ELECTRIC UTILITY 2008 RESOURCE PLAN

AUGUST 19, 2008

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1 SUMMARY

The City's Electric Utility is required by the State of Washington under RCW 19.280.030 to develop an Electric Utility Resource Plan (Plan) that must be submitted to the Washington State Department of Community, Trade and Economic Development (CTED) by September 1, 2008.

The reason for this is to assure that future resources are adequate to meet projected loads especially as the Bonneville Power Administration (BPA) changes the way it charges the City for energy.

This Plan proposes that the City will continue to purchase power from the BPA and that it will also seize the opportunity to increase the level of energy efficiency and deploy new resources that will further develop and diversify our electricity portfolio[1].

The City's energy future is essential to our community's economic health. The City has long benefited from having access to low-cost electricity from the federally based system. However, as the world and the energy industry change, the City faces a potentially serious threat to its economy in the form of rising electricity costs.

For Port Angeles, 67% of the money spent on retail power immediately leaves the local economy. With minimal downside risk, developing an Electric Utility Resource Plan that will increase efficiency and develop renewable resources will help protect the City's economy from rising energy costs, keep more dollars circulating in the local economy and in turn, help to increase the number of jobs that stay in our community.

2 BACKGROUND

The City of Port Angeles Electric Utility currently serves approximately 10,600 residential, commercial and industrial power customers. The Electric Utility has ten broad customer classes that include Industrial Transmission, Residential, Primary Metered, General Service, General Service Demand, General Service Demand Primary Metered, Municipal Water Pumping, Non-Profit/Tax Deductible, Yard/Area Lights, and Street Lights.

While this Plan is not a legally binding document, it provides a description of current power loads and resources, as well as the forecasted power loads and resources for 2013 and 2018 time periods as required by RCW 19.280.030. The Plan is available to the public from the City's website and will next be updated in 2010. It is anticipated that the 2010 Plan update will provide more substantive information regarding the City's future power sales contract with the BPA and the resulting rate impacts.

The Plan's objective is to create and implement a proactive agenda to help ensure that sufficient electrical resources are available to meet projected future loads. Achieving this objective will require consideration of all feasible options and developing a cost-effective plan that is adaptable to ever-changing circumstances.

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[1] *n.b.*, a glossary is provided in Appendix C for individuals not familiar with the terminology of an electric utility.

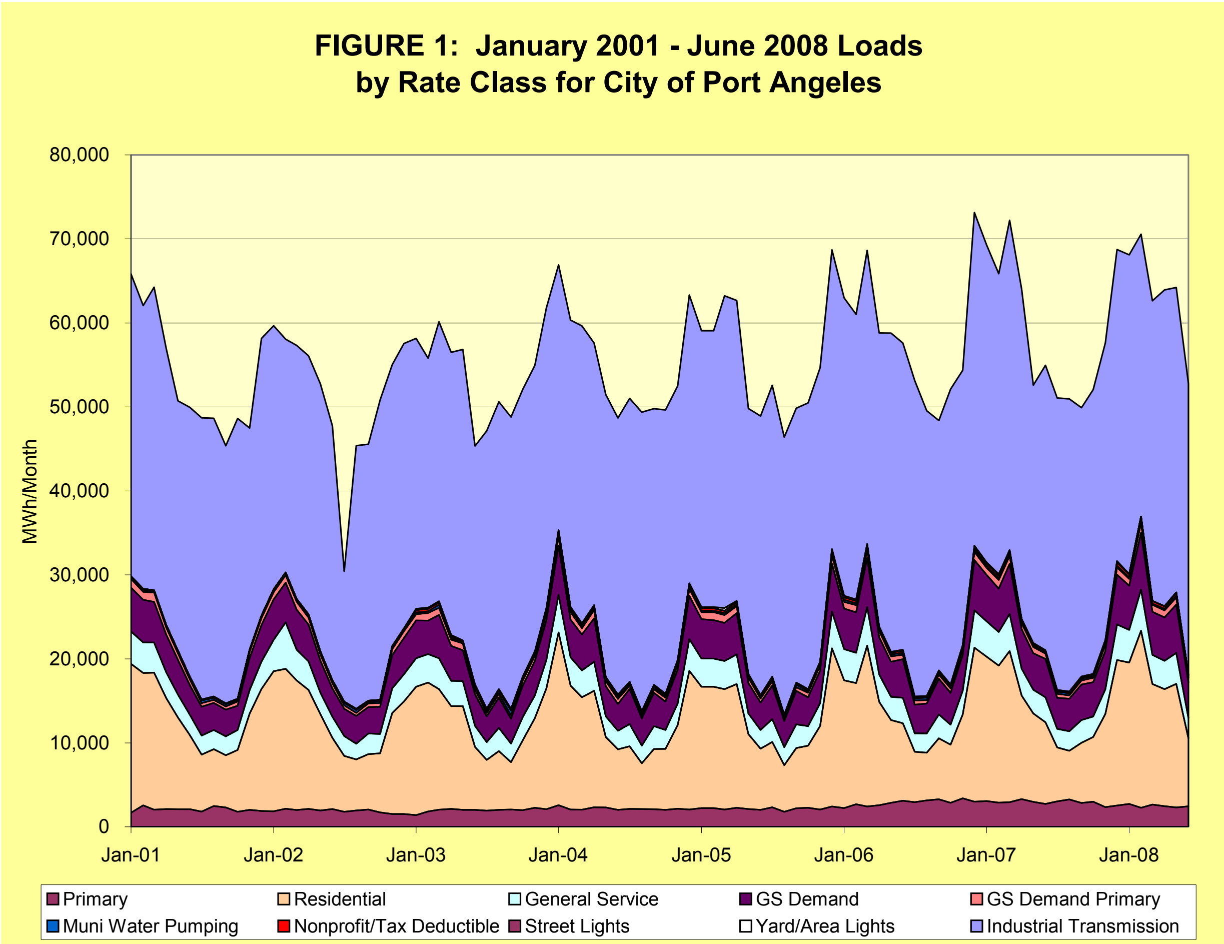
The City is exempt from meeting the Washington State mandatory conservation and renewable portfolio standards required for larger utilities. Regardless, the 2008 Plan still places special emphasis on energy efficiency and possible roll-out of new distributed or renewable energy power supplies located within the City's service territory.

The State requires that in its projection of resources estimated to serve future loads, the City's Plan must delineate what specific supply resources were chosen. Moreover, the City must provide an explanation on why such a decision was made if those chosen supply resources were not conservation, efficiency or renewable energy technologies.

Fulfilling this requirement should not necessarily be viewed as a burden. Developing this portfolio of resources in our neighborhood can help protect the economy from impacts of rising energy costs, as well as keep more dollars circulating in the local economy to help spur economic development.

The Plan is based on typical customer growth rates, the trends in rate class energy use, and the City's current and anticipated future mix of resources[2]. Figure 1 shows electricity consumption by rate class from January 2001 through June 2008. The chart demonstrates the seasonality of the loads and the City's annual winter consumption peak. As it constitutes about 60% of the City's total load, Figure 1 also demonstrates the scale of the Industrial Transmission load relative to the other rate class loads.

[2] As requested by the CTED, the following reporting units are Annual Energy in Average Megawatts (aMW) that are calculated as kWh/1000 kWh per MWh/8760 hours per year.



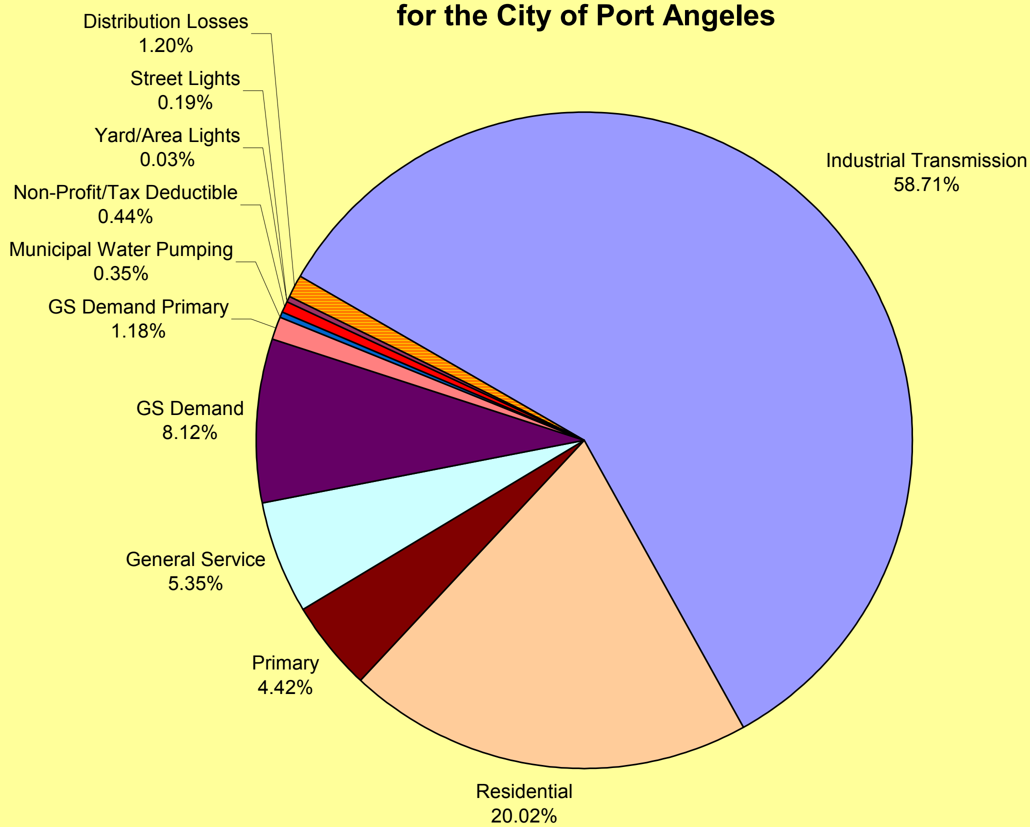
3 BASE YEAR

The base year started on July 1, 2007 and concluded on June 30, 2008. While the relatively harsh recent winter might skew the electricity consumption data upwards for winter-sensitive rates classes by a percentage point or so compared to using the 2007 calendar year, this data represents the most current actual information. The data also reflects the impacts of the load reduction of a key customer from the Primary Rate Class in November 2007, a customer representing about 1.00%-1.25% of the City's previous aMW load.

3.1 LOADS

As shown in Figure 2, the City has one Industrial Transmission customer that comprises almost 60% of the total load for the Base Year, roughly 48.38-aMW. As this power is metered from the BPA Port Angeles sub-station, distribution system line losses to the customer are already included.

FIGURE 2: Base Year Loads for the City of Port Angeles



The other nine rate classes are served by the City's distribution system, and the balance of their loads totaled 32.99-aMW during the Base Year. As calculated from historical records, distribution system losses are roughly 3% of the total distribution system load or 0.98-aMw during the Base Year[3]. The complete load including losses provided by the

[3] *n.b.*, The City's distribution system losses are less than standard averages for the electric utility industry that normally run from 3% to 5%. In some systems, these losses may increase to the 5% to 7% range or higher.

City to its customers during the Base Year totaled 82.35-aMW. This information is presented in greater detail in Table 1.

TABLE 1: Base Year Loads for the City of Port Angeles

SERVICE CLASS	**Annual aMW**
General Service	4.40
General Service Demand	6.69
GSD Primary Metered	0.97
Municipal Water Pumping	0.28
Non-Profit/Tax Deductible	0.36
Primary	3.63
Residential	16.49
Street Lighting	0.15
Yard Lighting	0.02
Distribution System Losses @ 3%	0.98
Distribution System Subtotal	33.97
Industrial Transmission	48.38
Total Loads	**82.35**

3.2 RESOURCES

The City's Electric Utility operates a small generation facility known as the Morse Creek Hydroelectric Project. The project was built in 1985-1987 as Federal Energy Regulatory Commission (FERC) project #6461, and it became operational in 1987 with a maximum rated capacity almost 0.50-MW. Because of streamflow and other issues, the project operated during the Base Year with an average capacity factor of around 45%, providing around 0.22-aMW. The City also has a load-wheeling agreement with the Clallam County Public Utility District (PUD) to serve about 35 City electric customers, which provided 0.09-aMW during the Base Year.

