



Most Critical Factors Impacting Cost-Effectiveness of Feedback Programs

Behavior, Energy and Climate Change (BECC) Conference
Washington, DC
December, 2014

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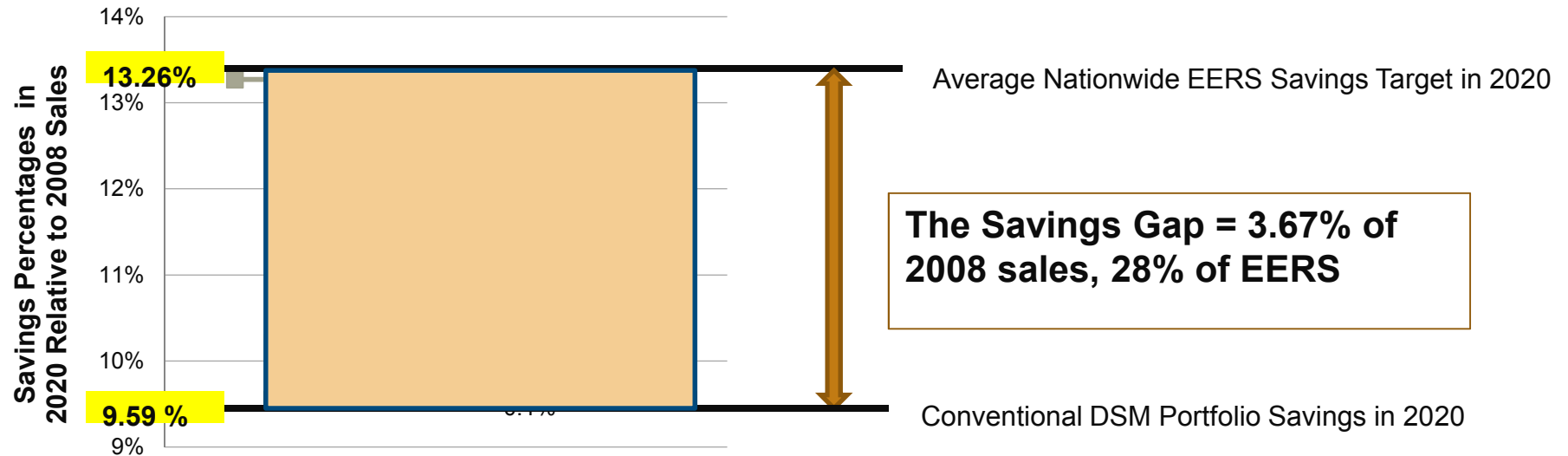
Background



ICF's "Big Squeeze" Analytics Initiative

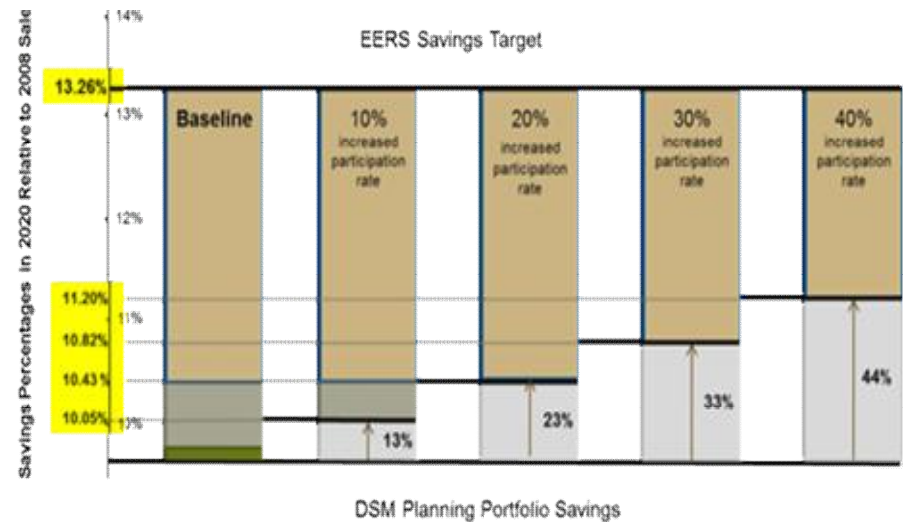
- Began in 2011 as clients sought to fill gaps in DSM portfolios caused by new lighting and appliance standards and building codes, as EERS policies called for increased savings impacts
- ICF used our DSM planning tools and worked with ACEEE to develop a representative EERS savings target and DSM portfolio
- The baseline analysis found that in 2020, a typical DSM portfolio would miss its EERS target by 22%
- We then developed a number of "gap-filler" program scenarios
- This paper reflects a deeper focus on behavior-based programs as a promising approach, with significant uncertainties.

The Saving Gaps



Specific program design analysis - Uncertainty!!

Cost-effectiveness!!!



