DOE BEHAVIORAL POTENTIAL ESTIMATES WORKSHOP

SUMMARY OF STAKEHOLDER THOUGHTS AND INSIGHTS

Workshop Date: June 13, 2016

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INTRODUCTION

- Goal of this DOE effort: Examine methods for quantifying the achievable energy savings potential of behavioral interventions
- Challenge: Estimate the percent of total technical potential behavioral interventions can be expected to achieve
  - There is a lot of variation between households, what actions people are willing to take, what actions they do actually take under different circumstances…the list goes on.
  - Some question the effectiveness of programs to elicit behavior changes.
- Our focus: Engage utilities to perform potential studies
  - Focus on what types of behaviors matter
  - Focus primarily on utility energy savings as opposed to broader goals around carbon emissions or other climate change-related metrics
- The big picture: Galvanize change
  - Estimating the potential of behavioral interventions calls attention to untapped energy savings.
  - As methods improve and data becomes more available, these studies will help focus program efforts.
- Limitations of the approach: The methods explored are limited in their focus on individuals and households as the primary agents of change and do not specifically address the systemic forces and opportunities that promote or impede change.

INTRODUCTION

The following set of slides provides an overview of the thoughts and ideas shared at the DOE Workshop on Behavioral Potential Estimates held in San Francisco on June 13, 2016.

This slide deck is organized into five parts, beginning with this introduction to the materials contained herein and the original workshop agenda.

Sections 2 through 4 are organized in reverse chronological order, beginning with an overall summary of workshop participants' recommendations concerning preferred method characteristics and/or practices (Section 2). This set of recommendations is a consolidated list that highlights the most prominent ideas that emerged looking across all three discussion groups.

Section 3 presents the core ideas that emerged from each of the three discussion groups. The thoughts and ideas of each discussion group are captured on a separate slide.

Section 4 presents participants' reflections concerning the merits and disadvantages of each of the three principal estimation methods presented at the workshop. These lists were compiled from participant ideas as shared via post-it-notes.

The final section provides a list of workshop participants.

WORKSHOP AGENDA

A.	12:15-1:00	Lunch and Introductions
B.	1:00-1:45	Overview of Existing Studies
		[***Break*** 10-15 min] 1:45 – 2:00
C.	2:00-3:00	Review of 3 Principal Estimation Methods
		[***Break*** 5-10 min] 3:00 -3:10
D.	3:10-4:30	Small Group Discussion of Proposals
E.	4:30-5:15	Report back and Discussion
F.	5:15-5:45	Conclusion and Next Steps

OVERVIEW OF THREE PRINCIPAL ESTIMATION METHODS

	Survey-Plus	Behavior Wedge	Carbon Footprint
Authors	Norton	Ehrhardt-Martinez	Jones and Kammen
Focus	Technical Electricity	Achievable Energy	Technical Carbon
Behavior Type	Res No & low-cost + Invest	Res No & low-cost + Invest.	Res, Transport, + Embedded
Number of Behaviors	16+	32	38
Savings Estimate (National)	5.2% Energy	2.4% Energy	7.6% Carbon
Data Collection Method	Mail surveys, in-home audits, data loggers	RECS, census, literature	Consumer Expenditures Survey, Bureau of Transportation Statistics, EIA, Bureau of Economic Analysis
Estimation Method	Baseline established through audits and monitoring. Savings are attributed to behavior and/or technology purchases.	Baseline estimated by end use at the city level. Savings are estimated using algorithms for each behavior, eligibility, and participation.	Baseline based on hh income and size. Savings are determined by estimating the carbon footprint of consumption patterns.

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SUMMARY OF PRINCIPAL WORKSHOP RECOMMENDATIONS

- Create a set of regional-level potential studies.
- Blend Survey and Wedge approaches into three options: wedge, wedge + light survey, and survey + site-based data.
- Determine how best to separate or distinguish between technology and behavior.
- Create common (potentially expanded) list of behaviors to include in the model using specific screening criteria.

