National Standard Practice Manual

for Assessing Cost-Effectiveness of Energy Efficiency Resources

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NATIONAL EFFICIENCY SCREENING PROJECT

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for Assessing Cost-Effectiveness of Energy Efficiency Resources

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Prepared by
The National Efficiency Screening Project

The National Efficiency Screening Project

The National Efficiency Screening Project (NESP) is a group of organizations and individuals working to update and improve the way that utility customer-funded electricity and natural gas energy efficiency resources are assessed for cost-effectiveness and compared to other resource investments. This National Standard Practice Manual (NSPM) is a publication of the NESP.

The NSPM builds on the 2014 NESP publication *The Resource Value Framework – Reforming Energy Efficiency Cost Effectiveness Screening*, a foundational document that presented a first version of the Resource Value Framework. The NESP and 2014 publication, through the emergence of this NSPM, was managed and supported by the Home Performance Coalition, and is currently coordinated by E4TheFuture. We acknowledge the generous funding support over the years that made this project and report possible: the MacArthur Foundation, the United States Department of Energy, and E4TheFuture.

The NSPM, and related materials from the NESP, are available at: https://nationalefficiencyscreening.org

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Abstract

This National Standard Practice Manual (NSPM) is intended to provide a comprehensive framework for assessing the cost-effectiveness of energy efficiency resources. The manual is directly applicable to all types of electric and gas utilities and jurisdictions where energy efficiency resources are funded by and implemented on behalf of electric or gas utility customers. The intended audience are those involved in assessing the cost-effectiveness of energy resources, including regulators, utilities, program administrators, energy resource planners, consumer advocates, and other stakeholders.

The NSPM provides guidance that incorporates lessons learned over the past 20 years, responds to current needs, and addresses and takes into account the relevant policies and goals of each jurisdiction undertaking efficiency investments.

The NSPM presents an objective and neutral Resource Value Framework that can be used to define a jurisdiction's *primary* cost-effectiveness test, which is referred to as a Resource Value Test. The Resource Value Framework is based on six principles that encompass the perspective of a jurisdiction's applicable policy objectives, and it includes and assigns value to all relevant impacts (costs and benefits) related to those objectives.

The NSPM also provides information, guidance, and templates that support the selection of components of a jurisdiction's Resource Value Test (e.g., the range of costs and benefits to consider and appropriate discount rates), the application of such tests (e.g., defining of analysis periods), and the documentation of the relevant policies as well as quantification of relevant costs and benefits. The NSPM also addresses the use of secondary tests in addition to a primary Resource Value Test.

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Executive Summary

Assessing the cost-effectiveness of energy resources such as efficiency involves comparing the costs and benefits of such resources with other resources that meet energy and other applicable objectives. Historically, energy efficiency (EE) has been assessed through integrated resource planning processes or via standard tests defined in the California Standard Practice Manual (CaSPM). These assessments entail comparing the cost of EE resources to forecasts of avoided supply-side resources and other relevant costs and benefits. This National Standard Practice Manual (NSPM) builds and expands upon the decades old CaSPM, providing current experience and best practices with the following additions:

- Guidance on how to develop a jurisdiction's primary cost-effectiveness test that meets the applicable policy goals of the jurisdiction.[1] The guidance also addresses the difficulties jurisdictions have had in consistently implementing concepts presented in the CaSPM.
- Information on the inputs and considerations associated with selecting the appropriate costs and benefits to include in a cost-effectiveness test and accounting for applicable hard-to-monetize costs and benefits, with guidance on a wide range of fundamental aspects of cost-effectiveness analyses.

The NSPM presents:

- **Universal Principles** for developing and applying cost-effectiveness assessments.
- **A step-by-step Resource Value Framework** for jurisdictions to use to develop their primary cost-effectiveness test: **the Resource Value Test (RVT)**, which addresses all of the traditional components of cost-effectiveness testing – but with explicit consideration of the specific policy framework for the particular jurisdiction.
- **Neutral, objective guidance and foundational information** for selecting and quantifying the components of a jurisdiction's test(s), and for applying and documenting the policies and data that were used to define the test, building on lessons learned over the past 20 years and responding to current needs.

The NSPM is relevant to all types of electric and gas utilities, including: investor-owned utilities, publicly owned utilities, federal power authorities, and cooperatives, as well as to any jurisdiction where EE resources are funded and implemented on behalf of electric or gas utility customers.

While this NSPM focuses on the assessment of utility EE resources, the core concepts—including the principles described in Chapter 1 and the Resource Value Framework ('the Framework') described in Chapter 2—can generally be used to assess the cost-effectiveness of supply-side resources or distributed energy resources (DERs).

ES.1 Universal Principles

A unique attribute of the NSPM, and embedded in the Resource Value Framework, is a set of universal principles to follow when developing an RVT for any particular jurisdiction. These principles, provided in Table ES-1, represent sound economic and

[1] The NSPM uses the term "jurisdiction" broadly to encompass states, provinces, federal power authorities, municipalities, cooperatives, etc.

regulatory practices, and are consistent with the input received from a broad range of stakeholders during the development of this manual.

Table ES-1. Universal Principles

Efficiency as a Resource	EE is one of many resources that can be deployed to meet customers' needs, and therefore should be compared with other energy resources (both supply-side and demand-side) in a consistent and comprehensive manner.
Policy Goals	A jurisdiction's primary cost-effectiveness test should account for its energy and other applicable policy goals and objectives. These goals and objectives may be articulated in legislation, commission orders, regulations, advisory board decisions, guidelines, etc., and are often dynamic and evolving.
Hard-to-Quantify Impacts	Cost-effectiveness practices should account for all relevant, substantive impacts (as identified based on policy goals,) even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value.
Symmetry	Cost-effectiveness practices should be symmetrical, where both costs and benefits are included for each relevant type of impact.
Forward-Looking Analysis	Analysis of the impacts of resource investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of the subject resources as compared to the costs and benefits that would occur absent the resource investments.
Transparency	Cost-effectiveness practices should be completely transparent, and should fully document all relevant inputs, assumptions, methodologies, and results.

ES.2 Resource Value Framework

The Resource Value Framework is used to construct a jurisdiction's primary cost-effectiveness test, the RVT, using a series of seven steps that define the framework. In some cases, the steps align directly with one of the universal principles.

The Framework encompasses the perspective of a jurisdiction's applicable policy objectives, and it includes and assigns value to all relevant impacts (costs and benefits) related to those objectives. The NSPM refers to this as the 'regulatory' perspective, which is intended to reflect the important responsibilities of institutions, agents, or other decision-makers authorized to determine utility resource cost-effectiveness and funding priorities. This perspective flows from the notion that determining whether a resource has benefits that exceed its costs requires clarity about the purpose of the resource investment decision.

> **Regulators/decision-makers** refers to institutions, agents, or other decision-makers that are authorized to determine utility resource cost-effectiveness and funding priorities. Such institutions or agents include public utility commissions, legislatures, boards of publicly owned utilities, the governing bodies for municipal utilities and cooperative utilities, municipal aggregator governing boards, and more.

The NSPM further provides information, templates, and examples that can support a jurisdiction in applying the universal principles, and also in constructing appropriate tests in a structured, logical, and documented manner that meets the specific interests and needs (as defined by policies) of the jurisdiction. The seven steps of the Framework are summarized in Figure ES-1 below.

Figure ES-1. Resource Value Framework Steps

STEP 1 Identify and articulate the jurisdiction's applicable policy goals.

STEP 2 Include all the utility system costs and benefits.

STEP 3 Decide which non-utility impacts to include in the test, based on applicable policy goals.

STEP 4 Ensure that the test is symmetrical in considering both costs and benefits.

STEP 5 Ensure the analysis is forward looking and incremental.

STEP 6 Develop methodologies to account for all relevant impacts, including hard to quantify impacts.

STEP 7 Ensure transparency in presenting the inputs and results of the cost-effectiveness test.

ES.3 Resource Value Test

The RVT is the primary cost-effectiveness test designed to represent a regulatory perspective, which reflects the objective of providing customers with safe, reliable, low-cost energy services, while meeting a jurisdiction's other applicable policy goals and objectives. As described in detail within the NSPM, each jurisdiction can develop its own RVT using the Resource Value Framework.

The RVT focus on the regulatory perspective differs from the three most common CaSPM traditional tests—the Utility Cost Test (UCT), Total Resource Cost (TRC) test and Societal Cost Test (SCT). These tests provide the perspective of the utility, the utility and participants, and society as a whole, respectively.

The RVT and Secondary Tests

The RVT serves as a primary test which assesses cost-effectiveness of efficiency resources relative to a jurisdiction's applicable policy goals that are under the purview of the jurisdiction's regulators or other decision-makers. However, there can be value in assessing cost-effectiveness of efficiency resources from perspectives represented by other tests. Among the potential purposes of using additional tests are:

- To inform decisions regarding how much utility customer money could or should be invested to acquire cost-effective savings;
- To inform decisions regarding which efficiency programs to prioritize if not all cost-effective resources will be acquired;
- To inform efficiency program design; and/or
- To inform public debate regarding efficiency resource acquisition.

Depending on a jurisdiction's energy and other applicable policy goals, the resulting RVT may or may not be different from the traditional cost-effectiveness tests. Put another way, it is possible for a jurisdiction's applicable policy goals to align with one of the traditional CaSPM tests, in which case its RVT will be identical to one of those tests. However, it is also possible—and indeed likely in many cases—that a jurisdiction's energy and other policy goals will not align well with goals implicit in any of the traditional tests. In such cases, the RVT will be different than all the traditional tests.

Furthermore, each jurisdiction's RVT can be unique, where the categories of impacts included in the RVT can vary across jurisdictions and/or over time. This is because the impacts are based on each jurisdiction's policy concerns, which can and do vary. *In contrast, the traditional UCT, TRC, and SCT tests are conceptually static; they do not change geographically or over time if applied in their purest conceptual form.* Table ES-2 compares the RVT with the CaSPM tests.

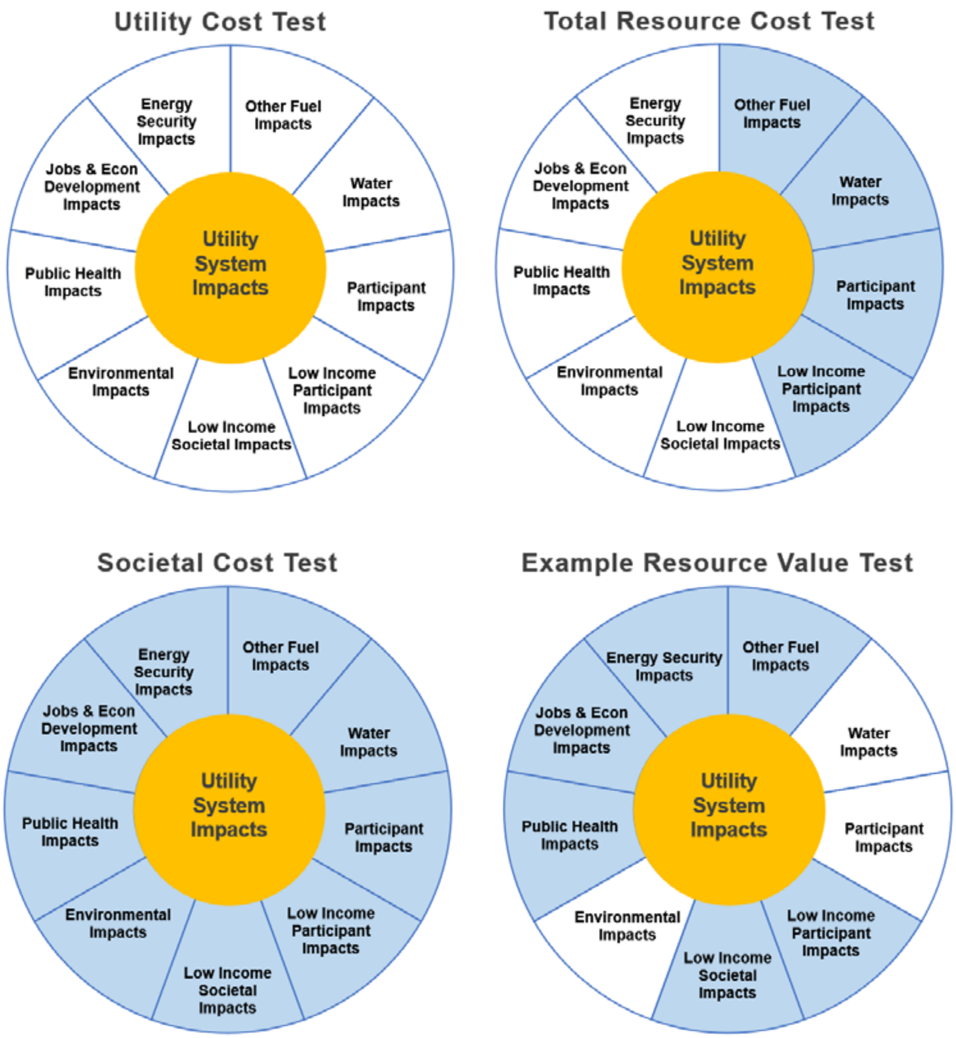
Table ES-2. Comparison of RVT with the Traditional CaSPM Tests

Test	Perspective	Key Question Answered	Categories of Costs and Benefits Included
Utility Cost Test	The utility system	Will utility system costs be reduced?	Includes the costs and benefits experienced by the utility system
Total Resource Cost Test	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	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

In those cases where a jurisdiction's policy goals align with one of the other tests, the RVT will be the same as that other test. This is discussed in Chapter 4.

Figure ES-1 compares the traditional cost-effectiveness tests to one that is developed using the Resource Value Framework. The gold circle in the center represents the utility system impacts, which should be included in any cost-effectiveness test. The sections around the circles represent non-utility system impacts that jurisdictions can choose to include in their primary test. Three of the circles indicate the impacts that would be included using the traditional cost-effectiveness tests. The fourth circle indicates a different set of impacts that would be included by a jurisdiction whose policies suggest accounting for other fuel impacts, low-income impacts, public health impacts, jobs and economic development, and energy security.

Figure ES-1. Examples of Primary Tests that Jurisdictions Could Develop Using the Resource Value Framework



To support the core principle to transparently document cost-effectiveness practices, this NSPM presents an RVT template, shown in Table ES-3, to assist jurisdictions in documenting assumptions and results of their analysis. More detail with examples is provided in Part I of the NSPM.

Table ES-3: Efficiency Cost-Effectiveness Reporting Template

Program/Sector/Portfolio Name:		Date:	
A. Monetized Utility System Costs		**B. Monetized 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	
Shareholder Incentive Costs		Energy Price Suppression Effects	
		Avoided Costs of Complying with RPS	
		Avoided Environmental Compliance Costs	
		Avoided Bad Debt, Arrearages, etc.	
		Reduced Risk	
Sub-Total Utility System Costs		**Sub-Total Utility System Benefits**	
C. Monetized Non-Utility Costs		**D. Monetized Non-Utility Benefits**	
Participant Costs	*Include to the extent these impacts are part of the RVT.*	Participant Benefits	*Include to the extent these impacts are part of the RVT.*
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	
Sub-Total Non-Utility Costs		**Sub-Total Non-Utility Benefits**	
E. Total Monetized Costs and Benefits			
Total Costs (PV$)		**Total Benefits (PV$)**	
Benefit-Cost Ratio		**Net Benefits (PV$)**	
F. Non-Monetized Considerations			
Economic Development and Job Impacts	*Quantitative information, and discussion of how considered*		
Market Transformation Impacts	*Qualitative considerations, and discussion of how considered*		
Other Non-Monetized Impacts	*Quantitative information, qualitative considerations, and how considered*		
Determination:	**Do Efficiency Resource Benefits Exceed Costs? [Yes / No]**		

ES.4 Applicability to Other Types of Resources

While this NSPM focuses on the assessment of EE resources, the core concepts can be applied to other types of resources as well. The cost-effectiveness principles described in Chapter 1, and the Resource Value Framework described in Chapter 2, can be used to assess the cost-effectiveness of supply-side resources or distributed energy resources (DERs)—including EE, demand response, distributed generation, distributed storage, electric vehicles, and strategic electrification technologies.

With regard to supply-side resources, the cost-effectiveness principles can be used in the context of integrated resource planning or when conducting any sort of economic analyses of specific generation, transmission, or distribution infrastructure investments. The Resource Value Framework can be used to identify the primary test for assessing these supply-side investments, or to identify the criteria that would be used to select the preferred resource plan in the context of an IRP. This approach would not only ensure sound practices for analyzing supply-side resources, it would also ensure that EE resources are analyzed comparably and consistently with supply-side resources.

With regard to DERs, the cost-effectiveness principles and the Resource Value Framework can be used as the foundation for assessing their cost-effectiveness. There are, however, ways in which other types of DERs might need to be treated differently from EE resources. These important DER-specific issues are beyond the scope of this NSPM, but should be addressed by each jurisdiction as they develop cost-effectiveness practices for DERs.

ES.5 Foundational Information Covered in the NSPM

Supporting the implementation of the Resource Value Framework for developing an RVT requires understanding of a wide range of cost-effectiveness related topics. These include identifying, quantifying, and documenting relevant policies, costs, and benefits—in addition to the analysis of related foundational considerations of cost-effectiveness tests. Thus, the NSPM not only presents the universal principles, the Framework, and associated RVT concepts and examples, but also provides information on related foundational topics that can be particularly valuable to those responsible for developing the RVT and its inputs. The NSPM can also be helpful for those seeking to understand the range of options and outcomes that can result from different RVTs.

Questions the RVT Does and Does Not Answer

The primary RVT can be used to answer the fundamental question of *which resources have benefits that exceed their costs*, where the benefits and costs are defined by the applicable policy goals of a jurisdiction and developed via Framework 7-step process. With this Framework, the resource investment decision question is addressed in a comprehensive and transparently documented manner.

Regulators and decision-makers typically need to answer a second critical question: *how much utility customer funding should be spent on EE resources?* The primary cost-effectiveness test is necessary but may not be sufficient for answering this second question, which requires consideration of jurisdiction-specific factors through a process such as integrated resource planning or rate proceedings.

The foundational topics covered in the NSPM, found in Parts I, II, or in the appendices, are as follows:

- Ensuring transparency of the assumptions, analysis and results (Chapter 3)

- Use of primary vs secondary cost-effectiveness tests (Chapter 5)
- Identifying relevant impacts (costs and benefits) to include in a Resource Value Test (Chapter 6)
- Methods that can be used to determine or account for all relevant impacts (Chapter 7)
- Considerations for including Participant Impacts (Chapter 8)
- Identifying appropriate discount rates (Chapter 9)
- Selecting an assessment level (Chapter 10)
- Selection of an analysis period (Chapter 11)
- Treatment of Early Replacement (Chapter 12)
- Treatment of Free Riders and Spillover (Chapter 13)
- Traditional Cost-Effectiveness Tests (Appendix A)
- DER Costs and Benefits (Appendix B)
- Accounting for Rate and Bill Impacts (Appendix C)

INTRODUCTION:
Purpose, Scope and Format

Purpose

The purpose of this National Standard Practice Manual (NSPM) is to help guide the development of a cost-effectiveness test for regulators, utilities, program administrators, efficiency planners, consumer advocates, and other efficiency stakeholders. In its simplest form, assessing the cost-effectiveness of energy resources involves comparing the costs and benefits of such resources with other resources. The manual describes the principles, concepts, and methodologies for sound, comprehensive, balanced assessment of the cost-effectiveness of EE resources, and can help involved parties identify the full range of efficiency resources whose benefits exceed their costs. Utility resource decision-makers can then use this information to decide which resources to acquire to meet their specific EE objectives, standards, or targets.

This manual is intended to serve as an objective, neutral guidance document that does not prescribe any one type of cost-effectiveness test *per se*.

This manual is intended to serve as an objective, neutral guidance document that does not prescribe any one type of cost-effectiveness test *per se*. Rather it sets forth a framework that includes key principles and steps to use within a jurisdiction to develop a primary cost-effectiveness test, and also to inform use of secondary tests.

The goal of this manual is to provide guidance that: (1) builds from the lessons learned over the past decades, (2) responds to current needs, (3) addresses the specific goals of each jurisdiction, and (4) can eventually be fully expanded to address all types of distributed energy resources (DER).

Why the Need for this NSPM?

Since the 1980s, the prevailing cost-effectiveness guidance document for EE resources has been the *California Standard Practice Manual* (CaSPM), which sets forth several ‘traditional tests’ commonly referred to as the Utility Cost Test (UCT), the Total Resource Cost (TRC) test, and the Societal Cost Test (SCT).[2] Last updated in 2002, the CaSPM presents important limitations with which jurisdictions have increasingly struggled over the years. This has led to the inconsistent application of the traditional tests. These limitations are generally characterized as follows:

a) The CaSPM does not provide guidance on how to develop a cost-effectiveness *framework*, and associated primary test, that reflects a jurisdiction’s energy and

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[2] See Appendix A for a summary of the Traditional Tests. The CA SPM’s chapters are organized around 4-5 tests: the Participant Test; the RIM test; the TRC test; the SCT (characterized as a variant of the TRC); and the Program Administrator Costs test, also referred to as the Utility Cost Test (UCT). This manual focuses on the most commonly used cost-effectiveness tests in practice today: the TRC test, UCT, and SCT.

other applicable policy goals. Such goals should be directly relevant to identifying the range of costs and benefits to include in a jurisdiction's cost-effectiveness analyses.

b) The three commonly used traditional tests (UCT, TRC, and SCT) are typically defined as having a specific set of costs and benefits depending on the perspective of either the utility, the utility and program participants, or society as a whole.[3] A jurisdiction's energy policies, however, seldom align precisely with any one of these types of perspectives. Moreover, these three tests do not account for a critical perspective: the perspective of reducing total utility costs to customers (relative to other resources) while also explicitly taking into account the jurisdiction's applicable policy goals. That broader perspective is intended to be reflective of the important responsibilities of a utility regulator. Hence the NSPM introduces this concept as the *regulatory perspective*.

c) Jurisdictions have struggled with ongoing debates about what costs and benefits should be included in their analyses, and whether and/or how to account for certain impacts. This is especially the case for hard-to-quantify non-energy impacts. These issues have been particularly challenging for the TRC test, the predominantly used screening test. Research has shown that most jurisdictions that use the TRC test treat costs and benefits asymmetrically by accounting for participant costs but not benefits (ACEEE 2012). The CaSPM lacks key principles and guidance that can help jurisdictions determine which impacts to consider. It further lacks options for how to account for such impacts, including those that are difficult to quantify.

Over time, implementation across the states has led to inconsistent application of the traditional tests. The result has been a myriad of variations of the tests, in particular the TRC test. For example, a TRC test in one state can look more like an SCT (e.g., due to the inclusion of environmental impacts), and TRC test results from one state to another often vary considerable due to different treatment of non-energy benefits where many states do not include benefits that are hard to quantify, thus resulting in asymmetrical treatment of costs and benefits. As a result, the benefit-cost ratios of similar programs using the TRC test are not comparable across jurisdictions—and the test itself is no longer the TRC test in its pure and intended definition.

More broadly, as the electricity industry evolves to increasingly plan for and implement DERs, there is a need for a comprehensive cost-effectiveness framework that jurisdictions can use to apply to all DERs. The core principles and concepts in this NSPM can be used as the foundation for developing cost-effectiveness practices for all types of DERs.

Scope of this Manual

This NSPM focuses on the assessment of EE resources whose acquisition is funded by, and implemented on behalf of, electricity and gas utility customers, and where the value of efficiency resources is assessed using estimates of avoided utility system costs and other relevant impacts. The manual is intended as a tool to inform decision-making regarding which particular EE program (or set of programs) should be implemented using customer funding.

[3] While most jurisdictions have historically used the CaSPM as the foundation for their cost-effectiveness tests, in practice many jurisdictions have deviated from those tests.

Note that the cost-effectiveness practices described in this manual are similar to integrated resource planning (IRP) practices, but different in some important respects.

The concepts in this NSPM can also apply to the assessment of other types of efficiency resources, such as building codes and appliance standards, government-funded efficiency resources, tax incentives for efficiency improvements, and more. However, this manual is focused on the assessment of ratepayer-funded EE programs because these programs have different types of costs and benefits and typically require more regulatory review and oversight.

Integrated Resource Planning (IRP) – the Other Way to Assess Cost Effectiveness

Some jurisdictions use long-term, IRP to help identify the portfolio of resources (supply-side and demand-side) that is least-cost and meets energy policy goals. Such IRP processes typically involve optimizing the costs, performance, and other attributes of all resource options in a dynamic fashion using optimization models, scenario analyses, and sensitivity analyses.

The cost-effectiveness practices described in this manual are similar to IRP practices, but different in some important respects. Both practices compare the long-run, marginal costs of different scenarios of resources to identify those with benefits that exceed costs, and both should use similar inputs regarding the future costs of EE, demand-side, and supply-side resources.

However, IRP and cost-effectiveness testing differ in that IRP typically allows for more sophisticated analyses of the impacts of EE impacts on utility system costs (e.g., modeling of EE loadshape impacts on power plant dispatch over time), and provides more flexibility for conducting scenario analyses and sensitivity analyses. On the other hand, though perhaps less dynamic, cost-effectiveness analyses using fixed avoided cost assumptions is commonly used to assess EE at a more granular level. It allows for assessment of a range of different types of programs, program designs, and even efficiency measures.

Applicability to Other Types of Utility Resources

While this NSPM focuses on the assessment of utility EE resources, the core concepts can be applied to other types of utility resources as well. The cost-effectiveness principles described in Chapter 1 and the Resource Value Framework described in Chapter 2 can be used to assess the cost-effectiveness of supply-side or distributed energy resources—including EE, demand response, distributed generation, distributed storage, electric vehicles, and strategic electrification technologies.

With regard to supply-side resources, the cost-effectiveness principles can be used in the context of integrated resource planning or when conducting any sort of economic analyses of specific generation, transmission, or distribution infrastructure investments. The Resource Value Framework can be used to identify the primary test for assessing these supply-side investments, or to identify the criteria that would be used to select the preferred resource plan in the context of an IRP. This approach would not only ensure sound practices for analyzing supply-side resources, it would also ensure that EE resources are analyzed comparably and consistently with supply-side resources.

With regard to DERs, the principles and Resource Value Framework can be used as the foundation for assessing their cost-effectiveness.[4] However, there are important ways in

[4] Most recent studies of DER cost-effectiveness use the CaSPM as a starting point. See for example (IREC 2013), (NYSERDA 2015), and (Consumers Union 2016).

which other types of DERs might need to be treated differently from EE resources. For example:

- Some costs and benefits of EE might not be applicable to other types of DER, and vice versa. Some of the costs and benefits of EE might have different magnitudes relative to other types of DERs, including time-varying differences and locational differences.[5]
- The approach for addressing rate, bill, and participant impacts might be different for different types of DERs.
- In some jurisdictions, the policy goals supporting other types of DERs might be different from those supporting EE.

These important DER-specific issues are beyond the scope of this NSPM, but should be addressed by each jurisdiction as they develop cost-effectiveness practices for DERs. In the future, this EE manual could be expanded to address these other types of DER specific issues.

How this Manual Differs from the California Standard Practice Manual

This Manual builds upon the concepts and techniques of the CaSPM by addressing limitations and applying lessons learned over the years in the use of the CaSPM "traditional" tests. The NSPM expands on the CaSPM in various ways:

1. It provides a set of *universal principles* that should be used to guide the development of cost-effectiveness tests.
2. It includes the foundational principle that a jurisdiction should consider *applicable policy goals* when developing its primary cost-effectiveness test; it thereby introduces the perspective of the regulator/agent relative to the relevant policy goals, which may differ from the perspectives provided in the CaSPM.
3. Rather than specify a set of pre-defined tests, it provides *a framework and a process* for a jurisdiction to develop *its own specific primary test* (or tests).
4. It provides more information on the different types of EE resource costs and benefits, and how they should be treated when developing a cost-effectiveness test.
5. It provides guidance on how to account for applicable hard-to-monetize costs and benefits, as well as guidance on how to apply qualitative considerations.
6. It provides guidance on how to develop inputs for cost-effectiveness tests, such as discount rates, early replacement of measures, free-riders, and spillover.

[5] Appendix B provides a comparison of costs and benefits of EE relative to other types of DERs.

Format of this Manual

Guidance on the Resource Value Framework and associated RVT is organized as follows:

Part I provides guidance on *how to develop* cost-effectiveness tests using the Resource Value Framework. It sets forth the set of universal principles that can be applied to any cost-effectiveness assessment, and provides a step-by-step process for jurisdictions to use to develop their primary RVT. Examples are provided, along with guidance on the use of secondary tests.

Part II provides more detailed information to assist jurisdictions in *developing inputs* for their RVTs, with guidance on what to include or not in the test by applying the Resource Value Framework process, and determining values for the inputs used in their primary test.

Appendices provide further detail on topics which may be relevant for some jurisdictions.

The intended audience for Part I is for regulators and other decision makers, policymakers, program administrators, EE and other DER stakeholders, evaluators, and other EE practitioners. Part II provides detailed guidance on key topics for those interested in delving into more details.

Table 1 shows the layout of the NSPM, with descriptions of the topics covered in each chapter.

Table 1. Overview of the National Standard Practice Manual

Part/Chapter	Topic	Description
Part I	**Developing Cost-Effectiveness Tests Using the Resource Value Framework**	
Chapter 1	Principles	Describes the key principles that should be applied in any resource cost-effectiveness assessment
Chapter 2	The Resource Value Framework	Provides an overview of the Framework and embodied principles, describes the dynamic nature of the RVT and its relevance to traditional cost-effectiveness tests
Chapter 3	Developing the Resource Value Test (RVT)	Sets forth the multi-step process for developing a primary test based on principles and framework set forth in Chapters 1-2; provides templates to document applicable policies, inputs, and results using a standard format
Chapter 4	RVT Relationship to Traditional Tests	Provides examples of hypothetical RVTs, and describes how a jurisdiction's RVT could compare to the traditional tests: UCT, TRC and SCT
Chapter 5	Secondary Cost-Effectiveness Tests	This chapter provides information about the potential role of secondary tests, their benefits and limits, and selecting and constructing such tests
Part II	**Developing Inputs for Cost-Effectiveness Tests**	
Chapter 6	Energy Efficiency Costs and Benefits	Describes the range of EE costs and benefits, both utility system and non-utility system, and information for selecting impacts to include in tests
Chapter 7	Methods to Account for Relevant Impacts	Provides guidance on options for accounting for relevant cost and benefits, including hard-to-quantify impacts as well as approaches for qualitatively including non-monetary impacts
Chapter 8	Participant Impacts	Expands upon guidance in Chapter 3 regarding how to determine whether to include participant impacts in the RVT
Chapter 9	Discount Rates	Describes ways to determine discount rates that are consistent with the jurisdiction's applicable policy goals
Chapter 10	Assessment Level	Describes the advantages and disadvantages of assessing EE at measure, program, or portfolio levels, and assessment level for fixed costs
Chapter 11	Analysis Period and End Effects	Describes the time period over which cost-effectiveness analysis should be conducted, and how to address any potential "end effects" problems
Chapter 12	Early Replacement	Describes how to analyze the costs and benefits of replacing operating equipment before the end of its useful life
Chapter 13	Free-Riders and Spillover	Describes how to address free-riders and spillover effects in cost-effectiveness analyses for jurisdictions that use net savings
Appendices		
Appendix A	Traditional Cost-Effectiveness Tests	Summarizes the commonly used traditional cost-effectiveness tests from the California Standard Practice Manual
Appendix B	DER Costs and Benefits	Summarizes similarities and differences in costs and benefits across different types of DERs
Appendix C	Rate and Bill Impacts	Describes key factors affecting rates and bills, and an approach for assessing related trade-offs
Appendix D	Glossary of Terms	Provides definitions for commonly used terms throughout the manual

Key Terminology Used in this Manual

Terms with specific meaning in the context of the concepts offered in this NSPM are provided below, with additional terms in Appendix D.

