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June 9, 2020

### MEMORANDUM

**TO: Power Committee**

**FROM: Charlie Grist, Tina Jayaweera, Kevin Smit, John Ollis**

**SUBJECT: Analyze the Bonneville Portfolio Scenario Update**

### BACKGROUND:

**Presenter:** Ben Kujala, Kevin Smit, Tina Jayaweera

**Summary:** In January, the Power Committee discussed the scenarios in more detail including the *Analyze the Bonneville Portfolio* scenario. Then at the May meeting, the committee reviewed the load forecast for Bonneville. This presentation is to provide context and allow for committee review of some key inputs for this scenario.

#### **BPA EE Supply Curves**

Staff will present the supply curves for the Bonneville Power Administration scenario for the Draft 2021 Power Plan. Staff will describe the modifications to the baseline conservation workbooks that were needed to create the BPA-specific supply curves. The primary changes are to the number of units for each sector: residential number of homes, commercial building square footage, industrial sector consumption by segment, and agricultural irrigated acres and number of dairy farms.

#### **BPA DR Supply Curves**

Staff will present the demand response supply curve for the Bonneville Power Administration scenario for the Draft 2021 Power Plan. Staff will describe the modifications to the baseline workbooks that were needed to create the BPA-specific supply curves. The primary changes are to the

loads and number of units for each sector: residential loads and number of homes, commercial loads and building square footage, industrial loads and sector consumption by segment, and agricultural loads and irrigated acres and number of dairy farms. The changes to the number of units will be described more fully in the energy efficiency supply curve presentation.

Workplan: Power Division A.1: Develop the 2021 Power Plan

# BPA Scenario Update



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## Analyze the Bonneville Portfolio



- **What Resources are Required to Meet the Administrator’s Obligation?**
- **Portfolio costs are one factor of many that the Council will consider and balance as it formulates recommendations on amounts of power to acquire to the Bonneville Administrator**
- **Much of the information needed for this analysis we expect to be supplied under the existing December 2017 agreement on 4(c)(9) information sharing with Bonneville**



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# Elements Needed to Analyze the Bonneville Portfolio

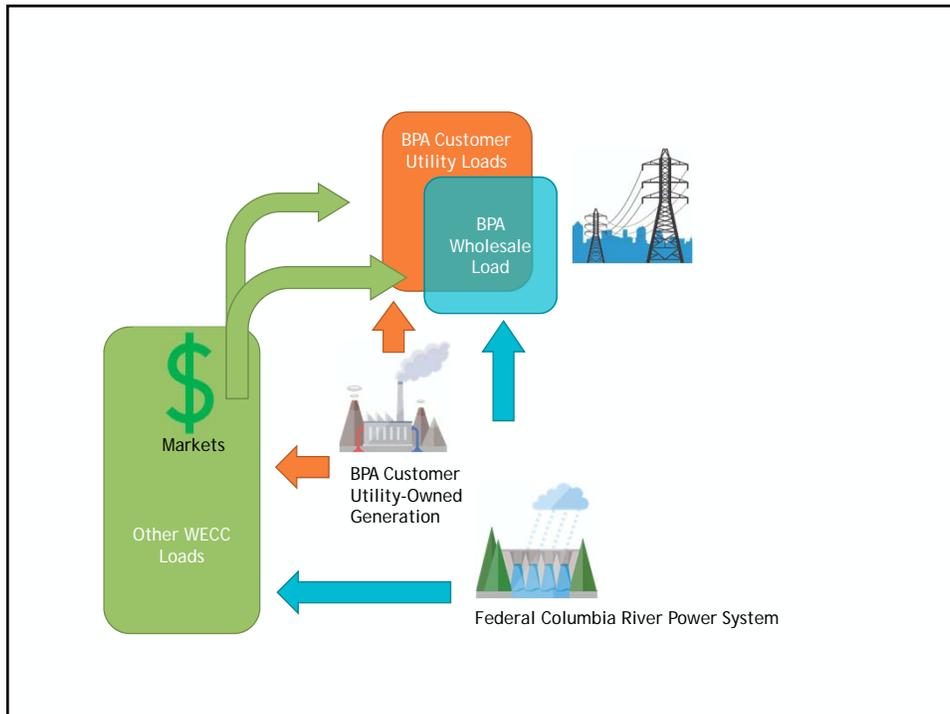
## Bonneville-specific:

- load forecast based on expected obligation (BPA wholesale load)
- generating resource potential and cost (with BPA-specific debt assumptions)
- EE Supply Curves
- DR Supply Curves - assuming Bonneville can arrange a contract for any DR potential in a customer utility that would be dispatched for Bonneville needs
- load to market price correlation
- market reliance limits

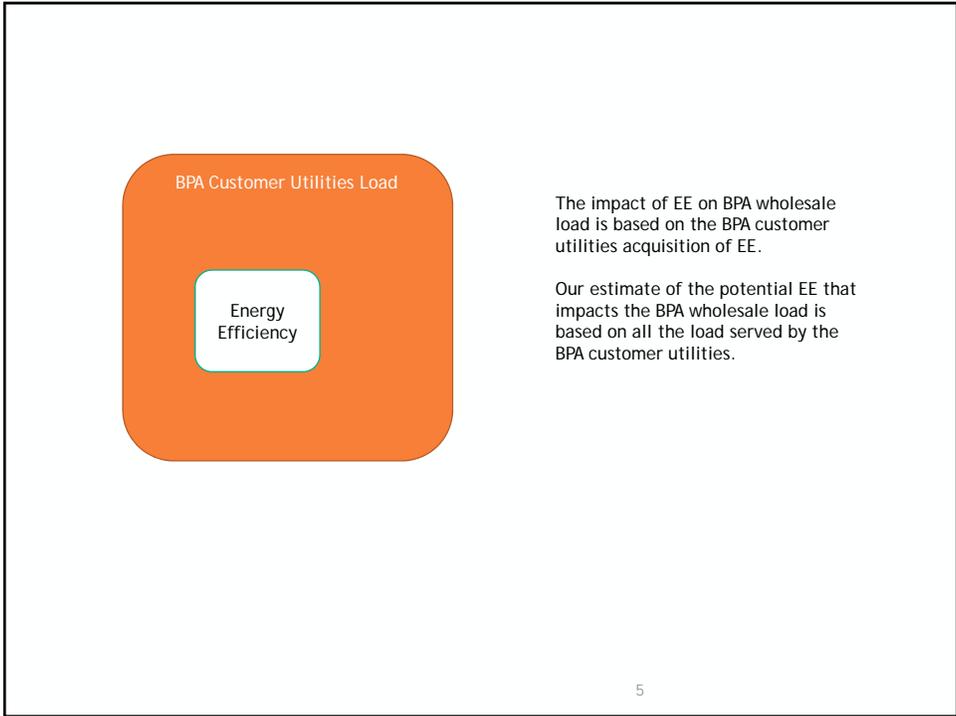
- existing resource parameters – aggregate for RPM
- market greenhouse gas emissions rate
- ASCC assumptions – *potentially* using federal GENESYS
- existing system revenue requirement - what is the current Bonneville portfolio revenue requirement?
- debt balance and payments
- transmission to market - beyond adequacy what is the maximum transmission that should be used for marketing opportunities