ICF's Earlier Analysis of Behavior-Based Programs



“Easing the Squeeze in DSM Portfolio Planning: A Quantitative Analysis of Potential Impacts of Behavior-Based Programs.”

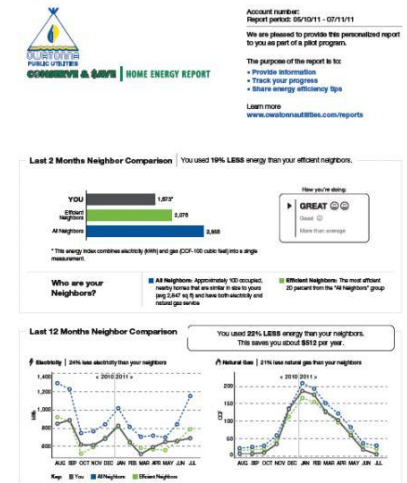
Presented at 2013 ACEEE Energy Efficiency as a Resource Conference

1. Extended ICF's original Big Squeeze analysis
2. Developed 5 feedback program types into the program model using existing literature and recent evaluation data
3. Used a more robust statistical technique – Monte Carlo simulation through @Risk software
4. Quantified the savings impact associated with each program type within the selected DSM portfolio

- **Program planners/administrators can fill 7%-36% (average of 17%) of the 2020 EERS savings gap by integrating residential feedback programs into DSM portfolio**

Objectives

1. Refined our initial assumptions (e.g. annual savings and participation) based on the 2013 performance data from multiple feedback programs
2. Analyze the four main screening tests on two types of feedback programs, using Monte Carlo simulation
 - Enhanced Billing (Home Energy Reports)
 - Real-Time Feedback (In-Home Energy Display)
3. Identified the top three most critical factors impacting each of the cost-effectiveness test



Home Energy Report

<http://www.owatonnautilities.com/residential-customers/home-energy-reports>



In-Home Energy Display Device

<http://www.edmi-meters.co.uk/chameleon-in-home-display/>

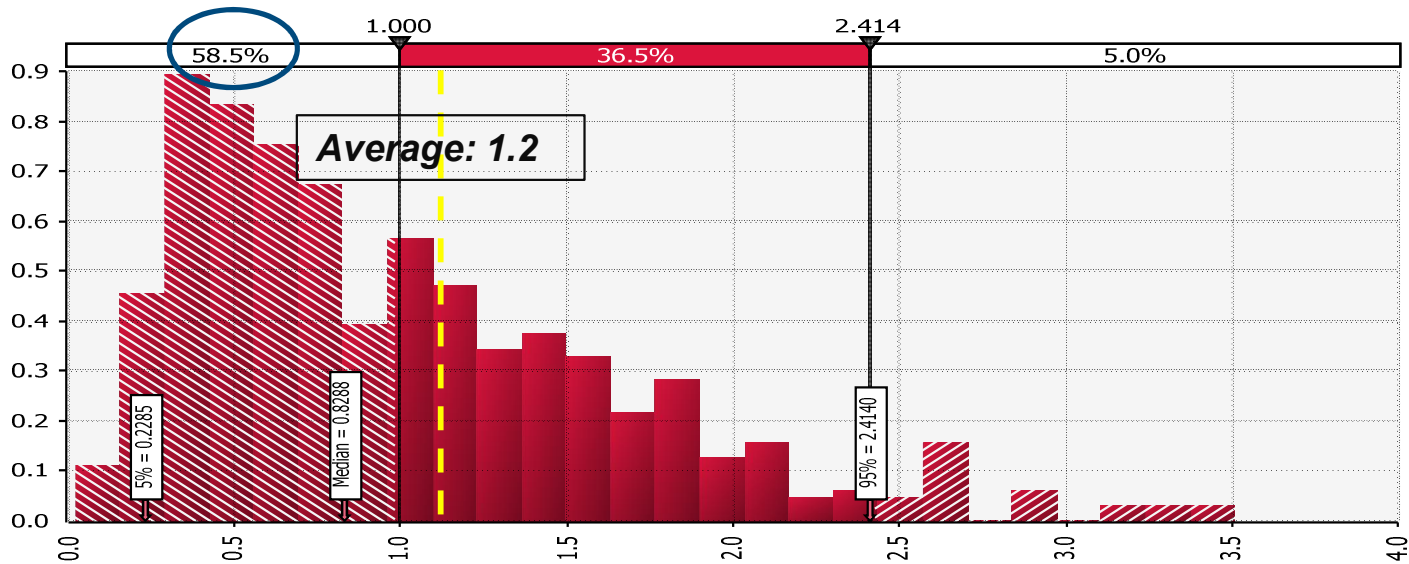
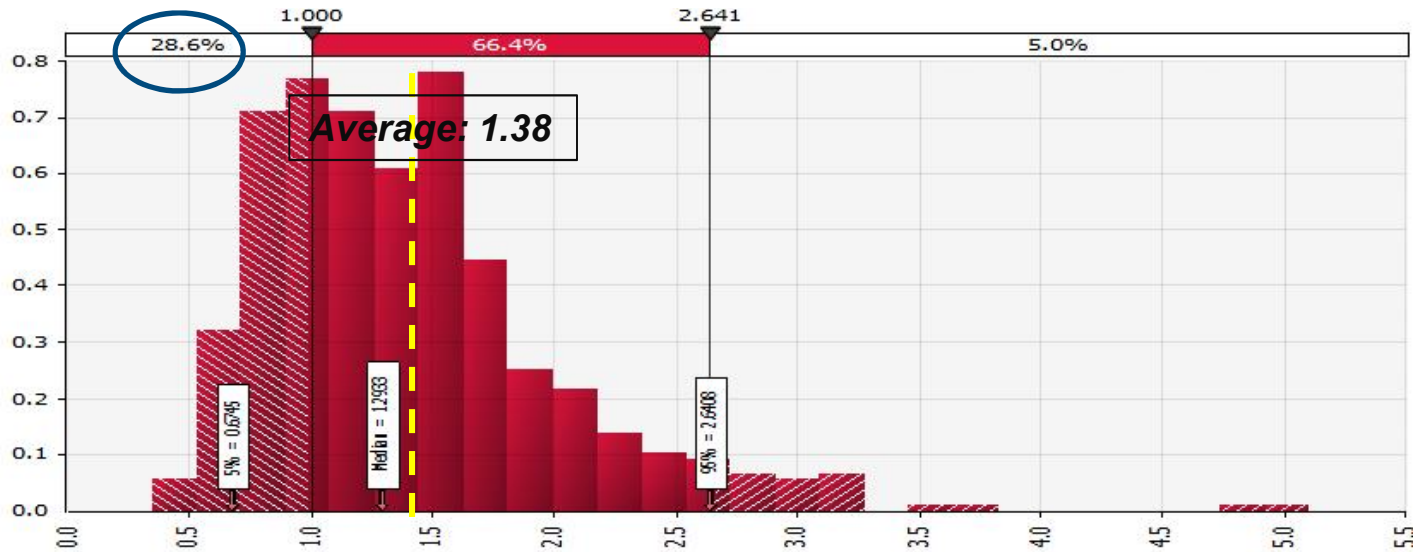
Cost-Effectiveness Results

