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

July 2, 2024

MEMORANDUM

TO: **Council Members**

FROM: **Kevin Smit**

SUBJECT: **Energy Efficiency Supply Curve Development Methodology**

BACKGROUND:

Presenter: Kevin Smit, Christian Douglass

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

Relevance: The Northwest Power Act requires energy efficiency to be treated in the same way as supply side resources when considering the Plan's resource strategy. To analyze EE in our production cost models (OptGen), staff develops a supply curve that provides bundles of the amount of EE available at different price points, with information on seasonal attributes.

Workplan: B.2.1 Prepare for the ninth power plan, developing a draft scope, preparing models and inputs, and developing environmental methodology.

Energy Efficiency Supply Curve Development Methodology

July 2024 Council Meeting

Kevin Smit

Christian Douglass

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

Overview

- History of conservation targets
- Conservation in the 2021 Plan
- Definitions (from the Title)
  - Efficiency as a Resource
  - What is Energy Efficiency?
  - What is a Supply Curve?
- Basic formula for estimating EE potential
- Supply curve development process
- New for the Ninth Plan

Context

This is the first in a series of “Primers” that provide background in how we develop various components of the power plan.

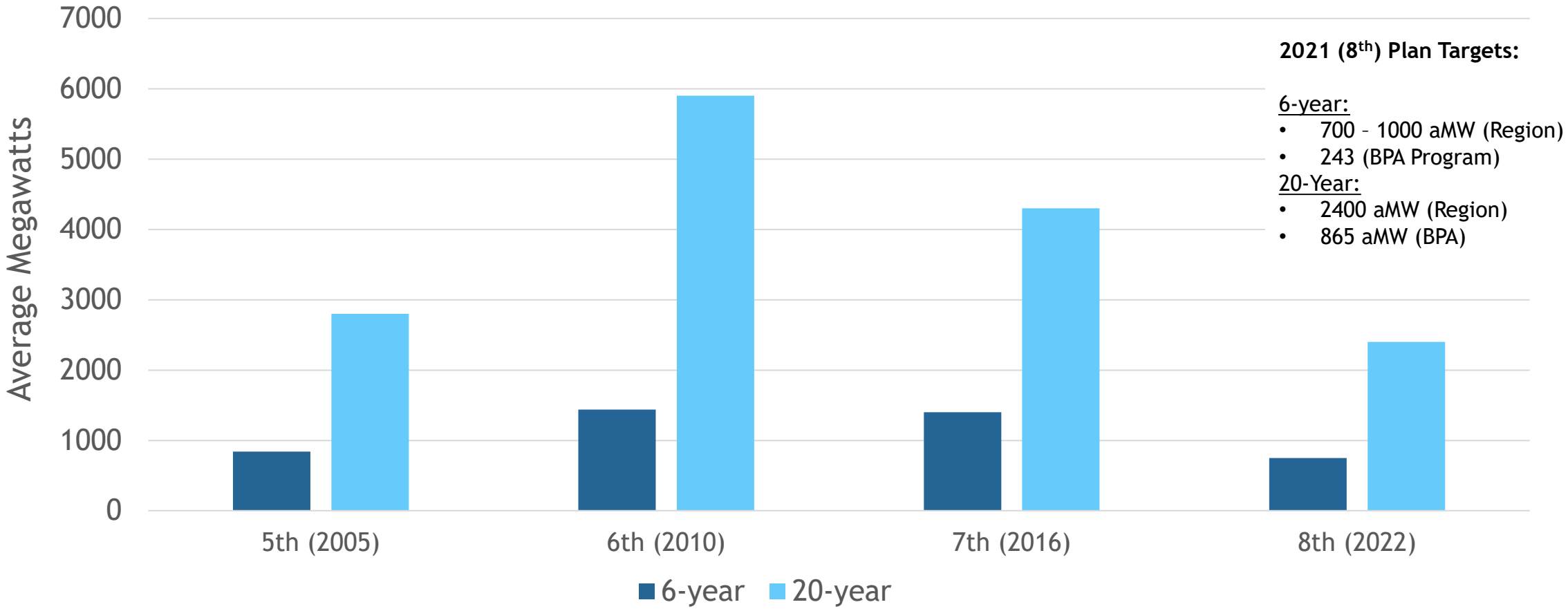
Energy Efficiency Supply Curves

Generating Resources Reference Plants

Demand Response Supply Curves

Etc.

Power Plan Targets 2005 - 2022



2021 (8th) Plan Targets:

6-year:
- 700 – 1000 aMW (Region)
- 243 (BPA Program)

20-Year:
- 2400 aMW (Region)
- 865 aMW (BPA)

Power Plan Targets (2005-2022) – More Detail

Plan	Energy Efficiency Target	Significant New EE Measures/Categories
2021 Plan (2022)	**750 - 1000 aMW by 2027 (6 years)** 2400 aMW by 2041 (20 years)	Motor-driven products: pumps, fans, compressors, advanced motors. VHE DOAS
Seventh Plan (2016)	1400 aMW by 2021 (6 years) 3000 aMW by 2026 4300 aMW by 2035 (20 years)	Server rooms, LED lighting, Ag sector measures, VRF systems, advanced control systems
Sixth Plan (2010)	1,200 aMW by 2014 (5 years) 5,900 aMW by 2030 (20 years)	Distribution system efficiency, consumer electronics (LED TVs), exterior and street lighting, Industrial sector EE (2x)
Fifth Plan (2005)	700 aMW by 2009 (5 years) 2,800 aMW by 2024 (20 years)	Compact fluorescent lighting, heat pump water heaters, AC/DC power converters, integrated building design

Conservation in the 2021 Power Plan

Sector and Measure Bundles

Residential	aMW by 2027
Dryer	8
Electronics	11
Food Preparation	0.1
HVAC Equipment	0.6
Weatherization	8
Smart Thermostats	6
Lighting	13
Refrigeration	5
Clothes Washers	22
Water Saving Devices	25
Circulator Controls	0.2
Level 2 EVSE	0.7
Total	**100**

Commercial	aMW by 2027
Electronics	46
Food Preparation	5
HVAC	40
Lighting	230
Motors/Drives	20
Process Loads	10
Refrigeration	40
Water Heating	9
Total	398

Industrial	aMW by 2027
Compressed Air	19
Energy Management	54
Fans and Blowers	14
HVAC	21
Lighting	41
Material Handling and Processing	9
Other	<1
Pumps	27
Refrigeration	24
Water/Wastewater	8
Total	227

Agriculture	aMW by 2027
Lighting	2.1
Dairy	0.8
Irrigation Hardware	4.7
Irrigation Motor	4.8
Other	0.1
Total	**13**

Distribution System	aMW by 2027
CVR	3.1

How did we get to the 750 aMW and the measure bundles?

Definitions and Process for Developing the EE Supply Curves

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Conservation as a Resource

Conservation (Energy Efficiency) is a resource

Conservation is to be evaluated/valued along side of other generating resources

Conservation is defined as a Resource in the NW Power Act:

Resource *means --*
electric ***power****, including the actual or planned electric power capability of* ***generating*** *facilities,* ***or*** *actual or planned load reduction resulting from direct application of a renewable energy resource by a consumer or from a* ***conservation measure****.* *(3(19))*

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…"

(From cost-effectiveness definition)

A Few Notes from the Power Act… (3(4))

Cost-effective means that such measure or resource must be forecast…

- to be reliable and available within the time it is needed, and
- to meet or reduce the electric power demand … of the **consumers** of the **customers** at an estimated incremental **system cost** no greater than that of the least-cost similarly reliable and available alternative measure or resource, or any combination thereof.

