Seattle City Light's Conservation Potential Assessment

BPA's CPAs
September 8, 2008

Outline

- 2006 Approach & Methodology
  - Overall
  - Sector
- Results
- Next Version

Approach

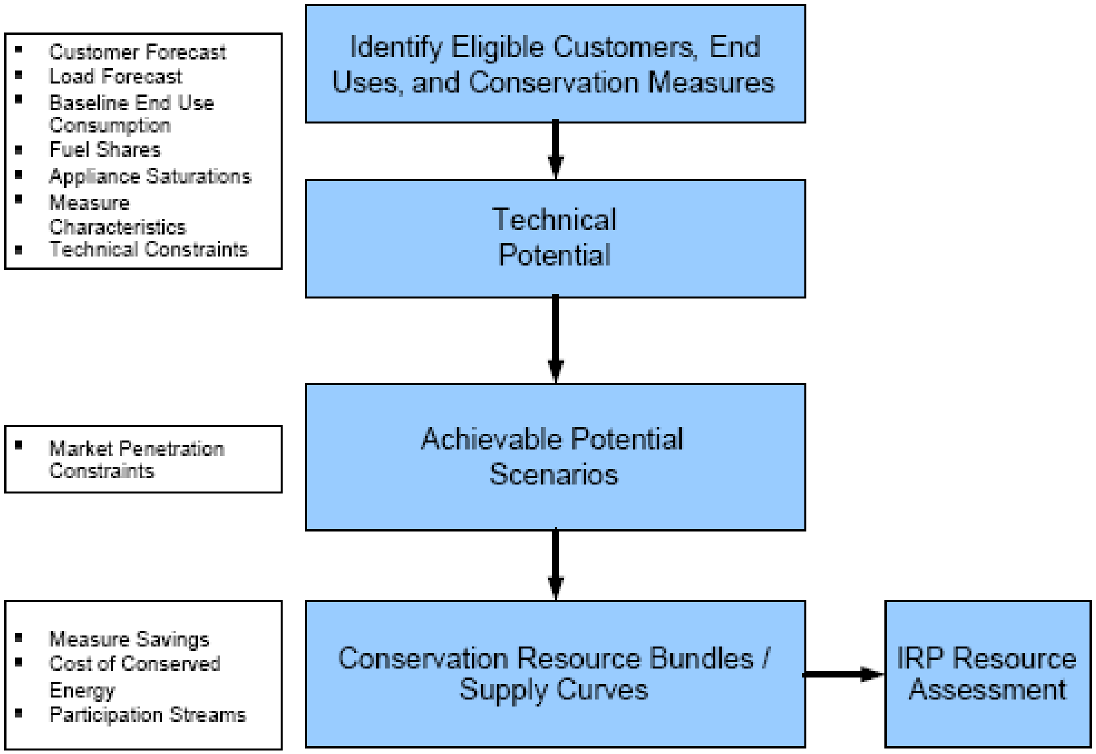
- Develop Technical Achievement Model for each sector by:
  - Developing a baseline forecast
  - Producing a potential forecast for each end use that incorporates installation of all feasible energy-efficiency measures
  - Calculating technical potentials by end use as the difference between the two forecasts
- Aggregate into resource blocks for incorporation into SCL's IRP modeling process.

Methodology
Divided into two phases.

- Phase 1
  - Develop Baseline Consumption by taking stock of efficiency characteristics of equipment, potential changes in codes, standards, and naturally occurring conservation
- Phase 2
  - Estimating Technical and Achievable potential
  - Technical x 70% = Achievable
  - Characterization of the achievable potential into resource blocks

Phase 2
4 Steps

Figure 1. Methodological Approach



Step 1

- Developing Base Case Forecast
  - Calibrated using SCL's 2004 Energy sales, customer forecasts, and appliance and equipment saturations. From these a benchmark was created for comparing the technical and achievable potentials.

Step 2

- Determine Measure Impacts
  - Integrate measure specific data with
    - baseline building stock data
    - base case-calibrated energy usage data
  - Produce estimates of levelized cost per unit of conserved energy

Step 3

- Estimate Phased-in technical potential
  - Sum up the technical potential across all measure categories

Step 4.

- Estimate Achievable Potential and Create Resource Bundles
  - Conservation potential analysis aggregated estimates into “blocks” of energy efficiency resources
  - Blocks then bundled according to 10 mill cost increments to assess the levelized cost for each end use

Residential Example

Figure 3. Conservation Resource Block Price Points, Residential Example

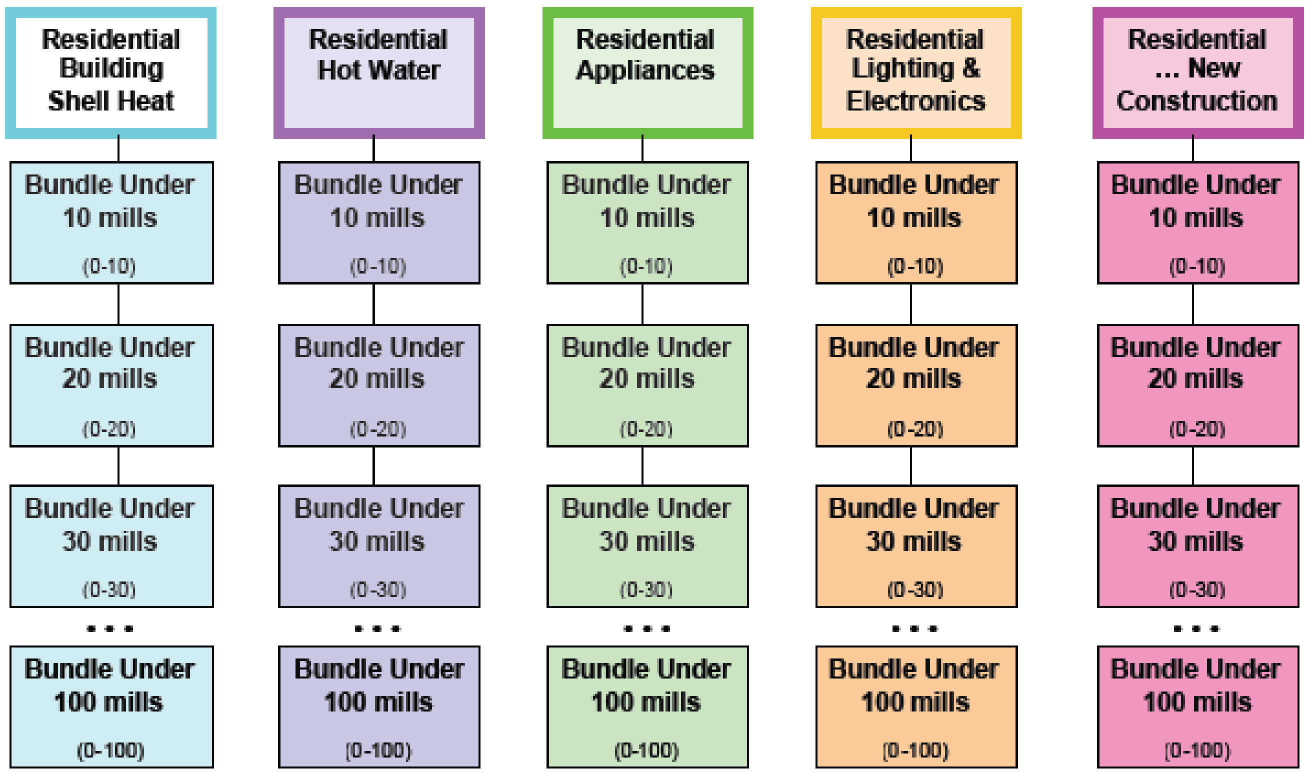


Figure Created by Debra Tachibana, SCL, 2006

Data Sources

- Seattle City Light
- Pacific Northwest Energy Studies
  - NPCC
  - RTF
  - PSE
- California Energy Commission
- Equipment Vendors
- Ancillary Sources

Industrial Sector Overview

- Assessment of 15 industrial segments and 12 end uses

Industrial Segment / SIC	End Use / Process
Food Kindred Products - SIC 20	Lighting
Lumber Wood Products - SIC 24	HVAC
Paper Allied Products - SIC 26	Air Compressors
Printing Publishing - SIC 27	Motors
Chemical Allied Products - SIC 28	Furnace
Petroleum Related - SIC 29	Refrigeration
Rubber Misc Plastics - SIC 30	Welding
Stone Clay Glass Concrete - SIC 32	Indirect Boiler
Primary Metal Industries - SIC 33	Electro Chemical Process
Fabricated Metal Products - SIC 34	Process Heat
Machinery except Electrical - SIC 35	Process Other
Electric Electronic Equip - SIC 36	Process Cooling
Transporation Equipment - SIC 37	
Instruments Related Products - SIC 38	
Miscellaneous - SIC 39	

Industrial Sector Approach

- Conservation potential based on the following steps:
  - Break out SCL's total industrial load by segment
  - Break out load in each segment by end use
  - Apply estimates of savings for different end uses to disaggregate load to calculate potential
- Key data sources include SCL's 1995 industrial technical potential study and the EIA's MECS

