Northwest Power and Conservation Council

April 2, 2013

MEMORANDUM

TO: **Power Committee Members**

FROM: **Tom Eckman and Massoud Jourabchi**

SUBJECT: **How Demand Forecasting and Conservation Resource Assessment Interact**

Treating conservation as a resource creates interactions between the demand forecast and conservation resource choices that need to be properly modeled. In this presentation, we will discuss the analytical approach that has been developed to ensure proper linkage between conservation resource planning and the demand forecast.

The demand forecast provides important information that is needed in order to estimate potential conservation savings. This includes estimating the number of buildings and the amount of electricity using equipment that can potentially be subject to efficiency improvements. But there are also more complicated interactions to consider. The demand model estimates efficiency improvements that will occur as consumers respond to changing prices. This creates a potential for double counting conservation; once in demand model responses and again in the conservation supply curve estimation.

A third level of interaction that must be considered is the so-called “take-back” effect. That is, when equipment or building efficiency is improved, energy cost will typically decrease. Consumers may respond by using more of the service that is now less expensive. For example, if a house is better insulated, the cost of heating will decrease and the owner may decide that he will remove the extra sweaters and turn the thermostat up a bit. The demand models are used to account for this effect.

In order to prevent over-estimation of conservation resource potential, a number of analytical steps were developed to create a proper interface between the demand forecast, conservation resources assessment, and the portfolio model.

The presentation covers inputs from the demand forecast model expressed in number of units, appliances, and their efficiency levels. Also discussed will be how the conservation assessment uses these inputs, how the conservation supply curves are generated, and how the optimum level of conservation, once determined by portfolio model, is incorporated into the demand forecast.

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The Demand Forecast and Conservation Analysis Interface

April 9th 2013

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&
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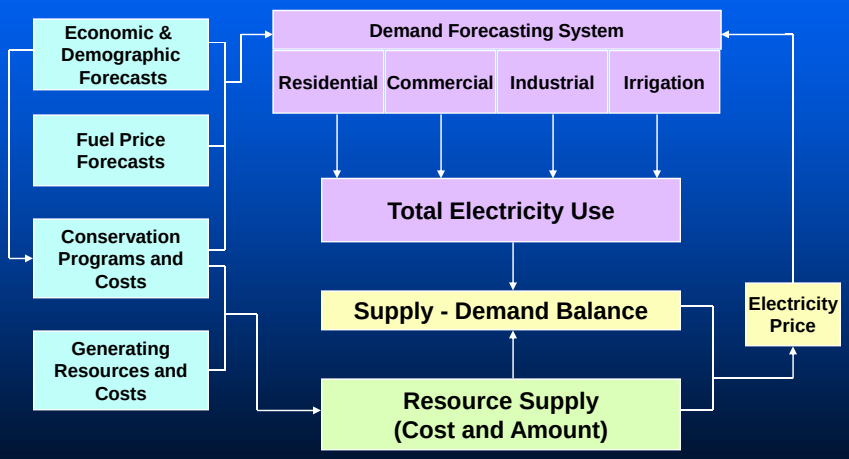
Council's Power Planning Process



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Demand Forecast Overview

Start with
1) Economic Forecast
- New Homes
- SQF of com. buildings
- Industrial output
- Miles traveled

2) Obtain Fuel Prices Forecast

3) Choose Efficiency/Fuel Trade off point

Calculate total Energy Cost

Input O&M Costs

Input Capital Costs

4) Determine Consumer Choice on Energy Efficiency

5) Compare consumer choice to Codes and Standards

6) Forecast Demand for New Capital (by fuel)

7) Forecast New Energy Requirements (by fuel)

8) Forecast Energy Requirements net Of retirements (by fuel)

9) Bring in other variables from calibration To 1985-2011 Annual Demand Monthly System Peak, Average & Min. Loads

Monthly system loads

Weather

Socio-demographic

10) Produce "Price Effect " Demand Forecast (by fuel, enduse , state)

