

2018 AND BEYOND POTENTIAL STUDY

CALIBRATION AND SCENARIOS WEBINAR
DECEMBER 12, 2016

PUBLIC PREVIEW SLIDES

NAVIGANT

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SECTION 2:	Calibration
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INTRODUCTION AND OBJECTIVES

- Discuss the process of calibrating the potential model
 - Take into account the order from SB350:

“In assessing the feasibility and cost-effectiveness of energy efficiency savings ... the Public Utilities Commission shall consider the results of energy efficiency potential studies that are not restricted by previous levels of utility energy efficiency savings.”
- Discuss scenarios in the context of goals setting
- Discuss cumulative goals
- Solicit Stakeholder Feedback

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PG MODEL OVERVIEW

OVERVIEW OF PG 2018 AND BEYOND MODEL

• **Simulation Period**

- Calibration: 2013 - 2015
- Forecast: 2018 - 2030

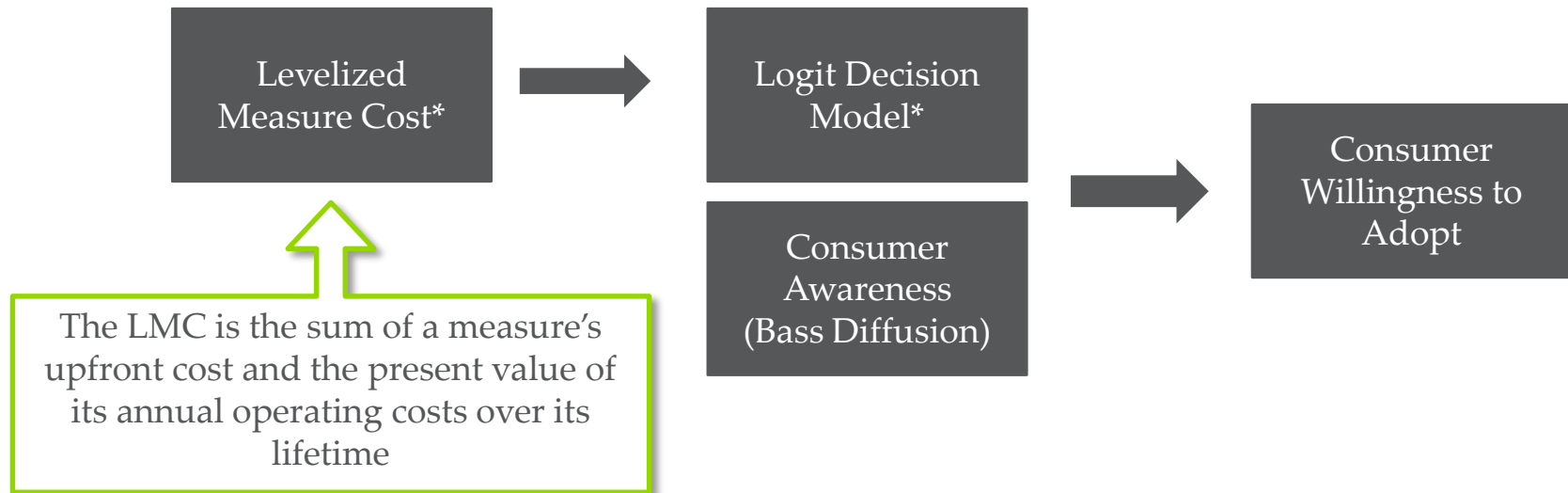
• **Dimensionality**

- Forecasts potential by utility, sector, building type, impact type, replacement type, end use and measure

• **Methodological Updates**

- Cost-effectiveness calculations and stock turnover algorithms accommodate existing baseline conditions
- Accommodates rebates in the form of \$/kWh and \$/therm
- Calculates annual economic potential (accounts for stock turnover) in addition to instantaneous economic potential.
- Uses bass diffusion approach to forecast market potential for Industrial/Ag technologies

CONSUMER PREFERENCE & TECHNOLOGY DIFFUSION LOGIC



*For residential and commercial measures only. Willingness for AIMS measures is calculated using a payback-based approach

CONSUMER WILLINGNESS OVERVIEW

Willingness – Levelized Measure Cost

The model uses a Levelized Measure Cost (LMC). The LMC reflects the present value of the cost of purchasing and operating the equipment over its EUL.

$$LMC = \text{Upfront Cost} + PV(\text{Annual Operating Cost}, iDR, EUL)$$

*evaluated at perpetuity based on iDR and EUL

The advantages of using the LMC approach are that it is more effective in capturing the effects of EE financing, allows for competing efficient technologies, and better predicts consumer behavior across measures with differing financial characteristics.

⁵ Gillingham, Newell, Palmer. "Energy Efficiency Economics and Policy." 2009.

⁶ CIEE. "Market failures, consumer preferences, and transaction costs in energy efficiency purchase decisions." 2004.

Willingness – Logit Decision Model

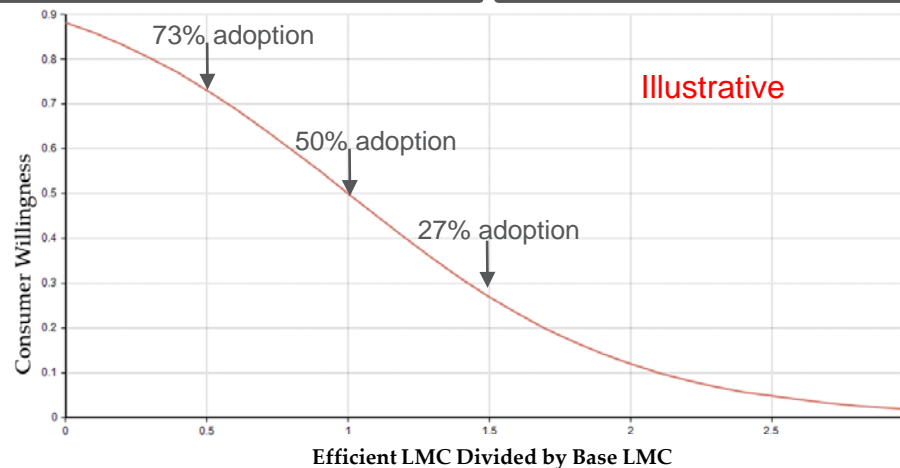
The willingness algorithm is a logit model that applies the LMC as the independent decision parameter.

