



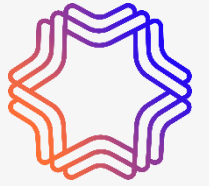
# Idaho Power 2022 Energy Efficiency Potential Study and IRP Bundling — For Reference Only

Date: November 10, 2022

Prepared for: Integrated Resource Plan Advisory Council (IRPAC)



# AEG Introduction



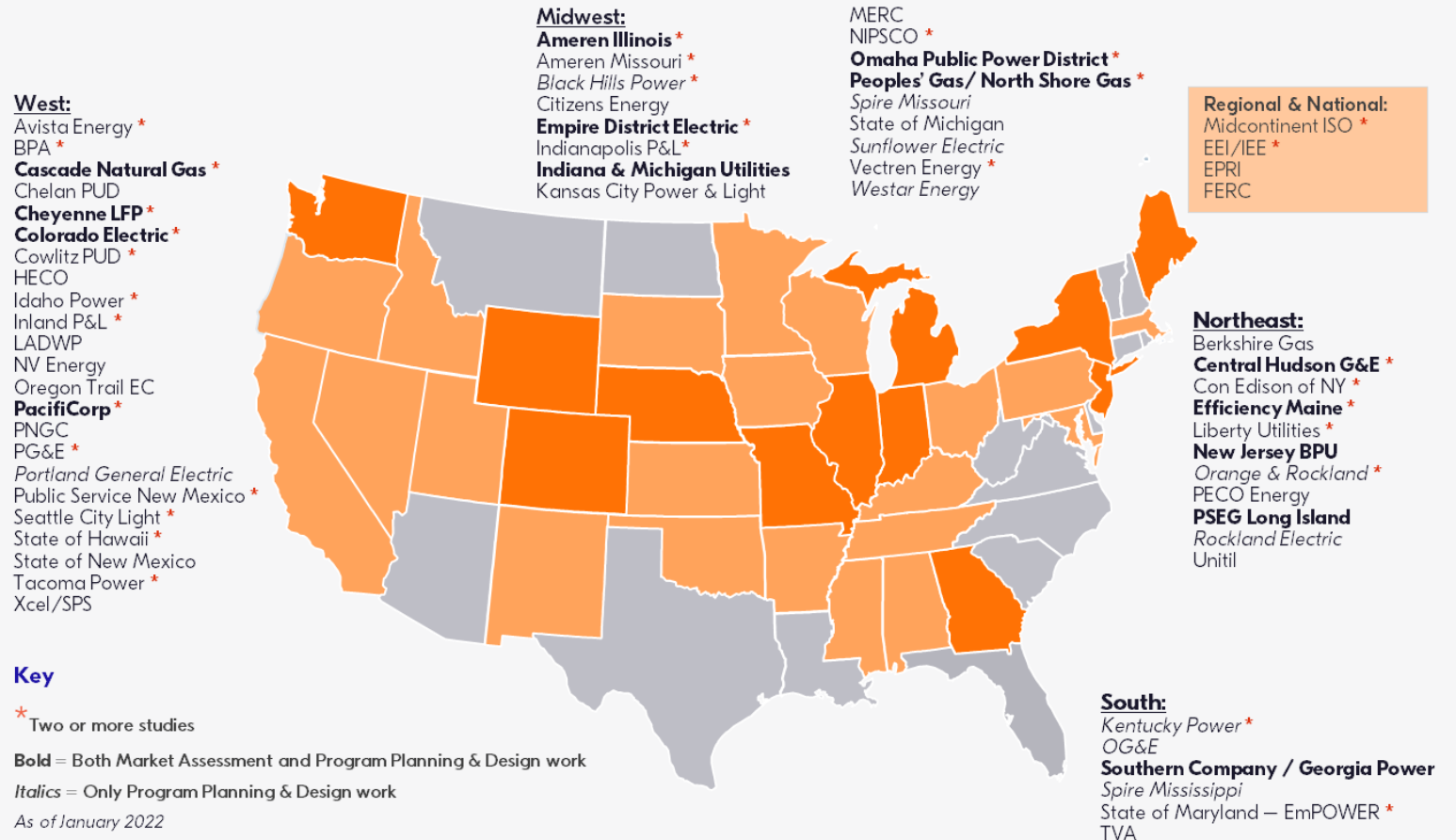
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Project Director



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EE Project Manager



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Analysis Lead



✓ 60 potential studies in last 5 years, many of these in the Pacific Northwest



# Study Objectives

1. Efficiently leverage the framework and data developed for the 2020 potential study to estimate long-term energy efficiency potential
2. Incorporate updated Idaho Power data and insights to understand how customers from each sector use energy and where opportunities for energy savings exist
3. Use potential estimates to support future resource planning efforts in Idaho Power's next Integrated Resource Plan