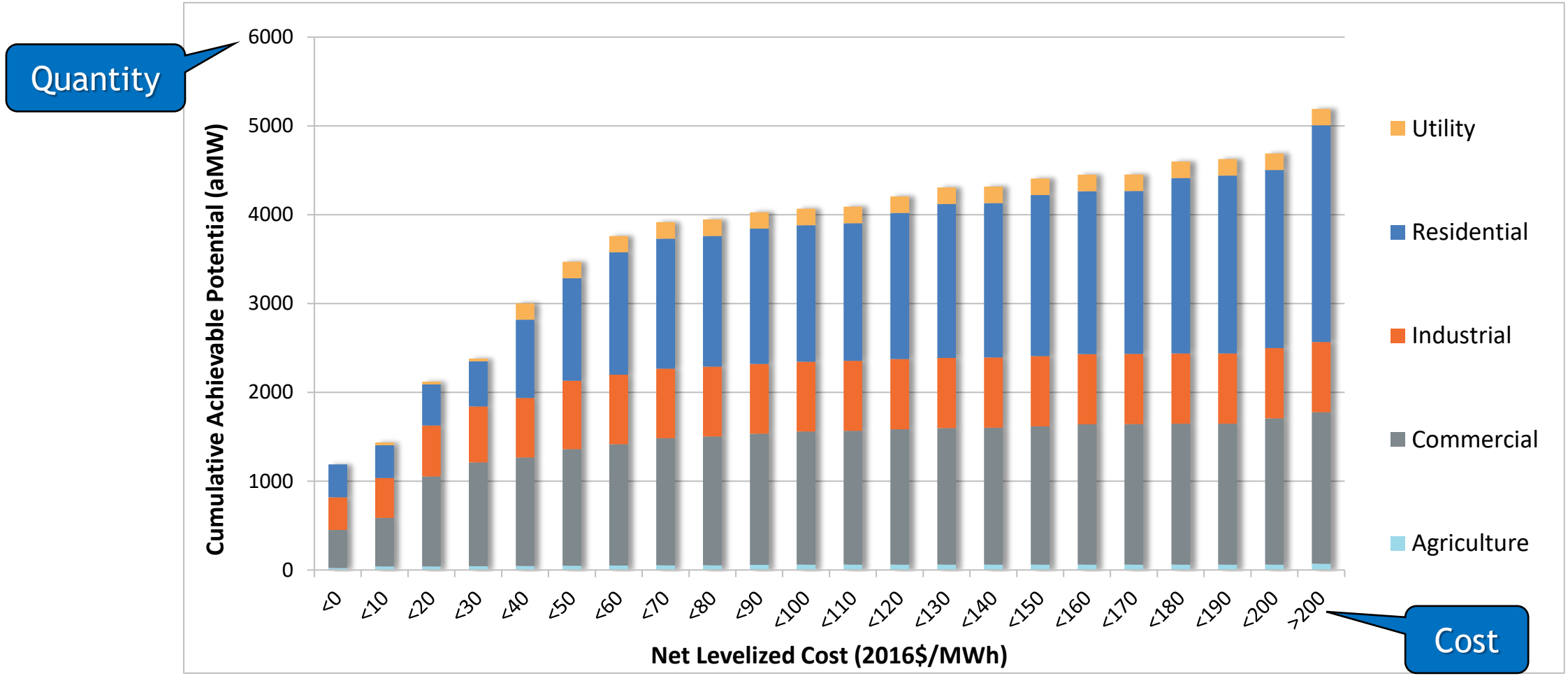
"System cost" means an estimate of **all direct costs of a measure or resource over its effective life**, including … the cost of distribution and transmission to the consumer and, among other factors, waste disposal costs, end-of-cycle costs, and fuel costs (including projected increases), and such **quantifiable environmental costs and benefits** … are **directly attributable to such measure or resource**.

What is a Supply Curve?

- 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
- The supply curve tells our optimization models how much EE is available and what cost
- A subset of the supply curve eventually leads to EE goals/targets

Supply Curve Example

(20-Yr Potential Supply Curve from 2021 Plan)



The Basic Formula for EE Savings

EE Savings Potential =
Number Units * kWh savings per Unit * Achievable Amount (%)

Examples:
- Number of homes
- Floor area of retail
- Number of refrigerators
- Acres irrigated
- Number of transformers

4,019,793

Total number of Single-Family (SF) homes in 2041

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

EXAMPLE:
Attic Insulation R0 – R49 in Heating Zones (HZs) 2&3 in a home with an electric furnace

2,253 kWh/year savings

9308 kWh/year (no attic insulation)
– 7055 kWh/year (R49 attic insulation)
= 2253 kWh/year savings

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

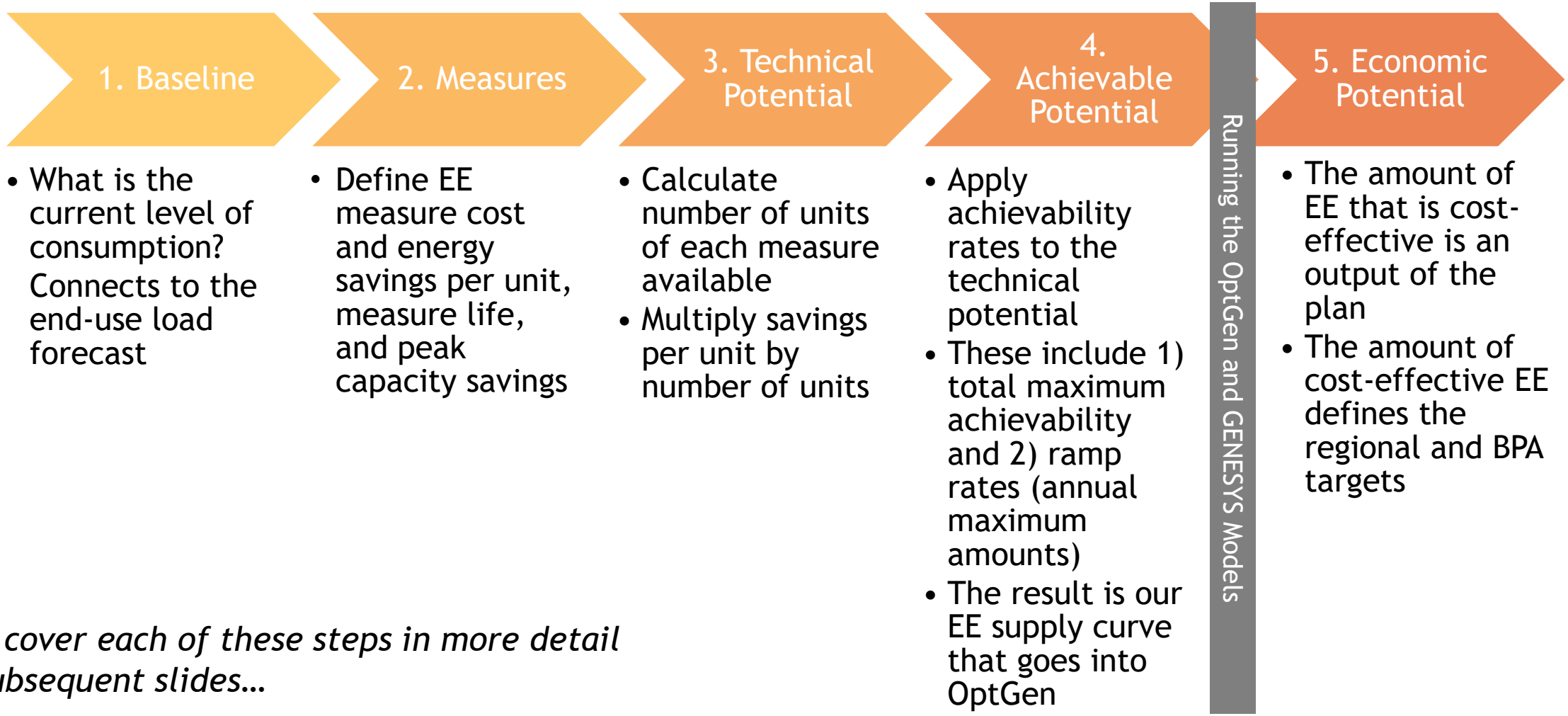
0.012% - applicability factor (% of all SF homes in HZs 2 & 3, with an electric furnace, with no attic insulation…)

85% - achievability factor

4,019,793 * 2,253 * 0.012% * 85%

= 900 MWh/year in total savings

Process Flow – Supply Curve and EE Target



- What is the current level of consumption? Connects to the end-use load forecast

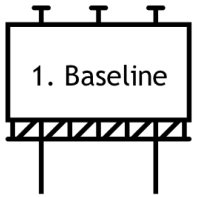
- Define EE measure cost and energy savings per unit, measure life, and peak capacity savings

- Calculate number of units of each measure available
- Multiply savings per unit by number of units

- Apply achievability rates to the technical potential
- These include 1) total maximum achievability and 2) ramp rates (annual maximum amounts)
- The result is our EE supply curve that goes into OptGen

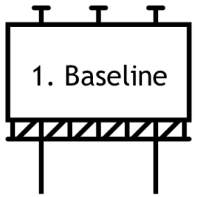
- The amount of EE that is cost-effective is an output of the plan
- The amount of cost-effective EE defines the regional and BPA targets

Will cover each of these steps in more detail in subsequent slides…



1. Establish the Baseline and Sync 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
  - Establish the base year and then “freeze” or fix the baseline
  - This ensures we don’t double count the EE
  - Product stock turnover results in some overall efficiency improvement



Baselines for Each Measure Depends on Decision Timing

New

New Homes, New Buildings

Decision when new item is built or purchased.

