AEG
APPLIED ENERGY GROUP

# Idaho Power 2022 Potential Study Update

Date: May 4, 2022
Prepared for: Energy Efficiency Advisory Group (EEAG)

# Agenda

- AEG Introduction
- Study Objectives
- Energy Efficiency
  - Overview of Methodology
  - Draft Non-Residential Results
  - IRP Bundling Approach Review
- Demand Response
  - Overview of Methodology

# AEG Introduction

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Project Director

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EE Project Manager

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DR Project Manager

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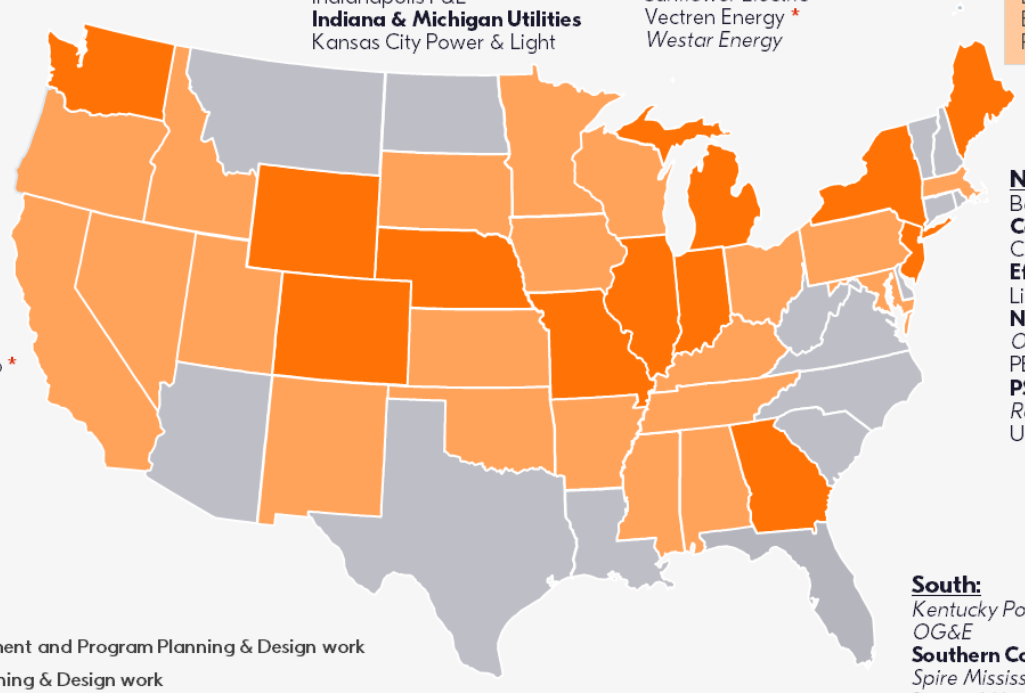
Analysis Lead

**West:**
Avista Energy *
BPA *
**Cascade Natural Gas** *
Chelan PUD
**Cheyenne LFP** *
**Colorado Electric** *
Cowlitz PUD *
HECO
Idaho Power *
Inland P&L *
LADWP
NV Energy
Oregon Trail EC
**PacifiCorp** *
PNGC
PG&E *
*Portland General Electric*
Public Service New Mexico *
Seattle City Light *
State of Hawaii *
State of New Mexico
Tacoma Power *
Xcel/SPS

**Midwest:**
**Ameren Illinois** *
Ameren Missouri *
*Black Hills Power* *
Citizens Energy
**Empire District Electric** *
Indianapolis P&L*
**Indiana & Michigan Utilities**
Kansas City Power & Light

MERC
NIPSCO *
**Omaha Public Power District** *
**Peoples' Gas/ North Shore Gas** *
*Spire Missouri*
State of Michigan
*Sunflower Electric*
Vectren Energy *
*Westar Energy*

**Regional & National:**
*Midcontinent ISO* *
EEI/IEE *
EPRI
FERC



**Northeast:**
Berkshire Gas
**Central Hudson G&E** *
Con Edison of NY *
**Efficiency Maine** *
Liberty Utilities *
**New Jersey BPU**
*Orange & Rockland* *
PECO Energy
**PSEG Long Island**
*Rockland Electric*
Unitil

**South:**
*Kentucky Power* *
*OG&E*
**Southern Company / Georgia Power**
*Spire Mississippi*
State of Maryland – EmPOWER *
TVA

**Key**

*Two or more studies

**Bold** = Both Market Assessment and Program Planning & Design work

*Italics* = Only Program Planning & Design work

*As of January 2022*

- 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 2022 Integrated Resource Plan

# Methodology and Data Sources

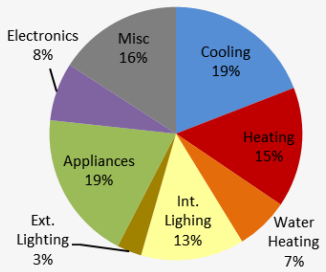
# Overview of AEG's Energy Efficiency Modeling Approach

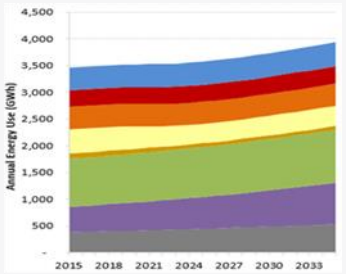
**Market Characterization**
- IPC Control Totals
- Customer Account data
- Secondary data
- IPC Market Research

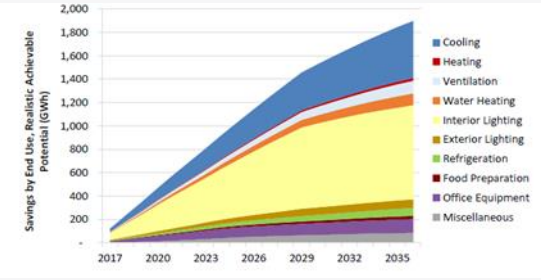
**Identify Demand-Side Resources**
- EE Technologies
- EE Measures
- Behavioral
- Emerging Tech

