National Standard Practice Manual

Benefit-Cost Analysis Model Assessment

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National Efficiency Screening Project

Prepared by
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1. INTRODUCTION

Since the publication of the National Standard Practice Manual (NSPM)[1] in 2017, stakeholders have asked whether existing benefit-cost analysis (BCA) models can support use of the NSPM cost-effectiveness (CE) framework. E4theFuture retained Apex Analytics, LLC (Apex) to conduct a high-level assessment of existing BCA models to review their compatibility with the NSPM framework and to identify recommendations for improvements.

Apex identified five prevalent, industry-standard national BCA models[2] for inclusion in this study:

- DSMore (Integral Analytics)
- E3 Calculator (E3)
- ePlan (ANB Systems)
- Portfolio Pro Plus (InTech)
- ProCESS (Navigant)

To conduct the assessment, Apex developed an Excel-based survey that included the following topics, addressed in detail in sections below.

A. How do BCA models treat possible range of impacts identified[3] in NSPM?

B. Can BCA models accommodate the addition of a new, user-defined test?

C. Do BCA models allow for different discount rates by CE test?

Please note that this research focused on readiness of models for NSPM application and did not comprehensively assess many of the other functionalities of BCA models such as alignment with traditional cost-effectiveness tests (i.e., California Standard Practice tests[4]), integrated resource planning, time and locational impacts, and risk assessments.

2. COST-EFFECTIVENESS MODELING WITHIN THE NSPM FRAMEWORK

As described in NSPM background materials[5], there are seven key steps to implementing the Resource Value Framework, as shown in Figure 1 below. The first six steps of these involve stakeholder processes to identify relevant jurisdictional policies and develop a Resource Value Test (RVT). Steps 5 through 7 also focus more on the practical aspects of conducting cost-effectiveness modeling, such as ensuring the analysis is forward-looking and incremental and

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[1] https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf

[2] Models were identified based on E4theFuture and Apex team industry knowledge. This study did not include a thorough identification of all BCA models.

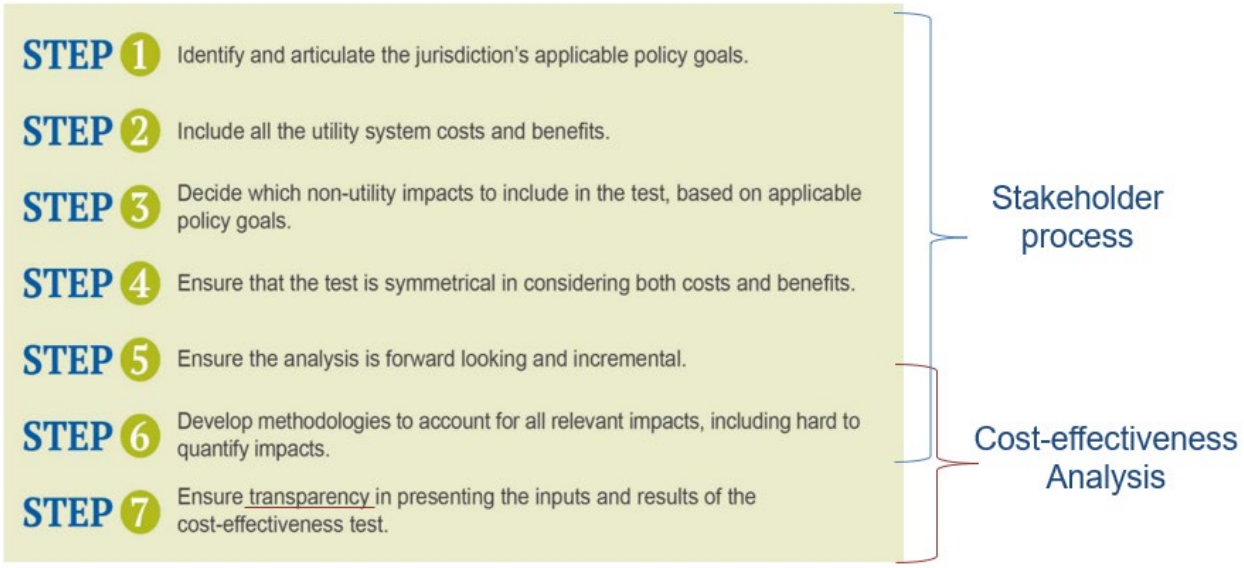
[3] Includes range of utility system impacts, and relevant non-utility system impacts identified in the NSPM, see Appendix 1 for full list.

