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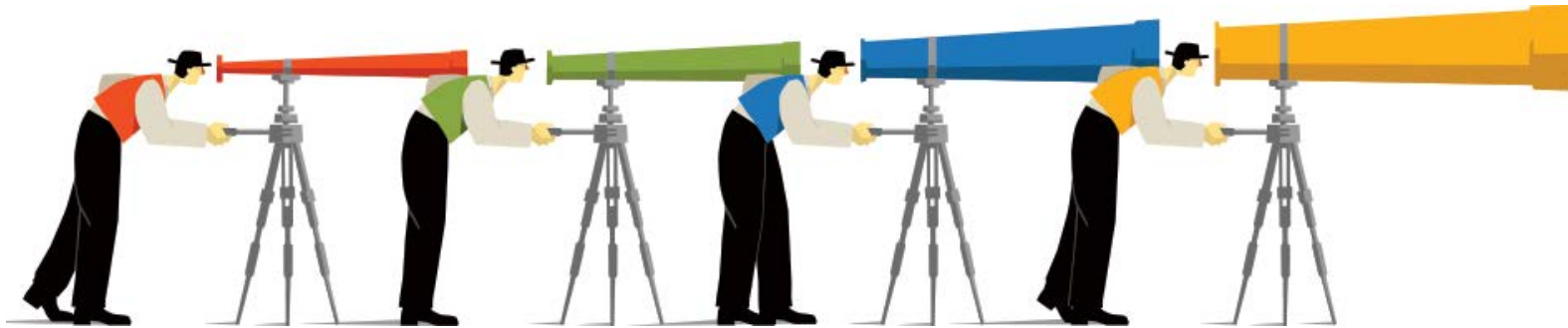
Existing Baseline Workshop

Discussion Slides

November 6, 2015

DISPUTES & INVESTIGATIONS · ECONOMICS · FINANCIAL ADVISORY · MANAGEMENT CONSULTING

Content of Report

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November 6, 2015

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Agenda

1 » Overview of Navigant Scope and Key Concepts

2 » Key Methodological Topic: Consumer Adoption

3 » Key Methodological Topic: Economics of Existing Baseline

4 » Data Collection

5 » Discussion and Questions for Stakeholders

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» As part of its role in the EE potential and goals study, Navigant has been tasked with developing the framework, supporting data, and analysis that will identify the additional savings potential related to the to-code, operational efficiency and behavioral initiatives targeted in AB 802

» Navigant's work scope includes:

Task 1: Develop methodology and select measures

Task 2: Collect data and conduct literature review

Task 3: Conduct existing conditions baseline scenario analysis

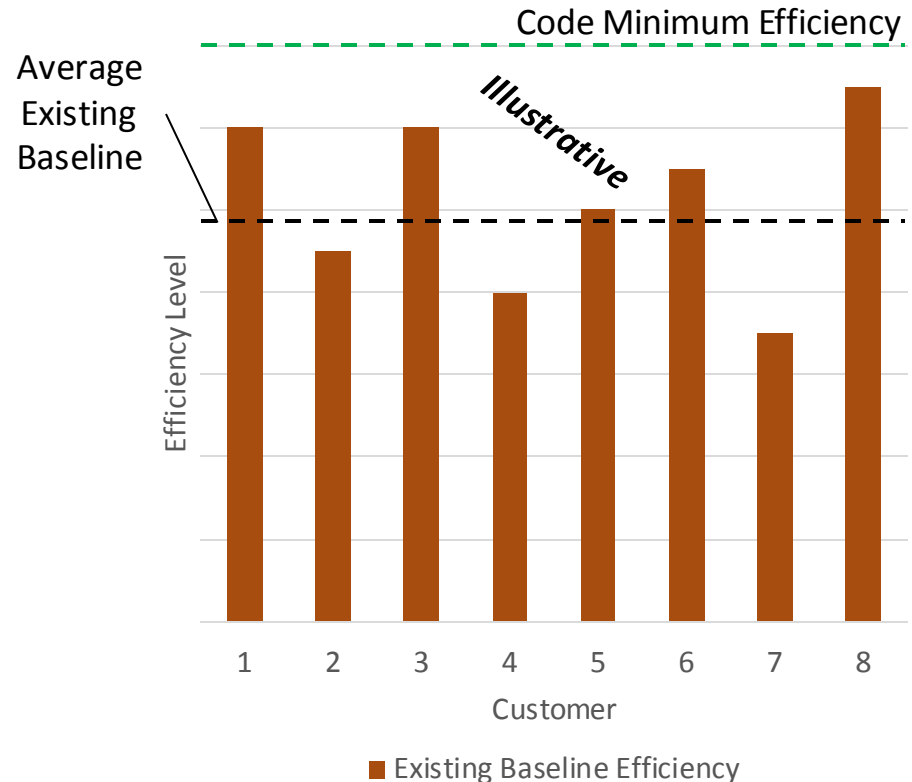Task 4: Update model to forecast incremental savings potential

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» Analysis continues to leverage the CPUC Potential and Goals PG Model

- The PG model is primarily a "bottom up" measure-based analyses to inform planning
- Although analysis framework is heavily measure focused, CPUC policy on eligible savings may follow a different framework
- Aggregate analysis results are still valid for aggregate planning purposes

» Our overarching direction:

- Develop a methodology to forecast saving relative to existing baseline
- Collect as much reliable **secondary data** as we can to inform the forecast
- Recognize that there will be data gaps that require assumptions
- Results from this analysis will be considered ***preliminary estimates***

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Existing Conditions Baseline Definition

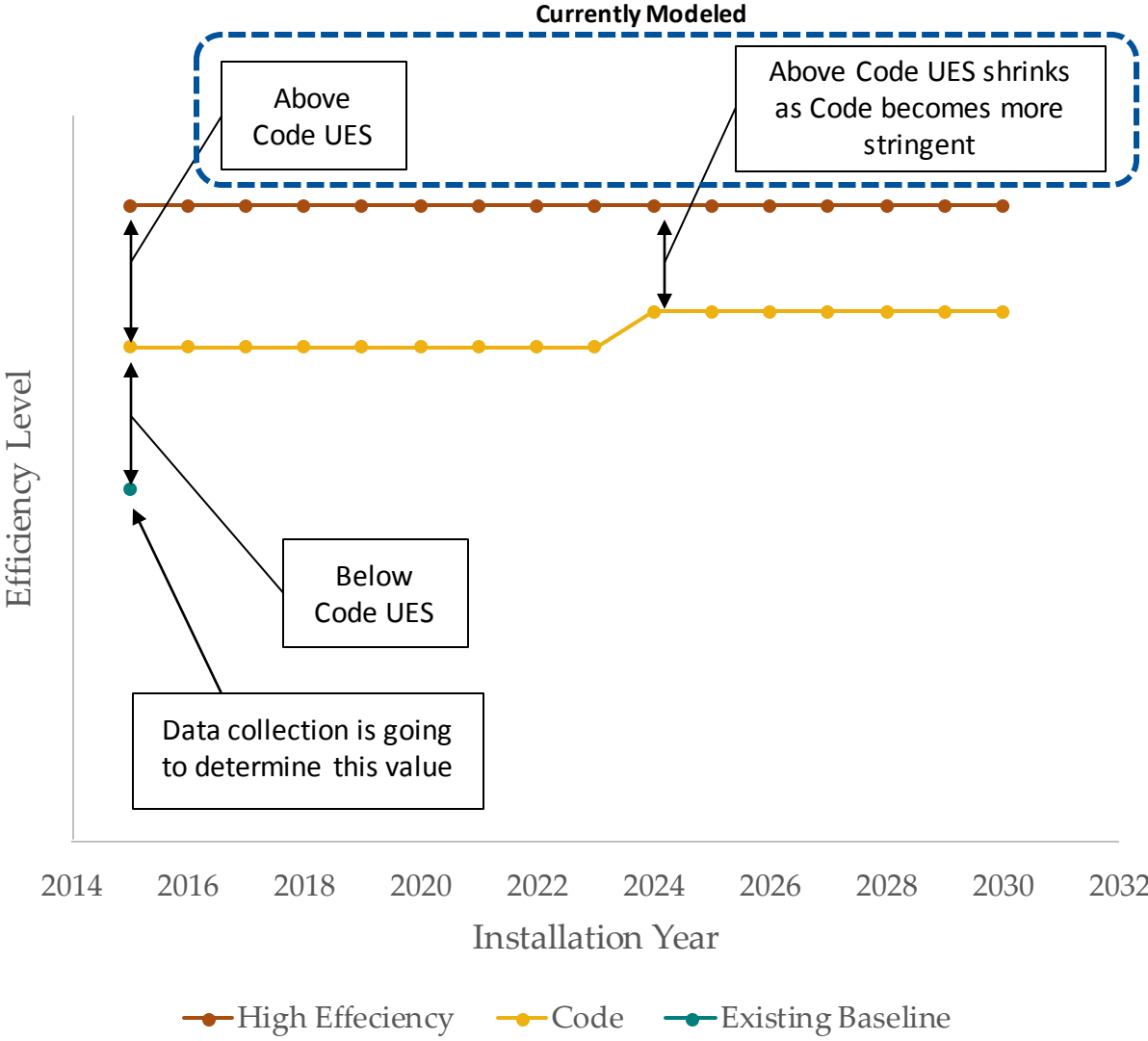| Term	Definition	Precedent
Code Baseline	Minimum level of efficiency required for new units that go into service	Set by the governing regulatory body or other industry standards
Existing Conditions Baseline	Level of efficiency of units going out of service (being replaced by new units)	Set by historical markets and is generally a mix of below and at code technologies. The overall market average existing conditions baseline may be below current code.