The City is currently a BPA full requirements customer; an electric utility that relies on the BPA for all power to supply its total load requirement other than that served by non-dispatchable generating resources totaling no more than six megawatts or renewable resources[4]. The Base Year electricity resources supplied by the BPA were

[4] The definition of a "full requirements customer" is included in 19.280 RCW.

Priority Firm (PF) purchases that totaled 82.04-aMW. Thus, as shown in Table 2, the sum of power resources matched the City's total load of 82.35-aMW.

TABLE 2: Base Year Resources for the City of Port Angeles

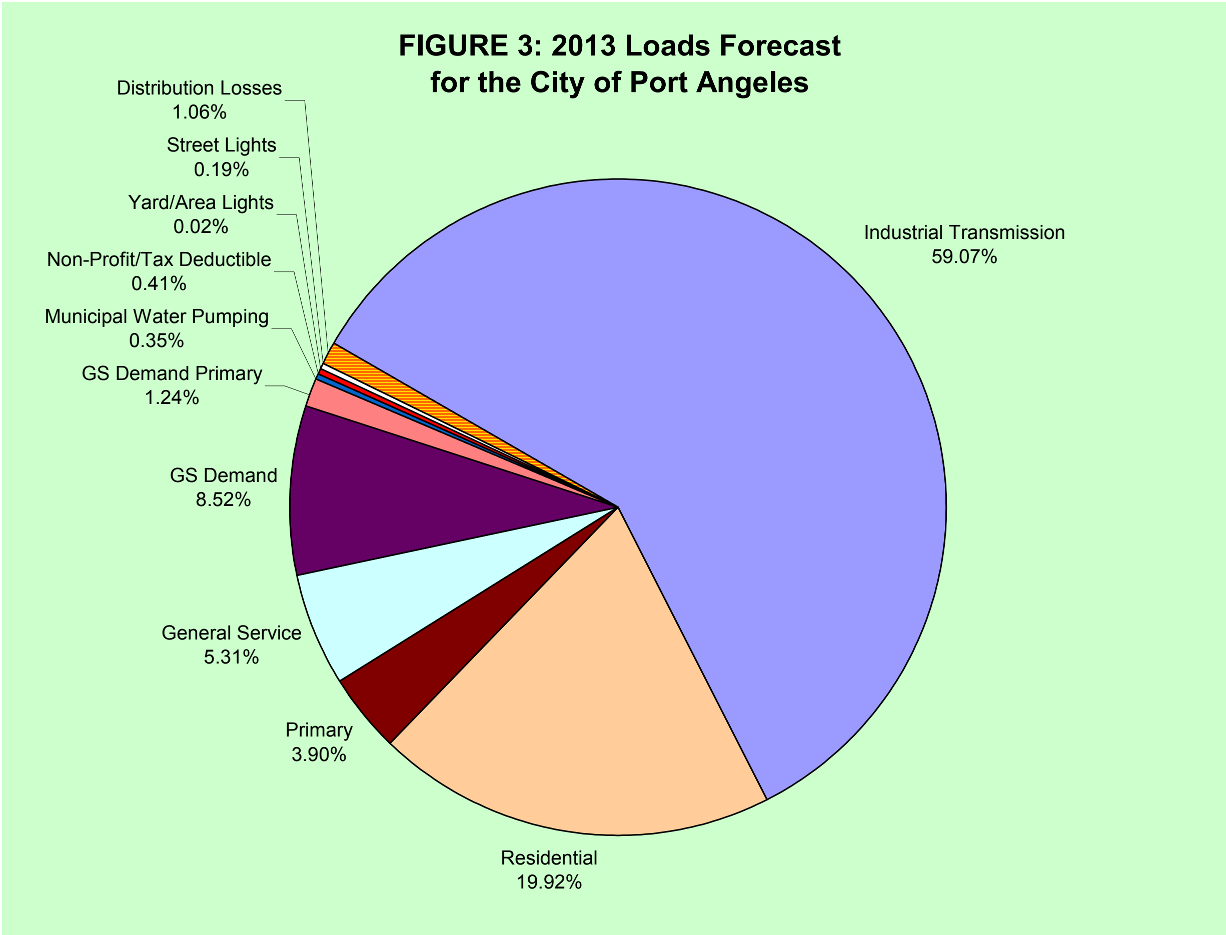
RESOURCE	Annual aMW
Morse Creek Hydroelectric Project	0.22
BPA Priority Firm Purchases	82.04
Clallam County PUD Wheeling	0.09
Total Resources	**82.35**

4 FIVE-YEAR FORECAST

The five-year forecast targeted the 2013 calendar year. All loads are estimated before reductions from conservation or demand response programs are considered. Both of these are treated as a power resource that is eligible to meet loads. The forecast is based on typical customer growth rates and average customer use patterns that the City has experienced. For service classes such as residential or light commercial buildings, the forecast also accounts for their seasonal load patterns. The complete set of charts showing the historic actual and forecasted energy consumption though 2018 for the ten rate classes served by the City is provided in the Appendix.

4.1 LOADS

As shown in Figure 3, the Industrial Transmission customer is projected to have a load similar to the Base Year, which is estimated to be 48.43-aMW including losses.



The other nine rate classes are a part of the overall City electrical distribution system, and the balance of their loads totaled 32.63-aMW for the five-year forecast period. Distribution system losses are estimated to be 3% of the distribution system load, or 0.97-aMw. The load provided by the City to its customers for the five-year forecast period totaled of 82.03-aMW. Table 3 provides this information in greater detail.

TABLE 3: Five-Year Forecasted Loads for the City of Port Angeles

SERVICE CLASS	**Annual aMW**
General Service	4.35
General Service Demand	6.98
GSD Primary Metered	1.01
Municipal Water Pumping	0.28
Non-Profit/Tax Deductible	0.33
Primary	3.19
Residential	16.33
Street Lighting	0.15
Yard Lighting	0.01
Distribution System Losses @ 3%	0.97
Distribution System Subtotal	33.60
Industrial Transmission	48.43
Total Loads	82.03

Note that the forecasted 2013 system load is slightly less than the Base Year. While there are several factors at play, three key reasons explain this slight reduction. First, the projected load growth simply replaced the recent load reduction of a key customer that represented about 1.00%-1.25% of the City's previous aMW load. Second is that while they are not an expressed factor of the Plan at this point, there are residual impacts resulting from the City's current conservation and efficiency programs. This is especially evident in the Residential rate class where the number of customers being served was estimated to increase by 1.8% while the average energy requirements per home was estimated to decrease by 4.1%. And third, the unseasonably colder winter that occurred during the Base Year.

4.2 RESOURCES

The Northwest Power and Conservation Council (NWPCC) developed a conservation target calculator[5] that may be used to determine electric utility conservation targets. The calculator is designed to determine a specific "Utility Share of Regional Target" that can be attributed to any utility located within the region. While the actual conservation

[5] http://www.nwcouncil.org/energy/UtilityTarget.htm. This calculator (updated 7/17/08) "may be used to determine public utility conservation targets under draft rules implementing I-937 in Washington State."

savings may vary from the amount projected by the calculator, this tool estimated that the 2013 conservation savings attributable to the City's efforts should be 0.73-aMW.

It is projected that the City Electric Utility will continue to operate the Morse Creek Hydroelectric Project. The City has filed an application for a license amendment with the FERC that stipulates minimum flows in all months of the year for the protection of Chinook salmon and bull trout, both listed as threatened species under the Endangered Species Act. The current FERC license stipulates minimum stream flows for only five months of the year. The proposed amendment would maintain higher stream flows in Morse Creek during all months of the year in order to provide a greater assurance that flow-related habitat is protected for the listed species as well as other salmonids that inhabit Morse Creek. While it may be possible to operate this facility during 2013 with an increased capacity factor, this Plan assumes it will operate on a schedule similar to the Base Year and provide 0.22-aMW. The City also expects to continue to participate in the existing load-wheeling agreement with the Clallam County PUD, which is estimated to provide 0.08-aMW during 2013.

As previously mentioned, the City currently is a BPA "full requirements customer." This means that it relies on the BPA for all power needed to supply its total load requirement. While many elements of BPA's proposed Tier 2 rate have yet to be revealed by that agency, one critical factor is to develop an estimate of the "High Water Mark" (HWM) that would be eligible for the BPA's continued Tier 1 load following rate. This is key, as the difference between the HWM and any residual load requirement will be the power block subject to the new Tier 2 rate schedule that has yet to be determined by the BPA[6].

While there are certainly more complicated methods that could be employed to estimate the City's HWM, the simplest proxy is to use a base of 95% of the forecasted 2011 load. In this case, the 2011 forecast estimated that the City's total system load would be 81.70-aMW. Therefore, the HWM was estimated to be 77.61-aMW (0.95 * 81.70).

[6] Why this issue is important is that any new load growth experienced by the federal power system will require additional sources of supply that will be more expensive to build and operate than the current existing capacity. The BPA proposes to use the Tier 2 rate schedule to charge customers the total incremental cost of these costly new power resources.

The sum of the attributable conservation resource, the Morse Creek Hydroelectric Project, the wheeled power from the Clallam County PUD, and the HWM BPA Tier 1 came a sum of 78.64-aMW. As the estimated total load came to 82.35-aMW, the amount of Tier 2 (or equivalent) power resources needed to match the City's total load was calculated to be 3.39-aMW. The forecast of resources required for the City is provided in Table 4.

TABLE 4: Five-Year Forecasted Resources for the City of Port Angeles

RESOURCE	**Annual aMW**
Conservation/Efficiency	0.73
Morse Creek Hydroelectric Project	0.22
BPA Tier 1 Purchases	77.61
BPA Tier 2 Purchases	3.39
Clallam County PUD Wheeling	0.08
Total Resources	82.03

While not a relatively large number, the projected Tier 2 "Gap" represents an average of about 4.1% of the forecasted 2013 load and could total some 29,700 MWh if no measures are taken to reduce it. The financial implications of this gap and options that could be used to reduce it will be addressed in a following section. While the City is well positioned to have options other than using one of the three listed BPA Tier 2 products, the preliminary staff recommendation is that the City would remaining a full-service BPA customer[7].

Given the current uncertainty, this option seems to be the best available to mitigate potential power supply costs and risks. Staff tentatively recommends that the City consider using the BPA Tier 2 Short-Term Rate offering to fill the "Gap" as it requires the least time commitment compared to the other Tier 2 product offerings. However, *"due to the short-term nature of the of potential customer commitments, BPA does not intend to permanently assign the costs of longer-term resources to this cost pool. It may be the case that some longer-term resource costs will be allocated temporarily to this cost pool, until those costs are allocated to a longer purchase period rate pool."* This statement, taken from the CTED

[7] Under the proposed terms of the new BPA power sales agreement, this category will be renamed a "load-following" customer.

"Short Form" instructions used to prepare this Plan, suggests that the trade-off for not executing a long-term Tier 2 power purchase agreement with the BPA presents the potential for some greater short-term price volatility.

