# Agenda

| Time Slot | Agenda Item |
| --- | --- |
| 12:30-1:20 | Part 1: Introduction & Low Income Potential |
| 1:30 – 2:30 | Part 2: High Level Methodology & Results |
| 2:35 – 4:15 | Part 3: Key Topics Methodology & Results |
| 4:20 – 5:00 | Part 4: Policy Discussion |

Gaps in timeslots are for breaks.

# Webex Participant Guide

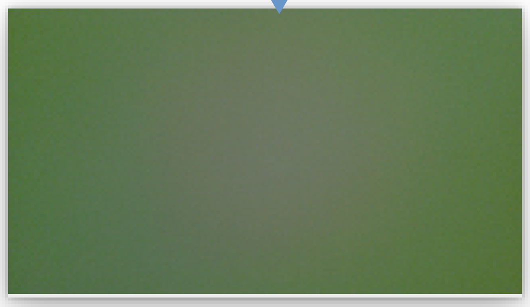
Un-Mute or Mute

Video On or Off

Click to see the participants

Click to see the chat and enter questions

If your **<u>video is on</u>**, you will see this box appear showing the video feed.



Gray means "on" (Not Muted, Sharing Video)

Red means "off" (Muted, Not Sharing Video)

Link to: [Cisco Webex Participant Guide]()

# Conference Call Etiquette During Q&A Sessions

- We know everyone is working from home, background noise if you are speaking is inevitable.
- <u>BUT</u> please mute yourself when you aren't speaking.
- Please do not place the line on hold.
- We are actively monitoring the chat window; consider submitting questions/comments via chat.

# CPUC EE Potential & Goals Study Team

- **Coby Rudolph**, Project Lead
- **Genesis Tang**
- **Lisa Paulo**
- **Jessica Allison**
- **Peter Franzese**
- **Travis Holtby**
- **Paula Gruendling**, Project Supervisor

# CPUC Low Income Team

- **Jason Symonds**, Project Lead
- **Kapil Kulkarni**

# Two EE Potential & Goals Tracks

**1. Goals-adoption Policymaking Track (Policy Track):**

Formal comments via EE rulemaking proceeding.

- Comments received in Spring 2020
- Proposed Decision issued on 4/16, comments/replies field in May 2021
- Comments on Potential and Goals in late May 2021
- Proposed Decision on Goals in Summer 2021

**2. Potential and Goals Study Track (Study Track):**

Informal work on the EE Potential & Goals Study.

- CPUC Energy Division staff (along with Guidehouse) has solicited ongoing, informal feedback from stakeholders on methodological and technical issues related to the Study.
- Today's workshop is the 8th stakeholder engagement meeting on the 2021 EE Potential and Goals Study (CPUC Workshops and CEC Demand Analysis Working Group meetings)

# EE Potential & Goals Background

Potential and Goals Study serves multiple purposes:

1. PG Study informs the CPUC Decision adopting IOU Energy Efficiency Goals.

2. EE Goals inform the statewide Demand Forecast (& IRP), SB 350 forecast.

# Potential & Goals Next steps

| Activity | Track / Venue | When |
| --- | --- | --- |
| ALJ Kao Ruling Questions (from 3/12/20) | Policy / formal comment | March 2020 |
| Study launch Workshop & Workplan | Study / informal comment | April 2020 Workshop |
| Measure characterization, data inputs | Study / informal comment | June 2020 DAWG mtg |
| Modeling | Study / informal comment | July 2020 DAWG mtg |
| Market studies, BROs, Low Income analysis | Study / informal comment | Oct 2020 DAWG mtg |
| Scenarios (PG study and IRP) and calibration | Study / informal comment | Nov 2020 DAWG mtg |
| Top-down plan, COVID adjustments, and reporting | Study / informal comment | Jan 2021 DAWG mtg |
| Top-down plan, COVID adjustments, and reporting | Study / informal comment | Jan 2021 DAWG mtg |
| Business Plan Guidance Decision | Policy / formal comment | PD issued 4/16/21 |
| Draft results and additional study review | Study / informal comment | TODAY |
| Proposed Decision on Goals Adoption for 2022 and Beyond | Policy / formal comment | Q2 /Q3 2021 |
| Decision on Goals Adoption for 2022 & Beyond | Policy / formal comment | Q3 2021 |
| Additional Policy Activities TBD | Policy / formal comment | TBD |

Completed Stakeholder Engagement

# 2021 Potential and Goals Final Report

May 13, 2021

| Start | End | Agenda Item | Presenter |
|---|---|---|---|
| 12:30 PM | 12:40 PM | Introduction | Coby Rudolph and Amul Sathe |
| 12:40 PM | 1:20 PM | Low Income Study* | Jason Symonds and Micah Turner |
| 1:20 PM | 1:30 PM | 10 min break | |

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*Timeslot includes time for Q&A

## Part 1 – Introduction and Low Income Study

# Guidehouse Team

## Speakers Today

**Amul Sathe**
**Project Director**
**Guidehouse**

**Karen Maoz**
**Project Manager**
**Guidehouse**

**Micah Turner**
**LI Lead Analyst**
**Guidehouse**

**Debyani Ghosh**
**EE-DR Integration Lead**
**Guidehouse**

**Benn Messer**
**Market Adoption Characteristics Study Manager**
**Opinion Dynamics Corporation**

Opinion Dynamics

**Christopher Dyson**
**Industrial and Agricultural Measure Study Lead**
**DNVGL**

DNV·GL

# What is the Potential and Goals (PG) Study?

- Develop estimates of energy and demand savings potential in the service territories of California's major investor-owned utilities (IOUs)
- Forecast from 2022-2032, reporting **net** savings
- Results have multiple uses:
  - Inform the CPUC goal setting process
  - Informs EE program portfolio planning and procurement, including the planning efforts of the CPUC, California Energy Commission (CEC), and California Independent System Operator (CAISO)
  - Inform strategic contributions to SB350 targets
  - Identifies new energy efficiency savings opportunities
- **The PG Study itself does not set goals; Guidehouse does not make recommendations to CPUC regarding goal setting.**

# What is a Potential Study?

Unit Energy Savings
Current Market Penetration

Avoided Costs
Measure Costs

Program Intervention
Customer Adoption Characteristics

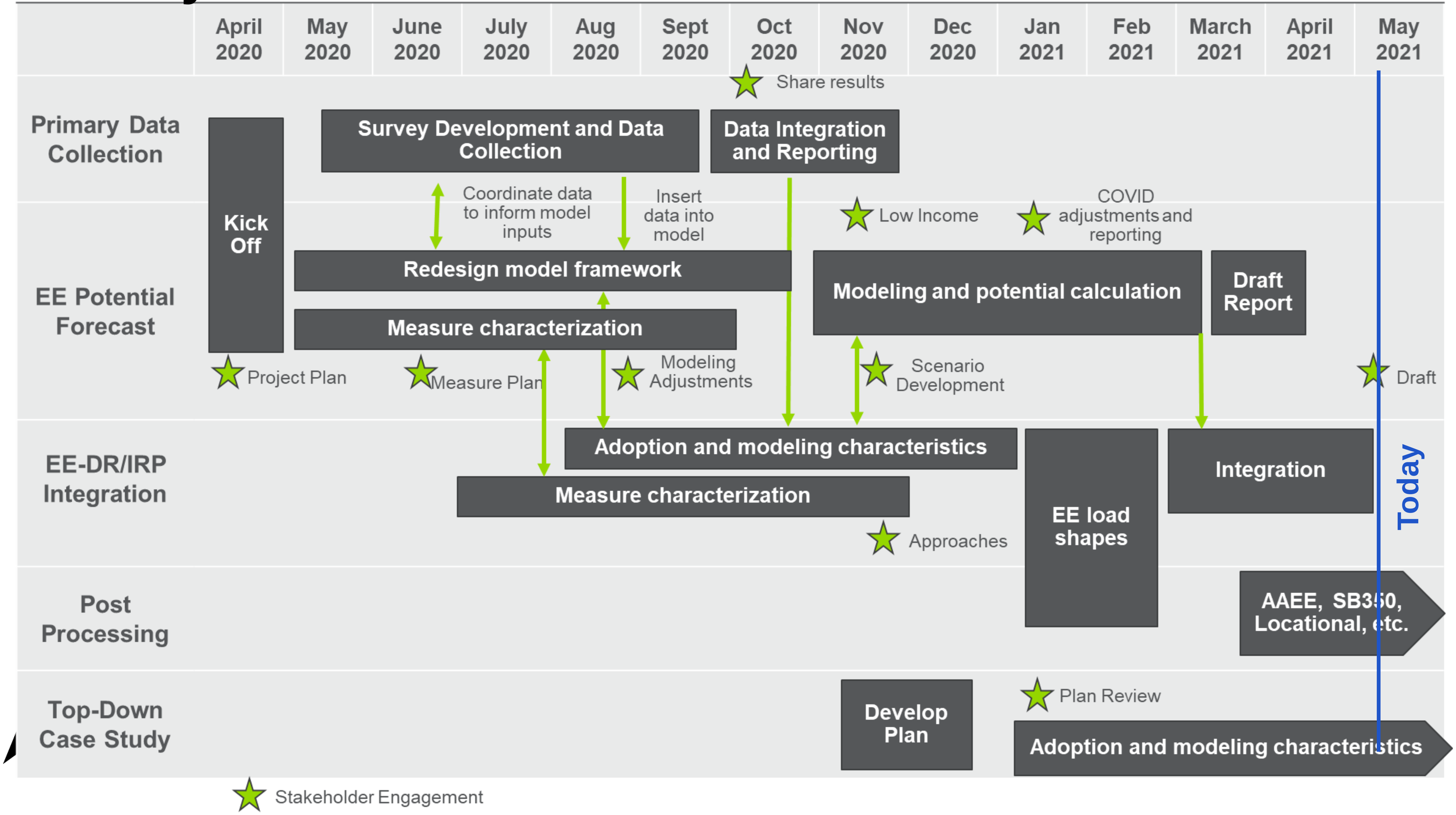
**Technical Potential**
Total energy savings available by end-use and sector, relevant to current population forecast

**Economic Potential**
CPUC Cost-effectiveness Screen

**Achievable Potential**
EE expected to be adopted

Establishes Goals & Scenarios for Forecast

# PG Study Workflow



# 2021 PG Study – Low Income Sector Results

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# Objective of 2021 Low-Income Potential Study

- Develop a forecast of the Technical and Achievable Potential for Energy Savings Assistance (ESA) Program

- Improve upon previous potential modeling efforts of the Low-Income sector

- Inform the CPUC and stakeholders on energy savings potential within the Energy Savings Assistance (ESA) program and residential low income sector in years to come.

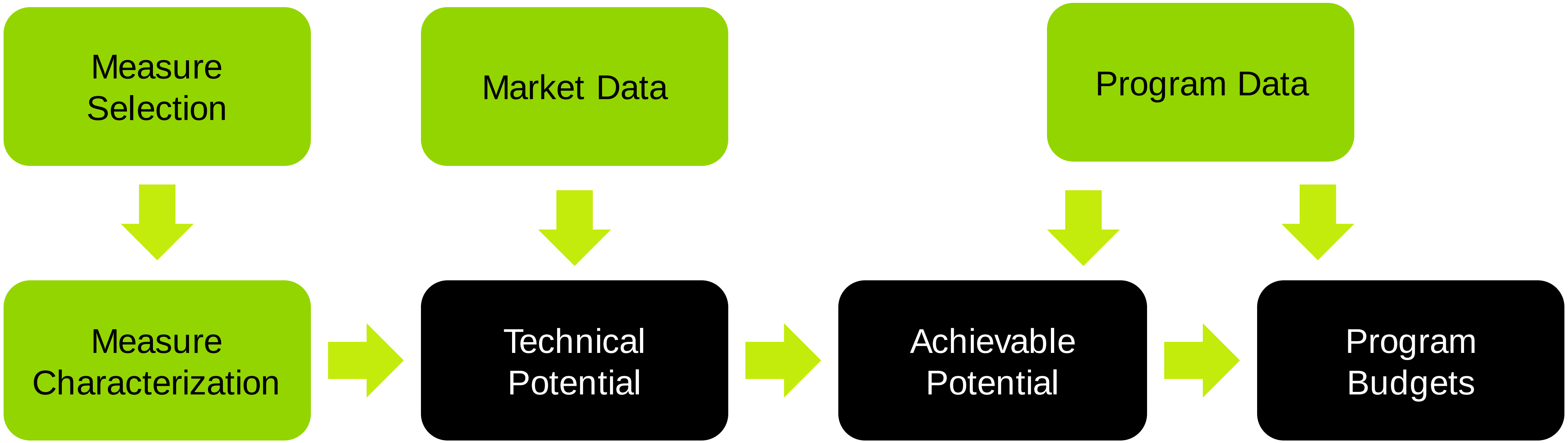
# Overview

## Assess the energy efficiency potential from the ESA program absent any program restrictions

| | |
|---|---|
| **What is different in 2021 Study?** | 2017 Study: Extrapolated savings based on historical ESA programs and budget<br>2019 Study: Analyzed potential using customer willingness algorithms (used for the residential sector EE equipment rebate programs) to calculate adoption<br>2021 Study: Unique analysis focused on ESA measure list, technology category historical and proposed adoption rates, and consideration on the incremental adoption of the existing technical potential |
| **Not in scope** | • Economic potential analysis<br>• Fuel Substitution measures<br>• Demand response savings<br>• New construction building types |

# Potential Analysis Steps

## Approach



# Measure Characterization

**Steps**

Prioritize Measure List

↓

Identify Measure-Level Data Sources

↓

Collect Data

↓

Characterize Measures

- Selected measures for characterization:
  - Current ESA program measures
  - Proposed ESA measures
  - 4 additional measures
    1. Solar Attic Ventilation Fan
    2. Water Heater Timers
    3. Cool Roof
    4. Duct Insulation

- Key characteristics for technical potential:
  - Density (e.g. products per household)
  - Saturation (percentage of market that is already efficient)
  - Technical suitability of measure for each building type (expressed as percentage)

# Market and Program Data Collection

## Building Stock

- IEPR forecast
- Climate zone-specific program installations
- Fraction of rented homes vs. owned homes
- Building type (SF*, MF)

## Past ESA Program Activity

- 2013-2019 past ESA program activity.
- Individual measure data includes:
  - Total measure costs
  - Number of installations
  - Energy impact (kWh, kW, Therms)

## 2020-2026 ESA Program Activity

- 2020 YTD installations
- 2021-2026 ESA Applications
- Individual measure data includes:
  - Total measure costs
  - Number of installations
  - Energy impact (kWh, kW, Therms)

**Mobile home included as part of single family analysis.*

# Technical and Achievable Potential Analysis

**Technical Potential** is the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken

$$\boldsymbol{Technical\ Potential} = Existing\ Building\ Stock_{year}\ (homes) * Measure\ Density\left(\frac{widgets}{home}\right) * (1 - Efficient\ Technology\ Saturation) * Unit\ Energy\ Impact_{year}\left(\frac{energy}{widget}\right) * Technical\ Suitability$$

**Achievable Potential** is the forecasted adoption as a percent of technical potential

$$\boldsymbol{Achievable\ Potential_{Year}} = (Initial\ Penetration\ Rate_{measure} * Prototypical\ Adoption\ Curve_{year}) * Total\ Technical\ Potential_{year}$$

Where:
**Initial Penetration Rate** is specific to each measure and utility and has a specific effective year.
**Prototypical Adoption Curve** is based on the scenario and measure category.
**Total Technical Potential** is the calculated technical potential.

*Note: Achievable potential is capped at 100% of Technical Potential*

# Mapping Measures to Adoption Characteristics

Mapped measures to appropriate Adoption Categories (A, B or C):

- Ease of implementation
- Require landlord approval
- Intrusiveness

| **Characteristics** | **A** | **B** | **C** |
|---|---|---|---|
| Ease of Installation | Difficult | Difficult | Easy |
| Landlord Approval needed? | Yes | Yes | No |
| Intrusive? | Yes | No | No |
| Example Measures | *Heat pump water heaters* | *Refrigerators* | *LED A-Lamps* |

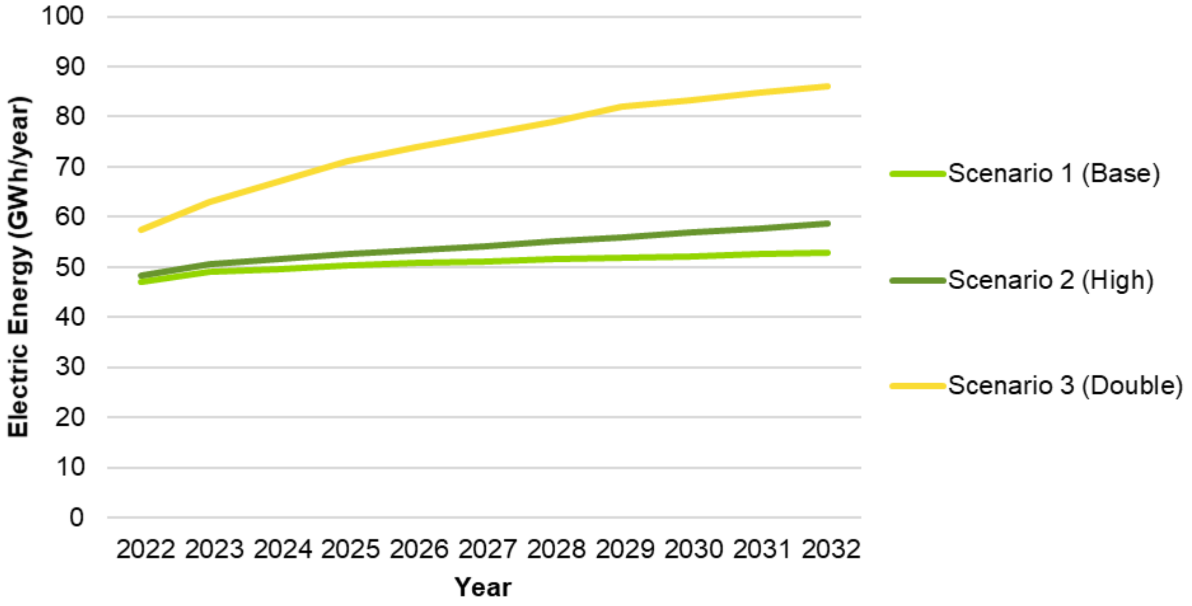
# Scenarios and Prototypical Adoption Curves

| Scenario | Adoption Category | Description of Prototypical Adoption Curves* |
|---|---|---|
| **Base**<br>Analyzed historical and proposed adoption of measures by category | A | Flat curve (no growth) |
| | B | Mild growth at 2% per year |
| | C | 4% growth per year, flattening in year 7 |
| **High**<br>Faster adoption than the base | A | 1% growth per year |
| | B | 3% growth rate per year |
| | C | 5% growth per year and then 3.5% starting in year 6 |
| **Double**<br>Doubles the initial penetration by the end of the modeling period | A | Linearly approaches 200% of initial penetration rate by the end of the modeling timeframe |
| | B | Linearly approaches 200% of initial penetration rate over the first 10 years, capping at 200% |
| | C | Linearly approaches 200% of initial penetration rate over the first 6 years, capping at 200% |

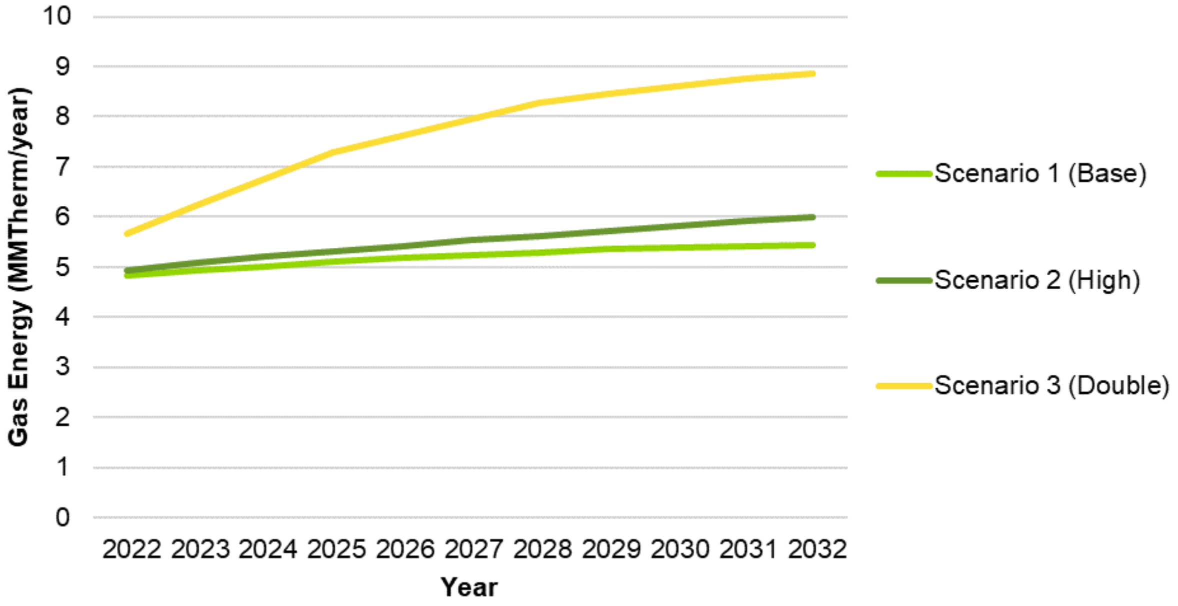
**Percentages apply to the initial penetration rate. In other words, 2% growth equivalent to multiplying the initial penetration rate by 1.02.*

# Achievable Potential Analysis – Results

## Electric Energy Savings – Statewide




## Gas Energy Savings - Statewide




**Achievable Potential in the Base Scenario as a Percent of Technical Potential**

| Fuel Type | 2032 |
|---|---|
| Electric (GWh/Year) | 2.6% |
| Demand (MW/Year) | 2.6% |
| Gas (MMTherm/ Year) | 1.0% |

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# Achievable Potential Analysis – Results

