As for why Ford is such a technology booster, he points at the price of oil: "The turmoil in the Middle East, a growing demand for energy in China, and the fact that oil is getting harder to find – all this suggests that gasoline is going to get more expensive over time and that customers are going to care increasingly about fuel efficiency." Ford makes a case for the estimate that by 2020, nearly a quarter of Ford's fleet will be electrified. Rather than place all its eggs in a singular basket, Ford is investing heavily in the competing technologies of hybrids, plug-in hybrids and all-electric vehicles. Key to this push is continued development and production of modern battery technology within our own borders, to ensure that no unforeseen factors can arbitrarily cut off our supply of batteries.

Electric or conventional, selling cars, and more cars, will only get you so far if it puts you smack in the heart of an epic two-week traffic jam. That's why Ford argues convincingly for smarter systems that make the most efficient, coordinated use of our existing and new infrastructure for cars, rail, buses and even smart parking.

"Now that the entire industry is finally moving in this direction, people sometimes ask me, Do I feel vindicated? I say, 'No, I feel energized.'"

TRANSPORTATION

Ford Focus electric to come with home solar option

By Chris Woodyard
USA TODAY

Ford is announcing that it is teaming with an established solar provider, SunPower, to sell a solar energy system through Ford dealers in conjunction with the Focus electric sedan that goes on sale in 2011.

Solar panels, to be mounted on the car owner's house, wouldn't necessarily directly charge the electric car's batteries. Rather, they would provide juice from the sun to the house equal to offset about 1,000 miles of driving a month in the electric Focus, a plug-in version of the new compact sedan. Electric cars are typically recharged overnight.

"In effect, you are driving a solar-powered car," says SunPower CEO Tom Werner. He says his customers are always commenting, "Wouldn't it be cool if I could power my car?"

To generate enough solar power for an electric-car offset, the system will have about 147 square feet of roof panels — about 11 panels that are 4 feet by 2 feet. The 2.5-kilowatt system will produce about 3,000 kilowatt hours of electricity a year.

The option will be offered by Ford dealers to Focus electric buyers, but will be a pricey option: about $10,000 after federal tax credits. Best Buy's Geek Squad, with which Ford already has a deal to install home chargers, can perform the solar installation.

The solar power option could get a good reception among environmentalist buyers who have figured out that even driving a plug-in EV isn't truly green because electricity is often made by burning fossil fuels at power plants.

"To have a scenario where you know you are offsetting (the electricity) used in your car, that's pretty attractive," says Ron Cogan, publisher of the Green Car Journal.

Ford Electric Vehicle Home Charging Station (Photo courtesy Ford)

HOME CHARGING STATION APPROVED

October 11, 2011 (Environmental News Service) - To charge the 2012 Ford Focus Electric, Ford's first all-electric car, drivers can use an innovative home charging station just approved by Underwriters Laboratory.

The Ford Electric Vehicle Home Charging Station is a Level 2 EV charging device, designed for Ford. Providing up to 32 amps at 240 volts AC (7.7 kW output), it fully charges the car's lithium ion battery in a little over three hours, more than four times faster than the standard portable charger. Ford Electric Vehicle Home Charging Station(Photo courtesy Ford)

"Charging is one of the most important components of owning an electric vehicle, so it was cru-cial to develop a charging station that made ownership easier and more affordable for Focus Electric owners," said Mike Tinskey, associate director for Ford's Global Electric Vehicle Infrastructure.

Ford and Leviton, a global manufacturer of electrical devices, announced that the new home charging station has achieved UL certification for three specific sets of Underwriters Laboratory requirements.

The new EV charging device is compatible with all additional industry safety standards and recommended practices, the two companies said.

The Ford EV Home Charging Station, including standard installation, features an ADA compliant, simple one-button user interface. It retails for $1,499.

Leviton will also roll out a specially designed home charging station for the 2012 Toyota Prius Plug-in Hybrid. The station decreases the required charging time for the Prius Plug-in to 1.5 hours compared to three hours using the factory-provided 120V cord set.

TRANSPORTATION

Seattle City Light:

From the 2010 Integrated Resource Plan: Possible 76% penetration of PEV's by 2030

"For the 2010 IRP analysis, instead of a generic 40-mile range plug-in hybrid electric vehicle, data for a mix of the Nissan Leaf (a BEV with a 24-kWH battery and a 100-mile range) and the Chevy Volt1 (a PHEV with a 16-kWh battery, back-up gasoline engine, and a 40-mile range) were used."...

..."Most charging is expected to occur in owner's homes at 220-VAC/40 amp circuits (Level 2 charging), although the batteries can be charged at 110-VAC/15 amp circuits (Level 1 charging from an ordinary household outlet) with a much longer charging time. The Level 3 charging stations (440-VAC/85 amp circuits) are being installed in public places will be used for some charging.

Because of its shorter range, the Volt seems more likely to need to be charged away from home (10 percent of charges) at a Level 3 charging station, while the assumption for the Leaf is fewer charges away from home (5 percent of charges). Level 2 charging takes about four hours for the Leaf and nearly three hours for the Volt, whereas Level 3 charging can be accomplished in less than half an hour.

Assumptions about rates of market penetration are the same as in the 2008 analysis, as are the consumption patterns over a 24-hour period. For the base case, market penetration reaches 49 percent by 2029, and 39 percent of charging occurs during peak hours, 6:00 am to 10:00 pm.

For the aggressive case, market penetration reaches 76 percent by 2029, and 49 percent of charging occurs during the peak period.

Figure 1. Share of New Vehicle Sales

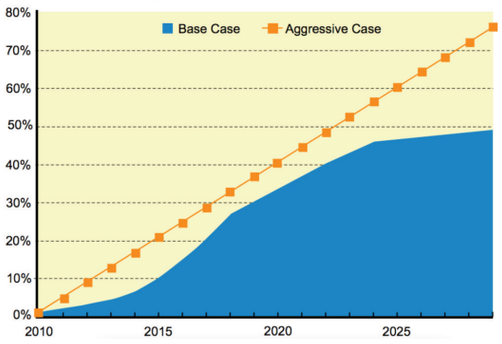
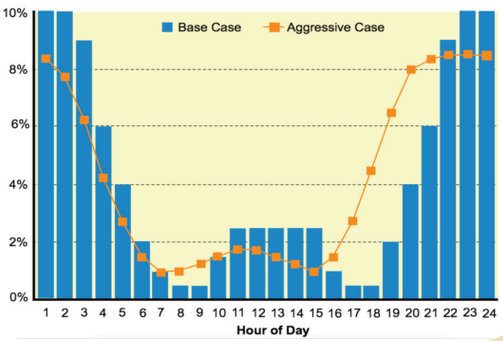


Figure 2. Charging Pattern



BOEING FLYING HIGH ON BIO-FUEL

Virgin Atlantic Airlines has flown a Boeing aircraft on a bio-fuel blend supplied Imperium Renewables, a Washington-based company that is the largest supplier of bio-diesel in the U.S.

On hand were a number of important figures in the world of alternative jet fuels, including U.S. Rep.Jay Inslee, D-Wash., Imperium's president, the Deputy Assistant Secretary of the U.S. Air Force, a Boeing representative, a few folks from the National Energy Technology Lab, and a representative from Commercial Aviation Alternative Fuels Initiative.

TRANSPORTATION

SOLARWORLD DEBUTS SPORT ELECTRIC AIRCRAFT, ELEKTRA ONE

SolarWorld, the Oregon-based largest U.S. manufacturer of solar panels for more than 35 years, showcased the maiden U.S. appearance of a zero-emissions electric aircraft on July 27, 2011, at EAA AirVenture Oshkosh 2011 in Oshkosh, Wis. SolarWorld and Germany's PC Aero worked together to pioneer the world's first comparatively affordable electric aircraft system complete with solar-equipped aircraft and solar-charging hangar.

PC Aero's Calin Gologan spoke at AirVenture, outlining his vision of electric flight, including a talk as part of the SolarWorld-sponsored World Electric Aircraft Symposium.

The single-seat Elektra One is designed for more than three hours of flight, a range of more than 250 miles, a cruising speed of more than 100 mph and zero emissions. With 1,400 propeller rotations a minute at cruising altitudes, Elektra One is nearly silent. The plane weighs 440 pounds, including battery, and can carry a payload of 220 pounds, including pilot.

The plane is expected to go on sale in 2012, pending certification as a new ultralight class aircraft in Germany. It recently won the Lindbergh Electric Aircraft Prize for aviation innovation.

Designed to maximize efficiency, the craft is made of a light fiber composite and powered by a 13.4 kilowatt, 17.96 horsepower, engine.

TRANSPORTATION

Mass Transit - Mass Solution

Buses and trains are the least-cost options for mass transportation in Washington. By transitioning these forms to renewable energy systems, Washington would reduce pollution and its associated health problems, help mitigate climate change, deal with future fossil fuel decline, and move toward energy independence.

Currently, long-distance mass commuting in the Northwest is energy inefficient. Moving to linked electric light rail systems, much like those Washington D.C. and Atlanta, will reduce environmental impacts and provide an alternative to traffic congestion around major metropolitan areas.

Once the patron has entered the major urban area by electric light rail, electric trolleys take over. Metro Transit currently has a fleet of 159 electric trolley buses, now nearing scheduled to be replaced by 2014. Replacing these aging electric trolleys with new more energy-efficient ones will continue to assist in moving the state toward energy independence.

