

AB802 TECHNICAL ANALYSIS

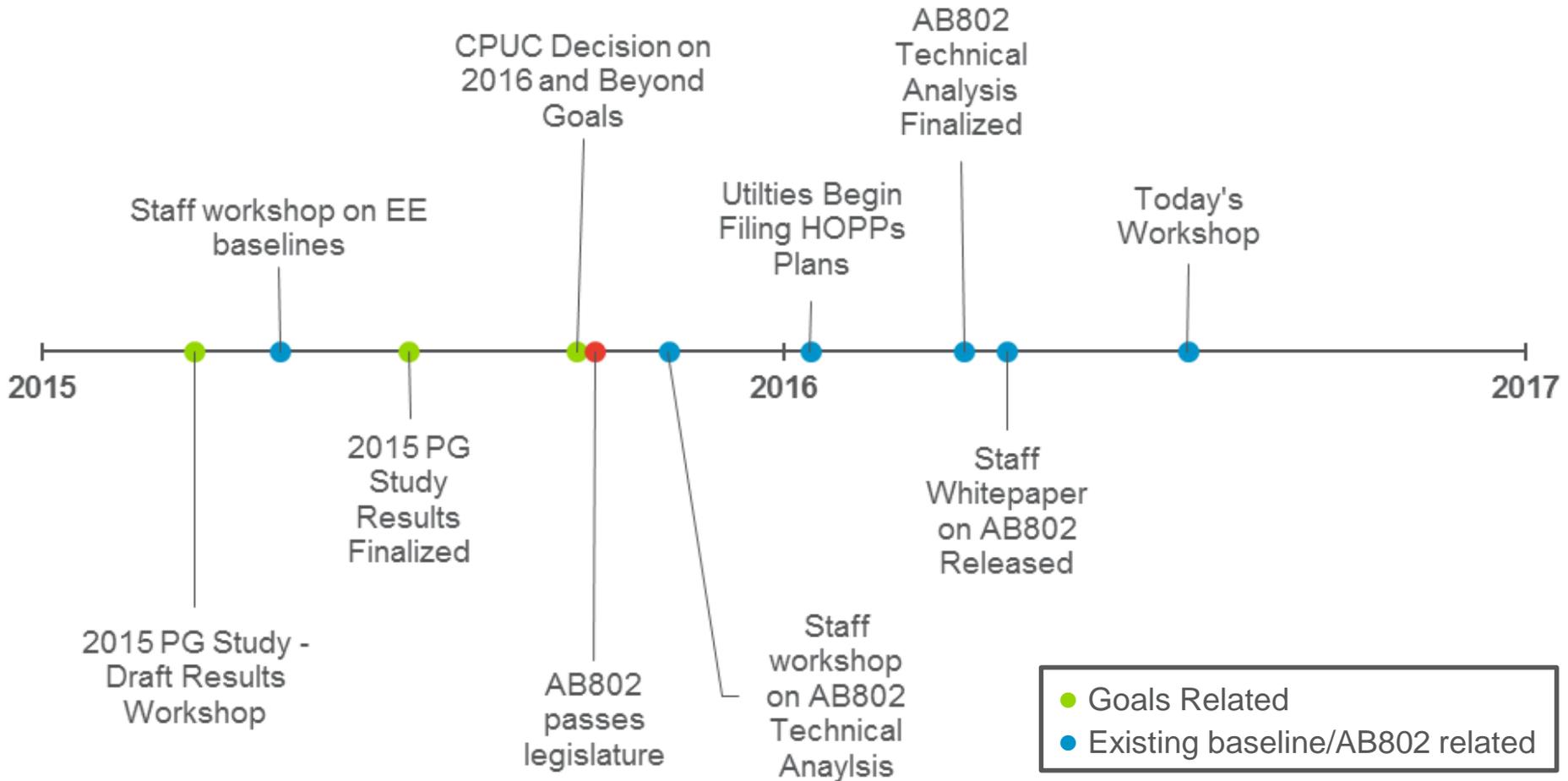
OVERVIEW OF STUDY AND RESULTS

NAVIGANT

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RECENT HISTORY OF THE POTENTIAL STUDY



AB802 – RELEVANT BILL LANGUAGE

*“the commission... shall, by September 1, 2016, authorize electrical corporations or gas corporations to provide financial incentives, rebates, technical assistance, and support to their customers to increase the energy efficiency of existing buildings **based on all estimated energy savings and energy usage reductions, taking into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings.** Those programs shall include energy usage reductions resulting from the adoption of a measure or installation of equipment required for modifications to existing buildings to bring them into conformity with, or exceed, the requirements of Title 24 of the California Code of Regulations, **as well as operational, behavioral, and retrocommissioning activities** reasonably expected to produce multiyear savings.”*

SCOPE OF THE AB802 TECHNICAL ANALYSIS (TA)

- **Preliminary** technical analysis of AB802's impact on EE potential
- Used to inform Commission staff white paper

- Overall direction:
 - Develop nomenclature required to categorize and define below-code savings
 - Develop a robust modeling methodology to serve as the basis to forecast below code savings
 - Consider if all below-code savings truly incremental or is a portion already counted elsewhere
 - Continue to use the same measures from the 2015 PG study
 - Collect as much reliable secondary data to inform a preliminary forecast
 - Identify additional Operational Efficiency savings
 - Test the new methodology and develop a **preliminary** forecast of the amount of additional EE potential that could be captured due to AB802.
 - Identify data gaps and areas for further research

SCOPE OF THE AB802 TECHNICAL ANALYSIS

- Includes above-code savings from all sectors
- Adds new savings in select areas due to AB802
- Updated methodology becomes the basis for next PG Study

Added Savings from AB802

Residential and Commercial “To Code” Equipment Upgrades

Commercial Operational Efficiency & Behavior

Res & Com
HVAC
Equipment

Commercial
Lighting

Res & Com
Water Heating
Equipment

Lighting
Controls

Building
Energy
Management

Tenant
Engagement

WHAT WAS OUT OF SCOPE?

- To-code savings from Industrial and Agriculture measures
 - CPUC staff interpreted AB802 to only cover the residential and commercial sector
- Certain below-code savings opportunities couldn't be captured as we were limited in our measure list:
 - Commercial and Residential building shell measures
 - Commercial refrigeration equipment
- Impacts of code compliance enhancement programs resulting from AB802
 - CPUC evaluations show limited data to substantiate compliance enhancement impacts

