Overview of Potential Studies: the Basics

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Agenda

- Welcome
- Broad Overview
- Goals of a Potential Study
- Resources and requirements – staffing, cost, time, RFP
- Modeling
- Types of Potential
- What data are needed?
- Regional Perspective
- Brainstorming on Needs: How can BPA help?

What is a Potential Study?

- Quantitative analysis of the amount of energy savings that either:
  - exists, *[technical]*
  - is cost-effective, *[economic]*
  - or could be realized through the implementation of energy efficiency programs and policies *[achievable]*.

Various Objectives of Potential Study

- Setting attainable energy savings targets.
- Quantifying the energy efficiency resource for system planning.
- Determining funding levels for delivering energy efficiency programs.
- Designing programs to achieve the long-term potential.
- Reassessing energy efficiency opportunities as conditions change.

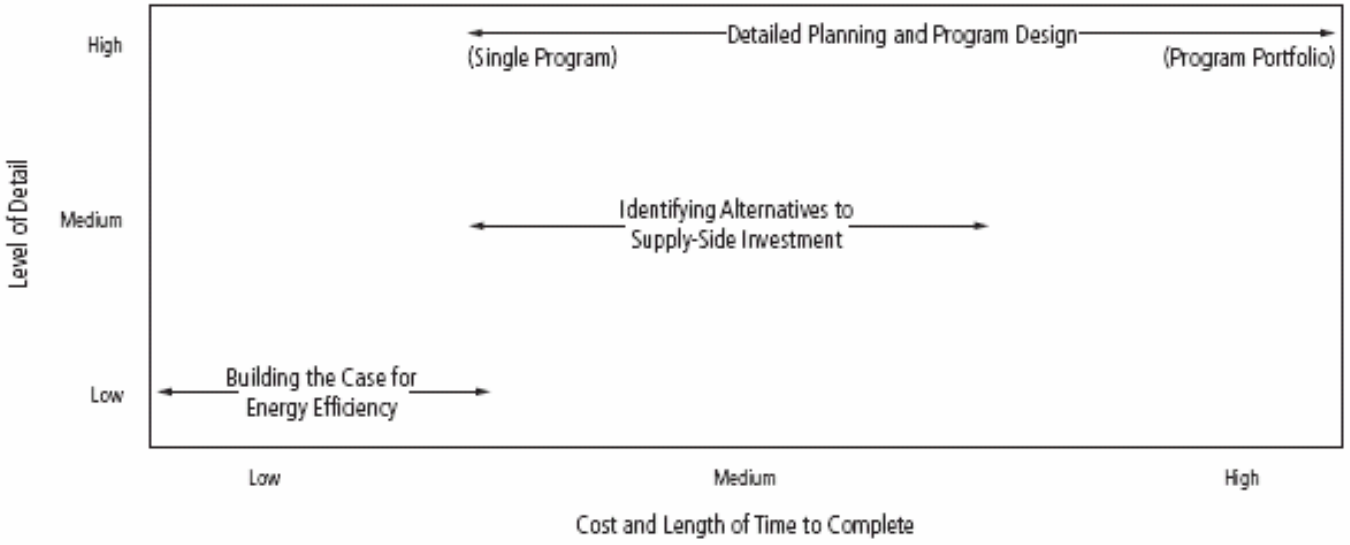
Basic Steps to Completing Potential Study

- Define objective and audience
- Select potential types to assess
- Determine level of detail
  - Considerations – policy question, data availability, resource constraints
- Data requirements:
  - Baseline end-use and efficiency data, energy forecasts, measure data, sales data.
- Select / define Methodology
- Conduct Study
- Use study to develop program design and program plans

Resource Requirements

- Building support and making the case for energy efficiency programs and funding
  - Cost: $20-75K, Time: 1-4 months
- Evaluating efficiency as an alternative to a specific supply-side project
  - Cost: $75-300K, Time: 4-12 months
- Determining how much to spend on efficiency, and how that money can best be spent
  - Cost: $75-500K, Time: 4-12 months

Figure ES-1. Considerations for Conducting Potential Studies



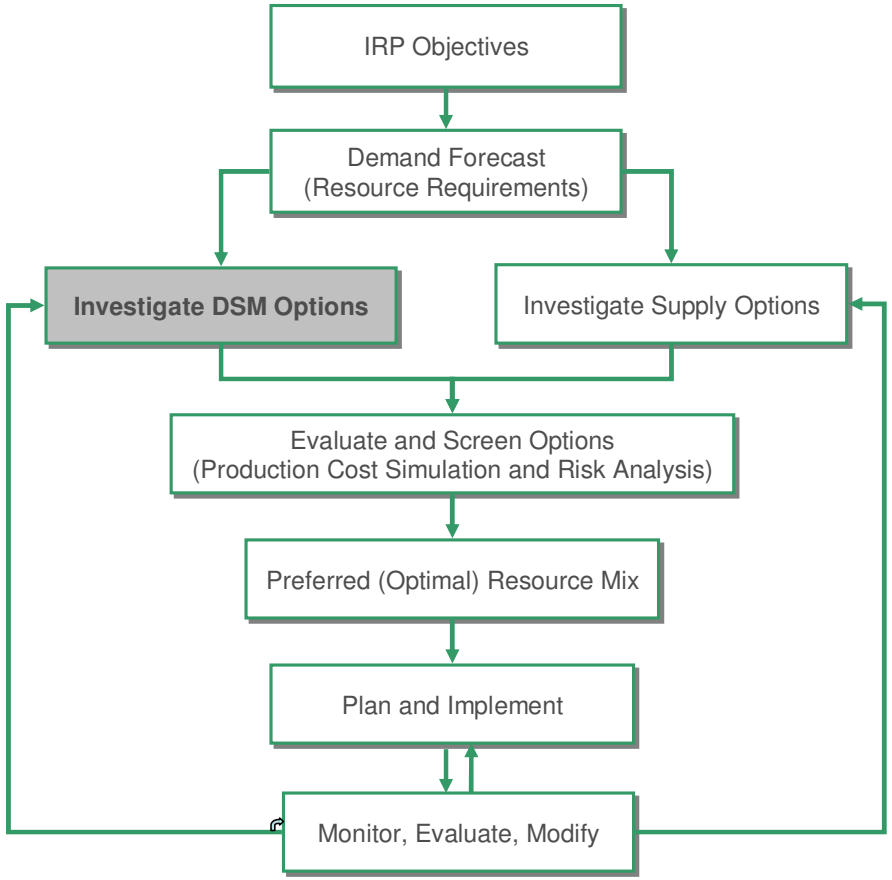
Source: http://www.epa.gov/cleanrgy/documents/potential_guide.pdf

Other Resource Considerations

- Staff time
  - RFP development
  - Contractor selection
  - Data collection
  - Review of results
  - Project Management
- Funding
  - Depends on number of sectors, etc.

Data Modeling

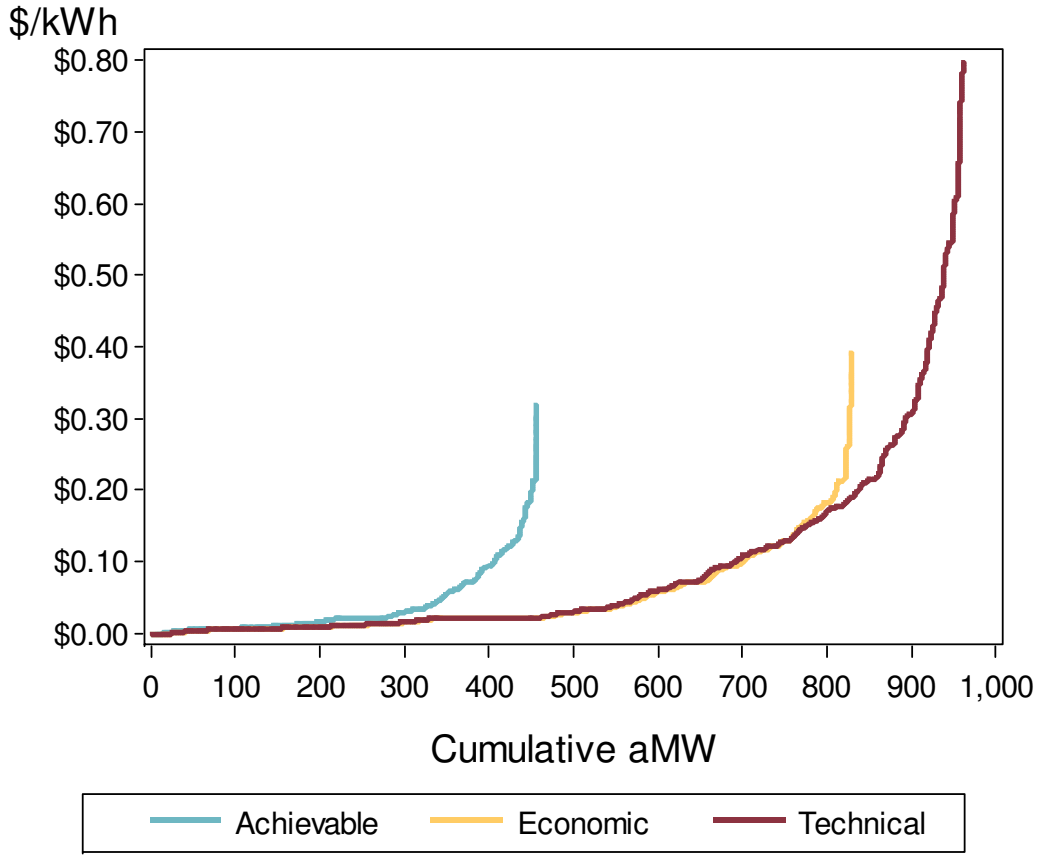
The role of CPA in the larger scheme of resource planning



The results:
What are the typical outputs of a CPA

- Available resource potential (MWh, MW, aMW)
  - Resource type (energy efficiency, demand response, etc.)
  - Potential by type (technical, economic, market – or achievable)
  - Potential by area, sector, segment, end-use, measure
  - Potential by availability (timing): retrofit versus lost opportunity
- Resource costs (cost of conserved energy, CCE)
  - Total cost
  - Levelized, per unit costs
- Cost effectiveness
  - Total resource cost (TRC)
  - Also utility and participant perspectives

The results:
The typical energy efficiency supply curve



Types of energy efficiency potential

- **Technical potential:** the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints
- **Economic potential:** the subset of the technical potential that is cost effective as compared to conventional supply-side energy resources
- **Achievable potential:** the amount of energy use that efficiency can realistically be expected to displace, taking into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time
- **Program potential:** the efficiency potential possible given program funding levels and designs and acceptable rate impacts
- **Naturally occurring potential:** efficiency potential gains resulting from normal market forces – technological improvement, energy prices, etc.

Estimating technical potential

- Estimating Technical potential = $\Sigma(SAVE_{mij})$

  $SAVE_{mij} = EUC_{eij} \times PCTSAV_{mij} \times APP_{mij} \times LIFE_{mij}$

  For each measure (m), end-use (i), customer segment (j) and equipment (e):

  SAVE = *annual energy savings (kWh)*

  EUC = *calibrated annual end-use equipment energy consumption*

  PCTSAV = *measure savings as % of EUC*

  APP = *measure applicability (fuel shares, saturations, technical feasibility, measure interactions and stacking)*

  LIFE = *expected life of measure (years)*

- Treatment of naturally occurring conservation (end-use efficiency assumptions, market driven conservation, codes and standards)
- Interactions
  - Technical measure interactions
  - "Stacking" effect

Determining economic potential

- Methodology consistent with “Standard Protocols” adjusted for the Northwest
  - Screening criterion: Total Resource Cost Test: NPV(b) / NPV(c) > 1
- Benefit components:
  - Avoided supply costs:
    - Avoided hourly generation costs
    - Avoided capacity costs
    - Avoided line losses
    - Deferred T&D expansion costs
  - Northwest conservation credit
  - Avoided non-energy costs (water, etc.)
- Cost components:
  - Incremental installed measure costs (labor and material)
  - On-going O&M (where applicable)
  - Program administration (program development, delivery, marketing, etc.)- 15% of installed measure cost, adjusted for inflation
  - Incentives (demand response only)

Estimating achievable potential

- Why is it important?
- Working hypotheses:
  - Projection of achievable potential is necessary for planning
  - Actual level of achievable potential is a function of:
    - Incentive levels
    - Length of the planning horizon and past program activity
    - Customer sector and vintage
  - There are a number of ways for approximating achievable potential:
    - Baselining (using historical experience)
    - Benchmarking (best practices, other potential studies and evaluations)
    - Baselines (historical experience)
    - Market surveys (customers' willingness to participate)
    - Professional judgment (survey of experts, focus groups, etc.)
  - There is no one right method for projecting achievable potential
  - Projections are subject to uncertainty (technological, economic, market, and regulatory)

Data modeling: available options

- Data modeling techniques for CPA vary greatly depending on complexity, level of resolution and, of course, cost. Choice of approach depends largely on the purpose CPA in expected to serve.