System improvements will also help. For example, the bus system in Curitiba, Brazil incorporates time saving pre-payment kiosks and elevated stations. The elevated stations allow for easy wheelchair access for users to quickly enter or exit. This system results in a typical dwell time of no more than 15 to 19 seconds at a stop. Curitiba's bus system also limits large bus traffic to main highways and incorporates smaller buses for arterial streets. City residents spend about 10 percent of their income on transportation, which is well below the national average of other areas. By modeling the bus system on Curitiba's system we should also incorporate hybrid/diesel buses into this plan. This would then allow for the buses to be converted to bio-fuel or hydrogen fuel cells in the future, and guarantee a fleet of buses for mass transit well in to 2030 and beyond.

Electric Light Rail

Sound Transit Link Light Rail began operations in 2009 with voter-approved expansions in coming years north via Northgate to Lynnwood and ultimately Everett, south to Redondo Heights Park & Ride in Federal Way and east via Mercer Island and Bellevue to Microsoft's main campus in Redmond.

Expanding what Sound Transit has already established to major cities throughout Washington can help address the long distance mass transportation needs. The social implications of a far reaching mass transit system are substantial. Patrons could commute to and from the city without ever having to look for parking or congest the highways.

The major disadvantage of light rail is cost. The 13.9-mile initial segment cost $2.2 billion, which includes a baseline capital budget of $2.07 billion, a program reserve of $128 million, and a $23.7 million payment to King County Metro for debt service re-lated to the transfer of the Downtown Seattle Transit Tunnel (DSST). The

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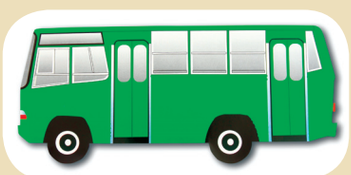

TRANSPORTATION

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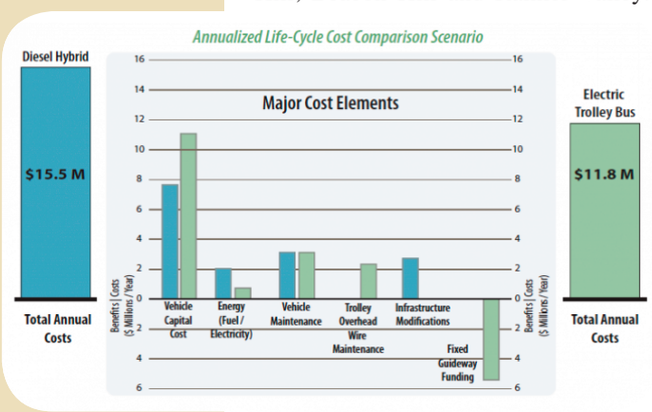
cost of the Airport Link is estimated at $269.1 million, which brings the cost of the total 15.6-mile project to $2.49 billion. The per-mile cost is about $151 million, which included construction of a deep tunnel, reconstruction of tracks in another tunnel, and construction of substantial elevated sections.

Electric Trolleys

An electric trolley buses draw electricity from overhead wires (generally suspended from roadside posts) using spring-loaded poles. They are distinct from other kinds of electric buses, which usually rely on batteries. The trolleys are directly tied into the electric grid and don't have secondary diesel generators. There are 14 Metro routes that use electric trolley buses running on more than 70 miles of two-way overhead wire throughout downtown Seattle, Ballard, Queen Anne, the University District, Capitol Hill, First Hill, Beacon Hill and Rainier Valley. In 2009, these routes accounted for over 19.7 million passengers boarding per year (according to 2009 data) or about 20 percent of Metro's weekly average.



Considerations

- Overall life cycle cost of electric trolleys is substantially lower than that of hybrid buses.
- Proven technology with rider familiarity.
- Power comes from 100% carbon neutral Seattle City Light.
- Saves hundreds of thousands of gallons of diesel each year.
- Approximately twice as energy-efficient as internal-combustion buses.
- Quietest transit vehicles available.
- Excellent hill climbing ability and acceleration.
- Not as flexible of a system (compared to diesel/hybrid) due to the infrastructure required.
- Electric trolleys have a higher capital cost than diesel/hybrid buses.

Hybrid electric/bio-diesel

Hybrid buses use a small diesel engine to turn a generator that, together with traction batteries, supply the necessary electrical energy to move the bus. The hybrid buses are "series hybrids" meaning there is no mechanical connection between the engine and wheels. The engine turns a generator that produces electricity to power drive motors that propel the bus. "Parallel hybrids," more similar to a Toyota Prius, use a blend of mechanical and electrical power. The drive control system on the series hybrids operates the diesel engine at its optimum emission and fuel economy settings. Traction batteries supply energy for acceleration, hill climbing, and other peak load conditions. This reduces diesel engine speed fluctuations and helps minimize engine emissions and increasing fuel economy. A hybrid bus can also recover and store braking energy. During vehicle deceleration, the control system changes the traction motor into a generator. The traction motor/generator is then used to help slow the vehicle as the traction motor/generator stores braking energy in the traction batteries. This increases the vehicle's fuel economy and brake life.

Considerations

- Hybrid buses emit 95 percent less particulate matter than the buses they replace.
- Produce 40 percent less nitrogen oxides and reduce greenhouse gases by 30 percent.
- An increase in fuel efficiency of 30 percent is anticipated.
- Regenerative braking allows energy to be stored in batteries that would other-wise

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TRANSPORTATION

Current fact

In 2009, electric-trolley routes accounted for over 19.7 million passengers boarding per year (according to 2009 data) or about 20 percent of Metro's weekly average.

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be lost as heat energy in braking.

- The hybrid drive system is adaptable to new technology developments that could lead to further emission reductions and fuel savings.
- Currently more expensive
- B100 biodiesel generally not suitable for use in low temperatures.
- Concerns about B100's impact on engine durability.

Hybrid buses carry a price premium over conventional diesel buses. The average price of a 40-foot hybrid bus typically ranges from $450,000-$550,000 compared to $280,000 -$300,000 for a conventional diesel bus. However, the price differential for hybrids can be offset by various federal incentives and grant programs. The federal Clean Fuels Grant Program covers 90 percent of the incremental cost of alternative fuel buses, including hybrids. In addition, the Federal Transit Administration (FTA) covers up to 80 percent of the purchase price of a standard diesel bus. Therefore a transit agency's share of matching funds for a hybrid is $80,000 when compared to $60,000 for a conventional diesel. As the technology matures and the market develops, the cost differential for hybrids is likely to decrease. (http://www.sfmta.com/cms/mfleet/hybrids.htm)

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Biodiesel

The perceived achievability of biofueled vehicles is high. With no new fueling infrastructure and no need to produce new types of vehicles not already on the market, it is a system ready to be used based on customer decision. Biodiesel can be made with the recycling of old fryer oils from local restaurants, by-products of food processing, or manufactured from biological sources grown on local Washington farms.

One promising idea of biodiesel can be seen with algae grown diesel being produced in Colorado. Washington may be able to use these same methods to grow algae derived diesel. The company Solix is a good example of the potential that algae derived diesel may have in addition to the benefits of bio-diesel in general. Solix claims the following advantages:

- Fully integrated flexible algae growth system for outdoor algae cultivation and species evaluation
- Maintains clean stable culture with minimal contamination mitigating the risk of culture crashes
- Can delivers high volumetric productivity from flask to 4,000 liters in 33 days
- Can be installed in one week
- Clean-in-place system
- Expandable to six growth basins
- Options such as heating and cooling allow operations across a wide variety of environmental conditions
- Allows genetically modified algae to be cultivated safely (with available options)

The final cost of algae biodiesel unclear at this time. Since the publication of "Biofuels Digest" the cost of algae biofuels range between $9 and $30.

"The $9-$30 cost ranges cited in the latest research reflect today's prices," said Biofuels Digest editor Jim Lane. "That's already competitive in some nutraceutical and food markets – for example, a pound of olive oil retails for around $17 at my store, or about $120 per gallon. But like the computer market – costs are expected to come down quickly." The Company's initial target is to be competitive with biodiesel, which historically sells for about $2 per gallon, wholesale. They believe they can reach this goal within a few years, and are ultimately aiming to compete with petroleum.

The government is also interested in advancing this technology as well. According to algae-book.com, the military is interested in the research and may even drop the cost of algae bio-fuel to about a $1 per gallon.

Considerations

- Domestically produced from non-petroleum, renewable resources
- Can be used in most diesel engines
- Less air pollutants (other than nitrogen oxides) and greenhouse gases
- Biodegradable
- Lower fuel economy and power (10 percent lower for B100, 2 percent for B20)
- Currently more expensive
- B100 generally not suitable for use in low temperatures
- Concerns about B100's impact on engine durability

Commercial Transportation

Commercial freight transportation falls into two categories, rail and truck.

- Truck reliance on petroleum based products can be reduced by phasing in of biodiesel (see "Biodiesel" above) and hybrid technologies. Tax and tariff benefits could encourage voluntary implementation of these technologies.
- The present day diesel electric rail systems need to be improved and promoted so more products can be shipped in this manner which is more efficient han over the road truck methods.