ILLUSTRATION OF SAVINGS CATEGORIES

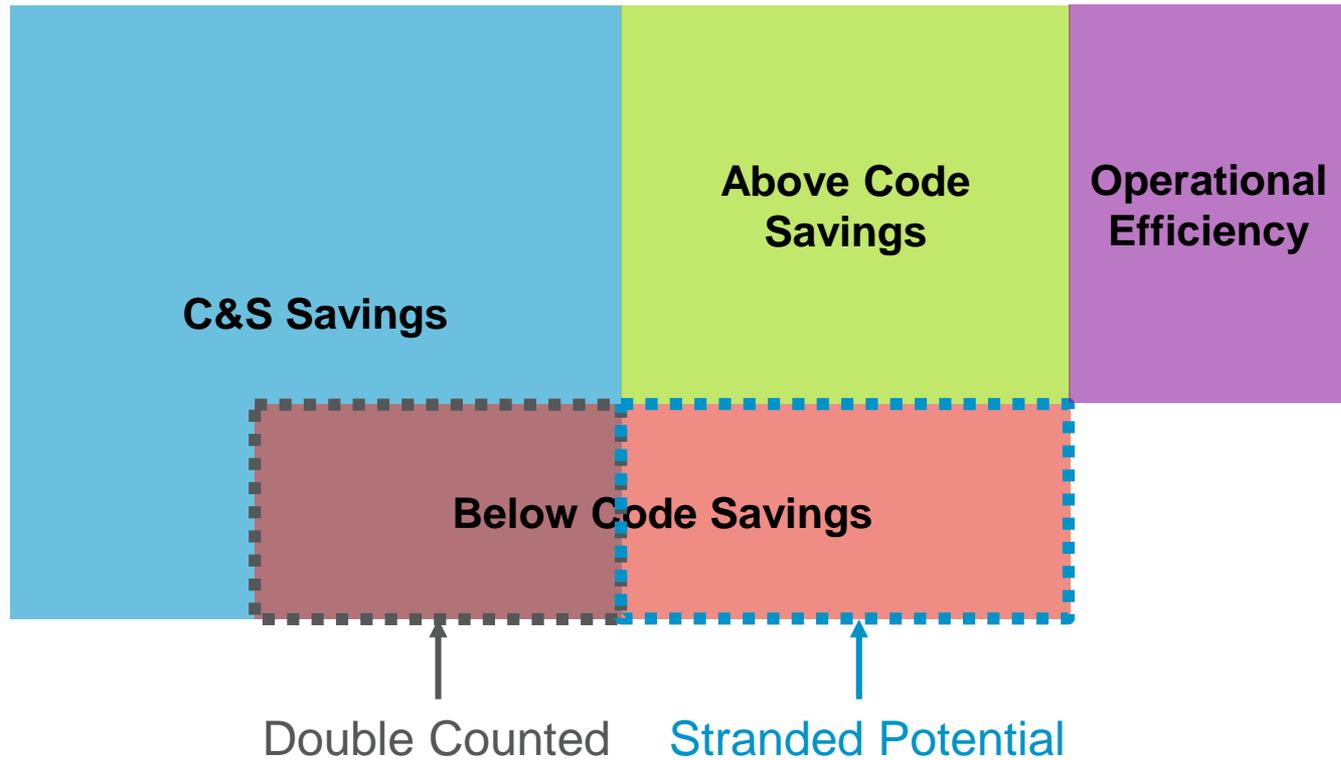


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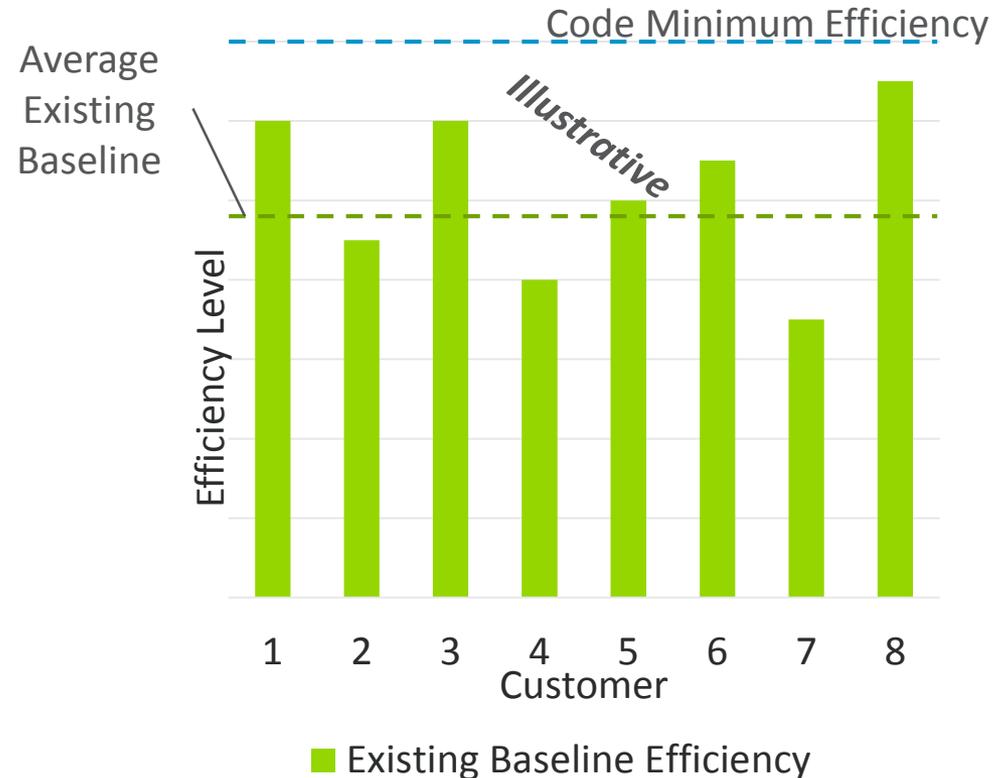
EXISTING CONDITIONS BASELINE DEFINITION

Term	Definition	Precedent
Code* Baseline	Minimum level of efficiency required for new units that go into service	Set by the governing regulatory body or other industry standards
Existing Conditions Baseline	Level of efficiency of units going out of service (being replaced by new units)	A range set by historical markets and is generally a mix of technologies below current code.

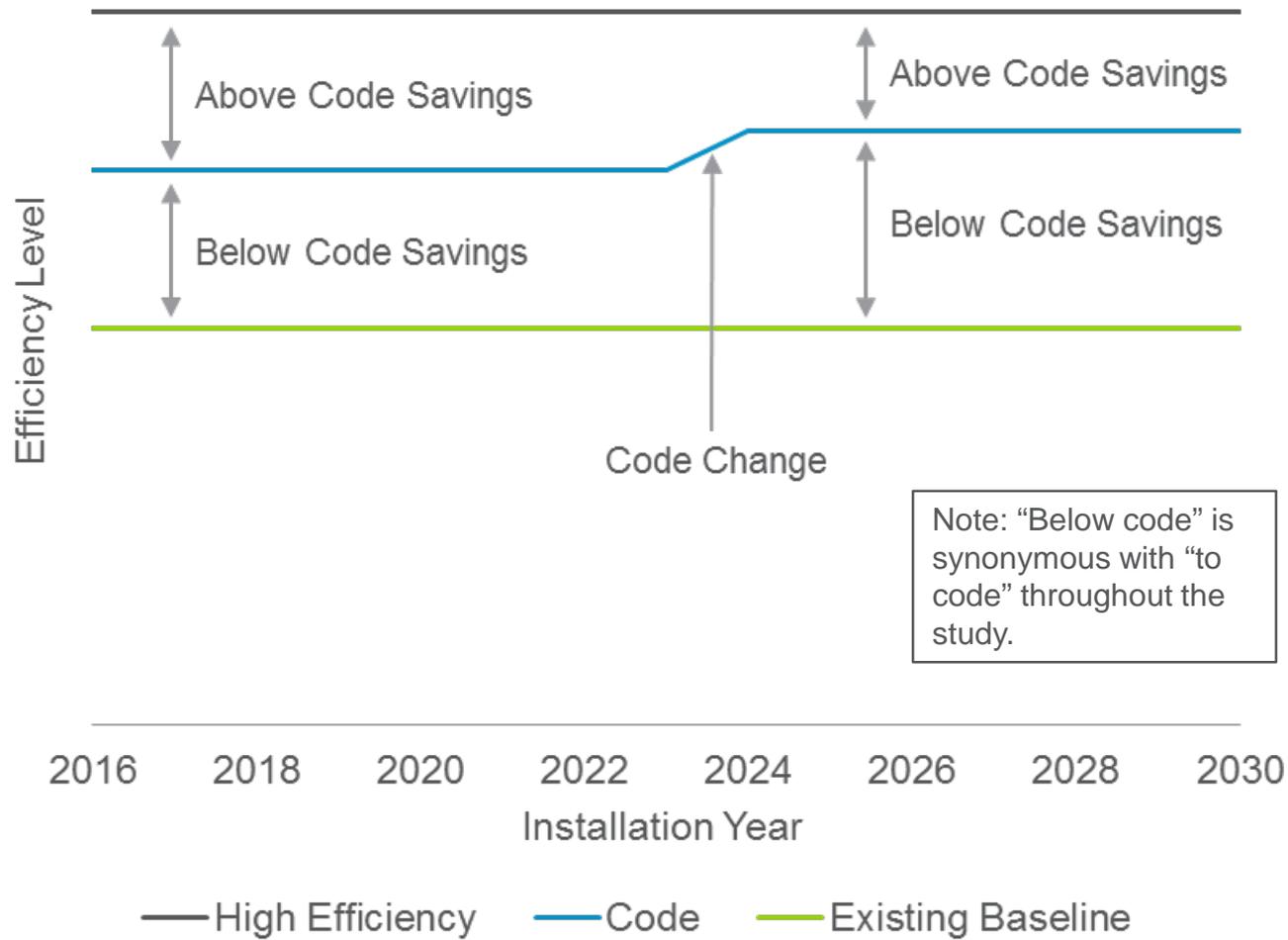
*Note: “Code” is used as a short form to mean either building code or appliance standard.

EXISTING CONDITIONS BASELINE DEFINITION

- In the real world:
 - Each customer has a different existing condition of equipment
 - Each customer has different energy savings
- For planning purposes:
 - Existing conditions baseline must be defined as an average for the market
 - Need a single energy savings value for each measure
- Similar to a “deemed savings” approach for planning purposes



MORE BELOW CODE SAVINGS AS C&S BECOMES MORE STRINGENT



DEFINITION OF STRANDED POTENTIAL

- Below-code savings that is not materializing in the market because there is no incentive for the customer to upgrade existing equipment.
- Opportunities for EE that are not currently captured by rebate programs or C&S.
- Utilities offering rebates for bringing existing equipment up to code motivate a whole new subset of customers to install EE measures and thus capture the Stranded Potential.
- Certain measures offer truly incremental, stranded potential.

Important note: Capturing stranded potential means removing functional equipment from the market.

CATEGORIES OF MEASURES

Universe of Measure Installation Categories

Installations
in New
Construction

Installations in Existing Buildings

Above Code
or Standard
Equipment
Installation

Replace on
Burnout
Equipment

Repair
Eligible
Equipment

Retrofit
Add-On

Retrofit
Replacement

Stranded Potential lies here

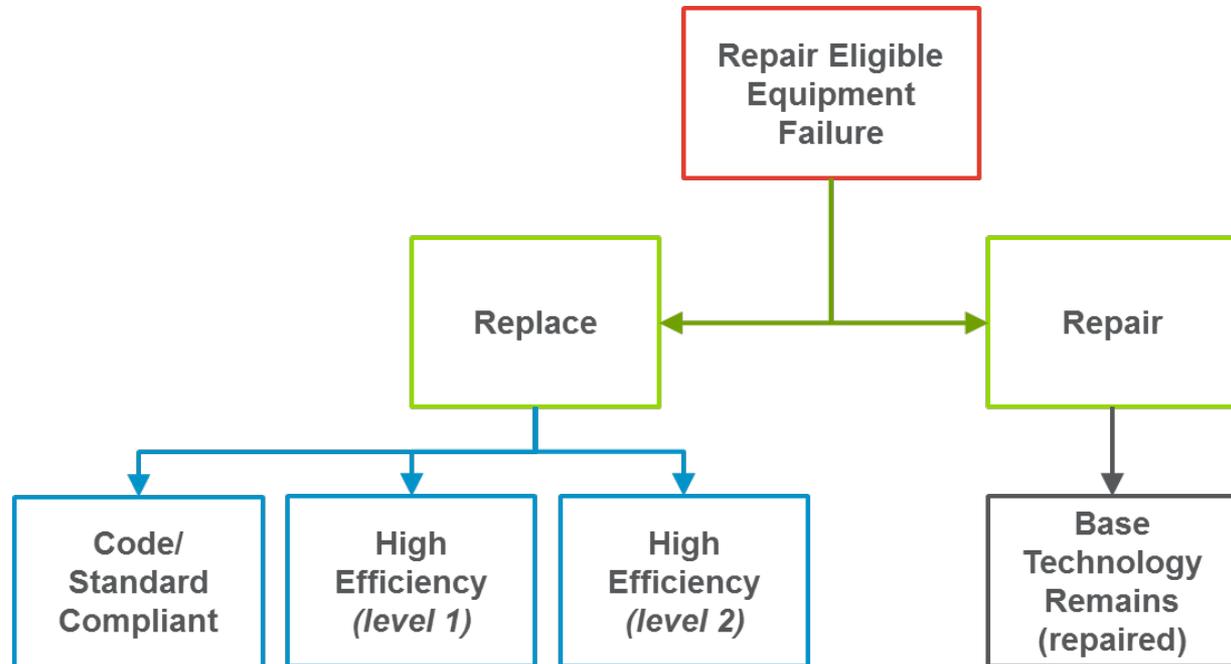
STRANDED POTENTIAL METHODOLOGY

- Stranded potential lies in two categories of measures:
 - Repair Eligible - customers have been repairing equipment at a low cost rather than replacing when it fails
 - Retrofit Replacement - no catastrophic system failure that triggers the customer to repair or replace the entire system

Equipment Fails

Decision 1: Repair/Replace

Decision 2: Replace With?