- Account for interaction effects, compliance, and persistence in estimating achievable savings.
- Provide information on both technical and achievable potential.
- Make underlying model assumptions as explicit as possible.

- Layer savings opportunities according to what can be achieved by particular intervention strategies and/or provide multiple degrees of "achievable" using different sets of assumptions.
- Prioritize programs by cost and target savings using a marginal abatement curve.
- Potentially segment savings opportunity by socio-economic characteristics of the region for which the potential study is being performed.

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GREEN GROUP: THOUGHTS AND RECOMMENDATIONS

- Blend survey and wedge approaches.
- Require less onerous data collection (by volume) than the survey method.
- Include an explicit list of behavioral actions (casting a wide net) and screening criteria.
- Provide explicit definitions of multiple achievable scenarios based on different program models/assumptions.
- Allow for varying degrees of adoption (actions performed x% of the time AND account for persistence of compliance)
- Incorporate interactive effect (“stacked effect”) of combining behavioral change (setpoint) with equipment change (more efficient).
- Create a national study to establish custom regional “archetypes” or profiles of equipment and practices for use in each region.
- Ground in data at the end use level.
- Make it cost efficient.
- Clarify behavior-only, technology-only, and both.
- Provide both technical and achievable potential.

BLUE GROUP: THOUGHTS AND RECOMMENDATIONS

- Allow for flexibility of method such that time, goals, and cost will determine how to develop the potential study.
- Use up-to-date data (which may require some primary data collection).
- Provide transparency around technology and assumptions used.
- Estimate variation in adoption based on primary (survey) data.
- Supplement secondary data with actual use/on-site data.

BLACK GROUP: THOUGHTS AND RECOMMENDATIONS

- Prefer the wedge approach.
- Consider carbon footprint method for goal-setting.
- Survey based method highlights the benefit of survey data.
- Points of tension: attributing savings to individual end-uses vs. savings measured in aggregate.
- Provide a separate wedge for “behavior” instead of assessing the behavioral aspect of each widget-based program separately.
- Prioritize measures to target by largest potential – use the 80/20 rule (20% of behaviors achieve 80% of savings).
- Prioritize programs by cost to achieve the behavioral savings using a marginal abatement curve.
- Leverage existing studies for benchmarking effectiveness of program designs.
- Provide more segmentation (e.g. geospatial or socio-economic).

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STAKEHOLDER COMMENTS ON TOP THREE METHODS

The following set of slides documents stakeholder comments on the top three estimation methods that were discussed in greater detail during the workshop: survey and survey-plus methods, Municipal Behavior Wedge, and Carbon Footprint.

Workshop participants were asked to record their thoughts concerning the merits, disadvantages, and potential modifications for each of the three key estimations methods. Participants recorded their thoughts on post-it-notes and pasted them on the corresponding flip charts. These thoughts have been consolidated in the following set of slides.

The slides in the section of the slide deck are organized according to the three key estimation methods discussed in the workshop (as identified above).

Each section is broken into four subsections that include:

1. a method summary slide,
2. a list of merits,
3. a list of disadvantages, and
4. a list of potential modifications.

Each of the lists included here conveys the ideas of the participants in their own words. In some cases the same ideas were shared by more than one workshop participant. In these instances, the idea is only listed once, however the number of times that the idea was mentioned by various participants is indicated by the number that appears in parentheses following the idea.

SURVEY-PLUS (with site data)

Method Comments

OVERVIEW OF SURVEY PLUS METHOD - NORTON, 2012

Saving Waste: Energy Use and Waste Analysis by End-Use; ComEd Residential and C&I Saturation/End-Use, Market Penetration & Behavioral Study

- Geographic Coverage: ComEd utility territory, IL
- Behaviors: 15 (6 investment behaviors)
- Methodology: Survey Data Measures + Site Visits + Data Loggers

Norton, Bill. "Saving Waste: Energy Use and Waste Analysis by End-Use." Opinion Dynamics. November 13, 2012.

