# Chapter 4: Conservation Supply Assumptions



## SUMMARY OF KEY FINDINGS

The Council defines conservation as improved energy efficiency. This means that less electricity is used to provide the same level of services. Conservation resources are measures that ensure that new and existing residential buildings, household appliances, new and existing commercial buildings, commercial-sector appliances, commercial infrastructure such as street lighting and sewage treatment, and industrial and irrigation processes are energy-efficient. These efficiencies reduce operating costs and ultimately decrease the need to build new power plants. Conservation also includes measures to reduce electrical losses in the region's generation, transmission, and distribution system.

The Council identified nearly 7,000 average megawatts of technically achievable conservation potential in the medium demand forecast by the end of the forecast period. Most of this potential, about 6,000 average megawatts, is available at a levelized (net) life-cycle cost of up to $200 per megawatt-hour (2006 dollars). Sources of achievable potential savings are about 50 percent higher than in the Fifth Power Plan.[1] The assessment is higher for two principle reasons. First, the Council identified new sources of savings in areas not addressed in the Fifth Power Plan: consumer electronics, outdoor lighting, and the utility distribution system. Second, savings potential has increased significantly in the residential sector as a result of technology improvements and in the industrial sector as a result of a more detailed conservation assessment.

[1] For purposes of comparison, the Council's Fifth Power Plan estimated that the achievable conservation was approximately 3,900 average megawatts at cost up to $120 per megawatt-hour. This plan's estimate of achievable potential is 5,860 average megawatts at an equivalent levelized life-cycle cost.

Not all of the nearly 7,000 average megawatts identified are cost-effective to develop. The Council uses its portfolio model to identify the amount of conservation that can be economically developed. The results presented in this chapter serve as an input to the resource portfolio model (RPM) which will test varying amounts of conservation against other resource options across a wide range of future conditions. The results of the RPM analysis are presented in Chapter 10.

The achievable savings at cost up to $200 per average megawatt break down as follows:

- About 2,600 average megawatts of conservation are technically achievable in the residential buildings and appliances sector. Most of the savings come from improvements in water-heating efficiency and heating, ventilating, and air-conditioning efficiency.

- Over 800 average megawatts of potential savings are estimated in the fast-growing consumer electronics sector. These savings come from more efficient televisions, set top boxes, desktop computers, and monitors primarily in homes but also in businesses.

- Approximately 100 average megawatts of conservation are available in the agriculture sector through irrigation system efficiency improvements, improved water management practices, and dairy milk processing.

- Over 1,400 average megawatts of potential savings are available from the commercial sector. Nearly two-thirds of commercial savings are in lighting systems. New technologies like light-emitting diodes and improved lighting fixtures and controls offer added potential savings in both outdoor and indoor lighting.

- Potential savings in the industrial sector are estimated to be nearly 800 average megawatts by the end of the forecast period. The industrial assessment found that effective business management practices could significantly increase savings from equipment and system optimization measures.

- Finally, potential savings from improved efficiency in utility distribution systems are estimated to be about 400 average megawatts by the end of the forecast period.

While there are a number of barriers to achieving these savings, the Council believes these challenges can be met.

## RECENT CHANGES SINCE THE FIFTH POWER PLAN

The Fifth Power Plan recommended that the region develop at least 700 average megawatts of conservation savings from 2005 through the end of 2009. Based on surveys conducted by the Council's Regional Technical Forum, regional conservation programs already achieved savings of 700 average megawatts by the end of 2008 and are likely to achieve a total savings of over 900 average megawatts by the end of 2009.

## *Federal Standards*

Since the Fifth Power Plan was adopted, Congress enacted the 2007 Energy Independence and Security Act (EISA) and the Department of Energy has promulgated several new standards.  The EISA legislation revised several existing federal efficiency standards and established new standards as well.  The most significant EISA standard requires "general service lighting" (40 - 100 watt lamps) to be at least 30 percent more efficient beginning in 2012, and 60 percent more efficient beginning in 2020.  The Fifth Power Plan estimated that converting standard incandescent bulbs to compact fluorescent light bulbs (CFL) could save the region 625 average megawatts by 2025.  The EISA standard does not cover all incandescent bulbs. For example, bulbs over 100 watts, parabolic reflector lamps, candelabra, and 3-way light bulbs are exempt. These standards phase in beginning with a 30 percent improvement in efficiency for 100 watt general service lamps in 2012 and end with a 60 percent improvement in efficiency for all 60 to 100 watt general service lamps in 2020. The Council estimates that approximately 285 average megawatts of regional conservation potential remains to be captured in residential lighting prior to 2020 and from lamps not covered by those standards. Savings from lamps covered by the initial phase of EISA should count toward the region's conservation target in 2010 and 2011.

EISA also sets minimum standards for certain commercial lighting products that were incorporated into the conservation assessment and load forecast.  In addition, new efficiency standards were developed and adopted since 2004 for a suite of residential and commercial appliances regulated by federal law or state standards.  Baseline assumptions for energy use of new appliances and equipment have been updated in the new conservation assessment to reflect these improved standards.  Table 4-1 shows a summary of all the federal standards that have changed since the adoption of the Fifth Power Plan and the effective dates of these new and/or revised standards.

**Table 4-1: New or Revised Federal Standards Incorporated in Sixth Power Plan Conservation Assessment Baseline Assumptions**

| Product Regulated | Effective Date |
|---|---|
| Battery Chargers and External Power Supplies | July 1, 2008 |
| Clothes Washers (Residential) | January 1, 2007 |
| Clothes Washers (Commercial) | January 1, 2011 |
| Consumer dehumidifier products | October 1, 2012 |
| Dishwashers (Residential) | January 1, 2010 |
| Ice Makers (Commercial) | January 1, 2010 |
| Motors | December 17, 2010 |
| Distribution Transformers (Low Voltage) | January 1, 2007 |
| Distribution Transformers (Medium-voltage, dry-type and Liquid-immersed distribution transformers) | January 1, 2010 |
| Packaged Air Conditioners and Heat Pumps (Commercial - ≥65,000 Btu/h) | January 1, 2010 |
| Refrigerators and Freezers (Commercial) | January 1, 2010 |
| Single-Package Vertical Air Conditioners and Heat Pumps | January 1, 2010 |
| Walk-In Coolers and Walk-In Freezers (Commercial) | January 1, 2009 |
| Ceiling Fan Light Kits | January 1, 2007 |
| Compact Fluorescent Lamps (Efficacy and Rated Life) | January 1, 2006 |
| Exit Signs | January 1, 2006 |
| Fluorescent Lamp Ballasts | Beginning October 1, 2009 and phasing in through July 2010 |
| Incandescent General-Service Lamps | Beginning January 1, 2012 and phasing in through 2014 |
| Incandescent Reflector Lamps | June 1, 2008 |
| Metal Halide Lamp Fixtures | January 1, 2009 |
| Torchieres | January 1, 2006 |

## *New Sources of Potential Savings*

Additional savings were identified from utility distribution systems. Distribution system savings, including voltage management and system optimization, add about 400 average megawatts of conservation potential not included in the Fifth Power Plan assessment.

A more in-depth analysis of the industrial sector more than doubled the conservation potential identified in the Fifth Power Plan.

Along with these major adjustments, the conservation assessment incorporates new conservation opportunities brought about by technological advances. For example, recent advances in solid-state lighting--light-emitting diodes (LED) and organic light-emitting diodes (OLED)--appear to offer significant opportunities for savings in televisions and some lighting applications. The arrival in the U.S. market of ductless heat pumps for space heating also provides new savings opportunities.

# ESTIMATING THE COST OF CONSERVATION

The Council determines the total resource cost of energy savings from all measures that are technically feasible. This process requires comparing all the costs of a measure with all of its benefits, regardless of who pays those costs or who receives the benefits. In the case of efficient clothes washers, the cost includes the difference (if any) in retail price between the more efficient

Energy Star model and a standard efficiency model, plus any utility program administrative and marketing costs. On the other side of the equation, benefits include the energy (kilowatt-hour) and capacity (kilowatt) savings, water and wastewater treatment savings, and savings on detergent costs.[2] While not all of these costs and benefits are paid by or accrue to the region's power system, they are included in the evaluation because ultimately, it is the region's consumers who pay the costs and receive the benefits.