[4] California Standard Practice Manual http://www.calmac.org/events/SPM_9_20_02.pdf

[5] See NSPM Standard Overview slide deck, April 2019 for summary information: https://nationalefficiencyscreening.org/wp-content/uploads/2019/04/NSPM-Standard-Overview-slide-deck-April-2019.pptx

that methodologies account for all relevant impacts. Step 7 identifies the need for transparency in inputs and results of the cost-effectiveness test, which was a focus of the research in this paper.

Figure 1. Resource Value Framework Steps



As shown in Table 1 below, the RVT perspective is that of regulators and decision-makers, which is a different focus from traditional tests such as the utility cost test (UCT), total resource cost test (TRC) and societal cost test (SCT).

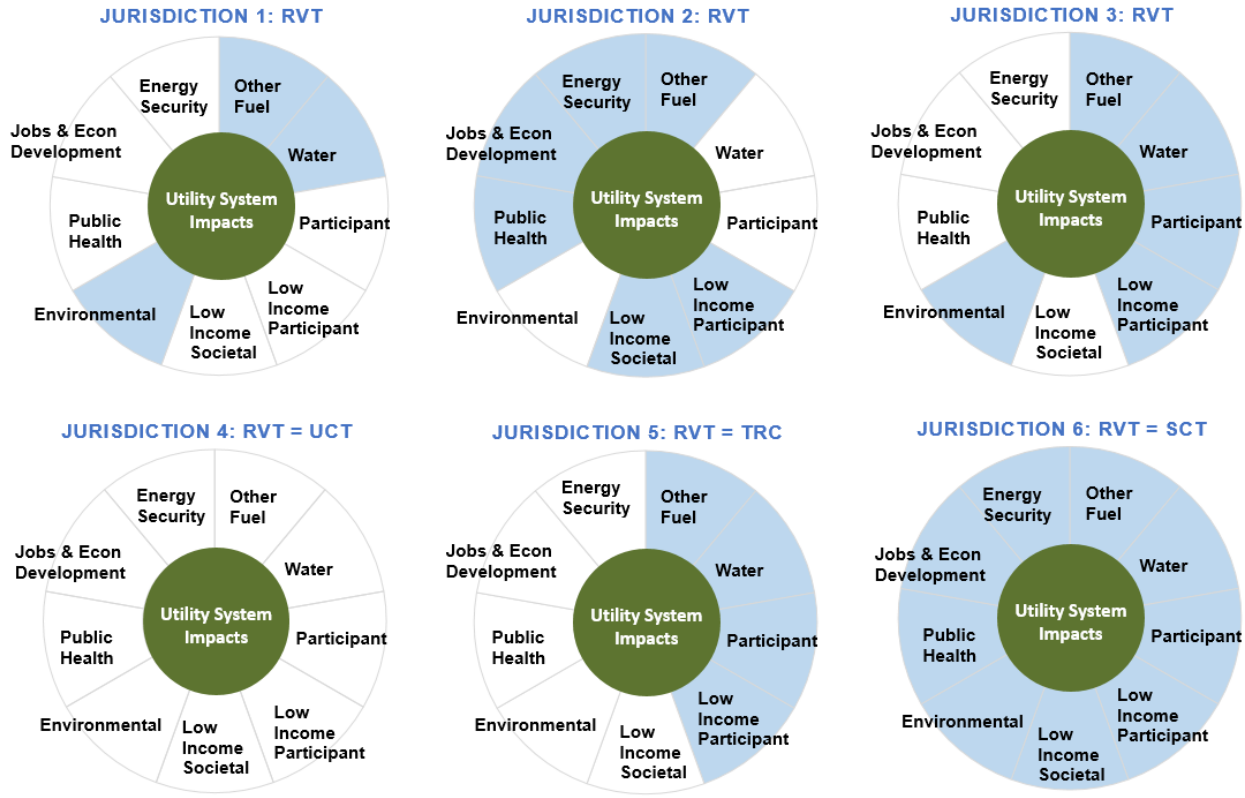
Table 1. RVT and Standard CE Test Perspectives