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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

Code Minimum Efficiency

Average Existing Baseline

Illustrative

Efficiency Level

Customer

■ Existing Baseline Efficiency

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Existing Conditions Baseline Definition

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Existing Conditions Baseline Definition

UES never changes over time

The entire market repairs equipment indefinitely (**not likely**)

Efficiency Level

Installation Year

2014 2016 2018 2020 2022 2024 2026 2028 2030 2032

High Effeciency   Code   Existing Baseline
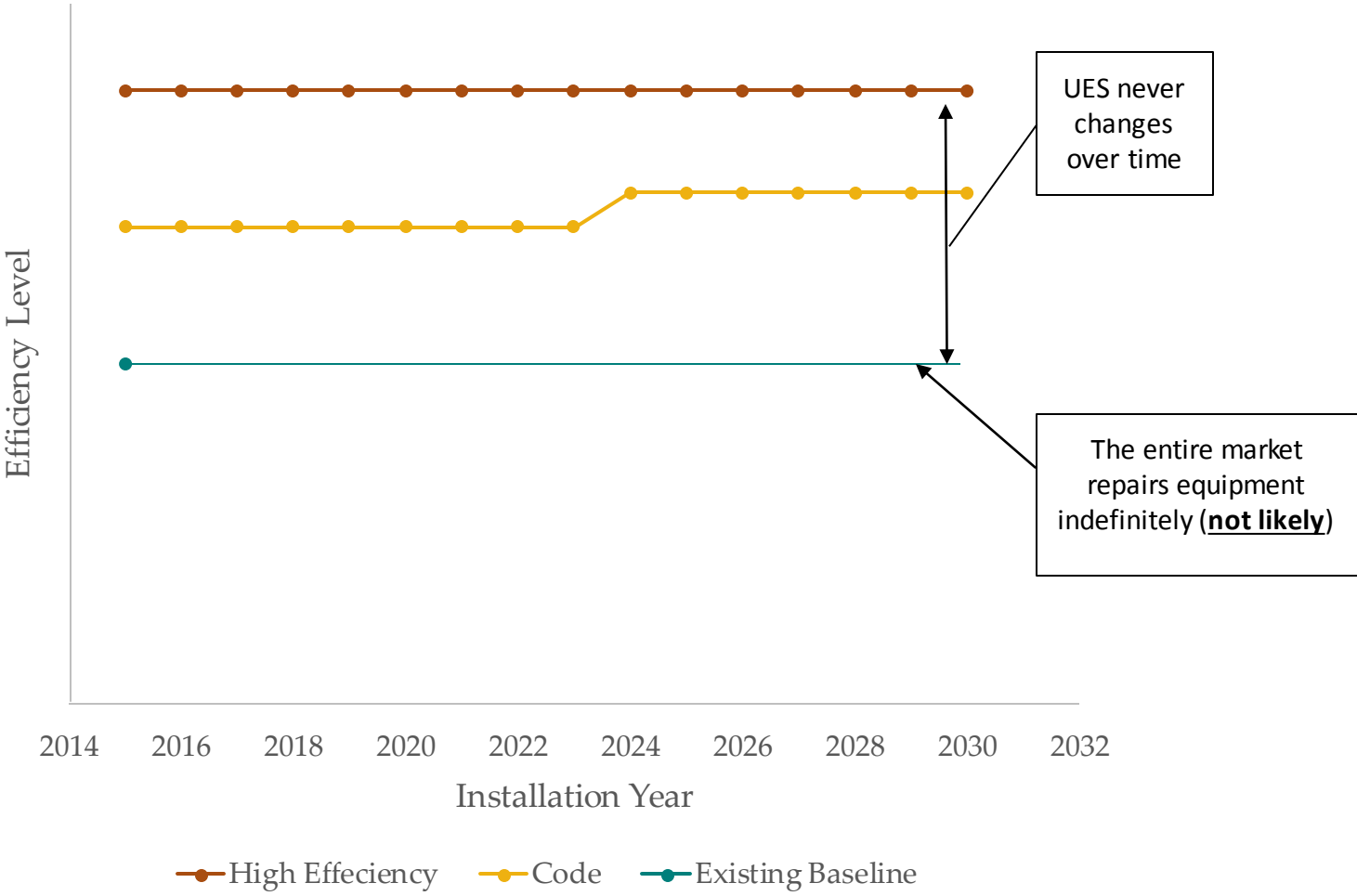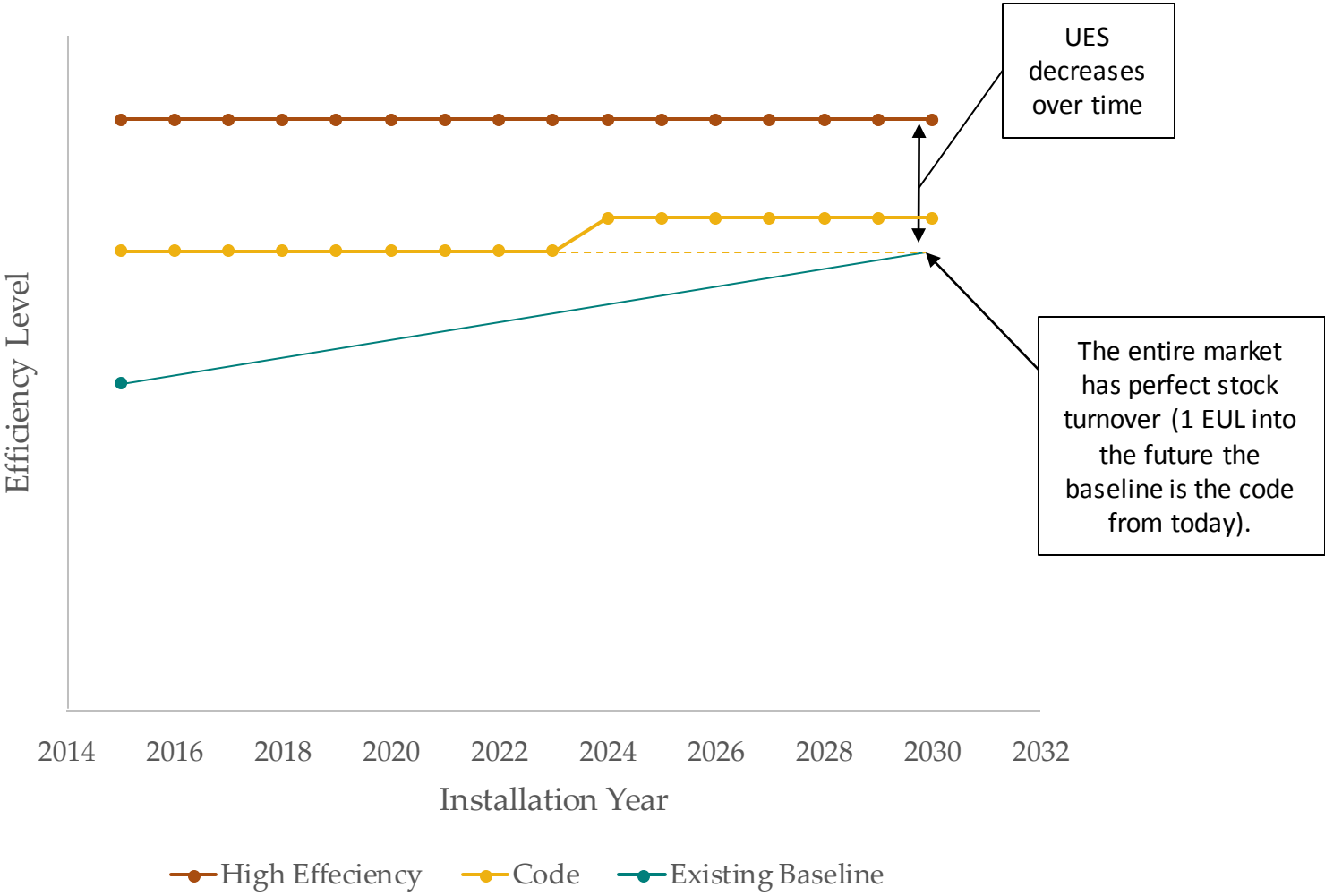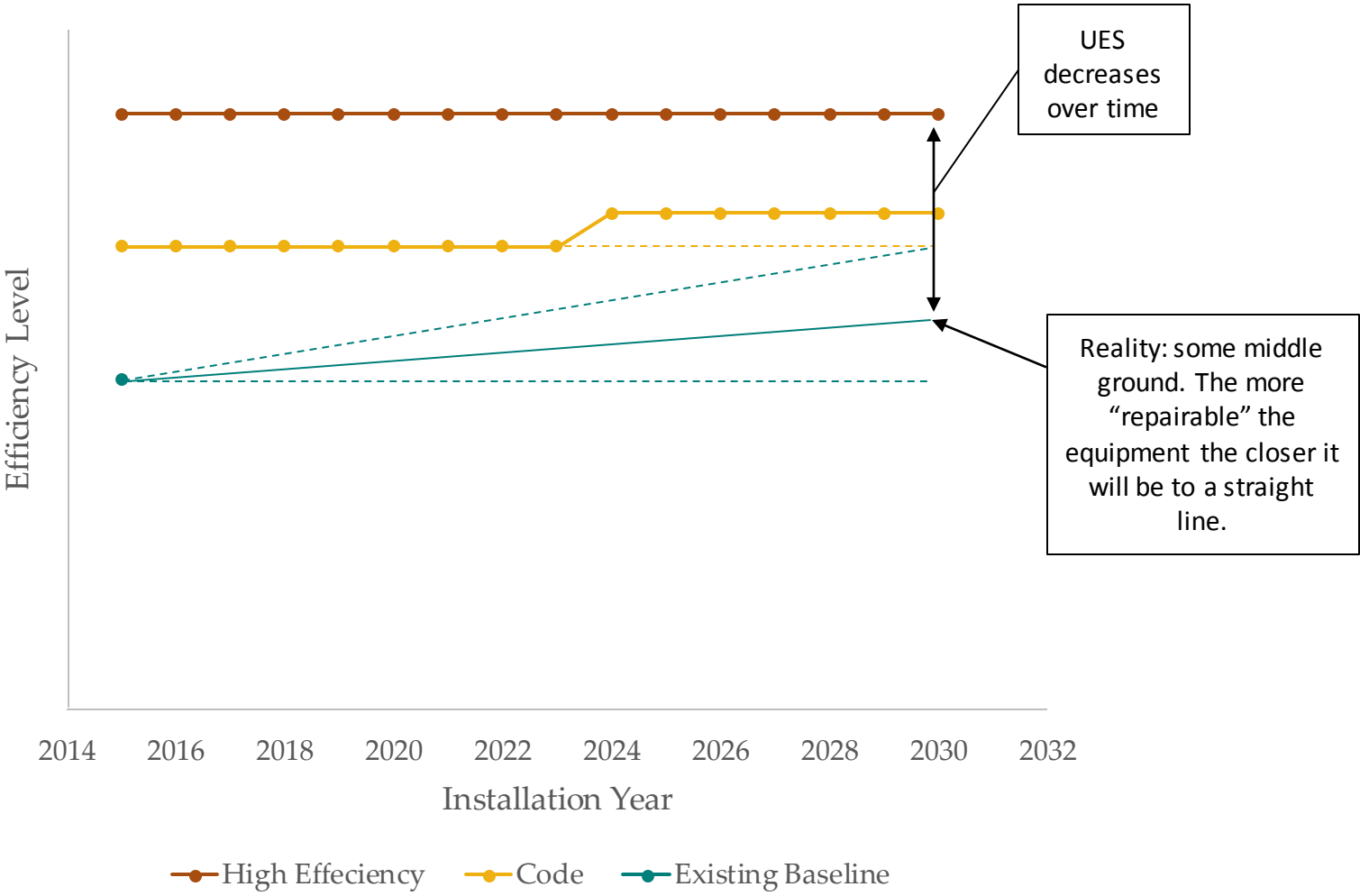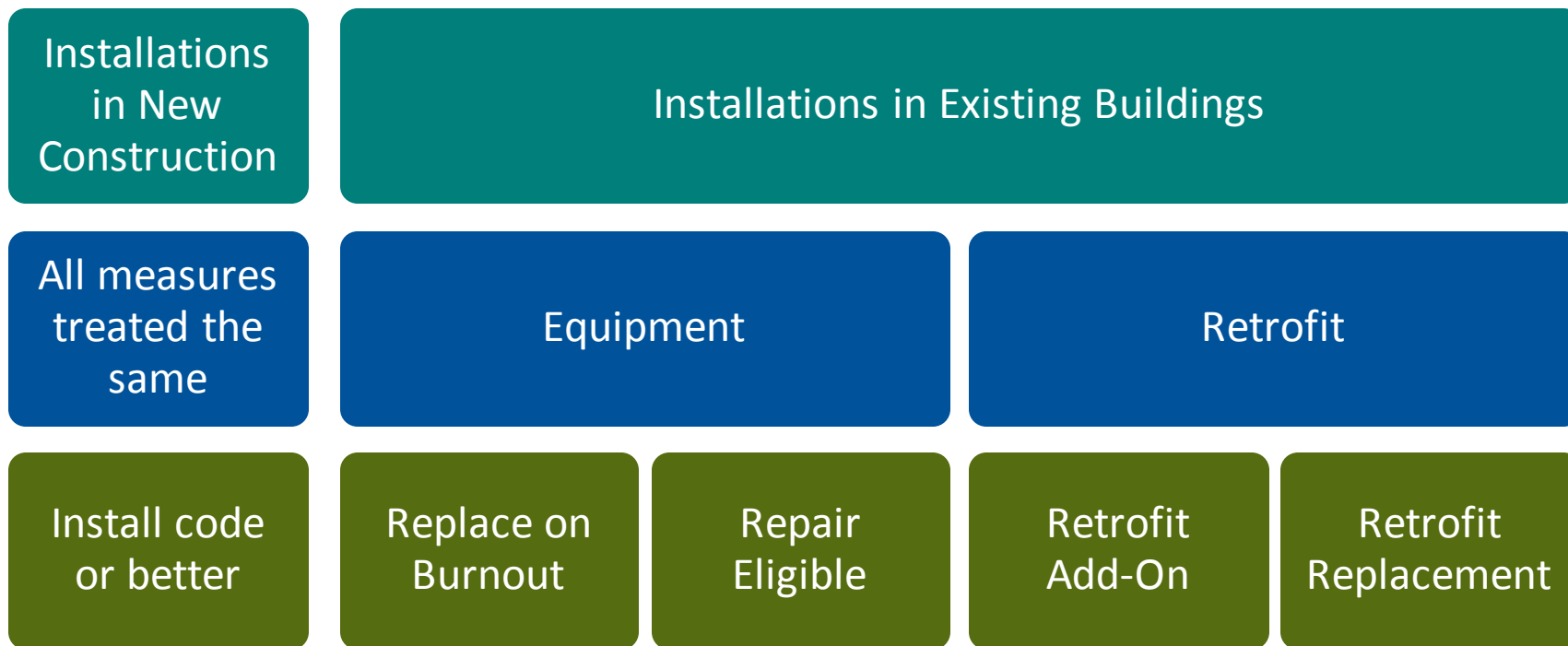
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Existing Conditions Baseline Definition