$$W_1 = \frac{e^{\beta LMC_1}}{\sum_i^n e^{\beta LMC_i}}$$

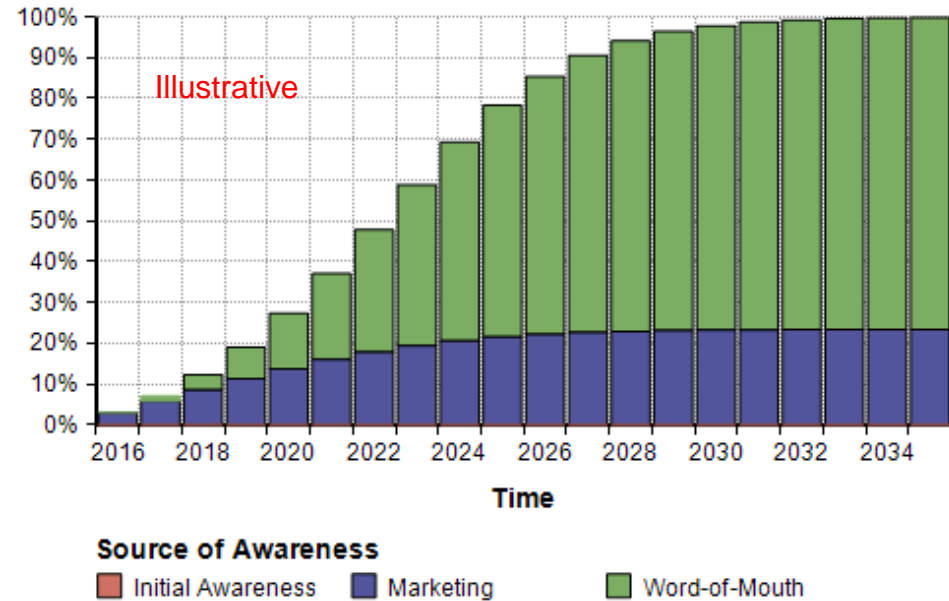
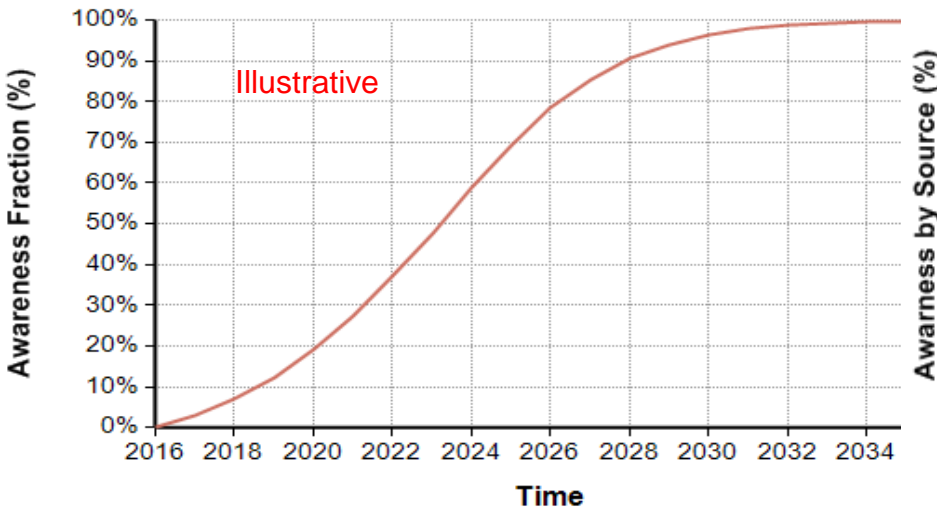
Where W is willingness, β is a sensitivity factor fit to willingness survey results, and LMC is the levelized measure cost.

⁷ McFadden, Daniel, Train, K. "Mixed MNL Models for Discrete Response." 2000. *Journal of Applied Econometrics*, Vol. 15, No. 5, pp. 447-470.

⁸ Train, Ken. "Discrete Choice Methods with Simulation." 2003. Cambridge University Press.

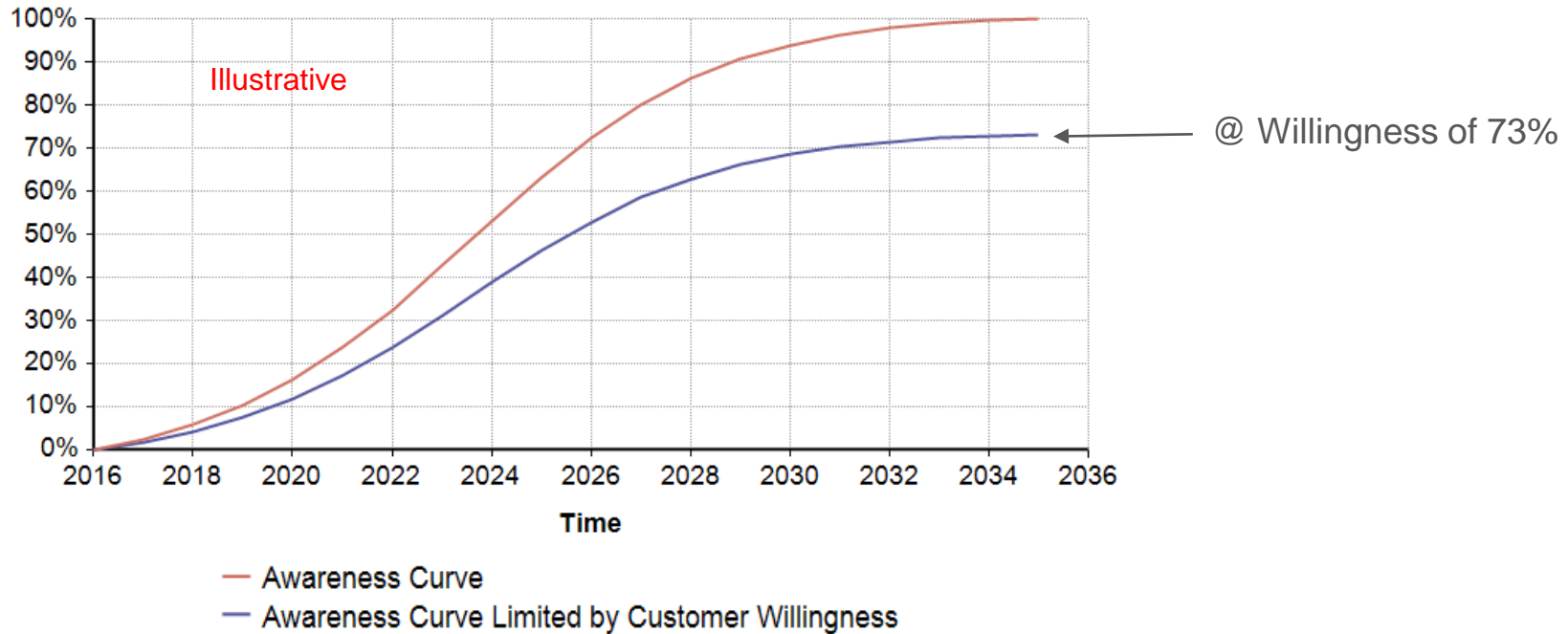


CONSUMER AWARENESS MODELLED WITH BASS DIFFUSION




- The Bass diffusion model produces an S-shaped awareness curve that can mimic technology adoption trajectories observed in real markets
- Key input parameters are:
 - Initial consumer awareness fraction
 - Marketing strength
 - Word-of-mouth strength