CE Test	Perspective	Key Question Answered	Categories of Costs and Benefits Included
Utility Cost Test (UCT)	The utility system	Will utility system costs be reduced?	Includes the costs and benefits experienced by the utility system
Total Resource Cost Test (TRC)	The utility system plus participating customers	Will utility system costs plus program participants' costs be reduced?	Includes the costs and benefits experienced by the utility system, plus costs and benefits to program participants
Societal Cost (SCT)	Society as a whole	Will total costs to society be reduced?	Includes the costs and benefits experienced by society as a whole
Resource Value Test	Regulator/decision makers	Will utility system costs be reduced, while achieving applicable policy goals?	Includes the utility system costs and benefits, plus those costs and benefits associated with achieving relevant applicable policy goals

Therefore, as jurisdictions implement the steps described above, it is expected that differences in policies will lead to variation in RVTs. These "jurisdictional-specific RVTs" may align directly with traditional CE tests, or may result in a unique RVT (see Figure 2 below). [6] This is important for BCA modeling because those RVTs that align directly with traditional tests are most likely to be supported well by existing BCA models.

[6] NSPM Standard Overview slide deck, slide 26. https://nationalefficiencyscreening.org/wp-content/uploads/2019/04/NSPM-Standard-Overview-slide-deck-April-2019.pptx

Figure 2. Examples of Jurisdiction-Specific RVTs



For those jurisdictional-specific RVTs that do not follow traditional CE tests, it was not clear how current BCA models could support their unique nature. Therefore, the following sections of this paper outline the findings of the BCA model assessment to understand NSPM alignment.

A. How do models treat possible impacts identified in the NSPM?

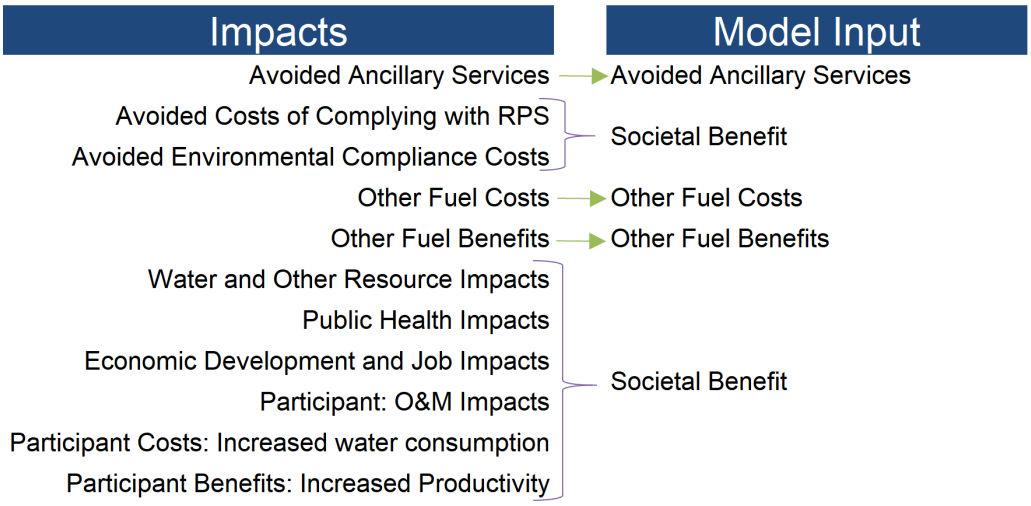
The NSPM outlines a range of possible utility and non-utility impacts for consideration by jurisdictions in developing their RVT (see Appendix 1 for a complete list). To maximize transparency, a BCA model would include, as separate model inputs, all relevant impacts for a jurisdictional-specific RVT.

To understand NSPM-compatibility with various impacts, Apex developed an Excel-based survey that asked the five modelers to identify how their model currently accounts for each of the 52 impacts included in the NSPM checklist using the following types:

- **Direct Treatment**: Each impact has its own direct input in the model as a cost or benefit. This is the ideal incorporation of impacts.
- **Indirect Treatment**: Impacts must be combined with another impact in order to be input into the model. To aggregate impacts, a user would most likely need to conduct pre-processing of inputs in order to normalize the impacts into similar units and aggregate the results into a single impact. This lacks transparency and could require a sophisticated user to conduct the analysis without errors. For example, multiple impacts could be

treated indirectly by combining them into a single category: e.g., societal benefits, as shown in Figure 3.

Figure 3. Example of Indirect Treatment



- **Custom Programming**: Model needs custom programming to address the impact, which is likely the highest cost/effort solution.

The following sections outline the results of the survey[7], based on major categories of impacts: utility system, non-utility and participant impacts.