## Scenario 1 (Base) Results by IOU

| Utility | Savings Type | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PG&E** | Electric (GWh/Year) | 18.85 | 19.63 | 19.82 | 20.00 | 20.18 | 20.33 | 20.48 | 20.63 | 20.80 | 20.97 | 21.14 |
| | Demand (MW/Year) | 4.91 | 5.06 | 5.12 | 5.17 | 5.23 | 5.28 | 5.33 | 5.38 | 5.42 | 5.46 | 5.50 |
| | Gas (MMTherm/ Year) | 2.22 | 2.27 | 2.31 | 2.35 | 2.39 | 2.42 | 2.45 | 2.48 | 2.50 | 2.52 | 2.54 |
| **SCE** | Electric (GWh/Year) | 24.72 | 25.74 | 26.06 | 26.38 | 26.70 | 26.88 | 27.07 | 27.25 | 27.38 | 27.51 | 27.64 |
| | Demand (MW/Year) | 5.16 | 5.33 | 5.39 | 5.45 | 5.51 | 5.55 | 5.58 | 5.61 | 5.64 | 5.67 | 5.69 |
| **SCG** | Gas (MMTherm/ Year) | 2.29 | 2.33 | 2.37 | 2.40 | 2.43 | 2.46 | 2.48 | 2.50 | 2.51 | 2.52 | 2.52 |
| **SDG&E** | Electric (GWh/Year) | 3.59 | 3.73 | 3.80 | 3.86 | 3.92 | 3.95 | 3.99 | 4.02 | 4.05 | 4.08 | 4.11 |
| | Demand (MW/Year) | 0.59 | 0.61 | 0.61 | 0.62 | 0.63 | 0.63 | 0.64 | 0.64 | 0.65 | 0.65 | 0.65 |
| | Gas (MMTherm/ Year) | 0.33 | 0.34 | 0.34 | 0.35 | 0.35 | 0.36 | 0.36 | 0.37 | 0.37 | 0.37 | 0.37 |
| **Total** | **Electric (GWh/Year)** | **47.16** | **49.11** | **49.68** | **50.24** | **50.80** | **51.17** | **51.53** | **51.90** | **52.23** | **52.56** | **52.89** |
| | **Demand (MW/Year)** | **10.66** | **10.99** | **11.12** | **11.25** | **11.37** | **11.46** | **11.55** | **11.63** | **11.71** | **11.78** | **11.85** |
| | **Gas (MMTherm/ Year)** | **4.84** | **4.94** | **5.02** | **5.10** | **5.18** | **5.24** | **5.29** | **5.35** | **5.38** | **5.41** | **5.44** |

*Note: Full results available in online Excel workbook results viewer*

# Program Budget Analysis

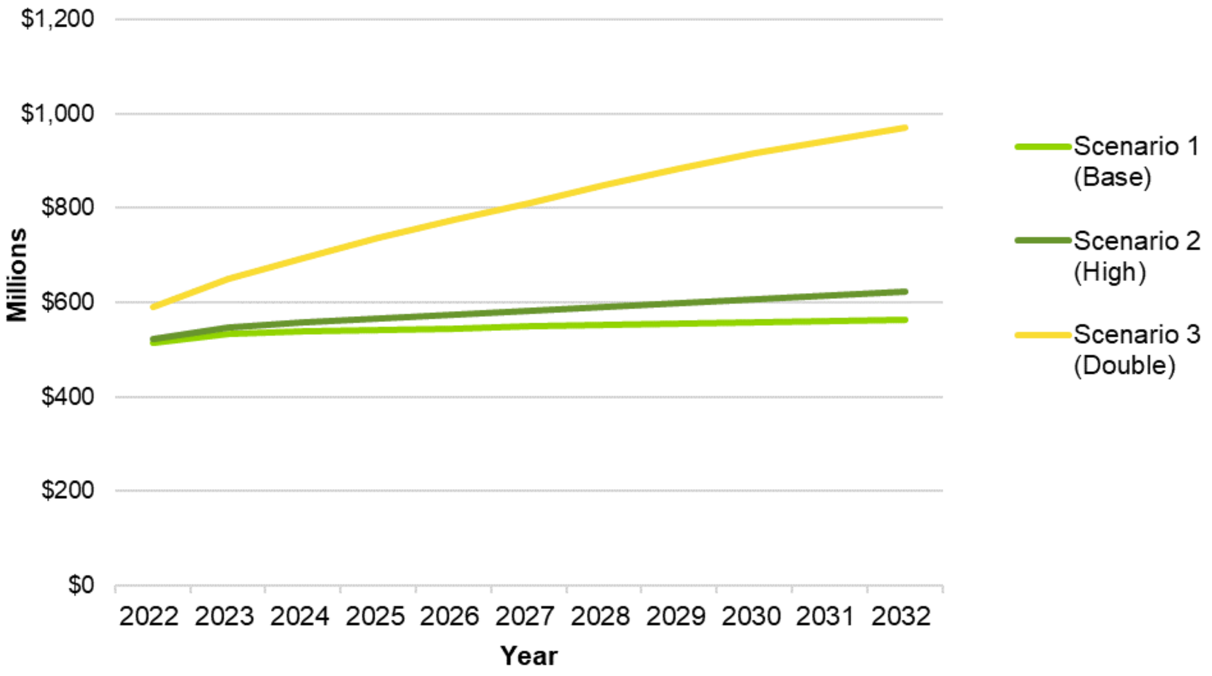
Program budgets were broken down into two components each with separate estimates for each achievable potential scenario.

| Equipment Expenses |
| --- |
| Annual technology adoptions<br>X<br>Deemed equipment expenses |

| Program Costs |
| --- |
| The forecast of program costs was conducted by assuming all program costs scale proportionally with equipment costs. This was based on scaling ratios from historic program years.<br><br>*Costs include implementation, training, inspections, marketing, education, EM&V, compliance, administration, and the CPUC Energy Division.* |

# Program Budget Analysis – Results

## Statewide Program Budgets – All Scenarios




## Program Budgets (in millions) by IOU – Scenario 1 (Base)

| Year | PG&E | SCE | SCG | SDG&E | Total |
|---|---|---|---|---|---|
| 2022 | $200.08 | $108.43 | $160.46 | $44.05 | $513.02 |
| 2023 | $208.45 | $115.45 | $163.31 | $46.20 | $533.40 |
| 2024 | $210.22 | $116.23 | $164.33 | $46.60 | $537.39 |
| 2025 | $211.99 | $117.01 | $165.35 | $46.99 | $541.35 |
| 2026 | $213.75 | $117.79 | $166.37 | $47.35 | $545.25 |
| 2027 | $215.26 | $118.49 | $167.12 | $47.66 | $548.53 |
| 2028 | $216.76 | $119.18 | $167.87 | $47.95 | $551.76 |
| 2029 | $218.25 | $119.87 | $168.61 | $48.25 | $554.98 |
| 2030 | $219.54 | $120.49 | $169.20 | $48.49 | $557.71 |
| 2031 | $220.81 | $121.10 | $169.79 | $48.73 | $560.44 |
| 2032 | $222.08 | $121.71 | $170.38 | $48.98 | $563.14 |

# P&P Manual Adjustments

Guidehouse analyzed Technical and Achievable potential using ESA program policies and procedures manual requirements.

Analysis is to provide context compared to existing program applications.

1. Disaggregate data to climate zone, building type, ownership type level
2. Remove ineligible items per the P&P manual
3. Reaggregate to the measure, utility, building type and end use level

# P&P Manual Adjustments

## Achievable Potential Constrained by P&P Manual Applicability by Utility – Base Scenario

| Utility | Fuel Type | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PG&E** | Electric (GWh/Year) | 14.13 | 14.33 | 14.52 | 14.71 | 14.90 | 15.06 | 15.21 | 15.37 | 15.51 | 15.64 | 15.78 |
| | Demand (MW/Year) | 2.84 | 2.88 | 2.92 | 2.96 | 2.99 | 3.02 | 3.05 | 3.08 | 3.10 | 3.12 | 3.14 |
| | Gas (MMTherm/ Year) | 1.57 | 1.60 | 1.63 | 1.65 | 1.68 | 1.70 | 1.71 | 1.73 | 1.74 | 1.75 | 1.76 |
| **SCE** | Electric (GWh/Year) | 18.00 | 18.34 | 18.69 | 19.03 | 19.37 | 19.57 | 19.78 | 19.98 | 20.12 | 20.25 | 20.39 |
| | Demand (MW/Year) | 3.06 | 3.12 | 3.18 | 3.24 | 3.29 | 3.33 | 3.36 | 3.39 | 3.41 | 3.43 | 3.45 |
| **SCG** | Gas (MMTherm/ Year) | 1.04 | 1.06 | 1.08 | 1.10 | 1.12 | 1.13 | 1.13 | 1.14 | 1.14 | 1.14 | 1.15 |
| **SDG&E** | Electric (GWh/Year) | 3.53 | 3.60 | 3.67 | 3.74 | 3.81 | 3.85 | 3.89 | 3.93 | 3.96 | 3.99 | 4.02 |
| | Demand (MW/Year) | 0.53 | 0.55 | 0.56 | 0.57 | 0.58 | 0.58 | 0.59 | 0.60 | 0.60 | 0.61 | 0.61 |
| | Gas (MMTherm/ Year) | 0.10 | 0.11 | 0.11 | 0.11 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| **Total** | **Electric (GWh/Year)** | **35.66** | **36.27** | **36.88** | **37.48** | **38.08** | **38.48** | **38.88** | **39.28** | **39.58** | **39.89** | **40.19** |
| | **Demand (MW/Year)** | **6.43** | **6.54** | **6.65** | **6.76** | **6.87** | **6.93** | **7.00** | **7.07** | **7.11** | **7.16** | **7.20** |
| | **Gas (MMTherm/ Year)** | **2.72** | **2.77** | **2.82** | **2.87** | **2.91** | **2.94** | **2.96** | **2.99** | **3.00** | **3.02** | **3.03** |

## Achievable Potential in the Base Scenario as a Percent of Technical Potential

| Fuel Type | Total Achievable Potential (2032) | P&P Manual Applicable Achievable Potential (2032) | Percent Change from Total to P&P Eligible Potential (2032) |
|---|---|---|---|
| Electric (GWh/Year) | 2.6% | 1.9% | -24% |
| Demand (MW/Year) | 2.6% | 1.6% | -39% |
| Gas (MMTherm/ Year) | 1.0% | 0.5% | -44% |

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# Discussion/Questions

# Appendix – Low Income

# Recommendations for next LI P&G Study

- **Benchmark program data to other state's low income EE programs**
  - Other states may provide new approaches and measures to program design and delivery
- **Expanded research for equipment saturation data**
  - A low income-specific saturation study may provide more accurate insights
- **Improving the adoption curves by better understanding customers barriers to installation and measure refusal**
  - Future achievable potential forecasting could benefit from more accurate forecasts
- **Further investigate outlier initial penetration rates**
  - Certain lighting measures had high initial saturation rates, which could be exceeding actual need

# Initial Penetration Rate

$$\textbf{\textit{Initial Penetration Rate}} = Total\ Program\ Installations_{year} / Total\ Technical\ Potential\ Installations_{year}$$

Where:

- **Total Program Installations** is the utility-specific documented or proposed first-year[1] measure installations in IOU program documents (in 2019 or later)
- **Total Technical Potential Installations** is the utility-specific total *possible* installations in that year.
  – Calculated directly from modeled Technical potential savings
- **New measures:** applied a uniform **0.5%** initial penetration rate[2,3]

1. *Used second or third-year program activity where more representative for some measures*
2. *New measures means either undocumented by the utility or absent from program documentation altogether*
3. *0.5% rate represents the lower-end of calculated initial penetration rates*

# Achievable Potential Analysis – Example Penetration Rate Calculation

| Steps | Calculation for PG&E Refrigerators |
|---|---|
| 1. Identify effective year | 2019 |
| 2. Calculate penetration rate in the effective year | 2019 installations/total technical potential installations = 1.6% |
| 3. Identify Scenario and Adoption Category | Scenario 1 (Base), B (more difficult to install, needs landlord approval, non-intrusive) |
| 4. Multiply initial penetration rate x prototypical adoption curve | 1.6% x |
| 5. Final Annual Achievable Penetration Rates | Study Time Period |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Category B | 100% | 102% | 104% | 106% | 108% | 110% | 112% | 114% | 116% | 118% | 120% | 122% | 124% | 126% | 128% |

| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.60% | 1.70% | 1.70% | 1.70% | 1.80% | 1.80% | 1.80% | 1.90% | 1.90% | 1.90% | 1.90% | 2.00% | 2.00% | 2.00% |

# BREAK UNTIL 1:30

| Time Slot | Agenda Item |
| --- | --- |
| 12:30-1:20 | Part 1: Introduction & Low Income Potential |
| 1:30 – 2:30 | Part 2: High Level Methodology & Results |
| 2:35 – 4:15 | Part 3: Key Topics Methodology & Results |
| 4:20 – 5:00 | Part 4: Policy Discussion |

# 2021 Potential and Goals Final Report

May 13, 2021

| Start | End | Agenda Item | Presenter |
| --- | --- | --- | --- |
| 1:30 PM | 1:35 PM | Introduction | Coby Rudolph |
| 1:35 PM | 1:55 PM | Potential Analysis Overview (Scope; key updates from 2019 - includes multi-attribute, TSB & more; study products) | Amul Sathe |
| 1:55 PM | 2:05 PM | Discussion | Travis Holtby |
| 2:05 PM | 2:25 PM | Results & key takeaways<br>Scenarios<br>Top line & EE results | Amul Sathe & Karen Maoz |
| 2:25 PM | 2:35 PM | Discussion | Travis Holtby |
| 2:35 PM | 2:40 PM | 5 min break | |

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# Part 2 – High Level Methodology and Results

# CPUC's Energy Efficiency Goals

- Energy efficiency outcomes that utilities are required to achieve annually
- CPUC adopts revised goals every two years
- Goals are informed by the P&G Study which forecasts cost effective, achievable savings. Study outputs may be used for goalsetting.
- Recently goals have been set using the 1st-year savings outputs from the P&G study: 1st-year GWh, MW, MMTherms
- CPUC Proposed Decision on EE business plan guidance, issued 4/16/21, proposes a new goals metric for 2024 and beyond: Total System Benefit (TSB)
- The 2021 P&G study includes the TSB for all scenarios but the IRP

# Total System Benefit Metric

- Total System Benefit (TSB) is a dollar value metric.
- TSB is calculated by taking the savings and loadshape of an energy efficiency resource and applying the hourly dollar values from the CPUC's Avoided Cost Calculators.
- TSB is one output of the P&G Study. It reflects the dollar value system benefit of the P&G study measure mix forecasted to be cost effective and achievable in the market.
- Use of the TSB output does not change the mix of measures in each scenario forecasted in the P&G Study.
- Guidehouse will explain the TSB calculation in more detail in the following slides.

# Potential Analysis Overview

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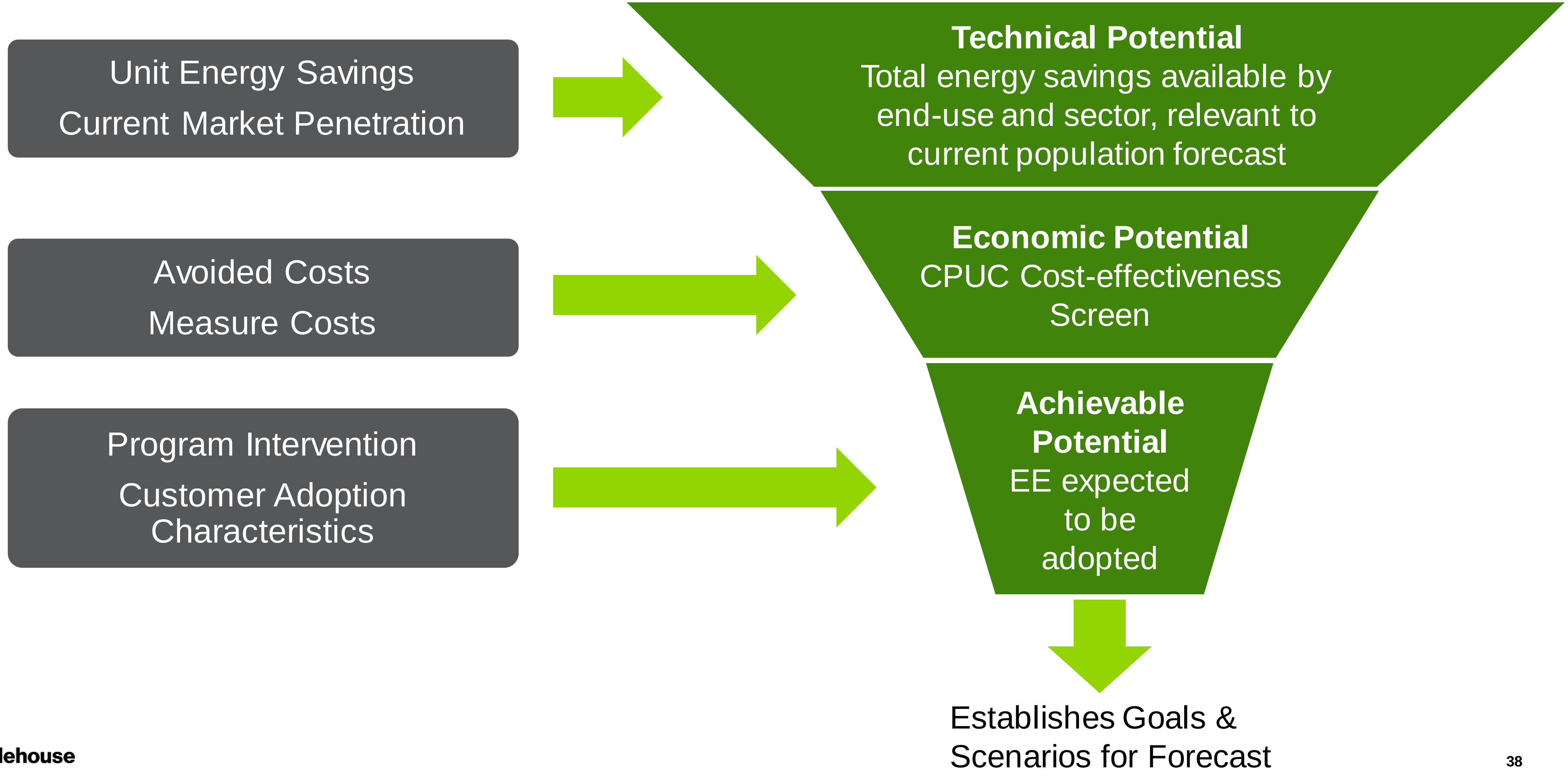
# What is a Potential Study?



# Potential and Goals Study Deliverables

**EE Potential Forecast**

Core effort also includes model development and producing scenario results.

**Primary Data Collection**

Two new sets of data to feed as inputs into the EE potential forecast

**EE/DR & IRP Integration**

Better coordination the EE with DR forecast; optimization of EE into the CPUC's Integrated Resource Plan (IRP) process.

**Post Processing**

Post process potential for additional needs: hourly impact estimates, supporting CEC, and locational disaggregation.

**Not Started**

**Top-Down Forecasting Pilot**

Explore forecasting EE potential using an alternate modelling approach.

**In Progress**

# Key Components of Measure Analysis

## PG Study requires some simplifications…

| Category | Notes |
|---|---|
| **Representative measure selection** | • Not every level of efficiency of every measure is captured in the PG Study.<br>• The measure list is designed to be "representative" of the larger universe of measures available. |
| **Weather sensitive measure treatment** | • Climate zones are grouped in three representative regions for each IOU.<br>• This captures weather dependent inputs while still allowing model simplicity. |
| **Load Shape and Avoided Cost* Mapping** | • Measures are mapped to average load shapes for cost effectiveness calculations.<br>• Average load shapes across each IOU, sector, and end use (removing building type, climate zone, and measure-level granularity). |

**Model used 2020 ACC values (what was available at the time of analysis)*

# What is new in the 2021 Study?

| | | |
|---|---|---|
| **Crosscutting Updates** | **Update Adoption Methodology** | • Update PG model algorithms to incorporate both financial and non-financial indicators in customer decision making |
| | **Total System Benefit (TSB)** | • A new way to quantify achievable potential as a monetary value for the utility life cycle benefit based on avoided costs |
| **Purpose Built Updates** | **Primary Data Collection** | • EE Market Adoption Characteristics Study informed the PG model algorithms updates<br>• Industrial/Agriculture Market Saturation Study provided new California-specific data for forecasting |
| | **Fuel Substitution** | • Included due to CPUC's policy in 2019 allowing fuel substitution |
| | **Demand Response (DR) Integration** | • Assess the sensitivity of integrating the benefits and costs of DR for DR-enabled EE technologies |
| | **IRP Optimization** | • Explored and refined the methods of incorporating demand side resources into the IRP |
| | **COVID-19 Pandemic Sensitivity** | • Developed to address the effects of the pandemic on achievable potential |

# Update Adoption Methodology

Historically, PG model calculated customers' willingness to adopt using a single measure attribute: lifetime cost. The change to multiple attributes (value factors) provides a more comprehensive understanding of consumer behavior and more reliable forecasting by integrating behavior science concepts.