MARKET PENETRATION MODELLED WITH BASS DIFFUSION



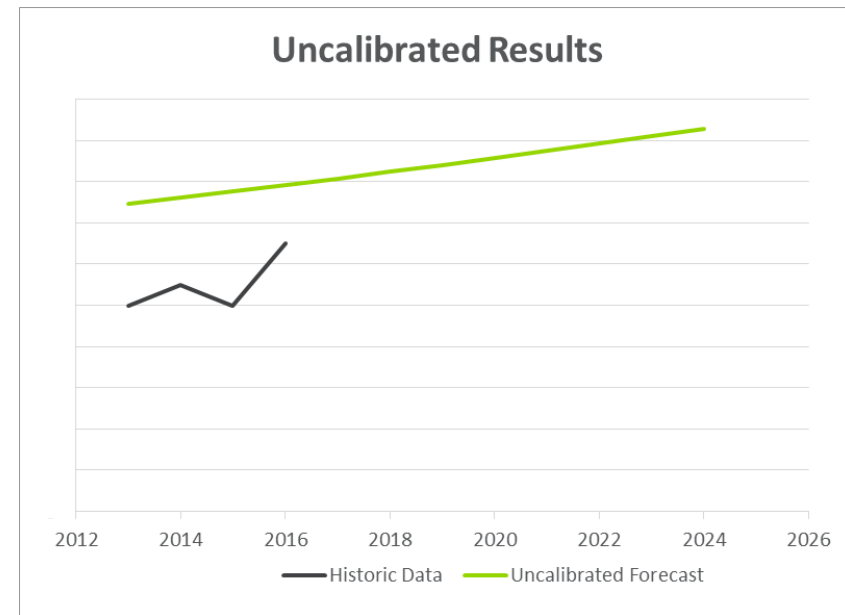
- Both consumer willingness and awareness dictate a measure's market penetration
- Example:
 - 100% of consumers are aware of a measure by 2035
 - 73% of consumers are willing to adopt the measure in 2035, based on an LMC ratio of 0.5
 - Market penetration in 2035 is $(100\% * 73\%) = 73\%$



BASIS AND NEED FOR CALIBRATION

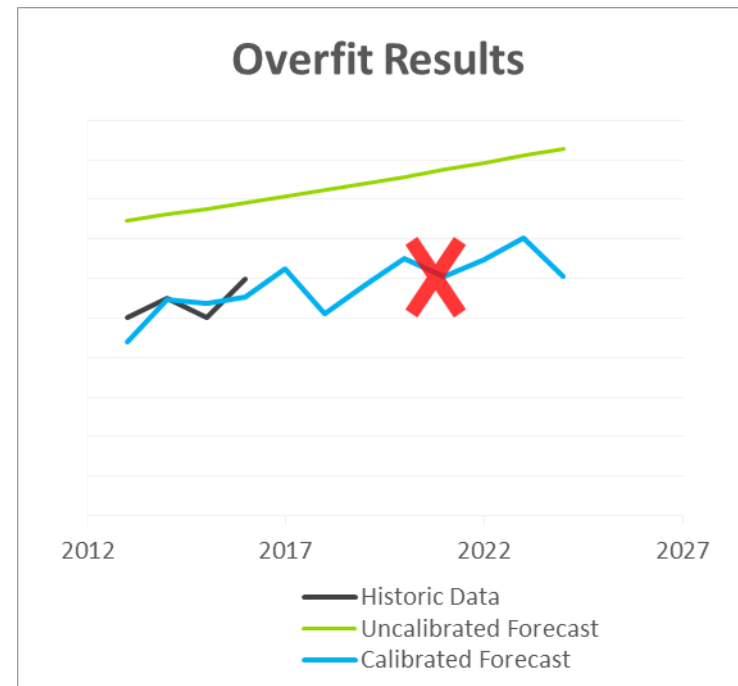
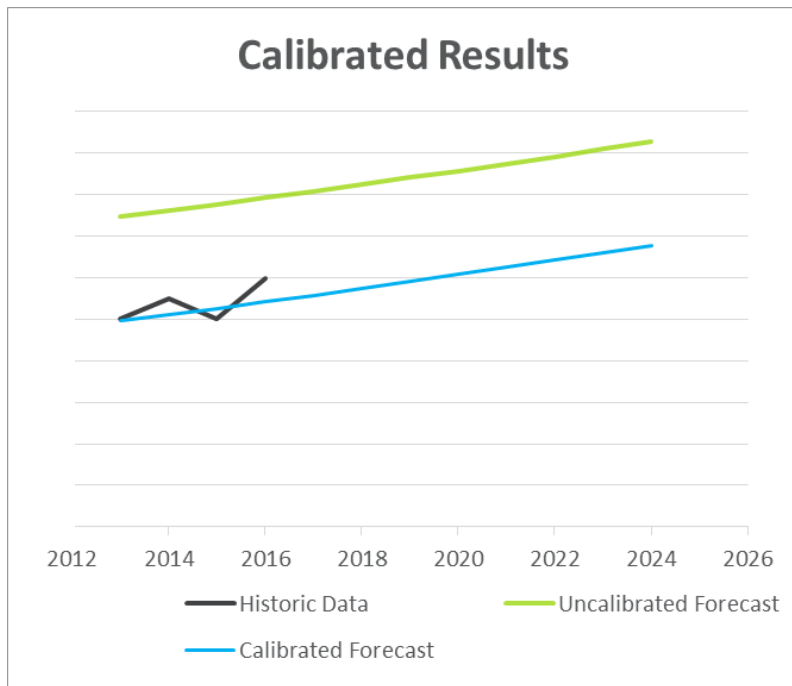
BASIS AND NEED FOR CALIBRATION

- Calibration is a standard process of adjusting model parameters such that model results align with observed data. The ability of a forecast to reasonably simulate observed data affords credibility and confidence.
- The model applies general market and consumer parameters to forecast specific technology adoption. There are often reasons that markets for certain end uses or technologies behave differently than the norm—both higher and lower.
- We would like to use historic observations to account for these differences.



BASIS AND NEED FOR CALIBRATION

- Anchors the model in actual market conditions and ensures that the bottom-up approach to calculating potential can replicate previous market conditions
- Accounts for varying levels of market barriers in different end uses
- We want to forecast based on past stable trends, but not to noise in the data.



WHAT DATA DO WE CALIBRATE TO?