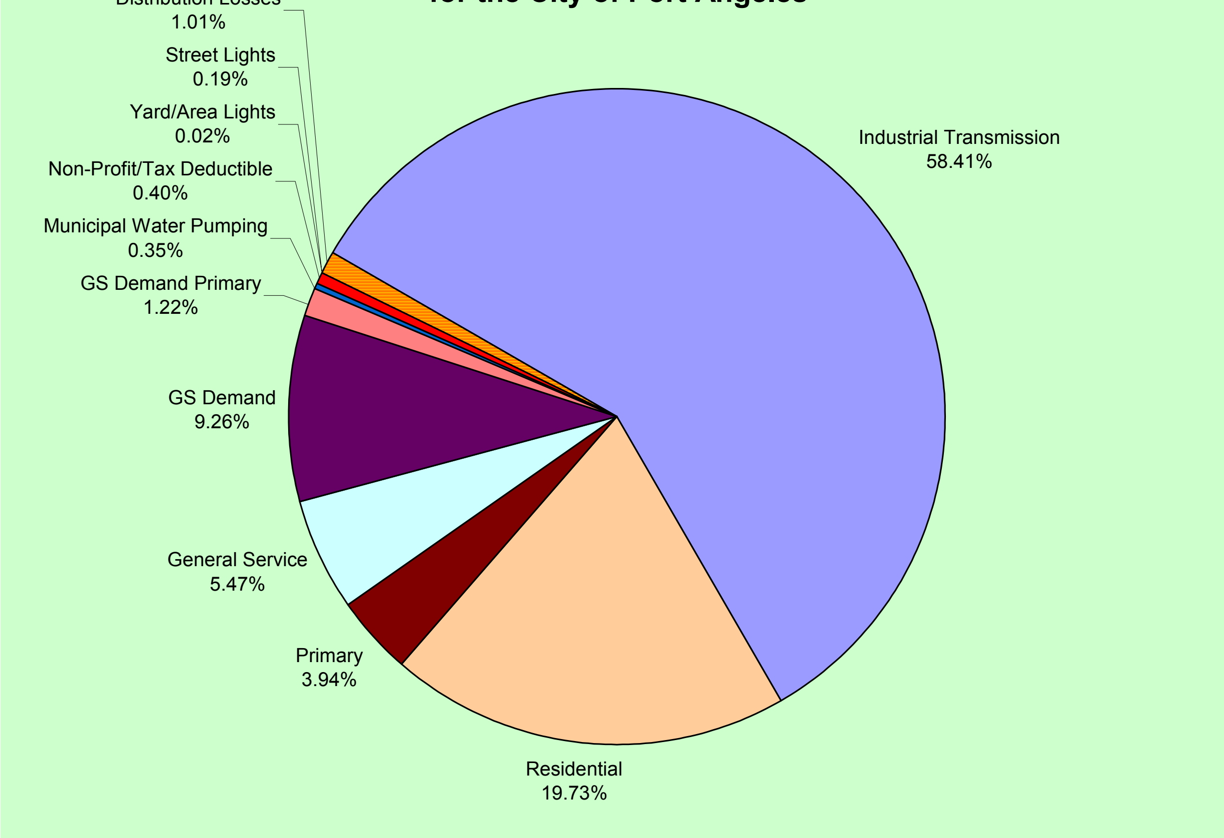
5 TEN-YEAR FORECAST

The ten-year forecast targeted the 2018 calendar year. As with the previous forecast, all loads were projected before the estimated reductions from conservation or demand response programs are considered. The forecast is based on the typical customer growth rates and the average customer use trends the City has experienced. Once again, for certain service classes the forecast accounted for their seasonal load patterns.

5.1 LOADS

Figure 4 shows the existing Industrial Transmission customer is projected to have a load similar to the Base Year, which is estimated to be 48.43-aMW including losses.

FIGURE 4: 2018 Loads Forecast for the City of Port Angeles



The other nine rate classes are a part of the overall City electric distribution system, and the balance of their loads totaled 33.61-aMW for the ten-year forecast. Distribution system losses are estimated to be 3% of the distribution system load, or 1.00-aMw. The total load provided by the City to its customers for the ten-year forecast came to 83.04-aMW. This information is provided in greater detail in Table 5.

TABLE 5: Ten-Year Forecasted Loads for the City of Port Angeles

SERVICE CLASS	Annual aMW
General Service	4.53
General Service Demand	7.67
GSD Primary Metered	1.01
Municipal Water Pumping	0.28
Non-Profit/Tax Deductible	0.33
Primary	3.27
Residential	16.36
Street Lighting	0.15
Yard Lighting	0.01
Distribution System Losses @ 3%	1.00
Distribution System Subtotal	34.61
Industrial Transmission	48.43
Total Loads	83.04

Note that the forecasted system load for 2018 is only slightly higher than the Base Year. One factor is that while they are not an express factor of the Plan at this point, there are continuing residual impacts resulting from the City's current conservation and efficiency programs. This is still especially evident in the residential rate class where the number of customers being served was estimated to increase by about 7.5% from the Base Year and the average energy requirements per home was estimated to decrease by 7.4%.

5.2 RESOURCES

It is projected that the City will continue to operate the Morse Creek Hydroelectric Project. Similar to the five-year forecast, this project is estimated to operate in 2018 with an average capacity factor of around 45% and provide about 0.22-aMW. The City also expects to continue to participate in the existing wheeling agreement with the Clallam County PUD, which is estimated to provide around 0.08-aMW during 2018. Using the

NWPCC calculator, the estimated 2018 conservation and efficiency savings attributable to the City's efforts would be 0.78-aMW[8].

The sum of the Morse Creek facility, the wheeled power from the Clallam County PUD, the attributable conservation resource, and the 77.61-aMW HWM Tier 1 power provided by the BPA came to a sum of 78.69-aMW. As the estimated load came to a total of 83.04-aMW, the amount of Tier 2 (or equivalent) power resources needed to match the City's total load was calculated to be 4.35-aMW. The forecast of resources required for the City is provided in Table 6.

TABLE 6: Ten-Year Forecasted Resources for the City of Port Angeles

Resources	**Annual aMW**
Conservation/Efficiency	0.78
Morse Creek Hydroelectric Project	0.22
BPA Tier 1 Purchases	77.61
BPA Tier 2 Purchases	4.35
Clallam County PUD Wheeling	0.08
Total Resources	83.04

Once again, while the projected Tier 2 "Gap" does not look like a relatively large number, it represents about 5.2% of the forecasted 2018 load and could equal around 38,100 MWh if no other measures are taken to reduce it. The financial implications of this gap and options that could reduce it will be discussed in the next section.

Once again, while the City is well positioned with options other than using one of the three listed BPA Tier 2 products, the tentative staff recommendation is that the City remain a BPA full-requirements customer using the BPA Tier 2 Short-Term Rate.

Of course, trend is not destiny and there are many situations that could occur that would render the 2013 or 2018 projections meaningless. For example, there is significant discussion about converting a majority of the country's vehicle fleet from gasoline to plug-in hybrid cars using electricity. While other consumer items such as a

[8] *n.b.*, While 2018 is not a component of the Fifth Plan prepared by the NWPCC, a linear regression equation was used to extrapolate the current data for the 2014-2018 period. The equation was seemingly a perfect fit, having a R^2 statistic equal to 1.

plasma television consumes about four times the electricity as recharging a plug-in hybrid, what would be the load impact if thousands of these new vehicles came on line simultaneously in the City service territory? Other local load impacts could be related to the City's contemplated annexation plans and who will ultimately serve those loads. The addition of new loads could possibly result from the Port's proposed new industrial park located south of the airport, or the loss of existing loads could potentially occur during the next ten years.

6 FUTURE CONSIDERATIONS

Despite some possible load increases for some of the individual rate classes, only a 0.84% cumulative increase in total load is projected for the City over the 10-year planning horizon. This is projected to increase loads from the current Base Year of 82.35-aMW to an estimated 83.04-aMW in 2018.

FIGURE 5: January 2001 - December 2018 Loads by Rate Class for the City of Port Angeles

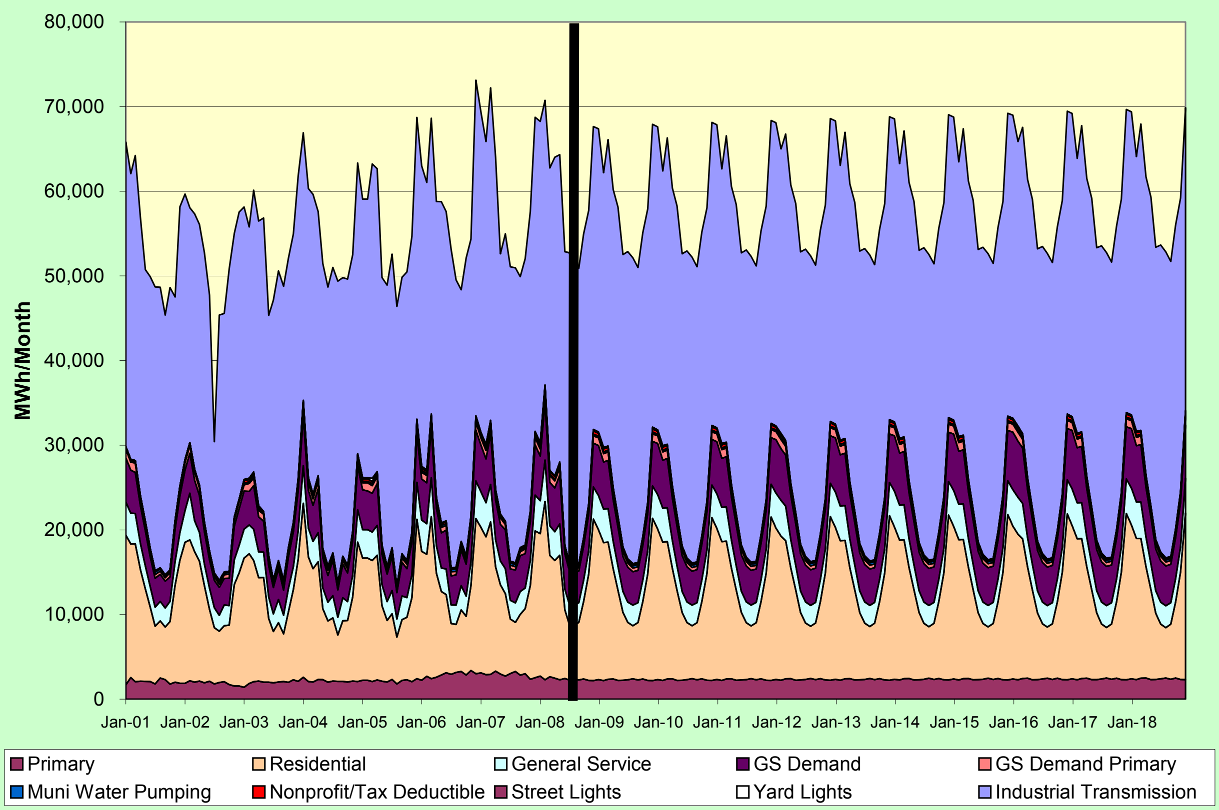


Figure 5 shows electricity consumption by rate class for the January 2001 projected through December 2018. As with the previous time series chart, it demonstrates load seasonality and the City's annual winter consumption peak. It also continues to demonstrate that the Industrial Transmission load will continue to be around 60% of the City's total electricity load.

This Plan proposes that the City will continue to remain primarily reliant on the BPA as a full-requirements customer. However, as will be discussed, the City also has the opportunity to further increase the deployment of its own efficiency and renewable resources, and thus further diversify its resource portfolio.

This opportunity should be seriously considered, as the Tier 2 "Gap" represents about 4.1% of the projected 2013 load and is projected to come to some 29,700 MWh if no other measures than what is currently being done are taken to reduce it. By 2018, the "Gap" could represent about 5.2% of the projected load and could equal almost 38,100 MWh.

While the BPA has not determined rates for its Tier 1 or Tier 2 products, the financial implications of the Tier 2 "Gap" and opportunities that could be used to reduce it must be addressed even if only a general trend is revealed instead of a precise answer.