- Avoided costs, refers to the costs of those electricity and gas resources that are deferred or avoided by the EE resources being evaluated for cost-effectiveness. The avoided costs are what make up the utility system benefits of EE resources.
- Distributed energy resources (DERs), refers to electricity and gas resources that are installed on customers' premises (behind the meter), to improve customer consumption patterns and reduce customer costs. These include EE, demand response, distributed generation, storage, plug-in electric vehicles, strategic electrification technologies, and more.
- Energy efficiency resource, refers to EE technologies, services, measures, or programs funded by, and promoted on behalf of, electricity and gas utility customers.
- Impacts, refers to both the costs and the benefits of a supply-side or demand-side resource.
- Jurisdiction, refers to states, provinces, utilities, municipalities, or other regions for which EE resources are planned and implemented.
- Primary cost-effectiveness test, refers to the cost-effectiveness framework that a jurisdiction most relies upon when choosing the efficiency resources in which to invest ratepayer money.
- Regulators and Other Decision Makers, refers to institutions, agents, or other decision-makers that are authorized to determine utility resource cost-effectiveness and funding priorities. Such institutions or agents include public utility commissions, legislatures, boards of publicly owned utilities, the governing bodies for municipal utilities and cooperative utilities, municipal aggregator governing boards, and more.
- Regulatory perspective, refers to the perspective of regulators or other agents that oversee efficiency resource investment choices. This perspective is guided by the jurisdiction's energy and other applicable policy goals—whether in laws, regulations, organizational policies, or other codified forms—under which they operate.
- Resource Value Framework, refers to a series of seven steps that can guide any jurisdiction to develop its primary test for assessing EE (and other DERs) cost-effectiveness. The Resource Value Framework embodies the key principles of cost-effectiveness analyses described in Chapter 1.
- Resource Value Test (RVT), refers to the primary cost-effectiveness test that a jurisdiction has developed using the Resource Value Framework. It embodies all of the key principles of cost-effectiveness analyses and accounts for that jurisdiction's applicable policy goals.
- Utility system, refers to all elements of the electricity or gas system necessary to deliver services to the utility's customers. For electric utilities, this includes generation, transmission, distribution, and utility operations. For gas utilities, this includes transportation, delivery, fuel, and utility operations. This term refers to any type of utility ownership or management, including investor-owned utilities, publicly owned utilities, municipal utility systems, cooperatives, etc.

PART I.
Developing Cost-Effectiveness Tests Using the Resource Value Framework

1. Principles of Cost-Effectiveness Analyses

This chapter presents the six core principles that are embodied in the Resource Value Framework and are fundamental to helping guide jurisdictions in the development of their primary cost-effectiveness test. These principles represent sound economic and regulatory practices and are consistent with the input received from a wide range of stakeholders during the development of this manual.

The following principles should be applied when developing and applying a jurisdiction's primary EE cost-effectiveness test:

1. **Efficiency as a Resource.** EE is one of many resources that can be deployed to meet customers' needs, and therefore should be compared with other energy resources (both supply-side and demand-side) in a consistent and comprehensive manner.
2. **Applicable Policy Goals.** A jurisdiction's primary cost-effectiveness test should account for its energy and other applicable policy goals. These goals may be articulated in legislation, commission orders, regulations, advisory board decisions, guidelines, etc., and are often dynamic and evolving.
3. **Hard-to-Quantify Impacts.** Cost-effectiveness practices should account for all relevant, substantive impacts (as identified based on policy goals,) even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard- to- monetize impacts is preferable to assuming those costs and benefits do not exist or have no value.
4. **Symmetry.** Efficiency assessment practices should be symmetrical, for example by including both costs and benefits for each relevant type of impact.
5. **Forward Looking**. Analysis of the impacts of efficiency investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of efficiency measures and those that would occur absent the efficiency investments.[6]
6. **Transparency.** Efficiency assessment practices should be completely transparent and should fully document all relevant inputs, assumptions, methodologies, and results.

These principles are relevant to cost-effectiveness analyses of any resource, supply or demand, and are embodied within the Resource Value Framework provided in this manual. The key issues associated with their application to such analyses will differ

[6] As further discussed in this chapter, sunk costs and benefits are not relevant to a cost-effectiveness analysis.

somewhat from resource to resource, depending on the unique characteristics of each resource.

Principle #1: Efficiency as a Resource

EE is a resource that can be used to defer or avoid spending on other electricity or gas resources. Consequently, an EE cost-effectiveness assessment should enable a full and fair assessment of the benefits and costs of the efficiency resource relative to other types of resources. The assessment should include comparisons to both supply-side resources and other demand resources to ensure accurate results. This principle necessitates that utility system costs and benefits always be included in cost-effectiveness analyses (see more detailed discussion in Chapter 3).

Principle #2: Applicable Policy Goals

A jurisdiction's EE cost-effectiveness framework should account for the energy and other applicable policy goals and objectives that apply to that jurisdiction. The choice between an investment in EE or investments in other demand and/or supply resources—i.e., what happens if efficiency investments are not made—can materially affect the costs, timeframe, and even ability to achieve such other policy goals. Cost-effectiveness analyses should guide or inform resource choices in that context.

Each jurisdiction's primary cost-effectiveness should recognize the full "resource value" of EE.

Thus, each jurisdiction's primary cost-effectiveness test should include all categories of relevant impacts (costs and benefits) consistent with its applicable policy goals. In other words, each jurisdiction's primary cost-effectiveness should recognize the full "resource value" of EE.

A jurisdiction's applicable policy goals are formally stated policy objectives that provide the overall policy context within which regulators and other agents make decisions regarding utility resource investments. These goals can be articulated in several different ways, including: legislation; executive orders; regulations; commission or board guidelines, standards or orders; and other pronouncements from a relevant governing agency. Importantly, identifying applicable policies for a jurisdiction is not a static process, but likely to evolve. For example, some jurisdictions may not have explicit statutes or regulations that address certain impacts that have been identified as important by stakeholders. In these instances, stakeholder input and due process often inform such policy development.

'Regulators/decision-makers' refers to all types of entities that oversee EE investments such as: utility regulators; boards or management teams of unregulated municipal or cooperative utilities; or federal, regional, or state power planning agencies.

Energy and other applicable policy goals often evolve over time in response to changes in the energy industries, changing perspectives from the legislature and regulators, and the evolving interests of and input from industry stakeholders. As such, identifying applicable policies for a jurisdiction is not a static process, but likely to evolve (e.g., as part of regulatory processes and stakeholder discussions.) The jurisdiction's cost-effectiveness test(s) may need to periodically evolve as well.

Table 2 below provides examples of policy goals. Some of these goals may overlap with each other, as is the case with reducing system risk and promoting resource diversity. Others may sometimes conflict with each other, as with reducing utility system costs and improving reliability, promoting customer equity, and/or reducing environmental impacts. Such trade-offs can only be systematically assessed and EE investment decisions can only be optimized if cost-effectiveness analyses account for all categories of impacts relevant to the jurisdiction's goals. Importantly, the constellation of applicable policy goals in any one jurisdiction is likely to differ in some ways from that of other jurisdictions.

Table 2. Examples of Energy-Related and Other Applicable Policy Goals[7]

Common Overarching Goals: Provide safe, reliable, low-cost electricity and gas services; protect low-income and vulnerable customers; maintain or improve customer equity.
Efficiency Resource Goals: Reduce electricity and gas system costs; develop least-cost energy resources; promote customer equity; improve system reliability and resiliency; reduce system risk; promote resource diversity; increase energy independence (and reduce dollar drain from the jurisdiction); reduce price volatility.
Other Applicable Goals: Support fair and equitable economic returns for utilities; provide reasonable energy costs for consumers; ensure stable energy markets; reduce energy burden on low-income customers; reduce environmental impact of energy consumption; promote jobs and local economic development; improve health associated with reduced air emissions and better indoor air quality.

Finally, this principle serves as a fundamental first step in developing a jurisdiction's primary cost-effectiveness—the RVT, as discussed in Chapters 2 and 3. The primary test thus reflects a mix of various perspectives impacted by the jurisdiction's applicable policies, otherwise referred to within this NSPM as the 'regulatory' perspective.

Fundamental to Principle #2 is the **concept of the 'regulatory' perspective**, which includes consideration of the full scope of issues for which regulators/decision-makers are responsible: (1) overall objective of requiring electricity/gas utilities to provide safe, reliable, low-cost services to customers; and (2) meeting their jurisdiction's other applicable policy goals.

Principle #3: Hard-to-Quantify Impacts

Ideally, all costs and benefits of EE resources that are relevant to a jurisdiction's applicable policy goals should be estimated in monetary terms, so that they can be directly compared.

Some impacts are challenging to quantify and put into monetary terms. Data may not be readily available, studies may require a considerable amount of time and/or resources to implement, and such studies might still result in significant uncertainty. That can be the case for impacts that are common to assessment of any type of resource. Examples include some utility system impacts (e.g., forecasts of resource needs and costs, impacts of future government regulations, and the magnitude and value of risk mitigation) as well as impacts that can be relevant to other jurisdictional policy objectives (e.g., value of reduced environmental impacts). It can also be the case for some impacts that may be unique to efficiency resources (e.g., benefits of improved comfort or business productivity).

Nevertheless, efficiency costs and benefits that are relevant to a jurisdiction's applicable policy goals and that can reasonably be assumed to be real and substantial should not be excluded or ignored because they are difficult to quantify and monetize. There are a

[7] This list is not intended to be exhaustive, nor is it intended to imply a recommendation of any policies for any jurisdiction. It is intended to illustrate the types of policies that jurisdictions typically establish.

variety of ways to develop estimates of impacts that are reasonable enough to inform investment decisions (see discussion in Chapter 7). Using "best available" information to approximate hard-to- quantify impacts is preferable to assuming that those costs and benefits do not exist or have no value. In a worst-case scenario, excluding substantive impacts from efficiency resource assessment will lead to results that are inaccurate and misleading.

Using "best available" information to approximate hard-to-quantify impacts is preferable to assuming that those costs and benefits do not exist or have no value.

Principle #4: Symmetry

For each type of impact included in a cost-effectiveness test, it is important that both the costs and the benefits be included in a symmetrical way. Otherwise, the test may be skewed and provide misleading results.

For starters, this means that all utility system costs (i.e., costs of running efficiency programs) and all utility system benefits (see Chapter 6 for a more detailed discussion of the range of utility system benefits) should be included in cost-effectiveness analyses.

It is important that both the costs and the benefits be included in a symmetrical way. Otherwise, the test may be skewed and provide misleading results.

In addition, if a jurisdiction's applicable policy goals dictate that impacts on efficiency program participants be included in its cost-effectiveness test, then both costs borne by those participants and benefits received by those participants should be included. On the cost side, this would most commonly be a portion of the efficiency measure costs (e.g., if the incremental cost of an efficiency measure is $1,000 and the utility program is providing a rebate of $300, then the participants are incurring the remaining $700 cost).[8] On the benefits side, depending on the measures or program, there may be a variety of non-energy benefits that are part of the reason a customer invested in the measure (e.g., improved comfort, improved building durability, improved business productivity, etc.). If the participant costs are included in the cost-effectiveness test, then such benefits would need to be included as well.

Similarly, if a jurisdiction's applicable policies dictate that other categories of impacts should be included in its cost-effectiveness test—whether other fuel, water, low income, environmental, public health, economic development, and/or other impacts—then all incremental[9] negative (cost) and positive (benefit) impacts should be captured in the test.

[8] In this example, the $300 rebate would already be included in the cost-effectiveness analysis as a utility system cost.

[9] Some of these impacts may already be partially captured in utility system impacts. For example, some environmental impacts may be captured in estimates of avoided costs that capture the impact of current and/or projected future environmental regulations. Thus, to avoid double-counting, only additional "incremental" impacts should be included.

Principle #5: Forward-Looking Analyses

Analysis of the impacts of efficiency investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of efficiency measures and those that would occur absent the efficiency investments.

This principle embodies three inter-related concepts. First, cost-effectiveness analyses should only consider forward-looking impacts. Historical (or "sunk") costs should not be included when estimating the impacts of future investment decisions — they cannot be changed and will remain in place under any future scenario. Therefore, they are not relevant when comparing future investment scenarios.[10]

Historical (or "sunk") costs should not be included when estimating the impacts of future investment decisions —they cannot be changed and will remain in place under any future scenario.

Second, cost-effectiveness analyses should include long-run costs and benefits. Electric and gas resources, including many efficiency resources, can last decades. As a result, often the resource decisions made today will affect customers far into the future. Utilities have a responsibility to meet customer needs in a safe, reliable, and low-cost way over the long term. Regulators have a responsibility to protect customers over both the short term and the long term. Over-emphasis on short-term costs could unduly increase long-term costs for customers (see Chapter 11) for related discussion of analysis periods and Chapter 9 for discussion of discount rates used to analytically balance trade-offs between short-term and long-term impacts).

Third, cost-effectiveness analyses should consider only marginal impacts. These are defined as the incremental changes that will occur because of the EE resource, relative to a scenario where the resource is not in place.

Principle #6: Transparency

EE cost-effectiveness analyses require many detailed assumptions and methodologies, and they typically produce many detailed results. For regulators, other decision-makers, and other stakeholders to properly assess and understand cost-effectiveness analyses—and therefore to ultimately ensure that cost-effectiveness conclusions are reasonable and robust—key inputs, assumptions, methodologies, and results should be clearly documented in sufficient detail to enable independent reproduction of cost-effectiveness screening results. This should include all aspects of the resource assessment, including: all costs and benefits included (including all hard-to-monetize impacts); modeling parameters such as study period, treatment of risk, and discount rates; and approaches to account for additional

Results should be clearly documented in sufficient detail to enable independent reproduction of cost-effectiveness screening results.

[10] Historical costs do have important implications for rate impacts and potential cost shifting between customers. These costs should be considered in a separate rate impact analysis, as discussed in more detail in Appendix C.

considerations.[11] Such documentation should also be sufficient to replicate calculated cost-effectiveness values.

The purpose of the *Transparency Principle* is to support clear and accessible information regarding (1) the underlying jurisdiction's policies used to identify relevant impacts for inclusion in the primary test; and (2) reporting of key assumptions, results, and references from the cost-effectiveness analyses. This principle also serves as the final step in the Framework process. In Chapter 3, template tables are provided to support jurisdictions in applying this principle.

[11] Because the cost-effectiveness of EE is measured relative to the avoided costs of other resources, the assessment of those avoidable costs should be similarly transparent.

2. The Resource Value Framework and Primary Test

This chapter introduces the Resource Value Framework as a multi-step process to develop a jurisdiction's primary cost-effectiveness test – the RVT. The chapter includes an overview of the purpose of a primary test, the dynamic nature of the RVT, and its relevance to traditional cost-effectiveness tests.

2.1 Summary of Key Points

- Jurisdictions typically require a primary test to identify cost-effective efficiency resources. The Resource Value Framework is a 7-step process for jurisdictions to develop their primary cost-effectiveness test: the Resource Value Test (RVT).
- The Framework embodies the universal principles presented in Chapter 1, and in some cases discrete steps in multi-step process reflect application of a specific principle.
- While the RVT serves as a primary cost-effectiveness test, there can be value in assessing cost-effectiveness of efficiency resources from perspectives represented by other, secondary tests.
- The RVT is based upon a dynamic concept, where categories of impacts included in the test can vary across jurisdictions and/or over time because it is based on each jurisdiction's applicable policy concerns, which can vary.

2.2 The Resource Value Framework

The Framework is a series of seven steps, as shown below, that can guide any jurisdiction to develop its primary EE cost-effectiveness test. The Framework embodies the key principles described in Chapter 1, some of which represent a specific step in the framework process. Chapter 3 provides details on each of these steps.

Step 1: Identify and articulate the jurisdiction's applicable policy goals.

Step 2: Include all the utility system costs and benefits.

Step 3: Decide which non-utility impacts to include in the test, based on applicable policy goals.

Step 4: Ensure that the test is symmetrical in considering both costs and benefits.

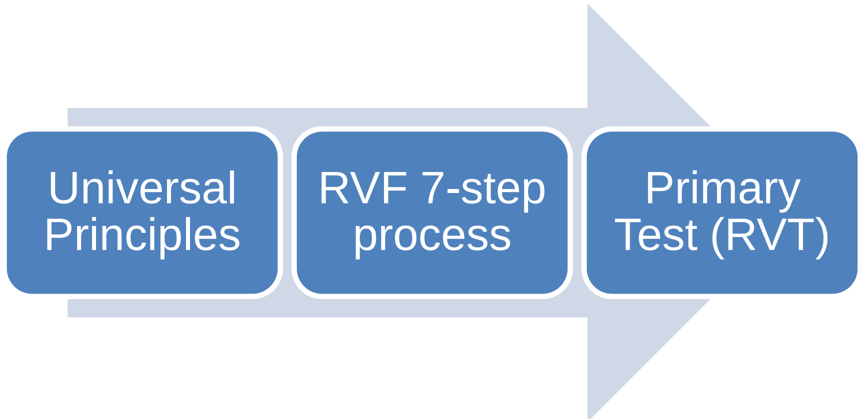
Step 5: Ensure the analysis is forward looking and incremental.

Step 6: Develop methodologies to account for all relevant impacts, including hard to quantify impacts.

Step 7: Ensure transparency in presenting the inputs and results of the cost-effectiveness test.

The relationship between the Framework, the underlying principles, and development of a primary RVT is provided in Figure 1 below and summarized further in this chapter.

Figure 1. The Foundation to Developing a Jurisdiction’s Primary Test



2.3 The Resource Value Test as the Primary Test

Jurisdictions typically rely upon a primary test to identify cost-effective efficiency resources. Developing a single, primary test can be useful when comparing many different types and scenarios of efficiency resources, and it is often necessary when an efficiency resource passes one type of test, but not others.

The primary test should answer the fundamental question: *Which efficiency resources have benefits that exceed costs, where these impacts are defined by the jurisdiction’s applicable policy goals*? The Resource Value Framework’s underlying principles and multi-step process can support a jurisdiction’s effort to answer this question, resulting in a comprehensive and transparent process that can help inform decisions on efficiency policies and practices in the jurisdiction.

The RVT serves as a primary test which assesses cost-effectiveness of efficiency resources relative to a jurisdiction’s applicable policy goals that are under the purview of the jurisdiction’s regulators and/or other decision-makers. However, there can be value in assessing cost-effectiveness of efficiency resources from perspectives represented by other, secondary tests.[12] Among the potential purposes of using secondary tests are:

The primary test should answer the fundamental question: *Which efficiency resources have benefits that exceed costs, where these impacts are defined by the jurisdiction’s applicable policy goals?*

- To inform decisions regarding how much utility customer money could or should be invested to acquire cost-effective savings;
- To inform decisions regarding which efficiency programs to prioritize if not all cost-effective resources will be acquired;
- To inform efficiency program design; and
- To inform public debate regarding efficiency resource acquisition.

For example, the primary cost-effectiveness test is necessary but may not be sufficient for answering a second critical question: *How much utility customer funding should be*

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[12] Chapter 5 provides more detail on the use of multiple cost-effectiveness tests.

spent on EE resources? This question will need to be answered by considering multiple factors such as:

- The results of the primary cost-effectiveness test;
- The results of secondary cost-effectiveness tests;
- Statutory or other requirements to implement all cost-effective EE;
- Statutory or other budget caps or constraints on efficiency resources;
- Statutory or other EE resource standards or other targets;
- Goals related to customer equity, or to providing access to all customer classes and customer types;
- Goals related to minimizing lost opportunities, or to addressing all electricity and gas end-use markets; and
- Rate, bill, and participation impacts of efficiency resources.[13]

2.4 The RVT as a Dynamic Test

The RVT reflects the impacts for which regulators/other decision-makers are responsible, including utility system impacts plus the impacts related to applicable policy goals. As such, different jurisdictions have different policy goals, and therefore they may develop different RVTs. While the RVT is conceptually a single test, in practice it might be different across jurisdictions because jurisdictions typically have a different mix of applicable policies that inform the inclusion of costs and benefits to the cost-effectiveness assessment.

The RVT is, therefore, based upon a *dynamic concept,* where categories of impacts included in the test can vary across jurisdictions and/or over time because jurisdictions' policy objectives can vary. This differs from the most common traditional tests—the UCT, TRC, and SCT—which are by associated perspectives (utility, utility plus participant, and society as a whole) *conceptually static*. The RVT can be tailored to a jurisdiction's specific interests and goals, while adhering to sound economic and public policy principles. The RVT thus provides a jurisdiction with flexibility to align with its energy and other applicable policies goals, and not be limited to the traditional tests.

> A jurisdiction's application of the Framework may result in developing a primary RVT that is the same as one of the traditional tests (UCT, TRC or SCT.) This could happen if the jurisdiction's applicable policy goals are conceptually aligned with one of those traditional tests. See Chapter 4 for examples and more details.

The dynamic nature of the RVT means that for any jurisdiction, depending on its applicable policy goals, the regulatory perspective (as described in Chapter 1) may be the same as or broader than the utility perspective. Or, it may be the same as or narrower than the societal perspective, if indeed a jurisdiction's policies reflect taking into consideration the range of all costs and benefits to society. Regulators/other decision-makers in some jurisdictions might have a relatively broad scope of responsibilities, based on their specific policy goals, while others may have a relatively narrow scope.

Chapter 3 provides detailed information on how jurisdictions can use the Framework to develop an RVT using the 7-step process. Chapter 4 provides examples of RVTs, including how they compare to common traditional cost-effectiveness tests.

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13 Appendix C provides a discussion of techniques for accounting for rate and bill impacts.

3. Developing the Resource Value Test

This chapter sets forth the detailed step-by-step process for developing a jurisdiction's primary cost-effectiveness test. The chapter ties in the principles introduced in Chapter 1, and provides template tables jurisdictions can use to support transparency in documenting cost-effectiveness analyses assumptions and results.

The Resource Value Framework's multi-step process, outlined in Figure 2 below, can be used to develop a jurisdiction's RVT as the primary cost-effectiveness test. This chapter provides guidance on each of these steps, and references relevant chapters and appendices where more detailed information is provided.

Figure 2. The Resource Value Framework Steps

STEP 1	Identify and articulate the jurisdiction's applicable policy goals.
STEP 2	Include all the utility system costs and benefits.
STEP 3	Decide which non-utility impacts to include in the test, based on applicable policy goals.
STEP 4	Ensure that the test is symmetrical in considering both costs and benefits.
STEP 5	Ensure the analysis is forward looking and incremental.
STEP 6	Develop methodologies to account for all relevant impacts, including hard to quantify impacts.
STEP 7	Ensure transparency in presenting the inputs and results of the cost-effectiveness test.

The first step is to identify and articulate the applicable policy goals of the jurisdiction. Articulating these goals at the outset of developing a framework, using a transparent process, will help ensure that the cost-effectiveness test is designed to properly account for them.

The second step is to recognize that EE is a resource that can be used to defer or avoid other energy resources, which requires that EE costs and benefits be evaluated consistently with the costs and benefits of other energy resources. As such, a cost-effectiveness test should begin by including all utility system impacts.

The *Key Principles* from Chapter 1 are embodied in the 7-step process, and in some cases, represent a discrete step.

The third step is to ensure that non-utility system impacts—both costs and benefits—associated with the jurisdiction's applicable policy goals are accounted for.

Once these first three steps are taken, then it is critical to ensure symmetry in the inclusion of the relevant impacts; to ensure the analysis is forward-looking and incremental; and to develop methods to account for all the relevant impacts. The final step is to provide transparency in presenting the inputs and results from the cost-effectiveness analysis.

3.1 STEP 1: Identify and Articulate Applicable Policy Goals

Review all 7 steps on page 18.

3.1.1 The Importance of Policy Goals

The first step is for a jurisdiction to identify and articulate its applicable policy goals, consistent with the *Policy Goals Principle* from Chapter 1. Documenting applicable goals at the outset of developing a test is necessary to ensure that the cost-effectiveness test explicitly and properly accounts for such goals.

Most regulators/decision-makers have broad statutory authority to: set rates that are fair, just, and reasonable; ensure that utilities and comparable entities provide customers with safe, reliable, and low-cost services; and generally guide utility actions that are in the public interest. This authority is typically defined in statutes and related regulations or other governing body decisions.

> **This first step of the Framework establishes a regulatory perspective, which reflects a mix of the various perspectives impacted by the jurisdiction's applicable policies.**

Most regulators/decision-makers also operate in the context of other relevant policies that affect their jurisdiction, many of which are applicable to the investment of customer funds in EE resources. Table 2 (in Chapter 1) provides examples of such policies.

These goals are established in many ways, typically by statutes, regulations, orders, state energy plans, and other government directives. As emphasized earlier, these policy goals evolve over time to reflect changing conditions and governmental and public priorities.

Importantly, this first step of the Framework establishes a regulatory perspective, which reflects a mix of the various perspectives impacted by the jurisdiction's applicable policies.

3.1.2 Documenting Applicable Policy Goals

Transparency of a jurisdiction's applicable policy goals is key to helping identify the relevant costs and benefits to include a primary cost-effectiveness test. Table 3 illustrates a simplified version of how a jurisdiction could articulate its applicable policy goals. It shows how a jurisdiction's laws, regulations, orders, etc. could be documented to identify the relevance of certain policy goals to efficiency cost-effectiveness assessment. This exercise would help to provide a clear platform from which interested parties can inform and confirm priorities, gaps, or missing needs, and identify appropriate costs and benefits.

Table 3. Example Summary of a Jurisdiction's Applicable Policy Goals

Applicable Laws, Regulations, Orders, etc.	Policy Impacts Reflected in Laws, Regulations, Orders, etc.						
	Least-Cost	Fuel Diversity	Risk	Reliability	Low-Income	Environ-mental	Economic Develop-ment
PSC statutory authority	X			X			
Low-income protection	X		X	X	X		
EE or DER law or rules	X	X	X	X	X		X
State energy plan	X	X	X	X	X	X	X
Integrated resource planning	X	X	X	X	X	X	X
Renewable portfolio standard		X				X	X
Climate change		X	X			X	
Environmental protection		X	X			X	

This table is presented for illustrative purposes only, does not represent the policies of any particular jurisdiction, and is not meant to be an exhaustive list of applicable policy goals.

A more comprehensive version of the table above would ideally also:

- document the specific applicable policies;
- include a description of the relevant applicable policies;
- identify areas where policies are evolving or may evolve and should be considered; and
- identify the specific costs and benefits that should be accounted for in the test.

3.1.3 Process and Stakeholder Input

Some jurisdictions may have little experience or precedent for evaluating their applicable policy goals that are applicable to utility resource cost-effectiveness analyses. Other jurisdictions may have a long history of statutes, regulations, commission orders, and other directives that provide guidance on specific applicable policy goals. Either way, when developing a primary EE cost-effectiveness test, it is important to start with a clear articulation of all applicable policy goals.

Ideally, applicable policy goals should be assessed and articulated with a process that is transparent and open to all relevant stakeholders such as consumer advocates, low-income representatives, state agencies, efficiency representatives, environmental advocates, and others. Key stakeholders can provide important viewpoints regarding the value of EE in the context of the jurisdiction's policy goals.

This stakeholder input can be achieved through a rulemaking process, a generic jurisdiction-wide docket, commission orders on specific EE plans, working groups, technical sessions, or other approaches appropriate for the jurisdiction. The process should address objectives based on current jurisdiction policies, and should also be flexible to address new or modified polices that are adopted over time.

Some jurisdictions may wish to incorporate input from government agencies or representatives that do not typically make decisions regarding EE cost-effectiveness, but would nonetheless have insights on the jurisdiction's applicable policy goals. For example, a state's public utility commission may wish to incorporate input from that state's department of environmental protection or department of health and human services (Regulatory Assistance Project 2013a).[14]

3.2 STEP 2: Include Utility System Costs and Benefits

STEP 2

Review all 7 steps on page 18.

The second step in developing an RVT is to include the utility system impacts that will be affected by the efficiency resource. The term utility system is used here to represent the entire utility system used to provide service to retail customers. In the case of electric utilities, this includes the generation, transmission, and distribution of electricity services. In the case of gas utilities, this includes the transportation, storage, and distribution of gas services. This term refers to any type of utility ownership or management, including investor-owned utilities, publicly owned utilities, municipal utility systems, cooperatives, etc.

> **It is essential to ensure that avoided cost estimates are comprehensive, up-to-date, informed by stakeholders, and ultimately reviewed and approved by regulators.**

The utility system costs and benefits should provide the foundation for every cost-effectiveness test. This ensures that the test will, at a minimum, indicate the extent to which total utility system costs will be reduced (or increased) by the efficiency resource over a specified period. It will also indicate the extent to which average customer bills will be reduced (or increased) by the efficiency resource, because total utility system costs determine average customer bills.[15]

Further, every cost-effectiveness test should include relevant utility system costs and benefits. In terms of costs, this should include the portion of the efficiency measure paid by the utility, other financial or technical support provided to participants, and any other utility-system costs associated with program administration and management. Regarding benefits, this should include all the utility system costs that will be avoided or deferred by implementing the EE resource.[16]

Utility system avoided costs are one of the most important inputs to any cost-effectiveness analyses of EE resources, and will significantly affect the results of the analyses. Therefore, it is essential to ensure that avoided cost estimates are

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[14] A recent statute in Michigan requires the commission to request an advisory opinion from the department of environmental quality regarding whether any potential decrease in emissions of sulfur dioxide, oxides of nitrogen, mercury, and particulate matter would reasonably be expected to result if the integrated resource plan proposed by the electric utility was approved (State of Michigan 2016).

[15] Note that the three traditional cost-effectiveness tests, the UCT, the TRC, and the SCT, all include utility system impacts, at a minimum.

[16] For the purposes of cost-effectiveness evaluation, the value of avoided utility system costs establishes the maximum amount that the utility system can contribute to a measure's costs, in order to be considered cost-effective without taking into consideration other participant and/or societal benefits and costs.

comprehensive, up-to-date, informed by stakeholders, and ultimately reviewed and approved by regulators.[17]

Including all utility system costs and benefits in any efficiency cost-effectiveness test is consistent with the *Efficiency as a Resource Principle* described in Chapter 1: that EE is a resource that should be compared with both supply-side and other demand-side energy resources in a consistent and comprehensive manner. Further, in a jurisdiction with competitive wholesale markets and distribution-only electricity utilities, it is important to account for the impacts on generation, transmission, and distribution because all these resources will be affected by the efficiency resource—even if distribution customers provide the funding of the efficiency resource.

Table 4 and Table 5 provide illustrations of the utility system costs and benefits that should be included in every cost-effectiveness test. Chapter 6 provides more detail on these utility system impacts, and Chapter 7 provides guidance on methods to develop values for these impacts.

Table 4. Example Electric Utility System Impacts to Include in Cost-Effectiveness Tests

Scope	Costs	Benefits
Utility System	Measure Costs (utility portion) Other Financial or Technical Support Program Administration Marketing and Outreach Evaluation, Measurement, and Verification Utility Performance Incentives	Avoided Energy Costs Avoided Generating Capacity Costs Avoided T&D Costs Avoided T&D Line Losses Avoided Ancillary Services Wholesale Price Suppression Effects Avoided Costs of Complying with RPS Avoided Environmental Compliance Costs Avoided Credit and Collection Costs Reduced Risk Increased Reliability

This table is presented for illustrative purposes, and is not meant to be an exhaustive list.