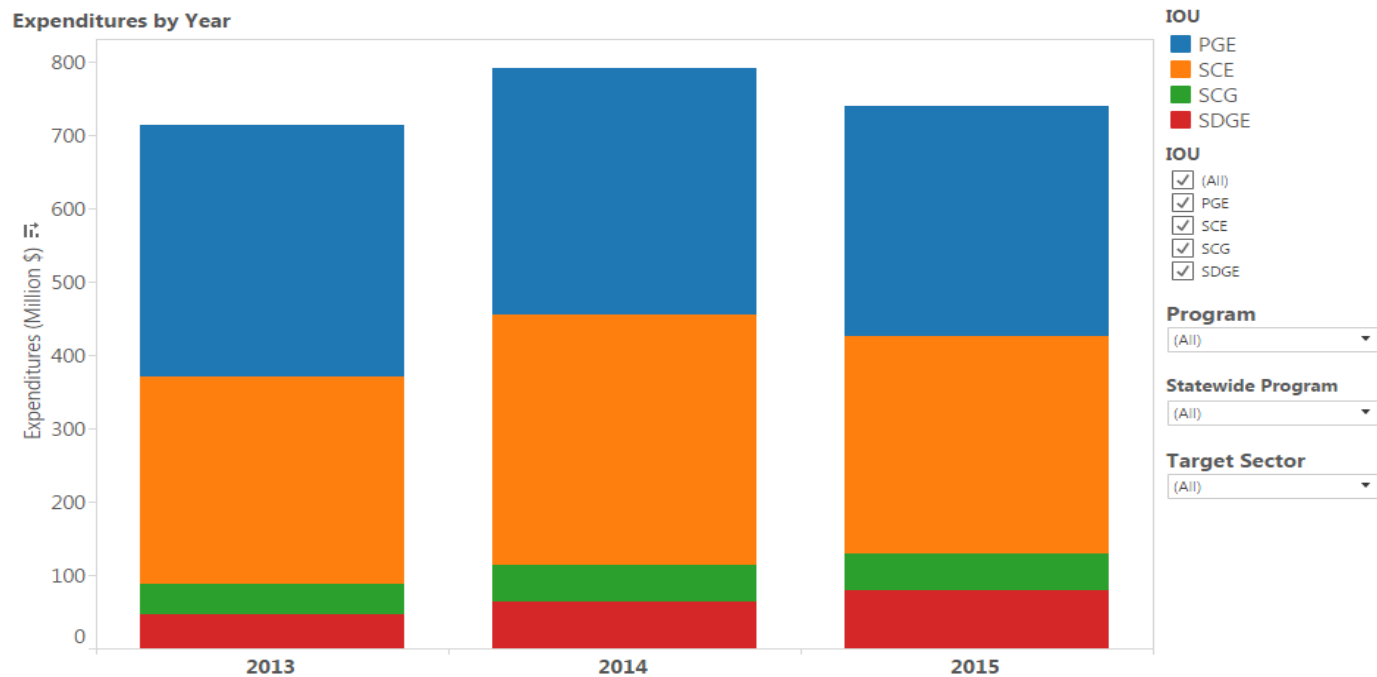
- 2015 Study:
 - Basis for goals: Above Code Gross Savings
 - Calibrated to evaluated program savings from 2006 - 2012
- A lot has changed since then:
 - Avoided cost updated - have generally decreased
 - Goals are to be expressed as Net
 - AB802: programs can include below code savings
- There is limited historic basis on which to calibrate...

WHAT DATA DO WE CALIBRATE TO?

The model will be calibrated primarily using historic program budgets

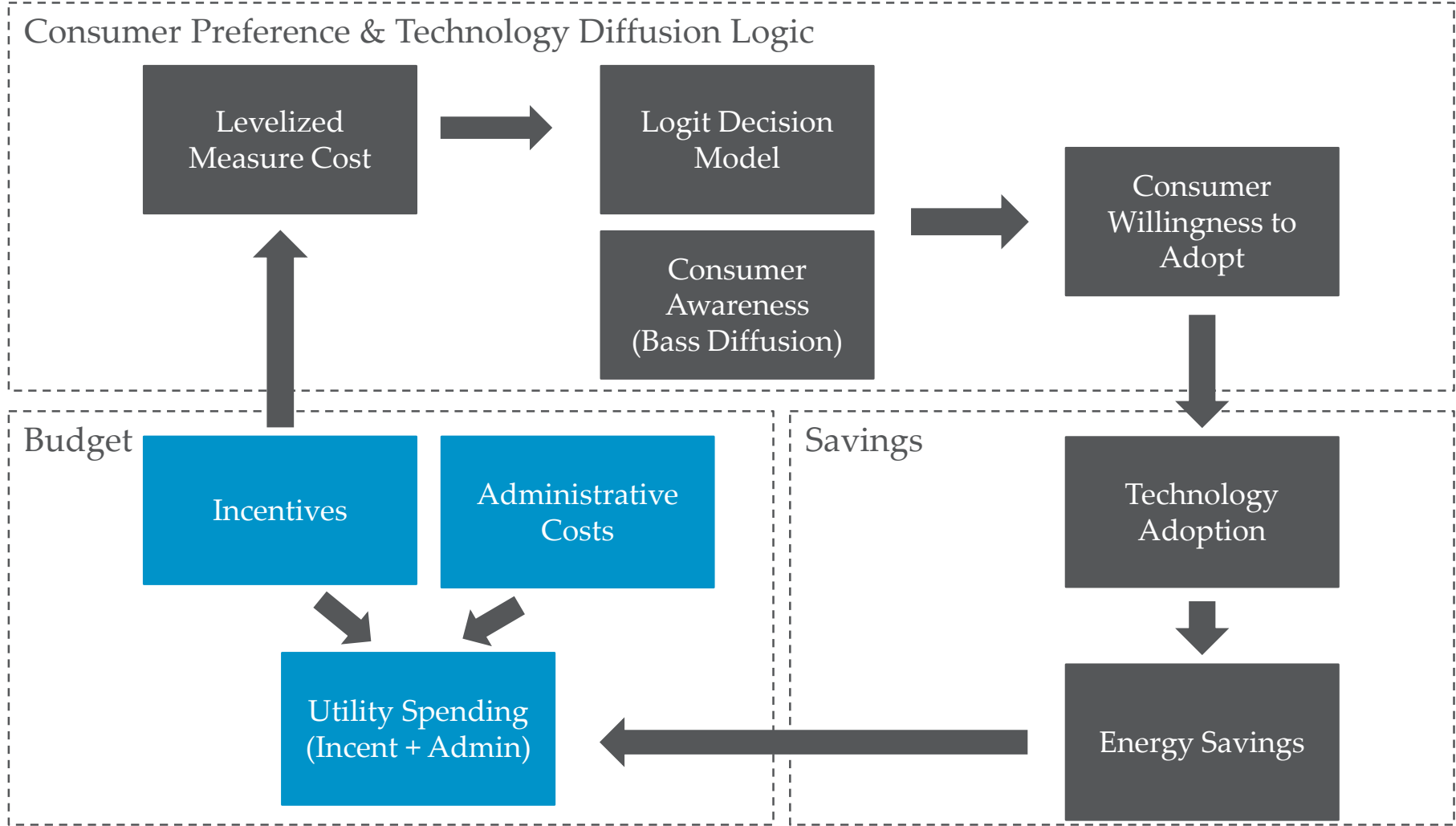
- Calibration inputs will include:
 - 2013-2015 IOU reported Incentive and Admin Expenditures in Compliance Filings