Air transportation uses a tremendous amount of fossil fuel. There is a possibility of reducing this amount through the use of biofuels but this is presently in the experimental stage.

TRANSPORTATION

Walking and biking

The Puget Sound Regional Council recently published "Transportation 2040" which includes walking and biking as a transportation options.

One of their key goals is to improve the cycling access to transit terminal and facilities. They would also like to add more bike racks on transit vehicles. The plan attempts to assure that any future construction to roadways will not interfere or block the connectivity of existing bicycle and pedestrian paths. Furthermore, any new construction of roads will consider cycling and walking into their right-of-way plans.

Transportation 2040 proposes development of regional bicycle systems and pedestrian networks that connect residential areas to transit centers by way of bicycling and walking. The plan focuses development and growth to within a mile of existing and planned transit stations for pedestrians and bike paths connecting developments in a three-mile radius. The plan prioritizes overcoming barriers like crossing a freeway or major arterials and fixing missing links between non-motorized networks. Ultimately a system of approximately 470 miles of new regional off-road walking and biking paths would be in the Puget Sound area.

In terms of walkability, Seattle ranks in fourth in the nation. Seattle has a population of 4.2 million, of which 3.1 percent commute by walking. What makes a city walkable?

"Typically, there is a core area or center, whether that's a main street or commercial strip. There needs to be enough people living in the area for businesses to flourish. Public transit runs frequently, and typically you'll find parks and open public spaces," said Josh Herst, CEO of WalkScore, a web-site that analyzes cities for their walk-ability. Along with parks, there needs to be a lot of corners and shorter blocks, which feel more walk-able than longer blocks. "People won't walk past blank spaces!" said Ed McMahon, senior resident fellow at the Urban Land Institute, which studies land use in urban areas. Walk-able cities not only feel safer, but they promote exercise and health and they are very social as you are constantly running into neighbors. (Cindy Perman, Walkable Cities, "CNBC.com", April 21, 2011)

The Seattle Bicycle Master Plan proposes development over the next 10 years of bicycle facilities on 62 percent (295 miles) of Seattle's arterial streets. The plan calls for 230 miles of assigned bicycle routes connecting all parts of Seattle. These routes would be located within a quarter-mile of up to 72 percent of Seattle schools and 95 percent of all Seattle residents. It also calls for the development of 50 percent more multi-use trails. (City of Seattle. Seattle Bicycle Master Plan. Seattle Washington 2007.)

An interesting example of successful attempts to increase bicycle ridership is the bicycle exchange program in many of the Scandinavian cities. The capital cites of Denmark, Finland, Norway and Sweden are all bicycle friendly. There is a service called CityBike which offers hundreds of bicycles that can be rented for a small fee. The bicycles are parked in card operated racks. The user pays a fee to ride the bike from point A to point B, and deposits it back into a similar rack. The identity/credit card allows the program to track individuals who fail to return bikes to the bike racks. The Yellow Bike program was an experiment in bike sharing in the United States.

TRANSPORTATION

The bus system of Curitiba, Brazil, exemplifies a model Bus Rapid Transit (BRT) system, and plays a large part in making this a livable city. The buses run frequently—some as often as every 90 seconds—and reliably, and the stations are convenient, well-designed, comfortable, and attractive. Consequently, Curitiba has one of the most heavily used, yet low-cost, transit systems in the world. It offers many of the features of a subway system—vehicle movements unimpeded by traffic signals and congestion, fare collection prior to boarding, quick passenger loading and unloading—but it is above ground and visible. Around 70 percent of Curitiba's commuters use the BRT to travel to work, resulting in congestion-free streets and pollution-free air for the 2.2 million inhabitants of greater Curitiba.

Final Assessment

Public awareness of transportation issues has changed in recent years. It has become accepted thought that we need to address the growing problems of fossil fuel costs and shortages, health effects of air pollution, increasing gridlock, and global warming. This change can be seen in the recent agreement between the federal government and automaker to increase the average fuel mileage to 55mpg by 2025. The significance of this agreement is multifaceted; it is the first instance where industry and the government were in agreement regarding the need for such a measure and the only possible way this goal can be achieved is by producing large numbers of electric and hybrid vehicles. http://slatest.slate.com/posts/2011/07/29/new_auto_fuel_economy_rules_obama_unveils_agreement_to_boost_fue.html

So the opportunity stands before us to lead the way into a brighter future, with the unique resources of the Pacific Northwest we can achieve independence from imported oil, improve the quality of life of all residents in this area, and contribute to the global community in a meaningful rather than a symbolic way. The choice is ours.

ENERGY CONSERVATION

Washington State and conservation of energy:
Our most cost effective resource

Conservation is not just a good idea in Washington State, it's the law.

Initiative 937 (I-937) obligates 17 utilities that serve 88 percent of the retail load to pursue all available conservation that is cost-effective, reliable, and feasible. By January 2010, each utility was required to a conservation plan that identifies its achievable cost-effective savings potential for the next 10 years. The utilities must use the methods outlined in the 6th Northwest Power Plan to shape their own conservation supply assessments.

Although the utilities do not have to specifically use the methods in the Sixth Northwest Power Plan, they have to use methods "consistent" with the plan. Another state law, Senate Bill 6001 section 3; (d) says: "By 2020, increase the number of clean energy sector jobs to 25,000 from the 8,400 clean tech jobs the state had in 2004."

Without question, the Sixth Northwest Power Plan is the definitive analysis of achievable conservation within the Northwest. Its goals, methods, and objectives map well on to Washington State and should be considered the gold standard of what is practical and achievable.

Low hanging fruit

Washington's residential buildings have the largest amount of conservation potential, according to the Sixth Northwest Power Plan. Whether they are new or existing building measures, challenges through 2030 can be met.

The medium-case forecast for Washington's annual residential sector demand shows 35 percent growth, going from 1,875MWa in 2010 to 2,497MWa in 2030. Residential buildings consume most of their energy when heating water, and heating and lighting spaces. Residential building envelope efficiency is a significant conservation opportunity.

Entertainment system energy use will grow rapidly for a brief period, followed by a movement to more efficient technologies as "always-on" devices are replaced by Internet streaming technologies. Other residential sector end- use loads include refrigeration, dishwashers, clothes washers, heating and air conditioning systems. All these residential sector loads can be expected to produce significant savings as technology develops.

Findings

- Washington can achieve its mandated conservation goals and meet the American Institute of Architecture (AIA) 2030 Challenge.
- Washington's building codes and conservation legislation effectively moves the state toward the goals of the AIA 2030 Challenge.
- Washington will be able to meet these goals while adding little new generation, even if required to remove the four Snake River dams and not re-licensing the Columbia Generation Station at Hanford.
- Every energy consuming sector of Washington has its own unique demands, yet some conservation endeavors are shared between sectors.

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ENERGY CONSERVATION

Resource strategy includes five recommendations:

1. Develop cost-effective energy efficiency aggressively — at least 1,200 average megawatts by 2015, and equal or slightly higher amounts every five years through 2030.
2. Develop cost-effective renewable energy as required by state laws, particularly wind power, accounting for its variable output.
3. Improve power-system operating procedures to integrate wind power and improve the efficiency and flexibility of the power system.
4. Build new natural gas-fired power plants to meet local needs for on-demand energy and back-up power, and reduce reliance on existing coal-fired plants to help meet the power system's share of carbon-reduction goals and policies.
5. Investigate new technologies such as the "smart-grid," new energy-efficiency and renewable energy sources, advanced nuclear power, and carbon sequestration."

According to the Plan, cost-effective energy efficiency could meet 85 percent of the new load over the next 20 years

Sixth Northwest Power Plan: A picture of future

Efficiency and renewables

"The Sixth Northwest Power Plan is the sixth five-year plan adopted by the Council since Congress passed the Northwest Power Act in 1980. The Power Plan, which guides the Bonneville Power Administration, details a strategy to meet future demand for electricity in a manner that assures an adequate, economic, affordable, and reliable power supply.

The Plan looks 20 years into the future. According to the Plan, Northwest population will increase from about 13 million today to 16.7 million by 2030, and load (the ongoing power requirement) will increase from about 21,000 average megawatts today to about 28,000 average megawatts by 2030, an increase of about 7,000 average megawatts overall or about 1.4 percent (about 339 average megawatts) per year.

The Northwest electricity system faces huge challenges: uncertainty about future climate-change policy, fuel prices, salmon-recovery actions, economic growth, and integration of variable wind power. Energy efficiency is the most cost-effective and least risky resource to meet future demand.

According to the Plan, cost-effective energy efficiency could meet 85 percent of the new load over the next 20 years (about 5,900 of 7,000 average megawatts). This efficiency, combined with new renewable energy, could delay investments in new fossil-fuel power plants until future environmental legislation is clear and alternative low-carbon energy sources have matured in technology and cost.

ENERGY CONSERVATION

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Lighting: The lowest branch on the tree

Residential lighting efficiencies will be dramatic as incandescent light bulbs are replaced with more efficient condensed fluorescent light bulbs (CFL), and light emitting diode (LED) bulbs and fixtures." Occupancy sensors in residential homes will add efficiencies. Additional potential can from induction lamps as these lamps use up to 50 percent less than conventional lighting systems. Induction lamp systems last 5-10 times longer than conventional systems, and exceed 100,000 hours of rated lifetime (over 22 years of 12 hrs/day operation). Electrode-less lamp design completely avoids the damage of delicate components such as filaments or electrodes that are the primary causes of conventional lamp failure. While induction lamps are currently more suitable for commercial and industrial applications, they can be designed to light homes for maximum savings potential.

