Duke Energy Indiana Market Potential Study

Contemporary Issues Technical Conference

Nexant

Reimagine tomorrow.

July 15, 2021

Outline

- **DEI and OSB coordination**
- **Nexant MPS Methodology**

Study Timeline and OSB Stakeholder Process

Study Timeline

- 7/20/2020 – Project Initiation
- 7/28/2020 – Draft Work Plan
- 8/11/2020 – Project Kickoff Meeting
- 12/16/2020 – Draft Technical Potential and Economic Potential
- 2/9/2020 – Draft Achievable Potential
- 3/5/2020 – Draft Report to Duke Energy
- *3/8/2021 – OSB discussion on overall study and draft findings*
- 3/24/2021 – Draft Final Report provided to OSB
- 4/5/2021 – Final Report

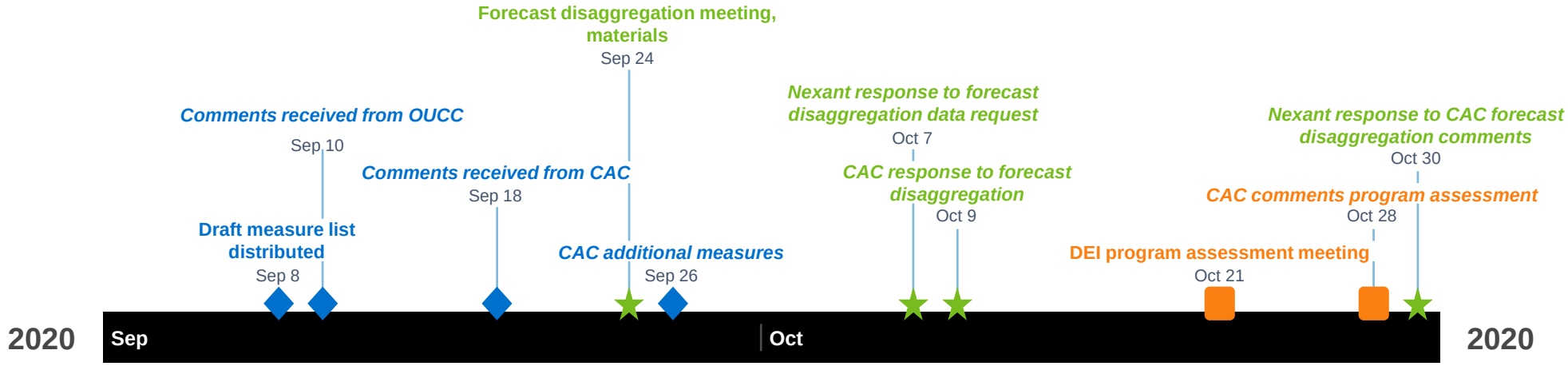
OSB Stakeholder Process

- 09/08/2020 – Draft measure list distributed
  - 09/10/2020 – Comments received from OUCC
  - 09/18/2020 – Comments received from CAC
  - 10/21/2020 – CAC additional measures
- 09/24/2020 – Forecast disaggregation meeting, materials
  - 10/07/2020 – Nexant response to forecast disaggregation data request
  - 10/09/2020 – CAC response to forecast disaggregation
  - 10/30/2020 – Nexant response to CAC forecast disaggregation comments
- 10/21/2020 – DEI program assessment meeting
  - 10/28/2020 – CAC comments program assessment
- 11/03/2020 – Draft residential measure impacts and parameters
- 11/04/2020 – Draft commercial and industrial impacts and parameters
  - 11/09/2020 & 11/10/2020 – OUCC comments re: measure list
  - 11/16/2020 – CAC residential measure comments
  - 11/17/2020 – CAC C&I measure comments pt. 1
  - 11/18/2020 – CAC C&I measure comments pt. 2
- 11/19/2020 – Discussion with OSB on measure comment, draft EE Res Tech. Pot, draft DR Tech. Pot.

OSB Stakeholder Process

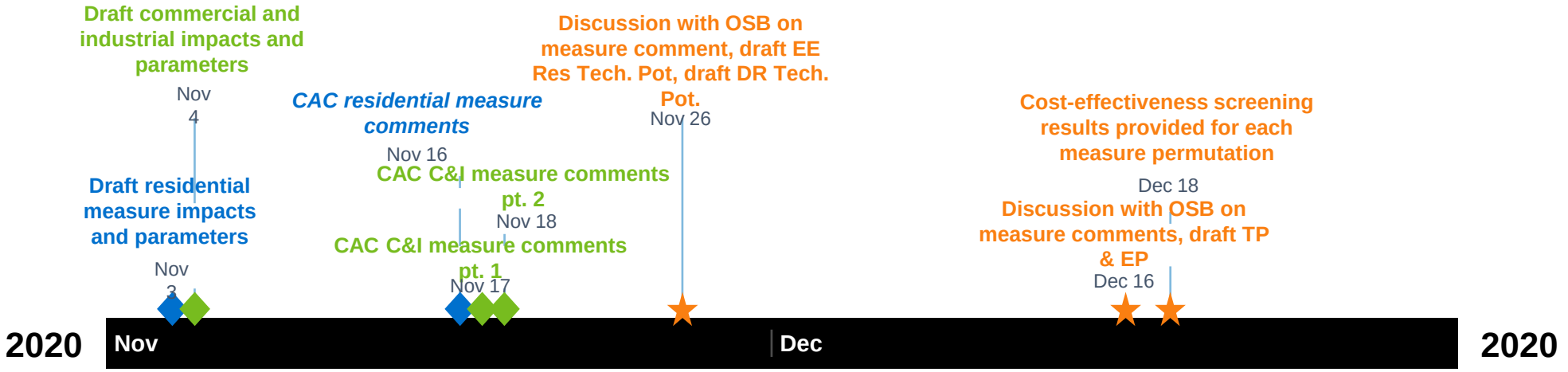
- 12/16/2020 – Discussion with OSB on measure comments, draft TP & EP
  - 12/16/2020 – PPT with draft TP and draft EP distributed to OSB
  - 12/16/2020 – Nexant responses to OSB comments on Res, Com, and Ind measure impacts
  - 12/18/2020 – Cost-effectiveness screening results provided for each measure permutation
- 12/29/2020 – Updated measure algorithms and parameters & measure impact files distributed to OSB reflecting revisions incorporated per OSB comments
  - 1/7/2021 – CAC comments on TP, EP and updated measure impacts
  - 1/19/2021 – Nexant responses to OSB comments on TP, EP, and updated measure impacts
- 1/19/2021 – Discussion with OSB on EP, EE AP Base Scenario, and DR AP (base & enhanced)
  - 1/19/2021 – PPT with draft EE AP Base, DR AP Base & Enhanced
- 1/22/2021 – CAC comments on updated measure impacts (Indiana TRM)
  - 1/26/2021 – Nexant response to OSB measure impacts (Indiana TRM)
- 2/5/2021 – CAC request for MPS AP details & format
- 2/9/2021 – Draft Achievable Potential (EE – all scenarios)
- 2/11/2021 –OSB meeting
- 2/19/2021 – OSB comments on AP
- 03/05/2021 – Draft Report submitted to Duke Energy

Study Updates and Files Transmitted (Sep-Oct)