For example, including local distribution system line losses, the City's wholesale power cost averaged slightly less than 3.0 ¢/kWh during the Base Year. Although the cost of Tier 2 power could be much higher, assume that the "Gap" power is provided to the City at a wholesale cost of 9.0 ¢/kWh.

As illustrated in Table 7, the result would be about a 12% increase in City wholesale power costs in 2013, and would increase to 16% in 2018. The cost increase in 2013 is estimated to be slightly more than $2.6 million with a blended wholesale rate of 3.35 ¢/kWh, and it is estimated to increase to almost $3.4 million in 2018 with a blended wholesale rate of 3.45 ¢/kWh.

TABLE 7: POSSIBLE TIER 2 "GAP" IMPACTS ON THE CITY OF PORT ANGELES

Period	MWh/Year	Wholesale Power Cost Increase (%)	Wholesale Power Cost Increase ($)
2013	29,696	12.4%	2,670,000
2018	38,106	16.0%	3,430,000

Given this potential exposure, it would seem prudent to reduce the projected Tier 2 "Gap" starting with two priorities that incorporate a lowest-cost/lowest-risk analytical approach to meeting future loads.

The first priority should be to seek all cost-effective conservation opportunities as the favored resource for meeting anticipated future loads, and look for options to accelerate those energy savings beyond the current estimates. All other things being held equal, rising wholesale power costs will enlarge the pool of cost-effective alternative resources. Beyond conservation, the City should also pursue distribution system peak-load management, renewable energy and cogeneration resources, with a strong preference for operations that could be developed within the City limits.

This approach would be a logical extension of the City's existing conservation initiatives, where the programs range from conservation tips and incentives for residences to incentives for custom energy conservation projects for commercial and industrial customers[9].

The City Electric Utility has also been active in the pursuit of non-traditional conservation opportunities, one of which included participating in the Olympic Peninsula Demonstration component of the Pacific Northwest GridWise Testbed Demonstration Project[10].

[9] However, the incentives now offered by the City for its existing conservation program are scheduled to end in December 2009 when the BPA terminates its funding for the various energy efficiency activities it provides to utilities within its service territory. A successor program is being planned by the BPA, but few details are currently available.

[10] http://gridwise.pnl.gov/docs/op_project_final_report_pnnl17167.pdf

The effort was a field demonstration where residential electric water heaters and thermostats, commercial building space conditioning, municipal water pump loads and several distributed generators were coordinated to manage electrical loads by communicating electric price signals in real-time. While a somewhat futuristic experiment, one practical result was this resource was well documented to produce significant power savings when market prices were presented to consumers and they could respond accordingly.

As a component of this modernization of the electrical grid, Electric Utility Staff will be preparing a report for Council in late-2008 on the consideration of a smart grid and a request to Council to set a public hearing with a determination in late-2009 to comply with certain sections of the Energy Independence and Security Act of 2007.

Another opportunity the Electric Utility is investigating is known throughout the region as the *Distribution Efficiency Initiative*. The emphasis is on cost-effective design, construction and operational decisions that optimize the regulation of local distribution service voltage, also known as Conservation Voltage Regulation or CVR. A total of 13 Northwest utilities participated in the initial phase of the initiative, and the results indicated *"operating a utility distribution system in the lower half of the acceptable voltage range (120-114 volts) saves energy, reduces demand, and reduces reactive power requirements without negatively impacting the customer. The energy savings results are within the expected values of 1%-3% total energy reduction, 2%-4% reduction in kW demand, and a 4%-10% reduction in kvar demand[11]."*

Staff is currently evaluating the potential to implement a CVR program across the City electrical distribution system. While some of the initial data suggests there may be a number of technical limiting factors that could prove challenging to overcome, it is anticipated that a CVR project may be proposed in 2009 as part of the City's 2009-2015 Capital Facilities Plan.

Also in early-2009, a Conservation Potential Assessment (CPA) will be completed that will help better determine where the most cost-effective resources lie and where to target future program efforts to maximize returns. This study will help to determine how much conservation potential is available within the City's service territory, and

[11] http://rwbeck.com/neea/

help determine the value of conservation to the electric utility as well as other items such as the impact of conservation efforts on the Electric Utility's load factor. One key deliverable with the CPA will be to develop a supply curve of conserved energy that identifies those measures having levelized costs that are less than the projected cost for Tier 2 power.

On the resource side, the City's supply options were increased by its recent membership with Energy Northwest. Also, Tier-2 resource strategic planning will begin in Spring-2009.

The Electric Utility will also continue to coordinate conservation activities with the Clallam County PUD. In the past, conservation programs between these two entities have cooperated on a number of initiatives. Future discussions could include jointly reviewing an exploration of the BPA's product choices, as well the possibility of obtaining some power from renewable energy resources. After conservation, small hydro, biomass/landfill gas, tidal energy, geothermal, cogeneration and wind could become energy resources of high priority.

6.1 AND WHAT OF THE FUTURE?

Energy efficiency is the quickest, cheapest, cleanest way to extend our energy resources. And, despite three decades of focus, residential and commercial buildings still hold great potential for increased energy efficiency. For example, residential customers may be surprised to find that they may be able to reduce their energy consumption by 20%-40% by sealing leaks around doors and windows, using more efficient appliances and windows, and by changing conventional light bulbs to compact fluorescents. As another example, a large retailer that self-reportedly is the biggest private user of electricity in the world, has proven technologies that will allow new stores to be 25%-30% more energy efficient. As a last example, unlocking the now hidden potential of cogeneration at existing industrial operations across the nation is estimated to have the potential of around 50 large power plants with roughly the same baseload capability as large nuclear or coal power plants.

While it is difficult today to prescribe the specific measures that are more cost-effective than purchasing Tier 2 power from the BPA, the essence of evaluating any demand-side program is to develop a "supply curve"[12] of the options, so that rational decisions may be made when choosing between competing alternatives[13]. Such a schedule would allow the City to rank choices in terms of their cost-effectiveness, since we do not wish to use those options that would increase the relative spending of our energy dollar.

The discussion that follows is only an initial attempt to define a possible direction for the City's Electric Utility and evaluate the magnitude of the impacts[14]. The outcomes are plausible and are not mutually exclusive. However, without a clear signal from customers and policymakers that this direction should be taken, program continuity cannot be assured and then the results become less certain.

6.1.1 Increased Conservation Scenario

As the first possible outcome, the "Increased Conservation" scenario represents the City undertaking two activities beyond the base forecast: Expand its existing conservation program and initiate a conservation voltage reduction (CVR) program.

For discussion purposes, an increased conservation effort is assumed to have a "stretch" increase of 5% over the basic 2013 forecast and a 10% "stretch" increase in 2018. The CVR program was assumed to offset 1% of the forecasted load in both 2013 and 2018.

What are the impacts of "Increased Conservation"?

Compared to the base forecast, the Tier 2 "Gap" in kWh was reduced by almost 25% in 2013 and by 20% in 2018. The financial savings that could potentially result from these two actions was estimated to total around $635,000/year in 2013 and slightly more than $675,000/year in 2018. The wholesale power cost impact was projected to be a 9.5% increase in 2013 compared to the base forecast projection of 12.4%. In 2018, the wholesale power cost impact was projected to be a 12.7% increase compared to the base forecast projection of 16.0%.

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[12] The basic question regards the arcane economic concept of using the marginal vs. incremental cost when making the investment, words that are sometimes used interchangeably. However, when discussing electric power plants, the incremental cost is the delivered cost of new facilities to the end consumer. The marginal cost only relates to the utility's production cost.

[13] Meier, A; Wright, J; and Rosenfeld A. 1983. *Supplying Energy Through Greater Efficiency.* Berkeley and Los Angeles: University of California Press.

[14] As part of the 2010 update to this Plan, a more extensive analysis will be completed to support the decision-making process.

Clearly, "Increased Conservation" can have an impact compared to the base forecast projection that assumed no other actions were taken than continuing the existing conservation program efforts.

6.1.2 Aggressive Conservation and New Resources Scenario

As the second possible outcome, the "Aggressive Conservation and New Resources" scenario represents a situation where the City undertakes activities in four areas: Expand its existing conservation program, initiate a systemic CVR program, develop co-generation at an industrial facility, and also develop a new renewable energy project.

A more aggressive conservation effort is assumed to provide a "stretch" increase of 10% over the basic 2013 forecast and a 20% "stretch" increase in 2018. The CVR program was assumed to offset 1% of the forecasted 2013 load and a 2.5% offset of the forecasted 2018 load. Co-generation, decentralized power generators that produce both electricity and heat water, was assumed at an industrial customer with a power generation rate averaging 1.0-aMW. The renewable project was assumed to be a landfill gas project located at the City's closed landfill, which was assumed to have a power output averaging 0.25-aMW.

What are the impacts of "Aggressive Conservation and New Resources"?

Compared to the base forecast, the Tier 2 "Gap" in kWh was reduced by 62% in 2013 and by 79% in 2018. The financial savings that could potentially result from these four actions was estimated to total more than $1.6 million/year in 2013 and more than $2.7 million/year in 2018. The resulting wholesale power cost impact was projected to be a 4.8% increase in 2013 compared to the base forecast projection of 12.4%. In 2018, the wholesale power cost increase was projected to be 3.3% compared to the base forecast projection of 16.0%.

"Aggressive Conservation and New Resources" can have a very significant impact compared to the base forecast projection that assumed no other actions were taken than continuing the existing conservation program efforts. Of course, both of these scenarios would result in the City incurring costs. However, under the right circumstances, these could also be considered investments in an essential infrastructure having a mitigating effect on potentially significant increases in wholesale power costs.

7 CONCLUSION

A recent study[15] confirms the current United States renewable energy and energy efficiency industry is substantially larger than previously thought; and some argue the industry is poised to grow into one of the main economic drivers of the 21st century. This study found that by 2030 these industries could generate up to $4.53 trillion in revenue in the U.S., and create more than 40 million new jobs.

The City's energy future is essential to our community's economic health. The City has long benefited from having access to low-cost electricity from the federally based system. However, as the world and the energy industry change, the City faces a potentially serious threat to its economy in the form of rising electricity costs.

For Port Angeles, 67% of the money spent on retail power immediately leaves the local economy. With minimal downside risk, developing a Plan that will increase energy efficiency and develop new renewable resources will help protect the City's economy from rising energy costs, keep more dollars circulating in the local economy and in turn, help to increase the number of jobs that stay in our community.

The Plan's objective is to create and implement a proactive agenda to help ensure that sufficient electrical resources are available to meet projected future loads. Achieving this objective will require consideration of all feasible options and developing a cost-effective plan that is adaptable to ever-changing circumstances.

The City's Electric Utility currently has an effective conservation program in place and is actively looking for new opportunities that will be evaluated in 2009 and 2010. Along with exploring new options to the proposed BPA Tier 2 offering, it may be possible to substantially mitigate the impacts of rising wholesale power costs.