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

Natural Replacement

Replace on Burn-Out,
Major Remodel

Decision when equipment fails or becomes obsolete.

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

Retrofit

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

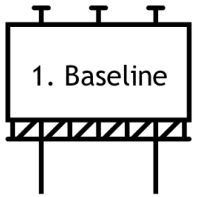
Decision timing is discretionary.

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

Identify EE Measures

- Over 100 measure categories in the 2021 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 (Conservation Voltage Regulation-CVR, reconductoring, transformers)
  - Across residential, commercial, industrial, agriculture, utility
- Over 2000 measure applications *(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

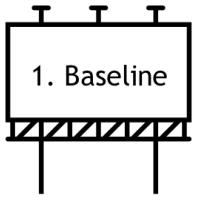
2021 Plan EE Measure List: Res & Com



- **Commercial**
  - **Compressed Air**
    - Compressors
  - **Electronics**
    - Computers
    - PowerStrips
    - Servers & Power Supplies
  - **Food Preparation**
    - Cooking
    - Pre-Rinse Spray Valve
  - **HVAC**
    - ARC
    - Chiller-System
    - Chiller-Upgrade
    - CircPumps
    - Commercial EM
    - Com-PTHP
    - ConnectedThermostats
    - DHP
    - Fans
    - Glass
    - HeatPumps
    - Secondary Glazing Systems
    - UnitaryAC
    - VHE-DOAS
    - VRF-DOAS
  - **Lighting**
    - Bi-Level Stairwell Lighting
    - Exterior Building Lighting
    - LEC Exit Sign
    - LPD Package
    - Parking Garage Lighting
    - Street and Roadway Lighting
  - **Motors/Drives**
    - Clean Water Pumps
  - **Process Loads**
    - EBHeaterControl
    - Elevators
  - **Refrigeration**
    - GroceryRefrigeration
    - IceAndVending
    - Refrig-Freezer
    - Water Cooler Controls
  - **Water Heating**
    - CircPumps
    - HPWH ResType
    - Showerheads
    - Washer

- **Residential**
  - **Dryer**
    - Clothes Dryer
  - **Electronics**
    - Advanced Power Strips
    - Desktop
    - Laptop
    - Monitor
    - UHD TV
  - **Food Preparation**
    - Electric Oven
    - Microwave
  - **HVAC**
    - ASHP Conversion
    - ASHP Upgrade
    - CAC
    - Cellular Shades
    - Circulator Controls
    - Circulators
    - DHP
    - DHP Ducted
    - Duct Sealing
    - GSHP
    - Heat Recovery Ventilation
    - RAC
    - ResWx
    - Smart tstats
    - Whole House Fan
  - **Lighting**
    - Fixtures
    - Lamps
    - Pin Lamps
  - **Other**
    - Air cleaners
    - Well Pump
  - **Refrigeration**
    - Freezer
    - Refrigerator
  - **Water Heating**
    - Aerator
    - Circulator Controls
    - Circulators
    - Clothes Washer
    - Dishwasher
    - HPWH
    - Showerheads
    - TSRV
    - WasteWater Heat Recovery
    - WH Pipe insulation
  - **Whole Bldg/Meter Level**
    - Behavior
    - EV Supply Equip

2021 Plan EE Measure List: Ag, Ind, & Utility



- **Agriculture**
  - **HVAC**
    - Dairy
  - **Irrigation**
    - Irrigation Hardware
  - **Lighting**
    - Dairy
    - Lighting
  - **Motors/Drives**
    - Dairy
    - Irrigation Motor
  - **Process Loads**
    - Stationary Engine Block Heater
    - Stock Tanks
  - **Refrigeration**
    - Dairy

- **Utility**
  - **Utility Distribution Sytem**
    - Utility Distribution System

CVR

- **Industrial**
  - **All Electric**
    - All Electric
  - **Compressed Air**
    - Compressed Air
    - Compressors
  - **Fans and Blowers**
    - Efficient_Fan
    - Fans and Blowers
  - **HVAC**
    - HVAC
  - **Lighting**
    - Lighting
  - **Low Temp Refer**
    - Advanced_Motors
    - Low Temp Refer
  - **Material Handling**
    - Advanced_Motors
    - Material Handling
  - **Material Processing**
    - Advanced_Motors
    - Material Processing
  - **Med Temp Refer**
    - Advanced_Motors
    - Med Temp Refer
  - **Melting and Casting**
    - Melting and Casting
  - **Other**
    - Other
  - **Other Motors**
    - Advanced_Motors
  - **Pollution Control**
    - Advanced_Motors
  - **Pumps**
    - Clean Water Pumps
    - Pumps

2. Develop Measure Data (Cost & Savings)

Energy Savings (kWh)

- Annual kWh per unit at the site
- Line losses from source to site
- Seasonal & daily shape of savings
- Measure interactions

Capacity Benefits (kW)

- Deferring a capacity resource ($/kW-yr)*
- Deferred distribution and transmission line expansion cost ($/kW-yr)
- Measure shape defines the kW impact

Non-Electric Impacts

- Water use changes
- Gas use changes
- Lamp replacements
- Quantifiable environmental impacts

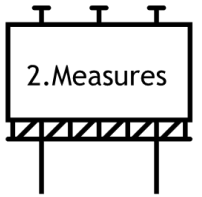
Costs

- Capital & financing
- Labor
- Program administration
- Operations & maintenance
- Reinstallation cost

Measure Life

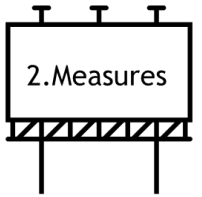
- Expected time until failure (“burn out”) or replacement

*The capacity resource deferral is usually defined after the portfolio optimization



Weatherization Savings Values Example:

Measure	Measure Savings per House					
	Heating Zone 1	Heating Zone 1	Heating Zone 1	Heating Zone 2 & 3	Heating Zone 2 & 3	Heating Zone 2 & 3
	Electric FAF	Zonal or DHP	Heat Pump	Electric FAF	Zonal or DHP	Heat Pump
Attic:R0-R38	1,386	837	796	2,001	984	748
Attic:R0-R49	1,404	849	806	2,030	998	760
Attic:R11-R38	367	340	159	541	525	315
Attic:R11-R49	388	356	168	574	548	331
Attic:R19-R38	193	134	82	295	193	140
Attic:R19-R49	216	152	90	335	221	156
Attic:R30-R38	65	57	27	97	30	67
Attic:R30-R49	91	78	37	134	45	87
Wall:R0-R11	803	660	451	1,684	1,099	562
Floor:R0-R19	243	408	210	593	514	147
Floor:R0-R25	260	443	228	639	558	159
Floor:R0-R30	270	465	239	667	586	168
Floor:R19-30	74	144	57	150	294	72
Window:Single-u30	560	492	238	864	440	235
Window:Double-u30	352	356	179	471	561	236
Window:u30-u22	63	68	43	114	116	47
Window:Single-u22	628	550	270	997	483	268
Window:Double-u22	415	424	222	585	677	282
Window: Single-Storm	639	498	254	986	469	265
Window: Double-Storm	482	534	196	705	1,049	279
Infiltration:cfm50 reduction	83	183	69	141	185	76
DuctInsulation:R0-R11	1,107	NA	170	786	NA	356