Utility System Impacts

For utility costs and benefits, Table 2 below shows how the five models treat the various impacts (the width of direct, indirect and custom columns represents the number of models meeting the criteria, where full width represents all five models).

In terms of costs, models typically treat utility costs as direct impacts. For example, all five models use direct inputs for measure costs, program administration costs, evaluation costs and market and outreach costs (i.e., the green bar in the direct column is full). For other financial/technical support costs, two models use indirect treatment and for shareholder/utility incentive costs, one model uses indirect treatment and one uses custom treatment. In terms of utility benefits, all models treat avoided energy, generating and capacity costs directly. Models require more indirect or custom treatment of benefits such as avoided T&D line losses, whole price suppression effects, avoided bad debt and arrearages and increased reliability and resilience.

Therefore, we find that existing models treat utility costs most transparency through direct treatment, while some utility benefits require indirect or custom treatment. Although this research

[7] Please note that Apex used self-reported information from survey responses and did not verify through a detailed assessment of models. In a few instances, Apex reviewed responses and made adjustments; these were sent to modeling staff for review.

is focused on the range of impacts identified in the NSPM, it is worth noting that these impacts are also relevant for standard CE tests. Therefore, transparency through direct treatment may also support standard CE tests as well.

Table 2. Utility Costs and Benefits

Category	Impact	Direct	Indirect	Custom
Utility Costs	**Measure Costs (utility portion)**			
	Other Financial or Technical Support Costs			
	Program Administration Costs			
	Evaluation, Measurement, & Verification			
	Marketing and Outreach			
	Shareholder/Utility Incentive Costs			
Utility Benefits	**Avoided Energy Costs**			
	Avoided Generating Capacity Costs			
	Avoided T&D Capacity Costs			
	Avoided T&D Line Losses - Energy kWh			
	Avoided T&D Line Losses - Peak kW			
	Avoided Ancillary Services			
	Wholesale Energy Price Suppression Effects- Energy kWh			
	Wholesale Energy Price Suppression Effects - Peak kW			
	Avoided Costs of Complying with RPS			
	Avoided Environmental Compliance Costs			
	Avoided Bad Debt, Arrearages, etc.			
	Reduced Risk / Fuel Diversity			
	Increased Reliability and Resilience			

** Impact titles in bold have 3 or more models using direct impacts.*

Non-Utility Impacts

For non-utility costs and benefits, Table 3 shows how the five models treat various impacts. Most models treat other fuel impacts and environmental impacts directly. Impacts associated with water and other resources, public health, economic development and energy security tend to require indirect or custom treatment.

Table 3. Non-Utility Costs and Benefits

Category	Impact	Direct	Indirect	Custom
Other Fuel Impacts	**Other Fuel Costs**			
	Other Fuel Benefits			
Water and Other Resource Impacts	Water and Other Resource Costs			
	Water and Other Resource Benefits			
Environmental Impacts	**Environmental Costs (e.g., Carbon)**			
	Environmental Benefits			
Public Health Impacts	Public Health Costs			
	Public Health Benefits			
Economic Development and Job Impacts	Economic Development and Job Costs			
	Economic Development and Job Benefits			
Energy Security Impacts	Energy Security Costs			
	Energy Security Benefits			

** Impact titles in bold have 3 or more models using direct impacts.*

Therefore, we generally found that existing models have limitations related to direct treatment of non-utility impacts. This could pose a potential limitation to those jurisdictions with specific policy goals related to job creation, or public health, for example. As noted earlier, the ideal approach is for BCA models to treat these impacts directly, but most lack this flexibility and feature. Yet, we also found that although the NSPM checklist identifies environmental costs and benefits as a single impact, many of the models surveyed have more granular impacts included in the model, such as emissions impacts of carbon dioxide, nitrogen oxide and sulfur oxide.

Participant Impacts

For participant costs and benefits, Table 4 shows how the five models treat the various impacts. Participant costs are treated directly for most models in the categories of measure costs, operations and maintenance (O&M), other fuel consumption and increased water consumption; financial costs and transaction costs are more frequently treated as indirect impacts. For participant benefits, direct treatment is typically used for reduced bills, O&M, other fuel consumption and avoided and deferred equipment replacement costs. Yet, many other participant benefit types, including comfort, health and safety, productivity and property improvements are treated indirectly. Similar to non-utility impacts above, we find this to be a limitation to transparency and flexibility, and potentially a barrier to symmetrical treatment of impacts as well.

