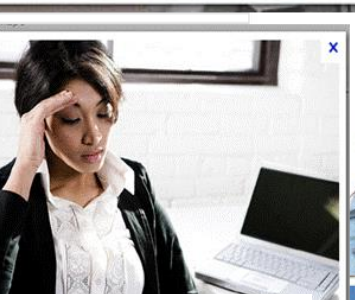
METHODS, EVIDENCE, AND POLICY SUPPORT – MULTIPLE BENEFITS/ NEIs



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IEA Multiple Benefits Meetings
Paris, 3/6/18

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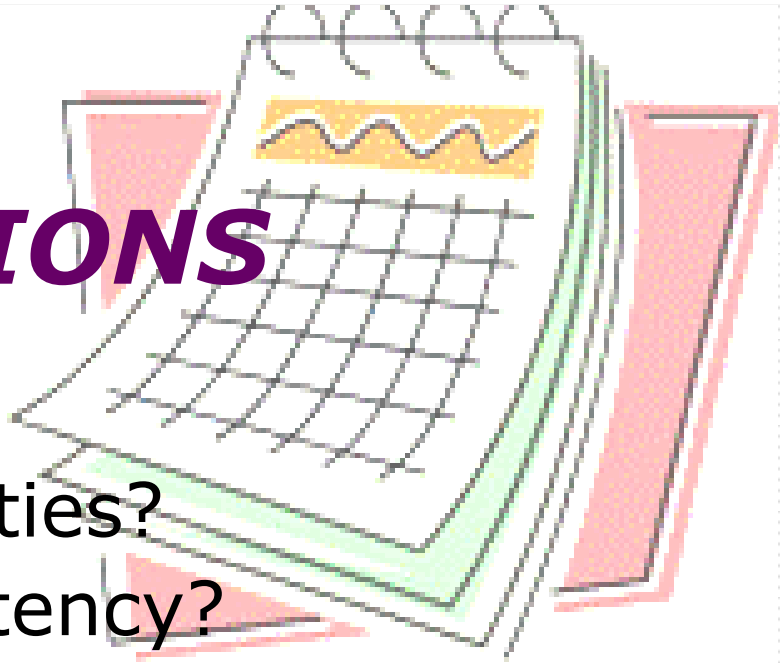
STATUS / QUESTIONS



1. Methods / BMPs?
2. Evidence? Gaps? Priorities?
3. Transferability / Consistency?
4. Policy Progress, Adoption, Barriers
5. Next Steps

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1. ARE THERE BMPS / MEASUREMENT METHODS?

MB/NEI PERSPECTIVES AND MEASUREMENT BMPs

- ❑ ***Program Attribution – Net Three:***
  - *Net Positive & NEGATIVE*
  - *Net beyond standard efficiency*
  - *Net to gross applies*
- ❑ ***Non-Overlapping***
- ❑ ***Consistent Units***
- ❑ ***Discount rates***

Utility	Society	Participant (Res&ICI)	
• Carrying cost on arrearages • Bad debt written off • Shutoffs / Reconnects • Notices; calls, collection costs • Emergency gas service calls (for gas flex connector and other programs) • Insurance savings • Transmission and distribution savings (usually distribution) • Fewer substations, etc. • Power quality / reliability • Reduced subsidy payments (low income) • Other	• Economic development benefits – direct and indirect multipliers • Tax effects • Emissions / environmental (trading values and/ or health / hazard benefits) • Health and safety equipment • Water and waste water treatment or supply plants • Fish / wildlife mitigation • National security • Health care • Other	• Water / wastewater bill savings • Operating costs (non-energy) • Equipment maintenance • Equipment performance (push air better, etc.) • Equipment lifetime • Shutoffs / Reconnects • Property value benefits / selling • (Bill-related) calls to utility • Comfort • Aesthetics / appearance • Fires / insurance damage (gas) • Lighting / quality of light • Noise • Safety	• Control over bill • Understanding / knowledge • "Care" or "hardship" (low income) • Indoor air quality • Health / lost days at work or school • Fewer moves • Doing good for environment • Savings in other fuels or services (as relevant) • GHG and environmental effects • Negatives

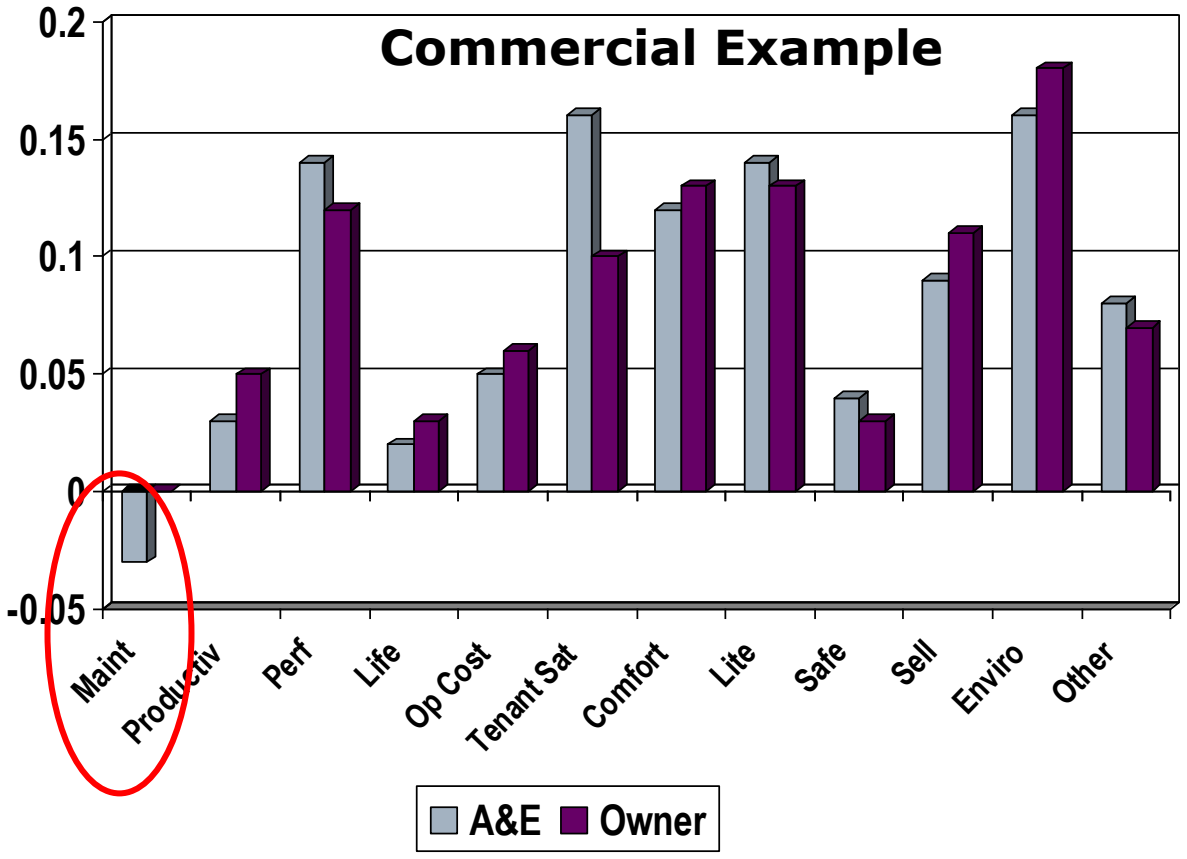
Source: (Skumatz/SERA,1996 on)

