NON-ENERGY BENEFITS (NEBS)

What have we learned in 20 years?

NEBs for Marketing, Designing, C/E, and Reflecting Quality of Life Changes

LIFE Conference, Albany, NY, May 29, 2014

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WHAT MATTERS IN ENERGY EFFICIENCY PROGRAMS?

- What matters, depends on your values.
- Efficiency & savings are not all that matters...
- Especially to your target audience
- Let’s talk about NEBs
  - Background, Estimation, Results, Applications, C/E, Gaps
20 YEARS OF NEBS PROGRESS...

Random, theorized lists ➔ Drivers, 3 main beneficiaries / perspectives

1990

Arrearages & minimal others ➔ Tested methods & BPs including HTM

1994-1996

Low income results ➔ Ranges / focus ➔ Models & broad 3-perspective results for varied programs, measures, portfolios, sectors

1996-2002+

Applications in Low inc. policy & mktg ➔ Broad applications incl. C/E

1996 onward

Skepticism ➔ Improving acceptance; State proceedings, chicken and egg

1996 ... recent

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

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NEB BACKGROUND / REVIEW / CONTEXT
BACKGROUND / HISTORY*

- 20 years of Non-energy benefits (NEBs)
  - Random + arrearage → Low income → HTM
  - Low income policy → broader
- Motivation
  - Implicit assumption of “0” is wrong, B/C bias, Granger, evaluation to guide decision-making
  - Theory / “bundled features”, positive and negative effects other than energy savings
- 3 Beneficiaries, drivers (1994-5)
  - Utility
  - Society
  - Participants
## NEB DRIVERS, 3 BENEFICIARIES

<table>
<thead>
<tr>
<th>Utility/Ratepayer</th>
<th>Societal</th>
<th>Participant (all)</th>
</tr>
</thead>
<tbody>
<tr>
<td>oPayments/financial</td>
<td>oEconomic development / job / multipliers</td>
<td>oPayments &amp; coll’n</td>
</tr>
<tr>
<td>oDebt collection efforts / calls</td>
<td>oTax impacts</td>
<td>oEducation</td>
</tr>
<tr>
<td>oEmergencies / insurance</td>
<td>oEnvironmental</td>
<td>oBuilding stock</td>
</tr>
<tr>
<td>oT&amp;D, power quality, reliability</td>
<td>oEmissions</td>
<td>oHealth</td>
</tr>
<tr>
<td>oSubsidy (LI)</td>
<td>oHealth</td>
<td>oEquipment service incl.</td>
</tr>
<tr>
<td>oOther</td>
<td>oWater &amp; other resources / utilities</td>
<td>productivity, comfort, maint, etc.</td>
</tr>
<tr>
<td></td>
<td>oNational security</td>
<td>oOther utilities (water, etc.)</td>
</tr>
<tr>
<td></td>
<td>oWildlife/Other</td>
<td>oOther (transactions, enviro, psychic, etc.)</td>
</tr>
</tbody>
</table>

More than 60 categories derive from these drivers. Include subsets as appropriate to application.

Source: (Skumatz/SERA, 2004)
### NEB CATEGORIES BY PERSPECTIVES – FROM DRIVERS

<table>
<thead>
<tr>
<th>Utility</th>
<th>Society</th>
<th>Participant</th>
<th>(res &amp; com’l)</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>
<td>• Control over bill</td>
</tr>
<tr>
<td>• Bad debt written off</td>
<td></td>
<td>• Operating costs (non-energy)</td>
<td>• Understanding / knowledge</td>
</tr>
<tr>
<td>• Shutoffs</td>
<td>• Tax effects</td>
<td>• Equipment maintenance</td>
<td>• “Care” or “hardship” (low income)</td>
</tr>
<tr>
<td>• Rec reconnects</td>
<td>• Emissions / environmental (trading values and/or health / hazard benefits)</td>
<td>• Equipment performance (push air better, etc.)</td>
<td></td>
</tr>
<tr>
<td>• Notices</td>
<td>• Health and safety equipment</td>
<td>• Equipment lifetime</td>
<td></td>
</tr>
<tr>
<td>• Customer calls / bill or emergency-related costs</td>
<td>• Water and wastewater treatment or supply plants</td>
<td>• Shutoffs / Rec reconnects</td>
<td>• Indoor air quality</td>
</tr>
<tr>
<td>• Other bill collection costs</td>
<td>• Fish / wildlife mitigation</td>
<td>• Property value benefits / selling</td>
<td>• Health / lost days at work or school</td>
</tr>
<tr>
<td>• Emergency gas service calls (for gas flex connector and other programs)</td>
<td>• National security</td>
<td>• (Bill-related) calls to utility</td>
<td>• Fewer moves</td>
</tr>
<tr>
<td>• Insurance savings</td>
<td>• Health care</td>
<td>• Comfort</td>
<td>• Doing good for environment</td>
</tr>
<tr>
<td>• Transmission and distribution savings (usually distribution)</td>
<td>• Other</td>
<td>• Aesthetics / appearance</td>
<td></td>
</tr>
<tr>
<td>• Fewer substations, etc.</td>
<td></td>
<td>• Fires / insurance damage (gas)</td>
<td>• Savings in other fuels or services (as relevant)</td>
</tr>
<tr>
<td>• Power quality / reliability</td>
<td></td>
<td>• Lighting / quality of light</td>
<td>• GHG and environmental effects</td>
</tr>
<tr>
<td>• Reduced subsidy payments (low income)</td>
<td></td>
<td>• Noise</td>
<td>• Negatives</td>
</tr>
<tr>
<td>• Other</td>
<td></td>
<td>• Safety</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Skumatz/SERA, 1996 on)
NEBs – BEST PRACTICES*