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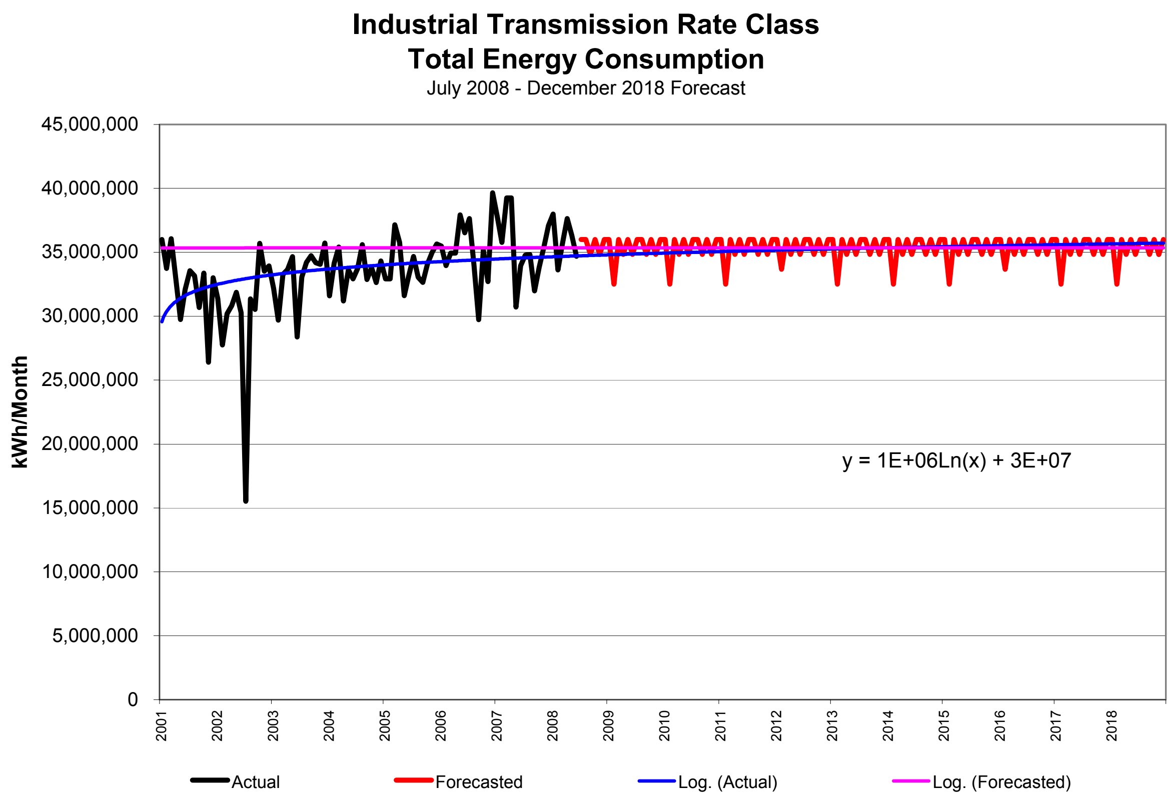
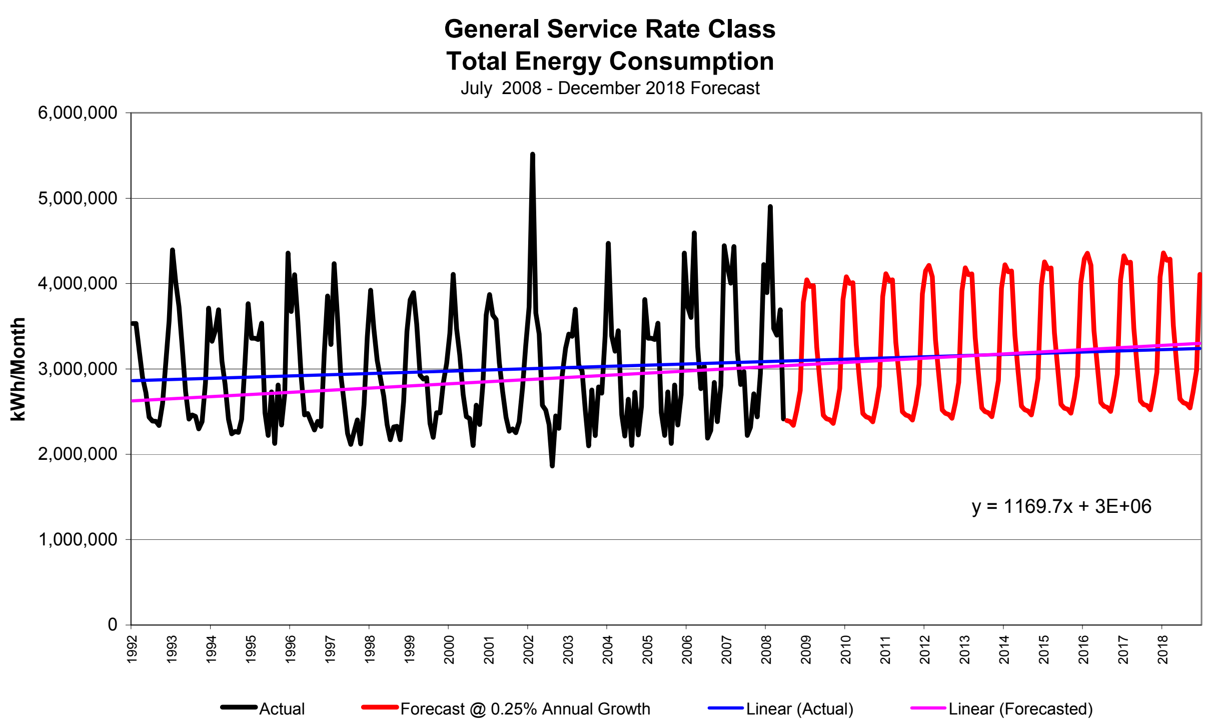
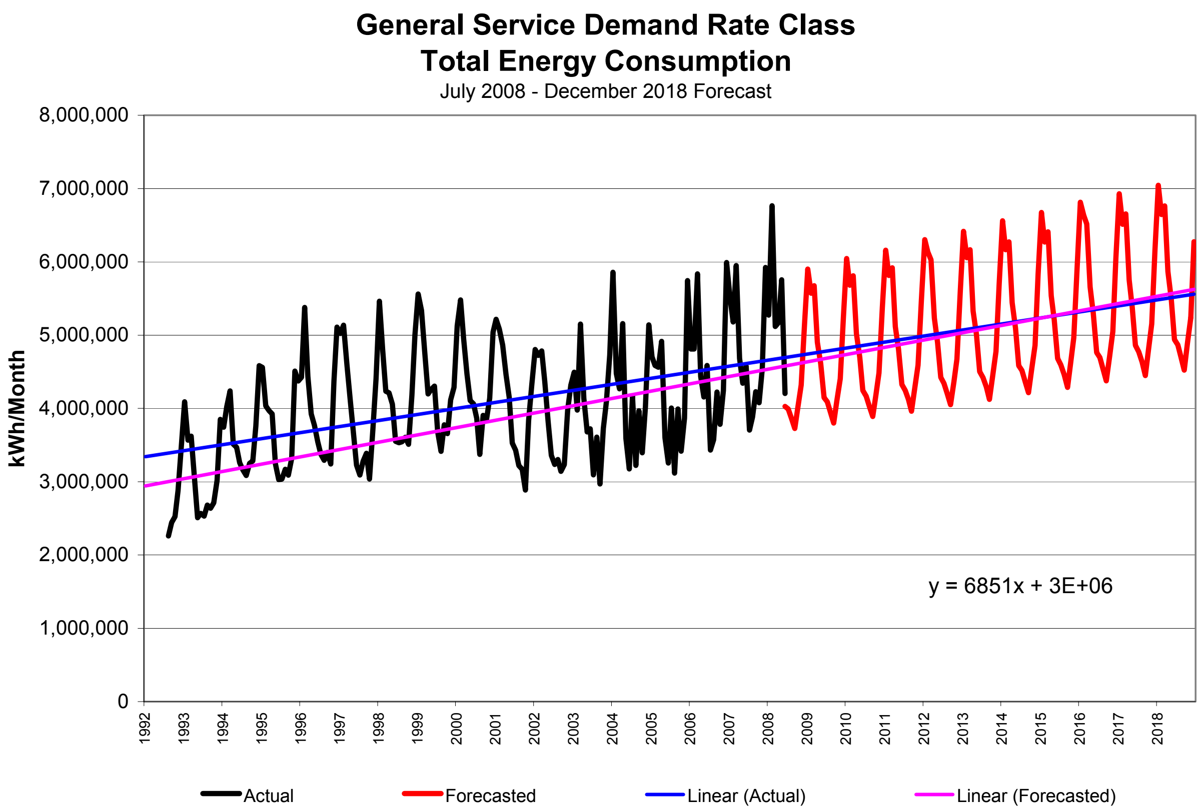
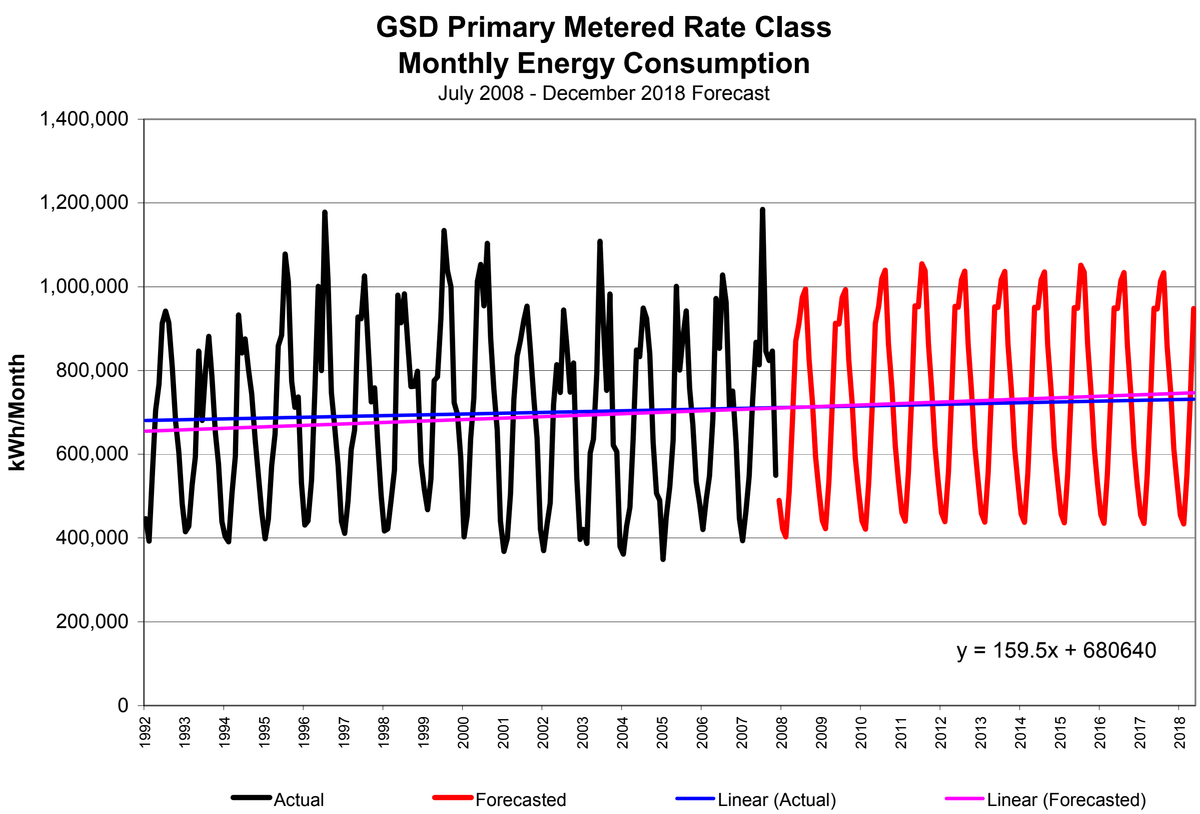
[15] Bezdek, R. 2008. *Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century*. Management Information Services, Inc. for the American Solar Energy Society.