Existing Conditions Baseline Definition

Universe of Measure Installation Types

Installations in New Construction	Installations in Existing Buildings	

All measures treated the same	Equipment	Retrofit

Install code or better	Replace on Burnout	Repair Eligible	Retrofit Add-On	Retrofit Replacement

Note: "Early Retirement" is not a type of measure but a type of program intervention.

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Types of Measures – Installations in Existing Buildings

| Measure Type	Description	Technology Example
Equipment - Replace on Burnout	New equipment needs to be installed to replace equipment that is no longer functional (not repairable).	Light bulbs
Equipment - Repair Eligible	Equipment reached the end of its EUL and fails ***but is repairable***. ***If*** its repaired, life extends past the EUL	HVAC Equipment
Retrofit Add-on	New equipment being installed onto an existing system. The add-on is not required for the operation of the existing equipment	HVAC controls, window film
Retrofit Replacement	New equipment is installed to replace previously existing equipment that either: a) has not failed b) is past the end of its EUL but is not compromising use of the building	Insulation

Why Measure Type Matters

» Two different purposes of an energy efficiency forecast:

– Inform CPUC policy and IOU goal setting process

– Inform California Energy Commission Statewide Demand Forecast (informs energy procurement)

» The full savings that IOUs can claim from programs may not necessarily be the savings that can be counted on in the CEC demand forecast. CEC already accounts for:

– Savings from Codes and Standards

– Naturally Occurring Energy Efficiency

» The different measure types may be treated differently in terms of what savings counts towards the CEC demand forecast.
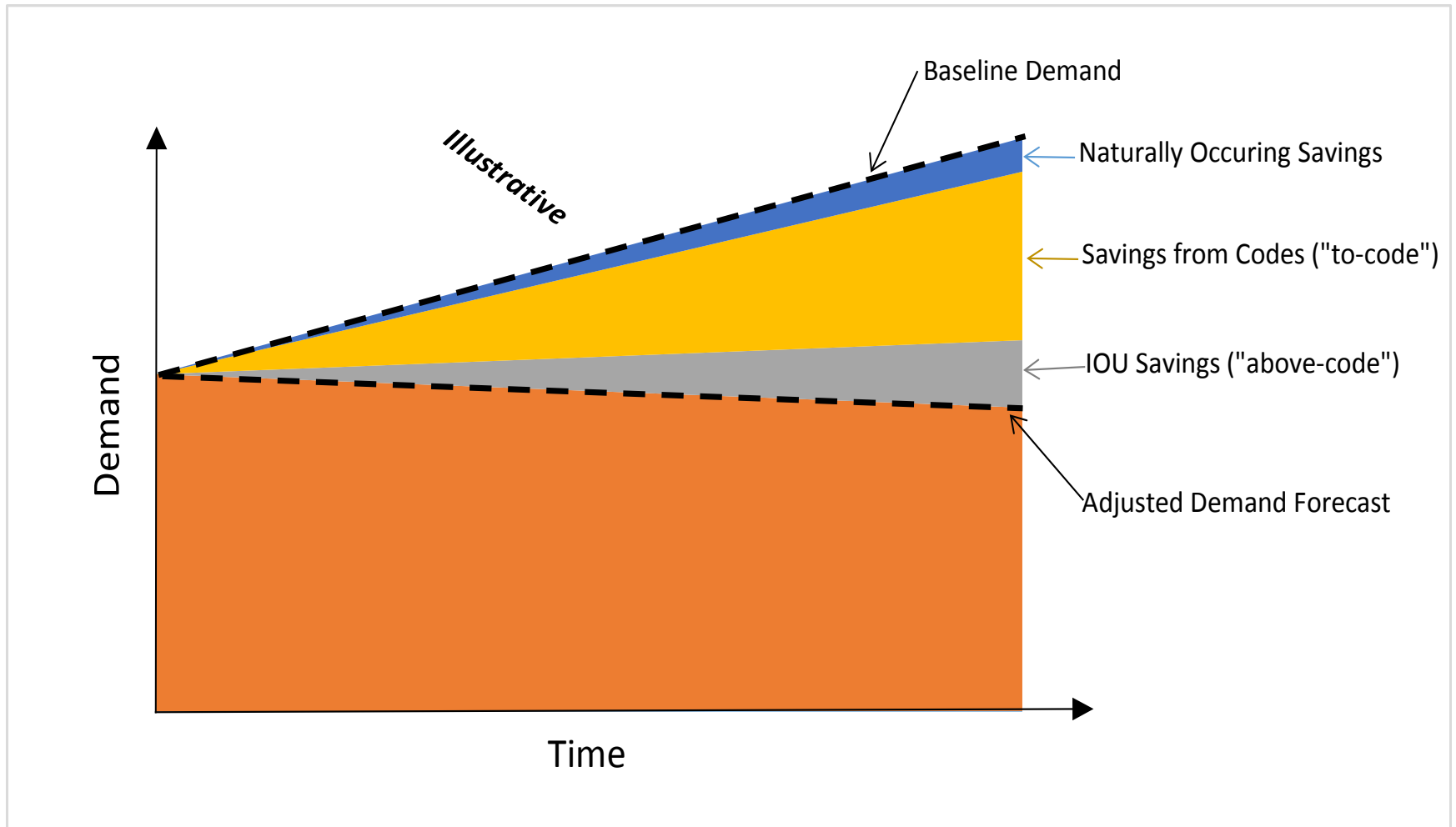
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IOU Claimable Savings vs. Demand Forecast Savings

