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2015 California Potential and Goals Study – Model Calibration

DAWG Presentation

February 17, 2015

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Purpose

- To discuss the process of calibrating the potential model, including:
  - Why is calibration needed?
  - What is the basis for calibration?
  - What data do we calibrate to?
  - Which parameters are adjusted?
  - What effects can be expected?
  - How might we interpret calibration?
  - Does calibrating to historic data constrain the future forecast?

Timeline

- Navigant will deliver draft results in March following the calibration activity.

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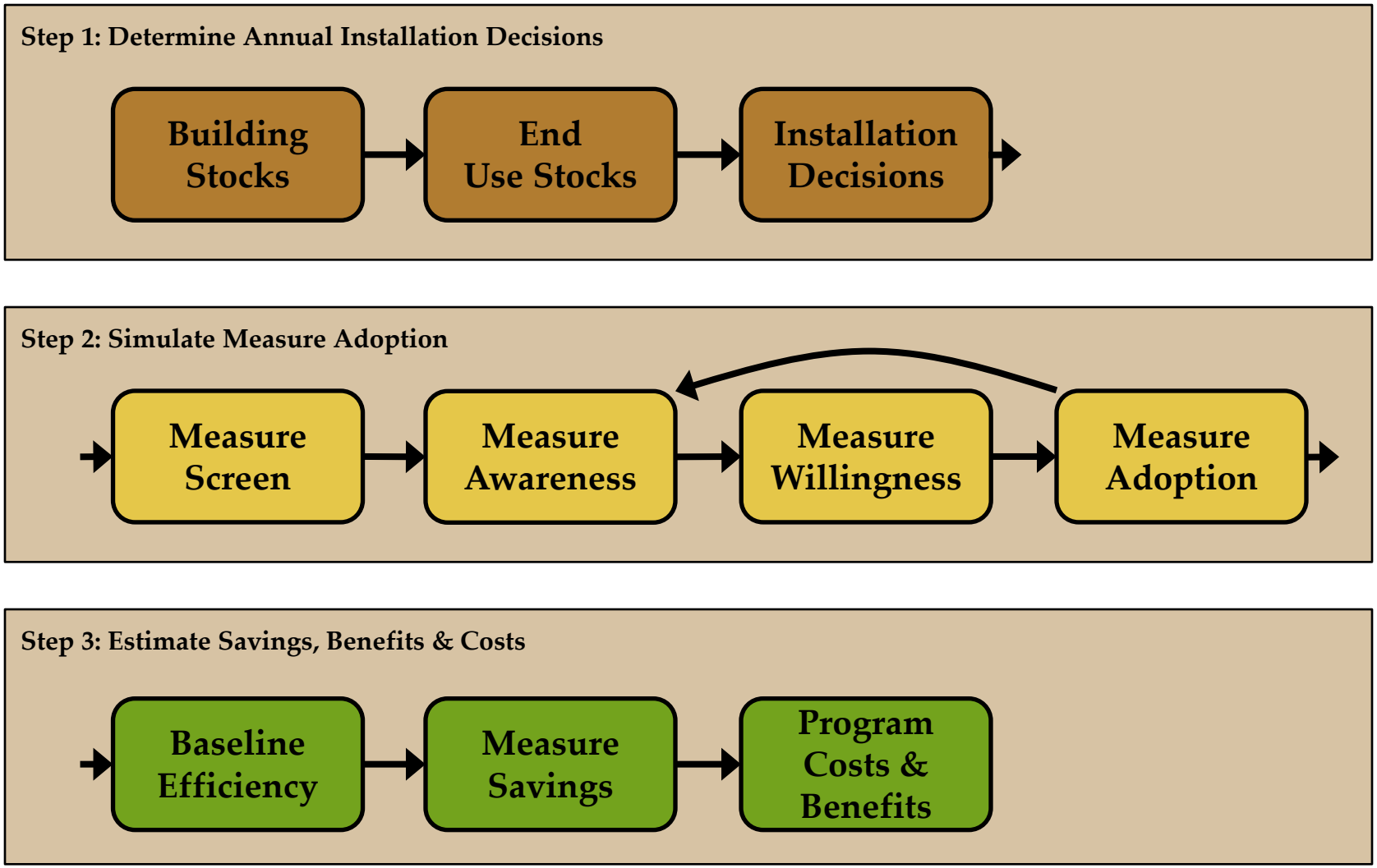
Voluntary measure adoption occurs in three general steps.