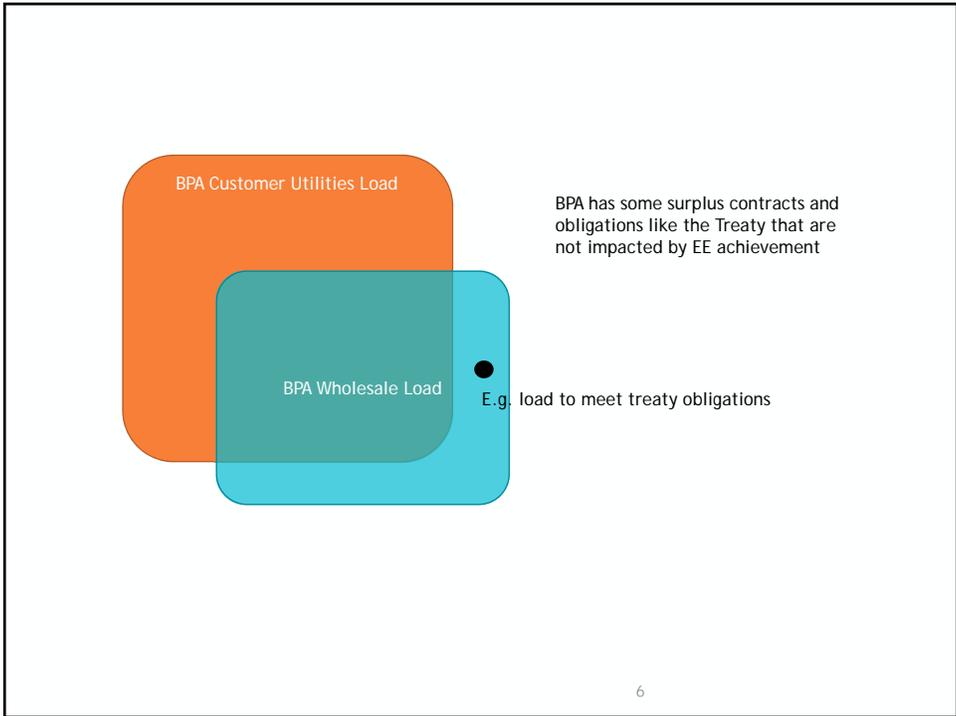
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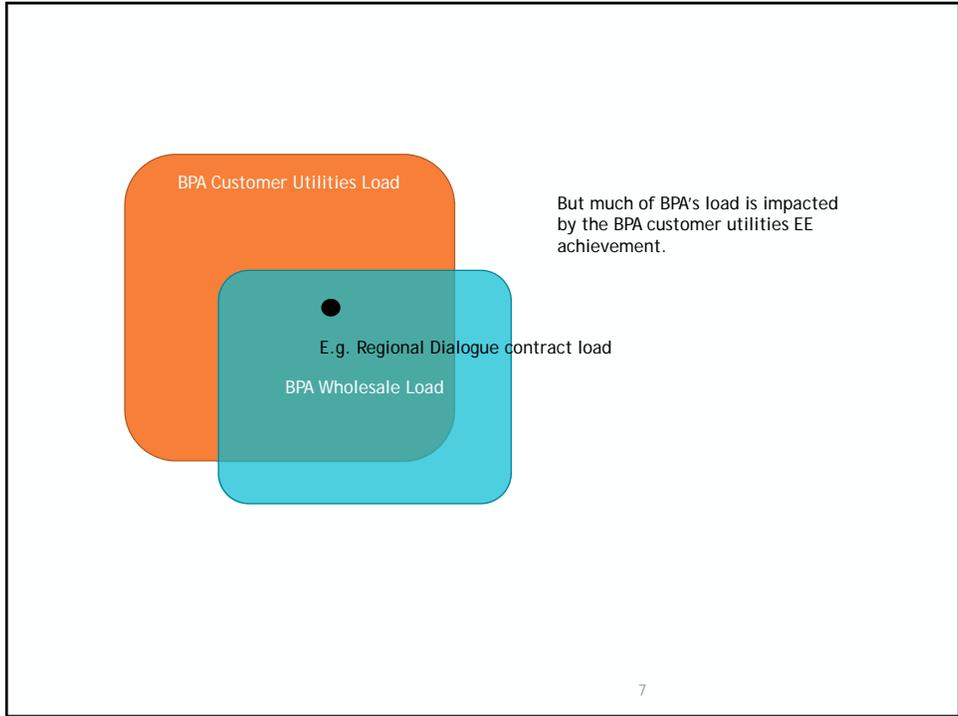
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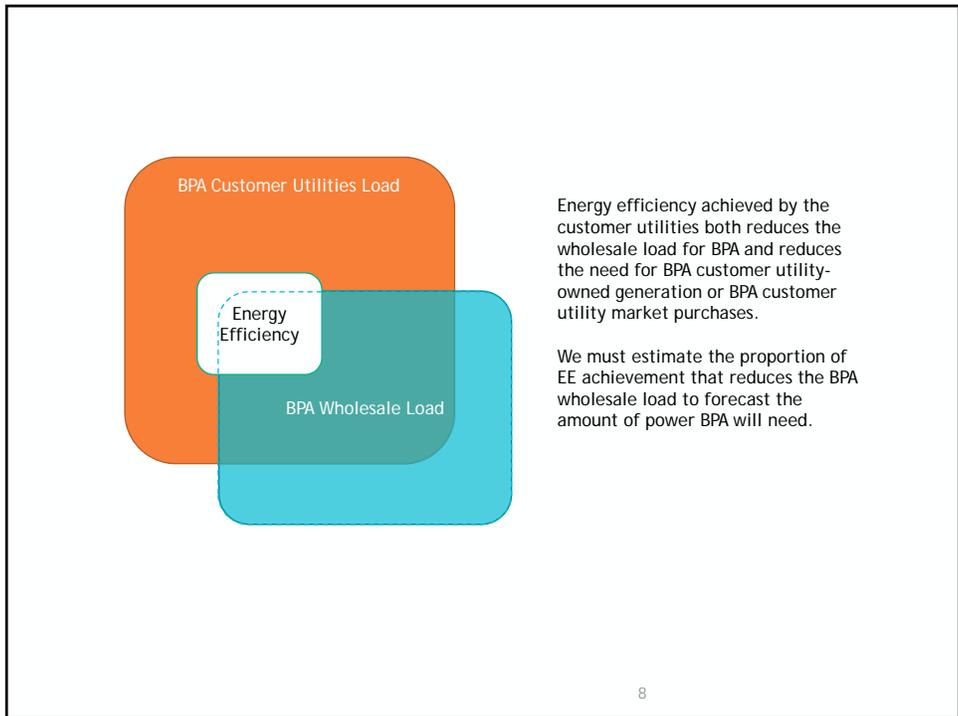
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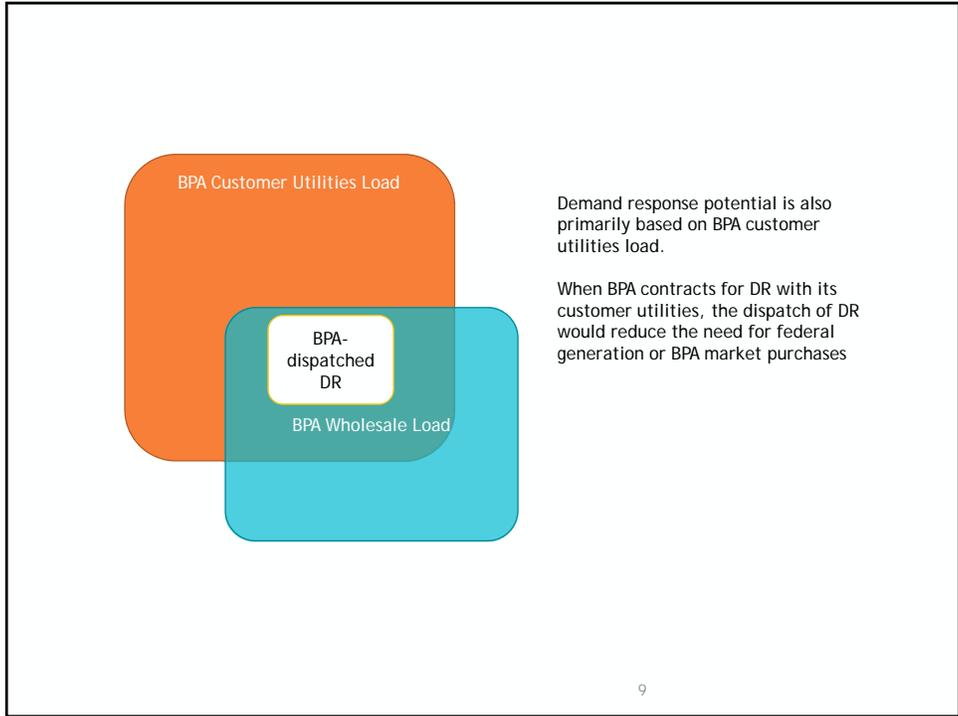
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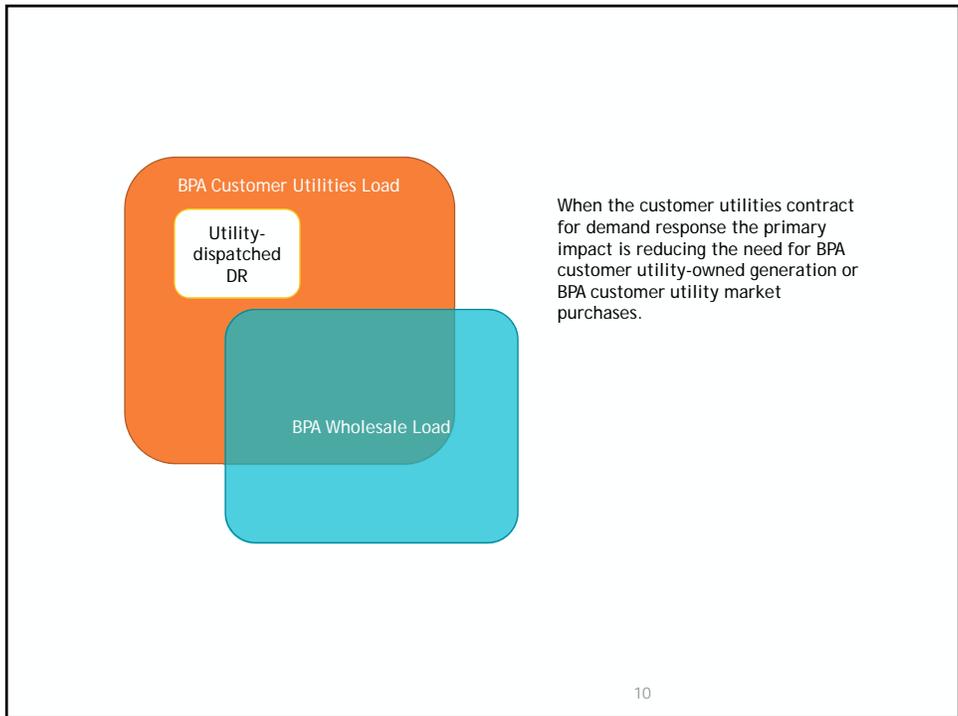
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## BPA Scenario: Generating Resources