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IOU Claimable Savings vs. Demand Forecast Savings
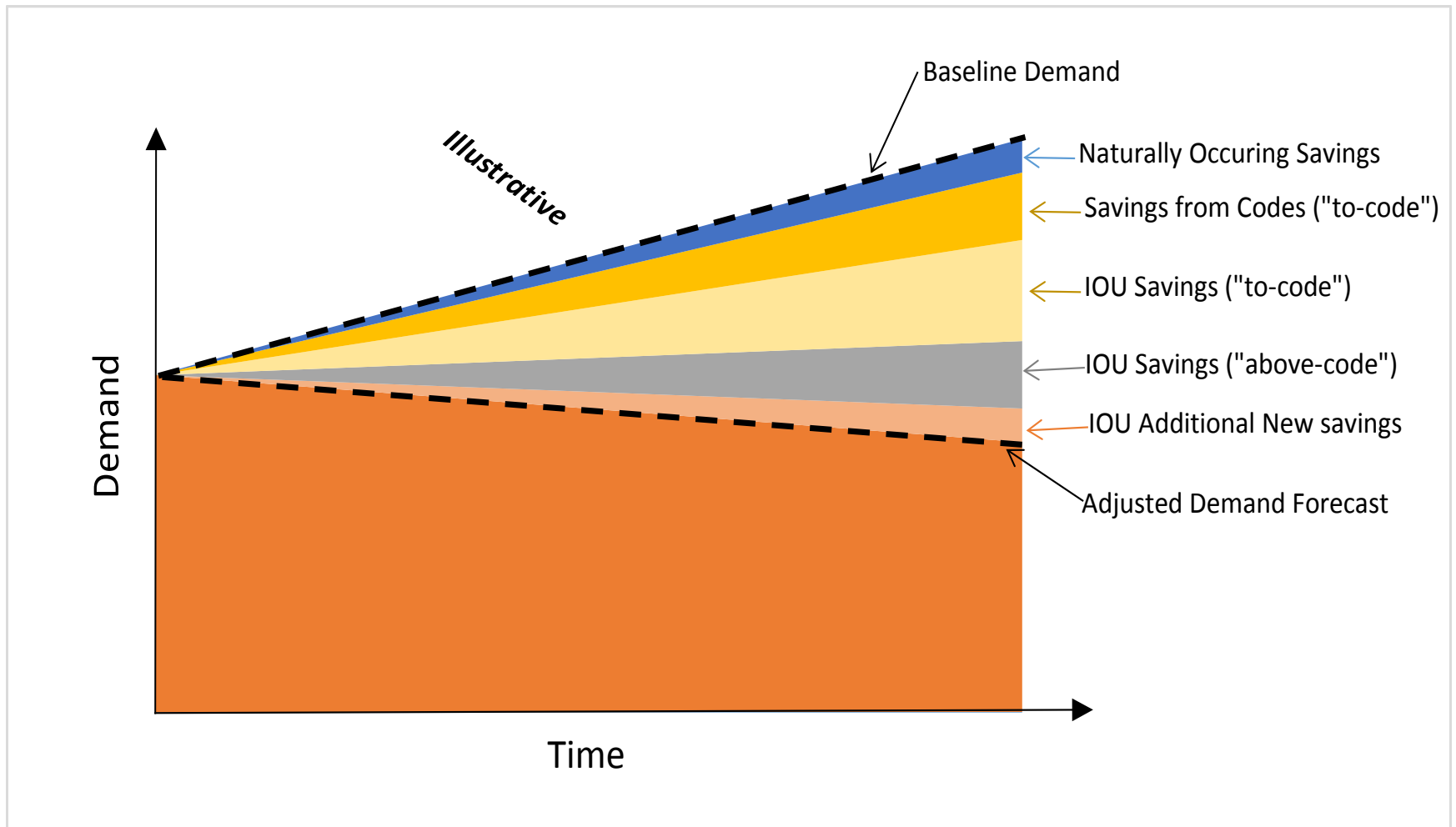
» Operational efficiency (OE) is a **system or building approach** to energy savings, not necessarily at an individual measure level

» OE represents efforts to increase the efficiency of how a building utilizes its existing equipment and systems

» By providing opportunities to educate and inform energy managers about the energy usage in their facilities, operational changes lead to improvements and ultimate innovation

» OE is becoming more important as it potentially represents a large portion of savings in C&I facilities
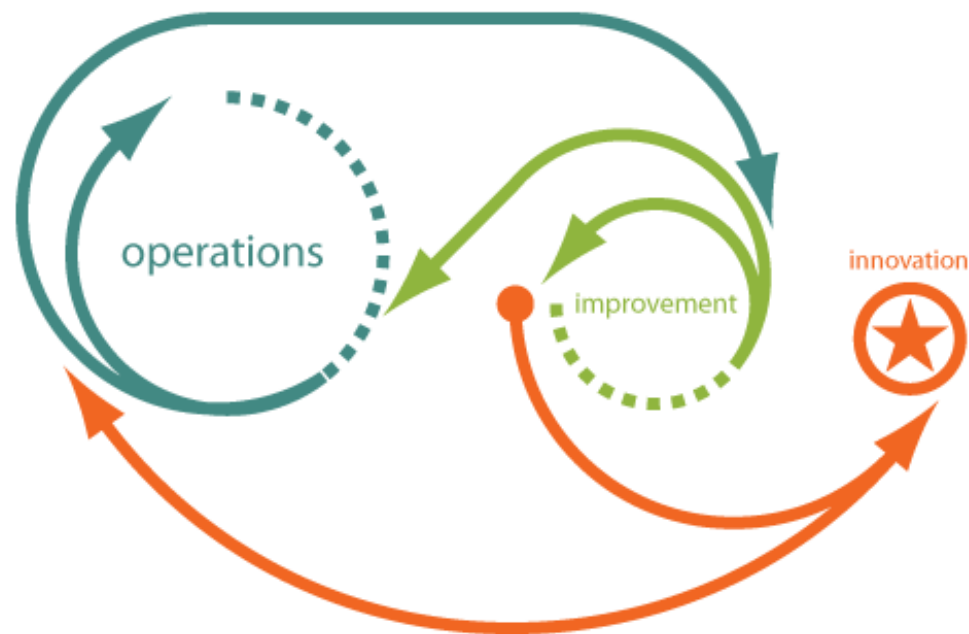
operations

improvement

innovation

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» Characteristics of load shape change from EE efforts

	Existing machine operating profile	Modified machine operating profile	Savings (Green shade)
Reduce power required for each load cycle.			
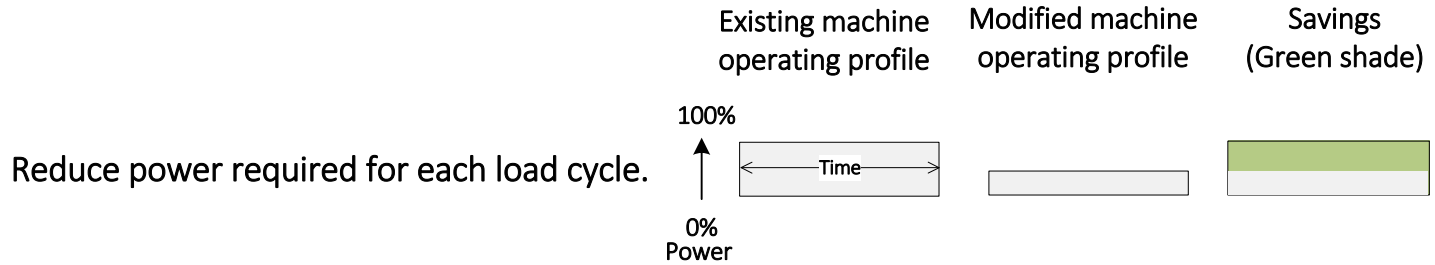
» Characteristics of load shape change from OE efforts

	Existing machine operating profile	Modified machine operating profile	Savings (Green shade)
Convert constant load to variable load.			
Reduce time duration of load cycle.			
Reduce total number of load cycles.			
Eliminate load or load cycle.		X	

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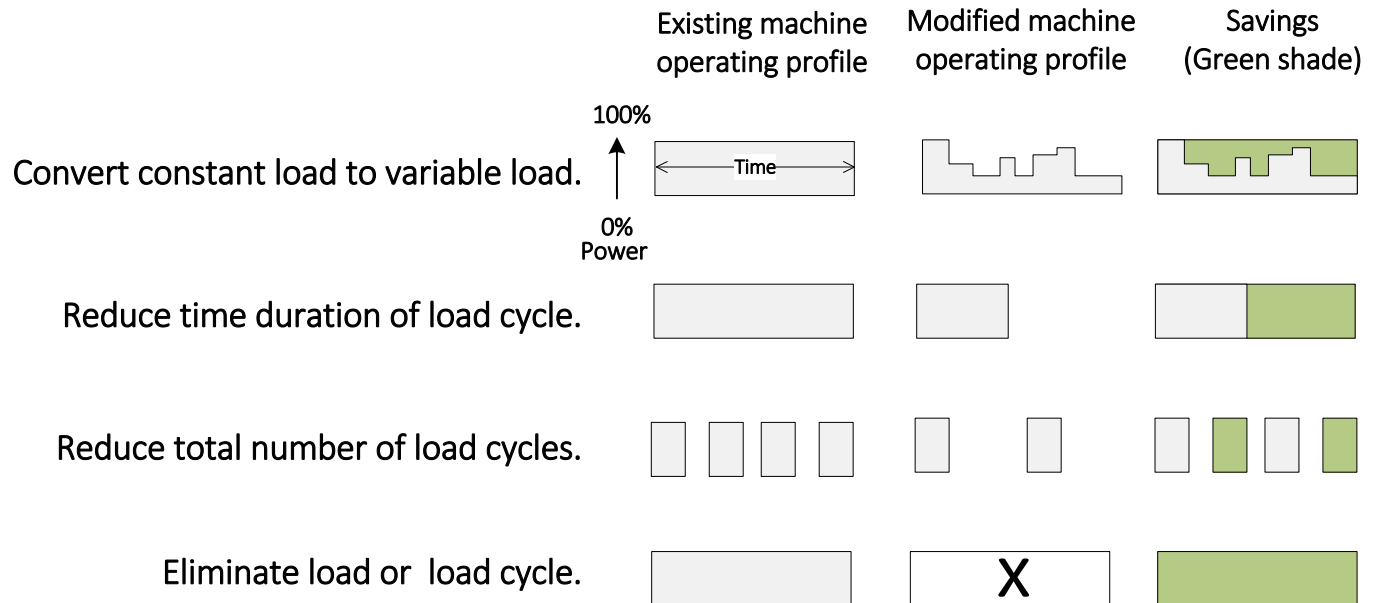
The OE Program Environment – A Continuum of Opportunities

Initiatives and Program Examples

Occupant Engagement
(e.g. turn off monitor)

MBCx Equipment
(e.g. NEMA motor)

MBCx Operation
(e.g. adjust all set points)

HVAC Equipment
(e.g. chiller replacement)

HVAC Operation
(e.g. demand control ventilation)

Lighting Equipment
(e.g. lamps and ballasts)

Lighting Operation
(e.g. daylight harvesting)