NEGATIVES / PERCEIVED COST OF PROGRAM BARRIERS

Residential Example

Negative MB/NEIs	Solar W/H
Appearance	-$14 NZ
Maintenance	-$9 NZ

Implications: Real, important
Design & incentive Implications (rebates, warranties)



Source: Skumatz Economic Research Associates research

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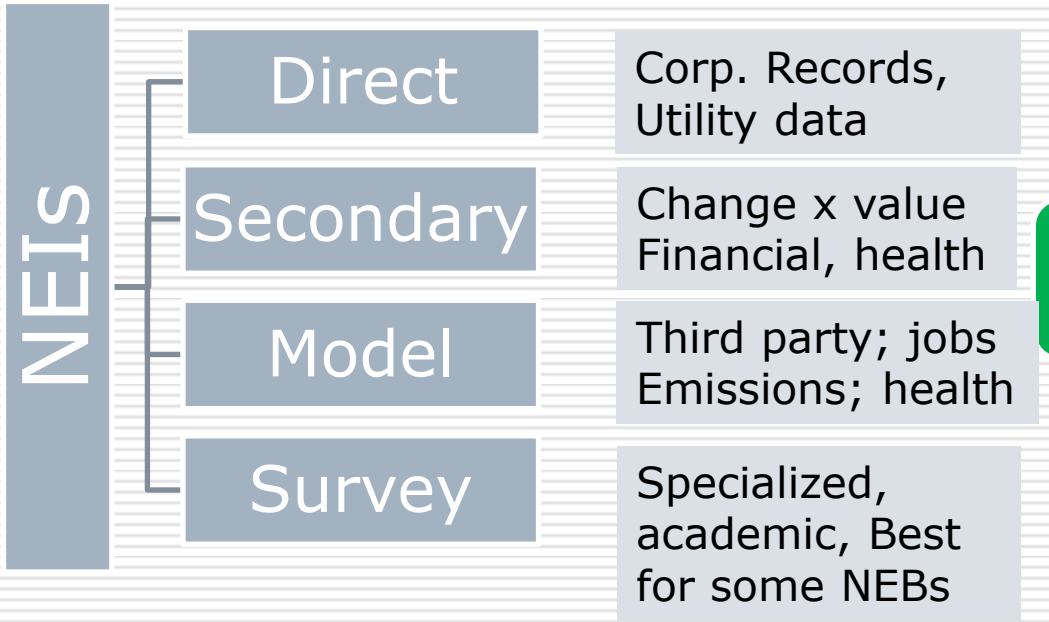
MB/NEI MEASUREMENT – 4 MAIN MEASUREMENT APPROACHES



Story of a ferry… then it is academic

- Established methods, but continual exploration
- Tradeoffs
  - Multiple methods / triangulation commonly used
  - Surveys most appropriate for some
  - Balancing precision, practical – avoid bias / stats / large "N"
  - Accuracy level needed… 80/20 for some applications

Source: Skumatz / SERA research

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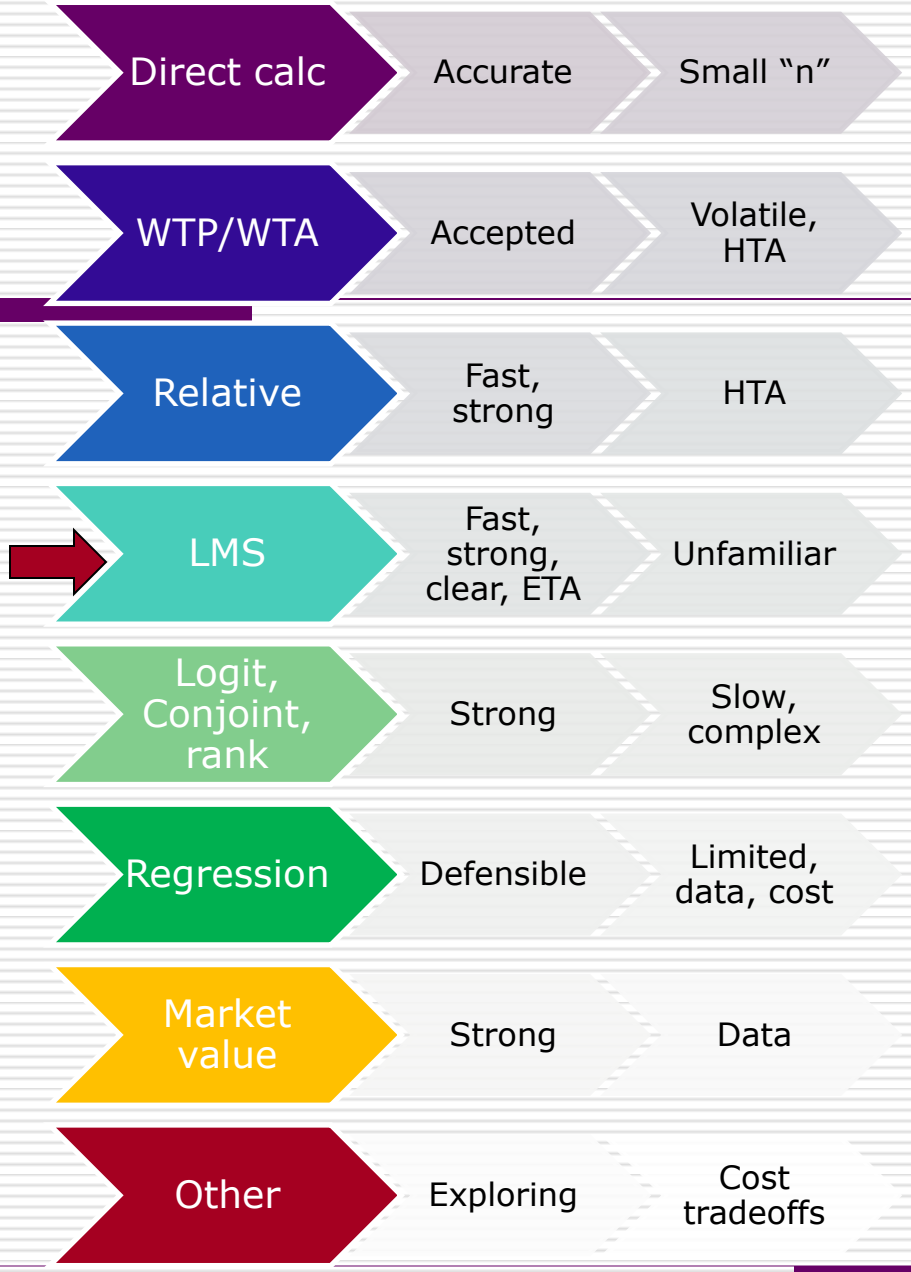
MEASURING PARTICIPANT MB/NEIs

- Best practices:
  - Many survey types - WTP vs. improvements / performance tradeoffs
  - Recommend in process (impact) surveys - barriers.