- Fixed costs of generation change based on financing assumptions
  - Regional Financing Assumptions
    - Projects use 50% debt and 50% equity
    - Projects are IOU financed
  - BPA Financing Assumption
    - Projects use 100% debt
    - BPA financing based on its access to capital



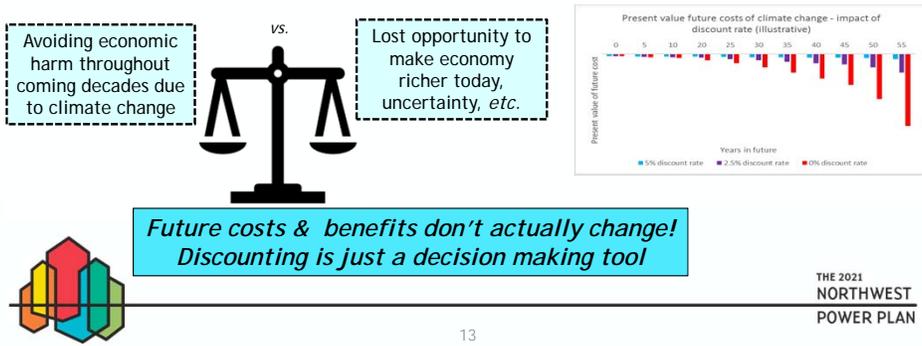
## Discount Rate Review

- *Four explanations* for defining **Discount Rate**:
  1. Describes the time preference for money
  2. Used to calculate the **value today** of all future costs and benefits
  3. Reflect that benefits in the future can be whittled down by inflation, risk, and today's lost opportunity
  4. *"A bird in the hand is worth two in the bush"*
- When planning with a **higher discount rate**, **near-term costs matter a lot**, and long-term costs and benefits are less emphasized
- Remember, though, discounting future costs or benefits doesn't actually make them smaller when the day arrives!
- Using a discount rate equal to the WACC of the entity making an investment decision is consistent with corporate norms and regional utility regulation



## Present Value of Future Costs & Benefits

- E.g. the Social Cost of Carbon (\$/ton of carbon) is the present value of costs occurring throughout the next several decades (or longer) caused by the harm of each additional ton of carbon
- A higher discount rate gives a lower emphasis to the future  
5% discount rate: \$12/ton of carbon  
2.5% discount rate: \$62/ton of carbon



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## Discount Rate for BPA Scenarios

- All future costs are discounted at the same rate when comparing resource portfolios
- For the Region we recommended 3.75% discount rate
- For the BPA Scenarios we use 2.84% discount rate
  - Excludes IOU finance costs from mix



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# Energy Efficiency Supply Curves for the BPA Scenario

Power Committee

June 16, 2020

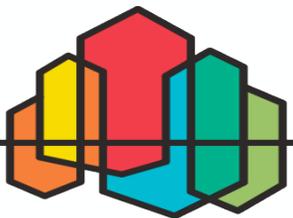


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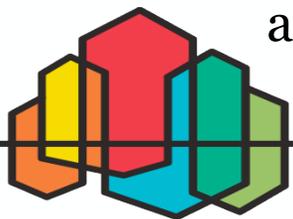
# BPA Scenario

- The BPA scenario is being developed to look more specifically at BPA loads and resources
- One primary data sets to be modified from the regional case is the EE supply curves
- Process:
  - Staff developed new units (number of homes, etc.) file
  - EE staff revised each EE measure file
  - BPA staff and consultants reviewed



# Changes from Regional

- Residential - Number of homes by house type
  - Electric space and water heating system shares
  - Appliance saturations
  - Distribution of homes by climate zone
- Commercial - Square feet of floor area by segment
  - Population shares
  - Distribution of commercial floor space by climate zone
- Industrial – Electricity consumption by segment
- Agriculture – Irrigated acres; # of dairy farms
  - incorporated state-specific shares based on irrigated acreage/dairy farms from Census of Agriculture



# Residential

- BPA territory contains ~37% of the residential homes in the region (based on population by county, as estimated in 2018 BPA potential assessment)
- These homes generally have higher electric saturation, based on 2016 Residential Building Stock Assessment (RBSA)

Number of Homes - Region and BPA

	BPA	Region	% BPA
Single Family	4,458,104	12,212,072	36%
Multifamily - Low Rise	997,248	224,289	44%
Multifamily - High Rise	295,342	144,842	20%
Manufactured	58,255	107,881	54%
<b>Total</b>	<b>5,808,949</b>	<b>12,588,984</b>	<b>46%</b>

End use	BPA Electric Saturation*	Region Electric Saturation*
Water heating	64%	49%
Space heating	55%	43%
Ovens	85%	79%

- Also able to incorporate differences in weatherization needs by building type based on RBSA data

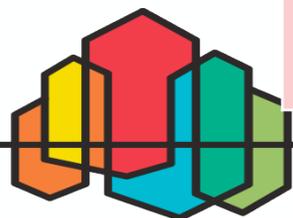


# Agricultural

- Incorporated BPA shares based on county data as analyzed for 2018 BPA conservation potential assessment

State	BPA Share Irrigated Acreage
Idaho	23%
Montana	28%
Oregon	50%
Washington	46%
Regional	34%

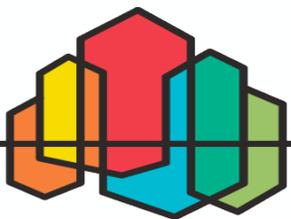
State	BPA Share Dairy Farms
Idaho	11%
Montana	24%
Oregon	65%
Washington	37%
Regional	25%



# Commercial

- Square footage by segment – 1.33 billion SF (37% of region) – CBSA2019
- Population – 5.7 million (38% of the region)
- Limited adjustments for fuel type or equipment saturations
  - CBSA 2019 recently released
  - BPA/regional differences are not yet well understood

	2022 Regional Existing Floor Space (Million SF)	2022 BPA Existing Floor Space (Million SF)	BPA Share of Region
Large Off	396	161	41%
Medium Off	203	82	41%
Small Off	187	76	41%
XLarge Ret	142	50	35%
Large Ret	213	76	35%
Medium Ret	100	36	35%
Small Ret	112	40	35%
School K-12	272	113	42%
University	133	67	50%
Warehouse	490	151	31%
Supermarket	52	20	38%
MiniMart	24	9	38%
Restaurant	52	21	41%
Lodging	185	72	39%
Hospital	114	46	40%
Residential Care	139	52	38%
Assembly	374	148	40%
Other	369	111	30%
<b>Total</b>	<b>3556</b>	<b>1331</b>	<b>37%</b>

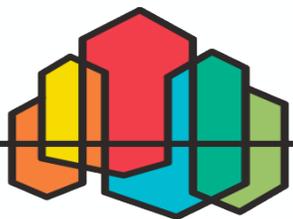


# Industrial

(2016 MWh)

