APPENDIX F: EFFECT OF FEDERAL APPLIANCE EFFICIENCY STANDARDS

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List of Figures and Tables

This appendix describes the steps used to estimate the impact of federal appliance standards on electricity demand in the Pacific Northwest for 2015-2035. The federal appliance standards reduce the amount of electricity needed in the future, but these reductions are not well-reflected in the econometric models used by many of the region's forecasters. This appendix is intended to help utility forecasters, energy-efficiency planners, and others in the region concerned with accounting for energy-efficiency achievements.

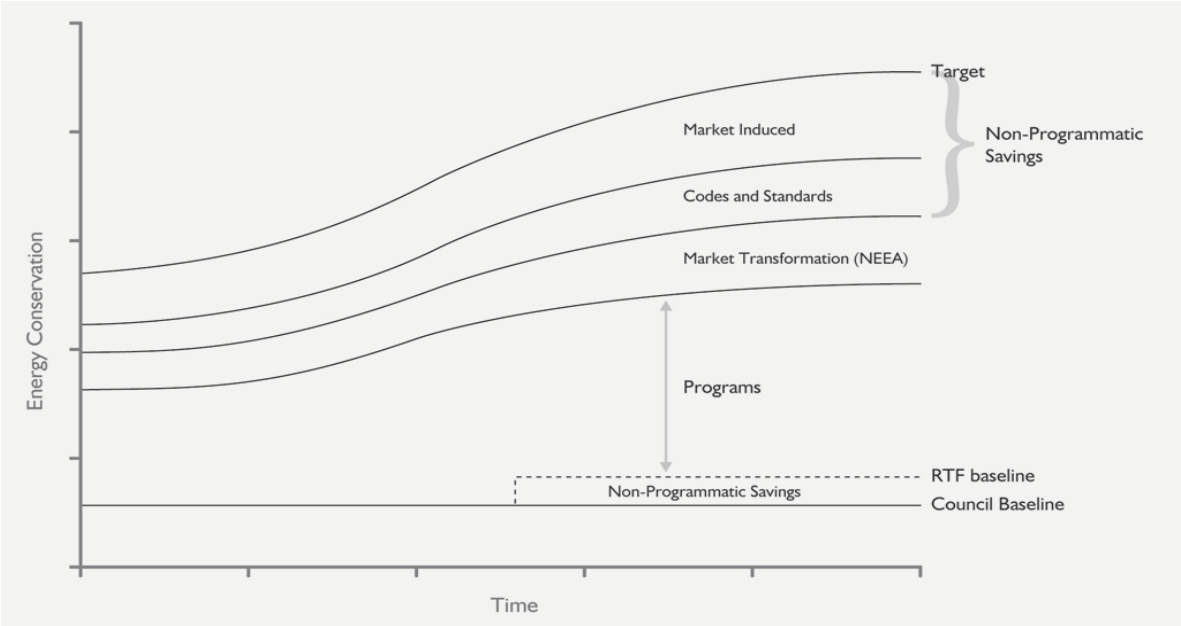
Typically, the Council's forecast of future loads starts with an estimate of current efficiency levels of enduse devices. For example, current loads for the refrigeration enduse in the residential sector depend on the current level of energy consumption of the refrigerators. The future forecast for refrigeration loads is dependent on the consumption of future refrigerators. Future efficiency depends on the relationship between cost of the refrigerators, efficiency of refrigerators, and consumer preferences. Also impacting future consumption are the standards enacted, at federal or state level, to remove less efficient refrigerator models from the market. A combination of push and pull effects influence consumers' choices.

Utility efficiency programs build on the existing baseline for each measure and incentivize consumer selections toward higher efficiency devices (Pull Effect). Federal and state standards, on the other hand, push for increasing the minimum efficiency of the devices. Combination of the two strategies pushes the low efficiency measures out and helps pull-in higher efficiency measures.

Implementation of standards helps reduce future loads more economically and more equitably than conservation programs. Typically, standards are applicable to 100 percent of consumer base, whereas the conservation programs will only eventually reach an upper limit of 85 percent of consumer base. The standards are also more equitable in that they do not require ratepayer funding for incentivizing conservation measures.