- There are several levels (more or less) of analysis one may consider. The choices are:
  - Council Conservation Calculator Option: Take utility share of Council's CPA target
  - Modified Conservation Calculator Option: Adjusting Council's CPA for utility-specific factors
  - Individual Utility analysis option: Use non-Council model, likely need consultant

CPAs: Objectives and Data Requirements

Conservation Potential Assessment Workshop
Bonneville Power Administration

September 8, 2008

Presented by:

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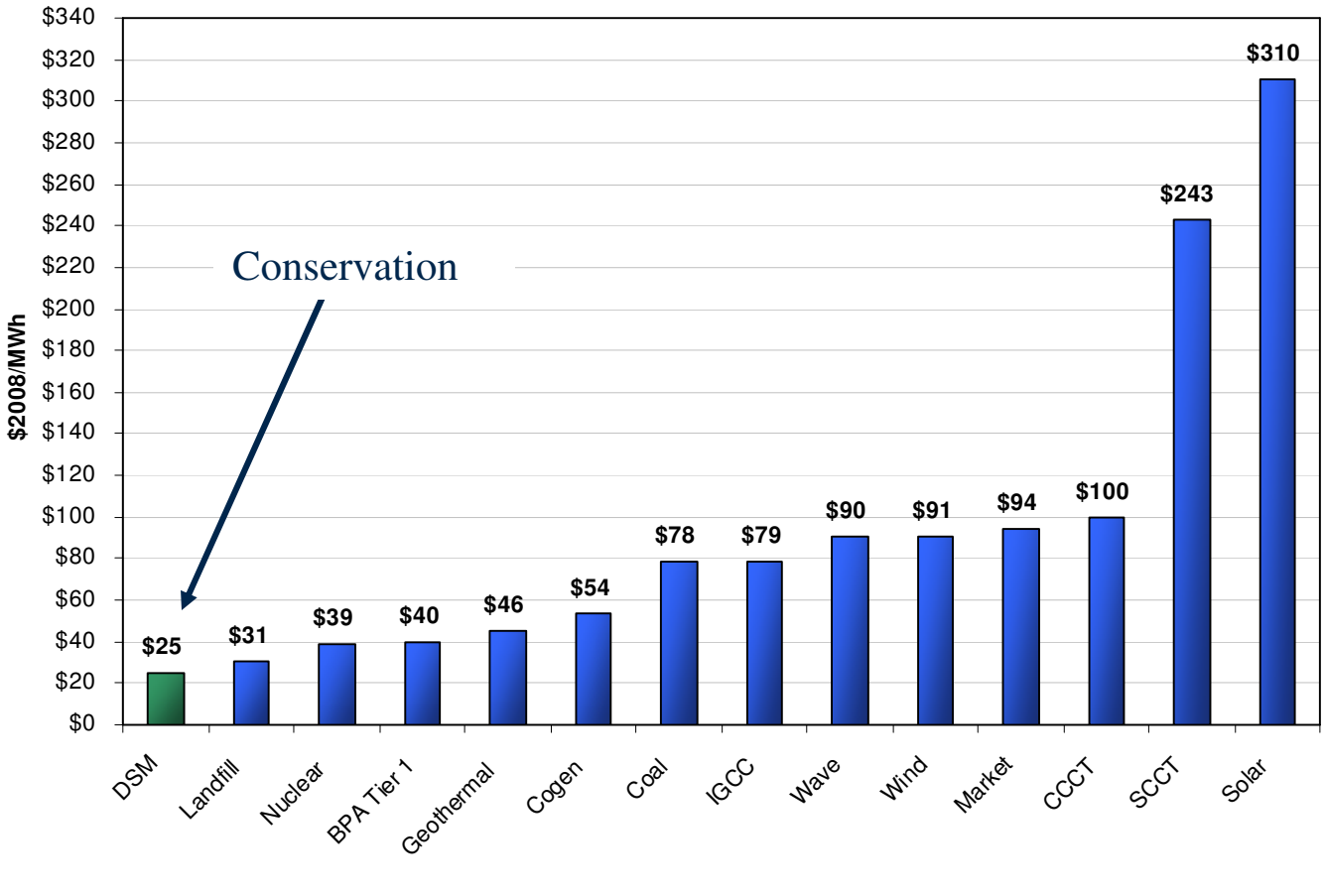
EES Consulting

Presentation Outline

- **Why Conservation?**
- **Why Conduct a Conservation Potential Assessment?**
- **CPA Process Overview**
- **Conservation Potential Study Data Requirements**
  - Customer characteristics data
  - Measure data
  - Historic conservation achievements

Why Conservation?

- **Conservation resources compare well with supply side resources**
  - Lower Cost
  - Lower Risk
- **Conservation as a resource and a customer service**



Why conduct a CPA?

- How much conservation is available and at what cost?
- When is it available?
- Identify new technologies, measures or practices
- Identify where potential exists – what programs have the most potential?
- Collect data for service territory
- Compare end-use energy consumption and available potential
- Meets requirements for state laws regarding energy efficiency acquisition – i.e., setting conservation targets
- Facilitate conversation regarding:

Strategies

Achievement

Uniqueness of Service Territory

Resource Goals

Energy Efficiency as a Resource

Cost Effectiveness

Technologies

Acquiring Conservation Resources

Original Research – Market and Measure Data Development

Conservation Potential Assessment

Plan and Implement Programs, Evaluate Programs

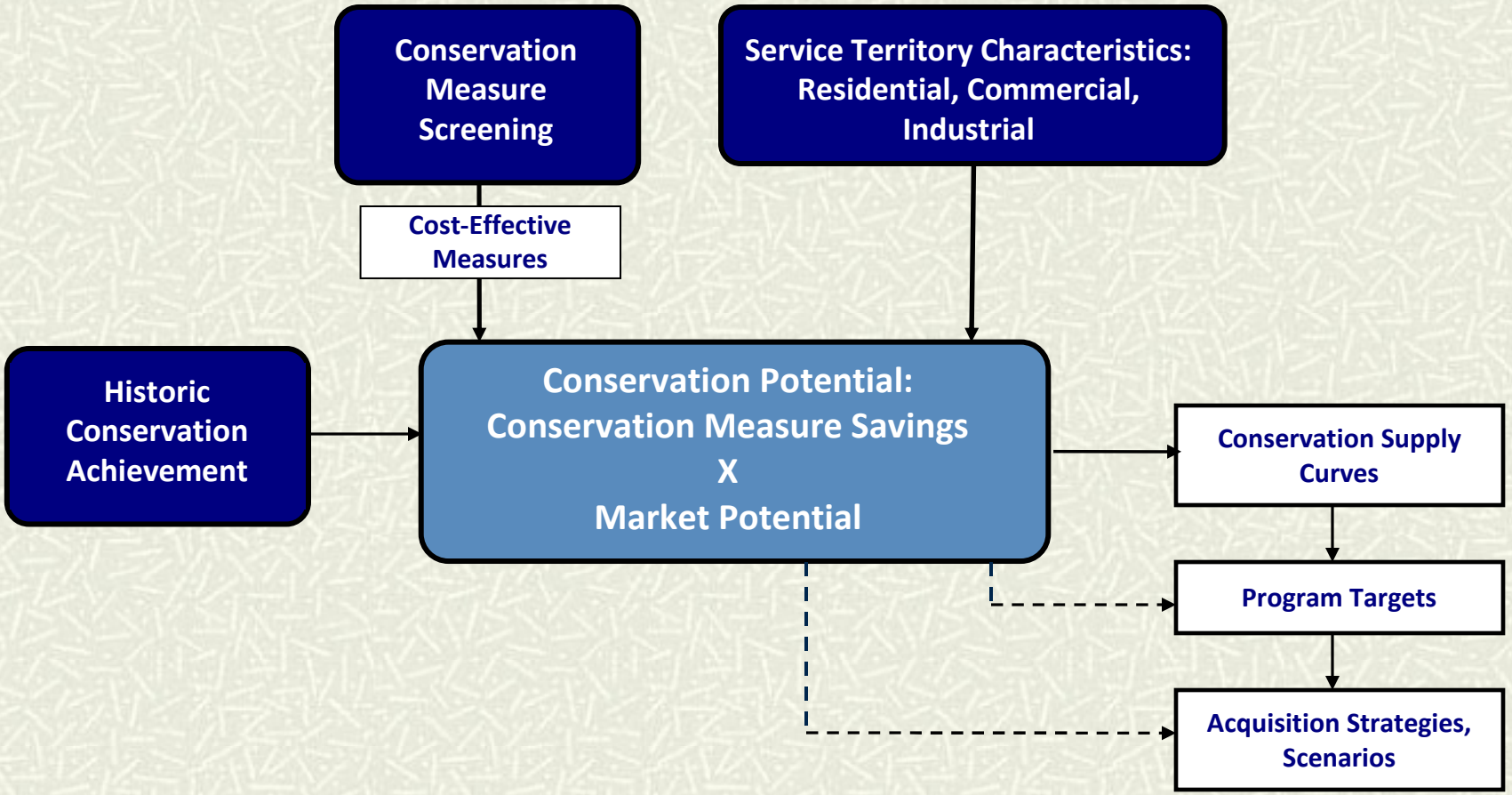
Customer Surveys

Building Stock Assessments

Efficient Shower Head

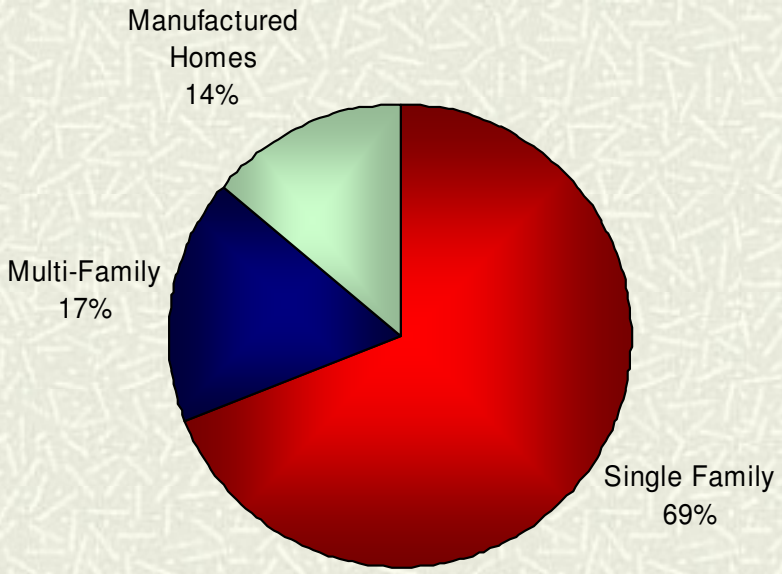
Heat Pumps

Conservation Potential Assessment Process



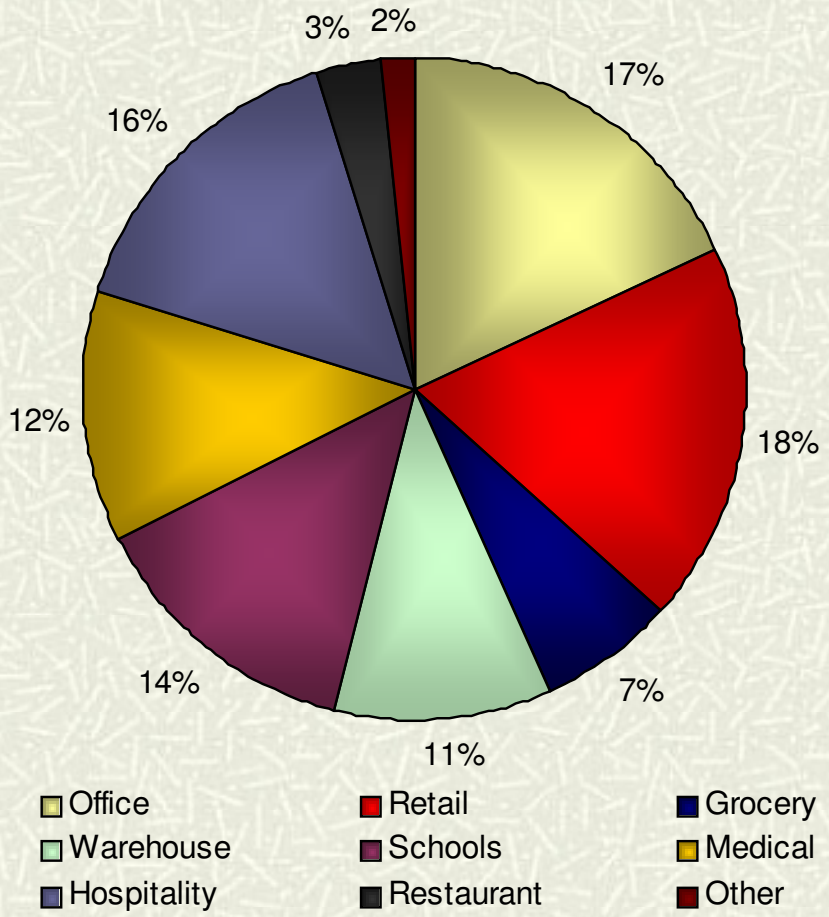
Service Territory Characteristics

- **Number of customers by customer class (Residential, Commercial, Industrial, Agriculture)**
- **Consumption by customer class**
- **Residential and commercial growth rates (and demo rates)**
- **Load forecasts**
- **Segment characteristics**
  - Residential
    - ✓ %single family, multifamily, mobile
    - ✓ Average square feet of floor area, window area
    - ✓ Home vintages
    - ✓ Heat types (e.g., % gas, % electric)
    - ✓ System types (e.g., heat pump vs. zonal)
    - ✓ CFL saturation



Service Territory Characteristics (cont.)

- **Segment characteristics (cont.)**
  - Commercial
    - ✓ Load by segment (e.g., office, retail, grocery, schools, etc.)
    - ✓ Floor area by segment
    - ✓ Number of buildings by segment
    - ✓ Heat types
    - ✓ Amount and type of AC
    - ✓ Measure saturation, especially lighting
  - Industrial
    - ✓ Major industrial customer loads
    - ✓ Industrial customer types (NAICS Codes)
    - ✓ Measure saturation
  - Agriculture
  - Other
    - ✓ Street lighting
    - ✓ Traffic Signals



Service Territory Data Sources

- **Your CIS system and other databases**
- **Customer Surveys**
- **Regional Surveys**
- **City/County/State Databases**
- **Economic Development Councils**
- **Census Data (Office of Financial Management Washington State)**
- **Pacific Northwest Regional Economic Analysis Project**
- **Industry Experts**
  - Commercial Realtors
- **National databases (e.g., InfoUSA, FW Dodge)**
- **Other ideas?**

Measure Screening

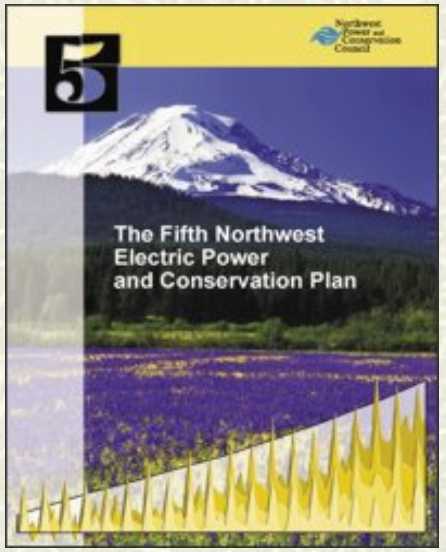
- **Measure Data**
  - Measure energy savings (incremental)
  - Measure cost (incremental)
    - ✓ Equipment
    - ✓ Labor
  - Measure life
  - Increased or decreased O&M costs
  - Non-energy benefits
  - Conservation load shapes
  - Avoided T&D losses
  - Value of deferred T&D
- **Program administrative costs**
- **Financial parameters (e.g., discount rate)**
- **Avoided cost (e.g., price forecast)**

Benefit/Cost Ratio =

$$\frac{\text{Present Value of Benefits (\$)}}{\text{Present Value of Costs (\$)}}$$