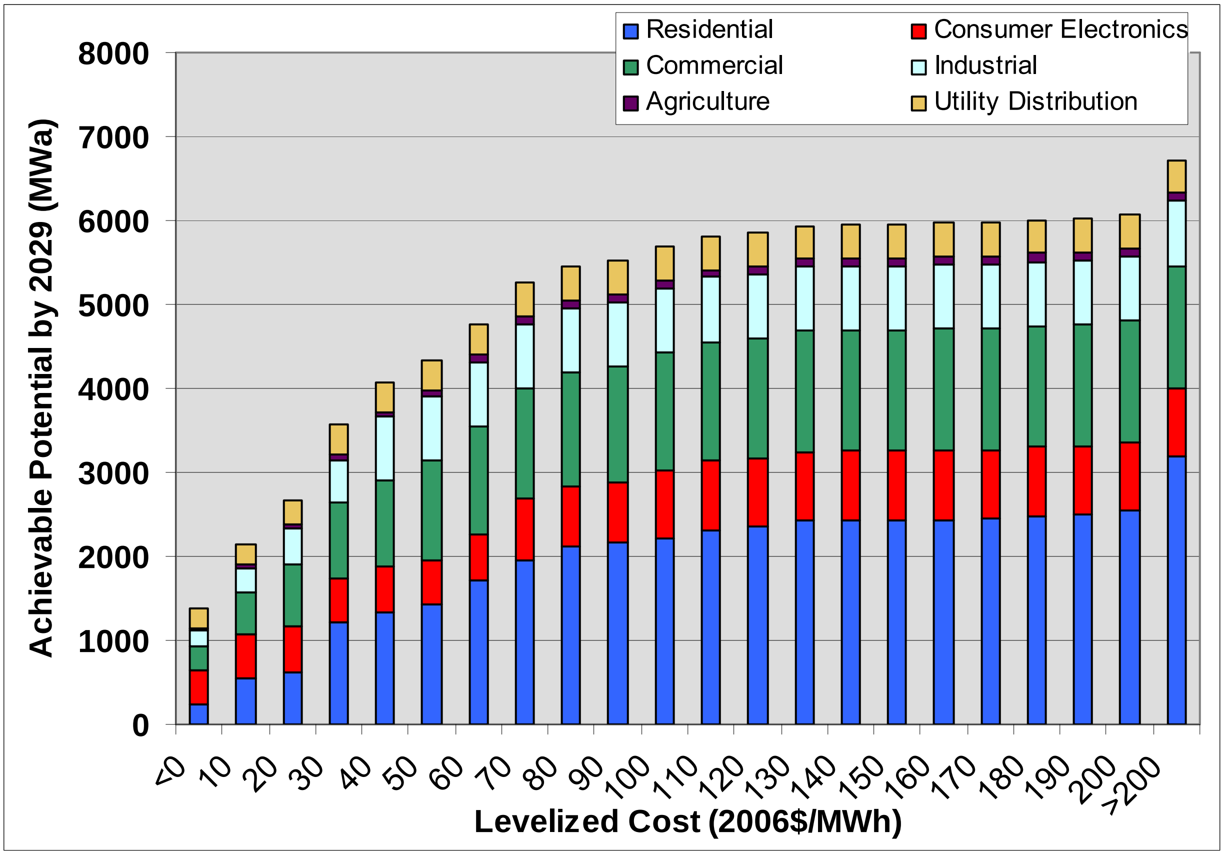
Once the *net cost* (levelized over the life of the conservation resource) of each of the conservation technologies or practices is determined, the technologies are ranked by cost in two supply curves that depict the amount of conservation resource available in the region. These net levelized costs of conservation are calculated the same way that levelized costs of new generating resources are calculated so they can be compared.

One supply curve represents all of the retrofit or non-lost opportunity resources. The other represents all the lost-opportunity conservation resources.[3] The Council divides conservation resources into these two categories because their patterns of deployment are different. Non-lost opportunity conservation resources can be deployed at any time. Lost-opportunity resources are only available during specific periods; for example, when new buildings are built with improved insulation. Savings from most appliances are available only as appliance stock turns over. If the savings from these lost-opportunity resources are not acquired within this limited window of opportunity, they are treated as lost and no longer available at that time or cost.

Figure 4-1 shows the Sixth Power Plan's estimate of the amount of conservation available by sector and levelized life-cycle cost. The Council identified about 6,000 average megawatts of achievable conservation potential in the medium demand forecast by the end of the forecast period at a levelized life-cycle cost of up to $200 per megawatt-hour (2006 dollars). New sources of potential savings result in about 50 percent more achievable potential compared to the Fifth Power Plan. Slightly less than half of the potential is from lost-opportunity measures.

[2] Energy-efficient clothes washers use less water and require less detergent.
[3] Lost-opportunity resources can only be technically or economically captured during a limited window of opportunity, such as when a building is built or an industrial process is upgraded.

**Figure 4-1: Achievable Conservation by 2029 by Sector and Levelized Cost**




# RESOURCE POTENTIAL ESTIMATES BY SECTOR

## *Residential Sector*

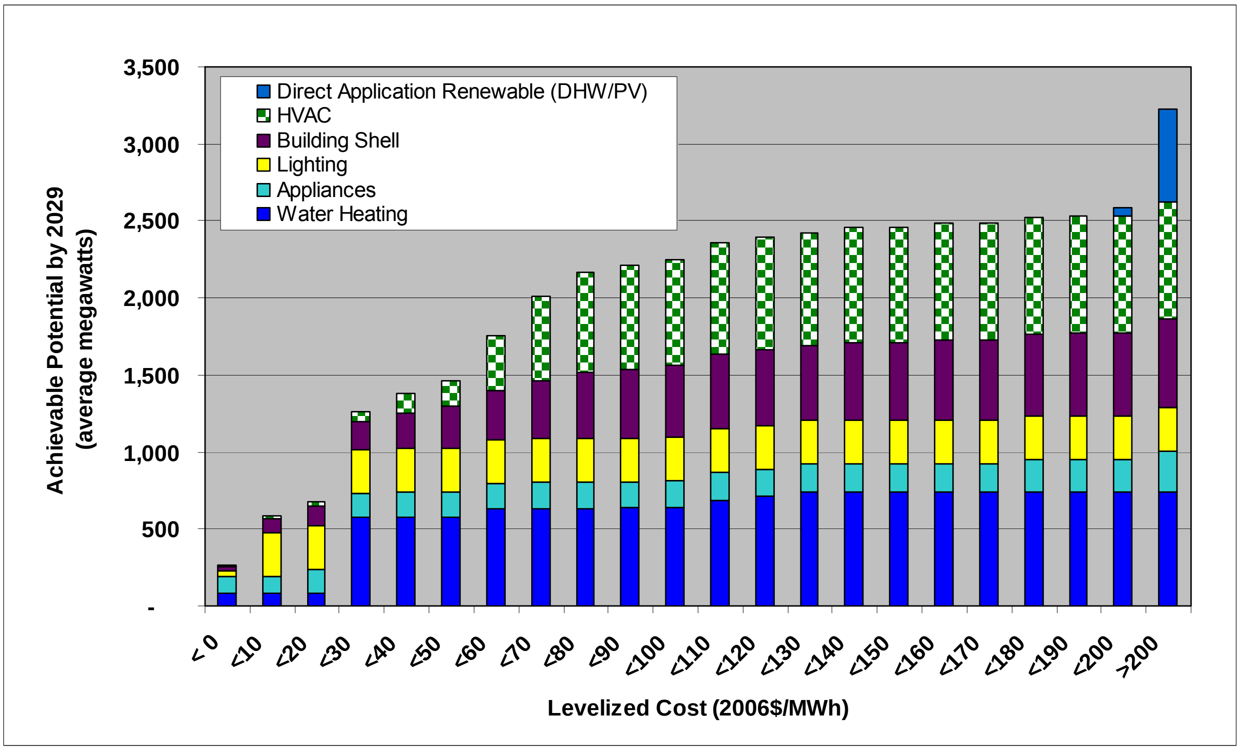
In the Fifth Power Plan, the Council estimated that approximately 1,600 average megawatts of conservation potential was technically available in the residential sector from improvements in lighting, appliances, and water-heating technologies at a levelized cost of less than $120 per megawatt-hour (2006 dollars). The Sixth Power Plan's estimate for these same end-uses places the remaining technically achievable conservation at nearly 2,600 average megawatts at an equivalent cost.

The largest decrease (475 average megawatts) in residential-sector potential came from the new federal efficiency standards for lighting. Figure 4-2 shows the residential resource potential by major category and cost. The figure shows that the largest remaining savings come from improvements in water-heating efficiency and heating, ventilating, and air conditioning (HVAC) efficiency. These increases in residential sector potential stem from greater availability of heat pump water heaters, the introduction of ductless heat pumps to the U.S. market, and cost reductions for high-efficiency heat pumps.

Since the adoption of the Council's Fifth Power Plan, the Northwest Energy Efficiency Alliance (NEEA), with the support of the Bonneville Power Administration and other regional utilities, and in cooperation with the Energy Trust of Oregon, launched a regionwide market transformation program to encourage the installation of split-system heat pumps. These systems, referred to as "ductless heat pumps," do not use forced-air ducts to perform their heating and cooling function. Instead, they distribute the hot or cold refrigerant created by an outside unit to inside units through refrigerant lines. The advantage of these systems is that they can be more easily installed in homes with electric resistance zonal heating systems (baseboard, ceiling radiant, or wall fan units). While these systems are used throughout Northern Europe and all across Asia, Australia, and New Zealand, they have only recently been promoted in the U.S. If the savings and cost estimates adopted by the Regional Technical Forum are confirmed through NEEA's market transformation venture, this technology has the potential to reduce regional space-heating use by approximately 200 average megawatts at a cost of less than $60 per megawatt-hour.

The Council's Fifth Power Plan estimated that regional electric water-heating use could be reduced by approximately 200 average megawatts through the installation of heat pump water heaters commercially available at the time of the plan's adoption.[4] However, since there were no major water heater manufacturers producing heat pump water heaters, the Council's estimate of potential savings from these heaters fell short.

