

# Estimating Incremental-Uncommitted Savings from Energy Efficiency in California

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## Presentation Overview

- Overview of the policy initiatives modeled to support development of CPUC energy savings goals
  - > Scenario definitions, modeling methods, key data sources, and assumptions
- Overview of key analytic caveats and uncertainty issues associated with the incremental uncommitted savings estimates

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## Scenarios Developed to Support Goal-Setting

Scenario Category	Scenario Components
IOU program potential	<ul style="list-style-type: none"> <li>• Full restricted market potential (TRC&gt;=0.85)</li> <li>• Base restricted market potential (TRC&gt;=0.85)</li> <li>• Naturally-occurring potential</li> </ul>
Big Bold Energy Efficiency Strategies	<ul style="list-style-type: none"> <li>• Residential new construction initiative</li> <li>• Commercial new construction initiative</li> <li>• Small HVAC initiative</li> </ul>
Future codes & standards (IOU perspective)	<ul style="list-style-type: none"> <li>• AB 1109 (“Huffman Bill”)</li> <li>• Strengthening of Title 24</li> <li>• Code compliance programs</li> </ul>
Future codes & standards (societal perspective)	<ul style="list-style-type: none"> <li>• AB 1109 (“Huffman Bill”)</li> <li>• Strengthening of Title 24</li> <li>• Revision of federal appliance standards</li> </ul>



## ASSET Scenarios – IOU Program Potential

- Market potential
  - > Amount of customer measure adoption and resulting savings that would occur over time in response to a given level of measure incentives
  - > Takes into account a variety of factors such as participant cost-effectiveness or payback period, awareness, and willingness to adopt
  - > “Restricted” to the potential savings from measures with TRC  $\geq 0.85$
  - > “Full” restricted market potential = incentives equivalent to full incremental cost of given EE measure
  - > “Base” restricted market potential = incentives equivalent to current, weighted-average measure incentives (based on 2004-2005 program cycle)
- Naturally-occurring potential
  - > Potential savings from customer adoptions that would occur in the absence of *further* utility programs from the outset of the forecast period, including free-riders, participant and non-participant spillover, and longer-term market effects



## Big Bold Energy Efficiency Strategies (BBEES)

- Commissioner Grueneich defined the BBEES initiatives as “strategies to promote maximum energy savings through the coordinated actions of utility programs, market transformation, and codes and standards” (April 13, 2007 scoping ruling)
- The BBEES initiatives therefore represent a significant departure from the incentive-based voluntary programs that comprise the vast majority of the current IOU program portfolios
- The CPUC directed the utilities to include specific programs to support the implementation of three specific BBEES initiatives in their 2009-2011 portfolio applications and their long-term Strategic Plans
  - > Small HVAC
  - > Residential new construction
  - > Commercial new construction



## BBEES – ZNE New Construction

- Definition: penetration of zero net energy (ZNE) new homes and commercial buildings according to milestones in D.07-10-032
- Attribution not addressed; savings estimated as penetration-weighted technical potential going forward
- Technical unit savings adjusted to be incremental to ASSET NC market potential savings estimates (based on voluntary incentives promoting 15% better performance than Title 24)
- Modeled based on annual NC market penetration assumptions
- Penetration-weighted savings estimates applied to:
  - > Res: WH+HVAC
    - assumes no significant change in scope of Title 24
    - avoids double-counting with lighting and appliance measures in other scenarios
  - > Com: WH, HVAC, interior lighting, and exterior lighting
    - assumes no significant change in scope of Title 24



# BBEES – Residential ZNE New Construction

- Market penetration and savings assumptions

Efficiency level:	Case:	Market Penetration:		
		2011	2015	2020
<b>Tier 2</b> (35% reduction in HVAC and WH from 2005 Title 24 levels)	High <sup>a</sup>	40%	90%	100%
	Mid	30%	60%	80%
	Low	20%	30%	60%
<b>Tier 3</b> (55% reduction in HVAC and WH from 2005 Title 24 levels)	High <sup>b</sup>	10%	40%	90%
	Mid	8%	25%	60%
	Low	5%	10%	25%

<sup>a</sup> High values reflect milestones in D.07-01-032

<sup>b</sup> High values reflect milestones in *California Energy Efficiency Strategic Plan (Draft)*



# BBEES – Commercial ZNE New Construction

- Market penetration and savings assumptions

Efficiency level:	Case:	Market penetration:		
		2011	2015	2020
30% reduction in HVAC, WH, and lighting from 2005 Title 24 levels	High <sup>a</sup>	30%	50%	70%
	Mid	20%	35%	55%
	Low	10%	20%	40%