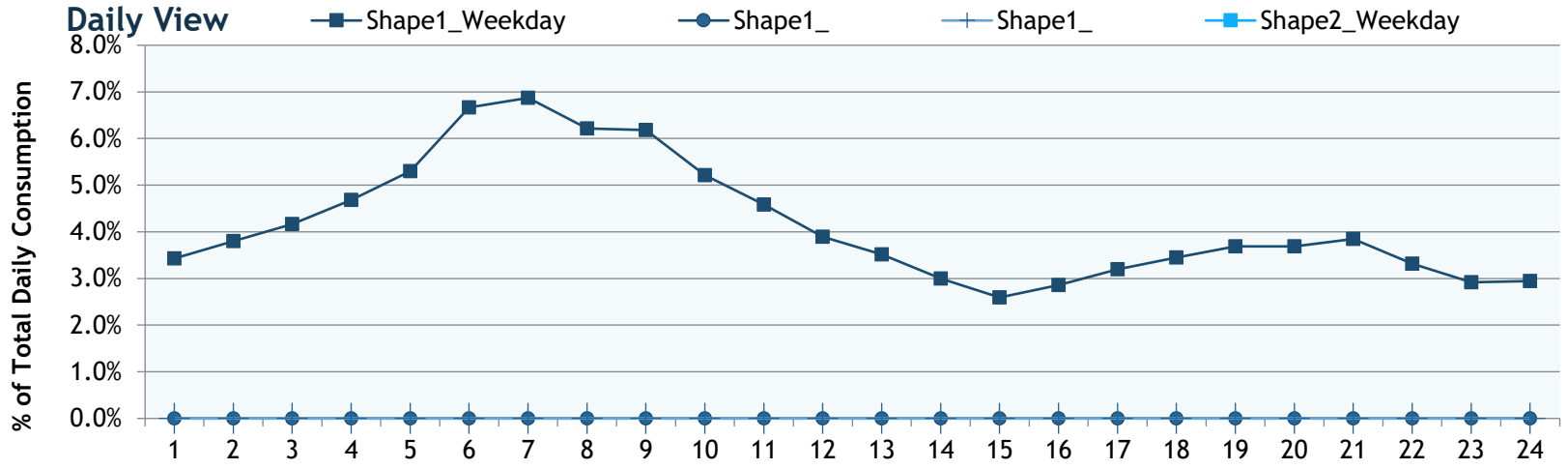


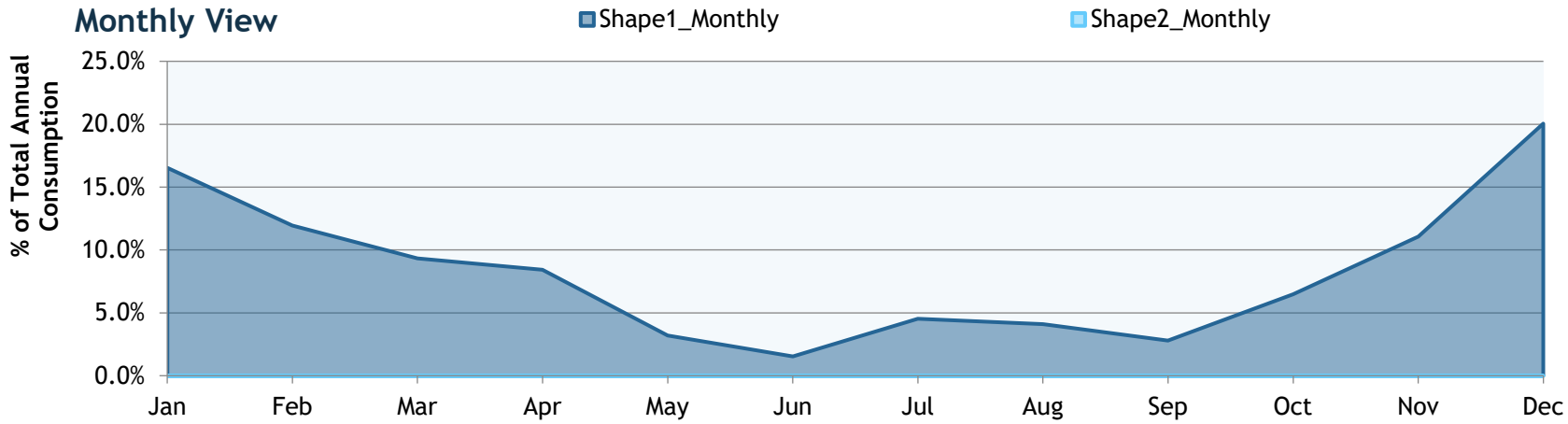
Weatherization Cost Values Example

Measure Name	Subcategory	Technology, Measure or Practice	Cost	Units
Single Family Weatherization - Insulate Attic - R0 to R38	Insulation	Attic:R0-R38	$ 1.33	$/ sf
Single Family Weatherization - Insulate Attic - R0 to R49	Insulation	Attic:R0-R49	$ 1.60	$/ sf
Single Family Weatherization - Insulate Attic - R11 to R38	Insulation	Attic:R11-R38	$ 1.06	$/ sf
Single Family Weatherization - Insulate Attic - R11 to R49	Insulation	Attic:R11-R49	$ 1.33	$/ sf
Single Family Weatherization - Insulate Attic - R19 to R38	Insulation	Attic:R19-R38	$ 1.06	$/ sf
Single Family Weatherization - Insulate Attic - R19 to R49	Insulation	Attic:R19-R49	$ 1.13	$/ sf
Single Family Weatherization - Insulate Attic - R30 to R38	Insulation	Attic:R30-R38	$ 0.61	$/ sf
Single Family Weatherization - Insulate Attic - R30 to R49	Insulation	Attic:R30-R49	$ 0.89	$/ sf
Single Family Weatherization - Insulate Wall - R0 to R11	Insulation	Wall:R0-R11	$ 1.68	$/ sf
Single Family Weatherization - Insulate Floor - R0 to R19	Insulation	Floor:R0-R19	$ 1.09	$/ sf
Single Family Weatherization - Insulate Floor - R0 to R25	Insulation	Floor:R0-R25	$ 1.28	$/ sf
Single Family Weatherization - Insulate Floor - R0 to R30	Insulation	Floor:R0-R30	$ 1.51	$/ sf
Single Family Weatherization - Insulate Floor - R19 to R30	Insulation	Floor:R19-30	$ 1.09	$/ sf
Single Family Weatherization - Insulate Ducts - R0 to R11	Insulation	DuctInsulation:R0-R11	$ 2.37	$/ sf
Infiltration Reduction - CFM50 reduction	Infiltration Control	Infiltration:cfm50 reduction	$ 0.680	$/ sf
Windows - Single Pane to Class 30	Window or Patio Door Replacement	Window:Single-u30	$ 24.09	$/ sf
Windows - Double Pane to Class 30	Window or Patio Door Replacement	Window:Double-u30	$ 24.09	$/ sf
Windows - Single Pane to Class 22	Window or Patio Door Replacement	Window:Single-u22	$ 27.98	$/ sf
Windows - Double Pane to Class 22	Window or Patio Door Replacement	Window:Double-u22	$ 27.98	$/ sf
Windows - Class 30 to Class 22	Window or Patio Door Replacement	Window:u30-u22	$ 3.89	$/ sf
Windows - Add a Low-e Storm Window to an existing Single Paned Window	Low-e Storm Window	Window: Single-Storm	$ 10.46	$/ sf
Windows - Add a Low-e Storm Window to an existing Double Paned Window	Low-e Storm Window	Window: Double-Storm	$ 10.46	$/ sf

Measure Savings Shapes

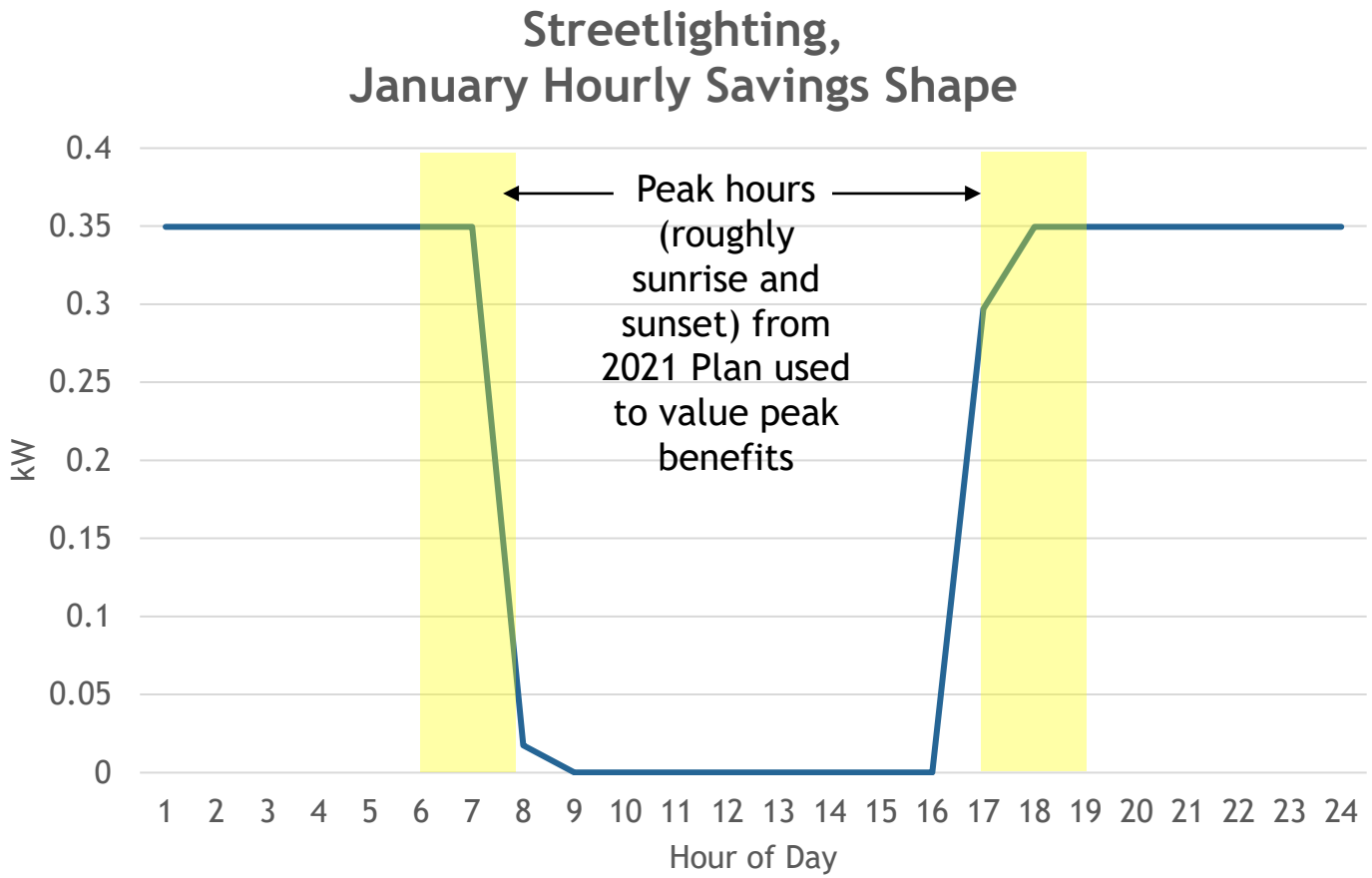
Example: Air Source Heat Pump: Heating zone 1