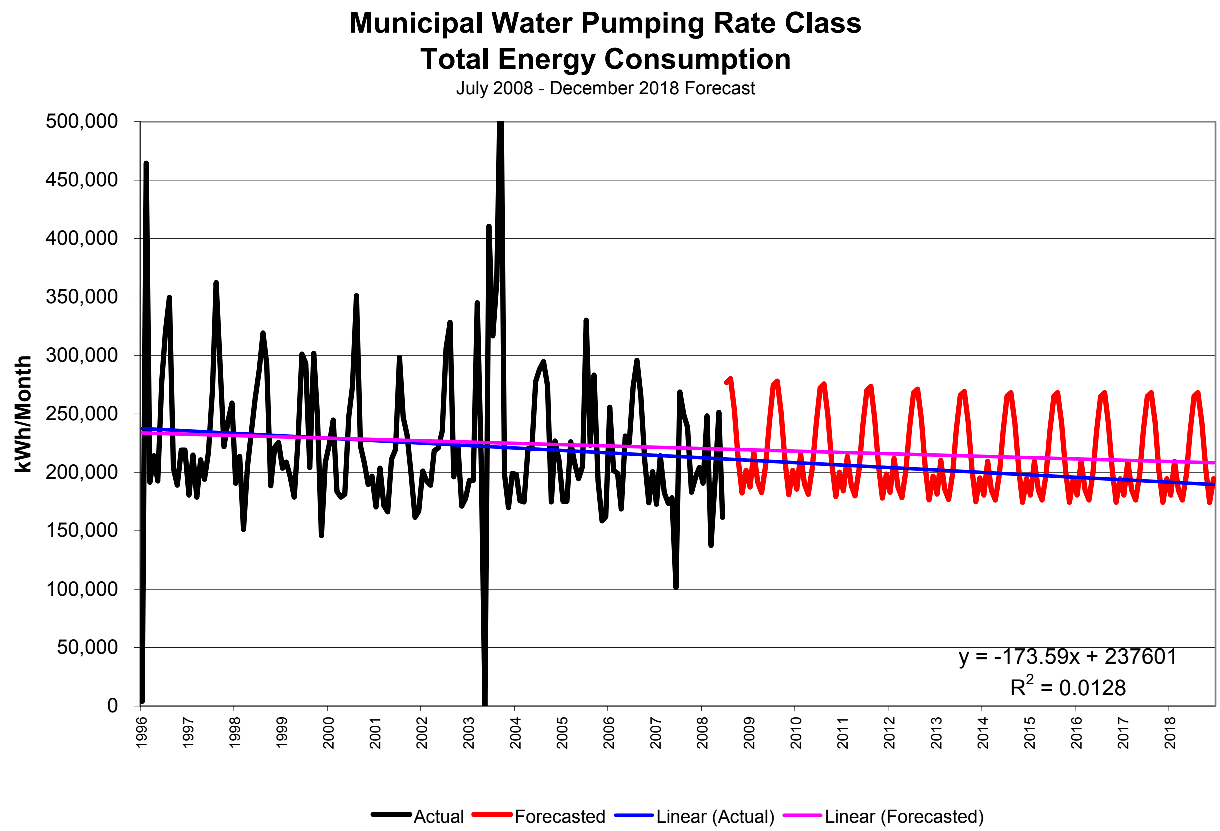
8 Appendix A: Forecasted Loads

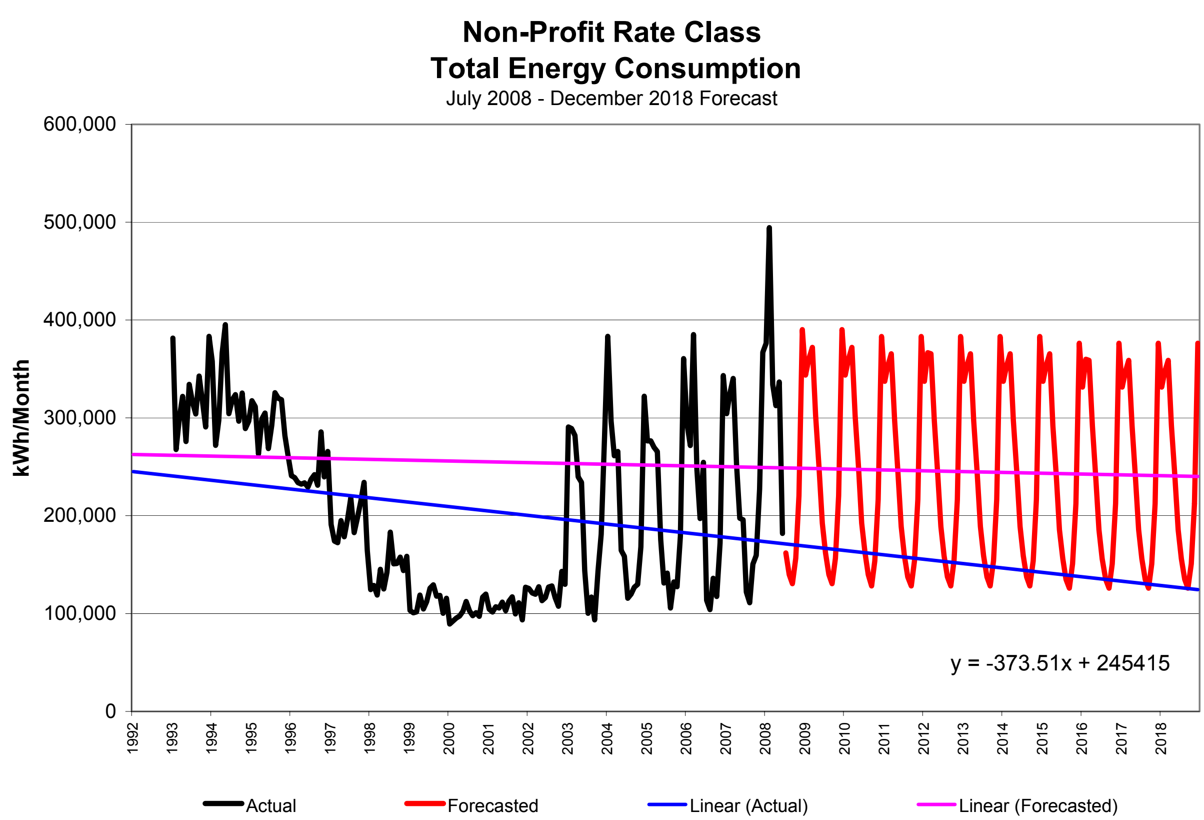


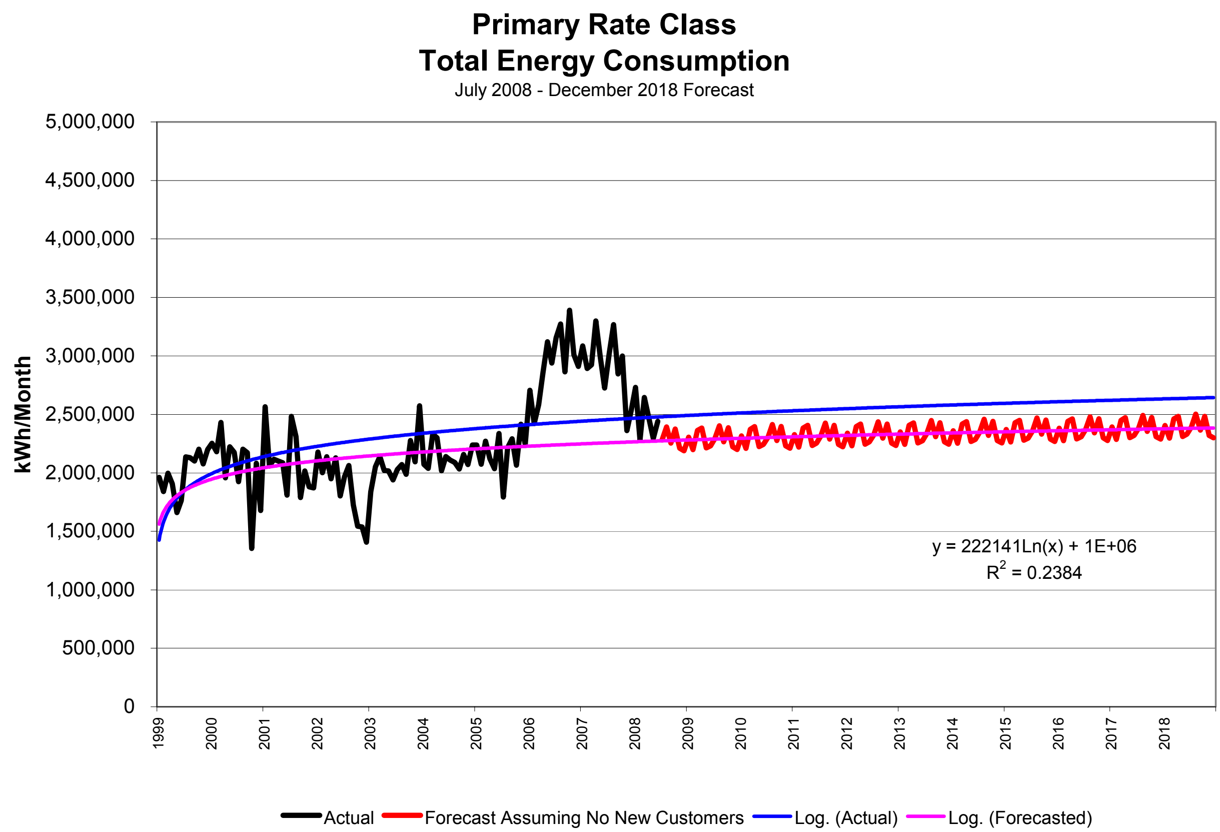


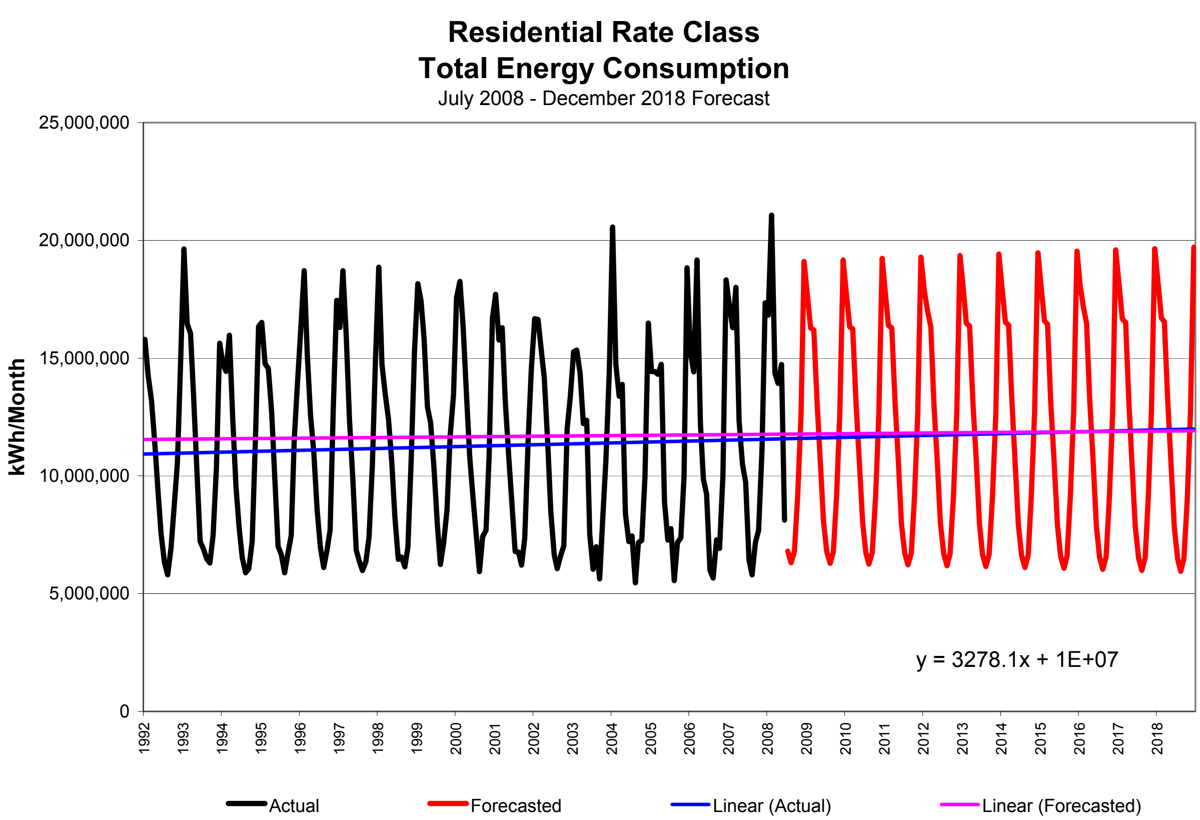

General Service Demand Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
y = 6851x + 3E+06
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)