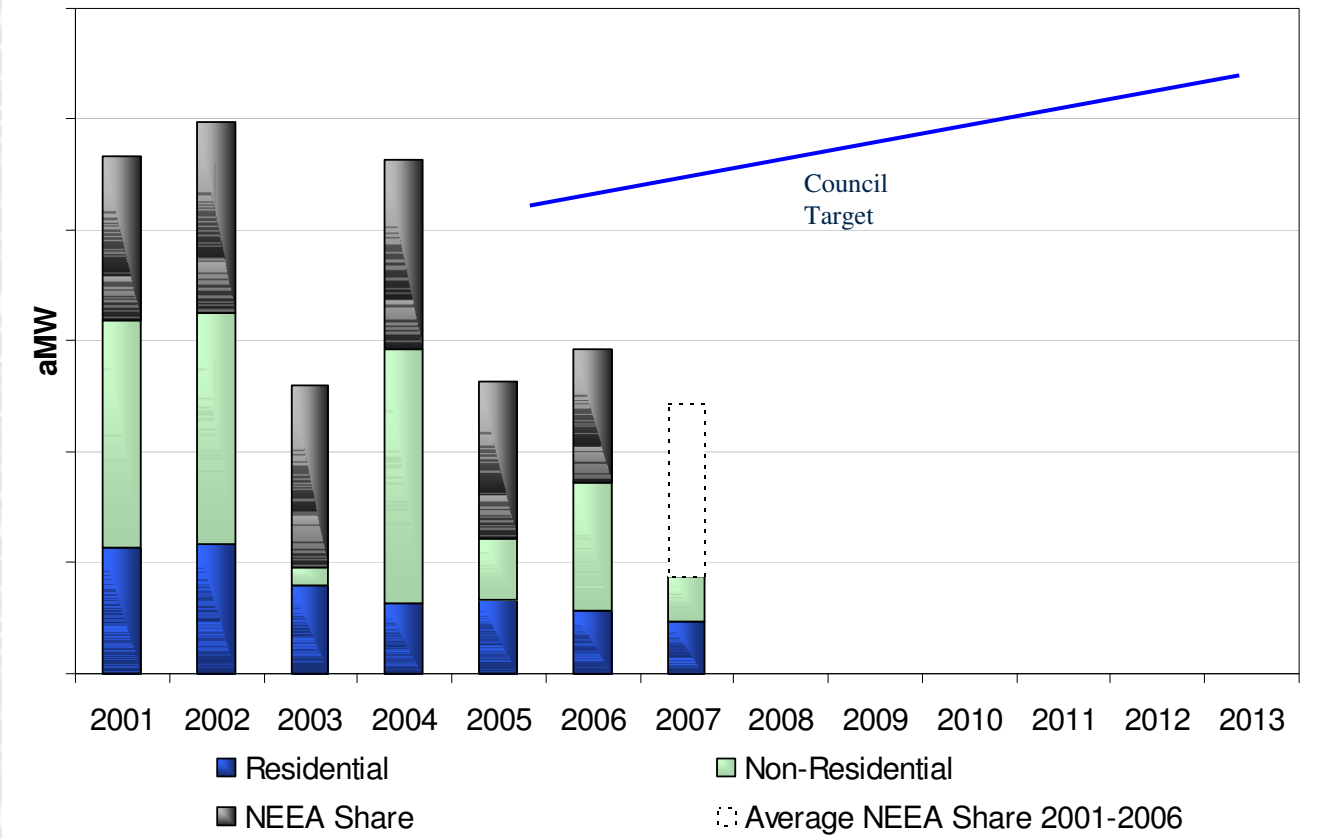
Measure Data Sources

- **Program evaluation reports**
- **Northwest Power and Conservation Council and Regional Technical Forum**
  - 5th Power Plan Data
  - 6th Power Plan Data (under development)
  - PTR
- **Other regional sources**
  - Peer utilities
  - NEEA
  - Other potential studies and related research
- **National**
  - California Database For Energy Efficiency Resources (DEER)
  - Energy Star
  - CEE
  - DOE and other government research



Current/Historic Conservation

- **Measure saturation**
  - Baseline conditions
- **Achievability rates**
- **NEEA Share**
  - From BPA
- **For reference, check the Council's Target Calculator**
- **Compare with results of CPA**



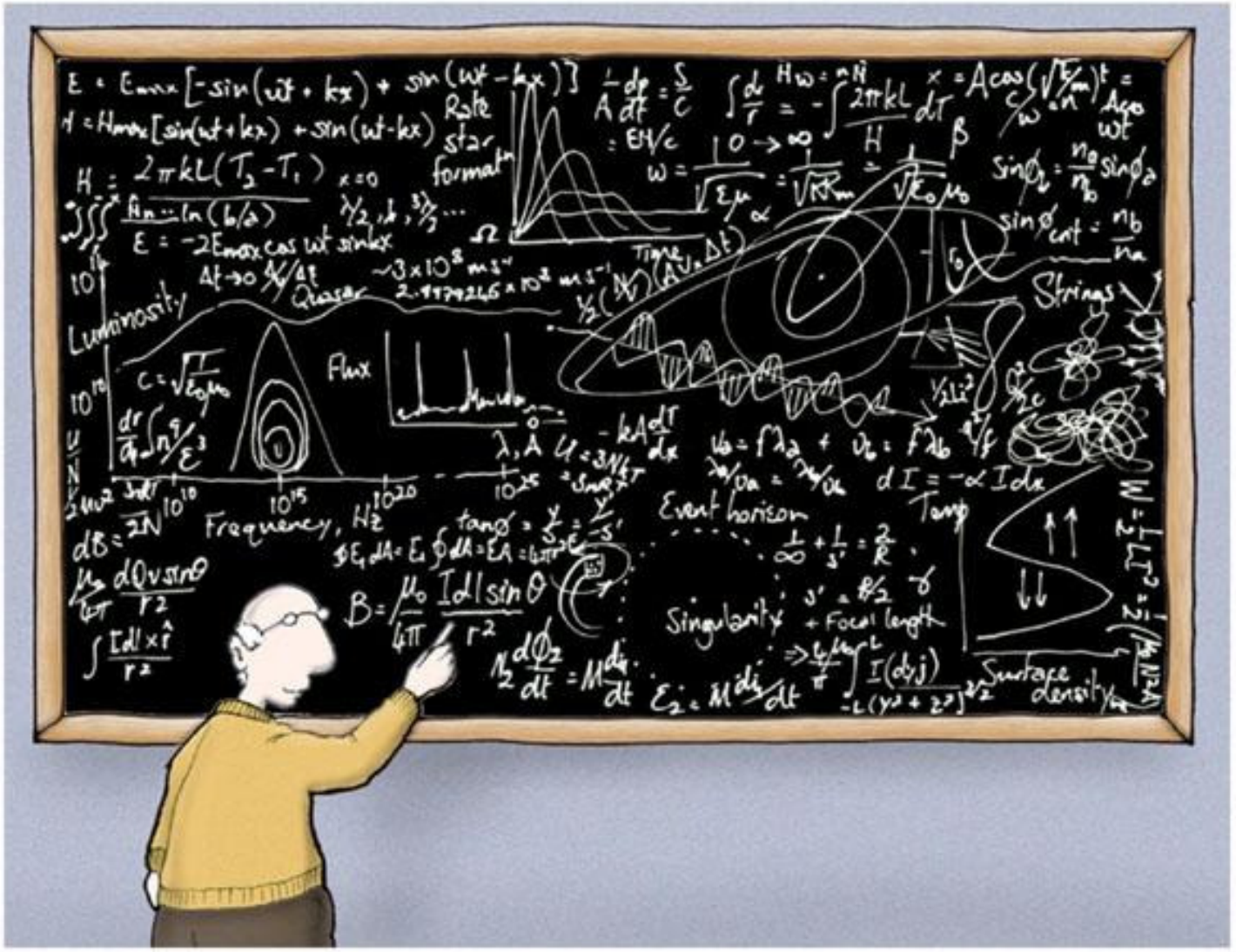
Summary

- **Begin with your unique service territory**
  - Who are your customers and how are they using energy now?
  - What programs have been successful?
  - Be open to changes
- **Be willing to act on the results of a CPA**
  - Pick a few programs and do them well – build from there
  - Educate
  - Tracking system(s)
  - Marketing and promotion
  - Evaluation

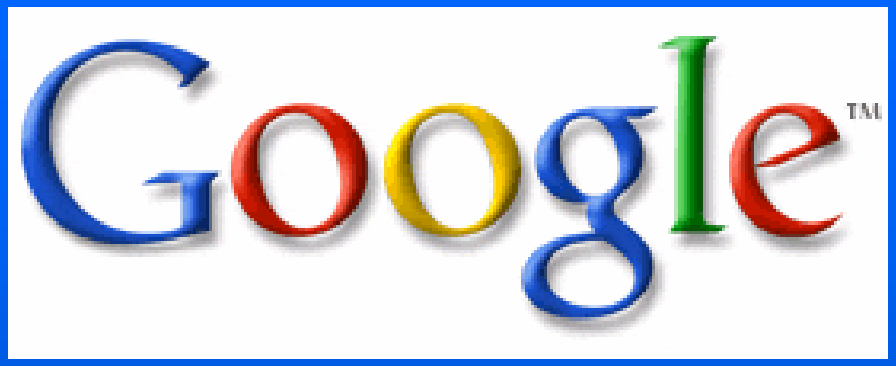
Council Conservation Resource Potential Assessment Methodology

Tom Eckman
Manager, Conservation Resources
September 8, 2008

Northwest Power and Conservation Council



How Do We Know How Much is Left To Do?



Web Images Groups Directory News

PNW Efficiency Potential

I'm Feeling Lucky Google Search

- Advanced Search
- Preferences
- Language Tools

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It's *Only* a Six Step Process

- Step 1 - Estimate ***Technical Potential*** *on a* ***per application*** *basis*
- Step 2 – Estimate ***Economic Potential*** *on a* ***per application*** *basis*
- Step 3 - Estimate number of ***applicable units***
- Step 4 – Estimate ***Technical Potential*** *for* ***all*** *applicable units*
- Step 5 - Estimate ***Economic Potential*** *for* ***all*** *applicable units*
- Step 6 – *Estimate* ***Realizable Potential*** *for* ***all realistically achievable*** *units*

Before You Start – Decide On A Cost-Effectiveness Metric

- Participant Cost Test (PTC)
  - Costs and benefits to the program participant
- Total Resource Cost (TRC)
  - All Quantifiable costs & benefits regardless of who accrues them. Includes participant and others' costs
- Utility Cost Test (UTC)
  - Quantifiable costs & benefits that accrue only to the utility system. Specifically excludes participant costs
- Rate Impact Measure (RIM)
  - Net change in electricity utility revenue requirements.
    - » Attempts to measure rate impact on all utility customers especially those that do not directly participate in the conservation program
    - » Treats "lost revenues" (lower participant bills) as a cost

The Basic Formula

Achievable Potential **=**

Number Units * Cost-Effective kWh per Unit * Market Penetration

Number Homes,
Floor Area of Retail
Number of TVs,
Acres Irrigated,
Pounds Steel

(kWh/Unit at Current Efficiency – kWh/Unit at Cost-Effectiveness Limit of Efficiency)

Current Efficiency is adjusted for adopted codes & standards and stock turnover (Frozen Efficiency)

Cost-Effective Limit of Efficiency is estimated from Portfolio Model Results. It is based on the cost of the next lowest cost resource available to meet load.

Fraction realistically achievable over time

Inputs to Resource Potentials Assessment Methodology

- Availability
  - Scope of measures
    - » Technologies
    - » Practices
  - Applicability territory
    - » Number of units
    - » Units savings
  - Achievable over time
    - » Retrofit
    - » Lost-Opportunity

- Costs
  - Materials & labor
  - Annual O&M
  - Periodic Replacement
  - Program Admin
  - Financing costs
  - Externalities
  - Other non-electric

Generic Methodology for Estimating Conservation Resource Potential & Targets

Measure Cost

- Program Data
- Contractor Bids
- Retail Price Surveys

Measure Savings and Load Shape

- End Use Load Research
- Engineering Models
- Billing History Analysis
- Independent Testing Labs

Measure Lifetime

- Evaluations
- Census Data
- Manufacturers Data
- Engineering Estimates

Supply Curves

- Number of eligible units* savings per unit = aMW
- Lost-opportunity resources
- Non-lost opportunity resources

PROCOST Model

Determines measure and program level "cost-effectiveness" using:

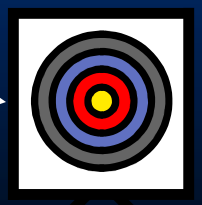
- Measure costs, savings & load shape
- *Aurora Market prices*
- T&D savings (losses & deferred $)
- 10% Act Credit
- Council Financial Assumptions (e.g. Discount Rate, Administrative costs, etc.)

