Northwest **Power** and **Conservation** Council

June 4, 2019

MEMORANDUM

TO: **Power Committee Members**

FROM: **Kevin Smit**

SUBJECT: **Develop Energy Efficiency Supply Curves for 2021 Power Plan**

BACKGROUND:

Presenter: Kevin Smit

Summary: In preparation for the 2021 Power Plan, staff will be providing the Power Committee a series of presentations on different aspects to developing the Plan. This presentation will be on the development of energy efficiency (EE) supply curves.

Relevance: Energy efficiency is one of the options considered by the Regional Portfolio Model when determining a low-cost resource mix for the plan horizon. To analyze EE in the Regional Portfolio Model, staff develops a supply curve that provides bundles of the amount of EE available at different price points, with information on seasonal attributes.

Workplan: A.1.1 Prepare EE supply curves for the 2021 Plan

More Info: In 2014, staff provided an overview of EE methodology in the plan for the Seventh Plan:
https://nwcouncil.box.com/s/nyuapot8l4yd5oen5ep2c0vioyt2a5v2

In 2017, staff provided a review of the definition of EE:
https://nwcouncil.box.com/s/dsd5y7y7vfzeacif9yl9e1i0qj56h8d2

In 2018, staff summarized the approach to EE Cost-Effectiveness:
https://nwcouncil.box.com/s/ox4vqgmgkgec4bfl7ojc58kksqhzgm20

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Energy Efficiency Supply Curve Development Methodology

Kevin Smit

June 2019 Power Committee Meeting

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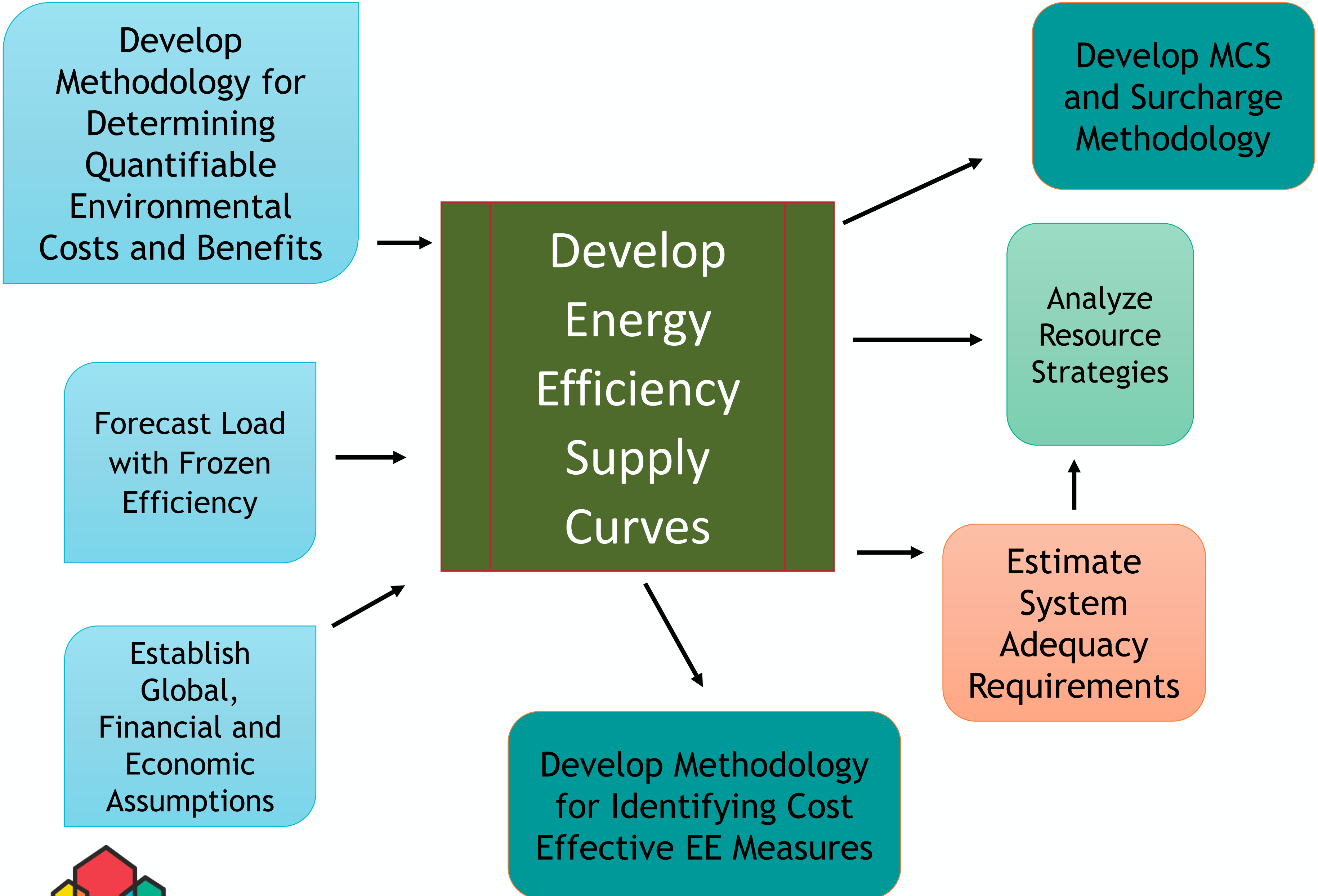
FOR A SECURE & AFFORDABLE ENERGY FUTURE

What is Energy Efficiency?
Definition of Conservation Under the Power Act

"Conservation" means any reduction in electric power consumption as a result of increases in the efficiency of energy use, production, or distribution.

1. Does the opportunity reduce electric power consumption?
2. Is the reduction in electric power consumption the result of an increase in efficiency of energy use, production, or distribution?