- Lifetime Cost (LMC)
- Upfront Cost
- Hassle Factor
- Eco Impacts
- Eco Signaling
- Non-conservation Performance

1. Identified value factors for customer adoption
2. Gathered and analyzed survey data
3. Calculated relative importance of six value factors
4. Revised model to accommodate additional factors customer's decision-making process

# Market Share Calculation

- Customer preference weights indicate relative importance of each value factor (e.g. do customers care more about cost or about eco impacts?)
- Each technology has a quantifiable value for each factor (e.g. how much does it cost? does it socially signal eco consciousness?)
- Multiply the two vectors and compare the values for competing technologies

## Measure Calculations

**Customer Preference Weights** X **Technology Characteristic**

| Customer Preference Weights | Technology Characteristic |
|---|---|
| $W_{\text{Lifetime Cost}}$ | $U_{\text{Lifetime Cost}}$ |
| $W_{\text{Upfront Cost}}$ | $U_{\text{Upfront Cost}}$ |
| $W_{\text{Hassle Factor}}$ | $U_{\text{Hassle Factor}}$ |
| $W_{\text{Eco Impacts}}$ | $U_{\text{Eco Impacts}}$ |
| $W_{\text{Eco Signaling}}$ | $U_{\text{Eco Signaling}}$ |
| $W_{\text{Non-conservation Performance}}$ | $U_{\text{Non-conservation Performance}}$ |

## Competition and Market Share

= **Weighted Average Value**

↓

**Decision Model**

$$\frac{Logit(Avg_{T1})}{\Sigma Logit(Avg_{Ti})}$$

↓

**Market Share (Willingness)**

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# Total System Benefits

## Represents the sum of the benefit that a measure provides to the electric and natural gas systems

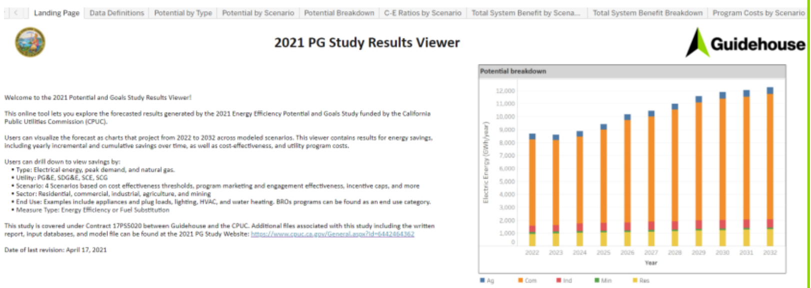
$$\mathit{Total\ System\ Benefit} = \mathit{Net\ Avoided\ Cost\ Benefits}\ (\mathit{Energy\ and\ Capacity}) - \mathit{Increased\ Supply\ Cost}$$

- The dollar value of the benefits that an EE resource contributes to the electric and gas systems
- TSB relies on:
  - Annual energy savings
  - Avoided costs & measure load shape
  - Measure life (EUL)
- TSB is the net present value over the EUL

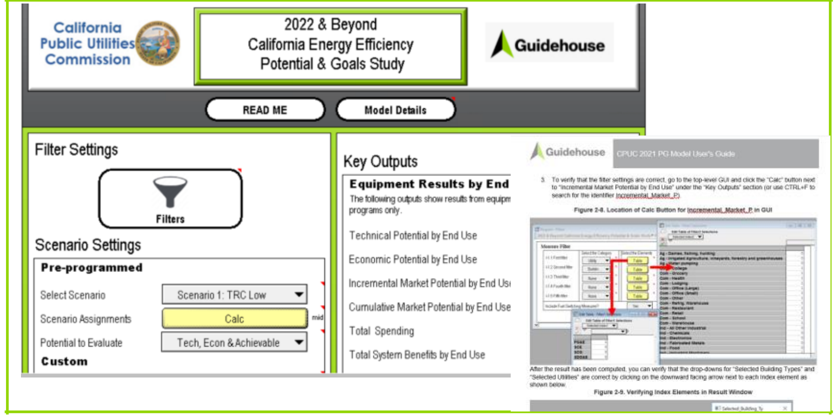
- Avoided Cost Benefits result from electric and gas energy and capacity savings for fuels offered by the utility.
- Supply Costs are treated as "negative energy savings" and come in two forms:
  - Interactive effects such as increased heating load due to decreased heat gain from more efficient lighting
  - Energy consumption of a specific fuel increased due to fuel substitution

# Study Products

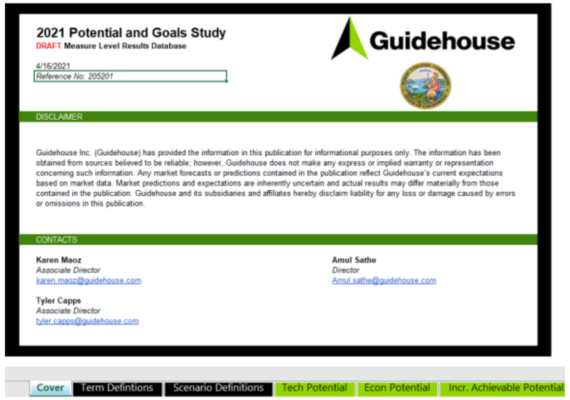
## Online Results Viewer




## Analytica Model/Users Guide




## Measure Level Results Database




## EE/BROs Technology Inputs




Available at: https://www.cpuc.ca.gov/General.aspx?id=6442464362

# Discussion/Questions

# PG Study Results

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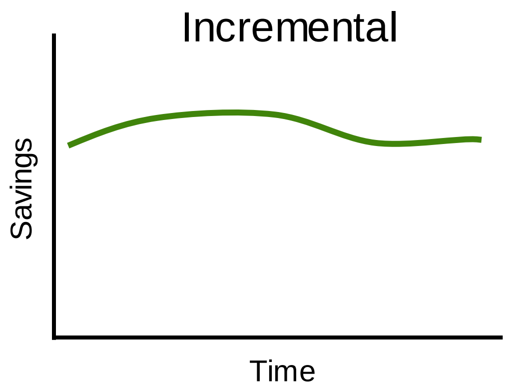
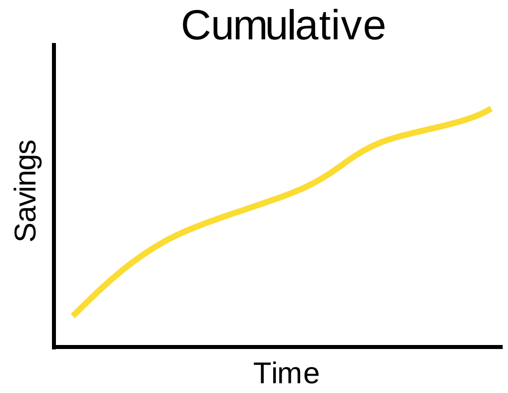
# Incremental vs. Cumulative Energy Savings

- **Incremental Savings**
  - Annual savings achieved in the first year that a measure is installed
  - Does not consider the additional savings that the measure will produce over the life of the equipment
  - This has historically been the basis for IOU program goals
- **Cumulative Savings**
  - Total savings from EE program efforts from measures installed starting in 2022 and that are still active in the forecasted year
  - Accounts for dual baselines, measures reaching end of useful life, measures being re-installed
  - Informs procurement planning




All results presented today are **incremental**

# Sources of Savings

The PG Model developed to forecast savings from multiple sources and sectors.

| | Residential | Commercial | Industrial | Agriculture | Mining |
|---|---|---|---|---|---|
| Rebated Technologies | X | X | X | X | X |
| Whole Building Programs | X | X | | | |
| Emerging Technologies | X | X | X | X | |
| Custom Applications | | | X | X | |
| Behavior, Retrocommissioning, Operational Efficiency (BROs) | X | X | X | X | |
| Codes and Standards | X | X | X | X | |
| Energy Efficiency Financing | X | X | | | |

# Scenario Design

| Levers → Scenario ↓ | C-E Test | C-E Threshold | Incentive Levels Capped | Program Engagement | Include Financing | Include EE-DR |
|---|---|---|---|---|---|---|
| **1: TRC Low** | TRC | 1 | 50% | Reference | No | No |
| **2: TRC Reference** | TRC | 0.85 | 50% | Reference | No | No |
| **3: TRC High** | TRC | 0.85 | 75% | Aggressive | Yes | No |
| **4: IRP Optimized** | TRC* | NA | 50% | Reference | No | No |

C-E = cost-effectiveness

Differences relative to the Reference Scenario

- Program engagement refers to the level of marketing awareness and effectiveness, as well as the level of aggressiveness of BROs program participation.
- Scenario 4:
  - Is based on the 38 MMT IRP scenario, the study also explored 46 and 30 MMT options
  - Does not have a C-E threshold for IRP; levelized costs are defined using the total resource cost
  - Does not include any fuel substitution or gas efficiency measures

# What Changed Since the Previous Study?

| Category | Update Relative to Previous Study | Directional Impact Relative to Previous Study | |
|---|---|---|---|
| **Lighting** | Incorporated higher efficiency LEDs provide savings above the standard LED baseline. | ↑ | Significant increase in lighting savings in the commercial sector. |
| **BROs** | Used more recent program evaluation results to inform the forecast. | ↑ | Gas savings increased across all scenarios, electric savings increased in some scenarios; Primarily from home energy reports (HERs). |
| **Whole Building** | Updated program data and new construction building codes, which provided refreshed inputs for whole building initiatives. | ↓ | Savings generally decreased across the commercial and residential sectors for gas and electric. |
| **Cost-Effectiveness** | Used 2020 avoided costs and revised measure inputs resulted in some measures no longer being cost-effective in early years. | ↓ | Decreases in savings observed for appliance/plug loads and commercial refrigeration. In 2026 and beyond avoided costs increase allowing more measures to become cost-effective, albeit with low impact. |
| **Market Adoption Study** | Included broader set of customer preferences on economic and non-economic factors when modeling technology adoption. | ↑↓ | Revised data affects different measures different ways. Measures that provide non-EE benefits to customers see increased adoption. Measures with low non-EE benefits and higher hassle see decreased adoption. |
| **Ind/Ag Study** | Incorporated primary data collected for these two sectors. | ↑↓ | Revised market data results in a higher forecast of electric savings from these sectors but shows decreased gas savings. |
| **EE-DR Integration** | Considered the costs and benefits of DR-enabled technologies along with their EE benefits. | ↑ | Accounting for DR benefits and costs overall would result in about a 5% increase in EE potential in the applicable end uses (lighting, appliances, water heating, HVAC). |
| **Fuel Substitution** | Allowed fuel substitution measures to be included in EE programs. | ↑ | The model shows very limited uptake of fuel substitution measures in this first assessment, though it does contribute to additional savings. |

# Overall Results

*For Rebate Programs and BROs*

*Excludes ESA/Low Income and C&S*

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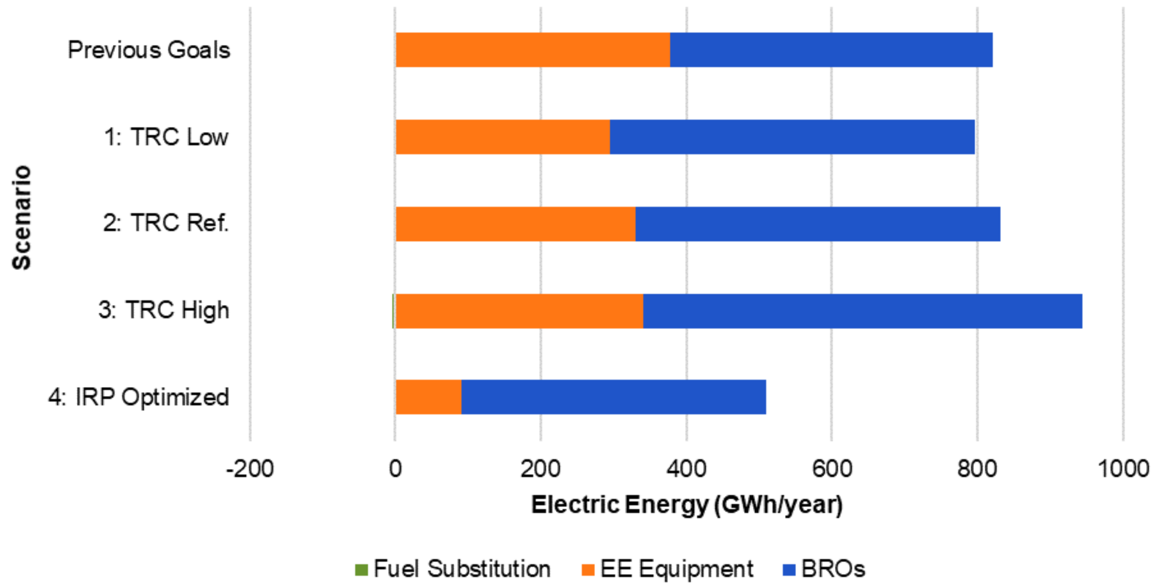
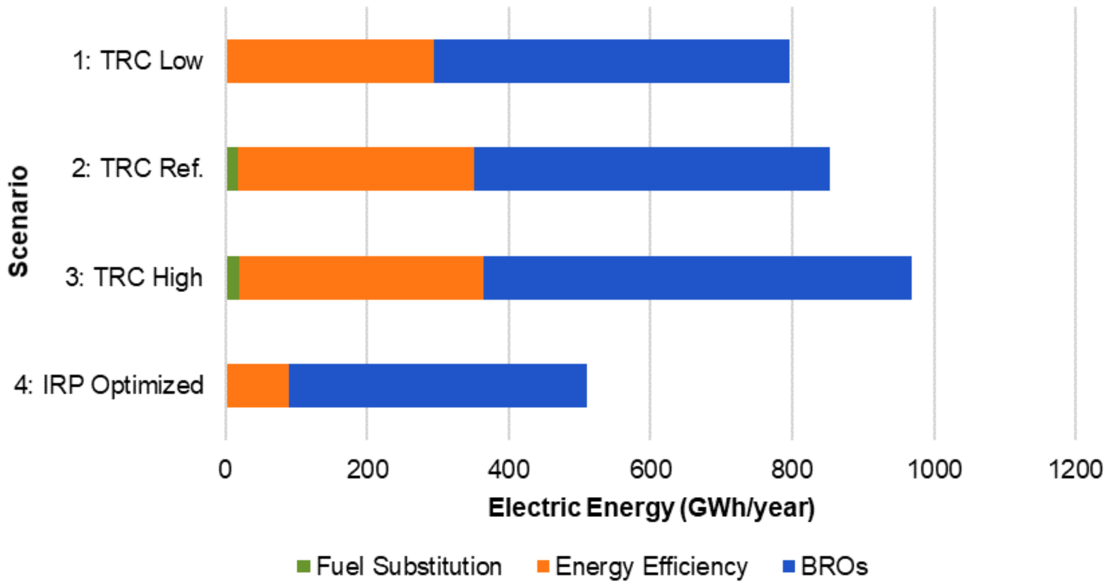
# 2022 Net Incremental Achievable Potential – Electric Energy

## Electric Savings




## Electric Savings – Fuel Substitution Converted

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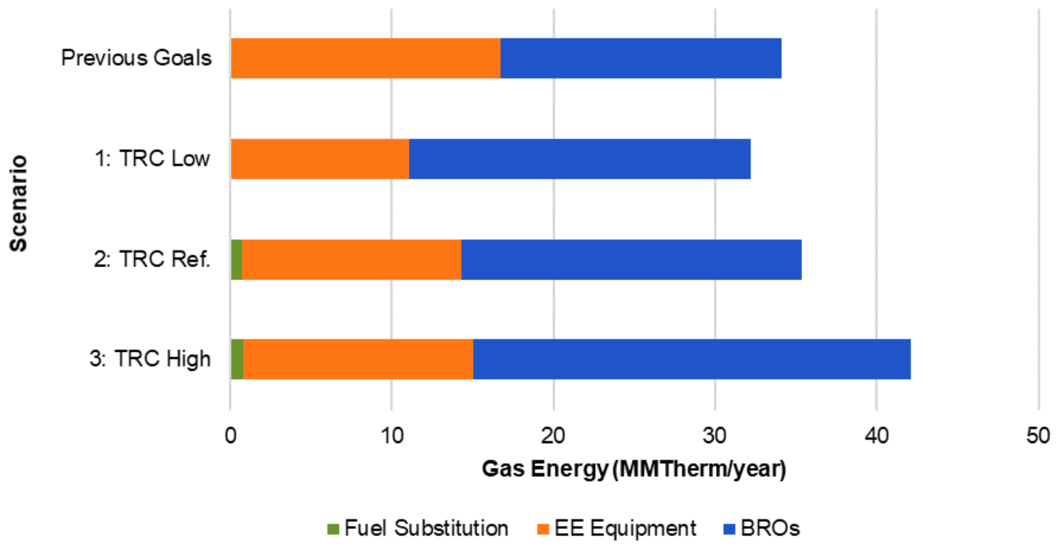
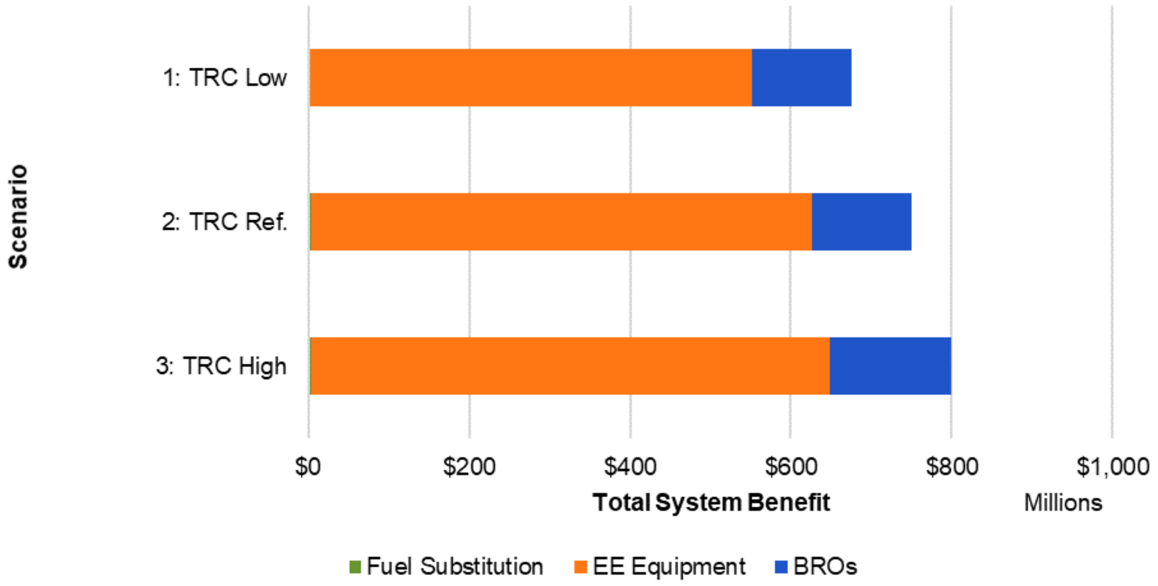
# 2022 Net Incremental Achievable Potential – Gas Energy and TSB

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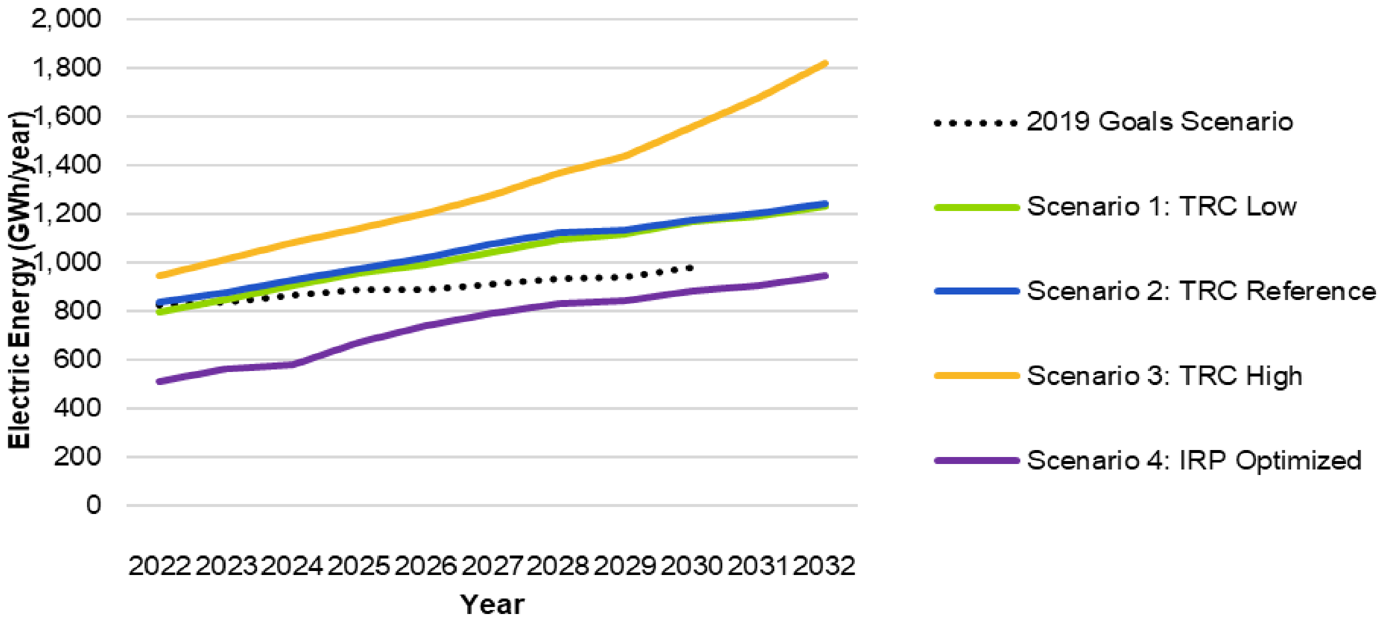
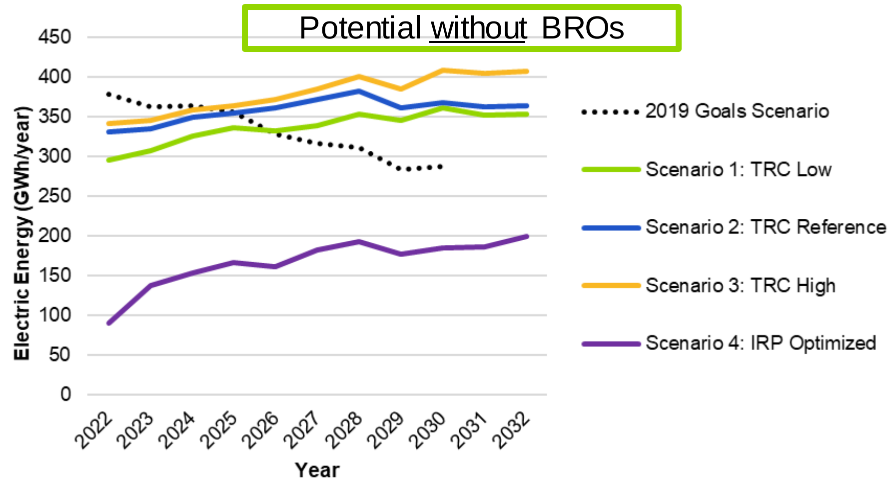
# Scenario Potential Results

## Electric Energy

- Equipment rebate program savings are different for each scenario
- BROs savings vary only in terms of reference versus aggressive. Scenario 3 is the only one with the aggressive program engagement