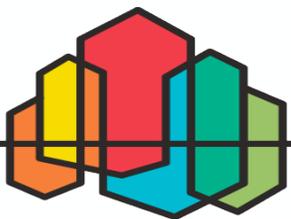
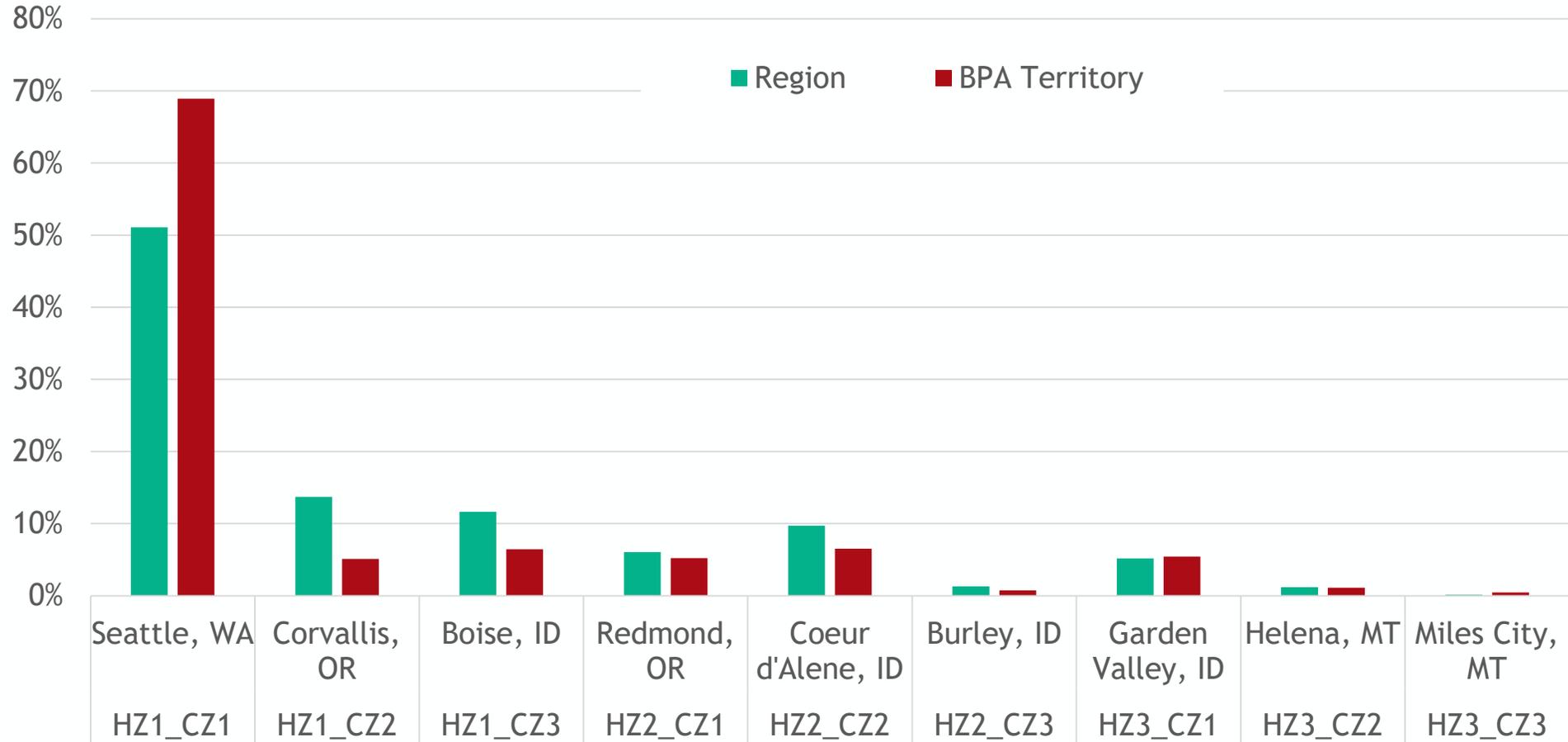
- Industrial consumption (MWh) by segment
- Worked closely with BPA Industrial staff to develop/verify BPA shares for each segment
- Wide range of differences depending on the segment

2021 Plan EE Segments	Total Regional	BPA	BPA Share of Regon
Water Supply	977,603	361,998	37%
Sewage Treatment	996,364	368,945	37%
Frozen Food	2,263,705	1,050,574	46%
Other Food	3,096,746	464,512	15%
Wood - Lumber	987,920	553,235	56%
Wood - Panel	349,256	202,568	58%
Wood - Other	1,939,986	1,004,956	52%
Pulp and Paper Mills (TMP)	3,139,947	2,543,357	81%
Pulp and Paper Mills (Kraft)	3,134,213	2,538,713	81%
Paper Conversion Plants	557,340	217,363	39%
Refinery	2,030,550	359,160	18%
Chemical Manufacturing	4,474,471	788,400	18%
Silicon Growing/Manufacturing	442,613	262,339	59%
Cement/Concrete Products	2,176,180	132,094	6%
Primary Metal Manufacturing	509,779	224,303	44%
Fabricated Metal Manufacturing	1,071,558	642,937	60%
Semiconductor Manufacturing	4,557,579	262,800	6%
Transportation Equipment	2,058,520	586,920	29%
Misc. Manufacturing	1,296,059	692,040	53%
Refrigerated Warehouse	921,147	359,160	39%
Fruit Storage	1,638,908	300,000	18%
<b>Total</b>	<b>38,620,446</b>	<b>13,916,374</b>	<b>36%</b>



# Milder Climate in BPA-Served Territory

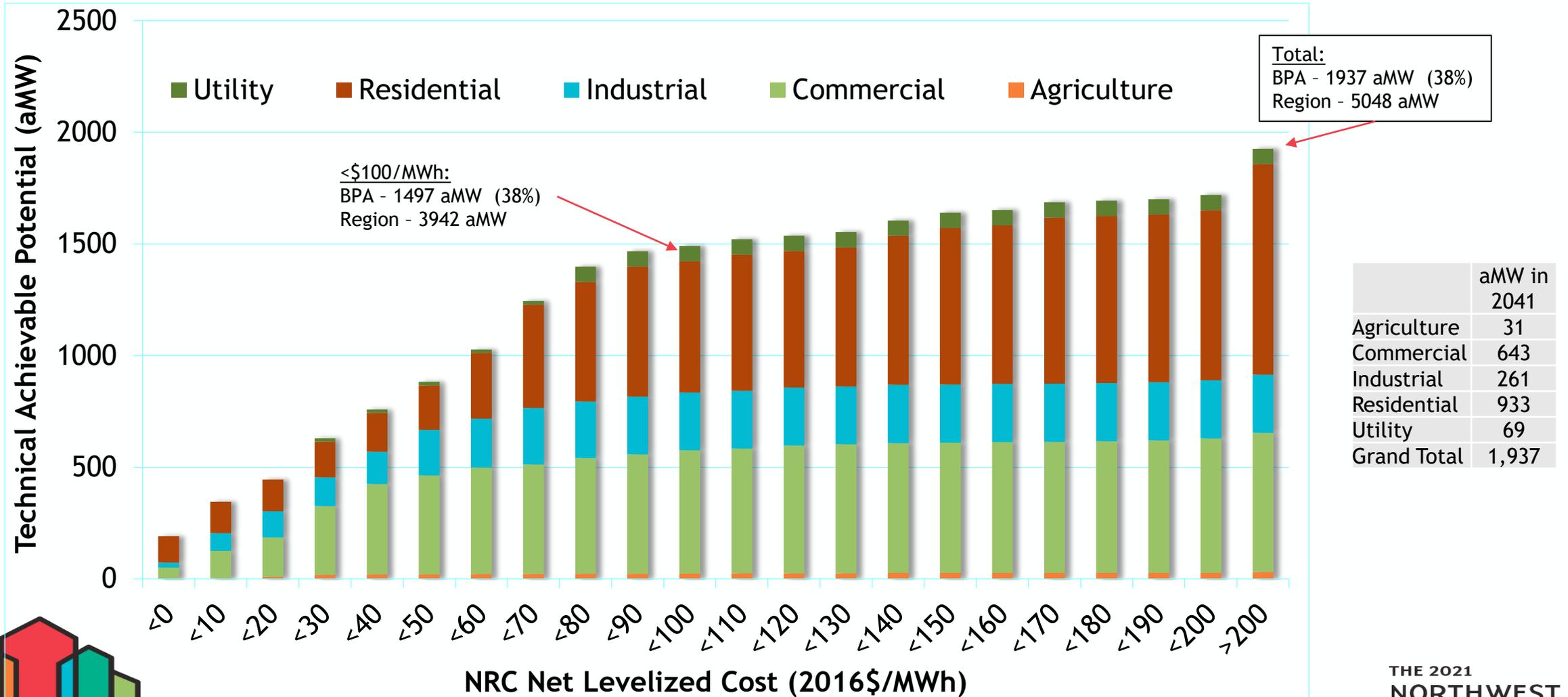
Population by Heating & Cooling Zone



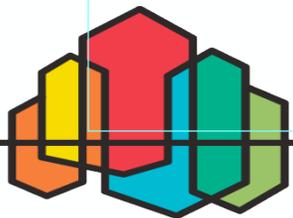
The background features several overlapping geometric shapes. A large teal pentagon is on the left. To its right is a light blue trapezoid. Further right is a light green rectangle. On the far left, a small light green trapezoid is partially visible. The text is overlaid on the teal and light blue shapes.