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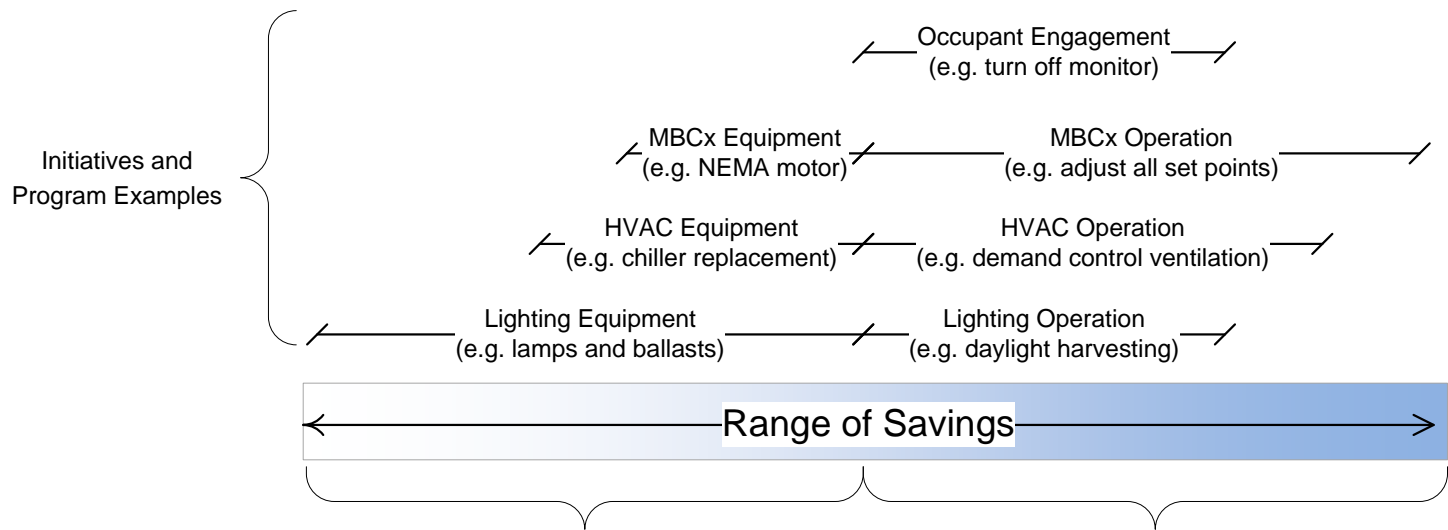
Comparative	Equipment Selection	Equipment Operation
Relationship to Work	Doing the same work for less energy	Doing less work
Definition	Associated with 'efficiency'	Associated with 'conservation'
Fuel savings	Same operating duration at lower power	Different operating duration and / or variable power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

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Operational Efficiency Savings

Building was constructed 20 years ago to code

Perfectly maintaining the operation of all building systems. Energy use remains the same over time. **Doesn't happen in the real world.**

Energy Use

Building Constructed (1995)

5 years old (2000)

10 years old (2005)

15 years old (2010)

20 years old (2015)

······ Code When Constructed

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Operational Efficiency Savings

Reality: Building "drifts" from optimal operation. Usage patterns change, equipment setting don't keep up, controls lag, etc.

Energy use increases

Operation Efficiency can bring the building back towards its original code energy use

Energy Use

Building Constructed (1995)

5 years old (2000)

10 years old (2005)

15 years old (2010)

20 years old (2015)

—— Baseline Energy Use
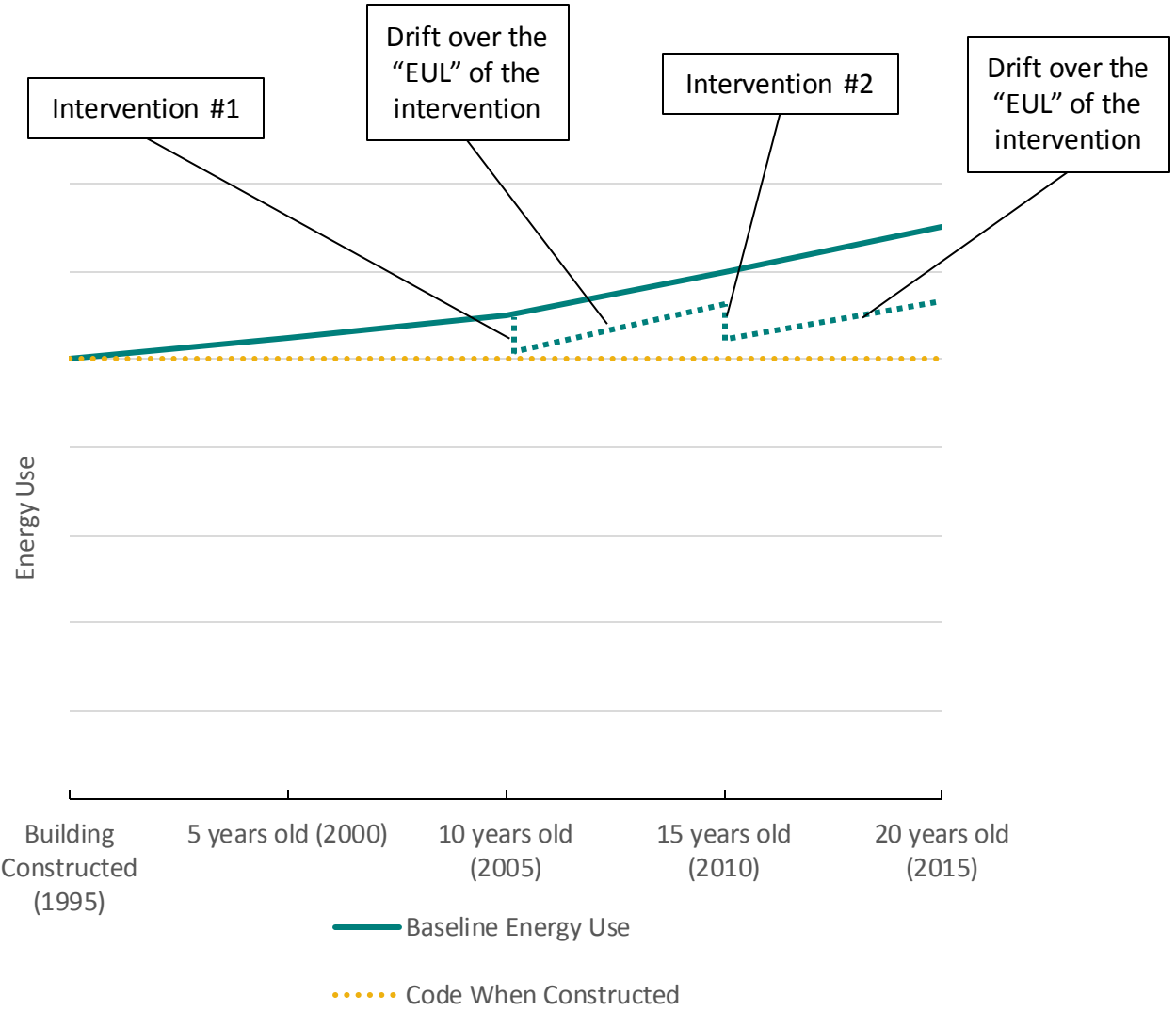
······ Code When Constructed

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Operational Efficiency Savings

True Operational Efficiency cannot bring a building to new construction code levels. New equipment would be needed to do that. Comparing to "new construction code baseline" is inappropriate.

Energy Use

Building Constructed (1995) — 5 years old (2000) — 10 years old (2005) — 15 years old (2010) — 20 years old (2015)

— Baseline Energy Use
······ Code When Constructed
······ Code for New Construction

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Operational Efficiency Savings

Intervention #1

Drift over the "EUL" of the intervention

Intervention #2

Drift over the "EUL" of the intervention

Energy Use

Building Constructed (1995)

5 years old (2000)

10 years old (2005)

15 years old (2010)

20 years old (2015)

—— Baseline Energy Use

······ Code When Constructed

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1 » Overview of Navigant Scope and Key Concepts

2 » Key Methodological Topic: Consumer Adoption

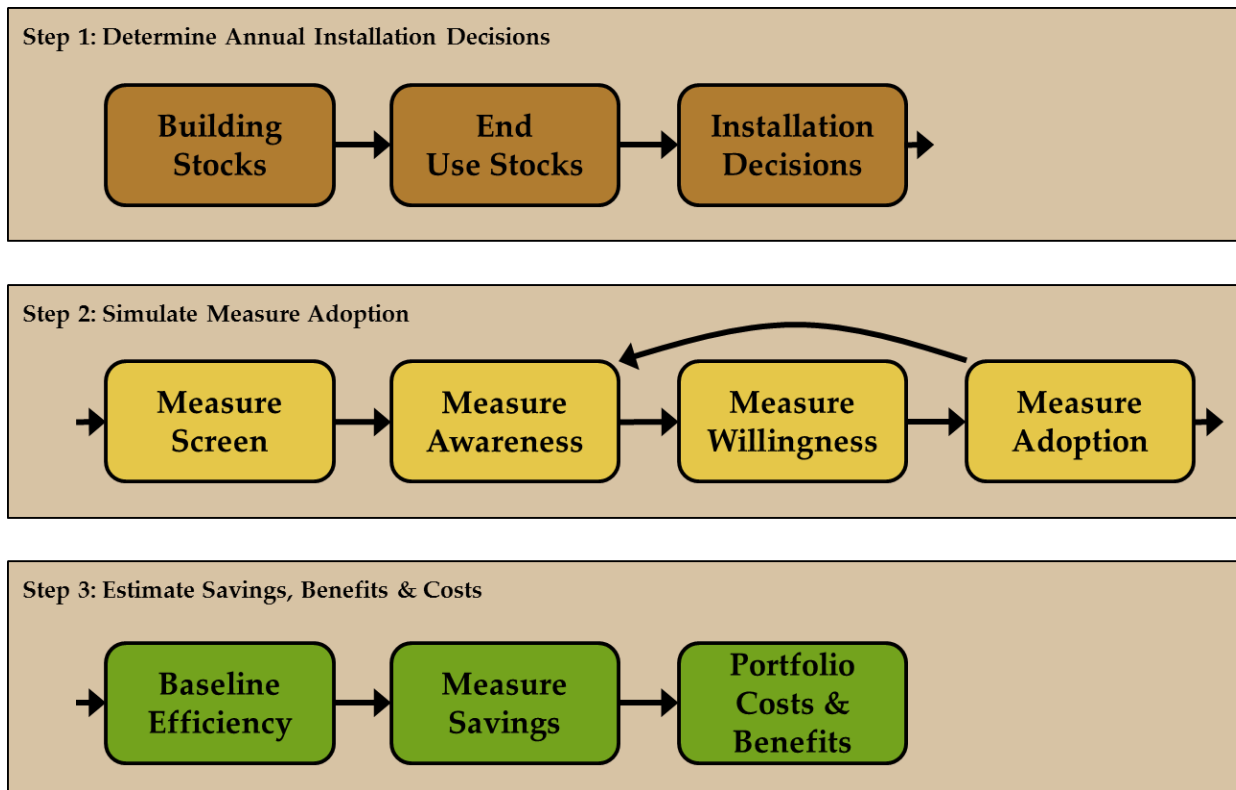3 » Key Methodological Topic: Economics of Existing Baseline