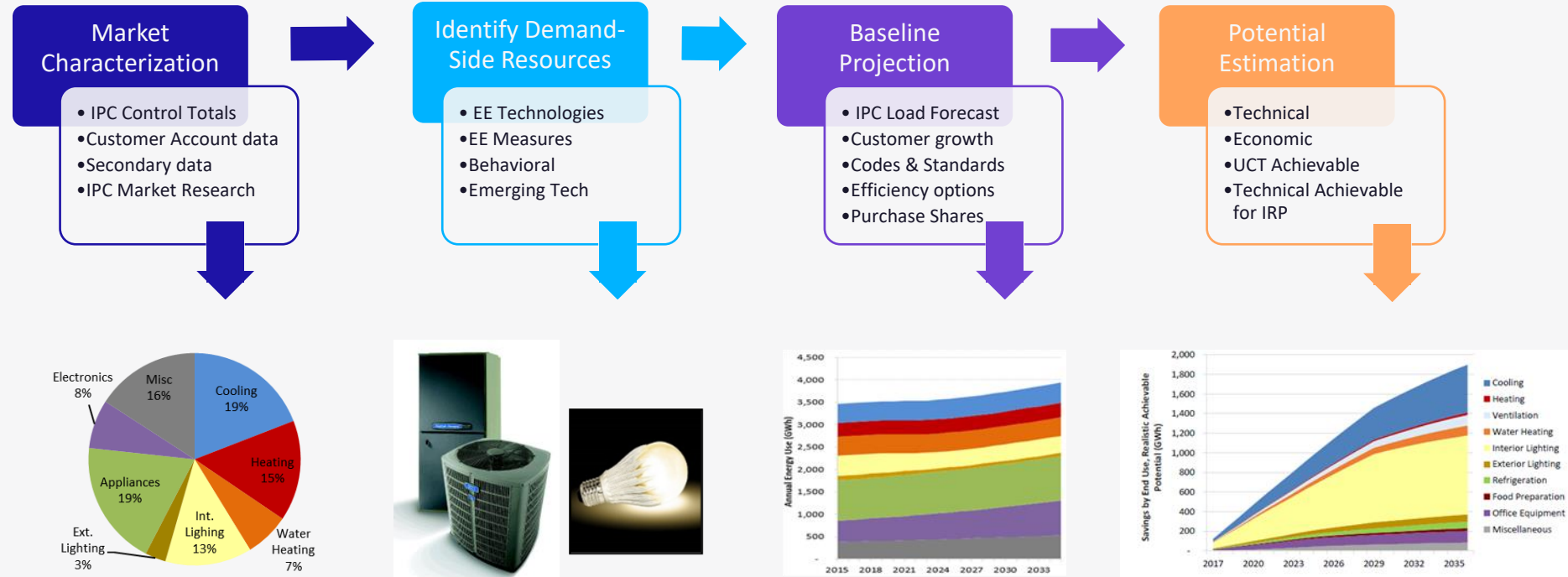


# Methodology and Data Sources

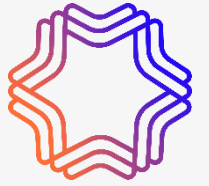




# Overview of AEG's Energy Efficiency Modeling Approach



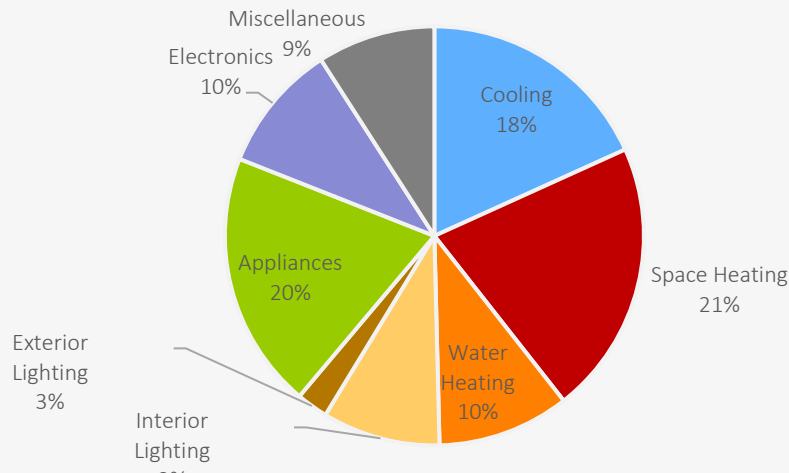
# Market Characterization



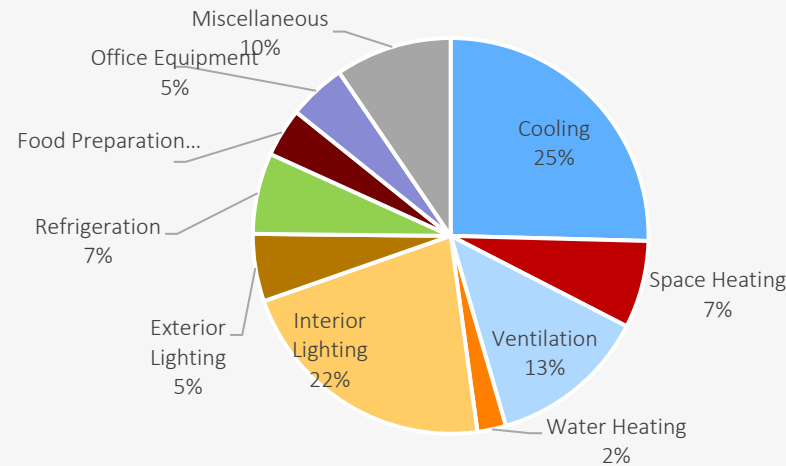
- ✓ Define energy-consumption characteristics in the base year of the study (2021)
- ✓ Incorporates Idaho Power's actual consumption and customer counts to develop "Control Totals"
- ✓ Grounds the analysis in Idaho Power data and provides enough detail to project assumptions forward and develop a baseline energy projection
- ✓ After separating electric consumption into sectors and segments, it is allocated to specific end uses and technologies

Base-year sector-level consumption by end-use:

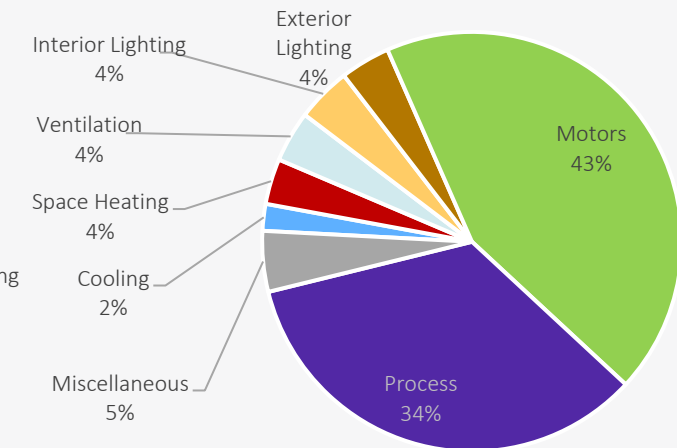
Residential



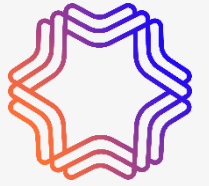
Commercial



Industrial



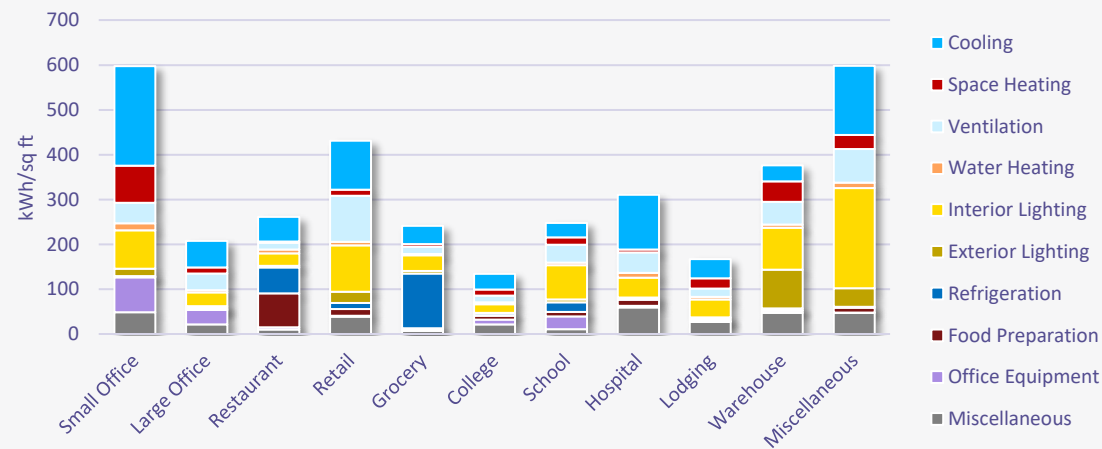
# Market Characterization



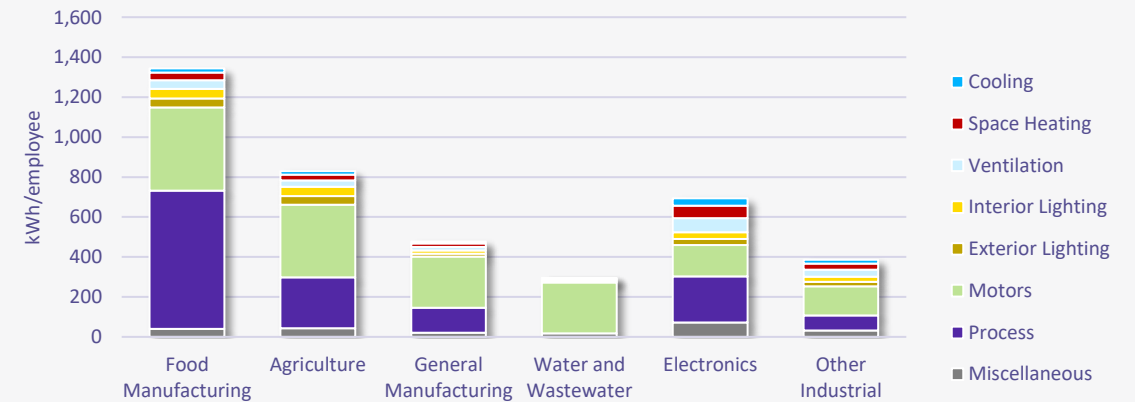
Base-year sector-level consumption by building type:

- ✓ Intensity by building type is shown by end use
- ✓ Average use per building has decreased in certain segments (Office, Schools, Grocery)
- ✓ Average use in Industrial building types overall have increased from previous study

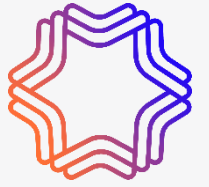
## Commercial



## Industrial

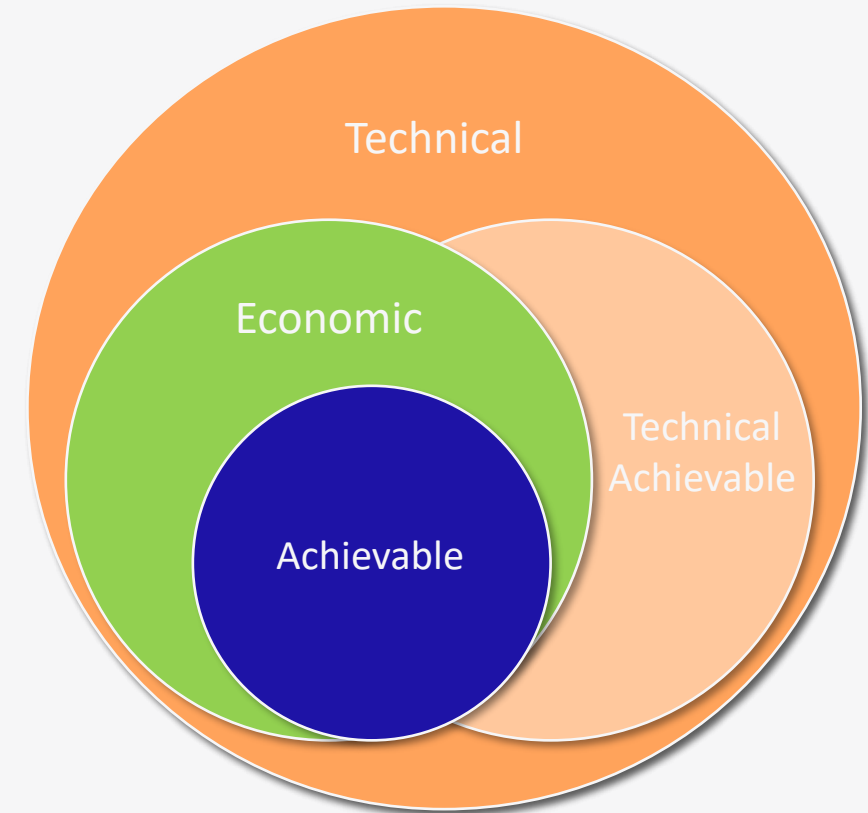


# Levels of Potential



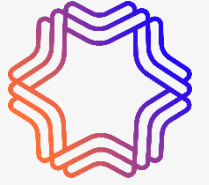
We estimate the following levels of potential:

- ✓ **Technical:** theoretical maximum where everyone chooses the efficient option when equipment fails regardless of cost
  - **Technical Achievable** provides an additional perspective into the EE potential landscape and is calculated by applying customer adoption curves directly to technical potential, rather than to the economic potential.
- ✓ **Economic** is a subset of technical potential that includes only cost-effective measures. Cost-effectiveness screening is performed under the UCT test.
- ✓ **Achievable** is a subset of economic potential that accounts for achievable participation within utility programs as well as non-utility mechanisms, such as regional initiatives and market transformation.





# Key Data Sources



## Idaho Power Data

- ✓ Customer account data including Standard Industrial Classification (SIC) codes
- ✓ All customer classes energy totals and forecast
- ✓ 2022 Residential Energy Use Study
- ✓ 2020 CPA conducted by AEG served as a starting point for many measure characterizations and applicable market/adoption rate assumptions
- ✓ Current Idaho Power Technical Reference Manual and recent program accomplishments

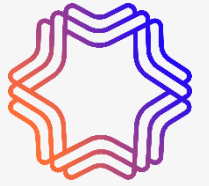
## Additional Data Sources:

- ✓ Benchmarking/comparison:
  - NEEA's Residential and Commercial Building Stock Assessments (2014 and 2019)
  - US Energy Information Administration (EIA) Manufacturing Energy Consumption Survey (MECS)
- ✓ Projections
  - US EIA Annual Energy Outlook (AEO) reference case forecast (equipment stock turnover assumptions)
  - Northwest Power and Conservation Council measure adoption ramp rates

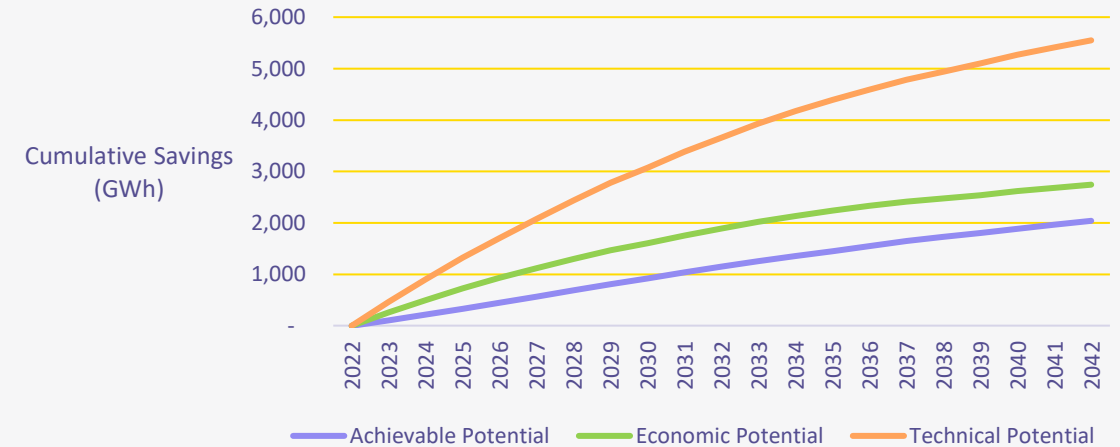


# Potential Results

# Potential Summary for All Sectors

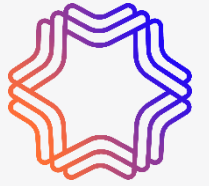


- ✓ Achievable Potential savings in the first year of 107 GWh, 0.7% of baseline usage.
  - Consistent with Idaho Power's 2022 program savings goal and recent accomplishments
- ✓ Achievable Potential savings reach 10% of baseline usage by 2042, an average of 0.5% annually
- ✓ 20-year Achievable Potential is 74% of Economic Potential