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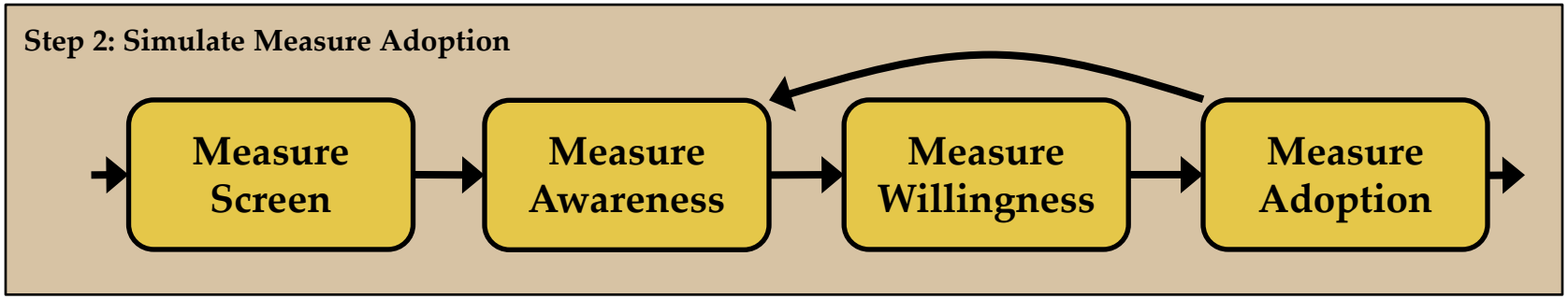
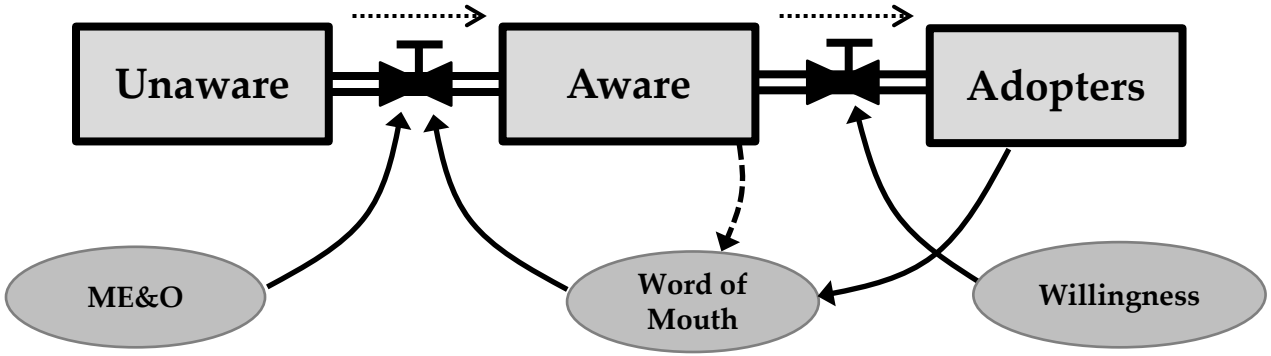
Calculating Market Adoption



- Awareness dynamically simulated based on Bass[1,2] approach.
- Bass generates S-shaped diffusion curve similar to the curves previously used.
- Parameter ranges will be estimated from non-EE data and calibrated to fit historic saturation data and program achievement data.



[1] *Bass, Frank. 1969. "A new product growth model for consumer durables." Management Science 15 (5): pp. 215–227.*
[2] *Sterman, John. 2000. "Business Dynamics: Systems Thinking and Modeling for a Complex World." McGraw-Hill.*