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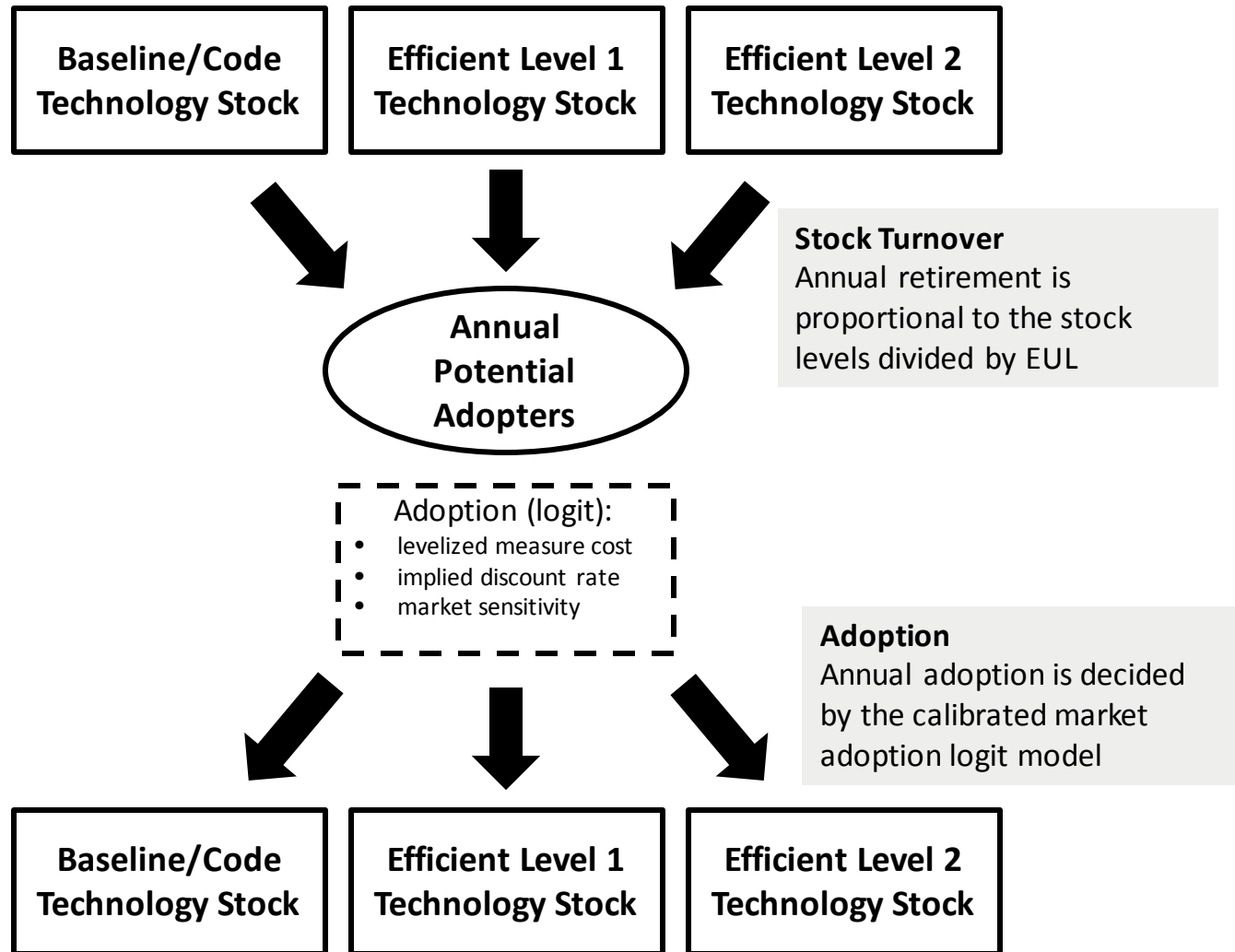
5 » Discussion and Questions for Stakeholders

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Consumer Adoption Principals

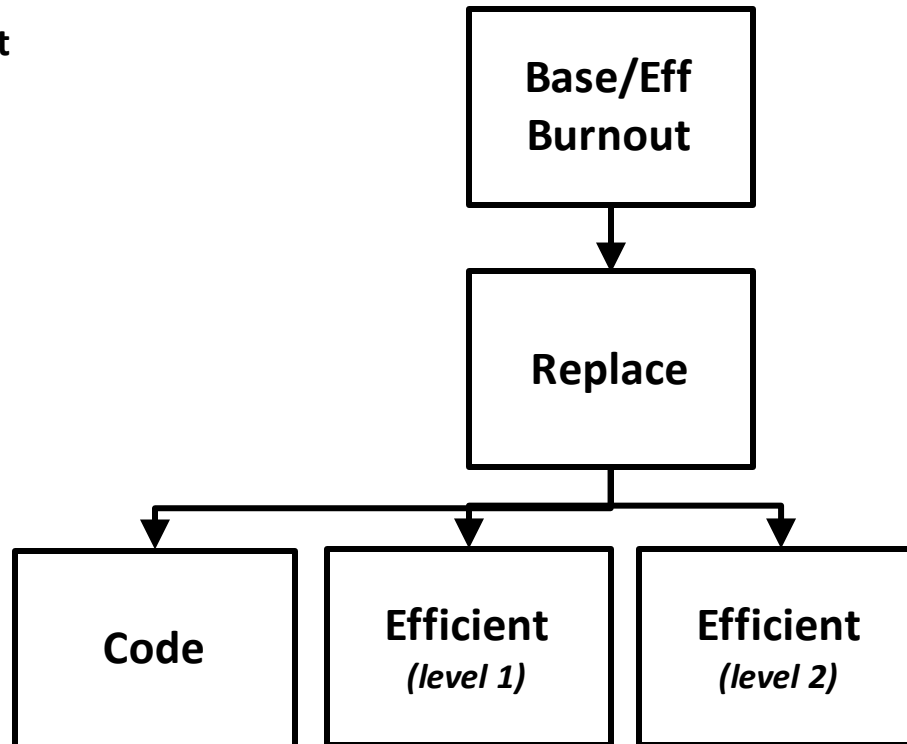» **Three-Step Approach to Calculating Market Potential**

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Current Adoption Logic

Baseline/Code Technology Stock **Efficient Level 1 Technology Stock** **Efficient Level 2 Technology Stock**

Annual Potential Adopters

Stock Turnover
Annual retirement is proportional to the stock levels divided by EUL

Adoption (logit):
- levelized measure cost
- implied discount rate
- market sensitivity

Adoption
Annual adoption is decided by the calibrated market adoption logit model

Baseline/Code Technology Stock **Efficient Level 1 Technology Stock** **Efficient Level 2 Technology Stock**

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Current Logit Illustration for Replace Stocks

Equipment Burnout

Base/Eff Burnout

Replace

Decision 1: Replace With?

Code

Efficient *(level 1)*

Efficient *(level 2)*

Modified (Nested) Logit Illustration for Repair Stocks

Equipment Burnout

Base/Eff Burnout

Sub-Code Repair Eligible

Decision 1:
Repair/Replace

Replace

Repair

Decision 2:
Replace With?

Code

Efficient *(level 1)*

Efficient *(level 2)*

Base Remains (repaired)

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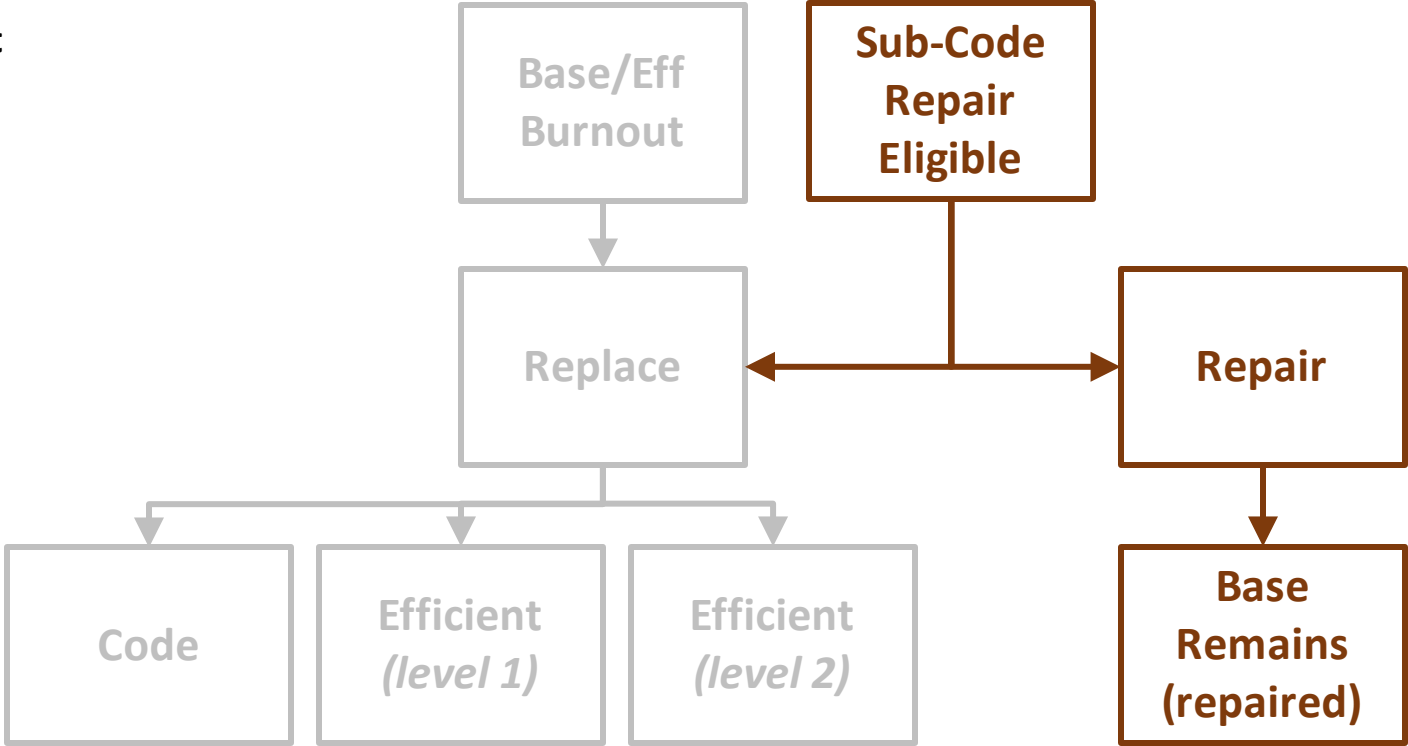
Modified Adoption Logic

