SOUP TO NUTS ON NON-ENERGY BENEFITS / NEIs

Methods, Results, and Application at the Utility & Regulatory Level

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TOPICS

- Background
- Measurement of NEBs
- Risk
- NEBs in State B/C
- Risk
- Gaps and Conclusions
Attention growing on NEBs* after 20 years

B/C to assess investments (programs, portfolios)

\[
\text{B/C} = \frac{f[\text{PV(attributable benefits stream)}]}{\text{PV(attributable cost stream)}}
\]

(With variations based on perspective...)

NEBs are net enhancement to “B” - incomplete
- Biased investments / decisions because all costs, not all benefits
- Omission - “0” is the wrong number

High value from multiple quantitative studies
- Evaluation’s purpose – to inform decision-making
20+ YEARS OF NEBS PROGRESS...

But there still isn’t agreement on name! - NEB, OPI, NNEB, MB, co-benefits...

Source: SERA, all rights reserved
## NEB PERSPECTIVES, CATEGORIES, BEST PRACTICES

<table>
<thead>
<tr>
<th>Utility</th>
<th>Society</th>
<th>Participant (Res&amp;ICI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Carrying cost on arrearages</td>
<td>• Economic development benefits – direct and indirect multipliers</td>
<td>• Water / wastewater bill savings</td>
</tr>
<tr>
<td>• Bad debt written off</td>
<td>• Tax effects</td>
<td>• Operating costs (non-energy)</td>
</tr>
<tr>
<td>• Shutoffs / Reconnects</td>
<td>• Emissions / environmental (trading values and/or health / hazard benefits)</td>
<td>• Equipment maintenance</td>
</tr>
<tr>
<td>• Notices; calls, collection costs</td>
<td>• Health and safety equipment</td>
<td>• Equipment performance (push air better, etc.)</td>
</tr>
<tr>
<td>• Emergency gas service calls (for gas flex connector and other programs)</td>
<td>• Water and waste water treatment or supply plants</td>
<td>• Shutoffs / Reconnects</td>
</tr>
<tr>
<td>• Insurance savings</td>
<td>• Fish / wildlife mitigation</td>
<td>• Property value benefits / selling</td>
</tr>
<tr>
<td>• Transmission and distribution savings (usually distribution)</td>
<td>• National security</td>
<td>• (Bill-related) calls to utility</td>
</tr>
<tr>
<td>• Fewer substations, etc.</td>
<td>• Health care</td>
<td>• Comfort</td>
</tr>
<tr>
<td>• Power quality / reliability</td>
<td>• Other</td>
<td>• Aesthetics / appearance</td>
</tr>
<tr>
<td>• Reduced subsidy payments (low income)</td>
<td></td>
<td>• Fires / insurance damage (gas)</td>
</tr>
<tr>
<td>• Other</td>
<td></td>
<td>• Lighting / quality of light</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Noise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Safety</td>
</tr>
</tbody>
</table>

### Net Three:
- Net Positive & negative
- Net beyond standard efficiency
- Net to gross

### Non-Overlapping Consistent Units

Source: (Skumatz/SERA,1996 on)
KEY APPLICATIONS OF NEBS

MARKETING & ROI –
Sell what’s valuable to customers; link to peers

B/C TESTS –
Refined C/E for program & portfolio; reduce bias in investment

PROGRAM REFINEMENT –
Positive & Negative NEBs for measures, barriers, incentives, and targeting

POLICY / GOALS
Quantifies Non-energy goals (e.g. Low income, jobs, etc).

TRAIN THE CHAIN –
Align / Educate Actors on NEB priorities

Source: SERA, all rights reserved
USES OF NEBS - NEGATIVES / PERCEIVED COST OF BARRIERS

Residential Example

<table>
<thead>
<tr>
<th>Negative BEBs</th>
<th>Solar W/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>-$14 NZ</td>
</tr>
<tr>
<td>Maintenance</td>
<td>-$9 NZ</td>
</tr>
</tbody>
</table>

NEBs MEASUREMENT – 4 MAIN MEASUREMENT APPROACHES

- Direct
  - Corp. Records, Utility data
- Secondary
  - Change x value
  - Financial Calcs
- Model
  - Third party; jobs
  - And emissions
- Survey
  - Specialized, academic, Best
  - for some NEBs

Methods discussion / Tradeoffs
- Multiple methods / triangulation
- Surveys most appropriate for some
- Balancing precision, practical – avoid bias / stats / large “N”
- Multiple survey approaches – story of a ferry
- Accuracy level needed... false comparisons...