Table 4. Participant Costs and Benefits

Category	Impact	Direct	Indirect	Custom
Participant Costs	**Measure Costs (customer portion)**			
	Financial Costs (customer portion)			
	Transaction Costs			
	Increased O&M Costs			
	Increased Other Fuel Consumption			
	Increased Water Consumption			
Participant Benefits	**Reduced Bills**			
	Reduced O&M Costs			
	Increased Comfort			
	Increased Health & Safety			
	Increased Productivity			
	Improved Aesthetics			
	Property Improvements			
	Reduced Other Fuel Consumption			
	Reduced Water Consumption			
	Additional Benefits for Low-Income Customers			
	Avoided & Deferred Equipment Replacement Costs			
Low Income Customer Impacts	Low Income Customer Cost			
	Low Income Customer Benefits			

** Impact titles in bold have 3 or more models using direct impacts.*

In summary, none of the surveyed models had all impacts listed in the NSPM as a direct input in the model. One surveyed model allows users to create new costs and benefits to include in cost-effectiveness modeling, so this model had the most flexible treatment of impacts. Generally, models tended to have direct impacts for those associated with traditional CE tests, such as utility costs, other fuel impacts and environmental impacts. Yet, many impacts required indirect treatment and some impacts required custom programming. Although indirect treatment allows for all relevant impacts to be included in models, as noted above, indirect treatment likely requires off-system processing of information to normalize the data into common units and aggregate into a single factor. This can require a sophisticated user and can lack transparency.

B. Can the model accommodate the addition of a new, user-defined test?

Given the potential for unique RVTs by jurisdiction (i.e., where an RVT doesn't align with standard tests, Figure 2 above), it would be ideal for users to define their RVT's relevant impacts and have the model return an associated cost-effectiveness test labeled as RVT (or another user defined-name). Figure 4 shows this conceptually. First, for each impact (e.g., measure costs, program administration costs, participant benefits, etc.), the user would decide if it is included in the unique RVT test. Then, after data input and analysis, the model would return RVT test results in addition to other traditional CE test outputs. This is shown on the right-hand side of the figure, where the jurisdiction-specific RVT result is provided as well as standard CE test outputs, such as UTC, TRC, and SCT.

Figure 4: Conceptual Accommodation of a New, User-Defined Test[8]

Impact Category	Include in RVT?
Measure Costs	Yes
Program Administration Costs	Yes
Avoided Environmental Compliance Costs	No
Avoided Ancillary Services	Yes
Other Fuel Impacts	Yes
Water and Other Resource Impacts	No
Public Health Impacts	No
Economic Development and Job Impacts	No
Participant Costs: Increased O&M Costs	Yes
Participant Costs: Increased water consumption	Yes
Participant Benefits: Reduced O&M	Yes
Participant Benefits: Increased Comfort	Yes
Participant Benefits: Increased Productivity	Yes

Data input and analysis

CE Test	Result
Jurisdiction-Specific Resource Value Test (RVT)	**1.4**
Total Resource Cost Test (TRC)	**1.3**
Societal Cost Test (SCT)	**1.6**
Utility Cost Test (UCT)	**1.2**

Currently, two models have the capability for users to define which impacts are included in a user-defined test and return associated results.

For those models that do not currently have the capability for a user-defined test, a sophisticated user would likely leverage one of the other traditional tests to model the jurisdiction's RVT. This would require that a user manually include only the relevant RVT impacts in the test and remember which traditional test was used for modeling the RVT. For example, if a user decided to model the RVT using the Societal Cost Test[9], then the user would input the RVT-associated impacts (which may not include all societal impacts, depending on jurisdiction policies) and discount rates into the model. Then, the model would return the RVT outputs, but it may be labeled as SCT. Although this would function to model a jurisdiction-specific RVT, it lacks transparency. Another option is for a user to conduct post-processing on modeling outputs to create an RVT test; this also requires a sophisticated user and can lack transparency.

[8] Values are illustrative and do not reflect actual BCA modeling.

[9] Because the Societal Cost Test includes all utility and non-utility costs and benefits, it would most likely be used as the proxy test for a jurisdiction-specific RVT. This provides the most flexibility for modeling purposes but requires a user to exclude non-relevant impacts in the modeling.