<sup>a</sup> High values reflect milestones in D.07-01-032



## BBEES – Small HVAC

- Definition: reshaping the residential and small commercial HVAC industry in California to promote retrofit/replacement with high-quality installations of optimally-sized, high-efficiency HVAC systems with low leakage ductwork
- Attribution not addressed; savings estimated as penetration-weighted technical potential going forward
- Modeled as ROB measure starting in 2009 in existing res segment only (to avoid double-counting savings from BB RNC scenarios) assuming 15-year EUL
- CPUC did not define specific performance or market penetration milestones for the BB HVAC initiative
- ROB market penetration assumptions developed to represent a significant acceleration of the SEER 15 CAC market in advance of the incoming federal standard in 2016: 10% in 2009, 50% in 2015, 75% in 2016, and then 100% through 2020
- Unit savings estimates based on: 1) field test results of PIER-funded HDAC demonstration project, 2) DEER values for savings from duct sealing and refrigerant charging



# BBEES – Small HVAC

- Savings assumptions

BB HVAC case:	HDAC savings	Duct sealing savings	Duct sealing incomplete
High	29%	14% - SFD 11% - MFD	50%
Mid	20%		50%
Low	17%		25%



## New Codes and Standards

- IOU perspective
  - > Revisions to C&S often obviate IOU programmatic efforts for related measures that are subsumed by new C&S
  - > In the absence of new efficiency measures and programs, the impact of revisions to C&S is a relative decrease in the achievable energy efficiency resource available to be captured by voluntary IOU programs going forward
  - > Frequent and significant revisions to C&S, therefore, could have potentially important impacts on the achievable market potential available to IOUs, especially in the absence of an influx of new, cost-effective efficiency measures and technologies
- Societal perspective
  - > Most relevant savings metric for resource procurement and GHG mitigation planning is the total savings potential for society at large, independent of whether the savings are derived through IOU programs, state codes and standards, or federal codes and standards



## New Codes and Standards

- IOU perspective
  - > AB 1109 (Huffman Bill)
  - > Title 24
- Societal perspective
  - > AB 1109
  - > Title 24
  - > Federal appliance standards
- Kept scope limited to new C&S judged to have most significant impacts and where sufficient information was available to adequately model potential impacts
  - > did not consider incoming Title 20 standards for battery chargers or federal standards for commercial clothes washers, vending machines, commercial freezers



## Codes & Standards – IOU Perspective

### ■ AB 1109 (Huffman Bill)

- > Definition: implementation of AB1109, using general service CFL potential as proxy (excludes specialty lamps, including reflectors)
- > Final rulemaking occurred in 2009; interim standards take effect in 2011 (~20 lm/W), final standards take effect in 2018 (45 lm/W)
- > Modeled as phase-out of general service CFLs from IOU portfolios over 2011-2018



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## Codes & Standards – IOU Perspective

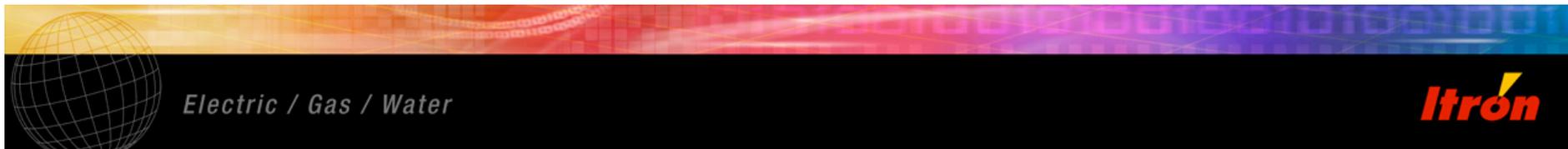
- Strengthening of Title 24
  - > Definition: the implementation of revisions to Title 24 that obviate current voluntary programs administered by the IOUs targeting new residential and commercial construction
  - > Modeled as phase out of current IOU NC programs (which promote 15% better performance than 2005 Title 24 levels) due to implementation of revised Title 24 standards in 2012
    - accounting for typical one-year lag between final rulemaking and implementation
  - > Penetration-weighted savings estimates applied to WH+HVAC in residential and WH, HVAC, and lighting in commercial



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## Codes & Standards – Societal Perspective