Illustrative 2013-2015 Calibration Targets



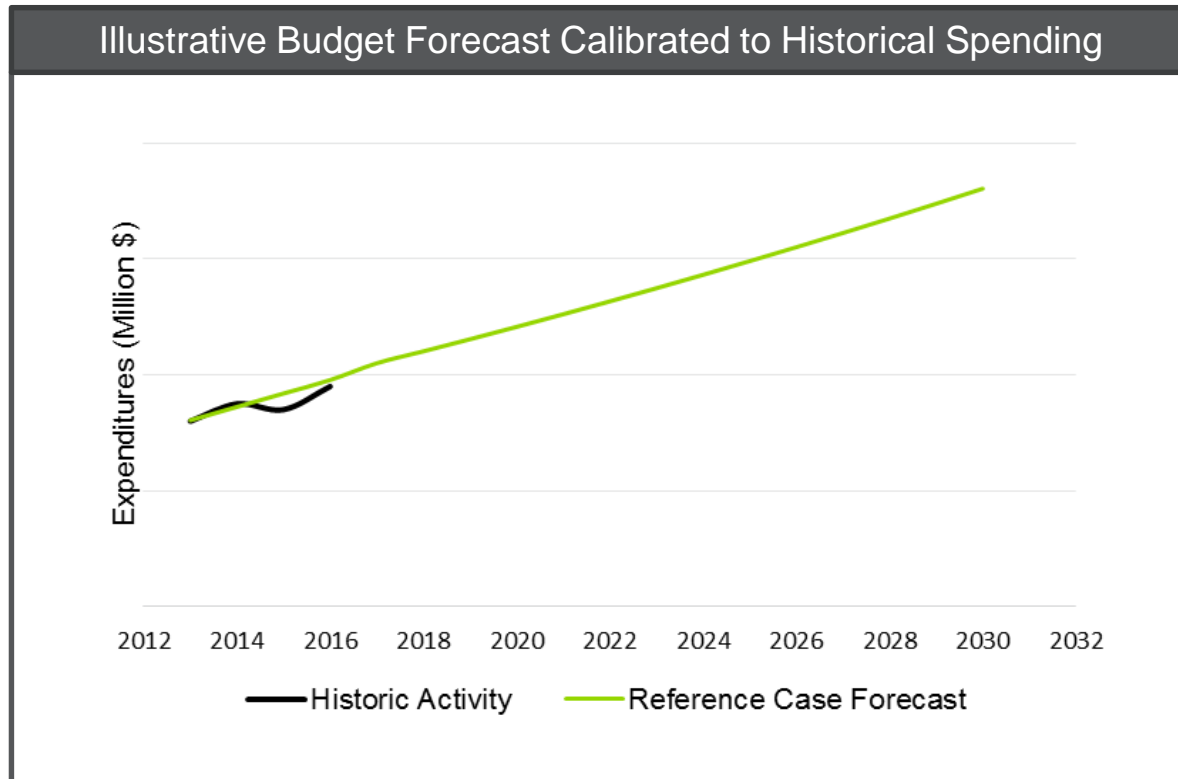
Source: <http://eestats.cpuc.ca.gov/>

INTERPLAY BETWEEN BUDGET AND SAVINGS



CALIBRATION APPROACH

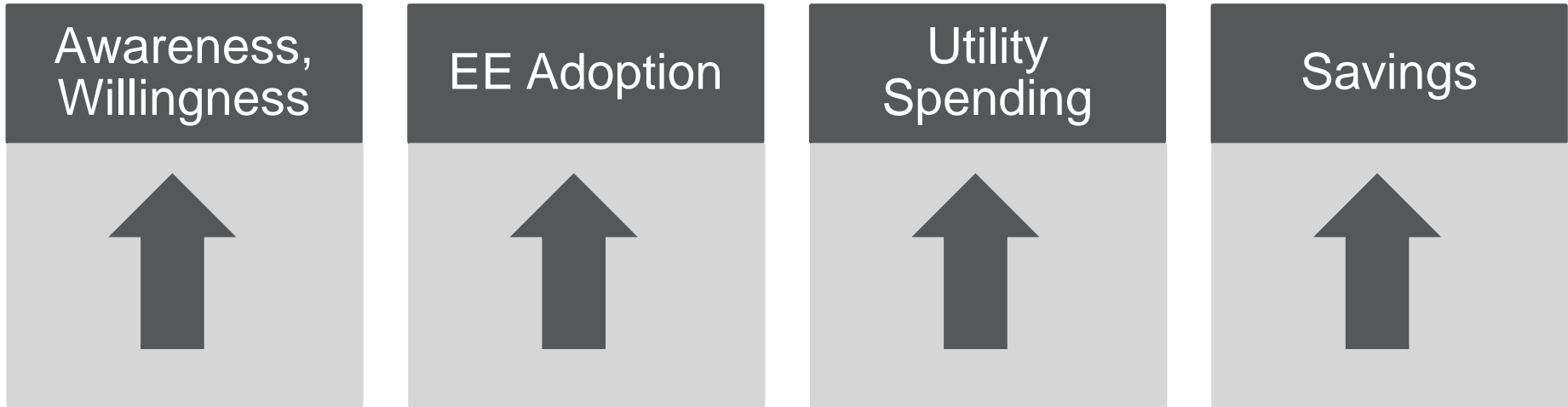
- Budget during calibration period is anchored to historical spending.
- Budget during forecast period is allowed to grow/change over time based on the inputs and assumptions that go into the model.



CALIBRATION LEVERS

Category	Lever	Impact on Model results
Awareness	Initial Awareness	Increasing initial awareness shortens the time required for a measure to reach 100% consumer awareness. Also sets upper bound on adoption in the first year.
	Marketing Strength	Increasing marketing strength increases adoption rate of measures in the nascent stage (i.e. having low initial consumer awareness). Less useful for measures having moderate to high initial consumer awareness.
	Word-of-Mouth (WOM) Strength	Increasing WOM increases adoption ramp rate, particularly in a measure's growth stage.
Willingness	Implied Discount Rate (iDR)	the iDR is adjusted when perceived market barriers are higher or lower than normal, or when factors other than cost effectiveness may play a larger role in purchase decisions.
	Sensitivity	the consumer sensitivity is adjusted when markets are considered mature and customer primary focus is measure cost effectiveness
	Incentive levels	Spending and savings are sensitive to incentive levels, so changes in incentive levels by small increments are explored.