Market Price Model

Provides Forecast of Hourly Avoided Capacity & Energy Costs Under Average Water Conditions

Portfolio Model

Determines NPV of Portfolios with Alternative Levels of Conservation vs Other Resources



Plan's Targets

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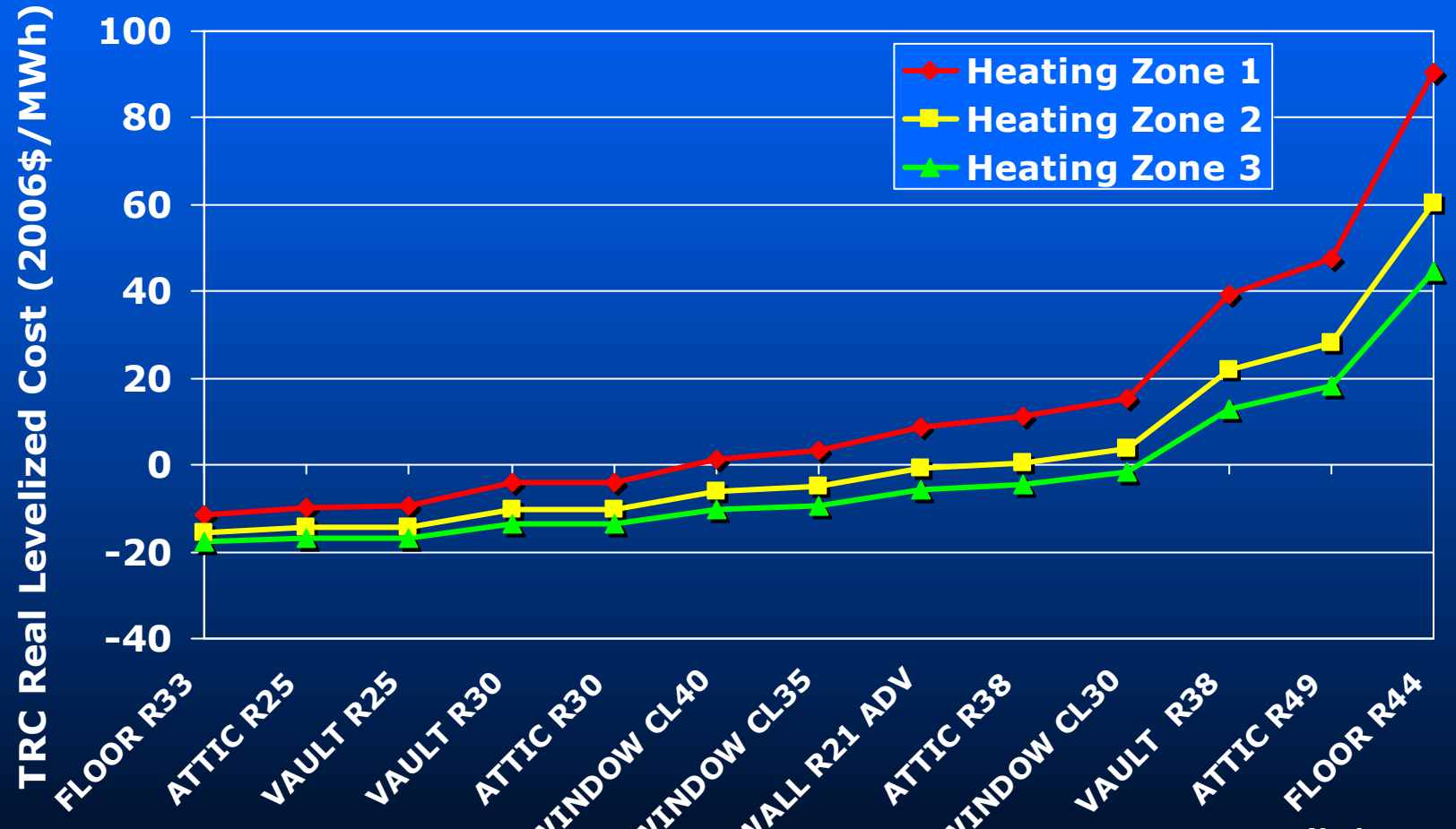
Results of Resource Potential Assessment Methodology

- Summarize availability & cost
  - Supply Curves
  - TRC levelized costs
    - » All Costs (net of benefits) per kWh
  - Lost-Opportunity Supply Curve
  - Retrofit Supply Curve (Non-Lost-Op)
  - Availability timeline
- Apples to apples comparison

Steps 1 & 2
Assessment of "Unit Level" Technical and Economic Potential

Example: Residential Space Heating for New Manufactured Homes



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Steps 1 & 2
Assessment of "Unit Level" Technical and Economic Potential

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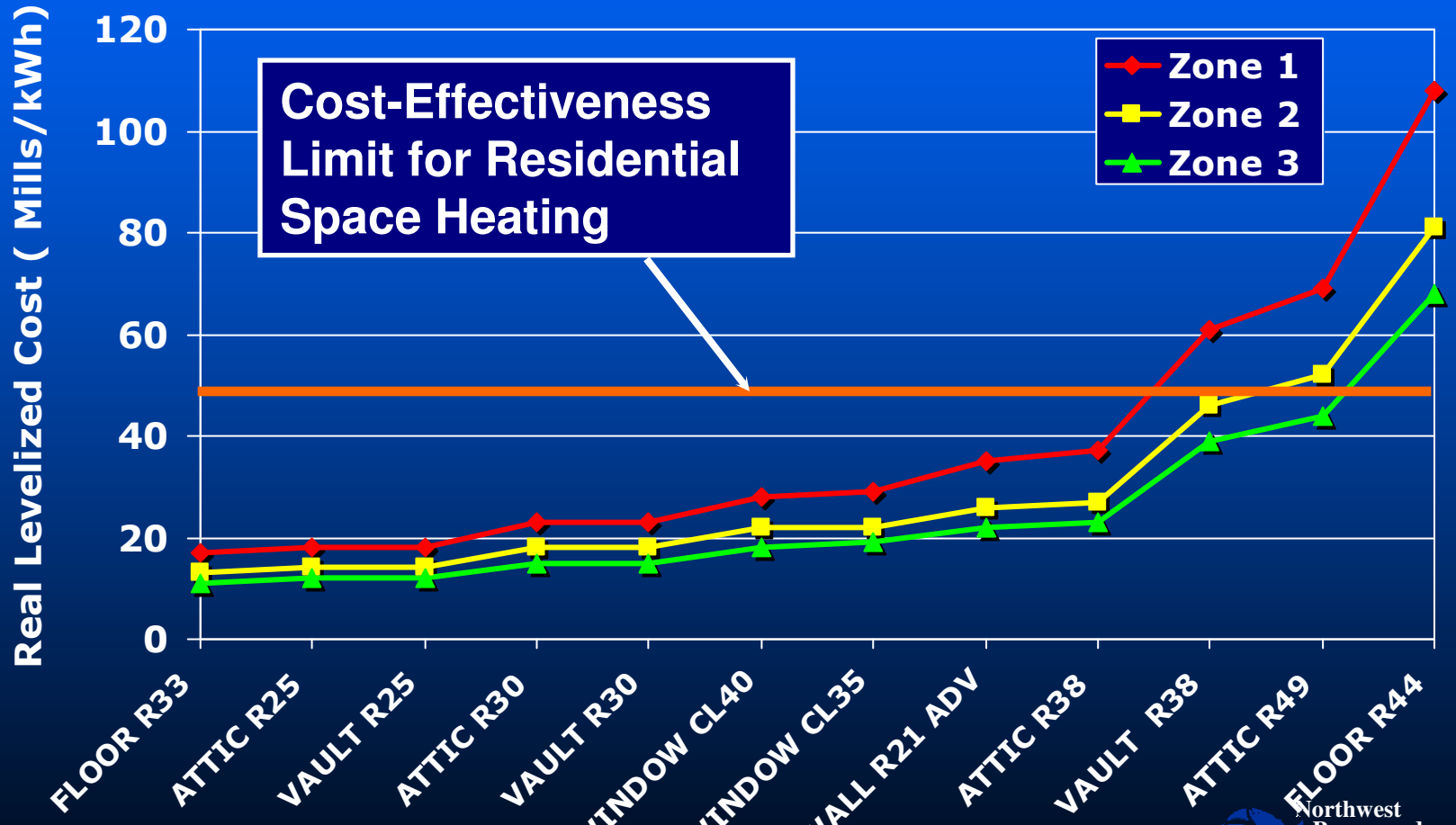

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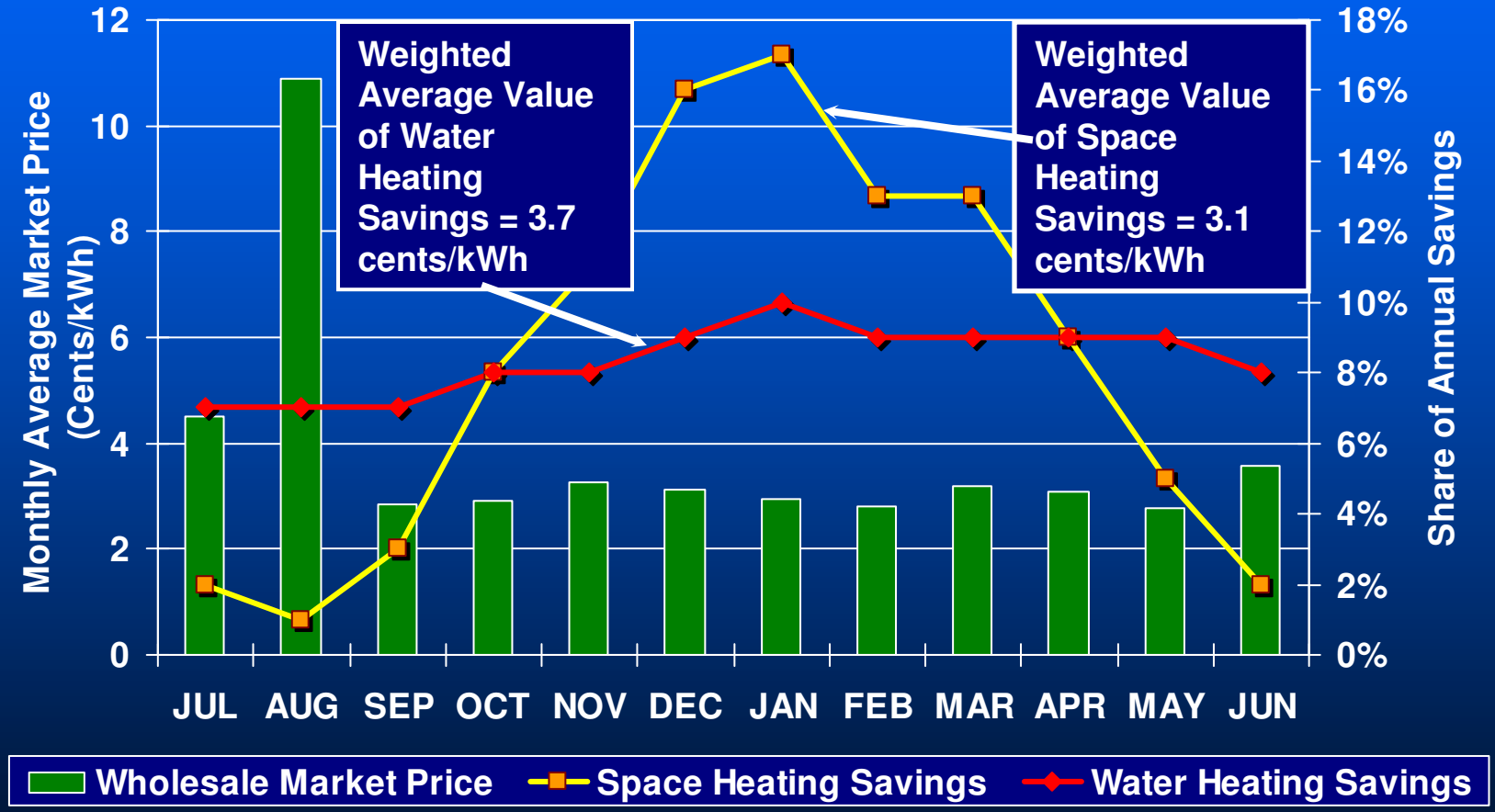
Each End Use Has a Different "Cost-Effectiveness" Limit



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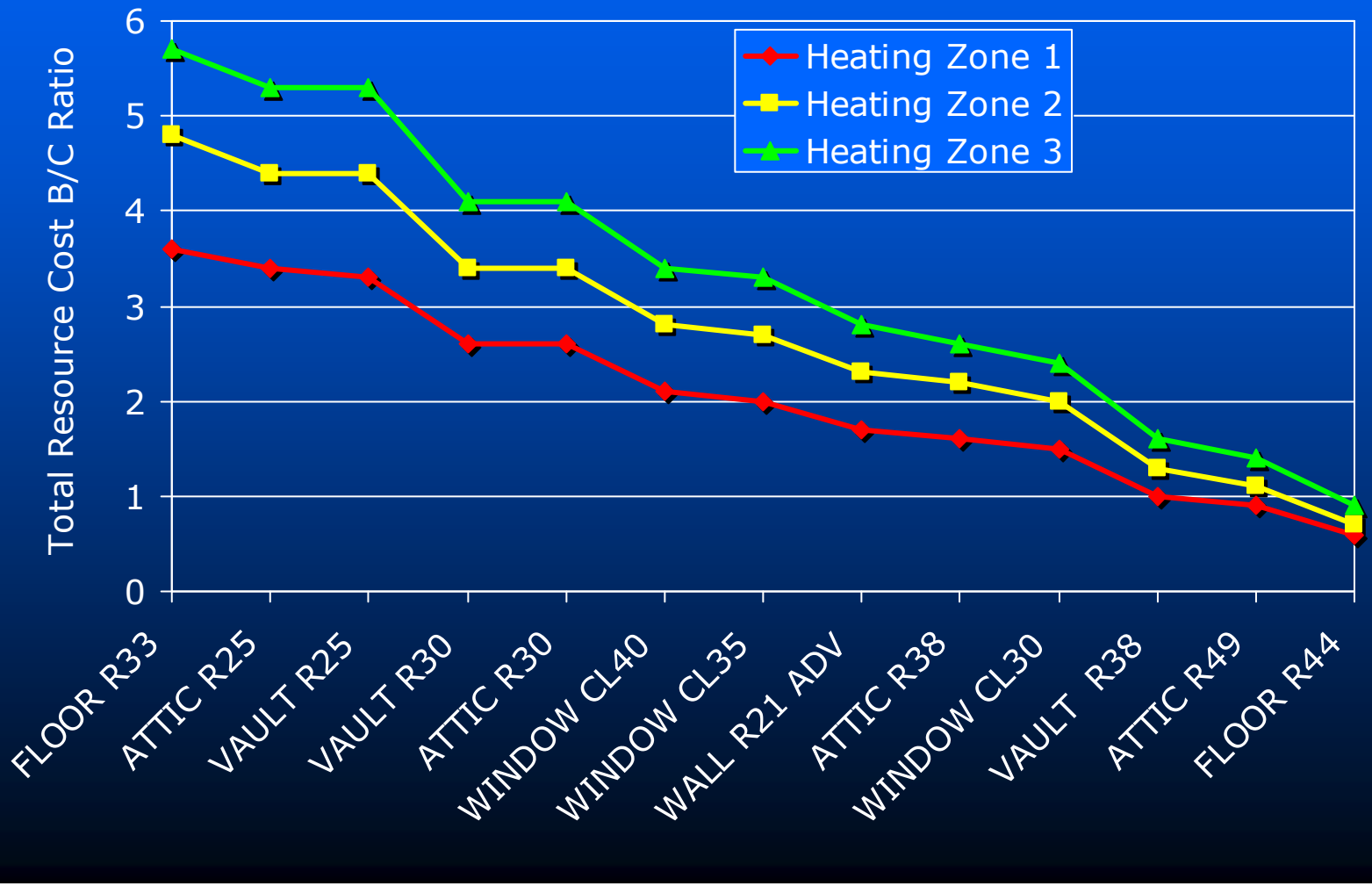