17 For good examples of this approach, see the New England Avoided Energy Supply Cost studies (AESC Study Group 2015); and the California Public Utility Commission cost-effectiveness calculator that embeds the state's official avoided costs in a model to calculate cost-effectiveness (CPUC 2016)

Table 5. Example Gas Utility System Impacts to Include in Cost-Effectiveness Tests

Scope	Costs	Benefits
Utility System	Measure Costs (utility portion) Other Financial or Technical Support Program Administration Marketing and Outreach Evaluation, Measurement, and Verification Utility Performance Incentives	Avoided Gas Costs Avoided Gas Pipeline Costs Avoided Gas Distribution Costs Avoided Gas Line Losses Wholesale Price Suppression Effects Avoided Environmental Compliance Costs Avoided Credit and Collection Costs Reduced Risk Increased Reliability

This table is presented for illustrative purposes, and is not meant to be an exhaustive list.

3.3 STEP 3: Decide Which Non-Utility Costs and Benefits to Include

Review all 7 steps on page 18.

The decision of which non-utility system costs and benefits to include in the RVT should build on Steps 1 and 2 of the Framework. Specifically, once a jurisdiction's applicable policies have been identified and articulated in Step 1, and utility system costs and benefits are identified to account for overarching goal to reduce electricity/gas costs and customer bills, Step 3 then involves deciding which non-utility costs and benefits to include in the test, based on applicable policy goals.

In some cases, the decision to include an impact might be straightforward. For instance, legislation establishing an EE resource standard might explicitly state that one of the goals of the standard is to promote economic development. In other cases, the decision might be less clear. For example, whether to include participant costs and benefits in the primary EE cost-effectiveness test might not be articulated anywhere (as discussed in Section 3.3). In these cases, the policy decision will need to be made by regulators and other decision-makers with appropriate input from relevant stakeholders.

Table 6 below presents a summary of commonly considered non-utility impacts that could be included in a primary test to the extent they are relevant to a jurisdiction. The table also indicates the relevant section in this chapter where each of the impacts is summarized, with more detail provided in Chapter 6 on the considerations for selecting EE costs and benefits.

In applying Step 3, regulators/decision-makers, with input from stakeholders, can cross-reference the broad range of non-utility costs and benefits addressed in this section, and further in Chapter 6. Jurisdictions can also build on the Table 3 template (from Step 1) by adding the specific costs and benefits that apply based on the identified applicable policy goals.

Table 6. Examples of Commonly Considered Non-Utility Impacts

Non-Utility Impact	Subsection	Description
Participant impacts	3.3.1	Impacts on program participants, includes participant portion of measure cost, other fuel savings, water savings, and participant non-energy costs and benefits
Impacts on low-income customers	3.3.2	Impacts on low-income program participants that are different from or incremental to non-low-income participant impacts. Includes reduced foreclosures, reduced mobility, and poverty alleviation
Other fuel impacts	3.3.3	Impacts on fuels that are not provided by the funding utility, for example, electricity (for a gas utility), gas (for an electric utility), oil, propane, and wood
Water impacts	3.3.4	Impacts on water consumption and related wastewater treatment
Environmental impacts	3.3.5	Impacts associated with CO_2 emissions, criteria pollutant emissions, land use, etc. Includes only those impacts that are not included in the utility cost of compliance with environmental regulations
Public health impacts	3.3.6	Impacts on public health; includes health impacts that are not included in participant impacts or environmental impacts, and includes benefits in terms of reduced healthcare costs
Economic development and jobs	3.3.7	Impacts on economic development and jobs
Energy security	3.3.8	Reduced reliance on fuel imports from outside the state, region, or country

This table is presented for illustrative purposes, and is not meant to be an exhaustive list.

See also Step 6 in this chapter, and supporting Chapter 6, which provides information and guidance on methods for accounting for relevant costs and benefits.

3.3.1 Ensuring that Utility Customer Payments Are Justified by Customer Benefits

Regulators/decision-makers are sometimes concerned that including non-utility system impacts in the cost-effectiveness analysis could unduly burden utility customers, particularly customers who do not participate in EE programs. Regulators and consumer advocates sometimes ask: Why should electricity customers pay for participant gas or oil savings? Why should gas customers pay for participant electricity or oil savings? Why should utility customers pay for environmental, jobs, or other societal benefits?

The answer to these questions is that utility customers should pay for these benefits if called for by applicable policies in statutes, regulations, and orders, as consistent with *Policy Principle*. Presumably, the advantages of these policy benefits will outweigh the disadvantages. In many cases, such as with reliability, reduced risk, fuel diversity, economic development, energy security, and environmental benefits, all utility customers will collectively share in the non-utility system benefits.

3.3.2 Consider Participant Impacts

Efficiency program participants experience several types of costs and benefits. Program participant impacts are summarized in Table 7, and discussed in more detail in Chapters 6 and 8.

Table 7. Program Participant Costs and Benefits

Affected Party	Costs	Benefits
Efficiency Program Participant	Measure Costs (customer portion) Financial Costs (customer portion) Transaction Costs Increased O&M Costs Increased Other Fuel Consumption Increased Water Consumption	Reduced Bills (typically reflected as avoided utility system costs) 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

This table is presented for illustrative purposes and is not meant to be an exhaustive list. Note that some of these impacts are energy related with others are not. Those that are not energy related are conventionally referred to as non-energy costs or non-energy benefits.

When considering whether to include participant impacts in the cost-effectiveness tests, it is important to consider two overarching points:

1. The decision of whether to include participant impacts in the primary cost-effectiveness test is a policy decision. Regulators may choose to include participant impacts in the primary cost-effectiveness test if that would achieve the jurisdiction's policy goals.
2. If regulators decide to include participant costs in any cost-effectiveness test, the test must also include participant benefits, and *vice versa*. This is necessary to ensure symmetrical treatment of participant impacts, consistent with *Symmetry Principle* set forth in Chapter 1.

With regard to the first point above, some jurisdictions may not have an explicit policy goal regarding whether to include program participant impacts when assessing EE resources. Legislators and other decision-makers may not have addressed this question when promulgating legislation or regulations related to EE resources. In these cases, regulators and other decision-makers should decide whether to include participant impacts based upon the policy context that does exist in the jurisdiction and with appropriate input from relevant stakeholders.

Rationale for Including Participant Impacts

Several key issues should be addressed when deciding whether to account for participant impacts in the primary cost-effectiveness test. Regulators and other decision-makers should determine whether there is a policy justification for including participant impacts in the primary test. They should also consider the rationale and advantages of including participant impacts in the primary test.

Table 8 provides a summary of the reasons to include participant impacts in their primary cost-effectiveness test, as well counter-points to these reasons. These points and counter-points are discussed in more detail in Chapter 8.

Table 8. Points and Counter-Points Regarding Whether to Include Participant Impacts

Reasons for Including Participant Impacts	Counter-Points
Including participant impacts accounts for the costs on all utility customers: participants and non-participants.	Participant impacts fall outside the scope of utility system impacts. If EE is treated purely as a utility system resource, then participant impacts are less relevant.
Including participant impacts accounts for the total cost of the resource. If the cost of a resource is split between two entities, then it might appear to be cost-effective when it is not.	If regulators prefer to account for the total cost of a resource in order to address concerns about costs being split between two entities, it is necessary to also account for the total benefits. This objective essentially requires the use of the SCT. If this objective is important enough, jurisdictions could use an SCT as a pre-screening test and an RVT as the primary test.
Including participant impacts will help protect program participants. Excluding such costs might result in participants paying "too much" for efficiency.	Including participant impacts will not accurately capture the benefits of program participants, because in practice the primary participant benefit is typically represented in terms of avoided utility costs, not reduced customer bills. The Participant Cost test is one way to protect participants.[18] In addition, program design is the best way to protect program participants, and sound program design will result in participants being better off.
Excluding participant impacts would exclude low-income participant benefits from the analysis	Low-income participant impacts can be included in the RVT, without including all participant impacts, if justified by policy goals. Well-defined low-income programs do not require participant costs, which eliminates the typical rationale for including participant impacts.
Excluding participant impacts would exclude other fuel and water impacts from the analysis.	Other fuel and water impacts can be included in the primary test, without including all participant impacts, if justified by policy goals.

Implications for Non-Participants

Including participant impacts in the cost-effectiveness test sometimes raises concerns about how this will affect non-participants. Should all utility customers pay for non-energy benefits that are enjoyed by only participants? Will including participant impacts unduly increase the cost of EE for all customers?

Including participant impacts in the cost-effectiveness test sometimes raises concerns about how this will affect non-participants.

For those jurisdictions that choose to include participant impacts in the RVT, these concerns can be addressed through program design. The incentives offered to the EE program participant could be capped at a level equal to the utility system avoided costs. This would prevent non-participants from paying more than the benefits they receive from the EE resource. This point is also discussed in Section 3.3.1.

In addition, recall that participant non-energy benefits should be included in the RVT if participant costs are included, and vice versa—consistent with the *Symmetry Principle*.

[18] The Participant Cost Test is described in Appendix A. As noted there, the Participant Cost Test is not well-suited for the purpose of assessing the value of EE resources. Nonetheless, it could be used as a secondary test for the purpose of protecting participants.

Those jurisdictions that do not want to support EE programs as a result of benefits that accrue only to participants could decide to exclude participant costs and benefits in the primary cost-effectiveness test.

3.3.3 Consider Low-Income Impacts

It is widely acknowledged that efficiency programs serving low-income customers and low-income communities provide important benefits beyond utility system impacts. Table 9 presents a summary of the types of low-income impacts beyond utility system impacts.

Table 9. Non-Utility Low-Income Costs and Benefits

Affected Party	Costs	Benefits
Efficiency Program Participant	Typically, none. Well-designed low-income programs cover all costs and remove all barriers to low-income customers.	Reduced energy burden Reduced O&M costs Increased comfort Increased health & safety/reduced medical costs Increased productivity Improved aesthetics Property improvements Reduced home foreclosures Reduced need to move/relocate due to unpaid bills
Society	Typically, none.	Alleviating poverty Improving low-income community strength and resiliency Reduced home foreclosures

This table is presented for illustrative purposes, and is not meant to be an exhaustive list.

Many of the benefits to low-income participants accrue to non-low-income efficiency program participants as well. However, the magnitude of some of these benefits can be greater in low-income homes, because (a) the pre-program condition of low-income housing can be worse than that of non-low-income housing, and (b) because the financial condition of low-income customers often more significantly constrains how they manage and live in their homes.

As indicated in Table 9 some low-income benefits affect low-income program participants while some affect society in general. Other low-income benefits, such as reduced foreclosures, could be characterized as accruing to both the participant and society.

Jurisdictions that have policy goals requiring or encouraging the protection of low-income customers should include low-income impacts in their RVT. It is not necessary to include all participant impacts in the RVT in order to include low-income impacts.

> The Colorado PUC requires Public Service Company of Colorado to account for low-income benefits by increasing avoided costs with a 25% proxy multiplier (Skumatz 2014).

Regulators and other decision-makers who choose to include low-income benefits in the RVT do not need to distinguish between benefits to the participant versus those to society. In both cases, the low-income benefits fall outside the scope of utility system impacts, and in both cases these benefits can be included in the primary test, as identified by the jurisdiction's applicable policies.

As noted earlier, some jurisdictions may not have explicit statutes or regulations that address whether low-income impacts should be included in EE cost-effectiveness analyses. In these instances, regulators should develop a policy on how to address low-income impacts; ideally with stakeholder input and due process.

3.3.4 Consider Other Fuel Impacts

Some efficiency resources can either reduce or increase the consumption of "other fuels," which includes fuels beyond those provided by the utility funding the efficiency resource. Other fuels can include savings or increased use of gas (for an electric utility funding the efficiency resource), electricity (for a gas utility funding the efficiency resources), oil, propane, biomass, or other fuels used in a home or business. Table 10 presents several examples of where other fuel impacts can occur in efficiency programs. Further detail on Other Fuels is provided Chapter 6.

Table 10. Examples of Other Fuel Impacts in Efficiency Programs

Program Option	Description
Multi-fuel measures	When efficiency measures for one type of fuel result in savings of another type; for example, when insulation is installed in buildings that are cooled with electric air conditioning but heated with other types of fuels. Multi-fuel efficiency measures are frequently used in building retrofit programs and in new construction programs.
Fuel-optimization measures	When customers can choose from multiple fuel types to optimize the efficiency of an end-use. For example, customers may be given the option to switch from an inefficient oil heating system to a high-efficiency gas heating system.
Fuel-neutral programs	When regulators and efficiency planners choose to offer whole-building efficiency programs that address all fuel types with a single program provided by a single program administrator. This results in more efficient program delivery, fewer transaction costs, greater efficiency measure adoption, and better customer service in general.
Combined heat and power programs	When technologies are used to generate electricity efficiently, but require increased consumption in other fuels such as natural gas or biomass.
Strategic electrification options	When programs are designed to promote switching from non-electric to electric fuel for policy reasons. For example, an electric utility may wish to promote electric vehicles to achieve environmental and transportation policy goals.

Some efficiency programs might include more than one of the program options listed above. For example, fuel-neutral programs typically include multi-fuel measures and can include fuel-optimization measures.

Jurisdictions that have policy goals promoting the efficient use of other fuels should include other fuel impacts in their RVT. This would be appropriate for jurisdictions with goals relating to multi-fuel measures, fuel-optimization measures, fuel-neutral programs, combined heat and power programs, or strategic electrification programs.

As described in Appendix C, it is not necessary to include participant impacts in the RVT in order to include other fuel impacts. Whenever other fuel impacts are included in a cost-effectiveness test it is important to ensure that the test properly accounts for both reductions and increases in the other fuels.

Illinois law requires that electric EE cost effectiveness testing account for quantifiable societal benefits, including avoided natural gas utility costs, and that natural gas EE cost-effectiveness considers other quantifiable societal benefits, including avoided electric utility costs (Illinois 2009).

3.3.5 Consider Water Impacts

Some efficiency measures affect the consumption of water resources, where efficiency can reduce water consumption and wastewater costs by making certain end-uses, such as water heaters, dish washers, or clothes washers, more efficient. EE measures can also reduce water consumption and wastewater costs by reducing the need for electricity generation from power plants that consume water (Regulatory Assistance Project 2013c). Further detail on water impacts is provided in Chapter 6.

Jurisdictions whose applicable policy goals require or encourage the reduction in water and wastewater resources should include these impacts in their RVT. It is not necessary to include participant impacts in the RVT in order to include water impacts. Either way, care should be taken to ensure there is no overlap in participant, utility, or societal water savings. Whenever these resources are included in a cost-effectiveness test it is important to ensure that both reductions and increases in water and wastewater resources are accounted for properly.

The Oregon Commission has determined that efficiency cost-effectiveness analyses should include total costs and total benefits, including quantifiable non-energy benefits, which should encompass water savings (Oregon 1994).

3.3.6 Consider Environmental Impacts

Efficiency resources can provide a variety of benefits by reducing the environmental impacts of the energy resources that are avoided or deferred. Table 11 summarizes some of these key environmental benefits. In some cases, efficiency programs might cause environmental costs, which must be accounted for along with environmental benefits. Further detail on environmental impacts is provided in Chapter 6.

Table 11. Examples of Environmental Impacts of EE Resources

Types of Environmental Impacts
• Reduced carbon emissions • Reduced emissions of criteria and other air pollutants • Reduced liquid and solid waste (nuclear, coal ash, etc.) • Reduced water for cooling electric generating stations, extracting natural gas (e.g., “fracking”), and other purposes • Reduced adverse impacts on the land that must be developed for new generating facilities • Reduced adverse impacts on land, air, and water from fuel mining or extraction

This table is presented for illustrative purposes and is not meant to be an exhaustive list. These environmental impacts can be in the form of costs or benefits. For each type of environmental impact included in the RVT, both costs and benefits, should be included.

The costs of complying with current and future environmental regulations should be included in the utility system costs. Only additional environmental impacts that might occur despite compliance with environmental regulations (i.e., residual impacts), should be considered a non-utility system impact. Regulators and efficiency planners should treat these two types of environmental impacts separately, to avoid double-counting.

Jurisdictions that have applicable policy goals requiring or encouraging the reduction of environmental impacts should include environmental impacts in their RVT.

3.3.7 Consider Public Health Impacts

District of Colombia law requires that in "supervising and regulating utility or energy companies, the Commission shall consider the *public safety,* the economy of the District, the conservation of natural resources, and the preservation of environmental quality" (District of Columbia 2008).

One of the results of some of the environmental emission and waste reductions discussed above is a reduction in the frequency and/or severity of health problems of populations impacted by fuel extraction and combustion. Such reductions can reduce the level of societal investment required in medical facility infrastructure, as well as in the health, well-being, and economic productivity of the populace.

Public health benefits can take the form of direct benefits in health of the populace caused by reduced air emissions from power plant generation due to EE investments. Health issues typically considered here include those associated with poor air quality due to ozone or smog, such as respiratory problems and asthma. Public health benefits can also take the form of indirect benefits from reduced healthcare costs for customers.

In addition to improved *outdoor* air quality and associated public health impacts, EE investments in buildings can improve the health of occupants by addressing and improving *indoor* air quality (IAQ), largely through improved building envelope and ventilation measures. While direct health impacts to home occupants, especially related to reduced asthma incidences, are relevant to participant impacts (as addressed above), there are also important broader public health impacts associated with reduced emergency room visits, and associated medical costs.

Jurisdictions whose applicable policy goals include improving public health should include public health impacts in their RVT. Jurisdictions that choose to include participant, environmental, and public health impacts should ensure that there is no double-counting across these three types of impacts.

Rhode Island law establishes state greenhouse gas reduction goals, and articulates that "consideration of the impacts of climate change shall be deemed to be within the powers and duties of all state departments, agencies, commissions, councils, and instrumentalities..." (Rhode Island 2014).

3.3.8 Consider Economic Development and Job Impacts

All types of utility resource investments will have economic development and job impacts. EE resources will typically increase jobs and economic development, relative to investments in supply-side resources. The types of jobs associated with EE generally fall into three categories:

- Jobs associated with managing, delivering, and evaluating the efficiency programs.
- Jobs associated with additional work and revenue that EE programs funnel to the supply chains associated with efficiency measures being installed in homes and

businesses; this includes contractors, builders/developers, equipment vendors, product retailers, distributors, manufacturers, and others (E4TheFuture 2016b, 4).

- Indirect impacts, where customers with reduced energy bills will have more disposable income that may be spent in the local community (or beyond), which helps create jobs and spur economic development.

Jurisdictions whose applicable policy goals include promoting jobs and economic development should include these impacts in their RVT. When this is done, it is necessary to also account for jobs lost or reduced economic development. In other words, the cost-effectiveness analysis should include *net* economic and job impacts from the efficiency program.

> Delaware's Energy Conservation and Efficiency Act states that the benefits of cost-effective EE include new economic development opportunities (Delaware 2009).

3.3.9 Consider Energy Security

EE can reduce the consumption of fuels and resources that are imported from outside the relevant jurisdiction. This can include fossil fuels that are imported from other regions, electricity that is imported by transmission lines, and natural gas that is imported through pipelines. It can also include fossil fuels that are imported from other parts of the world, including countries that are politically or economically unstable. Over-reliance upon imported fuels can increase price volatility and increase risks associated with energy supply and reliability.

> A Washington statute states that "increasing energy conservation and the use of appropriately sited renewable energy facilities will promote energy independence in the state and the Pacific Northwest region (Washington 2006).

Jurisdictions whose applicable policy goals include promoting energy security should include these impacts in their RVT. When this is done, it is necessary to ensure that there is no double-counting of this impact in other impacts, such as utility-system risk impacts and jobs and economic development impacts.

3.4 STEP 4: Ensure the Test Is Symmetrical

Review all 7 steps on page 18.

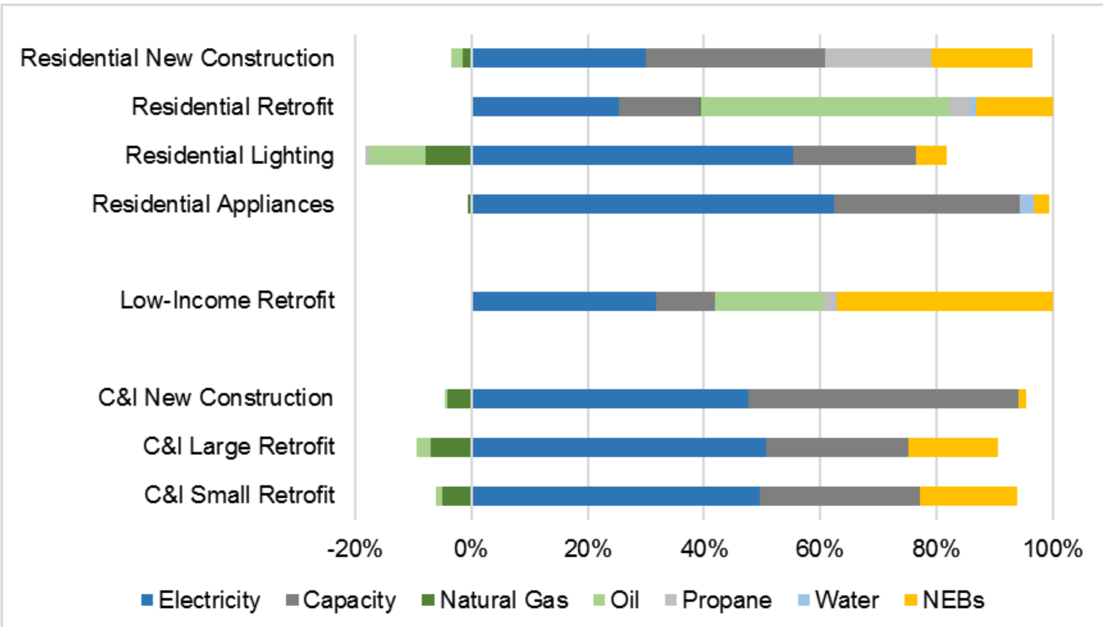
Once it has been determined what categories of impacts to include in a jurisdiction's RVT in Step 3, Step 4 is to ensure that the test includes all costs and all benefits associated with each category of impacts. If some costs are excluded, the framework will be inappropriately biased in favor of efficiency; if some benefits are excluded, the framework will be inappropriately biased against efficiency. If the test results in a bias either in favor of or against EE resources, the result will be a misallocation of resources, with higher than necessary costs incurred by utility customers. Hence the importance of applying the *Symmetry Principle* as a discrete step in the Framework process.

> **If the test results in a bias either in favor of or against EE resources, the result will be a misallocation of resources, with higher than necessary costs incurred by utility customers.**

One example of where this is especially important is regarding program participant costs and benefits. Where states have used the TRC test, which should include participant *costs*, most states do not in reality include participant *benefits* (ACEEE 2012).[19] This leads to a cost-effectiveness test that is skewed against EE. The results will understate the benefits of efficiency resources, and lead to higher utility costs than necessary (Regulatory Assistance Project 2012).

Figure 3 presents the percent of total benefits that are created by different types of benefits, including participant NEBs, using the results of cost-effectiveness analyses for actual efficiency programs operated by a Massachusetts electric utility (Eversource 2017). As indicated, participant NEBs can represent a large portion of total benefits, and will significantly affect the cost-effectiveness results.

Figure 3. Implications of Participant Benefits on Residential Efficiency Programs



Finally, applying the principle of symmetry sometimes requires estimating "net" impacts for certain types of benefits. For example, if economic development gains from EE resources are included in the cost-effectiveness framework, it is important to also include economic development losses associated with not implementing the avoided resources in the counter-factual scenario. This is frequently achieved by estimating net economic development gains from efficiency resources.

3.5 STEP 5: Ensure the Analysis Is Forward-Looking and Incremental

Review all 7 steps on page 18.

Step 5 applies the *Forward-Looking Principle,* which requires that cost-effectiveness analyses should be forward-looking and incremental. This requires accounting for future, long-run, marginal costs and benefits, which embodies three inter-related concepts.

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[19] Throughout this discussion, the term "participant benefits" refers to all of the benefits other than the reduction in the participant's utility bill.

1) Cost-effectiveness analyses should only consider forward-looking impacts. Historical (or “sunk”) costs should not be included when estimating the impacts of future investment decisions. Historical costs cannot be changed, and will remain in place under any future scenario, and therefore are not relevant when comparing future investment scenarios.[20]
2) Cost-effectiveness analyses should include long-run costs and benefits. Electric and gas resources can last for forty or even sixty years. Thus, the resource decisions made today will affect customers for decades in the future. Utilities have a responsibility to meet customer needs in a safe, reliable, and low-cost way over the long term. Regulators have a responsibility to protect customers over both the short term and the long term. Over-emphasis on short-term costs could unduly increase long-term costs for customers.[21]
3) Cost-effectiveness analyses should consider only marginal impacts. These are defined as the incremental changes that will occur because of the EE resource, relative to a scenario where the resource is not in place.

3.6 STEP 6: Develop Methodologies to Account for All Relevant Impacts

Review all 7 steps on page 18.

Step 6 applies the *All Relevant Impacts Principle.* This requires that all relevant impacts of EE resources that a jurisdiction has chosen to assess via its cost-effectiveness test should ideally be estimated in monetary terms. In this way, they can be readily compiled and compared directly. However, some EE impacts are difficult to quantify in monetary terms, either due to the nature of the impact or the lack of information available about the impacts.

Substantive EE resource costs and benefits should not be excluded or ignored because they are difficult to quantify and monetize. Approximating hard-to- quantify impacts is preferable to assuming that those substantive costs and benefits do not exist or have no value.

Table 12 summarizes five different approaches that can be used to account for all impacts of EE resources that a jurisdiction has chosen to include in its cost-effectiveness test. The approaches are listed in order of technical rigor and preference.

[20] Historical costs do have important implications for rate impacts and potential cost-shifting between customers. These costs should be considered in a separate rate impact analysis, as discussed in more detail in Appendix C.

[21] Discount rates are used to enable the regulators to properly balance short-term and long-term impacts on customers. This topic is addressed in Chapter 9.

Table 12. Different Approaches to Account for All Relevant Impacts

Approach	Description
Jurisdiction-specific studies	Jurisdiction-specific studies on EE costs and avoided cost offer the best approach for estimating and monetizing relevant impacts.
Studies from other jurisdictions	If jurisdiction-specific studies are not available; studies from other jurisdictions or regions, as well as national studies, can be used for estimating and monetizing relevant impacts.
Proxies	If monetized impacts are not available; well-informed and well-designed proxies can be used as a simple substitute.
Quantitative and qualitative information	Relevant quantitative and qualitative information can be used to consider impacts that cannot or should not be monetized.
Alternative thresholds	Pre-determined thresholds that are different from one (1.0) can be used as a simplistic way to account for relevant impacts that are not otherwise accounted for.

3.7 STEP 7: Ensure Transparency

Review all 7 steps on page 18.

The *Transparency Principle* provided in Chapter 1 constitutes a discrete and final step in the Resource Value Framework process. Transparency is critical to supporting a successful RVT. EE cost-effectiveness analyses require many detailed assumptions and methodologies, and they typically produce many detailed results.

There are two key junctures where transparency is addressed in this NSPM. The first is addressed as part of Step 1 earlier in Chapter 3.1, which includes a template format (Table 3) for how a jurisdiction could articulate its energy and other applicable policy goals. This exercise can help to provide a clear platform from which interested parties can confirm priorities, gaps or missing needs, and identify appropriate costs and benefits.

The second juncture for providing transparency is with regard to documenting the inputs, assumptions, and results of the cost-effectiveness analyses. A reporting template can be used to provide clear and consistent information for all interested parties. If used across jurisdictions, this template can provide comparability across cost-effectiveness assumptions and results to support sharing of data, where appropriate, and identification of possible opportunities for improvements in program design.

Why Transparency? In order for regulators and other stakeholders to properly assess and understand cost-effectiveness analyses—and therefore to ultimately ensure that cost-effectiveness conclusions are reasonable and robust—key inputs, assumptions, methodologies and results should be clearly documented in sufficient detail to enable independent reproduction of cost-effectiveness screening results.

3.7.1 Template Reporting Table

As a jurisdiction applies the Resource Value Framework to develop its cost-effectiveness test, transparent documentation of all key inputs, assumptions, methodologies, and results will help ensure that the approach to cost-effectiveness analysis is consistent with fundamental economic principles. It will also help to support stakeholder discussions and input to regulatory and other policymaker considerations and decisions.

The use of a standard template will help to provide a comprehensive, consistent, and easily accessible structure for such documentation. The template should present both the monetized and non-monetized findings of the assessment. It should include references for all key assumptions and methodologies used. The scope of reporting can be at the program, sector, or portfolio level. The sample template is provided in Table 13 below.

Table 13. Efficiency Cost-Effectiveness Reporting Template

Program/Sector/Portfolio Name:		Date:	
A. Monetized Utility System Costs		**B. Monetized 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	
Shareholder Incentive Costs		Energy Price Suppression Effects	
		Avoided Costs of Complying with RPS	
		Avoided Environmental Compliance Costs	
		Avoided Bad Debt, Arrearages, etc.	
		Reduced Risk	
Sub-Total Utility System Costs		**Sub-Total Utility System Benefits**	
C. Monetized Non-Utility Costs		**D. Monetized Non-Utility Benefits**	
Participant Costs	*Include to the extent these impacts are part of the RVT.*	Participant Benefits	*Include to the extent these impacts are part of the RVT.*
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	
Sub-Total Non-Utility Costs		**Sub-Total Non-Utility Benefits**	
E. Total Monetized Costs and Benefits			
Total Costs (PV$)		**Total Benefits (PV$)**	
Benefit-Cost Ratio		**Net Benefits (PV$)**	
F. Non-Monetized Considerations			
Economic Development and Job Impacts	*Quantitative information, and discussion of how considered*		
Market Transformation Impacts	*Qualitative considerations, and discussion of how considered*		
Other Non-Monetized Impacts	*Quantitative information, qualitative considerations, and how considered*		
Determination:	**Do Efficiency Resource Benefits Exceed Costs? [Yes / No]**		

Note that the most useful and appropriate way to present the results of analyses of monetized efficiency costs and benefits is in present value (PV$) terms. Present value is defined as the value today (or a given year) of a certain amount of money in the future, where the future value is converted to PV$ using a discount rate. (See Chapter 9 for discussion of discount rates).

In addition, the PV$ values should cover the full life of the resource being analyzed (see Chapter 11 for discussion of analysis periods), or what is sometimes referred to as the cumulative present value or the present value of lifecycle costs and benefits. A cumulative or lifecycle present value is the discounted sum of a stream of current and future annual costs and benefits.

3.7.2 Reporting Categories and Descriptions

The key reporting categories in Table 13, and supporting descriptions, are as follows:

- **Monetized Utility System Costs and Benefits.** Sections A-B of the template table report on the utility system impacts, the foundation of any cost-effectiveness analysis, consistent with the *Efficiency as a Resource Principle*. More detailed information on the sub-categories of utility system costs and benefits can be found in Chapter 6 of this manual.
- **Monetized Non-Utility Costs and Benefits.** Sections C-D of the template table report on the non-utility impacts, as identified and informed by the Framework Steps 1-6. Consistent with the *Symmetry Principle* for treatment of costs and benefits, for any category of costs included on the left side of the template in Table 13 (Section C) there should also be corresponding benefits included on the right side of the table (Section D)—and vice versa. More detailed information on the sub-categories of non-utility system costs and benefits can be found in Chapter 6 of this manual. A discussion of methodologies for monetizing impacts can be found in Chapter 7.
- **Benefit-Cost Ratios and Net Benefits.** Section E of the template table includes several reporting parameters that provide critical information regarding cost-effectiveness test results:
- **Total Costs (PV$) and Total Benefits (PV$)** are simply the sum of all monetized utility system and non-utility costs and benefits.
- **Benefit-Cost Ratio** is equal to the ratio of the cumulative present value of benefits to the cumulative present value of costs. This metric is especially useful as a simple benchmark for determining cost-effectiveness: if an efficiency resource's BCR exceeds 1.0, it means that benefits exceed costs. That criterion is typically used to indicate that something is cost-effective.