TV: A shrinking load?

Residential consumer electronics include power-drawing appliances like televisions, stereos, computers, video gaming systems, and movie playing systems. These efficiencies are applied during manufacturing as the consumer purchases energy-efficient models.

According to the BPA, the Northwest consumes nearly 3.7 billion kWh of energy each year on consumer electronics while technology is available now to reduce TV electricity consumption by 30-50 percent. This makes efficiency in televisions among the largest residential sources of conservation potential in the region.

While television efficiency is increasing, so is the number of sets per home. However, their use is decreasing as consumers opting for direct streaming and other Web-based technologies. There was an energy-use bump as always-on video recorders became more prevalent. Now, that bump is flattening as consumers migrate to instant on-line streaming.

Hot water shrinks

Residential water heater efficiencies are being achieved by updating the way in which water is heated. The American Council for an Energy Efficient Economy (ACEEE) compares the life-cycle costs of the different types of water heaters. According to the ACEE, an electric heat pump water heater is the most efficient with a low yearly energy cost. Solar water heating with electric back-up comes in a distant second. The least efficient type is the conventional oil-fired storage water heater. It costs the most and lasts fewer years than more efficient products.

The Sixth Northwest Power Plan suggests controlling water heaters to reduce peak load, achieve load following, and provide energy storage through use of line carrier signals from the utility or home energy control systems.

Pump up the heat

Residential conservation comes from upgrading the efficiency of heating, ventilating, and air-conditioning units as well as continued operational efficiencies and preventative maintenance. According to the Sixth Northwest Power Plan, the third largest increase in residential sector potential comes from the lower cost of high efficiency heat pumps for space heating. The plan's measures include converting new and existing single family and manufactured homes with electric forced-air furnaces to high-performance heat pumps.

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Sunlight can be cool

Washington Sunrise 2030 sees added potential in summertime air conditioning at least partially powered by solar electricity. The demand for air conditioning results in "coincidence." i.e., When the sun is out, it's hot and people demand air conditioning. Added loads from residential air conditioning can be countered with solar electricity, the conservation totals will increase and peak loads will decrease. As noted elsewhere, solar electric power is rapidly approaching cost parity. When this parity is reached, we can expect a very rapid advance in solar installations.

Homes with thicker skins

A building's envelope is the skin and susceptible to severe weather and other damaging forces. Making that skin more efficient - keeping heat in while allowing heat exchange ventilation - heaters stay off until conditions become extreme.

Thermal bridging – leaking heat — is a big problem in older or poorly built homes. Existing housing stock should have energy audits at the time of sale to find and seal air leaks, insulate the attic or basement, and upgrade to efficient windows and doors. The skin of a home must be enhanced with a weather-resistant exterior wall envelope per: WAC 51-50-1403 – Performance requirements . Also, WAC Section 101.2"… provides minimum standards for new or altered buildings and structure remodels to achieve efficient use and conservation of energy." It is important to remember that these are now minimum energy standards.

Industrial conservation: A wild card?

Washington's industrial sector is a challenge to forecast due its complex nature and ability to be influenced by disruptive technology. The Sixth Northwest Power Plan's Industrial analysis includes most of the region's Non Direct Service Industry (NDSI) plus refrigerated warehouse storage.

NDSI sector consumption is largely made up of pulp/paper, food processing, chemical products, primary metals other than aluminum, and lumber/wood products and refrigerated warehouse storage. The NDSI has declined since 2001 and is experiencing slow growth. Companies such as Google, Amazon, and Microsoft are known as "custom data-centers" and are included in the NDSI sector. The efficiency of these components depends on the specific energy saving models that these businesses purchase. The NDSI sector is expected to grow from 931MWa in 2010 to 1,090MWa by 2030.

Direct Service Industry: A vanishing breed

Washington's Direct Service Industry (DSI) has been primarily made up of aluminum smelters. As Washington's hydroelectric system grew during the 1940s and '50s, so did the aluminum industry. A single smelter or rolling mill can consume as much power as a city of 100,000 people. By 2001, global

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competition had shut down many plants. DSI energy demand is expected to grow from 173MWa in 2010 to 193MWa by 2030. Currently, BPA is adding DSI generation (aluminum) in Montana, but on a limited scale.

Conservation as profit center for business

Washington's commercial sector energy use is expected to grow from 1,677MWa in 2010 to 2,293MWa in 2030. The Sixth Northwest Power Plan's commercial conservation report analyzed over 250 efficiency and conservation measures in 19 different building types. Included in the plan's assessment are infrastructure end-use efficiencies and sewage treatment/ water supply pumping locations. The American Society of Heating, Refrigeration, and Air-conditioning Engineers, inc. (ASHRAE) is the state and national building code standard. The Council found that commercial building energy standards adopted by the four states in the region contain endeavors that exceed ASHRAE's Standard 90.1.

Lighting efficiency is again the lowest hanging fruit. Improvements in fluorescent lights, fixture efficiency, light positioning, lighting controls and efficient design are keys in conserving commercial sector energy. The Energy Independence and Security Act (EISA) requires "general service lighting" to be at least 30 percent more efficient beginning in 2012 and 60 percent more efficient beginning in 2030. Additional conservation comes from the use of motion sensors and automatic lighting controls in conjunction with efficient lighting wherever safe and plausible. Other automatic lighting devices on the market today include time-of-day controllers, smart power strips, and remote control power strips.

ASHRAE 90.1 standard calls for additional control requirements for display and accent lighting, case lighting, task lighting, non-visual and demonstration lighting.

Washington Sunrise 2030 sees added savings potential from infrastructure/ warehouse/ other lighting efficiency that comes from the implementation of induction lamps that could increase the plan's conservation totals. These lamps, as in the residential environment, use up to 50 percent less energy than conventional lighting systems. Induction lamps last 5-10 times longer than conventional systems, and exceed 100,000 hours of rated lifetime (over 22 years of 12 hrs/ day operation). However, Washington's "Least-Cost Planning" policy currently will not allow for the proactive integration of these slightly more expensive lamps.

Among other end-use opportunities are commercial refrigeration, beverage merchandisers, ice makers and other customer-interface machines. Modern dispensers go into a "sleep" mode and the power use will be reduced unless "woken" by a customer, or a sensor is triggered.

Turn down the power

Washington's utility distribution systems conservation comes from the Northwest Energy Efficiency Alliance (NEEA) pilot project to improve the efficiency of distribution systems . The plan's measures save energy, reduces demand, and reactive power management (load following).

The project found no evidence that voltage reduction has any direct adverse impact on customers. The results of the pilot demonstrated that utility distribution system voltage range can be reduced to save energy but there are still some barriers. These include regulatory disincentives, the need for outside assistance, lack of verification protocols to prove savings, and organizational challenges within the utility.

The Sixth Northwest Power Plan suggests these savings stem from several types of changes to distribution equipment and operations and system improvements.

Real time pricing: Data-driven decisions

Washington Sunrise 2030 considers the implications of Real Time Pricing (RTP) on homes and businesses in Washington State to add to conservation totals. RTP can be used in conjunction with renewable energy, as well as other programs. Savvy energy consumers seek

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"We know a lot about the ideal environment for a happy whale or a happy mountain gorilla. We're far less clear about what constitutes an Ideal environment for a happy human being. One common measure for how clean a mountain stream, is to look for trout. If you find the trout, the habitat is healthy. It's the same way with children in a city. Children are a kind of indicator species. If we can build a successful city for children, we will have a successful city for all people."

– Enrique Penalosa

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more control over where their energy mix comes from and control over their house energy use.

Most Washington households currently have electricity meters that simply record the total consumption of electricity since installation, meaning that the consumer cannot be charged prices that vary from hour to hour. The only way for a utility to read these meters is to send a meter reader; a costly, error prone, and potentially dangerous process.

Washington Sunrise 2030 re-labels the "Smart Grid" as the "Energy Web." The Energy Web is a set of emerging electric power information technologies that include household energy management devices and technologies that facilitate communication with the homeowner. By allowing households to more easily observe prices and consumption profiles and even automate how their appliances turn on or off in response to real time prices, customer's ability to respond to price changes will be enhanced. The locus of control shifts from a utility-centric structure to a consumer-centric model.

A culture of conservation

Conservation of energy is a presence in the minds of consumers, becoming less about restrictions and more about value. More and more people are remembering to turn out the lights, and as more energy efficient appliances appear in the market, we can expect to see an increase in responsible behavior. Washington has a higher penetration of hybrid vehicles than other parts of the country. The more that business advertises "green concepts," the stronger a conservation ethic will become in the mindset of Washington residents.