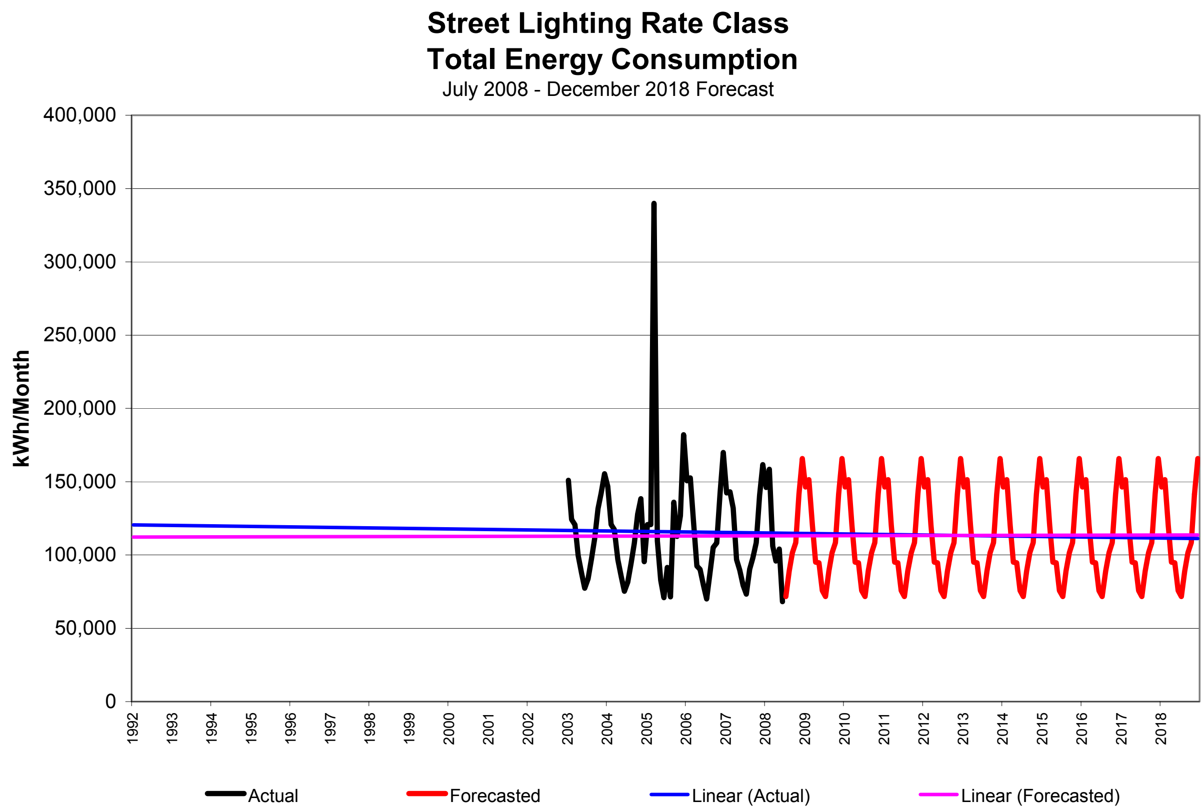

GSD Primary Metered Rate Class
Monthly Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
y = 159.5x + 680640
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)

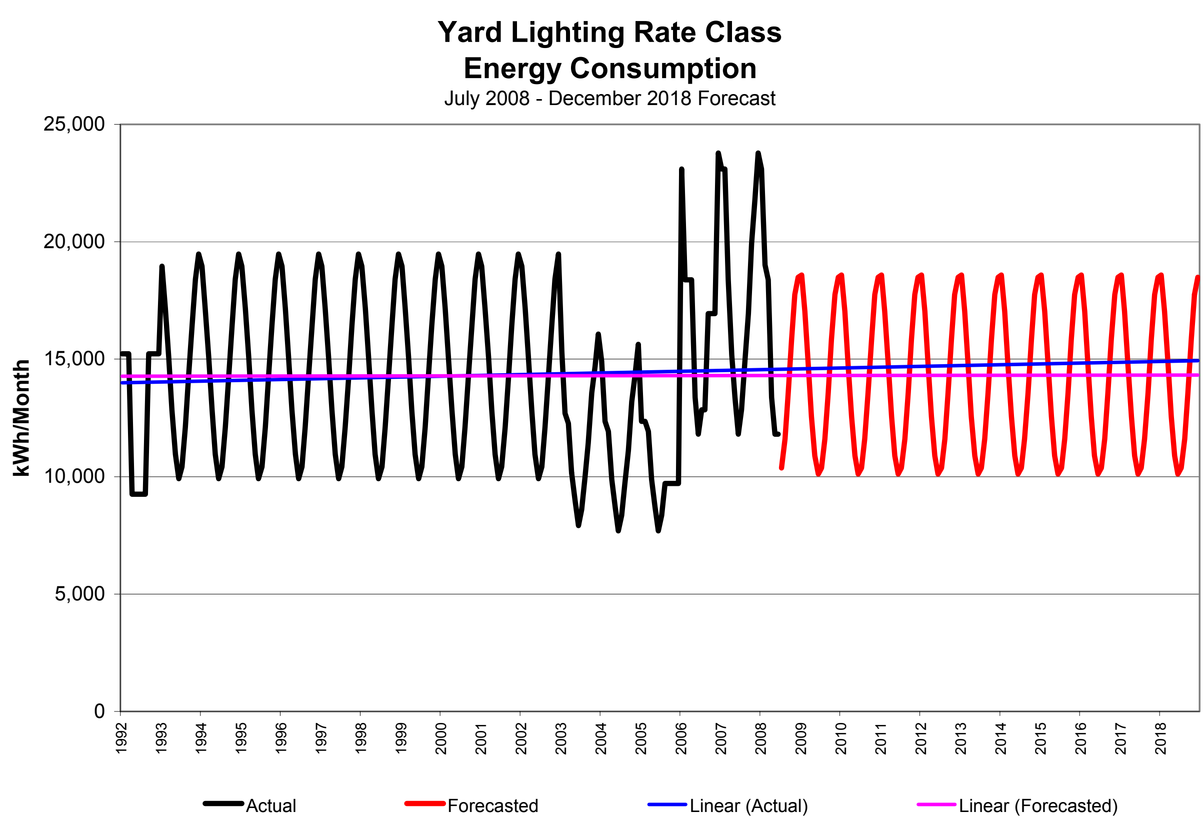

Municipal Water Pumping Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
y = -173.59x + 237601
R^2 = 0.0128
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)


Non-Profit Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
600,000
500,000
400,000
300,000
200,000
100,000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
y = -373.51x + 245415
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)


Primary Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
5,000,000
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
y = 222141Ln(x) + 1E+06
R2 = 0.2384
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Actual
Forecast Assuming No New Customers
Log. (Actual)
Log. (Forecasted)


Residential Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
y = 3278.1x + 1E+07
1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)


Street Lighting Rate Class
Total Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)


Yard Lighting Rate Class
Energy Consumption
July 2008 - December 2018 Forecast
kWh/Month
25,000
20,000
15,000
10,000
5,000
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Actual
Forecasted
Linear (Actual)
Linear (Forecasted)

9 APPENDIX B: PUBLIC NOTICE AND HEARINGS

As required by RCW 19.280.030, the following Notice was published by City Clerk on July 17, 2008 via newspaper and City website:

NOTICE OF PUBLIC HEARING

NOTICE IS HEREBY GIVEN that the City Council of the City of Port Angeles will hold a public hearing on Tuesday, August 5, 2008, at 7:00 p.m., or soon thereafter, at City Hall, 321 East Fifth Street. The purpose of the public hearing is to receive input on the proposed Electric Utility 2008 Resource Plan.

The City Hall is accessible for persons with disabilities. Please contact the City Clerk, 417-4634, if you will need any special accommodations to attend the meeting.

Becky J. Upton
City Clerk

The Proposed Plan was presented at the August 5, 2008 meeting of the City Council and subsequently published on City website.[16]

A Public Hearing was held on August 5, 2008 with two public comments presented:

1) Would the City be supportive of regional renewable energy development on the Olympic Peninsula?
2) Would the City be supportive of developing a customer-driven photovoltaic (PV) resource project in its service territory?

The answer to (1) is yes, the City would be interested in evaluating new resource opportunities after completing its Tier 2 strategic planning exercise. The answer to (2) is that the City proposed to the BPA developing a customer-driven PV project with the BPA funding 50% of the estimated $400,000 total system cost. The balance of the cost would have required funding through voluntary contributions of City electric customers. That grant request was denied by the BPA. Absent grant funding, the City does not now have the financial capacity to construct such a PV system, although the project may be reviewed again at a future time.

[16] See: http://www.cityofpa.us/pwEUtil.htm#PResourcePlan

10 APPENDIX C: BRIEF GLOSSARY[17]

Annual Energy, Average Megawatt (aMW). The amount of megawatts of energy averaged over the number of hours per year.

Avoided Cost. The total economic costs (consisting of the capital and operating costs to provide generation capacity and fuel, transmission, storage, distribution, and customer service) to serve end-use energy requirements using a given set of resources. These costs are referred to as "avoided" when an alternative set of resources is used to serve requirements. Avoided cost must be determined to assess the cost-effectiveness of potential supply-side and demand-side resources.

Base Load. The minimum average electric load over a given period of time.

Base Load Station. An electric generating facility designed for nearly continuous operation at or near full capacity to serve base load. Base load generating stations are operated to meet all, or part, of the minimum load demand of an electric system.

Benefit-Cost Ratio. The ratio of the value of a conservation measure's energy savings to its installed cost, with the energy savings value based on the utility's avoided cost.

Biomass. Plant material, vegetation, or agricultural waste used as a fuel or energy source.

Block Rate. A power product offered by the BPA for a fixed amount of power, delivered at a constant rate through the month.

Bonneville Power Administration or BPA. A power marketing and electric transmission agency of the United States government headquartered in Portland, Oregon.

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[17] Adapted from *Best Practices Guide: Integrated Resource Planning For Electricity* and from *Seattle City Light Integrated Resource Plan Glossary*. SEE: http://www.goodcents.com/Info/Best%20Practices%20Guide_IRP%20Planning.pdf and http://www.seattle.gov/light/news/issues/IRP/Docs/Glossary_07_18_06.pdf

British Thermal Unit or Btu. A commonly used unit of energy, especially for fuels or heat. A kilowatt-hour (kWh) is equal to approximately 3413 Btu.

Building Envelope. The roof, floor, walls, doors, and windows that separate the inside of a building from the outside. Also known as building shell.

Capacity. The maximum amount of electrical load that a device can carry at one time.

Capacity Factor. The ratio of the average output of an electric power generating unit for a time period to the unit's total capacity rating. A 50% capacity factor means that, for example, a power plant produces on average half of the electricity that it could have produced if operated continuously at its full capacity rating.

Cogeneration. The sequential production of electricity and useful thermal energy from the same energy source. This is also sometimes defined as the joint production of electricity and useful thermal or mechanical energy for industrial process, space conditioning or hot water loads. Also called combined heat and power (CHP).

Coincident Demand. The rate of electricity demand of a customer or group of customers at the time of an electric system's total peak demand.

Coincident Peak. Customer demand at the time of electric system peak demand.