RESIDENTIAL MEASURE CATEGORIES

Measure Classification	End Use Category	End Use Sub-Category
Equipment – Replace on Burnout	Plug Loads & Appliances	Dishwasher Laundry Refrigeration PC/Monitors
	Indoor/Outdoor Lighting	Lamps
	Recreation	Pool Pumps
Equipment – Repair Eligible	HVAC	Space Heating Space Cooling
	Service Hot Water	Water Heaters/Boilers
Retrofit Add-On	Building Envelope	Window Film
	HVAC	Ventilation
	Service Hot Water	Boiler Controls
Retrofit Replacement	Plug Loads & Appliances	Smart Strips Appliance Recycling
	Building Envelope	Insulation
	HVAC	Duct Sealing/Repair
	Indoor/Outdoor Lighting	Fixtures/Ballast Controls

COMMERCIAL MEASURES CATEGORIES

Measure Classification	End Use Category	End Use Sub-Category
Equipment – Replace on Burnout	Plug Loads & Appliances	Office Equipment
	Food Service Equipment	Cooking Equipment
	Indoor/Outdoor Lighting	Screw in Lamps
Equipment – Repair Eligible	HVAC	Space Heating, Space Cooling Chillers
	Service Hot Water	Water Heating/Boilers
Retrofit Add-On	Building Envelope	Window Film
	Plug Loads & Appliances	Vending Machine Controller Office Equipment
	Commercial Refrigeration	Add On Controllers, VSD's, Doors, ASH, etc.
	Process Heat/Refrigeration	Variable Frequency Drive
	HVAC	Space Cooling, Ventilation, Controls, Energy Management Systems
	Service	HVAC Quality Maintenance Retro-Commissioning
Retrofit Replacement	Building Envelope	Insulation
	HVAC	Duct Sealing/Repair
	Indoor/Outdoor Lighting	Fixtures/Ballast Controls
	Service Hot Water	Distribution (Insulation)

STRANDED POTENTIAL – MEASURE DATA COLLECTION

Two data collection efforts supported the AB802 TA

1. Identify the efficiency level of existing equipment

- Focused on equipment that is at and older than its measure EUL
- Two methods:
 - Market data - Average efficiency level from saturation/market studies
 - C&S Approach – “What was the code/standard minimum efficiency 1 EUL ago?”

2. Additional data for Repair Eligible Measures

- Stranded Equipment Saturation - fraction of equipment in the market that is beyond it's EUL
- Repair Cost – Typical cost to repair equipment when a component fails
- Repair Life – Additional lifetime that the repair offers

Full list of assumption documented in the report

REPAIR ELIGIBLE EQUIPMENT SATURATION

- Fraction of equipment in the existing marketing that is beyond its useful life
- Data not available by building type, though we hypothesize there are differences

Measure Type	Sector	Stranded Equipment Saturation	Source
Split AC	Residential	17%	CLASS
Split HP	Residential	14%	CLASS
Furnace	Residential	10%	CLASS
Electric Water Heating	Residential	3%	CLASS
Gas Water Heating	Residential	5%	CLASS
Split AC	Commercial	25%	CSS
Split HP	Commercial	17%	CSS
Package AC	Commercial	33%	CSS
Package HP	Commercial	41%	CSS
Boilers	Commercial	77%	CaITF
Chillers	Commercial	77%	Navigant Assumption (Same as Boilers)
Furnace	Commercial	24%	CSS
Electric Water Heating	Commercial	25%	Navigant Assumption
Gas Water Heating	Commercial	25%	Navigant Assumption

UTILITY REBATE ASSUMPTIONS

- Modeled a tiered incentive approach in which incentives are set based on estimated first year savings (kWh and therms).
- A cap is also set such that incentives do not exceed 50% of the equipment's incremental cost.

Residential	To-Code Rebate	Above-Code Rebate
Electric Savings	\$0.36/kWh	\$0.73/kWh
Gas Savings	\$6.07/Therm	\$12.14/Therm
Commercial	To-Code Rebate	Above-Code Rebate
Electric Savings	\$0.35/kWh	\$0.70/kWh
Gas Savings	\$3.37/Therm	\$6.73/Therm
Incentive Cap		
Percent of Incremental Cost	50%	

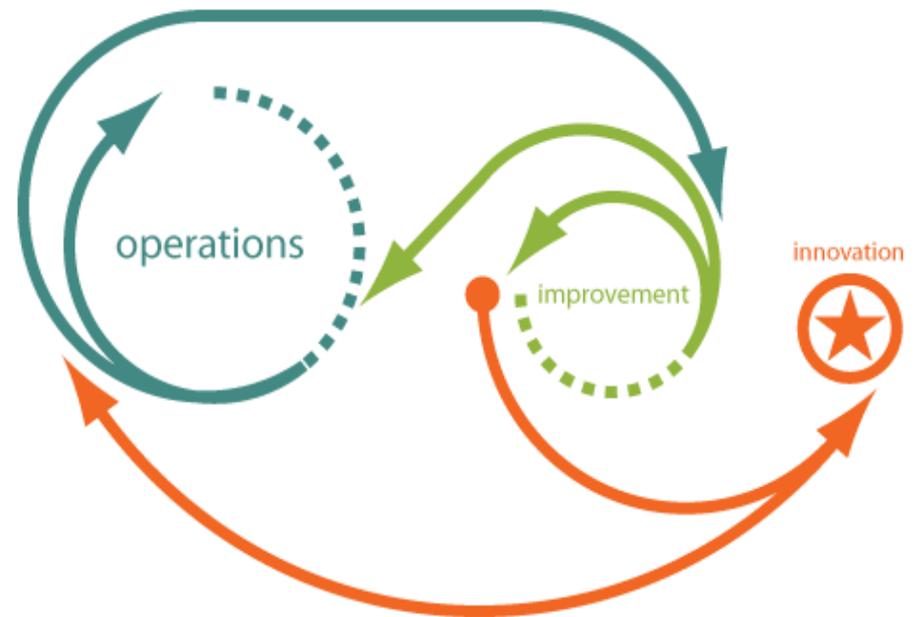
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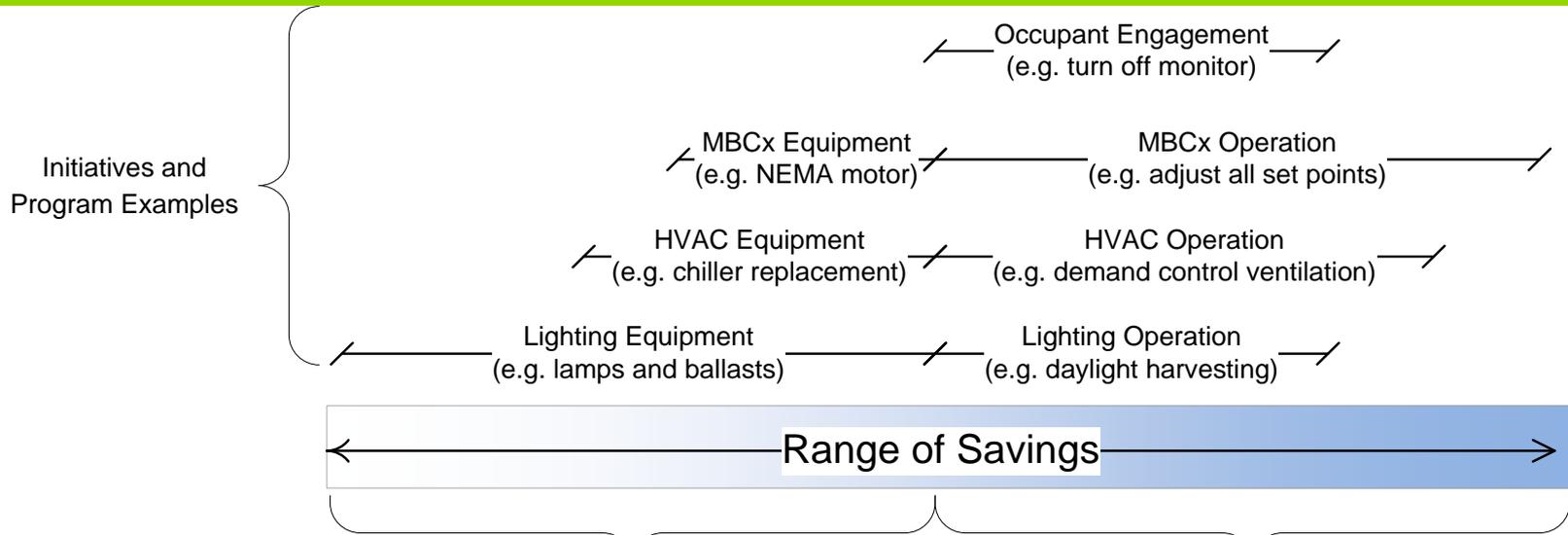
DEFINING OPERATIONAL EFFICIENCY

Operational efficiency (OE) is a system or building approach to energy savings, not necessarily at an individual measure level. Includes:

- Type 1 – Operator Behavior
- Type 2 – Autonomous Machine Control
- Type 3 – Building Tenant Engagement



THE OE PROGRAM ENVIRONMENT – A CONTINUUM OF OPPORTUNITIES



	Comparative	Equipment Selection	Equipment Operation
Relationship to Work		Doing the same work for less energy	Doing less work
Definition		Associated with 'efficiency'	Associated with 'conservation'
Fuel savings		Same operating duration at lower power	Different operating duration and / or variable power levels
Load shape impacts		Keeps load shape, but shifts it 'down'	Changes load shape
Organizational decisions		Purchasing decisions	Operating decision
Forecasting EE potential		Potential is estimated by modelling equipment stock turnover	Potential is calculated by estimating the average change in load profile
Nature of measure costs		Many projects require capital budgets	Most projects are expensed