Commercial Sector Overview

- Examination of 13 segments and 15 end uses (biotech and data centers placeholders for future assessment)

Commercial Segment	End Use
Dry Goods Retail	Space Heat ASHP
Grocery	Space Heat WSHP
Office	Space Heat Boiler
Restaurant	Space Heat Furnace
Warehouse	Space Heat Radiant/Baseboard
Hospital	Cooling Chillers
Hotel/Motel	Cooling DX
School	Cooling HeatPump
University	Ventilation
Other	Lighting
Data Centers	Water Heat
Biotech	Refrigeration
Multifamily Common Area	Cooking
	Plug Load
	Other

Commercial Sector Approach

- CBSA data used to characterize the end uses in SCL's commercial segments and develop a baseline forecast to represent consumption in absence of conservation
- Measure data used to create alternate forecasts to represent:
  - Equipment replacement in existing construction
  - Shell and retrofit improvements in existing construction
  - Equipment upgrades in new construction
  - Shell upgrades and in new construction

Residential Sector Overview

- Three residential home types and 13 separate end uses were included in the analysis:

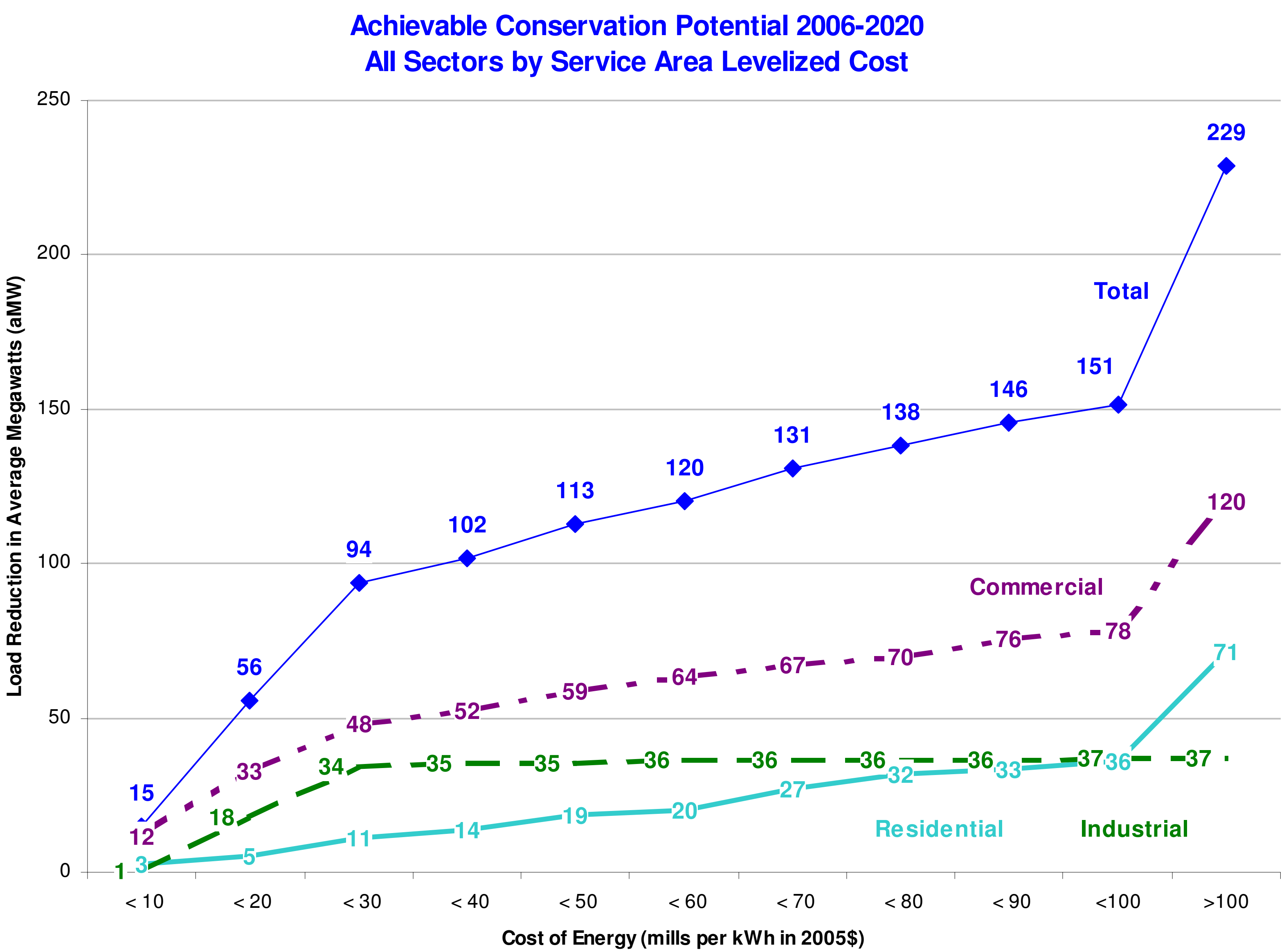
Residential Segment	End Use
Single Family, Detached	Central Heat
Single Family, 2 - 4 Units	Room Heat
Multifamily	Heat Pump
	Central AC
	Room AC
	Lighting
	Water Heat
	Refrigerator
	Freezer
	Cooking
	Dryer
	Plug Load
	Other

Residential Approach

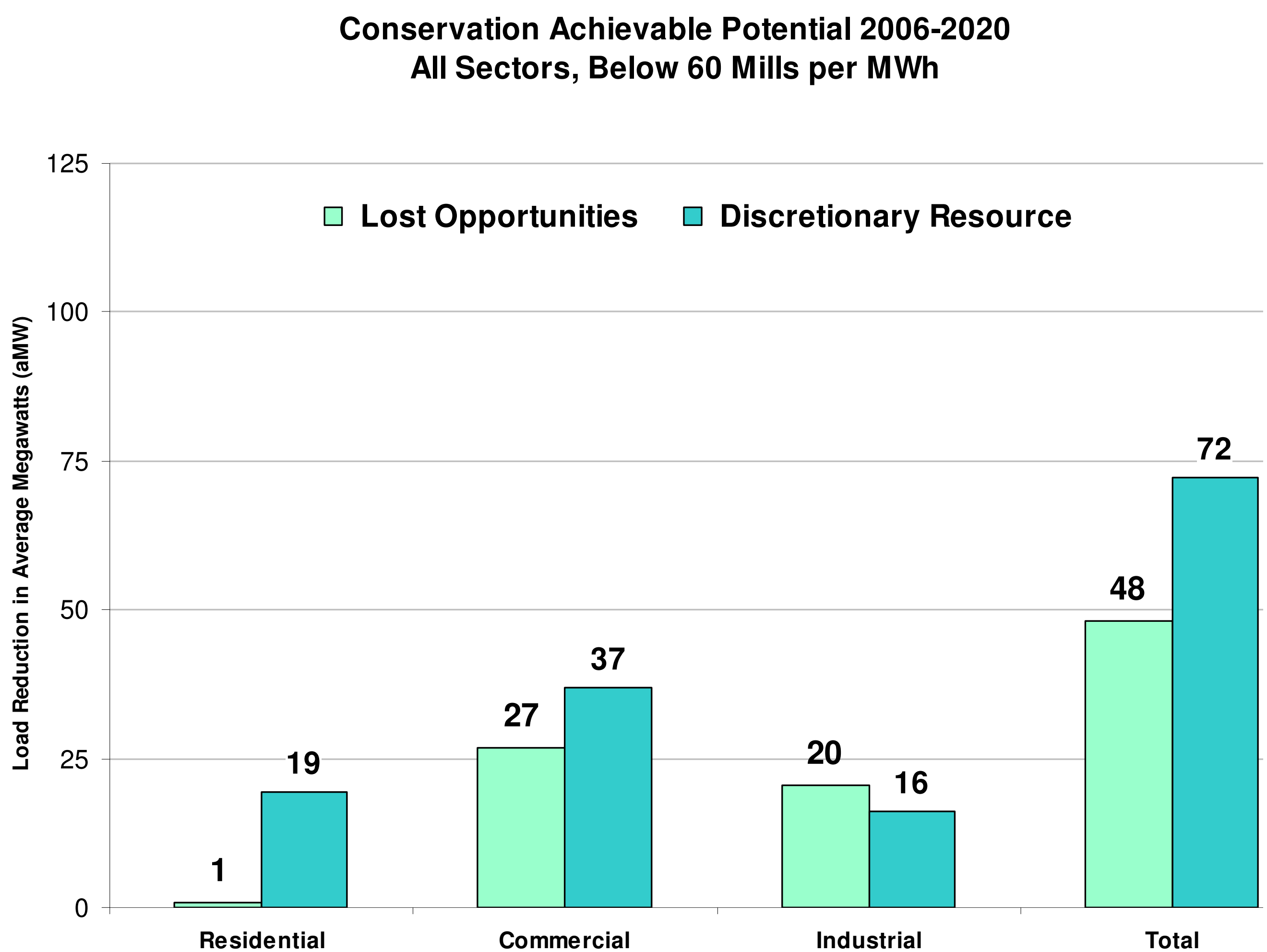
- SCL residential customer survey data used to characterize the SCL's residential segments and develop a baseline forecast to represent consumption in absence of conservation
- Measure data used to create alternate forecasts to represent:
  - Equipment replacement in existing construction
  - Shell and retrofit improvements in existing construction
  - Equipment upgrades in new construction
  - Shell upgrades and in new construction