"ComEd Residential and C&I Saturation/End-Use, Market Penetration & Behavioral Study." Opinion Dynamics. March 20, 2013.

Savings as % of National Consumption or Emissions	Focus	Technical/ achievable	Range of Behaviors
5.20%	Electricity	Technical	Res. actions + EE investment

SURVEY-PLUS WITH SITE DATA: Stakeholder Comments

Merits

- Granularity at end-use level
- Bottom up approach
- Concept of “shared waste” to acknowledge interplay of technology and use of it (2)
- Focus on eliminating waste
- Estimates a range rather than average
- Data-driven
- Statistically relevant
- Nested on-site data collection corrects for self-reporting bias
- Scalable
- Can capture both baseline behavior and propensity to change
- Statistically significant to area of interest
- Rigorous definition of behavioral baseline
- Uses primary data for geography of interest
- Measure-level behavioral improvements assigned to add operational assumptions (i.e. HOU, set points, etc.,)
- Saturation levels are very useful
- Explicit treatment of interaction between technology potential and behavior
- Sociodemographic dimensions
- Translatable to discrete action
- Ground-up full-scale assessment of usage and potential at a HH level
- Credible, if ambitious, approach
- Tailored to utility/regional usage
- Builds on existing potential model framework and assumptions
- Incorporates behavior and technology

SURVEY-PLUS WITH SITE DATA: Method Comments

Merits (cont'd)

- Rigorous
- Robust bottom-up approach
- End-use granularity
- Meaningfully, IDs tech-only, behavior-only, and shared savings
- Detects/estimates waste by end use → illustrates opportunity of intervention

Disadvantages

- Cost (9)
- Ability to scale (2)
- How can a baseline for behavior be defined? (2)
- Bottom-up approach
- Doesn't build in changes to existing technology – no accounting for tech advances
- Pre-selected behaviors
- Long process (3)
- Simplified modeling (integrative effect of multiple behaviors)
- Limited by data collection instrument
- Expensive to get monitoring data
- Definitions subject to wide variety of interpretations in survey instrument

SURVEY-PLUS WITH SITE DATA: Method Comments

Disadvantages (cont'd)

- Difficult to account for all behavioral measures of interest
- Survey self-reports may not be accurate
- Uses normative assumptions of "efficient" behavior
- Limited to only defined operational improvements type of measures
- EE potentials do not look at transportation
- No real translation to achievability (2)
- Estimates waste but doesn't provide forecasts (2)
- Requires a high degree of primary data collection
- Focused on a point estimate
- Limited set of discrete activities that look painful [i.e., may face participation barriers]
- Arbitrary definitions of "minimum needed'
- Only addresses particular technologies pre-assumed to be of high value
- Sample based regional estimate does not equal solid information to extrapolate (external validity)

SURVEY-PLUS WITH SITE DATA: Method Comments

Potential Modifications

- Leverage broader sets of existing survey data (utility, program, etc.)
- Use advanced data analytics (predictive models) coupled with calibrated AMI data to predict baseline usage
- Leverage broader set of demographic data to augment surveys
- Identify which specific programs or policies would achieve how much savings
- Incorporate temporal aspect (adoption curves, persistence)
- Need consensus on what is efficient
- Incorporate renewable penetration and carbon objectives
- Account for usage offset by onsite generation
- Consider interactive effects of different behaviors
- Data and method to validate estimates.
- Quantify uncertainty of estimates
- Make definition of minimum need more tailored to end user need/comfort (e.g., temperatures needed for comfort, lighting used for security, etc.)
- Incorporate explicit criteria for selection of measures/actions included and screen a wider list
- Include multiple levels of “achievable” based on different program/policy/model/ assumptions
- Provide guidance for planning on: with shared waste, what is the most cost-effective opportunity? (i.e. what should be done first?)