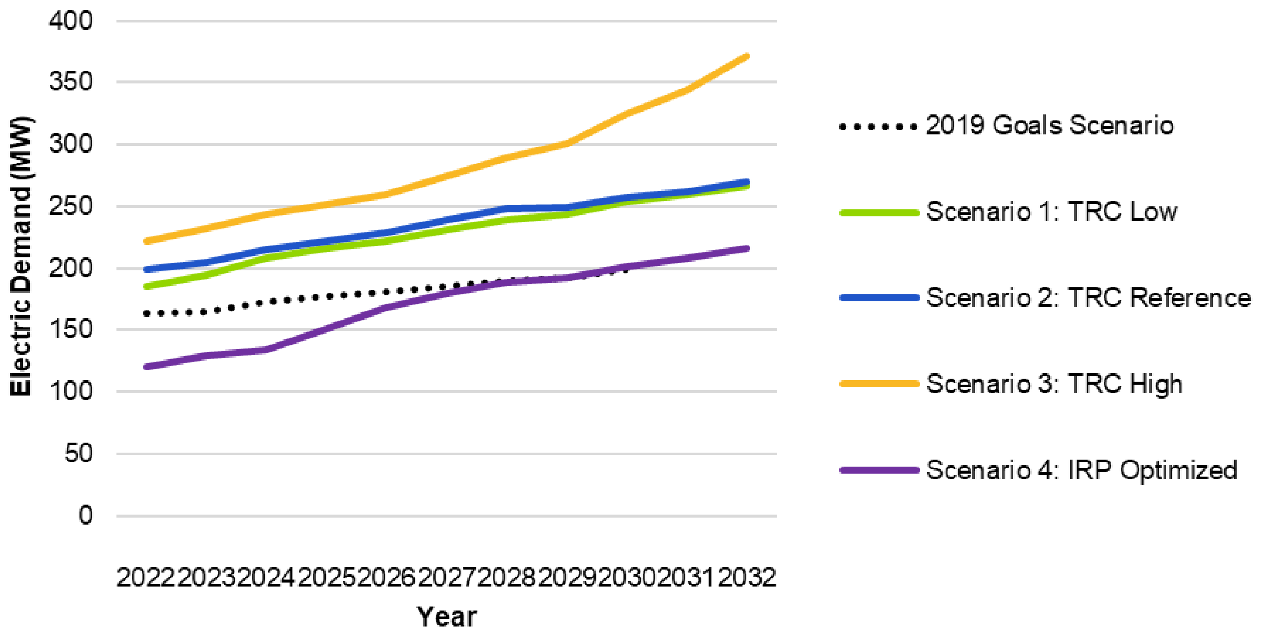

- BROs savings bolstered 2019 potential forecast in future years
- BROs provides 60-80% of the first-year savings (depending on the scenario and year)



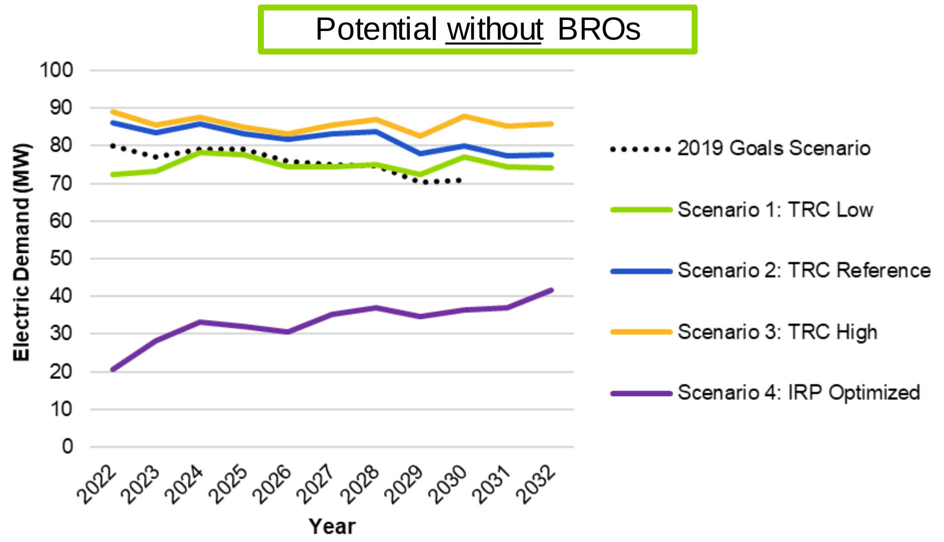
# Scenario Potential Results

## Peak Demand

- Equipment rebate program savings are different for each scenario
- BROs savings vary only in terms of reference versus aggressive. Scenario 3 is the only one with the aggressive program engagement




- Without BROs savings are relatively flat over forecast period

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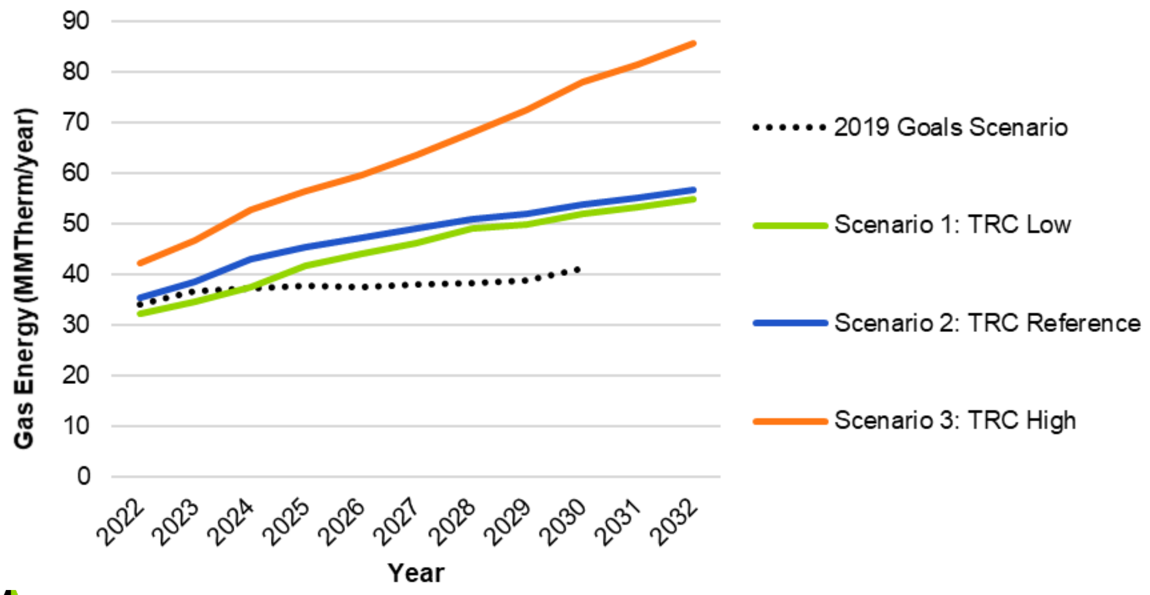
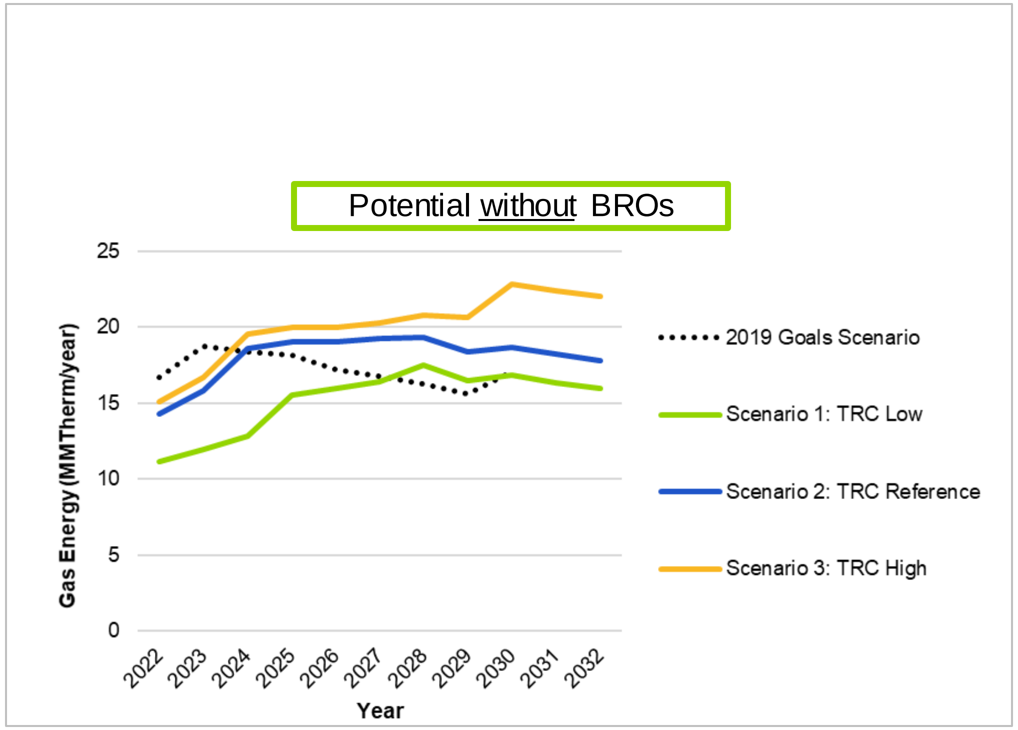
# Scenario Potential Results

## Gas Energy

- Scenario 4 is not displayed since the IRP only considers electric savings
- Scenario 1 with a TRC of 1.0 and Scenario 2 with a TRC of 0.85 have little difference in their savings potential.
- The trends to increase savings are driven in Scenario 3 by changing to aggressive program engagement
- BROs savings smooths out the code baseline adjustments every 3 years (Title 24 baseline)

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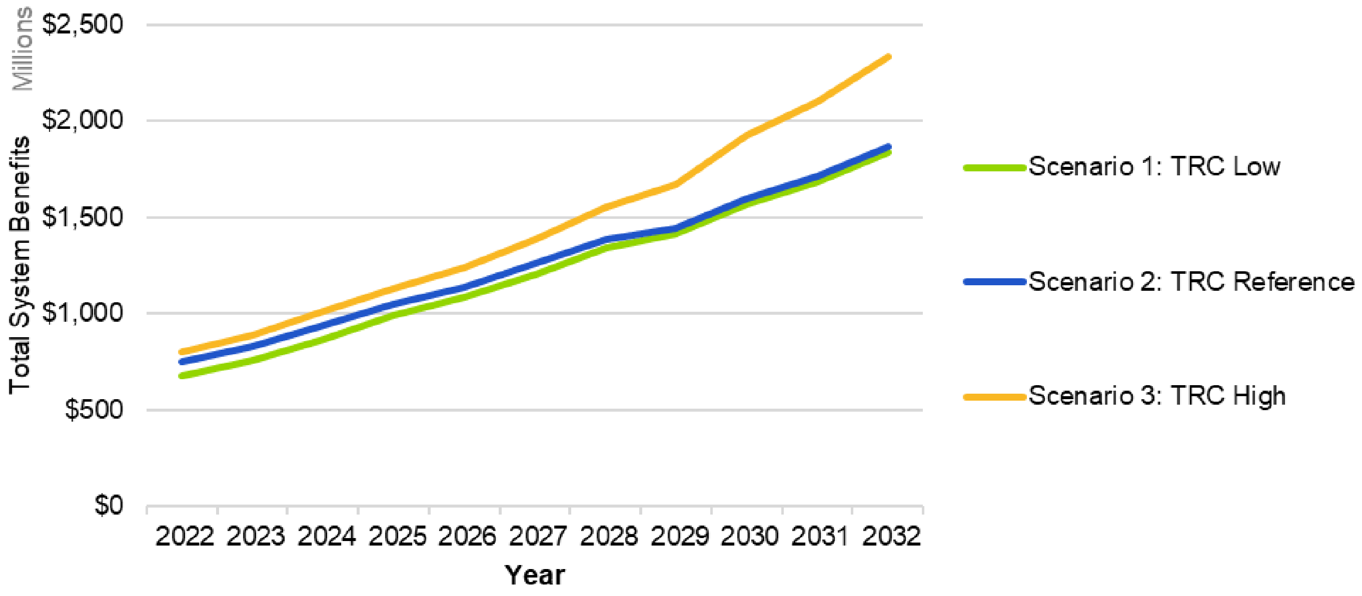
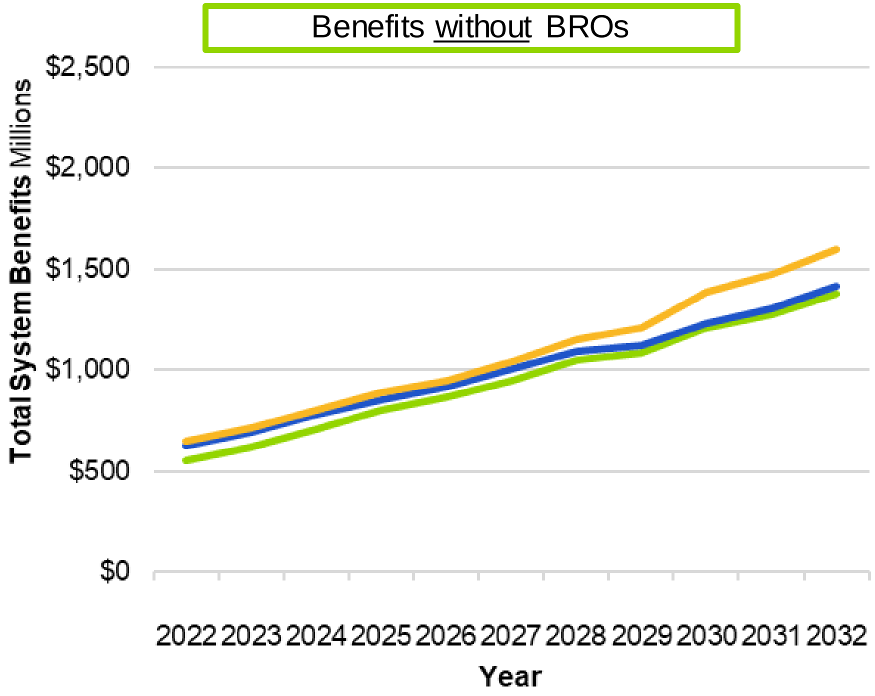
# Scenario Potential Results

## Total System Benefits

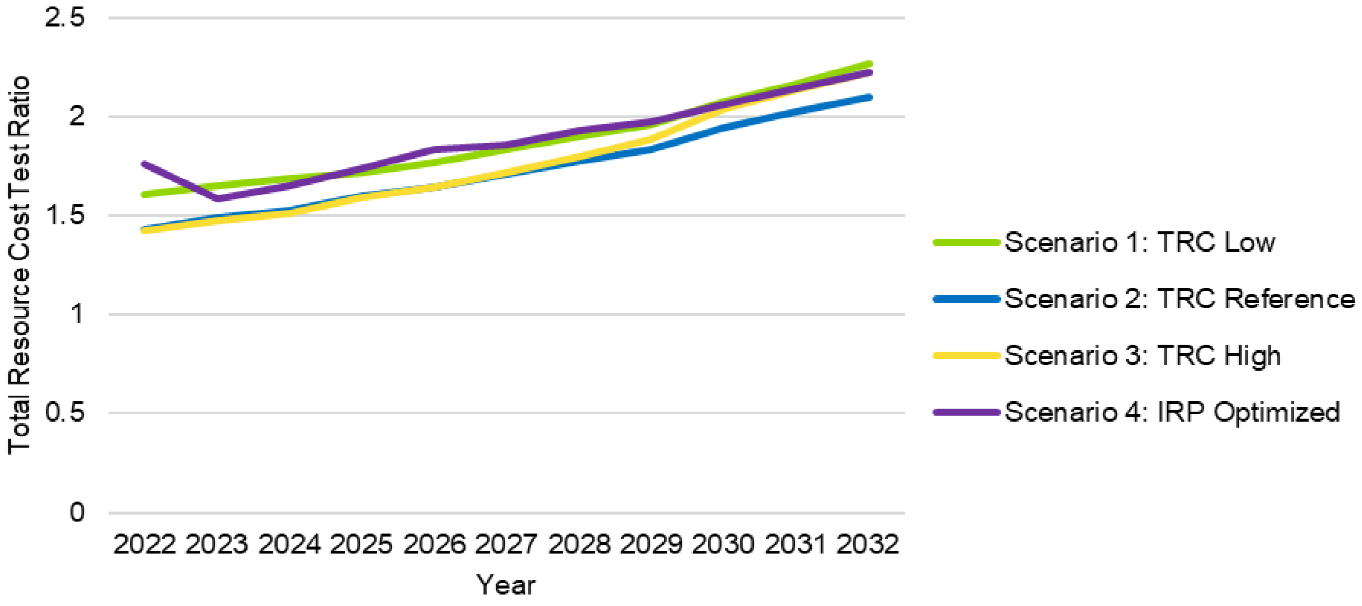
- TSB appears smoother than the first-year savings because TSB is a lifecycle benefit calculation across all savings. Longer life measures have high lifecycle benefits resulting in high TSB.
- TSB tracks with EE equipment savings and avoided costs
- Although EE equipment savings is flat, TSB grows due to growth in avoided costs
- Smaller proportion of TSB comes from BROs compared to BROs' contribution to first year savings



# Scenario Potential Results

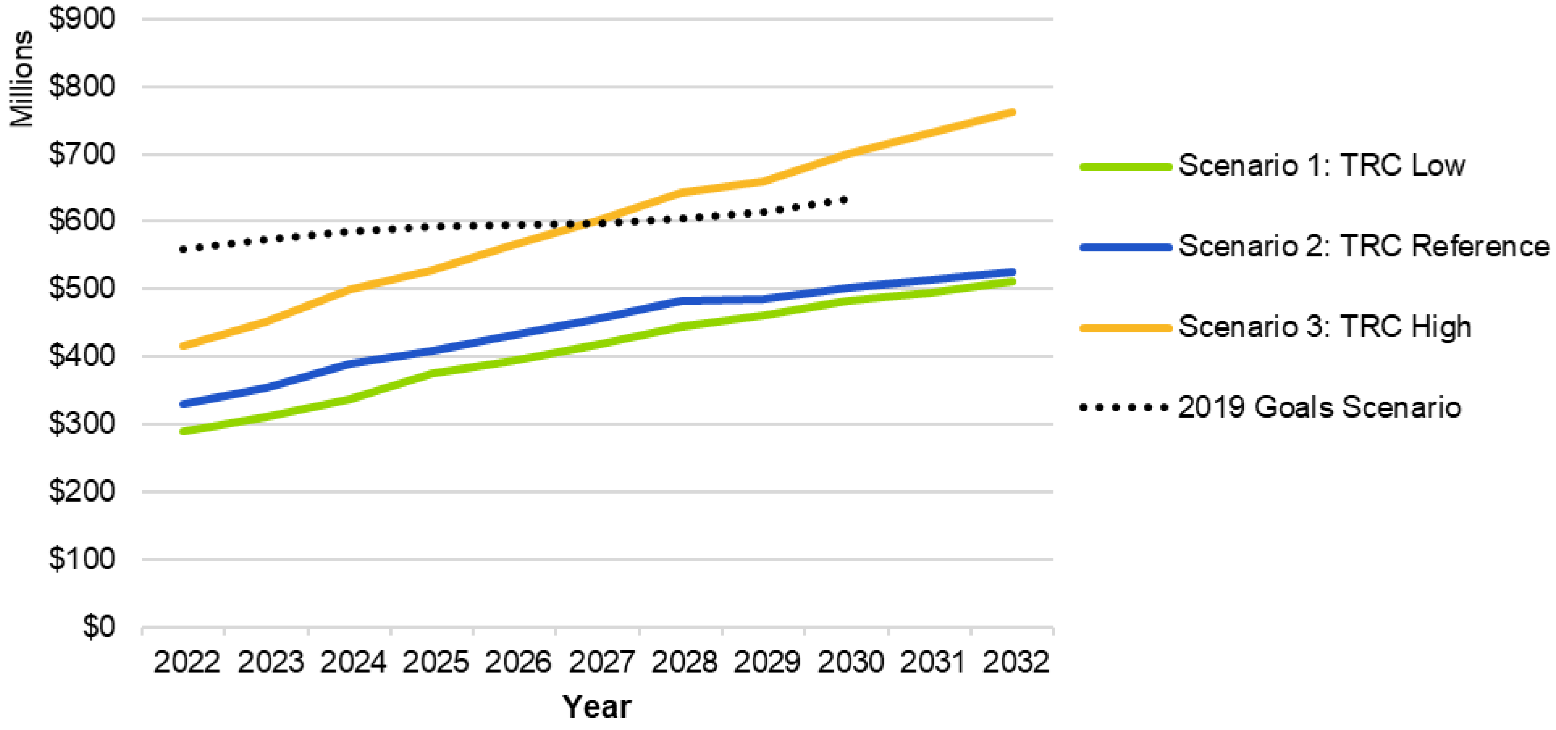
## Cost-Effectiveness




- Account for benefits and costs from rebated measures and BROs (exclude low income and C&S)
- Results exclude non-resource program costs, which are typically accounted for in a portfolio-level cost-effectiveness assessment.
- Scenario 3 is higher than Scenario 2 in the later years, mostly due to the growth in BROs program penetration over the study period. BROs programs tend to have a higher TRC than the EE equipment.
- The TRC is generally the highest for the IRP Optimized scenario because the IRP model selects the lowest cost measure bundles on the supply curve and BROs programs.