**Baseline Projection**
- IPC Load Forecast
- Customer growth
- Codes & Standards
- Efficiency options
- Purchase Shares

**Potential Estimation**
- Technical
- Economic
- UCT Achievable
- Technical Achievable for IRP



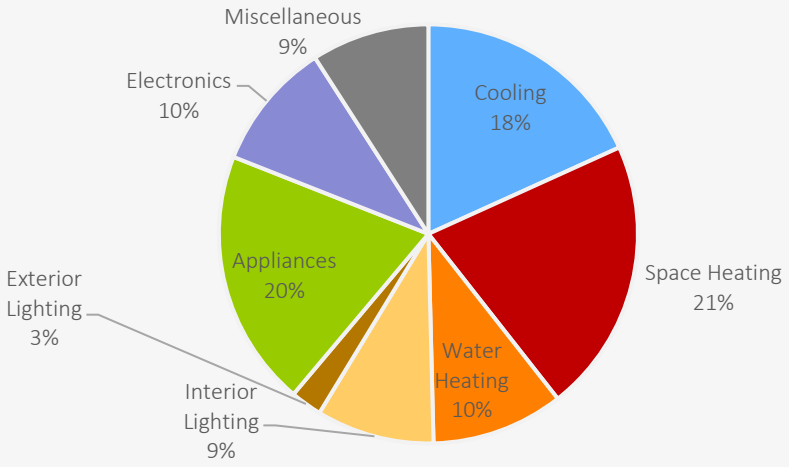



# Market Characterization

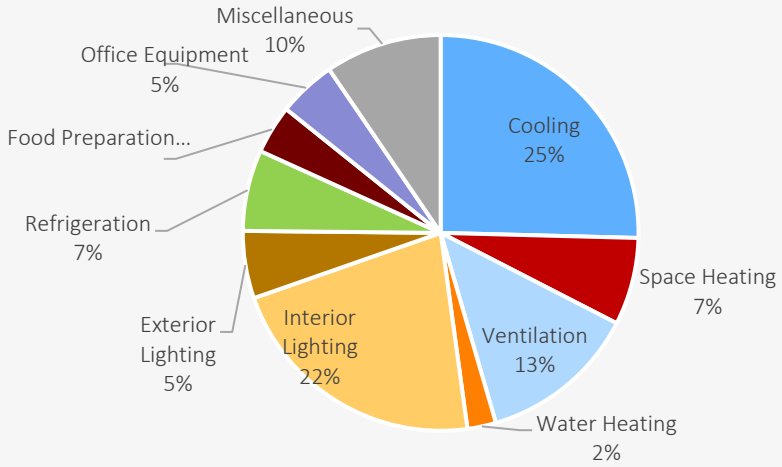
- Define energy-consumption characteristics in the base year of the study (2021)
- Incorporates Idaho Power's actual consumption and customer counts to develop "Control Totals"
- Grounds the analysis in Idaho Power data and provides enough detail to project assumptions forward and develop a baseline 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:

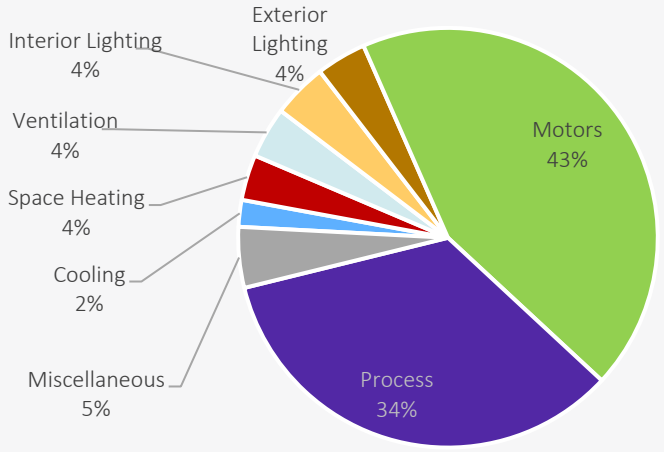
## Residential




## Commercial




## Industrial





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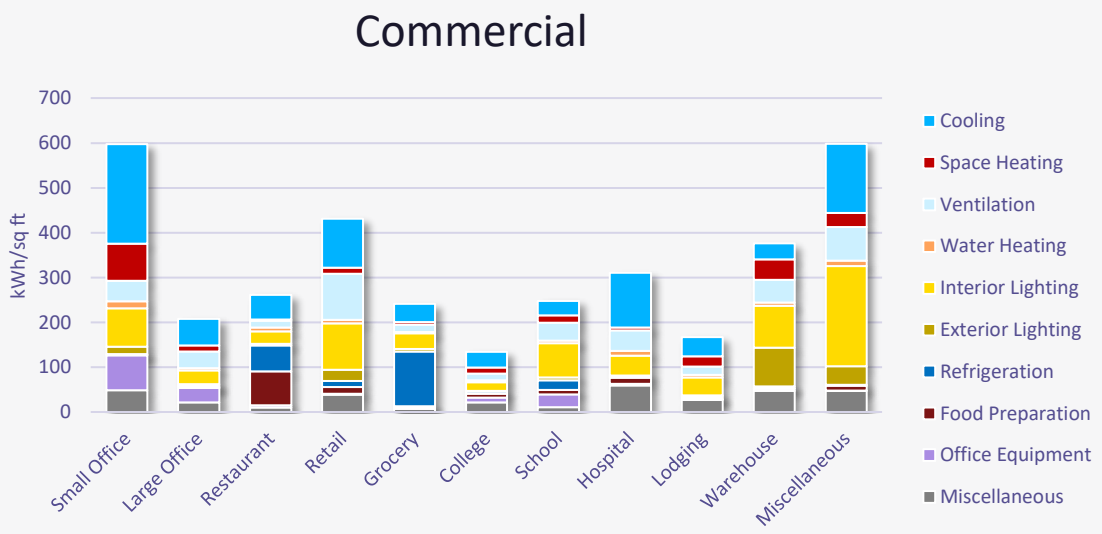
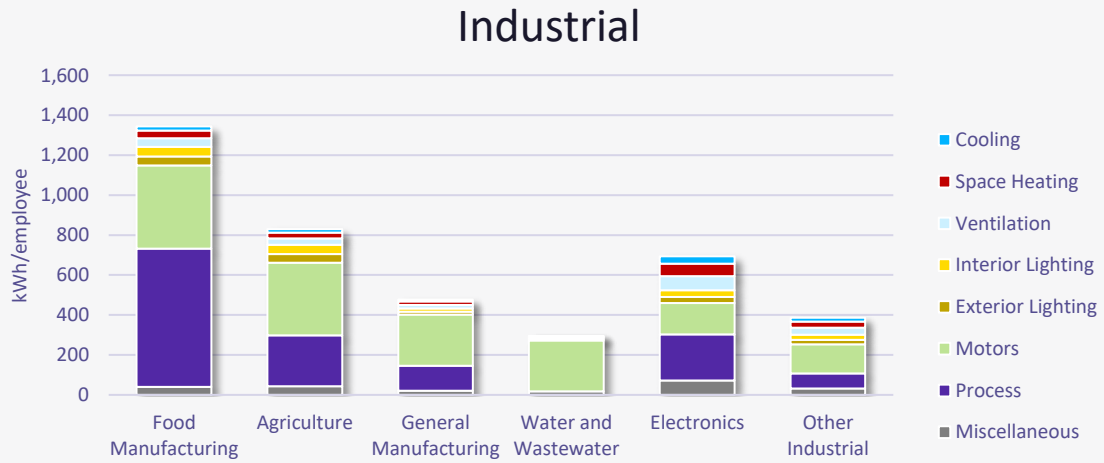
# Market Characterization