**Figure 4-2: Residential-Sector Achievable Conservation by Sector and Levelized Cost**




Three major U.S. water heater manufacturers began producing heat pump water heaters in 2009. Consequently, the Council raised its estimate of the maximum penetration of these systems from 25 percent of single family and manufactured homes with electric water heat to 50 percent. Nevertheless, since these are new products, it is likely that their initial market penetration rates will be modest. The Council assumes that by the end of 2014 the market share of these heaters

[4] A heat pump water heater uses a compressor that circulates hot refrigerant through a heat exchanger in a water tank to heat water rather than electric resistance elements.

will be just over 1 percent. However, by 2030 heat pump water heaters could reduce regional electric water heating use by over 490 average megawatts at a cost less than $30 per megawatt-hour.

The third largest increase in residential sector potential came from the lower costs of high-efficiency heat pumps for space heating. When the Fifth Power Plan was adopted, the minimum federal standards for heat pumps and air conditioners had just gone into effect. As a result, there was little price competition among products that exceeded these new standards. Based on program data obtained from the Energy Trust of Oregon, high performance heat pump costs have come down. Moreover, it now appears that heat pumps with a minimum performance level of 17 percent above the federal standards are more cost competitive than those that only exceed the federal standards by 10 percent. At a levelized life-cycle cost of less than $80 per megawatt-hour, there are almost 375 average megawatts of savings available from converting new and existing single family and manufactured homes with electric forced-air furnaces to high-performance heat pumps. At less than $80 per megawatt-hour, the potential savings from upgrading new and existing homes with higher efficiency heat pumps are 100 average megawatts.

## *Agriculture Sector*

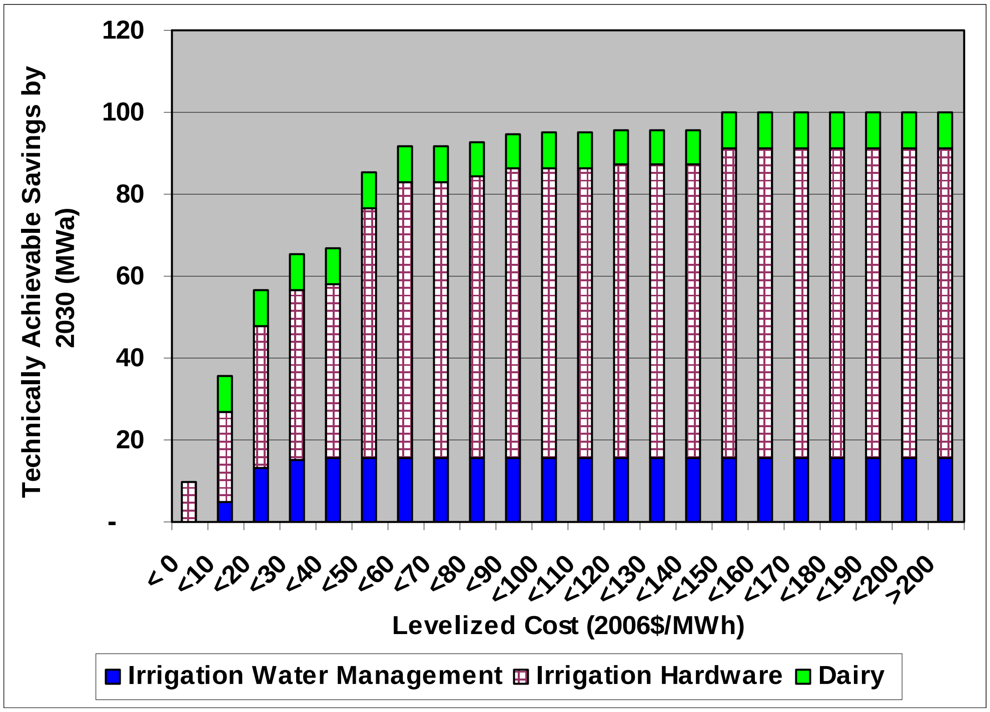
The Fifth Power Plan identified approximately 100 average megawatts of conservation potential available in the region through efficiency improvements in irrigation system hardware. Since the Fifth Power Plan, almost 685,000 acres have been added as land irrigated by pressurized sprinkler systems. However, due to improvements in system efficiency, such as the conversion to low-pressure delivery systems and improved water management, total estimated regional electricity use for irrigation decreased from 655 average megawatts to 645 average megawatts.

After accounting for these changes, the Council estimates that approximately 75 average megawatts of conservation remains available through hardware efficiency improvements such as pump efficiency, leak reduction, conversion to lower pressure applications, and better sprinkler/nozzle management practices at costs significantly below $100 per megawatt-hour.

Along with improving irrigation system hardware, better water management practices could also reduce the energy consumed in irrigation. Despite some of the measure's limitations due to state-specific water laws, over 15 average megawatts of conservation potential are available in the region through scientific irrigation water scheduling. More potential exists if mechanisms can be found to ensure that irrigation water savings on one farm are not consumed by additional irrigation on farms with junior water rights.

Non-irrigation "on farm" electricity use in the remainder of the agriculture sector is dominated by dairy milk production. According to the Department of Agriculture, the region produced approximately 20 billion pounds of milk in 2007. Idaho and Washington rank among the top 10 states in milk production and Oregon ranks 18. The Council estimates that 2007 electricity use for dairy milk production was approximately 55 average megawatts. Many of the dairies in the region, and particularly in Idaho, were established and/or enlarged within the last decade. Consequently, many already have energy-efficient lighting, pumps, and milk cooling equipment. Nevertheless, the Council estimates that approximately 10 average megawatts of conservation potential is available through improvements such as variable-speed drives on milking machine vacuum pumps, the use of flat-plate heat exchangers for pre-cooling milk prior to refrigeration, and improved lighting. A summary of the technically achievable conservation in the agriculture sector is shown in Figure 4-3

**Figure 4-3: Agriculture Sector Achievable Conservation by 2030 (MWa) by Sector and Levelized Cost**



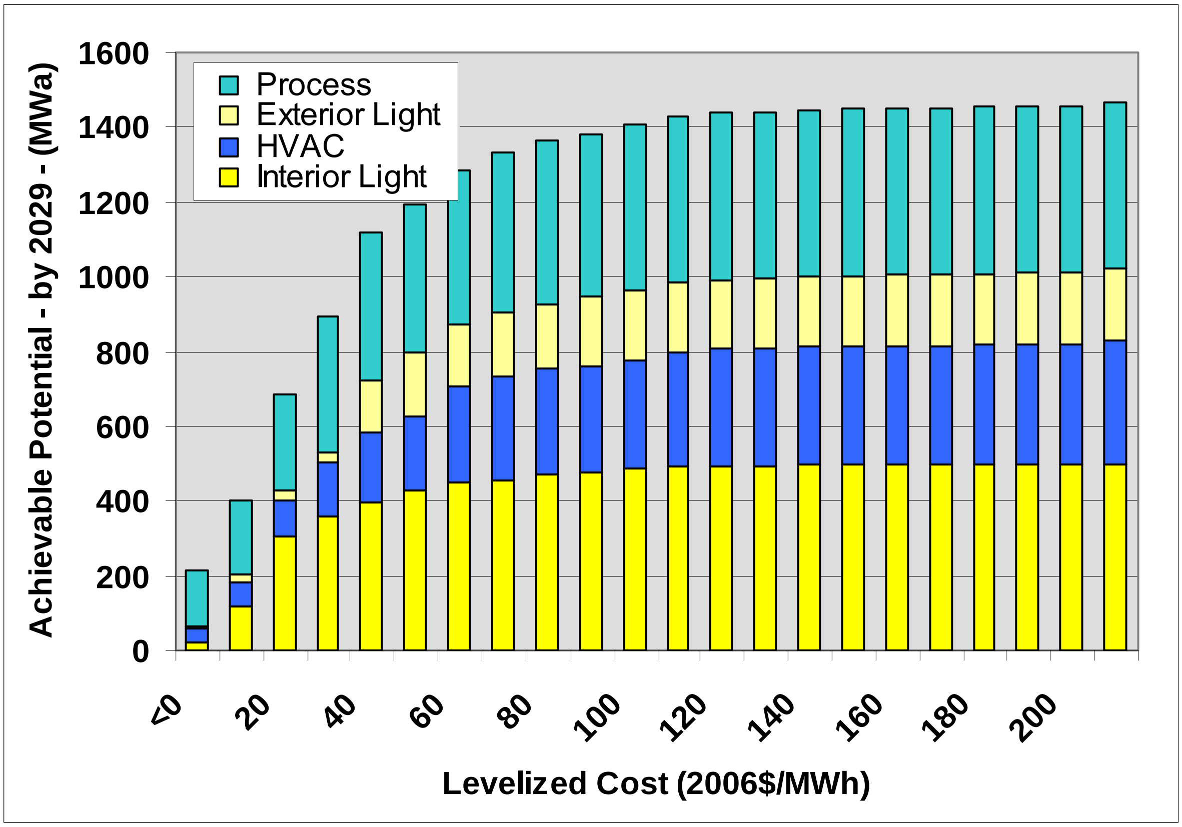

## *Commercial Sector*

Over 250 commercial-sector conservation measures were analyzed to develop the conservation potential for the Sixth Power Plan. The assessment includes lighting, heating, ventilation, and air conditioning (HVAC), and envelope measures in 19 separate building types such as offices, retail stores, warehouses, and schools. The assessment covers several classes of electricity-intensive process equipment used in buildings such as refrigerators, computers, and ventilation hoods. The assessment also covers infrastructure activities such as street and highway lighting, municipal sewage treatment, and municipal water supply.