Steps 3 - Estimate of the Number of Applicable Units

Example: New Manufactured Housing

- ***Number of New Electrically Heated Units Sited in PNW by 2030*** = 100,000 (Forecast model estimate)
- ***Location*** (Based on 2005 sales data)
  - Heating Zone 1 = 64 %
  - Heating Zone 2 = 27 %
  - Heating Zone 3 = 9 %
- ***Frozen Efficiency Use*** @ 2005 "Current Practice" = 7600 kWh/year (Characteristics based on survey data from manufacturers & use based on simulation model calibrated to end use metering)
- ***Technical Potential*** unit savings = 3200 kWh/year
- ***Economic Potential (i.e.,Cost-Effective)*** *unit* savings = 3100 kWh/year

Steps 4-6
Derive the Technical, Economical and Achievable Potential

Technical Potential =

3200 kWh/year X 1.09 line loss adjustment

X 100,000 units => 40 MW

Economic Potential =

3100 kWh/yr X 1.09 line loss adjustment

X 100,000 units => 38 MW

Achievable Potential = g3

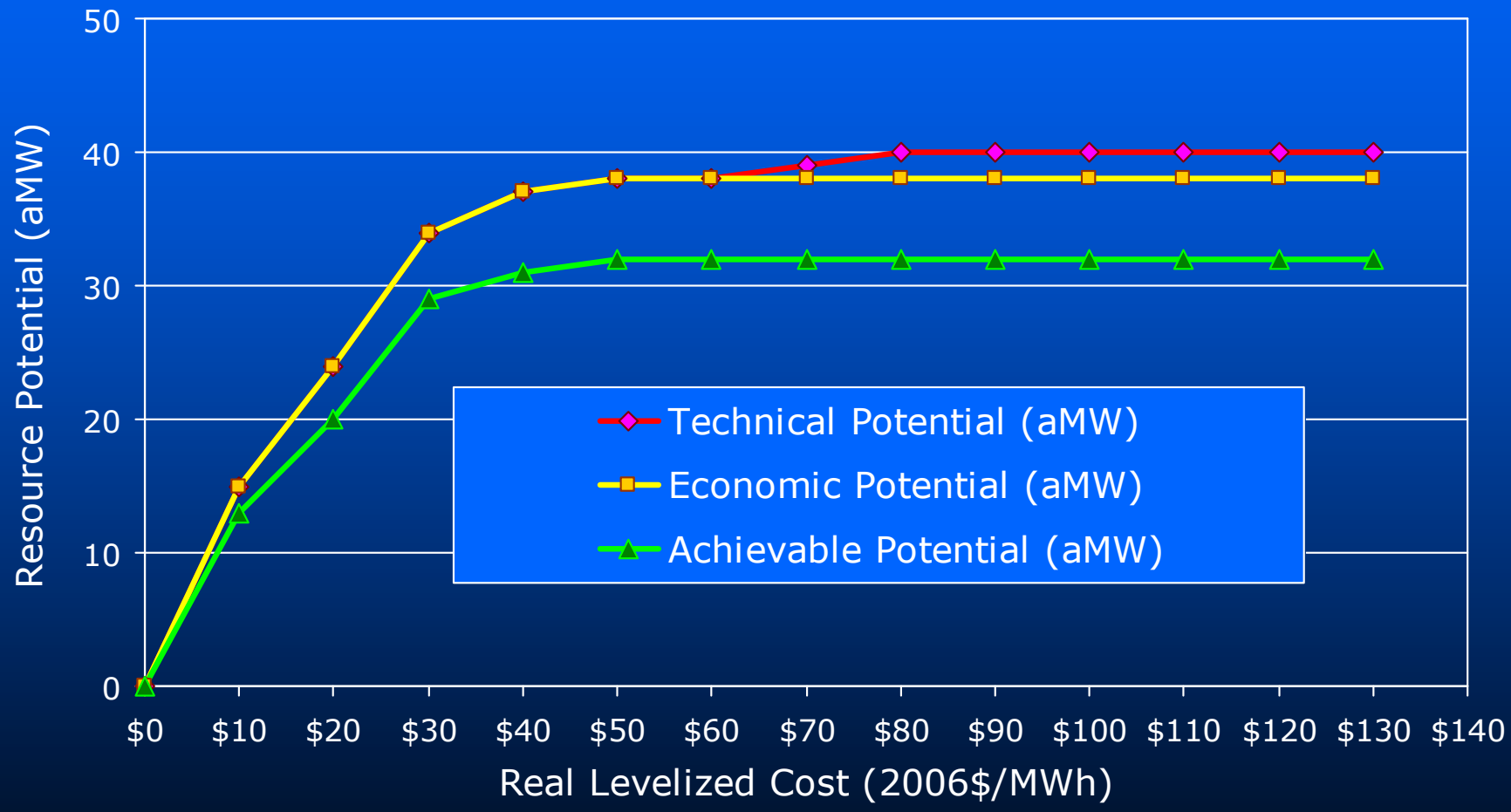
38 MW X 85 % achievable => 32.5 MW

Who Made Up "That Number"?

Slide 15

g3 Added "Achievable"
grist, 5/28/2008

Illustrative New Manufactured Housing Space Heating Resource Potential in 2030



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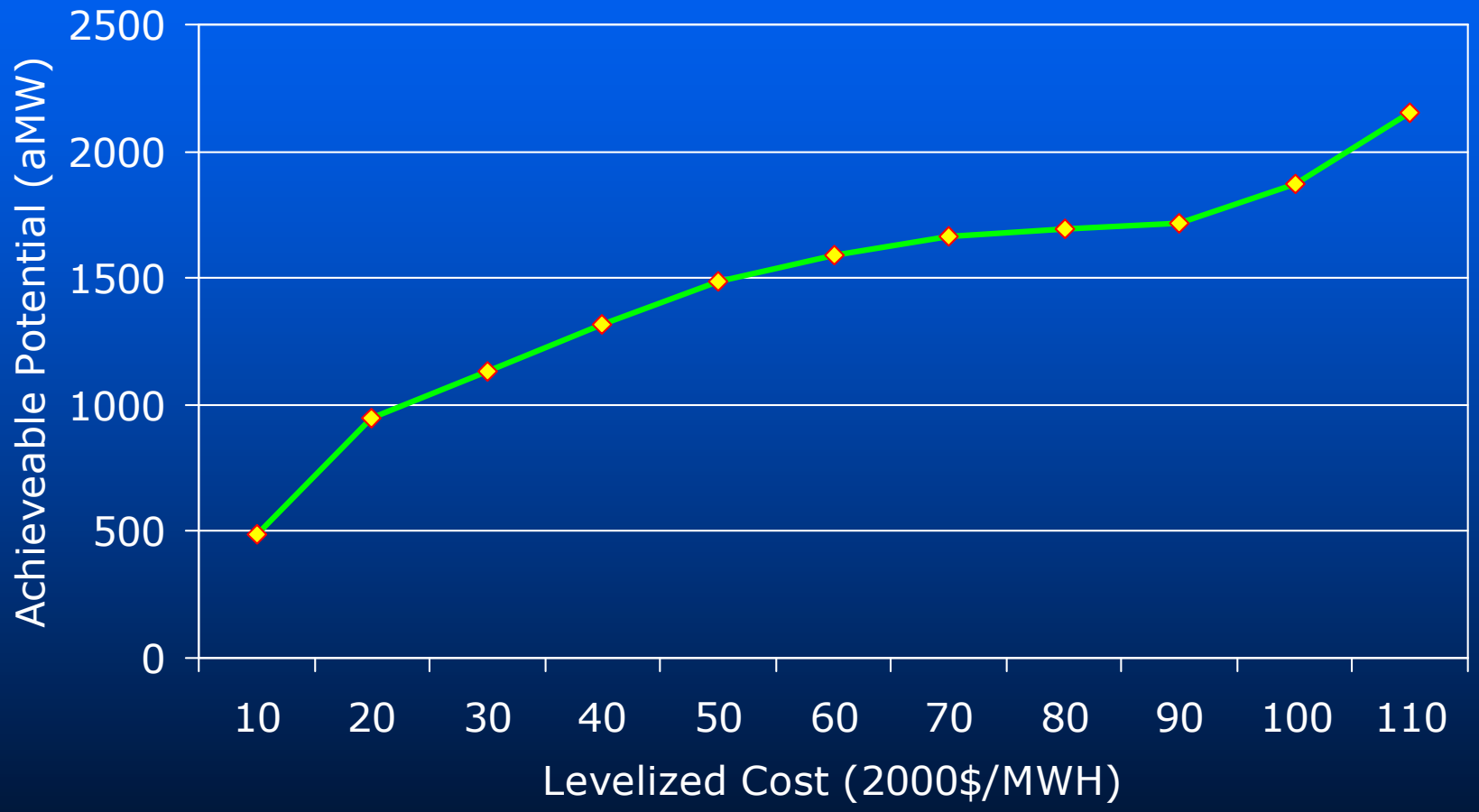
5th Plan's Non Lost-Opportunity Supply Curve



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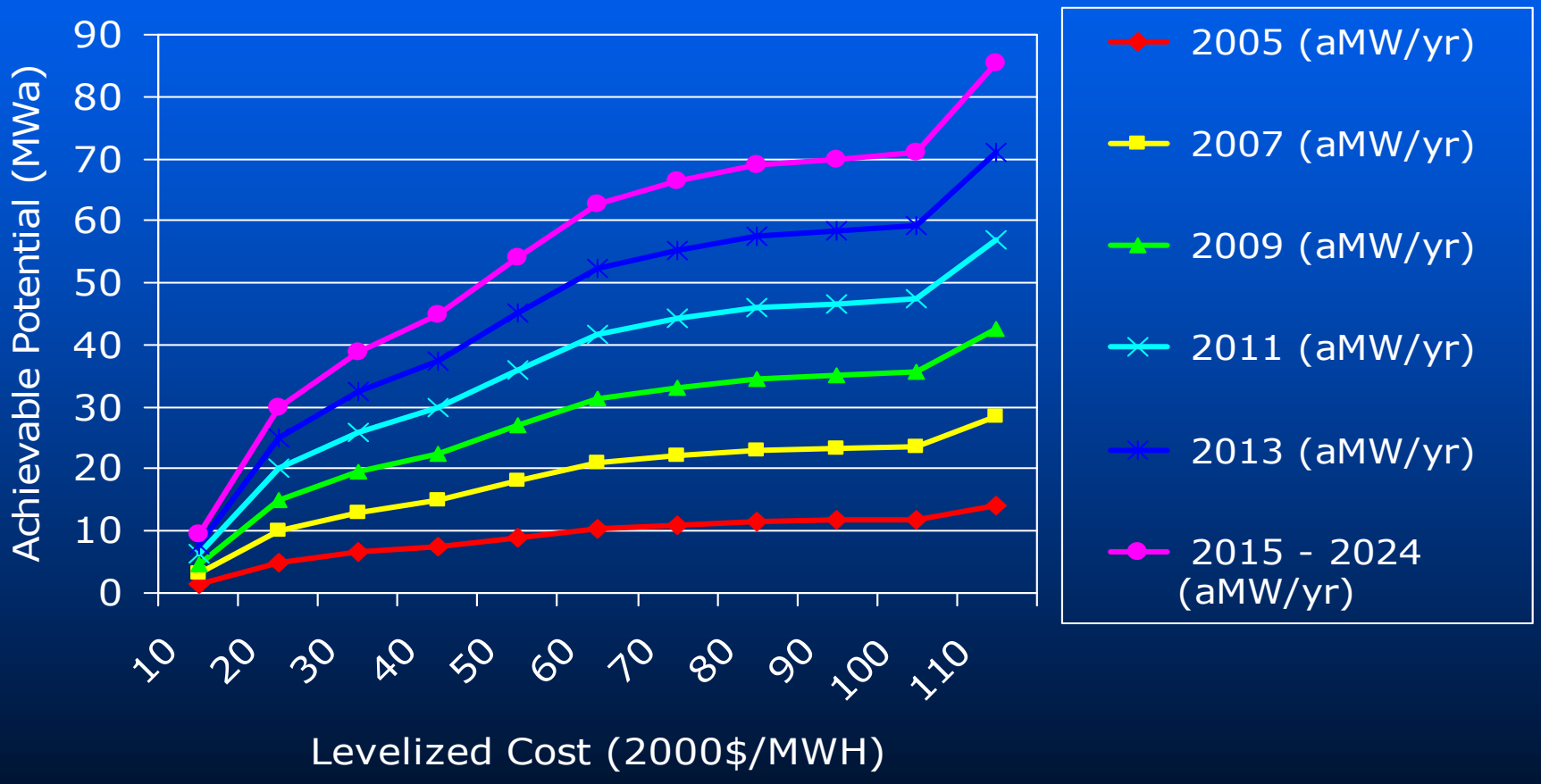
5th Plan's Lost-Opportunity Supply Curves