Combined-Cycle Generating Plant. A generating plant using one or more combustion turbines in combination with a steam cycle to produce energy at a higher overall efficiency than a combustion turbine alone. In one combined-cycle configuration, hot exhaust gases from the combustion turbine are used to raise steam. The steam is then passed through a turbine, which turns a generator. Combined-cycle plants are fueled with oil, natural gas, and sometimes with coal that has been converted into a gas ("gasified"). A combined cycle turbine operates most efficiently when it is run for long periods of time without being ramped up and down.

Combustion Turbine or CT. Sometimes called gas turbines (similar to a jet engine), these devices burn oil or natural gas, converting the heat energy from the burning fuel to mechanical energy by directing the flow of combustion gasses against rows of radial blades fastened to a central shaft. The central shaft is connected to an electric generator.

Combustion turbines, because of their generally rapid firing time, are designed for meeting short-term peak demands placed on power distribution systems. They are frequently ramped up and down as needed.

Combined Heat and Power or CHP. See: cogeneration.

Commercial Sector. Non-residential facilities that provide services, including retail, wholesale, finance, insurance, and public administration.

Conservation and Efficiency. RCW 19.280.020 defines conservation and efficiency resources as "any reduction in electric power consumption that results from increases in the efficiency of energy use, production, transmission or distribution."

Cost-Effective. The present value (PV) of the benefits of the potential resource under consideration over the planning period are greater than the PV of its costs. Cost-effectiveness is always measured relative to an alternative. Cost-effectiveness can be measured from a variety of perspectives, which vary in terms of the specific costs and benefits included in the calculation.

Cost-Effectiveness Index. This is an indicator of the cost of saving electricity through a given type of conservation measure. The Index is calculated by dividing the additional cost of the efficiency measure (relative to standard technologies) by the energy savings it produces. Sometimes called the Cost of Saved Energy or CSE.

Customer. An individual or entity that purchases electric service as one account under one contract or rate schedule. If service is supplied to a customer at more than one location, each location is generally counted a separate customer, unless the locations are served under one billing account.

Customer Charge. An amount paid periodically by a customer for electric service, exclusive of demand and/or energy consumption. It is often based upon utility costs incurred for metering, meter reading, billing of customers, etc.

Customer Class. A group of customers with similar characteristics, such as economic activity or level of electricity use.

Customer-driven Program. Where a utility or third-party develops and builds a renewable power generation system to sell the electricity under a long-term contract to customers who are voluntarily subscribers.

Demand. The rate at which electricity is delivered by a system or part of a system, or to a load point or set of loads. It is measured in kilowatts, kilovolt amperes or other suitable unit at a given instant or averaged over a designated period of time. Demand include many measures such as:

> Average demand: The demand on, or the power output of, an electric system or any of its parts over an interval of time, determined by dividing the number of kilowatt hours by the number of hours in the interval.
>
> Billing demand: The demand for which a customer is billed. Since billing demand is based on the provisions of a rate schedule or contract, it does not necessarily equal the actual measured demand of the billing period.
>
> Coincident demand: Two or more demands that occur during the same time interval. Often used to express the demand level of subgroups of customers that occurs at the time of the electric system's overall maximum peak demand.
>
> Instantaneous peak demand: The demand at the instant of greatest load, usually determined from the readings of indicating meters or graphic meters.
>
> Integrated demand: The summation of continuously varying instantaneous demands during a specified demand interval.
>
> Maximum demand: The greatest demand that occurs during a specified time period.
>
> Non-coincident demand: The peak demands of subgroups of customers that do not coincide with system peak demand.

Demand Charge. The portion of the charge for electric service that is based on billing demand under an applicable rate schedule.

Demand Forecast. Projected demand for electric power. A load forecast may be short-term (e.g., 15 minutes) for system operation purposes, long-term (e.g., 5 to 20 years) for generation planning purposes, or for any range in between. Load forecasts may include peak demand (kW), energy (kWh), reactive power (kVAR), or load profile. Forecasts may be made of total system load, transmission load, substation/feeder load, individual customers' loads, or appliance loads.

Demand-Side Resource. The energy service needs met through a measure or program on the customer's side of the power meter .

Dispatch Order. The order of priority in which each electric generation unit is selected for operation during a given time interval.

Dispatching. The operating control of an integrated electric system to assign load to specific generating units as loads vary, to control operations of high-voltage lines and substations, and to operate the interconnections with other electric systems, including energy transactions.

Diversity. The diversity among customers' demands, which creates variations among the loads in distribution transformers, feeders, and substations at a given time. A load diversity is the difference between the sum of the maximum of two or more individual loads and the coincident or combined maximum load. It is usually measured in kilowatts (kW).

Economic Dispatch. A dispatch order based on realizing the most economical production of electricity for customers.

Electric System. The generation, transmission, distribution and other facilities operated as an electric utility or a portion thereof.

Energy. Electric energy is a measure of the amount of usage over time and is measured in kilowatt-hours (kWh) or megawatt-hours (MWh).

End-Use. Useful work, such as light, heat, and cooling, which is produced by electricity or other forms of energy.

Energy Audit. Analysis of a facility's electricity and other energy usage, often including recommendations to alter the customer's electric demand or reduce energy usage. An audit usually is based on a visit by an energy analyst or engineer to the home, building, or manufacturing or agricultural facility.

Energy Charge. The charge for electric service based upon the amount of electric energy (kWh) consumed and billed under an applicable rate schedule. See also customer charge and demand charge.

Energy Efficiency Program. A program aimed at reducing overall electricity consumption (kWh). Such savings are generally achieved by substituting technically more efficient equipment to produce the same level of end-use services with less electricity. Compare with conservation; contrast with load management.

Energy, electric. As commonly used in the electric utility industry, electric energy means kilowatt-hours (kWh).

Off-Peak Energy. Electricity supplied during periods of relatively low system demand.

On-Peak Energy. Electricity supplied during periods of relatively low system demand.

Externality. A cost or benefit from production or consumption that is not accounted for in market prices. Costs and benefits that do not have market value, and thus current or projected prices, are externalities. For example, the costs of damage to human health from certain air pollutants are negative environmental externalities.

Geothermal. Power generated from heat energy derived from hot rock, hot water or steam below the earth's surface.

Heat rate. Generating unit efficiency, usually expressed in BTU's of input energy required to produce a kWh of electrical output in a given power plant. See British thermal Units.

HVAC. An acronym for heating, ventilating, and air conditioning services required in buildings, or for the equipment used to provide HVAC services.

Hydro or hydroelectric power. A generating station or power or energy output in which the device generating the electricity is driven by water power.

Incremental Cost. The difference in costs between two alternatives, for example, between that of an efficient technology or measure and the standard technology.

Levelized Cost. The uniform annual cost that results in the same net present value over the planning horizon as the stream of actual annual average costs. An example of a levelized cost is a monthly mortgage payment.

Line Losses. Kilowatt-hours and kilowatts lost in the transmission and distribution lines under specified conditions.

Load. The amount of electric power consumed at any specified point or points on a system. Load originates primarily in the power consuming equipment of the customers.

Load Duration Curve. A graph showing a utility's hourly demand, sorted by size, as well as by the amount of time a given level of demand is exceeded during the year.

Load Factor. The ratio of the average load in kilowatts supplied during a given period to the peak or maximum load in kilowatts occurring during that period. Load factor may be calculated for a customer, customer class or the entire electric system.

Load Forecast. See demand forecast.

Load Management. The controlling, by rescheduling or direct curtailment, of the power demands of customers or groups of customers in order to reduce the total load that a utility must meet at times of peak demand. Load management strategies are designed to either reduce or shift demand from on-peak to off-peak, while conservation (see energy efficiency) strategies reduce usage over larger multi-hour periods. Load management may take the form of normal or emergency procedures. Utilities often encourage load management by offering customers a choice of service options with varying price incentives.

Load Shape. The time-varying usage pattern of customer demand for energy.

Load Shedding. The turning off of electrical loads to limit peak electrical demand.

Load Shifting. Shifting load from peak to off-peak periods. Applications include use of storage water heating, storage space heating, cool storage, and customer load shifts to take advantage of time-of-use or other special rates.

Loss of Load Probability or LOLP. A measure of the probability that system demand will exceed available capacity during a given period.

Marginal Cost of Energy. The cost of providing an incremental unit of energy.

Marginal Cost of Capacity. The cost of meeting an incremental unit of peak-demand.

Marginal Resource. The most expensive resource, in terms of short-run marginal (fuel and operating) cost, needed at a given time.

Market Barriers. Forces in the marketplace of goods and services that inhibit customer selection based on economic criteria and restricted access to capital.

Megawatt or MW. One million Watts.

Megawatt-hour or MWh. A unit of electrical energy equal to one million Watt-hours or 1000 kWh.

Non-Technical Losses. Commercial losses from theft of electricity through unauthorized connections, tampering with meter reading, metering errors, etc.

Peak Demand. The maximum rate of electricity consumption, expressed in MW. May be expressed for groups of electricity users or the whole system, and by season (summer or winter) or annually. See: demand. Also called peak load.

Peak load. See: demand.

Peaking Unit, or peaker. A generating station that is normally operated to provide power during maximum load periods.

Photovoltaic or PV. A field of technology and research related to using solar cells for energy by converting sunlight directly into electricity.

Planning Period. The time period over which the utility resource plan is performed.

Potential Resources. Resources, either supply-side or demand-side, which are either currently commercially available, feasible or are expected to be commercially available within the planning period.

Present Value. The value of a cost or stream of yearly costs that have been discounted to reflect the fact that future benefits or expenditures are worth less than current benefits or expenditures. Also called Present Worth. See: discount rate.

Present Worth. See: present value.

Pumped Storage Hydroelectric Plant. An electric generation facility consisting of a higher reservoir, a lower reservoir, pipes connecting the two reservoirs, and turbine-generator units that can be reversed to become pumps. At times when electricity demand is low, base load generating plants provide electricity to pump water from the lower reservoir to the higher. During peak demand periods, water is released from the higher reservoir, spins the turbine-generator units to generate electricity, and is expelled to the lower reservoir.

Renewables. A resource such as solar energy or wind that is inexhaustible without fear of it running out, like oil.

Resource Plan. A strategic planning approach that provides a process for a utility to evaluate a wide range of power resource alternatives.

Revenue Requirements. The amount of revenues that a utility needs to receive in order to cover operating expenses, pay debt service, and provide a fair return to common equity investors.

Scenario. A possible course of future events. In the Plan, scenarios are used to evaluate portfolios of energy resources under a range of circumstances other than the baseline forecast.

Shaping. Configuring a resource portfolio so that power generation capability and delivery of purchased power closely matches changes in demand over time. Shaping can help to avoid unnecessary costs and the need to sell surplus power.

Slice. A power product offered by the BPA for an amount of power that varies year to year according to the amount of water flowing through the BPA hydroelectric system. In a good water year (above average precipitation), more power is delivered to the same customer than in a poor water year (below average precipitation).

Strategic Load Growth. The increase of end-use consumption during certain periods. The result is a general increase in energy sales beyond the valley filling (defined herein) strategy. Strategic load growth may involve increased market share of loads that are, or can be, served by competing fuels, as well as economic growth.

Supply-Side Resource. A resource option that produces electricity.

Valley Filling. The building of off peak loads. An example valley filling technology is thermal storage (water heating and/or space heating or cooling) that increases night time loads and reduces peak period loads. Valley filling may be desired in periods when the long-run incremental cost of supply is less than the average price of electricity. (Adding off-peak load under those circumstances decreases the average price.)

Watt (W). The electrical unit of power or rate of doing work. A light bulb rated at 100 W requires 100 W of power to light it fully. The watt is named after James Watt for his contributions to the development of the steam engine, and from a technical basis a watt is one joule of energy per second.

Watt-hour (Wh). The total amount of energy used in one hour by a device that requires one watt of power for continuous operation. Electric energy is commonly sold by the kilowatt-hour (1000 Wh or 1 kWh).