BEHAVIOR WEDGE MODEL

Method Comments

BEHAVIOR WEDGE OVERVIEW - EHRHARDT-MARTINEZ, 2015

Behavior Wedge Profile: Model Development and Documentation; Municipal Behavior Wedge Project: Methodology Report;

Behavior Wedge Profiles for Cities: Estimating Achievable Savings and Critical Behaviors

- Geographic Coverage: City-level estimates (could be state, regional, national)
- Behaviors: 32 (6 investment behaviors)
- Methodology: Existing Data Resources as Model Inputs

Ehrhardt-Martinez, Karen, et al. (2013). Behavior Wedge Profile: Model Development and Documentation, Garrison Institute Climate, Mind and Behavior Program.

Ehrhardt-Martinez, Karen. (2015). Municipal Behavior Wedge Profile: Methodology Report, Garrison Institute.

Ehrhardt-Martinez, Karen. (2015). Behavior Wedge Profiles for Cities: Estimating Achievable Savings and Critical Behaviors, European Council for an Energy Efficient Economy (eceee) Summer Study.

Savings as % of National Consumption or Emissions	Focus	Technical/ achievable	Range of Behaviors
1.5-2.4%	Energy	Achievable	Res. actions + EE investment

BEHAVIOR WEDGE MODEL: Method Comments

Merits

- Easily scalable (5)
- Good directional view of opportunity at an aggregate city/regional/state level
- Helps prioritize what to go after, where
- Adoption assessment is very comprehensive (i.e. not just consumer economics)
- Low cost (5)
- Cost effective (2)
- Can be adapted to other regions and even other market segments
- Granular in scope
- Broken down by end use
- City scale
- Short term versus long term achievable potential
- Built up end use or measure level impacts
- Effective and scalable use of existing data yet provides sufficient rigor
- Strong focus on primary end uses.
- Leverages existing data (2)
- Short time frame to develop estimates
- Ranking measures is very useful
- Saturation rates are useful
- Compelling framework, terminology
- Relative simplicity
- Includes 32 primary behaviors that are relevant around the country
- Includes mix of purchase and habitual behaviors
- Helps prioritize interventions strategies regionally

BEHAVIOR WEDGE MODEL: Method Comments

Merits (cont'd)

- Use of RECS data that are readily available
- Based on data of what is currently in place and current practices

Disadvantages

- Limits view to what is viewed in RECS/Census
- Variance of the population not captured – makes scalability difficult
- Dependent on generic assumptions
- Rigor of baseline behavior portfolio
- Does the method require primary data to produce reliable results?
- Limited applicability of RECS/Census data.
- Based on older existing data
- Uses normative assumptions of "efficient" behavior
- Expert judgement for adoption rate seems opaque and difficult to judge in terms of merits

BEHAVIOR WEDGE MODEL: Method Comments

Disadvantages (cont'd)

- Doesn't account for changes in HH actions that may change over time
- Primary data from surveys and rule-of-thumb
- Unclear how behavioral assumptions are specific to region
- Unclear how to benchmark results to existing efforts on consumption
- Unclear how interactive effects are incorporated
- Relies on existing data, which will become stale
- Algorithm-based savings estimates
- Limited out of discrete activities that look painful
- Uncertainty of tech savings estimation

Potential Modifications

- Add features to allow for data variation
- Ground achievability estimates in terms of specific approaches (e.g. information campaign)
- Identify which specific programs or policies would achieve how much savings
- Extend to incorporate existing potential model framework (e.g. contextualize results within specific organizational interventions)
- Consider a wider array of actions, or include explicit (cost-effectiveness?) screening of actions
- Include multiple levels of "achievable" based on different programs
- Also include technical potential

BEHAVIOR WEDGE MODEL: Method Comments

Potential Modifications (cont'd)

- More clearly separate results into technology vs. behavior only
- Combine with actual behavioral data
- Use smart meter data to infer baseline energy use profile
- Quantify uncertainty of estimates

CARBON FOOTPRINT MODEL

Method Comments

CARBON FOOTPRINT OVERVIEW – JONES AND KAMMEN, 2011

Quantifying Carbon Footprint Reduction Opportunities for U.S. Household and Communities

- Geographic Coverage: multiple levels (city, state, MSA)
- Behaviors: 38 (13 investment behaviors)
- Methodology: Existing Data Resources as Model Inputs

Jones, Christopher M. & Daniel M. Kammen. (2011). Quantifying Carbon Footprint Reduction Opportunities for U.S. Household and Communities, Environmental Science & Technology.