The aggregate Sixth Power Plan conservation potential is similar to what was identified in the Fifth Power Plan, over 1,400 average megawatts. However, the allocations by measure and end use are different. For the Sixth Power Plan, there is more conservation potential in lighting and less in HVAC. Updated analysis has reduced conservation potential for several key HVAC measures that appeared in the Fifth Power Plan. However, new technology and design practices in lighting offer more potential than identified five years ago. In addition, the Sixth Power Plan identifies savings in areas not addressed in the Fifth Power Plan, including interior lighting controls, outdoor lighting, street and highway lighting, and computer server rooms. A summary of the supply curves by major end-use category is shown in Figure 4-4.

Lighting efficiency measures top the list of commercial conservation potential. Improvements in fluorescent lights, fixture efficiency, lighting controls, and improved lighting design contribute to the large and low-cost potential available for indoor lighting. The availability of new lights such as light-emitting diodes (LED) and improved emerging technologies such as ceramic metal halide lighting also contribute to the large lighting conservation potential. For example, streetlight, parking lot, and outdoor-area lighting can now take advantage of emerging LED technology in certain applications and reduce consumption 25 to 50 percent.

**Figure 4-4: Achievable Commercial Sector Savings Potential by 2029 (MWa) by End Use and Levelized Cost**



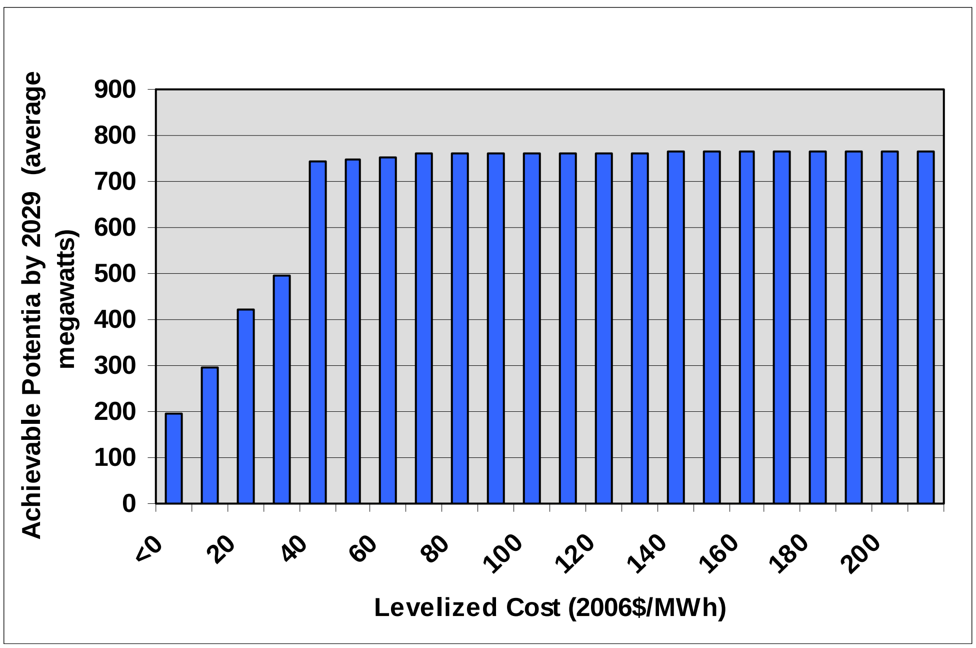

Nearly two-thirds of commercial-sector conservation potential identified in the Sixth Power Plan is lost-opportunity conservation. The increase in lost-opportunity conservation compared to the Fifth Power Plan is primarily due to a revised approach to modeling natural lighting stock turnover as a lost-opportunity conservation measure. Retrofit conservation is more expensive than lost-opportunity conservation, so overall costs of commercial conservation are somewhat lower than in the Fifth Power Plan. Two-thirds of the conservation potential costs less than $40 per megawatt-hour.

Much of the remaining conservation potential in the commercial sector requires a high degree of human intervention to achieve it. For example, careful choice of lamp, ballast, fixture, control, and layout are needed to install highly efficient lighting systems with excellent visual characteristics. In order to increase a building's efficiency beyond energy code requirements, improved building design practices are also needed. Relatively sophisticated HVAC engineering, smart control systems, and careful system operations are needed to harvest much of the low-cost HVAC energy savings.  In addition, the commercial sector is complex, with a variety of decision makers and market channels that can deliver high-efficiency equipment and well-trained designers and system operators.  Implementation strategies will need to take these factors into consideration in the design of efficiency programs and market interventions.

## *Industrial Sector*

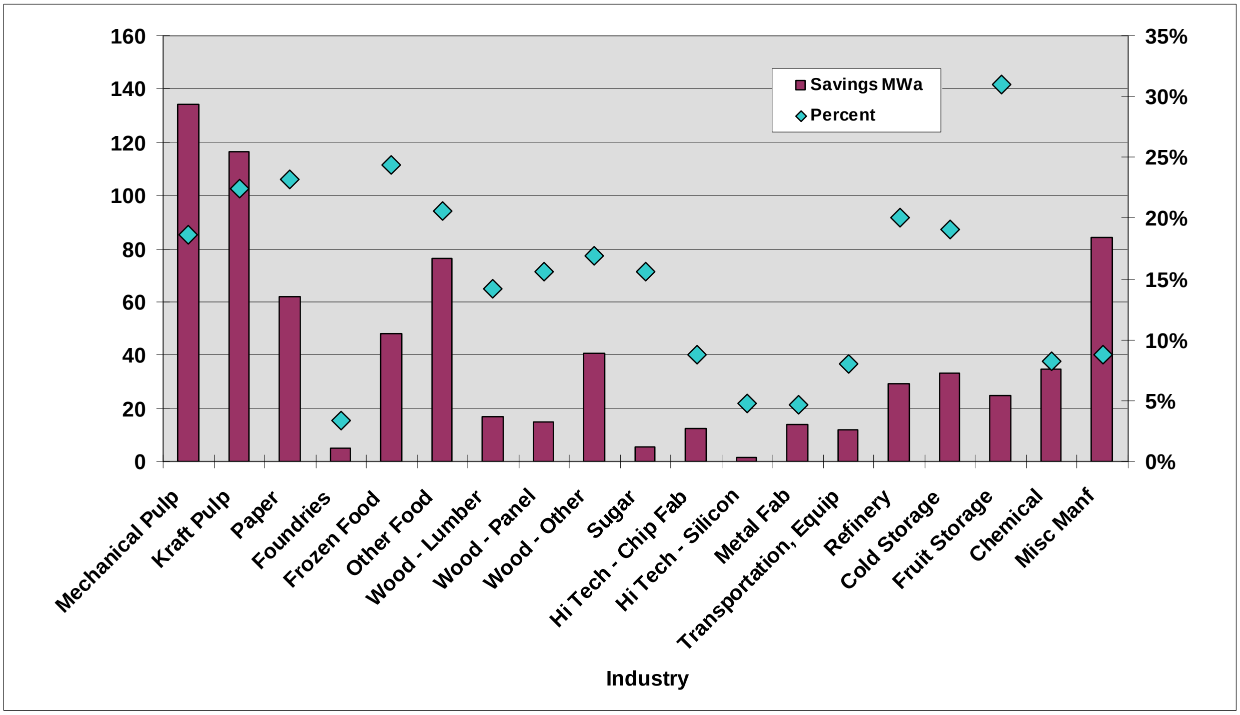
In the Fifth Power Plan, the industrial sector's potential was estimated to be 5 percent of 2025 sales, or 350 average megawatts.  For the Sixth Power Plan, the Council, with financial support from the Bonneville Power Administration, contracted an in-depth study of industrial-sector potential.  The industrial-sector conservation assessment evaluates 63 conservation measures and practices as they apply to 19 Northwest industries.  This research indicates potential savings of nearly 800 average megawatts by 2029.  Industrial savings are low cost.  Nearly all of the savings have levelized costs of less than $50 per megawatt-hour.  Almost half the savings costs $20 per megawatt-hour or less.  Figure 4-5 shows the savings achievable by 2029 in the industrial sector.

**Figure 4-5:  Achievable Industrial Sector Savings Potential by 2029 (MWa) by Levelized Cost**




Savings vary by industry both in average megawatts and as a fraction of industry electric use.  The pulp and paper industry has the largest overall potential for electric savings, over 300 average megawatts.  The food processing and food storage industries are the second largest with about 200 average megawatts of potential.  Savings as a fraction of electricity use range from 4 percent in foundries to nearly 25 percent.  Savings fractions are relatively high in the food processing and storage industries.  These facilities use large amounts of electricity for refrigeration, freezing, and controlled-atmosphere storage.  Significant efficiency improvements are available for those end-uses.  Sectorwide, potential savings are about 15 percent of industry electric use.  Figure 4-6 shows savings for the industry subsectors.