HTM=Hard to measure; HTA=Hard to answer

Source: SERA Research

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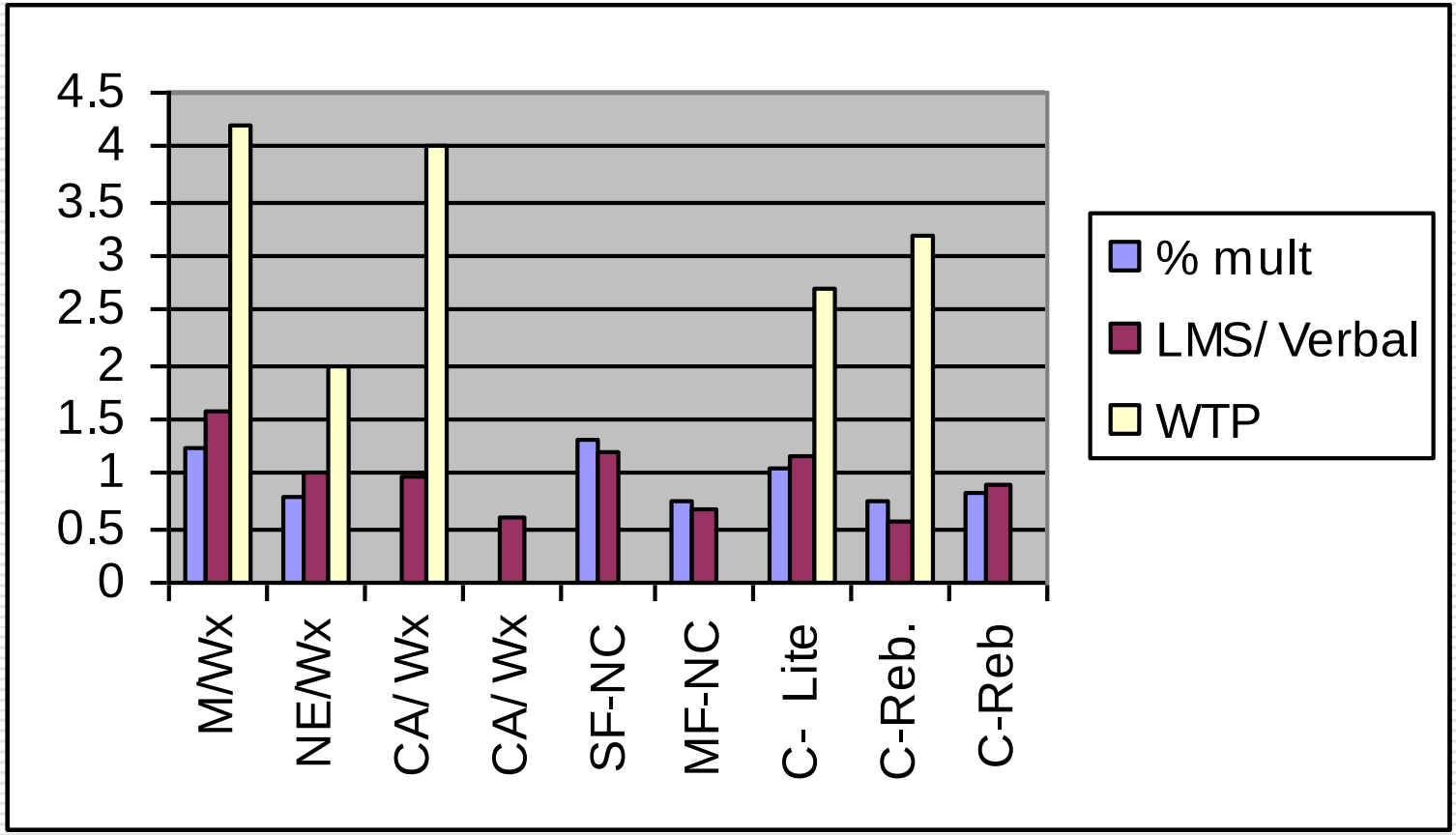
PARTICIPANT MEASUREMENT METHODS COMPARISON



Source: SERA Research

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PROS AND CONS OF MB/NEIS MEASUREMENT METHODS

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

Source: Skumatz / SERA research

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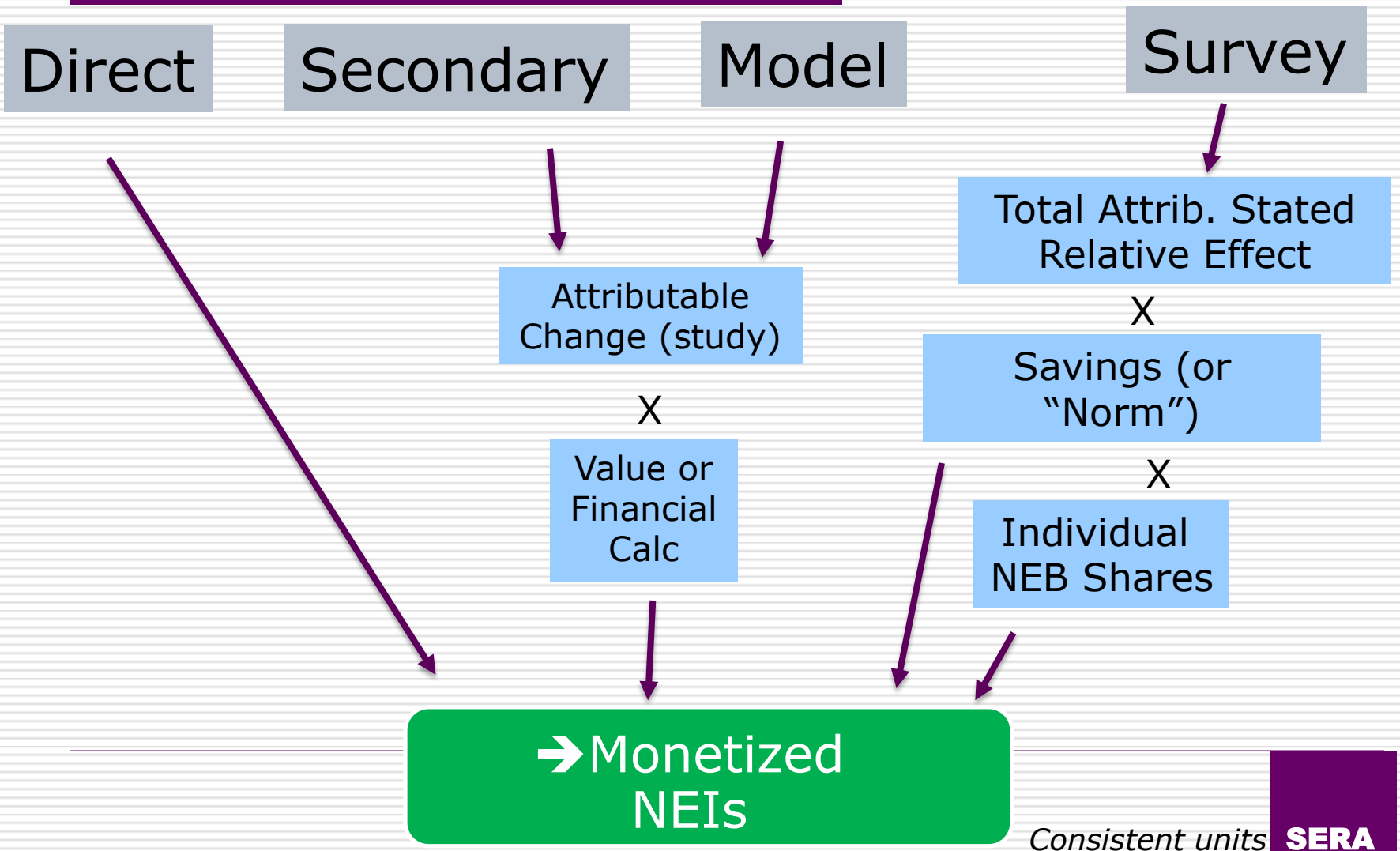
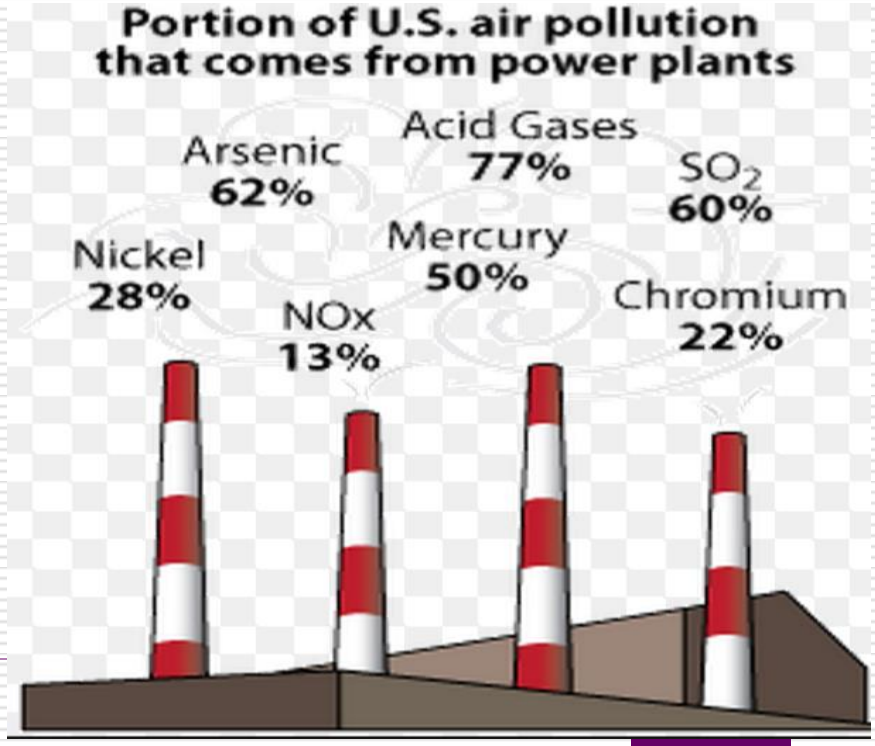
HOW THE MB/NEIs ARE MONETIZED (NEED MONETIZED IN B/C & ROI CALCULATION)