Christopher M. Jones and Daniel M. Kammen, Spatial Distribution of U.S. Household Carbon Footprints Reveals Suburbanization Undermines Greenhouse Gas Benefits of Urban Population Density. Environ. Sci. Technol., 2014, 48 (2), pp 895–902. <http://pubs.acs.org/doi/abs/10.1021/es4034364>.

Savings as % of National Consumption or Emissions	Focus	Technical/ achievable	Range of Behaviors
7.60%	Carbon	Technical	Any res. actions & invest. + personal transport + embedded energy/carbon

CARBON FOOTPRINT MODEL: Method Comments

Merits

- Helps prioritize efforts for what to target
- Doesn't require a lot of the data we normally struggle to collect
- Strong prioritization tool
- High level (state/nation) scenario planning
- Broadly comprehensive. Places EE in context of climate change in short, mid and long-term perspectives
- Leverages existing data (lower $)
- Includes high geographic granularity (available now for all U.S. zip codes, cities, counties, and states)
- Places focus on biggest imperative and ranks actions (2)
- Most flexible in providing geo-specific information (scalable) (2)
- Good for creating stretch goals for policy makers
- Provides scenario-based planning to help prioritize efforts
- Considers policy needs and framework
- Considers carbon and renewable production
- Model can break out data into end uses Allows us to look at tradeoffs, context, vs. "mini" changes

CARBON FOOTPRINT MODEL: Method Comments

Disadvantages

- Built for policy
- Econometric model
- Broad scope (hard to compare apples-to-apples with the other approaches)
- As currently formulated, better suited for benchmarking and scenario planning than quantifying potential
- A scenario planning tool suitable for driving GHG policy negotiations rather than EE potential forecasting tool
- Not a behavior potential estimation method – not tied to actual current state of specific behavior
- Ambiguous about adoption rate of technologies to get at the level from where it started
- Carbon conservation not always aligned with energy efficiency
- Focused on aggregate and averages.
- Model doesn't go well with existing potential assessment models
- Carbon-based planning not typical. Utility EE potential only touches on a small part of the model
- Doesn't isolate "behavior" within all policy related items (maybe bottom-up approach does)
- Technical potential appears to be minimum case, not reach goal
- No consideration of actual rate of action taking
- Relevance to utilities and PUCs unclear

CARBON FOOTPRINT MODEL: Method Comments

Potential Modifications

- Are there opportunities to identify behavior items in isolation to other practices?
- Model output depends on model structure and assumptions
- Need to be explicit/transparent and show sensitivities of primary drivers
- Combine with survey data to bring household granularity into the picture
- Define behavior profiles
- Quantify uncertainty of estimates

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LIST OF WORKSHOP PARTICIPANTS

- Mike Li, DOE
- Karen Ehrhardt-Martinez, Navigant
- Greg Wikler, Navigant
- Kristin Landry, Navigant

- Bruce Ceniceros, SMUD
- Anne Dougherty, Illume Advising
- Miriam Goldberg, DNV GL
- Tianzhen Hong, LBNL
- Chris Jones, Berkeley
- Mithra Moezzi, recently Portland State University, now independent
- Lucy Morris, PG&E
- Bill Norton, Opinion Dynamics

- Matt O'Keefe, OPower
- Olivia Patterson, Opinion Dynamics
- Scott Pigg, 7th Wave, Madison
- Shahana Samiullah, SCE
- Brian Smith, PG&E
- Paul Stern, NAS (on the phone)
- David Thayer (in place of Luke), PG&E
- Aquila Velonis, Cadmus
- Jordan Wilkerson, PG&E