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Overview of Willingness

Willingness – Levelized Measure Cost

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

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

**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.

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

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.*

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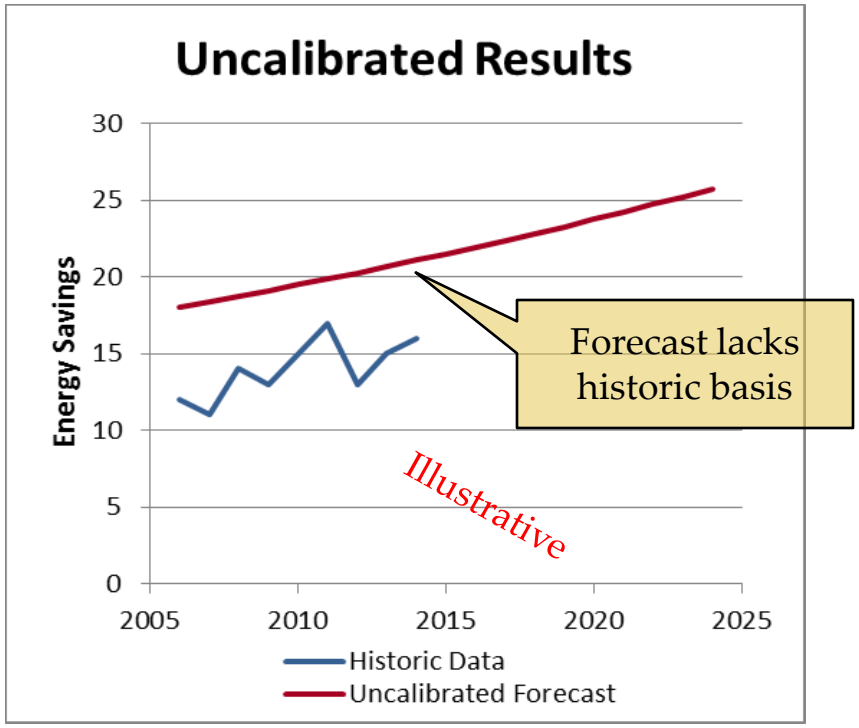
Why is calibration needed?

- 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.



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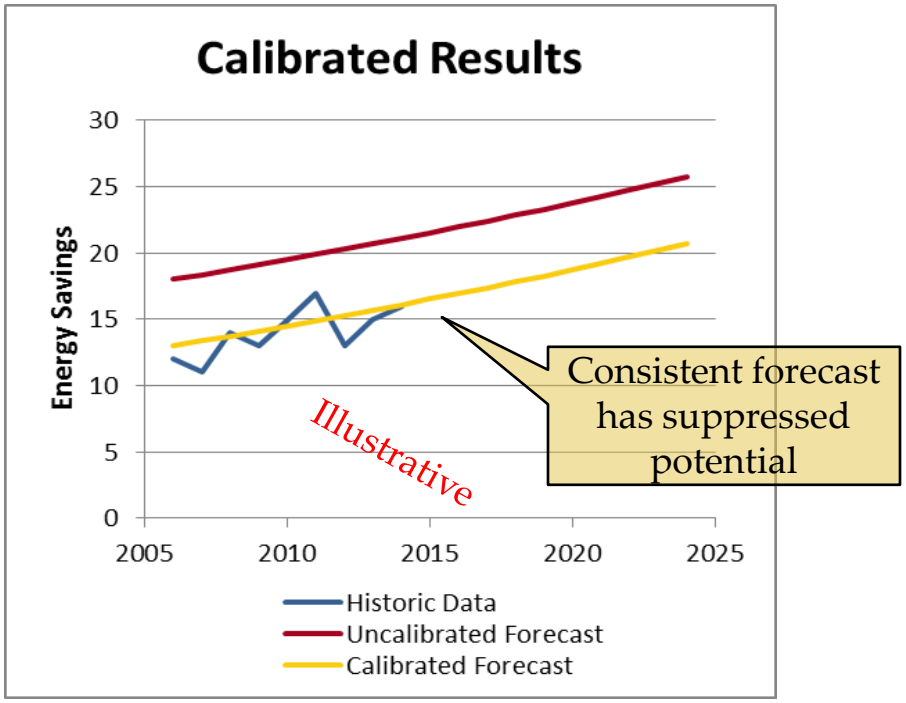
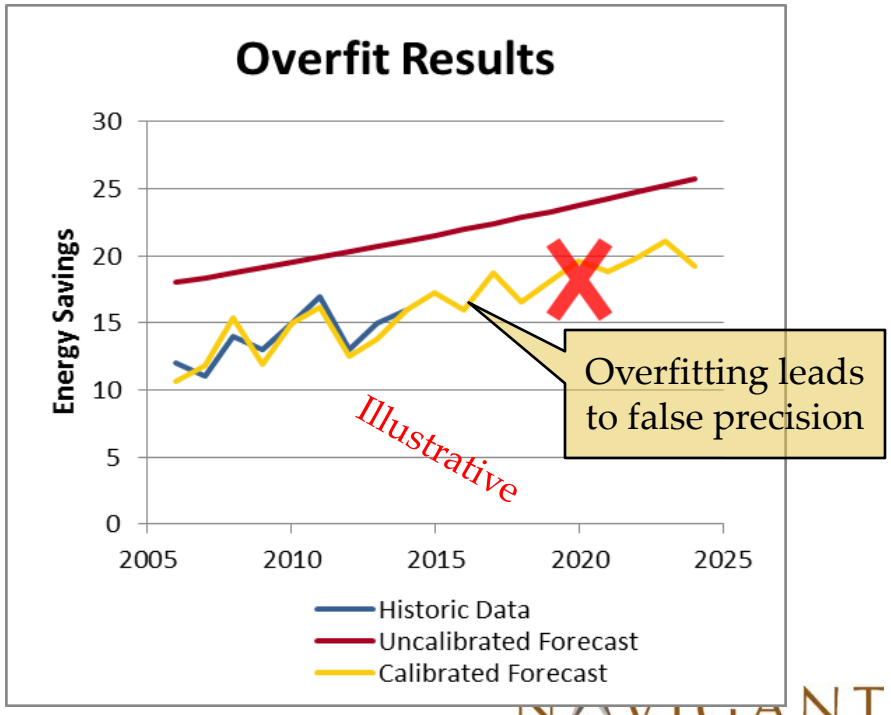
Why is calibration needed?