- AB 1109 (Huffman Bill)
  - > Definition: implementation of AB1109 according to changes to Title 20 adopted in August 2009
  - > Modeled as implementation of efficiency standards for general service lamps (~20 lm/W starting in 2011, increasing to 45 lm/W in 2018)
  - > Savings based on targets stipulated in AB1109 (aggregate residential lighting savings of 50% by 2020 and commercial lighting savings of 25% by 2020)



## Codes & Standards – Societal Perspective

- Strengthening of Title 24
  - > Definition: periodic strengthening of Title 24 performance levels for RNC and CNC
  - > Modeled as phase out of IOU voluntary NC programs, concurrent phase-in of higher Title 24 performance levels over time starting in 2011
    - assumed typical 1-year lag between rulemaking and implementation of Title 24 revisions
  - > Savings estimated as technical potential going forward, taking into account annual NC rates and technical unit savings assumptions
  - > Penetration-weighted savings estimates applied to WH+HVAC in residential and WH, HVAC, and lighting in commercial

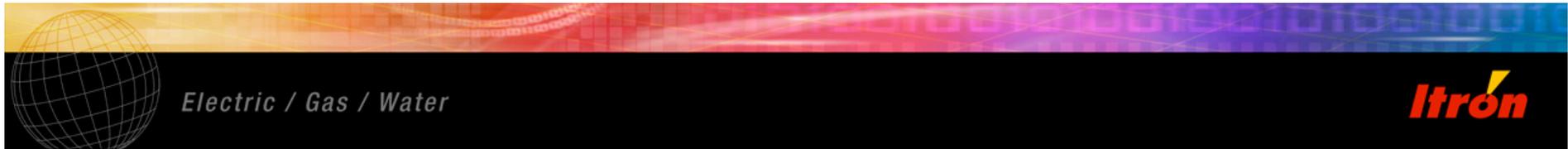


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# Title 24 – Societal Perspective

- Technical unit savings and periodicity assumptions

Title 24 case	Technical unit savings (relative to previous code)	Periodicity
	2011-2020	
Residential:		
High	10%	2011, 2014, 2017 (3 revisions)
Mid	10%	2011, 2014 (2 revisions)
Low	10%	2014 (1 revision)
Commercial:		
High	5%	2011, 2014, 2017 (3 revisions)
Mid	5%	2011, 2014 (2 revisions)
Low	5%	2014 (1 revision)



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## Codes & Standards – Societal Perspective

- Strengthening/expansion of Federal appliance standards
  - > Definition: revision of federal appliance standards according to USDOE's *Five-Year Schedule of Issuance of Appliance Rulemakings* (published January 31, 2006)
  - > Most significant standards anticipated: high-efficiency CD, DW, CAC, RAC, PTAC, and PTHP
  - > Modeled as ROB measure in existing building segment (to avoid double-counting with measures in NC C&S scenarios)
  - > Savings estimated as stock-turnover weighted technical potential going forward
  - > Currently none of these measures pass TRC and thus are not included in ASSET estimates of economic or market potential; savings in C&S (societal) scenario thus treated as incremental to ASSET market potential savings estimates



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# Appliance Standards – Societal Perspective

- Technical unit savings and periodicity assumptions

Equipment type:	Unit savings	EUL	Periodicity	
			rulemaking	implementation
Clothes dryers	13%	18 years	2011	2016
Dishwashers	48%	13 years	2009	2014
Residential CAC	12% - SFD 15%- MFD	15 years	2011	2016
Residential RAC	10%	12 years	2011	2016
Commercial PTAC	18%	15 years	2008	2013
Commercial PTHP	18%	15 years	2008	2013