OPERATIONAL EFFICIENCY METHODOLOGY

- Selected programs representative across continuum of Operational Efficiency:
 - HVAC/Lighting Operation – Building Operator Certification (already assessed in the 2015 Potential Study)
 - MBCx Operation – through broader enablement of existing energy management control system infrastructure
 - Lighting Operation – through broader enablement of existing lighting control infrastructure
 - Occupant Engagement – through various intervention strategies including tenant engagement efforts
- Approach:
 1. Understand the current market baseline in California
 2. Consider any code requirements
 3. Document savings per participant from existing studies
 4. Estimate annual program participation leveraging available data and professional judgement
 5. Estimate program costs leveraging available data and professional judgement

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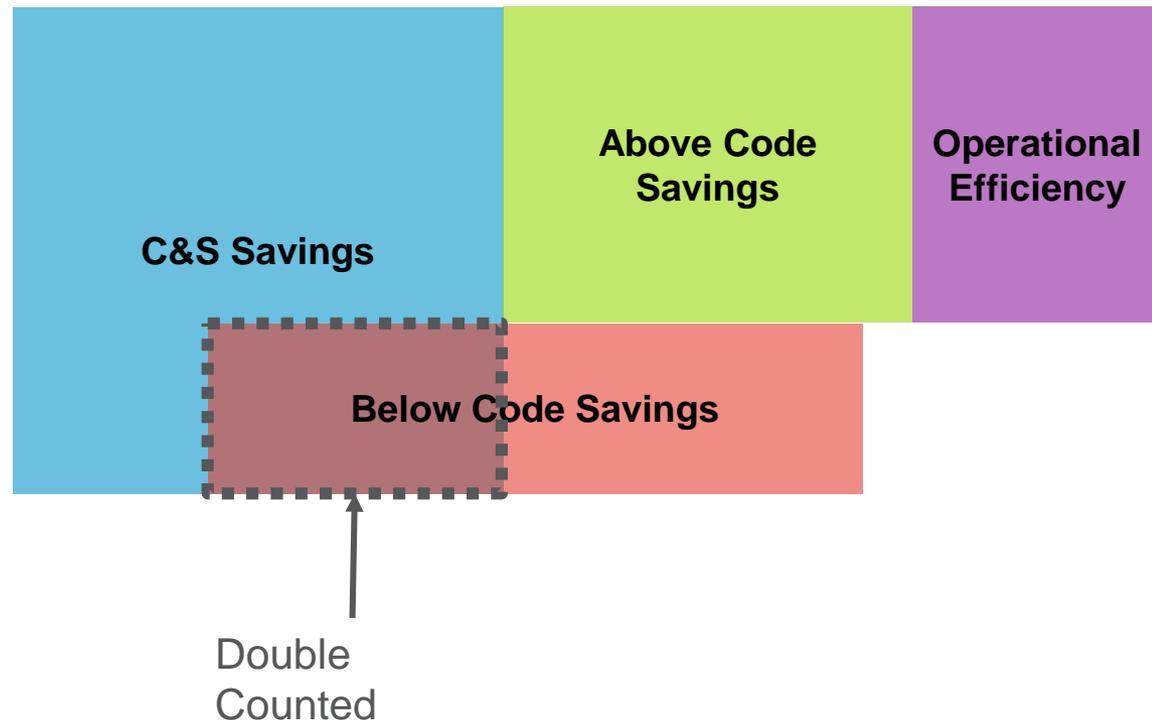
DEFINITION OF DOUBLE COUNTED SAVINGS

- Double Counted savings is:
 - Below-code savings generated from rebated equipment that would be realized even in the absence of rebate programs.
 - Equipment naturally turns over and is replaced with code-compliant equipment.
 - Already embedded and accounted for in the CEC Demand Forecast

Important note: Double counted savings means PAs claim below-code savings from equipment that fails, is no longer functional and has been replaced with new equipment.

DOUBLE COUNTED SAVINGS METHODOLOGY

- In an ideal world, double counted savings is zero
- Our goal was to understand the risk if policies are too open ended
- How much of the savings already being attributed to C&S is at risk of being double counted?
- Calculated top-down based on the savings expected from C&S



DOUBLE COUNTED SAVINGS METHODOLOGY

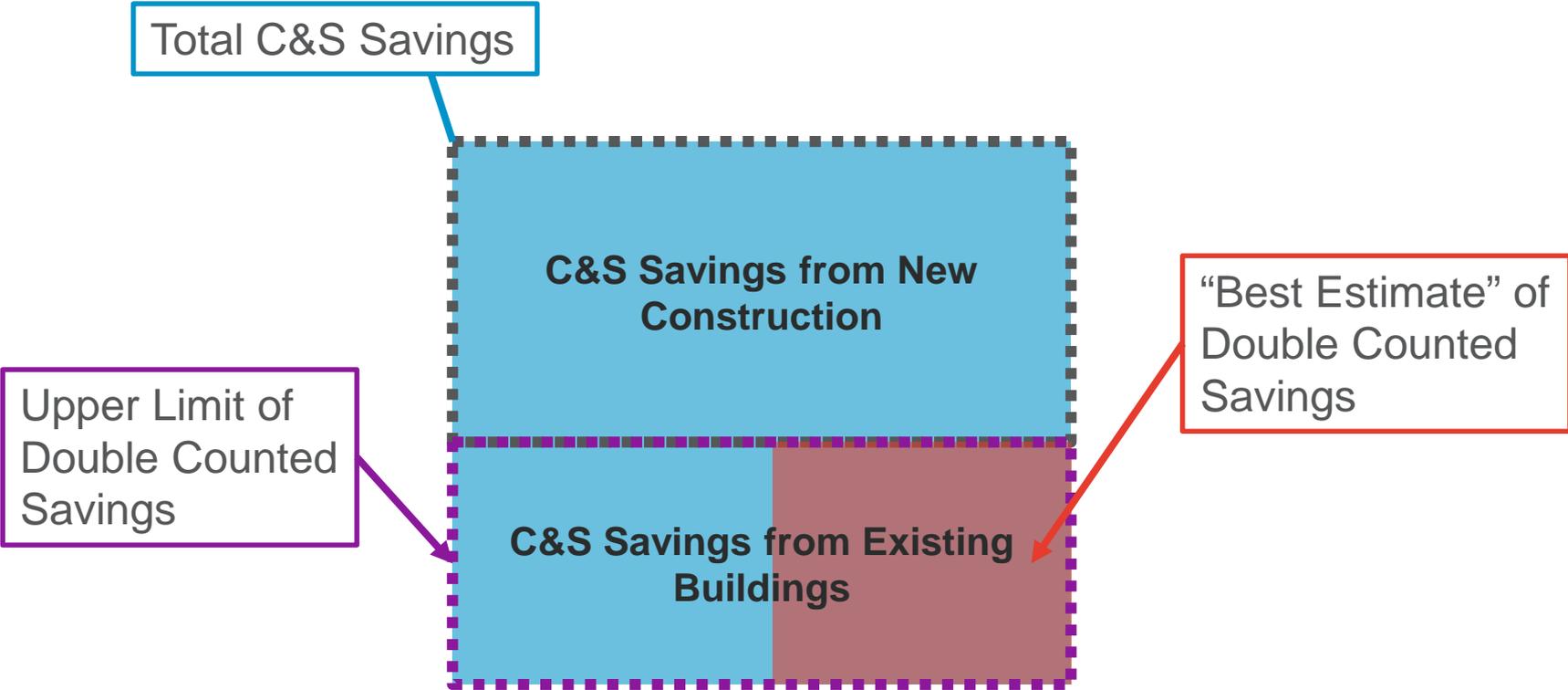
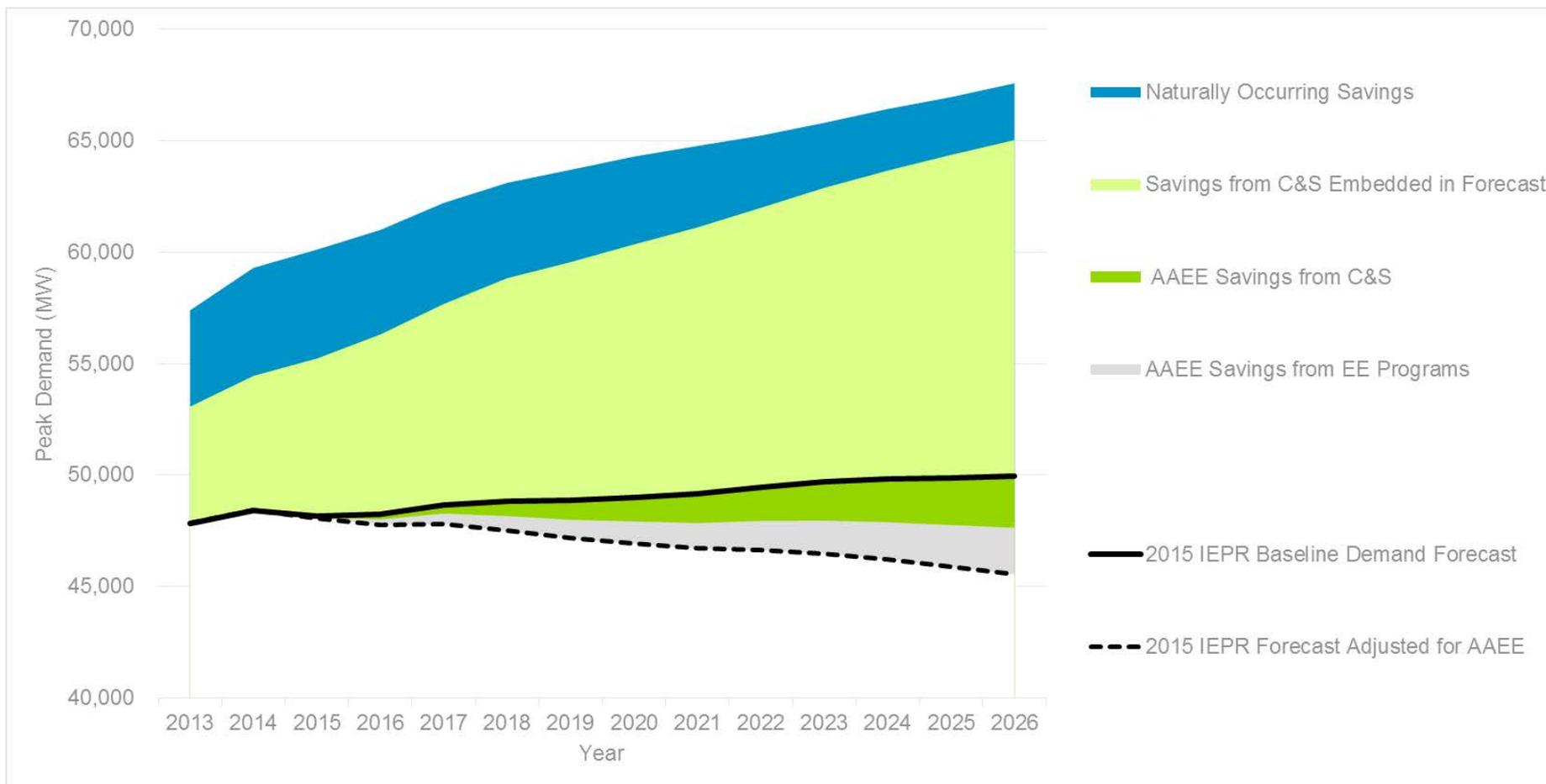