Monetized NEBs

Story of a ferry... then it is academic

Source: Skumatz / SERA research
### MEASURING PARTICIPANT NEBs

#### Best practices:
- WTP not fruitful
- 7+ better options

#### Net Three:
- Net positive & negative
- Net beyond standard efficiency
- Net to Gross

#### Non-overlapping

#### Consistent units

#### Recommend in ALL process (impact) surveys - barriers.

<table>
<thead>
<tr>
<th>Method</th>
<th>Characteristics</th>
<th>HTM</th>
<th>HTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct calc</td>
<td>Accurate, small “n”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WTP/WTA</td>
<td>Accepted, volatile, HTA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative</td>
<td>Fast, strong, HTA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LMS</td>
<td>Fast, strong, clear, ETA</td>
<td></td>
<td>Unfamiliar</td>
</tr>
<tr>
<td>Logit, Conjoint, rank</td>
<td>Strong</td>
<td></td>
<td>Slow, complex</td>
</tr>
<tr>
<td>Regression</td>
<td>Defensible, limited, data, cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market value</td>
<td>Strong</td>
<td></td>
<td>Data</td>
</tr>
<tr>
<td>Other</td>
<td>Exploring, cost tradeoffs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HTM=Hard to measure; HTA=Hard to answer

Source: SERA Research
HOW THE NEBs ARE MONETIZED (CAN’T USE “FEEL GOOD” IN A B/C or ROI CALCULATION!)

Direct
Secondary
Model
Survey

Attributable Change (study)
Value or Financial Calc

Total Attrib. Stated Relative Effect
Savings (or translation) (“Norm”)
Individual NEB Shares

⇒ Monetized NEBs
PARTICIPANT MEASUREMENT METHODS COMPARISON

Source: SERA Research
# PROS AND CONS OF NEBS MEASUREMENT METHODS

<table>
<thead>
<tr>
<th>Used for</th>
<th>Major Advantages</th>
<th>Major Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct measurement</td>
<td>(specific studies of changes on-site)</td>
<td></td>
</tr>
<tr>
<td>Com’l labor, productivity, etc.</td>
<td>Direct, precise, attributable</td>
<td>Small estimation sample sizes; specialized cases, poor transferability; expensive</td>
</tr>
<tr>
<td>Secondary measurement</td>
<td>(attributable change in incidence times marginal valuation from secondary literature)</td>
<td></td>
</tr>
<tr>
<td>Insurance, water, health, others</td>
<td>Long history; easy secondary sources</td>
<td>Not available for all NEBs</td>
</tr>
<tr>
<td></td>
<td>Credible to reviewers; vetted inputs</td>
<td></td>
</tr>
<tr>
<td>Models</td>
<td>(third party, vetted model s of attributable impacts based on local / program inputs on base &amp; test case)</td>
<td></td>
</tr>
<tr>
<td>Emissions, economics</td>
<td>Third party, peer-vetted models available for economics / jobs and emissions</td>
<td>Not available for all NEBs</td>
</tr>
<tr>
<td>Surveys</td>
<td>(multiple academic-based approaches for surveys of participant effects, valued appropriately)</td>
<td></td>
</tr>
<tr>
<td>Wide variety of Participant NEBs</td>
<td>Large sample sizes &amp; statistical properties</td>
<td>Concerns about surveys as a source of quantitative values &amp; reliability</td>
</tr>
<tr>
<td></td>
<td>Affordable</td>
<td>Recall from survey respondents</td>
</tr>
<tr>
<td></td>
<td>Multiple estimates leading to similar ranges</td>
<td>Proper attribution to programs, measures</td>
</tr>
<tr>
<td></td>
<td>Direct method of measuring some key NEBs</td>
<td></td>
</tr>
</tbody>
</table>