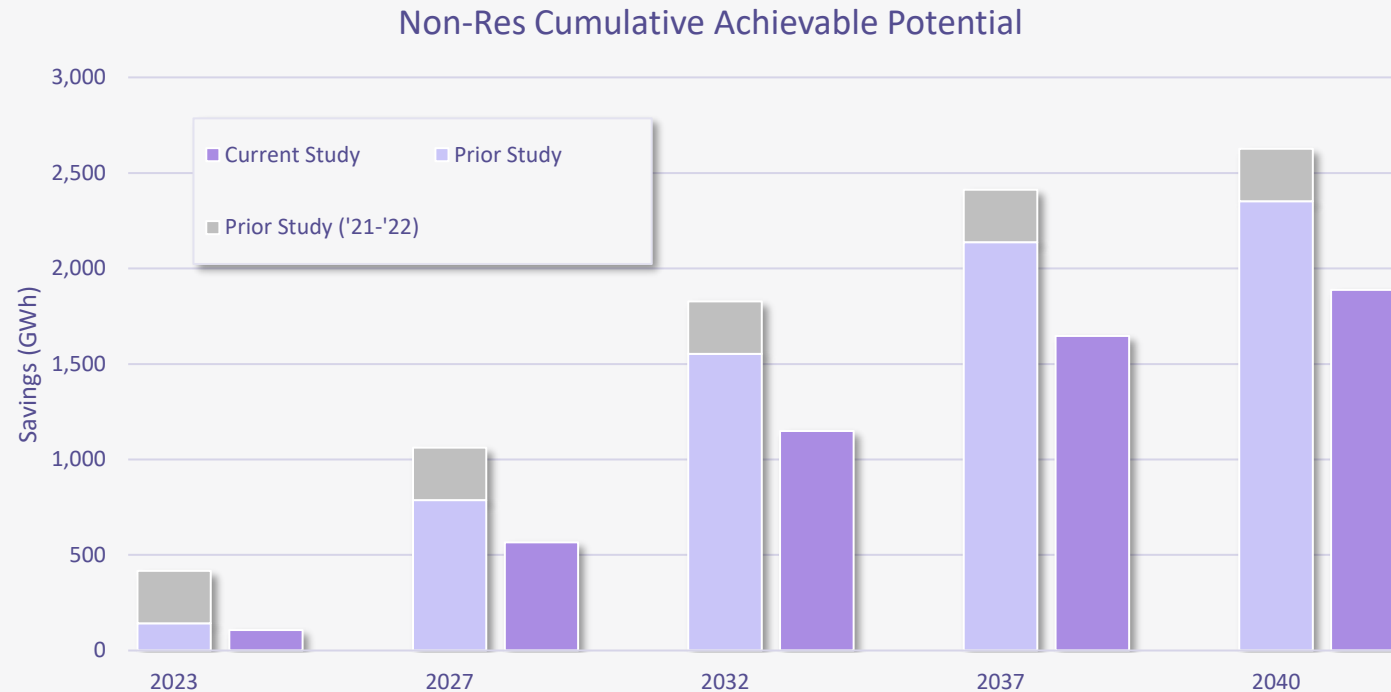
Summary of Energy Savings	2023	2027	2032	2037	2042
Baseline Projection (MWh)	15,881,781	16,696,599	17,793,020	18,997,324	20,343,787
Cumulative Savings (MWh)					
Achievable Potential	106,953	565,355	1,148,767	1,646,071	2,042,593
Economic Potential	260,642	1,119,620	1,889,830	2,417,196	2,745,956
Technical Potential	468,282	2,081,115	3,662,539	4,785,266	5,554,761
Energy Savings (% of Baseline)					
Achievable Potential	0.7%	3.4%	6.5%	8.7%	10.0%
Economic Potential	1.6%	6.7%	10.6%	12.7%	13.5%
Technical Potential	2.9%	12.5%	20.6%	25.2%	27.3%

# Comparison with Prior Study

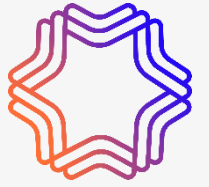


## Cumulative Achievable Potential

- ✓ Studies cover different 20-year periods, which creates comparison challenges
- ✓ Figure below compares cumulative potential by calendar year – gray boxes show potential from first two years of prior study

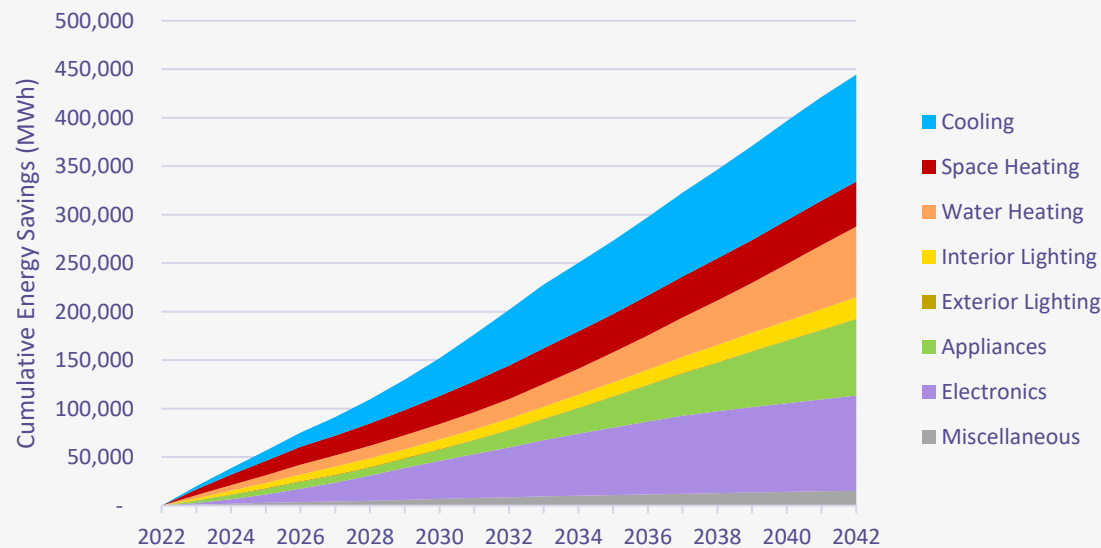


# Residential Potential by End Use and Segment

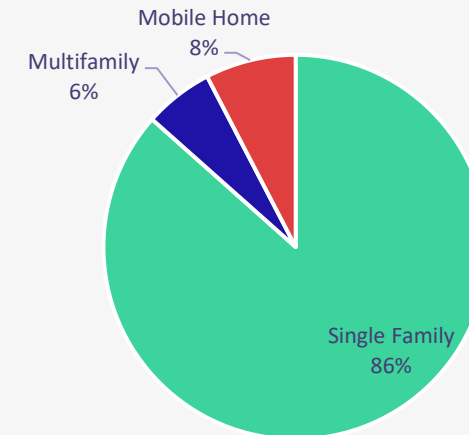


Cumulative Achievable Potential in 2042

- ✔ Lighting provides the largest portion of savings in the Commercial sector, followed by the Cooling end use
- ✔ Potential by market segment is heavily influenced by the distribution of baseline sales