How are the EE Measure Shapes Used?

- System load shape is used for calculating the marginal line losses (site to busbar)
- Measure shapes are used to define the amount of electricity being saved (kW) at the defined peak hour(s), or hour of greatest need
  - Avoided transmission value
  - Avoided distribution value

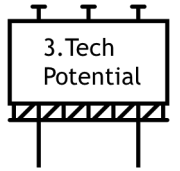


Calculate Levelized Cost

- The cost and benefit streams are levelized over the lifetime of the measure
- The final measure is defined by its:
  - Electricity savings (kWh)
  - Levelized cost ($/kWh)
  - Capacity impact (kW)
- Formula:

Costs Included	Benefits Netted Out
Capital & Labor	Deferred T & D Expansion
Annual O&M	Regional Act Credit
Program Administration	Avoided Periodic Replacement
Periodic Replacement	Other Fuel Benefits
Other Fuel Costs	Non-Energy Impacts
Non-Energy Impacts	

$$\text{NRC Net Levelized Cost} = \frac{NPV(cap\ cost * (1 + admin) + ann\ O\&M + other\ fuel + NEI - Def\ T\&D - RAC - OFB)}{Measure\ kWh\ Savings}$$



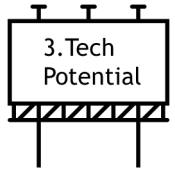
3. Estimate Technical Potential

- The technical EE potential is essentially multiplying the measure savings by the number of units for each measure.
- The technical potential is the theoretical maximum EE that could be achieved/acquired for a given measure

Data Sources:
- Stock assessments (RBSA, CBSA, IFSA)
- Council forecast models
- EIA – RBECS, CBECS, MECS
- DOE Rule making data sets (TSDs)
- Product sales data

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

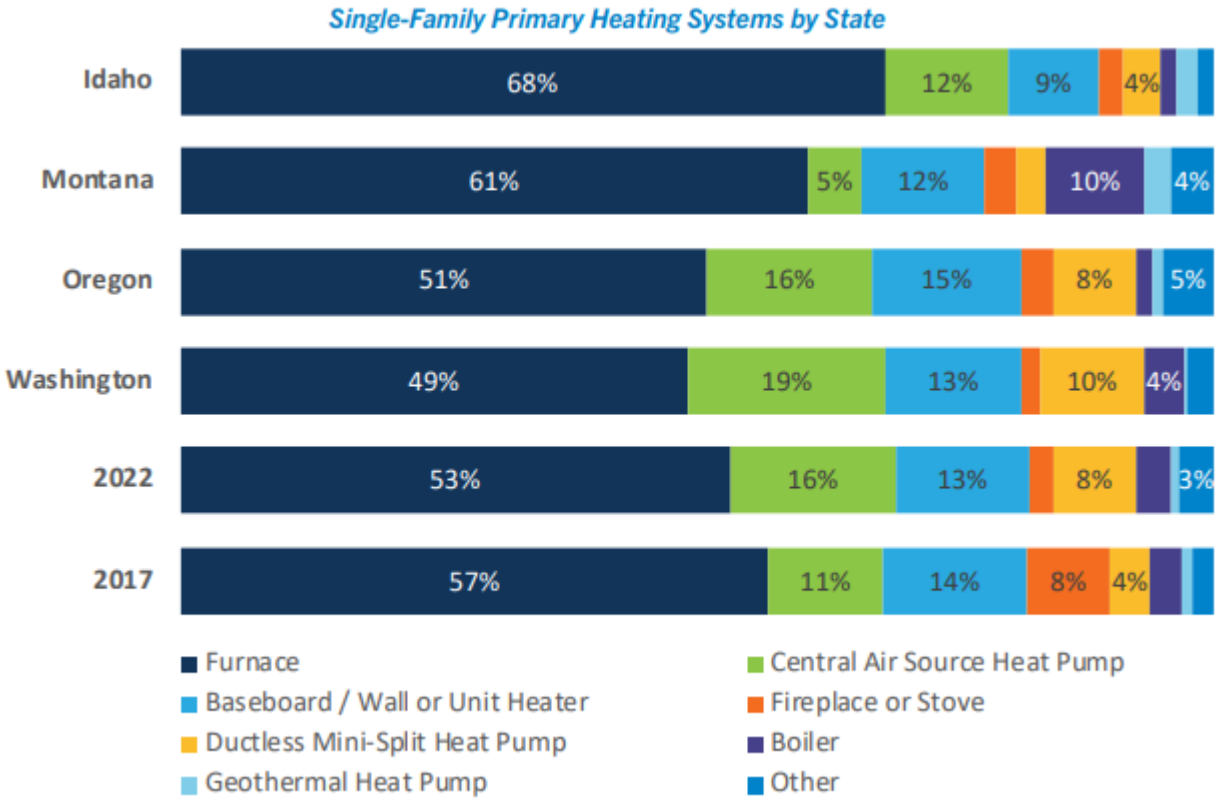
Technical Potential Data Examples: Residential Housing and Commercial Building SF Forecasts