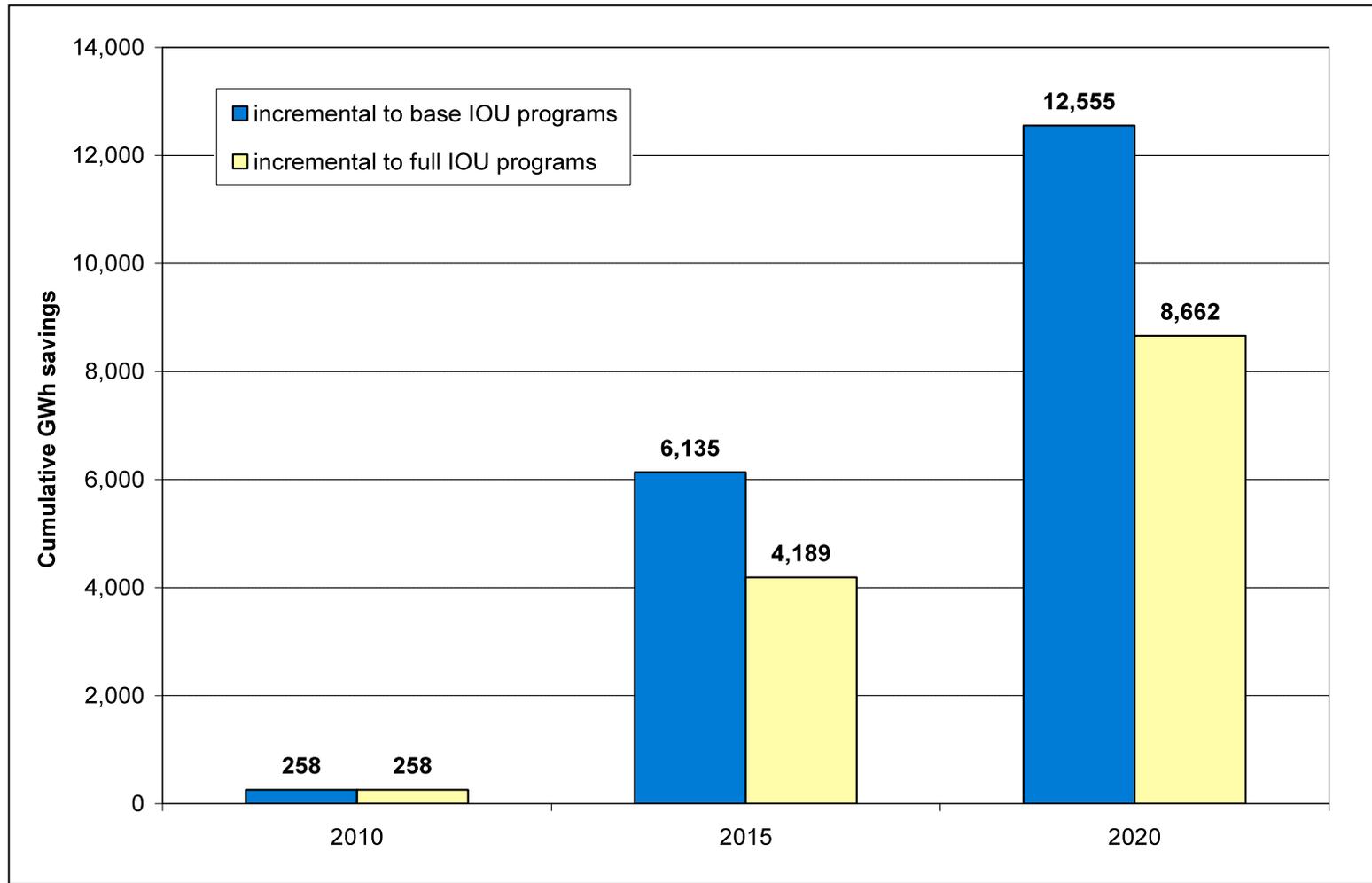
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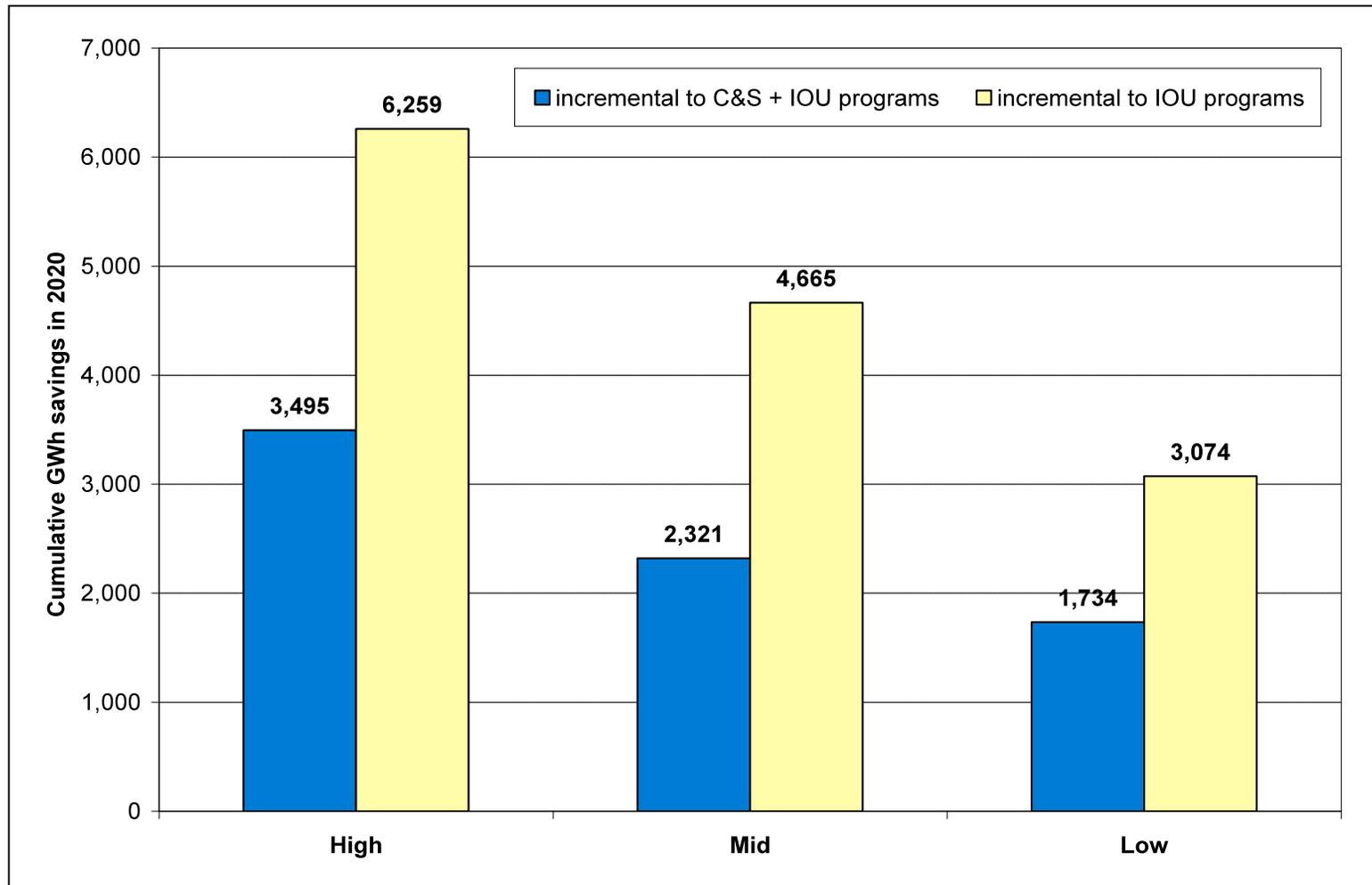
# Key Interactions – Huffman Bill and IOU Programs