  The BCR metric can be useful for comparing efficiency resources with each other (i.e., a higher BCR indicates one resource is "more cost-effective" than another), because it effectively normalizes the results for programs of different sizes. This metric is also useful for comparing efficiency resources across utilities and jurisdictions of different sizes, again because it effectively normalizes the results for any differences in size.[22]

The BCR metric provides an important element of information that is not provided by a net benefits metric. It does this by indicating the relative effectiveness of the money spent on the resource. i.e., how many dollars of benefits are received per dollar spent. For example, a net benefit of $10 million in PV$ does not indicate how much money was needed to generate those net benefits. It could have cost $90 million, with benefits of $100 million and a BCR of 1.11. Or it could have cost $4 million, with benefits of $14 million and a BCR of 3.50.[23]

- **Net Benefits (PV$)** is equal to the difference between the cumulative present value of benefits and the cumulative present value of costs. This metric is useful as a benchmark for determining cost-effectiveness: if an efficiency resource's net benefits are greater than zero, it should be deemed to be cost-effective.

  The net benefits metric provides an important element of information that is not provided by the BCR metric, by indicating the absolute magnitude of the benefits to be gained by the efficiency resource. For example, a BCR of 2.2 does not indicate how much money will be saved by the resource. It might save $1 million, $10 million, or $100 million.

  The net benefits of efficiency resources cannot easily be used to compare efficiency resources across different utilities and jurisdictions. A large utility would naturally expect to have higher net benefits than a small utility for a comparable type of program.

- **Non-Monetized Considerations.** Section F of the template shown in Table 13 is where discussion of the non-monetized impacts should be summarized. See Chapter 7 for discussion of techniques for consideration of non-monetized impacts.

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[22] However, in making such comparisons it is important to recognize that different utilities and jurisdictions might have different avoided costs, i.e., different benefits for the same amount of savings. Different jurisdictions might also include different impacts in their resource assessment test.

[23] On the other hand, trying to maximize the BCR by including only measures/programs with the highest BCRs can result in excluding resources that are still cost-effective and would contribute to greater net benefits. This is sometimes referred to as "cream-skimming."

4. Relationship to Traditional Tests

This chapter provides examples of the RVT for a hypothetical set of jurisdictions, emphasizes the variable nature of the RVT, and discusses its relationship with the cost-effectiveness tests that have traditionally been most commonly used (the UCT, TRC and SCT).

4.1 Summary of Key Points

- Because the RVT is based on each jurisdiction's policy objectives, and those objectives can vary across jurisdictions, it can—indeed, it should—take a variety of different forms across different jurisdictions.
- Among the forms the RVT can potentially take are the conceptual forms of the three traditional used tests: the UCT, TRC test, or the SCT. The RVT will align with one of those tests only if the jurisdiction's policy objectives are (1) limited to just minimizing utility system costs (UCT); (2) concerned with minimizing the combination of utility system costs, other fuel costs, and efficiency program participant costs—but with no other impacts (TRC); or (3) concerned with all potential societal impacts (SCT).
- However, in most jurisdictions, the mix of relevant policy objectives will lead to an RVT that is different in at least some respects from the conceptual construct of each of the traditional tests.
- Many jurisdictions that have been nominally using one of the traditional tests have actually modified the tests—adding or subtracting categories of impacts—to the point where they are fundamentally different from the conceptual construct of such tests. In effect, those jurisdictions have attempted to do what the Resource Value Framework is designed to do: develop a test that aligns with their policy objectives. However, because such efforts are not always as systematic, transparent, or grounded in key principles of cost-effectiveness as they could be, the resulting tests can be less effective in addressing jurisdictional policy objectives than if an RVT was developed using the framework put forward in this manual.

4.2 Resource Value Test Examples

As explained in Chapters 1–3, using the Framework process leads a jurisdiction to develop a primary RVT that is specific to each jurisdiction, based on its applicable policy objectives. Thus, RVTs can and should take a variety of different forms across different jurisdictions. Among the forms an RVT could potentially take are the conceptual forms of the traditional tests: the UCT, the TRC test, and the SCT.

Alternatively, a jurisdiction's RVT can take—and probably often will take—a form that is different from the conceptual construct of the traditional tests. The extent to which a jurisdiction's RVT diverges from or aligns with the traditional tests will be a function of the jurisdiction's relevant policy objectives.

Alternatively, a jurisdiction's RVT can take—and probably often will take—a form that is different from the conceptual construct of the traditional tests.

This is shown for six hypothetical jurisdictions described in the bullets below and summarized in Table 14. For illustrative purposes, the six jurisdictions are split into two groups. First, in hypothetical jurisdictions 1 through 3, the application of the Resource Value Framework leads to development of an RVT that differs from the traditional cost-effectiveness tests. Second, in hypothetical jurisdictions 4 through 6, the application of Framework leads the jurisdiction to the development of an RVT or primary test where the impacts included are consistent with what should be included in the traditional cost-effectiveness tests, in their conceptual form.

Table 14. Mix of Policy Objectives Leading to Different Jurisdictional RVTs

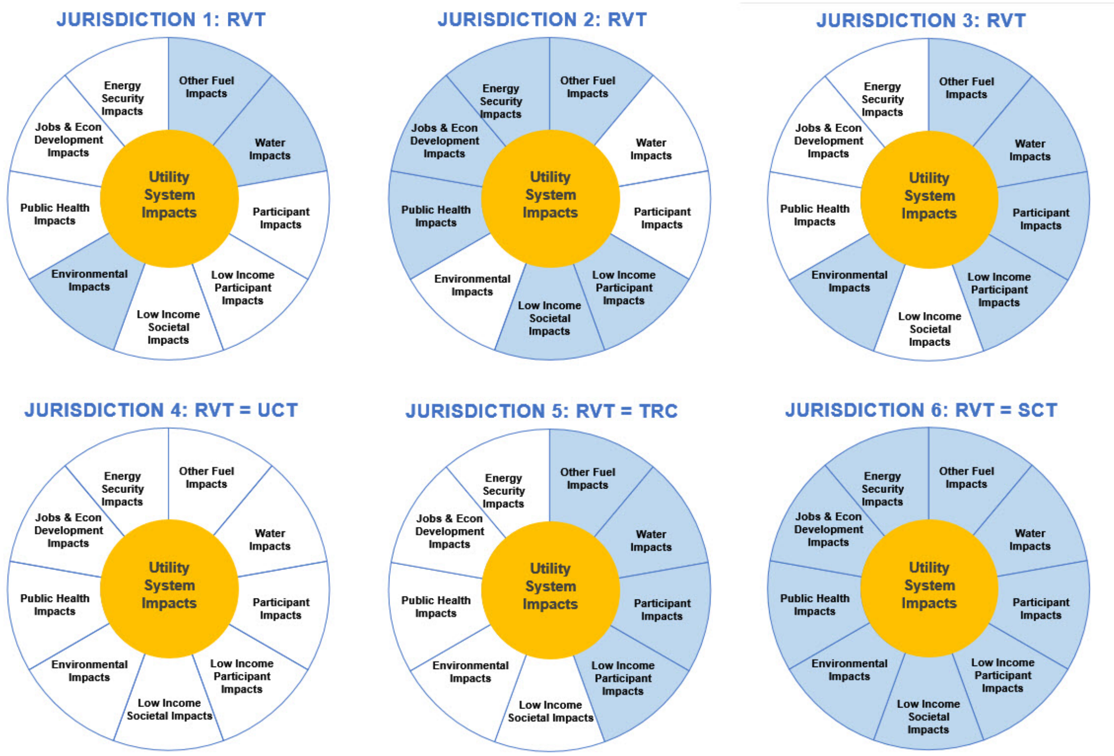
Impacts	Jurisdiction					
	1	2	3	4	5	6
	RVTs Differ from Any Traditional Test			RVT = UCT	RVT = TRC	RVT = SCT
Utility System	✓	✓	✓	✓	✓	✓
Other Fuels	✓	✓	✓		✓	✓
Water	✓		✓		✓	✓
Participants			✓		✓	✓
Low-Income Participants		✓	✓		✓	✓
Low-Income Societal		✓				✓
Environmental	✓		✓			✓
Public Health		✓				✓
Economic Development		✓				✓
Energy Security		✓				✓

- **Jurisdiction #1** is interested in not just minimizing utility system costs, but also with minimizing total energy costs (i.e., across all fuels), minimizing water costs, and minimizing environmental costs. Because it is concerned with more than utility system costs, its RVT is not the same as the UCT. Because it is not concerned with participant costs but is concerned with environmental costs, its RVT is not the same as the TRC. And because it is not concerned with either participant costs or a range of other impacts (other than the environment), its RVT is not the same as the SCT.
- **Jurisdiction #2** represents a jurisdiction that is interested in utility system impacts, other fuel impacts, low-income impacts, public health impacts, economic development impacts, and energy security impacts. Again, that mix of concerns is not the same as the mix represented by either the UCT, TRC, or SCT.
- **Jurisdiction #3** is interested in utility system, other fuel, water, participant, low-income participant, and environmental impacts. That mix of concerns is clearly much more than those captured by the UCT or TRC and less than those captured by a strict application of the SCT. In short, it is somewhere "between" the TRC and SCT.
- **Jurisdiction #4** determines that its only policy interest related to efficiency investments is in minimizing costs to the funding utility system, producing an RVT that is conceptually identical to the UCT.

- **Jurisdiction #5** determines that its policy interests are limited to impacts on the utility system plus impacts on other fuels, water, and EE program participants (low-income and non-low-income). Therefore, its RVT is conceptually consistent with the TRC.[24]
- **Jurisdiction #6** determines that its policy interest extends to all utility, other fuel, water, participant, low-income, environmental, public health, economic development, energy security, and any another relevant non-utility impacts, producing an RVT that is conceptually identical to the SCT.[25]

These six scenarios are also illustrated graphically in Figure 4. The graphics for Jurisdictions 1, 2 and 3 show that the applicable policies for these jurisdictions would lead these jurisdictions to an RVT that differs from any one of the traditional cost-effectiveness tests. While for Jurisdictions 4, 5 and 6, the applicable policies would lead these jurisdictions to developing a primary test that aligns with the traditional UCT, TRC, and SCT, respectively.

Figure 4. Mix of Policy Objectives that Lead to a Jurisdictional RVT Identical to a Traditional Test



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[24] The phrase "conceptually consistent with the TRC" is used because the concept underlying the TRC is consideration of utility system plus participant impacts. As discussed further in Appendix A, the application of the TRC in most jurisdictions has historically often not been consistent with that concept because most jurisdictions that use the TRC include all participant costs but only a portion of or even no participant non-energy benefits, violating the symmetry principle described in Chapter 1 of this manual.

[25] The phrase "conceptually identical to the SCT" is used because the concept underlying the SCT is consideration of all utility, other resource, participant, and societal impacts. As discussed further in Appendix A, the application of the SCT in most jurisdictions is not consistent with that concept because most jurisdictions that use the SCT (1) include all participant costs but only a portion of or even no participant non-energy benefits and (2) do not fully account for all societal impacts.

Note: The size of the "pie pieces" in these graphs is not intended to convey any sense of relative magnitude or importance of the different categories of benefits.

4.3 Conceptual Differences between the RVT and Traditional Tests

Conceptually, each of the three traditional tests represents a different perspective on cost-effectiveness: the perspective of the utility system (UCT), the combined perspective of the utility system plus efficiency program participants (TRC), and the societal perspective (SCT). Thus, each addresses a fundamentally different cost-effectiveness question and includes a different set of costs and benefits. A more detailed discussion of these tests is included in Appendix A.

The new test put forward in this manual—the RVT—represents a different perspective: minimizing costs in the context of a jurisdiction's applicable policy goals. As Table 15 shows, analysis from that perspective answers a conceptually different cost-effectiveness question than any of the three questions answered by the traditional tests: will utility system costs be reduced while achieving relevant policy goals? As discussed in Section 4.2, depending on the energy policies of a jurisdiction, that may or may not lead to inclusion of different categories of impacts (costs and benefits) in the test. The conceptual differences between the RVT and the three traditional tests are summarized in Table 15.

Table 15. Comparing the RVT and the Traditional Tests

Test	Perspective	Key Question Answered	Categories of Costs and Benefits Included
Utility Cost Test	The utility system	Will utility system costs be reduced?	Includes the costs and benefits experienced by the utility system
Total Resource Cost Test	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	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	Regulators or 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 energy policy goals

In those cases where a jurisdiction's policy goals align with one of the other tests, the RVT will be the same as that other test.

Importantly, the RVT is conceptually dynamic rather than static, i.e., it can include different types of impacts in different jurisdictions because policy objectives can vary across jurisdictions. And within any given jurisdiction, the components of the RVT can evolve over time as policies change. In contrast, the categories of impacts included in the traditional tests—UCT, TRC, and SCT—are conceptually fixed. They would not change (either across jurisdictions or over time) if the tests were applied in their purest conceptual form (as shown in Figure 5 for example.)

That said, in reality many jurisdictions have used and/or are currently using tests that go by the name of one of the traditional tests, but are fundamentally different from the conceptual construct of those tests. Examples include:

- States that nominally use the TRC, but exclude other fuel impacts and/or exclude participant non-energy benefits even though such impacts would need to be included to represent the conceptual construct of the TRC—i.e., cost-effectiveness from the combined perspective of the utility system and efficiency program participants;
- States that nominally use the TRC, but include environmental or other impacts that are beyond the conceptual scope of the TRC; and
- States that nominally use the SCT, but do not include any societal impacts other than environmental impacts—i.e., falling short of a true societal perspective.

The Regulatory Perspective flows from the notion that it cannot be determined whether a resource has benefits that exceed its costs without first being clear about what goals the resource investment decisions should accomplish.

In effect, some jurisdictions appear to have been doing or trying to do what the RVT is explicitly designed to do: developing a test that aligns with their policy objectives. However, rather than systematically building such a test from the ground up using the Framework described in this manual, decision-makers started with one of the traditional tests and then added categories of impacts that were construed to be important to add, and/or subtracted categories of impacts that were not considered important enough to include. Such a process could potentially lead to the very same test that the application of the Resource Value Framework would produce.[26]

However, such a piecemeal approach suffers from several drawbacks. First, the process is not likely to be initially grounded in the key principles of cost-effectiveness analysis enunciated in this manual. Second, it begins with a traditional test, which may not be the best starting point and whose economic implications may not be fully understood. Third, the consideration of policy objectives may not be systematic or sufficiently thorough. As a result, such a process can lead to a test that does not fully align with the jurisdiction's policy objectives or other cost-effectiveness fundamentals. Finally, the process for arriving at the test may not be transparent enough to enable an adequate level of understanding and informed input by stakeholders. For these multiple reasons, the use of the Framework to develop a jurisdiction-specific cost-effectiveness test is the recommended approach.

In reality, many jurisdictions have used and/or are currently using tests that go by the name of one of the traditional tests, but are fundamentally different from the conceptual construct of those tests.

[26] The California Public Utility Commission Staff recently proposed a new cost-effectiveness test for DERs that is generally consistent with an RVT (California Public Utility Commission Staff 2017). The Staff proposes to use a test that includes utility system impacts, participant impacts, and specific environmental impacts. California has been using the TRC test for many years, and the environmental impacts were added based on legislative directives. While the Staff proposal refers to its new test as an SCT, it does not include all societal impacts. Rather, the California test accounts for the state's applicable policies — and thus is consistent with an RVT.

5. Secondary Cost-Effectiveness Tests

This chapter provides information about the potential role of secondary tests, their benefits and limits, and selecting and constructing such tests.

5.1 Summary of Key Points

- The purpose of the primary RVT is to address the threshold question of whether a resource has benefits that exceed its costs and therefore merits acquisition.
- Secondary tests can help address other important questions such as how much utility customers should be expected to pay for a resource that is cost-effective under the RVT, which programs to prioritize if it is not possible to pursue all cost-effective efficiency and/or if there should be constraints on key program design features (e.g., financial incentive levels).
- Secondary tests can also help clarify sensitivities to and/or inform decisions regarding which categories of impacts to include in the RVT.
- There is a wide range of potential secondary tests to consider. Decisions on which secondary tests to use should be a function of the primary purpose(s) for using them and the policy priorities of the jurisdiction.

5.2 Potential Reasons for Using Multiple Tests

As covered in Chapter 3, the RVT is designed to answer for jurisdictions the most fundamental question in assessing efficiency resources: *what is the universe of resources whose benefits exceed their costs and therefore merit acquisition (in lieu of acquiring other supply or demand-side resources)?* However, there can also be value in assessing cost-effectiveness of efficiency resources from other perspectives represented by other tests. Among the potential purposes of using additional tests are:

- **To inform decisions regarding which categories of impacts to include in the primary RVT**. In many cases, the decision as to whether a jurisdiction's applicable policies would support inclusion of a category of impacts in the RVT will be very clear. However, in some cases it may not be quite so obvious or straight-forward. In those cases, there may be value to assessing efficiency resources through two or more potential variations of the RVT to fully understand the sensitivity of results to and therefore the implications of the inclusion or exclusion of one or more categories of impacts in the primary RVT.
- **To inform decisions regarding how much utility customer money could or should be invested to acquire cost-effective savings**. As noted above, the RVT is designed to answer the threshold cost-effectiveness question of which efficiency resources have benefits that exceed costs and therefore merit acquisition. Depending on the policies of a jurisdiction, it may or may not necessarily answer (or fully answer) questions of how those resources should be acquired or who should pay for their acquisition, including how much the utility system (i.e., utility customers through their utility bills) should be prepared to pay to acquire them. Secondary cost-effectiveness test results can be used to help inform answers to such questions.

- **To inform decisions regarding which efficiency programs to prioritize if not all cost-effective resources will be acquired**. As noted above, the RVT is designed to answer the threshold question of which resources are cost-effective. In a policy environment in which all cost-effective resources must be acquired, the RVT may be all that is needed to inform decisions on which efficiency programs to fund. However, jurisdictions that do not attempt to acquire all cost-effective efficiency—for example because of statutorily-set funding constraints—may need to make choices *between* cost-effective resources to decide which cost-effective efficiency programs to fund. Jurisdictions may choose to prioritize programs based on RVT net benefits (i.e., which programs have the greatest economic net benefits under their primary test). Alternatively, they may decide to also consider the results of other cost-effectiveness tests to inform such decisions.
- **To inform efficiency program design**. Related to the two points above, there can be important efficiency program design implications associated with decisions to limit how much utility customers should pay for efficiency resources. If secondary cost-effectiveness tests are used to inform decisions on utility customer spending limits, they can also be used to inform related program design decisions (e.g., rebate levels for efficiency measures).
- **To inform public debate regarding efficiency resource acquisition.** Decisions on which categories of impacts to include in a jurisdiction's RVT may be controversial. Thus, by looking at cost-effectiveness through different perspectives that may be favored by different stakeholders, analysis with multiple tests can provide information useful to ongoing dialogue regarding the merits of different levels or types of efficiency resource acquisition.

5.3 Secondary Tests to Consider

There is a wide range of options jurisdictions can consider for secondary tests. At one end of the spectrum is the UCT, which includes only benefits and costs to the utility system funding efficiency resource acquisition. At the other end of the spectrum is the SCT, which includes the full universe of impacts resulting from efficiency resource acquisition. There are numerous additional options in between. Decisions on which of these options to use as secondary tests should be driven by the primary purpose(s) of the secondary analyses.

5.3.1 Understanding Implications of Impacts Included in the RVT

One appropriate purpose of using multiple tests would be to understand the implications of including or excluding certain categories of impacts in a jurisdiction's RVT (primary test.) In particular, this would allow for the examination of categories of impacts about which there may have been some uncertainty, or even controversy, regarding their inclusion (or exclusion) in the RVT. For example, if there was some uncertainty regarding whether either participant impacts or public health impacts should be included in the RVT, with the ultimate decision being to include both, it may be useful to supplement RVT cost-effectiveness analysis with three sensitivity analyses: (1) removing participant impacts from the RVT; (2) removing public health impacts from the RVT; and (3) removing both participant and public health impacts from the RVT.

5.3.2 Informing Efficiency Program Selection, Spending, and/or Design Decisions

Another purpose of secondary tests could be to inform decisions regarding how much utility customers should pay for efficiency resources, which would have implications for which programs should be prioritized over others and/or program design (particularly participant rebates or other forms of financial incentives). In such a case, the secondary test or tests should be those that best represent the perspective of regulators or other decision-makers regarding such decisions.

For example, if the jurisdiction decides that utility customers (i.e., the utility system) should not pay more for an efficiency resource than they receive back in benefits (i.e., reduced utility system costs), then the UCT would be the secondary test to use. Consider, for example, the following hypothetical scenario for a jurisdiction using the UCT for this purpose:

- a jurisdiction whose RVT included utility system impacts, other fuel impacts, participant impacts, low-income impacts, and environmental impacts;
- a non-low-income efficiency program which provides rebates for efficiency measures equal to 80 percent of the measure costs and has administration, marketing, and other non-incentive costs equal to 20 percent of the total program budget; and
- as illustrated in Table 16, an RVT benefit-cost ratio of 1.67, but with only 40 percent of the benefits being utility system benefits and the other 60 percent being other fuel, participant, and environmental benefits such that the UCT benefit-cost ratio is 0.80.

In this example, the RVT suggests that the efficiency program is cost-effective so that the efficiency resource merits acquisition. However, because the jurisdiction does not want utility customers to pay more for efficiency resources than the value to the utility system (i.e., it does not want utility customers to be paying for other fuel savings, improved participant comfort, or other non-utility benefits), it may choose not to run the program—or at least not run it as initially designed. Another option would be to reduce the rebate level enough so that the utility program does pass the UCT—in this case to something less than 60 percent of the measure cost.

Table 16. Using Secondary Test to Address Program Selection or Design Questions

Impact Category	RVT			UCT		
	Question: Is resource worth acquiring?			Question: How much is it appropriate for utility customers to pay for it?		
	Benefits	Costs	Net Bens	Benefits	Costs	Net Bens
Utility System	$8	Rebate: $8 Admin: $2 Total: $10	-$2	$8	Rebate: $8 Admin: $2 Total: $10	-$2
Participant	$7	$2	$5			
Low Income	$0	$0	$0			
Other Fuels	$3		$3			
Environmental	$2	$0	$2			
Total	$20	$12	$8	$8	$10	-$2
Ben-Cost Ratio			1.67 to 1			0.80 to 1

Alternatively, the policy framework for a jurisdiction may allow a determination that it is acceptable for utility customers to pay for certain types of non-utility benefits. For example, regulators may decide, based on a jurisdiction's existing policies, that they are willing to allow utility customers to pay for benefits from saving other fuels and benefits to low-income customers, but not non-low income participants' benefits, environmental benefits, public health benefits, etc. In this example, the secondary test of interest would be a test that includes utility system impacts, other fuel impacts, and low-income impacts. Under that secondary test, the program in the hypothetical example described above would pass cost-effectiveness screening because the sum of the utility system benefits, other fuel benefits, and low-income benefits (i.e., $11 in aggregate) would exceed the program cost ($10).

5.3.3 Informing Public Debate

If secondary tests are to be conducted to inform public debate, it may make sense to consider a range of secondary tests. This range could include both ends of the cost-effectiveness perspective continuum—the UCT and the SCT—as well as any others that represent perspectives that are held by important stakeholders within the jurisdiction. This process could be useful for assisting in the development of the ultimate primary RVT for a jurisdiction.

PART II.
Developing Inputs for Cost-Effectiveness Tests

6. Energy Efficiency Costs and Benefits

This chapter describes the range of EE costs and benefits (i.e., impacts), both utility system and non-utility system impacts, and information for selecting cost and benefits to include in cost-effectiveness assessments.

6.1 Summary of Efficiency Resource Impacts

In Part I of this NSPM, Chapter 3 set forth the key Framework Steps 2–3 to consider both utility-system and non-utility system impacts. These steps relate to the underlying principles that (a) a jurisdiction’s energy and other relevant policies are central to the decision of which impacts to apply, (b) utility system impacts are the foundation of any cost-effectiveness test, and (c) every cost should be matched with its associated benefit, and vice versa, to ensure symmetry.

This chapter builds on Chapter 3 by providing more detail on the wide range of EE costs and benefits that could be considered in cost-effectiveness testing. Information on the range of impacts includes a description of the cost, benefit, and/or net impact, along with any necessary context or key considerations. Where helpful, additional resources are provided for even further guidance.

Examples of different types of EE resource impacts are summarized in Table 17.

Table 17. Summary of Efficiency Resource Impacts

	Type of Impact	Description
Utility System	Costs incurred or saved by the utility that funds the efficiency resource	Includes costs to utility of acquiring efficiency resources. Savings can include reductions in costs to the utility system associated with both avoided capital investments (e.g., for new generating facilities, environmental compliance and T&D) and avoided variable operating costs (e.g., energy/fuel costs).
Non-Utility System	Participant measure costs	Participant measure costs accrue when the financial incentives provided by efficiency programs cover only a portion of the cost of an efficiency measure. Program participants bear the balance of the measure cost.
	Participant non-resource impacts	Impacts on program participants that are not related to resource (fuel or water) savings. Including asset value, productivity, economic well-being, comfort, health and safety, and customer satisfaction.
	Incremental low-income participant impacts	Impacts on low-income program participants that are different from or incremental to non-low-income participant impacts. Includes reduced foreclosures, reduced transiency, and poverty alleviation.
	Other fuel impacts	Impacts on end-use fuels that are not provided by the funding utility, for example, electricity (for a gas utility), gas (for an electric utility), oil, propane, and wood.
	Water impacts	Impacts on participant water consumption and related wastewater treatment.
	Environment	Impacts associated with CO_2 emissions, criteria pollutant emissions, land use, etc. Includes only those impacts that are not included in the utility cost of compliance with environmental regulations.
	Public health	Impacts on public health. Includes health impacts that do not overlap with participant impacts or environmental impacts, and includes benefits in terms of reduced health care costs.
	Economic development and jobs	Impacts on economic development and jobs.
	Energy security	Reduced reliance on fuel imports from outside the state, region, or country.

This table is presented for illustrative purposes and is not meant to be an exhaustive list. The non-utility impacts presented here can be either a cost or a benefit, or can have a net impact that accounts for both costs and benefits. For a comprehensive discussion of EE resource impacts, see Regulatory Assistance Project 2013c.

The balance of this chapter provides additional detail on the impacts referenced in Table 17. Appendix B provides more information about how the costs and benefits relate to other DERs.

6.2 Utility System Impacts

There are a variety of relevant utility system costs and benefits which should be included in any primary cost-effectiveness test.

6.2.1 Utility System Costs

EE Measure Costs

The utility portion of measure costs can take a variety of forms. Among the most common are rebates provided to program participants, whether end-use customers or other market actors such as retailers, contractors, distributors, and manufacturers. Also common are buy-downs of interest rates for financing investments in efficiency measures.

Other Efficiency Financial Incentives

Other incentives include payments to support trade ally reporting on sales of efficient products, and/or funding or co-funding of marketing of efficient products by trade allies. “Spiffs” are another common incentive. These are sales bonuses provided to retail or contractor sales staff for selling efficient products.

Other Efficiency Program and Administrative Costs

These additional costs support utility outreach to trade allies, technical training, other forms of technical support, marketing, and administration and management of efficiency programs and/or portfolios of programs.

Evaluation, Measurement, and Verification (EM&V)

EM&V costs entail either the analysis of markets for efficiency products and services to inform the design of efficiency programs or the retrospective assessment of the effectiveness of efficiency programs.

Performance Incentives

In regulated utility systems, utilities often receive payments for meeting specific performance metrics related to the success of efficiency programs.

6.2.2 Utility System Benefits

Avoided Energy Costs

These are the values of avoiding the generation or the purchase of electric energy (i.e., kilowatt-hours, or kWh)[27] and/or natural gas resulting from investments in efficiency. The marginal cost of avoided energy can vary considerably by both season and time of day. The load shapes of different efficiency resources—i.e., the portion of energy savings that occur during different seasons and different times of day—can also vary substantially. The value of avoided energy costs should account for such differences to the extent possible and practical.

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[27] Typically valued at either forecast wholesale market prices in jurisdictions with competitive wholesale markets or forecast marginal costs of generation for jurisdictions that regulate vertically integrated utilities.

Avoided Generating Capacity Costs

Some portion of the savings of efficiency resources will occur at times that are coincident with system peak demands. Thus, efficiency resources will reduce the amount of money that must be invested in electric generating capacity.[28] The magnitude and type of that reduction will vary considerably from measure to measure, depending on the portion of energy savings that occur during times of system peak demand. Over the long term, efficiency programs can also defer or avoid the need for construction of baseload generation.

Understanding T&D Line Losses

When estimating the magnitude of avoided line losses, it is important to recognize that line losses grow exponentially with load. As a result, the marginal loss rate associated with the last increment of load added to—or removed from—the T&D system (i.e. incremental losses divided by incremental load) is greater than the average loss rate for all load (i.e. total losses divided by total load). Thus, the magnitude of line loss reductions associated with efficiency savings should be based on estimates of marginal—not average—line loss rates (Regulatory Assistance Project 2011).

Further, there should be separate average marginal line loss rates for energy savings and peak savings. By definition, marginal line loss rates at the time of peak will be considerably higher than the weighted average of marginal line loss rates across all hours of the year when energy is saved. Two studies suggest that weighted average marginal loss rates over the course of a year are typically on the order of about 150 percent of average annual loss rates and that marginal loss rates at the hours of system peak (i.e. related to avoided generating capacity) might be twice as great, or on the order of 300 percent of average annual loss rates (Regulatory Assistance Project 2011), (Illinois Commerce Commission 2014).

Avoided Reserves

Electric utilities and/or electric system operators always plan to have at their disposal reserve capacity that can be deployed when a generator shuts down or there is some other form of disruption to the supply of generating capacity. Typically ranging from 7 percent to 25 percent, reserve requirements vary depending on the size of the system and its principle sources of generating capacity (Regulatory Assistance Project 2011). When efficiency resources reduce the amount of generating capacity required for a system, they can also reduce the amount of reserves needed. The value of avoided reserves should either be included in estimates of avoided capacity costs or included separately.

Avoided T&D Costs

Efficiency resources reduce loads on the T&D system. To the extent that at least some portion of those load reductions occur during T&D peaks, they can defer or eliminate the need for investments that would otherwise be required to address localized T&D capacity constraints.

Such deferrals can be passive, meaning they result from system-wide efficiency programs implemented for broad-based economic or other reasons not related to the

[28] There are some exceptions. For example, some heating efficiency measures installed in electric service territories that are summer peaking (and vice versa) will not avoid generating capacity costs. Alternatively, jurisdictions that are forecast to have excess generating capacity well into the future—i.e. beyond the life of the efficiency savings being analyzed—may have no avoidable capacity costs.

intent to defer specific T&D projects. In such cases, the value of avoided T&D costs in some parts of the system are spread across total system T&D peak savings.[29]

They can also be active, such as when geographically targeted efficiency investments are intentionally designed to defer specific T&D projects. The value of active deferrals per peak kW saved will typically be considerably higher than the value per kW for passive deferrals.