Also, must be "…reliable and available within the time it is needed…"

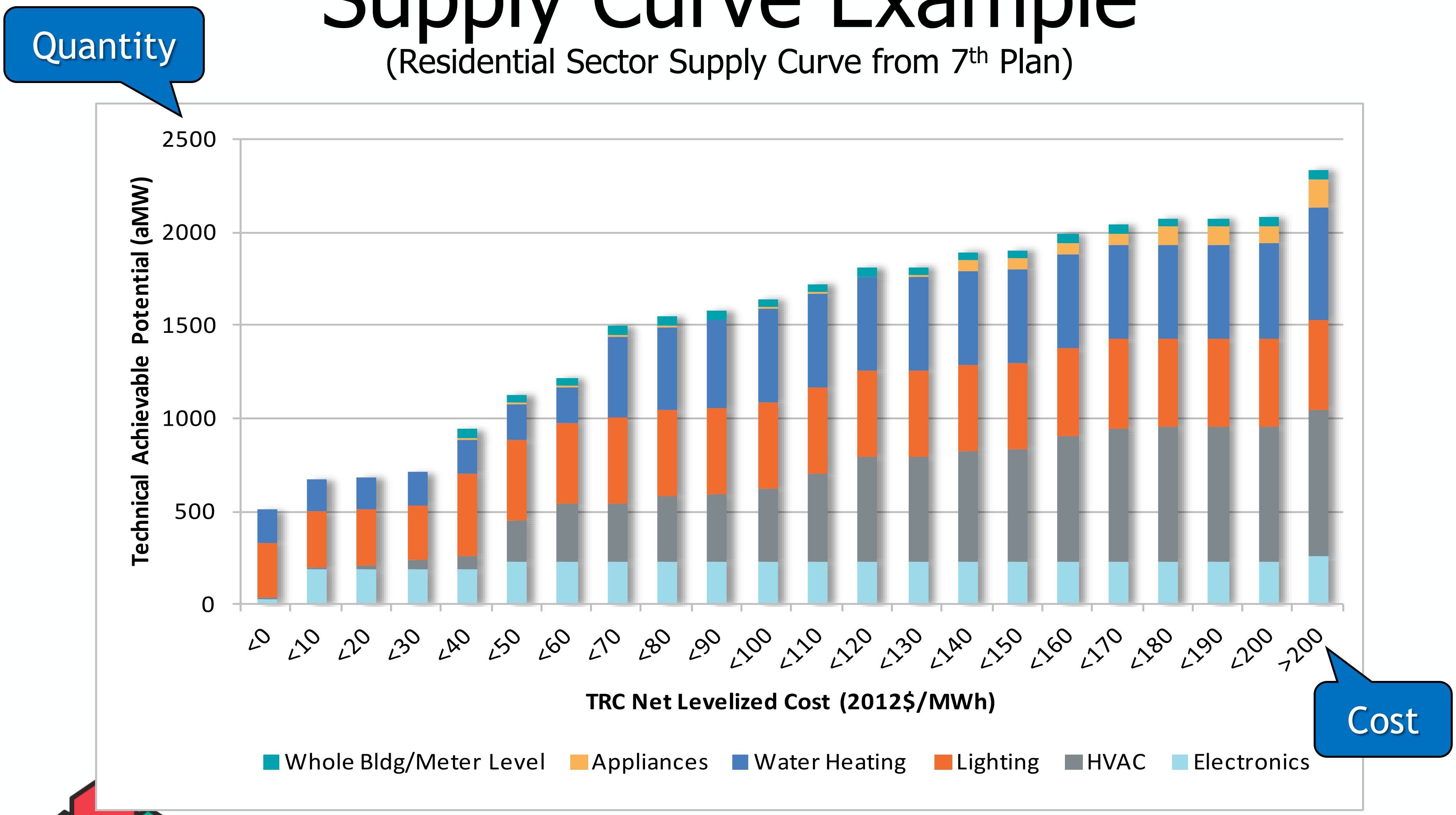

Develop Methodology for Determining Quantifiable Environmental Costs and Benefits
Forecast Load with Frozen Efficiency
Establish Global, Financial and Economic Assumptions
Develop Energy Efficiency Supply Curves
Develop MCS and Surcharge Methodology
Analyze Resource Strategies
Estimate System Adequacy Requirements
Develop Methodology for Identifying Cost Effective EE Measures

EE Supply Curves

- Conservation resources need to compete along with supply side resources on an “apples to apples” basis
- The energy efficiency supply curves include the electricity savings, levelized cost, and other attributes necessary to compare EE with other supply-side resources
- The supply curves are the result of a region-wide conservation potential assessment
- Eventually leads to EE goals/targets

Supply Curve Example

(Residential Sector Supply Curve from 7th Plan)



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The Basic Formula for Savings

Achievable Savings Potential =

Number Units * kWh savings per Unit * Achievable Penetration

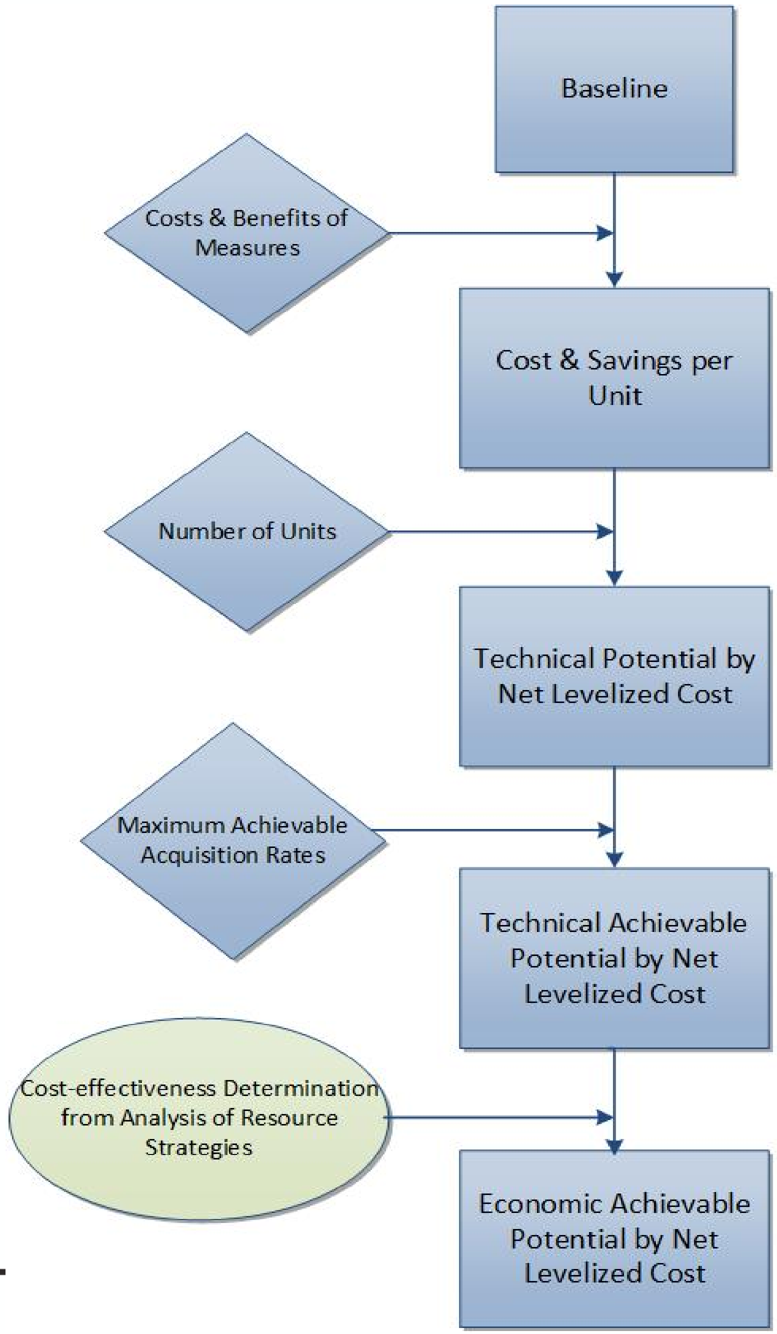
Examples:
- Number Homes
- Floor Area of Retail
- Number of Refrigerators
- Acres Irrigated
- Number transformers