2. EVIDENCE FOR VALUES? GAPS? PRIORITIES?

EMISSIONS (SOCIETAL NEBS)

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



Subtotals by major categories Weatherization Programs	Dollar NEB Values Range Low-High	Typical Value	Percentage NEB Values Range Low-High	Typical Value	Consis- tency	Varies with Pgm Target Audience, et
UTILITY PERSPECTIVE						
Payment-related	$2.55 - $14.50	$6.40	1% - 14.5%	4.7%	*	Pgm
Added if Low Income subsidies avoided	$3.00 - $25.00	$13.00	4% - 29.0%	16.4%	*	Pgm & target
Service Related	$0.10 - $8.50	$3.25	0.1% - 2.7%	0.8%	*	Pgm
Other Primary Utility	$0.13 - $2.60	$1.40	2.1% - 3.3%	2.4%		
TOTAL UTILITY NEBs	$5.78 - $50.60	$24.05	7.4% - 49.5%	24.4%		
UTILITY NEBs MULTIPLIER	3% - 25%	12%				
SOCIETAL PERSPECTIVE						
Economic	$8.00 - $340.00	$115.00	3.0% - 237.6%	31.1%	*	Pgm
Environmental / Emissions	$3.00 - $180.00	$60.00	0.7% - 57.9%	7.1%	**	Ltd variation
H&S equipment / fires	$0.00 - $0.30	$0.00	0.3% - 0.3%	0.0%		Pgm
Health Care	$0.00 - $0.00	$0.00	0.0% - 0.0%	0.0%		Pgm
Water / Wastewater infrastructure	$1.00 - $28.00	$15.00	0.9% - 33.1%	17.0%		Pgm
TOTAL SOCIETAL NEBs	$12.00 - $548.30	$190.00	5.0% - 329.0%	55.3%		
SOCIETAL NEBs MULTIPLIER	6% - 274%	95%				
PARTICIPANT PERSPECTIVE						
Water and Other bills	$2.85 - $54.00	$15.00	4.5% - 63.4%	20.0%	*	Pgm
Financial / customer service	$0.27 - $36.70	$3.60	8.7% - 16.4%	3.4%	*	Pgm & target
Economic Dev'p / Hardship	$0.00 - $115.00	$75.00	26.3% - 55.3%	8.0%		Pgm & target
Equipment Operations	$26.00 - $127.00	$82.00	17.1% - 42.7%	28.4%		Pgm
Comfort, Noise, Related	$26.00 - $105.00	$69.00	12.2% - 51.3%	26.6%	*	Pgm
Health / Safety	$3.02 - $100.50	$16.50	1.5% - 59.5%	12.8%	*	Pgm
Control / Education and Contributions	$26.25 - $177.00	$89.75	19.8% - 72.0%	26.2%	*	Pgm
Home Improvements	$10.50 - $77.00	$36.00	8.3% - 38.4%	18.8%	~	Pgm
Special / reliability / other	$0.00 - $4.05	$0.00	0.0% - 4.8%	0.0%		Ltd, target
TOTAL PARTICIPANT NEBs	$94.89 - $796.25	$386.85	98.5% - 403.8%	144.1%		
PARTICIPANT NEBs MULTIPLIER	47% - 398%	193%				
All NEBs Multipliers: Relative to Bill Savings						
Utillity	3% - 25%	12%	7% - 49%	24%		
Societal	6% - 274%	95%	5% - 329%	55%		
Participant	47% - 398%	193%	99% - 404%	144%		
ALL Multiplers - relative to bill savings	56% - 698%	300%	111% - 782%	224%		
NOTE: Ltd variation for emissions are for peak / off-peak focused programs.						