History:
- Primary vs. secondary and tertiary effects (NEBs)...
- Noted key applications; then went “conservative” until comfort level increased & more estimations
- *Chicken and Egg – important uses <-> trusted uses;* (won’t incorporate effects until well-measured; no money at measurement unless “serious” applications...)

Best practices / issues – “NET NEBs”

- Redundancy / perspective
- Net positive / negative
- Net standard efficiency
- Net free riders
- Minimizing overlap / double-counting (drivers)
- Application subsets
- Attribution & precision; depends; relative to use; net
- MONETARY terms
NEB ESTIMATION APPROACHES
BACKGROUND – MEASUREMENT OF NEBS

- Early – arrearages and related (low income budgets)
- Challenge – “Hard to Measure” (HTM) – stuck, no progress
  - Traditional WTP/WTA; unsuccessful; ferry & academic (1996)
  - Methods progress - 20 years of research; hundreds of studies; US & international
  - Functions/objective vs. perceptions
- Goals and practical tradeoffs for defensible estimates
  - Need reasonable data quality
  - Need ability to collect data
  - Need sufficient number of observations for reliability / transferability / bias issues
  - Need quality responses
  - Singular NEBs issue / overlap
  - ➔ Accuracy, consistency, unbiased, large sample...
## NEBs MEASUREMENT – 4 MAIN MEASUREMENT APPROACHES*

<table>
<thead>
<tr>
<th>Direct Measurement</th>
<th>Secondary + Lit/Meas</th>
<th>Modeling</th>
<th>Survey-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Records, billing data, market info; regression</td>
<td>• Incremental incidence * valuation</td>
<td>• 3rd party or specialized models</td>
<td>• Multiple approaches</td>
</tr>
<tr>
<td>• Utility, arrears, debt, calls, notice, subsidies; broader individ.</td>
<td>• Water savings, insurance, O&amp;M, etc.</td>
<td>• Emissions, Economics</td>
<td>• Participant effects (HTM) -only option for some</td>
</tr>
<tr>
<td>• Sample size</td>
<td>• Many factors available</td>
<td>• Many straightforward, but also slippery slope</td>
<td></td>
</tr>
</tbody>
</table>

### Story of a ferry... then it’s academic

### Strengths & weaknesses

**Balancing precision & practical**

Avoid bias, achieve high numbers

False comparisons?

### Survey options

- CV (WTP/WTA; open v. bounded)
- Relative scaling (LMS, comparative, numeric)
- Ranking (Ord. Logit, AHP, rank, conjoint)
- Hedonic Regr
- Other

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*SERA*
PARTICIPANT MEASUREMENT METHODS COMPARISON – STATED PREFERENCE

Other papers compare WTP, Bounded WTP, LMS (SERA/WEA 2006) (Source: Skumatz/SERA ACEEE paper 2002)
EMPIRICAL RESULTS – STATED PREFERENCE COMPARISONS

- Survey results
- Hi-efficiency versus standard model

<table>
<thead>
<tr>
<th>Question format</th>
<th>NEB value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative scaling</td>
<td>75</td>
</tr>
<tr>
<td>Discrete CV</td>
<td>70</td>
</tr>
<tr>
<td>Rank-order</td>
<td>85</td>
</tr>
<tr>
<td>Open-ended CV (avg)</td>
<td>611</td>
</tr>
<tr>
<td>Open-ended CV (med)</td>
<td>36</td>
</tr>
</tbody>
</table>

Source: Skumatz Economic Research Associates research (boiler)
# ASSESSMENT OF NEB MEASUREMENT & DATA COLLECTION METHODS*