Figure F - 1 shows the multiple mechanisms used to achieve energy conservation. Starting with a baseline of energy consumption at end use and technology level, the program activities push energy conservation to a higher level. Market transformation activities then further enhance the energy conservation initiatives on an upstream basis. The codes and standards play the role of keeping the less efficiency technologies out of the consumer's hand. The combination of programmatic initiatives and standards also cause market induced (not incentivized) efficiency that consumers partake on their own. The result is a cooperative mechanism through for which codes and standards truncate the less efficient options from a given market, while the programmatic initiatives push the more efficient (above baseline) into the market.

Figure F - 1: Programmatic and Non-programmatic Factors Impacting Energy Savings



SUMMARY OF RESULTS

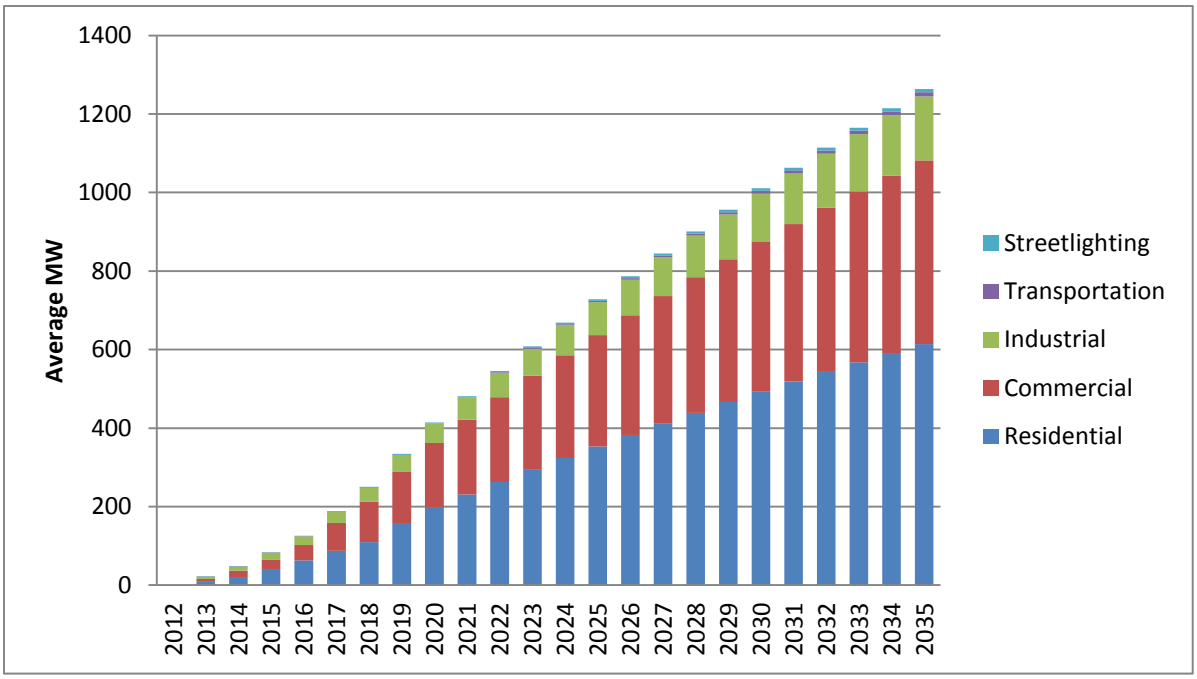
The Council estimates that the federal efficiency standards on appliances used in residential, commercial, and industrial sectors, adopted since the preparation of its Sixth Power Plan, will reduce system loads in the Pacific Northwest by more than 1,264 average megawatts between 2012 and 2035. The standards are estimated to reduce winter peak loads by over 2,100 megawatts by 2035.

Table F - 1 and Figure F - 2 present the sector-level and sector and end-use-level load reductions for the starting and ending period of analysis.