# Scenario Potential Results

Program Spending for resource acquisition programs (EE equipment and BROs programs)



# Discussion/Questions

# Rebate and BROs Programs

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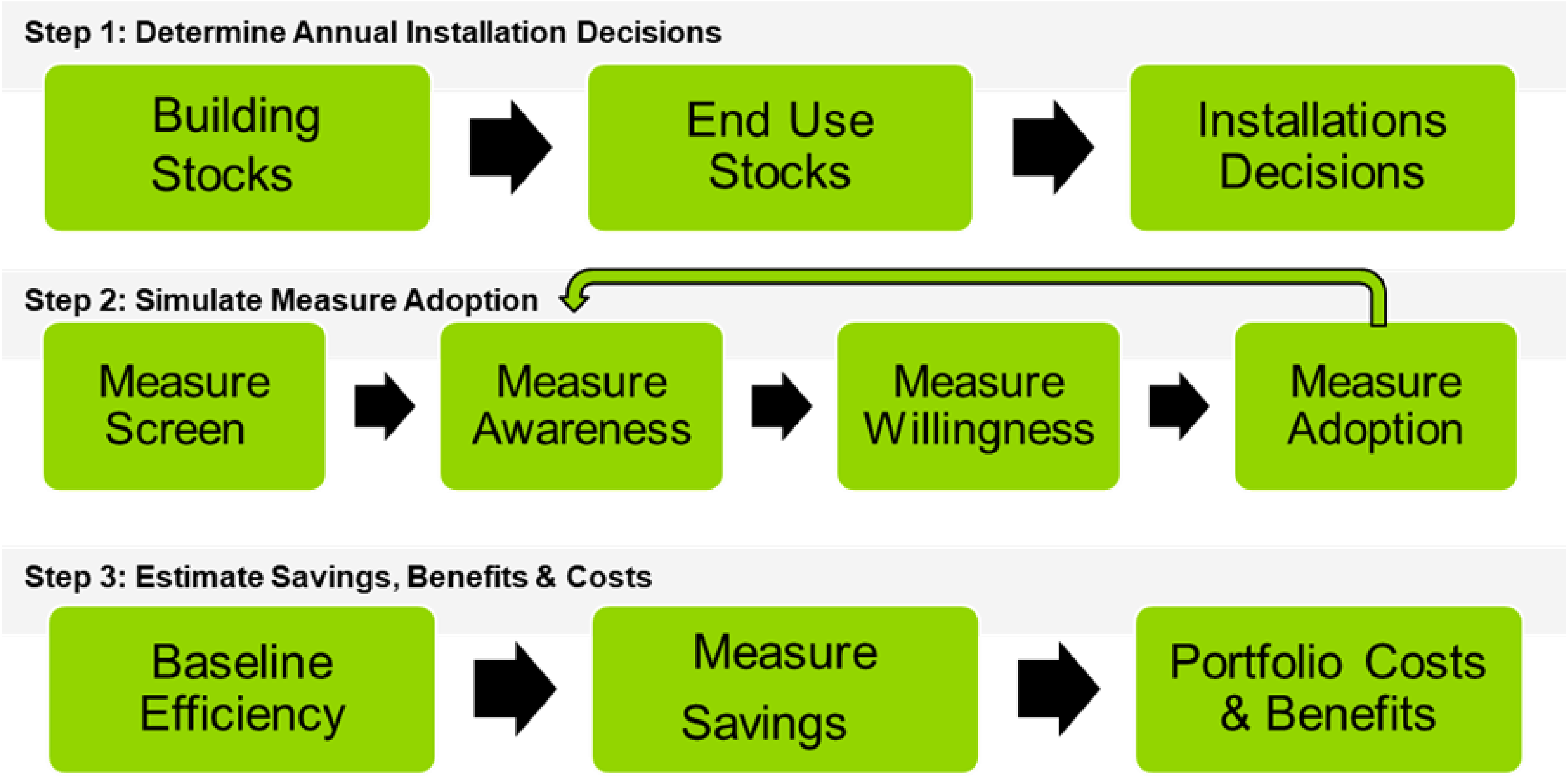
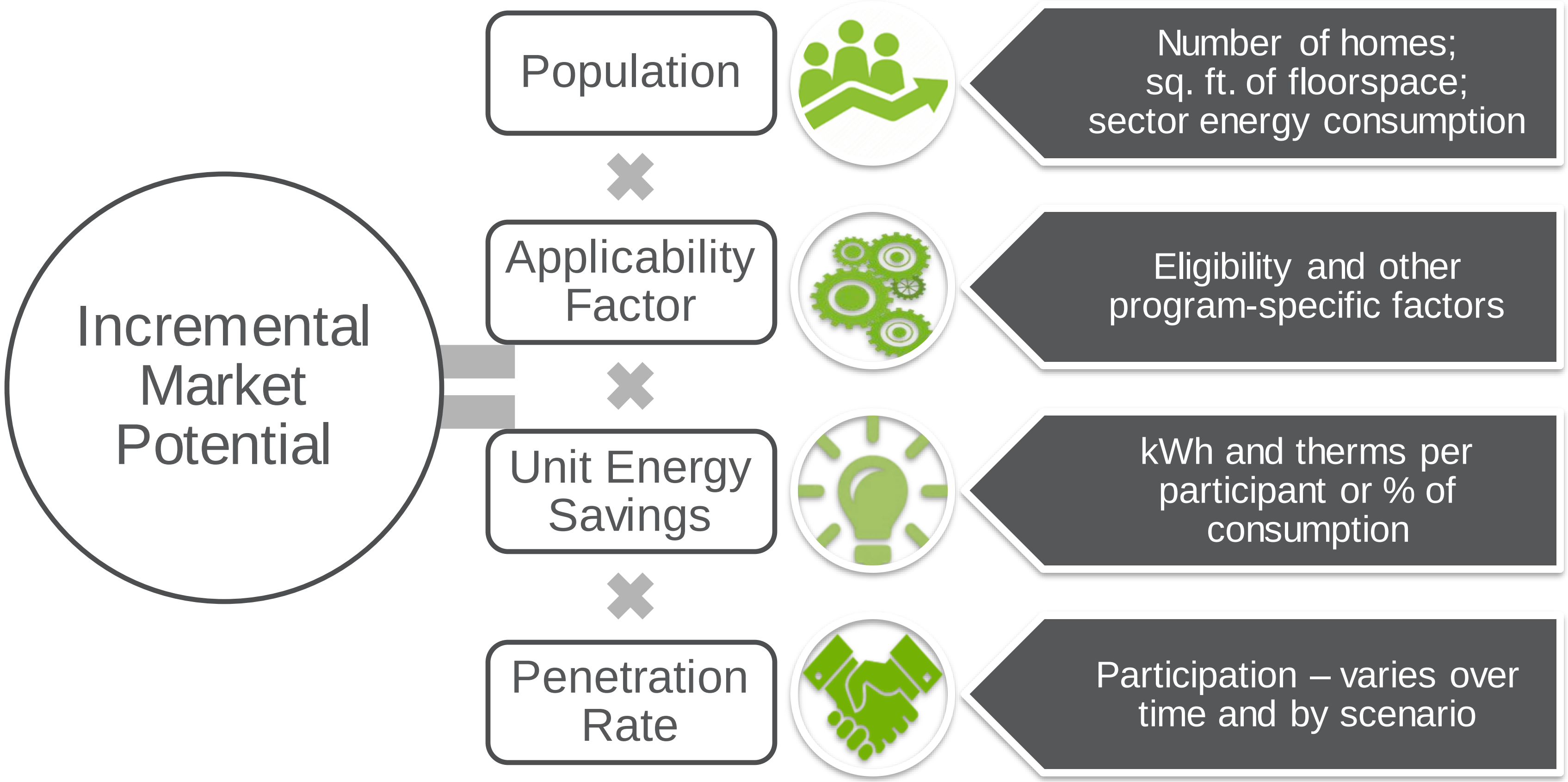
# Bottom-up Approach – Rebated Technologies

## Residential, Commercial, Characterized Custom Ind/Ag/Mining



# Top-Down Approach – Rebated Programs and BROs

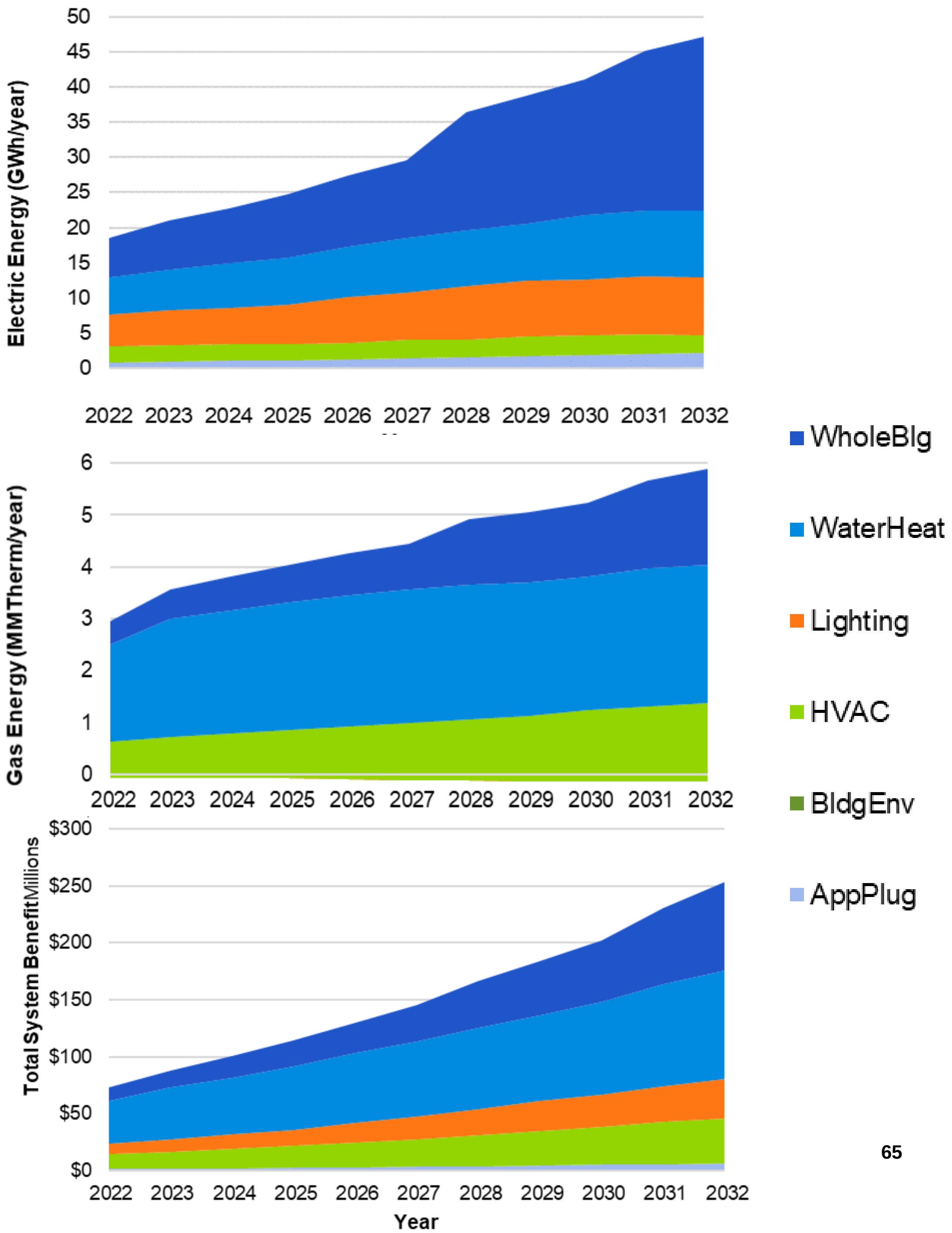
## BROs Programs and Industrial/Agriculture Generic Custom and Emerging Technologies



# Residential - EE Equipment
## Scenario 2: TRC Reference

Note: Does **not** include BROs

- Whole building and water heating are key drivers
- Whole building savings are mostly from exceeding building code in new construction homes
- Water heating generates the most TSB of all Residential end uses
- The lower TRC threshold between Scenario 1 (1.0 TRC) and Scenario 2 (0.85 TRC) result in:
  – Adopted fuel substitution (decreasing electric and increasing gas HVAC)
  – Increased water heating and appliance/plug load measures

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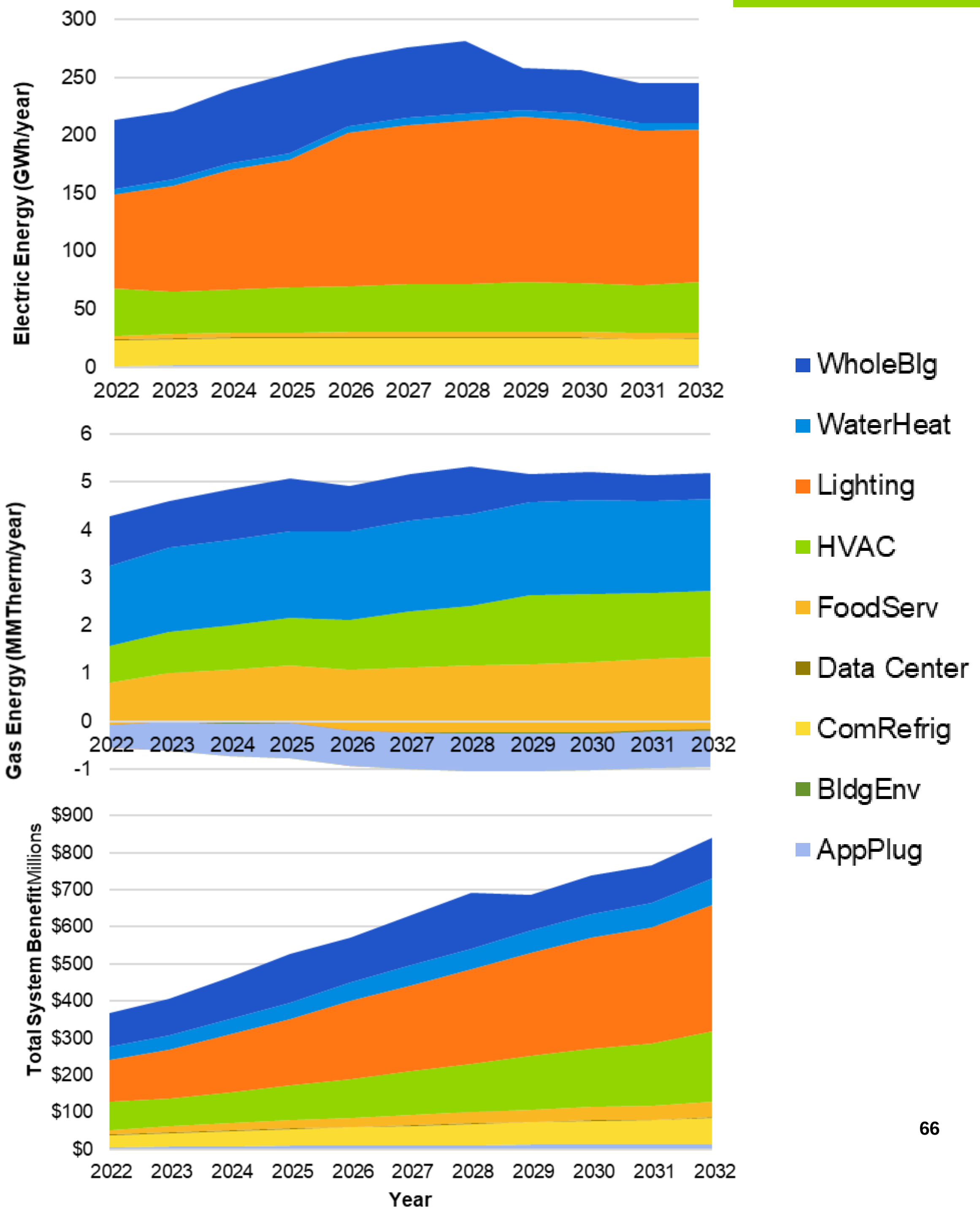
# Commercial - EE Equipment

## Scenario 2: TRC Reference

Note: Does **not** include BROs

- The key drivers are Lighting, HVAC, Water Heating, and Whole Building
  - Efficient LED fixtures provide new potential for commercial LED fixtures whereas, in the previous study, limited lighting potential existed due to the LED baseline policy
  - Whole building savings decreases are adjustments made to a shifting baseline due to Title 24 code updates
- The lower TRC threshold between Scenario 1 (1.0 TRC) and Scenario 2 (0.85 TRC) result in:
  - Increasing electric savings by 10%.
  - Commercial water heating increases about 20% from instantaneous gas water heaters.

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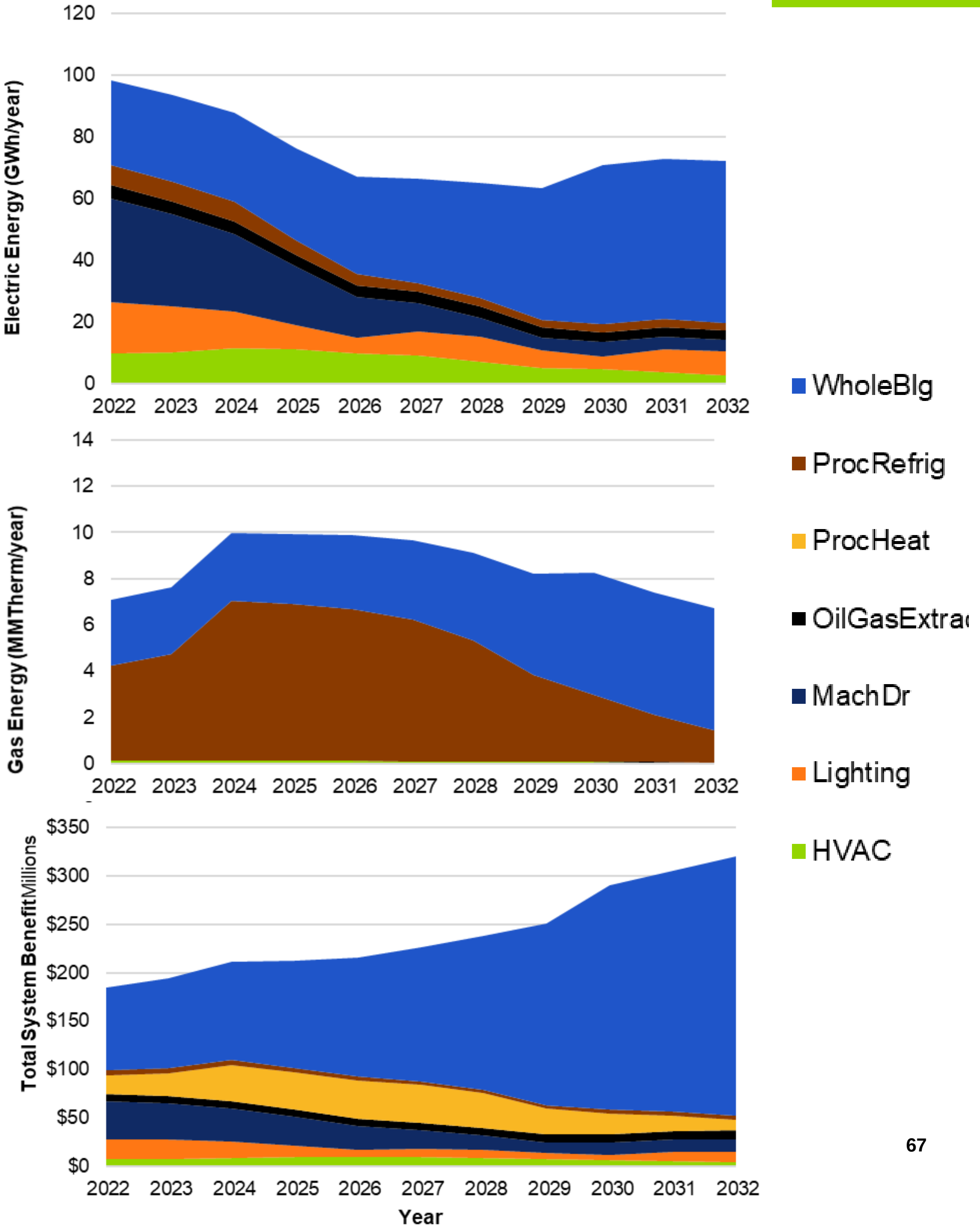
Negative gas savings are due to the lighting interactive effects. AppPlug end use has positive savings that overlaps on the figure with the negative lighting savings.

# Agriculture, Industrial, and Mining EE Equipment

## Scenario 2: TRC Reference

Note: Does **not** include BROs

- The Ind/Ag Market Study uncovered additional opportunities for savings
- Overall sector first-year incremental savings are still forecast for both electric and gas to decrease over time due to the market saturation of characterized EE measures
- Whole Building (Generic Custom and Emerging Technology) are a large portion of the TSB
- TSB grows over time despite flat/declining energy savings as avoided costs increase
- Scenario 2 savings have 27% more than Scenario 1 due to increase in process heat.

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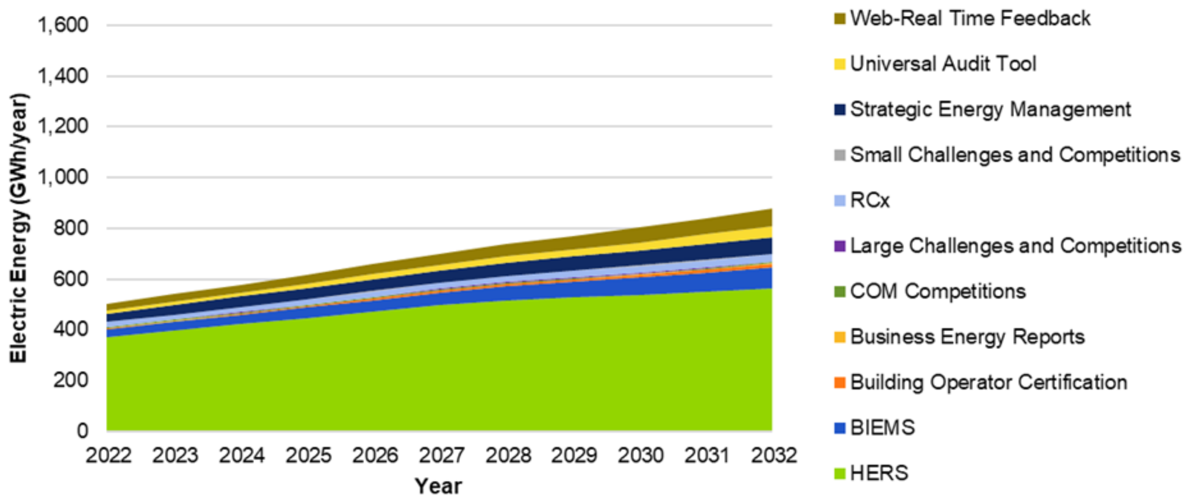
# BROs Results

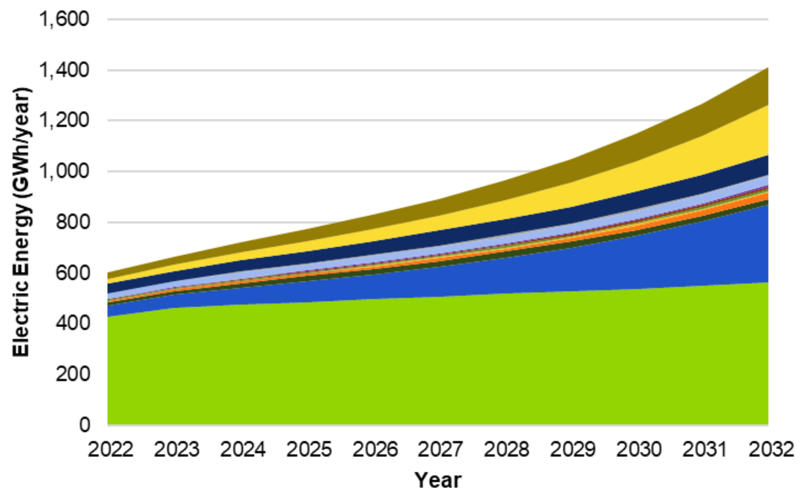
## Savings grow as participation increases over time

- **Residential**: Home Energy Reports (HERs) presents the greatest potential for electric, gas, and peak demand.
- **Commercial**: Building Energy and Information Systems (BEIMS) show significant electric and peak demand savings.
- **Industrial/Agricultural**: Strategic Energy Management is a bigger contributor to gas savings than it is for electric savings