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VALUE RANGES

- Normalizing issues
- Commercial

		RES Avg $	RES Range (times)	RES Quality (*=low)	RES Other	RES Range (mult)
UTILITY						
	Payment Related	6.4	**+	****		
	If Low Income	13	**	****		
	Service Related	3.25	**+	**		
	Other primary Util	1.4	**	*		
	Total					
SOCIETAL						
	Economic	115	***	*** improvi	Mult: 1.057, .52-.86, 1.64	**+
	Emissions	60	***	****		
	H&S Eqpt/Fires	0	**	*		
	Health Care			*		
	Water/WW Infra	15	**	***		
PARTICIPANT						
	Water/other bills	15	***	***	1.7-1.8, 8, 10, 5, 17, 18	**
	Financial/Pymt/CSF	3.6	******	**		
	Hardship	75	**	*		
	Eqpt Operations	82	*+	**	35, 49, 54, 124, 28, 151	*+
	Comfort, Noise, etc	69	*+	***	31, 41	*
	H&S	16.5	****	*	2-8, 1-6, 6-8	*****
	Control / Educ	90	**	*		
	Home Improvem't	36	**	***	60, 133	**

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

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EXPRESSING NEBS VALUE–Cx

Yellow is highest per category	NEB Value per $1 of gross Cx cost	NEB Value per $1 Cx rebate provided	Benefit per "net" Cx cost ($1)	Benefit per building square foot	Imptc of Cx compared to construct & O&M cost (0-100)
Overall	$1.00	$2.30	$3.10	$0.50	70.5
Respondent Role					
Facility Mgrs	$1.20	$2.80	$4.30	$0.70	79.1
Construction related	$0.90	$1.20	$2.00	$0.40	68.8
A&E	$0.60	$2.90	$0.80	$0.80	62.5
Facil / maint	$0.50	$1.20	$1.10	$0.20	46.7
Building Type					
Office	$2.00	$4.90	$3.40	$1.00	91.3
University	$0.90	$2.00	$4.90	$0.60	70.5
Prison (small sample)	*-$0.40*	*-$0.80*	*-$0.60*		50.0
Other	$0.90	$2.00	$1.70	$0.50	58.0
Business Type					
Gov't / University	$1.10 / $0.80	$2.60 / $1.80	$3.90/$1.70	$0.60 / $0.40	67.5 / 75.0
Systems Commissioned					
HVAC only / More	$1.40 / $0.90	$3.00 / $2.20	$10.50/$1.80	$1.20 / $0.40	79.0 / 67.7
Type of Commissioning					
New / Retrofit	$0.70 / $1.90	$1.60 / $4.70	$2.90/$3.70	$0.50 / $0.70	62.1 / 90.0

Strong value from RetroCx

Source: SERA Research

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PROGRESS / GAPS

- Measure-based NEBs
  - Some measure-based estimates
  - For multi-measure programs – need to sample for measures; until then:
    - Across the board
    - Savings share
    - Regression
- Commercial gaps in multiple measures
  - Strong on lighting; some motors; weak cooking, process

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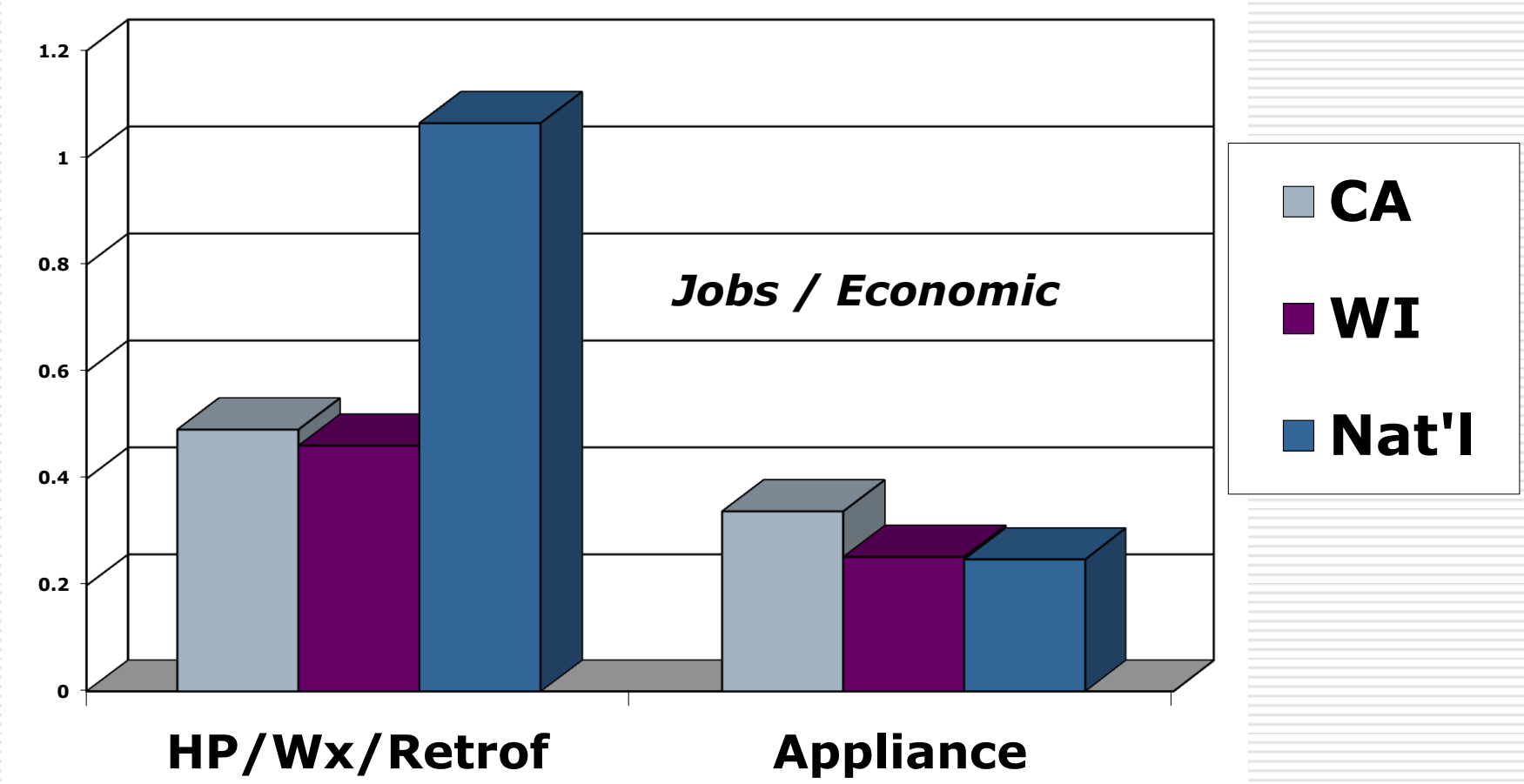
JOBS / ECONOMICS – PROGRAM VARIATIONS



(Source: Skumatz /SERA ECEEE 2007, ACEEE 2006)

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PROGRESS / GAPS

- Gas vs. Electric
  - Some research–commonly program-wide, not disaggregated
  - Limited research finds participant NEBs may 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; Gap.

IEA EVIDENCE / MEASUREMENT SUBCOMMITTEE

- Evidence on Values
  - Health, emissions, jobs / econ, productivity, property values
- …on Applied Measurement methods
  - Measurability issues, overviews, health, GHG modeling progress
- …on Applications, Uses, and Users
  - National health care policy, Firms, planners & outreach, B/C, National economic development…
- … on Transferability
  - Patterns in values; transferability between countries
- … and Assessment of Research Gaps
  - Values, Measurement methods, Applications / uses, Transferability, Underpinnings

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3. TRANSFERABILITY / CONSISTENCY?