Replace on Burnout vs. Repair Eligible

"Real Incremental Savings" – Above code only

Replace on Burnout will at least meet code – savings may already be counted in the CEC demand forecast

X Failure

Equipment Efficiency

Year 0 | 1/3 EUL | 2/3 EUL | 1 EUL

Code — Existing Condition Baseline — High Efficiency Replacement

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Replace on Burnout vs. Repair Eligible

Equipment Efficiency (vertical axis)

"Real Incremental Savings" – Relative to EB

X Failure

Option to Repair and Extend Life

Year 0   1/3 EUL   2/3 EUL   1 EUL

— Code   — Existing Condition Baseline   — High Efficiency Replacement
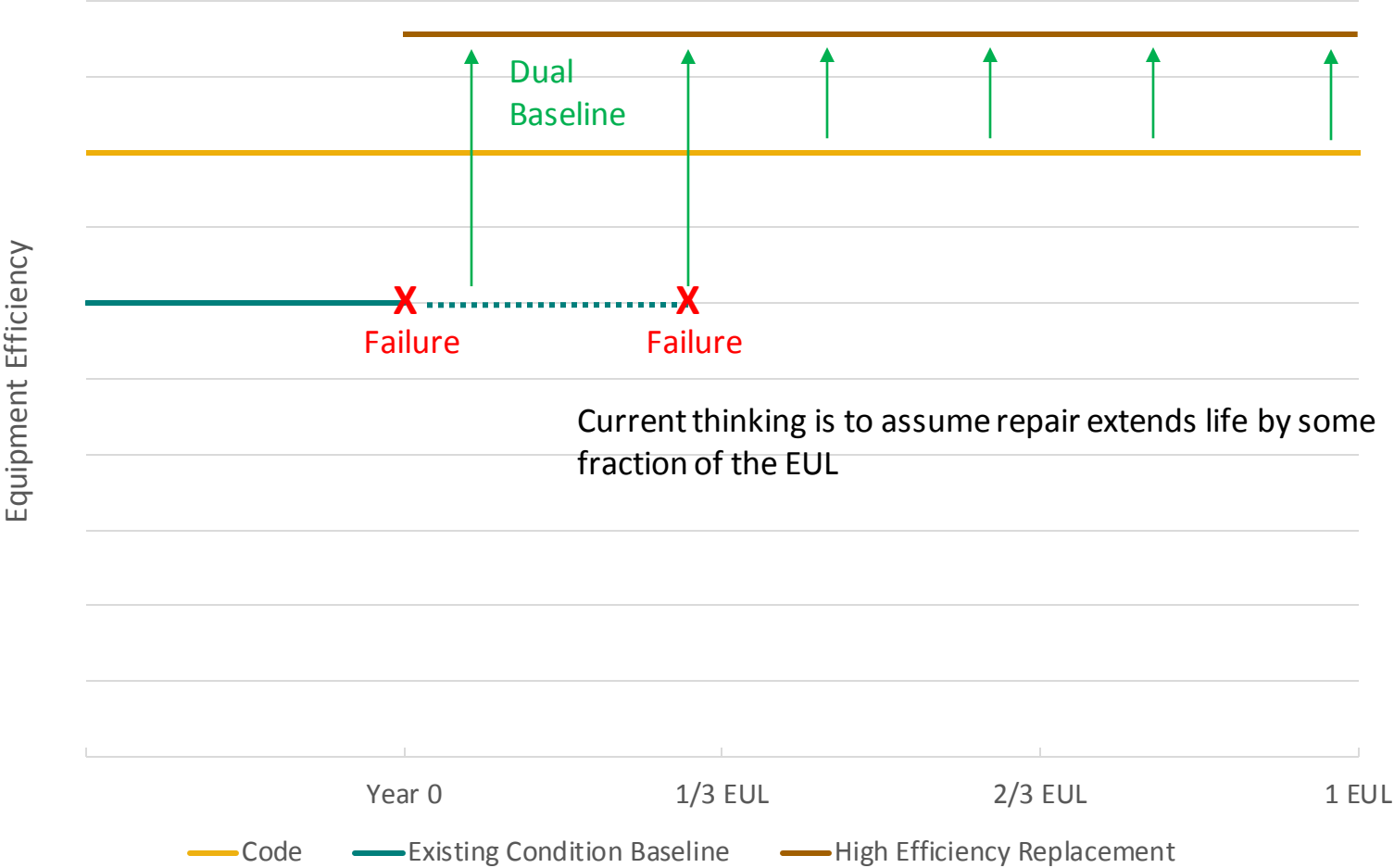
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Replace on Burnout vs. Repair Eligible

Replace on Burnout vs. Repair Eligible
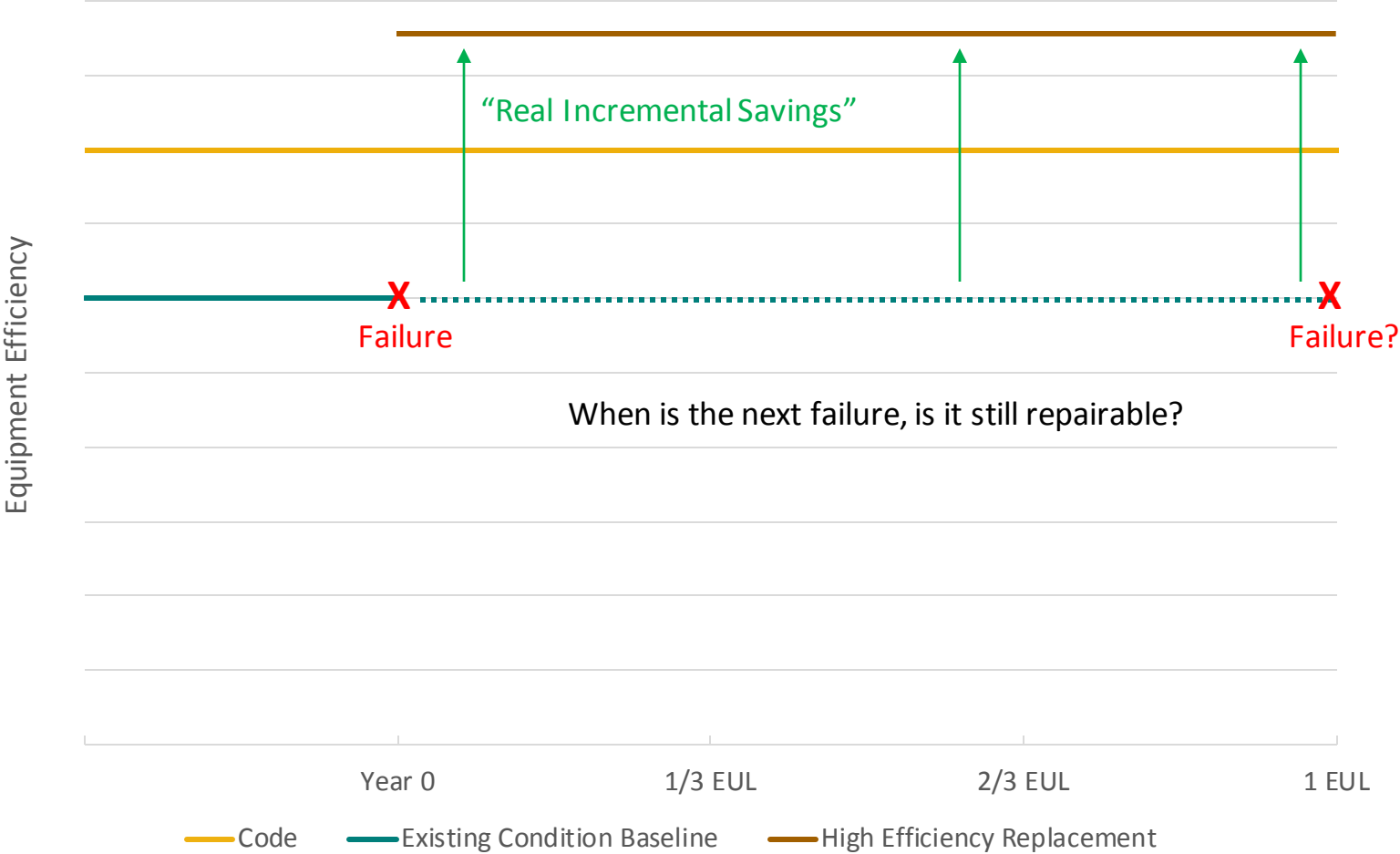
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Effects of Existing Baseline Policy on IOU Program Economics

Cost Effectiveness

- Cost effectiveness tests are well established and can account for existing baselines
- Added benefits (claiming below-code savings) means added costs (full equipment cost)
- **This analysis is not meant to recommend changes in the Cost Effectiveness framework**

Incentives

- Influence customers to adopt high efficiency technologies
- Key driver for forecasting adoption of energy efficiency
- Under the existing baseline framework, incentives may be available for projects and technologies that did not previously qualify for incentives
- **Analysis will forecast the impact of existing baseline policy on IOU program budgets; thus, we need insight on how incentives will change under the new policy.**