Reference




Aggressive

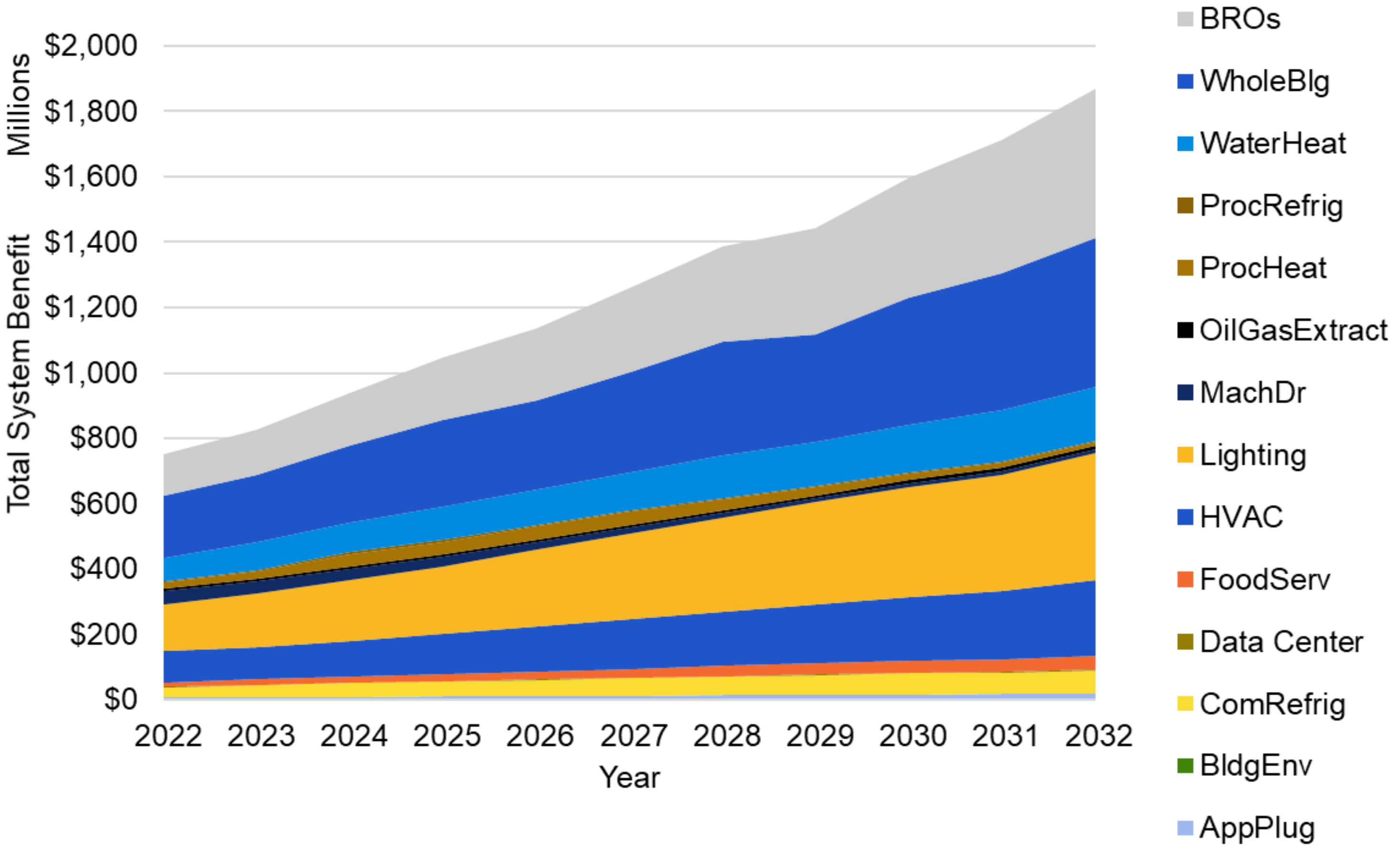



Aggressive level of engagement increases savings 18% and 28% in 2022 and 61% and 63% in 2032 for electric and gas, respectively.

# TSB Results – EE Equipment + BROs Combined

## Scenario 2: TRC Reference

- TSB figure includes EE, FS, and BROs
- TSB increases over time as avoided costs increase
- BROs contributes over 50% of the first-year energy savings, but a smaller portion of the TSB due to its short EUL
- AIM TSB increases over time despite the decrease in energy savings due to the increasing avoided costs

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# 2021 Potential and Goals Final Report

May 13, 2021

| Start | End | Agenda Item | Presenter |
|---|---|---|---|
| 2:40 PM | 2:55 PM | Ind/Ag Study* | Chris Dyson |
| 2:55 PM | 3:10 PM | Market Adoption Study* | Benn Messer |
| 3:10 PM | 3:20 PM | Discussion | Travis Holtby |
| 3:20 PM | 3:35 PM | Fuel Substitution | Karen Maoz |
| 3:35 PM | 3:45 PM | EE-DR | Debyani Ghosh |
| 3:45 PM | 3:55 PM | IRP | Karen Maoz |
| 3:55 PM | 4:00 PM | 5 min break | |
| 4:00 PM | 4:10 PM | COVID sensitivity | Amul Sathe |
| 4:10 PM | 4:25 PM | Discussion | Travis Holtby |

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*Timeslot includes time for Q&A

# Part 3 – Key Topics: Methodology and Results

# Industrial and Agriculture Study

DNV·GL

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## Targeted Subsectors

- **Industrial**
  - –Food services/production
  - –Chemical manufacturing
  - –Electronics/semiconductor
- **Agricultural**
  - –Greenhouses
  - –Dairies
  - –Water pumping (agricultural sector only)

## Research Objectives

- Identifying up to 3 technologies/systems with greatest potential for future energy savings in 6 prioritized subsectors
- Quantifying market penetration of selected technologies/systems
- Projecting customer willingness to adopt EE technologies w/ and w/o program interventions

# Data Collection for P&G Model Inputs

## Industrial and agriculture measure characterization

- Percent savings, as a % of end use related to the measure
- Percent end use, as a % of total site usage
- Percent of sites with equipment (technical applicability and suitability for the technology)
- Percent at baseline conditions

Included 18 measure characterizations for the P&G model

- Introduction of an EE measure that had previously not been in the model
- Revision of an existing measure and now characterized at a finer level with CA-based data
  - E.g., heat recovery in the Chemical Manufacturing sector

# ~60 expert interviews & lit review were used for EE technology/system identification

| Industrial | Agriculture |
|---|---|
| **Chemical Manufacturing** | **Dairies** |
| Heat recovery | Heat recovery |
| Automation and optimization | VFDs on pumps |
| VSDs | Fans and ventilation |
| **Electronics Manufacturing** | **Greenhouses** |
| Chilled water plant optimization | LED growlights |
| O&M retrocommissioning | High efficiency HVAC |
| Low-pressure drop HEPA/ULPA filters | Energy curtains |
| **Food Production** | **Water Pumping for Agriculture** |
| Refrigeration system optimization | Efficient pumps and motors |
| Heat recovery | Sensors and controls |
| VFDs | Comprehensive program |

# Vendor & Customer Interviews

- ~60 equipment vendor interviews for recommended EE measures - Vendors identified through web searches, lit review, PA referrals, and initial vendor interviews
- 50 end user interviews across the 6 subsectors – Identified by NAICS code in InfoSource database

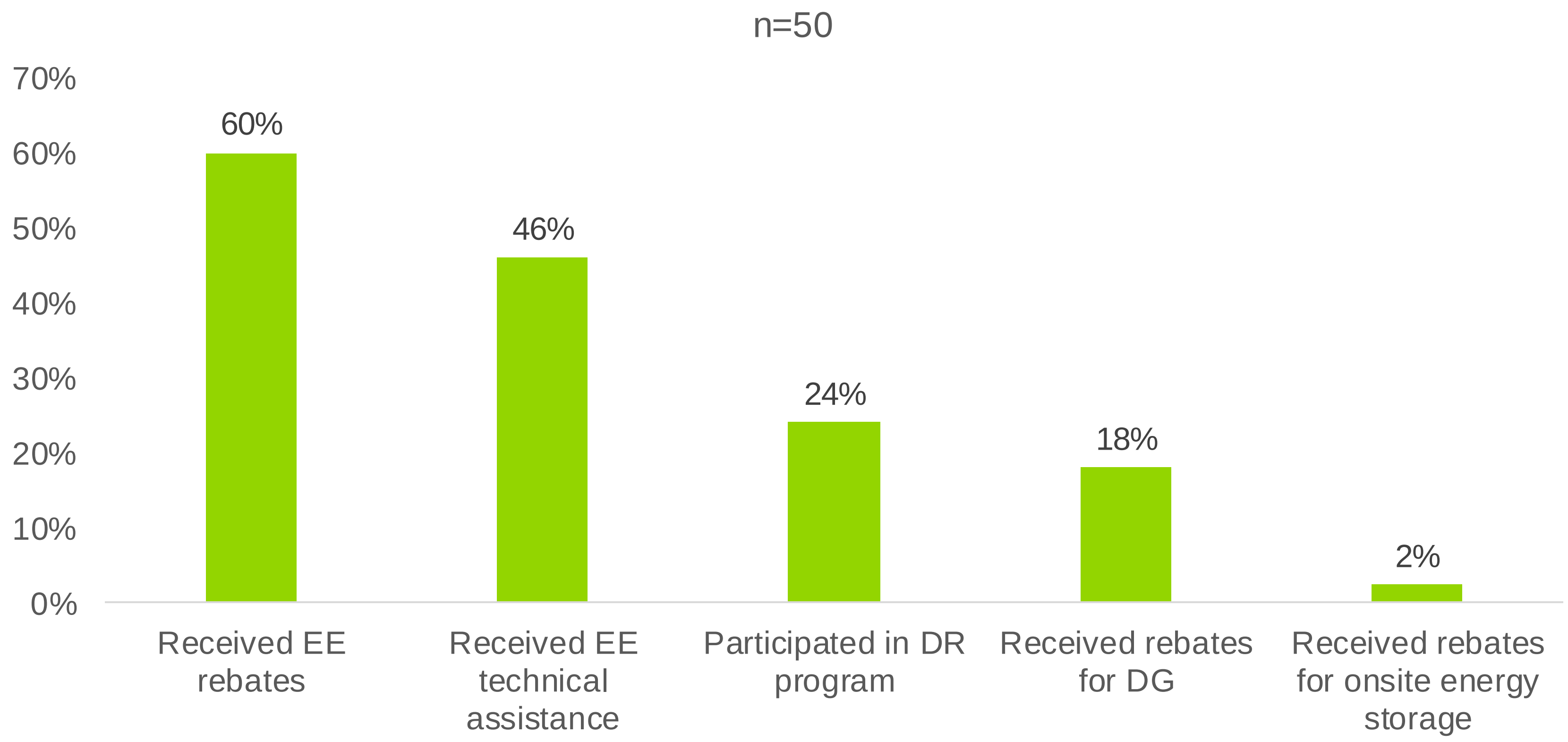
| Scope of Vendor Interviews | Scope of Customer Interviews |
|---|---|
| • Penetration of recommended EE measures as observed among their client base<br>• Barriers to EE implementation<br>• Whether EE faced competition from renewables, DR<br>• Average energy savings of these EE measures | • Penetration of recommended EE measures w/in their own facility<br>• Barriers to EE implementation<br>• Whether EE faced competition from renewables, DR<br>• Payback/ROI criteria for EE projects<br>• Awareness of, participation in EE, DG, and DR programs/rebates<br>• Likelihood of purchasing EE equipment based on example incremental costs & incentive levels<br>• Involvement in DG and its impacts on their willingness to invest in EE<br>• Impact of COVID on operations |

# EE Measure Saturation

- Saturation is the % of applicable equipment that is energy efficient
- Sizable opportunities for EE improvements exist in the industrial and agricultural subsectors
  - Only one of the 17 EE measures had saturation levels above 60%
  - 7 of the EE measures had saturation levels below 40%

| Subsector | EE Measure | Average Measure Saturation |
|---|---|---|
| Electronics Manufacturing | Chiller plant optimization | 15% |
| | RCx | 44% |
| | Low pressure drop filters in cleanroom spaces | 38% |
| Food Production | Refrigeration system optimization | 43% |
| | Boilers and heat recovery | 15% |
| | VFDs on pumps and motors | 68% |
| Chemical Manufacturing | Heat recovery | 21% |
| | Advanced automation and optimization | 31% |
| | Mechanical drives/VSDs | 46% |
| Dairies | Refrigeration system heat recovery | 24% |
| | VFDs on pumps | 32% |
| | EE fans and ventilation | 55% |
| Water Pumping for Agriculture | Efficient pumps and motors | 53% |
| | Sensors and controls | 52% |
| Greenhouses | LED grow lights | 40% |
| | EE HVAC | 44% |
| | Energy Curtains | 51% |

# EE, DG, and DR programs have much untapped potential in industrial/ag subsectors




~40% of facilities haven't reported ever receiving an EE rebate

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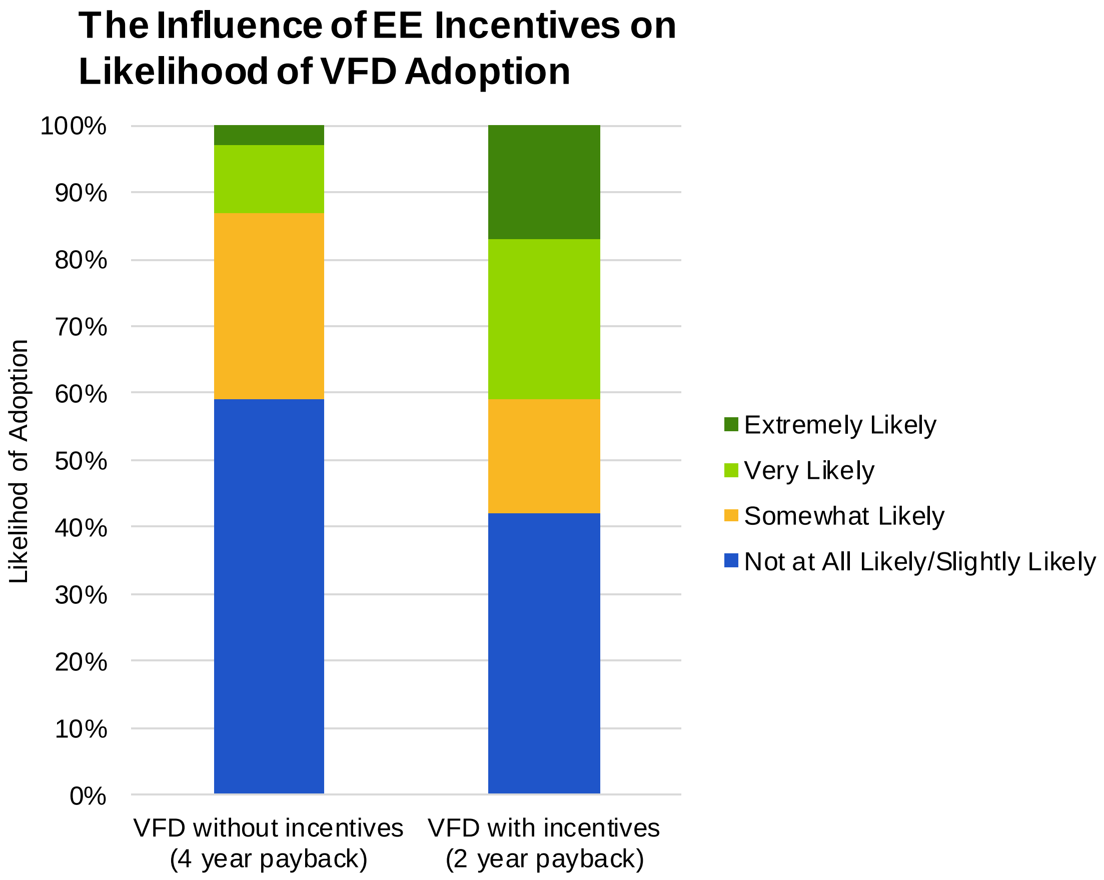
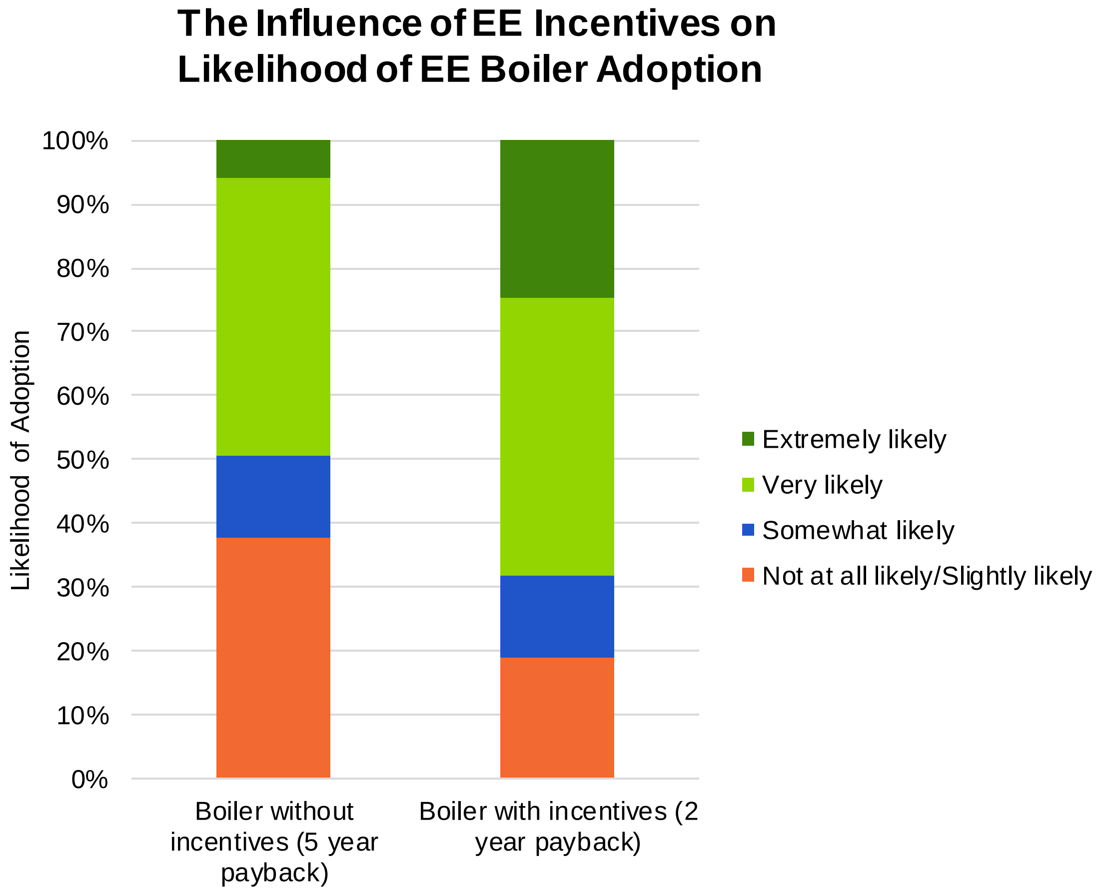
# EE Incentives can Impact Willingness to Adopt EE



# Recommendations for Future Research

- Completing IDIs with DG experts and equipment vendors
- Conducting a broader and deeper analysis of the NEM database
- Studying the impacts of greenhouse expansion on the lighting mix in the California agricultural sector
- Interviewing additional greenhouse end users

# Integrating Data into the PG Study

## Information informed multiple inputs and parameters

- Measure input characterization:
  - *Energy savings:* measure's estimated energy savings
  - *Technology density:* percentage of sites with equipment
  - *Technology efficiency saturation level:* percentage of sites that have the equipment that are at baseline efficiency levels
  - *Technical suitability:* percentage of sites that are willing and able to install a given technology
- Adjustments to model's willingness curves
  - Aligning national data collected on payback acceptance with the information available from this market study
- Revised market data results in a higher forecast of electric savings from these sectors but shows decreased gas savings

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# Market Adoption Study

Opinion Dynamics

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# Market Adoption Study

**Objectives**

- Consider a broader set of customer preferences on economic and noneconomic factors when modeling energy efficient technology, fuel substitution, and demand response (DR) adoption
- Collect residential and commercial customer characteristics, attitudes, and behaviors (value factors) to inform reported adoption decision-making
- Create distinct clusters of residential customers (non-low income single-family) that share similar attitudes about the environment, energy conservation, social signaling, and financial outlook to inputs into the PG model

**Data Collection Approach**

- Mail-push-to-web surveys across residential, multifamily, and commercial segments
- Surveys fielded July to September 2020

| Segment | Sample Size | Completes | Response Rate | Incentive |
|---|---|---|---|---|
| **Single Family Residential** | 7,475 | 598 | 14% | $10 |
| **Multifamily Residential** | 3,030 | 104 | 8% | $25 |
| **Commercial** | 19,270 | 757 | 7% | $25 |

# Value Factor Descriptions

- Customers' considerations when making energy efficient equipment purchase decisions that can influence their willingness to make the purchase
  - Lifetime Costs: importance of long-term energy costs/savings of the equipment
  - Upfront Costs: importance of initial out-of-pocket price of equipment
  - Eco Impacts: importance of environmental impacts from energy consumption
  - Social Signals: importance of being perceived as environmentally/socially responsible
  - Hassle Factor: importance of ease/difficulty, convenience/inconvenience of installing/operating equipment
  - Non-consumption Performance: importance of non-energy benefits, aesthetics, features

- Mean scores will be reported across EE, DR, and fuel switching measures by segment
  - 1 to 5 scale where 1 means not at all important and 5 means very important in decision making.