CALIBRATION DYNAMICS



Question for Stakeholders

1. Any feedback on our proposed approach to calibrate using budget?

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SCENARIOS IN THE CONTEXT OF GOALS

- The past:
 - Goals were informed by one reference forecast calibrated to historic program activity
 - Scenarios were only considered in the AAEE forecast (after the CPUC had established goals)
- This update:
 - The CPUC would like to consider multiple scenarios to inform goal setting process
 - Scenarios will not consider external uncertainties (i.e. low/mid/high population forecast) but rather focus on things that the CPUC and IOUs can influence
 - Scenarios can be used to assess how IOU programs can contribute the SB 350 mandate

INTERNALLY VS. EXTERNALLY INFLUENCED VARIABLES

Internal

- Cost-effectiveness test
- Incentive levels
- Marketing & Outreach
- Behavior, Retro commissioning & Operational (BROs) customer enrollment over time
- Financing (?)



External

- Building stock forecast
- Retail price forecast
- Avoided cost forecast
- Measure-level input uncertainties (unit energy savings, unit costs, densities)
- Financing (?)



INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Cost-Effectiveness: Different tests may screen different measures:

- Total Resource Cost (TRC)
- Program Administrator Cost (PAC)
- Modified Total Resource Cost (SCT)

While there is no mandate for individual technologies to be cost effective, the PG study screens measures to remove those with low C-E from the forecast. The PG model will also calculate portfolio cost-effectiveness as an output for each scenario.

Questions for Stakeholders:

1. We previously only used the TRC test to screen measures. What are the pros/cons of using other tests beyond the TRC?
2. What should the threshold be? Past threshold was $TRC = 0.85$ (with allowance of 0.5 for Emerging Tech)
3. Should the threshold vary by technology?

INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Incentive Levels: Higher rebates reduce the LMC of a measure, which increases customer adoption.

Questions for Stakeholders:

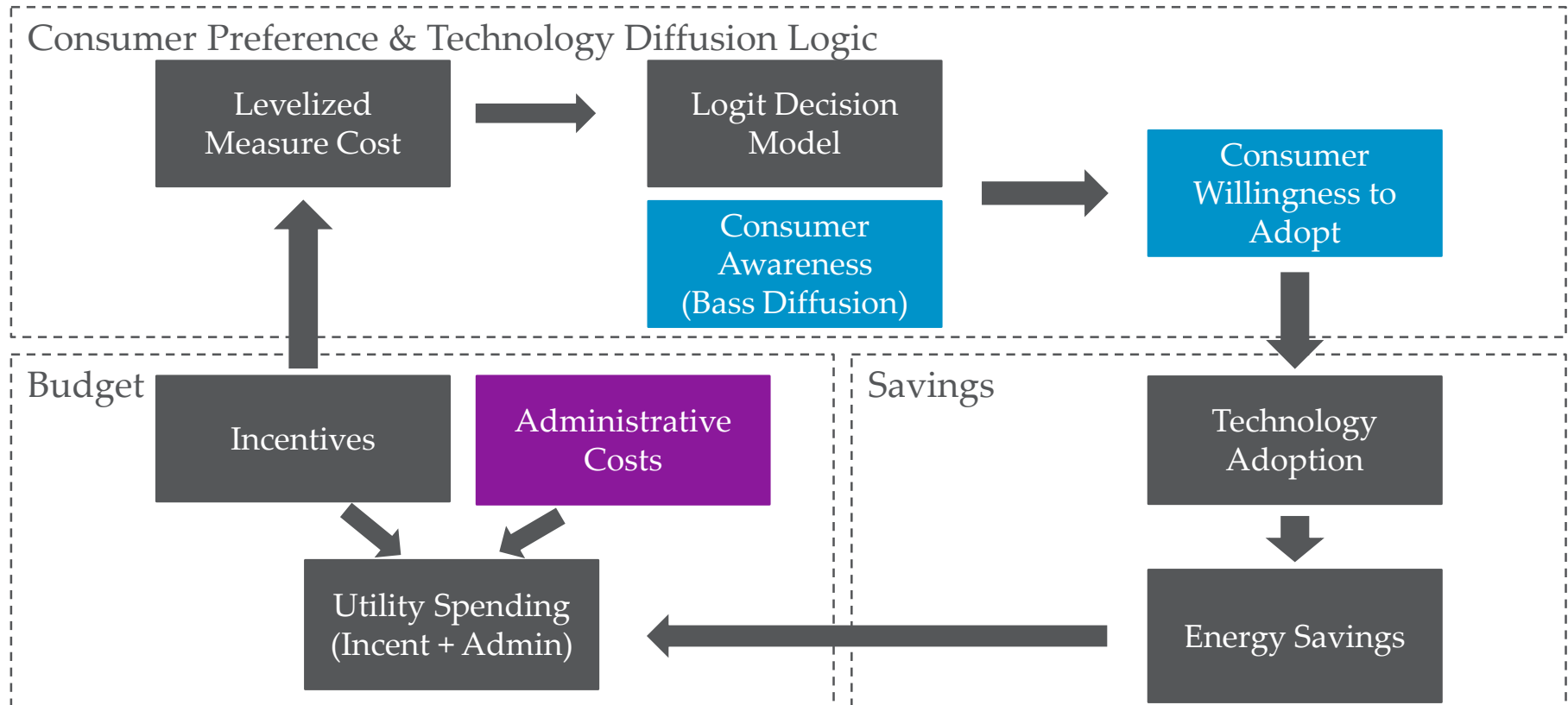
1. Is a \$/savings approach (similar to that implemented in the AB 802 Technical Analysis) appropriate for the reference case?
2. Should different scenarios consider different rebate levels?
3. If yes, what is the appropriate range of rebates to consider?