## Assessing Participant NEB Measurement & Data Collection Methods

<table>
<thead>
<tr>
<th>LOW PERFORMANCE</th>
<th>HIGH PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOW COST</strong></td>
<td></td>
</tr>
<tr>
<td>- Willingness to Pay (WTP) (volatile)</td>
<td>Web ✗</td>
</tr>
<tr>
<td>- Willingness to Accept (WTA)</td>
<td>Verbal scaling, LMS</td>
</tr>
<tr>
<td>- Bounded WTP/WTA</td>
<td>Comparative / numeric</td>
</tr>
<tr>
<td>- Mail-in</td>
<td>Discrete choice</td>
</tr>
<tr>
<td>- Email</td>
<td>Ranking</td>
</tr>
<tr>
<td>- Phone/fax</td>
<td>Ordered logit</td>
</tr>
<tr>
<td><strong>HIGH COST</strong></td>
<td></td>
</tr>
<tr>
<td>- Direct valuation (obs, bias)</td>
<td>Regression (ltd categ)</td>
</tr>
<tr>
<td>- Market valuation (obs, bias)</td>
<td>Intercept survey ✗</td>
</tr>
</tbody>
</table>

Based on SERA tests, comparisons, studies
NEB RESULTS: EXAMPLES

Presenting Residential, low income examples; have many other residential & commercial as well – applies across all.
WHICH SOURCES OF NEBS ARE HIGH VALUE?

- Results sample of ~100 programs we’ve done & lit review
- Which sources dominate?
- Utility 10%; Societal 40-60%, participant 30-50%
- Considerable variation by program, climate, measures

Source: (Skumatz/SERA) ACEEE2010 & others)
WHICH NEBS ARE HIGHEST VALUE?*

- Utility (10%)
  - Few, low value (arrearages, subsidies)
- Societal (40-60%)
  - Emissions
  - Economic development
  - Potentially health (not well measured yet)
- Participant (30-50%); *(often higher for low income)*

**Residential**
- Comfort
- Avoid moving / homelessness; home value
- Illness / health
- Ability to pay other bills / savings
- Green

**Commercial**
- Tenant satisfaction
- Maintenance
- Comfort
- Ability to sell
- Productivity
- Green

- Gaps
  - Health & safety, peak, infrastructure, security, hardship

*Source: Skumatz Economic Research Associates research*
ARE NEBS HIGH VALUE?

- Energy savings are less than ¼ of benefits from low income weatherization programs – less than 1/10 for some programs

NEB vs. Energy Savings Value

Including all NEBs

Omitting can misrepresent decisionmaking & impacts… with implications

Source: (Skumatz/SERA 2010 & others)
WHICH PARTICIPANT NEBS ARE HIGH VALUE?

Example Participant NEBs breakdown

- Comfort & services: 29%
- Home & value: 18%
- Health-related: 24%
- Educ/bills/other: 29%

Top NEBs similar across many programs (some variation in #s). New Zealand programs showed “environmental” among most important also.

Share of NEBs

Persistence issues...

Source: (Skumatz/SERA) ACEEE1997 & others
UTILITY NEBS
EXAMPLE: LOW INCOME WX

Utility NEBs for Template Program

- Debt WriteOff (util): 13%
- Arrears (util): 0%
- Shutoffs (util): 1%
- Reconnects (util): 0%
- Notices (util): 7%
- Coll'n Costs (util): 0%
- Gas Calls (util): 0%
- Calls to CSRs (util): 2%
- T&D (util): 16%
- Rate subsidy: 61%
- Health/Safety (util): 0%

MODELS
Source: Skumatz Economic Research Associates research
TOP NEBS FOR WX PROGRAM
(Percent of total survey-based participant NEBs)

Regressions to decompose/attribute drivers:
Measures: Insulation, furnace, draft repair
Demographics: Children, elderly,

Source: Skumatz Economic Research Associates research
PERCENT OF TOTAL NET NEB VALUES BY NEB CATEGORY: ZALEH/NZ

Total NEB multiplier: 3

Source: Skumatz/SERA
NEBS

- NEBs values depend on measures included
  - Decomposition of packages
- Some patterns
- Enemy of the good...
**SOCIETAL IMPACTS**

- Strong economic development performance
- Emissions – vary by generation; much measurement
- Hardship reduction; health care, infrastructure
- Gaps

(Company: Skumatz /SERA ECEE 2007, ACEEE 2006)
NEBS MEASURED IN SURVEYS: CHANGES IN...