Results

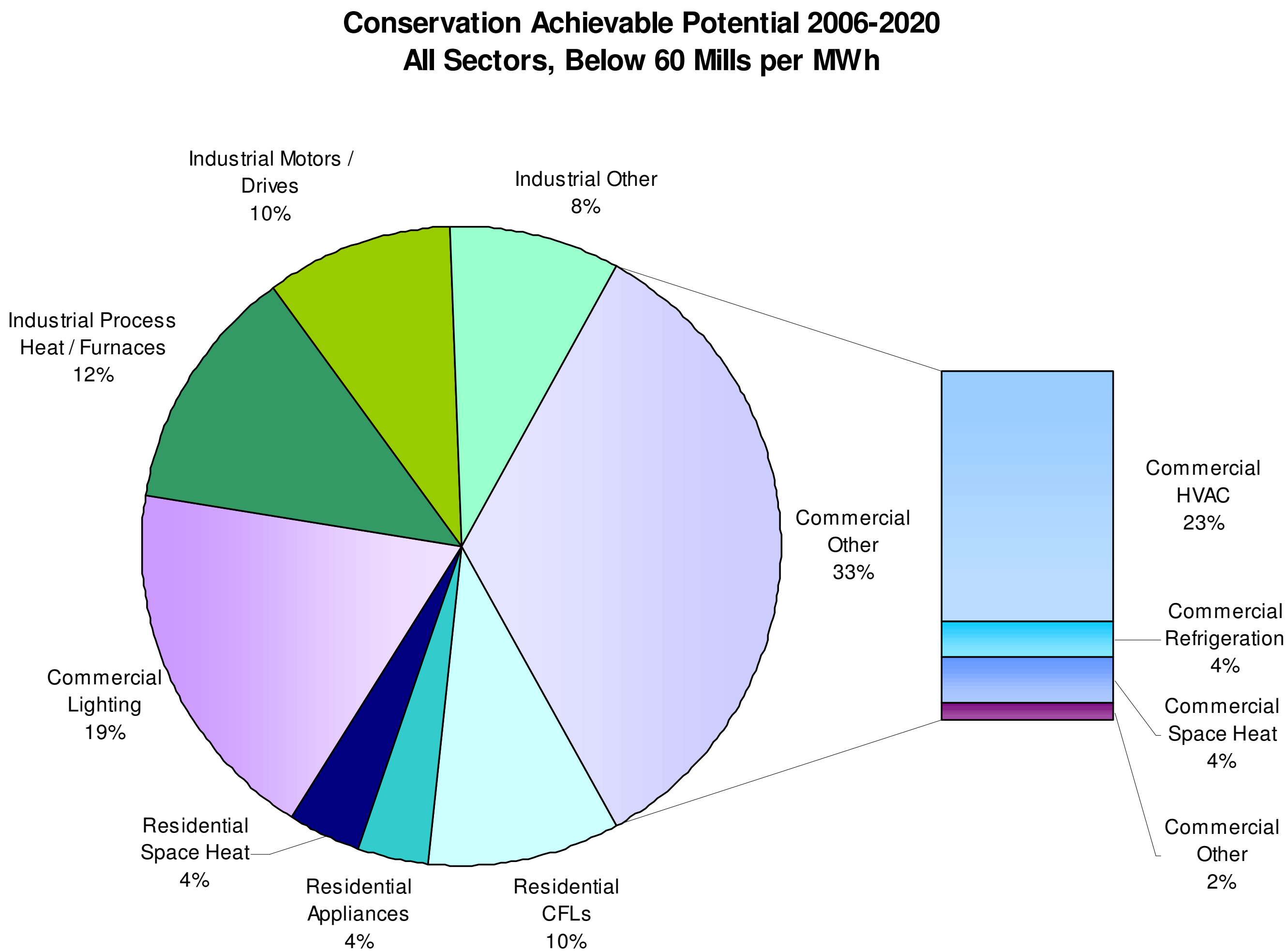
- Levelized 15 yr achievable conservation potential in SCL's service territory estimated to be 229 aMW.
  - Residential 71.3 aMW
  - Commercial 120.4 aMW
  - Industrial 37.1 aMW
- 53% of the savings are available at a cost of $.06/kWh


Achievable Conservation Potential 2006-2020
All Sectors by Service Area Levelized Cost
Load Reduction in Average Megawatts (aMW)
Cost of Energy (mills per kWh in 2005$)
0
50
100
150
200
250
< 10
< 20
< 30
< 40
< 50
< 60
< 70
< 80
< 90
<100
>100
Total
Commercial
Residential
Industrial
15
56
94
102
113
120
131
138
146
151
229
12
33
48
52
59
64
67
70
76
78
120
1
18
34
35
35
36
36
36
36
37
37
3
5
11
14
19
20
27
32
33
36
71

Results

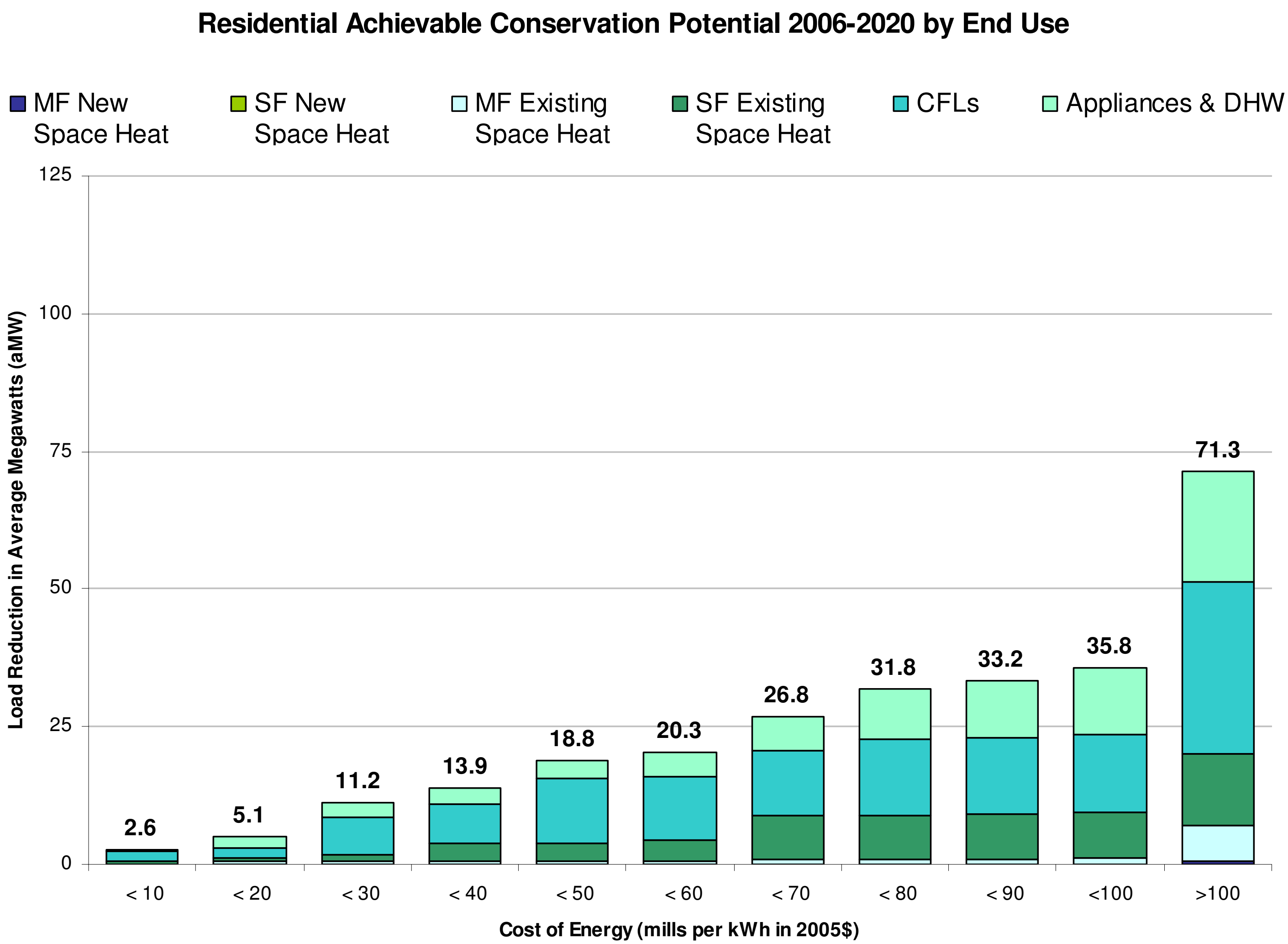

Conservation Achievable Potential 2006-2020
All Sectors, Below 60 Mills per MWh
Lost Opportunities
Discretionary Resource
Load Reduction in Average Megawatts (aMW)
125
100
75
50
25
0
1
19
27
37
20
16
48
72
Residential
Commercial
Industrial
Total