Table F - 1: Direct Impact of Federal Standards in Northwest Loads (aMW)

	2015	**2035**
Residential	41	614
Commercial	25	467
Industrial	17	163
Transportation	0	11
Street lighting	1	8
Total Direct Impact	83	1,264

Figure F - 2: Year by Year Direct Impact of Federal Standards



INTRODUCTION

The U.S. federal government's policies on energy efficiency have developed over decades, beginning with the Energy Policy and Conservation Act of 1975, which called for energy efficiency targets, followed by the National Appliance Energy Conservation Act of 1987, which established minimum efficiency standards for a number of household appliances. The Energy Policy Act of 1992, and the Energy Independence and Security Act of 2007 (EISA) expanded the equipment subject to efficiency standards.

The standard-setting process followed by the U.S. Department of Energy requires that standards be reviewed at least once every six years from their effective date, and that they be set at levels to achieve the maximum improvement in energy efficiency that is "technically feasible and economically justified." The Energy Policy and Conservation Act directs the U.S. Department of Energy to consider seven factors in its analysis when determining whether a potential standard is economically justified:

1. Economic impact on consumers and manufacturers
2. Lifetime operating cost savings compared to increased product cost
3. Total projected energy savings over at least one lifetime of the product
4. Impact on product utility or performance
5. Impact of any lessening of competition
6. Need for national energy efficiency
7. Other factors the Secretary considers relevant

Of these factors, maintaining consumer choice and quality of service has often been an issue. A study[1] by the American Council for an Energy-Efficient Economy and the Appliance Standards Awareness Project analyzed the effect of federal efficiency standards on 10 residential, commercial, and lighting products. The study found that performance was maintained and in many cases improved, and that manufacturers offered new features in the products. Price declined or stayed the same in five out of the nine products for which data were available, and the price increases of the other four products were more than offset by the savings in electricity bills.

Using the Council's Seventh Power Plan's medium forecast of households, square footage of commercial building stock, load growth in industrial, street lighting, transportation sectors, and appliance stocks, the federal appliance standards' impact on the 2015 appliance stock is estimated to reduce electricity demand by 83 aMW. This analysis has incorporated updated appliance saturations based on the Residential Building Stock Assessment 2012/2013, Commercial Building Stock Assessment 2013/2014, and updated regional economic and demographic forecasts. A majority of these standards savings are from the residential sector.

Sector level impacts by 2015 and 2035 are shown in Table F - 2. Residential sector impacts by end use are shown in Table F - 3. Commercial sector impacts by end use are shown in Table F - 4. Industrial and other sector impacts by end use are shown in Table F - 5.

Table F - 2: Direct Impact of Federal Standards in All Sectors (aMW)

Sector	2015	2035
Residential	41	614
Commercial	25	467
Industrial	17	163
Transportation	0	11
Street lighting	1	8
Total Direct Impact	83	1,264

[1] Joanna Mauer, Andrew DeLaski, Steven Nadel, Anthony Fryer, and Rachel Young, "Better Appliances: An Analysis of Performance, Features, and Price as Efficiency Has Improved," ACEEE Research Report # 132, May 2013. http://www.aceee.org/research-report/a132

Table F - 3: Year by Year Direct Impact of Federal Standards in Residential sector (aMW)

End Use	2015	2035
Space Heating	5	353
Water Heating Under 55	10	84
Lighting	7	33
Refrigeration	2	14
Freezer	2	13
Clothes Washer	0.1	1
Clothes Dryer	10	49
Dishwasher	1	6
Cooking	1	31
Air Conditioning	1	2
Other Non-Substitutables	3	26
Water Heating Over 55	0.5	2
Total	41	614

Table F - 4: Year by Year Direct Impact of Federal Standards in Commercial Sector (aMW)

End Use	2015	2035
Space Heating	1	13
Water Heating	2	20
Other Substitutables	0	15
Refrigeration	3	185
Lighting	11	110
Air Conditioning	5	62
Other Non-Substitutables	2	62
Total	25	467

Table F - 5: Year by Year Direct Impact of Federal Standards in Industrial and other Sector (aMW)

	2015	2035
Process Heat	2	18
Motors	7	70
Other Subs	2	24
Miscellaneous	5	52
Total Industrial	17	163
Total Transportation sector*	0.1	11
Total Street lighting and pumping **	1	8

*Includes Electric vehicles and public transportation, **- includes fresh water and waste water treatment facilities.