Fraction of available or remaining stock that is realistically achievable over time

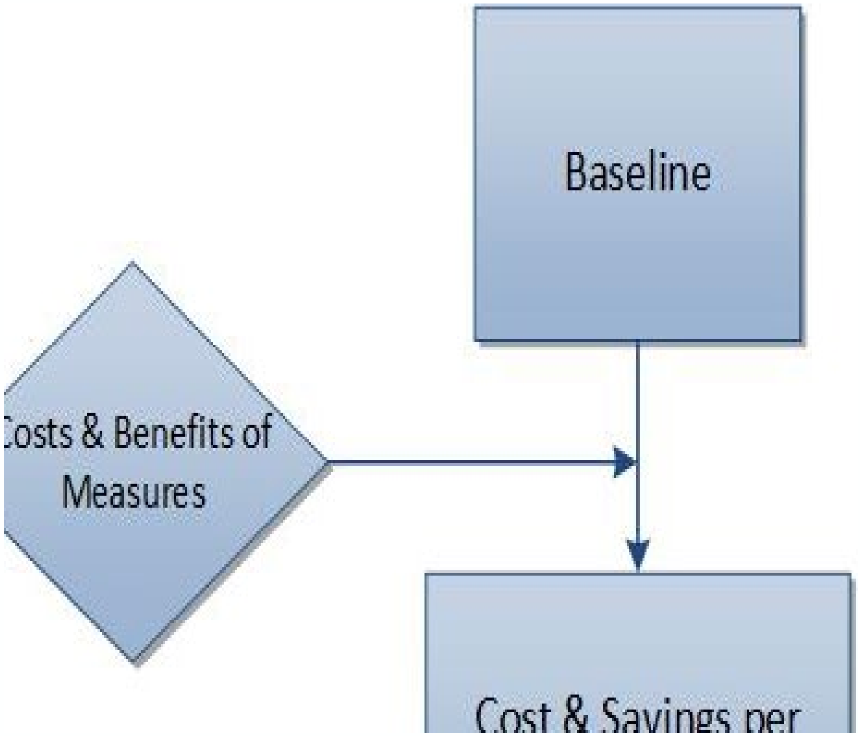
(kWh/Unit at **Baseline** Efficiency – kWh/Unit at **Improved** Efficiency)

Process Flow

1. Baseline
    - Identify measures that save electricity
    - Establish the measure's "baseline" consumption (i.e., what the measure is compared against)
2. Cost & Savings Per Unit
    - Estimate incremental electricity & capacity savings per unit
    - Estimate incremental costs & benefits per unit
    - Estimate measure life
3. Technical Potential
    - Calculate cost per kWh saved
    - Calculate number of units available
    - Multiply unit savings and cost by the number of units
4. Technical Achievable Potential
    - Apply achievability limits
    - Ramp rates



1. Establish Baseline



Identify EE Measures

- Example - Nearly 100 measures categories in Seventh Power Plan *(e.g., Air Source Heat Pump)*
  - Buildings (insulation, windows, heat pumps, etc.)
  - Appliances (refrigerators, dishwashers, ovens, steamers, etc.)
  - Processes (energy management, pump optimization, etc.)
  - Utility distribution system (poles, wires, and transformers)
  - Across residential, commercial, industrial, agriculture, utility
- Over 1600 measure permutations *(e.g., Energy Star Air Source Heat Pump, heating zone 1, new construction)*
  - By heating zone, vintage, heating system type
  - Factors that change incremental cost or savings

Baseline

Depends on Decision Timing

New

- New homes
- New buildings
- New equipment
- New additions

Decision when new item is built or purchased.

Baseline is best of minimum code requirement, federal standard, or common practice

Natural Replacement

- Burn-out
- Remodel
- Market shifts

Decision when burnout or obsolescence.

Baseline is best of minimum code requirement, federal standard, or common practice

Retrofit

- Remove & Replace (windows)
- Add-on (insulate attic of older home)

Decision timing is discretionary.

Baseline is as-found condition, unless subject to code or standard

Sync Baseline with Electricity Load Forecast

- Forecasts of electricity demand AND conservation potential must both use same baseline efficiency
  - Use the same units and growth forecasts
  - Same unit efficiency assumptions
- Frozen Efficiency Forecast
  - (See load forecast presentations)
  - Establish the base year and then "freeze" or fix the baseline
  - Product turnover results in some overall efficiency improvement