CONSISTENCY & TRANSFERABILITY OF MB/NEIs

- US policymakers of two minds:
  - Transferability to save costs, reduce risk; but
  - Relevant to "our" program?

Variability	Relevant NEB Categories
Program / measure invariant (suitable for "adder")	• Environmental / emissions – links to energy savings (varies with generation mix, and local air conditions, and time of day, but not primarily with measures / program)
Program / measure dependent	• Economic – societal (depends on measures and local manufacture / installation) • Health and safety, health care, illnesses – societal and participant (measure) • Water / wastewater infrastructure and water bill savings – societal and participant • Participant benefits including: equipment operations, lifetime, O&M, comfort, noise, control / education, home-improvements. Note: if measure bundles are "similar" participant NEB multipliers are similar in different areas of country.
Climate dependent	• 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.
Residential Target dependent (low income or MF vs. SF) Biz sector	• Payment related – utility (arrearages, etc. stronger for low income targets) • Health and safety, health care, illnesses – societal and participant (higher with chronically ill, vulnerable populations) • Participant benefits related to hardship and payments • Initial information indicates non-low-income NEBs for occupant MFs are similar to SF

Source: Skumatz / SERA research

TRANSFERABILITY –VARIATIONS INTERNATIONALLY?

- Variations in priority topics (e.g. mold)
- Values (major variations in costs like health…)
- Many studies lack clear information on program design features / assumptions for transferability
  - And some studies exclude some MB/NEIs, affecting comparisons
- Not extensively researched (yet);
  - IEA evidence subcommittee

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4. USE IN POLICY – US ADOPTION & BARRIERS

US POLICY FRAMEWORK IS MOSTLY STATE B/C TESTS

- NOT All MB/NEIs should be included
- Since 2002, check marks for which NEBs for each test
- TRC, SCT, etc.

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

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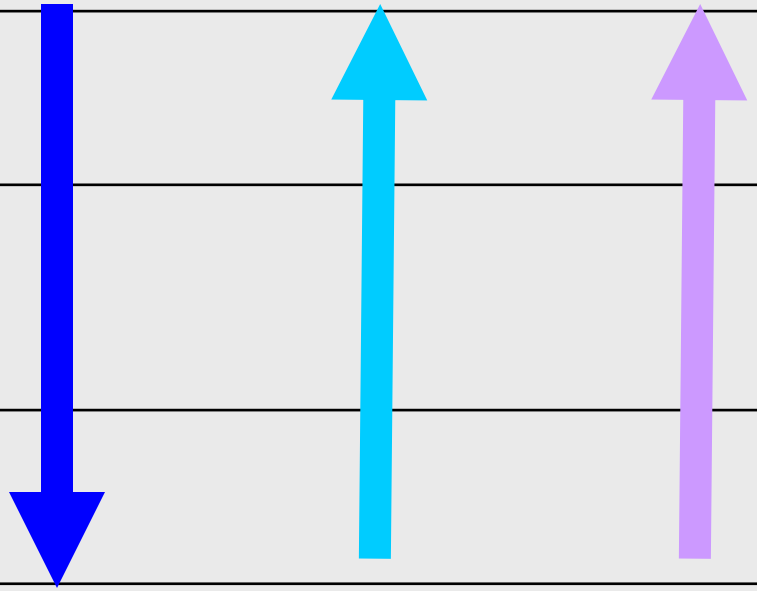
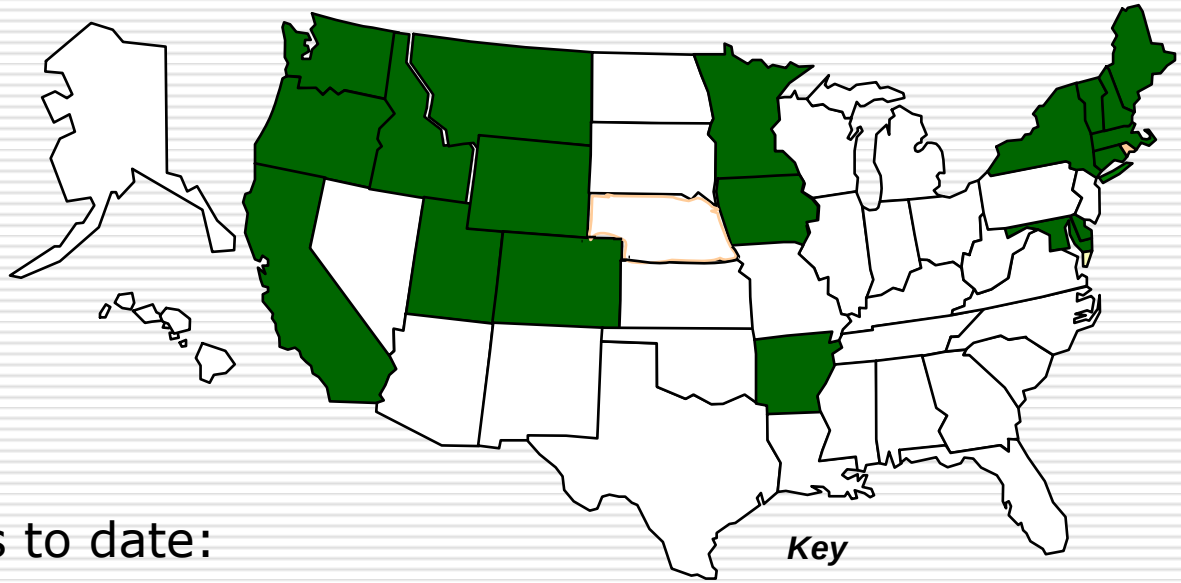
4 MAIN METHODS FOR INCLUDING MB/NEIs IN REGULATORY TESTS

	Maximize DSM opportunities & feedback; Accuracy / tailoring	Minimize Regulatory & Implementer Risk	Minimize Evaluation Cost
Adder			
Readily Measurable			
Hybrid			
All NEBs			



STATES WITH MB/NEIS 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.

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STATE TREATMENT OF NEIs

Regulatory / Screening Application	Utilities / regions	
Program Marketing	Fairly widespread use in utilities / states across the country	
ADDER 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)	
EASILY MEASURED 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 (measureable 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)	MORE AGGRESSIVE ==>
HYBRID	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.	
ALL-IN / 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.	