Results



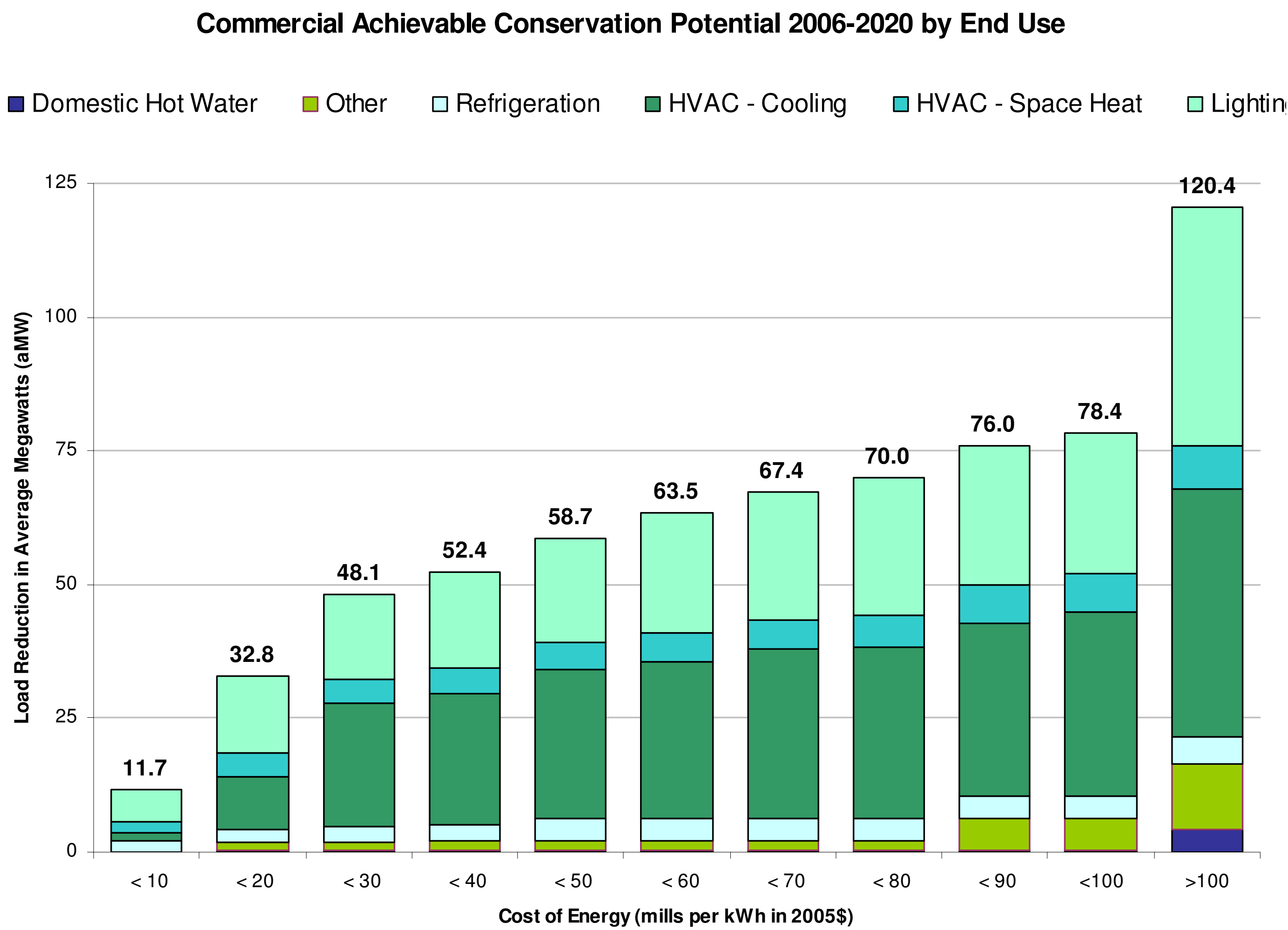
Conservation Achievable Potential 2006-2020
All Sectors, Below 60 Mills per MWh
Industrial Motors / Drives 10%
Industrial Other 8%
Industrial Process Heat / Furnaces 12%
Commercial Other 33%
Commercial HVAC 23%
Commercial Refrigeration 4%
Commercial Space Heat 4%
Commercial Other 2%
Commercial Lighting 19%
Residential Space Heat 4%
Residential Appliances 4%
Residential CFLs 10%

Results



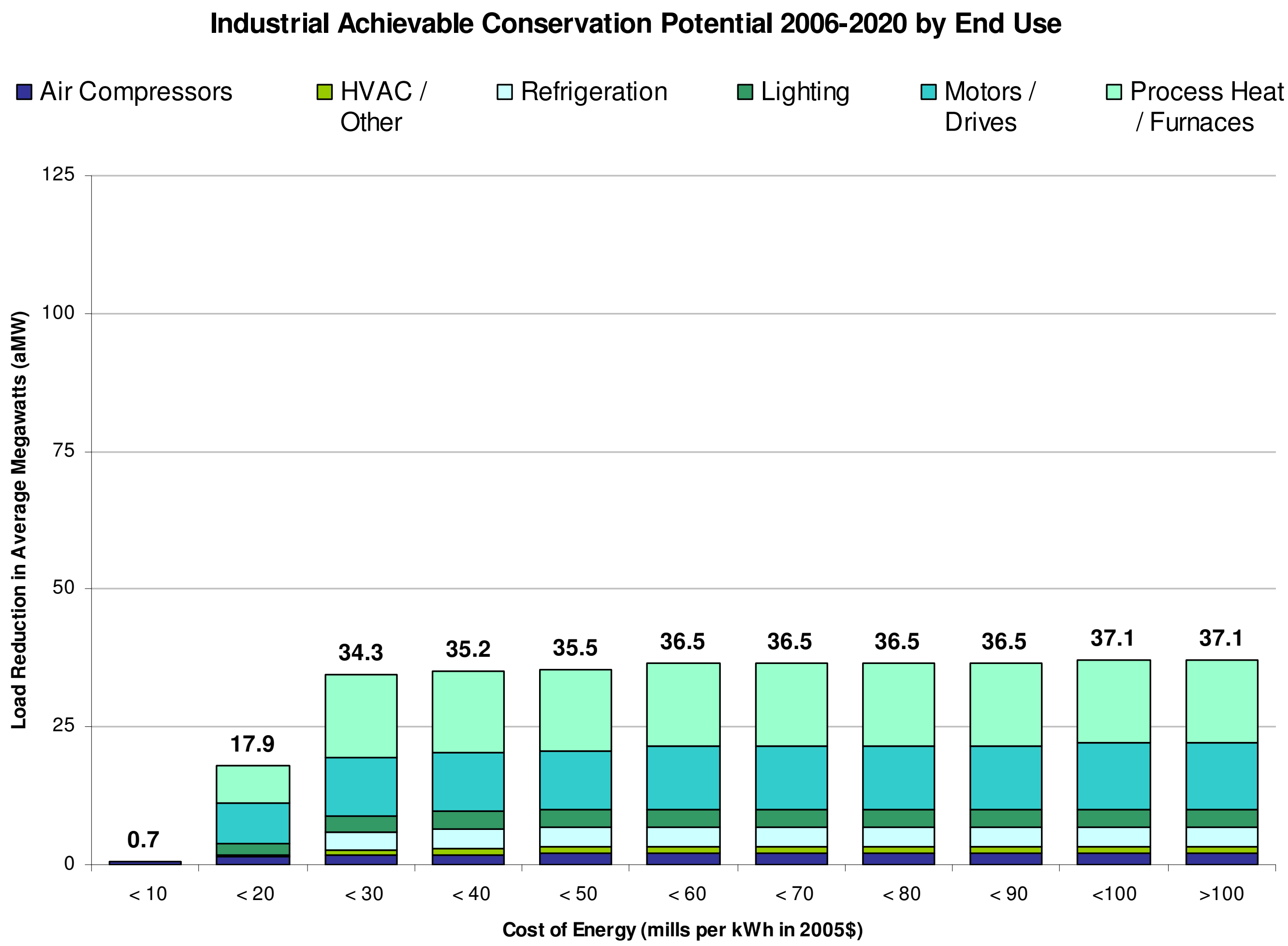
Residential Achievable Conservation Potential 2006-2020 by End Use
MF New Space Heat
SF New Space Heat
MF Existing Space Heat
SF Existing Space Heat
CFLs
Appliances & DHW
Load Reduction in Average Megawatts (aMW)
125
100
75
50
25
0
2.6
5.1
11.2
13.9
18.8
20.3
26.8
31.8
33.2
35.8
71.3
< 10
< 20
< 30
< 40
< 50
< 60
< 70
< 80
< 90
<100
>100
Cost of Energy (mills per kWh in 2005$)