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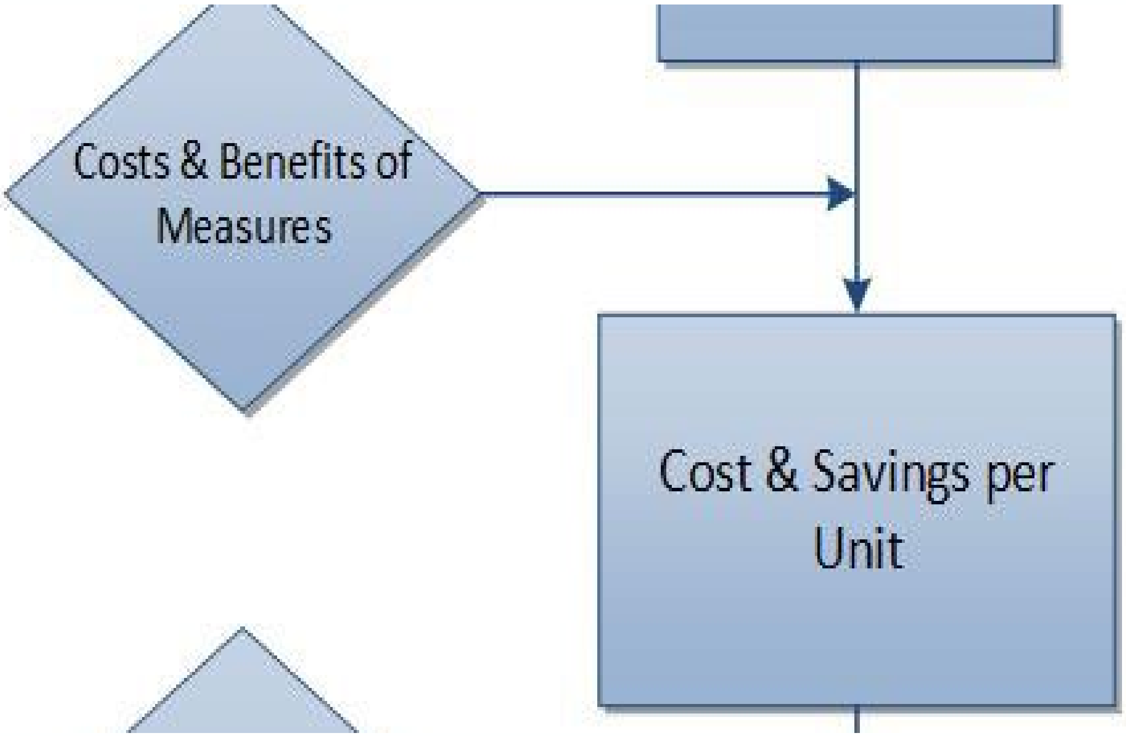
2. Develop Measure Data



Cost & Savings Per Unit

Energy Savings (kWh)

- kWh per unit at the site (annual)
- Line losses from source to site
- Seasonal & daily shape of savings
- Measure interactions
- Measure "Take Back"

Capacity Benefits (kW)

- Where coincident with peak:
  - Deferred distribution and transmission line expansion cost
  - Quantified in $/kW-yr

Costs

- Capital & Financing
- Labor
- Program Administration
- Operations & Maintenance
- Reinstallation Cost

Non-Electric Impacts

- Water use changes
- Gas use changes
- Operations & maintenance
- Lamp replacements
- Quantifiable Environmental Impacts

Measure Life

- Expected lifetime of the measure

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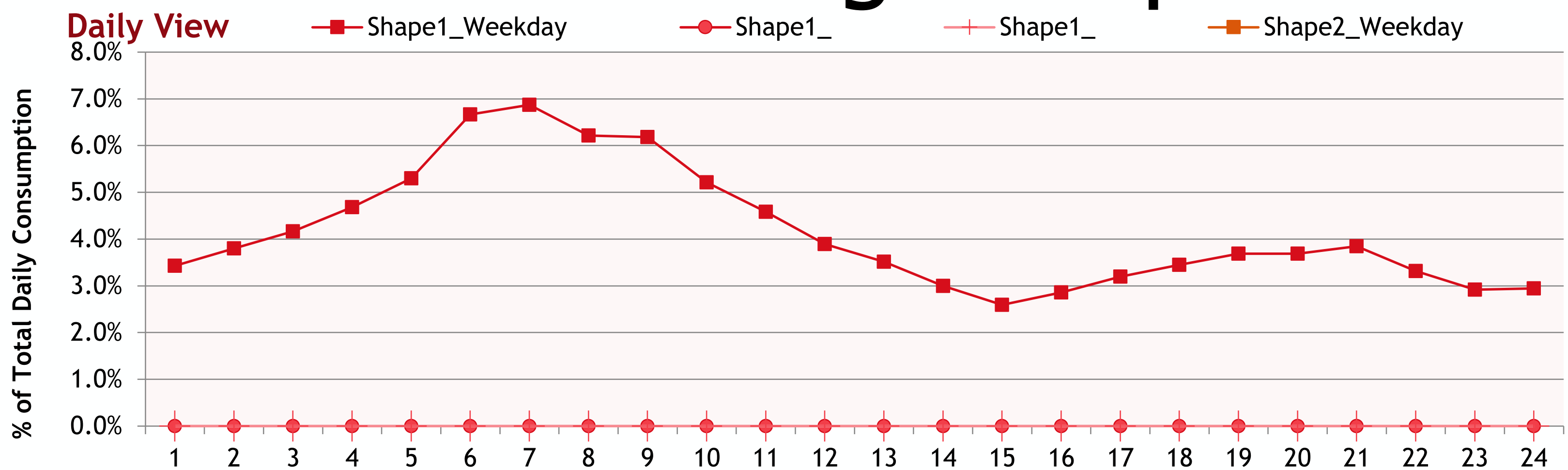
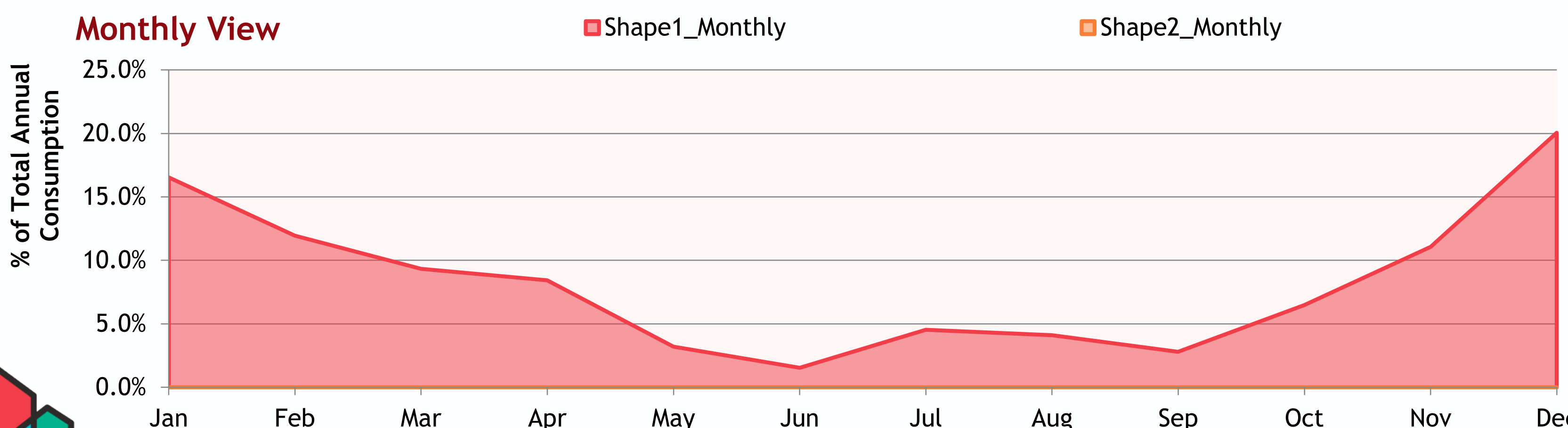
Example: Air Source Heat Pump:
Heating zone 1