- Total Resource Cost (TRC)
- Program Administrator Cost / Utility Cost Test (PAC / UTC)
- Ratepayer Impact Measure (RIM)
- Participant Cost Test (PCT)



<http://www.squidoo.com/real-estate-problems-and-solutions>

Distributions of TRC Ratio



With current data, there is a higher chance that Enhanced Billing program types will be cost-effective compared to Real-Time Feedback



Cost Effectiveness Ratios – Lifetime

TRC					
Name	Average		%5 Percentile	%50 Percentile	%95 Percentile
Enhanced Billing	1.38		0.65	1.30	2.59
Real-Time Feedback	1.20		0.22	0.89	2.27
PAC					
Name	Average		%5 Percentile	%50 Percentile	%95 Percentile
Enhanced Billing	1.38		0.65	1.30	2.59
Real-Time Feedback	1.24		0.23	0.91	2.28
RIM					
Name	Average		%5 Percentile	%50 Percentile	%95 Percentile
Enhanced Billing	0.38		0.25	0.37	0.55
Real-Time Feedback	0.40		0.16	0.35	0.56
PCT					
Name	Average		%5 Percentile	%50 Percentile	%95 Percentile
Enhanced Billing	N/A		N/A	N/A	N/A
Real-Time Feedback	2.90		1.20	2.45	4.78

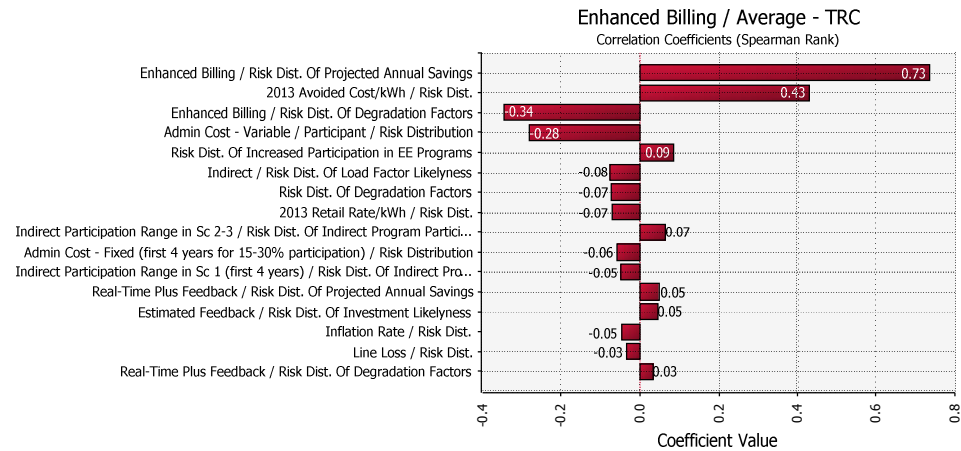
Most Critical Factors Impacting Cost-Effectiveness of Feedback Programs