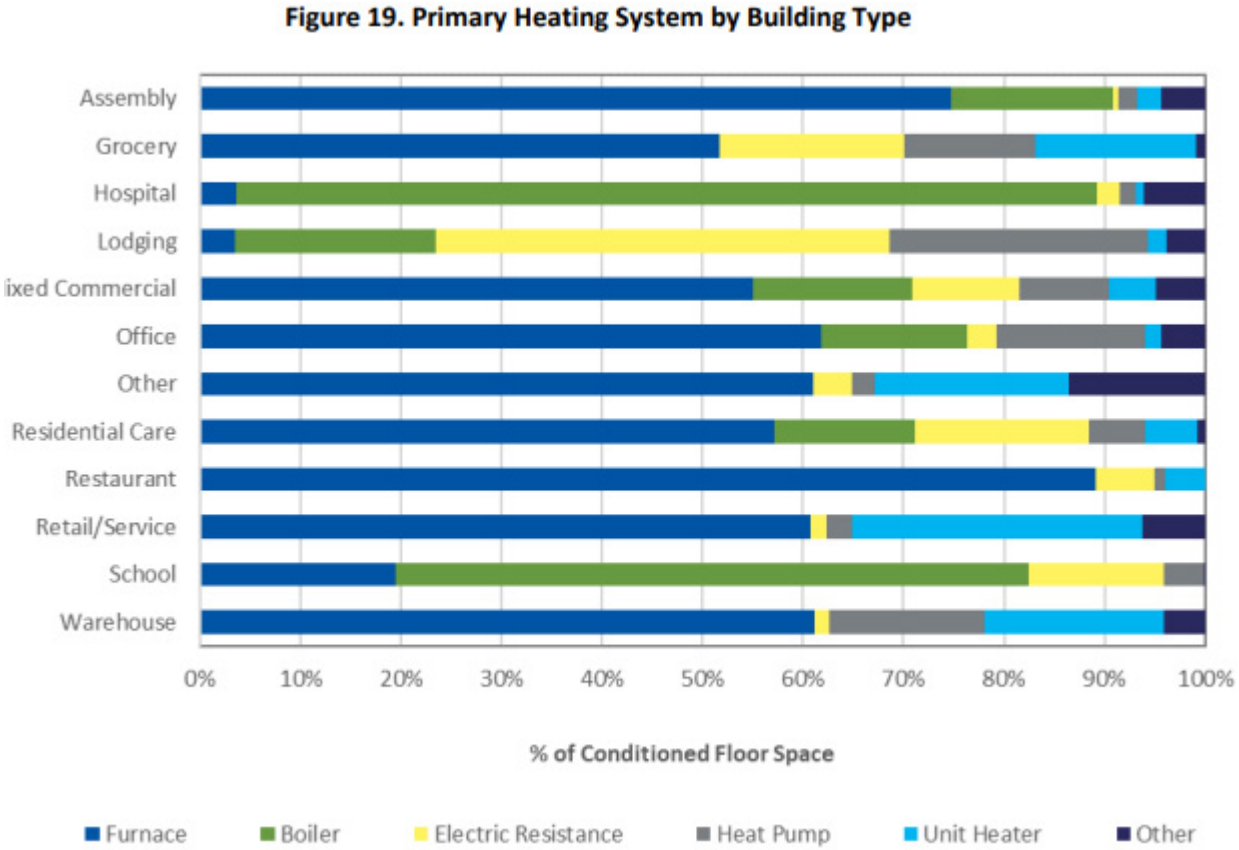


Sector	Building/Industry Type	Vintage / Subcategory	Forecast Units	2022	2023	2024
Res	Single Family	New	Buildings	51,978	50,642	49,646
Res	Multifamily - Low Rise	New	Buildings	21,353	21,123	21,016
Res	Multifamily - High Rise	New	Buildings	6,219	6,115	6,097
Res	Manufactured	New	Buildings	4,099	4,171	4,265
Res	Single Family	Existing	Buildings	4,418,134	4,408,102	4,398,092
Res	Multifamily - Low Rise	Existing	Buildings	997,938	995,672	993,411
Res	Multifamily - High Rise	Existing	Buildings	295,302	294,632	293,962
Res	Manufactured	Existing	Buildings	586,202	579,937	573,740
Com	Large Off	Existing	Millions SqFt	396	395	394
Com	Medium Off	Existing	Millions SqFt	203	202	202
Com	Small Off	Existing	Millions SqFt	187	187	186
Com	XLarge Ret	Existing	Millions SqFt	142	141	140
Com	Large Ret	Existing	Millions SqFt	213	212	211
Com	Medium Ret	Existing	Millions SqFt	100	100	99
Com	Small Ret	Existing	Millions SqFt	112	111	111
Com	School K-12	Existing	Millions SqFt	272	272	271
Com	University	Existing	Millions SqFt	133	133	133
Com	Warehouse	Existing	Millions SqFt	490	488	485
Com	Supermarket	Existing	Millions SqFt	52	52	52
Com	MiniMart	Existing	Millions SqFt	24	24	23
Com	Restaurant	Existing	Millions SqFt	52	51	51
Com	Lodging	Existing	Millions SqFt	185	184	183
Com	Hospital	Existing	Millions SqFt	114	113	113
Com	Residential Care	Existing	Millions SqFt	139	139	138
Com	Assembly	Existing	Millions SqFt	374	372	371
Com	Other	Existing	Millions SqFt	369	365	362

To 2041…

RBSA and CBSA Data Examples

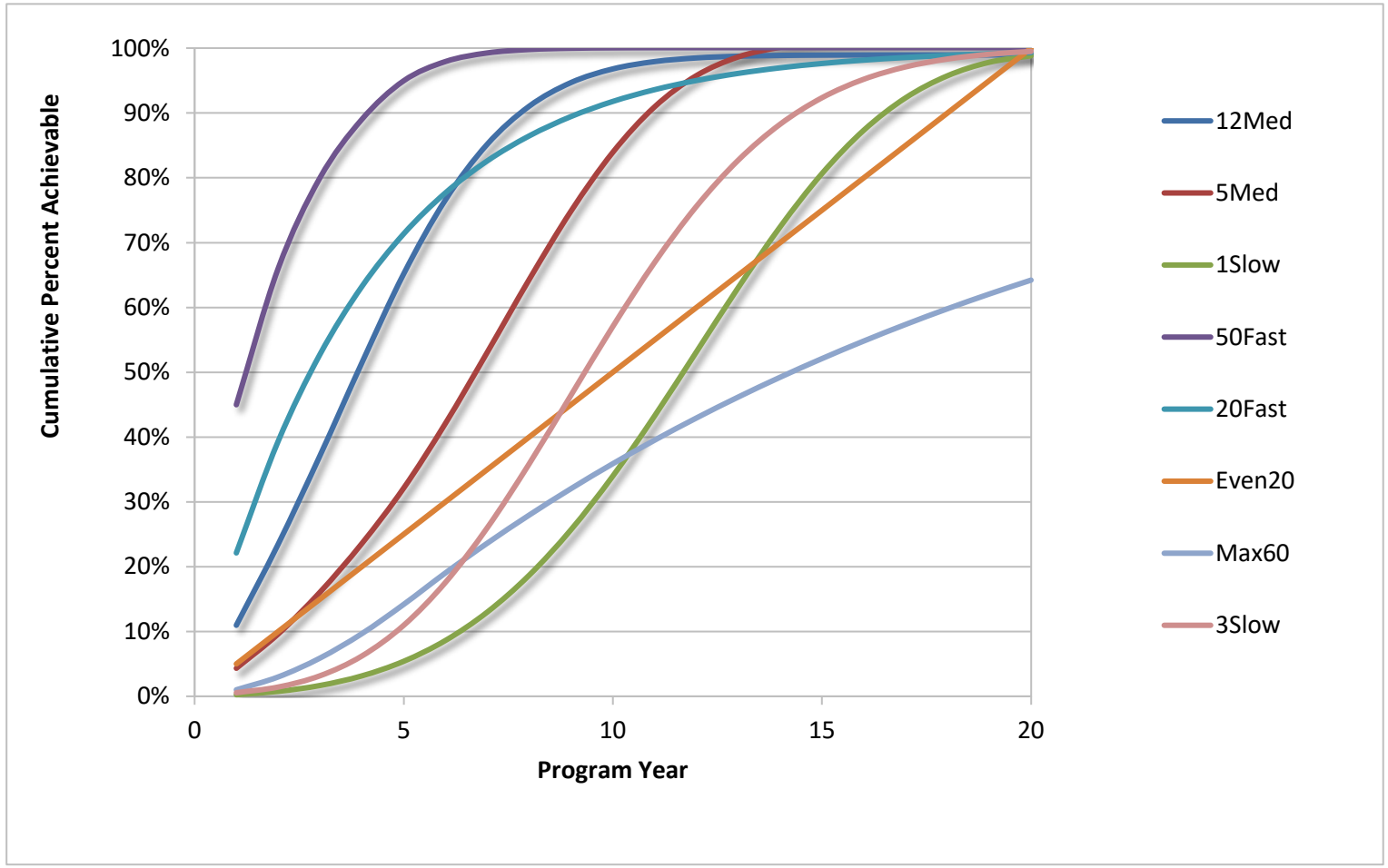




4. Achievable Potential

- *Achievable Potential* is Always Less Than *Technical Potential*
  - Less than 100% adoption assumed (we use 85% to 95%)
  - Assumes not all customers will accept the efficient unit, even if offered at no cost to the consumer
  - Reference: Hood River Project in the 80's
- 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
- 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 – Annual Achievability Limits