Residential Savings by Segment in 2042

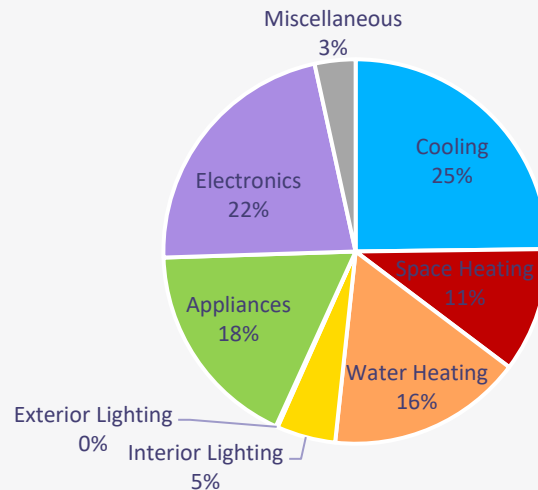


# Residential Top Measures – Achievable Potential



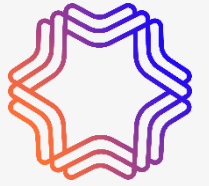
- Central AC and Water Heater equipment replacements provide the highest savings in 2042, followed by Energy STAR Clothes Washers
- General Service Lighting potential is significantly lower than prior studies due to EISA standards, and is not included in the Top 20 measures

Residential Savings by End Use in 2042



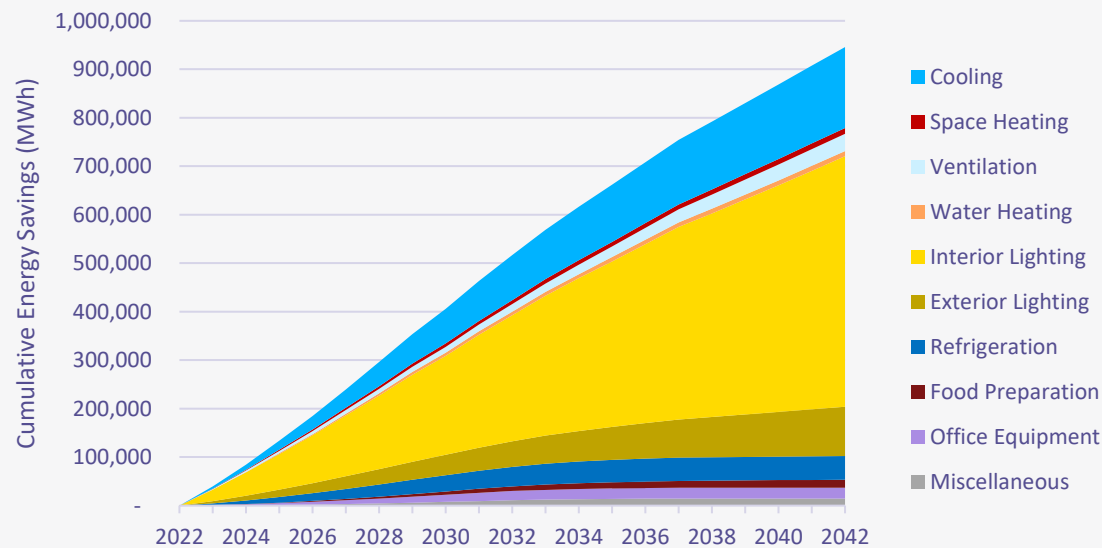
Rank	Measure	Achievable Potential in 2032	Achievable Potential in 2042	% of Total
1	Central AC	29,697.5	60,225.9	13.5%
2	Water Heater (<= 55 Gal)	6,995.2	56,371.2	12.7%
3	TVs	26,154.9	50,404.1	11.3%
4	Clothes Washer - ENERGY STAR (8.0)	8,244.3	45,003.1	10.1%
5	Set-top Boxes/DVRs	21,460.7	43,485.5	9.8%
6	Behavioral Programs	41,024.9	39,776.4	8.9%
7	Clothes Dryer	2,512.5	23,126.4	5.2%
8	Linear Lighting	8,075.6	18,595.3	4.2%
9	Air-Source Heat Pump	4,852.6	18,173.8	4.1%
10	Connected Thermostat - ENERGY STAR (1.0)	14,310.3	16,591.6	3.7%
11	Insulation - Ceiling Installation	4,900.9	6,158.2	1.4%
12	Pool Heater	2,235.5	6,136.0	1.4%
13	Freezer	690.2	6,038.8	1.4%
14	Building Shell - Liquid-Applied Weather-Resistive Barrier	666.6	5,665.4	1.3%
15	HVAC - Plant Shade Trees	1,787.8	5,392.5	1.2%
16	Room AC - Recycling	920.3	4,265.2	1.0%
17	Insulation - Basement Sidewall	3,297.6	4,129.6	0.9%
18	Well pump	1,245.1	3,723.2	0.8%
19	MH LI - HVAC and Wx	1,716.8	3,378.5	0.8%
20	Ducting - Repair and Sealing	2,527.7	3,220.5	0.7%
<b>Total of Top 20 Measures</b>		<b>183,317.1</b>	<b>419,861.1</b>	<b>94.4%</b>
<b>Total Cumulative Savings</b>		<b>202,063</b>	<b>444,612</b>	<b>100.0%</b>

# Commercial Potential by End Use and Segment

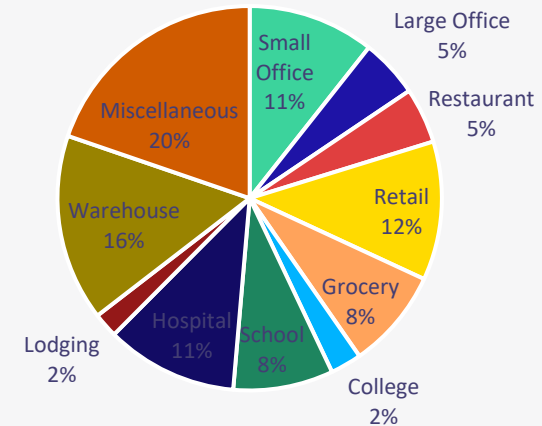


Cumulative Achievable Potential in 2042

- ✔ Lighting provides the largest portion of savings in the Commercial sector, followed by the Cooling end use
- ✔ Potential by market segment is heavily influenced by the distribution of baseline sales



Commercial Savings by Segment in 2042

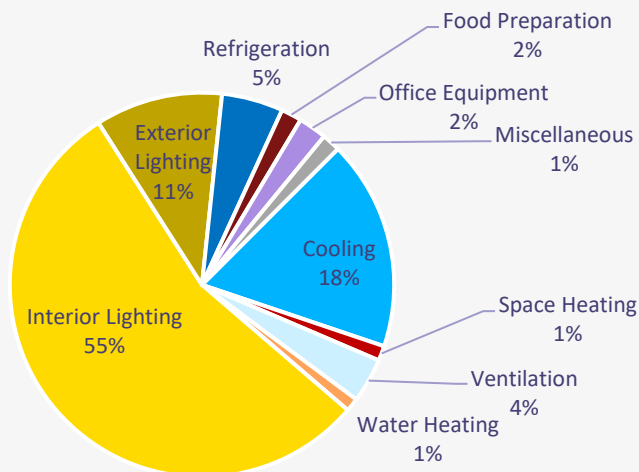


# Commercial Top Measures – Achievable Potential



- ✓ Linear and High-Bay Lighting continue to provide the most savings, and includes lighting control technologies
- ✓ Water-Cooled Chillers and Duct Repair savings increased since previous study, due to increase of HVAC usage