ENERGY CONSERVATION

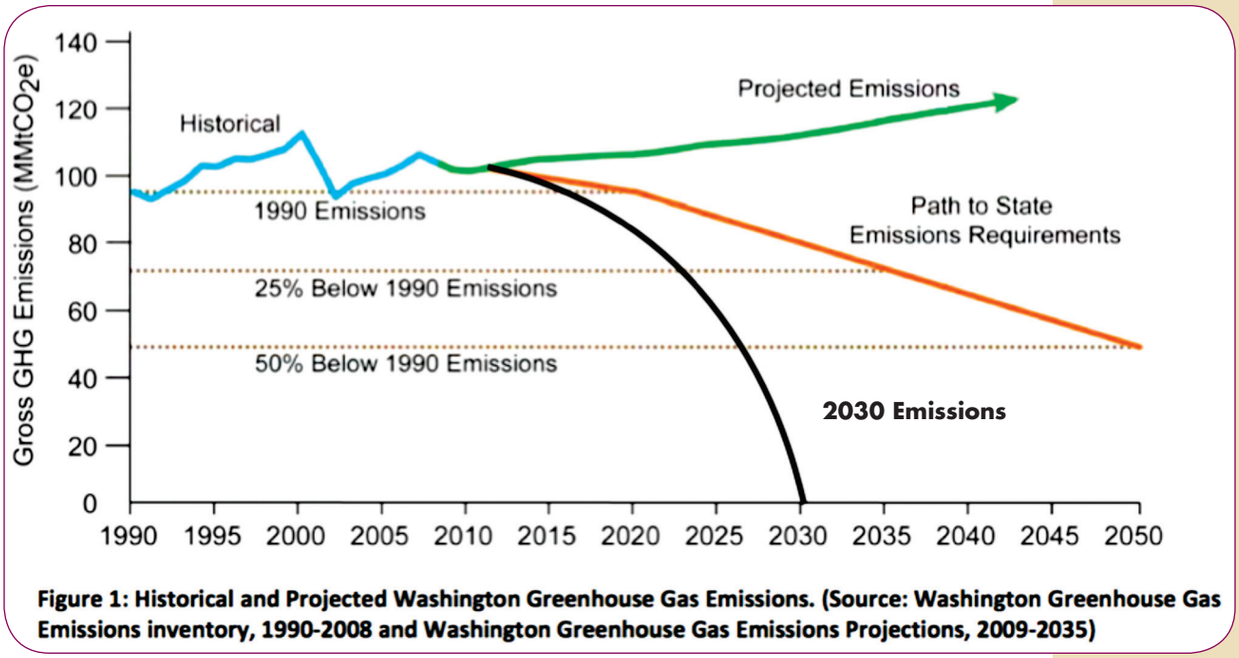


Figure 1: Historical and Projected Washington Greenhouse Gas Emissions. (Source: Washington Greenhouse Gas Emissions inventory, 1990-2008 and Washington Greenhouse Gas Emissions Projections, 2009-2035)

Thermally induced climatic chaos:

Global warming is real, and some people are going to get very rich dealing with it

The state Department of Ecology's "Path to a Low-Carbon Economy" states the climate-change problem succinctly:

"Global climate change is the economic and environmental issue of our lifetime. The science is clear that we must move forward quickly to reduce greenhouse gas (GHG) emissions in order to mitigate its effects. Without action, climate change will negatively affect nearly every part of Washington's economy through changes in temperature, sea level, and water availability."

"Climate change poses a significant threat to Washington's environment and economy. Warming temperatures have caused a significant decrease in spring snowpack throughout the world. In Washington, changes in snowpack will continue to decrease summer water availability, increasing the competition among water users for an already scarce resource."

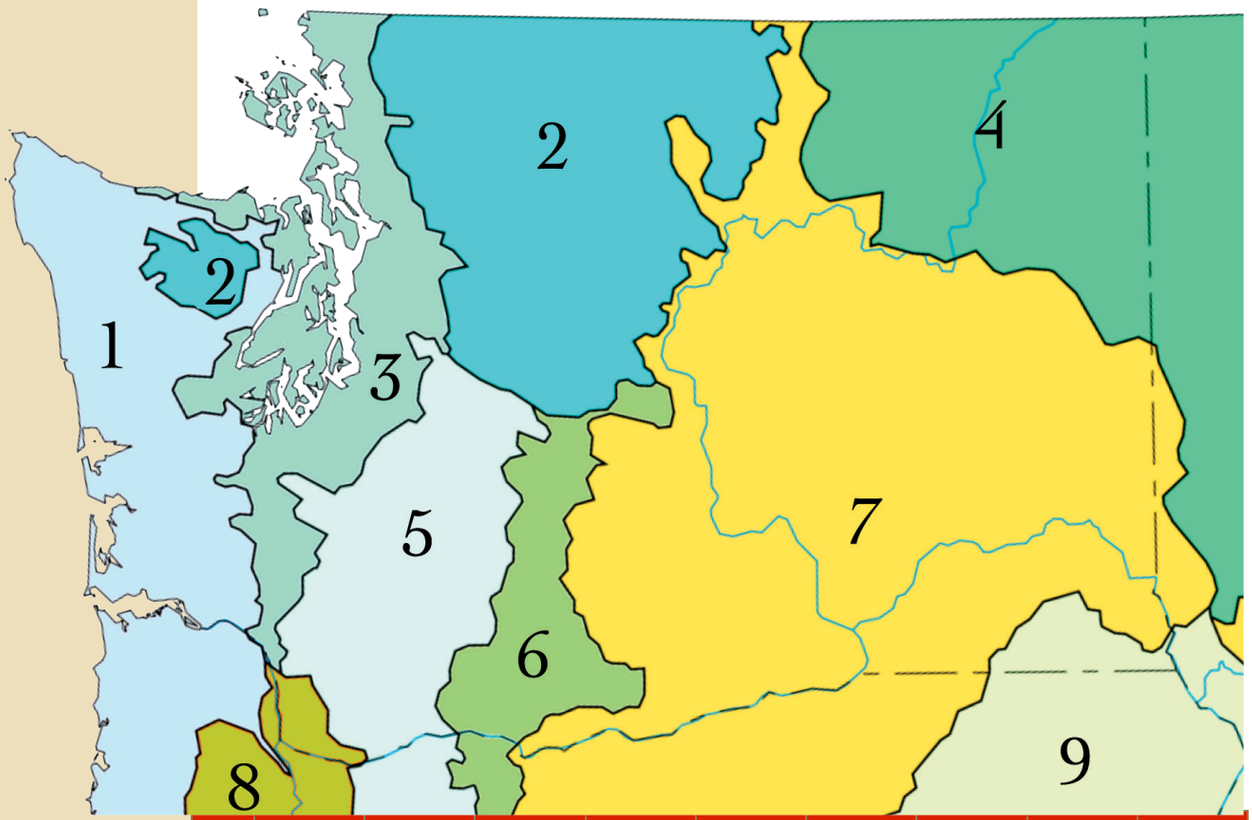
The Department of Ecology goals are mapped out in state law. In 2008, the Legislature put into law the state's GHG emissions reduction limits first adopted by Gov. Chris Gregoire in Executive Order 07-02. Washington must reduce emissions to:

- 1990 levels by 2020
- 25 percent below 1990 levels by 2035
- 50 percent below 1990 levels by 2050

These are worthy goals; however it is important to remember that as state law, they are minimum goals. To do any less would be a breach of the law.

Washington Sunrise 2030 maps out a path that gets the state to carbon neutrality much more quickly and profitably. Energy efficiency, renewables, and better planning do not entail hardship, but rather a path to clean air, climate stability, high employment, and profit.

ENERGY CONSERVATION



This map shows ecological regions identified by biotic and abiotic phenomena that bring differences in ecosystem quality and integrity.

These include solar radiation, average air temperature, freezing periods, vegetation, climate, geology, soils, land use, wildlife, and hydrology. EPA's Level III is used but may be revisited as experience grows.

These eco-regions considered were developed by Omernik (1987). Eco-regions serve as a spatial framework for environmental resource management and describe areas of similar type, quality, and quantity of environmental resources.