Measure Savings Shapes





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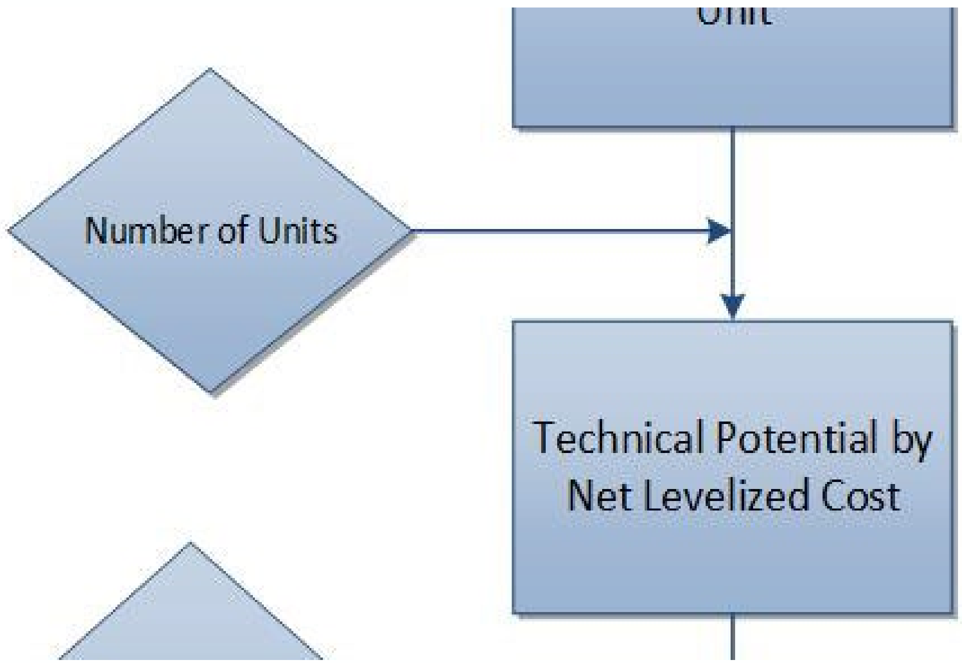
3. Estimate Technical Potential



Estimate Number of Units

Examples of Units

- Number of replacement clothes washers per year (360,000)
- Number of new single family homes per year (60,000)
- Floor area of Mini Mart groceries (45,000,000)
- Sq.Ft. of attics with no insulation in older homes (540,000,000)

Data Sources:

- Stock assessments (RBSA, CBSA, IFSA)
- Council forecast models
- DOE Rule makings
- Product sales data

Annual Estimates

- Year-by-year for 20-year forecast period
- Existing stock minus demolition & conversion
- New stock added
- New appliances added
- Appliance & equipment turnover

Estimate Number of Units Where Measure is Applicable

New

- New homes
- New buildings
- New equipment
- New additions

Number of units driven by population or economic growth

Natural Replacement

- Burn-out
- Remodel
- Market shifts

Number of units driven by equipment life, turnover rates, consumer preference & obsolescence

Retrofit

- Remove & Replace
- Add-on

Number of units driven by remaining stock not adopting measure

Multiplying measure savings by number of units gives us the Technical Potential

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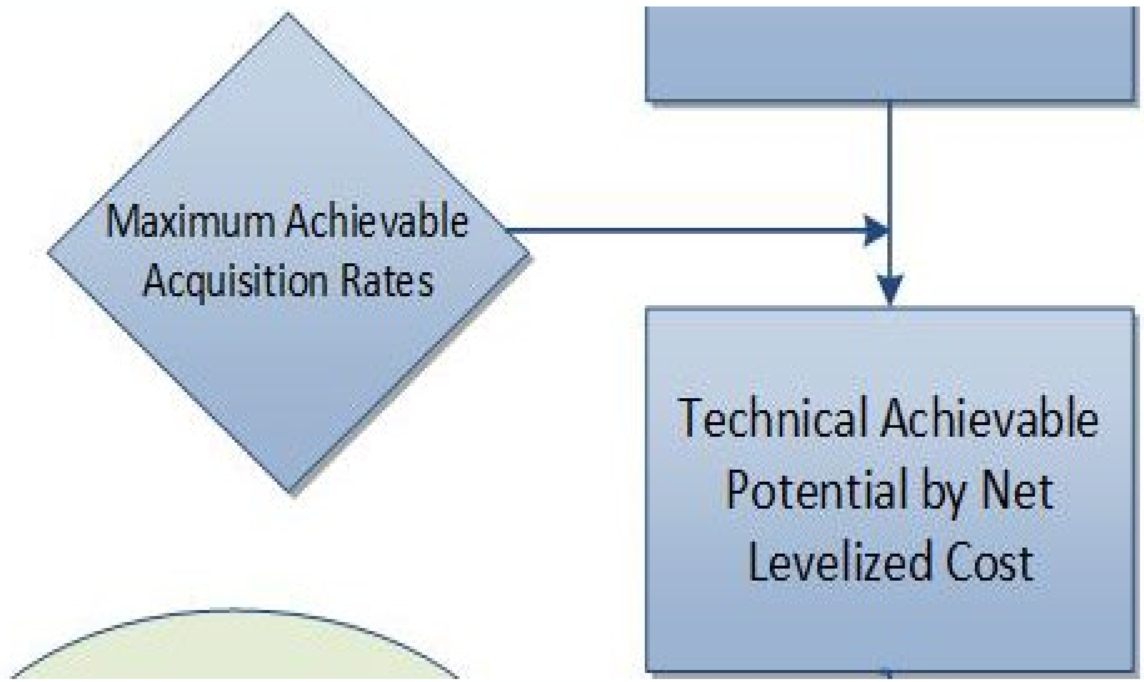
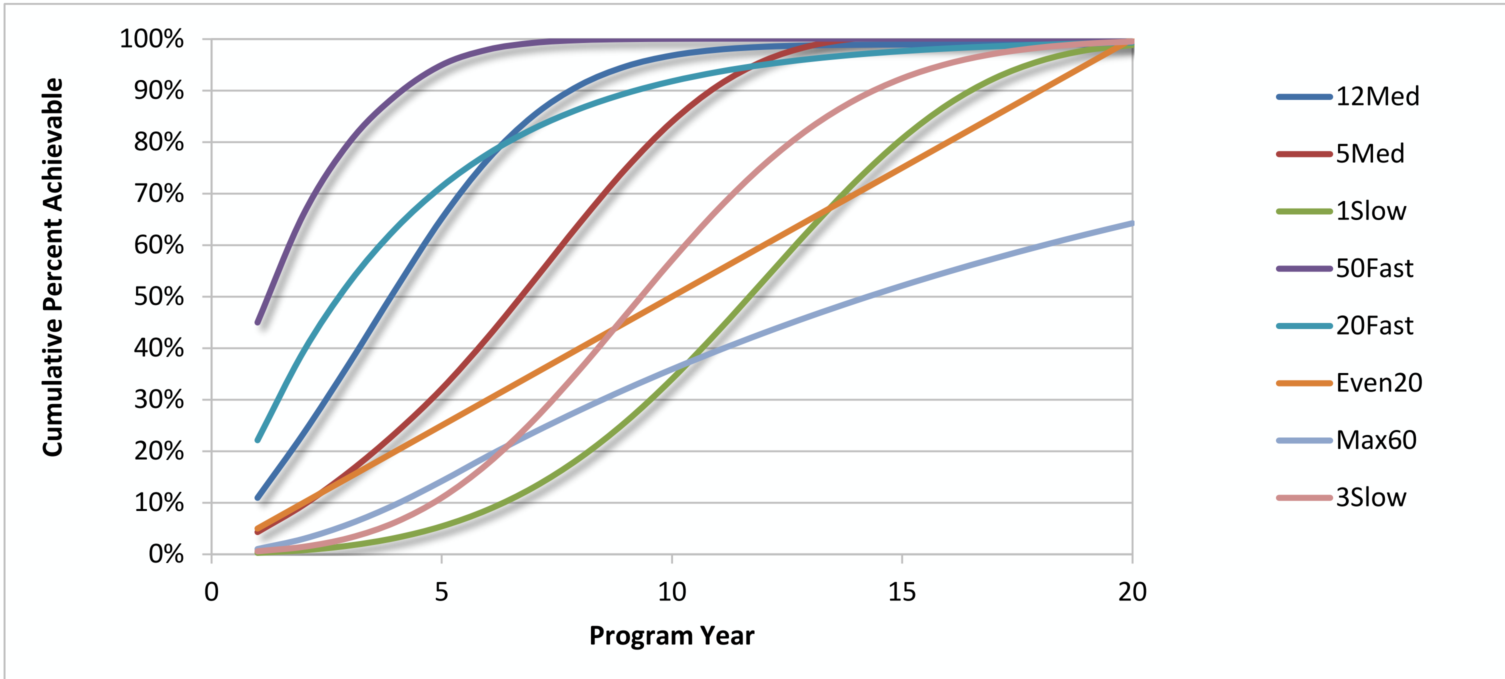
4. Estimate Achievable Potential