**Figure 4-6: Achievable Industrial Sector Savings Potential by Industry Subsector**




The 63 measures include an array of efficient equipment, improved operations and maintenance, demand reduction, system-sizing, system optimization, and improved business management practices. About one-quarter of the savings are specific to industry subsectors such as refiner plate improvements in mechanical pulping, or refrigeration improvements in frozen food processing. About three-quarters of the savings are applicable in pump, fan, compressed air, lighting, and material handling systems that occur across most industry subsectors. For these measures, the savings come primarily from more efficient equipment and system optimization. The assessment also found that effective business management practices can significantly increase equipment and operational savings.

Most industrial conservation measures are complex and require considerable design and careful implementation. Many measures and practices need continuing management and operational attention to ensure continued savings. The human factor to achieve these savings is also critical. Implementation strategies will need to take these factors into consideration in the design of efficiency programs and market interventions.

## *Utility Distribution Systems*

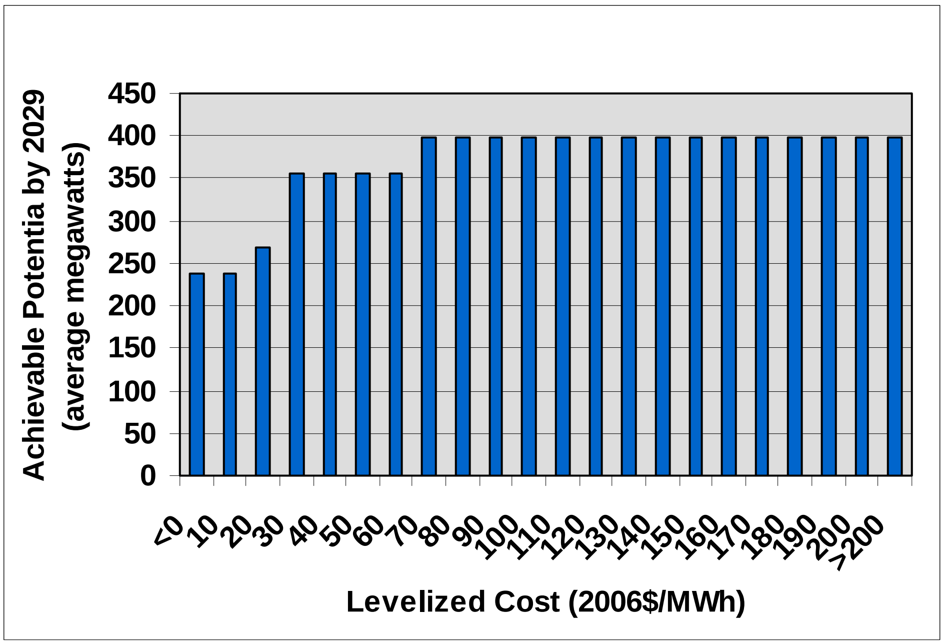
Potential savings from utility distribution systems come from a NEEA project to improve the efficiency of utility distribution systems. Based on the results of a pilot program in six utilities across the region, the study demonstrated that operating a utility distribution system in the lower portion of the acceptable voltage range (120-114 volts) saves energy, reduces demand, and reduces reactive power requirements without hurting the customer. As a package, these measures are referred to as conservation voltage reduction.

Reducing excess voltage saves energy for both the customer and the utility.  Savings could amount to about 400 average megawatts by 2029.  Levelized costs for distribution savings are low.  Figure 4-7 shows that two-thirds of potential savings cost less than $30 per megawatt-hour.

These savings stem from several types of changes to distribution equipment and operations. They include system improvements that reduce primary and secondary line losses, optimize reactive power management on substation feeders and transformers, and balance feeder voltage and current.  These improvements help limit the total voltage drop on the feeder from the substation to the customer's meter while staying within industry standards.  The NEEA study results indicate energy savings of 1 to 3 percent, a kilowatt peak-demand reduction of 2 to 5 percent, and a reactive power reduction of 5 to 10 percent.  Approximately 10 to 40 percent of the savings are on the utility side of the meter.

There are a number of barriers, however, to implementing voltage regulation.  These include regulatory disincentives, the need for outside assistance, lack of verification protocols to prove savings, and organizational challenges within utilities.  The Council believes most of these barriers can be addressed and that near-term savings are achievable.

**Figure 4-7:  Achievable Utility Distribution System Efficiency Savings Potential (MWa) by Levelized Cost**



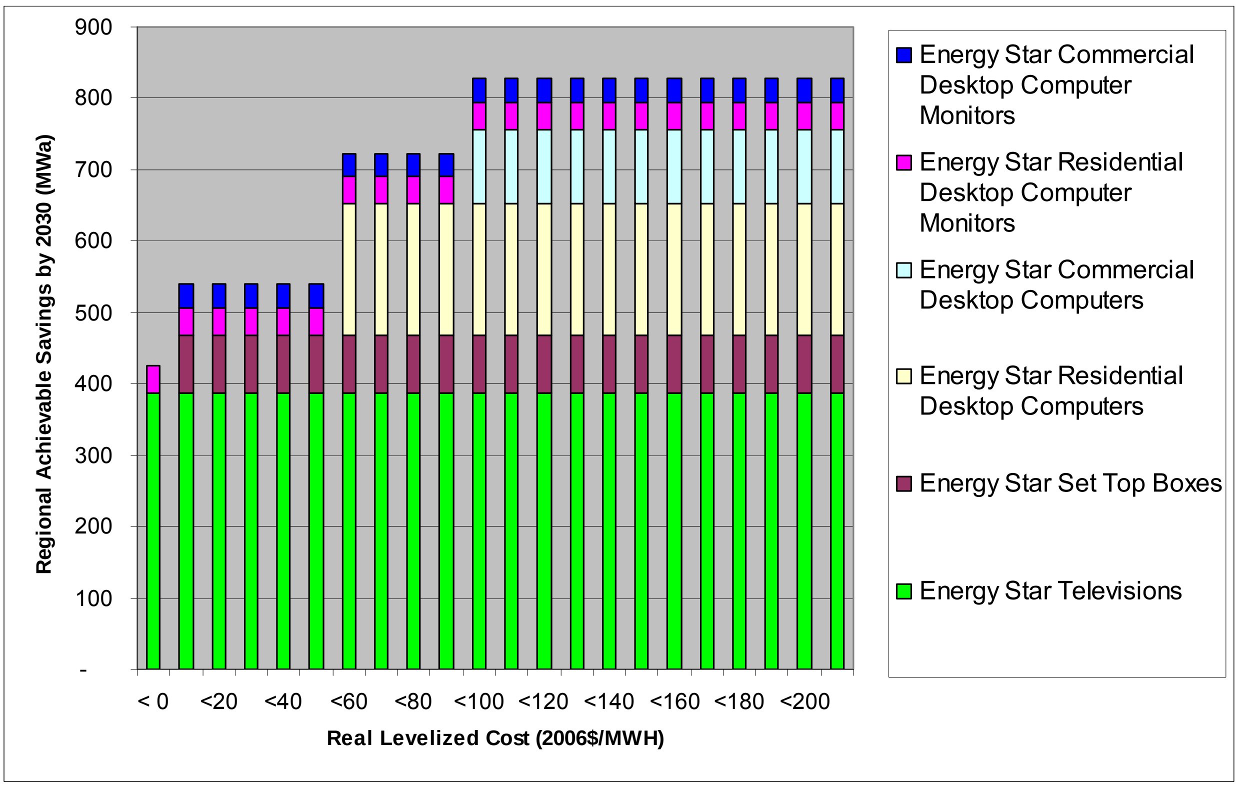

## *Consumer Electronics*

Consumer electronics, such as televisions, set top boxes (digital video recorders, satellite and cable television tuners, digital television converters), computers and monitors, is one of the fastest growing segments of electricity use in the region.  This increase is driven by both the growth of these devices and the additional features that increase energy use.  For example, in 2007, the number of televisions in the average home exceeded (2.73) the average number of occupants (2.6) for the very first time.  If current trends continue, it is anticipated that by 2015 over 90 percent of the televisions sold will have screen sizes exceeding 32 inches.  Energy consumption increases with screen size.

There are a significant number of options available to increase the efficiency of these devices. Some of these options simply involve better power management of this equipment when it is not in use. Other options, especially for televisions and computer monitors, will involve the transition from plasma and liquid crystal display (LCD) screens to LED and OLED screens. LED televisions already on the market consume 40 percent less than comparably sized models using LCD technology, while also producing a higher quality picture.

Figure 4-8 shows the achievable potential from improvements in consumer electronics totaling 825 average megawatts by the year 2029.  Most of the savings potential, over 700 average megawatts, is available at a levelized life-cycle cost of less than $60 per megawatt-hour. Moreover, as can be seen in this figure, over half of these savings are from improving the efficiency of televisions.

**Figure 4-8:  Consumer Electronics Savings Potential by Levelized Cost**




# ESTIMATING THE AVAILABILITY OF CONSERVATION OVER TIME

The Council establishes constraints on the availability of the conservation in these supply curves, which are used in the Council's portfolio modeling process.  The portfolio model selects the quantity and timing of both generating and conservation resource development.  Because significant quantities of conservation are available at costs below most forecasts of future market prices, the portfolio model would deploy all of the low-cost conservation immediately, unless the pace of conservation deployment is constrained to achievable rates.