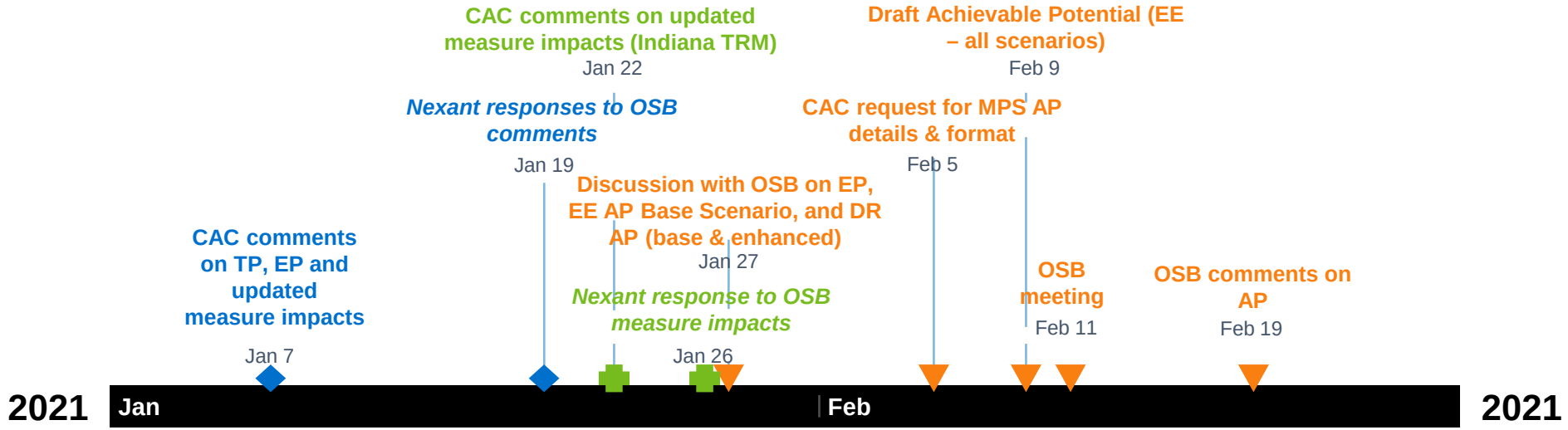
Study Updates	Files *(Nexant Responding to Comments)*
Measure List	20200908_Measure Development Process_draft.pdf; 20200908_DEI MPS Measure List_DRAFT_CAC--9-18-2020_nexant response.xlsx; 20201019_Response to OSB Comments on Draft Measure List.pdf; 20201103_Follow Up on Measure List Comments from OSB.pdf
Forecast disaggregation	20201030_Response to OSB Comments on Disaggregated Forecast.pdf
Program assessment	DEI MPS - Program Planning - 102120.pdf

Study Updates and Files Transmitted (Nov-Dec)



Study Updates	Files *(Nexant Responding to Comments)*
Residential impacts and parameters	20201216_Response to OSB Comments on Res Measure Impacts.pdf
Commercial and industrial impacts and parameters	20201216_Response to OSB Comments on Com Measure Impacts.pdf; 20201216_Response to OSB Comments on Ind Measure Impacts.pdf
Discussion on measure comments, draft TP & EP	20201216_DEI MPS Tech Potential_DRAFT.pdf; 20201216_DEI MPS Econ Potential_DRAFT.pdf; 20201228_DEI Measure Impacts_XXX.xlsx (excel format for Res, Com, and Ind); 20201228_XXX Measure Algorithms and Parameters.xlsx (excel format for Res, Com, and Ind); DEI MPS - EP Measure Cost-Effectiveness.xlsx (CONFIDENTIA, thru sftp)

Study Updates and Files Transmitted (Jan-Feb)



Study Updates	Files *(Nexant Responding to Comments)*
CAC comments on TP, EP and updated measure impacts	20210119_Response to OSB Comments on TP_EP_Measure Impacts.pdf
Measure impacts (Indiana TRM)	Nexant response via email (1/26) Title: Re: DEI MPS--Request to Use Dif Source for C&I HVAC Measures
Discussion on EP and AP with all scenarios	20210119_DEI MPS Econ_Ach Base_DRAFT.pdf; 20210216_DEI MPS_EE Ach_Res_DRAFT.pdf; 20210216_DEI MPS_EE Ach_NonRes_DRAFT.pdf; 20210219_Program Cost Slides_Res_DRAFT.pdf; 20210219_Program Cost Slides_NonRes_DRAFT.pdf

Market Potential Framework

Overall Work Plan

Kickoff /Data Collection

Vision of study parameters

Key items to consider

Data requests

Mkt. Charact.