Source: Skumatz / SERA research
**PROGRESS: TRANSFERABILITY OF NEBS**

Cost savings, consistency if transferable vs. risk

<table>
<thead>
<tr>
<th>Variability</th>
<th>Relevant NEB Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program / measure invariant (suitable for “adder”)</td>
<td>• Environmental / emissions – links to energy savings (varies with generation mix, and local air conditions, and time of day, but not primarily with measures / program)</td>
</tr>
<tr>
<td>Program / measure dependent</td>
<td>• Economic – societal (depends on measures and local manufacture / installation)</td>
</tr>
<tr>
<td></td>
<td>• Health and safety, health care, illnesses – societal and participant (measure)</td>
</tr>
<tr>
<td></td>
<td>• Water / wastewater infrastructure and water bill savings – societal and participant</td>
</tr>
<tr>
<td></td>
<td>• Participant benefits including: equipment operations, lifetime, O&amp;M, comfort, noise, control / education, home-improvements. Note: if measure bundles are “similar” participant NEB multipliers are similar in different areas of country.</td>
</tr>
<tr>
<td>Climate dependent</td>
<td>• Participant benefits including comfort, but when expressed as percent of energy savings, this variability may be mitigated. Note: if measure bundles are “similar” participant NEB multipliers are similar in different areas of country.</td>
</tr>
<tr>
<td>Residential Target dependent (low income or MF vs. SF)</td>
<td>• Payment related – utility (arrearages, etc. stronger for low income targets)</td>
</tr>
<tr>
<td></td>
<td>• Health and safety, health care, illnesses – societal and participant (higher with chronically ill, vulnerable populations)</td>
</tr>
<tr>
<td></td>
<td>• Participant benefits related to hardship and payments</td>
</tr>
<tr>
<td></td>
<td>• Initial information indicates non-low-income NEBs for occupant MFs are similar to SF</td>
</tr>
<tr>
<td>Subtotals by major categories</td>
<td>Dollar NEB Values Range Low-High</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td><strong>UTILITY PERSPECTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>Payment-related</td>
<td>$2.55 - $14.50</td>
</tr>
<tr>
<td>Added if Low Income subsidies avoided</td>
<td>$3.00 - $25.00</td>
</tr>
<tr>
<td>Service Related</td>
<td>$0.10 - $8.50</td>
</tr>
<tr>
<td>Other Primary Utility</td>
<td>$0.13 - $2.60</td>
</tr>
<tr>
<td>TOTAL UTILITY NEBs</td>
<td>$5.78 - $50.60</td>
</tr>
<tr>
<td>UTILITY NEBs MULTIPLIER</td>
<td>3% - 25%</td>
</tr>
<tr>
<td><strong>SOCIETAL PERSPECTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>Economic</td>
<td>$8.00 - $340.00</td>
</tr>
<tr>
<td>Environmental / Emissions</td>
<td>$3.00 - $180.00</td>
</tr>
<tr>
<td>H&amp;S equipment / fires</td>
<td>$0.00 - $0.30</td>
</tr>
<tr>
<td>Health Care</td>
<td>$0.00 - $0.00</td>
</tr>
<tr>
<td>Water / Wastewater infrastructure</td>
<td>$1.00 - $28.00</td>
</tr>
<tr>
<td>TOTAL SOCIETAL NEBs</td>
<td>$12.00 - $548.30</td>
</tr>
<tr>
<td>SOCIETAL NEBS MULTIPLIER</td>
<td>6% - 274%</td>
</tr>
<tr>
<td><strong>PARTICIPANT PERSPECTIVE</strong></td>
<td></td>
</tr>
<tr>
<td>Water and Other bills</td>
<td>$2.85 - $54.00</td>
</tr>
<tr>
<td>Financial / customer service</td>
<td>$0.27 - $36.70</td>
</tr>
<tr>
<td>Economic Dev’p / Hardship</td>
<td>$0.00 - $115.00</td>
</tr>
<tr>
<td>Equipment Operations</td>
<td>$26.00 - $127.00</td>
</tr>
<tr>
<td>Comfort, Noise, Related</td>
<td>$26.00 - $105.00</td>
</tr>
<tr>
<td>Health / Safety</td>
<td>$3.02 - $100.50</td>
</tr>
<tr>
<td>Control / Education and Contributions</td>
<td>$26.25 - $177.00</td>
</tr>
<tr>
<td>Home Improvements</td>
<td>$10.50 - $77.00</td>
</tr>
<tr>
<td>Special / reliability / other</td>
<td>$0.00 - $4.05</td>
</tr>
<tr>
<td>TOTAL PARTICIPANT NEBs</td>
<td>$94.89 - $796.25</td>
</tr>
<tr>
<td>PARTICIPANT NEBS MULTIPLIER</td>
<td>47% - 398%</td>
</tr>
<tr>
<td><strong>All NEBs Multipliers:</strong></td>
<td></td>
</tr>
<tr>
<td>Relative to Bill Savings</td>
<td></td>
</tr>
<tr>
<td>Utility</td>
<td>3% - 25%</td>
</tr>
<tr>
<td>Societal</td>
<td>6% - 274%</td>
</tr>
<tr>
<td>Participant</td>
<td>47% - 398%</td>
</tr>
<tr>
<td>ALL Multipliers - relative to bill savings</td>
<td>56% - 698%</td>
</tr>
</tbody>
</table>