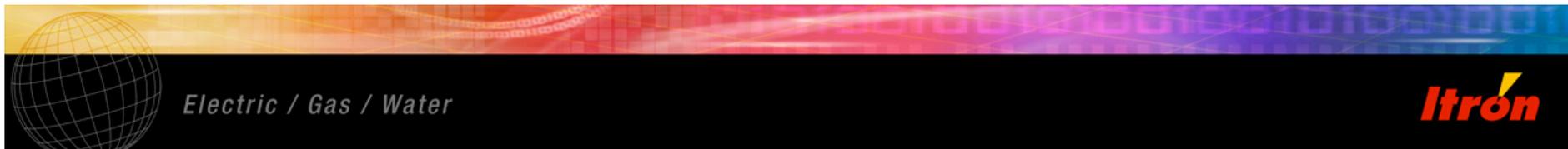




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# Key Interactions – BBEES and Title 24





## Key Caveats and Uncertainty Issues

- Inherent uncertainties in trying to reasonably predict outcomes from future actions
- Unique challenge of trying to interact the inputs and outputs from two different modeling platforms in a way that avoided systematic bias and ensured a reasonable level of internal consistency
- Identifying and reconciling all of the differences between the CEC's 2009 IEPR forecast and the 2008 CPUC Goals study was beyond the scope of this study



## Key Caveats and Uncertainty Issues

- We focused our analytic efforts and priorities on identifying and reconciling as many of the most important differences in key inputs, methodologies, and assumptions as possible within the project schedule
  - > Reconciling key differences in baseline end-use characterizations (e.g. UECs and saturations) and adopting common forecasts of key energy service demand drivers (e.g. housing counts and commercial floor stock)
  - > Framing cumulative savings using a common base year
  - > Expressing savings in common metrics
  - > Identifying areas of duplication and contradiction across the two forecasts and, where possible, developing methods to address such them