Characterize Duke Energy Indiana's customer market

Measures

Conduct research on residential, commercial and industrial measures

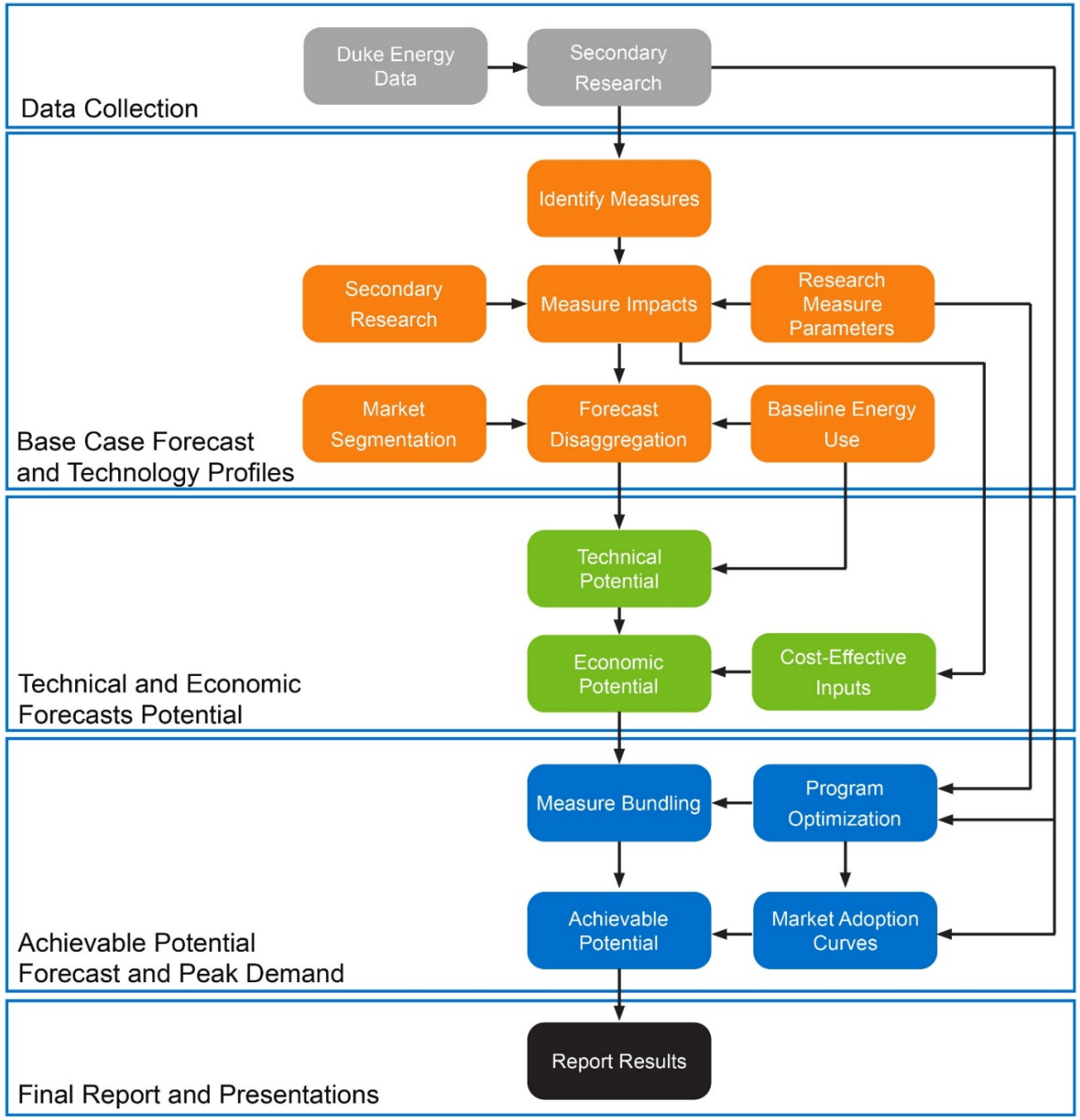
Modeling

Model technical, economic, achievable potential from 2021 - 2045

Reporting

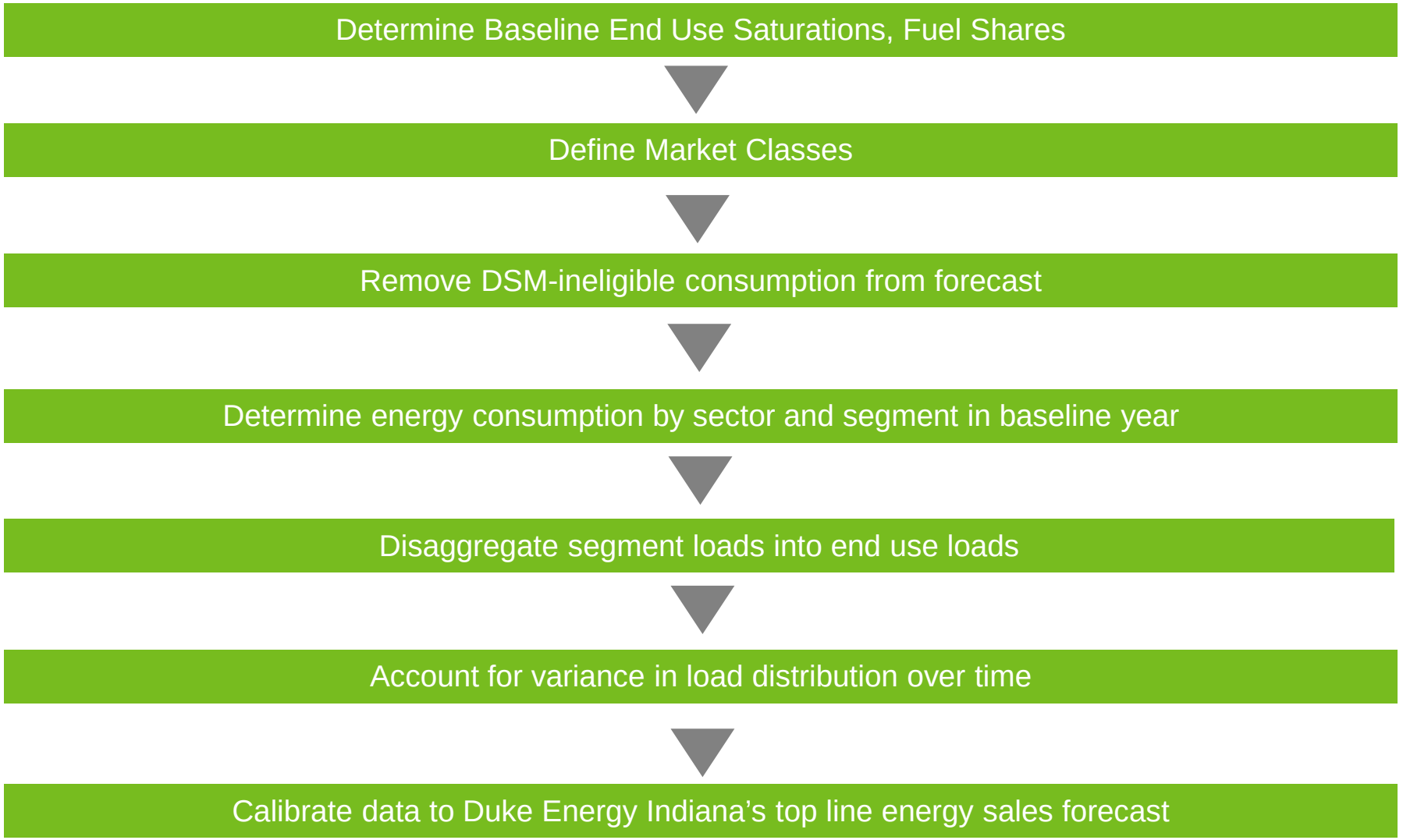
Deliver reports and peripheral analysis workbooks

Nexant MPS

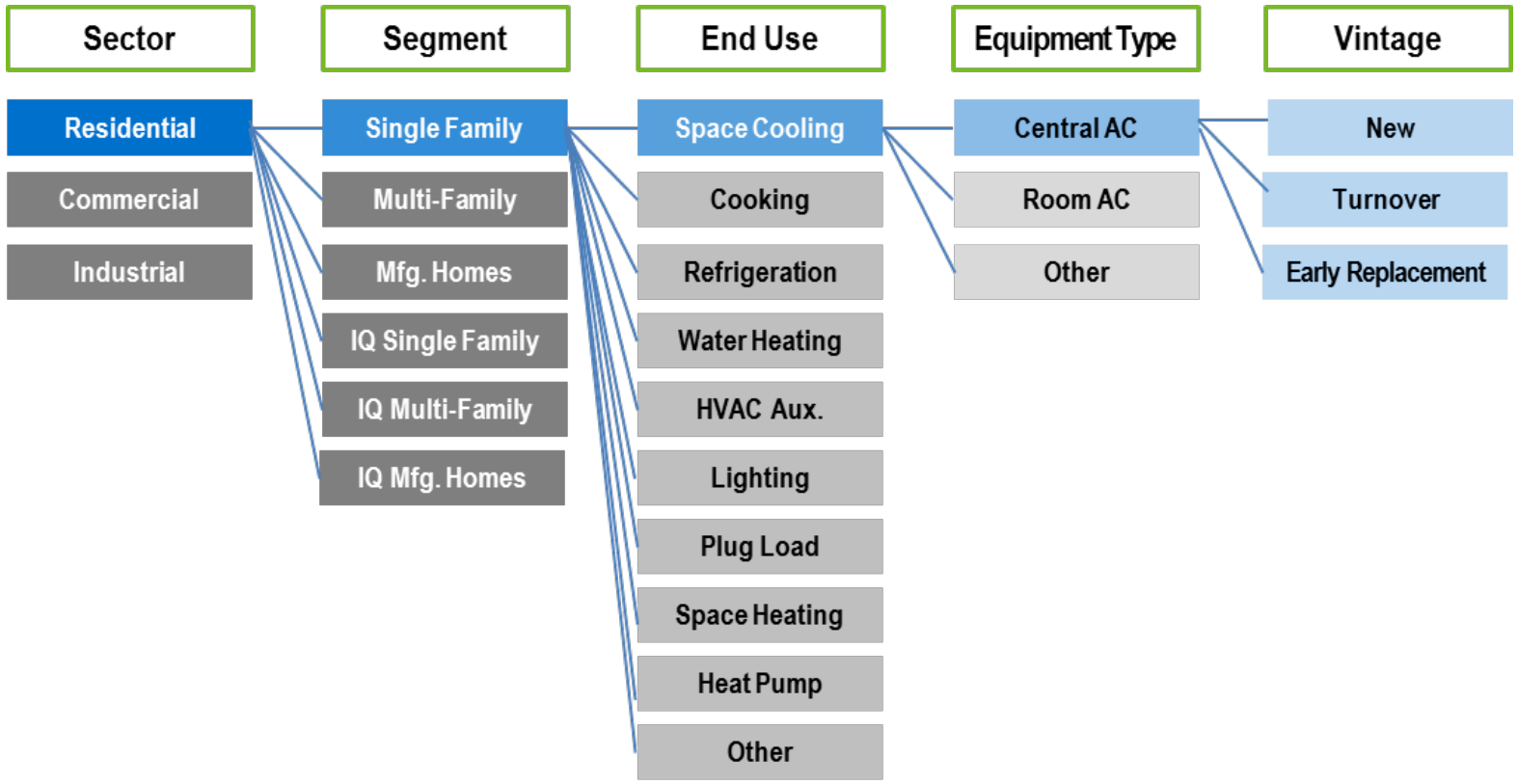

Duke Energy Data
Secondary Research
Data Collection
Identify Measures
Secondary Research
Measure Impacts
Research Measure Parameters
Market Segmentation
Forecast Disaggregation
Baseline Energy Use
Base Case Forecast and Technology Profiles
Technical Potential
Economic Potential
Cost-Effective Inputs
Technical and Economic Forecasts Potential
Measure Bundling
Program Optimization
Achievable Potential
Market Adoption Curves
Achievable Potential Forecast and Peak Demand
Report Results
Final Report and Presentations