Results



Commercial Achievable Conservation Potential 2006-2020 by End Use
Domestic Hot Water
Other
Refrigeration
HVAC - Cooling
HVAC - Space Heat
Lightin
Load Reduction in Average Megawatts (aMW)
125
100
75
50
25
0
11.7
32.8
48.1
52.4
58.7
63.5
67.4
70.0
76.0
78.4
120.4
< 10
< 20
< 30
< 40
< 50
< 60
< 70
< 80
< 90
<100
>100
Cost of Energy (mills per kWh in 2005$)

Results


Industrial Achievable Conservation Potential 2006-2020 by End Use
Air Compressors
HVAC / Other
Refrigeration
Lighting
Motors / Drives
Process Heat / Furnaces
Load Reduction in Average Megawatts (aMW)
125
100
75
50
25
0
0.7
17.9
34.3
35.2
35.5
36.5
36.5
36.5
36.5
37.1
37.1
< 10
< 20
< 30
< 40
< 50
< 60
< 70
< 80
< 90
<100
>100
Cost of Energy (mills per kWh in 2005$)

Next Version

- Starting to scope; draft in July 2009
- Fill in strategic data gaps
  - Use new data (i.e. CFL saturation)
  - Prioritize near-term research efforts
  - Leverage for multiple purposes: planning, marketing, delivery
- Expanded list of measures
- New avoided cost assumptions
- Two versions:
  - I-937 Compliance (floor)
  - SCL Resource Planning
- Update as new key information becomes available
  - Multi-year (3+) contract for CPA support

Conservation Potential Assessment
Lessons Learned

Acquiring The Bigger Picture

- McMinnville Water & Light's Conservation Assessment was conducted within the context of a larger Integrated Resource Plan developed by EES.

  - Preliminary Findings and Objectives outside the scope of a traditional Conservation Assessment

  - Program Justification

    -Program development focused on resource acquisition rather than emerging markets.

Preliminary Objectives:

- Assess the net present value of conservation given an allocated FBS and the exposure to Tier 2 pricing
1. Do nothing prior to allocation
2. Maintain current conservation efforts
3. Shoot for the moon

- Identify the best funding mechanism
1. CRC/CAA (75% add back)
2. Utility Funded (100% add back)
3. Mix

Preliminary Findings

- MW&L's Integrated Resource Plan developed by EES identified conservation as the utility's least cost resource acquisition option.

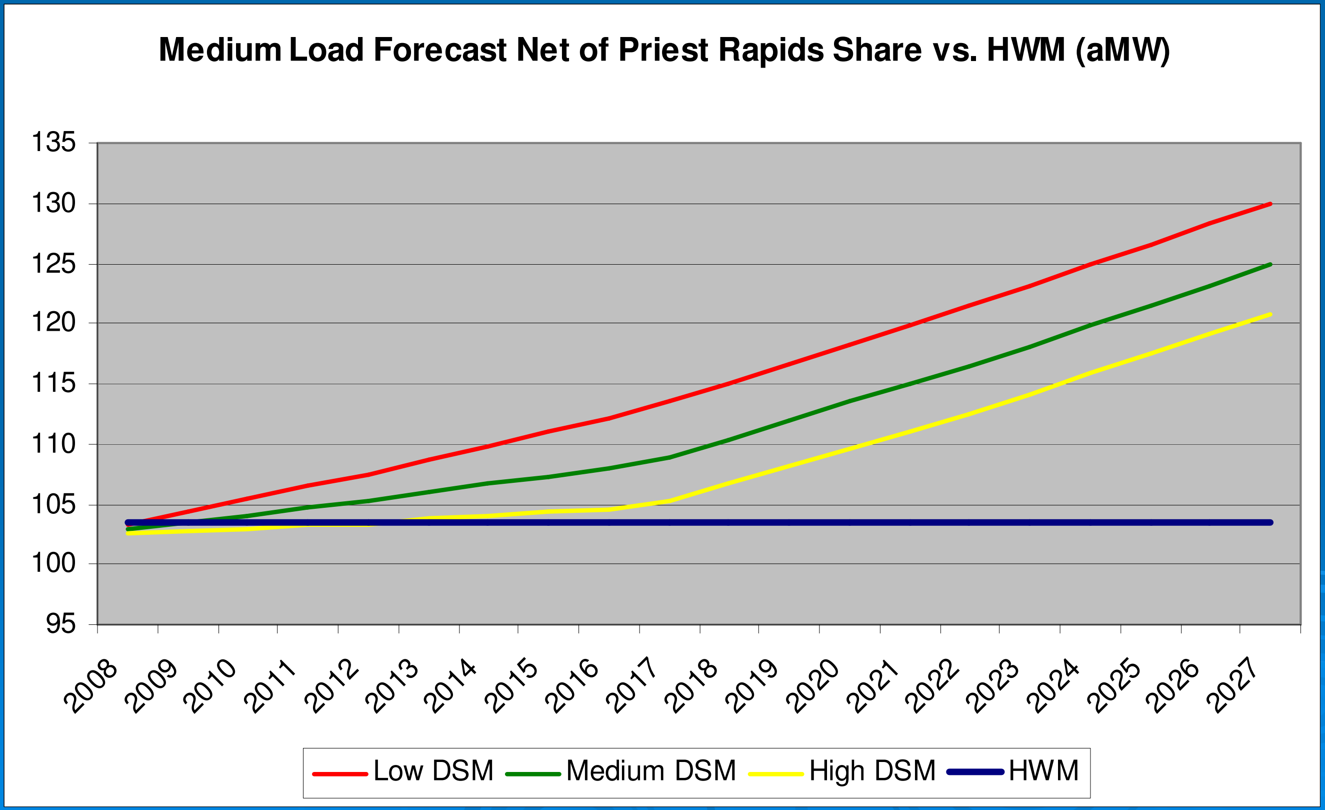
  - Staff Recommendation: The utility should consider setting a target that no cost-effective conservation be overlooked.

Effects of Conservation

	No Conservation	BPA Funded	100% Utility Funded
HYPOTHETICAL RETAIL LOAD	HIGHER	LOWER	LOWER
TIER I ALLOCATION	LOWER	HIGHER	HIGHER
TIER II REQUIRED	HIGHER	LOWER	LOWER
FUTURE ENERGY COSTS	HIGHER	LOWER	LOWER

Conservation Benefits

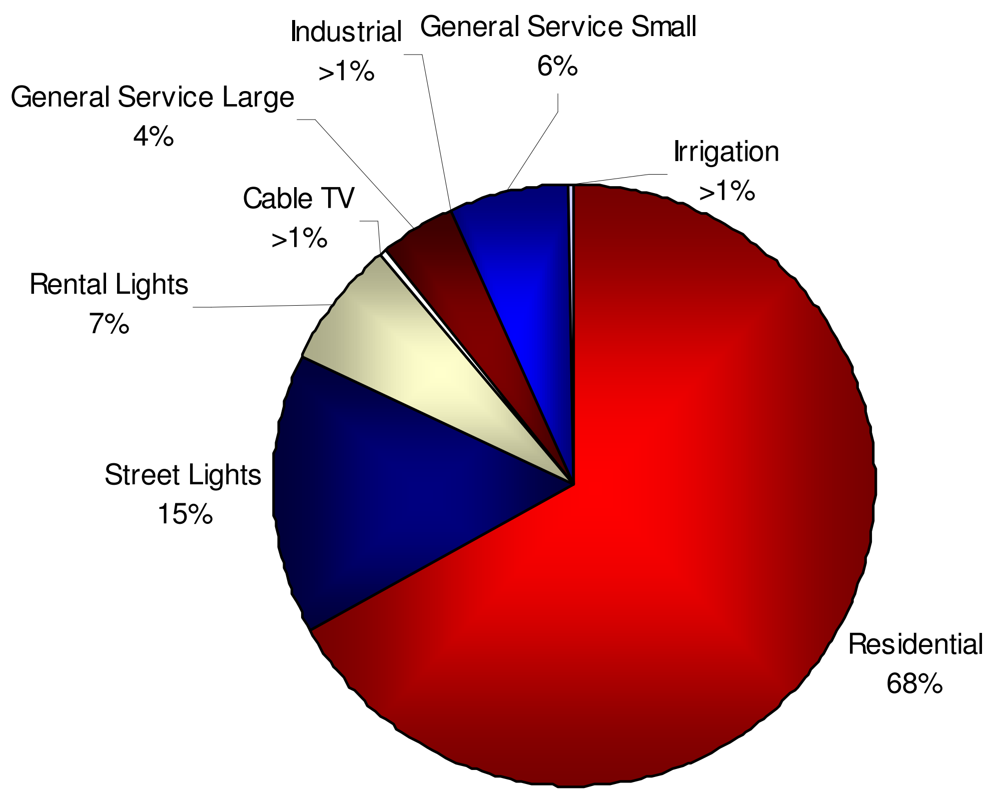
Conservation can defer the need for Tier 2 or other higher cost resources