# Single-Family Segmentation Clusters

- Used Latent Class Analysis, a statistical method, to identify four attitudinal-based clusters
  - The attitudinal inputs included values related to environmental preservation, energy use and conservation, purchasing decisions, social signaling, and perceived financial wellbeing

| Cluster | Size | Description |
|---|---|---|
| Average Californians | 50% | Attitudes and values are normally distributed (does not strongly skew in either direction on most items) |
| Eager Adopters | 20% | Believes strongly in environmental issues, wants to save energy, and has the financial means to afford energy upgrades |
| Likely Laggards | 19% | Not very concerned with environmental issues, saving energy, or social signaling; fairly apathetic |
| Economically Strained Environmentalists | 11% | Extremely concerned with environmental issues, however efficiency upgrades can be out of financial reach, so desire to save energy is both altruistic and pragmatic; social signaling is important |

# Overall Value Factors For All EE Measures

- Value factors listed from most to least important and are somewhat consistent between the groups

| Segment | Eco Impacts | Lifetime Costs | Hassle Factor | Non-Consumption Performance | Social Signals | Upfront Costs |
|---|---|---|---|---|---|---|
| **SF (n=598)** | 4.1 | 3.6 | 3.2 | 3.2 | 3.1 | 2.7 |
| **MF (n=104)** | 4.2 | 3.4 | 3.4 | 2.8 | 3.6 | 2.8 |
| **COM (n=757)** | 4.1 | 3.6 | 3.2 | 3.0 | 3.6 | 2.5 |

# Value Factors For EE Measure Types

| High-Touch Technology | Lifetime Costs | Hassle Factor | Non-Consumption Performance | Upfront Costs |
|---|---|---|---|---|
| SF | 3.6 | 3.2 | 3.0 | 2.6 |
| MF | 3.4 | 3.4 | 2.7 | 2.7 |
| COM | 3.5 | 3.2 | 2.9 | 2.3 |
| **Low-Touch Technology** | | | | |
| SF | 3.7 | 3.2 | 3.4 | 2.8 |
| MF | 3.5 | 3.5 | 2.9 | 2.8 |
| COM | 3.6 | 3.2 | 2.9 | 2.7 |
| **Fuel-Substitution** | | | | |
| SF | 3.4 | 3.2 | 3.3 | 2.8 |
| MF | 3.3 | 3.3 | 3.1 | 2.8 |
| COM | 3.3 | 3.2 | 2.9 | 3.2 |

# SF Residential Value Factors: All EE Measures by Clusters

| SF Clusters | Lifetime Costs | Eco Impacts | Hassle Factor | Social Signals | Non-Consumption Performance | Upfront Costs |
|---|---|---|---|---|---|---|
| Average Californians (n=299) | 3.6 | 4.0 | 3.2 | 2.9 | 3.2 | 2.8 |
| Eager Adopters (n=120) | 4.0 | 4.9 | 3.2 | 3.4 | 3.2 | 2.1 |
| Likely Laggards (n=114) | 3.1 | 3.2 | 3.1 | 2.7 | 2.9 | 2.4 |
| Economically Strained Environmentalists (n=66) | 3.8 | 4.5 | 3.3 | 3.8 | 3.1 | 3.4 |

# Commercial Value Factors: All EE Measures by Segment

| Segment | Eco Impacts | Social Signals | Lifetime Costs | Hassle Factor | Non-Consumption Performance | Upfront Costs |
|---|---|---|---|---|---|---|
| Office (n=175) | 4.1 | 3.6 | 3.5 | 3.2 | 3 | 2.3 |
| School (n=31) | 4.3 | 3.8 | 3.7 | 3.4 | 3.1 | 2.6 |
| Retail (n=101) | 4.0 | 3.5 | 3.5 | 3.3 | 2.9 | 2.7 |
| Other (n=124) | 4.0 | 3.5 | 3.5 | 3.1 | 2.8 | 2.7 |
| Health (n=102) | 4.2 | 3.8 | 3.6 | 3.5 | 3.0 | 2.6 |
| Restaurant (n=61) | 4.1 | 3.7 | 3.5 | 3.2 | 3.0 | 2.5 |
| Warehouse (n=82) | 3.9 | 3.6 | 3.6 | 3.2 | 2.8 | 2.5 |
| Lodging (n=47) | 4.2 | 3.8 | 3.6 | 3.1 | 3.1 | 2.7 |
| Grocery (n=25) | 3.7 | 4.0 | 3.7 | 3.3 | 3.4 | 2.9 |
| College (n=9) | 4.1 | 3.8 | 3.7 | 3 | 2.9 | 2.6 |
| Small/Medium (n=425) | 4.0 | 3.6 | 3.6 | 3.1 | 2.9 | 2.5 |
| Large (n=332) | 4.1 | 3.7 | 3.6 | 3.3 | 3.0 | 2.6 |

# Key Takeaways and Recommendations

- **Takeaways**
  - Data collected improves the fundamental decision science the PG forecast is based upon.
  - Value factors are unique to this study and their relative importance are mostly consistent across (but do slightly vary by) market segments, technologies, and customer characteristics.
  - Most important value factors reported by customers: Eco Impacts and Lifetime Costs
  - The non-low income SF residential market splits into four distinct clusters that are unique to this study but could be replicated in future studies and applied to the IOUs' population of customers with additional research
- **Recommendations**
  - Future studies could explore how the customer attitudinal and behavioral metrics change over time and how the sensitivity of parameters impact these metrics.
  - Gathering input from program administrators and implementers on the type of value factors and representative technologies to include in future studies that will best inform program delivery.

# Impacts of Multi-Attribute Analysis

| Sector | Technology Group | Market Study Impacts | Description |
|---|---|---|---|
| **Commercial** | Split System AC - Hot-Dry* | Higher adoption | Benefits from eco impacts outweigh the barriers posed by upfront costs, which makes the efficient measures more attractive compared to a pure LMC analysis. |
| **Commercial** | LED High and Low Bay | Minimal impact to adoption | Relative benefits of other value factors are similar to the benefits of LMC. |
| **Commercial** | Small Gas Water Heaters | Lower adoption | Barriers from upfront costs and hassle factor lead to efficient measures being less attractive than the baseline measure compared to the LMC-only case. |
| **Commercial** | Fuel Substitution Convection Oven† | Lower adoption | Upfront costs feature more prominently in the decision-making consideration as a barrier to adoption. |
| **Residential** | Smart Water Heating Controls (Elec) | Higher adoption | DR incentives reduce upfront costs, which improves the attractiveness of the DR-enabled, efficient measure when considering all value factors. |

* In this instance, only LMC, upfront costs, and eco impacts serve to differentiate measures within a competition group.

†Not all value factors are applicable and social signaling is not considered for fuel substitution technologies.

**Example:**
**Gas Water Heaters**

# Discussion/Questions

# Key Topics: Methodology and Results

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# Fuel Substitution

## Three Areas of Unique Fuel Substitution Logic

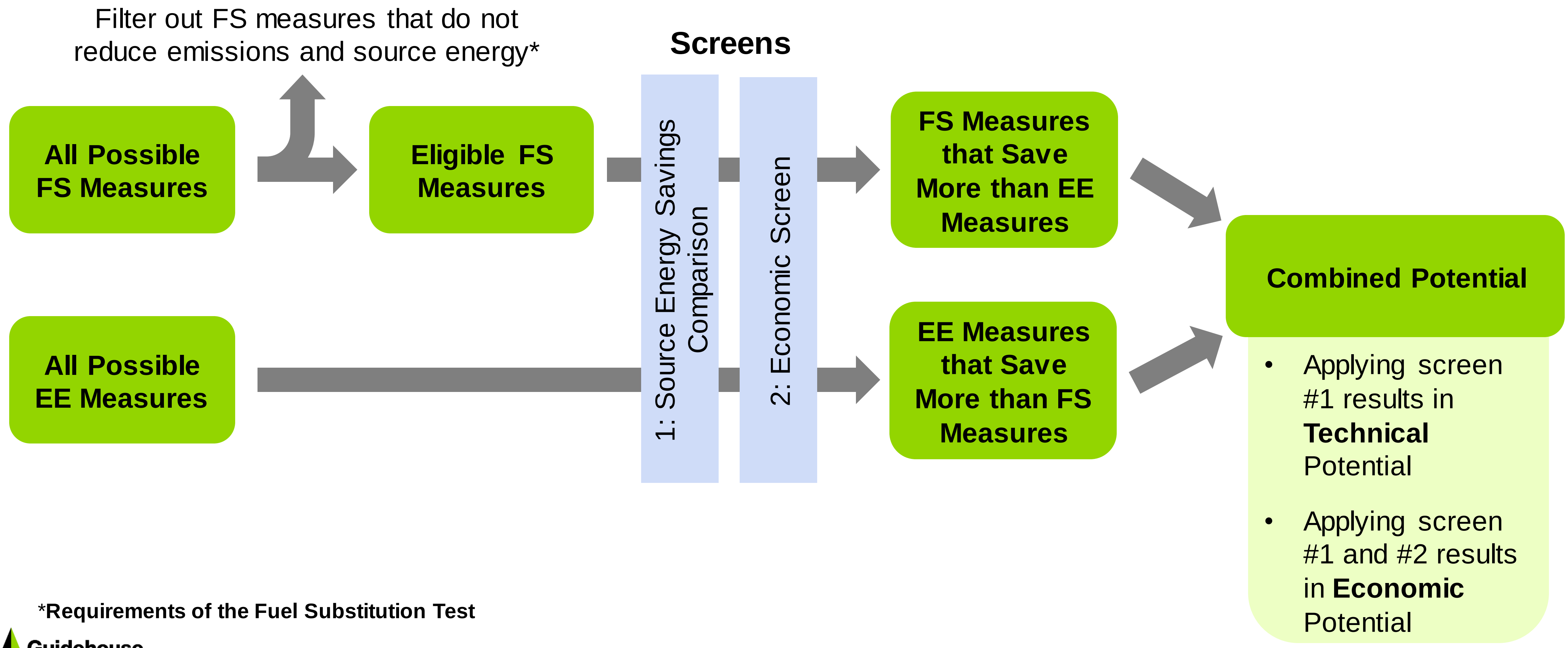
Competing FS with EE measures based on source energy savings

Using fuel substitution test to pre-screen measures

Different considerations when choosing to adopt EE vs. FS measures

# Fuel Substitution

## Screening for Technical and Economic Potential



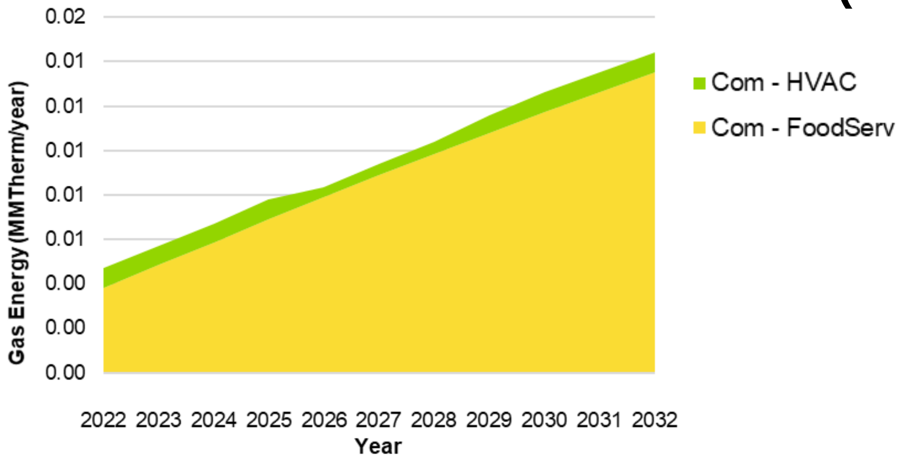

***Requirements of the Fuel Substitution Test**

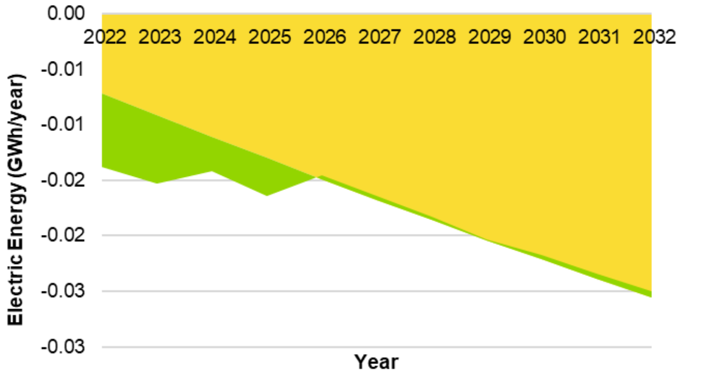
# Fuel Substitution

## Savings Results

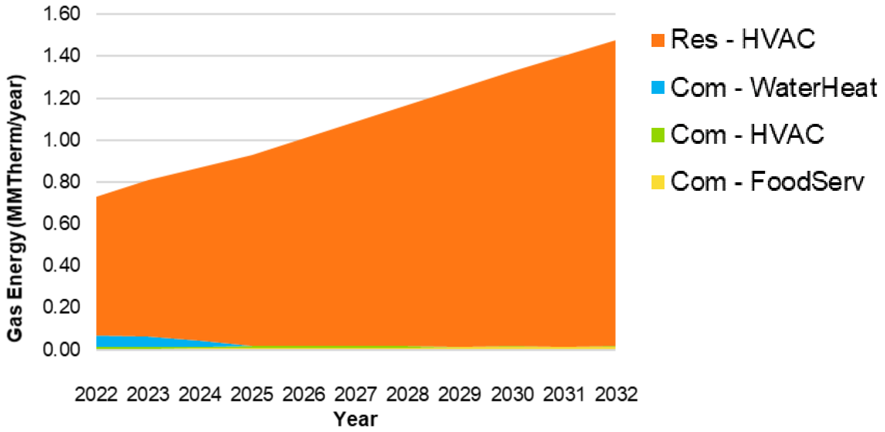
- Relatively few fuel substitution measures have been included in 2021 ABALs filed by the IOUs.
- SCE filings show measures to have a TRC greater than 1.0 specifically in climate zone 9:
  - Commercial steamers (food service) and commercial packaged heat pumps (both of which were found to be cost-effective in the PG Study)
  - SEER 15 residential heat pumps (the 2021 Study models SEER 18)
  - Residential ductless mini-split heat pumps

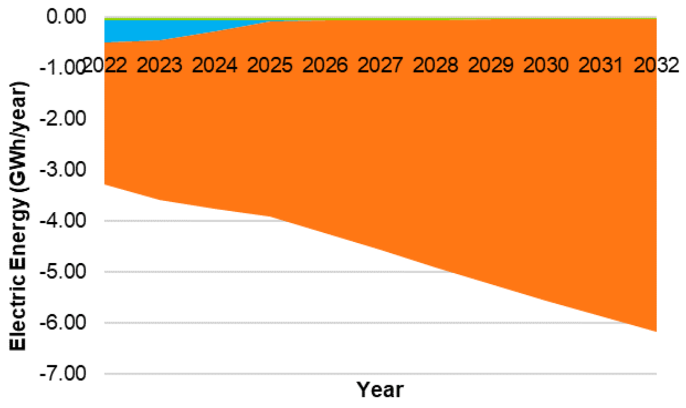
**Scenario 1 (TRC = 1.0)**




**Scenario 2 (TRC = 0.85)**



# Fuel Substitution

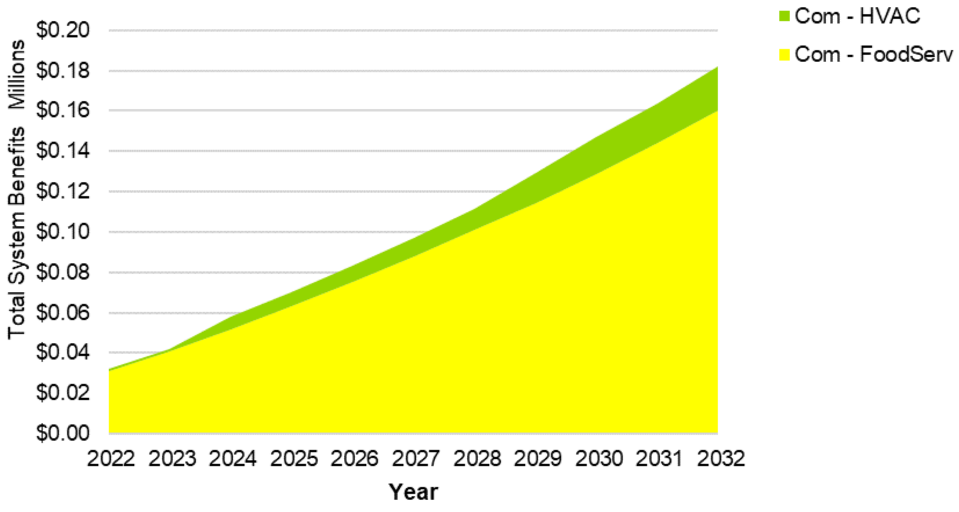
## TSB Results

$$\textbf{Total System Benefit} = \textbf{Net Avoided Cost Benefits (Energy and Capacity)} - \textbf{Increased Supply Cost}$$

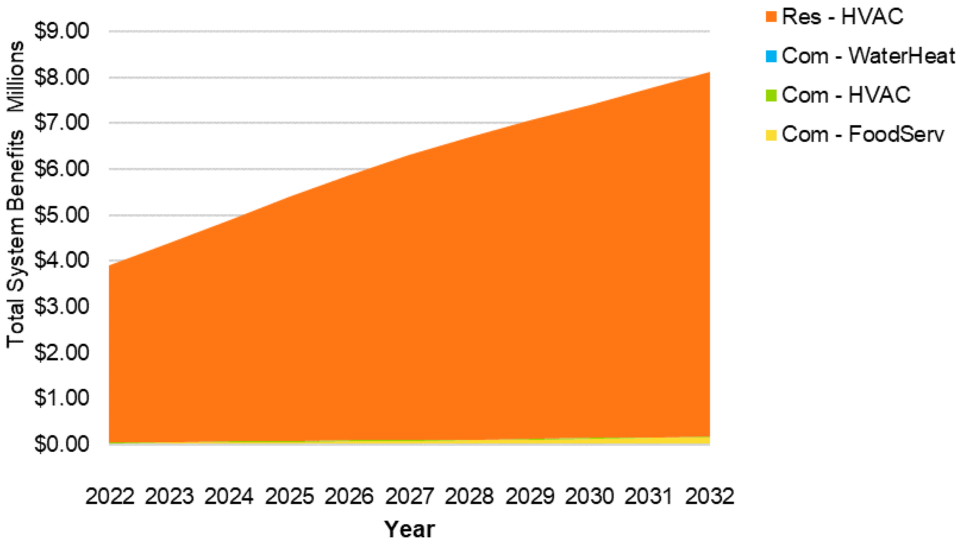
$$TRC = \frac{PV(\textit{Avoided Cost Benefits})}{\textit{Incremental Cost} + \textit{Admin Costs} + PV(\textit{Supply Costs})}$$

- Measures with a TRC > 1.0 should always have a positive TSB. When a measure TRC is less than 1.0, the TSB can be negative. Commercial heat pump water heaters in some years have a negative TSB.
- Growth rate in fuel substitution potential decreases over time because the electric avoided costs increases at a faster rate than the gas avoided costs.

Scenario 1 – TRC Low




Scenario 2 – TRC Reference

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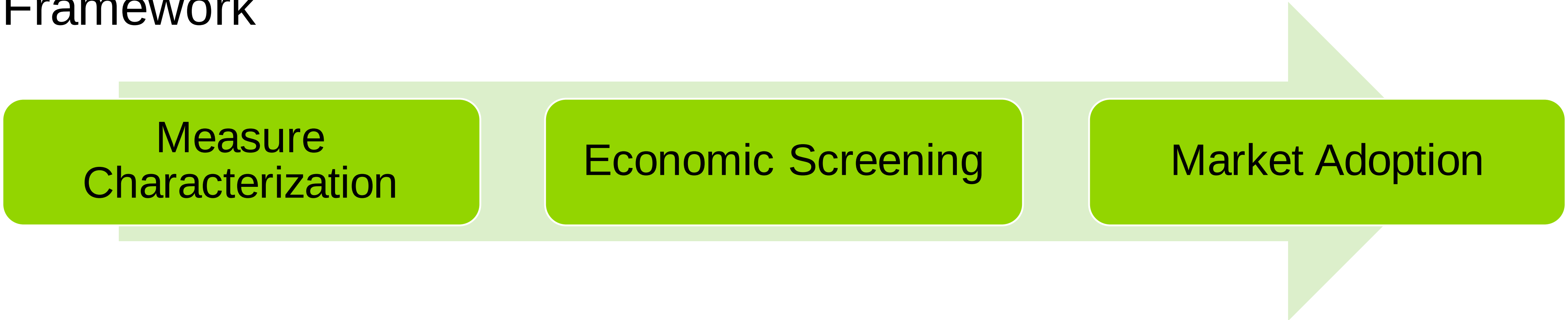
# Fuel Substitution

## Cost-effectiveness Considerations

- **Avoided Cost Calculations:** At the time of publishing the draft report, electric avoided costs increase significantly over the coming decades while gas avoided costs increase at a lower rate. CPUC should ensure both electric and gas avoided costs are based on consistent assumptions and input data.
  - Electric avoided cost for some measures increases more than 400% by 2047
  - Meanwhile gas avoided cost for the corresponding sector increased less than 180% by 2047
- **Application of Load Shapes:** The ACC and CET apply prototypical load shapes to calculate cost-effectiveness. Only a limited number of fuel substitution-specific load shapes are in use and could be expanded.
- **Measure Cost:** There are differing data sources for baseline and replacement technologies, possibly outdated data sources, and a lack of clarity in unit basis for published cost data.
- **Program Costs:** Initial utility programs around fuel substitution may be more expensive than their EE counterparts, better data is needed.

# EE-DR Integration

## Framework




- Commission decision (D18-05-01) instructed PG study to address the co-benefits of EE-DR, this is the first PG study to examine this topic
- Economic screening required assumptions as there is no combined EE/DR policy on cost effectiveness
  – CPUC guidance would need to be issued regarding integrated cost effectiveness to consider this for goals
- Results are not included in core scenarios due to limitations in EE/DR cost effectiveness guidance, but rather presented as a sensitivity analysis

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# EE-DR Integration

## Approach to Market Adoption

**Smart Thermostats**

| | **Benefits (examples)** | **Interest Group %** |
|---|---|---|
| EE Only | EE Rebate only | 60% |
| EE + DR | EE Rebate, plus DR Incentives | 35% |
| DR Only | DR Incentives only | 5% |

**Annual Market Saturation for Smart Thermostats**
(EE+DR and EE only)

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Values are illustrative

# EE-DR Integration

## Portfolio Impact

- There are two impacts of including DR considerations:
  - Impacts technology cost-effectiveness with adding DR benefits and costs.
  - Impacts customer financial attractiveness with the addition of DR benefits.
- Results
  - Impacts on portfolio is less than 5%
  - Larger impacts observed for the residential sector with minimal changes in potential in the other sectors.