Forecast Disaggregation and Customer Segmentation

Forecast Disaggregation

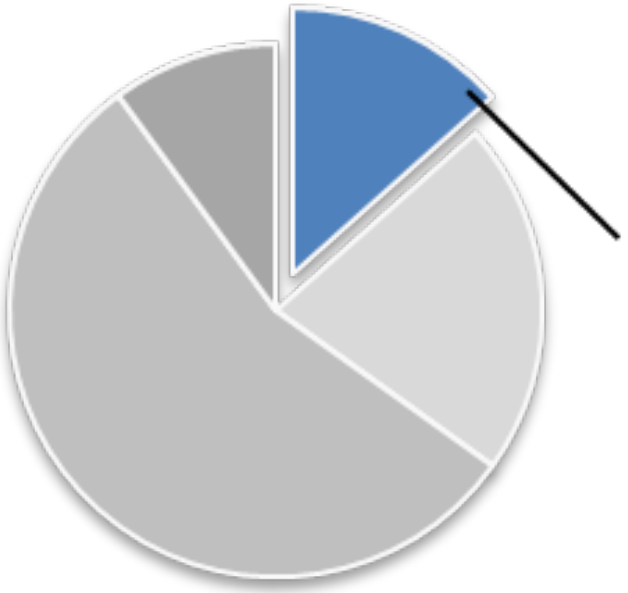


Forecast Disaggregation



Modeling Overview

1. Base year disaggregated using customer data

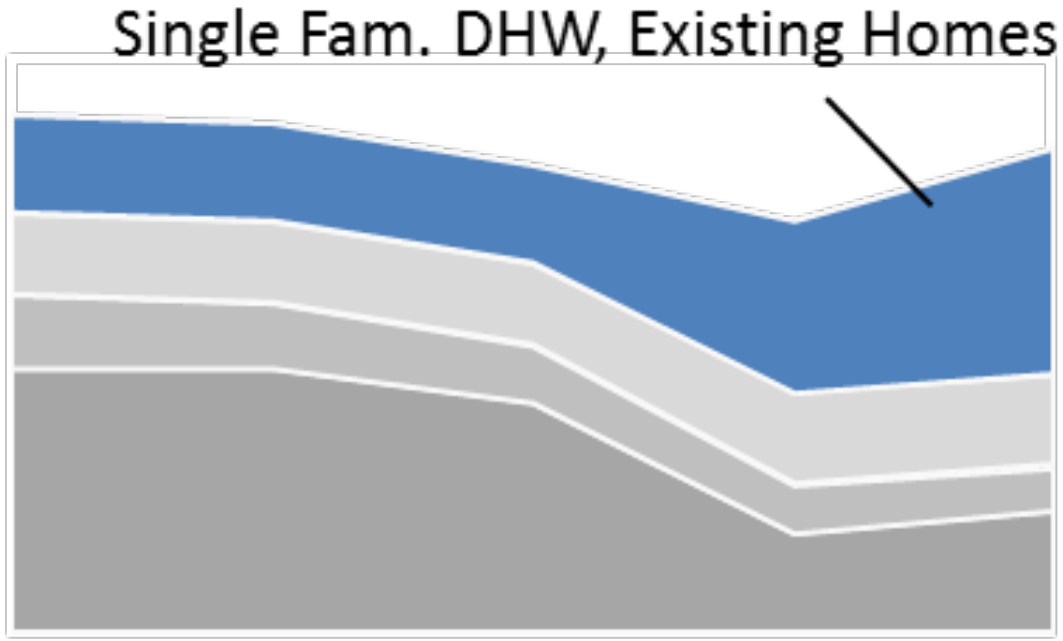


For instance:

- **Build Type**: Single Family
- **End Use:** Hot Water
- **Equip Type:** DHW Heater
- **Vintage:** New Construction

Modeling Overview

2. Forecast disaggregated over study period



Modeling Overview

3. Measures align with disagg. forecast

Equipment Measure EN101:

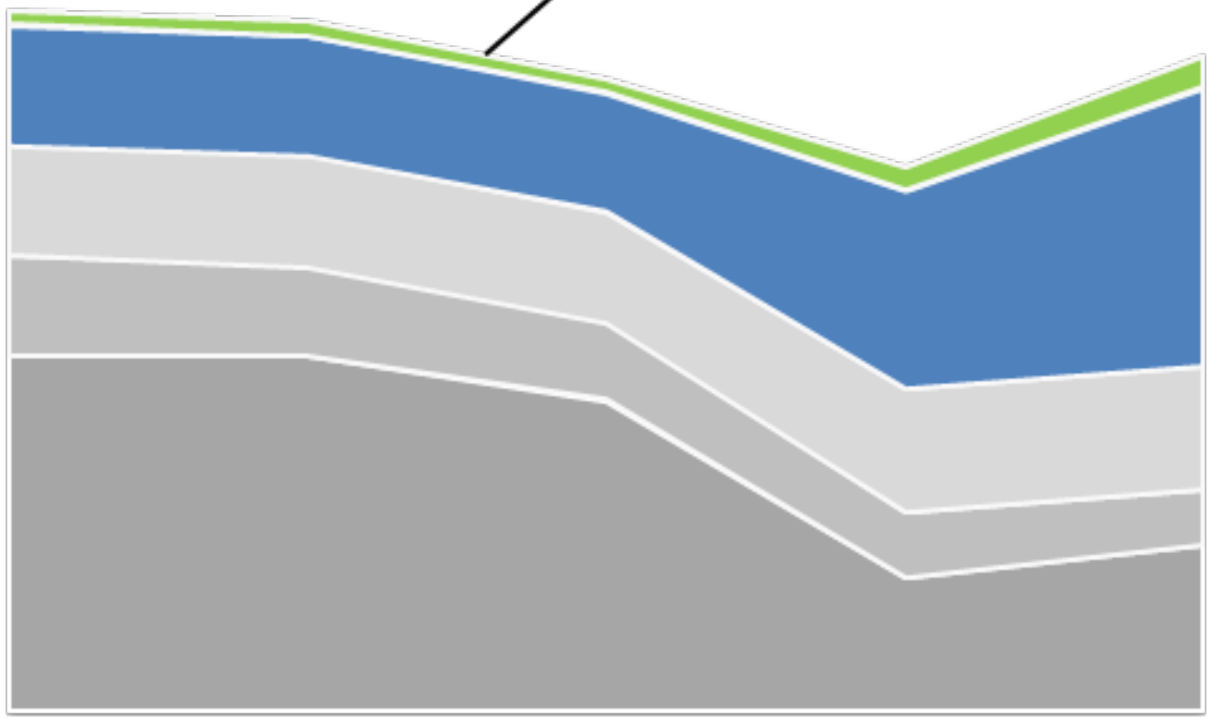
High Efficiency Tankless Domestic Water Heater, single family, new construction

- Savings: 10%
- TRC Ratio: 1.5

Modeling Overview

4. Most cost-effective measure applied 1st

Equipment-type-specific forecast is reduced by 10% savings



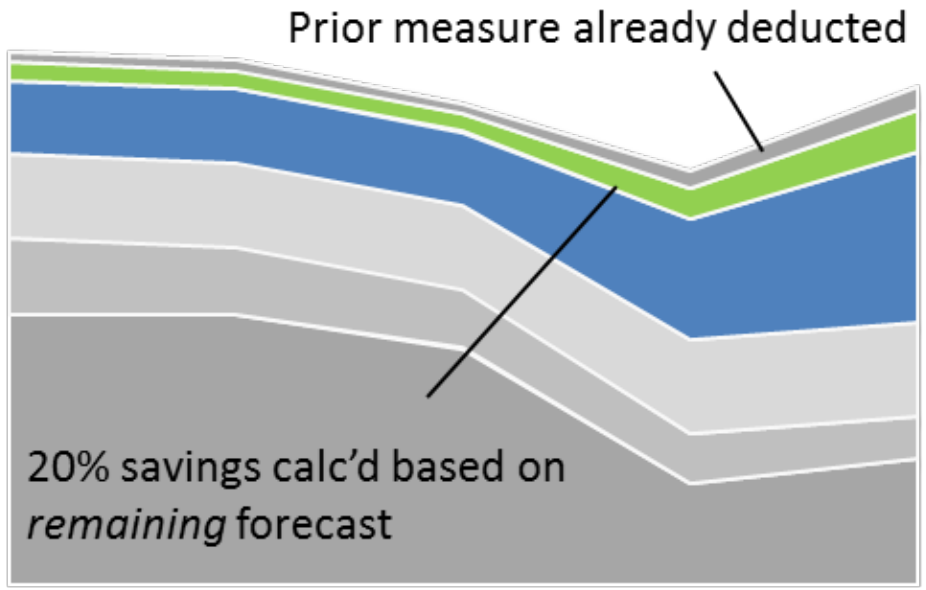
Modeling Overview

5. Next most cost-effective measure applied *to remaining forecast only*

Non-equipment Measure NN102:

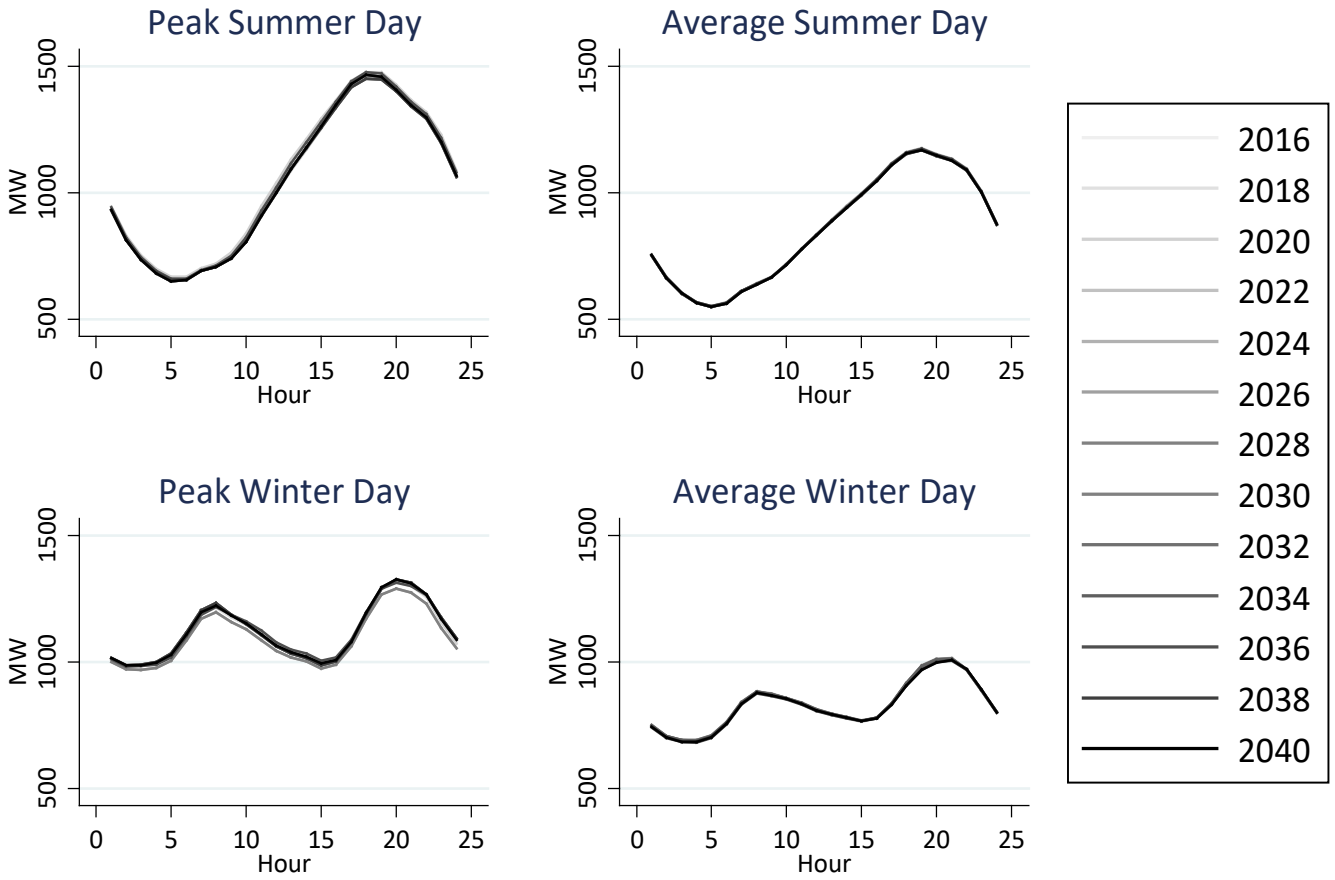
High Efficiency Dishwasher, single family, new construction

- Savings: 20%
- TRC Ratio: 1.1



Defining System Peak

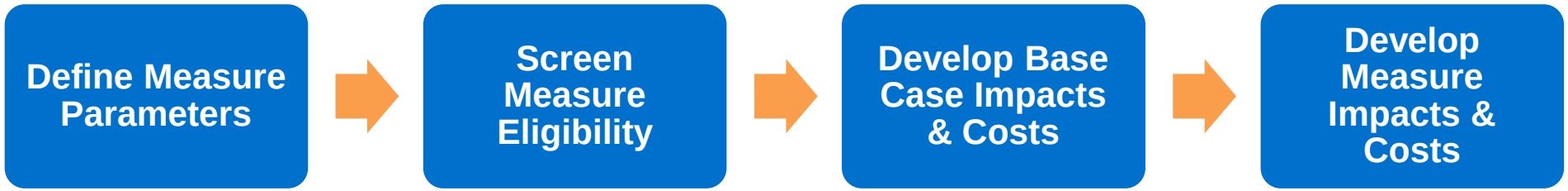
- **Analyze hourly system load forecast to determine how the system load shape is expected to change over the study horizon**
- **Potential shifts include:**
  - Change in peak hour
  - Change in peak season (e.g. summer to winter)
- **Look at differences between summer/winter shapes:**
  - Smooth S-shaped pattern in summer with peak hours in late afternoon/early evening
  - Bi-modal winter shape
- **Additional analysis also done to determine utility "peakiness" and seasonal/hourly distribution of peak loads**