# High-Level EE Supply Curve Data

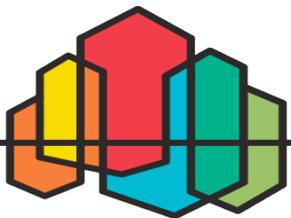
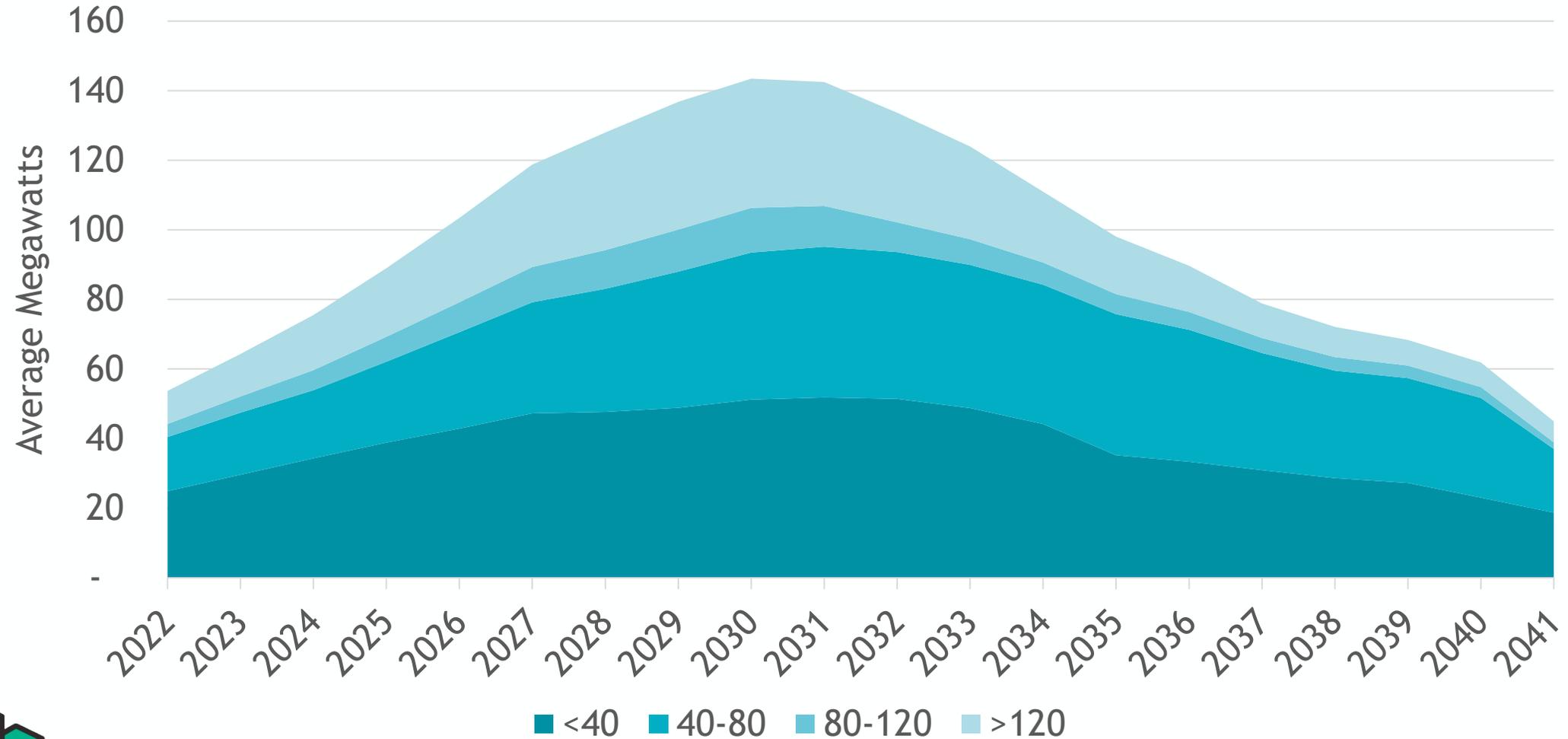
# Savings By Sector & Levelized Cost



	aMW in 2041
Agriculture	31
Commercial	643
Industrial	261
Residential	933
Utility	69
Grand Total	1,937

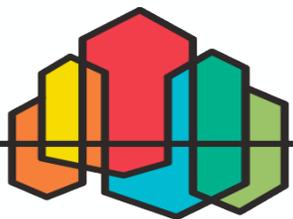
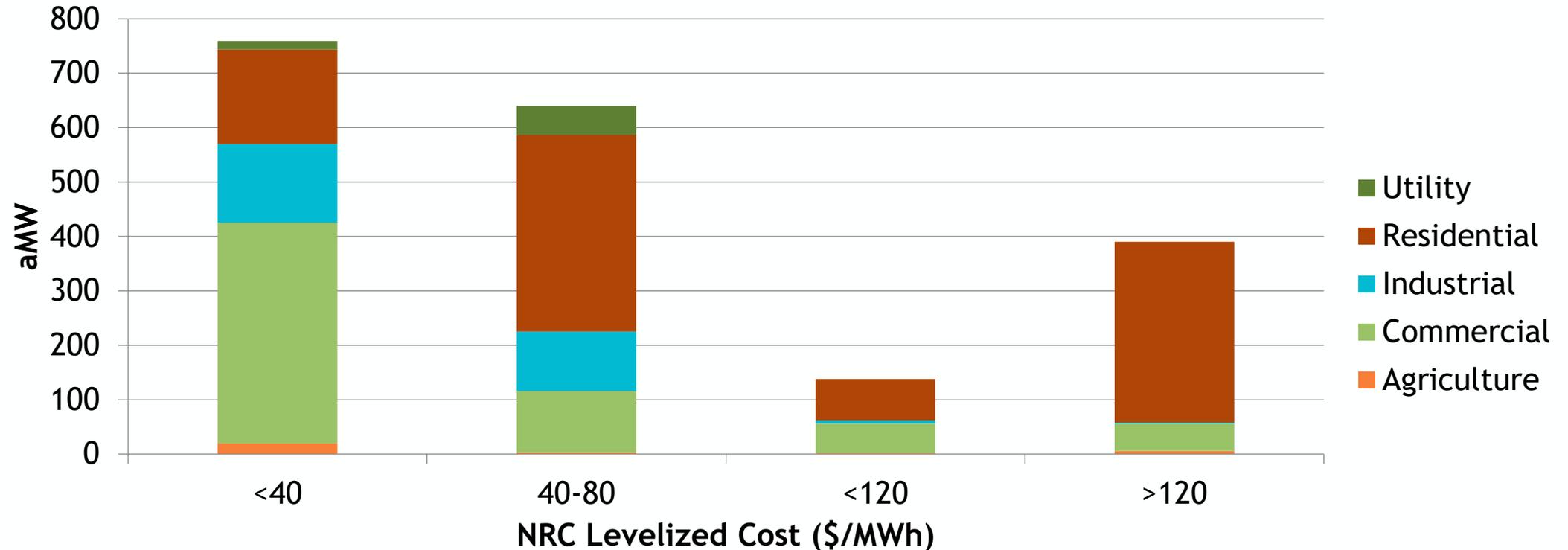


# Technical Potential by Levelized Cost bin (\$/MWh) & Time



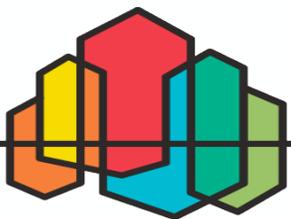
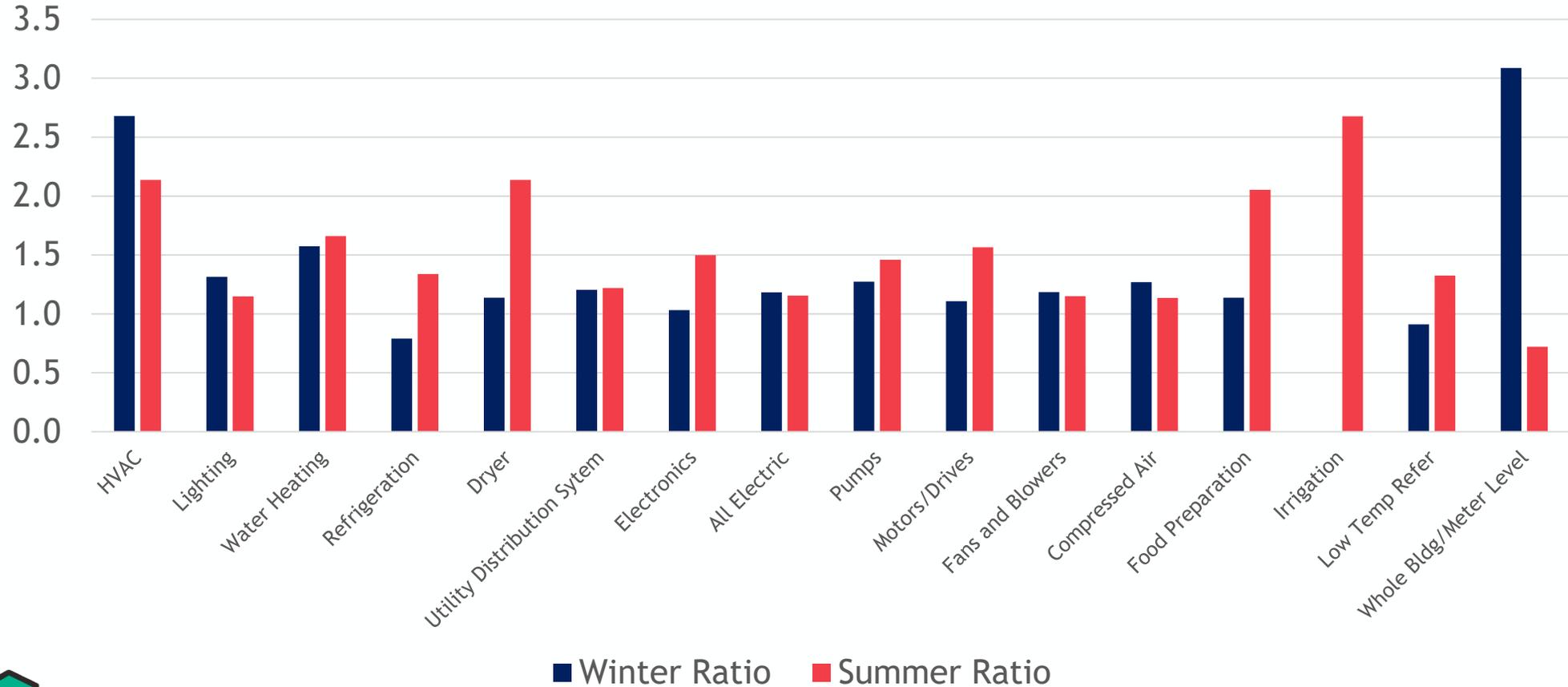
# Potential Savings by Cost Bin & Sector