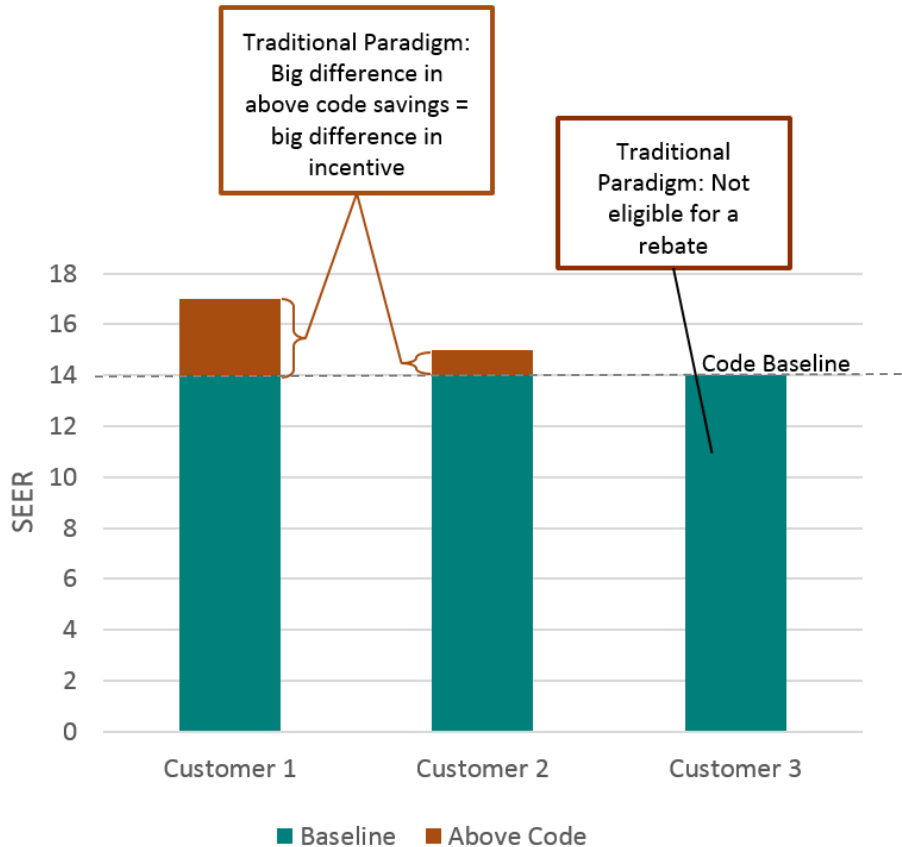NAVIGANT

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Economics – Cost Effectiveness Test Inputs

Measure Type	Benefits	Duration of Benefits	Measure Costs
Equipment – Replace on Burnout	Above code energy savings only	EUL of replacement	Code to Efficient incremental cost
Equipment – Repair Eligible	Savings relative to existing baseline for equipment RUL, and then above code energy savings (dual baseline)	EUL of efficient replacement	Full cost of efficient equipment minus repair cost (minus deferred replacement credit)
Retrofit Add-on	Savings relative to existing baseline	RUL of baseline	Full cost of efficient equipment
Retrofit	Savings relative to existing baseline	EUL of replacement	Full cost of efficient equipment

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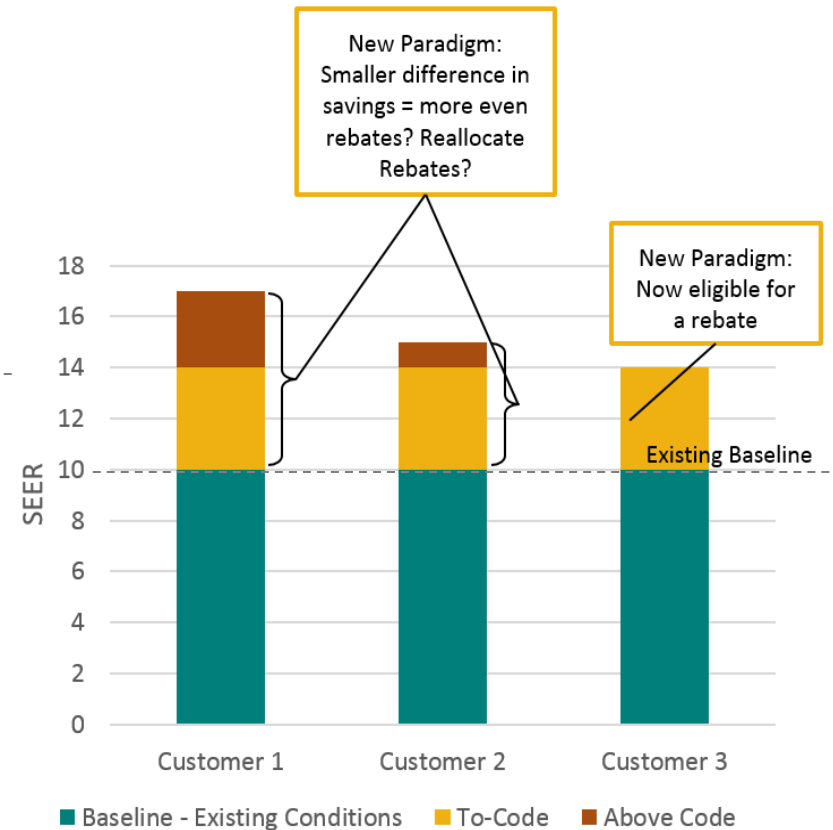# Economics - Rebates and Program Costs

» **The traditional model:**

– Rebates as a percent of incremental measure cost

– Key driver in customer adoption model:

bigger incentives = more adoption

» **The new model:**

– Need some way to assign/give an incentive to below code savings

Traditional Paradigm: Big difference in above code savings = big difference in incentive

Traditional Paradigm: Not eligible for a rebate

Code Baseline

SEER

Customer 1   Customer 2   Customer 3

■ Baseline ■ Above Code

New Paradigm: Smaller difference in savings = more even rebates? Reallocate Rebates?

New Paradigm: Now eligible for a rebate

Existing Baseline

SEER

Customer 1   Customer 2   Customer 3

■ Baseline - Existing Conditions ■ To-Code ■ Above Code

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Strawman for Modified Incentives

Approach	Description	Advantages	Disadvantages
Percent of Incremental Cost	Incentives set as 50% of incremental measure cost	Consistent with current rebate paradigm and PG model framework	Ignores measure level differences in the cost to achieve one kWh of savings—does not prioritize measures along EE supply curve
$/first-year kWh	Sets incentives at a $/kWh savings value up to some cap related to the cost of equipment (e.g. 50% of the incremental measure cost)	More budget efficient than percent of incremental cost strategy	Portfolio emphasizes first-year energy savings, de-emphasizing measures with long lives
Levelized $/kWh	Same approach as $/first-year kWh, except savings are calculated as levelized across the life of the measure	Levelized $/kWh results in greater net benefits than $/first-year kWh, because it accounts for measure life	May lead to unbalanced portfolios which overemphasize certain measures

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Data Collection – Managing the Data

Market Study Literature Review

Databases:
CLASS, CSS, CBECS, DEER, ASHRAE etc.

State and Federal Standards:
DOE Codes & Standards, Title 20, Title 24, and AB758

Case Studies, Reports and Workpapers:
IOU workpapers, CalTF report, SoCalREN & BayREN etc.

Stakeholder comments from April 28th workshop:
All comments and sources were reviewed

Data Processing

Data source prioritization

Data clean up and Final Baselines determined

Final Baseline Database

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Navigant has established a priority of data for use in defining existing conditions baseline

Residential:

1. Market Study Databases:
   California Lighting and Appliance Saturation Survey (CLASS)

2. DEER

3. Title 20, Title 24 and Federal Codes and Standards

4. Workpapers and Case Studies

Commercial

1. Market Study Databases:
   California Saturation Survey (CSS)
   ASHRAE Owning and Operating Cost Database

2. DEER

3. Title 20, Title 24 and Federal Codes and Standards

4. Workpapers and Case Studies

* Data priority was determined based on type of data sources, how up-to-date the data source is, and quality of data.

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Data Collection – Example

» Based on the Data Collection effort and the Source Prioritization established by Navigant, the team is in the process of determining the baseline for measures. Below are some examples of findings to date:

Measure Name	Code Efficiency	Existing Baseline Efficiency	Methodology
Residential Gas Furnace	80% AFUE	77.5% AFUE	Queried the CLASS database for equipment older than 10 years and determined the Existing Baseline.
Residential Split System AC	14 SEER	10 SEER	Queried the CLASS database for equipment older than 10 years and determined the Existing Baseline.
Commercial Gas Water Heater	0.57 EF	0.54 EF	Queried the ASHRAE Owning and Operating Cost Database and determined the average age of equipment currently in the market (which was used to determine the average Install Year). Historic appliance standards were used to determine the efficiency for Commercial Gas Water Heaters in the Install Year.

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» Measures that are classified as Repair Eligible require additional data to be collected.

» The team needs to make the following determinations

– Which measures are repair eligible?

– For those that are repair eligible, what fraction of the population tends to repair equipment upon failure?

» Assumptions are needed for the following

– The cost of repairing equipment

– The added lifetime that repairing equipment provides

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Measure Types - Residential

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

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Measure Types - Commercial

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
	Recreation	Pool Pumps Pool Heaters Pool Covers
Equipment – Repair Eligible	Commercial Refrigeration	Casework, Compressors, Condensers, etc.
	HVAC	Space Heating Space Cooling Chillers
	Service Hot Water	Water Heating/Boilers

Measure Types - Commercial

Measure Classification	End Use Category	End Use Sub-Category
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	Ventilation Controls Energy Management Systems
	Service	HVAC Quality Maintenance Retro-Commissioning
	Service Hot Water	Recirculation Pumps Boiler Controls
Retrofit Replacement	Building Envelope	Insulation
	HVAC	Duct Sealing/Repair
	Indoor/Outdoor Lighting	Fixtures/Ballast Controls Parking Garage Lighting
	Service Hot Water	Water Fixture Replacements Distribution (Insulation)

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» *General Data Sources:*

   – *Are there data sources the Navigant team is not currently leveraging that can provide information on existing conditions baselines?*

» *Measure Classifications:*

   – *Please review the Measure Classifications tables (slides 43-45) and provide detailed comments on whether the measure classifications are accurate or need revision. If they need revision, please provide an explanation, and/or point to data sources that would justify the re-classification.*

   – ***Important note: Repair Eligible measures are those that can be repaired at the end of their useful life to further extend equipment life***

» *For each measure classified as "Equipment - Repair Eligible"*

   – *What fraction (percentage) of the population tends to repair equipment upon failure at the end of its useful life?*

   – *What is the average cost of repairing equipment to extend life vs. purchasing new code compliant equipment (i.e. repair costs X% of replacing)?*

   – *What is the added lifetime that repairing equipment provides relative to the baseline (i.e. repairing adds y% to the equipment lifetime)?*

» *Can trade associations or equipment manufacturer associations provide data for annual new sales and estimates of secondary market sales for appliances and equipment sold in California?*

– *Example:*

o *X new residential refrigerators sold in California on an annual basis*

o *Y used residential refrigerators sold on the secondary market in California on an annual basis*

» *How will Program Administrator (PA) incentives and budgets change now that savings below code can be valued?*

- *Will PAs increase/decrease/maintain current incentive levels for measures historically offered through rebate programs?*

- *Will below code savings be valued the same as above code savings when offering rebates?*

- *Do PAs foresee significant changes to total program budgets? If so, in what direction?*

- *What rebate framework will be considered incent below code savings?*

- *What limitations/caps do PAs expect to use when offering rebates under the existing baseline paradigm (i.e. no more than x% of equipment cost)?*

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