Achievable Potential

- Less than 100% adoption generally assumed
  - Assumes not all customers will accept the efficient unit, even if offered at no cost to the consumer
- Achievability Assumes:
  - Utility system can pay all cost (if measure is cost-effective based on power system benefits)
  - Many efficiency requirements can be embedded in codes/standards
  - 20-year time frame
- *Achievable Potential* is Always Less Than *Technical Potential*
- Annual Achievability is limited by "Ramp Rates"
  - Not all energy efficiency can be acquired immediately
  - Identifies the pace of EE adoption over time
  - Developed through advisory committee input

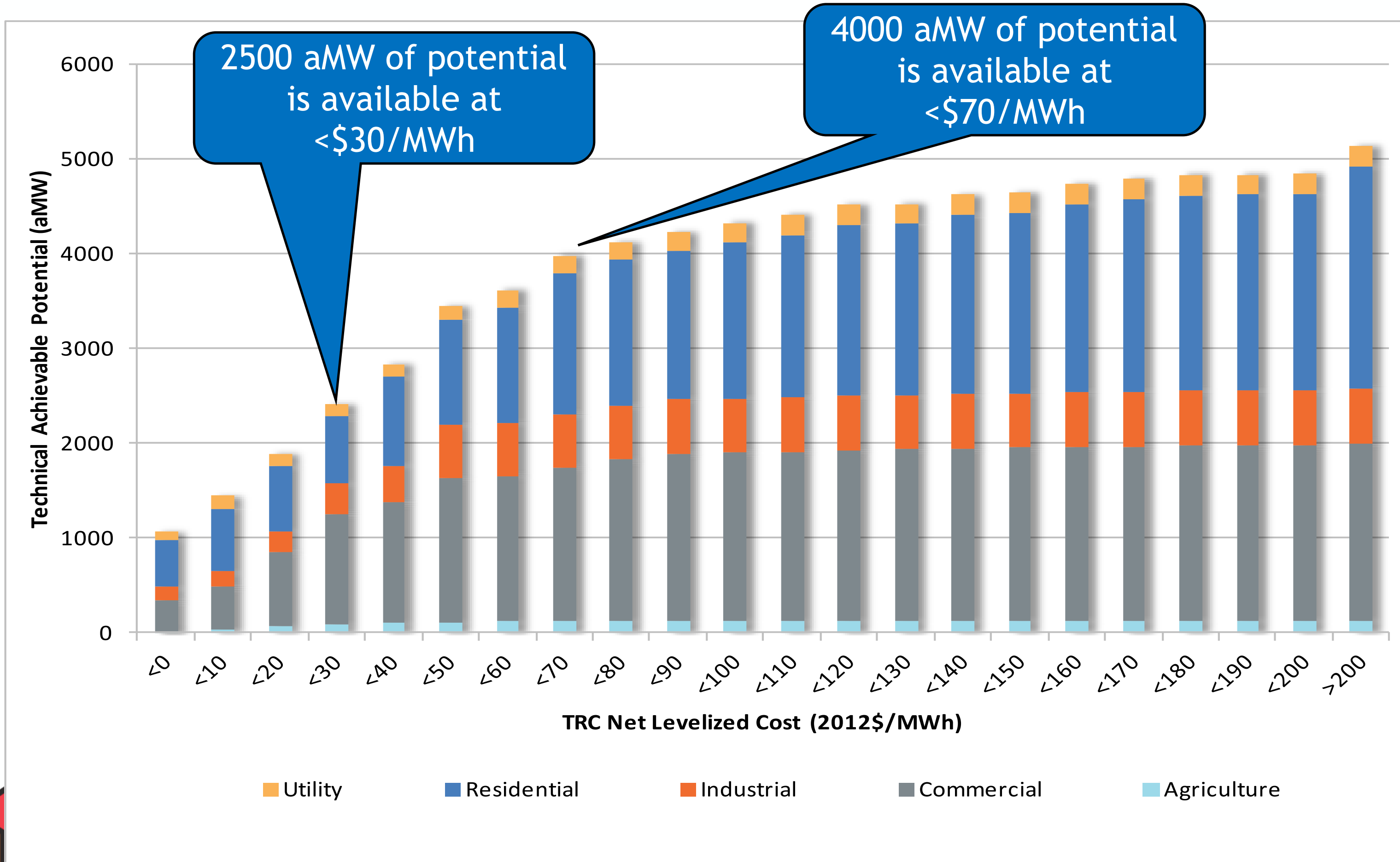
Ramp Rates



Data Sources that inform Ramp Rates:

- Past program performance
- Cost of measure
- Consumer acceptance
- Non-energy impacts
- Physical availability of equipment
- Training & education requirements

Achievable Potential Supply Curve:
Add Up Each Measure Cost and Savings



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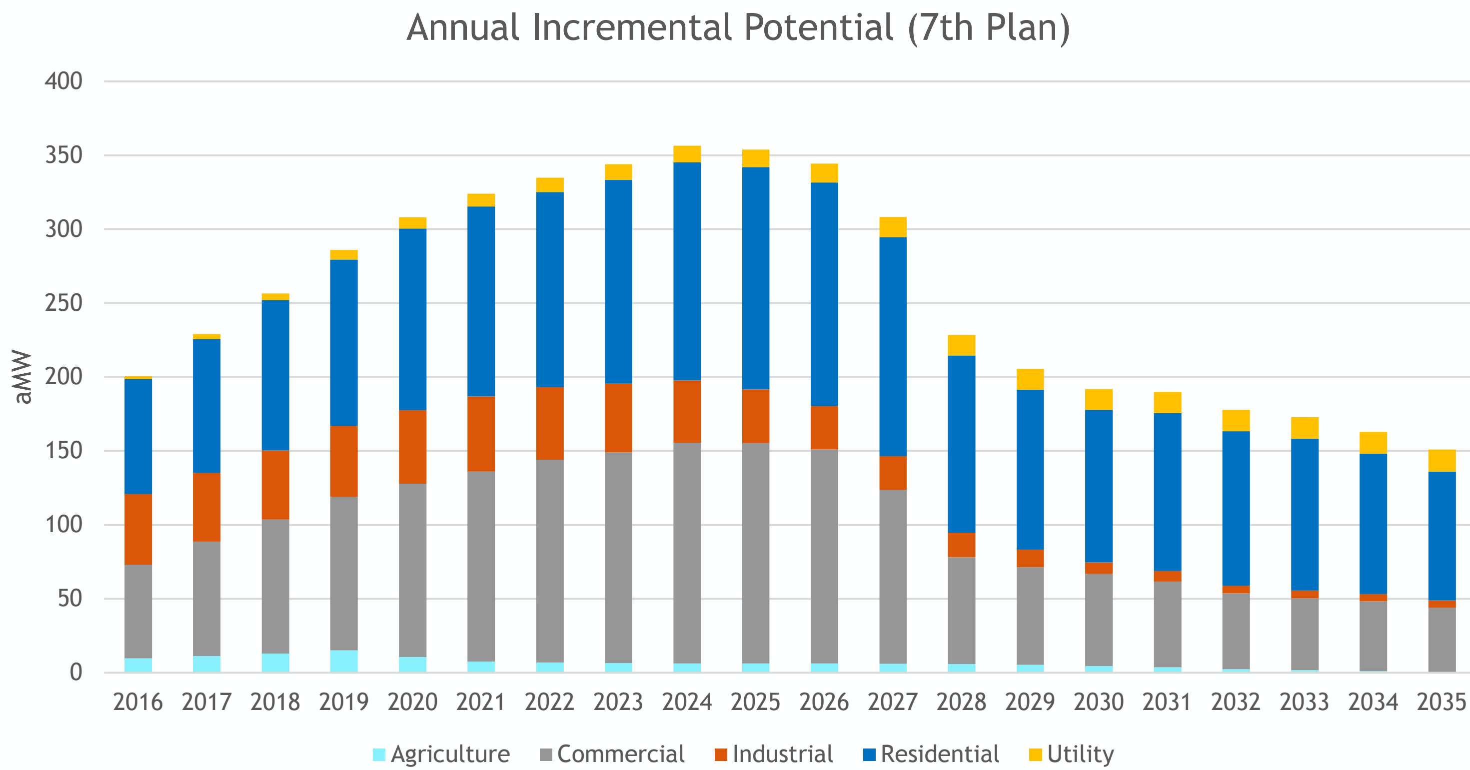
Annual Potential Including Ramp Rates



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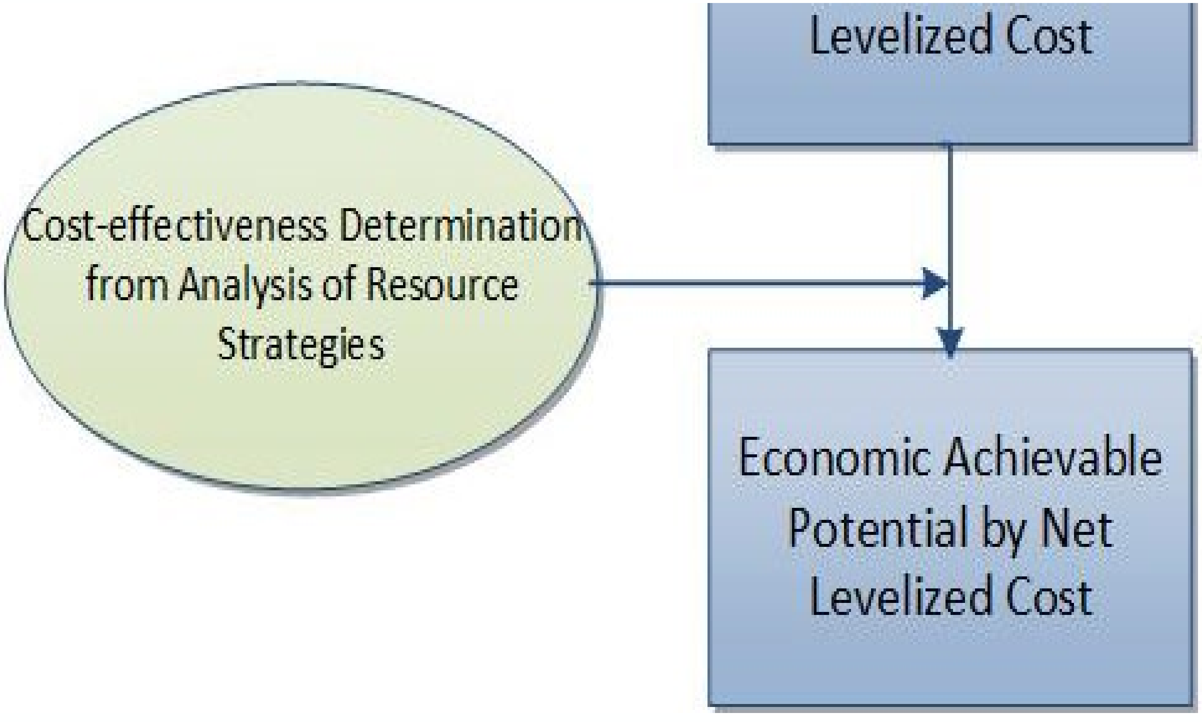
Hand-off to RPM – Resource Strategy