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





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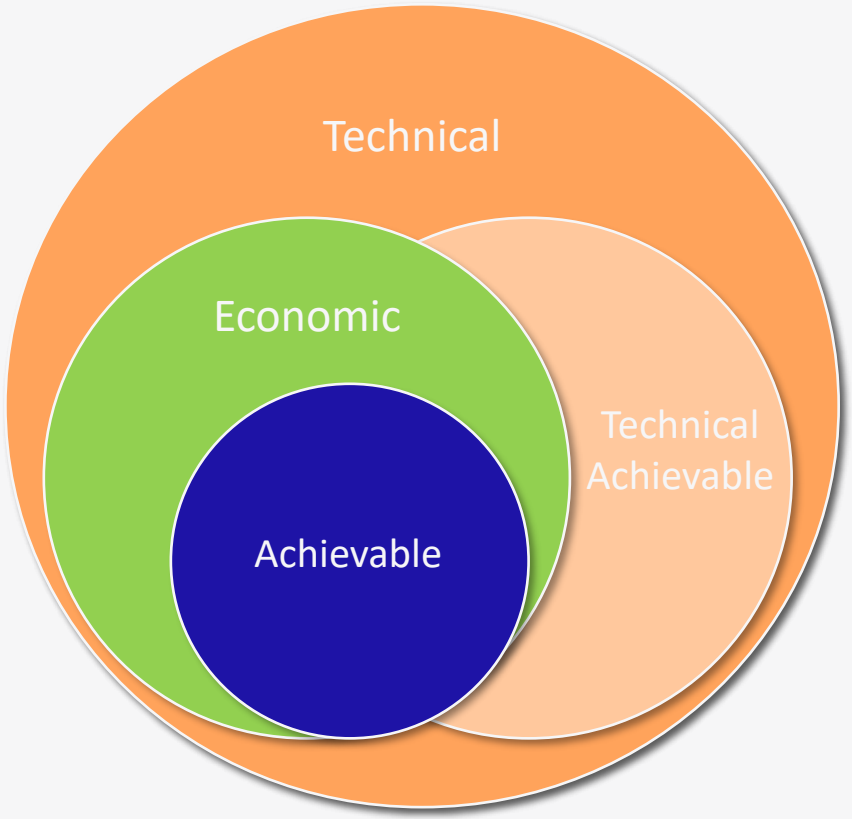
# Levels of Potential

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

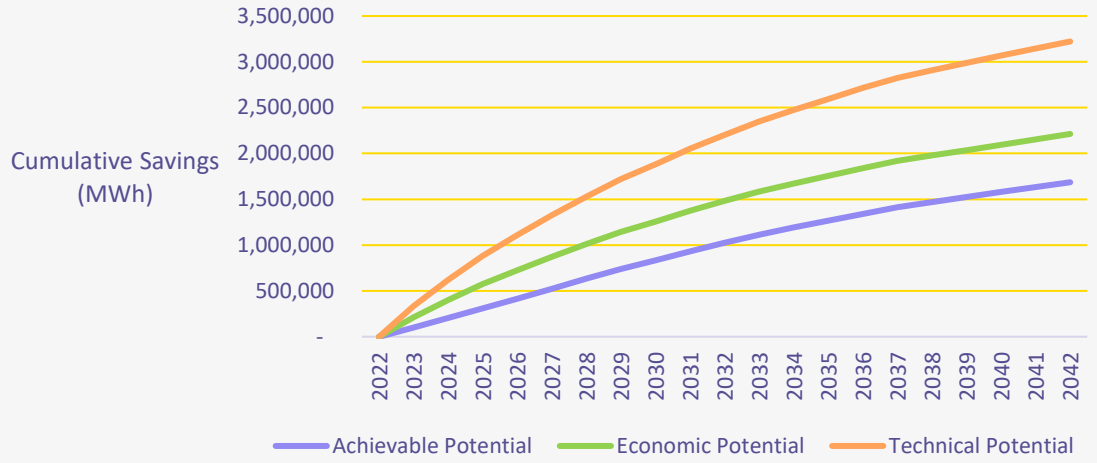
## Additional Data Sources:

- 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

# Draft Non-Residential Potential Results

# Potential Summary of Non-Res Sectors

- Non-Residential Achievable Potential savings in the first year of 100 GWh, 1.0% of baseline usage
  - Consistent with Idaho Power's 2022 program savings goal and recent accomplishments
- Achievable Potential savings reach 13.3% of baseline usage by 2042, an average of 0.7% annually
- 20-year Achievable Potential is 77% of Economic Potential