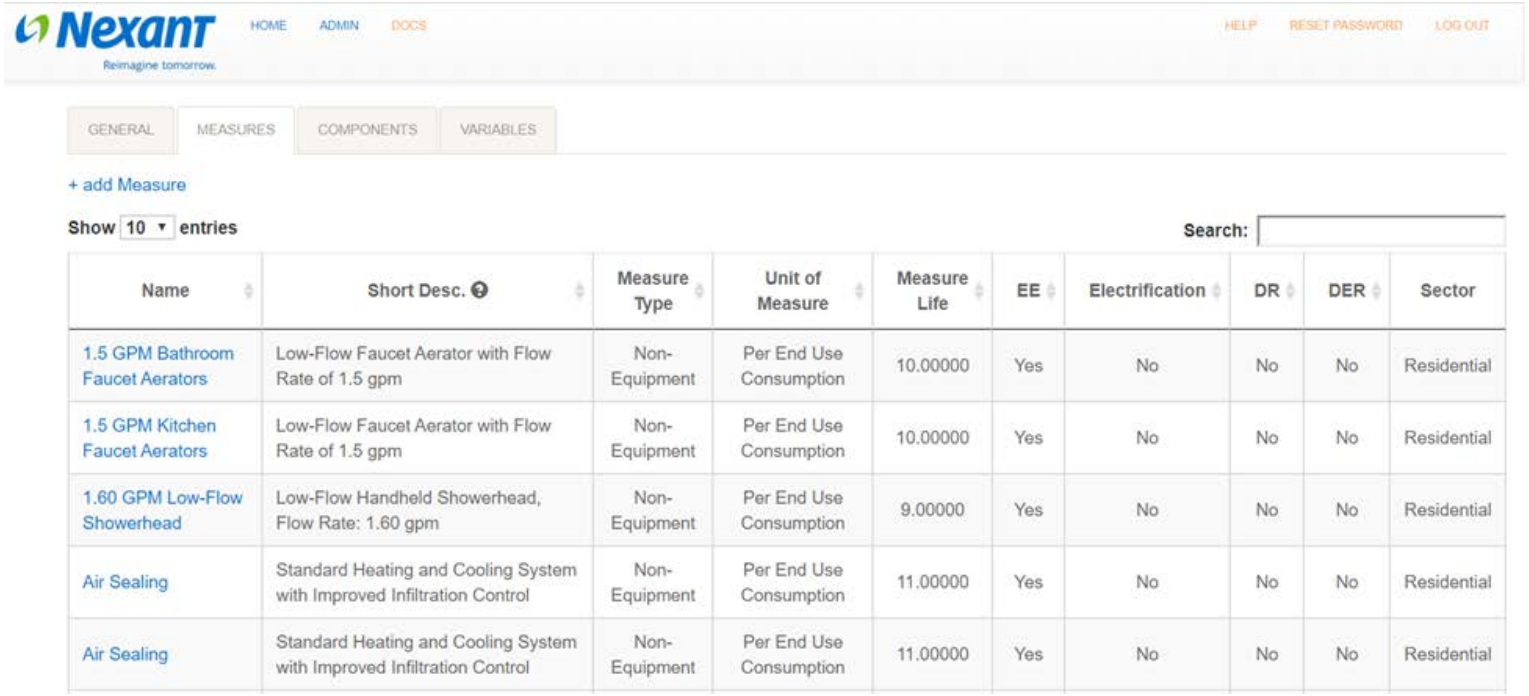
Measure Development

Measure Research Steps

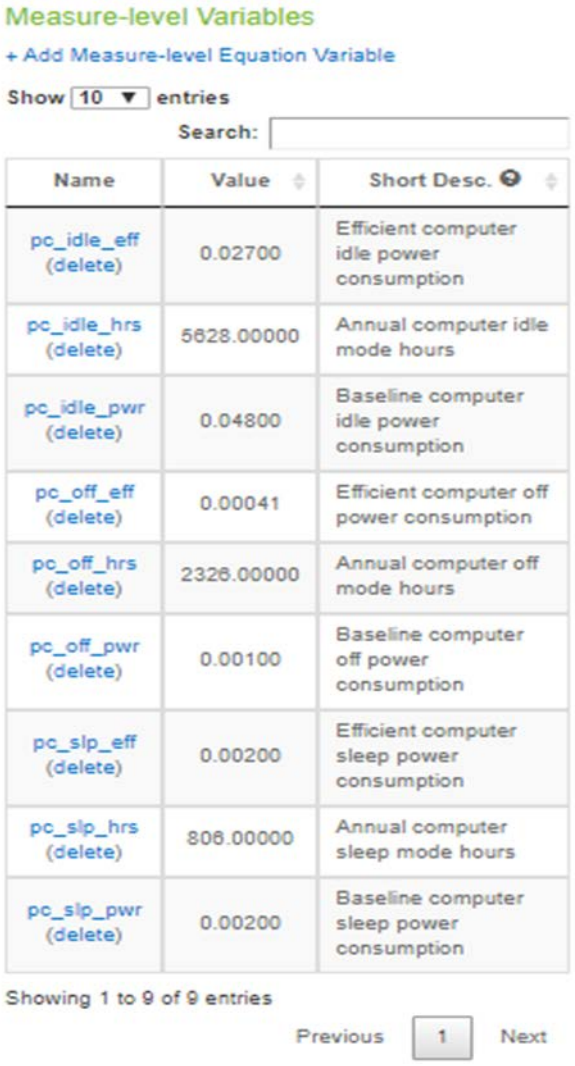
- **Measure data required:**
  - Efficient and baseline technology characteristics
  - Equipment and labor costs
  - Equipment useful life
  - Energy and demand savings
  - Applicability and current saturation
- **Measure sources:**
  - Existing DEI program measures
  - Regional TRMs
  - Nexant measure library
  - OSB inputs
  - Custom measures and new technologies



Measure Library



Name	Short Desc.	Measure Type	Unit of Measure	Measure Life	EE	Electrification	DR	DER	Sector
1.5 GPM Bathroom Faucet Aerators	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Non-Equipment	Per End Use Consumption	10.00000	Yes	No	No	No	Residential
1.5 GPM Kitchen Faucet Aerators	Low-Flow Faucet Aerator with Flow Rate of 1.5 gpm	Non-Equipment	Per End Use Consumption	10.00000	Yes	No	No	No	Residential
1.60 GPM Low-Flow Showerhead	Low-Flow Handheld Showerhead, Flow Rate: 1.60 gpm	Non-Equipment	Per End Use Consumption	9.00000	Yes	No	No	No	Residential
Air Sealing	Standard Heating and Cooling System with Improved Infiltration Control	Non-Equipment	Per End Use Consumption	11.00000	Yes	No	No	No	Residential
Air Sealing	Standard Heating and Cooling System with Improved Infiltration Control	Non-Equipment	Per End Use Consumption	11.00000	Yes	No	No	No	Residential



Name	Value	Short Desc.
pc_idle_eff (delete)	0.02700	Efficient computer idle power consumption
pc_idle_hrs (delete)	5628.00000	Annual computer idle mode hours
pc_idle_pwr (delete)	0.04800	Baseline computer idle power consumption
pc_off_eff (delete)	0.00041	Efficient computer off power consumption
pc_off_hrs (delete)	2328.00000	Annual computer off mode hours
pc_off_pwr (delete)	0.00100	Baseline computer off power consumption
pc_slp_eff (delete)	0.00200	Efficient computer sleep power consumption
pc_slp_hrs (delete)	806.00000	Annual computer sleep mode hours
pc_slp_pwr (delete)	0.00200	Baseline computer sleep power consumption

Technical Potential

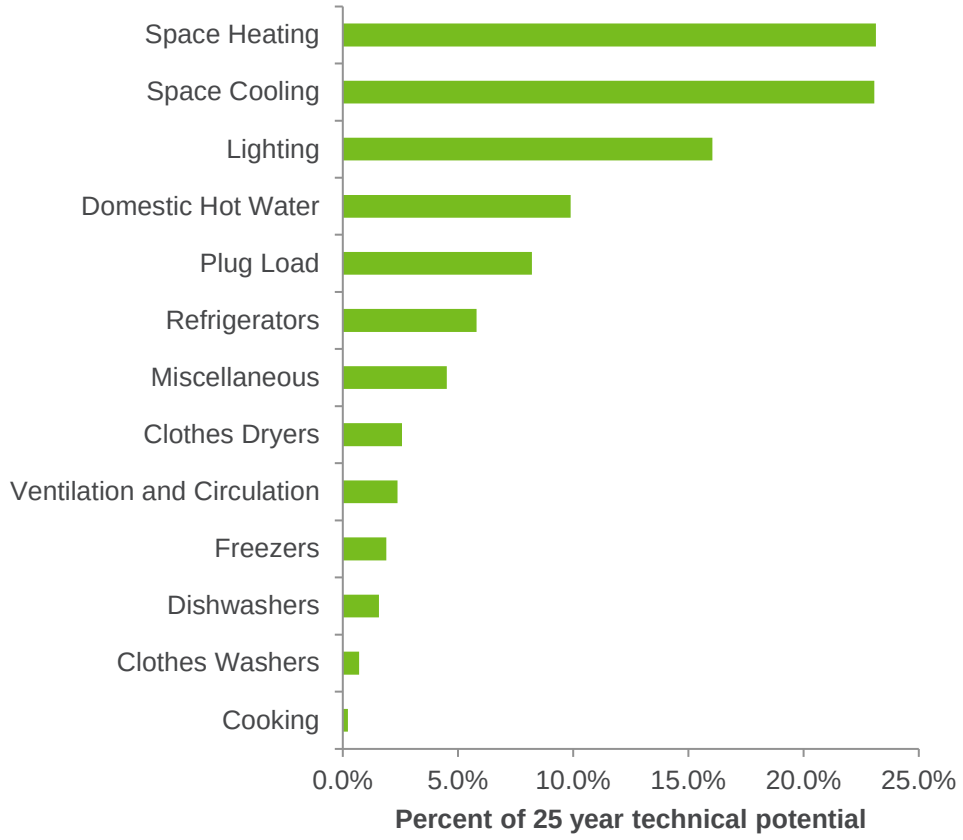
End use EE technical potential – 2018 DEI MPS