AB 802 Technical Analysis Incentive Levels

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

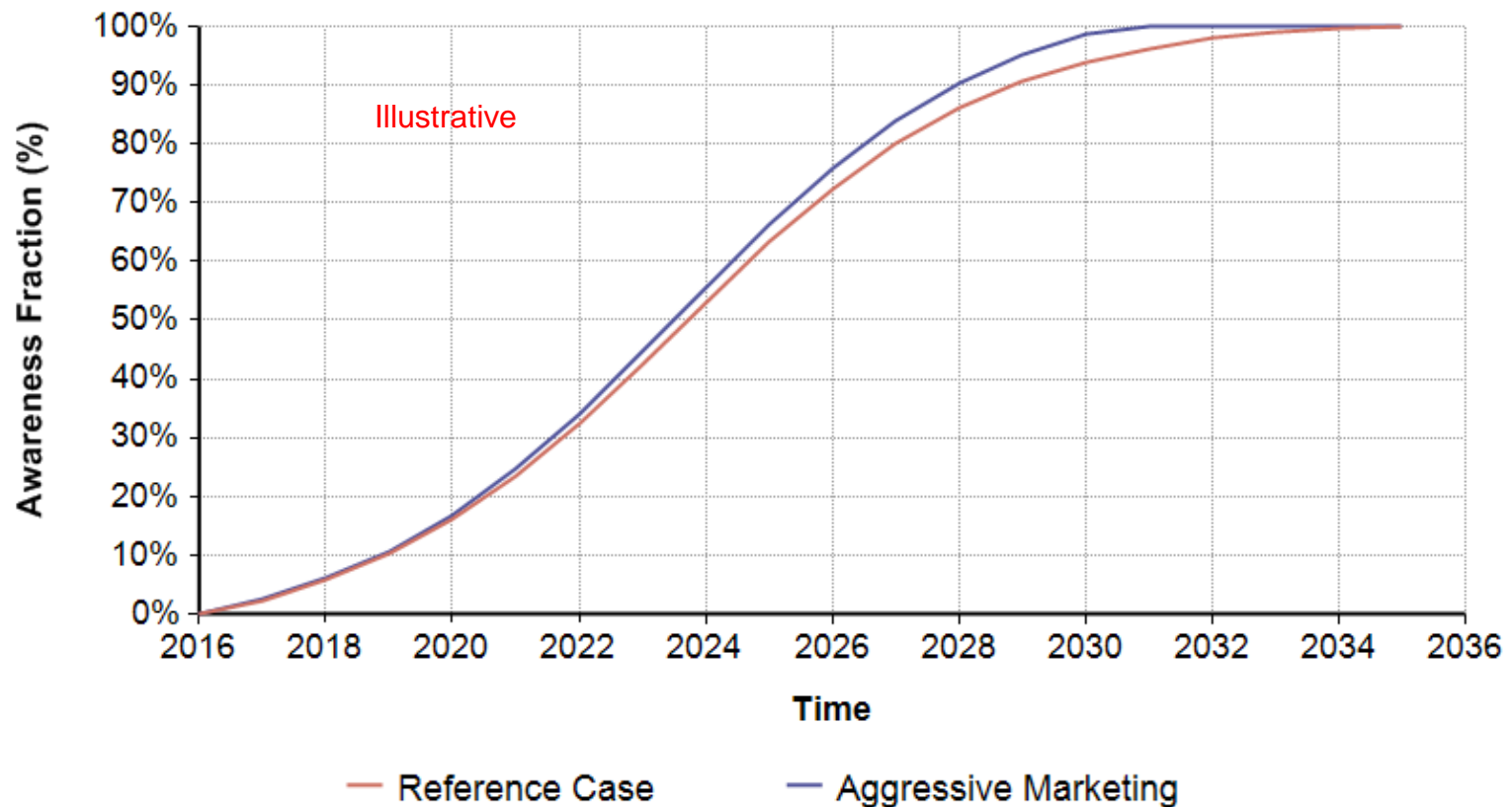
INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Awareness: Increasing marketing strength through program design increases adoption rate of measures in the nascent stage. This in turn increases administrative spending.



INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Awareness: Increasing marketing strength through program design increases adoption rate of measures in the nascent stage. This in turn increases administrative spending.



INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Willingness: Financing affects consumer iDR, which is adjusted when perceived market barriers are higher or lower than normal, or when factors other than cost effectiveness may play a larger role in purchase decisions.

Question for Stakeholders:

1. Is the energy efficiency financing industry primarily driven by IOU activities or by other market forces?
2. Should different scenarios consider different financing levels/schemes?

INTERNAL VARIABLES THAT INFLUENCE POTENTIAL FORECAST

Non-equipment Savings: Home energy reports, strategic energy management and continuous energy improvements programs can count towards goal-setting.

- Participation levels in future BROs programs could vary based on utility decisions
- Higher levels of participation in BROs gets us closer to SB350 mandate
- Assuming one forecast for BROs participation may result in a “self-fulfilling prophecy”

Illustrative Example: Home Energy Report Participation Levels

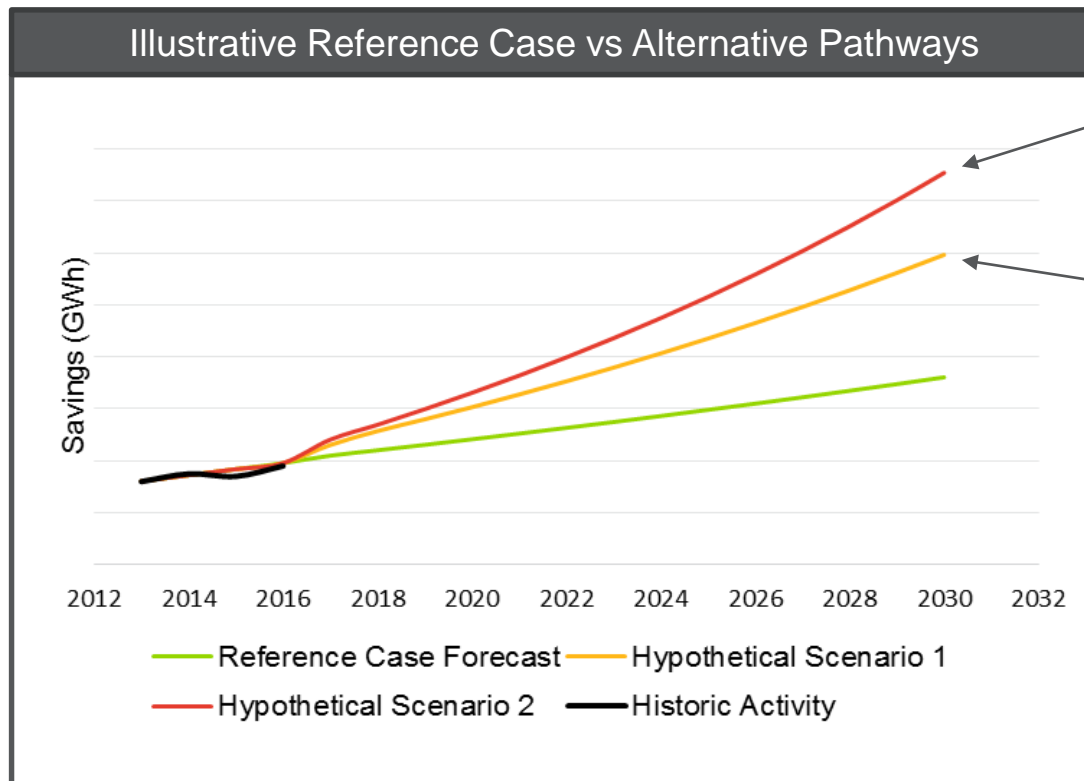
IOU	Reference Case	Option 2	Option 3
PG&E	22%	30%	40%
SCE	5%	10%	15%
SDG&E	0.8%	5%	10%
SCG	16%	20%	30%

Questions for Stakeholders:

1. Should BROs modeling contain sensitivity around participation levels?
2. What is the basis for considering multiple participation levels?