Max Achievable Conservation by Sector at Various Price Bins  
(Incremental)



# EE Capacity

Peak to Energy Savings Ratios by End Use

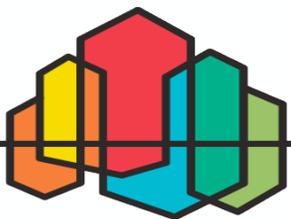


# Shares by End-Use

(Technical Achievable Potential in 2041, Residential and Commercial Sectors)

Residential Sector			
	BPA (aMW)	Region (aMW)	BPA Share
Dryer	83	242	34%
Electronics	54	123	44%
Food Preparation	8.8	23	38%
HVAC	437	1035	42%
Lighting	30	92	33%
Refrigeration	28	81	35%
Water Heating	282	650	45%
Whole Bldg/Meter Level	10	21	45%
Other	0.38	1.03	37%
<b>Grand Total</b>	<b>933</b>	<b>2268</b>	<b>41%</b>

Commercial Sector			
	BPA (aMW)	Region (aMW)	BPA Share
Compressed Air	3.6	10	38%
Electronics	34	86	39%
Food Preparation	12	30	40%
HVAC	233	629	37%
Lighting	200	536	37%
Motors/Drives	43	114	38%
Process Loads	10	25	38%
Refrigeration	87	233	37%
Water Heating	22	57	39%
<b>Grand Total</b>	<b>643</b>	<b>1,720</b>	<b>37%</b>

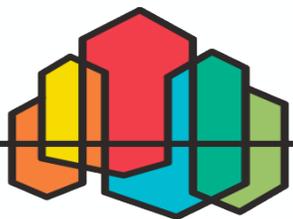




**End**

# Number of Homes – Region and BPA

	Regon	BPA	BPA Share
Single Family	4,418,134	1,723,072	39%
Multifamily - Low Rise	997,938	339,299	34%
Multifamily - High Rise	295,302	100,403	34%
Manufactured	586,202	187,585	32%
	<b>6,297,577</b>	<b>2,350,359</b>	<b>37%</b>



**Residential**

BPA territory contains ~25% of the residential homes in the region (based on population by county, as estimated in our BPA regional assessment).  
 These homes generally have higher electric consumption, based on 2016 Residential Building Stock Assessment (RBSA).

Category	BPA Territory	Region Excludes
Single Family	1,723,072	2,695,062
Multifamily - Low Rise	339,299	658,639
Multifamily - High Rise	100,403	194,900
Manufactured	187,585	398,617

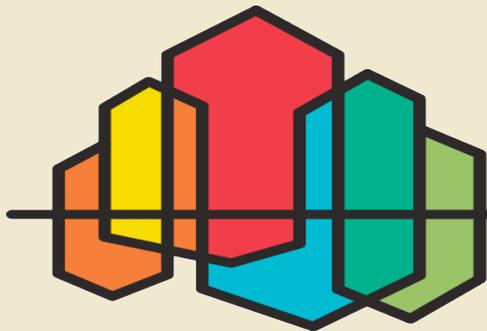
\* This table incorporates differences in weatherization needs by building type and on BPA data.

# Demand Response Supply Curves for the BPA Scenario

16 June 20

Power Committee

Tina Jayaweera, John Ollis

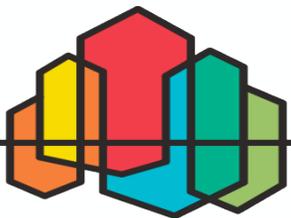


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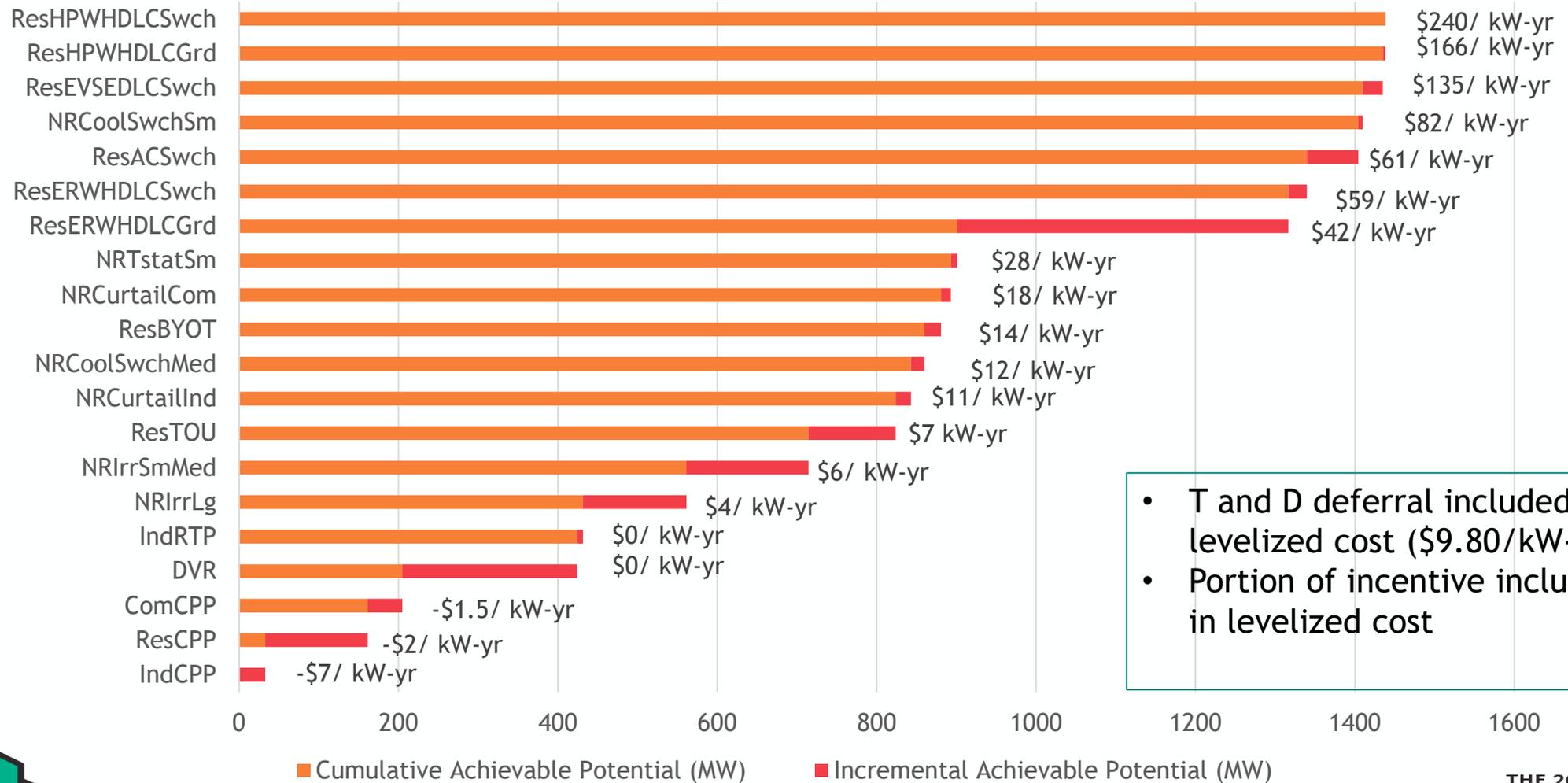
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# BPA Changes from Region

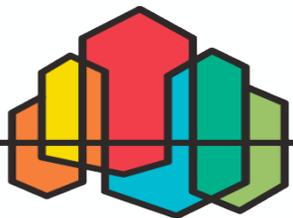
- Portion of regional loads – approx. 36% (excludes new large single loads, direct access customers)
- Hourly load profile – slight change due to mix of loads
- Portion of customers – approx. 37% (same as EE, varies by sector)
- Sector specific changes (same as EE)
  - Residential – Higher electric shares for space/water heating
  - Commercial – Do not have data to inform a BPA difference aside from total loads/square feet by building segment
  - Industrial – Mix of industries changes
  - Agriculture – Percent of irrigated land/dairy farms by state