Cumulative technical potential is led by lighting, space cooling, and space heating

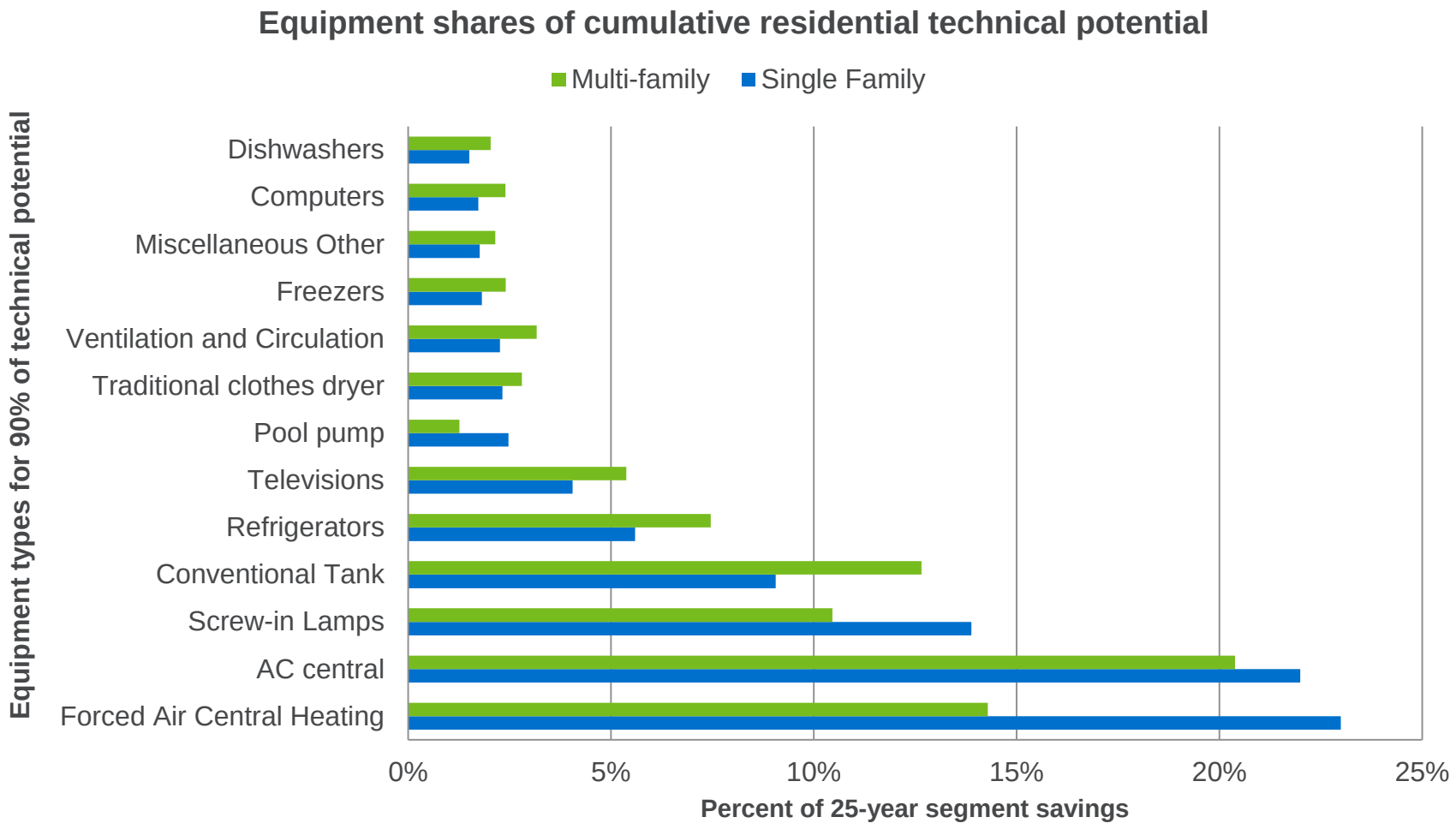
Estimated savings in 2041

2041 Cumulative technical potential – DEI	MWh	% of Savings
Cooking	7,829	0.2%
Clothes Washers	24,499	1%
Dishwashers	53,670	2%
Freezers	64,486	2%
Ventilation and Circulation	81,066	2%
Clothes Dryers	87,962	3%
Miscellaneous	154,375	5%
Refrigerators	198,672	6%
Plug Load	280,509	8%
Domestic Hot Water	338,310	10%
Lighting	548,348	16%
Space Cooling	788,498	23%
Space Heating	791,081	23%

DEI technical cumulative potential by residential end use



EE technical potential – DEI high impact equipment types (2018 DEI MPS)



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Economic Potential

Economic Potential

- **Measure screening criterion: UCT**
- **Benefits:**
  - Avoided fuel costs, bill savings, etc.
  - Avoided costs, bill savings, and lost revenue calculated for each measure permutation via DSMore
- **Costs**
  - Need to estimate incentive rates and program costs for each measure to screen
  - General program archetypes, not specific program plans
- **Application in model**
  - Measures ranked by BCR

DSM Program Assessment and Achievable Potential

DSM Program Assessment

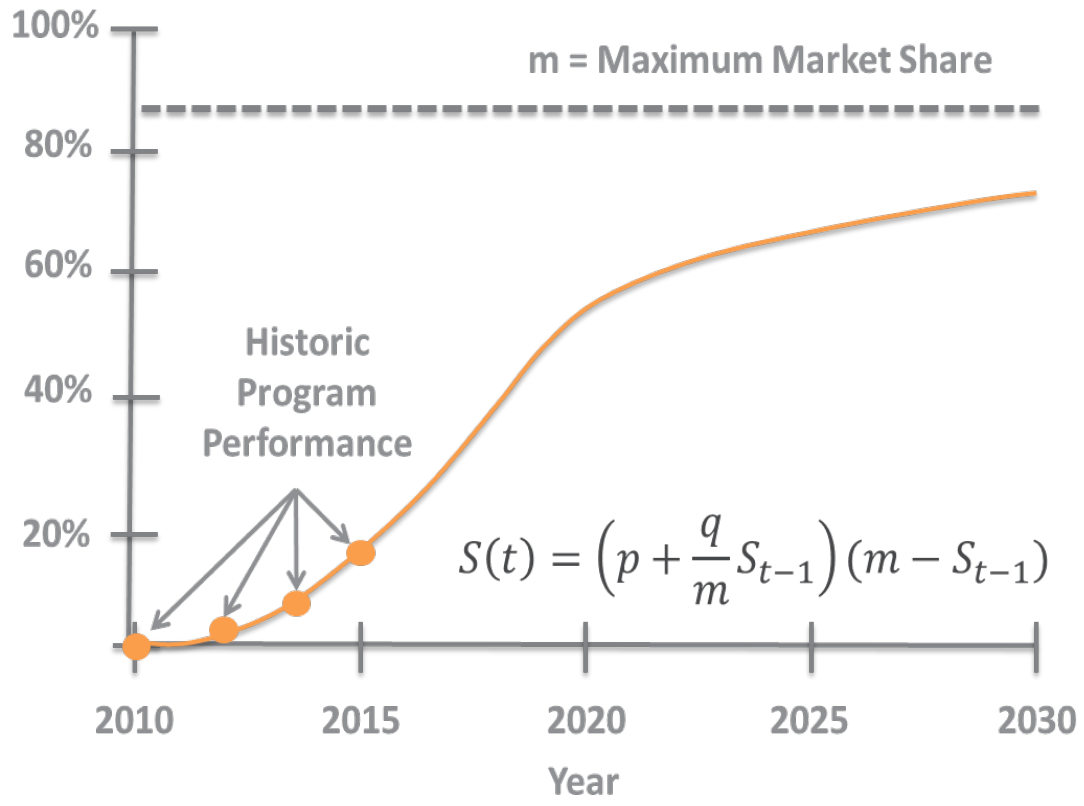
- Review historic program offerings, participation trends, and compile EM&V results
- Discuss historic program accomplishments and future program goals with Duke Energy program staff
- Program gap analysis
- Measure bundling and updated program concepts