PATHWAYS TO FUTURE SAVINGS

- Reference case assumes business-as-usual scenario
- Alternative pathways represent composite scenarios that pull different levers
- Aggressive pathway would illustrate IOUs contributions toward meeting SB350



Eg. Increased marketing & higher incentives

Eg. Increased marketing

Questions for Stakeholders

1. Did we miss any variables/levers for consideration?
2. What variables/levers should be highlighted in our assemble of the pathways?

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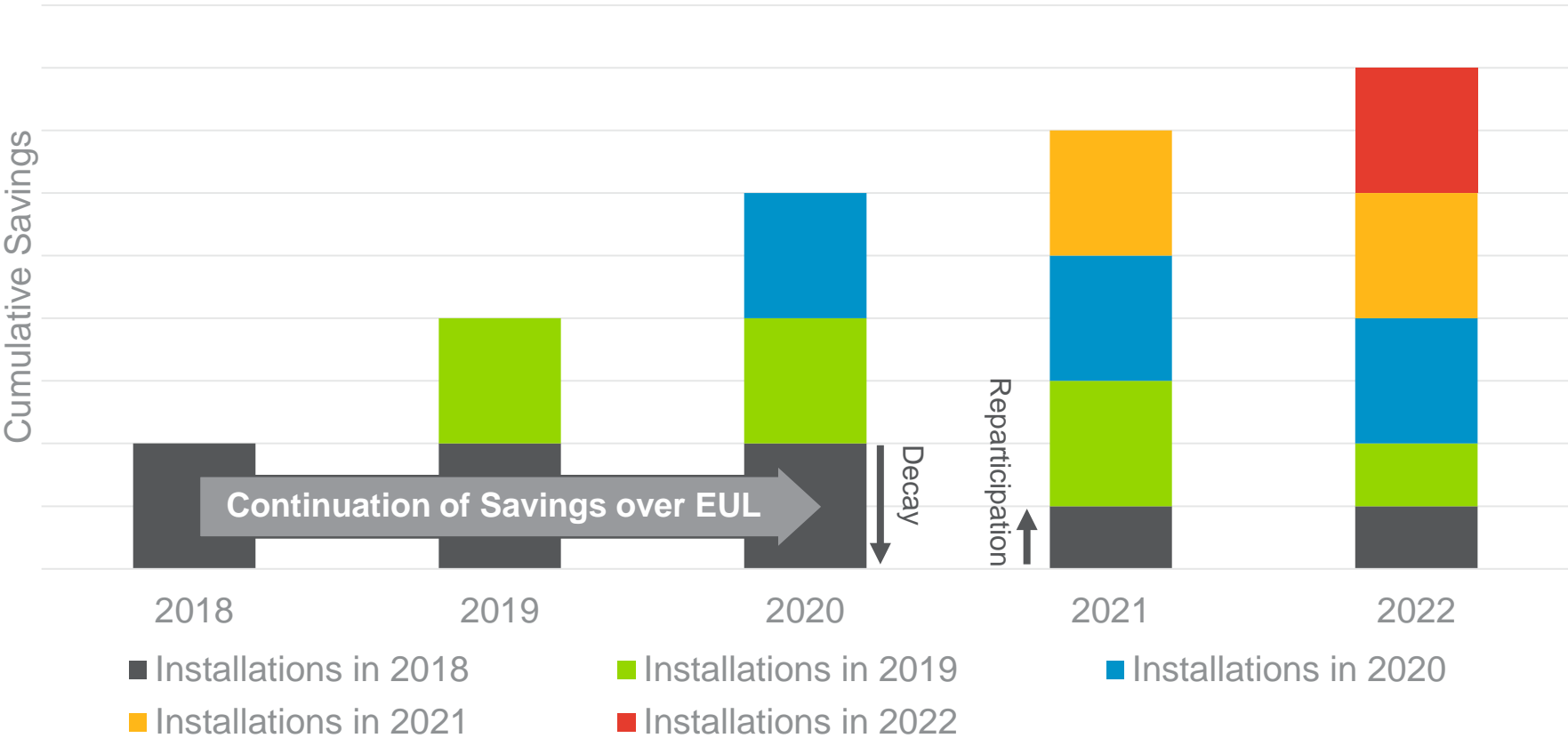
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HOW DO WE CUMULATE SAVINGS OVER TIME?

- Cumulative savings represent the total energy efficiency program savings from measures installed since a “start year” and are still “active” in the current year
- “Active” savings are calculated by accounting for:
 - Decay of savings as measures reach the end of their useful lives
 - Codes & standards that come into effect over time
- Unlike annual savings, cumulative savings include savings from reparticipants
 - In the past, only savings from first-time adopters were counted towards the goals
 - Sustained savings from re-adoptions needs to be accounted for in the CEC demand forecast
 - Model assumes reparticipants re-adopt measures at the same rate as new participants

ILLUSTRATION OF CUMULATIVE SAVINGS

Cumulative Savings of a Hypothetical Measure Installed by Various Customers Over Time, EUL = 3 years



QUESTIONS ON CUMULATIVE SAVINGS

Question for Stakeholders

1. When do we start cumulating savings?

2. There is no new research to inform treatment of decay/reparticipation in the PG model. What should we assume about decay?
 - a. Starting with the 2013 PG model, reparticipation estimated based on market penetration rates (varies by measure)
 - b. 2011 PG model assumed a blanket reparticipation rate of 50% based on CPUC D. 09-09-047

3. D. 09-09-047 required that the utilities make up 50% of the savings decay as measures expire.
 - a. 2015 PG study annual market potential included only new participants
 - b. Thoughts on how to address with regard to cumulative savings?

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INFORMAL WRITTEN COMMENTS

- CPUC staff welcome additional informal, written comments.
- **Please prioritize providing comments on scenarios over other topics**
- Due date: December 20, 2016
- E-mail to **all three**:
 - Paula Gruending paula.gruending@cpuc.ca.gov
 - Amul Sathe amul.sathe@navigant.com
 - Chris Ann Dickerson cadickerson@cadconsulting.biz
- No need to e-mail the entire service list, these are not formal comments.

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