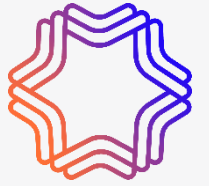
Commercial Savings by End Use in 2042



Rank	Measure	Achievable Potential in 2032	Achievable Potential in 2042	% of Total
1	Linear Lighting	242,679.1	506,777.5	53.6%
2	High-Bay Lighting	45,204.1	77,845.3	8.2%
3	Water-Cooled Chiller	16,817.3	52,804.9	5.6%
4	Ducting - Repair and Sealing	15,714.6	19,060.1	2.0%
5	Server	15,891.3	18,526.0	2.0%
6	Retrocommissioning	16,815.0	14,682.2	1.6%
7	RTU	5,803.2	14,503.3	1.5%
8	Engine Block Heater Controls	9,527.3	12,620.3	1.3%
9	Ventilation - Variable Speed Control	1,538.6	11,742.8	1.2%
10	Air-Source Heat Pump	4,360.5	11,639.2	1.2%
11	Refrigeration - Heat Recovery	8,053.5	11,075.6	1.2%
12	Refrigeration - Variable Speed Compressor	8,985.8	10,602.0	1.1%
13	Grocery - Display Case - Door Retrofit	8,522.5	10,317.8	1.1%
14	Air-Cooled Chiller	3,446.5	9,402.1	1.0%
15	Area Lighting	5,419.9	9,302.3	1.0%
16	General Service Lighting	6,027.1	8,279.2	0.9%
17	Ventilation	3,149.0	8,078.1	0.9%
18	HVAC - Maintenance	7,497.2	7,673.9	0.8%
19	Oven	4,698.7	7,529.9	0.8%
20	Advanced New Construction Designs	323.9	7,374.1	0.8%
<b>Total of Top 20 Measures</b>		<b>430,475.1</b>	<b>829,836.6</b>	<b>87.7%</b>
<b>Total Cumulative Savings</b>		<b>516,487</b>	<b>945,942</b>	<b>100.0%</b>

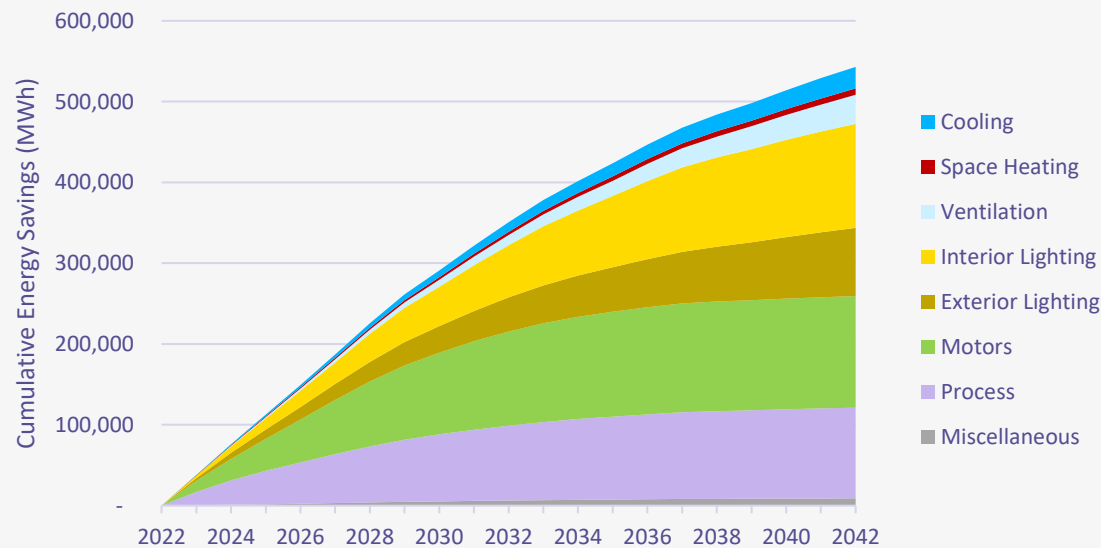


# Industrial Potential by End Use and Segment

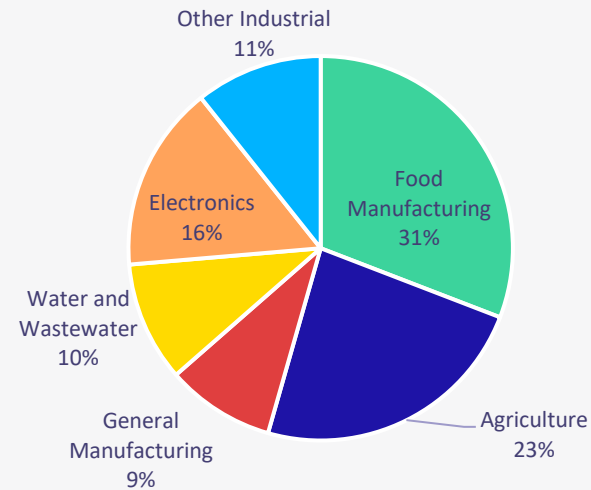


Cumulative Achievable Potential in 2042

- ✓ Ramp rates for this sector reflect the maturity of IPC's industrial programs
- ✓ Savings in the motors end use are made up of VFD measures, as well as Compressed Air and pumping equipment upgrades
- ✓ Lighting savings in this sector come from replacement of High-Bay Lighting to LEDs



Industrial Savings by Segment in 2042



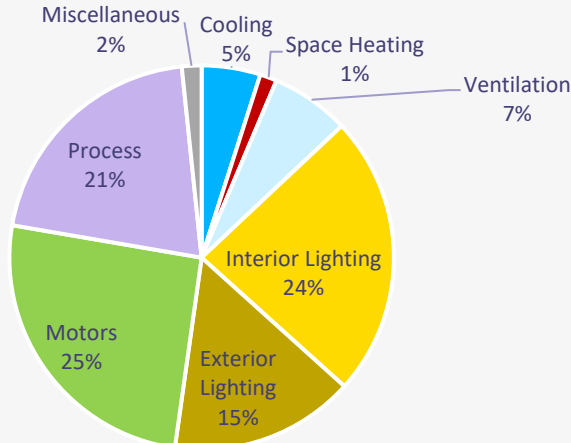
# Industrial Top Measures – Achievable Potential



## Industrial Sector

- ✓ Some Compressed Air measures from previous study were consolidated in the 2021 Power Plan
- ✓ Linear and High-Bay includes savings incorporate lighting control technologies