11) Then use Hourly System Load

12) Forecast Peak hour load , Monthly Energy by enduse and state

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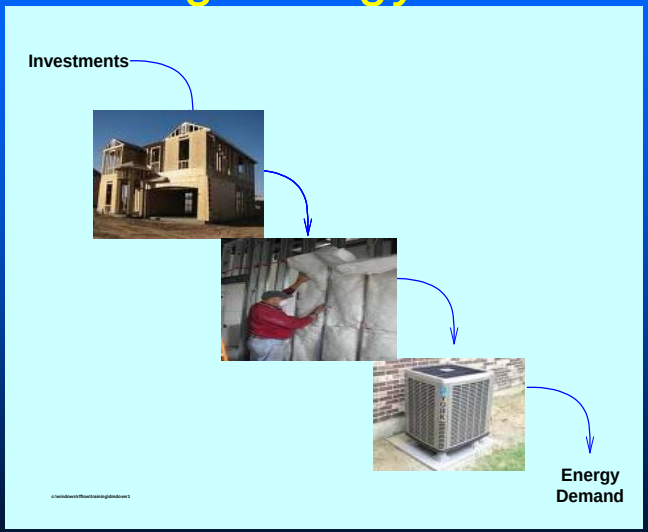
Tracking Energy Demand



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Major Factors Influencing Demand

- Long-term factors
  - Economic Activity
  - Energy Prices
  - Technology choices
  - Socio-economic changes
- Short-term factors
  - Weather
  - Income

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Basic Building Blocks of Long-term Demand Forecasting Model

For each enduse in each sector consumption is determined in part by:

- Number of Units (A)
- Fuel efficiency choices (B)
- Fuel choice (C)

Energy use by an enduse = A * B * C

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Number of Units (A)

- Driven by the economic forecast
  - Number of Existing home
  - Number of New Homes (Single, Multi, Manuf.)
  - Square footage of existing commercial buildings
  - Square footage of new commercial buildings
  - Level of production from industrial, agricultural and mining firms
  - Income of residential sector
  - Miles traveled
- Source of information: Global Insight and in-house analysis
- Review process: State economists and Demand Forecast Advisory Committee

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Fuel Efficiency Choices (B)

- An important consumer choice is between increased efficiency and higher capital cost
  - It involves a trade-off between potentially higher up-front costs and lower operating costs
  - For Example, if a very high efficiency water heater is purchased, the capital cost will be large, but the future operating costs will be lower
- Source of information: various sources and studies (LBL, DOE, …)
- Review process: DFAC

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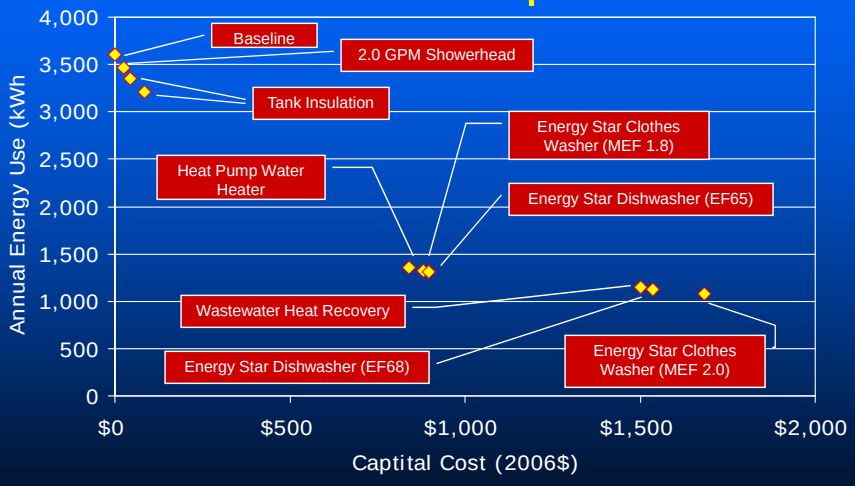
Residential Hot Water Heating Efficiency Curve Consumer Perspective



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Fuel Choice (C)

- When customers trade one fuel for another on the basis of relative cost of fuels, factors considered include:
  - Capital Cost
  - Operation and maintenance cost
  - Non-price factors such as customer preference for one fuel over another
- Source of information: Historic fuel prices, National and regional survey of customer choices, Calibration demand to 1985-2011
- Review process: Demand Forecast Advisory Committee

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Illustrative Example Demand from Water Heating in New Homes

Electric water heaters demand in new homes is calculated as:

- Number of new single family homes: 20,000/yr
- Baseline Electricity Efficiency: 0.90 Energy Factor = 3600 kWh/yr
- Market share of electric: 69%
- Electricity Demand for water heating added per year
- 20,000*.69*3600 ~ 49,680 MWH ~ 5.67 MWa

Similar approach is used for existing homes. Existing homes are tracked over-time and the energy use is reduced each year based on the physical life of the device (i.e., as existing units fail, they are replaced units meeting federal minimum efficiency standards).