Top Three Critical Factors Impacting TRC



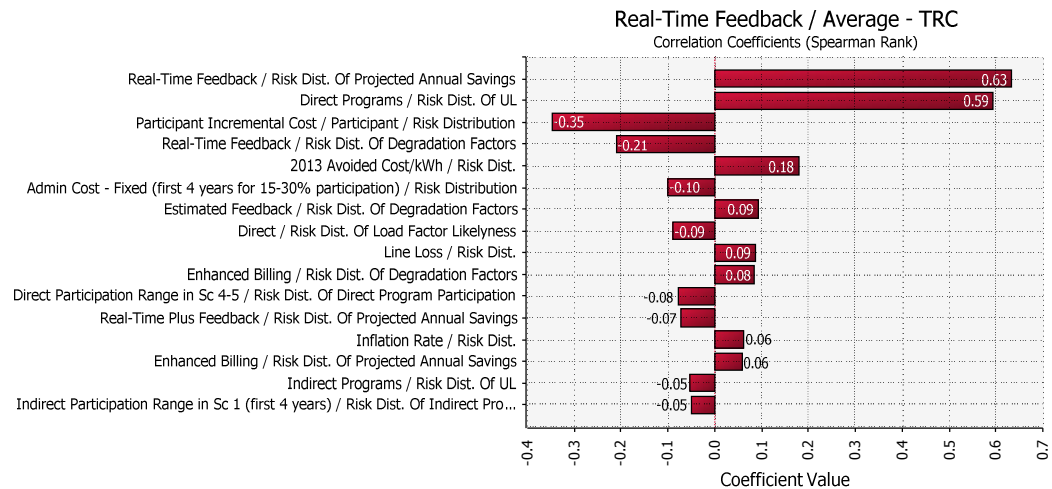
Enhanced Billing – TRC

1. Annual Savings (0.73)
2. Avoided Cost/KWh (0.43)
3. Admin Cost – Variable (-0.34)



Real-Time Feedback – TRC

1. Annual Savings (0.63)
2. Measure UL (0.59)
3. Participant Incremental Cost (-0.35)





Summary of Three Most Critical Factors Impacting Each Cost-Effectiveness Test

	TRC		PAC		RIM		PCT
	Enhanced Billing	Real-Time Feedback	Enhanced Billing	Real-Time Feedback	Enhanced Billing	Real-Time Feedback	Real-Time Feedback
Highest	Household Savings %	Household Savings%	Household Savings%	Household Savings%	Avoided Cost/kWh	Household Savings%	Household Savings%
2nd Highest	Avoided Cost/kWh	Useful Life	Avoided Cost/kWh	Useful Life	Retail Rate/kWh	Useful Life	Useful Life
3rd Highest	Admin Cost – Variable / Participant	Participant Cost	Admin Cost – Variable / Participant	Incentives	Household Savings%	Avoided Cost/kWh	Participant Cost

*The factors in black: administrators may not have much control over their mutability
 The factors in red: administrators could change to improve the cost-effectiveness*



Most Critical Factors

Most critical factors that can make behavioral programs more cost-effective are:

- **Enhanced Billing**
 - Annual Household Savings Per Participant (0.73)
 - Admin Cost – Variable Per Participant (-0.34)
- **Real-Time Feedback**
 - Annual Household Savings Per Participant (0.63)
 - Useful Life (0.59)

Implication: Achieving higher, more consistent energy savings is the key in driving cost-effectiveness and ultimately encouraging utilities to initiate behavioral programs.

Summary of Findings



- In our core analysis:
 1. TRC and PAC results suggest that both Enhanced Billing and Real-Time Feedback programs can be cost-effective.
 2. But there is a higher chance (about 59%) that the Real-Time Feedback program will not pass TRC and PAC
 3. There is a lower chance (about 29%) that the Enhanced Billing program will not pass TRC or PAC.
- In our sensitivity analysis:
 1. Increasing savings per household has the highest impact on improving cost-effectiveness.
 2. Useful Life has second highest impact for Real-Time Feedback, followed by participant cost and incentives.
 3. Avoided cost/kWh is the second most critical TRC/PAC factor for Enhanced Billing, followed by admin cost per participant
- **Key Takeaway:** *In order to improve the cost-effectiveness, it's critical to continuously consider innovative methods to create deeper impacts on customer energy use behavior to achieve **higher, more consistent energy savings***