- 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.





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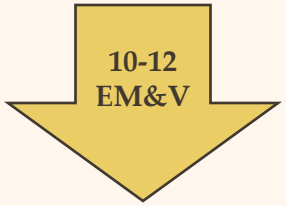
What data do we calibrate to?

- Use past program performance based on ex-post evaluation results
- In 2013 study, 10-12 achievements were based on ex-ante reported savings.
- In 2015 study, 10-12 achievements are based on ex-post evaluated gross savings.

2013 Study	06-09	10-12	13-14
Program Achievements	Evaluated Gross Savings	Ex Ante Reported Savings	Utility Compliance Filings



2015 Study	06-09	10-12	13-14
Program Achievements	Evaluated Gross Savings	Evaluated Gross Savings	Utility Compliance Filings

Ex-post evaluated gross savings are used as calibration targets in the model

What data do we calibrate to?

- Program achievements are aggregated at the end-use level before being used for calibration purposes (see example below).

Gross Electric Savings (kWh) – SCE/Residential		
End Use	EM&V 06-09	EM&V 10-12
Appliance/Plug	358,334,568	209,077,353
Lighting	1,371,515,084	2,033,851,792
HVAC	19,411,693	10,447,323
Envelope	2,670,700	2,236,715
Water Heating	712,506	1,605,956

Source: *CA Standard Program Tracking Database*

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Which parameters are adjusted?

- ***Willingness*** is the primary target of calibration.
  - *Implied Discount Rate* – 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.
- ***Awareness*** is sometimes, but rarely used.
  - Results are generally insensitive to awareness factors when measures are replace on burnout (RoB) with a measure life greater than 5 years because stock turnover dominates the timing.
  - *Word of mouth and marketing factors* - For retrofit and short-lived measures awareness can be adjusted to better fit the timing of market growth.
- Calibration is achieved via parameter multipliers.
- Emerging technology (ET) potential is not suppressed due to calibration. However, individual risk factors are applied to each ET to minimize risk of over reliance on unproven technologies and markets.

What effects can be expected?

- Parameters are adjusted to fit historic observations during the calibration period. Then the parameters are applied to the forecast period, which begins in the year of most recent density data vintage.
- General measure adjustments are down, but some are up.
- Calibrating up and down can have different effects in a dynamic model.
  - Calibrating down brings down the market share.
  - Calibrating up can increase the market share, but also leave less potential for the future

How might we interpret calibration?

Calibrating willingness parameters and holding them constant throughout the forecast period implies that certain characteristics will continue in the future as they have in the past:

- Consumer attitudes and values
- Non-financial product attributes
- Market barriers
- Program efficacy and budget
- Program priorities