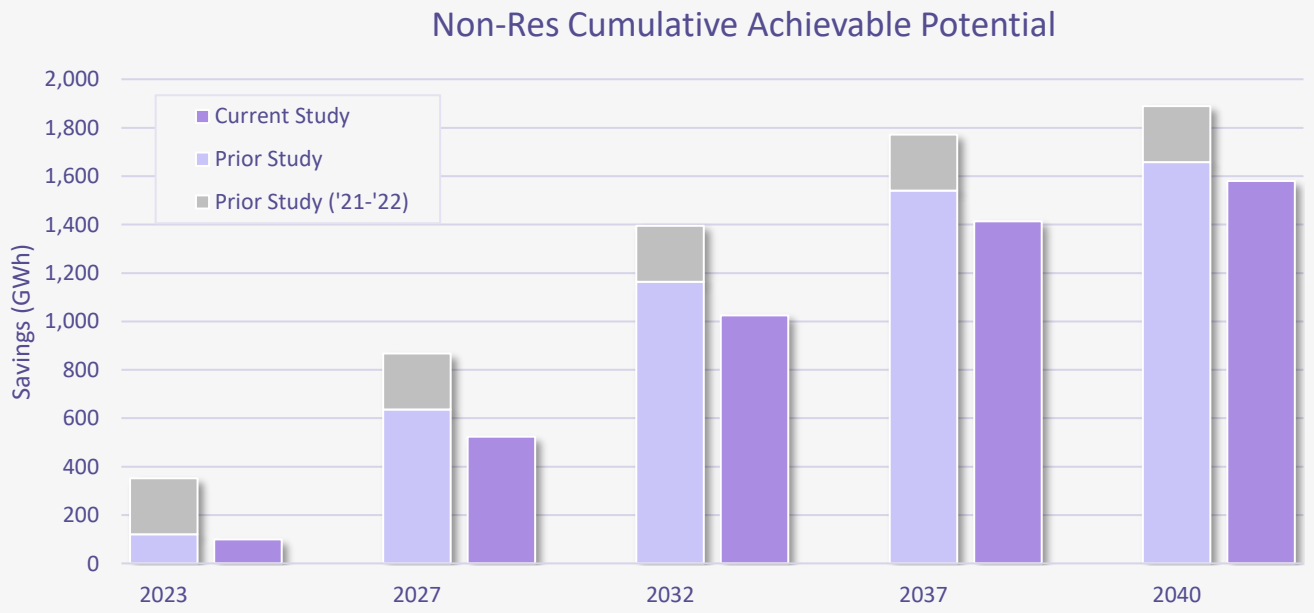



| Summary of Energy Savings | 2023 | 2027 | 2032 | 2037 | 2042 |
|---|---|---|---|---|---|
| **Baseline Projection (MWh)** | 9,870,603 | 10,394,033 | 11,111,002 | 11,849,126 | 12,656,700 |
| **Cumulative Savings (MWh)** | | | | | |
| Achievable Potential | 100,541 | 524,826 | 1,023,608 | 1,411,274 | 1,683,487 |
| Economic Potential | 214,469 | 872,087 | 1,479,698 | 1,916,592 | 2,208,520 |
| Technical Potential | 335,372 | 1,323,077 | 2,197,088 | 2,819,527 | 3,215,341 |
| **Energy Savings (% of Baseline)** | | | | | |
| Achievable Potential | 1.0% | 5.0% | 9.2% | 11.9% | 13.3% |
| Economic Potential | 2.2% | 8.4% | 13.3% | 16.2% | 17.5% |
| Technical Potential | 3.4% | 12.7% | 19.8% | 23.8% | 25.4% |

# Comparison with Prior Study

Non-Residential Cumulative Achievable Potential

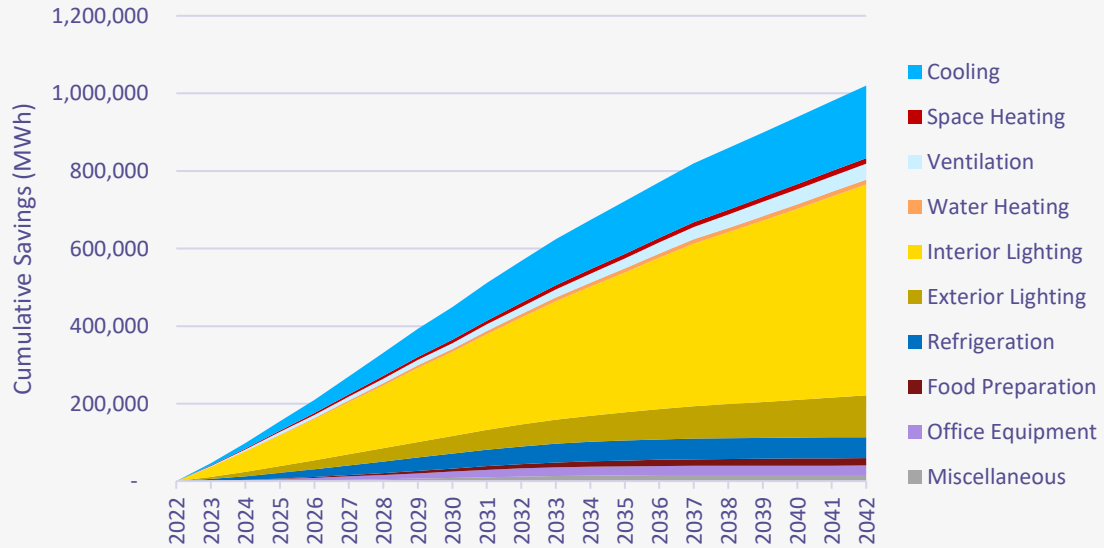
- Studies cover different 20-year periods and creates comparison challenges
- Figure below compares cumulative potential by calendar year – gray boxes show potential from first two years of prior study