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## Key Caveats and Uncertainty Issues

- Some differences do remain and therefore introduce an unknown level of overall uncertainty in the results
- Based on professional judgment of the study team, the five most important analytic caveats and uncertainties are:
  - > Electricity price assumptions
  - > Differences in committed savings estimates
  - > Annual savings trends
  - > Savings decay from IOU programs
  - > Uncertainty associated with achieving the BBEES targets

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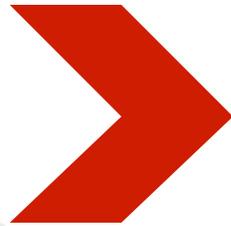
## Uncertainty in End-Use Peak-to-Energy Ratios

- Additional uncertainty specific to peak demand savings results related to use of, and uncertainty associated with, end-use peak-to-energy ratios
- Current peak demand savings results reflect use of “normal weather” peak-to-energy relationships
- Actual, year-to-year weather conditions and peak-to-energy relationships have varied significantly in recent years (PG&E residential example)
  - > 2004 (mild year): 0.228
  - > 2006 (hot year): 0.312
  - > 2009 (forecasted “normal” year): 0.275
- Shifts in the system peak hour (and time of year) can also have significant impacts on the peak-to-energy relationship for ALL end uses, not just weather-sensitive end uses
  - > e.g. shoulder loads like residential lighting

Indications in blue = Locked elements



Electric / Gas / Water

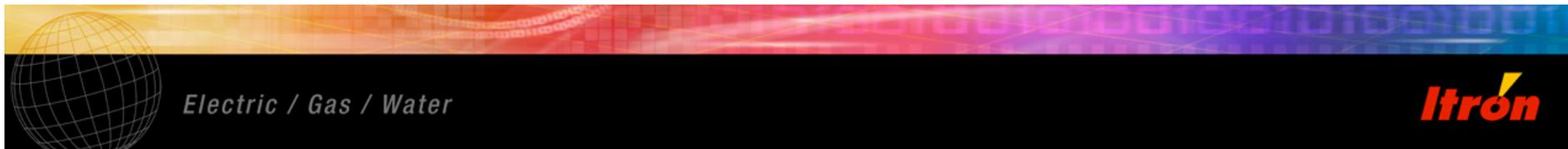


## Appendix Slides



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## Scenario Definitions and Assumptions

- In general, the quantitative assumptions used in each of the scenarios remained identical with those used in the 2008 CPUC Goals study
- Small number of assumptions were revised to reflect knowledge learned since the time the 2008 CPUC Goals study was conducted
  - > revised the assumptions associated with the 2008 revision to Title 24 and the assumptions used to describe the impacts of AB1109 (the Huffman Bill)
- All of the scenario definitions, assumptions, and data sources used in this study are documented in detail in section 3 of Itron's technical report (Attachment A of draft CEC Staff Report posted 1/27/10)



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## Scenario Definitions and Assumptions

- Goals study assumed fairly aggressive update to Title 24 in 2008
  - > In reality, very few significant new energy efficiency requirements, particularly in RNC, and implementation pushed out to 2010
  - > For this study, 2008 revision excluded from Title 24 scenario assumptions; other Title 24 assumptions unchanged from 2008 CPUC Goals study
  - > Revised interactions with BBEES initiatives accordingly
- Goals study assumed linear progress towards Huffman Bill targets between 2011 and 2020
  - > Implementation of the Huffman Bill revised to reflect the performance targets and timelines now specified in Title 20
  - > Revised interactions with IOU lighting programs accordingly



## Electricity Price Assumptions

- Electricity prices increase ~15%, in real terms, from 2008 to 2020 in the 2009 IEPR demand forecast
- Electricity prices were assumed to be constant, in real terms, in the 2008 Itron potential update study
- Results, in principle, in different levels of naturally-occurring adoptions and other forms of price-sensitive customer behavior between the 2009 IEPR forecast and the 2008 Itron potential update study
- Straightforward (analytically) to incorporate the CEC's electricity price forecasts into Itron's estimates of achievable market potential from IOU programs
  - > Would require significant time and resources beyond the scope and schedule of current study