C. Do models allow for different discount rates by CE test?

To provide flexibility and transparency, it is ideal if BCA models allow users to define unique discount rates for different CE tests. For example, it's possible that a regulatory-focused test such as the RVT could use a different discount rate than a utility cost test.

Based on the Apex survey of BCA models, four of five models have the ability to model different discount rates for different cost-effectiveness tests. For the single model that does not have this capability, a user would likely have to run different model scenarios with different discount rates.

3. SUMMARY

Overall, we find that it's possible to model unique RVTs in existing BCA models. Yet, we also found that models tend to lack the flexibility to assess RVTs in a transparent way. That is, in most models, users must combine multiple impacts into a single input (i.e., indirect treatment) and a unique RVT test result is not returned by the model. These barriers can be overcome using pre-processing of impacts, leveraging other test categories or post-processing of outputs. Yet, these actions can lack transparency and can require sophisticated users to avoid errors.

This assessment did find two models with flexibility to support NSPM compatibility. These models allow a user to define a jurisdiction-specific RVT and one of these models allows the user to define new impacts to be included in the model (thereby treating nearly all impacts as direct).

Based on this analysis, we suggest the following adjustments to some BCA models could enhance flexibility and transparency:

- **Models should add a wider range of discrete impact options.** Ideally, impacts associated with a jurisdiction-specific RVT should be modeled directly and not require pre-processing. Yet, we also realize that this is a balance, as more model inputs add complexity.
- **Models should allow for a user-defined RVT test.** Ideally, users could select which inputs are included in their jurisdiction-specific RVT, and associated model results would be separate from other, traditional CE tests.

Additionally, we find that the NSPM could support the modeling industry by refreshing and prioritizing the list of possible impacts for models to include. For example, which impacts (i.e. utility system, non-utility system, participant) represent the largest of majority of magnitude of value, which others less so. Also, environmental impacts could be more clearly specified, and some impact categories may need adjustment, clarification or revision. Finally, there is also opportunity to expand this research to conduct deeper assessments of individual models and identify how the models treat distributed energy resources.

APPENDIX 1: CE CHECKLIST

Energy Efficiency Cost-Effectiveness Testing Check List

Indicate with an X which costs and benefits are accounted for in current utility CE testing analysis. Available at the NESP website.[10]

A. Utility System Costs		B. Utility System Benefits	
Measure Costs (utility portion)		Avoided Energy Costs	
Other Financial or Technical Support Costs		Avoided Generating Capacity Costs	
Program Administration Costs		Avoided T&D Capacity Costs	
Evaluation, Measurement, & Verification		Avoided T&D Line Losses	
Marketing and Outreach		Avoided Ancillary Services	
Shareholder/Utility Incentive Costs		Wholesale Energy Price Suppression Effects	
Other – describe		Avoided Costs of Complying with RPS	
		Avoided Environmental Compliance Costs	
		Avoided Bad Debt, Arrearages, etc.	
		Reduced Risk / Fuel Diversity	
		Increased Reliability and Resilience	
		Other - describe	
C. Non-Utility System Costs		**D. Non-Utility System Benefits**	
*Participant Costs (see below)		* Participant Benefits (see below)	
Low-Income Customer Costs		Low-Income Customer Benefits	
Other Fuel Costs		Other Fuel Benefits	
Water and Other Resource Costs		Water and Other Resource Benefits	
Environmental Costs		Environmental Benefits	
Public Health Costs		Public Health Benefits	
Economic Development and Job Costs		Economic Development and Job Benefits	
Energy Security Costs		Energy Security Benefits	
Other – describe		Other – describe	
F. Other Qualitative Impact Considerations (describe if not monetized)			
Economic Development and Job Impacts			
Market Transformation Impacts			
Other Qualitative Impacts			
***Participant Impacts**			

[10] NSPM Template Cost-Effectiveness Results Reporting Table
https://nationalefficiencyscreening.org/resources/templates/

Costs		Benefits	
Measure Costs (customer portion)		Reduced Bills (often an avoided utility system costs)	
Financial Costs (customer portion)		Reduced O&M Costs	
Transaction Costs		Increased Comfort	
Increased O&M Costs		Increased Health & Safety	
Increased Other Fuel Consumption		Increased Productivity	
Increased Water Consumption		Improved Aesthetics	
Other – describe		Property Improvements	
		Reduced Other Fuel Consumption	
		Reduced Water Consumption	
		Additional Benefits for Low-Income Customers	
		Avoided & Deferred Equipment Replacement Costs	
		Other - describe	