Therefore, the Council establishes two types of constraints on the amount of conservation available for development.  The first constraint is the maximum achievable potential over the 20-year period covered by the Council's power plan.  The Sixth Power Plan assumes that no more than 85 percent of the technically feasible and cost-effective savings can be achieved.[5]

The second constraint is the rate of annual deployment, which represents the upper limit of annual conservation resource development based on implementation capacity.  Such constraints include the relative ease or difficulty of market penetration, regional experience with the measures, likely implementation strategies and market delivery channels, availability of qualified installers and equipment, the number of units that must be addressed, the potential for adoption by building code or appliance standards, and other factors.

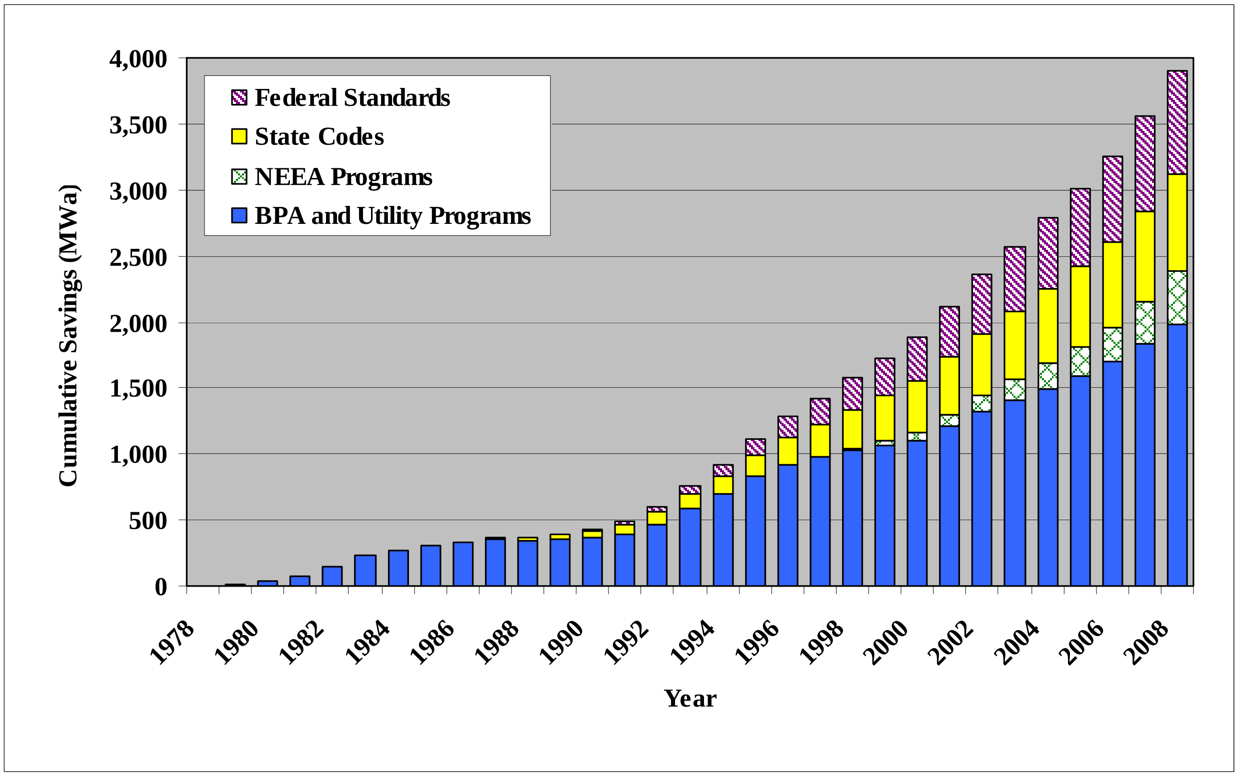
The upper limit of annual conservation resource development reflects the Council's estimate of the maximum that is realistically achievable.  Since there is no perfect way to know this limit, the Council used several approaches to develop estimates of annual achievable conservation limits.  First, the Council reviewed historic regional conservation achievements and considered total achievements, as well as year-to-year changes.  The Council also considered future annual pace constraints for the mix of conservation measures and practices on a measure-by-measure basis.  As in the Fifth Power Plan, annual deployment limits were developed separately for lost-opportunity and non-lost opportunity conservation.

## *The Pace of Historic Conservation Achievements*

Over the last 30 years, the region acquired nearly 4000 average megawatts in energy savings. Annual rates of conservation acquisition vary considerably.  Figure 4-9 shows the Council's estimate of cumulative regional conservation achievements since 1978.  Figure 4-10 shows annual program conservation acquisitions since 1991, excluding savings from codes or standards.

[5] In 2007, Council staff compared the region's historical achievements against this 85 percent planning assumption. The results of this review supported continued use of the estimate, or perhaps even the adoption a higher one in the Sixth Power Plan.  The paper is on the Council website at http://www.nwcouncil.org/library/2007/2007-13.htm.

**Figure 4-9:  Cumulative Regional Conservation Achievement 1978-2008 (MWa)**

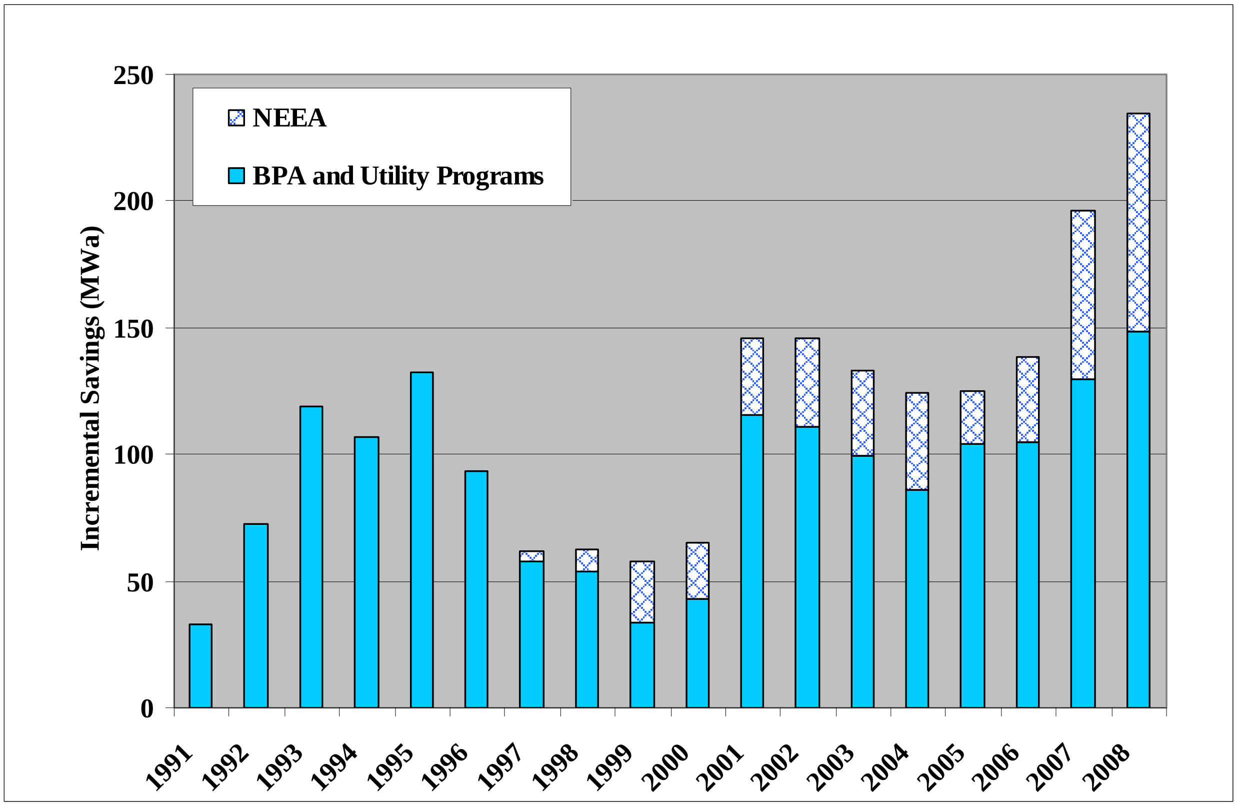



Over this 30-year period, the mix of measures has changed significantly.  Early years were dominated by residential programs.  In the 1990s, commercial and industrial programs were added.  Starting in the mid-1980s, state building codes began to capture significant savings.  About five years later, federal appliance standards also added savings. Fluctuations in annual achievements, shown in figure 4-10, were caused by many factors.  For example, response to the energy crisis of 2000-2001 brought on a surge in conservation achievement, more than doubling the annual conservation acquisition rate between 2000 and 2001.  And the threat of retail competition in the late-1990s was a key factor in the drop in utility-sponsored conservation activity in that period.

Over the last 20 years, state building codes and federal and state appliance standards have accounted for over one-third of all savings.  Savings from codes and standards accumulate slowly over time.  They do not result in large annual jumps in acquisition because they apply only to new buildings or replacement equipment.  Furthermore, code and standard savings would not have been possible without utility programs that demonstrated the savings could be achieved.

Bonneville, utility, and Energy Trust of Oregon conservation programs, Oregon tax credits, NEEA market transformation, and other programs have delivered the bulk of the savings over time.  Annually, these program savings ranged from lows of about 60 average megawatts per year to 235 average megawatts per year in 2008, the most recent year reported.  Since 2001, regional programs, without codes and standards, delivered about 150 average megawatts per year on average.  Annual rates of program acquisition since 2001 have been between 115 to 235 average megawatts per year, which is consistently higher than long-term annual rates for program delivery.