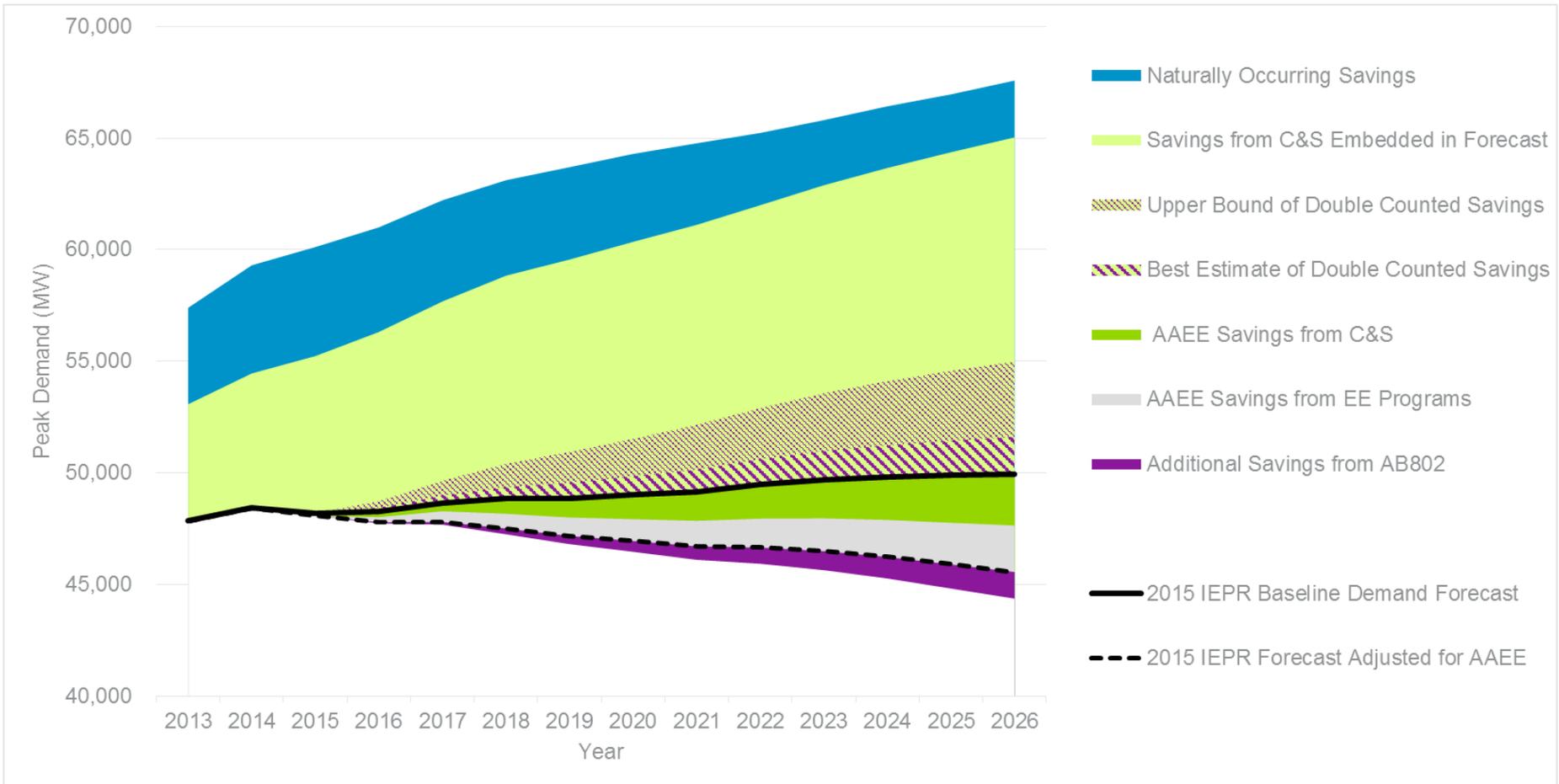
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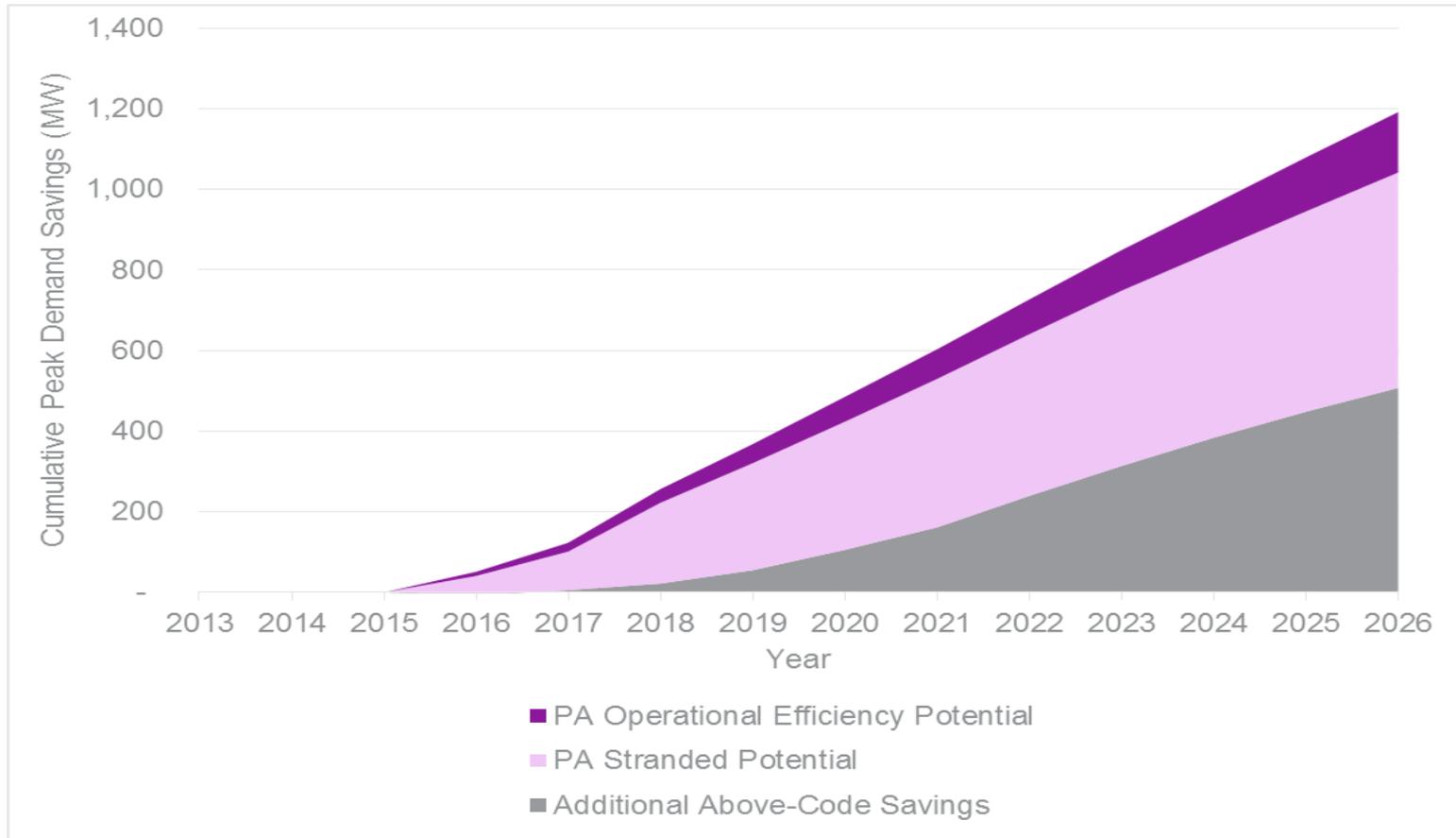
AAEE AND THE STATEWIDE DEMAND FORECAST



AB802 IMPACTS ON THE STATEWIDE DEMAND FORECAST



ADDITIONAL SAVINGS FROM AB802 – DEMAND



PUBLIC RESULTS VIEWER

- As with the 2015 Study, Navigant developed a results viewer for the AB802 Technical Analysis, available at: <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=11187>
- Results for each IOU are available
- Pivot tables and charts to filter for specific slices of the results



CPUC Potential Study
AB802 TECHNICAL ANALYSIS RESULTS VIEWER
PUBLIC DRAFT



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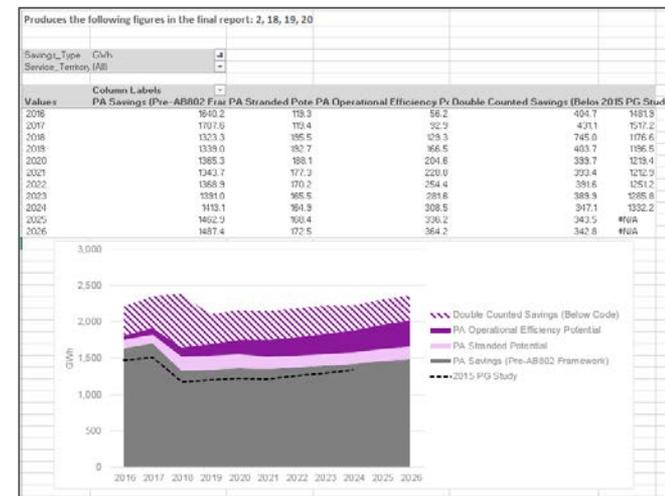
The CPUC AB802 Technical Analysis Results Viewer provides the user several visualization dashboards that can be used to draw inferences of the savings potential data generated by Navigant's analysis. Additionally, it allows the user to manipulate and analyze the data at different levels of granularity - Statewide potentials, IOU potentials, Potential by Use-Category, etc.