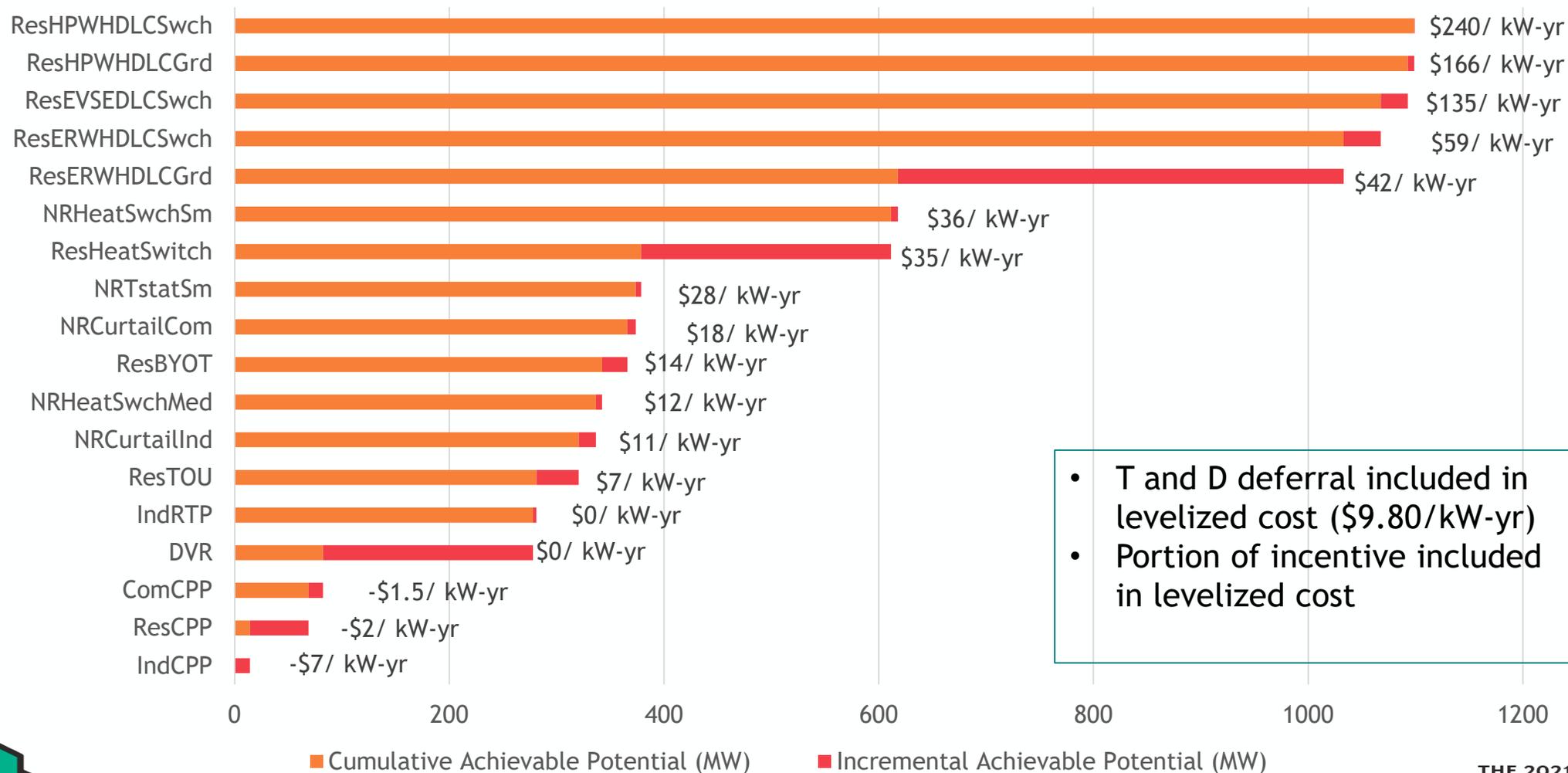
# Summer – 1438 MW total



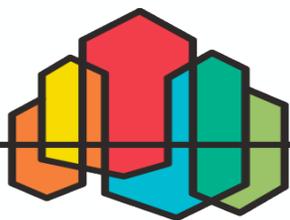
- T and D deferral included in levelized cost (\$9.80/kW-yr)
- Portion of incentive included in levelized cost



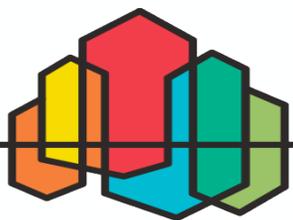
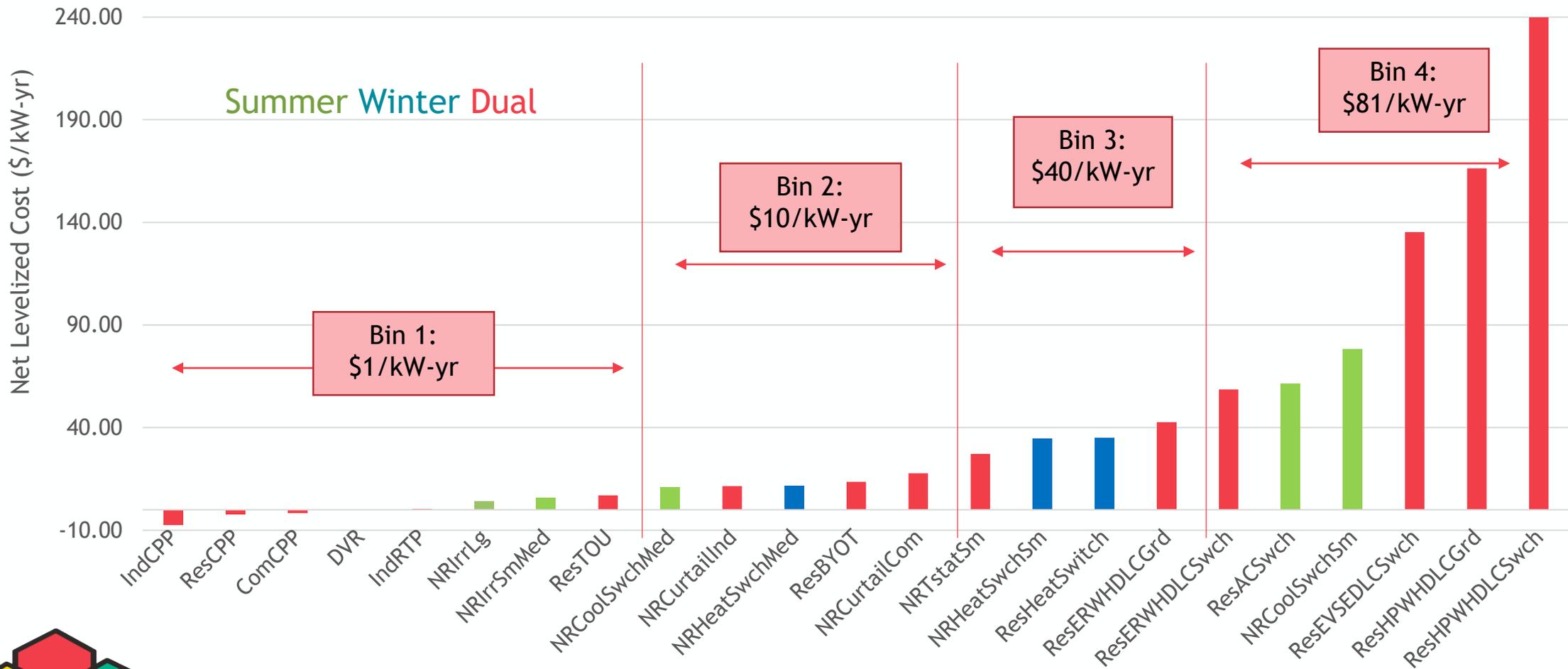
# Winter – 1099 MW total



- T and D deferral included in levelized cost (\$9.80/kW-yr)
- Portion of incentive included in levelized cost

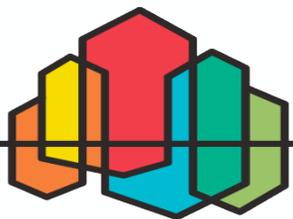
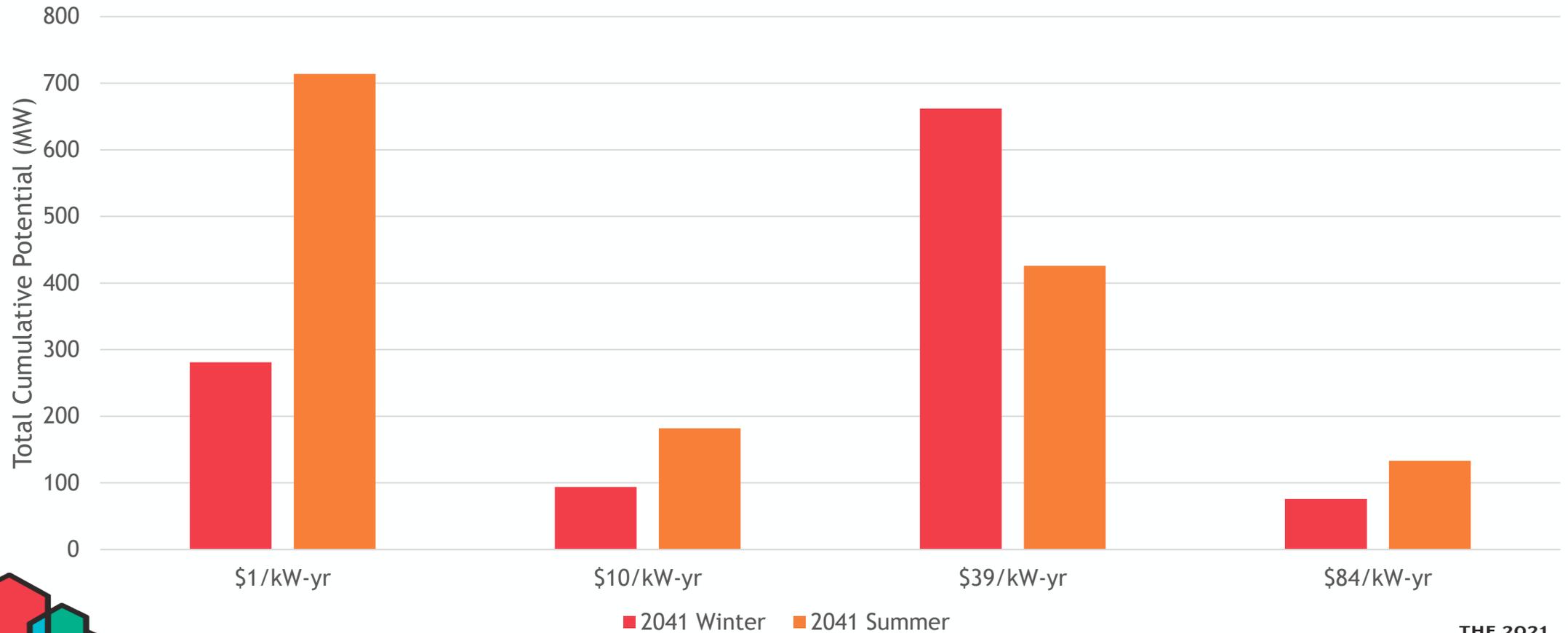