In recent years, there has been an increased interest in the value of avoiding distribution costs with DERs. The value of avoided distribution costs can vary significantly depending upon the specific location on the electricity grid. As EE resources become increasingly used, along with other types of DERs, to avoid distribution costs it will be important to develop more sophisticated estimates of the locational values of avoided distribution costs (Analysis Group 2016; ICF International 2016; SEPA 2016; National Grid 2015).

Avoided T&D Line Losses

A portion of all electricity produced at electric generating facilities is lost as it travels from the generating facilities to the homes and businesses that ultimately use the power.[30] Thus, every kWh of efficiency savings realized at the customer's side of the meter equates to more than one kWh of savings at the electric generator. Similarly, every peak kW of savings by end-use customers equates to more than one peak kW of generating capacity. Another key characteristic of line losses is that they expand exponentially as the system experiences higher volumes. For this reason, it is important that calculations account for marginal loss rates for energy savings and peak savings.

Avoided Ancillary Services

Ancillary services are those services required to maintain electric grid stability and security. They include frequency regulation, voltage regulation, spinning reserves, and operating reserves. Efficiency resources may reduce the need for these services by reducing loads on the T&D system. To the extent that these reduced loads lead to lower ancillary services costs, those avoided costs should be included as a benefit.

Energy and/or Capacity Price Suppression Effects

In jurisdictions with competitive wholesale energy and/or capacity markets, prices will be a function primarily of the magnitude of demand. Thus, increased investment in efficiency resources is likely to benefit all consumers through reduced market clearing prices (at least to some extent and for some period of time).

It should be noted that price suppression effects from efficiency resources acquired in a given utility service territory will typically extend beyond the borders of that service territory. This is due to the regional nature of most wholesale markets, which tend to

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29 Estimates of avoided T&D costs can be very utility-specific. For example, 2015 values for New England electric utilities varied between $33/kW-year for Connecticut Light and Power to $200/kW-year for National Grid Rhode Island, with the unweighted average of reported values being $113/kW-year (AESC Study Group 2015). Another benchmarking study found that the avoided distribution cost assumptions across 25 utilities ranged from $0 to $171/kW-year, with an average of just over $48; it also found average avoided transmission cost assumptions to range from $0 to $89/kW-year, with an average of about $20 (Mendota Group 2014).

30 There are analogous "pipe losses" on gas T&D systems, though they tend to be much smaller in magnitude (in percentage terms) than electric losses.

encompass multiple utility service territories. Thus, regulators that include price suppression effects in cost-effectiveness analyses also need to decide whether to include only the value of price reductions to customers in the utility service territory in question, in the entire jurisdiction under the regulator's purview, or in the entire region.

Another consideration is the ongoing debate regarding whether price suppression effects should be considered a benefit or whether there is no net benefit because consumer price decreases are counter-balanced by reductions in generators' profits. This is particularly relevant in jurisdictions that adopt a broader, more "societal" view of impacts on cost-effectiveness analyses.

Avoided Costs of Compliance with RPS Requirements

In jurisdictions that have adopted a Renewable Portfolio Standard (RPS) expressed as a percentage of electric generation, new efficiency resources will by definition reduce the absolute amount of renewable resources that must be purchased. When those required renewable resources are forecast to cost more than other sources of electric generation, their avoided purchase represents avoided RPS compliance costs. Thus the efficiency resources provide an additional utility system benefit, provided the avoided costs are not already reflected in the avoided energy, capacity, and T&D costs discussed above.

Avoided Environmental Compliance Costs

By reducing the amount of electricity that needs to be generated, efficiency resources can lower future costs of complying with environmental regulations. In estimating the value of such savings, it is important to account both for all regulations that have already been promulgated and those that have a significant probability of being promulgated in the future (Regulatory Assistance Project 2012).

Avoided Credit and Collection Costs

All utilities incur some costs associated with customers who are not keeping up with their energy bill payments. Those costs can take a variety of forms, including costs of notices and support provided to customers in arrears, costs associated with shutting off service and turning it back on, carrying costs associated with arrears, and costs of writing off bad debt.

Because efficiency programs lower customers' energy use and energy bills, they can reduce the probability of customers falling behind or defaulting on bill payment obligations. That can be a particularly important benefit of efficiency programs targeted to low-income customers. Since these benefits are costs avoided by the utility and they accrue directly to all utility customers, they are classified here as a utility system benefit.

Reduced Risk

Efficiency resources can reduce utility system risk in several ways. Key among them are: creating a more diverse portfolio of resources that can meet customers' energy needs (all other things being equal, diversity reduces risk); reducing uncertainty in forecasts of future loads and related capital investment needs; and reducing exposure to potential future fuel price volatility associated with other resource types (particularly natural gas, oil, and/or coal-fired generation) (Ceres 2012). Also, as a resource that can be implemented in many relatively small increments, efficiency resources provide more optionality than large central generation facilities.

There are different ways to value risk reduction. For example, the most recent New England regional avoided cost study estimated a "risk premium" of nine percent. This was added to avoided energy costs to account for one aspect of efficiency's risk mitigating effects: uncertainty in the range of future wholesale energy prices (AESC Study Group 2015). Similarly, another screening tool approach is to report cost-effectiveness for several scenarios; e.g., a "best estimate" of future avoided costs, versus a probability-weighted average of future avoided costs.[31] The difference between the two essentially represents a "risk premium" associated with future price volatility. Alternatively, Vermont's regulators have mandated since 1992 that efficiency resource costs be reduced by 10 percent to reflect efficiency's "comparative risk and flexibility advantages" relative to supply resources (VT PSB 1990).

Increased Reliability

By lowering loads on the grid, efficiency can reduce the probability and/or likely duration of customer service interruptions. The magnitude of the value of this benefit will vary, with less value to systems that are projected to be in a good state of reliability for years into the future and more value to systems that are not. There could be some overlap between this benefit and the benefits of reduced risk, avoided capacity costs and/or avoided T&D costs. Thus, any assessment of the value of increased reliability would need to ensure that there is no "double-counting" of overlap with such other benefits.

6.3 Non-Utility System Impacts

This section describes the different types of non-utility system impacts. Many of these impacts can be experienced in the form of costs or benefits, or both. For example, some efficiency measures might increase or decrease the use of other fuels. For each type of impact included in a cost-effectiveness test, both costs and benefits should be included in order to be consistent with the *Principle of Symmetry*.

6.3.1 Participant Impacts

Efficiency program participants typically incur costs and realize benefits beyond those associated with utility system impacts. A more detailed discussion of these costs and benefits is provided below.

Efficiency Measure Costs

Participant measure costs accrue when the financial incentives provided by efficiency programs cover only a portion of the cost of an efficiency measure. Program participants bear the balance of the measure cost. Participant measure costs should include only the participant's portion of the incremental measure costs, i.e., the extent to which the EE measure cost exceeds the baseline measure cost.

Participant Non-Resource Costs and Benefits

Non-resource participant costs and benefits can be divided into residential and business impacts. Residential efficiency measures can provide a wide variety of other non-resource benefits to customers. Some notable examples include improved comfort such as from sealing and insulating leaky homes, improved building durability such as

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[31] One tool for example is Integral Analytics' DSMore cost-effectiveness screening tool. Other approaches include Value-at-Risk, a common approach used to examine risk in probabilistic scenario analyses.

eliminating creation of “ice dams” through sealing and insulating attics, improved health and safety (E4TheFuture 2016a), and improved aesthetics.

For businesses, non-resource benefits can come in a variety of forms, but are commonly distilled down to improved productivity (ACEEE 2015). Such benefits can apply to many types of commercial and industrial customers, including private business, schools, hospitals, government agencies, and more.

Table 18 provides a summary of the different types of participant non-resource benefits.

Table 18. Participant Non-Resource Benefits[32]

Category	Examples
Asset value	• Equipment functionality/performance improvement • Equipment life extension • Increased building value • Increased ease of selling building
Productivity	• Reduced labor costs • Improved labor productivity • Reduced waste streams • Reduced spoilage/defects • Impact of improved aesthetics, comfort, etc. on product sales
Economic well-being	• Fewer bill-related calls to utility • Fewer utility intrusions & related transactions costs (e.g., shut-offs, reconnects) • Reduced foreclosures • Fewer moves • Sense of greater “control” over economic situation • Other manifestations of improved economic stability
Comfort	• Thermal comfort • Noise reduction • Improved light quality
Health & safety	• Improved “well-being” due to reduced incidence of illness—chronic (e.g., asthma) or episodic (e.g., hypothermia or hyperthermia) • Reduced medical costs (emergency room visits, drug prescriptions) • Fewer sick days (work and school) • Reduced deaths • Reduced insurance costs (e.g., for reduced fire, other risks)
Satisfaction/pride	• Improved sense of self-sufficiency • Contribution to addressing environmental/other societal concerns

In some cases, participating customers might experience non-resource costs. For example, some EE measures might increase labor costs or result in increased noise.

Low-Income Participant Costs and Benefits

Low-income participants can incur the same types of costs as non-low-income participants. However, in recognition of the reality that low-income consumers usually cannot afford to pay even a fraction of the cost of efficiency measures, their portion of

[32] See Synapse 2014 and Skumatz 2014 for more detail.

measure costs are often lower by design than the portion borne by non-low-income customers.

Low-income benefits can come in two forms:

1. Benefits include the same *types* of participant benefits as realized by non-low-income residential participants—O&M savings, other fuel savings, water savings, and non-resource benefits described above—though the *magnitude* of some of these benefits are often greater for low-income customers than for non-low-income customers. This is because the condition of the low-income housing stock is often worse and/or because the economic stress under which low-income customers live can result in greater sacrifice of amenity (e.g., comfort) absent efficiency investments.
2. Some participant non-resource benefits—particularly those related to economic well-being—are unique, or largely unique, to this subset of residential customers. Examples include reduced home foreclosures and reduced need to move residence as a result of unpaid bills.

The value of low-income benefits can be substantial, potentially greater than the value of utility system and other energy benefits (SERA 2014).

Operation and Maintenance (O&M) Costs and Benefits

Efficiency measures have the potential to either increase or reduce O&M costs for participants. For example, when an efficient heat pump is installed to displace much less efficient electric resistance heating, there is a modest ongoing annual cost associated with maintaining or servicing the heat pump (compared to no significant maintenance costs for electric resistance baseboard heat). In other cases, efficient technologies provide O&M benefits. Commonly cited examples include efficient lighting technologies such as compact fluorescent lamps (CFLs) and/or Light Emitting Diode (LED) lamps that last longer than their baseline alternatives. They therefore eliminate both the need to purchase and the time and labor required to install several replacement products in the future.

Literature on Non-Energy Impacts

There is a wealth of literature available on the non-energy impacts of EE resources. The following references may be useful for those seeking further information on this topic: ACEEE 2006, Lawrence Berkeley National Laboratory 2014, International Energy Agency 2014, NMR 2011, Oak Ridge National Laboratory 2014, SERA 2006, SERA 2010, SERA 2014, SERA 2016, Tetratech 2012.

Other Fuels Costs and Benefits

Many efficiency measures reduce consumption of both electricity and non-electric energy sources such as natural gas, fuel oil, propane, and wood. The reduction of these fuels provides a benefit that is outside the utility system. Among the most common examples are: building envelope measures such as insulation and air sealing; HVAC distribution system measures such as duct sealing and insulation; and control measures in buildings that are cooled electrically and heated by gas, oil, or propane. In such cases, there is economic value associated with reductions in fuels not supplied by the funding utility.

Conversely, some electric efficiency measures increase consumption of other fuels. For instance, electric efficiency resources can reduce the “waste heat” from inefficient lighting, refrigeration, or air flow components, thereby increasing the need for other fuels used for building space heating. In such cases, the economic benefit of electricity efficiency can be offset—at least in part—by the economic cost of increased consumption of other fuels. Similarly, the economic benefit of reduced consumption of one fuel resulting from fuel-switching measures can be offset—at least in part—by the cost of increasing consumption of other fuels.

Water and Wastewater Costs and Benefits

A number of EE measures also reduce water use. Indeed, in many cases, energy is saved precisely because less water is needed. Examples include low-flow devices (e.g., showerheads, faucet aerators, spray-rinse valves for commercial dish-washing, clothes washers, and improved agriculture techniques). In such cases, there can be economic value associated with both reduced water consumption and reduced wastewater treatment.

6.3.2 Societal Impacts

Environmental Impacts

Efficiency resources can provide a wide range of environmental benefits. These can include reductions in air emissions associated with fossil fuel combustion; the disposal costs of waste from various energy sources (nuclear, coal ash, etc.); the amount of water needed for cooling electric generating stations, extracting natural gas (e.g., "fracking") and other purposes; the amount of land that must be cleared and/or developed for new generating facilities; and adverse impacts on land, air, and water from fossil fuel mining or extraction. Examples of negative environmental impacts include additional waste streams and/or emissions from the production, use, and disposal of efficient products.

It is important to avoid overlap between impact categories. Some positive impacts may be accounted for in calculations of utility system costs under the utility cost of compliance with environmental regulations. Similarly, only those negative impacts that are incremental to impacts from standard or inefficient products should be included.

Public Health Impacts

Some of the environmental emission and waste reductions discussed in the point above result in a reduction in the frequency and/or severity of health problems of populations impacted by fuel extraction and combustion. Such reductions can have positive implications for the level of societal investment required in medical facility infrastructure, as well as in the health, well-being, and economic productivity of the populace.

There could be some overlap between public health benefits and either participant benefits or environmental benefits. Thus, any quantification of public health benefits should ensure that any such overlap is not double-counted.

Economic Development and Jobs

Investment in efficiency resources will result in additional jobs and economic development in several ways.

- First, there are jobs associated with managing and delivering the efficiency programs.
- Second, there are jobs and economic development effects associated with additional work and revenue that such programs funnel to the supply chains

associated with efficiency measures being installed in homes and businesses. These supply chains include: contractors, builders/developers, equipment vendors, product retailers, distributors, manufacturers, and other elements.

- Third, to the extent that the efficiency resources are less expensive than the energy they save, consumers will have more disposable income. When that additional disposable income is spent in the local community (or beyond), it helps to create jobs and spurs economic development.

Conversely, by reducing or avoiding supply-side resources, efficiency resources will reduce the number of job and related local economic development benefits of supply-side investments. Jurisdictions that include economic development and/or job impacts in their primary cost-effectiveness test should account for both positive and negative impacts.

Net economic development and/or job gains are often expressed in terms of increased gross domestic product (GDP) or gross state product (GSP) and/or job-years. It is not clear how these metrics can be translated into monetary terms suitable for inclusion in efficiency benefit-cost analyses, particularly since the drivers of these benefits (efficiency program spending and reduced utility system costs) are already included in the cost-effectiveness analyses. At a minimum, such benefits can be considered without using monetary values. This point is discussed in Chapter 7.

Societal Low-Income Impacts

In some cases there may be low-income community or societal impacts that go beyond those realized by program participants. Examples include poverty alleviation, improving low-income community strength and resiliency, and reduced home foreclosures (any societal impacts from reduced foreclosures must be incremental to the participant impacts related to foreclosures).

Energy Security Impacts

Some jurisdictions have policies designed to increase energy independence and/or energy security. EE investments that reduce imports of various forms of energy inherently advance such goals. There could be some overlap between (a) the benefit of improved energy independence and security and (b) either local jobs and economic development or risk reductions. Thus, any assessment of the magnitude or value of improved energy independence would need to ensure that there is no double-counting of overlap with such other benefits.

Other Impacts

There may be other impacts not included in the list above. These would need to be assessed to ensure they do not overlap with the impacts already defined.

Several of the non-utility system impacts described above, notably the impacts on environment, public health, and economic development, will likely accrue within a broader territory. They can accrue: within the utility service territory in which an efficiency program is run; outside of that service territory but within the jurisdiction of regulators overseeing the program (e.g., within a state); and outside of the jurisdiction governed by the regulators. Thus, in jurisdictions for which energy policies dictate that such impacts be considered, regulators will need to consider the geographic boundary of the impacts.

7. Methodologies to Account for Relevant Impacts

This chapter provides guidance on options for accounting for relevant cost and benefits, including hard-to-quantify impacts as well as approaches for qualitatively including non-monetary impacts.

7.1 Summary of Key Points

All impacts of EE resources that a jurisdiction has chosen to assess via its cost-effectiveness test should ideally be estimated in monetary terms so that they can be compiled readily and compared directly. However, some EE impacts are difficult to quantify in monetary terms, either due to the nature of the impact or the lack of information available about the impacts.

The third key principle described in Chapter 1 is that cost-effectiveness practices should account for all relevant, important impacts, even those that are difficult to quantify and monetize. Approximating hard-to-monetize or hard-to- quantify impacts is preferable to assuming that substantive costs and benefits do not exist or have no value.

Table 12 from Chapter 3.6 summarizes five different approaches that can be used to account for all impacts of EE resources that a jurisdiction has chosen to include in its cost-effectiveness test. The approaches are listed in order of technical rigor and preference.

Preferably, any impacts included in a cost-effectiveness test would be based on monetary values that are rigorously estimated and transparently documented. The first two subsections below discuss using studies from within or outside of a jurisdiction to develop monetary values. The next three sub-sections discuss approaches for addressing hard-to-monetize impacts.

7.2 Jurisdiction-Specific Studies

Jurisdiction-specific studies that quantify costs and monetize relevant benefits as possible are the most rigorous and reliable way to estimate the benefits of EE programs. These studies should use local information to the greatest extent possible, by utility, by state, by province, or by the relevant Regional Transmission Organization/Independent System Operator. These studies should be derived from, or at least be consistent with, the most recent integrated resource planning studies available, wherever they exist.

Jurisdiction-specific avoided cost studies should be comprehensive, transparent, use best practices, and use all relevant information available at the time.

Jurisdiction-specific avoided cost studies should be comprehensive, transparent, use best practices, and use all relevant information available at the time. These avoided cost studies should be updated periodically, to reflect the most recently available information.

Ideally, these avoided cost studies should be prepared by independent third parties, guided by stakeholders, and ultimately reviewed and approved by regulators. For a good example of this approach, see the New England Avoided Energy Supply Cost studies (AESC Study Group 2015). Another example is the California Public Utility Commission cost-effectiveness calculator that embeds the state's official avoided costs in a model to calculate cost-effectiveness (CPUC 2016).

Many jurisdictions have developed technical reference manuals (TRM) to document the costs and operating characteristics of EE resources. TRMs are critical for jurisdictions to support the cost inputs of a jurisdiction's EE cost-effectiveness tests. TRMs should use information that is as up-to-date as possible, and should account for jurisdiction-specific costs as much as possible (Beitel et al. 2016).

7.3 Studies from Other Jurisdictions

In some cases, for some impacts, a jurisdiction-specific study might not provide all the information needed for a cost-effectiveness test. In these cases, it may be appropriate to use results from other jurisdictions. This could include studies prepared for other utilities, other states, other jurisdictions, other regions. It could also include regional or national studies that do not necessarily focus on any one jurisdiction or region.

However, efficiency planners must take care to ensure that the value of a particular cost or benefit in another jurisdiction is equal to, or sufficiently comparable to, the value in the jurisdiction of interest. If not, it may be necessary to adjust values from other jurisdictions before using them. For example, labor costs in one part of the country might be significantly different from other parts of the country. These differences can be accounted for by adjusting costs accordingly.

7.4 Proxies

For the purpose of EE cost-effectiveness analyses, a proxy is a simple, quantitative value that can be used as a substitute for a value that is not monetized by conventional means. Proxies can be applied to any type of cost or benefit that is hard to monetize and is expected to be of significant magnitude (NEEP 2014).

Proxies should be developed by making informed approximations based upon the best information currently available regarding the relevant impact.

Proxy values are typically based on professional judgment; but they should not be developed or perceived as arbitrary values. Proxies should be developed by making informed approximations based upon the best information currently available regarding the relevant impact. This should include a review of relevant literature on the specific impact, as much quantification of the impact that is both feasible and reasonable, a review of proxy values used by other jurisdictions, and consideration of conditions specific to the relevant jurisdiction.

To date, proxies have most frequently been used to account for efficiency resource benefits such as low-income benefits, participant non-energy benefits, or risk benefits (NEEP 2014). However, proxies can also be used to account for other hard-to-monetize efficiency costs and benefits. Proxies could be used, for example, to account for the degradation of energy savings over time, i.e., to account for a “rebound” effect where customers increase energy consumption as a result of reduced energy costs.

Level of Application

Proxy values can be developed for different levels of application, ranging from a single proxy value that applies to an entire portfolio of efficiency resources to different proxy values for each efficiency impact.

When choosing the level of detail to apply to a proxy, there may be a tradeoff between accuracy and feasibility. Proxies that are more detailed are likely to more accurately represent the magnitude of the specific impact in question. However, proxies that are more detailed are also likely to require more information and greater costs to develop.

One advantage of more detailed proxies is that they are more transferrable across programs, across utilities, and over time. For example, an impact-level proxy such as improved health and safety, applied to residential retrofit efficiency programs, is likely to be generally applicable to other residential retrofit programs and remain relatively constant over time. Conversely, a sector-level proxy to account for all participant non-energy benefits for the residential sector should, in theory, be different for different programs and could change over time as the mix of efficiency measures changes over time.

Type of Proxy

Several different types of proxies can be used to account for EE program impacts.

- Percentage Adder: A percentage adder approximates the value of non-monetized impacts by scaling up impacts that are monetized. This type of proxy is the simplest and easiest to apply.
- Electricity Savings Multiplier ($/MWh): An electricity savings multiplier approximates the value of non-monetized benefits or costs relative to the quantity of electricity saved by an efficiency resource.
- Gas Savings Multiplier ($/therm): This is the same as an electricity multiplier, but can be applied to programs that primarily, or exclusively, provide gas efficiency improvements. It offers the same advantages and disadvantages of electricity multipliers.
- Fuel Savings Multiplier ($/MMBtu): A fuel multiplier approximates the value of non-monetized benefits or costs relative to the total quantity of fuel saved by an efficiency resource, regardless of the type of fuel saved (e.g., electricity, gas, oil, propane).
- Customer Adder ($/customer): A customer adder (or subtraction) approximates the value of non-monetized benefits relative to the number of customers served by an efficiency program.
- Measure Multiplier ($/measure): A measure multiplier (positive or negative) approximates the value of non-monetized benefits or costs relative to the number of measures installed by an efficiency program.

As with the choice of level of application for a proxy, the choice of which type can result in a tradeoff between accuracy and feasibility. Proxies that are more focused (e.g., by measure, by customer, or by fuel) are more likely to accurately represent the magnitude of the specific impact in question. However, proxies that are more focused are also likely more difficult and expensive to develop.

7.5 Quantitative and Qualitative Information

Some impacts might be difficult to put into monetary terms or to address through proxies. Other impacts may not even be appropriate to put into monetary terms.[33] In these cases, other types of quantitative and qualitative information can be used to inform the cost-effectiveness decision.

Once all efforts to monetize EE costs or benefits have been considered and exhausted, the following steps can be used to consider additional quantitative and qualitative information.

Step A: Provide as much quantitative evidence as possible

For those impacts that remain non-monetized, it may be possible to put them into quantitative terms. Quantitative values generally provide more concrete information for decision-makers to consider, relative to qualitative values or no values at all. Quantitative values of efficiency impacts should be documented in detail, along with justification for why and how the values are relevant to the cost-effectiveness analysis.

For example, jurisdictions that choose to include job impacts might want to present this impact in terms of the number of job-years, rather than a monetized value for jobs. Regulators and efficiency planners could then compare different energy resources according to how many job-years are created by each one.

Step B: Provide as much qualitative evidence as possible

Those impacts that are not monetized or quantified should be addressed qualitatively. Qualitative information can provide some information for decision-makers to consider, relative to no information at all. For those efficiency impacts that are addressed qualitatively, efficiency planners should develop and present as much qualitative evidence as possible regarding those impacts. This evidence should also include a justification for why the considerations are relevant to the cost-effectiveness analysis.

For example, a jurisdiction might choose to consider incremental market transformation benefits without quantifying or monetizing such benefits. In this case, regulators or efficiency planners would consider the incremental market transformation benefits, without necessarily estimating what those benefits are either in terms of energy savings or dollar savings.

Step C: Present quantitative and qualitative evidence alongside monetary results

The monetary impacts of EE resources should be the core of the cost-effectiveness analysis, and ideally should include the vast majority of the impacts being considered. These monetary results should be presented in a transparent, detailed, easily-reviewable way, as described in Section 3.7.

[33] For example, it may not be appropriate to directly compare the monetary values of economic development and job impacts to the other monetary values in a cost-effectiveness analysis. This issue is addressed in Section 6.3.2.

Any non-monetized impacts of efficiency resources should be presented along-side the monetary impacts.[34] This allows the regulators and other decision-makers to directly compare the monetized, quantitative, and qualitative factors.

Step D: Decide upon the implications of the quantitative and qualitative evidence

Regulators and other decision-makers should then use the monetary, quantitative, and qualitative evidence to decide whether an efficiency resource is cost-effective. In some cases, the monetary results alone might be sufficient to make this decision, e.g., if the monetary benefits exceed the monetary costs, and all the non-monetary evidence indicates there will be additional benefits. The cost-effectiveness decision might also be easy if the monetary benefits are slightly less than the monetary costs, but the non-monetary benefits are clearly significant enough to make up the difference.

In other cases, the decision might not be so clear. For example, if the monetary benefits do not exceed the costs, but the non-monetary benefits are not necessarily significant enough to make up the difference. In these cases, regulators and other decision-makers should make a cost-effectiveness determination, based on all the evidence presented, and with input from relevant stakeholders.

Step E: Document and justify the decision

Finally, the cost-effectiveness decision should be fully documented and justified. This is necessary to provide transparency regarding the decision for the resource in question, and to provide guidance on how similar decisions will be made in future cost-effectiveness analyses.

Example of Using Qualitative Information

The Oregon PUC has two orders (UM551 and UM 590) that set forth a specific set of qualitative conditions under which violation of strict cost-effectiveness limits could be justified to account for non-monetary impacts.

Measures that are not cost effective could be included in utility programs if the following can be demonstrated:

1. The measure produces significant non-quantifiable non-energy benefits. In this case, the incentive payment should be set at no greater than the cost-effective limit (defined as present value of avoided costs plus 10 percent) less the perceived value of bill savings, e.g. two years of bill savings.
2. Inclusion of the measure will increase market acceptance and is expected to lead to reduced cost of the measure.
3. The measure is included for consistency with other DSM programs in the region.
4. Inclusion of the measure helps to increase participation in a cost-effective program.
5. The package of measures cannot be changed frequently and the measure will be cost effective during the period the program is offered.
6. The measure or package of measures is included in a pilot or research project intended to be offered to a limited number of customers.
7. The measure is required by law or is consistent with Commission policy and/or direction.

The conditions above apply both to measures and programs with the exception of Item D (OR PUC, 2014).

[34] Section 3.7 presents an example template for how the monetized, quantified, and qualitative information could be presented.

7.6 Alternative Thresholds

Alternative thresholds are another approach for addressing hard-to-monetize impacts. Such thresholds allow efficiency resources to be considered cost-effective at pre-determined benefit-cost ratios that are different from one (1.0). Regulators can apply a benefit-cost ratio of greater than one (1.0) to account for efficiency resource costs that have not been monetized, or a benefit-cost ratio of less than one (1.0) to account for non-monetized benefits. Regulators can apply alternative thresholds to account for hard-to-monetize impacts at the program, sector, or portfolio level.

Alternative thresholds are, by design, a simplistic way of recognizing that the hard-to-monetize impacts are significant enough to influence the cost-effectiveness analysis. The primary advantage of this approach is that it does not require the development of specific monetary or proxy values. Instead, it is more of a general reflection of the regulators' willingness to be flexible in accounting for certain impacts.

Note that using alternative benchmarks can essentially have the same effect as applying a proxy value if the proxy is applied at the same level of the cost-effectiveness screening (e.g., measure or portfolio). For example, an alternative portfolio level benefit-cost ratio benchmark of 0.9 is equivalent to a portfolio level benefit multiplier of 11 percent; and an alternative benefit-cost ratio benchmark of 0.8 is equivalent to a benefit multiplier of 25 percent.

Regulators should ensure that alternative thresholds are as transparent as possible and are established prior to the cost-effectiveness analysis. Regulators should articulate which resources the alternative thresholds can be applied to, what the threshold is, and the basis for the threshold chosen.

7.7 Sensitivity Analyses

Sensitivity analyses can be used to test the implications of input assumptions that are hard to monetize or whose monetary values are especially uncertain. The cost-effectiveness test can be applied with high, medium, and low estimates of certain inputs to see how the range of estimates will affect the results.

Sensitivity analyses can be used to test the implications of input assumptions that are hard to monetize or whose monetary values are especially uncertain.

Sensitivity analyses of hard-to-monetize inputs offer two advantages. First, they indicate the extent to which these costs or benefits will affect the cost-effectiveness results. Those costs or benefits with a minor impact on the results, regardless of whether a high or low value is used may not require much additional attention. Conversely, those with a major impact on the results might warrant additional research and analysis to improve the estimates of their magnitudes.

Second, sensitivity analyses indicate the extent to which the accuracy of the input will affect the cost-effectiveness results. If an efficiency resource is clearly cost-effective, or clearly not cost-effective, regardless of whether the high or low input assumption is used, then there may be little need or value in improving the accuracy of that input. Conversely, if the input has a notable impact on the cost-effectiveness results depending upon whether the high or low value is used, then it may be necessary to take some additional steps to improve the accuracy of the input or account for it in other ways.

Sensitivity analyses can be used regardless of whether the estimate is monetized, is a proxy, or is somehow addressed with quantitative or qualitative information. However, for administrative ease jurisdictions may want to limit sensitivity analyses to cost-effectiveness inputs that are relatively uncertain and are likely to have a significant impact on the results.

7.8 Reliability of Data

All future costs and benefits of electricity and gas utility resources need to be estimated, and thus there is uncertainty in analyzing the cost-effectiveness of any type of energy resource—demand or supply. Including hard-to-monetize impacts does not change a cost-effectiveness calculation from an absolute to an estimated range of values. It may appear that accounting for hard-to-monetize impacts will reduce the accuracy and precision of the decision, but in fact the results will be more reliable than simply ignoring the hard-to-monetize impacts altogether.

The line between a rigorously established, monetary value and one that is less rigorously established can be subjective, because some level of professional judgement and estimation is typically involved in the development of all cost-effectiveness inputs. For example, the projected values for avoided costs or the effective useful life of an efficiency measure cannot be directly measured in advance.

All substantive impacts should be included in a jurisdiction's analyses, with documentation of the assumptions and analyses. It should account for them in decision-making, recognizing the limits of the reliability of the overall cost-effectiveness analyses. To not include all substantive impacts increases the risk of making an error of omission (not including efficiency resources that are more cost-effective than other resources), as well as an error of commission, including efficiency resources that are not as cost-effective as other resources.

8. Participant Impacts

This chapter expands upon guidance in Subsection 3.3.2 regarding how to determine whether to include participant impacts in the RVT. It explains the policy objectives that might suggest including participant impacts, as well as key considerations regarding those objectives.

8.1 Summary of Key Points

Efficiency program participants experience several types of costs and benefits. Program participant impacts are summarized in Table 7 (Chapter 3) and discussed in more detail in Chapter 6.3.1Appendix C.

When considering whether to include participant impacts in the RVT, it is important to recognize two overarching points. First, the decision of whether to include participant impacts in the primary cost-effectiveness test is a policy decision. Second, if regulators decide to include participant costs in any cost-effectiveness test, the test must also include participant benefits, and *vice versa*.

Table 8 in Chapter 3 provides a summary of the reasons to include participant impacts in the primary cost-effectiveness test, as well counter-points to these reasons. These points and counter-points are discussed in more detail below.