	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
INS	2x6 walls + 2" foam - R 38 oe 8 in aipa Ceiling - R48	2x6 walls + 2" foam - R 38 oe 8 in aipa Ceiling - R48	2x6 walls + 2" foam - R 38 oe 8 in aipa Ceiling - R48	8" sips or advanced framing plus 4" foam	8" sips or advanced framing plus 2" foam	8" sips or advanced framing plus 2" foam	8" sips or advanced framing plus 2" foam	2x6 walls + 4" foam - R 38 Ceiling - R48	8" sips or advanced framing plus 2" foam
VENT	Use humidity controlled bath fan and room air to air heat exchange	Air to Air heat recovery vent system	Use humidity controlled bath fan and room air to air heat exchange	Air to Air heat recovery vent system	Air to Air heat recovery vent system	Air to Air heat recovery vent system	Air to Air heat recovery vent system	Use humidity controlled bath fan and room air to air heat exchange	Air to Air heat recovery vent system
HEAT	Mini-split	Wood heat or pellet stove, if a re-forestry effort can be annual activity	Mini-split	Wood heat or pellet stove, if a re-forestry effort can be annual activity	Wood heat or pellet stove, if a re-forestry effort can be annual activity	Wood heat or pellet stove, if a re-forestry effort can be annual activity	Geo thermal heat pump	Geo thermal heat pump possibly Mini-split	Geo thermal heat pump or wood/pellet stove
GLAZING	Double-glazed moderate solar gain, low-E Argon/Krypton U.27 SHGC.56 VT.50	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC .40 VT.50	Double-glazed moderate solar gain, low-E Argon/Krypton U.27 SHGC.56 VT.58	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC.40 VT.50	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC .40 VT .50	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC.40 VT.50	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC.40 VT.50	Double-glazed moderate solar gain, low-E Argon/Krypton U.27 SCGC.56 VT.50	Triple-Glazed High-Solar-Gain Low-E Glass, Argon/Krypton Gas U.18 SHGC.40 VT.50
DHW	Heat Pump Water heater in unheated space	Solar domestic hot water consider wood	Heat Pump Water heater in unheated space	Solar domestic hot water	Solar domestic hot water consider wood	Solar domestic hot water consider wood	Solar domestic hot water	Heat PumpWater heater in unheated space	Solar domestic hot water consider wood
ELECT	Photovoltaic	Photovoltaic possible wind	Photovoltaic	Photovoltaic possible wind	Photovoltaic possible wind	Photovoltaic possible wind	Photovoltaic possible wind Stirling cycle	Photovoltaic	Photovoltaic possible wind
APPL	Induction cook-top Micro-wave condensing dryer En star ref.	Induction cook-top Micro-wave condensing dryer En star ref. consider wood cooking	induction cook-top Micro-wave condensing dryer En star ref.	Induction cook-top Micro-wave condensing dryer En star ref. consider wood cooking	Induction cook-top Micro-wave condensing dryer En star ref. consider wood cooking	Induction cook-top Micro-wave condensing dryer En star ref. consider wood cooking	Induction cook-top Micro-wave condensing dryer En star ref.	Induction cook-top Micro-wave condensing dryer En star ref.	induction cook-top Micro-wave condensing dryer En star ref. consider wood cooking

LAND USE

Land Use:
'What' and 'where' decisions are foundational to everything

With our state's population expected to reach 8.2 million people by 2030, certain questions must be addressed if we are to handle this growth sustainably.

According to the EPA …"land development is occurring at a far higher rate than population growth, resulting in sprawl. In the nation's 34 metropolitan areas with populations greater than one million people, between 1950 and 1990 the population increased 92.4 percent, while the urbanized land area grew by 245 percent, or 2.65 times the population growth rate".

So, where will everyone live? How will our communities evolve to meet the needs of a growing populace? How can we keep from developing our natural open spaces? How can we design our built environments to be vibrant, healthy, safe and livable, energy efficient and be sustainable?

Background

Since the Industrial Revolution, urban centers have seen tremendous growth worldwide. The majority of any region's population will be found in its industrial center.

In fact, more than half of the world's populations now live in an urban center. The process which draws people from rural areas to urban areas or its' suburbs is known as urbanization. Urbanization can be cause by many factors, the most prevalent being the availability of jobs. Other factors that contribute to urbanization are education, housing, and transportation.

Much of our current planning and development in the United States is a result of the Federal Highway Act of 1956 signed into law by Dwight D. Eisenhower. It was the largest public works project in American history at that time and the act was intended "to help people move from urban areas to the suburbs."

The federal government paid for 90 percent

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Findings

To achieve the goal of sustainable growth and a higher quality of life for Washington State by 2030, we must:

- Incorporate land-use planning based on smart growth, new urbanism, transit-oriented development and LEED ND principles.
- Redesign existing infrastructure by retrofitting suburban sprawl into viable communities, densify existing cities and add mixed-use and walkable communities to industrial districts.
- Design our built environment for the public domain and human dimension and not the automobile.
- Link communities and cities with a variety of choices of transportation options.
- Make "location efficiency" an important factor in determining the total energy consumption of buildings and transportation for land-use planning decisions.
- Take action.

LAND USE

	Energy-efficient home and car	*Transit-oriented location*	*Energy-efficient home and car in a transit-friendly site **
A household in this type of home in a conventional suburban location can reduce its energy consumption by...			
Single-family detached home	34 percent	38 percent	53 percent
Single-family attached home (rowhouse or townhouse)	35 percent	41 percent	56 percent
Multifamily home	38 percent	49 percent	62 percent
	...just by adopting energy-efficiency measures in its home and driving a fuel-efficient car.	...just by being located in a transit-friendly site.	...by making its home and car more energy efficient and being on a site that is close to transit.

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of highway construction with states paying the balance. The federal portion of the costs has been paid for by taxes on gasoline and diesel fuel." After World War II, there came an incredible growth and prosperity in this country and the suburban lifestyle appeared to be the answer to how we should live. It promised community, privacy and safety from the ills of the city.

Federal policies during this time subsidized the zoning of the suburbs through a large federal grant program, financed its housing through the federal mortgage system, built highways and ignored the inner cities. The subdivision, the mall, the office park and the automobile became a part of the American identity.

However 60 years later, that identity is becoming less useful. The suburban model is out of sync with economic needs and environmental challenges. A series of recessions of the 1970s to now, the energy crisis and non-nuclear families, point to this as well as do the empty-nesters and young professionals who are returning to the cities.

The original suburban developments, built in the 19th and early 20th centuries, were modeled after the European suburbs. They were located along railroad lines at stations and maintained an urban structure, with mixed uses and good walkability. However, post-war suburbs, from the late '40s on, differed greatly in design. They were made up of single uses - subdivisions, office parks and shopping centers strung together by arterials and highways. They were low-density development and ignored any traditional neighborhood structure and sense of community. It is these auto-centric developments of the post-war era, typically described as sprawl, that have created alienated monotonous environments, vehicular pollution, energy inefficiencies, traffic congestion, and crime.

For more than 30 years, urban designers, planners and architects have promoted a different direction for growth in the American metropolis - a land-use pattern that would develop a new regional growth strategy. This direction integrates the urban and the suburban land-use patterns, provides places for community and for privacy, the auto and pedestrian, large institutions and small businesses, and allows social diversity, environmental protection and transit to thrive in close proximity. This new urban design movement became known as "New Urbanism."

Two important urban planners in the late '80s were Peter Calthorpe and Doug Kelbough. In 1989, they published a book called "The Pedestrian Pocket Book: A New Suburban Design Strategy." It described a foundation for change around a "simple cluster of housing, retail space and offices within a quarter-mile walking radius of a transit system" As Calthorpe states "Pedestrians are the catalyst which makes the essential qualities of communities meaningful." See diagram below.

The design of the pedestrian pocket matured into the "Transit-Oriented Development" (TOD) approach which promotes a more compact urban form consisting of high-density housing and other retail and business uses at strategic points along a regional transit system. It provides a commercial center, jobs and housing, while preserving natural habitats that are all within a 2,000-foot walking distance.

In the early '90s, The Congress for New Urbanism was founded which incorporated

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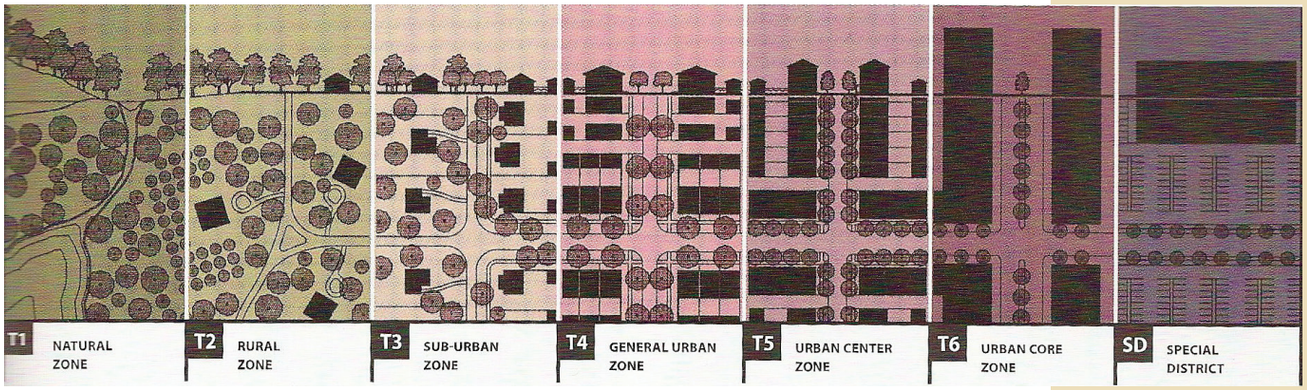

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the TOD concepts and the following guiding principles into its goals:

- Expansion of transit
- A more compact urban form
- Single-use zoning should be replaced with standards for mixed-use, walkable neighborhoods
- Urban design policies should create an architecture oriented toward the public domain and human dimension rather than the private domain and auto scale.
- Diversity of scale, of uses, of building types, of open spaces, of population types, and natural systems.

It also included guidelines for building orientation, scale, detailing, and density with their primary purpose to reinforce, support and activate public spaces, commercial centers and transit. Extensive redesign of existing roads and highways would be required in order to accomplish the desired shift from auto centric roads and highways to a finer grained, more connected network that allows pedestrian, bikes and transit as well as autos to all coexist.

Current Thinking

Several important studies conducted this past year reveal the importance of intelligent land-use planning in order to reduce energy consumption, a major component of sustainability.

An EPA study with Jonathan Rose Companies published in April 2011: "Location Efficiency and Housing Types –Boiling it Down to BTUs" looked at energy issues associated with a range of development approaches and found that "housing types and location, along with energy-use features of homes and vehicles, all have an important role to play in achieving greater energy efficiency."