| NOTE: Ltd variation for emissions are for peak / off-peak focused programs. |
PROGRESS AND GAPS

- Consistency / Transferability
  - Some programs / types; others less studied
  - Transferability research

- Measure-based NEBs
  - Some measure-based estimates
  - For multi-measure programs – need to sample for measures; until then:
    - Across the board
    - Savings share
    - Regression
PROGRESS AND GAPS

- Gas vs. Electric
  - Some research—usually program-wide, not broken down
  - International research found participant NEBs have similar order of magnitude multipliers
  - Not much research on fuel patterns – a gap / thin

- MF
  - Less-commonly-studied; complicated by poor response and complexity of sector (decision-maker; some measures in home / some central); separate from low income not common
  - Study provides some indicative results on occupants vs. owners (112% vs 71%); some comparisons to SF; this is a gap

- Commercial gaps in some measures
USING NEB / NEI VALUES

- Improve Cost-effectiveness (C/E) of Marketing (better uptake/contact)
- ROI & Payback calculations
- Deeper Measures – beyond lighting

<table>
<thead>
<tr>
<th>Environment</th>
<th>Quality</th>
<th>Quantity</th>
<th>PgmAvail</th>
<th>Flicker</th>
<th>Maintenance</th>
<th>Lifetime</th>
<th>Sales/Productivity</th>
<th>Safety</th>
<th>Noise</th>
<th>Control</th>
<th>Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>0.2</td>
<td>0.15</td>
<td>0.1</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Total NEBs Multiplier = X

Savings value = $X
NEB VALUES
ARE NEBS HIGH VALUE?

- Energy savings are often the minority of benefits from program measures– Don’t ignore that!

**NEB vs. Energy Savings Value**

Including all NEBs

Omitting can misrepresent decisionmaking & impacts... with implications

Source: (Skumatz/SERA 2010 & others)
RESIDENTIAL PROGRAMS
“NEBBED”

- New construction (incl ES)
- Lighting
- Weatherization
- Audit
- Home Performance (&ES)
- Appliances
- Water heating
- Insulation
- Window coverings
- Eqpt. rebate
- Training / outreach
- Real time pricing
- Solar / renewables
- MF
- Many others
- Thousands of surveys, results
  - By measures
  - By program types
  - By sectors
  - By stakeholders
  - By geography
- Variety of end uses
TOP NEBS FOR WEATHERIZATION PROGRAM

Weatherization program; multiplier > 1

Source: SERA Research
RESULTS FOR ENERGY STAR® APPLIANCES

Source: SERA Research
INSULATION RESULTS (DUNEDIN & ENERGY SMART)

- Comfort-related
- Dampness/Mold
- Ease of selling/renting
- Reduced moves
- Health
- Environmental
- Budget/finances
- Noise
- Other

5% increments to 50%

Source: SERA research
ENERGY STAR HOMES & HP PROGRAMS - RESIDENTS

Source: SERA Research
C&I PROGRAMS “NEBBED”

- New construction
- Lighting
- Motors
- Audit
- Eqpt. rebate
- Commissioning
- Technical assistance
- Training / outreach
- PV
- Retail renewable
- SPC

- DG / CHP
- HVAC
- Equipment rebate
- Other

- Building codes, incentives by cities

- Thousands of surveys, results
  - By measures
  - By program types
  - By many sectors
  - By stakeholders
  - By geography

- Variety of end uses
Variety of measures... disaggregated Results by measure type, business Type, etc...
C&I NEW CONSTRUCTION

(Pct of Total Partic NEBs)

Source: SERA Research
Besides enviro, Costs, performance, Light, comfort, Productivity impt. – Varled by measure...