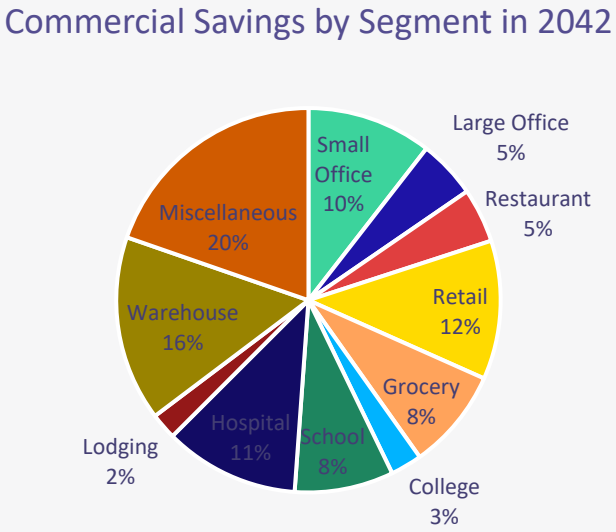


# Commercial Potential by End Use and Segment

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

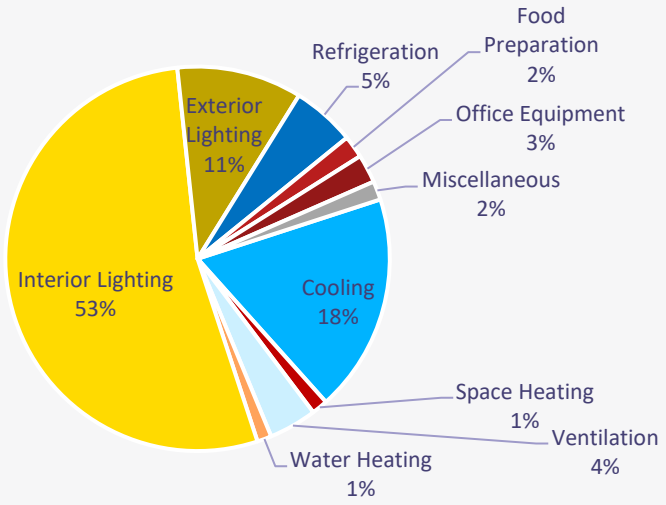


# Commercial Top Measures – Achievable Potential

- 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

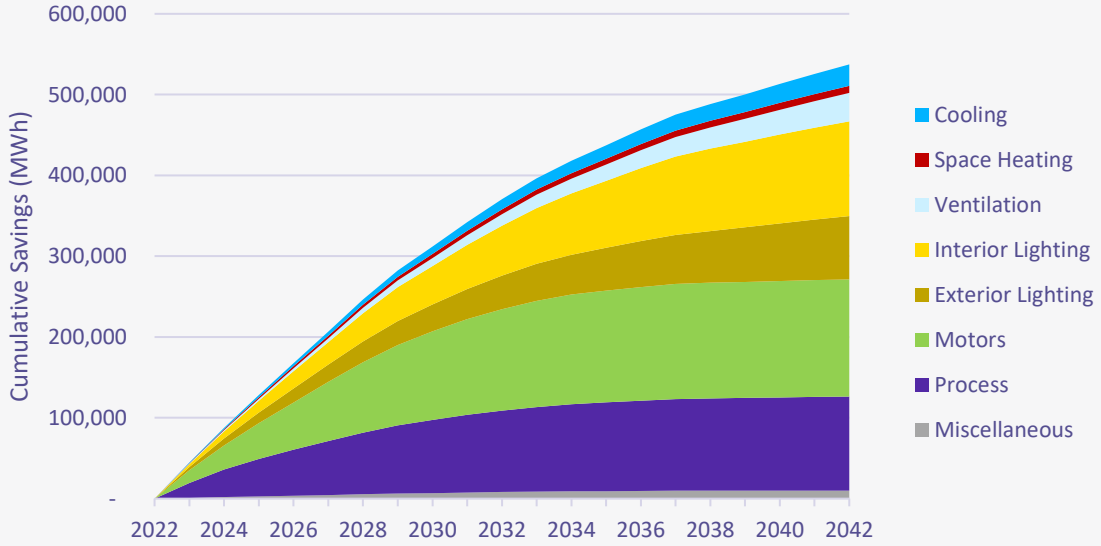


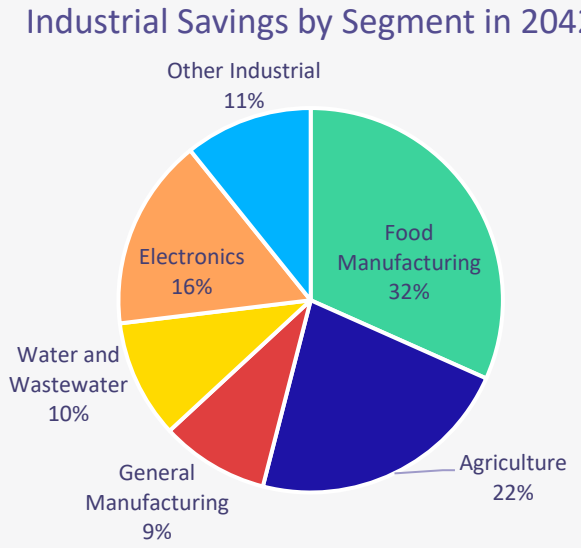

| Rank | Measure | Achievable Potential in 2025 | Achievable Potential in 2042 | % of Total |
|---|---|---|---|---|
| 1 | Linear Lighting | 68,997 | 533,450 | 52.3% |
| 2 | High-Bay Lighting | 13,260 | 81,942 | 8.0% |
| 3 | Water-Cooled Chiller | 1,977 | 62,123 | 6.1% |
| 4 | Server | 3,290 | 21,795 | 2.1% |
| 5 | Ducting - Repair and Sealing | 3,805 | 21,738 | 2.1% |
| 6 | Retrocommissioning | 15,899 | 16,538 | 1.6% |
| 7 | RTU | 1,008 | 14,701 | 1.4% |
| 8 | Engine Block Heater Controls | 1,330 | 13,898 | 1.4% |
| 9 | Ventilation - Variable Speed Control | 10 | 13,456 | 1.3% |
| 10 | Air-Source Heat Pump | 526 | 12,252 | 1.2% |
| 11 | Refrigeration - Heat Recovery | 1,458 | 11,877 | 1.2% |
| 12 | Refrigeration - Variable Speed Compressor | 3,156 | 11,536 | 1.1% |
| 13 | Air-Cooled Chiller | 473 | 11,061 | 1.1% |
| 14 | Grocery - Display Case - Door Retrofit | 1,385 | 11,042 | 1.1% |
| 15 | Area Lighting | 1,595 | 9,792 | 1.0% |
| 16 | Ventilation | 568 | 9,504 | 0.9% |
| 17 | General Service Lighting | 2,801 | 9,233 | 0.9% |
| 18 | Oven | 672 | 8,859 | 0.9% |
| 19 | HVAC - Maintenance | 1,755 | 8,829 | 0.9% |
| 20 | Hot Food Container | 453 | 8,222 | 0.8% |
| | **Total of Top 20 Measures** | **124,416** | **891,849** | **87.4%** |
| | **Total Cumulative Savings** | **154,677** | **1,020,034** | **100.0%** |

