



Northwest Industrial Supply Curve

6th Power Plan

Prepared For
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Introduction

The Northwest Power and Conservation Council commissioned the development of a full industrial supply curve for its 6th Power Plan. To improve over traditional methods, the Council approved a bottom-up method to constructing this supply curve, employing as much regional load, program tracking, and case study data as possible. Throughout development the supply curve underwent continual model vetting, and was designed for maximum flexibility for end users.

Primary Architecture

The three components of this curve are interlocking and meticulously documented. The following is a review of three major components:

- Sector Characterization. Our best estimate of MWh sales to industrial customers in the region.
- Energy Splits to Process End-Uses
- Energy Conservation Measures (ECMs)

Sector Characterization:

The Sector Characterization is an assessment of the distribution of industrial electrical loads in the Pacific Northwest. The vast majority of this data was supplied by the region's utilities, and was organized by SIC or NAICS subsectors to obscure the sensitive customer data. Where possible each raw dataset was reviewed for classification accuracy against alternative data, replacing irregularities after careful discussion and consultation with the Council and its stakeholders.

Defining parameters of the Sector Characterization:

- The data collected from the regional utilities are based on a 2006 calibration year
- The sector characterization does not include mining, agriculture, irrigation, water/waste water or the aluminum industry. Aluminum plants are typically Direct Service Industries to the Bonneville Power Administration.
- Refrigerated warehouses are included despite being technically classified Commercial due to their load profiles being more similar to industrial loads. Refrigerated warehouses do not include commercial refrigeration or refrigerated fruit storage.

Energy End-use Splits:

The end-use splits are found in a series of tables. The first shows industries and end-uses matrix with the percent relative electrical consumption within. The second table provides additional end-use splits on the miscellaneous manufacturing industries. Finally, the third table is graphic representations of end-use splits that are provided in 9 charts.

The end-use splits are the amalgamation of several regional sources. First, BC Hydro made a substantial investment in modeling the end-uses in their industrial sector. Since the Pacific Northwest and British Columbia share several industries, climates, and international market conditions, their data was directly applicable to the Industrial Supply Curve model. Secondly, a database of northwest industrial motor audits by Oregon State University provided supplemental and proofing data. Lastly, multiple regional industrial plant audit databases substantiated the data of the previous two sources.

Energy Conservation Measures (ECMs):

The ECMs included in the Industrial Supply Curve are the result of real-world data. The measures are based the review of numerous case studies and regional program data. Their underlying assumptions and calculations are documented on the “Detail” worksheet.

SEG/Stellar has identified "typical" measures by characterizing the following parameters:

Field Title	Definition
ECM No.	A numerical identifier that can be cross-referenced to the Detail worksheet
Conservation Measure	Short measure description
First Cost (\$/kWh)	The first-year cost of measure implementation computed from the energy savings.
Deployment	Signifies whether the measure is a replacement or a retrofit (i.e. whether full installation costs are included)
Sector	The industry the measure applies to
Enduse App	The end-use technology the measure applies to
% Savings	The percent electrical savings of the measure computed as the product of % Savings * Measure Applicability * Penetration Rate * Inventory Factor * Process Share * MWh consumption for each sector.
Measure Applicability	The percent of the affected industries physically capable of utilizing the measure. The product of Fraction Uncompleted * Physical Applicability.
Achievable Potential	The percent market penetration (100% for Technical Potential)
Lifetime	The number of years the measure can be applied to
Annual Fuel Impact (therm/kWh)	Secondary fuel (natural gas, fuel oil, etc.) savings
Annual O&M Cost	The annual cost of operations and maintenance
Annual Non-Energy Benefit	The annual value of non-energy benefits of the measure (e.g. maintenance, replacement costs, etc.). This field is treated as a negative cost over the life of the measure, computed from the energy savings.
Levelized Cost (\$/kWh)	The cost of the measure amortized over the life of the measure including non-energy benefits
Enduse Code	End-use group code
Loadshape	Load shape code defined by NWPCC. Refrigeration apportioned between shapes, such as 20% 1 Shift, 30% 2 Shifts, 50% 3 Shifts.

Model Components

This section outlines the construction and operation of the supply curve model Excel workbook.

User Interface Worksheet:

The User Interface worksheet is a single location on the Program Summary worksheet where users can change the basic parameters of the model. It was designed for utility planners to adjust the model to fit their unique market conditions.

The User may input the following:

- Year
- Discount Rate
- Territory (review copy is limited to the Region to avoid proprietary issues)
- Penetration Assumption (Technical or Achievable)
- Deployment options (Retrofit, Replacement or Both)

Note: It is necessary to click the Macro button in order to cut, paste and sort data for the graphs. Critical calculations elsewhere in the model have been hidden or locked to prevent accidental modification of the model.

Calculation Worksheets:

For each sub-sector, there is a calculation worksheet. Most of the parameters are reiterated from the ECM page.

The Detail worksheet is where measure values are calculated and documented. An identifier is provided to cross-reference measures to the ECM summary worksheet. The Detail worksheet notes critical assumptions and sources for each measure.

The Forecast Worksheet takes MWh sales from the base year and projects according to the NWPPC forecast. The MWH Sales worksheet shows the base-year sales data as described in Sector Characterization

The Inventory Table is set up to avoid double-counting. It represents the remaining potential for a measure, assuming that the least cost measures are done first. For example, earlier installation of a transformer measure might reduce the potential for savings from a motor measure.

Summary and Results Worksheets:

The Summary and Results worksheets roll-up the calculations for each of the major pieces of the industrial supply curve – Sector Characterization, End-use Splits, and Energy Conservation Measures.

These worksheets are:

- Program Summary;
- Results;
- ECMs;
- End-uses; and

One can select Year, Territory, Penetration Assumption, or Deployment options, on the Program and Summary worksheet. It is necessary to click the Macro button in order to cut, paste and sort data for the graphs. The Summary page aggregates Potential Savings (MWh/yr), Initial Cost (1000\$), Annual O&M Cost (1000\$) and computes Levelized Cost (\$/kWh) for the aggregated sum. The levelized cost calculation is simplified by using the specified discount rate – it does not attempt to duplicate the Procost methodology that allows for multiple discount rates and capital sources.

The Results page provides a summary of the measures that most impacting the supply curve. One chart indicates the savings potential percentage for each industry, while another chart bundles the savings potential of measures by type (Cross-Industry Systems, Industry-Specific Process, and Management).

The following is a listing and description of the Industrial Supply Curve model worksheets:

Worksheet Name	Description
Program Summary	Allows user to input model parameters. Shows the industrial supply curves in kWh and aMW along with input values
Procost Report	
Results	Shows computed savings as summary page listing measures by savings. This table provides some context for which measures are the most important.
MechPulp	Worksheets with each major industry that contain the following: <ul style="list-style-type: none"> • industry-specific measures; • process shares; • the industry's regional electrical load; and • an individual supply curve.
KraftPulp	
Foundries	
FrozenFood	
OtherFood	
Sugar	
Lumber	
Panel	
Wood	
ElecFab	
Silicon	
MetalFab	
Equipment	
ColdStorage	
FruitStorage	
Refinery	
Chemical	
MiscManf	
ECMs	Lists the industry cross-cutting measures and values. On this page one can change unit costs or savings. Cross references ECM No. to the Details worksheet.
Detail	Provides greater detail on measure descriptions, calculations, assumptions, and sources
Inventory	Controls for double counting of measures
End-uses	Provides tables and charts of end-use technology electrical consumption percentage by industry
Forecast	Forecasts the consumption of the major industries through 2030
Loadshapes	Provides the loadshapes for each industry. All except refrigeration are provided