Below is a brief description of the several tabs contained in the Results Viewer, followed by general instructions for the basic use of the Tool.

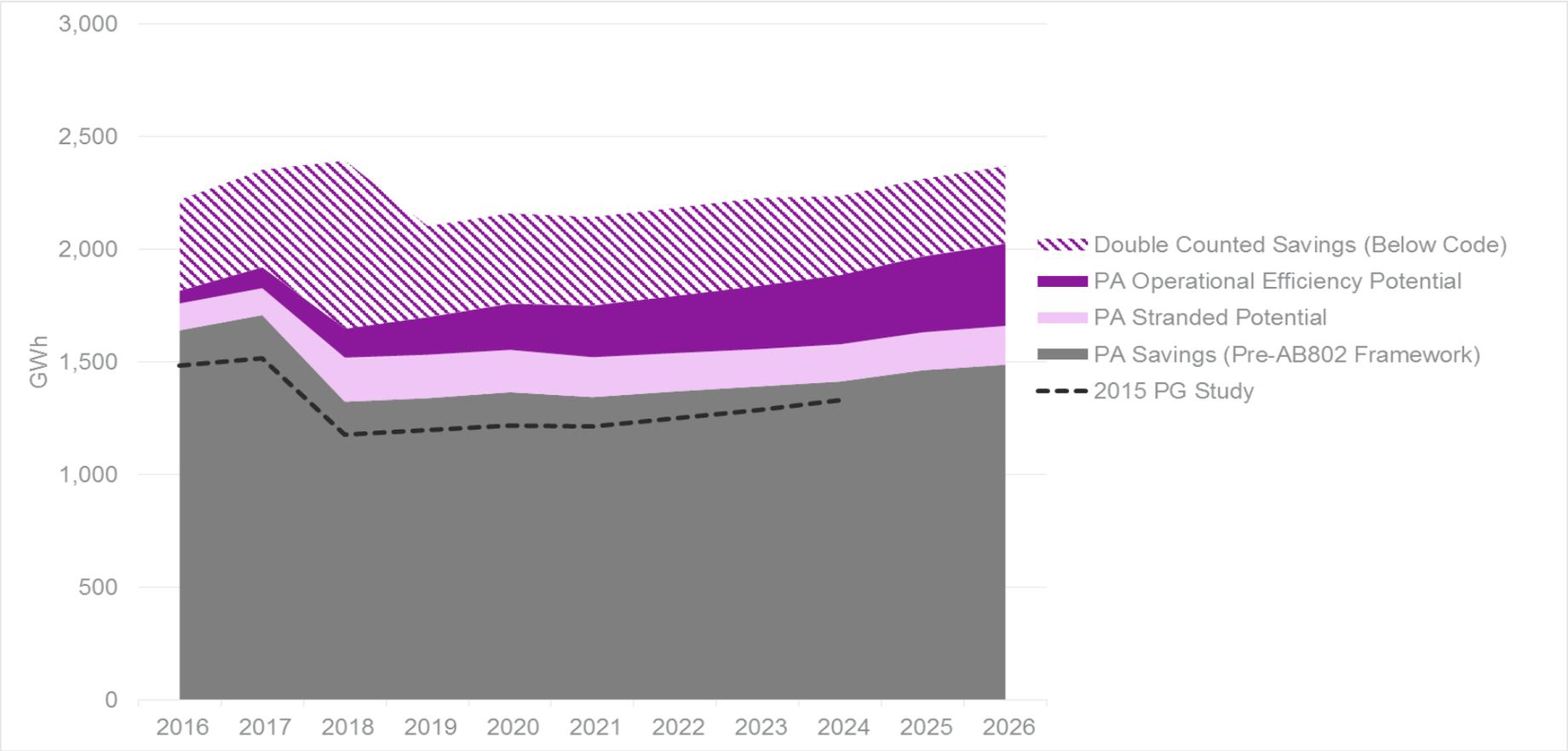
WARNING: Deleting or Renaming any tabs, rows, columns or cells could alter the data leading to inaccurate visualization dashboards.

TABS IN THE RESULTS VIEWER

Welcome & Instructions
Definitions
Incremental Savings
Annual Budget
PA Savings
PA Stranded Potential
Ope ...