## Differences in Committed Savings Estimates

- CEC's estimates of savings from committed IOU programs exhibit some significant differences with those estimated under the Goals Cases
  - > Measure rebate levels assumed in the 2009 IEPR forecast are known to be higher than those assumed in the Low Goals case and lower than those assumed in the Mid and High Goals Cases
- Differences in realization rate assumptions and net-to-gross accounting
  - > Reconciling most significant differences is an area that could be potentially addressed in a more timely fashion, ideally leveraging the full set of 2006-2008 ex-post program evaluation studies (none of which were available in time for the 2008 CPUC Goals Study or the 2009 IEPR forecast)
  - > Important to note that these differences only affect the respective estimates of savings from committed programs through 2012 and do not, by definition, affect the estimates of incremental savings from uncommitted programs



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## Annual Savings Trends

- SESAT modeling framework designed to focus primarily on end-point outcomes (e.g. 2020) and leverages results of stock turnover modeling outside of the model to estimate year-to-year trends
  - > e.g. the detailed stock turnover modeling embedded in Itron's ASSET model, new construction rates developed by CEC
- In this study, the temporal dynamics of savings from Huffman Bill are the most uncertain across all delivery mechanisms assessed
  - > Title 20 specifies interim efficiency levels for two distinct product segments defined by lumen output for which there is insufficient market data to reasonably segment lighting market according to lumen output
  - > Unable to directly estimate expected temporal dynamics, particularly over the period covered by the interim standards
  - > Also, new lighting standards face potentially significant savings "leakage" due to sheer volume and diversity of manufacturers and products affected which could significantly impact actual realized savings over time