# 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

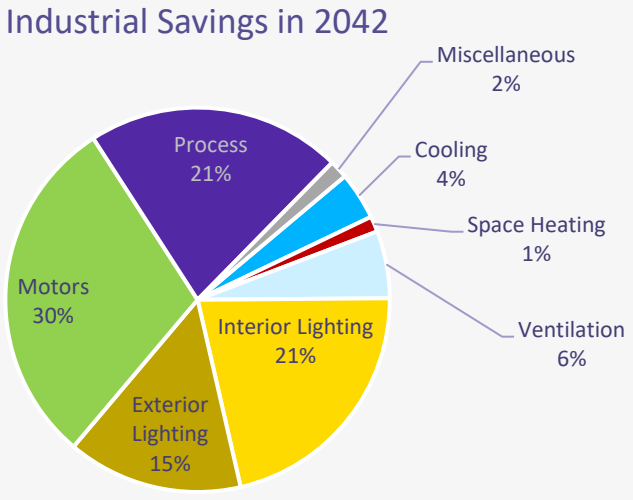


# Industrial Top Measures – Achievable Potential

Industrial Sector

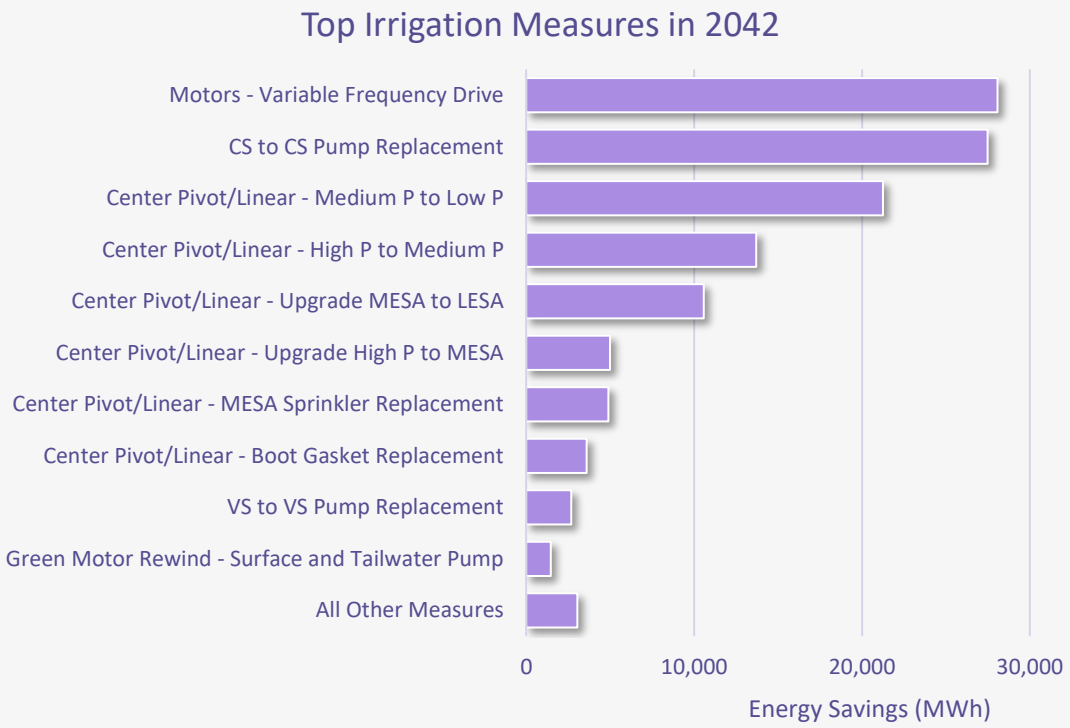
- Some Compressed Air measures from previous study were consolidated in the 2021 Power Plan
- Linear and High-Bay includes savings incorporate lighting control technologies




| Rank | Measure | Achievable Potential in 2025 | Achievable Potential in 2042 | % of Total |
|---|---|---|---|---|
| 1 | Linear Lighting | 12,143 | 117,049 | 21.8% |
| 2 | High-Bay Lighting | 8,338 | 65,528 | 12.2% |
| 3 | Strategic Energy Management | 19,837 | 44,182 | 8.2% |
| 4 | Refrigeration - Floating Head Pressure | 14,768 | 37,304 | 6.9% |
| 5 | Ventilation | 1,487 | 32,949 | 6.1% |
| 6 | Refrigeration - High Efficiency Compressor | 10,520 | 26,381 | 4.9% |
| 7 | Pumping System - Controls | 2,786 | 22,411 | 4.2% |
| 8 | Refrigeration - System Optimization | 8,702 | 21,037 | 3.9% |
| 9 | Compressed Air - End Use Optimization | 10,557 | 15,066 | 2.8% |
| 10 | Switch from Belt Drive to Direct Drive | 1,834 | 13,598 | 2.5% |
| 11 | Material Handling - Variable Speed Drive | 2,925 | 13,424 | 2.5% |
| 12 | Process - Tank Insulation | 4,397 | 12,477 | 2.3% |
| 13 | Water-Cooled Chiller | 491 | 11,850 | 2.2% |
| 14 | Advanced Industrial Motors | 1,201 | 9,880 | 1.8% |
| 15 | Fan System - Equipment Upgrade | 1,075 | 9,009 | 1.7% |
| 16 | Municipal Sewage Treatment - Optimization | 5,923 | 8,462 | 1.6% |
| 17 | Pumping System - System Optimization | 1,018 | 7,130 | 1.3% |
| 18 | Fan System - Controls | 856 | 6,911 | 1.3% |
| 19 | High Frequency Battery Chargers | 1,341 | 6,599 | 1.2% |
| 20 | Air-Cooled Chiller | 248 | 5,536 | 1.0% |
| | **Total of Top 20 Measures** | **110,445** | **486,781** | **90.6%** |
| | **Total Cumulative Savings** | **128,091** | **537,211** | **100.0%** |

# Irrigation Top Measures – Achievable Potential

- Potential savings are similar to previous study




| Rank | Measure | Achievable Potential in 2025 | Achievable Potential in 2042 | % of Total |
|---|---|---|---|---|
| 1 | Motors - Variable Frequency Drive | 11,058 | 28,065 | 22.2% |
| 2 | CS to CS Pump Replacement | 8,765 | 27,478 | 21.8% |
| 3 | Center Pivot/Linear - Medium P to Low P | 43 | 21,254 | 16.8% |
| 4 | Center Pivot/Linear - High P to Medium P | 83 | 13,695 | 10.8% |
| 5 | Center Pivot/Linear - Upgrade MESA to LESA | 22 | 10,569 | 8.4% |
| 6 | Center Pivot/Linear - Upgrade High P to MESA | 846 | 4,985 | 3.9% |
| 7 | Center Pivot/Linear - MESA Sprinkler Replacement | 2,589 | 4,885 | 3.9% |
| 8 | Center Pivot/Linear - Boot Gasket Replacement | 1,123 | 3,588 | 2.8% |
| 9 | VS to VS Pump Replacement | 854 | 2,679 | 2.1% |
| 10 | Green Motor Rewind - Surface and Tailwater Pump | 484 | 1,450 | 1.1% |
| 11 | Thunderbird - Hub Replacement | 370 | 1,419 | 1.1% |
| 12 | Green Motor Rewind - Well Pump | 400 | 1,198 | 0.9% |
| 13 | Wheel/Hand - Nozzle Replacement | 725 | 1,087 | 0.9% |
| 14 | Center Pivot/Linear - High P Sprinkler Replacement | 624 | 920 | 0.7% |
| 15 | Wheel-Line - Convert to Low Pressure System (Alfalfa) | 2 | 894 | 0.7% |
| 16 | Wheel/Hand - Gasket Replacement | 453 | 868 | 0.7% |
| 17 | Wheel/Hand - Drain Replacement | 293 | 556 | 0.4% |
| 18 | Green Motor Rewind - Booster Pump | 173 | 518 | 0.4% |
| 19 | Hand-Line - Convert to Low Pressure System (Alfalfa) | 0 | 137 | 0.1% |
| | **Total of Top Measures** | **28,907** | **126,242** | **100.0%** |
| | **Total Cumulative Savings** | **28,907** | **126,242** | **100.0%** |