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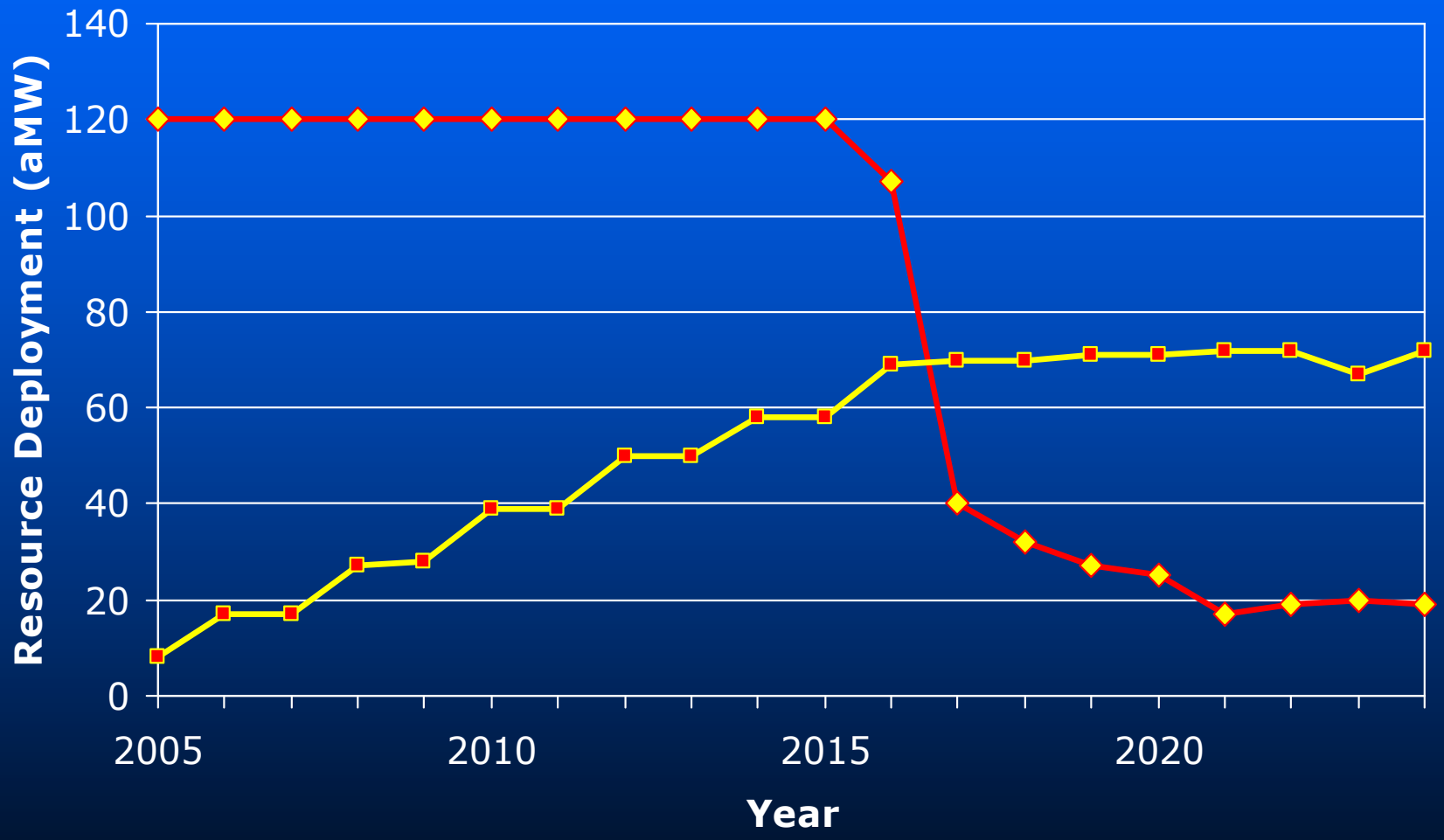
Retrofit Resources and Lost-Opportunity Resources Are Deployed Differently



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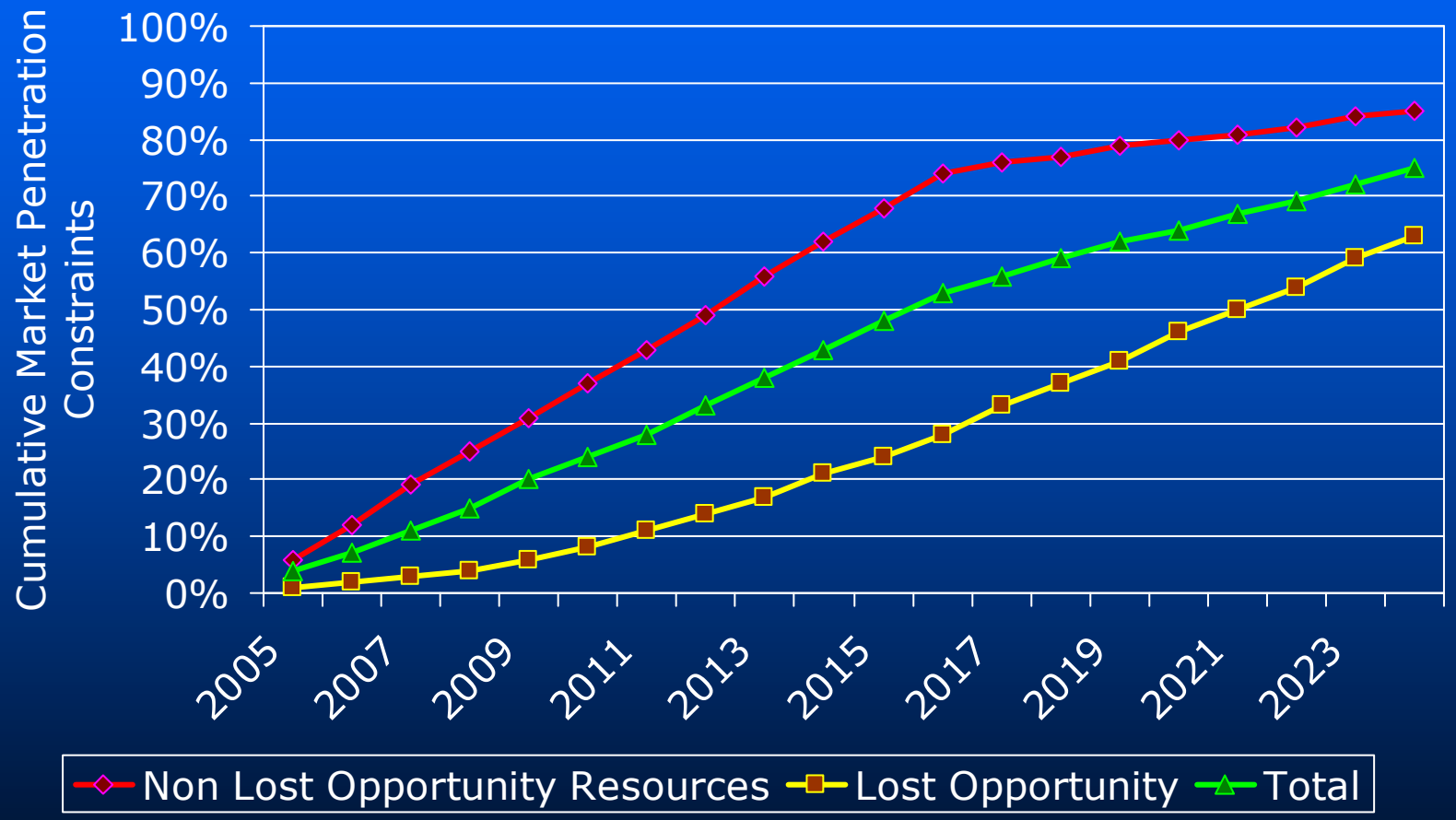
Realizable Potential - The amount of conservation you acquire ***will be*** constrained by "budgets and infrastructure" – NOT by cost-effectiveness



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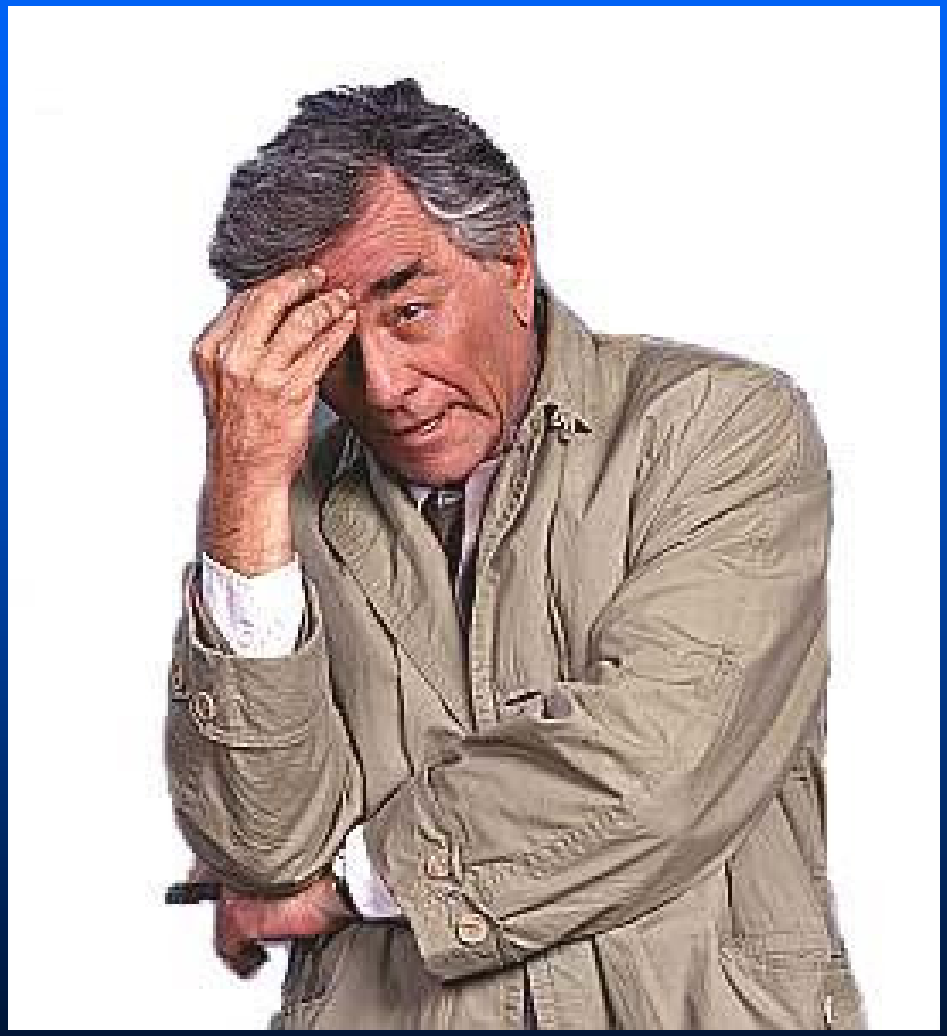
Questions



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The Basic Formula

g1

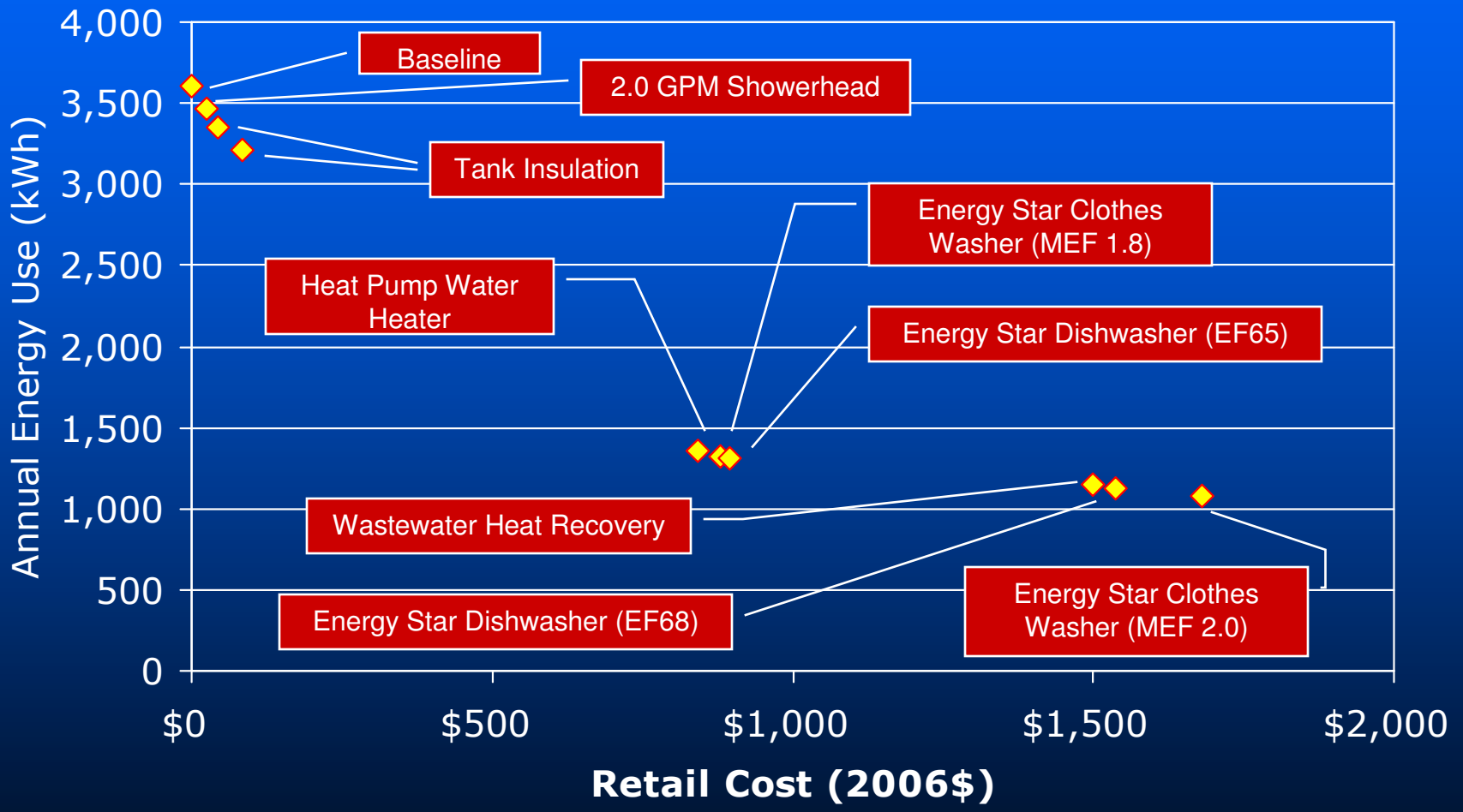
Achievable Potential **=** Number of Applicable Units X (Energy Use @ Frozen Efficiency - Energy Use @ Cost Effectiveness Limit) X Expected Market Penetration

Where :

Frozen Efficiency Use **=** Current efficiency adjusted for stock turnover and adopted changes in codes and standards.