8.2 Policy and Symmetry

When considering whether to include participant impacts in the cost-effectiveness tests, it is important to recognize two overarching points:

1. The decision of whether to include participant impacts in the primary cost-effectiveness test is a policy decision. Regulators may choose to include participant impacts in the primary cost-effectiveness test if that would achieve the jurisdiction's policy goals.

2. If regulators decide to include participant costs in any cost-effectiveness test, the test must also include participant benefits, and *vice versa*. This is necessary to ensure symmetrical treatment of participant impacts, consistent with *Symmetry Principle* set forth in Chapter 1.

With regard to the first point above, some jurisdictions may not have an explicit policy goal regarding whether to include program participant impacts when assessing EE resources. Legislators and other decision-makers may not have addressed this question when promulgating legislation or regulations related to EE resources. In these cases, regulators and other decision-makers should decide whether to include participant impacts based upon the policy context that does exist in the jurisdiction and with appropriate input from relevant stakeholders.

In making this decision, it is important to consider the rationale and implications of including participant impacts in the primary test. These are discussed in the following sections.

8.3 Account for the Impacts on All Customers Combined

One of the reasons for including participant impacts in the primary cost-effectiveness test is to account for the impacts on all utility customers, both program participants and non-participants, regardless of who experiences the impacts. This allows for a broader accounting of impacts than what is included as utility system costs alone.

It is important to recognize that participant impacts fall outside the scope of utility system impacts.

However, it is important to recognize that participant impacts fall outside the scope of utility system impacts, and that this distinction is important when assessing efficiency resource cost-effectiveness. Some of the participant impacts are energy-related while others are not. For example, a customer might use an efficient lighting rebate to install high-end lighting measures that offer aesthetic benefits as well as efficiency improvements. In this case, the customer incurs non-energy costs (higher costs than the low-end efficiency measure), and enjoys non-energy benefits (in terms of improved aesthetics). The presence of non-energy costs and non-energy benefits is an important consideration when deciding whether to include participant impacts in the primary efficiency screening test.

8.4 Account for the Total Cost of the Resource

Another reason sometimes mentioned for including participant impacts in the primary cost-effectiveness analysis is to account for the total cost of the resource. This reason is predicated on the concern that *not* accounting for the total cost of a resource might result in a decision that appears cost-effective but is not. In other words, if the cost of a resource is divided up between two entities (the utility and the participant), then there is a risk that the total cost of the resource exceeds the total benefit, but neither the utility nor the participant would recognize this because each entity is concerned with only its own costs. This could be considered an uneconomic outcome, because the total (utility plus participant) costs might exceed the total benefits. This point is explained in the example in the text box.

If the goal of the cost-effectiveness analysis is to assess the total cost of a resource, then it is necessary to include the total benefits of the resource as well. And the total benefits must include utility system, participant, and societal benefits. In this example, there may be non-utility system benefits (participant or societal) that are not considered. One example is environmental benefits. Continuing the text box example, assume that the resource in question has environmental benefits that are equal to 2 cents/kWh. This would mean that the total benefit of the utility system plus the environmental benefits would be 12 cents/kWh, which is higher than the total costs of 11 cents/kWh. This would mean that the resource is in fact cost-effective when this additional benefit is accounted for.

An Incomplete Picture of Costs and Benefits

Assume that an electricity utility has an avoided cost (including all utility system benefits) of 10 cents/kWh, with retail rates equal to 14 cents/kWh, and that an efficiency resource has a total (incremental) cost of 11 cents/kWh. This efficiency resource would be considered to be not cost effective if the total cost were accounted for (because 11 cents is greater than 10 cents).

Now assume that the utility offers a customer rebate of 5 cents/kWh to adopt this measure, which requires the customer to pay 6 cents/kWh for the remainder of the cost. If the total cost were split between the utility and the participating customer in this way, then the UCT would indicate the resource is cost-effective (because 5 cents is less than 10 cents/kWh), and the customer would conclude that the resource is cost-effective (because 6 cents is less than 14 cents).

In this example, if the total cost were not considered as part of the cost-effectiveness analysis, then *it appears as though* an uneconomic resource would be deemed to be cost-effective from purely a total costs perspective.

However, this conclusion does not account for all the benefits of the resource, and thus provides an incomplete picture of costs and benefits.

This example illustrates why, if regulators are interested in the total costs of a resource to avoid uneconomic outcomes, they must also account for the total benefits of the resource. In theoretical terms, this naturally leads to the conclusion that the only way to avoid this type of uneconomic outcome is to apply an SCT that accounts for all the costs and benefits of the resource. Using a test that includes all the participant impacts, without other impacts, will not answer this key question.

However, this conclusion does not mean that regulators must necessarily use an SCT as the primary test for assessing EE cost-effectiveness. If regulators are interested in the total cost of a resource solely to avoid potentially uneconomic outcomes, an SCT could be used as a preliminary, pre-screening test to ensure that all efficiency resources being considered will not result in the uneconomic outcome described above. Then the RVT could be applied as the primary test for determining whether the *relevant* benefits exceed the *relevant* costs.

Finally, if regulators and others are concerned about utility customers paying “too much” for an efficiency resource because the total costs have not been compared to the total benefits, then regulators can require that utility incentives to the participant for EE resources be capped at a level equal to the utility system avoided costs. Continuing the example above, the customer incentive would be capped at 10 cents/kWh, which means that utility customers would never be required to pay more than what the resource is worth to them. This concept is discussed in Subsection 3.3.1 as well.

8.5 Protect Program Participants

Another reason to include participant impacts in the primary cost-effectiveness test would be to protect program participants. This reason is based on the presumption that including participant impacts in the test will ensure that participants' benefits will exceed costs.

> **The conventional method of including participant impacts in a cost-effectiveness test does not provide a clear indication of the impact on participants.**

There are several considerations regarding the extent to which including participant impacts in the cost-effectiveness test will protect program participants. First, the conventional method of including participant impacts in a cost-effectiveness test does not provide a clear indication of the impact on participants. The benefits to participating customers will be in the form of reduced bills, which will be driven by the energy savings times the retail prices they pay for energy. However, the benefits that are included in the cost-effectiveness test used to account for participant impacts (the TRC test) are in the form of avoided utility costs, not reduced bills. In short, the difference between retail energy prices and utility avoided costs will typically distort the overall impacts on efficiency program participants.

Second, the Participant Cost test is a much more accurate means of protecting efficiency program participants, because this test uses reduced bills as the primary benefit to participants. Also, the Participant Cost test does not dilute the impacts on participants by combining them with the utility system impacts. The Participant Cost test is discussed in more detail in Appendix A.

Finally, the best way to ensure that program participants are protected is through efficiency program design. Successful and effective efficiency programs should be designed to entice customers to participate. This naturally leads to program designs that ensure that participants' benefits exceed their costs. If a program design results in participants' benefits not exceeding costs, then the program is not likely to be successful and should be redesigned. The Participant Cost test can, and often is, used as a way to ensure that programs are designed in a way that will entice customers by providing them with net benefits.

California's Methodology for Treating Non-Energy Costs and Benefits

The California efficiency program administrators have used the TRC test as their primary efficiency cost-effectiveness test, and they have applied an atypical methodology for addressing the challenges associated with the participant impacts. The California program administrators do not include either the participants' non-energy costs or non-energy benefits. In this way, the California TRC test includes only energy-related impacts—the utility system impacts plus the participants' energy-related impacts.

- The participant costs are determined by first estimating the total participant cost, and then subtracting estimated participant non-energy costs from those.
- The participant benefits are defined as only those related to energy impacts. Therefore, all participant non-energy impacts (comfort, health, safety, aesthetics, productivity, etc.) are excluded from the cost-effectiveness analysis.

8.6 Account for Low-Income Program Participant Benefits

Another reason to include participant impacts in the primary cost-effectiveness test would be to allow for the inclusion of low-income participant benefits. Efficiency programs can provide significant benefits to low-income customers, including reduced energy burden, improved health and safety, improved comfort, and more. If program participant impacts are included, then it follows that low-income participant benefits must be included as well.

There are two important considerations when deciding whether participant benefits should be included in the primary test to ensure that low-income benefits are included. First, if a jurisdiction has a policy goal of providing efficiency programs for the benefit of low-income participants, this does not mean that the primary cost-effectiveness test must account for the participant benefits of all customers to do so.

While it is true that if program participant costs are included in a test, then low-income customer benefits should be included as well, the inverse is not necessarily true. A jurisdiction might have a clear policy goal to account for low-income participant benefits, but not a comparable goal to account for all customer participant impacts. In fact, some states already do this. For example, Connecticut and Michigan use the UCT as the primary cost-effectiveness test, but do not require low-income efficiency programs to pass a cost-effectiveness test because of their participant benefits.

The second, and related, consideration is that well-designed low-income programs typically do not include any participant costs. By their very nature, low-income customers are unable or unlikely to participate in efficiency programs if there is any kind of participant cost, or even any significant participant transaction costs. This makes low-income efficiency programs fundamentally different from other efficiency programs. Some of the reasons that might support the inclusion of participant impacts in the primary cost-effectiveness test, such as considering all costs and protecting participants, are not relevant if there are no participant costs.

8.7 Account for Other Fuel and Water Impacts

Similarly, another reason to include participant impacts in the primary cost-effectiveness test would be to allow for the inclusion of other fuel and water impacts. Some efficiency programs can save a significant amount of other fuels, such as electricity (for a gas utility), gas (for an electric utility), oil, propane, or wood. These other fuel savings can sometimes represent a large portion of the savings from efficiency measures, particularly for certain programs such as home retrofit or new construction programs. They can also allow for a fuel-neutral, whole building approach to EE program delivery. If program participant costs are included in the primary cost-effectiveness test, then it follows that participant benefits must be included as well.

While it is true that if program participant costs are included in the primary cost-effectiveness test, then participant other fuel and water impacts must be included as well, the inverse is not necessarily true. A jurisdiction might have a clear policy goal to account for other fuel and water savings, but not a comparable goal to account for all customer participant impacts. This could happen, for example, if a jurisdiction has policy goals supporting fuel-neutral, whole building approaches to efficiency program delivery, but not a comparable goal to account for all participant impacts. A jurisdiction might also have a policy goal of considering all potential fuel savings in order to assess strategic electrification opportunities, but not a comparable goal to account for all participant impacts. This issue is also addressed in Subsection 3.3.4.

8.8 Quality of the Information

Some participant costs and benefits can be difficult to quantify and monetize, for three reasons.

- Total incremental costs.[35] When designing and implementing efficiency programs, the cost to the utility system, i.e., the financial incentive provided to the participant, is known with great certainty. The amount that the participant pays is known with less certainty, and in some cases, can be very difficult to estimate. This is particularly true for efficiency measures where a wide range of customer options and costs are available.
- Non-energy costs. For some efficiency measures, a portion of the incremental costs are a result of product features that are not related to efficiency savings. These non-energy costs often result in a wide range of total incremental costs for efficiency measures, creating a challenge for efficiency planners who typically require one cost estimate for cost-effectiveness analysis.
- Non-energy benefits. The nature of some of these impacts, such as improved productivity, increased health and safety, and improved aesthetics, makes them uncertain, variable by customer and by program. They require different types of analyses to identify them (SERA 2014).

The fact that there are challenges with estimating participant costs and benefits does not, in and of itself, mean that they should be ignored in cost-effectiveness analyses.[36] It does mean that regulators and other decision-makers should consider these challenges, along with the other factors described above, when deciding whether to include participant impacts in the primary cost-effectiveness test.

[35] The term “incremental cost” is used to refer to the portion of cost associated with the improved efficiency of the measure, which is equal to the difference between the cost of the efficiency measure and a baseline measure.

[36] As described in Chapter 1, one of the key principles of cost-effectiveness analyses is that all relevant impacts should be accounted for, even the hard-to-quantify and hard-to-monetize benefits. In addition, Chapter 7 provides methodologies and techniques for accounting for all relevant costs and benefits, including those that are hard to monetize.

9. Discount Rates

This chapter provides guidance on how to determine a discount rate for the RVT that is consistent with the objective of the cost-effectiveness analysis and the jurisdiction's applicable policy goals. The concepts described in this chapter can also be used to determine discount rates for other cost-effectiveness tests, including tests used for DERs and supply-side resources.

9.1 Summary of Key Points

The discount rate reflects a particular pattern of "time preference," which is the relative importance of short- versus long-term impacts. A higher discount rate gives more weight to short-term impacts, while a lower discount rate gives more weight to long-term impacts.

The choice of discount rate is a policy decision that should be informed by the jurisdiction's energy and other applicable policies—and thus should reflect the regulatory perspective, as described earlier in the manual. This perspective recognizes that the objective of efficiency cost-effectiveness analysis is to identify those utility resources that will best serve customers over the long term, while also achieving applicable policy goals of the jurisdiction.

The following steps can assist jurisdictions in determining the discount rate for the RVT:

Step A: Articulate the jurisdiction's applicable policy goals. These should be the same goals used in developing the RFT and should serve as the basis of the jurisdiction's regulatory perspective.

Step B: Consider the relevance of a utility's weighted average cost of capital (WACC). Is the utility investor time preference consistent with the jurisdiction's applicable policy goals?

Step C: Consider the relevance of the average customer discount rate. Should the discount rate be based on the average utility customer time preference? Does this time preference adequately address applicable policy goals and future utility customers?

Step D: Consider the relevance of a societal discount rate. Is a societal time preference and use of a societal discount rate consistent with the jurisdiction's policy goals and associated regulatory perspective?

Step E: Consider an alternative discount rate. Given that the regulatory perspective may be different from the utility, customer, and societal perspective, the discount rate does not need to be tied to any one of these three perspectives. For example, regulators/decision-makers could decide to use a discount rate that is lower than the utility WACC and the customer discount rate, but higher than the societal discount rate.

Step F: Consider risk implications. Consider using a low-risk discount rate for EE cost-effectiveness if the net risk benefits of EE resources are not somehow accounted for elsewhere in the cost-effectiveness analysis.

9.2 The Purpose of Discount Rates

Discount rates are an essential aspect for assessing any multi-year project or investment. They allow analysts to compare costs and benefits that occur over different time periods.

Some utility costs, such as power plant siting, licensing, and construction, occur in the short term. Other utility costs such as fuel and O&M stretch into the long-term future. A power plant takes a few years to build, and then generates electricity for decades. Many efficiency resources can be implemented within a year or two, and then save energy for many years thereafter.

The discount rate essentially reflects a particular pattern of "time preference," which is the relative importance of short- versus long-term costs and benefits.

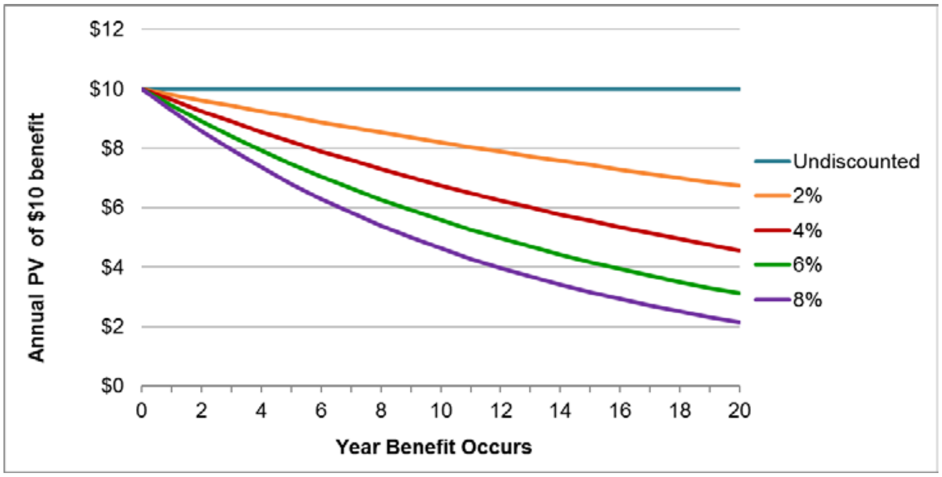
The key point here is that dollars at different times in the future are not directly comparable values; they are apples and oranges. Applying discount rates turns costs and benefits in different years into comparable values.

The discount rate essentially reflects a particular pattern of "time preference," which is the relative importance of short- versus long-term costs and benefits. A higher discount rate gives more weight to short-term costs and benefits than to long-term costs and benefits, while a lower discount rate weighs short-term and long-term impacts more equally. Different economic actors may have differing discount rates, based on their own time preferences.

The choice of discount rates is a critical element of any long-term cost-effectiveness analysis because it has large impacts on the results. This is especially true when the analysis involves long-lived efficiency resources such as building retrofit programs and new construction programs.

Figure 5. Implications of Discount Rates (annual present value dollars) illustrates how EE benefits (e.g., avoided generating fuel costs) can be affected by different discount rates. This example starts with an annual fuel costs savings of $10 per year over the course of a 20-year period. The top, blue line indicates the magnitude of the future avoided costs assuming no discount rate. The other lines present the annual present value of the avoided fuel benefit, depending upon the discount rate used. As indicated, higher discount rates will dramatically reduce the value of avoided fuel savings benefits in Year 20, while lower discount rates have a much smaller impact.

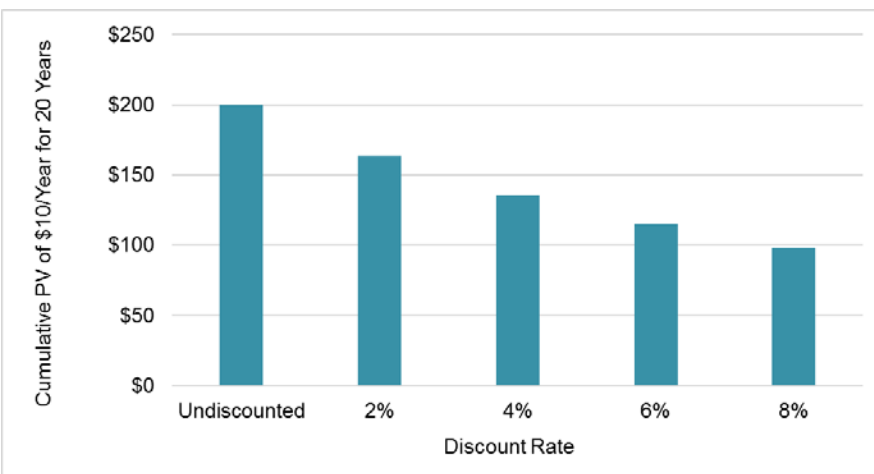
Figure 5. Implications of Discount Rates (annual present value dollars)



These benefits are presented as real dollars (i.e., excluding inflation), and the discount rates are real discount rates.

Figure 6 presents the same information using cumulative present values. Without discounting, a stream of $10 over 20 years would equal $200. The cumulative present value of this stream would be considerably lower. A real discount rate of 8 percent would result in a cumulative present value that is half the cumulative value of the original stream.

Figure 6. Implications of Discount Rates (cumulative present value dollars)



9.3 Commonly Used Discount Rates

Different Perspectives and Time Preferences

Table 19 summarizes several types of discount rates that could be used for energy resource cost-effectiveness assessment. For each type of discount rate, it indicates the time preference represented by that rate, a range of typical values, some brief notes, and sources.

Table 19. Discount Rate Options for Cost-Effectiveness Analyses

Type of Discount Rate	Potential Indicator of Time Preference	Typical Values (in real terms)	Notes and Sources
Societal	Societal cost of capital, adjusted to consider intergenerational equity or other societal values	<0% to 3%	In addition to low-risk financing, government agencies have a responsibility to consider intergenerational equity, which suggests a lower discount rate (US OMB 2003). Society's values regarding environmental impacts might warrant the use of a negative discount rate (Dasgupta, Maler, and Barrett 2000).
Low-Risk	Interest rate on 10-year U.S. Treasury Bonds	-1.0% to 3%	Over the past decade the real interest rate on 10-year U.S. Treasury Bonds ranged between -0.6% and 3.0% percent. As of the publication of this document, the real interest rate on 10-year U.S. Treasury Bonds was 0.4 percent (multpl.com 2017).
Utility Customers on Average	Customers' opportunity cost of money	varies	Customers' opportunity costs can be represented by either the cost of borrowing or the opportunity costs of alternative investments (Pindyck and Rubinfeld 2001, 550). The real rate on long-term government debt may provide a fair approximation of a discount rates for private consumption (US OMB 2003).
Publicly Owned Utility	Publicly owned utility's cost of borrowing	3% to 5%	Publicly owned utility costs of capital are available from the Federal Energy Regulatory Commission Form 1, Securities Exchange Commission 10k reports, and utility Annual Reports.
Investor-Owned Utility	Investor-owned utility's weighted average cost of capital	5% to 8%	Investor-owned utility costs of capital are available from the Federal Energy Regulatory Commission Form 1, Securities Exchange Commission 10k reports, and utility Annual Reports.

Typical values of discount rates are in real terms, as opposed to nominal. Real discount rates should always be applied to real cash flows, and nominal discount rates should always be applied to nominal cash flows. The utility cost of capital should be after-tax.

The typical values presented in Table 19 are provided for illustrative purposes only; other values outside these ranges are also possible. Other points to consider include: that these values can change over time according to changing economic conditions; that there are multiple options for determining a low-risk discount rate; and that different utility customers will have different time preferences, which can be determined in multiple ways. It is also worth noting that the value to use for the societal discount rate is subject to much debate. Further discussion on the range of values for discount rates is beyond the scope of this manual.

EE planners and other stakeholders often recommend that the choice of discount rate for efficiency analysis should reflect the perspective represented by the cost-effectiveness test in use. For example, the U.S. Department of Energy and Environmental Protection Agency's National Action Plan on Energy Efficiency (NAPEE, 2007, 5-4) states that:

- The societal discount rate should be applied when using the SCT.
- The utility weighted average cost of capital should be applied when using the UCT, the TRC test, or the Rate Impact Measure (RIM) test.
- A customer discount rate should be used when applying the Participant Cost test.

While there is some logic to the concept of matching the discount rate to the perspective of the test used, this logic must be applied carefully. First, it is important to recognize the role of the applicable policies in developing the cost-effectiveness test and in determining the appropriate time preference. Second, it is important to be clear on whose perspective is actually represented in particular discount rates. These issues are discussed in the following sections.

The Role of the Cost of Capital

In general, the cost of capital is a key factor in determining discount rates. It indicates the time value of money (or the opportunity cost for alternative investments) for the relevant entity. However, cost of capital is not the only factor that dictates the appropriate discount rate to use for utility investments.

As described above, the primary objective of a utility cost-effectives analysis is to identify those utility resources that will best serve customers over the long term, while also achieving applicable policy goals of the jurisdiction. In light of this objective, the time preference for cost-effectiveness analysis should account for more than just the cost of capital; it should also account for the value of utility service over the long term and applicable policy goals. In other words, important utility services (such as providing safe and reliable power) and important policy goals (such as protecting low-income customers or promoting economic development) are all factors that affect the time preference relevant to the cost-effectiveness analysis.

This point is widely accepted in the application of the societal discount rate. That rate, which is used in multiple applications, reflects more than simply the cost of capital to society. It also reflects societal values and priorities, such as long-term benefits to society, achieving societal goals, addressing the needs and interests of multiple entities across society, and more. In a similar way, the discount rate used for cost-effectiveness analysis could reflect more than just the cost of capital.

9.4 The Regulatory Perspective

The regulatory perspective is an important concept for determining a jurisdiction's primary cost-effectiveness test (as described in Chapters 1 and 2), and associated discount rate. This perspective is typically not recognized or accounted for in the traditional cost-effectiveness tests, yet it is critical for identifying the costs, benefits, and priorities most relevant for any one jurisdiction.

The regulatory perspective is the most relevant perspective for determining a discount rate for the primary cost-effectiveness test.

The regulatory perspective includes the full scope of issues for which regulators and other relevant decision-makers are responsible. It is typically based upon statutes, regulations, executive orders, commission orders, and ongoing policy discussions.

Chapters 1 and 2 address why the regulatory perspective should be used to develop the primary RVT for a jurisdiction, and Chapter 3 provides more detailed guidance. By the same logic, the regulatory perspective is the most relevant perspective for determining a discount rate for the primary cost-effectiveness test.

9.5 The Investor-Owned Utility Perspective

When deciding which discount rate is most appropriate to use for cost-effectiveness analyses, regulators and other decision-makers should carefully consider the relevance of the "utility perspective." The investor-owned utility perspective is discussed in this section, and the publicly owned utility perspective is discussed in the next section.

The Investor-Owned Utility Perspective

The utility WACC is typically used to indicate the time preference for investor-owned utilities (i.e., reflects the time preference of the utility investors, which is the after-tax cost of equity and the cost of debt). The key goal of utility investors is to maximize the returns on their investments. Therefore, the time preference of utility investors is not necessarily the same as the time preference of utility customers, or the regulatory time preference.

Regulators/decision-makers should recognize this important distinction when considering whether to use the utility WACC as a discount rate. The primary objective of the cost-effectiveness analysis is to identify those utility resources that will best serve customers with safe, reliable, low-cost energy services over the long term. This objective is fundamentally different from the objective of maximizing utility investors' returns. These different objectives dictate different time preferences.

Another objective of the cost-effectiveness analysis is to meet the jurisdiction's applicable policy goals, which might include, for example, reducing the energy burden for low-income customers, reducing price volatility, reducing reliance upon fossil fuels, and reducing carbon emissions. Again, this objective of meeting applicable policy goals is fundamentally different from the objective of maximizing utility investors' returns; and these different objectives dictate different time preferences. These longer-term, broader objectives suggest that utility cost-effectiveness analyses should place a higher value on future impacts than utility investors would.

The Cost of Capital of Different Utility Resources

The goal of cost-effectiveness analysis is to compare the relative economics of investing in different resource options. The cost of capital used for resource acquisition varies across resource types. Therefore, even from a utility perspective, the discount rate used for such comparisons should reflect the cost of capital across the resource options under consideration.

A subset of resource costs, such as avoided capacity for generation, transmission, and distribution facilities, are financed by utility debt and equity. In contrast, it is often the case that EE resources and some supply-side resource costs have a much lower cost of capital than the WACC. The utility system costs of acquiring efficiency resources are typically recovered promptly through reconciling charges, and therefore involve no debt or equity costs. Similarly, some supply-side resource costs, such as fuel and purchased power costs are recovered promptly through reconciling charges, and therefore have little to no cost of capital.

In sum, when considering all of the resources used in the cost-effectiveness analyses (EE, avoided energy, avoided purchased power, avoided capacity) the actual WACC is considerably lower than the utility WACC, given the amount of resources that are not financed with debt or equity. This suggests that the utility WACC may be too high for the purposes of comparing the cost-effectiveness of different resources in utility resource planning.

Collection of Revenues to Pay for Debt and Equity

It is sometimes argued that the utility WACC should be used as a discount rate because investor-owned utilities need to collect sufficient revenues to pay dividends and interest to their investors. However, this rationale is not valid because the choice of the discount rate has no impact on the ability of the utility to recover its cost of capital.

The recovery of any debt and equity costs associated with resource acquisition should be included in the calculation of each resource's costs and benefits in the cost-effectiveness analysis. For example, the avoided capital cost of a new power plant should be calculated in terms of annual revenue requirements, which should include depreciation plus the recovery of debt, equity, and taxes over the book life of the asset. Given that the recovery of debt and equity costs should be included in all of the relevant costs and benefits of the resources, there is no need to tie the utility cost of capital to the discount rate.

Unregulated Companies Versus Regulated Utilities

It is also important to consider whether the concept of using the investor-owned utility WACC for a discount rate is appropriate for regulated utilities. While this concept is standard practice for unregulated companies, there are several important differences between unregulated businesses and regulated utilities.

The differences between unregulated businesses and regulated utilities are similar to those described above regarding the utility investor perspective. In fact, the utility investor perspective is essentially the same as the perspective of unregulated businesses, where the primary objective is to maximize profits. Regulated utilities have broader and longer-term objectives, which suggests that regulated utilities should place a higher value on future impacts than unregulated businesses do.

This point is particularly important given that using utility WACC for discount rates is so deeply embedded in utility industry practices. Much of the reason for this is likely due to the conventional practices used in other industries. Before continuing the use of conventional practices for unregulated businesses, regulators/decision-makers should carefully consider whether those conventional practices apply to regulated utilities.

9.6 The Publicly Owned Utility Perspective

Publicly owned utilities, such as public power authorities, municipal utilities, and cooperatives, likely have a different time preference than investor-owned utilities. First, the cost of capital for publicly owned utilities is typically based solely on debt, and therefore is much lower than the WACC of investor-owned utilities.

Second, publicly owned utilities are different from investor-owned utilities by design. One of the reasons for creating publicly owned utilities is to shift the focus of the utility management away from utility investors and toward the needs and interests of customers. Therefore, the time preference of publicly owned utilities is likely to be more aligned with the time preference of utility customers as a whole.

Many publicly owned utilities are overseen and managed by public or customer representatives. For example, municipal utilities are typically overseen by municipal selectmen, councilmen, or boards of customer representatives, and cooperative utilities are typically managed directly by boards of customers or customer representatives.

The boards and agencies that manage publicly owned utilities (i.e., the ultimate decision-makers on resource assessment) essentially act as both the "regulators" and the utility management. Consequently, for publicly owned utilities the utility perspective is naturally more aligned with the "regulatory" perspective. This suggests that publicly owned utilities should naturally place a higher value on long-term costs and benefits than investor-owned utility investors would.

9.7 The Utility Customer Perspective

As described above, the primary objective of utility cost-effectiveness analysis is to identify those utility resources that will best serve customers over the long term, while also achieving applicable policy goals of the jurisdiction. Given that a key objective of the analysis is to serve customers, the utility customer time preference is an important consideration in determining the appropriate discount rate for the analysis.

Regulators/decision-makers should consider several issues when assessing customer time preference. The customers' cost of capital is only one factor that will influence the customers' time preference. Customers are interested in several aspects of utility services beyond just the costs. For example, they may also be interested in reliability of services, price volatility, power quality, etc. These additional aspects of utility service mean that customers might place a different time preference on dollars spent on utility services relative to dollars spent on other products or other investments.

In addition, the customer cost of capital varies considerably across customer classes, and also across customers within classes. Any one cost-effectiveness test, however, can use only one discount rate. Therefore, to the extent that

> In some ways, the time preference from a regulatory perspective is aligned with utility customers' time preference. In both cases, time preference should be consistent with the objective of identifying those resources that will best serve customers. The time preference from the regulatory perspective, however, captures two additional considerations. First regulators/other decision-makers have a responsibility to ensure that utility resources will meet applicable policy goals. Second, regulators have a responsibility to consider both current and future customer interests. For both of these reasons, the regulatory perspective should place a higher value on long-term costs and benefits than the utility customer perspective.

the customer cost of capital is used to inform the determination of a discount rate, it should be an average cost of capital that represents the broad range of utility customers.

9.8 Risk Considerations

Accounting for Risk in Determining the Discount Rate

Risk is often cited as an important factor to consider when determining a discount rate, because risk can affect the value that one might place on long-term versus short-term impacts. However, risk can be represented in different ways in a cost-effectiveness analysis, and it is important to be careful that any treatment of risk in the discount rate recognizes how risk is addressed in the rest of the analysis to ensure that there is no double-counting or under-counting of risk.

Risks can vary considerably across different types of utility resources. For example, EE resources tend to create relatively low risk; generators create different amounts of capital cost, siting, and construction risks; fossil-fueled generators create price escalation and volatility risks; and transmission and distribution facilities impose their own kinds of risks (Ceres 2012).

In general, it is preferable to account for such resource-specific risks separately and explicitly for each resource type, rather than embed it in a discount rate. Discount rates are applied to all resources in a cost-effectiveness analysis. Applying a single discount rate to all resources to reflect risks associated with any one of those resources, could conflate the treatment of resource-specific risk with the overall choice of time preference. Instead, resource-specific risk should be accounted for in developing the cost and benefit inputs to the cost-effectiveness analysis.