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Supplementary Slides

Feedback Program Types and Probability Distribution of Key Input Parameters

- *Electricity Savings*
- *Participation*
- *Useful Life*
- *Program Costs and Planning Assumptions*

Feedback Program Type



Feedback Program Type	Feedback Type	Participation Plan
Enhanced Billing (HER)	Indirect	Opt-out
Real-Time Feedback	Direct	Opt-in

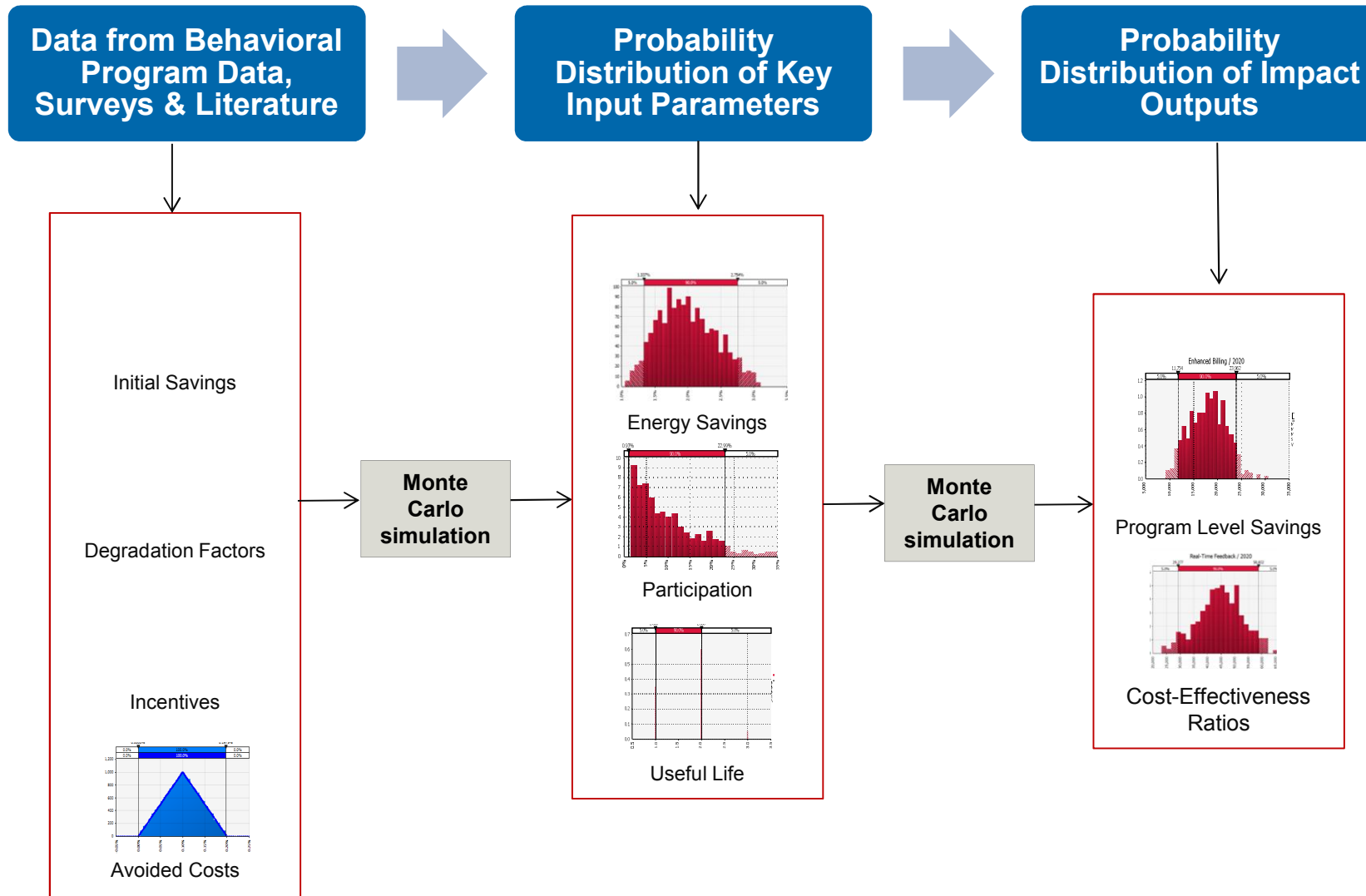
Opt-out Participation Plan

- Broad program reach, shallow saving rates
- High continuing costs to maintain savings, e.g. mailers