Industrial Savings by End Use in 2042



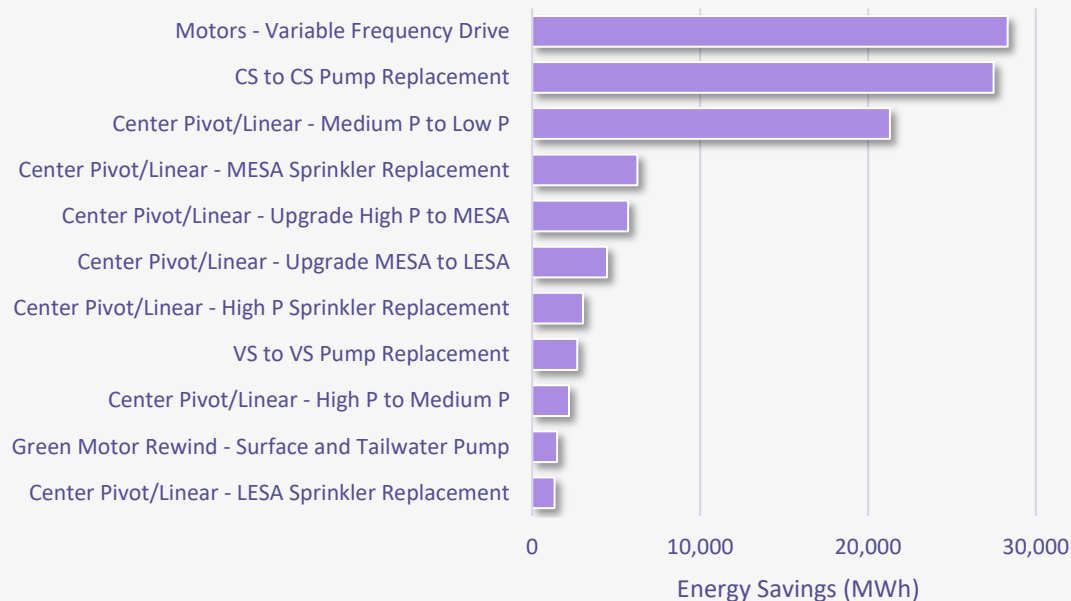
Rank	Measure	Achievable Potential in 2032	Achievable Potential in 2042	% of Total
1	Linear Lighting	57,566.7	128,642.0	23.7%
2	High-Bay Lighting	39,623.3	72,925.3	13.4%
3	Refrigeration - Floating Head Pressure	33,186.1	39,771.0	7.3%
4	Ventilation	12,120.1	35,157.9	6.5%
5	Refrigeration - High Efficiency Compressor	23,714.0	28,113.5	5.2%
6	Pumping System - Controls	17,628.1	22,738.2	4.2%
7	Refrigeration - System Optimization	19,094.9	22,344.8	4.1%
8	Strategic Energy Management	10,662.8	20,684.4	3.8%
9	Compressed Air - End Use Optimization	14,955.4	15,420.0	2.8%
10	Switch from Belt Drive to Direct Drive	11,476.9	13,733.1	2.5%
11	Material Handling - Variable Speed Drive	10,643.6	13,297.4	2.4%
12	Process - Tank Insulation	12,329.5	13,087.7	2.4%
13	Water-Cooled Chiller	4,180.0	12,663.2	2.3%
14	Advanced Industrial Motors	7,677.2	10,021.1	1.8%
15	Fan System - Equipment Upgrade	6,946.1	9,135.4	1.7%
16	Municipal Sewage Treatment - Optimization	8,426.4	8,442.3	1.6%
17	Pumping System - System Optimization	6,508.6	7,155.8	1.3%
18	High Frequency Battery Chargers	5,462.3	7,078.4	1.3%
19	Fan System - Controls	5,425.0	7,009.2	1.3%
20	Air-Cooled Chiller	2,026.5	5,907.2	1.1%
<b>Total of Top 20 Measures</b>		<b>309,653.7</b>	<b>493,327.7</b>	<b>90.8%</b>
<b>Total Cumulative Savings</b>		<b>350,774.2</b>	<b>543,050.4</b>	<b>100.0%</b>

# Irrigation Top Measures – Achievable Potential



✓ Potential savings are similar to previous study

Top Irrigation Measures in 2042



Rank	Measure	Achievable Potential in 2032	Achievable Potential in 2042	% of Total
		2032	2042	
1	Motors - Variable Frequency Drive	28,549	28,327	26.0%
2	CS to CS Pump Replacement	23,845	27,478	25.2%
3	Center Pivot/Linear - Medium P to Low P	3,360	21,297	19.5%
4	Center Pivot/Linear - MESA Sprinkler Replacement	5,558	6,270	5.8%
5	Center Pivot/Linear - Upgrade High P to MESA	5,414	5,715	5.2%
6	Center Pivot/Linear - Upgrade MESA to LESA	710	4,461	4.1%
7	Center Pivot/Linear - High P Sprinkler Replacement	2,674	3,024	2.8%
8	VS to VS Pump Replacement	2,324	2,679	2.5%
9	Center Pivot/Linear - High P to Medium P	931	2,174	2.0%
10	Green Motor Rewind - Surface and Tailwater Pump	1,297	1,480	1.4%
11	Center Pivot/Linear - LESA Sprinkler Replacement	1,342	1,326	1.2%
12	Green Motor Rewind - Well Pump	1,072	1,223	1.1%
13	Wheel/Hand - Nozzle Replacement	844	954	0.9%
14	Wheel-Line - Convert to Low Pressure System (Alfalfa)	144	904	0.8%
15	Wheel/Hand - Gasket Replacement	515	583	0.5%
16	Green Motor Rewind - Booster Pump	463	528	0.5%
17	Wheel/Hand - Drain Replacement	377	425	0.4%
18	Hand-Line - Convert to Low Pressure System (Alfalfa)	22	139	0.1%
Total of Top 18 Measures		79,443	108,988	100.0%
Total Cumulative Savings		79,443	108,988	100.0%



# IRP Energy Efficiency Bundling

# Bundling Methodology Overview



- ✓ The methodology is generally the same as in Idaho Power's 2021 IRP with two enhancements
  - Bundles reflect results of the updated Energy Efficiency Potential Study
  - An additional summer cost bundle was added to provide additional granularity for IRP consideration
- ✓ Methodology Overview
  - Calculate available non-economic savings (economic savings already removed from load forecast)
  - Calculate Average hourly peak impacts
  - For each measure, calculate the average hourly impact for summer and winter peak periods
  - Categorize each measure by peak season
  - Create cost bundles by sector and season
  - Calculate weighted levelized cost for each bundle



# Grouping Measures by Resource Shape



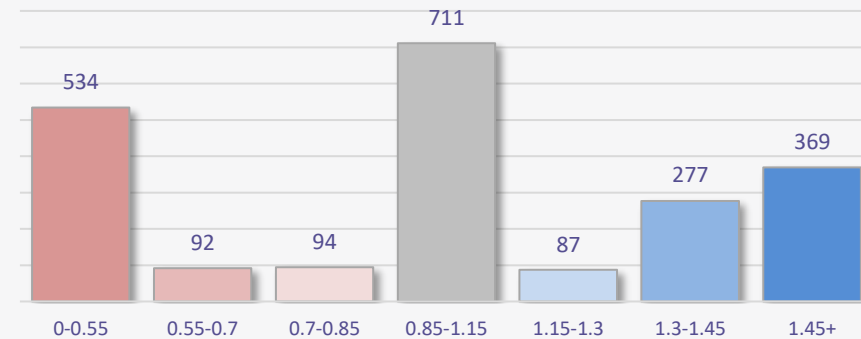
For each measure **not included in the economic potential**, AEG calculated the ratio of summer to winter impacts:

- ✓ Ratios near 1.0 indicate measures with minimal seasonal variation (e.g., refrigeration)
- ✓ Higher ratios = Larger summer impacts (blue bars)
- ✓ Lower Ratios = Larger winter impacts (red bars)

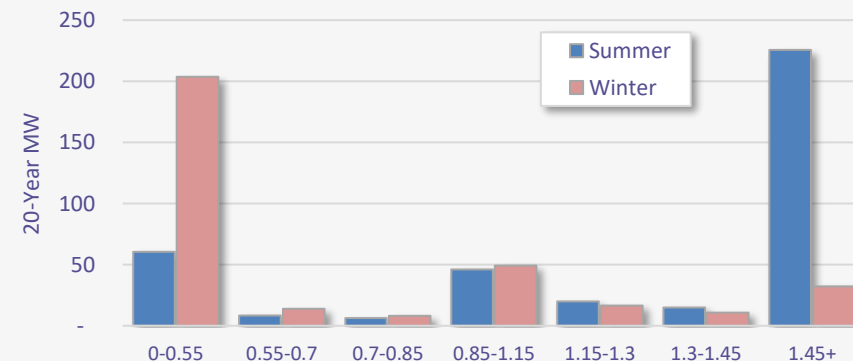
Resources are grouped based on contributions on summer and winter weekdays