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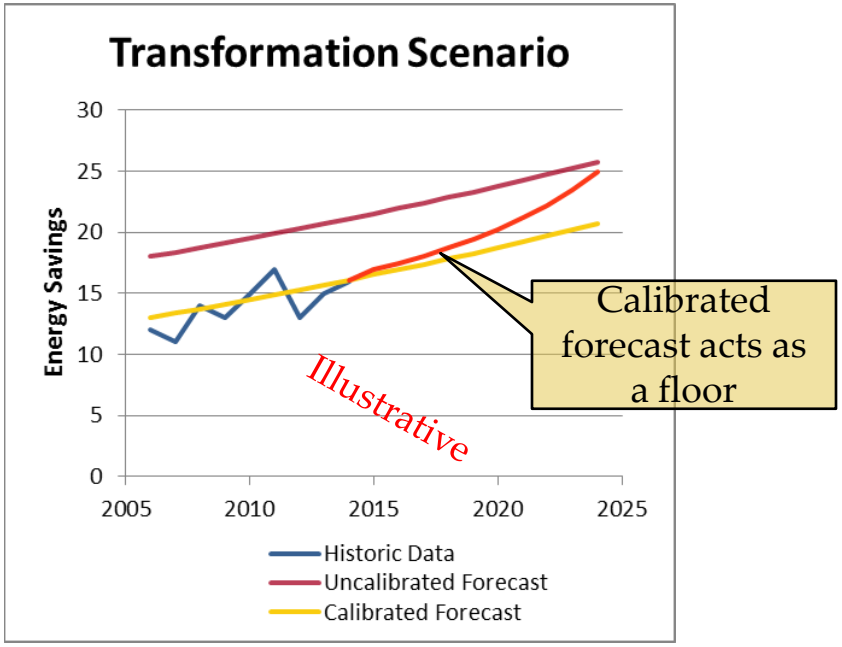
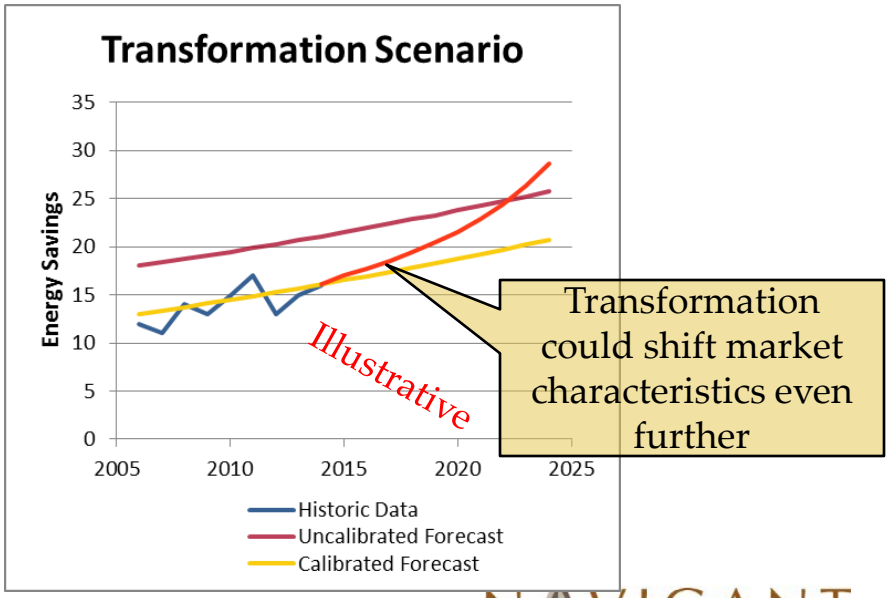
Does calibrating to historic data constrain the future forecast?

- Yes, but reasonably so. In the short term, it is unlikely that conditions could change sufficiently to warrant relaxing calibration multipliers.
- It may be useful to examine the effects of relaxing calibration constraints in the long term. The past is not always a perfect predictor of the future.
- The *iDR* could be adjusted further toward the market interest rate as a way to simulate a transformation scenario for certain end uses.





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Market Transformation Scenario

- An alternative calibration approach that allows for future shifts in programmatic priorities and consumer attitudes that would increase future savings.
- For example, Strategic Plan aims to transform the HVAC and lighting end-uses as a departure from past energy efficiency delivery activities.

HVAC: "*The residential and small commercial heating, ventilation, and air conditioning (HVAC) industry will be transformed to ensure that technology, equipment, installation, and maintenance are of the highest quality to promote energy efficiency and peak load reduction in California's climate*." The goals that aim to transform future HVAC efficiency delivery by increasing customer and contractors education and awareness, establishing quality standards, and accelerating penetration of advanced technologies (among other things).

Lighting: "*By 2020, advanced products and best practices will transform the California lighting market. This transformation will achieve a 60-80 percent reduction in statewide electrical lighting energy consumption by delivering advanced lighting systems to all buildings.*" This include initiatives to "*Develop and implement coordinated policies, procedures, and other market interventions that eliminate barriers, accelerate lighting.*"

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