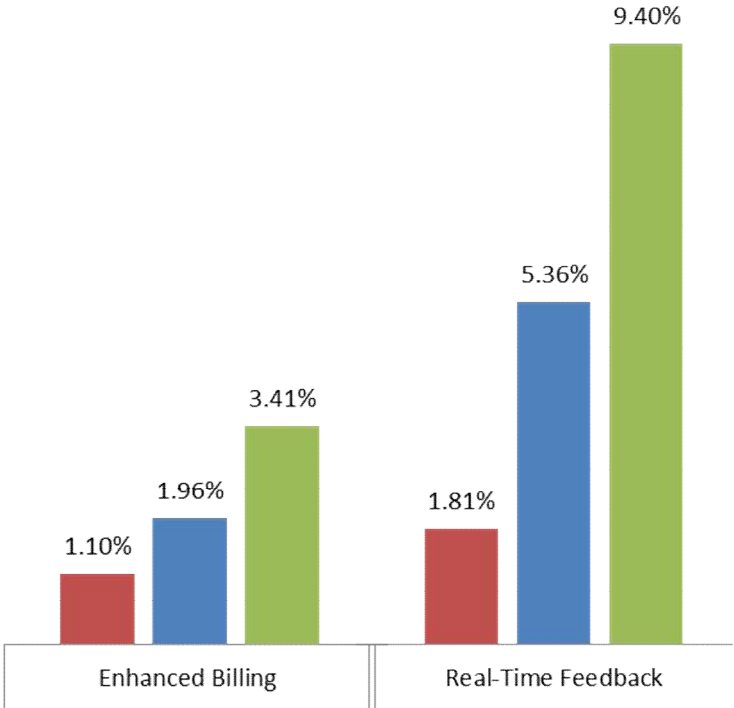
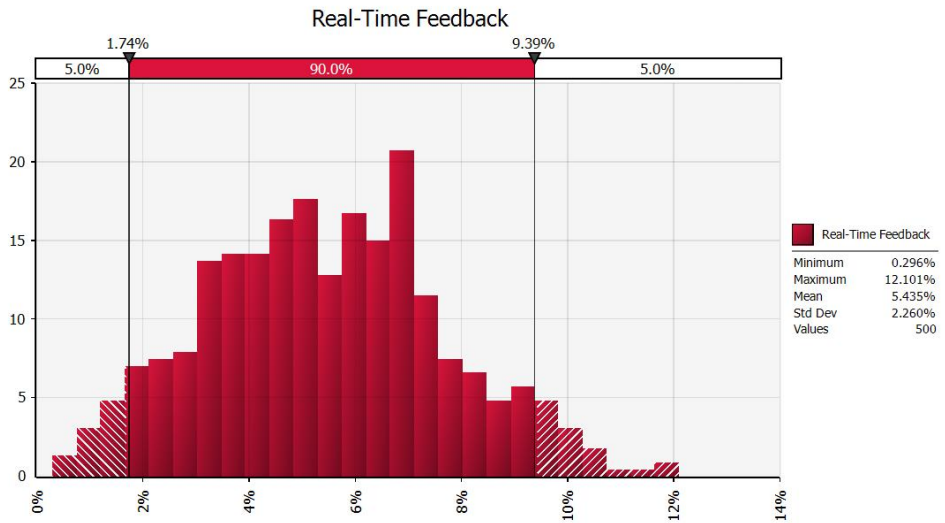
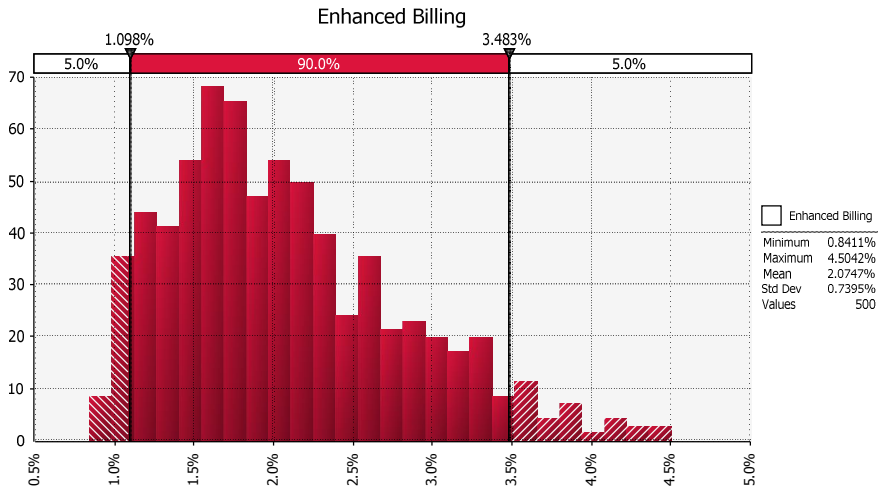
Opt-in Participation Plan

- Narrow program reach, deep saving rates
- Upfront cost to acquire, low continuing cost