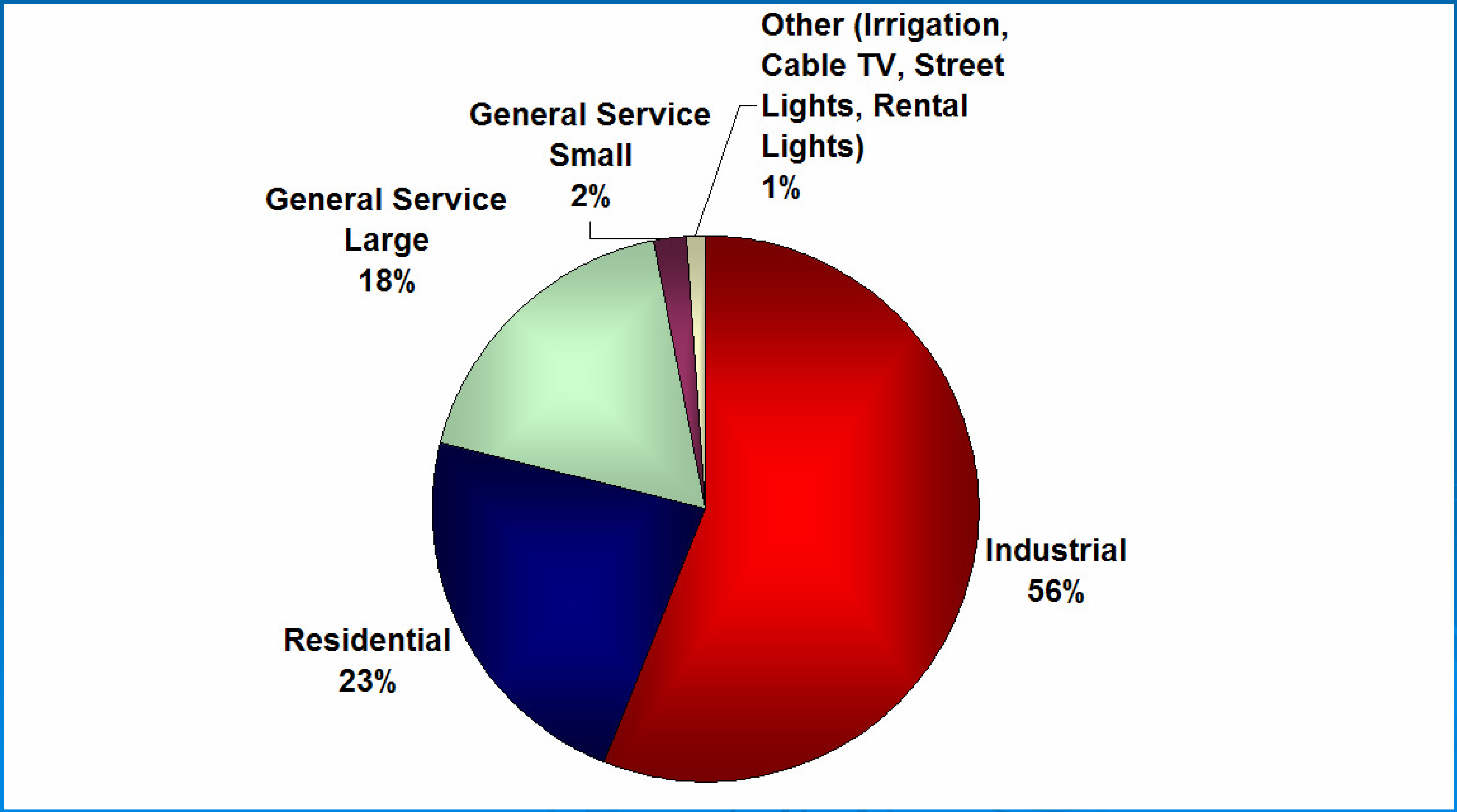
What Tools Do We Have?

Cost Effective Measures	
Residential Measures	***Commercial & Industrial Measures***
Domestic Water Heater (EF93)	Commercial Retrofit Lighting
Domestic Water Heater (EF91)	Commercial or MF Clothes Washer
Lighting (CFLs)	Commercial Building Weatherization
Clothes Washer - Mid-Efficiency	EE Reach-in Refrigerator
Clothes Washer - High Efficiency	EE Reach-in Freezer
Energy Star Dishwasher	Exit Sign Replacement
Windows	Spray Head Replacement
Insulation	LED Traffic Lights
Energy Star New Homes	C&I Custom Projects
Heat Pumps	Variable Speed Drives
Refrigerator & Freezer Decommissioning	Compressed Air Motors
Energy Star Refrigerator	New Commercial Lighting
Efficient Shower Head	Rooftop HVAC

Number of Customers By Class



Load by Customer Class



Lessons Learned

- Some industry assumptions just don't fit.
  - Natural Gas customer saturation
    - Varies greatly on cost of power
  - Industrial potential
    - Incomplete without comprehensive analysis
  - Market opportunities do not always translate to market potential
  - It's the economy stupid
    - New construction vanished
    - Residential markets flat lined
  - Flexibility is the king of program implementation

Reality Check

- Local and regional activity confirmed that BPA incentives alone were insufficient to move markets.

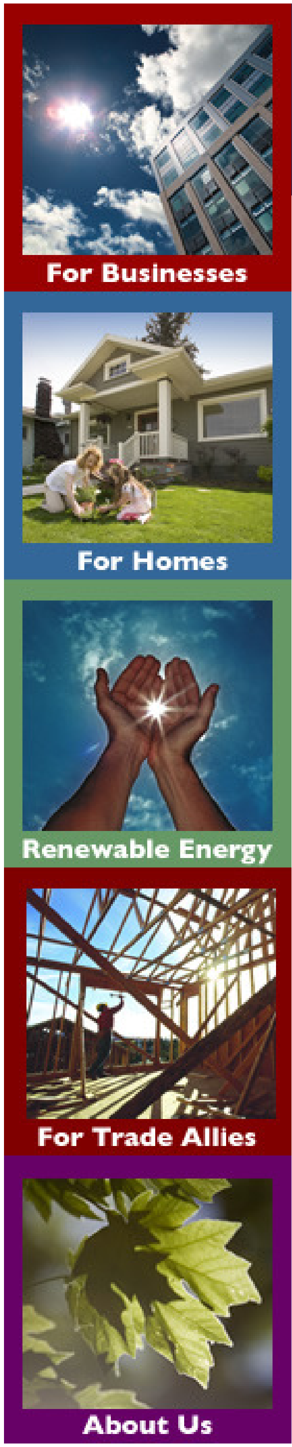
Without Utility Funding		
Residential		
Measure		Count
Heat Pumps		30
WX		180
Appliances		450
PTCS		50
Energy Star MH's		75
Commercial		
Measure		Count
Lighting		20
HVAC		5
Motors, Drives		12
New Construction		15
E-Smart Grocer		20

The Solution: Enhanced Funding

- Industrial
- Commercial
- Residential

Equity across all customer classes

$0.25 per kWh of first annual energy savings up to 30% of the project costs for BPA approved and verified projects / measures.



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Beyond Supply Curves

BPA Supply Curve Hoedown

Fred Gordon- Energy Trust of Oregon
Lakin Garth- ditto
Tom Eckman- NW Power and Conservation Council
Charlie Grist- likewise

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WE'VE BEEN DRIVING WHILE LOOKING IN THE REAR VIEW MIRROR

- Planning for efficiency for purposes of budgeting, IRP, carbon, etc. is based on supply curves.
  - AMW or therms available at price x by year y.
  - Usually built up from equipment options to end uses, sectors, then total.
- Supply curves typically estimate based on *currently commercial* equipment, current costs, and current savings.
  - But *the supply changes rapidly*

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LINEAR SOLUTIONS TO FORECASTING HAVE FAILED

- Can't just forecast technologies getting cheaper
  - There aren't many high-cost technologies in most supply curves, because nobody's paying for them.
- Our track record at forecasting timing, cost, and savings of specific emerging technologies (and changes for existing technologies) is dismal.

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SO WE NEEDED ANOTHER APPROACH

- An exploratory mission!
- Review changes in NW Power & Conservation Council supply curves since 1983.
- See if changes follow any predictable, logical pattern

WHY NW Power Council Curves?

- 5 Power plans since 1983.
- Consistency of staffing, objectives, framework (compared to others)
- They're downstairs, so we can bug them a lot
- They were willing to help

First Cut- Overall Trends (AMW)

Year	83	86	91	96	05
Residential	2400	1900	1200	700	1300
Commercial	1400	1200	1100	500	1100
Industrial	600	500	500	600	400
Total	4400	3600	2700	1700	2700

(Totals don't add due to rounding.)