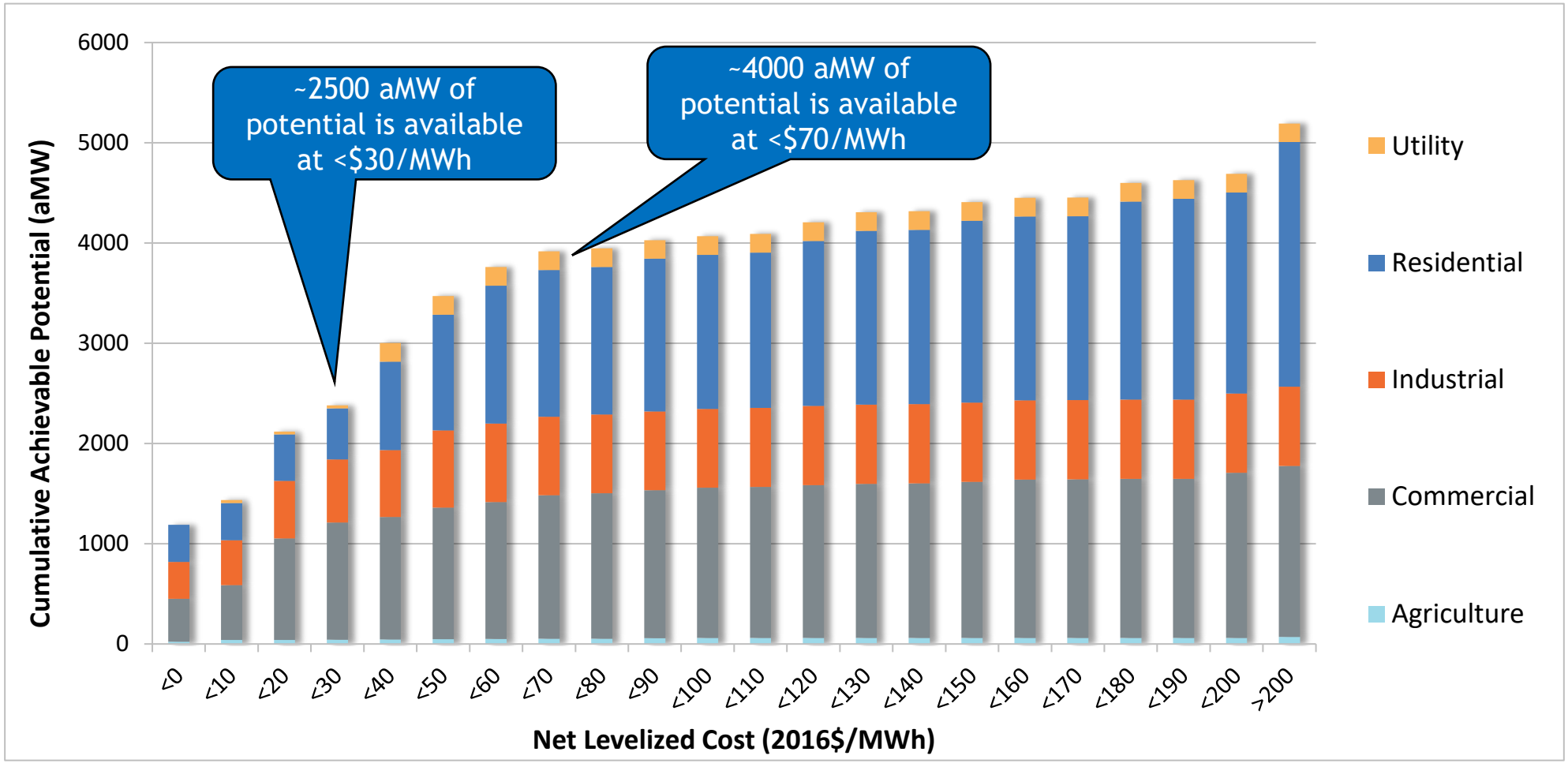


Achievability is first capped at 85% to 95% of total technical potential, and then ramp rates are applied

Data Sources that inform Ramp Rates:

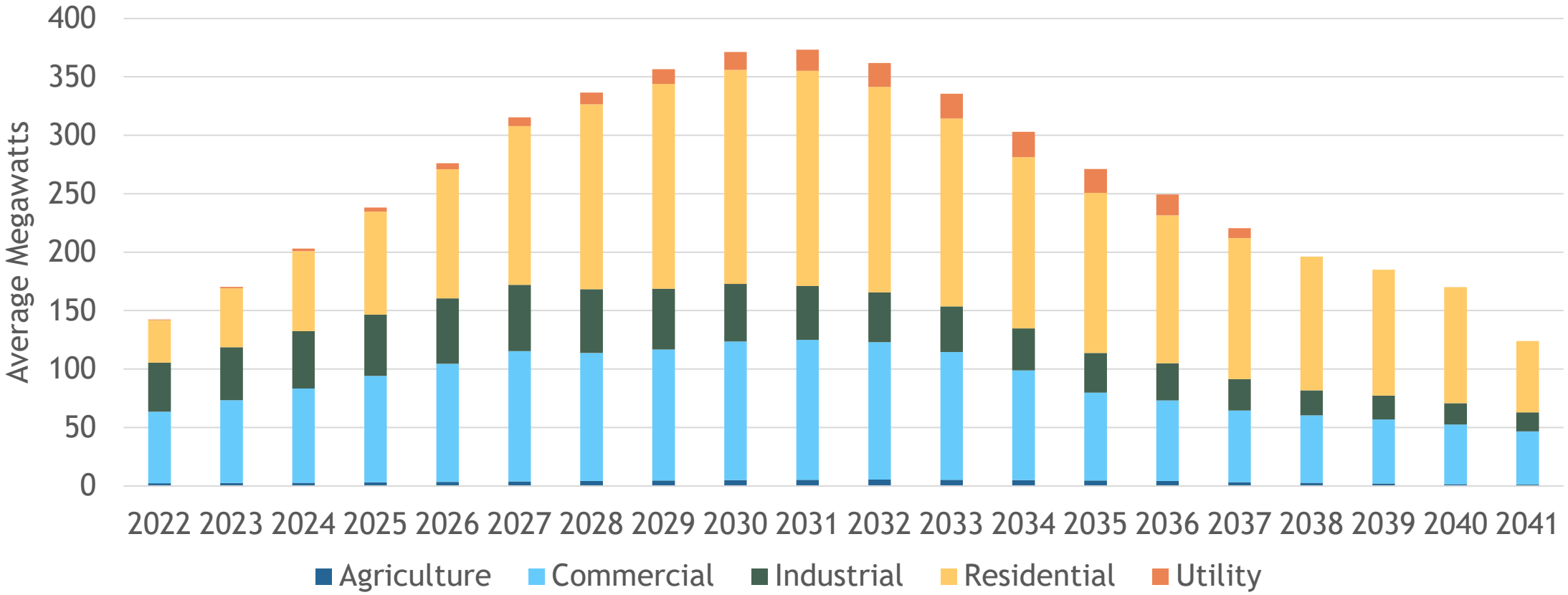
- Past program performance
- Cost of measure
- Consumer acceptance
- Non-energy impacts
- Physical availability of equipment
- Training & education requirements
- Advisory committee discussions

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



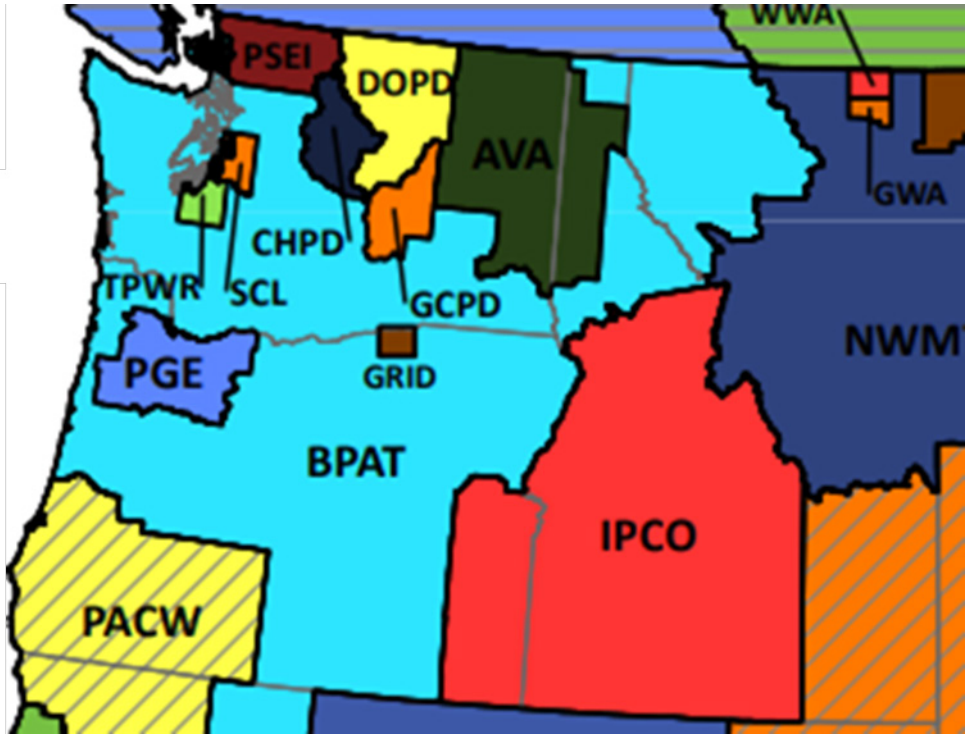
Annual Conservation Resource Availability

(Includes the impact of ramp rates and achievability limits)