An energy efficient, multifamily home using fuel-efficient vehicles and located in a transit-friendly site consumes less than 30 percent of the 240 million BTU's used by a single-family, detached home without energy-efficient features and located in an auto dependent site. The right diagram shows reductions up to 62 percent can be achieved with increased density, more energy efficient home construction and use of transit.

In March 2010, the Center for Neighborhood Technology (CNT) published, an updated H+T Index (Housing and Transportation) which is an interactive mapping Web site where users can see results at the neighborhood level, including housing density and other community characteristics. This index shows that "by quantifying the average transportation costs for households based on location, (represents)"….a more holistic and accurate view of the true cost of housing."

CNT was also partially responsible for the "Location Efficient Mortgage" (LEM) program which recognized the savings available to people who live in location efficient communities. The LEM program was discontinued in early 2011.

Another study, by the Environmental Building News (EBN), looked at the relationship between location and energy, and their results show that

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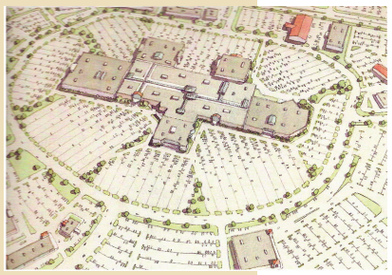

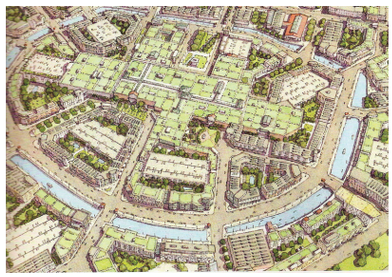

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commuting office workers consume from 30 percent to 50 percent more energy than the amount of energy the office building itself used.

"In an average new office building built to code, transportation accounts for more than twice as much energy use as building operation."

EBN proposes "Transportation Energy Intensity," which has been used in the freight industry as a measure of how efficiently freight can be transported, be also applied as a metric of building performance. It could establish the "amount of energy associated with getting people to and from a building whether they are commuters, shoppers, vendors, or homeowners." Ways to improve the "Transportation Energy Intensity" would include the "D-factors" (density, distance to travel, diversity of uses, and design of streetscapes.)

This study concluded that more attention to location and land-use planning as a part of our green development is necessary and that performance ratings of buildings must also measure the transportation energy intensity with a point system to be incorporated into the LEED and Energy Star certification programs.

Intelligent urbanism by way of better planning and design standards and policy change will help reduce our energy demands. As Calthrope states "urbanism, along with auto and building efficiency standards, is the low hanging fruit in the climate change challenge and would provide more vibrant cities, lower household costs, healthier population"

An alternative to our current land-use codes is the SmartCode, a form base code intended to replace conventional zoning codes and be administered by planning departments. It was developed by Andres Duanny and Elizabeth Pater Zyberk, and it incorporates the New Urbanism principles with pedestrian-scaled, mixed-use and fine-grained urbanism. It includes all scales of design, from regional planning to cities, blocks, and even individual buildings including signage. Currently, about 40 cities in the U.S. have adopted SmartCode. One of the code's main principles is that land use is divided into seven zones or habitats that range from very rural to very urban and are called transects.

Another guide for planners, developers and government officials is the Sprawl Repair which provides guidance and strategies for "transforming fragmented and inefficient development into livable communities." The primary goal of Sprawl Repair is to modify the reparable areas of the current sprawl, such as turning subdivisions into walkable neighborhoods, shopping centers and malls into town centers and leaving those areas that are irreparable to parks, agricultural uses or natural land.

State Land Use Policies

According to the state Department of Transportation (WSDOT), during the 1800s, Washington's population mainly lived in rural areas. During the early 20th Century this began to change and continues to change, exponentially. In 1910, 53 percent of Washington residents lived in urban areas. In 2000, 82 percent of us lived in cities.

"Metropolitan Statistical Areas" (MSAs) describe a "core area containing a large population nucleus, together with adjacent rural communities that have a high degree of economic and social integration with that core." As of the year 2000, Washington had six MSAs, which encompassed 84 percent of the state's population. Seattle is considered a "CMSA" or consolidated metropolitan area. By the year 2030, WSDOT predicts there will be two new MSAs and that 88 percent of the population will live in MSAs.

For more than 20 years, Washington has taken a progressive approach to addressing climate change and sustainable growth. The 1990 Growth Management Act (GMA) was "enacted

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- Encourage development in existing urban areas
- Reduce sprawl
- Ensure that adequate public facilities are in place for new development
- Retain, enhance, and conserve open space, recreation, and habitat areas

- Growth Management Act

in response to rapid population growth and concerns with suburban sprawl, environmental protection, quality of life, and related issues." Twenty-nine of our counties must, or have chosen to, plan under the GMA. The other ten counties must "plan for critical areas and natural resource land only under the GMA.

Under the GMA, local governments have the final say in any land use plans; the GMA outlines the states' planning goals, makes planning required for large and fast growing areas, oversees that the states' goals are met, and requires planning on a regional basis for specific issues.

The goals that were laid out in the GMA are still pertinent today:

- Encourage development in existing urban areas
- Reduce sprawl
- Ensure that adequate public facilities are in place for new development
- Retain, enhance, and conserve open space, recreation, and habitat areas
- Protect the environment and enhance water and air quality and availability of water
- Meet the goals and policies of the Washington State Shoreline Management Act as set forth in RCW 90.58.020
- Encourage economic development that is within the capacity of the state's existing natural resources.

Other progressive state legislation and policies, which advocate and support sustainability, include the following:

- House Bill 2815 (2007-08) focuses mainly on reducing greenhouse gas emissions. It aims to achieve this by mandating that the Department of Transportation adopt statewide goals of reducing per capita vehicle miles traveled by 50 percent by the year 2050. "The decrease is incremented every fifteen years; 18 percent reduction by 2020, 35 percent by 2035, and 50 percent by 2050." Although this is mainly to reduce greenhouse gas emissions, this will directly affect land use and planning since developments will have to be denser and sprawl will have to be curtailed.
- Senate Bill 6580 (2007-08) calls for reduction of greenhouse gas emissions associated with new development and transportation by implementing land use and transportation regulations. It is meant to be used hand-in-hand with the Growth Management Act, Its end goal is that local governments will draft and adopt plans that "minimize land use patterns that increase vehicle usage, encourage compact communities, in-filling, denser development, linkage with transit options, and other practices that reduce the number of vehicle miles traveled, and encourage

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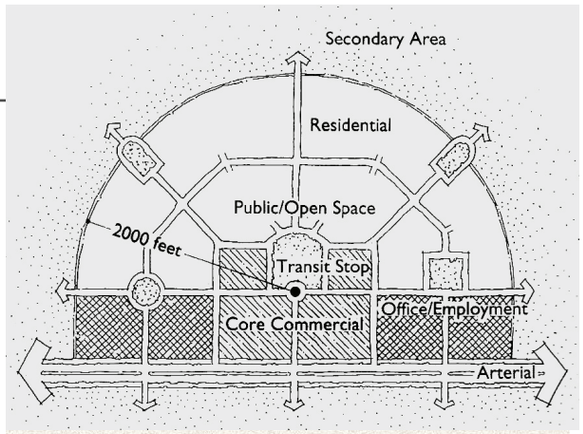
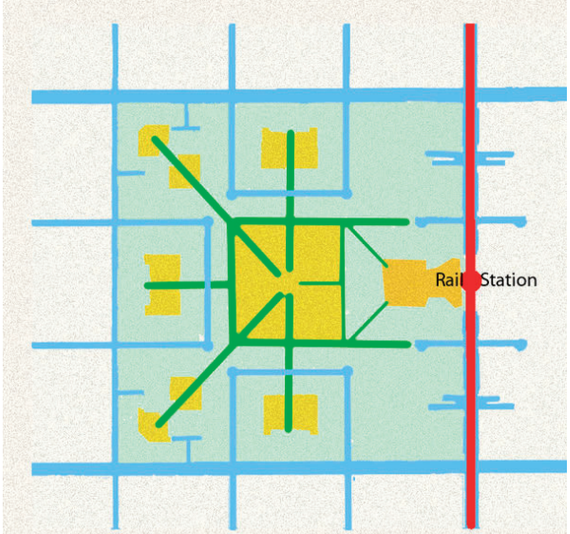
In January, 2011, the state Department of Ecology published the Climate Change Response Strategy, in which it identified the infrastructures which would be most vulnerable to climate change as a result of global warming.

green jobs and the provision of affordable housing in areas near employment and service centers." The bill stresses that the longer we wait, the worse things will get.

- Senate Bill 5854 (2009-10) focuses on reducing climate pollution in the built environment. Citing that 30 percent of Washington's greenhouse gas emissions comes from energy use in buildings, the bill states that energy efficiency is the "cheapest, quickest, and cleanest way to meet rising energy needs, confront climate change, and boost our economy." It will promote "super efficient, low-energy use building codes; requiring disclosure of buildings' energy use to prospective buyers; making public buildings models of energy efficiency; financing energy saving upgrades to existing buildings; and reducing utility bills for low-income households."