Addressing Resource-Specific Risk

There are at least three techniques for addressing resource-specific risk. First, resource-specific risk should be accounted for in the financing costs of the resources themselves. The cost of capital used to determine the cost of each resource should reflect the capital and construction risks associated with that resource. For example, a large new nuclear plant could be assumed to have a high, risk-adjusted, cost of capital to reflect the relevant nuclear capital and construction risks. In contrast, the cost of acquiring EE resources are typically recovered promptly through reconciling charges, and therefore no financing costs are included in their costs.

Once the financial risk of each resource has been accounted for in the financing costs, any other resource-specific risk considerations should be explicitly applied to the costs of those resources. For example, for efficiency resources that avoid potential fuel price volatility or escalating carbon emissions costs (i.e., risk benefits that are not captured in the avoided costs themselves) this risk benefit can be accounted for by either reducing the cost of the efficiency resources or increasing the magnitude of avoided costs (VT PSB 1990).

Finally, the analysis used to develop avoided costs should employ risk assessment techniques to account for the risks associated with the portfolio of resources that define avoided costs (Ceres 2012). There are multiple techniques for portfolio risk assessment, including scenario analyses and probabilistic analyses.

Energy Efficiency Risk

There may be situations where the costs or benefits used in the EE cost-effectiveness analysis do not properly reflect resource-specific risks. For example, the full set of risks associated with avoided costs (e.g., risks associated with avoided fuel costs) may not be fully captured in the avoided costs that are input to the cost-effectiveness analysis.

In such situations, regulators/decision-makers may choose to apply a low-risk discount rate to reflect the net risk benefits of EE resources, because those benefits are not otherwise accounted for in the inputs to the analysis. There are multiple options for determining a low-risk discount rate; the interest rate on 10-year U.S. Treasury bonds is frequently used for this purpose. Several states currently use this low-risk indicator for determining the discount rate their EE cost-effectiveness analyses (NEEP 2014, 43).

9.9 Determining the Discount Rate

9.9.1 Discount Rate for the Resource Value Test

Ultimately, the choice of discount rate is a policy decision—a decision regarding how much weight to give to long-term versus short-term costs and benefits. When determining the discount rate for the RVT, this policy decision should be guided by the regulatory perspective, the same perspective that is used to define that test.

The regulatory perspective may differ from one jurisdiction to another. Therefore, each jurisdiction should determine a discount rate for the RVT based on its own policies and goals. Regulators/decision-makers can take the following steps to make this determination.

The regulatory perspective may differ from one jurisdiction to another. Therefore, each jurisdiction should determine a discount rate for the RVT based on its own policies and goals.

Step A: Articulate Policy Goals

Section 3.1 describes how regulators should identify and articulate policy goals as the first step in the Resource Value Framework. Those same policy goals should be articulated and applied when determining the discount rate for the RVT.

Step B: Consider the Utility Investor Perspective

Regulators should consider whether the utility WACC represents the regulatory time preference, based on the considerations outlined above. Is the utility investor time preference consistent with the jurisdiction's regulatory perspective and policy goals? Is the utility investor time preference the appropriate time preference for resource planning? Does the utility WACC accurately reflect the cost of capital of efficiency and the other resources being assessed?

- If the answer to these questions is "yes," then the utility WACC could be used as the discount rate.
- If the answer to these questions is "no," then a discount rate that is lower than the utility WACC could be used. A lower discount rate would be warranted if either (a) the actual cost of capital across all resources is lower than the utility's WACC; or (b) the regulatory perspective places a greater value on long-term impacts than utility investors.

Step C: Consider the Average Customer Discount Rate

Regulators should consider whether the average customer discount rate represents the regulatory time preference, based on the considerations outlined above. Should the discount rate be based on the average utility customer cost of capital? Does this time preference adequately address applicable policy goals and future utility customer?

- If the answer to these questions is "yes," then the average customer discount rate as the discount rate could be used.
- If the answer to these questions is "no," then a discount rate that is lower than the average customer discount rate could be used. A lower discount rate would be warranted if the customer discount rate does not adequately account for policy goals and long-term customer impacts.

Step D: Consider the Societal Discount Rate

Regulators should also consider whether a societal discount rate is appropriate for the primary cost-effectiveness test, based on the considerations outlined above. Is a societal time preference consistent with the jurisdiction's applicable policy goals?

- If the answer to this question is "yes," then a societal discount rate could be used.
- If the answer to these questions is "no," then a discount rate that is higher than the societal discount rate could be used. A higher discount rate would be warranted if the jurisdiction's places less value on long-term impacts than society would.

Step E: Consider an Alternative Discount Rate

Regulators/decision makers should also consider whether to use a discount rate that is not tied to any one of the three perspectives described above. The regulatory perspective may be different from the perspective of utility investors, customers, and society; thus, the regulatory time preference and discount rate could be different as well.

- Does the jurisdiction's regulatory perspective suggest a greater value on long-term impacts than that of utility investors?
    - If so, then use a discount rate that is lower than the utility WACC. If not, then use a discount rate that is higher than the utility WACC.
- Does the jurisdiction's regulatory perspective suggest a greater value on long-term impacts than that of customers?
    - If so, then use a discount rate that is lower than that of customers. If not, then use a discount rate that is higher than that of customers.
- Does the jurisdiction's regulatory perspective suggest a greater value on long-term impacts than that of society?
    - If so, then use a discount rate that is lower than that of society. If not, then use a discount rate that is higher than that of society.

Step F: Consider Risk Implications

Resource-specific risk issues are best accounted for in estimating the costs of each resource, for example in the resource-specific cost of capital, as adjustments to a resources costs or benefits, and/or in the avoided cost portfolio modeling process.

Nonetheless, there may be situations where the EE costs or benefits do not properly reflect resource-specific risks. For example, the full set of risks associated with avoided costs (e.g., risks associated with avoided fuel costs, risks associated with construction costs) are often not captured in the cost-effectiveness inputs. In such situations, regulators and other decision-makers may choose to apply a low-risk discount rate to reflect the net risk benefits of EE resources, because those benefits are not otherwise accounted for in the inputs to the analysis.

9.9.2 Discount Rates for Different Cost-Effectiveness Tests

The discount rate concepts and considerations described in this chapter are not only relevant to the RVT; they are also relevant to other tests.

The Utility Cost Test

For all the reasons discussed above in Section 9.5, regulators and other decision-makers should be circumspect about using the utility WACC as the discount rate for the UCT. The utility WACC represents the perspective of utility investors, which is fundamentally different from the customer or regulatory perspectives.

This distinction between the customer or regulatory perspectives and utility investor perspectives is relevant regardless of which test is used for EE cost-effectiveness. In all cost-effectiveness analyses, the purpose is to identify resources that best serve customers, and the regulators are in the best position to define what is in the long-term interest of customers. Therefore, the discount rate to use for the RVT should be used for the UCT as well.

In all cost-effectiveness analyses, the purpose is to identify resources that best serve customers, and the regulators are in the best position to define what is in the long-term interest of customers.

Note that the UCT does not represent the perspective of the "utility" *per se* (i.e., in terms of the interests of utility investors or utility management). This test includes all the costs and benefits within the scope of the "utility system" that is used to serve customers, as described in Section 3.3 and Section 6.2.

This distinction between the "utility" (i.e., investors) and the "utility system" (i.e., customers) is important when considering whether the utility WACC is relevant for the UCT. The purpose of the UCT is to identify those resources that will best serve customers, including all costs that customers pay to the utility, and all benefits that customers receive from the utility. This is different from the goal of maximizing value for utility investors.

Total Resource Cost Test

The choice of a discount rate for the TRC test should be based on the same considerations as the choice for the UCT. Adding participant impacts in the test does not change the fact that the purpose of the cost-effectiveness analysis is to provide the best services to customers, and not to maximize shareholder value.

The Societal Cost Test

It is widely accepted that the societal discount rate should be used for the SCT. This is consistent with the notion of aligning the discount rate with the relevant perspective of the test. It is also consistent with the concepts and considerations described above regarding a societal preference for achieving policy objectives and placing greater weight on long-term resource impacts.

The Participant Cost Test

It is widely accepted that a customer-based discount rate should be used in the Participant Cost test. Since the objective of this test it to determine the impacts on program participants, and is not to compare efficiency resources with other resources, a customer-based discount rate is appropriate for this test.

9.9.3 Discount Rates for Analyzing Different Resource Types

The overarching purpose of cost-effectiveness analyses *for any type of utility resource* is to identify those resources that will best serve customers over the long term. Therefore, one of the central concepts of this chapter—that the discount rate should be based on the regulatory perspective, which may be different from the utility investor perspective—is applicable to all types of utility resources.

Regulators and other decision-makers should use the steps described in subsection 9.9.1 to determine the discount rate for analyzing the cost-effectiveness of any type of utility resource. This includes all types of DERs (EE, demand response, distributed generation, and storage), as well as all types of supply-side resources (generation, transmission, and distribution).

The rationale for determining the discount rate for the RVT is relevant across all of these resources. Further, using the same discount rate across all utility resource cost-effectiveness analyses will make the results of those analyses comparable. It will also allow for a more direct comparison across all resource types.

10. Assessment Level

The cost-effectiveness of efficiency resources can be assessed at several levels of aggregation. Assessments can focus on individual measures, individual customer-specific projects, individual programs combining multiple measures and/or projects, sectors (e.g. all residential or all business programs), or portfolios of programs (across all sectors). This chapter discusses the advantages and disadvantages of conducting cost-effectiveness analyses at each of those levels. It also discusses the level at which fixed costs should be included in analyses.

10.1 Summary of Key Points

- Cost-effectiveness assessment at all levels—measure, project, program, sector, and portfolio—can provide valuable insight into program design and implementation. Efficiency planners and other stakeholders may want to analyze efficiency resources at several, if not all, of these levels.
- When applying the primary cost-effectiveness test, or otherwise determining which efficiency resources merit funding, regulators and efficiency planners should rely upon program-level, sector-level or portfolio-level cost-effectiveness results.
- When applying the primary cost-effectiveness test, or otherwise determining which efficiency resources merit funding, regulators and efficiency planners should not rely upon measure-level or project-level cost-effectiveness results. Any advantages of measure-level and/or project-level application are typically outweighed by the disadvantages.
- Consistent with the principle that cost-effectiveness analyses should be forward-looking and focused only on marginal impacts (see discussion in Chapter 1), efficiency program costs should be included in cost-effectiveness analyses only at the level at which they become variable. For example, fixed program costs should not be allocated to measures for the purpose of assessing the cost-effectiveness of individual measures and fixed portfolio-level costs should not be allocated to programs for the purpose of assessing the cost-effectiveness of individual programs.

10.2 Assessment Level Options

10.2.1 Measure-Level Assessment

Resource assessment at the measure level means that each individual measure promoted by an efficiency program must be cost-effective on its own. Screening at the measure level is the most restrictive application of the cost-effectiveness tests.

Measure-level application of cost-effectiveness requirements will essentially guarantee that every measure included in an efficiency program will be cost-effectiveness on its own. However, application of cost-effectiveness requirements at that level can have perverse implications. In some cases, it could reduce the overall net economic benefits of efficiency investments. That can occur for any of the following reasons:

- A customer's interest in a non-cost-effective measure may be key to persuading the customer to install a package of measures that are cost-effective in aggregate. In such cases, the flexibility to promote the non-cost-effective measure as part of a package will lead to greater overall net benefits.
- A customer's interest in a non-cost-effective measure may be key to the development of a relationship with the customer that can lead to installation of cost-effective measures in the future. In that sense, promotion of the non-cost-effective measure can be analogous to a marketing investment.
- Installation of a non-cost-effective measure may be necessary in order to technically or safely enable the installation of other cost-effective measures. An example of this would be the installation of non-cost-effective mechanical ventilation in order to make indoor air quality acceptable when tightening up a building.

Another disadvantage of requiring all measures to be cost-effective is that it can be difficult to account for non-energy impacts, hard-to-monetize impacts, or additional considerations at the measure level. Some non-energy impacts, such as improved health and safety, are obtained through a package of multiple measures, and it is impractical to apply such impacts on each measure.

10.2.2 Project-Level Assessment

Resource assessment at the project level means that the combination of measures implemented together in a package for an individual customer must be cost-effective on its own. Project-level assessments are typically conducted only for projects undertaken by larger business customers for which the transaction cost of a site-specific assessment can be justified.

Project-level application of cost-effectiveness requirements will essentially guarantee that every project included in an efficiency program will be cost-effectiveness on its own. However, application of cost-effectiveness requirements at that level can have some (though fewer) of the perverse implications of measure-level cost-effectiveness requirements. Specifically, supporting the implementation of a non-cost-effective package of measures in which a customer is interested can facilitate development of a relationship with customer that can produce a more cost-effective project later. Also, depending on whether and how participant non-energy benefits are included in cost-effectiveness assessments, the full value of non-energy benefits of a project may not be captured in project-level cost-effectiveness assessments.[37]

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[37] The focus of this discussion is solely on the use of cost-effectiveness analysis to determine which investments merit acquisition from either utility system or broader perspectives. Efficiency programs targeted to large business customers often present costs and benefits to individual customers from the customer's perspective (i.e. using retail energy prices rather than avoided system costs, as well as considering customer non-energy benefits that may or may not be part of a jurisdiction's cost-effectiveness test). Similarly, some low-income programs base the determination of which measures to install on the savings-to-investment ratio (i.e., benefit-to-cost ratio) derived using the customer's retail rate. The merits of such customer-focused analyses are fundamentally different from those discussed here regarding utility system resource analyses.

10.2.3 Program-Level Assessment

Resource assessment at the program level means that the measures and/or projects within a program must be cost-effective collectively. Some individual measures and/or projects may not be cost-effective on their own, but could still be included in the program if the overall program were cost-effective.

The primary advantage of this approach is that it best represents the costs and benefits of initiatives that combine a set of actions (e.g., marketing, education, technical support, financial support, etc.) into a single package offered to customers. In addition, resource assessment at the program level avoids the problems noted above regarding missing the interrelationships between measures. These include technical connections and the ability to engage customers in ways that can lead to increasing net economic benefits, as well as the ability to properly capture customer non-energy benefits where warranted.

A disadvantage of this approach is that a program might include one or more measures that are not individually cost-effective and are not needed to account for the concerns addressed above. This has the effect of decreasing to some extent the overall cost-effectiveness of the program. However, this concern can be addressed with sound program design. Efficiency program planners and designers should include only those efficiency measures that effectively contribute to achieving the specific goals of the program.

One other potential concern with program-level screening is that it might preclude certain special programs that address important objectives at the sector or portfolio level. For example, pilot programs to test new and unproven program designs might not appear cost-effective, but might provide future sector or portfolio benefits that cannot be identified in the present. For that reason, jurisdictions that apply program-level screening may want to allow these types of programs to be considered in a sector-level assessment.

10.2.4 Sector-Level Assessment

Resource assessment at the sector level means that the programs within a sector (e.g., low-income, residential, commercial and industrial)[38] must be cost-effective collectively. Some programs may not be cost-effective on their own, but could still be implemented if the combined impact of all of the programs targeted to a given sector were cost-effective.

The primary advantage of this approach is that it indicates the costs and benefits of initiatives to provide a package of efficiency services to an entire sector. This may allow for non-cost-effective programs to be provided to a sector for the purpose of providing a complete set of efficiency services to that sector—an objective often driven by concerns

[38] Some jurisdictions treat low-income programs as their own "sector," because of the special consideration often given to such customers in program design and delivery. Others treat low-income programs as part of the residential sector. Alternatively, though commercial and industrial customers could be considered to be different "sectors," most efficiency programs targeted to business customers are do not differentiate between those two groups of customers, creating what are called business, non-residential, or commercial & industrial (C&I) sector programs. For the purpose of this manual, we call out low-income, residential, and C&I as three sectors of interest for illustrative purposes only. The conceptual discussion in this section applies regardless of whether low income is treated as its own sector or as part of the residential sector and regardless of whether commercial and industrial are treated as their own sectors or combined.

about equitable access to efficiency programs across a large range and number of customers.

The primary disadvantage of this approach is that it could result in the inclusion of efficiency measures or programs that are not individually cost-effective, thereby decreasing the economic value of the suite of programs for that sector.

10.2.5 Portfolio-Level Assessment

Evaluation at the portfolio level means that the programs within a portfolio (i.e., combining all programs together) must be cost-effective collectively. Some programs may not be cost-effective on their own, but could still be pursued if the combined impact of all of the programs was cost-effective.

The primary advantage of this approach is that it indicates the costs and benefits of the entire suite of EE programs.

The primary disadvantage of this approach is that it could result in implementing efficiency measures or programs that are not cost-effective, thereby decreasing the economic value of the overall portfolio.

10.3 Properly Accounting for Fixed and Variable Costs

A variety of costs are incurred in the acquisition of efficiency resources. It is important that those costs be included at the proper analytical level—e.g., measure, program, sector and/or portfolio—when analyzing the economics of efficiency resources. In a nutshell, only costs that are variable at a given analytical level should be included in cost-effectiveness analysis for that level because they are the only costs that can be avoided as a result of the analysis. Costs that are largely fixed at a particular analytical level should not be "allocated" or otherwise included *at that level;* doing so could lead to rejection of investments whose marginal benefits exceed their marginal costs, thereby lowering net economic benefits. That does not mean that costs that are fixed at a given analytical level should be omitted or ignored altogether. Instead, they can and should be included at higher level analyses at which they are variable and therefore are avoidable.

Only costs that are variable at a given analytical level should be included in cost-effectiveness analysis for that level.

For example, when assessing the economics of efficiency measures, one should include only costs that largely increase or decrease in proportion to the number of measures installed. That will obviously include the cost of the measures themselves, and could also include some program costs that are largely variable. Examples would include rebate processing costs, if the program administrator is paying a vendor a price for every rebate processed, and inspection costs if the program is committed to inspecting a certain percentage of all projects.[39] However, other program costs that are either largely

[39] Alternatively, if the program is committed to inspecting enough projects to get a statistically valid sample, such that the number of inspections would not change significantly or at all between a level of 2000 and

fixed or do not change in proportion to program participation levels, such as the costs of marketing[40] or managing and evaluating the program, should not be included in the economic analysis of individual measures. Rather, they should be included only at program-level cost-effectiveness assessment.

Similarly, portfolio costs that are either largely fixed or do not change in proportion to the number of programs or participation levels in those programs should not be allocated to programs for the purpose of analyzing the economics of individual programs. Rather, they should only be included at portfolio-level cost-effectiveness analysis. Such costs can include portfolio-level marketing, management, and evaluation costs.

The tables below illustrate the importance of accounting for largely fixed costs at the proper analytical level. Table 20 shows that for each of five programs analyzed, the benefits exceed the variable costs of the programs. When largely fixed portfolio costs (equal to about 25 percent of the sum of the five program costs) are added to the sum of the variable impacts of the five programs, the portfolio itself is shown to be cost-effective, providing total net benefits of $800,000.

Table 20. Proper Analysis with 25 Percent Fixed Portfolio Costs Included at Portfolio-Level Analysis

	Benefits ($000)	Costs ($000)	Net benefits ($000)	Positive net benefits?
Program 1	$500	$250	$250	Yes
Program 2	$300	$200	$100	Yes
Program 3	$1000	$400	$600	Yes
Program 4	$500	$300	$200	Yes
Program 5	$1000	$850	$150	Yes
Sum of all programs	$3300	$2000	$1300	Yes
Portfolio-level costs	$0	$500	-$500	
Total portfolio impacts	$3300	$2500	$800	Yes

Table 21 shows that when the fixed portfolio-level costs are improperly allocated as 25 percent “adders” to each of the programs, the fifth program is no longer seen as cost-effective. If that program is then removed from the portfolio, but with portfolio costs remaining unchanged, the portfolio net benefits decline by $150,000 (i.e., the marginal impact of the fifth program on the portfolio) to $650,000.[41] In short, including fixed costs

10,000 participants, then such inspection costs should be treated as largely fixed and captured at the program level rather than at the measure level.

[40] Marketing costs can be somewhat variable in the sense that more marketing should lead to more participation. However, that relationship is rarely linear with the number of measures installed. In addition, and perhaps more importantly, program marketing budgets are often treated as largely fixed. That is, while marketing can play an important role in driving program participation, the costs of marketing do not go up and down as the number of participants goes up and down.

[41] Removing the fifth program would require a reallocation of the fixed portfolio cost to the remaining four programs (i.e. each of the remaining four programs would now be allocated a larger portion of the fixed portfolio costs). In this example, the four remaining programs would still all be cost-effective even after absorbing this larger allocation. However, under a different set of example programs, it is possible that the resulting larger allocation of fixed costs would render another program cost-ineffective.

at the improper level can reduce the economic benefits of efficiency resource acquisition.

Table 21. Improper Analysis with 25 Percent Fixed Portfolio Costs Allocated to Individual Programs

	Benefits ($000)	Costs ($000)	Net benefits ($000)	Positive net benefits?
Program 1	$500	$313	$188	yes
Program 2	$300	$250	$50	yes
Program 3	$1000	$500	$500	yes
Program 4	$500	$375	$125	yes
Program 5	$1000	$1063	-$63	no
Sum of all programs	$3300	$2500	$800	yes
Portfolio-level costs	*Included as adder for each program*			
Total portfolio if non-cost-effective programs excluded	$2300	$1650	$650	yes

11. Analysis Period and End Effects

Analysis period refers to the number of years over which the costs and benefits of a resource investment are forecast and compared. This chapter describes the time period over which cost-effectiveness analysis should be conducted, and how to address any potential 'end effects.'

11.1 Summary of Key Points

- The analysis period should be long enough to capture the full stream of costs and benefits associated with the efficiency resources being analyzed.
- Since most efficiency resource costs are incurred immediately while benefits are spread out over time, failing to use an analysis period that covers the full life of the resource creates an "end effects" problem that biases cost-effectiveness assessments against efficiency resources.
- If it is not possible or is impractical to extend the analysis period to the full life of the efficiency resources being analyzed, then a second best alternative is to amortize costs of the efficiency resource over the full life of the benefits and then compute the net present value (NPV) of both costs and benefits for the same number of years. This better aligns the portion of the costs being considered with the portion of the benefits being considered.

11.2 Analysis Period

Analysis period refers to the number of years over which the costs and benefits of a resource investment are estimated and compared when assessing the resource's cost-effectiveness. The analysis period should be long enough to capture the full stream of costs and benefits associated with the resources under analysis.

For example, an assessment of three years of implementation of an efficiency program which includes measures that last 30 years (a common assumption for some building envelope measures such as insulation upgrades) should have at least a 32-year analysis period—i.e., long enough to assign value to benefits (and costs) for each of the 30 years of life of a measure installed in the third of the three program years analyzed.

If any of the programs are projected to have longer-term market effects, the analysis period should be extended to account for the life of the savings from the post-program period increases in measure installations. For example, if a three-year program promoting building envelop efficiency measures is expected to affect market penetrations of such measures for five years after the three-year program period ends (i.e., in Years 4 through 8), then the analysis period should be extended to 37 years. This is long enough to assign value to the benefits and costs for each of the 30 years of life of a measure installed in the eighth (and last) year of the forecast, post-program period market effects.

11.3 End-Effects Problems

If the cost-effectiveness analysis does not fully capture all of the impacts, there may be what is commonly called an "end effects" problem in which the analysis captures the full cost of an efficiency resource, but not all of the benefits. This occurs because costs are usually incurred at the time of installation of an efficiency measure and therefore are entirely within the analysis period, while benefits are typically spread out over the life of the measure, with some of the benefits occurring after the end of the analysis period. The asymmetrical treatment of costs and benefits results in an analytical bias against efficiency.[42]

This is illustrated in Table 22, which compares the results of using (A) a proper analysis period for an efficiency resource with a 20-year life, and (B) a truncated analysis period of 15 years that creates an end-effects problem. In this hypothetical example, an analysis of the full lifetime benefits of the efficiency resource suggests the resource is cost-effective, with a benefit-cost ratio of 1.15. In contrast, when only 15 of the 20 years of benefits are counted because the analysis period is shorter than the resource life, one would reach the inaccurate conclusion that the resource is not cost-effective, with a benefit-cost ratio of 0.96.

Table 22. How Truncated Analysis Period Leads to End-Effects Problems

Resource Cost	**$1,000**
Annual Benefit	**$80**
Resource Life	**20**
Real Discount Rate	**3%**

A. Full Analysis Period (20 Years)—No End-Effects Problem

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**NPV**
Cost	$1000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1000
Benefit	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$1226
Net Benefit																					$226
Benefit-Cost Ratio																					1.23

B. Truncated Analysis Period (15 Years)—End-Effects Problem

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**NPV**
Cost	$1000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0						$1000
Benefit	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80						$984
Net Benefit																					($16)
Benefit-Cost Ratio																					0.98

11.4 Remedies for End-Effects Problems

The preferred remedy to an end-effects problem is to extend the analysis period to cover the full life of the efficiency resource whose installation is influenced by an efficiency program. However, if that is determined to be impractical, then a "second best"

42 Note that there can also be some O&M costs or cost savings that occur over the life of an efficiency resource. Use of a proper analysis period is important to accurately reflect the economic value of such O&M changes as well.

alternative is to account for only a portion of the costs of the measure (comparable to the portion of the benefits captured). A simple way to accomplish this is to amortize the costs over the life of the efficiency measure and then calculate the NPV of the resulting annualized costs. This is done over the same period that the NPV of the benefits of the measure are computed.

Table 23 illustrates the result of this approach, using the same assumptions as in the example in Table 22. Part A shows that amortizing costs produces the same NPV result as not amortizing costs when analyzing the full 20-year life of the resource. Part B shows that amortizing the cost in this way produces the same benefit-cost *ratio* under a truncated analysis period as under an analysis period long enough to capture impacts over the full life of the resource. However, the net benefits under this approach ($181 in this example) are lower than under an analysis period that captures impacts over the full life of the resource ($226 in this example). Thus, though this approach is clearly preferable to a truncated analysis that captures all of the resource costs and only some of the resource benefits, it is still better to extend the analysis period to cover the full life of the resources being analyzed, when possible.[43]

Table 23. How Amortizing Costs to Align with Resource Life Ameliorates End-Effects Problems

A. Full Analysis Period (20 Years) with Cost Amortized over Resource Life

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**NPV**
Cost	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$1000
Benefit	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$1226
Net Benefit																					$226
Benefit-Cost Ratio																					1.23

B. Truncated Analysis Period (15 Years) with Cost Amortized over Resource Life

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**NPV**
Cost	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65	$65						$802
Benefit	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80						$984
Net Benefit																					$181
Benefit-Cost Ratio																					1.23

[43] The difference in net benefits can be important if they are necessary to cover fixed program costs to make a program cost-effective (or to cover fixed portfolio costs to make a portfolio of programs cost-effective). For example, if the $1,000 cost assumption in Table 22 and Table 23 was only a per unit efficiency measure cost, and if a program could lead to installation of 10,000 measures, the net benefits from the measures alone would be $1.81 million under the “truncated analysis with costs amortized” approach (i.e., $181 in net benefits per measure from Part B of Table 23 multiplied by 10,000). Thus, if fixed program costs were $2.00 million, the program would appear to not be cost-effective under the “truncated analysis with costs amortized approach.” However, it would be cost-effective if the analysis period covered the full life of the efficiency measures for which the net benefits of the measures would be more accurately calculated at $2.26 million (the $226 per measure from Table 22 Part A multiplied by 10,000 measures).

12. Analysis of Early Replacement

Early replacement occurs when a functioning piece of equipment is replaced with a more efficient model before it normally would have been replaced. This chapter provides guidance on how to analyze the costs and benefits of such early replacement efficiency measures.

12.1 Summary of Key Points

- Under cost-effectiveness tests that do not include participant impacts, the early replacement measure cost is simply the cost the utility incurs to promote the installation of the measure.
- Under cost-effectiveness tests that include participant impacts, the initial cost of an early replacement measure is partially offset by the benefit of deferring the replacement cost that would otherwise have been incurred several years later (i.e., by pushing the date on which the next replacement piece of equipment will have to be purchased much farther out into the future).
- The benefits of early replacement measures are partially a function of the efficiency of the equipment that would have been installed later in the baseline scenario. If the future baseline replacement efficiency is the same as that of the early replacement measure, there is simply one stream of benefits for just the duration of the early replacement period. In other instances, the early replacement measure is more efficient than the new equipment that would otherwise have been purchased in several years (the future baseline replacement efficiency). If this is the case, cost-effectiveness analysis should account for two different streams of impacts: one for the duration of the early replacement period and another for remaining useful life of the early replacement measure.

12.2 Overview

This section addresses why cost-effectiveness analysis of early replacement measures and programs requires special attention, as compared to other common measure categories.

Efficiency measures typically fall into one of four categories:

New Construction: in which a building is going to be constructed, and an efficiency program prompts developers, builders, or contractors to install more efficient products or use more efficient construction practices than they otherwise would have.

Time-of-Sale/Natural Replacement: in which a product is going to be sold and purchased, such as when an appliance breaks down and needs to be replaced, and an efficiency program is designed to persuade a vendor to sell and/or a customer to purchase a more efficient product than they otherwise would have.

Retrofit: in which efficiency programs incentivize customers to install new efficiency measures in an existing space, such as an un-insulated attic.

Early Replacement: in which an existing inefficient product is functioning and would not otherwise be replaced until a future year, and an efficiency program prompts a customer to replace it with a more efficient product sooner than he or she otherwise would have.

For the first three of those efficiency measure classifications, the cost impacts are commonly felt only in the first year (i.e., the incremental cost of an efficiency upgrade over a standard measure that would otherwise have been purchased or the full cost of a retrofit measure). The savings are thus simply the difference between the baseline efficiency and the new efficiency that will recur annually for the life of the measure.

Characterization of both the costs and savings of early replacement measures can be more complicated for two reasons:

- Early replacement changes the timing of costs relative to when they could be incurred in the baseline scenario (i.e., absent the early replacement)—at least in cases where a jurisdiction chooses to include participant costs and benefits; and
- That change in timing can lead to the need to account for multiple baseline assumptions (assumptions that change over time) for both costs and savings.

This section provides guidance on how to account for changes in the timing of costs, and accounting for multiple baselines for both costs and savings/benefits.

12.3 Accounting for Changes in the Timing of Costs

Under an early replacement scenario, there is the initial full cost of the replacement product. However, there are also potential cost savings from not having to buy the new product that would otherwise have been purchased several years into the future (depending on which categories of impacts are included in the cost-effectiveness test selected per guidance in Chapter 3).

Consider, for example, the following hypothetical early replacement scenario:

- The customer has a 10-year-old and still functioning heating system with a 70 percent efficiency rating, and the heating system is normally assumed to last 15 years;
- *Absent an efficiency program influence*, the customer is expected to replace its 10-year-old heating system in five years with a new 90 percent efficient model that will cost $5,000;
- *With the efficiency program influence*, the customer decides to scrap its existing inefficient heating system and replace it today with a new 90 percent efficient model that costs $5,000.

In this case, there would be only five years of savings from the early replacement. If the cost-effectiveness test includes participant impacts, the net cost of the efficiency resource is equal to the $5000 initial cost of the early replacement *minus the NPV of the benefit of deferring a new purchase from the beginning of Year 6 to the beginning of Year 16*.[44] It is critically important that the reduction in cost associated with deferring the next new purchase be incorporated into cost-effectiveness analyses. To not account for

[44] Year 6 is when the customer would otherwise have had to buy a new replacement heating system; Year 16 is when the customer will have to replace the new heating system that was just installed.

it would result in markedly overstating the costs of early replacement measures and programs.[45]

Calculating the value of that deferral requires a cost amortization approach identical to that of minimizing the end-effects problems outlined in Chapter 11. This serves to align the mismatched timing of costs under the baseline condition and the early replacement condition, as illustrated in Table 24.