Cost Effectiveness Limit **=** Cost of next similarly available and reliable resource (represented by future wholesale market prices) adjusted for T&D cost deferrals, environmental costs & risks (fuel price, carbon control, etc.) – *Estimated from Portfolio Model Results*

Retail Cost and Efficiency Trade-off Curve Electric Water Heating



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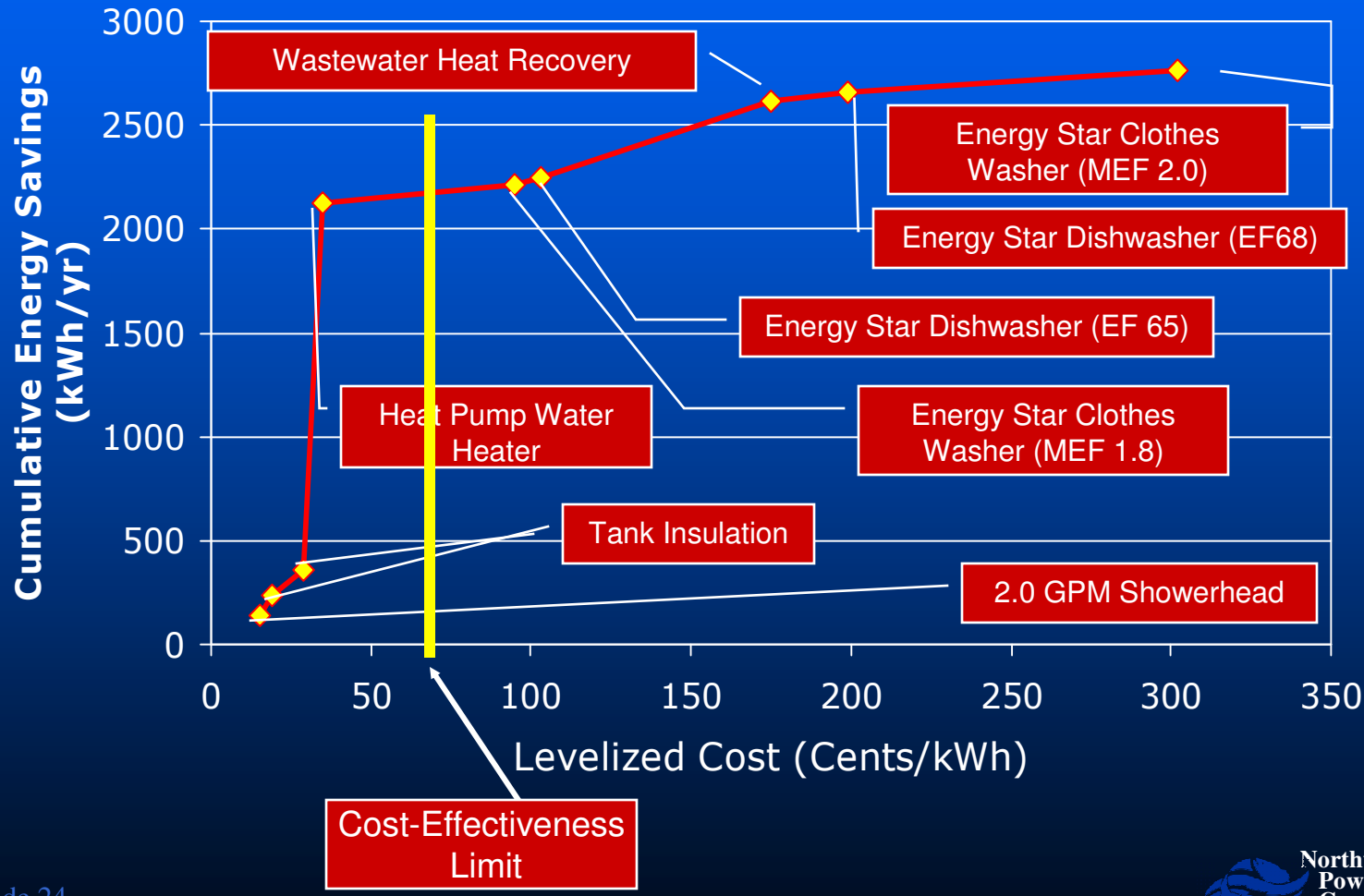
Residential Hot Water Heating Dwelling Unit Supply Curve



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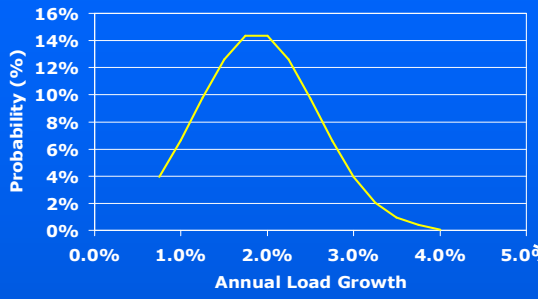
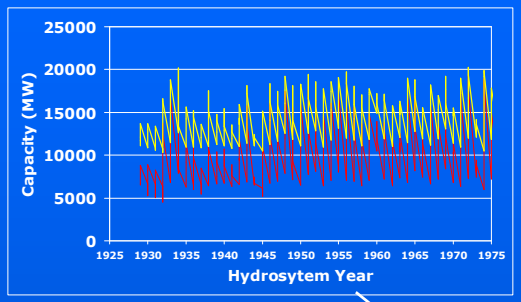
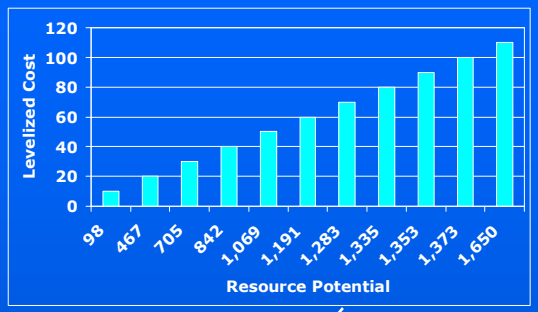
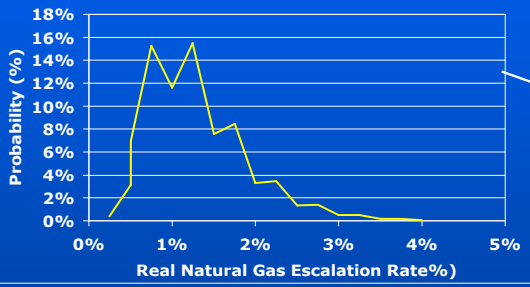
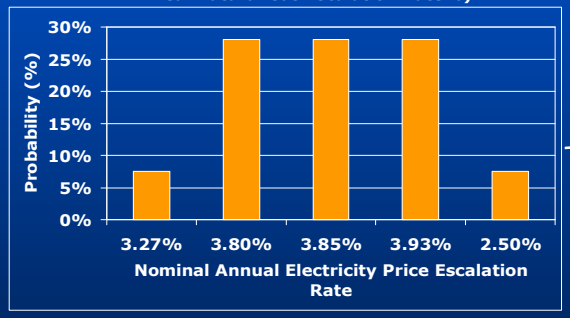
PNW Portfolio Planning – ***Scenario Analysis on Steroids***

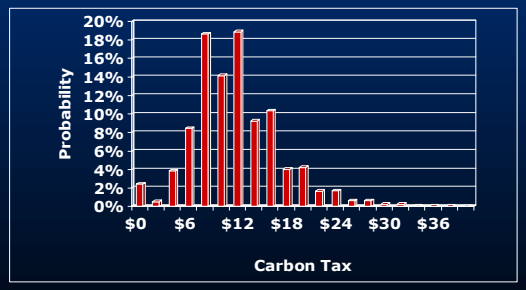


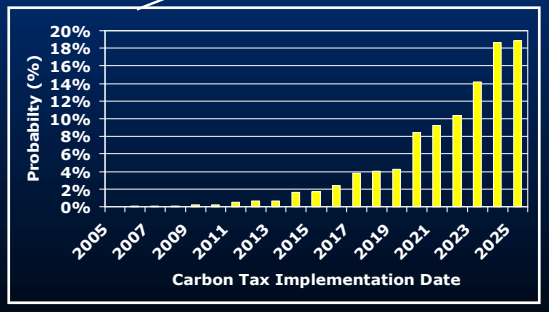






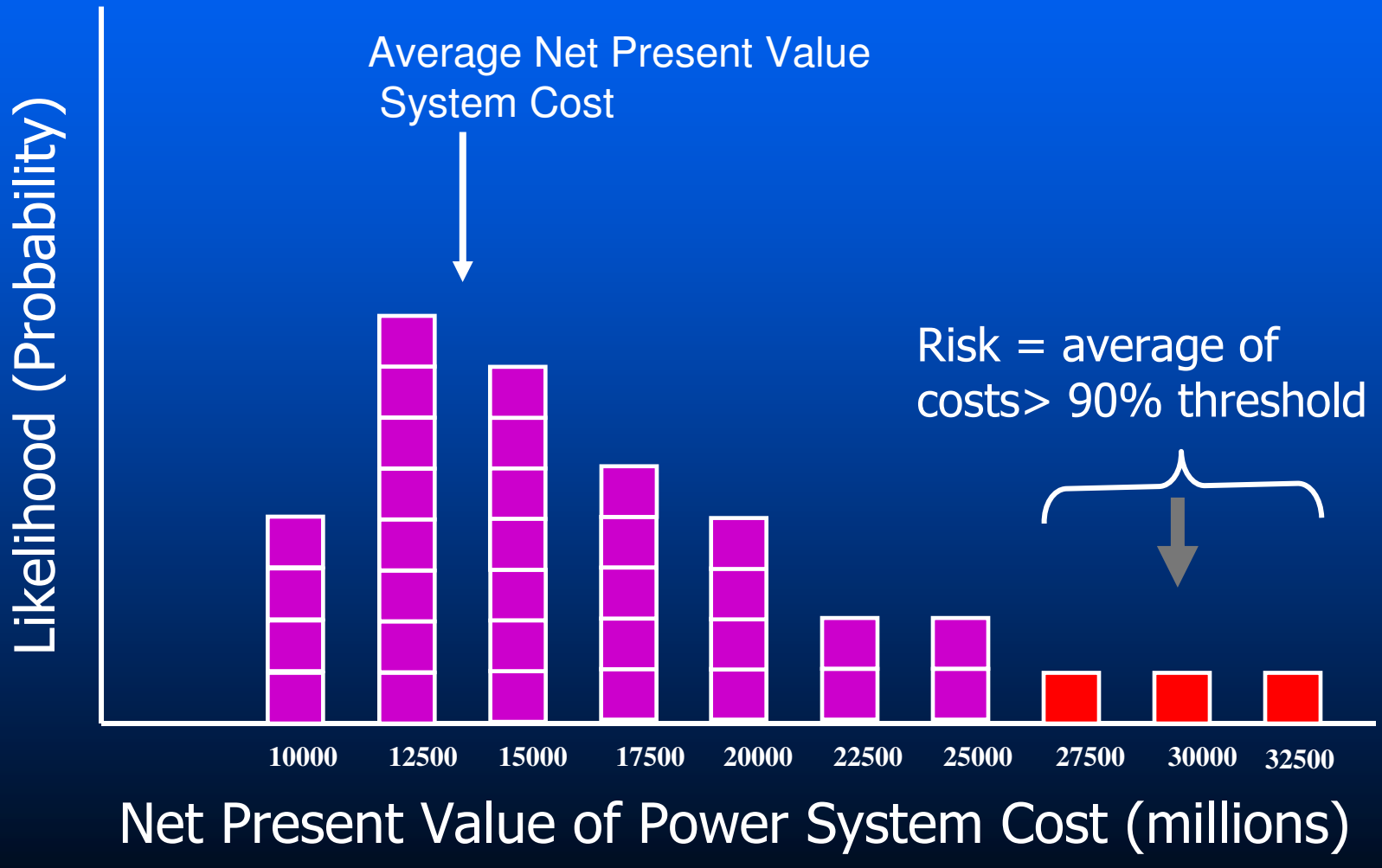




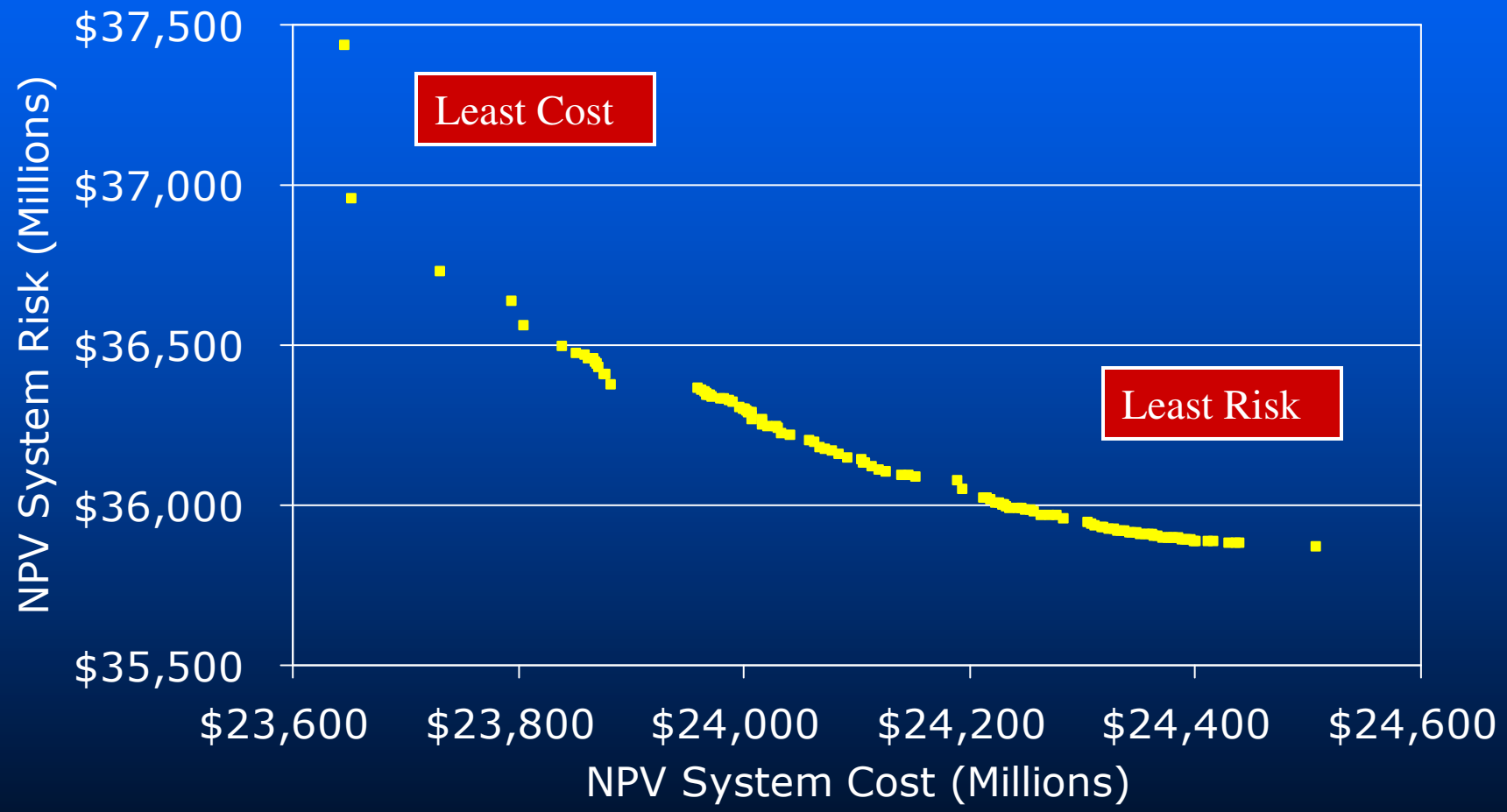


Portfolio Analysis Model

Portfolio Model Calculates Risk and Expected Cost Associated With Each Plan Across 750 "Futures"