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Conservation Supply Curve for Water Heaters

- Frozen-efficiency Forecast uses the base use of 3513 kWh/year to estimate water heating demand in new homes.
- Conservation supply curve estimation starts from the base use and moved along the efficiency-cost trade-off curve.
- Conservation potential for various points along the curve are estimated in a similar fashion to the forecasted demand calculations.
- Annual Energy is converted to monthly peak, average and minimum loads to create monthly system peak, average and minimum load.

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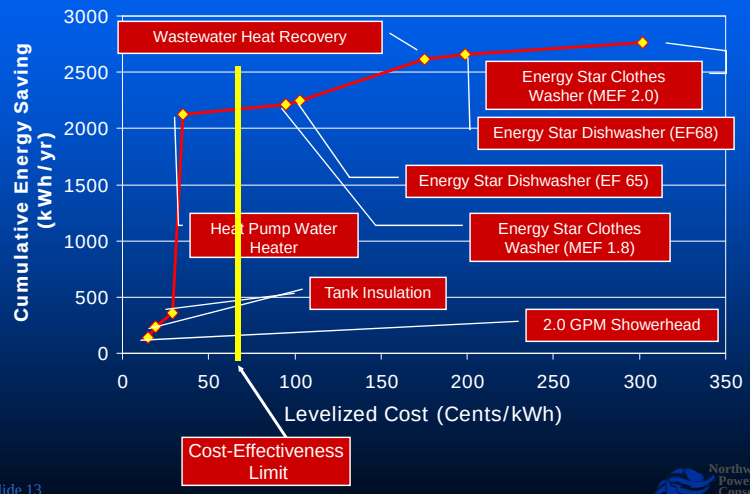
Residential Hot Water Heating Dwelling Unit Supply Curve

Power System Perspective



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Demand Forecast, Conservation supply & Resource Optimization

- Frozen-efficiency Forecast and the Conservation supply curves consistent with the forecast is provided to RPM.
- In the RPM, load forecast is subjected to 750 different futures and optimum level of conservation acquisition as well as other resource options is determined.
- The optimum conservation level is fedback to the demand forecast model
- A new Sales forecast reflecting impact of conservation targets and costs is produced.

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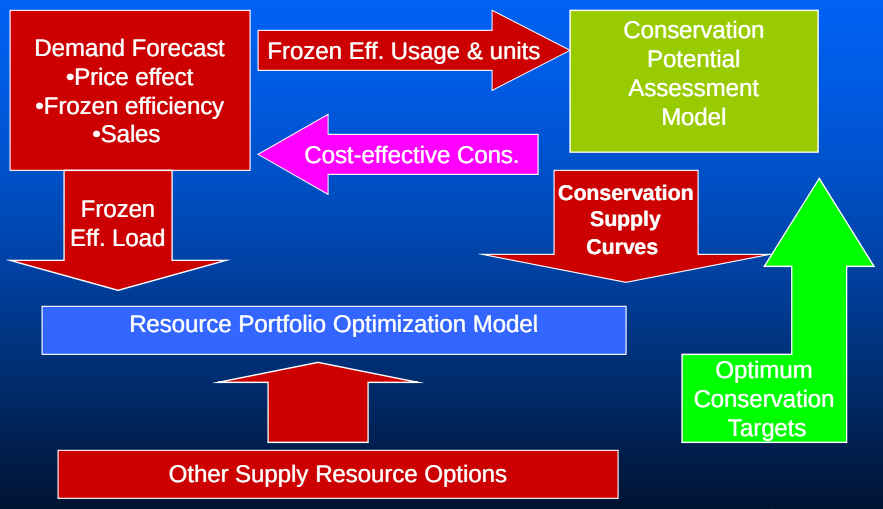
Demand forecast and Conservation Interface



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Summary

- Demand Forecast and Conservation Resource estimates have common baseline for:
  - Number of new units added and retired
  - Enduse Characteristics
    - » Efficiency, life of equipment,
    - » Building codes and standards
    - » Load shapes
- Changes in Demand forecast changes conservation resource potential.

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