- ✓ Summer: August 8-10 pm
- ✓ Winter: January 8-9 am

Measures by Ratio Group



Impacts by Ratio Group



# Example Measures By Group



	Residential	C&I	Irrigation
<b>Summer</b>	<ul style="list-style-type: none"> <li>• Central AC</li> <li>• Whole-House Fan Installation</li> <li>• Windows – High Efficiency</li> <li>• Room AC</li> <li>• Insulation Radiant Barrier</li> <li>• Appliance Recycling</li> <li>• Advanced Power Strips</li> </ul>	<ul style="list-style-type: none"> <li>• RTU - Evaporative Precooler</li> <li>• HVAC – Economizer</li> <li>• Evaporative Central AC</li> <li>• RTU - Advanced Controls</li> <li>• Exterior Lighting - Enhanced Controls</li> <li>• Thermostat - Connected</li> <li>• HVAC – Economizer</li> <li>• Ventilation – Demand Controlled</li> </ul>	<ul style="list-style-type: none"> <li>• Motors - Variable Frequency Drive</li> <li>• Variable Rate Irrigation</li> <li>• Wheel Line - Leveler Maintenance</li> <li>• Center Pivot/Linear - LESA Sprinkler Replacement</li> </ul>
<b>Winter</b>	<ul style="list-style-type: none"> <li>• Air Source Heat Pumps</li> <li>• ENERGY STAR Home Design</li> <li>• Ductless Mini Split Heat Pump</li> <li>• Windows - Low-e Storm Addition</li> <li>• Thermostat – Connected</li> <li>• Water Heaters</li> <li>• Water Heater – Low Flow Showerheads</li> </ul>	<ul style="list-style-type: none"> <li>• Insulation – Ceiling</li> <li>• Advanced New Construction Designs</li> <li>• HVAC – Energy Recovery Ventilator</li> <li>• Ductless Mini Split Heat Pump</li> <li>• Water Heater – Drain water Heat Recovery</li> <li>• Windows - High Efficiency Glazing</li> </ul>	

# Initial Measure Bundling



## Process:

1. Group measures by sectors and season
2. Identify natural break points in the supply curve
3. Calculate weighted average cost of measures in bundles
4. Check that bundles produce at least 1 MW per resource per year
  - ✓ Most bundles are too small (<1 MW/year), so need to be combined

Peak Season	Price Range	Average Annual MW	Weighted Levelized Cost (\$/MWh)
Residential Summer	Low	1.16	\$71
	Low-Mid	0.15	\$109
	Mid	0.41	\$173
	High	8.81	\$463
Residential Winter	Very Low	2.56	\$40
	Low	0.18	\$46
	Low-Mid	1.05	\$57
	Mid	0.28	\$74
	Mid-High	2.60	\$94
	High	2.87	\$212
C&I Summer	Low	1.01	\$65
	Low-Mid	0.69	\$118
	Mid	0.29	\$175
	High	0.99	\$841
C&I Winter	Low	1.57	\$65
	Mid	1.03	\$135
	High	1.14	\$852

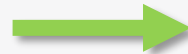


# Revised Measure Bundling

Collapse Sectors and Price Ranges



Peak Season	Price Range	Average Annual MW	Weighted Levelized Cost (\$/MWh)
Residential Summer	Low	1.16	\$71
	Low-Mid	0.15	\$109
	Mid	0.41	\$173
	High	8.81	\$463
Residential Winter	Very Low	2.56	\$40
	Low	0.18	\$46
	Low-Mid	1.05	\$57
	Mid	0.28	\$74
	Mid-High	2.60	\$94
	High	2.87	\$212
C&I Summer	Low	1.01	\$65
	Low-Mid	0.69	\$118
	Mid	0.29	\$175
	High	0.99	\$841
C&I Winter	Low	1.57	\$65
	Mid	1.03	\$135
	High	1.14	\$852



Peak Season	Price Range	Average Annual MW	Weighted Levelized Cost (\$/MWh)
Summer	Low	3.19	\$80
	Mid	0.73	\$172
	High	9.96	\$501
Winter	Low	7.24	\$68
	High	6.67	\$371

# Revised Measure Bundling

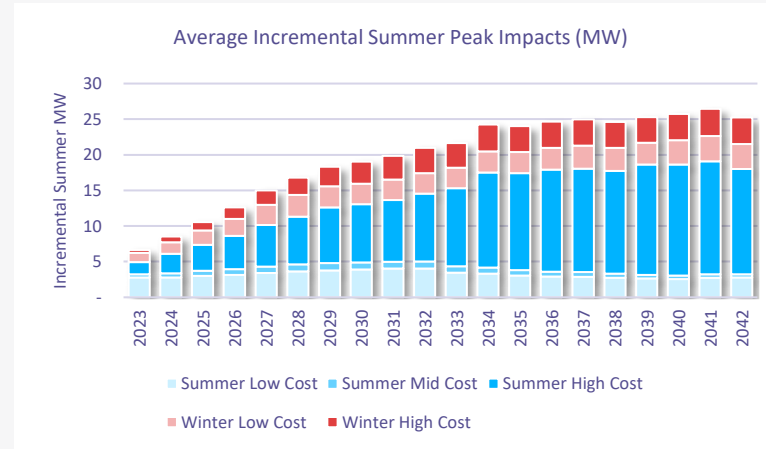
## Incremental Annual Impacts

### Key Findings:

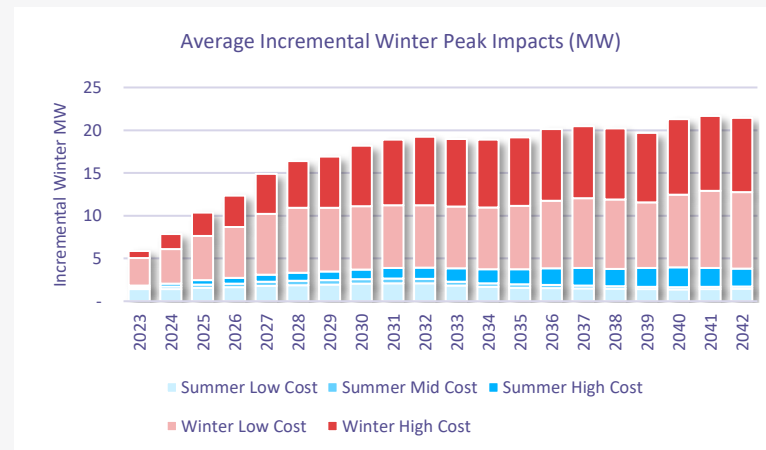
- All bundles provide impacts in both seasons, but impacts for each bundle are higher in the season identified by the measure ratios
- Potential for demand reduction is significantly higher in the winter, driven by the winter-focused bundles.
  - Reminder: Economic Achievable Potential is not included in these graphs and will tend to have higher summer impacts due to higher avoided costs in that season



Summer



Winter



# Thank You.

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