Achievable Potential Assumptions

- Achievable program potential is a subset of the market and reflects market conditions
- Duke Energy has been offering programs for 10+ years; managing program lifecycle: assess, design, evaluate, respond
- Duke Energy pursues cost-effective EE savings with programs designed under UCT test
- Past program performance indicates market response to existing program offers
- Performance represents mature, managed programs in context of customers' preferences for EE tech, value of EE investment relative to opportunity costs
- Fundamental changes in program performance will not occur absent changes to underlying preferences, market conditions
- Incremental changes to program delivery produce incremental changes in participation

Adoption Scenarios

- Product diffusion theory[1]
- Market data from across North America
- Duke Energy program performance
- Program concept updates



[1]Bass, F. 2004. Comments on "A New Product Growth for Model Consumer Durables the Bass Model" (sic). Management Science 50 (12_supplement): 1833-1840. http://pubsonline.informs.org/doi/abs/10.1287/mnsc.1040.0300. Accessed 01/14/2016.
Buskirk, R. 2014. Estimating Energy Efficiency Technology Adoption Curve Elasticity with Respect to Government and Utility Deployment Program Indicators. LBNL Paper 6542E. Sustainable Energy Systems Group, Environmental Energy Technologies Division. Ernest Orlando Lawrence Berkeley National Laboratory. http://escholarship.org/uc/item/2vp2b7cm#page-1. Accessed 01/14/2016.

Residential AP Enhanced (Measures) - Savings by End Use

End Use	Year 25 Cumulative (kWh)	Share (%)
Residential Domestic Hot Water	306,990,607	41.15%
Residential Space Cooling	130,591,442	22.58%
Residential Space Heating	130,671,890	22.59%
Residential Miscellaneous	98,109,370	16.96%
Lighting	18,762,593	3.24%
Refrigerators	18,923,375	3.27%
Plug Load	14,858,950	2.57%
Clothes Dryers	9,348,276	1.62%
Residential Ventilation and Circulation	7,614,993	1.32%
Freezers	3,995,411	0.69%
Residential Cooking	2,864,275	0.50%
Clothes Washers	2,064,076	0.36%
Dishwashers	1,144,185	0.20%
Total	745,939,443	

Residential AP Enhanced (Measures) - Top 20 Measures Year 1

Measure Name	Incremental (kWhs)	Share (%)
Behavior Modification Home Energy Reports	52,199,580	47%
ENERGY STAR LED, 6W_Halogen Baseline	7,867,467	7%
Energy Star LED, 9W_Halogen Baseline	5,974,099	5%
Energy Star LED, 13W_Halogen Baseline	5,372,962	5%
ECM Motor	4,663,574	4%
Energy Efficiency Education in Schools	4,107,556	4%
Energy Star LED Directional Lamp	4,004,898	4%
Energy Star LED, 9W_Incandescent Baseline	3,186,819	3%
Energy Star LED, 13W_Incandescent Baseline	3,059,908	3%
ENERGY STAR LED, 6W_Incandescent Baseline	2,096,237	2%
Variable Speed Pool Pump Motors	2,094,636	2%
Smart Thermostat	2,069,418	2%
Specialty Behavior Modification Home Energy Reports	1,392,233	1%
Residential New Construction Tier 3 (30% more efficient)	1,132,544	1%
Energy Star Central AC - 15 SEER	824,596	1%
Heat Pump Water Heater 50Gallons	778,527	1%
Residential New Construction Tier 2 (20% more efficient)	768,321	1%
Energy Star Central AC - 16 SEER	722,024	1%
Behavior Modification Home Energy Reports - Active Engagement	675,501	1%
Filter Whistle	641,743	1%

Residential AP Enhanced (Measures) - Top 20 Measures Year 5

Measure Name	Incremental (kWhs)	Share (%)
Behavior Modification Home Energy Reports	53,687,598	57%
RealTime Information Monitoring	5,416,354	6%
Energy Efficiency Education in Schools	4,151,325	4%
Heat Pump Water Heater 50Gallons	3,903,556	4%
Smart Thermostat	3,618,547	4%
Variable Speed Pool Pump Motors	2,842,914	3%
ECM Motor	2,163,750	2%
Energy Star LED Directional Lamp	1,918,329	2%
Specialty Behavior Modification Home Energy Reports	1,431,920	2%
Energy Star Central AC - 15 SEER	1,089,978	1%
ENERGY STAR LED, 6W_Halogen Baseline	989,145	1%
Energy Star LED, 13W_Halogen Baseline	964,190	1%
Energy Star LED, 9W_Halogen Baseline	948,728	1%
Energy Star Central AC - 16 SEER	946,576	1%
Behavior Modification Home Energy Reports - Active Engagement	694,758	1%
Filter Whistle	670,355	1%
Programmable Thermostat	625,289	1%
Air Sealing	584,216	1%
Energy Star Central AC - 18 SEER	557,195	1%
Energy Star LED, 13W_Incandescent Baseline	459,393	0%

Residential AP Enhanced (Measures) - Top 20 Measures Year 10

Measure Name	Incremental (kWhs)	Share (%)
Behavior Modification Home Energy Reports	55,903,068	56%
RealTime Information Monitoring	10,533,173	11%
Heat Pump Water Heater 50Gallons	8,414,784	8%
Energy Efficiency Education in Schools	4,310,996	4%
Variable Speed Pool Pump Motors	3,091,553	3%
Smart Thermostat	2,945,902	3%
Specialty Behavior Modification Home Energy Reports	1,491,010	1%
Energy Star Central AC - 15 SEER	1,201,401	1%
Air Sealing	1,178,258	1%
Energy Star Central AC - 16 SEER	1,042,148	1%
ASHP 23.5 SEER from Electric Resistance	909,421	1%
ASHP 15 SEER from Electric Resistance	832,225	1%
Duct Sealing	831,976	1%
ASHP 14 SEER from Electric Resistance	779,560	1%
Behavior Modification Home Energy Reports - Active Engagement	723,429	1%
Heat Pump Water Heater 80 Gallons	713,403	1%
Energy Star Central AC - 18 SEER	612,830	1%
Energy Star Doors	564,288	1%
Ceiling Insulation R-49	544,291	1%
Smart Meter Usage App	532,399	1%

Residential AP Enhanced (Measures) - Top 20 Measures Year 25

Measure Name	Incremental (kWhs)	Share (%)
Behavior Modification Home Energy Reports	67,800,703	54%
Heat Pump Water Heater 50Gallons	19,813,991	16%
RealTime Information Monitoring	13,284,894	11%
Energy Efficiency Education in Schools	5,202,011	4%
Variable Speed Pool Pump Motors	3,745,493	3%
ASHP 23.5 SEER from Electric Resistance	2,152,900	2%
ASHP 15 SEER from Electric Resistance	1,904,680	2%
Specialty Behavior Modification Home Energy Reports	1,808,335	1%
ASHP 14 SEER from Electric Resistance	1,780,305	1%
Energy Star Central AC - 15 SEER	1,528,011	1%
Heat Pump Water Heater 80 Gallons	1,496,311	1%
Smart Meter Usage App	1,390,724	1%
Energy Star Central AC - 16 SEER	1,325,366	1%
Behavior Modification Home Energy Reports - Active Engagement	877,395	1%
Energy Star Central AC - 18 SEER	779,323	1%
Energy Star ASHP, 18.5 SEER, 10.2 HSPF	403,426	0%
Air Sealing	186,613	0%
Energy Star ASHP, 16 SEER, 9.0 HSPF	167,218	0%
Duct Sealing	132,639	0%
Home Energy Management System	128,925	0%

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