Source: SERA Research
# EXPRESSING NEBS VALUE–Cx

<table>
<thead>
<tr>
<th>Yellow is highest per category</th>
<th>NEB Value per $1 of gross Cx cost</th>
<th>NEB Value per $1 Cx rebate provided</th>
<th>Benefit per &quot;net&quot; Cx cost ($1)</th>
<th>Benefit per building square foot</th>
<th>Impct of Cx compared to construct &amp; O&amp;M cost (0-100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>$1.00</td>
<td>$2.80</td>
<td>$3.10</td>
<td>$0.50</td>
<td>70.5</td>
</tr>
<tr>
<td>Respondent Role</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facility Mgrs</td>
<td>$1.20</td>
<td>$2.80</td>
<td>$4.30</td>
<td>$0.70</td>
<td>79.1</td>
</tr>
<tr>
<td>Construction related</td>
<td>$0.90</td>
<td>$1.20</td>
<td>$2.00</td>
<td>$0.40</td>
<td>68.8</td>
</tr>
<tr>
<td>A&amp;E</td>
<td>$0.60</td>
<td>$2.90</td>
<td>$0.80</td>
<td>$0.80</td>
<td>62.5</td>
</tr>
<tr>
<td>Facil / maint</td>
<td>$0.50</td>
<td>$1.20</td>
<td>$1.10</td>
<td>$0.20</td>
<td>46.7</td>
</tr>
<tr>
<td>Building Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>$2.00</td>
<td>$4.90</td>
<td>$3.40</td>
<td>$1.00</td>
<td>91.3</td>
</tr>
<tr>
<td>University</td>
<td>$0.90</td>
<td>$2.00</td>
<td>$4.90</td>
<td>$0.60</td>
<td>70.5</td>
</tr>
<tr>
<td>Prison (small sample)</td>
<td>-$0.40</td>
<td>-$0.80</td>
<td>-$0.40</td>
<td></td>
<td>50.0</td>
</tr>
<tr>
<td>Other</td>
<td>$0.90</td>
<td>$2.00</td>
<td>$1.70</td>
<td>$0.50</td>
<td>58.0</td>
</tr>
<tr>
<td>Business Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gov't / University</td>
<td>$1.10 / $0.80</td>
<td>$2.60 / $1.80</td>
<td>$3.90 / $1.70</td>
<td>$0.60 / $0.40</td>
<td>67.5 / 75.0</td>
</tr>
<tr>
<td>Systems Commissioned</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVAC only / More</td>
<td>$1.40 / $0.90</td>
<td>$3.00 / $2.20</td>
<td>$10.50 / $1.80</td>
<td>$1.20 / $0.40</td>
<td>79.0 / 67.7</td>
</tr>
<tr>
<td>Type of Commissioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New / Retrofit</td>
<td>$0.70 / $1.90</td>
<td>$1.60 / $4.70</td>
<td>$2.90 / $3.70</td>
<td>$0.50 / $0.70</td>
<td>62.1 / 90.0</td>
</tr>
</tbody>
</table>

**Strong value from RetroCx**

Source: SERA Research
SOCIETAL NEB EXAMPLES
JOBS / ECONOMICS – ALL PROGRAMS AREN’T ALIKE

- Economics, Emissions, Hardship

Jobs / Economic

HP/Wx/Retrof Appliance

(Source: Skumatz /SERA ECEE 2007, ACEEE 2006)
EMISSIONS (SOCIETAL NEBS)

- Simple to complex models (slippery slope)
- Baseload vs. peak
- Some elements well / already accepted
- Incorporation as adder
Utility NEBs for Template Program

Debt WriteOff (util) 13%
Rate Subsidy (util) 61%
Health/Safety (util) 0%
Coll’n Costs (util) 0%
Gas Calls (util) 0%
Calls to CSRs (util) 2%
Shutoffs (util) 1%
Reconnects (util) 0%
Notices (util) 7%
Low Income Weatherization

Example:
Payment-related
T&D
Rate subsidy

Source: Skumatz Economic Research Associates research
These NEBs are **DOLLAR VALUES**, so can be used to adjust payback and ROI

- Gross payback: 5.6 yrs ➔ 2.5*
- B/C incl all partic NEBs: 0.9 ➔ 1.9

Total participant NEB multiplier ranges ~25%-300%+, depending on measure(s), target(s), climate, etc.