# Binning



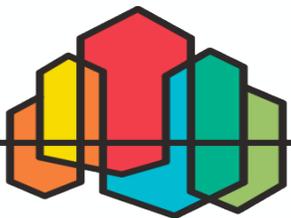
Note: due to some early RPM findings, we adjusted Bin assignments

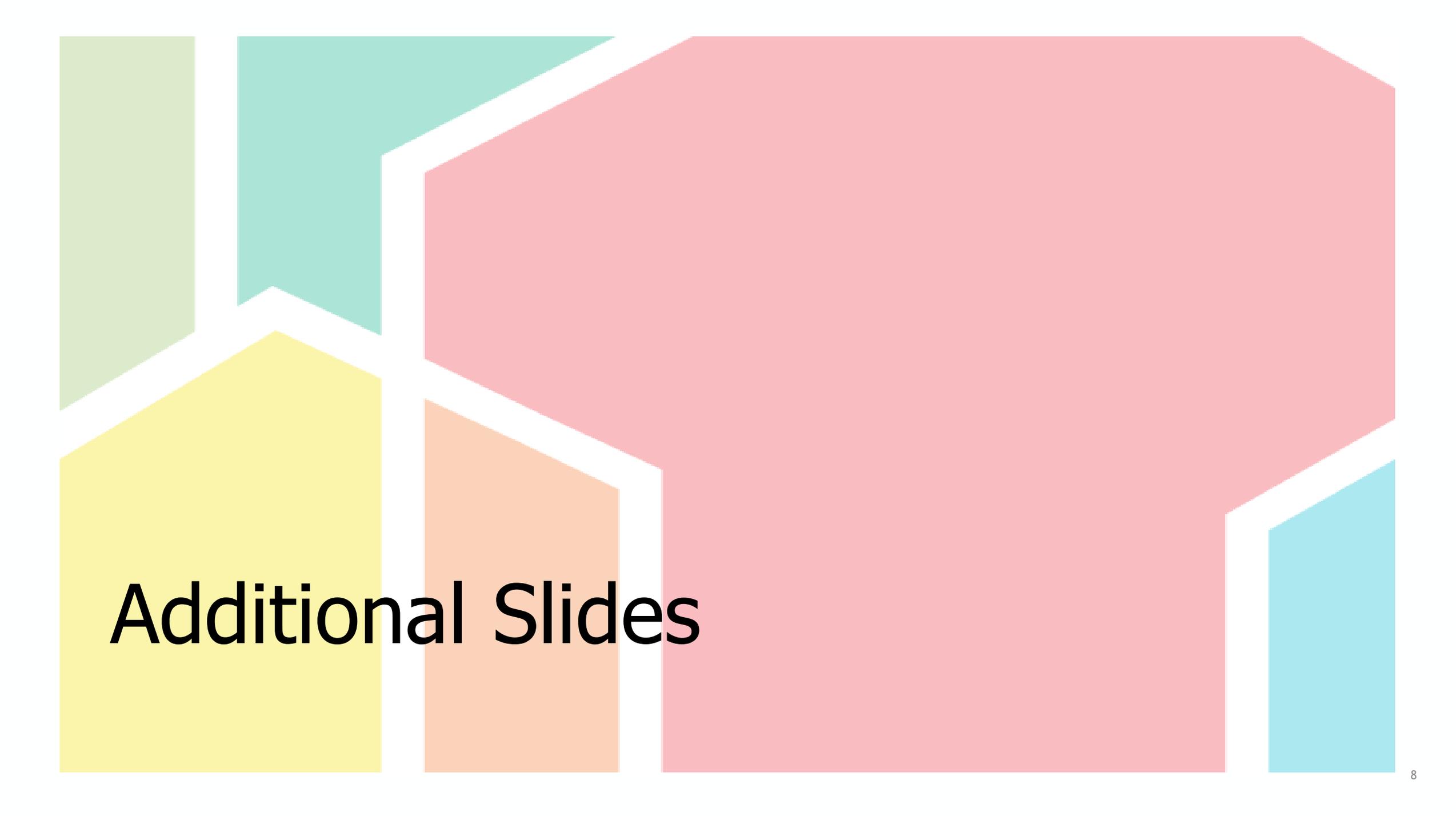
# Total Potential by Price Bin & Season



# BPA Potential Compared to Region

- BPA DR Potential is ~40% of regional
  - BPA Residential is ~43% of region, due to higher electric shares for space and water heating
  - Relatively more potential in winter, due to more electric heating loads
- Levelized costs are comparable, within a couple dollars per kW-yr by bin





**Additional Slides**

# Types of DR

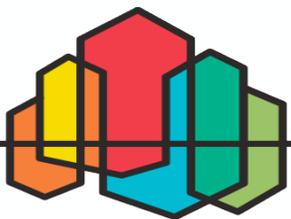
- Firm/Controlled

- Allows either interruptions of electrical equipment or appliances that are directly controlled by the utility or are scheduled ahead of time.



- Non-firm/Price-Based

- Outside of the utility's direct control and are driven by pricing.

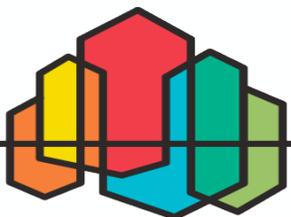


# Products Considered - Residential

Summer Only	Winter Only	Dual Season
AC Switch	Heating Switch	Bring-Your-Own-Thermostat
		Water heater (heat pump and electric resistance) - switch
		Water heater (heat pump and electric resistance) - grid-connected
		Electric Vehicle Supply Equipment control
		Critical Peak Pricing
		Time-of-Use

Black text indicates controllable DR

Blue text indicates price-based DR

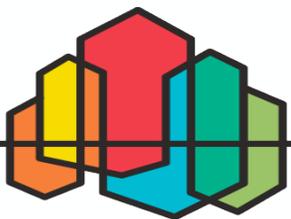


# Products Considered – Non-Residential

Summer Only	Winter Only	Dual Season
Irrigation Control (Large & Small)	Heating Switch (Small & Medium Com)	BYOT (Small Com)
AC Switch (Small & Medium Com)		Demand Curtailment (industrial & commercial)
		Demand Voltage Regulation
		Critical Peak Pricing
		Real Time Pricing

Black text indicates controllable DR

Blue text indicates price-based DR



# Chart Abbreviation Key

Abbreviation	Product	Abbreviation	Product
ResCPP	Residential Critical Peak Pricing	ComCPP	Commercial Critical Peak Pricing
ResTOU	Residential Time of Use	IndCPP	Industrial Critical Peak Pricing
ResEVSEDLCSwch	Residential Electric Vehicle Supply Equipment Control	IndRTP	Industrial Real Time Pricing
ResERWHDLCGrd ResERWHDLCswch	Residential Electric Resistance Water Heater Control Grid/Switch	NRlrrLg NRlrrSmMed	Irrigation Control Large/Sm Med Farms
ResHPWHDLCGrd ResHPWHDLCswch	Residential Heat Pump Water Heater Control Grid/Switch	NRTstatSm	Nonresidential (small bldg) Bring-Your-Own-Thermostat
ResACSwch ResHeatSwch	Residential AC/Heat Control Switch	NRCurtailCom	Commercial Curtailable Load
ResBYOT	Residential Bring-Your-Own-Thermostat	NRCurtailInd	Industrial Curtailable Load
DVR	Demand Voltage Regulation	NRCoolSwchSm NRHeatSwchSm	Nonresidential Small Bldg Control Switch Cool/Heat
		NRCoolSwchMed NRHeatSwchMed	Nonresidential Medium Bldg Control Switch Cool/Heat