P edestrian Pocket : Circulation diagram

Introduced by the Puget Sound Regional Council (PSRC), Vision 2040 is a plan that aims to protect our people, our prosperity, and our planet. The PSRC is an independent organization that "works with local governments, businesses, and citizens to build a common vision for the region's future." The plan was co-developed and adopted by officials from King, Snohomish, Kitsap, and Pierce counties. The plan takes cues from new urbanist ideals in that it will attempt to handle the region's population growth in a way that is smart, sustainable, and environmentally friendly; aiming to efficiently provide public services and amenities. Vision 2040 calls for "focusing development in cities, containing the expansion of growth into rural areas, and conserving rural areas and natural resource lands."

Reducing sprawl and urban expansion is a major theme in the plan. By doing so, the plan hopes to reduce the amount of, and cost of, transportation needed by people and goods, decrease the amount of impervious pavement and structures, and provide a more healthy environment by reducing pollutants that harm health and our climate.

Vision 2040 is different from other plans for several reasons. It was developed through a public process that combined insight from regional elected officials, interest groups, public agencies, and individuals. The plan provides an environmental framework, regional growth strategy, policies to guide growth and development, and implementation actions. This is not unlike other growth management strategies. Where Vision 2040 differs from the others is that it also calls for measures to track progress. If a region wishes to update or amend the plan, they must submit their proposal to the PSRC for review.

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Vision 2040 seeks to meet and exceed the goals set forth in Washington's Growth Management Act.

Climate Change Strategy

In January, 2011, the state Department of Ecology published the Climate Change Response Strategy, in which it identified the infrastructures which would be most vulnerable to climate change as a result of global warming. It recommended strategies and actions for priority planning areas. Land use is one of them and their land-use recommendations included the following:

- Our local and state governments must make impact assessments, maps and update their planning policies to recognize climate changes.
- Renewable energies must be encouraged at a commercial scale level. Complete streets and increased urban forestry should be encouraged where feasible. (Complete streets are streets that are designed for all kinds of users whether driving, walking, bicycling or transit)
- Address climate change impacts in local land use planning.
- Increase carbon storage (carbon sequestration), the "preservation and restoration of natural landscape features… low impact development…and sustainable building features", develop methods to retrofit into existing community, and preserve urban and community forests."
- Address increased fire potential and include regulation regarding vegetation management, fire danger rating systems and water supplies for development. Higher temperatures and less water is projected, which could impact public financing for fighting fires.
- Identify state funding priorities and limits to determine the extent of risks taken in certain locations due to climate change.

Another document currently in draft form is the Seattle 2030 District. Compiled by a team of property owners, utility companies, engineers, architects, construction companies, a large health care provider and city officials, a map of nine downtown districts was planned as a working model to reduce energy, water and carbon-dioxide emissions on a district level.

"While individual buildings will have specific opportunities for energy reductions, a district approach will provide the opportunity for district-wide heat recovery, distributed generation, and other district energy efficiencies that can reduce the demand for resources. The 2030 District will provide members a roadmap to own, manage, and develop high performance buildings by leveraging existing market resources and by creating new tools and partnerships to overcome current market barriers."

Nine districts are to be established: Uptown, South Lake Union, Belltown, Denny Triangle, Retail Core, Waterfront, West Edge, First Hill and Pioneer Square. Goals are for existing buildings to achieve 50 percent carbon reduction by 2030, and new buildings to be carbon neutral by 2030. Targets will be met by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20 percent maximum) renewable energy and/or certified renewable energy credits.

Other current pursuits include environmental partnerships between the City of Seattle and King County, such as the Eco Industrial District (EID) program. The idea is to redevelop and strengthen the industrial areas of the city, creating sustainable livable communities by maximizing resources — utilizing waste products from one business that could potentially be an input resource for a neighboring firm, proving workforce housing, promoting green job creation, with recreation and public transit located nearby.

Two areas being considered are SoDo (south of the dome) and the Duwamish River corridor in south Seattle. Seattle's City Council is working with the Seattle Office of Economic Development and the Mayor to draft an EID scope of work for the fall of 2011.

National Policies, Studies

In 1996, the U.S. Environmental Protection Agency joined with several non-profit and

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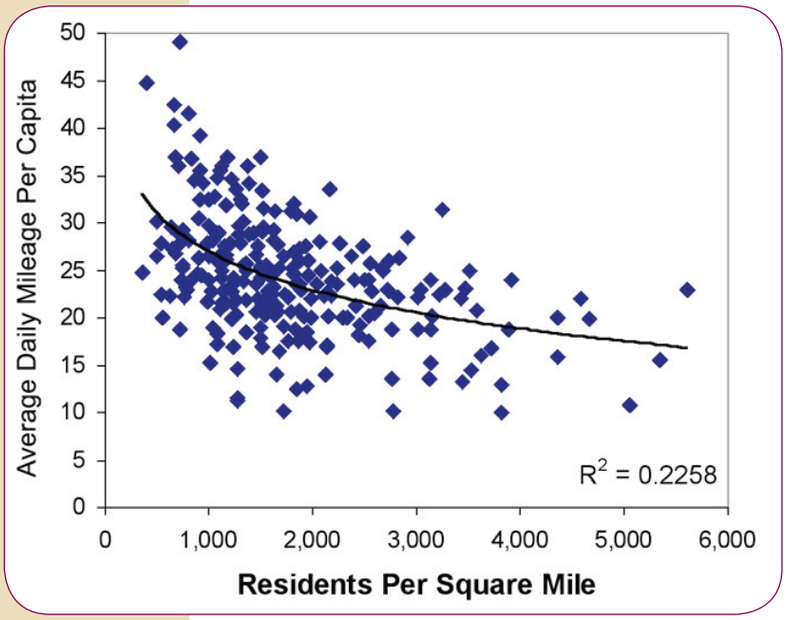

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government organizations to form the Smart Growth Network (SGN). It was formed in response to the concerns for how communities should grow and for the protection of the environment. It includes the following guidelines:

- Mix land uses
- Take advantage of compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Make development decisions predictable, fair, and cost effective
- Encourage community and stakeholder collaboration in development decisions

Reid Ewing, at the National Center for Smart Growth states that the connectivity of a community can be evaluated through a "connectivity index" which is determined by "dividing the number of roadway links (street segments between intersections) by the number of roadway nodes (intersections). The higher the connectivity index, the better for a walkable community." He has determined a minimum connectivity index of 1.4 is considered necessary for a walkable community. Also, according to John Thomas at the EPA, "a one-quarter to one half-mile range is the distance people will walk to transit."

The popular Leadership in Energy and Environmental Design (LEED) rating system has added a new program—LEED for Neighborhood Development. The program shifts the focus from individual buildings and applies it to the neighborhood context. Administered by the U.S. Green Building Council, LEED for Neighborhood Development (LEED – ND) was developed in conjunction with the Natural Resources Defense Council, the Congress for New Urbanism, and the USGBC.

The program is divided into three categories: Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. Different levels of certification are awarded for points earned. In LEED – ND there are 110 total possible points; 100 points plus ten bonus points. Twenty-seven points can be earned for the Smart Location and Linkage category. Twenty-nine points can be earned for Green Infrastructure and Buildings. The remainder of the points can be earned in the Neighborhood Pattern and Design category which has a total of forty-four possible points. The ten bonus points are earned through Regional Priority credits, total of four points, or through Innovation and Design Process credits, total of six points.

There are some programs that address the need for public education on sustainable land use. One such program is the American Institute of Architects' AIA Sustainability 2030 which promotes lasting change through advocacy, design, and community. Since it is an architectural entity, the advocacy and design sections of the program are primarily focused on building design. However, AIA goes beyond the individual in the community section.

Under the program's Center for Communities by Design, there are two Design Assistance Teams (DAT). These teams are "architect-led, multidisciplinary teams" which "indentify ways

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to encourage desirable change in a community." The first DAT is the Regional/Urban Design Assistance Team which has been in operation since 1967. It's focus is on using a charrette style approach to conduct a four day, onsite workshop with all levels of the community in need. The second DAT, the Sustainable Design Assistance Team, focuses on performing a broad assessment of the community and providing sustainability advice on future "policies and design solutions." And, like most sustainable growth initiatives, both teams encourage community members to actively participate in envisioning what they want their community to be like, stressing that good design makes economic sense since it will attract people to their community, that density is more functional and environmentally sound, and that public physical and mental health will benefit from an intelligently developed built environment.

Conclusion

- There are plenty of land-use ideas which support and advocate sustainable growth.
- Some are new ideas that stretch the comfort levels and traditional ideals we have been taught to embrace. Some ideas have been around for quite some time but have not been implemented. Some ideas have been implemented and have succeeded; some have failed.
- To accomplish the goal of sustainable growth, a combination of strategies and actions will need to be implemented at federal, state and local levels by land use decision makers, the design and construction industry, affordable housing advocates and others.
- It will involve restructuring our transportation, reconfiguring many parts of our cities and neighborhoods, as well as maintaining and preserving our natural environment.

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The Solar/Renewable Energy Career Pathway leads to a new high-growth, high-wage industry that is literally the dawn of a new age. Partners include leading industry experts, the K-12 public school system, Washington State University, King County Workforce Development Council and organized labor.

The Zero Energy House — a solar demonstrator designed and built by WSU Students, housed at Shoreline Community College.