Value of 100% HALVES Payback, doubles ROI

Source: Skumatz Economics (SERA)

(*) for NEBs Multiplier of 1.25)
NEBS IN COST-EFFECTIVENESS APPLICATIONS

...2001 ON
NEBS IN B/C

- TRC / Societal, Participant, UCT, RIM... NEBs
  - For true representation of B & C, elements of NEBs address missing factor bias
  - Better guide measure, program, & portfolio investment
  - Address by:
    - 1) incl monetized NEBs or
    - 2) exclude all costs associated with achieving NEBs or
    - 3) use UCT
  - B/C applications were considered early on, then pulled back, awaiting more quantitative evidence
CORRECTING & IMPROVING C/E TESTS – 2001 on...

Information readily available on NEB refinements needed to all traditional types of B/C tests in use – “Check-marks” for which NEBs need to be added To each test has been available since 2002-2005...

<table>
<thead>
<tr>
<th>Test</th>
<th>Benefits</th>
<th>Costs</th>
<th>States Using Traditionally</th>
<th>Improved treatment with NEBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility Cost (or Program Administrator Test) (UCT or PAC)</td>
<td>• Avoided supply costs for transmission, distribution, and generation (TD&amp;G)</td>
<td>• Program administration</td>
<td>CA, CT, HI, IA, IL, IN, MI, MN, MO, NY, OR, RI, TX, VA, WA, BPA</td>
<td>Use cost only paid by the utility</td>
</tr>
<tr>
<td></td>
<td>• Avoided gas and water supply costs</td>
<td>• Participant incentives</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increased supply cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratepayer Impact Measure (RIM) (or No Loser's Test, or non-participants test)</td>
<td>Same as above plus • increased revenue</td>
<td>Same as above plus • Decreased revenue</td>
<td>AR, CO, FL, GA, HI, IA, IN, MI, MN, NC, ND, NV, SC, VA, WI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant cost</td>
<td>• Utility bill reductions • Participant incentives</td>
<td>• Participant direct costs</td>
<td>AR, CA, FL, HI, IA, IN, MI, MN, NY, VA</td>
<td>Participant NEBs</td>
</tr>
</tbody>
</table>
APPLICATION TO B/C

- Initial hesitancy - 2001’s LIPPT
  - Lack of literature, unfamiliar methods
  - Expansion of research, literature, values

- Early adopters
  - Adders
  - Readily measureable
  - Hybrid
  - “All in”

- Expansion?
  - Concern with risk / calculation accuracy

Source: Skumatz / SERA research
# METHODS TO INCLUDE NEBs IN REGULATORY TESTS

<table>
<thead>
<tr>
<th></th>
<th>Maximize DSM opportunities &amp; feedback; Accuracy / tailoring</th>
<th>Minimize Regulatory &amp; Implementer Risk</th>
<th>Minimize Evaluation Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Readily Measurable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All NEBs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: SERA Research
## State Treatment of NEBS

<table>
<thead>
<tr>
<th>Regulatory / Screening Application</th>
<th>Utilities / regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Marketing</td>
<td>Fairly widespread use in utilities / states across the country</td>
</tr>
</tbody>
</table>

### Test / Pgm Screen - adder
- IA (10% elec, 7.5% gas, 1999); CO (10% adder, 25% Low Inc, 2008); OR (Carbon $15/ton; 10% adder, 2008); WA (10% adder, 2008); VT (15%+15% LI); DC (10%); NY($15 adder for carbon); NW (15%); for low income (LI) or <1 (CA*, ID, OR, WA*, UT, WY, NH, NY, CT)