**Figure 4-10:  Annual Conservation Achievements from Programs 1991-2008 (MWa)**




There were three historic periods when program savings showed fast acceleration.  The 1991-1993 period, the 2000-2001 period, and more recently the 2005-2008 period.  During these periods, regional program activities increased by over 40 average megawatts year-to-year, not counting codes and standards.

The Regional Technical Forum's survey of 2008 conservation achievements indicate that regional program savings alone are 235 average megawatts.  Consequently, recent savings exceed the targets established in the Fifth Power Plan by a wide margin.  The Fifth Power Plan's called for a cumulative 700 average megawatts between 2005 and 2009 through all mechanisms.  If conservation acquisition continues to accelerate, it appears that the region will capture over 900 average megawatts through just Bonneville and utility programs alone, exceeding the targets by about 30 percent.

## *Estimating the Annual Availability of Future Conservation Development*

To gauge the pace for future conservation development, the Council estimated how fast the region could develop the remaining conservation measures identified in the Sixth Power Plan.  To do this, the Council estimated year-by-year acquisition rates for each of the measure bundles identified in the conservation assessment.

The results of this year-by-year and measure-by-measure analysis are only one indication of how fast the region could deploy conservation.  Clearly, deployment efforts could shift from the assumptions made in this analysis.  Acquisitions of specific measure bundles could accelerate or slow down. Nevertheless, the annual limits give some idea of how fast conservation could be brought on line with multi-year acquisition strategies, ramp-up rates for new programs, and a more or less steady pace in the long run.

There are about 200 measure bundles that were considered in this analysis. Details of these assumptions are in the conservation appendices.

In estimating the level of conservation that could be achieved in the future, the Council considered several factors. For all measure bundles, the Council assumed multi-year acquisition plans. Depending on the measure, getting to full penetration could take as little as five years or as long as 20 years. The Council also considered retrofit and lost-opportunity measures differently. Table 4-2 shows the results of the year-by-year, measure-by-measure approach used to estimate the pace of conservation development. Energy savings represent total potential, regardless of cost.

**Table 4-2: Achievable Pace of Future Conservation Development Approximate Savings Potential by Time Period (MWa)**

| | Lost Opp | Non-Lost Opp | Total |
|---|---|---|---|
| **20-Yr Cumulative** | 3,400 | 3,300 | 6,700 |
| **5-Yr Cumulative (2010-2014)** | 390 | 990 | 1,380 |
| **5-Yr Annual Ramp Up** | 35 to 120 | 170 to 220 | 200 to 340 |
| **5-Yr Annual Average** | 80 | 200 | 280 |

Most retrofit measures were paced at annual acquisition rates that require 15 to 20 years to accomplish. However, it was assumed that some retrofit measure bundles with simple, proven delivery mechanisms, like low-flow showerheads, could be accomplished in as little as five years. Annual acquisition rates for new retrofit initiatives or measures that have not been targeted previously, such as distribution-efficiency, were estimated to start slowly and accelerate to a steady annual pace. As a result, these new retrofit measures account for only about 20 percent of this five-year total because low penetration rates were assumed in the early years.

Measures that are already targeted by current programs were assumed to accelerate from a higher starting point. Across all retrofit opportunities the available potential increases from about 170 average megawatts in 2010 to 220 average megawatts per year by 2014. In aggregate, this results in nearly 1,000 average megawatts of retrofit conservation viewed as available potential in the first five years. This is about one-third of the Council's 3,300 average megawatt retrofit supply curve. At an average pace of only 160 average megawatts per year, it would take about 15 years to acquire the 2,400 average megawatts of retrofit potential that has an average cost less than $30 per megawatt-hour.

For lost-opportunity measures, it was assumed that the maximum achievable pace of acquisition never exceeds 85 percent of the annual units available. The bulk of lost-opportunity measures were assumed to take five to 15 years to reach this 85 percent annual penetration rate. Lower (0.5 to 15 percent) first-year penetration rates were assumed for lost-opportunity resources new to regional programs because acquiring these measures is slower given the relative difficulty of deploying them. For lost-opportunity measures where the region has experience and for ongoing programs, such as residential appliances, first-year penetration rates were set relatively higher and with a faster ramp-up rate over time.

The annual acquisition for all lost-opportunity conservation measures start at a penetration rate of about 15 percent, increases to around 80 percent in 12 years, and reaches the assumed maximum 85 percent in 15 years. In aggregate, this results in about 390 average megawatts of available savings potential from lost-opportunity conservation resources over the first five years covered by the Sixth Power Plan. About one-third of these savings are from new measures in the plan. The maximum annual pace for lost-opportunity conservation accelerates from 35 average megawatts per year in 2010 to 120 average megawatts per year five years out, and to 200 average megawatts per year 10 years out.

In combination, this analysis indicates that nearly 1,400 average megawatts of lost-opportunity and retrofit conservation are available over the 2010-2014 action plan period. Maximum annual average acquisitions increase from 200 average megawatts per year in 2010 to almost 350 average megawatts per year within five years. The estimates of acquisition rates produced by this analysis are used to estimate annual pacing constraints in the portfolio model. Along with information on historic performance, and utility and NEEA plans, these estimates also help inform the Council's near-term conservation targets for the region.

## *Testing Annual Pace Constraints for the Portfolio Model*

Because the maximum annual pace of conservation achievement is to a major extent a function of the level of resources dedicated to acquiring conservation, the Council performed sensitivity tests to estimate the impact of achieving conservation faster and slower than assumed in the base case. For a high-case sensitivity, the Council assumed a 10-year period to develop the first 2,400 average megawatts of retrofit conservation, instead of the 15 years assumed in the base case. This means an average pace of 220 average megawatts per year for retrofit conservation and no increase in the ramp-up for lost-opportunity conservation. For the low-case sensitivity, the Council assumed that no more than 100 average megawatts per year of retrofit conservation could be developed, and the lost-opportunity ramp-up would take 20 years to reach 85 percent annual penetration, instead of 15 years in the base case. At the high-case sensitivity, 1,500 average megawatts could be developed over the first five years of the action plan. For the low-case only about 800 average megawatts would be developed in the five years of the action plan. The results of these sensitivity tests are discussed in Chapter 10.

Figures 4-11 and 4-12 show the maximum annual conservation rates used as the base case assumptions and the high- and low-conservation sensitivity cases.

**Figure 4-11: Maximum Conservation Acquisition Rates Tested for Non-Lost-Opportunity Conservation**

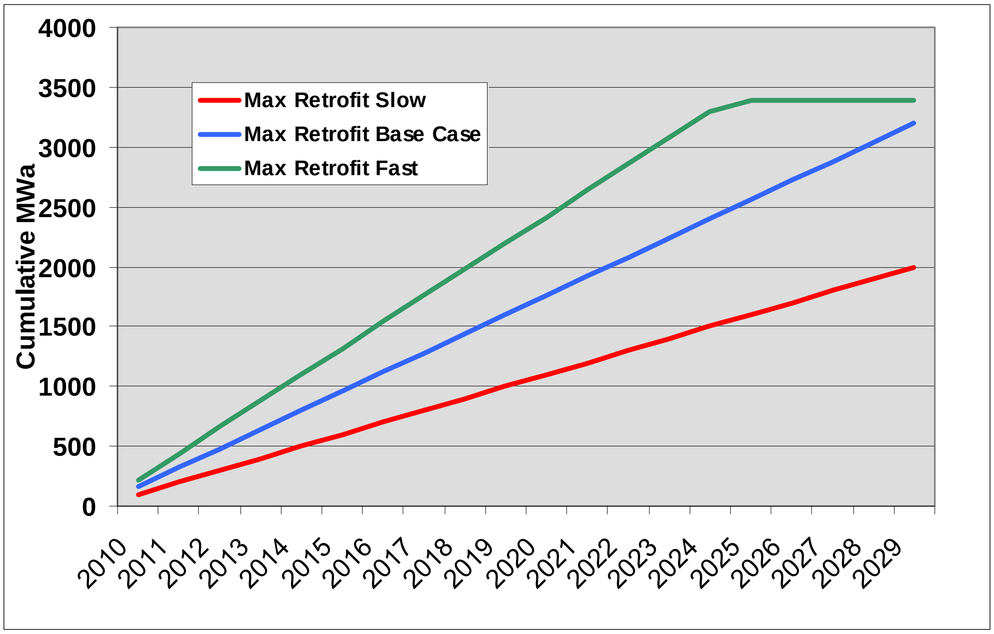
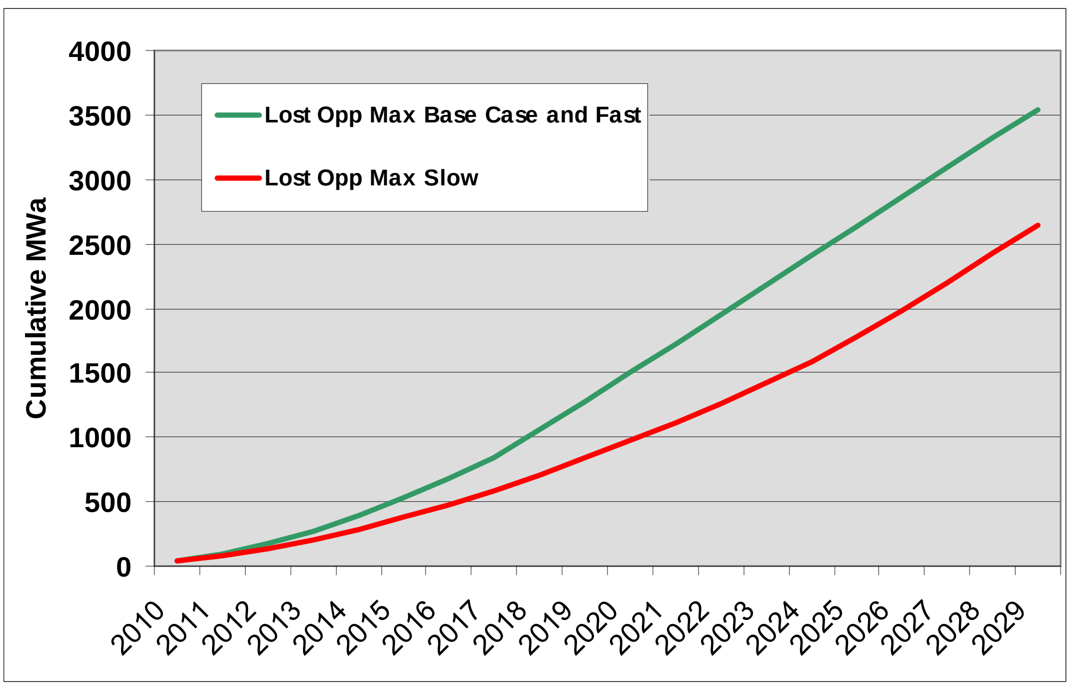