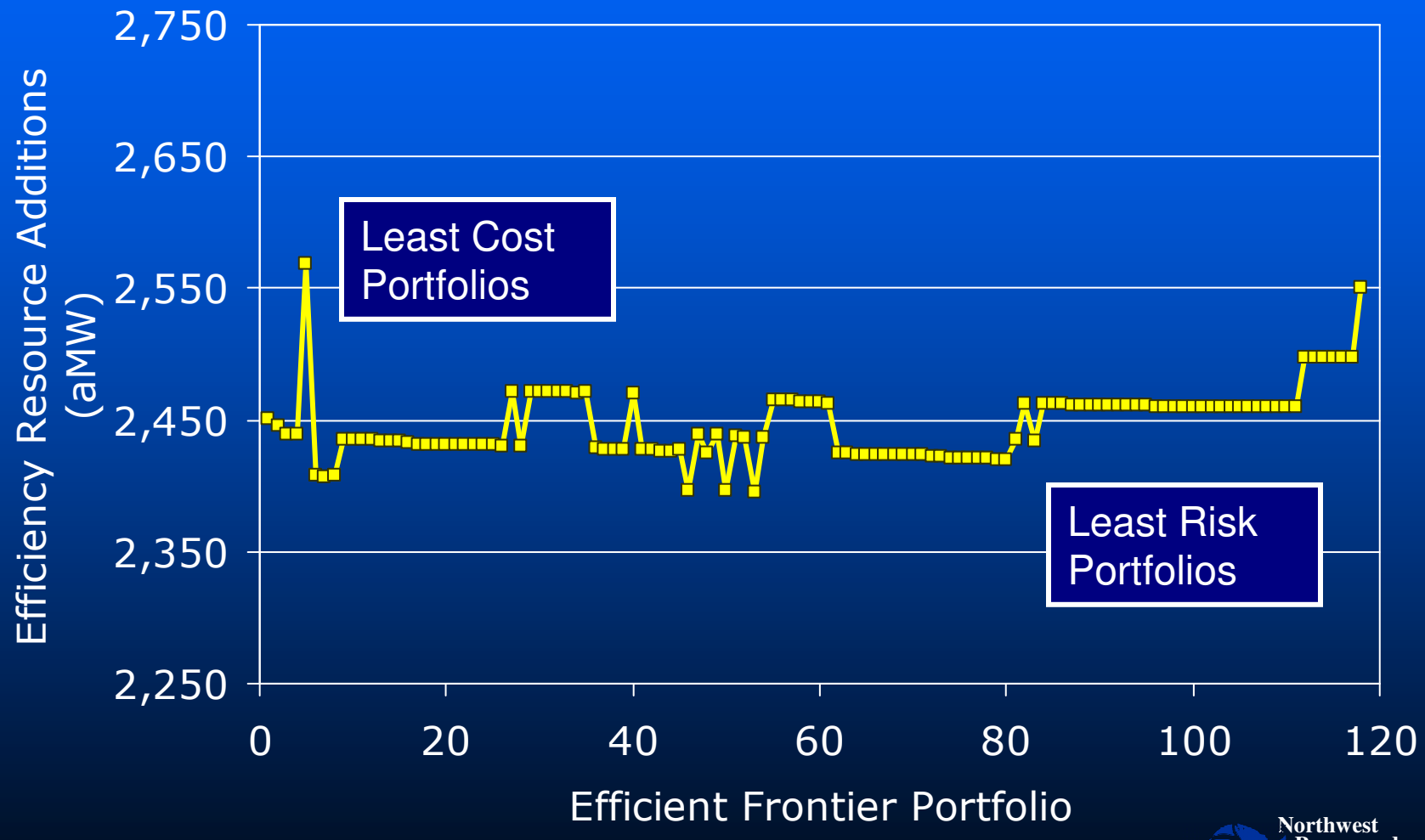


Plans Along the Efficient Frontier Permit Trade-Offs of Costs Against Risk



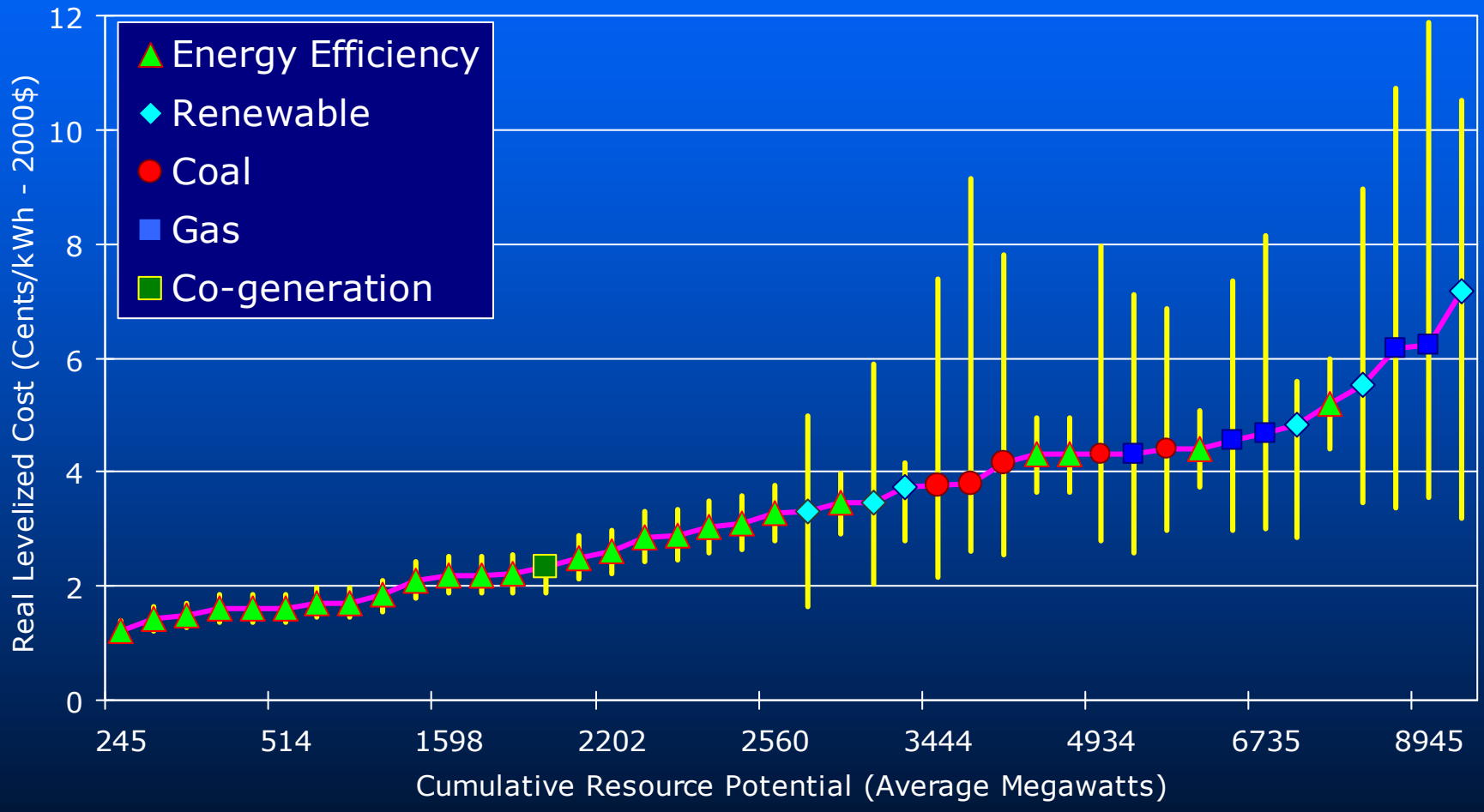
Northwest Power and Conservation Council

All Plans Along the "Efficient Frontier" Acquire Virtually the Same Amount of Energy Efficiency



Northwest Power and Conservation Council

Portfolio Analysis On One Slide

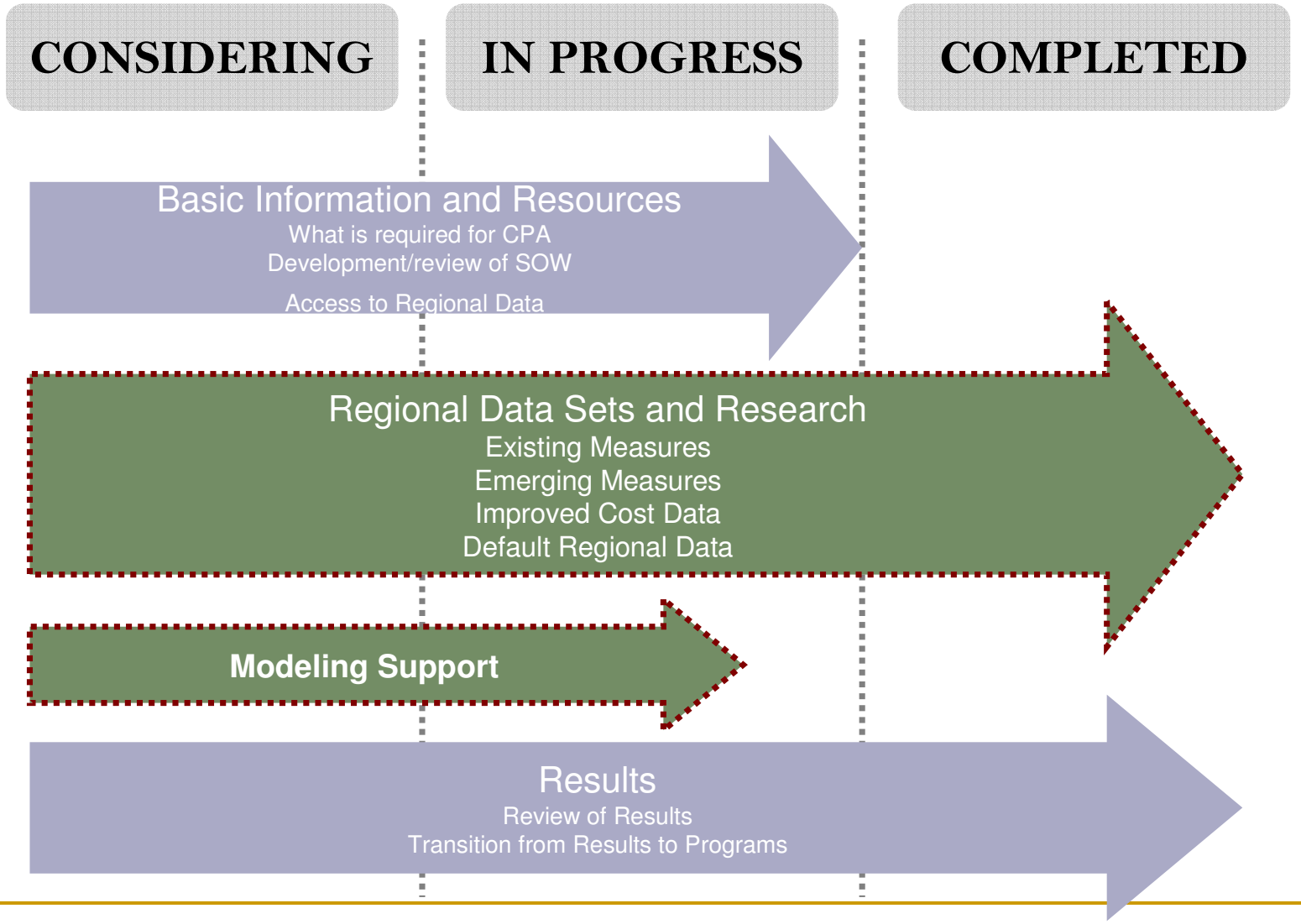


Resource potential for generic coal, gas & wind resources shown for typical unit size. Additional potential is available at comparable costs.

Brainstorming: How can BPA help with CPA Process?

- What we heard from utilities at the Brown Bag
- What are new, additional ideas?

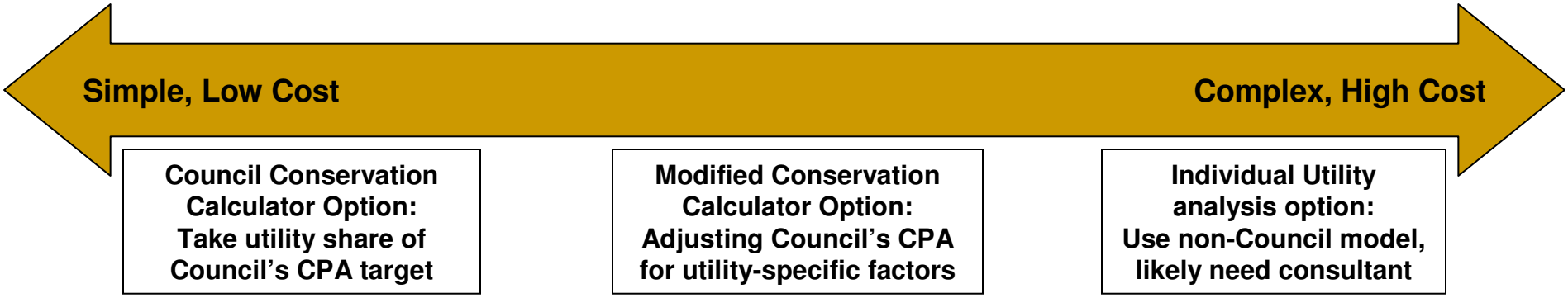
Brainstorming on How BPA Can Help



Regional Data Sources and Availability

- Some suggestions from Brown Bag included:
  - Regional measure database
    - Updated incremental costs
    - Emerging Technologies
    - Indications of differences by region
    - What is out of date?
  - Other large-scale data collection exercises
    - CFL saturation
    - RASS
    - End Use Load profiles
  - Research on New Measures
    - Distribution and production efficiencies
    - AMR systems
  - How effective can programs be (achievable potential)
  - Pull data out of early 1990s segmentation models
- BPA is working on these issues in various ways:
  - Coordination with Council, RTF, NEEA
  - Northwest Energy Efficiency Taskforce is tackling these issues

Modeling Support



- There are likely economies of scale for BPA to support the medium- to high-cost modeling areas
  - Supporting a process to make Council's CPA models ready for public use, e.g, more modular format, documentation, etc.
  - Support process to issue a joint RFP for utilities to participate in a shared modeling approach with a single contractor

CPA Results into Program Planning

- Session on this topic later this afternoon
- BPA will hire consultant in the spring to support analysis of 6th Power Plan to move from supply curves (individual measures) to program design and planning.
  - We expect this process to include discussions with NEEA, RTF, etc for areas that are not ready for utility acquisition programs