### Test / Pgm Screen - readily measured
- MA (NEBs must be "reliable & with real economic value"; utility, prop, H&S, comfort; LI; eqpt, util, all costs of complying with foreseeable environmental regulations); CA (low income); VT (maint, eqpt replacement, LI, comfort, H&S, prop, util, societal); CO (measurable with current mkt values); NH (as adder; LI); BCHydro (maint, GHG, lifetime, product loss, productivity, floorspace); DC (eqpt, comfort, H&S, prop, societal); OR (esp. C&I; carbon value on societal test, PV deferred plant extension, water / sewer savings, laundry soap); CT (LI); RI (LI; quantify util, societal; H&S, eqpt, prop, comfort); NY (LI, eqpt)

### Test / Hybrid (potential adder & measured)
- CO (measureable with current mkt values); OR (esp. C&I; carbon value on societal test, PV deferred plant extension, water / sewer savings, laundry soap); DC, VT.

### Test / Pgm Screen - Broad
- With quantification: MA, RI. MA order / decision - becoming broader - count in res & ICI / demonstratable including survey-based (not yet econ); Broad-based inclusions of all NEBs as an official screen: not yet found.

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Source: ©Skumatz Economic Research Associates (SERA); may be used with permission of author
STATES WITH NEBS IN C/E TESTS

NEB options to date:
- Adders
- “Readily Measured”
- Hybrid
- “All-In”

Various stages of deliberations, working groups, TRM work, etc. in states in Midwest, mid-Atlantic and elsewhere.
Selected State Progress

- CA
  - 2001 – LIPPT, model*

- NY
  - Mid-2000s measurement & scenarios, not included*

- CO
  - Adders (10% electric, 25% LI, 5% gas)*

- VT
  - 15% adder; helped by previous research*

- DC
  - 10% NEB adder, 10% risk, 10% enviro + NEBs in goals & measured benchmarks

Source: Skumatz / SERA research
SELECTED STATE PROGRESS

- Dominos / ongoing:
  - Midwest – Some NEBs in tests, intervenor raised, TRM process, discussions stalled
  - Mid-Atlantic – Considered as part of broader regulatory change; “informational proceedings”, B/C expected in next stage
  - Midwest – Regulatory commission decided to conduct revisions of B/C rules; considered NEB process; reversed that section of rules; pick up again next year

- Sellable” name – “Prince Albert in a Can” if that’s what they need...!

Source: Skumatz / SERA research
APPLICATION TO B/C AS “NEXT STEP” (circle back!)

- Initial hesitancy – 2001’s LIPPT
  - Lack of literature, unfamiliar methods
  - Expansion of research, literature, values
- Early adopters
  - Adders
  - Readily measureable
  - Hybrid
  - “All in”
- Expansion?
  - Concern with risk / calculation accuracy

Source: Skumatz / SERA research
NEBS IN B/C – NEB RISK IN CONTEXT (ACCURACY / BIAS)

- Simplified B/C Inputs- Lets compare the risks/ranges

\[ \frac{PV[NTG \times (Sav + NET NEB) \times \text{Lifetime}]}{PV(\text{Cost})} \ldots \]

**NTG** – accuracy, measurement, incomplete

**Savings**: Impact, repeatedly & expensively measured, little variation, $100K+

**EUL**: Lists 20+ years old, Origins (!), technologies, dated, varies / local, values 50% - 2x+ variation

**Cost**: Complicated, expensive, local, changes

**Discount rate**: Not highly complicated, purpose / use; <WACC, risk link, regulatory environment;

**NEBs**: Lit exists, comparability, transferability, local, inexpensive to add to existing studies, gaps

**Conclusion** ➔ “Measuring (savings) with a micrometer, cutting with a chainsaw”

NEBs as accurate as many inputs (all could improve)

RELATIVE Risk from NEBs?