- Comfort
- Aesthetics / appearance
- Lighting quality / quantity
- Noise
- Safety
- Property value(*)
- Moves
- Control over bill / knowledge / concern / notices, etc.
- Doing good for environment
- Equipment lifetime*
- Equipment maintenance*
- Illness / lost days / visits / cost
- Other bills*
- Business productivity
- Other
- Valuation metrics vary for valuing these impact changes
  - Some directly valued from survey responses (depending on method)
  - Others “valued” (e.g. calls times length times value of time)

Some can be derived other ways, checked
Some should be explored as financial calculations instead (*)
**PROGRESS & GAPS IN NEBs***

- **Greatest progress – beyond “lists”**
  - Utility: coll’n; some T&D, subsidies
  - Societal: Climate change – models; Economic development (net)
  - Participant: water/sewer, payment-related; property value, some illness, moves, “soft” in total (not assoc. with measures); some O&M & performance

- **Needs more work / gaps**
  - Utility: T&D, kW, capacity, health and safety, insurance, substation infra, power quality
  - Society: Water infrastructure, hardship; kW/capacity; H&S, neighborhood improvement; (wildlife; national security, tax)
  - Participant: Limited progress on hardship indicators (LI); com’l performance/prod; fire/safety/gas; chronic health/H&S / IAQ
  - Overall: persistence pattern (& underlying EULs weak); transfer-ability, policymakers, B/C

*Source: SERA research*
RESULTS

All Monetized
PROGRESS IN APPLICATIONS OF NEBS
KEY APPLICATIONS OF NEBS

Source: SERA research
KEY APPLICATIONS OF NEBS

- **Sell what is valued**
  - NEBs are what is valued (market research)
  - Bundle of services – “utility” – NOT irrational
  - NEBs > Energy sav.
    - (trust in savings?)
    - Perception important
  - Easier to sell
  - Sell on THEIR values

Source: SERA research
KEY APPLICATIONS OF NEBS

- **Design / Refine / Evaluate Programs**
  - Positive ➔ all equal...
    - Expand measures bringing most NEBs
    - Target those with greatest NEBs
  - Negative
    - Refine program with rebates, warranties...
    - Up to $ suggested
  - Better process eval.

*Source: SERA research*
KEY APPLICATIONS OF NEBS

- Train the Chain
- Found “disconnects”
- Need their support
- Lost potential
- Train, educate to maximize support

Source: SERA research
KEY APPLICATIONS OF NEBS

- Reflect Policy Goals
- NEBs ARE THE GOALS of many low income programs / Q of Life
- Comfort, ability to pay, school retention, etc
- Hardship metrics

Source: SERA research
KEY APPLICATIONS OF NEBS

- Cost-Effectiveness
  - Program & portfolio choice
  - Bias in current tests – TRC, Societal Test, etc.
  - Includes all costs, not (all) benefits
  - Increase investment in EE, including LI
  - Which NEBs depends on test
  - Progress in states / participating, estimating

Source: SERA research
ADJUSTED PAYBACKS – ADDING ONLY PARTICIPANT EFFECTS

- Gross payback: 5.6 yrs ➔ 2.5 yrs
- Net payback excl. FR: 9.0 yrs ➔ 4.0 yrs
- B/C incl all partic NEBs: 0.9 ➔ 1.9
- B/C adj for FR: 0.55 ➔ 1.2

Source: Skumatz Economics (SERA)
# METHODS TO INCLUDE NEBs IN REGULATORY TESTS

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

*Source: SERA Research*
STATE / REGULATORY NEBS

- Measured for 20 years
  - evaluated, worked with states & regulators & interveners in proceedings & stakeholder groups – incl. international

- More states reviewing

- Results show bigger NEBs for Low Income programs

- More states incorporate LI adders / policy recognition
DIRECTIONS & LEFTOVERS*

- Feedback to design
- Perception they are inaccurate – Risk, accuracy
  - Level needed for decisions? Need reliability for important uses - False accuracy / spreadsheets & forecasting
- Perception that NEBs are costly
  - Next steps: CT - Incorporating NEBs into all process evaluations; incremental set of question on surveys
- Retention: follow measure? EULs reliable? 25 yr tech change
- Consequences of omission
  - Bias in EE investment; getting max for same budget/same for less
  - Incomplete understanding of participation,
  - Ineffective marketing / targeting campaigns,
  - Under-capture in market;
  - Inefficient / ineffective / suboptimal programs & portfolios...
**SUMMARY ON NEBS**

- Measured & valuable – MORE valuable than savings
- Tested, consistent methods
- Important uses incl. C/E
  - Bundle of services, Chicken & egg
- Key for bringing & reflecting value & goals –
- Can use NOW – sell on what they value – piggy-back on social mktg, SE

*We’ve measured for 20 years, evaluated, worked with states & Regulators & interveners in proceedings & stakeholder groups*
THANK YOU!!

Questions?

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