Source: ©Skumatz Economic Research Associates (SERA); may be used with permission of author

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

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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
- State adoption
  - Numbers, precedent (name an issue)
  - Intervenors / legislation / collaboratives

Source: Skumatz / SERA research

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B/C EQUATION – POLICY FRAMEWORK RISK SOURCES

- B/C=**[PV[NTG*(Sav+NET NEI)*Lifetime]/PV(Cost)…]**

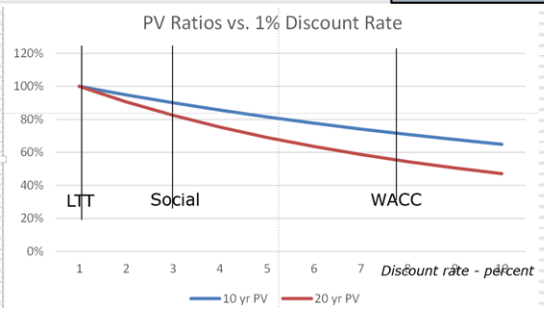
Discount rate: WACC, LT bonds, Societal (1-8+%). Regulatory

NTG – survey, incomplete (FR)

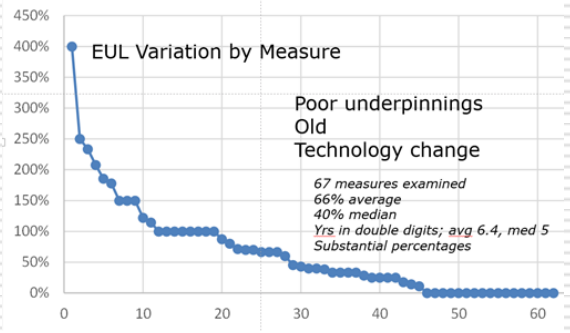
Savings: Impact, protocols, frequent

EUL: 20+ yr old, not well researched, dated technologies, variation

Cost:compllcated, local, changes



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



- Measuring savings with a micrometer – cutting with a chainsaw
- NEIs as accurate as many inputs – relative risk
- Telling a story

Source: Skumatz / SERA Independent research

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FORMAT FOR STATE-LEVEL MB/NEI RECOMMENDATIONS

	Utility	Soc	Part	Conserv. Rec'm	Rationale
Base Percent	X%	X%		X%	Program-invariant (kWh)
Low Income	X%	X%	X%	X%	Policy rationale; mult sources
Weatherization		X%	X%	X%	Substantial Participant & Soc impacts
Measure / Program-specific			X%		Varies by measure, sector
Other Recom's					Local Research

Developing values for multiple states & utilities

Source:
Skumatz / SERA

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5. NEXT STEPS / CONCLUSIONS

IEA EVIDENCE / MEASUREMENT SUBCOMMITTEE

- Members from US, EU (Germany, France, Netherlands, UK, Sweden) and Australia; academics, consulting, industry, government
- Focus of the Subcommittee
  - Consider measurement of all NEBs, not just current ones, and multiple (and improved) measurement methods (primary, secondary, and survey-based)
  - Short term priorities include those relevant for cost-effectiveness & political / program attention (health)
  - Advance research to get MBs well & consistently measured / accepted / well-known AND integrated into program & policy analysis as a matter of routine.
  - Defensible, well-estimated NEB values
  - Documentation and continued progress; library.

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IEA EVIDENCE / MEASUREMENT SUBCOMMITTEE

- Key early activities:
  - Assemble / review / assess existing literature and assemble case studies
  - Matrix of values for sectors, mapping for measures & programs
  - ID where normalized NEBs are transferable (international)
  - Vet new estimation methods
  - Evidence on policy applications / opportunities
  - ID / fill research gaps
- IEPPEC Paper (2016) published reviewing 30 papers, 6 topics (health, emissions, jobs / econ, productivity, property values)

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IEA EVIDENCE / MEASUREMENT SUBCOMMITTEE

- On-going monitoring of international research, metrics, case studies, best practices; stakeholder engagement
- Next Steps in each area
  - Values – ID gaps / "bound" values; political traction, high value; library / resource
  - Measurement methods - next generation methods
  - Applications / uses – inventories underway
  - Transferability – consistency of values; national policy approaches
- Conclusion
  - First literature review by committee; continuing to work toward goals

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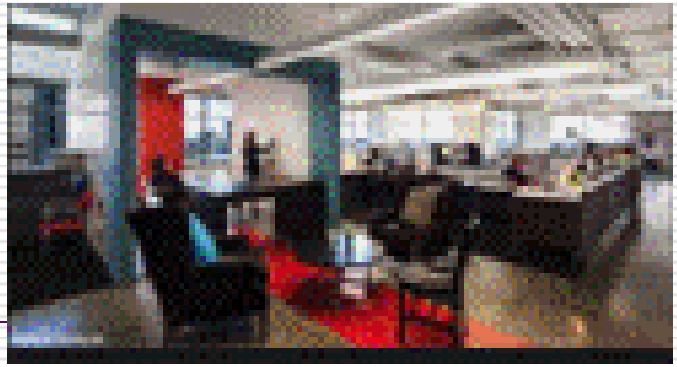
TAKEAWAYS ON MBs / NEIs



1. Defensible methods
2. Available estimates
   - Valuable – many exceed savings
   - Gaps
3. Transferable (depends)
4. Uncertainties acceptable?
   - Relative risk; Benefit-cost
5. Policy progress / State dominos
   - US framework mostly state level; different internationally
6. Next Steps – continued research internationally on topics

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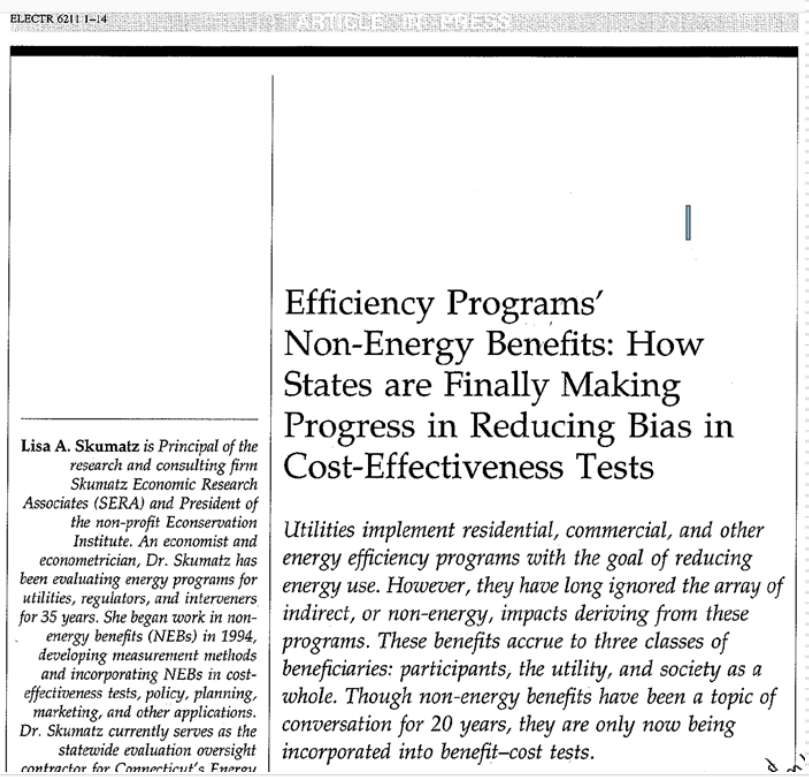
Questions?



ELECTR 6211 1–14 ARTICLE IN PRESS

Efficiency Programs' Non-Energy Benefits: How States are Finally Making Progress in Reducing Bias in Cost-Effectiveness Tests

Utilities implement residential, commercial, and other energy efficiency programs with the goal of reducing energy use. However, they have long ignored the array of indirect, or non-energy, impacts deriving from these programs. These benefits accrue to three classes of beneficiaries: participants, the utility, and society as a whole. Though non-energy benefits have been a topic of conversation for 20 years, they are only now being incorporated into benefit–cost tests.