Uncertainty Analysis - Monte Carlo Simulation



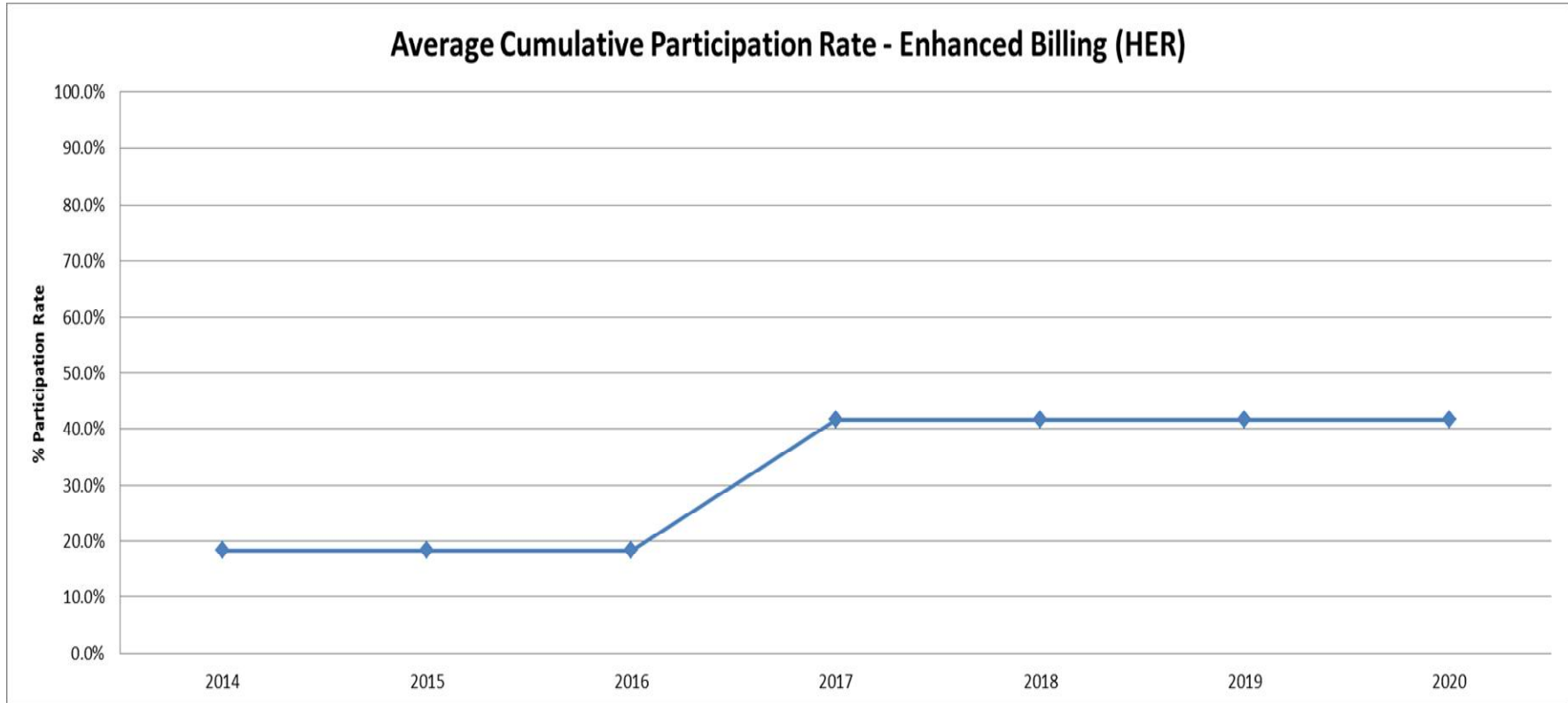
Direct Energy-Use Reduction



Participation Inputs – Enhanced Billing



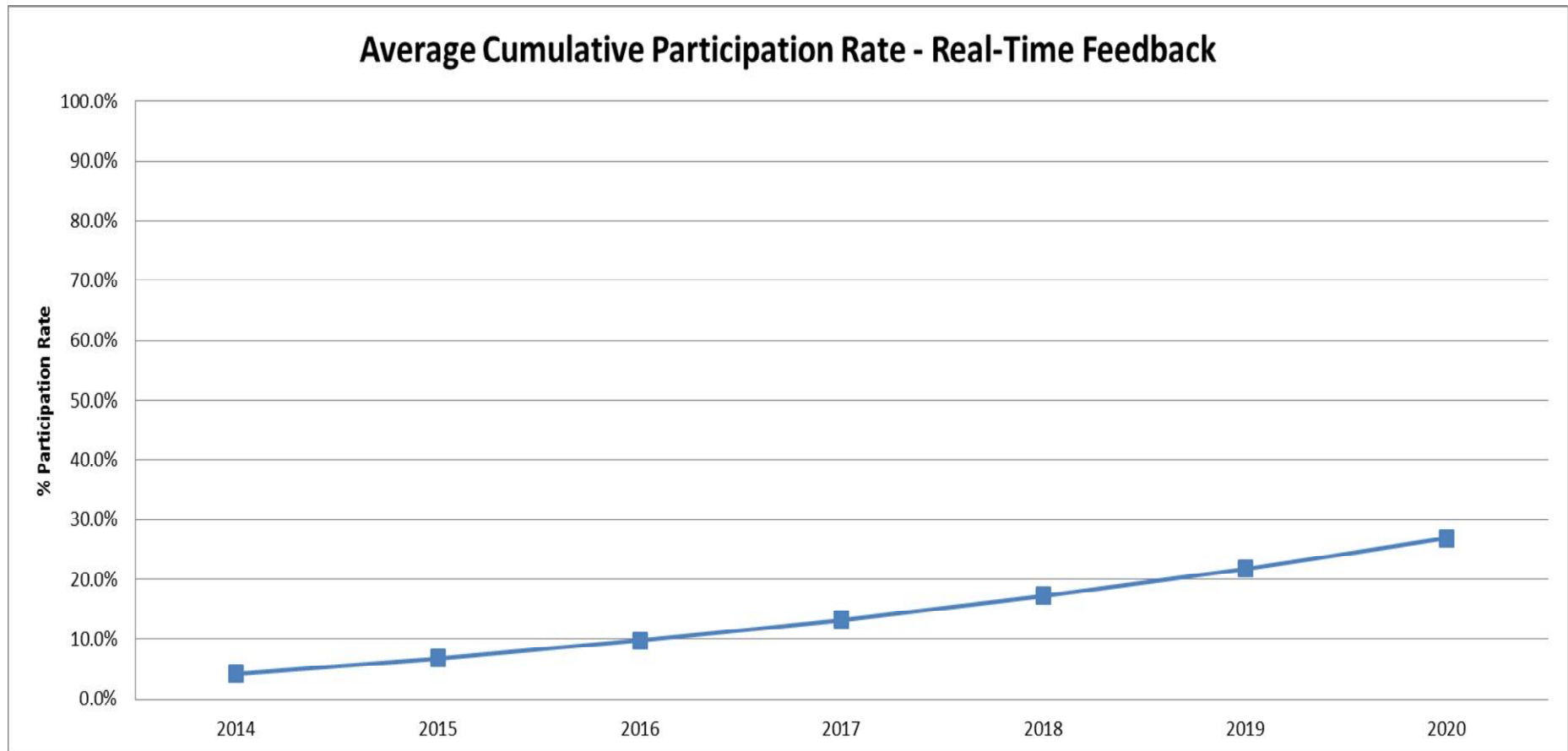
	Min	Most Likely	Max
Participation Range in Sc 1 (first 3 years)	10.0%	20.0%	25.0%
Participation Range in Sc1 (after 3 years)	30.0%	40.0%	55.0%



Participation Inputs – Real Time Feedback



- ❑ Participation starts at 1%-3% with the average of 2% and
- ❑ Gradually ramps up to 20%-35% with the average of 27% by 2020





Useful Life Input Distributions

Enhanced Billing: Assumed that the savings will persist as long as customer will get the report, meaning that, if the customer receive energy reports for 4 years, the saving will be also calculated for 4 years (treated as UL of 1 year)

Real-Time Feedback Program	Min	Most Likely	Max
	2	5	6
Probability of Occurrence	35%	60%	5%



Program Cost & Planning Assumptions

Enhanced Billing Assumptions	Min	Most likely	Max
Admin Cost - Fixed (first 4 years for 15-30% participation)	\$ 300,000	\$ 400,000	\$ 550,000
Admin Cost - Fixed (first 4 years for 30-55% participation)	\$ 450,000	\$ 600,000	\$ 850,000
Admin Cost - Variable / Participant	\$ 6	\$ 10	\$ 14

Real Time Feedback	Min	Most likely	Max