Federal efficiency standards also reduce peak loads. Each appliance makes its own unique contribution to peak load, so that efficiency improvements to those appliances have unique impacts on peak loads. The Council's analysis used data from the End-Use Load and Consumption Assessment Program (ELCAP), conducted by Bonneville from 1986 to 1989 as well as the recent Residential Building Stock Assessment (RBSA) metering study conducted in 2012-2014, to estimate the effects of efficiency improvements on power system peak loads.

One of the findings from the recent RBSA study was that the many enduses are less "peaky" than earlier findings from ELCAP.

By 2035, winter peak loads are estimated to be about 10 percent lower as a result of standards. The baseline peak is estimated to be about 34,000 megawatts; appliance standards lower this peak load to about 31,000 megawatts.

METHODOLOGY

The Council's Seventh Plan used a frozen efficiency forecast as the basis for evaluating resource needs in the future. It assumes that baseline energy consumptions of specified equipment and structures remain at fixed levels over the forecast period. These fixed levels are commonly set at current practice at the time the forecast is made. The Council has used the frozen efficiency concept in its forecasting since its First Power Plan in 1983, avoiding the possibility of double counting efficiency improvements.[2]

The frozen efficiency forecast, in addition to reflecting current practice, also reflects future improvements in efficiencies from known standards. For example, the federal lighting standards from EISA 2007, which take effect from 2013 to 2020, were included in the plan's frozen efficiency forecast.

Improvement in Distribution Transformers

One of the standards that impact all end-uses is for distribution transformers. The Council has used the analysis conducted for EIA/AEO 2014 by Navigant Consulting to estimate the potential reduction in loads due to more efficient distribution transformers. The analysis includes dry-type low voltage distribution transformers, medium voltage dry-type distribution transformers for industrial processes, and liquid filled distribution (LFD) transformers. LFD transformers are all medium voltage with well over 90 percent of shipments serving utilities and the remainder serving industrial processes. To simulate impact of these standards, the Council increased the efficiency of distribution transformers by about 2 percent cumulatively during 2015 and 2035. The average transmission and distribution (T&D) losses during 1995-2013 is estimated at about 10.5 percent. Overtime, the Council has assumed that the efficiency of distribution system to improve from this standard, reducing the T&D losses to closer to 8.6 percent. For more details on this standard see pages the report "analysis and representation of Miscellaneous Electric Loads in NEMS" December 2013.

Dynamic Standards

DOE is required by law to renew and reevaluate existing and new standards every sixth year. The Council has attempted to model the impact of such renewal of standards in a scenario called Dynamic Standards. The Council's analysis has shown that impact of federal standards would keep the loads flat if the existing standards are renewed and improved by 10 percent

[2] This could occur if a conventional forecast included efficiency improvements (lowering resource requirements) and planners also counted those improvements as part of the energy efficiency potential (estimated based on current practice) available to meet future loads.

every six years during 2015-2035. Table F - 6 below shows the impact of Dynamic Standards. The load growth rate declines from about 0.8 percent in the base case to 0.13 percent.

Table F - 6: Impact of Dynamic Standards on Average Annual Growth Rate of Load

2015-2035	Base case	Dynamic Standard
Peak (MW)	0.60%	0.03%
Annual Average (aMW)	0.80%	0.13%
Low Load Hours (aMW)	0.90%	0.19%

The primary caveat to this analysis is that there are a vast and growing number of standards at various stages of implementation. In this appendix, the Council has presented its best estimate of the impact of these standards as the Seventh Plan was being developed. However, there are more technologies and standards that are scheduled for implementation, so estimates shown should be treated as minimum impacts. As more standards are finalized future load growth is further reduced.

For a more complete listing of all federal standards, please see Chapter 12 Conservation Resources.