Source: Skumatz / SERA
Independent research

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DISCOUNT RATE MATTERS

PV Ratios vs. 1% Discount Rate

Discount rate - percent

Source: Skumatz / SERA Research

Source: Skumatz / Electricity Journal, IEPEC paper, independent research
EUL VARIATIONS-ADOPTED VALUES

EUL Variation by Measure

67 measures examined
66% average
40% median
Yrs in double digits; avg 6.4, med 5
Substantial percentages

Poorly supported
Old
Technology change

Source: Skumatz Economic Research Associates /SERA independent research
KEY QUESTIONS FOR IMPROVING TESTS - BALANCE

- Tradeoffs – How much to improve tests? Depends on costs & benefits of accuracy improvements (in NEB categories)
  1. Which NEBs most valuable?
  2. What value range arises from reasonable cost measurement (eval budget)
  3. Does inclusion of this RANGE (low vs. high value) change the B/C conclusion?

On the cusp...

If NO, You’re done And bias addressed sufficiently

IF YES, Refine measurement up to value or cost of “wrong” decision

Source: SERA, all rights reserved
### IMPLICATIONS FOR JUSTIFIABLE NEB's VALUES – SERA FORMAT FOR STATES

<table>
<thead>
<tr>
<th></th>
<th>Utility</th>
<th>Soc</th>
<th>Part</th>
<th>Conserv. Rec’m</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Percent</td>
<td>X%</td>
<td>X%</td>
<td></td>
<td>X%</td>
<td>Program-invariant</td>
</tr>
<tr>
<td>Low Income</td>
<td>X%</td>
<td>X%</td>
<td>X%</td>
<td>X%</td>
<td>Multiple sources</td>
</tr>
<tr>
<td>Weatherization</td>
<td></td>
<td>X%</td>
<td>X%</td>
<td>X%</td>
<td>Substantial Participant impacts</td>
</tr>
<tr>
<td>Measure / Program-specific</td>
<td></td>
<td></td>
<td>X%</td>
<td></td>
<td>Varies by measure, sector</td>
</tr>
<tr>
<td>Other Recom’s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Local Research</td>
</tr>
</tbody>
</table>

Developing values for multiple states & utilities

Source: Skumatz / SERA
TAKEAWAYS ON NEBS/NEIS

☐ 1) Valuable – can exceed savings; matters, bias
☐ 2) Defensible methods, available estimates
☐ 3) Transferable, depending… “add-on” analysis
☐ 4) Uncertainties acceptable?
  ■ Rigor, surveys, risk, put into perspective
  ■ B/C=f[pv{NTG*(Savings+Net NEB)*EUL}/{PV(Cost...)}]

  ■ Other sources of bias to research (EUL, NTG, etc.) bring high variation

☐ 5) States are incorporating NEBs / dominos
  ■ input in deliberations in multiple states

☐ 6) and useful besides...!

Source: Skumatz / SERA research
May be used with permission of author
THANK YOU!!

Questions?

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Skumatz Economic Research Associates (SERA),
Phone: 303/494-1178
skumatz@serainc.com
POWER OF NEBS – BARRIERS, DISCONNECTS
## NEGATIVE NEBS VALUE / PERCEIVED COST OF BARRIERS

<table>
<thead>
<tr>
<th>Negative NEB values / cost of barrier</th>
<th>Solar Water Heat NZ$ / Euros</th>
<th>Solar Design NZ$ / Euros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance (NZ$ / Euros)</td>
<td>-14 / -7</td>
<td>-3 / -2</td>
</tr>
<tr>
<td>Maintenance (NZ$ / Euros)</td>
<td>-9 / -5</td>
<td>-5 / -3</td>
</tr>
<tr>
<td>Other (NZ$ / Euros)</td>
<td>-</td>
<td>-3 / -2</td>
</tr>
<tr>
<td>Total value of Negative NEBs for Measure (and share of energy savings)</td>
<td>-23 / -12 (0.79)</td>
<td>-11 / -6 (.06)</td>
</tr>
</tbody>
</table>

### Implications: Negatives / barriers
Can be very real & important. Can address with redesign, or, presumably, rebates. Perhaps warranties...

Source: Skumatz Economic Research Associates research
C&I - NEGATIVE NEBS (BARRIERS) & ACTOR – “DISCONNECTS”

NEBs Influence on Incorporating HP/EE: Direction & Importance by Actor

Owners more positive – Underinvestment? ➔ train?

Note*: A>E (~4 vs. ~2) for these NEBs

Uses: ID “winners”, influencing factors for intervention, “disconnects”, program, interventions, research, assess / design training, target needed actors…