Reflects:

- Conservation moving into baseline
- Methodology improvements
- Innovations
- Load changes

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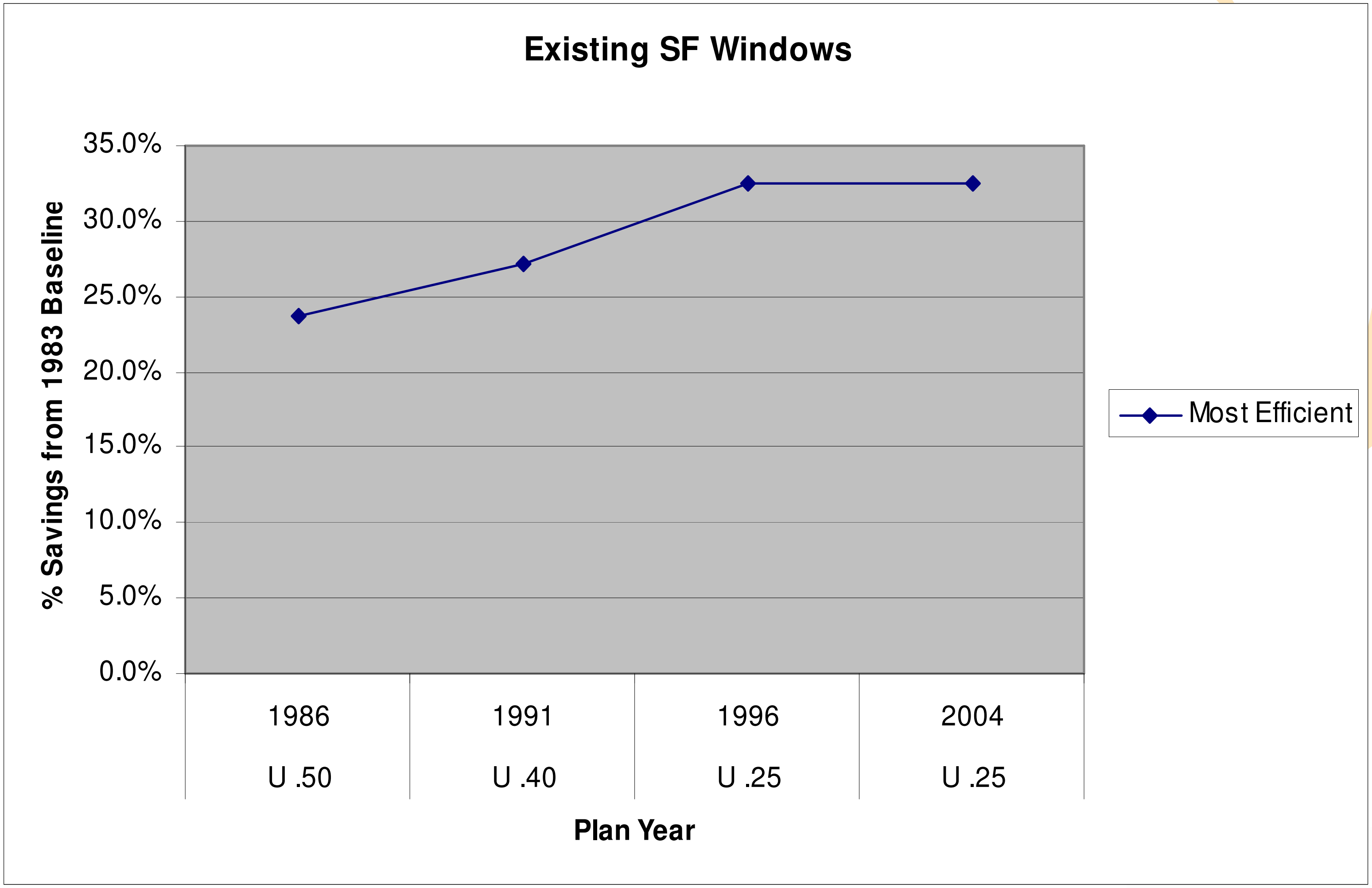
Focus on Select Technologies

- Windows
- Compact Fluorescents
- Washing Machines
- Heat Pump Water Heaters

Existing Single Family Windows- Potential Savings



Single Family Window Savings Estimates Grew Gradually but Substantially

Key drivers:

- Initial rating methods were inaccurate, so there was more to save than we thought.
- NFRC ratings in 1992 drove changes in window design. (*note: ratings improvement follow program push)*
- NEEA market transformation program created a big market for efficient windows, driving more innovation.
- Programs are pushing past new .35 baseline. Advanced products are now more available.

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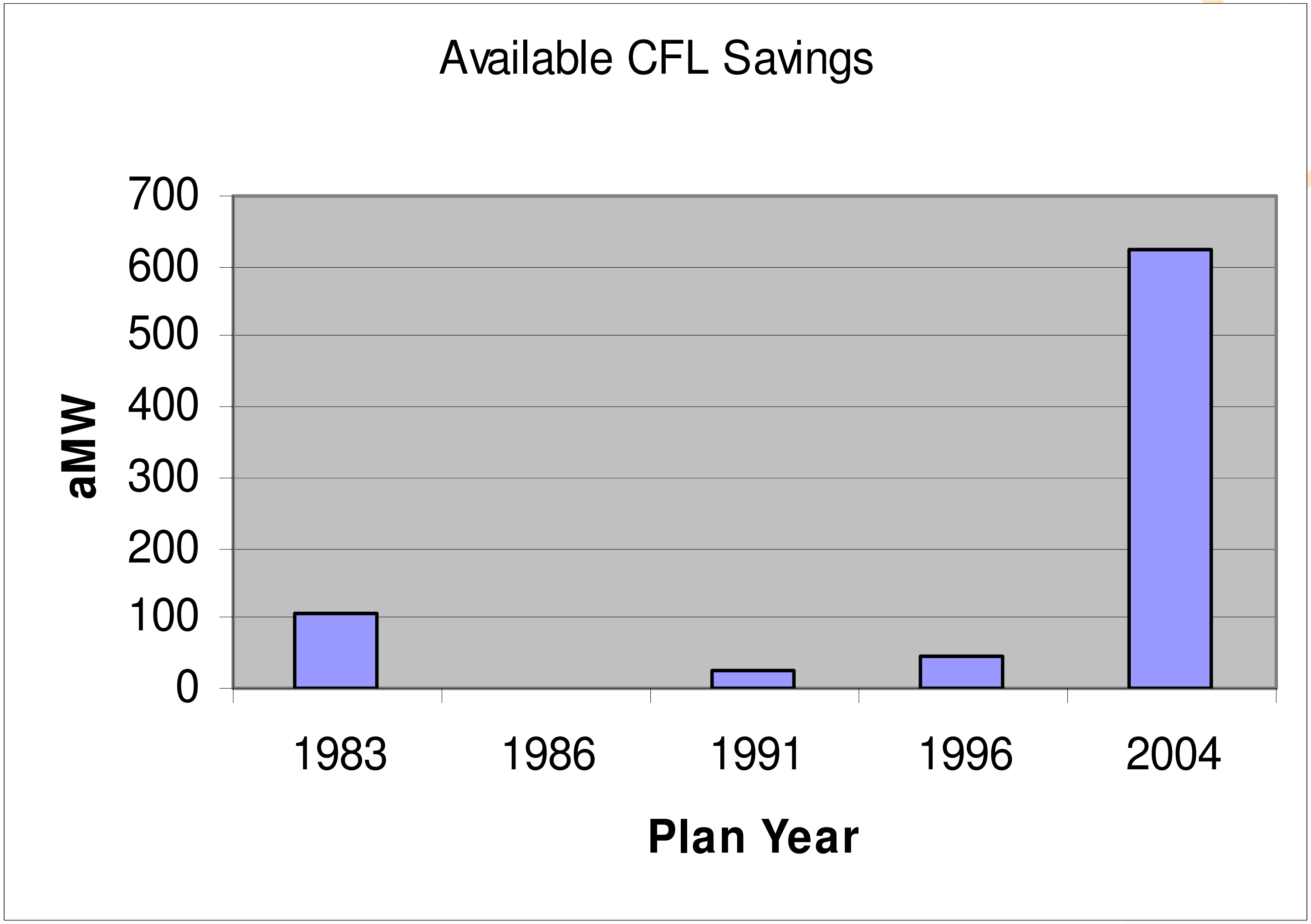
CFL Savings Potential in the Pacific NW



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CFLS- What Happened?

- 1983: Methods under refinement- probably too optimistic.
- 1986-1996: Products were expensive, performed poorly, too big, poor color, power factor, etc.   Manufacturers viewed it as a high margin specialty item. Utilities offered rebates, pressed for progressive refinement.
- 2000-1

CFLs: Millennial Change

- Product size shrunk, quality improved, price dropped.
- NW had established a network of retailers.
- Then the West Coast power system went into crisis.
- Millions were sold nationwide, highest per capital in NW.
- The industry recognized a profitable, high volume product. The product has undergone continual improvement (with more industry prodding) ever since.