Admin Cost - Fixed	\$ 200,000	\$ 300,000	\$ 500,000
Incentives / Participant	\$ 100	\$ 200	\$ 250
Participant Incremental Cost / Participant	\$ 100	\$ 170	\$ 300

Planning Assumptions	Min	Most Likely	Max
Discount Rate – Company (used for all tests except PCT)	7%	8%	9%
Discount Rate – Participant (used for PCT)	12%	15%	18%
Inflation Rate	1%	2%	3%
2013 Avoided Cost/kWh	\$ 0.03	\$ 0.06	\$ 0.09
2013 Avoided Cost/kW	\$ 60	\$ 85	\$ 110
2013 Retail Rate/kWh	\$ 0.08	\$ 0.12	\$ 0.18



Applicability of Results

- The results of this study may not be directly applicable for designing/delivering feedback programs for a particular service area, as we did not consider key demographic or geographic factors such as customer propensity to participate, customer load shape characteristics, potential benefits of a given behavioral incentive design, or availability of smart metering infrastructure to enable and support various program designs.
- We believe the methods and the results are indicative and encouraging enough that DSM planners should explore these options. By quantifying the range of possible outcomes and the associated uncertainty and risk, this analytical approach gives DSM planners and administrators a more rigorous way to consider feedback programs.