# IRP Bundling

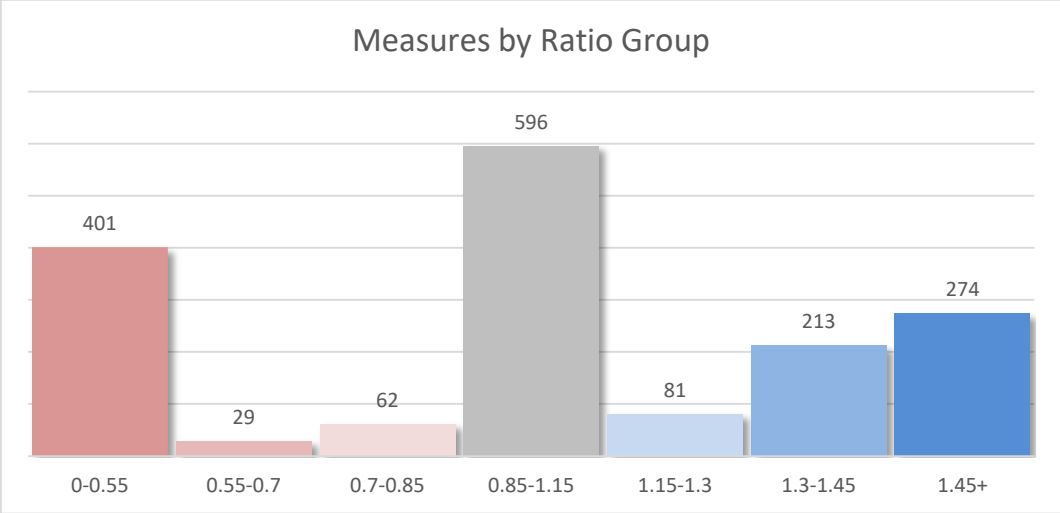
# Review of 2021 IRP Bundling

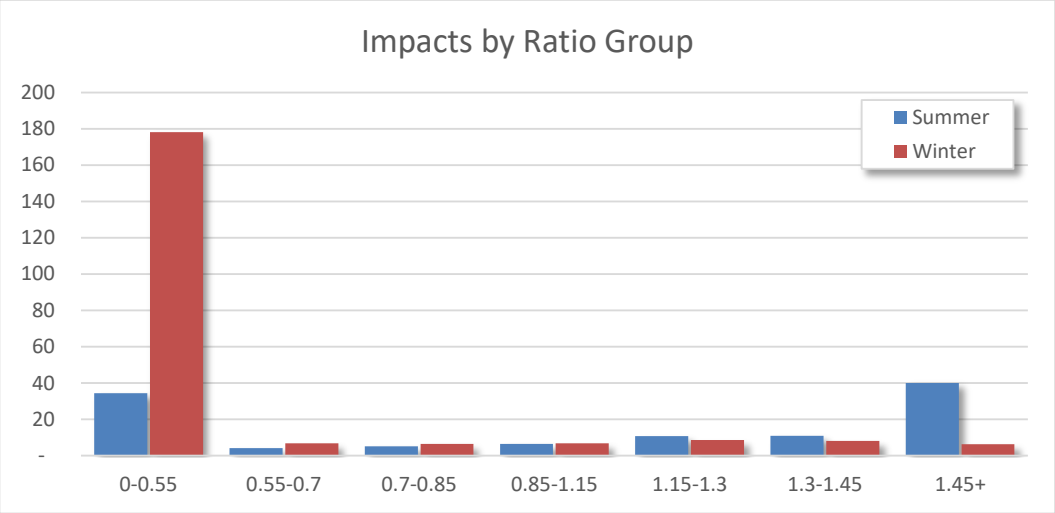
Objectives

- Include the identified economic potential as a resource in IRP modeling
- Allow the IRP to identify additional energy efficiency resources based on resource needs and cost relative to resource alternatives
- Bundle measures to provide a manageable number of energy efficiency resources for IRP modeling
- Group similar measures together based on:
  - Resource shape (e.g., measures with impacts concentrated during the summer peak)
  - Cost
- Ensure that measure bundles are large enough to be able to affect IRP resource decisions (e.g., MWs, not kWs)

# 2021 IRP Bundling Methodology

- 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 were grouped based on contributions during the following hours:
  - Summer weekdays: August 8-10 pm
  - Winter weekdays: January 8-9 am

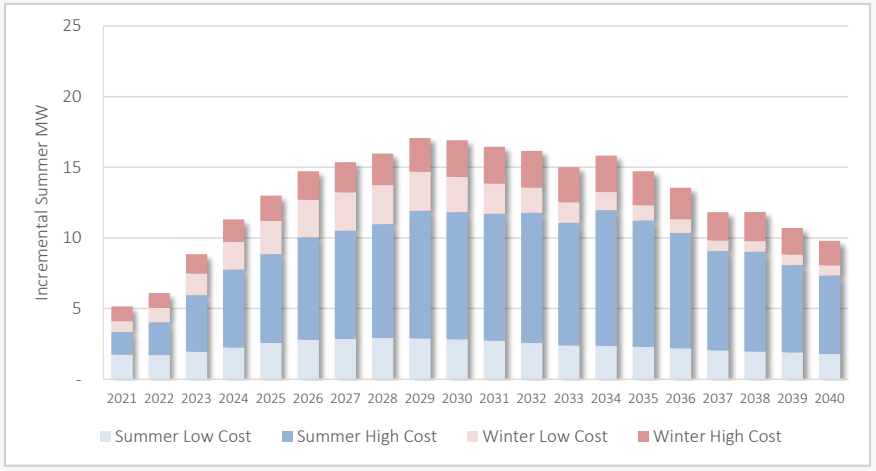


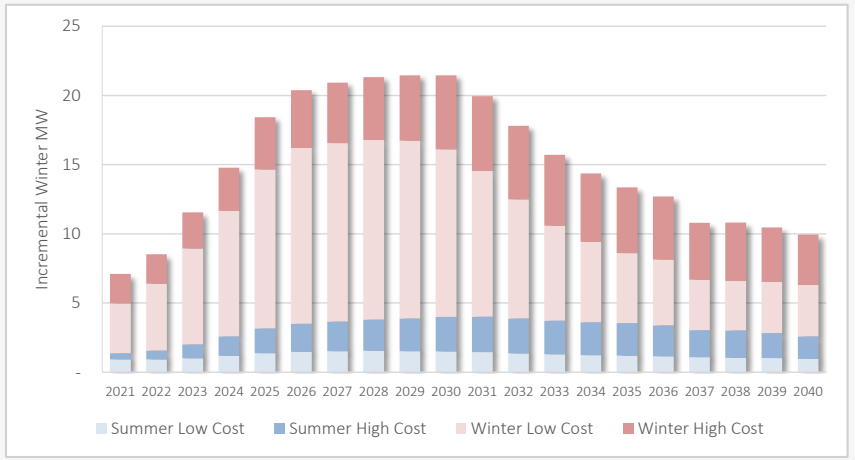
# Key Findings from 2021 IRP Bundling

- All bundles provide impacts in both seasons, but impacts for each bundle were higher in the season identified by the measure ratios
- Potential for demand reduction was 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
- The bundling approach met the identified objectives and Idaho Power and AEG plan to use the same approach for the 2023 IRP