- Supply curve: amount (aMW) by levelized cost bin ($/MWh)
- Peak impacts: Peak vs off-peak, quarterly

5. Estimate Economic Potential and Cost-Effectiveness



Economic Achievable Potential

- The Economic Potential is determined by the resource strategy analysis
  - Council determines this potential based on analytical results and judgment
  - Results in the regional EE targets/goals
- After the regional EE target is established, we need a method for determining if new measures are cost-effective relative to the Plan results
  - RTF continues to develop measures
  - BPA and utility EE programs

EE Cost-Effectiveness

Based on Resource Strategy from the Power Plan

Benefits	Costs
Avoided Energy	**Capital and Labor**
Avoided Capacity	Annual O&M*
Regional Act Credit	Program Admin
Non-Energy Benefits	Non-Energy Costs

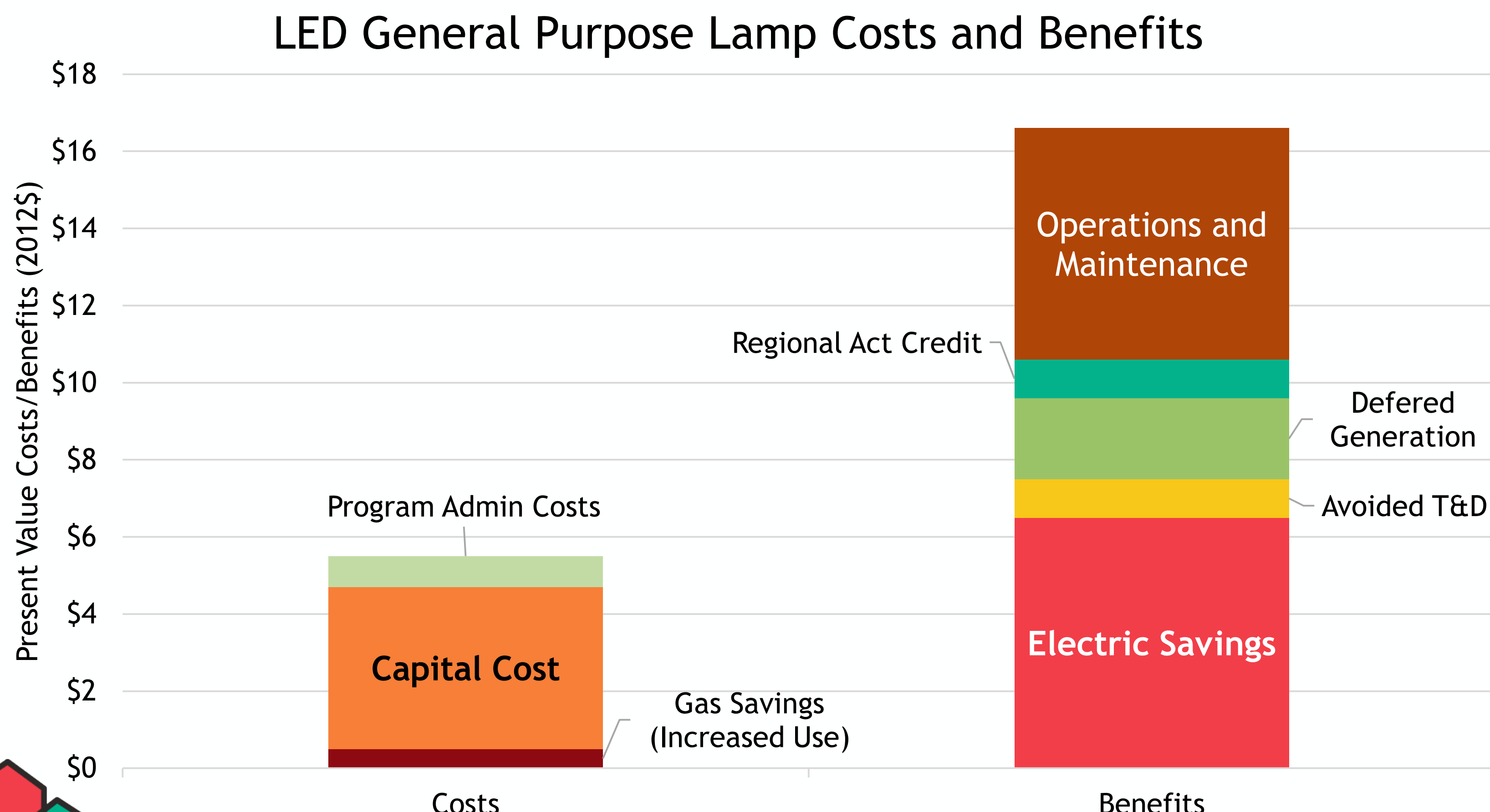
Additional benefits may include: Other fuel benefits, avoided periodic replacement, risk mitigation

Additional costs may include: Other fuel costs, periodic replacement

If benefits > costs, measure is cost effective relative to the Plan findings

The Avoided Energy, Avoided Capacity, and Risk Mitigation benefits are determined based on resource strategy results

An Example: LED Light Bulb



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Q&A

- Who Does this Work?
  - Charlie Grist (Commercial, Industrial)
  - Tina Jayaweera (Residential, Ag)
  - Kevin Smit (Commercial, Industrial)
  - Jennifer Light (and RTF Contract Analysts)
  - Mike Starrett (Distribution Efficiency)
- With support from:
  - NEEA
  - Bonneville
  - Energy Trust of Oregon
  - National Labs, Research Organizations, Universities
  - Individual utilities
  - Consultants