**Annual Incremental Achievable Potential (excluding BROS)**

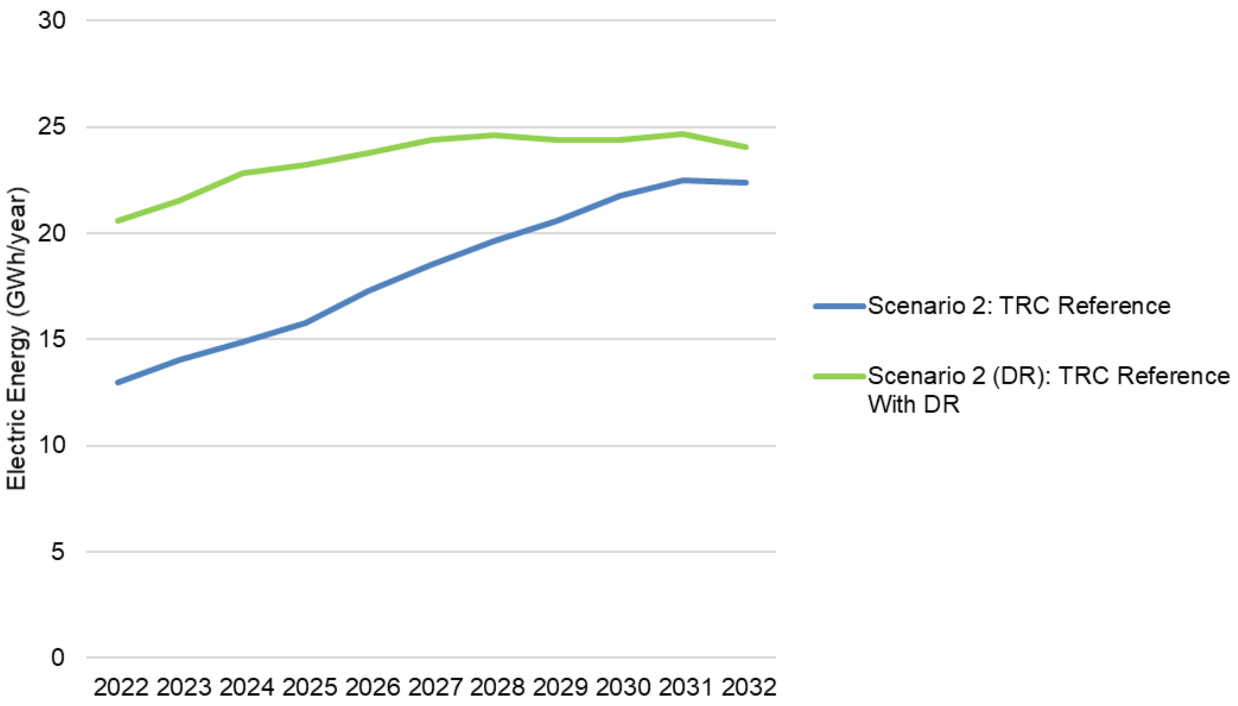
| Year | Scenario 2: TRC Reference | Scenario 2 (DR): TRC Reference With DR | Percent Difference |
|---|---|---|---|
| 2022 | 330.41 | 340.85 | 3.2% |
| 2023 | 335.49 | 344.79 | 2.8% |
| 2024 | 349.66 | 358.84 | 2.6% |
| 2025 | 354.45 | 362.98 | 2.4% |
| 2026 | 360.77 | 368.09 | 2.0% |
| 2027 | 372.06 | 378.71 | 1.8% |
| 2028 | 382.64 | 388.28 | 1.5% |
| 2029 | 360.87 | 365.33 | 1.2% |
| 2030 | 368.22 | 371.44 | 0.9% |
| 2031 | 362.88 | 365.67 | 0.8% |
| 2032 | 364.46 | 366.98 | 0.7% |

# EE-DR Integration

## Residential Sector Results

- **Residential annual incremental potential** for select end-uses is on an average **~50% higher with DR in early years (2022-2026)**, with the difference narrowing over time to an average **~20% higher potential with DR in later years (2027-2032).**

- **Smart thermostat potential increases substantially with addition of DR.** Addition of DR benefits leads to the technology being cost-effective in a few cases (and not cost-effective on an EE-only basis).
  - Smart thermostats annual incremental potential with DR is on an **average ~10 times potential without DR in early years (2022-2026) and ~5 times potential without DR in later years (2027-2032)**.

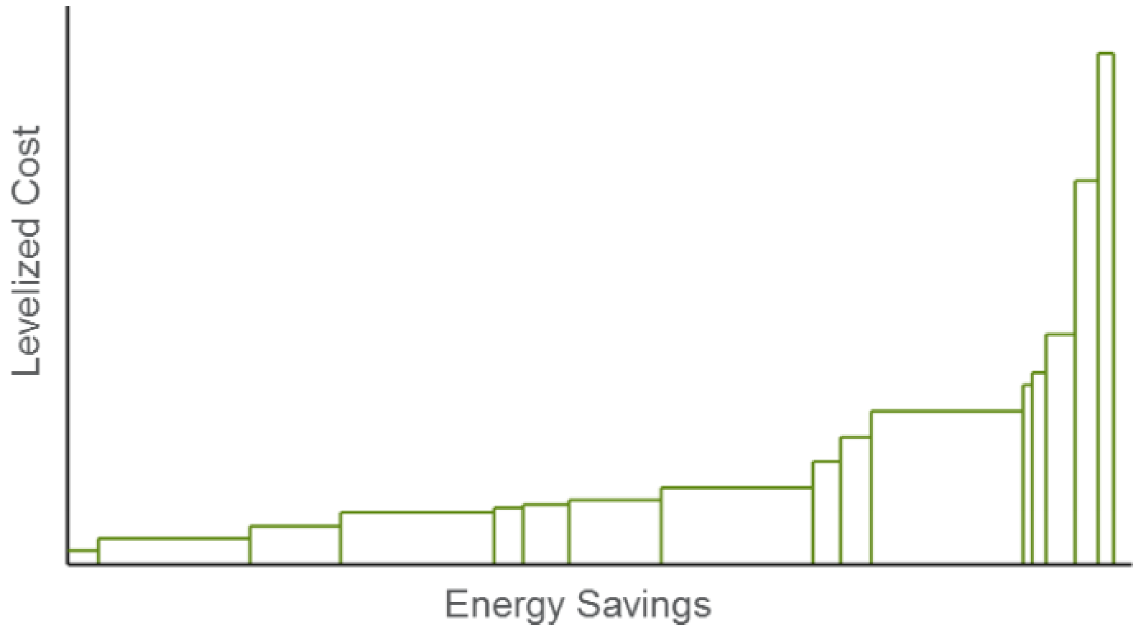



Note: Only includes HVAC, lighting, water heating, and AppPlug end uses.

# IRP – Integration of EE

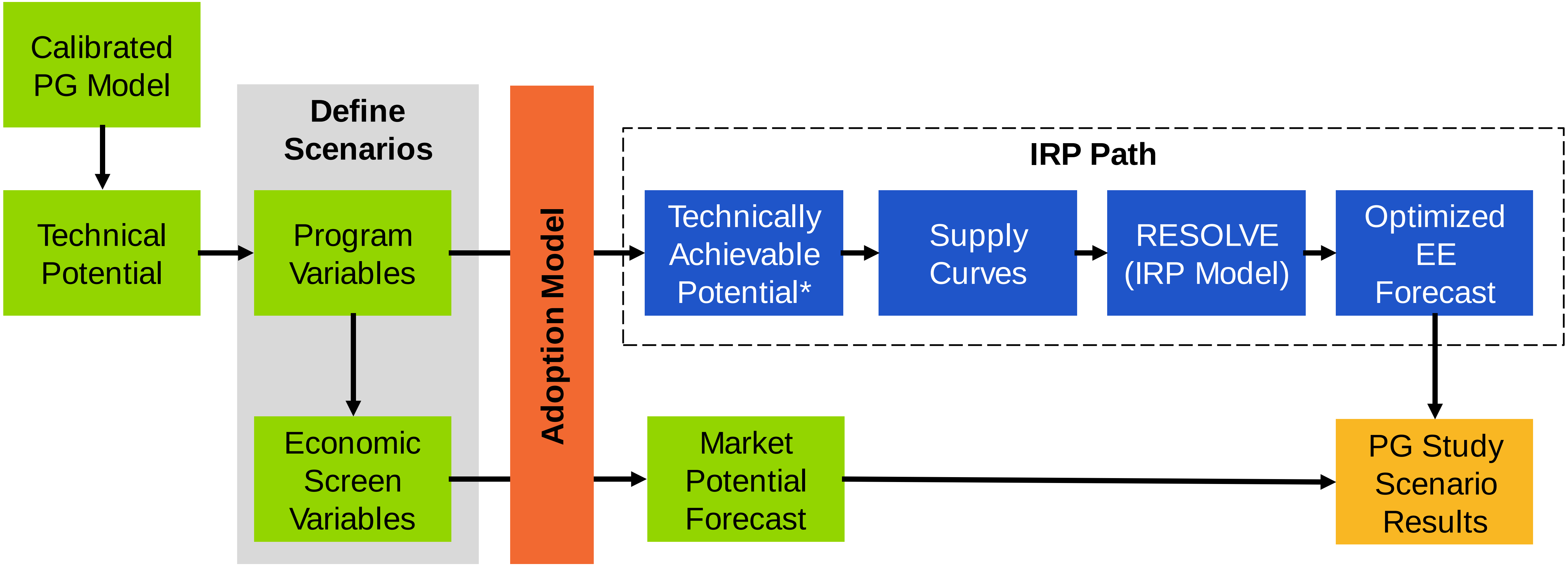
## Overview

- The IRP is a roadmap to meet forecasted annual peak and energy demand, with consideration of an established reserve margin, through a combination of supply-side and demand-side resources
- Supply curves offer a useful way to illustrate the amount of energy savings available per dollar spent.
- Supply curves are made up of bundles of EE measures.
- What is not optimized in the IRP model:
  - Natural gas energy efficiency
  - Fuel substitution
  - Low Income and Codes and Standards Programs
  - Demand response co-benefits



# IRP – Integration of EE

## Process and Scenarios



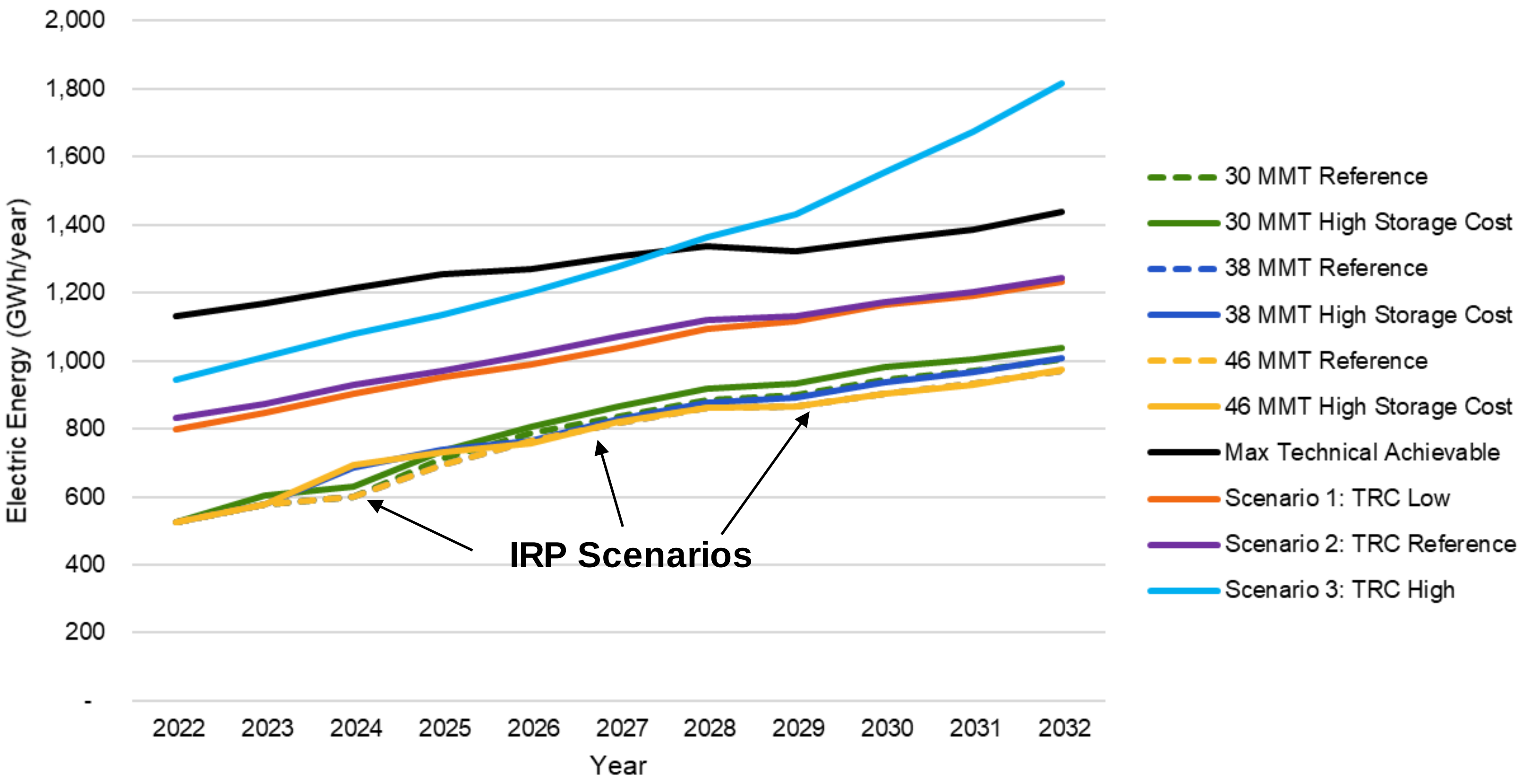

* Technically achievable potential is the model's adoption forecast for ALL measures (with no cost-effectiveness screening)

# IRP – Integration of EE

## Scenario Results Comparison

Differences in comparison between RESOLVE and PG Model:

- RESOLVE values each bundle based on the profile of savings over the year with the levelized cost as the main driver of selection.
- RESOLVE has added emphasis on hourly savings because the model optimizes based on cost to meeting electric resource needs at specific hours of the day and year.

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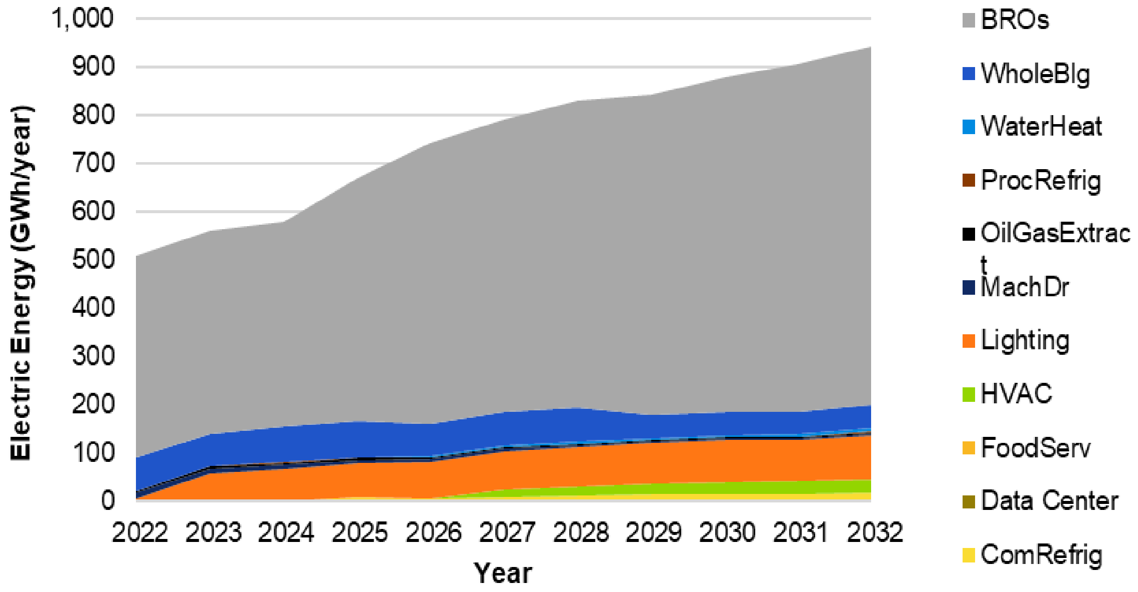
# IRP – Integration of EE

## Scenario 4: IRP Optimized (38 MMT Reference Storage Cost)

- The IRP selected a higher proportion of BROs compared to EE equipment since BROs, on average, have a lower levelized cost.
- Residential sector, in addition to BROs, the IRP selects whole building programs as optimal. Residential lighting, HVAC, and appliances/plug loads are not selected at all.
- Commercial sector, food service and appliance/plug loads are not selected as optimal. HVAC is selected in 2027 and beyond, and lighting (a large saver in Scenarios 1-3) is selected in 2023 and beyond.

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# COVID-19 Sensitivity Analysis

## Overview

- All inputs to the PG study are rooted in pre 2020 data (before the COVID-19 pandemic)
- Key question: how would the pandemic impact the forecast of EE savings?
- Data and Assumptions were used to adjust inputs to the PG model to simulate the impacts of COVID-19 on EE adoption:

| | |
|---|---|
| **Building Stock Changes** | • Restaurant and retail stock and consumption<br>• Residential customers applying for CARE rates (transitioning to low income sector) |
| **Adoption Changes** | • Market adoption study value factor adjustments |
| **Recovery Rate** | • Consumer confidence and building stock ramping in 2022 and 4 years to recover to pre-pandemic normal |

# COVID-19 Sensitivity Analysis

## Results show minimal impact

| Unit | Sensitivity | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| GWh | No COVID-19 | 832.4 | 874.6 | 927.3 | 971.4 |
| | COVID-19 | 825.8 | 869.7 | 924.4 | 971.1 |
| | **% Difference** | **0.8%** | **0.6%** | **0.3%** | **0.0%** |
| MW | No COVID-19 | 199.1 | 204.7 | 215.2 | 221.4 |
| | COVID-19 | 197.8 | 203.7 | 214.6 | 221.3 |
| | **% Difference** | **0.6%** | **0.5%** | **0.3%** | **0.0%** |
| MMTherms | No COVID-19 | 35.4 | 38.6 | 43.1 | 45.3 |
| | COVID-19 | 35.0 | 38.3 | 43.0 | 45.3 |
| | **% Difference** | **1.0%** | **0.7%** | **0.3%** | **0.0%** |
| TSB ($ Millions) | No COVID-19 | $750.25 | $828.09 | $938.75 | $1,045.61 |
| | COVID-19 | $737.38 | $817.84 | $931.99 | $1,043.32 |
| | **% Difference** | **1.7%** | **1.2%** | **0.7%** | **0.2%** |

# Discussion/Questions

# 2021 Potential and Goals Final Report

May 13, 2021

| Start | End | Agenda Item | Presenter |
|---|---|---|---|
| 4:25 PM | 4:35 PM | Policy Questions | Coby Rudolph |
| 4:35 PM | 4:55 PM | Discussion | Coby Rudolph |
| 4:55 PM | 5:00 PM | Closing | Travis Holtby |

## Part 4 – Policy Discussion

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# Policy Questions

- Ruling on 4/23/21 issued a set of questions for stakeholders to respond to
- This is an opportunity to ask clarifying questions
- Feedback can also be provided – though parties should file formal comments for your recommendations to be considered
- Feedback requested on next steps for Total System Benefit metric/transition.

# Policy Questions - Scenarios

The P&G Study forecasted savings using the following scenarios.

- Which scenario is most appropriate?
- Alternative recommendations?

| Levers → Scenario ↓ | C-E Test | C-E Threshold | Incentive Levels Capped | Program Engagement | Include Financing? |
|---|---|---|---|---|---|
| **1: TRC Low** | TRC | 1.0 | 50% | Reference | No |
| **2: TRC Reference** | **TRC** | **0.85** | **50%** | **Reference** | **No** |
| **3: TRC High** | TRC | 0.85 | 75% | Aggressive | Yes |
| **4: IRP Optimized*** | N/A | N/A | 50% | Reference | Yes |

# Policy Questions - COVID Impacts

- Is the range appropriate? If not why?
- Should it be considered in goals?

| Unit | Sensitivity | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| GWh | No COVID-19 | 832.4 | 874.6 | 927.3 | 971.4 |
| | COVID-19 | 825.8 | 869.7 | 924.4 | 971.1 |
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| | **% Difference** | **1.7%** | **1.2%** | **0.7%** | **0.2%** |

# Policy Questions - Data Assumptions and Methodology

- Do you agree with our assumptions?
- If not, what other publicly available data should we be using, or what methodology should we have used?

# Policy Questions - Fuel Substitution (FS) Savings

- This is the first time the PG study has forecasted FS savings.
- D.19-08-009 Fuel Substitution Decision established a method for applying fuel substitution savings to Goals: convert original fuel (gas) savings to new fuel (electric) savings and apply the savings to new fuel (electric) goals.
- How should the FS we found be reflected in goals – gas savings only? Gas savings and electric increases?
  - How should we address the conversion?
  - Alternative methods?

# Policy Questions - Total System Benefit (TSB)

- Definition: total net benefit that a measure provides to the electric and natural gas systems.
  - The dollar value of the benefits that an energy efficiency resource contributes to the electric and gas systems
  - Included: energy, capacity, GHG compliance cost
  - Generally speaking, the benefit portion of the TRC
- Any changes to definition?
  - Do you agree with calculation of benefit
  - Specifically for Fuel Substitution TSB?

**Total System Benefit (TSB) Calculation:**

\$TSB = \$ System Benefits – \$ Increased Supply Costs (fuel substitution or interactive effects, if applicable)

**TRC Calculation (simplified)**

$$TRC = \frac{\$\text{ System Benefits}}{\$\text{ Costs (Incremental Measure Costs, Program Admin Costs, Increased Supply Costs if applicable)}}$$

# Total System Benefit (TSB)

- What further stakeholder engagement should the CPUC/Energy Division conduct regarding Total System Benefit
- What questions do you have about TSB that CPUC can work to clarify?

# Reminders and Next Steps

**Stakeholder engagement is critical and CPUC and the Potential and Goals Study team values the input and direction provided.**

- Study-related comments are formal, filed in the R13-11-005 proceeding.
- Study-related comments are due May 21
- Reply comments are due May 28.

Formal comments may only be filed by parties to the R13-11-005 proceeding. For information about becoming a party to a CPUC proceeding, visit www.cpuc.ca.gov/Party_to_a_Proceeding.

# Questions and Discussion

# Stay Informed

**CPUC's 2021 Energy Efficiency Potential & Goals Webpage:**
https://www.cpuc.ca.gov/General.aspx?id=6442464362

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