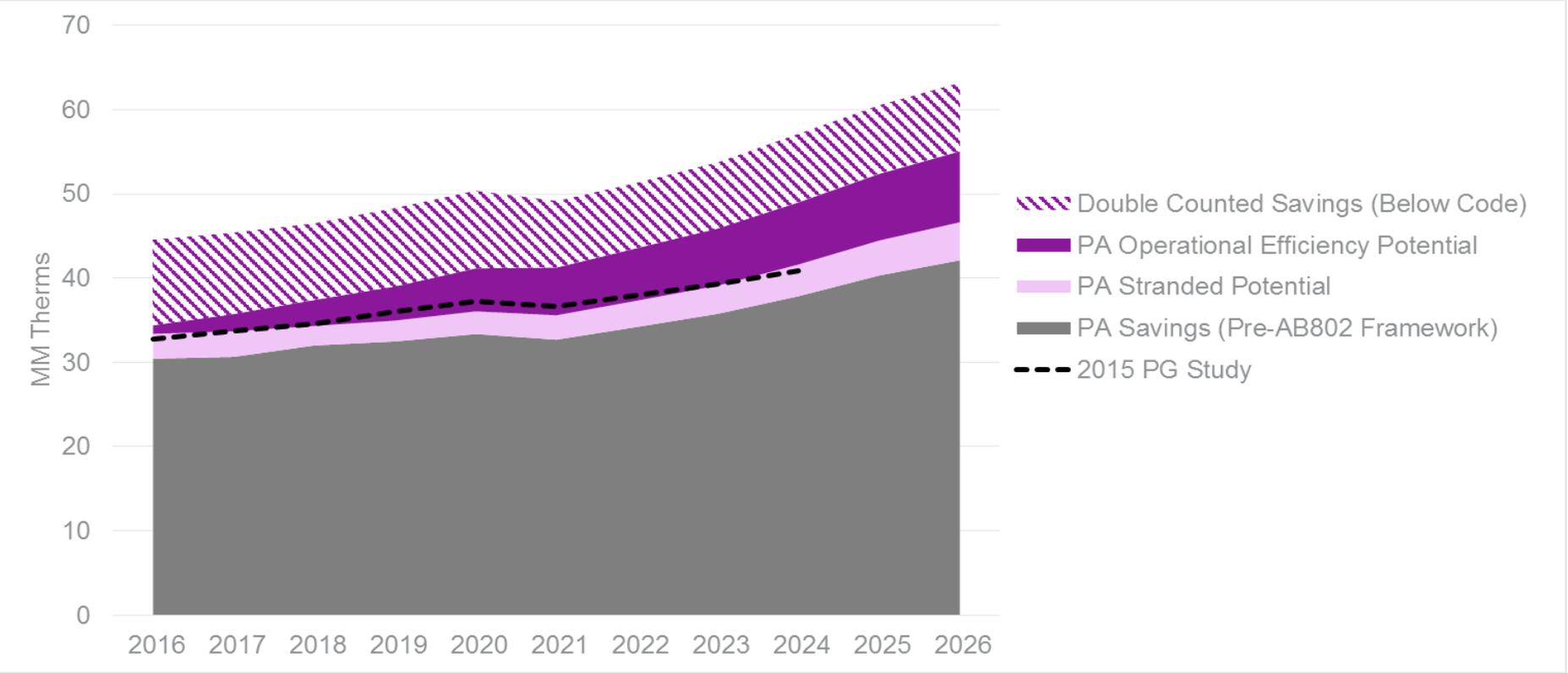


STATEWIDE INCREMENTAL ELECTRIC SAVINGS

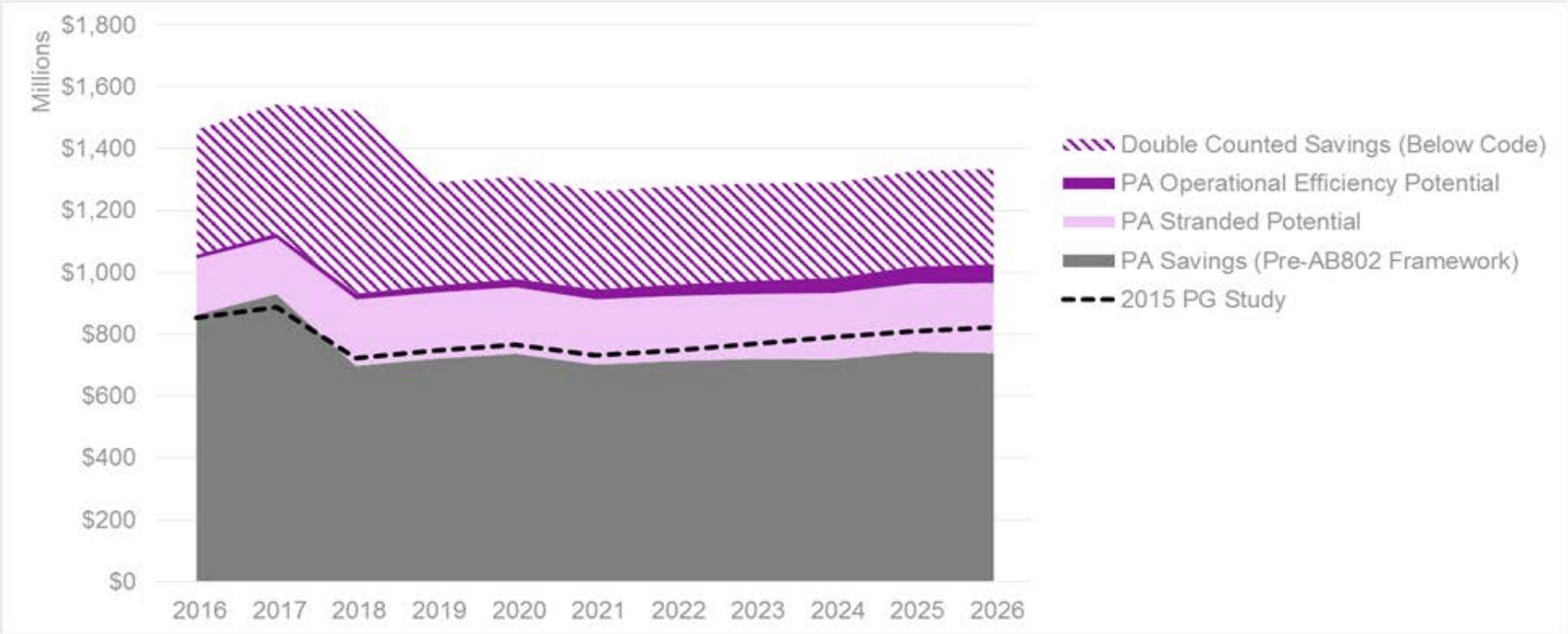


Note: Double Counted Savings shows "Best Estimate"

STATEWIDE INCREMENTAL GAS SAVINGS

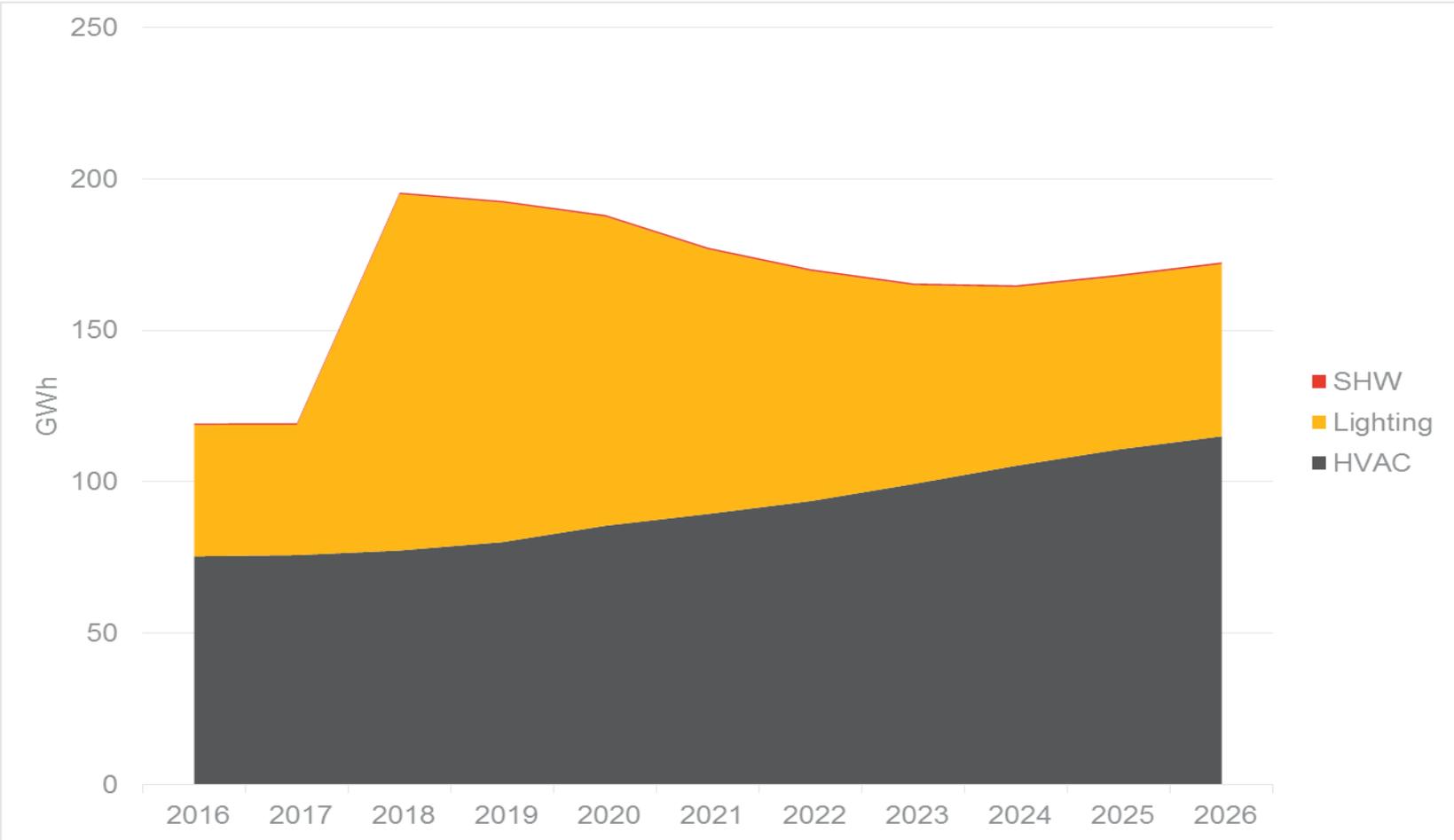


IMPACTS ON PROGRAM BUDGET (ALL IOUS)

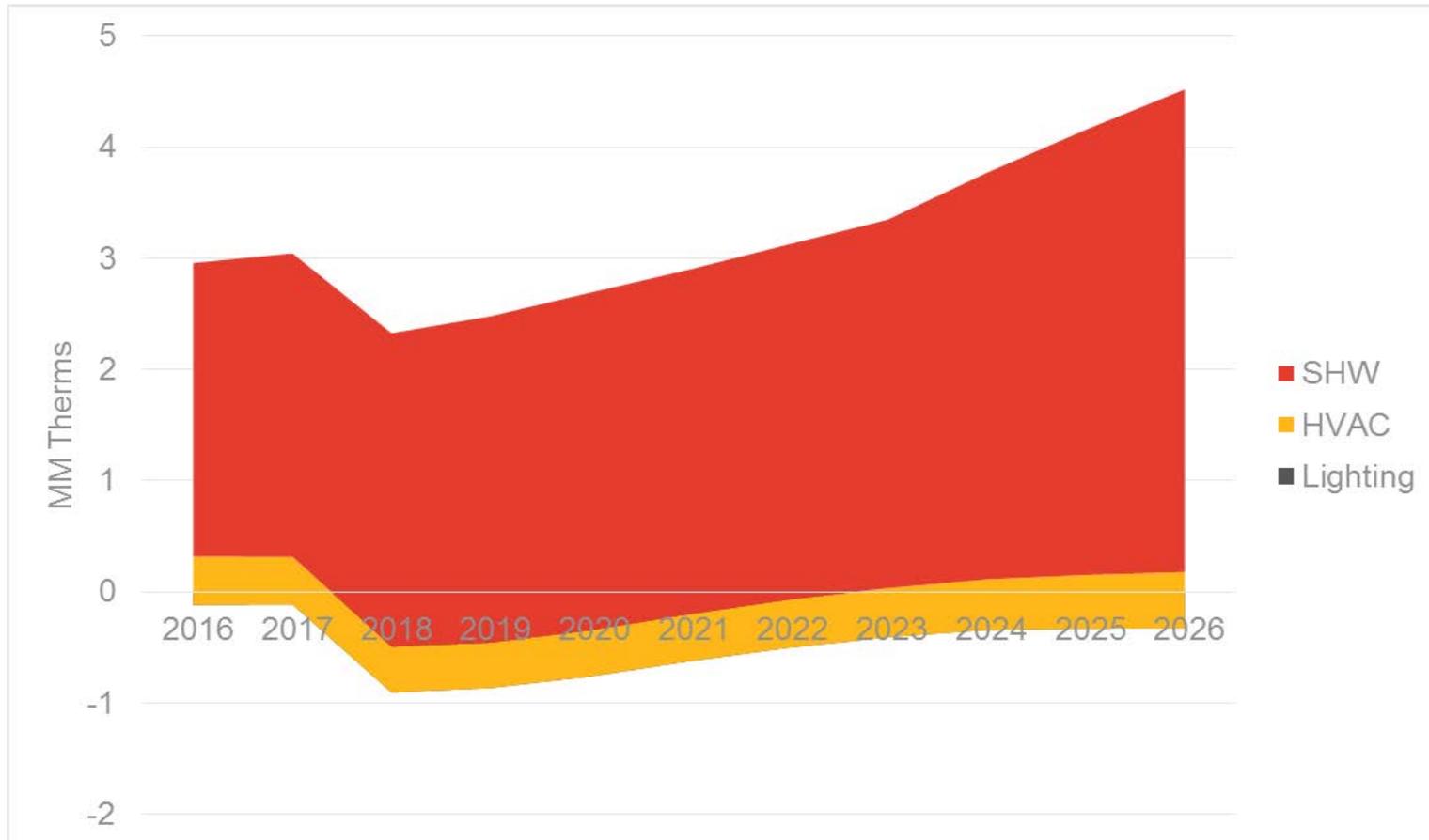


Note: Double Counted Savings shows "Best Estimate"