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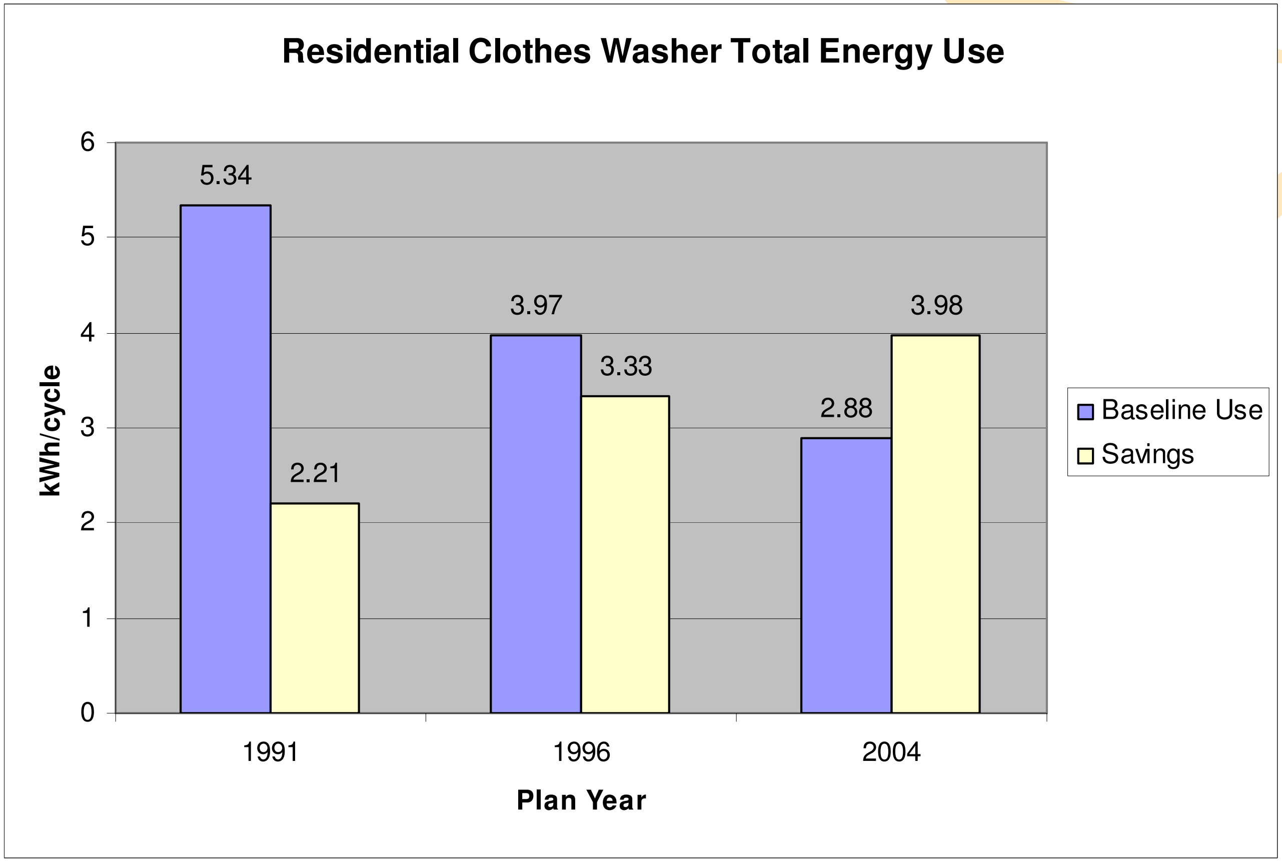
Residential Clothes Washers



What Drove Changes in Washers?

- Innovations were taking hold overseas.
- NW and then national programs helped create a market for “premium washers”. All the big manufacturers followed.
- Improved rating system (MEF) in 2001 to account for water savings (note: improved ratings again *follow* program action.)
- As baseline increases, utility programs ratchet up, and the availability of higher-end manufacturer products follow.

Heat Pump Water Heaters

- NW installed successful but expensive “hand-built” units in the 1980s.
- Small manufacturers have been introducing products that have been inadequately designed for 20 years.
- HPWHs appear in the supply curves, then disappear and then reappear.
- With entry of major appliance manufacturers in product development, maybe a reliable product is on its way.
- Or not: sometimes manufacturers use utility rebates to field test their betas.

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Recap

- New and improved technologies are critical to forecasting conservation supply.
- We are dismal at forecasting them.
- Conservation supply is likely to increase.
- How much? Oh, pretty much. Er, we don't know.

Okay, It's a Mess, but What are We Supposed to Do?

When Fancy Pants Methods Cannot Deliver- GUESS INTELLIGENTLY!!!!!!!

"I'd rather be approximately right than exactly wrong"

Ben Bronfman

Principles:

- Use informed guesswork and reasonableness checks
- Focus on unbiased estimates
- Don't let the detail of the data get in the way of the big picture story it tells.
- Use the capability of the Integrated Resource Planning Process to Deal with Uncertainty

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Options:

- Use the bottom-up supply curve as a lower bound estimate of efficiency.
  - Pick another number as the upper bound estimate.
  - Say, based on zero net energy new buildings and homes by 2030?
  - Assign lower probabilities to higher savings estimates.
- Project a rate of acquisition
  - When we run out of retrofit resources, assume a diminished but continued acquisition rate.
  - Say, 50%?

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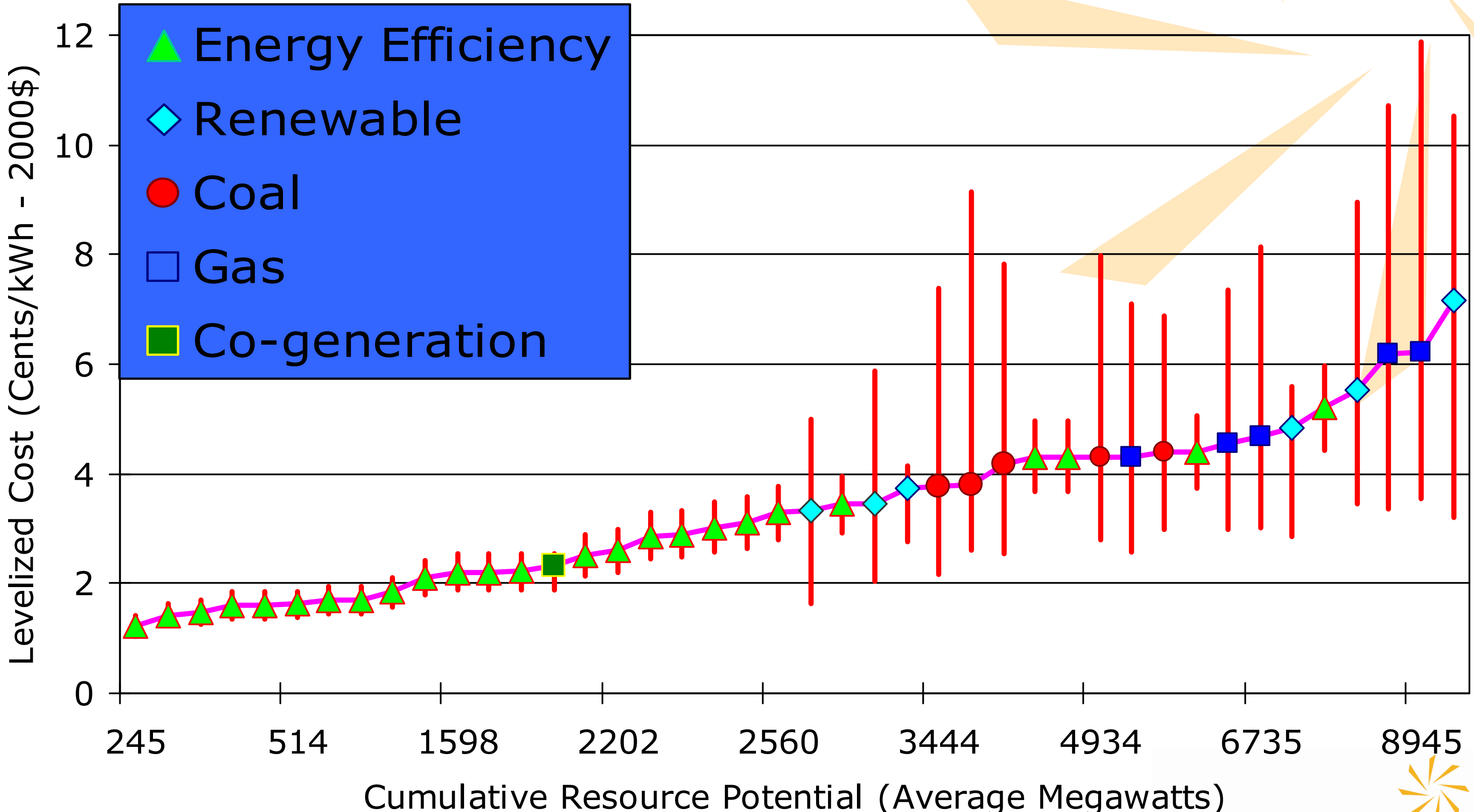
Everything Else is More Risky



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

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Summary

- There will be more conservation than supply curves can forecast.
- Supply curve models are useful for providing low-case estimates.
- We will need to guess how much more we will find based on principles of reasonableness.
- More conservation did not come from paper studies. It came from intervening in markets:
  - Making innovation profitable
  - Demanding accountability for performance

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