Lisa A. Skumatz *is Principal of the research and consulting firm Skumatz Economic Research Associates (SERA) and President of the non-profit Econservation Institute. An economist and econometrician, Dr. Skumatz has been evaluating energy programs for utilities, regulators, and interveners for 35 years. She began work in non-energy benefits (NEBs) in 1994, developing measurement methods and incorporating NEBs in cost-effectiveness tests, policy, planning, marketing, and other applications. Dr. Skumatz currently serves as the statewide evaluation oversight contractor for Connecticut's Energy*

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We're developing products and services that enhance customers' productivity and positively impact their energy efficiency

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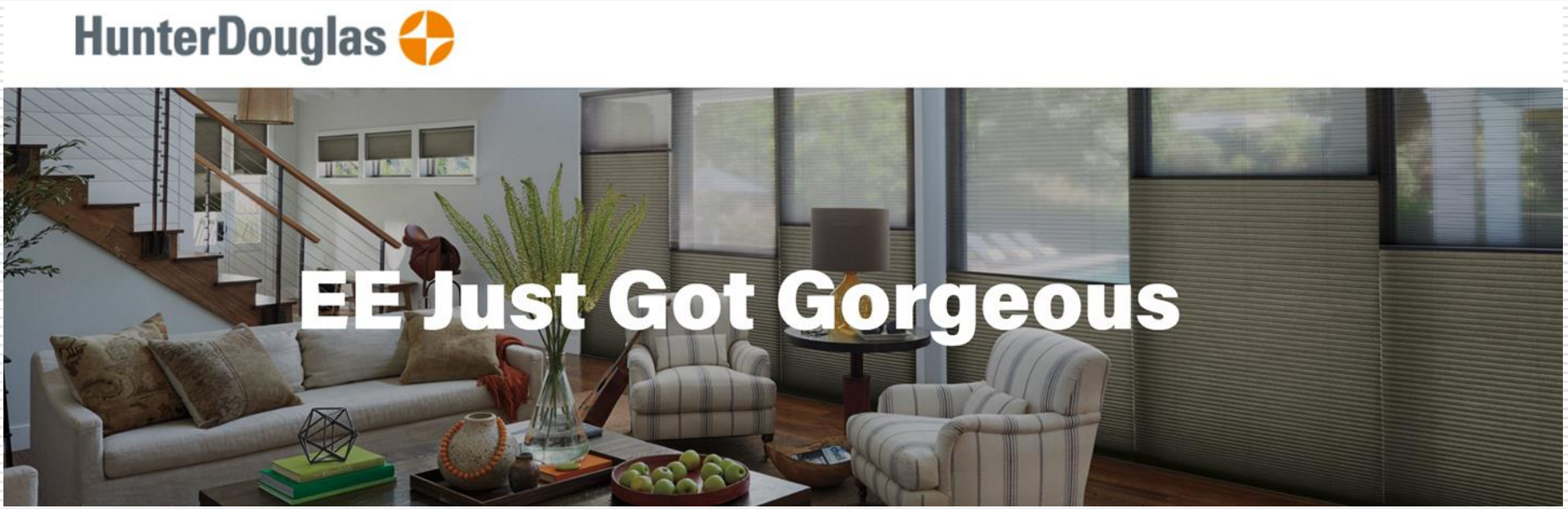
APPEALING BEYOND EE



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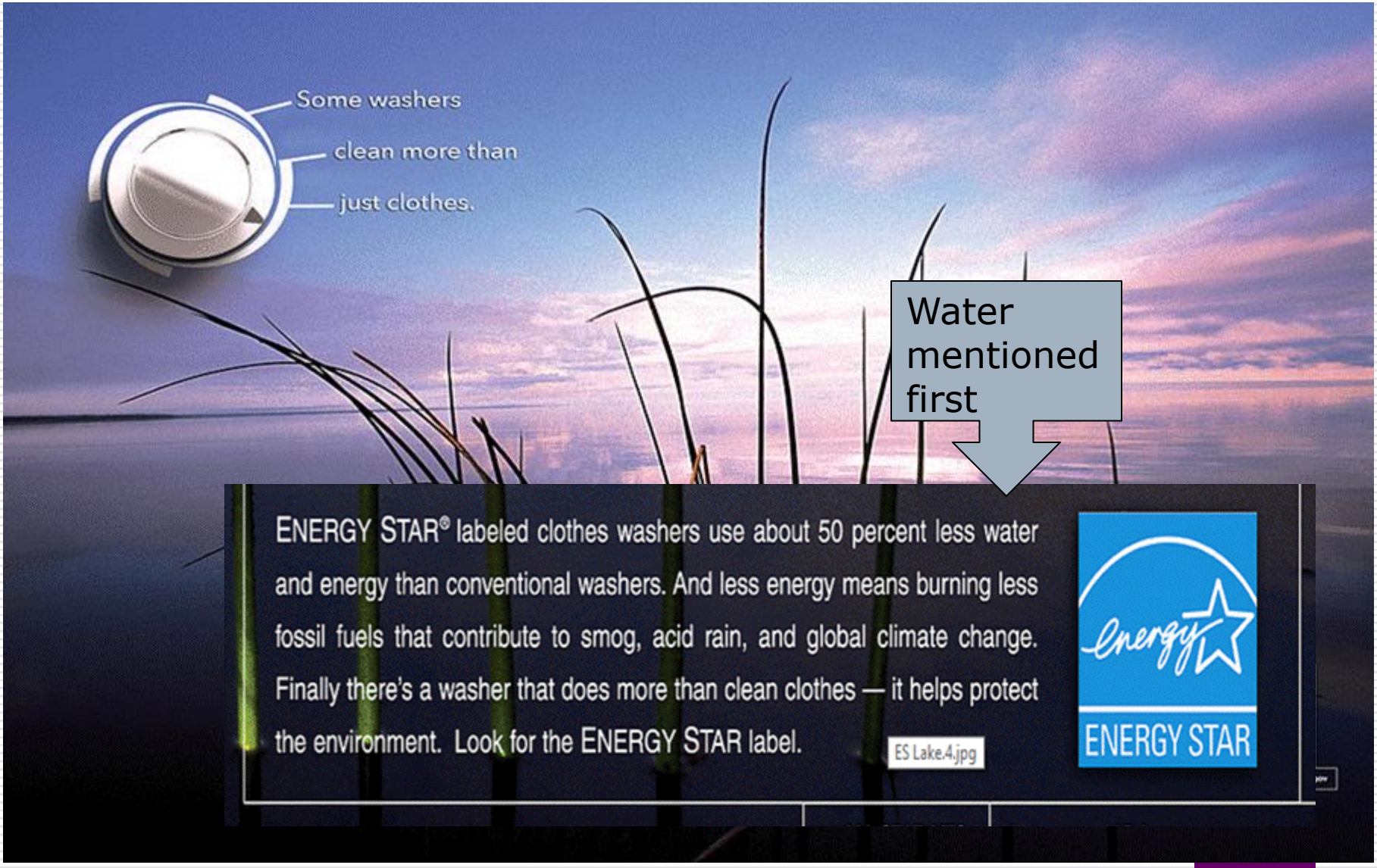
BEYOND EE-"SELLABLE" TO SEGMENTS

BEYOND EE - "SELLABLE" TO SEGMENTS



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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