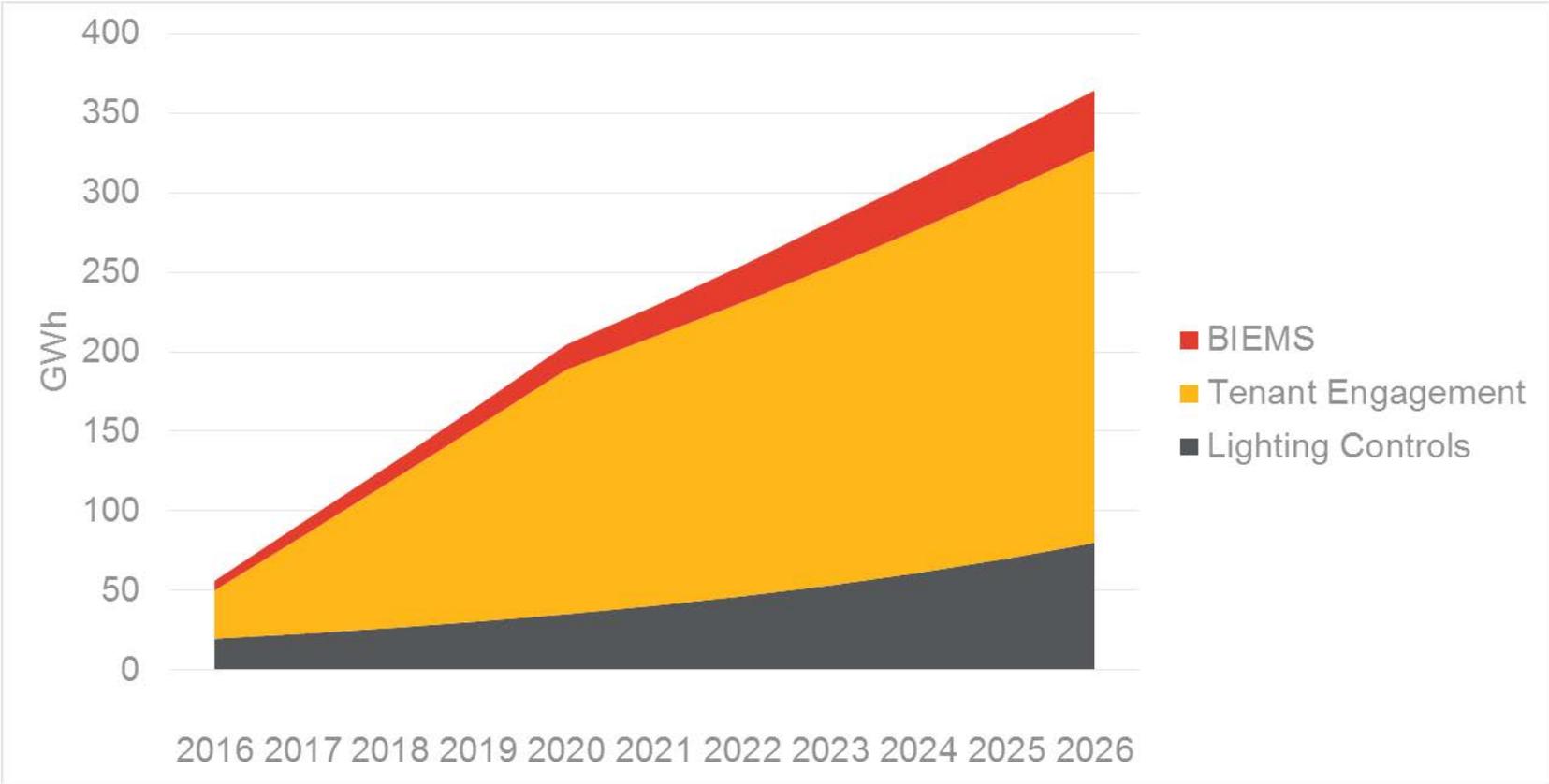
ELECTRIC STRANDED POTENTIAL BY END USE



GAS STRANDED POTENTIAL BY END USE



ELECTRIC OPERATIONAL EFFICIENCY POTENTIAL BY END USE



GAS OPERATIONAL EFFICIENCY POTENTIAL BY END USE

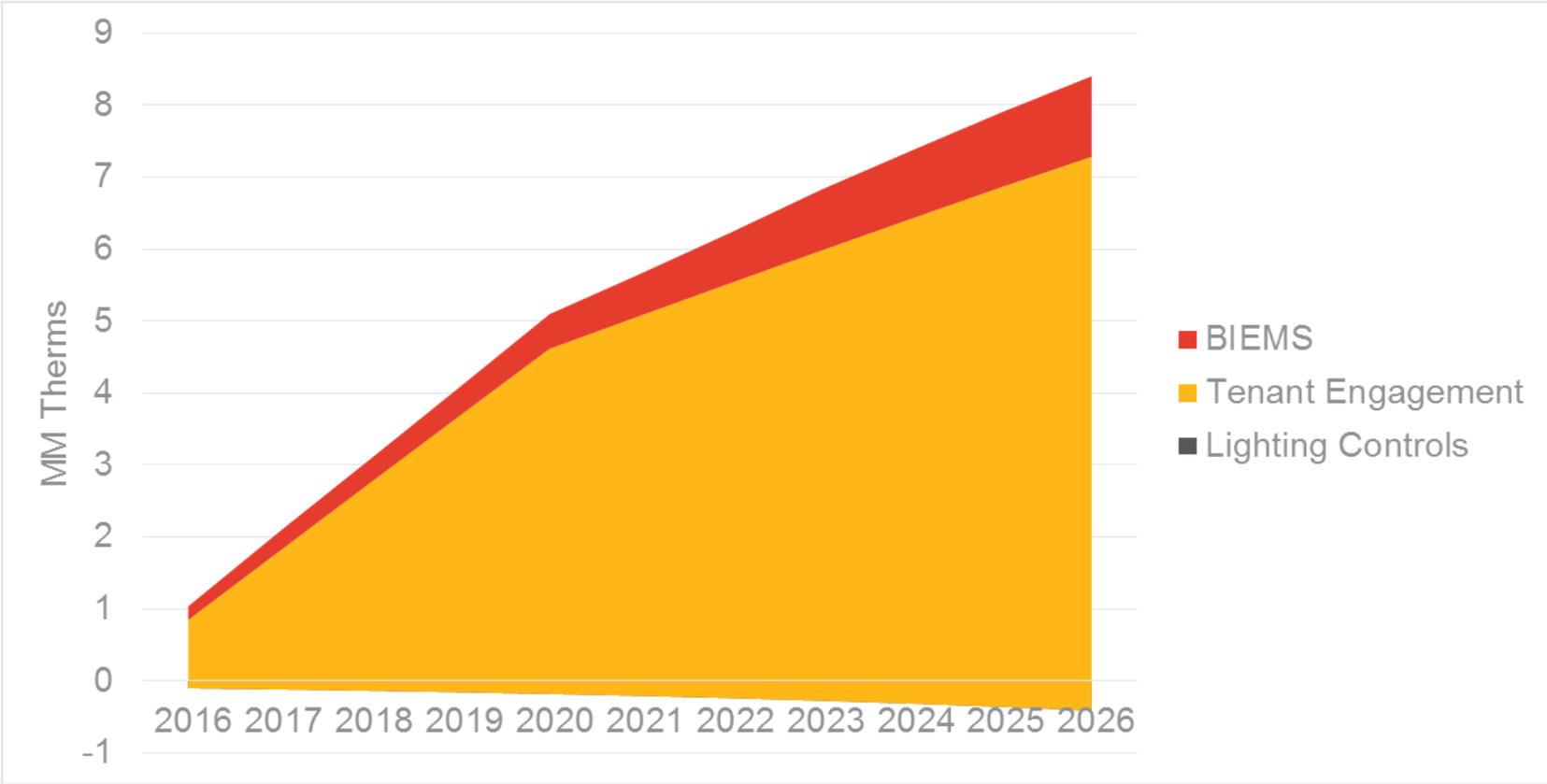


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RECOMMENDATIONS – EXPANDING POTENTIAL STUDY

- The AB802 Technical Analysis will serve as the methodology basis for the 2018 Potential Study.
- Several research tasks and additional data collection may be needed as part of the Potential Study:
 - **Characterize Additional Residential and Commercial Equipment** such as building envelope and commercial refrigeration equipment
 - **Characterize Below Code Savings Opportunities in the Agriculture and Industrial Sectors.** Additional clarity is needed regarding CPUC baseline policy these sectors.
 - **Further Research to Inform Operational Efficiency Savings.** Consider additional interventions, research persistence, and industrial sector opportunities.

RECOMMENDATIONS – IMPROVING MODELING

- Several methodology refinements may be needed as part of the Potential Study to advance the analysis of AB802:
 - **Align Modeling Methodology with the evolving CPUC policy framework.** Policy “unknowns” regarding program/measure eligibility and how IOUs will be credited savings
 - **Further Research to Inform the Double Counted Savings.** Useful considerations may include:
 - Understanding of the number of naturally occurring to-code savings in building alterations in California
 - Information available from NMEC pilot studies.
 - **Comparison and Alignment to CEC Demand Forecast.** Future AAEE analysis would require a comparison and alignment of assumptions between used by this study and the CEC demand forecast.

RECOMMENDATIONS – OTHER STUDIES

- Other studies and efforts could collect data that would better inform future modeling of below-code savings:
 - Expand saturation studies to consider a broader list of technologies and end uses.
 - Collect data (age, condition, efficiency level) on equipment removed by program participants.
 - Research measure repair characteristics (cost, equipment life extension, etc.)

Discussion and Q&A

CONTACTS

GREG WIKLER

Project Director

415.399.2109

Greg.wikler@navigant.com

AMUL SATHE

Project Manager

415.399.2180

Amul.sathe@navigant.com

SURYA SWAMY

Modeling Lead

415.356.7112

Surya.swamy@navigant.com

CARISHMA MENON

Model Programmer

415.356.7154

Carishma.menon@navigant.com