**Figure 4-12: Maximum Conservation Acquisition Rates Tested for Lost-Opportunity Conservation**




# COUNCIL METHODOLOGY

The Northwest Power Act establishes three criteria for resources included in the Council's power plans:  resources must be 1) reliable, 2) available within the time they are needed, and 3) available at an estimated incremental system cost no greater than that of the least-cost similarly reliable and available alternative.[6] Beginning with its first power plan in 1983, the Council interpreted these requirements to mean that conservation resources included in the plans must be:

- Technically feasible (reliable)
- Economically feasible (lower cost)
- Achievable (available)

Development of the conservation potential assessment takes into account an assessment of what has been accomplished and what remains to be done. The first step in the Council's methodology is to identify all of the technically feasible potential conservation savings in the region. This involves reviewing a wide array of commercially available technologies and practices for which there is documented evidence of electricity savings. Over 300 specific conservation measures were evaluated in developing the conservation potential for the Sixth Power Plan. This step also involves determining the number of potential applications in the region for each of these technologies or practices. For example, electricity savings from high-efficiency water heaters are only "technically feasible" in homes that have, or are forecast to have, electric water heaters. Similarly, increasing attic insulation in homes can only produce electricity savings in electrically heated homes that do not already have fully insulated attics. At the conclusion of this step, the Council's load forecast and conservation assessment are adjusted and calibrated to reflect changes in baseline conditions since the adoption of the Fifth Power Plan.

The Sixth Power Plan's assessment reflects program accomplishments, changes in codes and standards, technological evolution, and the overall adoption of more energy-efficient equipment and practices since the Fifth Power Plan was adopted in 2004. There are five significant changes:

1. Accounting for utility conservation program savings since 2004.
2. Adjusting both the load forecast and the conservation assessment to reflect improvements in federal and state standards for lighting and appliances.
3. Adding potential savings from utility distribution efficiency improvements and consumer electronics.
4. Increasing potential industrial savings from a more in-depth analysis.
5. Adding potential savings from new technologies and practices that have matured to commercial readiness since the Fifth Power Plan's estimates were developed.

[6] See Section 839a(4)(A)(i) and (ii) of the Northwest Power Planning and Conservation Act. (http://www.nwcouncil.org/library/poweract/3_definitions.htm or http://www.nwcouncil.org/LIBRARY/poweract/poweract.pdf)

## *Implications for the State of Washington's I-937 Requirements*

Initiative 937 (I-937) in the state of Washington, approved by the voters in 2006, obligates 17 utilities that serve 88 percent of the retail load in that state to "pursue all available conservation that is cost-effective, reliable, and feasible." By January 2010, each utility the law applies to must develop a conservation plan that identifies its "achievable cost-effective potential" for the next 10 years, "using methodologies consistent with those used by the Pacific Northwest electric power and conservation planning council in its most recently published regional power plan." Every succeeding two years, the utility must review and update its assessment of conservation potential for the subsequent 10-year period.

I-937 is a matter of state law, and does not alter or obligate the Council in its conservation and power planning under the Northwest Power Act. Similarly, the Council has no authority to interpret, apply or implement I-937 for the utilities and regulators in the state of Washington. But because the two mandates intersect--the state's utilities are to engage in conservation planning "using methodologies consistent with" the conservation planning methodology used by the Council--it is helpful to understand some of the issues raised by the two planning processes.

There is some misunderstanding that I-937 requires Washington utilities to meet some pro-rata share of the conservation targets in the power plan. In fact, I-937 does not require the state's utilities to adopt or meet conservation targets set forth in the Council's plan, nor does the plan identify any particular utility's "share" of regional conservation targets. However, I-937 does require utilities to develop their own plan using methods "consistent with" the methodology used in the Council's plan, leaving it to the utilities' discretion to adapt the planning methods to their particular circumstances. To assist Washington consumer-owned utilities in this effort, the Washington Department of Commerce (Commerce),[7] with the assistance of the Council staff and others, adopted rules in 2008 outlining the methodology the Council uses in its conservation planning. Although one sub-section of these rules allows utilities to adopt a share of the Council's regional targets, this is an option, not a requirement. The Washington Utilities and Transportation Commission (UTC) also adopted rules to guide the investor-owned utilities. These rules are not as prescriptive and, per the law, integrate I-937 requirements into ongoing regulatory practice.

Concern has also been expressed about the fact that utilities will need to produce their first I-937 conservation plans at the precise moment the Council is making the transition from the Fifth to the Sixth Regional Power Plan. On this issue we should point out that the Council's methodology is essentially the same in the Sixth and Fifth Power Plans and is clearly described in Chapter 4 of this draft. The conservation targets are higher in the Sixth Power Plan because of changes in prices, technology, and other factors, not because of a change in methodology.

The Council's plan describes the analytical methods used to identify cost-effective achievable conservation and provides a menu of possible cost-effective measures for utilities to consider. Neither I-937 nor the Council's plan requires utilities to choose any of the plan's particular measures in particular amounts. The utilities may make that judgment based on their own loads (composition, amounts, and growth rates) and their own determination of avoided cost and the measures available to them.

[7] Formerly the Washington Department of Community Trade and Economic Development (CTED)

There are two issues—“ramping” and “penetration rates”—that may present potential inconsistencies between I-937 and the Council’s conservation methodology. An important element in the Council’s methodology is the principle that it takes time to develop certain conservation measures to their full potential, while other measures are available right away. Consequently, conservation potential ramps up and on occasion ramps down. The Council uses its ramp rate assumptions, along with other information and the results of its regional portfolio model, to establish five-year cumulative conservation targets for the region. The end result is that achievable conservation potential under the Council’s planning assumptions will not be evenly available across each year in the period. I-937 separately instructs the utilities to identify not just cost-effective potential over the 10-year life of the utility’s conservation plan for I-937, but also to identity and meet biennial conservation acquisition targets that must be “no lower than the qualifying utility’s pro rata share for that two-year period of its cost-effective potential for the subsequent 10-year period.” Having to acquire 20 percent of any 10-year target in any two-year period under I-937 may produce different two-year targets than would result using ramp rates consistent with the Council’s methodology. Commerce rules do not address what is meant by “pro-rata share,” but the UTC rules state that “‘pro rata’ means the calculation used to establish a minimum level for a conservation target based on a utility’s projected ten year conservation potential.” Because the provisions of I-937 are a matter of state law, this issue is not one that the Council can resolve in its plan.

A related, but distinct, issue concerns conservation measure “penetration” rates. Part of the Council's methodology is to estimate the extent of total penetration of a conservation measure in the area of study over the total period analyzed. The Commerce rules address this issue, calling on utility conservation plans to “[i]nclude estimates of the achievable customer conservation penetration rates for retrofit measures and for lost-opportunity (long-lived) measures.” Because, as with “ramp rates,” I-937 requires a ten-year plan while the Council produces a twenty-year plan, the rules needed to harmonize the potential difference between penetration rates over ten years versus penetration rates over twenty years. As a result, the Commerce rules then go on to describe the Council’s 20-year and 10-year penetration rates (from the Fifth Plan, although they do not differ in the Sixth Plan), “for use when a utility assesses its” conservation potential. The UTC rules are silent on penetration rates.

One final point to consider is the treatment of savings achieved through building codes and other standards. The Council’s conservation methodology calculates the conservation potential for measures that might, at some point, be covered by building codes or energy codes, and then assumes that the savings will be accomplished over time by either utility programs or codes. If codes are adopted that ensure the capture of the potential savings, then those savings are “counted” against the regional target. The rules adopted by Commerce for I-937 do not appear to be inconsistent with this approach while the UTC rules do not address this issue specifically.