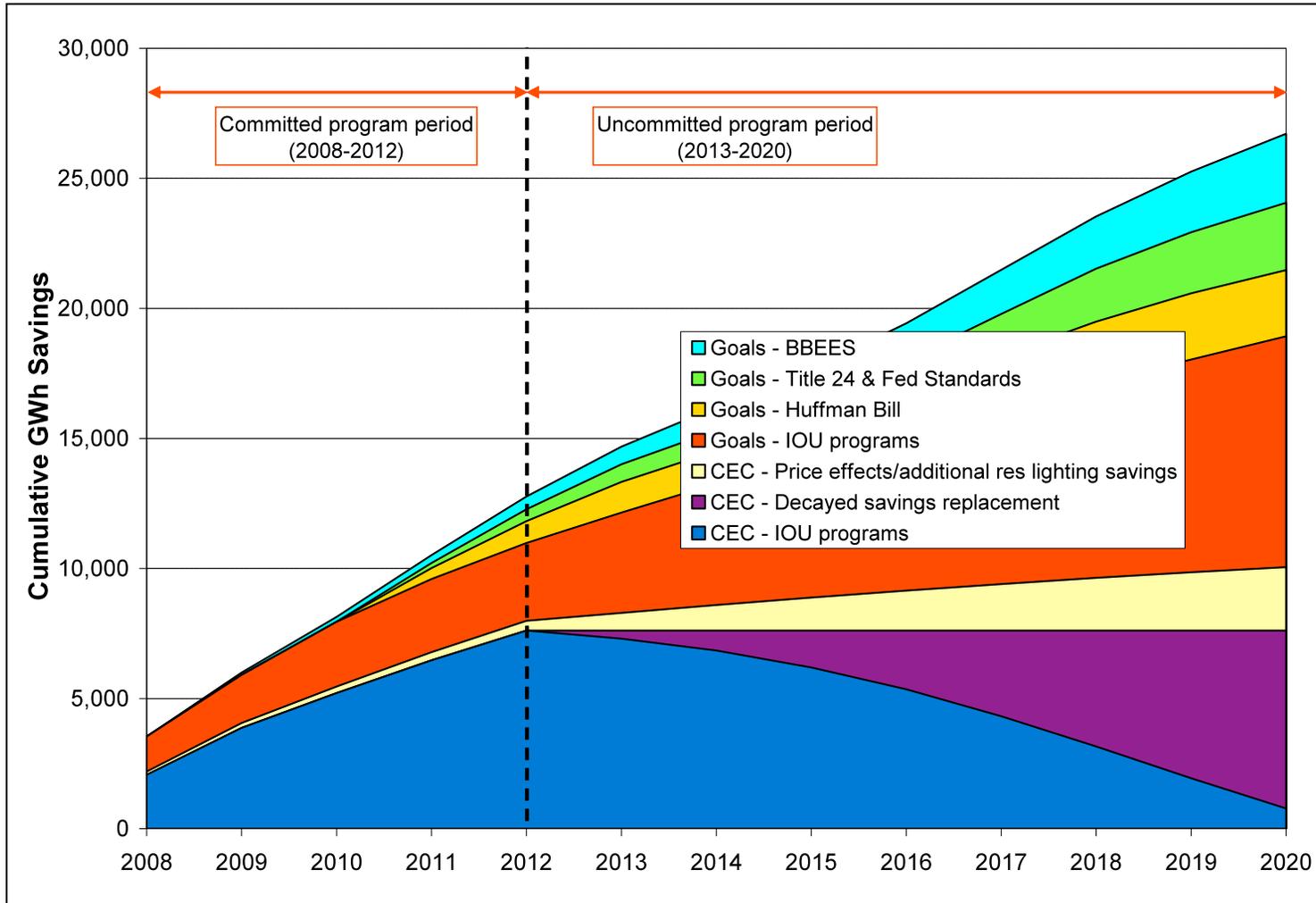


## Savings Decay from IOU Programs

- Savings from IOU programs (as estimated by the CEC) were shown as decaying significantly from 2013 forward
  - > Represents theoretical absence of efforts to replace efficiency measures at the end of their useful lives as assumed in the 2009 IEPR forecast
- CPUC and CEC staff agreed to treat savings from committed IOU programs as constant from 2013 forward per CPUC's policy rules
  - > Thus considered savings-replacement to be associated with committed programs rather than uncommitted programs
  - > Current estimates of incremental, uncommitted savings do not interact with any assumed levels of measure savings decay from previous IOU program cycles



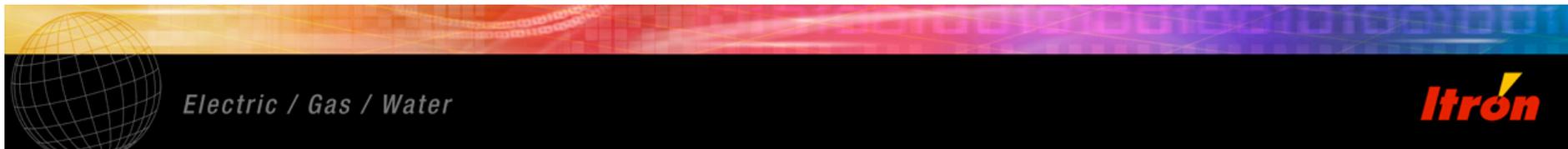
# Savings Decay from IOU Programs





## Savings Decay from IOU Programs

- Considerable uncertainty associated with modeling and predicting measure savings decay
  - > Decay rates used by the Energy Commission and reflected in the 2009 IEPR forecast currently depend on assumptions rather than observed behavior
- Clearly a need for comprehensive, quantitative assessments of measure savings decay across a wide range of measures being offered through IOU programs in order to reliably estimate measure savings decay in aggregate
  - > E.g., on-going market saturation studies, panel studies of program participants, and detailed analyses of ex-post program evaluation results over multiple program cycles



## Uncertainty of Achieving BBEES Targets

- All programmatic activities modeled are well established with the key exception of the BBEES initiatives
  - > Significant departure from vast majority of current IOU program portfolios or current procedures and mandates that govern Title 20 and Title 24
  - > Regardless of the assumed delivery mechanism, achieving the specific market penetration rates for ZNE new construction reflected in the BBEES targets will require, by the CPUC's own characterization, "an aggressive and creative action plan"
- Reasonable to describe the outcomes associated with the BBEES initiatives for ZNE homes and buildings as highly uncertain
  - > Potential energy and peak demand savings from BBEES initiatives currently estimated as penetration-weighted technical potential



## Uncertainty of Achieving BBEES Targets

- Important to consider the share of total incremental, uncommitted savings from the BBEES initiatives
  - > Relatively modest share of total incremental, uncommitted energy savings by 2020 (~20%)
  - > But nearly half of total incremental, uncommitted peak demand savings by 2020 (38-44%)
  - > 90% of energy and peak savings from BBEES initiatives from ZNE new homes and commercial buildings
- Total incremental, uncommitted peak demand savings are highly sensitive to one's expectations about whether and to what extent the BBEES targets for ZNE new construction can be achieved
  - > Critical to actively monitor development of all aspects of the ZNE market in order to assess actual progress towards the BBEES targets and evaluate likelihood of achieving the BBEES milestones on a regular and timely basis



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## Current CFL Saturation in California

- Question arose during the 2/3/10 CEC Staff's Technical Workshop concerning current saturation of CFLs in California and whether the AB 1109 standards will actually result in significant lighting savings
- Most recent survey found that current CFL saturation in California is significant but residential lighting market is far from fully transformed
  - > 35% according 2005 RECS (table HC15.13)