Units by Regional Zone/BA

- For the Ninth Plan, we will need to disaggregate the units by BA
  - Instead of one supply curve for the region, we will develop 17 different supply curves
- Locational differences, e.g., weather, T&D deferral



BA #	Draft 9th Plan BA List
1	BPA_OR
2	BPA_WA
3	BPA_IDMT
4	PSE_North
5	PSE_Central
6	PSE_Olympia
7	PGE
8	AVA
9	PACW
10	PACE
11	IPCO
12	NWMT
13	SCL
14	TPWER
15	DCPUD
16	CCPUD
17	GCPUD

Hand-off to OptGen - Resource Strategy

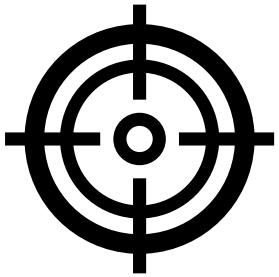
- Supply curve: amount (aMW) by levelized cost bin ($/MWh)
- Peak impacts: hourly energy shape

Modeling and resource strategy development take place after the handoff to OptGen

5. Economic Achievable Potential

The Economic Potential is determined by the resource strategy analysis

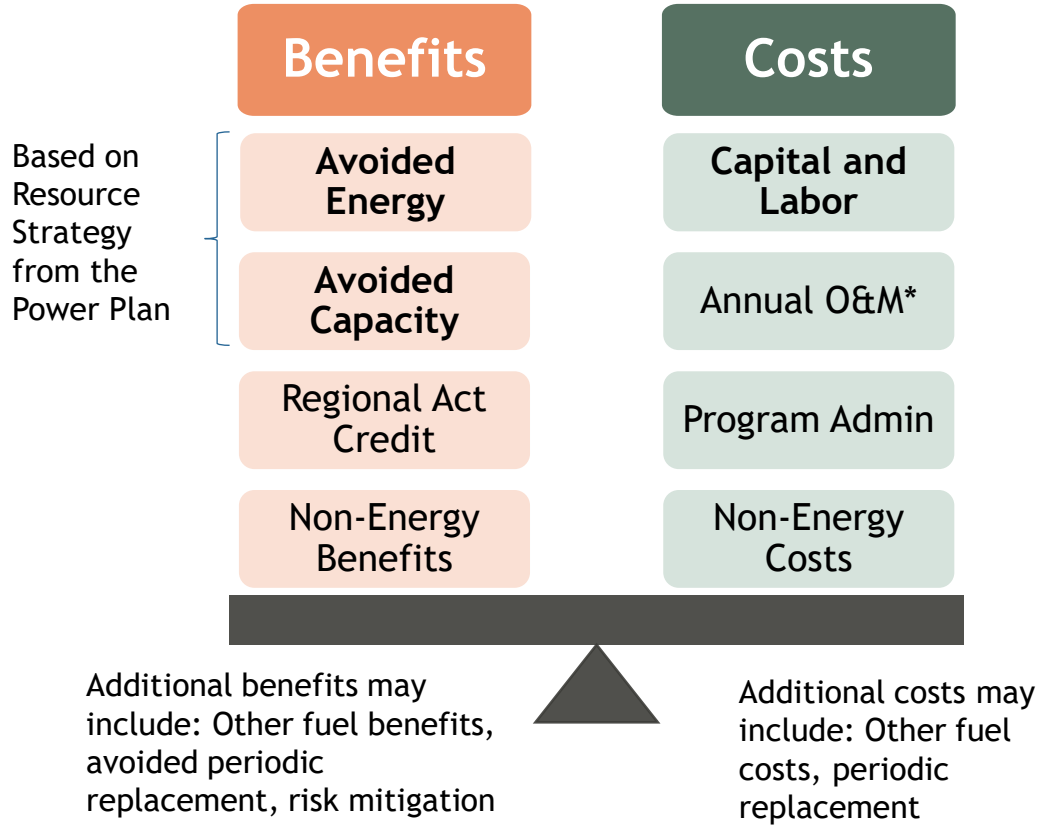
- Council determines this potential based on analytical results and judgment
- Results in the regional EE targets/goals



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

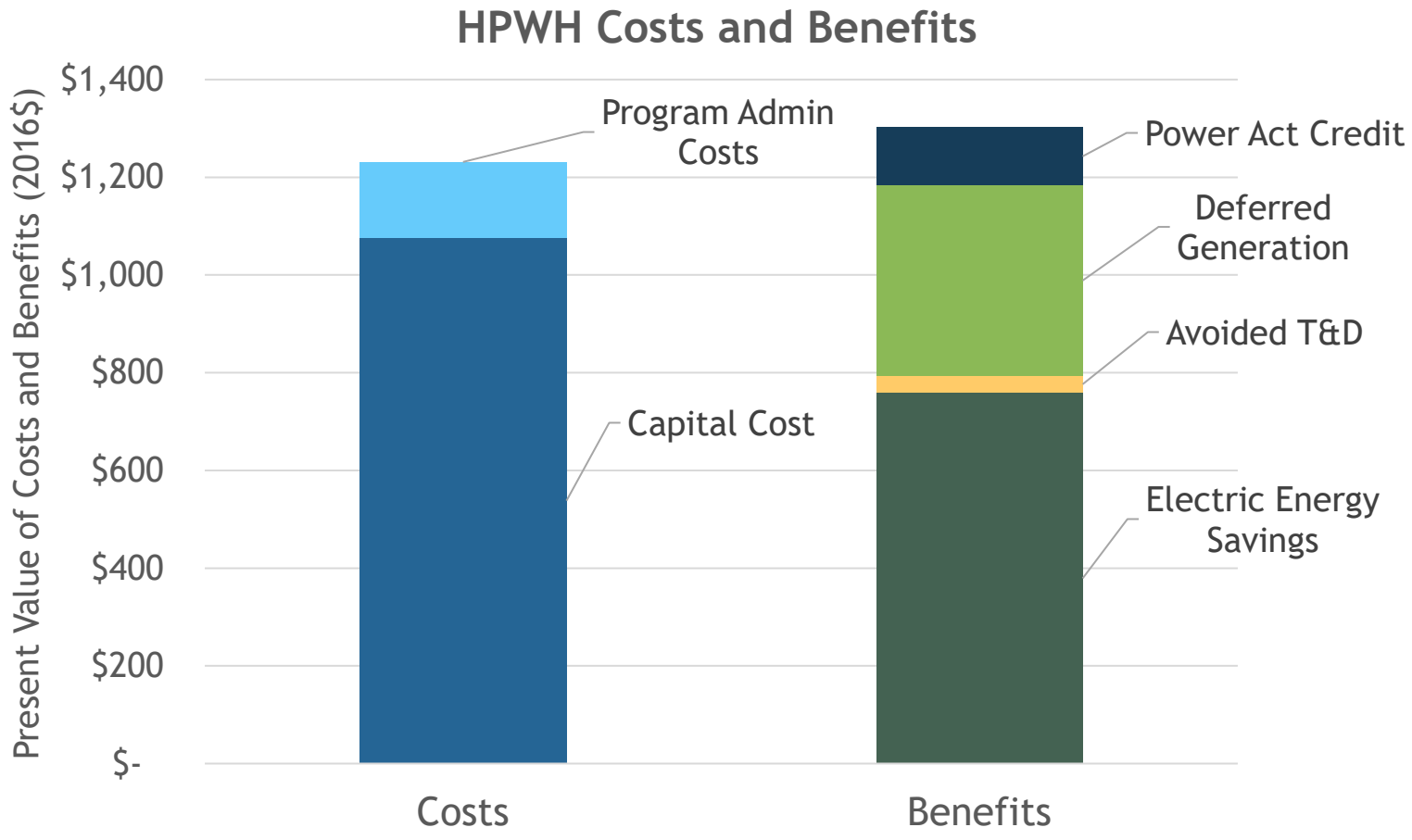
EE Cost-Effectiveness – Always Relative to Alternative Resources From the Plan



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: Res Heat Pump Water Heater (HPWH)



Note: Tier 4 efficiency HPWH in a garage, heating zone 1, using 2021 Plan inputs.

What is new for the upcoming Ninth Plan?

- Expanding our work to 17 zones/BAs
- Research is underway for:
  - Data centers
  - Strategic energy management
  - Ag sector EE
  - Distribution efficiency, including reconductoring
  - Administrative/overhead costs of EE
  - Water Supply and Wastewater Treatment EE
  - Motor measures
  - HVAC and Heat pumps
- Seeking new emerging technologies that are “reliable and available”
  - Ozone laundry
  - UV and Ultrasonic dryers
  - Micro heat pumps (VS window heat pump)
  - Industrial High Temperature Heat pumps
  - Etc.


Questions/Comments