Summer

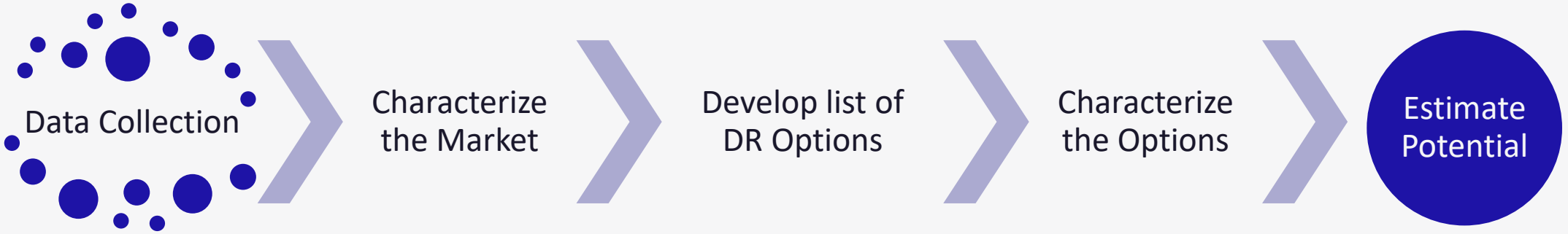



Winter



# Demand Response

# Approach to the Study




**Align with EE Potential Study**
- Market Profiles

**Secondary Sources**
- Industry or regional reports
- Previous studies

**Segmentation by Customer Class**
- Residential
- Commercial
- Industrial
- Irrigation

**Program Options**
- Water Heater Switch/Grid Control
- AC Load Switch Control
- Bring Your Own Thermostat
- Electric Vehicle Charging Control
- Irrigation Control
- Curtailment
- Time-Varying Rates (Time Of Use, Critical Peak Pricing, Real Time Pricing)

**Develop Program Assumptions**
- Impacts
- Participation
- Technology
- Costs
- Incentives

**Technical Achievable Potential**
- Potential for all programs regardless of cost and without consideration of dual participation

**Achievable Potential**
- Integrated program options without participant overlap

# Data Sources/Collection

**Program Impact and Cost assumptions mainly based on NWPCC 2021 Power Plan**

- Customize for Idaho Power's service territory
- Will diverge from Council assumptions where appropriate

**Supplement with data specific to the demand response potential assessment from Idaho Power:**

- Peak period definitions
- Residential End Use Survey results
- Current DR program data, including recent impact evaluations
  - Irrigation Peak Rewards
  - Flex Peak
  - A/C Cool Credit
- Incorporate planned changes to existing programs
  - Extended season, later event windows, increased incentives
  - Updated enrollment info available in mid-May

# Program Options to Assess

- Model the demand response programs and rates included in the Council's 2021 Power Plan.
- Based on the value to Idaho Power's system, the analysis will focus on summer programs but incorporate the winter impacts and other assumptions as relevant.

| Residential | Commercial | Industrial/Irrigation |
|---|---|---|
| Residential Critical Peak Pricing* | Commercial Critical Peak Pricing* | Industrial Critical Peak Pricing* |
| Residential Time of Use* | Small Commercial Bring-Your-Own-Thermostat* | Industrial Real Time Pricing* |
| Residential Electric Vehicle Supply Equipment Control* | Commercial Curtailable Load* | Industrial Curtailable Load* |
| Residential Electric Resistance Water Heater Control Grid and Switch* | Commercial Small Building AC Load Control Switch | Irrigation Control Large and Small/Medium Farms |
| Residential Heat Pump Water Heater Control Grid and Switch* | Commercial Medium Building AC Load Control Switch | |
| Residential AC Load Control Switch | | |
| Residential Bring-Your-Own-Thermostat* | | |

* Winter impacts available

# Assumptions and Updates

AEG and Idaho Power are currently reviewing Council assumptions for appropriateness. Key considerations include:

**Idaho Power's Window of Need**

- Not necessarily at system peak; later in the day when solar resources are no longer available.
- Need to investigate how well Council assumptions support this shift.

**Include Full Incentive Costs**

- The Council uses a Total Resource Cost (TRC) perspective for cost-effectiveness, which only counts a portion of the incentive as a proxy for participant costs. Idaho Power uses a Utility Cost Test (UCT) perspective, so full incentives should be counted.

**Costs to Upgrade/Implement Software**

- The Council cost assumptions may not include the costs of upgrading/implementing all of the software to support programs. Estimating these costs can be difficult (particularly rate programs).

# Developing Demand Response Resource Costs

- DR Programs have both upfront and ongoing costs according to the table below
- DR costs are levelized over the 20 year forecast
- Levelized costs are presented in $/kW-year

| One-Time Fixed Costs | One-Time Variable Costs | Ongoing Costs |
|---|---|---|
| Program Development Costs ($/program) | Equipment Costs ($/participant) | Administrative Costs (shared costs) |
| | Marketing Costs ($/participant) | O&M Costs ($/participant) |
| | | Incentives ($/participant or $/kW) |

- Consider how to spread winter and summer costs (Council assumes a 50/50 split)
- Bundle development and administrative costs for programs that will be administered together, e.g., grid-interactive and switch-controlled water heating

# Estimate DR Potential

To estimate DR potential, AEG will apply the technology and program data/assumptions to the baseline demand projection.

### 1. Technical Achievable Potential

- Potential for each program option in isolation.
- Demand reductions for each program given expected customer participation without regard to program competition
- Incorporates program ramp-up time to provide a realistic estimate of the impacts in each year of the planning period
- Total identified potential from all programs is not achievable, but lays the groundwork for incorporating program hierarchy

### 2. Achievable Potential

- Demand reductions for each program given expected customer participation accounting for competition between programs (i.e., program options are stackable)
- Incorporates program ramp-up time to provide a realistic estimate of the impacts in each year of the planning period
- Does not account for program economics, i.e., the cost-effectiveness of the programs in each year.

AEG will provide a cost per kW-year of potential but will not perform economic screening (will be performed in the IRP model)

# Thank You.

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