In short, the amortizing or annualizing of the different purchase times under the baseline and early replacement scenarios has the effect of lining up costs so that the only difference is five years of annualized costs under the early replacement scenario. (The annualized cost under the baseline and early replacement scenarios are the same in Years 6 through 20, cancelling each other out.) Importantly, that also aligns the cost analysis with the benefits analysis (i.e., both costs and benefits occur only in Years 1 through 5).

Table 24. Amortization to Address Mismatched Timing of Baseline and Early Replacement Costs

Costs		Savings	
Efficiency Measure Cost	$5000	Installed Measure Efficiency	90%
Standard New Product Cost	$5000	Standard New Product Efficiency	90%
Resource Life	15	Existing Efficiency	70%
Existing Product Remaining Life	5	Savings Annual Value (Years 1-5)	$600
Real Discount Rate	3%	Savings Annual Value (Years 6 and Beyond)	$0

A. Mismatched Timing of Costs Incurred under Baseline and Early Replacement Program Scenarios

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Baseline	-	-	-	-	-	$5000	-	-	-	-	-	-	-	-	-	-	-	-	-	$5000
Early Replace	$5000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$5000	-	-	-	$5000

B. Net Costs and Benefits of Early Retirement Calculated through Cost Amortization

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	NPV
Costs																					
Baseline	-	-	-	-	-	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$4313
Early Replace	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$6231
Net	$407	$407	$407	$407	$407	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$1918
Benefits	$600	$600	$600	$600	$600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$2830
Net Benefits	$141	$141	$141	$141	$141	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	$912
Benefit-Cost Ratio																					1.48

12.4 Accounting for Multiple Baselines for Both Costs and Savings

Unlike in the more straightforward example above, there can also be differences between the cost and efficiency of the early replacement measure that is installed today

45 Again, this is only an issue if the cost-effectiveness test includes participant impacts. If it does not, the change in timing of costs associated with future equipment purchases is not relevant.

and the standard new product that would have otherwise been installed five years from now. For example, consider the following modifications to the hypothetical scenario outlined above:

- The customer has a 10-year-old and still functioning heating system with a 70 percent efficiency rating;
- This class of products is normally assumed to last 15 years, so absent an efficiency program influence, the customer is expected to replace its 10-year-old heating system in five years;
- The standard new heating system five years from now is expected to be an 85 percent efficient model that costs $4500;
- Within 10 years, the standard new heating system is expected to be a 90 percent efficient model that costs $5000;
- With the efficiency program influence, the customer opts to scrap its existing old inefficient heating system and replace it today with a new 90 percent efficient model that costs $5000. The new model is not only more efficient than the old heating system it is replacing, but also more efficient than the new heating system the customer would have bought five years from now.

In this case, as depicted in the bottom of

Table 25, there would be five years of the same level of savings as assumed in the first hypothetical example depicted in Table 24 (i.e., the difference between the old 70 percent and the new efficient 90 percent efficient model). However, unlike in the Table 24 example, there would continue to be savings in Years 6 through 20, though the magnitude of those savings would be lower than in the first five years (i.e., the difference between a standard new 85 percent efficient model and an efficient new 90 percent efficient model). Thus, in the hypothetical example, the NPV of benefits is more than $1300 greater ($4140 vs. $2830) than in the Table 24 example.

On the cost side of things, there would not only be a difference between no baseline cost and the amortized costs of the 90 percent efficient model for the first five years, but also a slightly higher amortized cost in the subsequent 15 years to reflect the difference in cost between a new 85 percent efficient model and a new 90 percent efficient model. Thus, in this hypothetical example, the NPV of costs is also greater—by over $400 ($2349 vs. $1918)—than in the Table 24 example.

The net effect of these changes in costs and benefits is an increase in net benefits per measure of nearly $900 (i.e., $1791 vs. $912) relative to the net benefits of the Table 24 example. It should be noted that the direction of this change is unique to this set of hypothetical assumptions. For example, if the cost of a new 85 percent efficient model in Year 6 was assumed to be $3500 instead of $4500 (with the 90 percent efficient model still costing $5000), the net benefits would be virtually identical to those of the example in Table 24. If the 85 percent efficient model cost only $2400 (with the 90 percent efficient model still costing $5000), the measure would actually fall below a 1.00 benefit-cost ratio.

Table 25. Amortization to Address Multiple Baselines for Savings and Costs of Early Replacement

Costs		Savings	
Efficiency Measure Cost	$5000	Installed Measure Efficiency	90%
Standard New Product Cost	$4500	Standard New Product Efficiency	85%
Resource Life	15	Existing Efficiency	70%
Existing Product Remaining Life	5	Savings Annual Value (Years 1-5)	$600
Real Discount Rate	3%	Savings Annual Value (Years 6 and Beyond)	$124

A. Mismatched Timing of Costs Incurred under Baseline and Early Replacement Program Scenarios

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Baseline	$0	$0	$0	$0	$0	$4500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5000
Early Replace	$5000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$5000	$0	$0	$0	$5000

B. Net Costs and Benefits of Early Replacement

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	**NPV**
Costs																					
Baseline	-	-	-	-	-	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$366	$3882
Early Replace	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$407	$6231
Net Cost	$407	$407	$407	$407	$407	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$41	$2349
Benefits	$600	$600	$600	$600	$600	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$124	$4140
Net Benefits	$193	$193	$193	$193	$193	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$83	$1791
Benefit-Cost Ratio																					1.76

13. Free-Riders and Spillover

This chapter describes how to address free-riders and spillover effects in cost-effectiveness analyses, for those jurisdictions that focus on net savings for those analyses.

13.1 Summary of Key Points

In jurisdictions that focus on net savings for their cost-effectiveness analyses:

- The treatment of free ridership and spillover effects should be a function of the categories of impacts that a jurisdiction chooses to include in the cost-effectiveness test it adopts pursuant to the process outlined in Chapter 3.
- With regard to free riders:
  - Financial incentives paid to free riders are a cost only if the cost-effectiveness test excludes participant impacts; otherwise the value of the financial incentive to the participant offsets the cost of the financial incentive to the utility system. In other words, the net cost of free riders is zero under any test that includes participant impacts.
  - No benefits from free riders should be included in any cost-effectiveness test.
- With regards to spillover:
  - There are no costs associated with spillover in jurisdictions whose cost-effectiveness test includes only utility system impacts. Spillover should increase costs under tests that include participant impacts.
  - Spillover increases benefits in every test.

Table 26 summarizes which categories of impacts are affected by free-rider and spillover effects, as further discussed below.

Table 26. Categories of Impacts Affected by Free-Riders and Spillover

Category	Free-Riders		Spillover	
	Costs	Benefits	Costs	Benefits
Utility System Impacts	Increase	n/a	n/a	Increase
Participant Impacts	Decrease	n/a	Increase	Increase (if applicable)
Other Impacts	n/a	n/a	Increase (if applicable)	Increase (if applicable)
Total/Net Impact	Increase only if test *excludes* participant impacts; otherwise no net effect	No effect under any test	No increase if test includes only utility system impacts; otherwise an increase	Increase under every test

13.2 Applicability and Definitions

This section addresses the economic concepts underpinning how free-ridership and spillover effects should be treated in cost-effectiveness analyses in jurisdictions that choose to focus on net savings. This section does not address the relative merits of focusing on net savings versus focusing on gross savings, as that is beyond the scope of a guidance document focused solely on the construct and application of cost-effectiveness analysis. This section has no relevance to or application for cost-effectiveness analyses in jurisdictions that choose to focus on gross impacts.

Key definitions to consider in applying guidance from this section are as follows:

- **Free-ridership** refers to efficiency program savings that would have occurred in the absence of the program.[46]
- **Spillover** refers to the installation of efficiency measures or adoption of efficiency practices by customers who did not directly participate in an efficiency program, but were nonetheless influenced by the program to make the efficiency improvement.[47]
- **Gross program impacts** are impacts before or without any adjustments for free-ridership and spillover.
- **Net program impacts** include adjustments for free-ridership and spillover.

13.3 Economic Treatment of Free-Rider Impacts

This section describes which free rider impacts should be included in cost-effectiveness analysis in jurisdictions that focus on net savings, given the categories of impacts that such jurisdictions include in their cost-effectiveness tests.

13.3.1 Utility System Impacts

Benefits: No utility system benefits associated with any savings achieved by free-riders should be included in cost-effectiveness analyses of an efficiency program because the program did not cause those benefits.

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[46] There are three forms of free-ridership: (1) total free-riders—or efficiency program participants who would have installed the same efficiency measures at same time even if the program had not been run; (2) partial free-riders—or participants who would have made some, but not all, of the efficiency investments they made in the absence of the program; and (3) deferred free-riders—participants who would have made the same efficiency investments in the absence of the program, but at a later date (NREL 2014—see: http://www.nrel.gov/docs/fy14osti/62678.pdf).

[47] Spillover can take multiple forms, including both (1) participant spillover—or savings that were influenced by a customer's participation in efficiency program but were beyond those tracked by the program; and (2) non-participant spillover—or savings that were produced by customers who were influenced by a program even though they did not directly participate in it. Participant spillover can be further subdivided into savings that occur at the same site as savings from program participation (known as "inside spillover") and savings that occur at other sites (typically) owned or operated by the same customer (known as "outside spillover"). Participant spillover can also be subdivided into savings that are from measures or actions that are same as those that were recorded by the program (known as "like spillover") or from different kinds of efficiency measures (known as "unlike spillover"). (NREL 2014—see: http://www.nrel.gov/docs/fy14osti/62678.pdf)

Costs: Any financial incentives paid to free-riders should be treated as a utility system cost, because they are part of the overall cost to the utility of operating an efficiency program. For example, if a customer that receives a $100 rebate from a utility efficiency program for an efficiency measure that it would have installed absent the program, the utility system has incurred a $100 cost.

13.3.2 Participant Impacts

Benefits: No participant benefits associated with any savings achieved by free-riders should be included in cost-effectiveness analyses of efficiency programs because the participants would have achieved the same benefits absent the program.

Costs: Financial incentives paid to free-rider participants should be treated as a negative cost to participants because such participants would not have received any such financial support absent the program. This reduction in cost to participants cancels out the cost of free-riders to the utility system. Thus, under cost-effectiveness tests that include both utility system and participant impacts, the net cost of free-riders is zero.

Consider the example in subsection 13.3.1 in which a customer that receives a $100 rebate from a utility efficiency program for an efficiency measure that it would have installed absent the program. As discussed in subsection 13.3.1, the $100 is a utility system cost. Thus, if the jurisdiction's cost-effectiveness test included utility system impacts (as all tests must) but did not include participant impacts, there would be a net cost from the free-rider of $100. However, that changes if the jurisdiction's cost-effectiveness test also includes participant impacts because $100 cost to the utility system is offset by a $100 benefit to the free-rider participant. Put another way, under a test that includes both utility system and participant impacts, the $100 rebate is what is often called a transfer payment. It has distributional impacts—by moving money between customers—but no *net* cost to customers as a whole (which is the perspective that matters under cost-effectiveness tests that include participant impacts as well as utility system impacts).

13.3.3 Other Types of Impacts

Benefits: No other types of benefits associated with any savings achieved by free-riders (other fuel savings, water savings, environmental emission reductions, public health cost savings, poverty reduction, job creation, energy security, etc.) should be included in cost-effectiveness analyses of efficiency programs because they would have been realized absent the program as well.

Costs: Any other types of costs associated with efficiency investments by free-riders should not be included in cost-effectiveness analyses of efficiency programs because they would also have been incurred absent the program.

13.3.4 Summary of Economic Treatment of Free-Riders

Table 27 summarizes the proper economic treatment of free-rider costs and benefits for jurisdictions that focus on net (rather than gross) impacts.

Table 27. Summary of Economic Treatment of Free Riders

Category	Free-Riders	
	Costs	Benefits
Utility System Impacts	Increase	n/a
Participant Impacts	Decrease	n/a
Other Impacts	n/a	n/a
Total/Net Impact	Increase only if test *excludes* participant impacts; otherwise no net effect	No effect under any test

13.4 Economic Treatment of Spillover Effects

This section describes what spillover impacts should be included in cost-effectiveness analysis in jurisdictions that focus on net savings, given the categories of impacts that such jurisdictions include in their cost-effectiveness tests.

13.4.1 Utility System Impacts

Benefits: All utility system benefits associated with spillover effects should be included in cost-effective analyses of an efficiency program because they were caused by the program.

Costs: There are no utility system costs directly associated with spillover effects because, by definition, investments made to produce spillover effects are not subsidized by efficiency programs (i.e., if a customer receives a rebate for installing a measure it is a program participant; spillover effects are produced when customers install measures without taking rebates or other program services).

13.4.2 Participant Impacts

Benefits: In jurisdictions that include participant impacts in their cost-effectiveness test, all spillover participant benefits associated with spillover effects should be included in cost-effectiveness analyses because such effects were caused by the efficiency programs being analyzed.

Costs: All spillover participant costs associated with spillover effects should be included in cost-effectiveness analyses because such effects were caused by the efficiency programs in question.

13.4.3 Other Types of Impacts

Benefits: In jurisdictions that include other types of impacts in their cost-effectiveness test (other fuel impacts, water impacts, environmental impacts, public health impacts, low-income impacts, job impacts, energy impacts, etc.), all other benefits associated with spillover effects should be included in cost-effectiveness analyses because such effects were caused by the efficiency programs under analysis.

Costs: All other types of costs associated with spillover effects should be included in cost-effectiveness analyses because such effects were caused by the efficiency programs under analysis.

13.4.4 Summary of Economic Treatment of Spillover Effects

Table 28 summarizes economic treatment of spillover costs and benefits.

Table 28. Summary of Economic Treatment of Spillover Effects

Category	Spillover	
	Costs	Benefits
Utility System Impacts	n/a	Increase
Participant Impacts	Increase	Increase (if applicable)
Other Impacts	Increase (if applicable)	Increase (if applicable)
Total/Net Impact	No increase if test includes only utility system impacts; otherwise, an increase	Increase under every test

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Appendix A. Traditional Cost-Effectiveness Tests

This appendix provides a description of the tests that are used for assessing EE cost-effectiveness: the Utility Cost, Total Resource Cost, Societal Cost, Participant Cost, and Rate Impact Measure tests. While these tests are described in the California Standard Practice Manual, those descriptions are not clear for all purposes, and many jurisdictions have deviated from the tests described there. The descriptions below are intended to provide the theoretical underpinnings of *what should be included* in these tests, which might be different from *what is included* in these tests in practice.

A.1 Overview

This appendix provides information on the three commonly used traditional screening tests: the UCT (also known as the Program Administrator Cost Test); the TRC test; and the SCT.[48] As discussed in both the introduction to this manual and in Chapter 4, a jurisdiction using the Resource Value Framework could develop a primary cost-effectiveness test that fully aligns with one of these traditional tests—assuming they are appropriately applied according to the principles set forth in Chapter 2 of this NSPM. This appendix describes the key elements of these three traditional tests. Where necessary, users of this manual can cross-reference Chapter 4 with this appendix to help guide considerations of the relationship with the traditional cost-effectiveness tests.

For each of the traditional tests, this appendix provides:

- A description of the test;
- The relevance of the test for cost-effectiveness assessment;
- The costs and benefits covered under each test; and
- limitations of each test.

This appendix also briefly addresses the Participant Cost and Ratepayer Impact Measure tests, as defined by the CaSPM. However, as discussed below, neither the Participant test nor the RIM test are conceptually consistent with the core principles of cost-effectiveness analysis discussed in Chapter 1. Thus, neither is appropriate as a tool for resource investment choices (though they can provide information that is potential useful for other purposes, such as program design).

Table 29 provides a conceptual overview of the traditional cost-effectiveness tests. Table 30 provides a summary of the various costs and benefits that, to be consistent with the analytical perspective each test is intended to represent, should be included in these tests (although they are not always included in practice). Additional information on each test is provided in the sections that follow.

[48] While most jurisdictions have historically used the CaSPM as the foundation for their cost-effectiveness tests, in practice many jurisdictions have deviated from those tests.

Table 29. Conceptual Overview of the CaSPM Cost-Effectiveness Tests

Test	Perspective	Key Question Answered	Summary Approach
Utility Cost	The utility system	Will utility system costs be reduced?	Includes the costs and benefits experienced by the utility system
Total Resource Cost	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	Society as a whole	Will total costs to society be reduced?	Includes the costs and benefits experienced by society as a whole.
Participant Cost	Customers who participate in an efficiency program	Will program participants' costs be reduced?	Includes the costs and benefits experienced by the customers who participate in the program
Rate Impact Measure	Impact on rates paid by all customers	Will utility rates be reduced?	Includes the costs and benefits that will affect utility rates, including utility system costs and benefits plus lost revenues

Table 30. Costs and Benefits of the CaSPM Cost-Effectiveness Tests

	UCT	TRC Test	SCT	Participant Cost Test	RIM Test
EE Costs:					
Efficiency Program Costs	Yes	Yes	Yes	---	Yes
Efficiency Portfolio Costs	Yes	Yes	Yes	---	Yes
Financial Incentive Provided to Participant	Yes	Yes	Yes	---	Yes
Participant Financial Cost of Efficiency	---	Yes	Yes	Yes	---
Participant Non-Financial Cost of Efficiency	---	Yes	Yes	Yes	---
Participant Increased Resource Consumption	---	Yes	Yes	Yes	---
Societal costs (environmental, health, etc.)	---	---	Yes	---	---
Lost Revenues	---	---	---	---	Yes
EE Benefits:					
Avoided Energy Costs	Yes	Yes	Yes	---	Yes
Avoided Generation Capacity Costs	Yes	Yes	Yes	---	Yes
Avoided T&D Capacity Costs	Yes	Yes	Yes	---	Yes
Avoided T&D Losses	Yes	Yes	Yes	---	Yes
Wholesale Market Price Suppression Effects	Yes	Yes	If applicable	---	Yes
Avoided Environmental Compliance Costs	Yes	Yes	Yes	---	Yes
Avoided RPS Compliance Costs	Yes	Yes	Yes	---	Yes
Avoided Credit and Collection Costs	Yes	Yes	Yes	---	Yes
Participant Resource Savings (fuel, water)	---	Yes	Yes	Yes	---
Participant Non-Resource Benefits	---	Yes	Yes	Yes	---
Reduce Low-income Energy Burden	---	---	Yes	---	---
Environmental Benefits	---	---	Yes	---	---
Jobs and Economic Development Benefits	---	---	Yes	---	---
Societal Health Care Benefits	---	---	Yes	---	---
Increased energy security	---	---	Yes	---	---
Customer Bill Savings	---	---	---	Yes	---

Chapter 6 provides descriptions for the costs and benefits listed here.

A.2 Utility Cost Test

Description: The purpose of the UCT is to indicate whether the benefits of an EE resource will exceed its costs from the perspective of only the utility system. The UCT includes all costs and benefits that affect the operation of the utility system and the provision of electric and gas services to customers. For vertically integrated utilities, this test includes all of the costs and benefits that affect utility revenue requirements. For utilities that are not vertically integrated, this test includes all costs and benefits that affect utility revenue requirements, plus additional costs and benefits associated with market-based procurement of electricity and gas services. The UCT is sometimes referred to as the Program Administrator Cost test, to include those cases where ratepayer-funded EE programs are implemented by non-utility administrators. The UCT is a more accurate name because the costs and benefits included in this test are those that affect the utility system, not those that affect the Program Administrator.

Relevance to EE Assessment: The UCT is useful for identifying the impact of EE on utility system costs and average customer bills, and thus is consistent with the principle that EE is a resource. It is also useful for identifying the extent to which utility investments will provide reduced costs to that same overall group of utility customers, and therefore can have value (among other factors) for informing decisions on relative program priorities, program design (e.g., customer incentive levels) and/or limits on program spending. As discussed in Chapter 3, the UCT should serve as the foundation upon which a jurisdiction's efficiency assessment test is built. From this foundation, other relevant impacts should be added to align the test with the jurisdiction's energy-related policy goals.

Costs Included: The UCT should account for all utility system costs that are incurred to implement the EE resource. This includes all costs that the utility must recover from customers, including: financial incentives for efficiency measures, efficiency program costs, and efficiency portfolio costs.

Benefits Included: The UCT should account for all utility system costs that are avoided by the EE resource. For electricity utilities, this includes avoided energy costs, avoided generation capacity costs, avoided reserves, price suppression effects, avoided transmission costs, avoided distribution costs, avoided ancillary services costs, avoided T&D line losses, avoided environmental compliance costs, avoided RPS compliance costs, avoided credit and collection costs, and the value of reductions in risk and/or increases in system reliability. For gas utilities, this includes avoided gas commodity costs, avoided gas distribution costs, avoided gas storage costs, avoided gas distribution losses, avoided environmental compliance costs, the value of risk mitigation and/or increased reliability, and avoided credit and collection costs.

A.3 Total Resource Cost Test

Description: One of the key principles of cost-effectiveness assessment is that utility EE investments should be evaluated as a resource and compared with other demand-side and supply-side resources. The TRC does so from the combined perspective of the utility system and participants. Thus, this test includes all impacts of the UCT, plus all impacts on the program participants.

Relevance to EE Resource Assessment: The TRC test provides more comprehensive information than the UCT by including the impacts on participating customers. As a result, this test includes impacts on other fuels, which allows for a comprehensive assessment of multi-fuel programs and fuel-switching programs. This test also conceptually includes other non-energy impacts on participants. This is particularly important for low-income programs.

Costs Included: This TRC test should account for all utility system and program participant costs incurred to implement the EE resource. This includes all costs described above for the UCT, plus any costs incurred by the program participant, including: financial cost to purchase efficiency measures; increased consumption of other fuels; increased O&M costs; and participant non-financial costs.

Benefits Included: This test should account for the utility system and program participant benefits that are experienced because of the EE resource. This includes all benefits described above for the UCT, plus any resources and benefits experienced by the program participant, including: other fuel savings, water savings, participant O&M savings, and all other participant non-resource benefits. The appropriate application of TRC requires that all such participant benefits are fully included in order to ensure symmetry with the inclusion of participant costs.

A.4 Societal Cost Test

Description: The purpose of the SCT is to indicate whether the benefits of an EE resource will exceed its costs from the perspective of society as a whole. This test provides the most comprehensive picture of the total impacts of an EE resource. This test includes all the impacts of the TRC test, plus the additional impacts on society. Note that the CaSPM refers to the SCT as a "variation" of the TRC test (CPUC 2001). Since then, many jurisdictions and many studies have referred to the SCT as a separate test with different implications.

Relevance to EE Resource Assessment: The SCT is useful for identifying the total universe of economic impacts of investment in EE resources. It is particularly apt for jurisdictions that have particular interest in a range of societal considerations, such as environmental or economic development concerns, in addition to an interest in minimizing utility system and efficiency program participant costs.

Costs Included: This test should account for all costs that are incurred to acquire the EE resource. This includes all costs described above for the TRC test, plus any costs incurred by society, including environmental costs and reduced economic development.

Benefits Included: This test should account for all of the benefits that result from the EE resource. This includes all benefits described above for the TRC test plus any benefits experienced by society, including: low-income community benefits, environmental benefits, economic development benefits, and reduced health care costs.

A.5 Participant Cost Test

Description: The intended purpose of this test is to indicate whether the benefits of an EE program will exceed its costs from the perspective of the EE program participant. This test includes all impacts on the program participants, but no other impacts.

Relevance to EE Resource Assessment: The Participant Cost test is not appropriate for assessing the value of EE as a resource because, unlike the other four tests described here, it values benefits based on avoided electricity and gas *rates* rather than on avoided utility system *costs*. That violates the fundamental principle that cost-effectiveness analysis should be "forward-looking" (see Chapter 1) because electric and gas rates are designed to recover both variable (i.e., avoidable) costs and fixed (unavoidable) costs, some of which were incurred in the past. An example would be the cost of previous capital investments in the T&D system or generating capacity in vertically integrated utilities.[49]

That said, the Participant test can have value for the purpose of informing efficiency program design (e.g., the level of financial incentives to offer prospective participants and/or the need for marketing to better inform participants of non-energy benefits that they may value) by providing insight into energy bill impact on participants.

Note that the US Department of Energy uses a different test to determine whether to include efficiency measures to participants in federally-funded weatherization assistance programs. It uses the savings-to-investment ratio; where the numerator is the present value of net savings in energy, water, non-fuel, or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure, and the denominator is the present value of the cost of the proposed energy or water conservation measure.

A.6 Rate Impact Measure Test

Description: The purpose of this test is to indicate whether an EE resource will increase or decrease electricity or gas rates (i.e., prices). This test includes all of the costs and benefits of the UCT, plus estimates of the utility lost revenues created by EE programs. When regulators take steps to allow utilities to recover the lost revenues of EE programs, through rate cases, revenue decoupling, or other means, then the recovery of these lost revenues will create upward pressure on rates. If this upward pressure on rates exceeds the downward pressure from reduced utility system costs, then rates will increase, and *vice versa*.

Relevance to EE Resource Assessment: The RIM test should not be used for purpose of determining which efficiency resources are cost-effective—i.e., have benefits that exceed their costs—because, like the Participant test, it does not measure changes in net economic costs across a population; rather, it is a measure of distribution equity. Even in that context, the RIM test only considers one of the three factors regulators should consider when exploring distributional equity concerns: rate impacts, bill impacts, and efficiency program participation rates that affect the portion of customers who will experience net increases or decreases in their bills. See Appendix C for a more detailed discussion of how to more holistically conduct and assess the trade-offs associated with rate impacts.

[49] They may be "avoided" in part by participants, but typically only if a larger portion is then recovered by non-participants. Put another way, a portion of participant benefits is often just a shift in costs from one customer group (participants) to another (non-participants) rather than a true cost savings.

Table 31. Summary of the CaSPM Cost-effectiveness Tests

Test	Purpose	Relevance to EE Assessment
Utility Cost	Indicates the extent to which ratepayer-funded efficiency will reduce costs to that same group of ratepayers; provides a foundation for all efficiency assessment tests	To indicate the impact of efficiency on utility system cost and average customer bills; serves as a foundation for all efficiency assessment tests
Total Resource Cost	Provides a more comprehensive view of EE impacts than the UCT, including impacts of other fuels, which is helpful for multi-fuel programs, and impacts on EE program participants (if properly applied with symmetrical treatment of costs and benefits)	Indicates the total cost of efficiency, regardless of who pays for it
Societal Cost	Most comprehensive test, enabling an assessment of cost-effectiveness based on the universe of costs and benefits of efficiency resource investment	Indicates the full impact of efficiency on society
Participant Cost	Useful in program design, to inform appropriate participant incentives	Not relevant for cost-effectiveness screening
Rate Impact Measure	Indicates whether long-term rates will increase or decrease on average	No appropriate for cost-effectiveness assessment; see Appendix C

Appendix B. Costs and Benefits of Other Types of DERs

This NSPM should serve as a foundation for assessing the cost-effectiveness of DERs. There are, however, important ways in which other types of DERs might need to be treated differently from EE resources. These important DER-specific issues are beyond the scope of this NSPM, but should be addressed by each jurisdiction as they develop cost-effectiveness practices for DERs. This appendix presents an introductory overview of how the types and magnitudes of costs and benefits might differ between EE resources and DERs.

While this NSPM focuses on the assessment of utility EE resources, the core concepts can be applied to other types of utility resources as well. The cost-effectiveness principles described in Chapter 1 and the Resource Value Framework described in Chapter 2 can be used to assess the cost-effectiveness of supply-side resources or distributed energy resources—including EE, demand response, distributed generation, distributed storage, electric vehicles, and strategic electrification technologies.

With regard to DERs, the cost-effectiveness principles and the Resource Value Framework can be used as the foundation for assessing their cost-effectiveness. There are, however, important ways in which other types of DERs might need to be treated differently from EE resources. For example,

- Some costs and benefits of EE might not be applicable to other types of DER, and vice versa. Some of the costs and benefits of EE might have different magnitudes relative to other types of DERs, including time-varying differences and locational differences.[50]
- The policy decision of whether and how to include participant impacts might be different for different types of DERs.
- The approach for addressing rate, bill, and participant impacts might be different for different types of DERs.
- Distributed generation resources can inject power into a distribution grid, while EE resources do not.
- In some jurisdictions, the policy goals supporting other types of DERs might be different from those supporting EE.

These important DER-specific issues are beyond the scope of this NSPM, but should be addressed by each jurisdiction as they develop cost-effectiveness practices for DERs.

This appendix presents an introductory overview of how the types and magnitudes of costs and benefits might differ between EE resources and DERs. The tables below provide an overview of the different types of costs and benefits associated with EE, demand response, distributed generation, and distributed storage. Many of the costs and benefits associated with DERs are the same or similar to those associated with EE. In some cases, however, DERs impose different types of costs or benefits.

[50] Appendix B provides a comparison of the costs and benefits of EE resources relative to those of other types of DERs.

Table 32 provides an overview of the types of costs and benefits that might be relevant to any type of DER. While most of these were described in Chapter 6, the table also includes some impacts that are not relevant to EE.

Table 32. Relevant Costs and Benefits of Distributed Energy Resources

<table>
<tr><th colspan="3">Costs</th><th colspan="2">Benefits</th></tr>
<tr><td rowspan="10">Utility System</td><td rowspan="5">Program costs</td><td>Measure costs (utility portion)</td><td rowspan="10">Utility System Avoided Costs</td><td>Avoided energy costs</td></tr>
<tr><td>Other financial incentives</td><td>Avoided generation capacity costs</td></tr>
<tr><td>Other program and administrative costs</td><td>Avoided reserves or other ancillary services</td></tr>
<tr><td rowspan="2">Evaluation, measurement, and verification</td><td>Avoided T&D system investment</td></tr>
<tr><td>Avoided T&D line losses</td></tr>
<tr><td rowspan="2">Utility incentives</td><td rowspan="2">Performance incentives</td><td>Wholesale market price suppression</td></tr>
<tr><td>Avoided RPS or EPS compliance costs</td></tr>
<tr><td>Integration</td><td>Interconnection costs</td><td>Avoided environmental compliance costs</td></tr>
<tr><td rowspan="2">Distribution Capital</td><td rowspan="2">Distribution system upgrades</td><td>Avoided credit and collection costs</td></tr>
<tr><td>Reduced risk</td></tr>
<tr><td rowspan="7">Non-Utility</td><td rowspan="7">Participant Costs</td><td rowspan="2">Measure costs (participant portion)</td><td>Low Income</td><td>Reduced low-income energy burden</td></tr>
<tr><td rowspan="3">Public</td><td>Public health benefits</td></tr>
<tr><td>Interconnection fees</td><td>Energy security</td></tr>
<tr><td>Annual O&M</td><td>Jobs and economic development benefits</td></tr>
<tr><td rowspan="2">Participant increased resource consumption</td><td>Environmental</td><td>Environmental benefits</td></tr>
<tr><td rowspan="2">Participant Benefits</td><td>Participant health, comfort, and safety</td></tr>
<tr><td>Non-financial (transaction) costs</td><td>Participant resource savings (fuel, water)</td></tr>
</table>

This table is presented for illustrative purposes, and is not meant to be an exhaustive list.

Different types of DERs might also have different magnitudes for the same type of cost or benefit. For example, one of the core purposes of EE and distributed generation is to reduce energy consumption from the grid, thereby avoiding energy costs on the utility system. Demand response and storage, however, typically *shift* the timing of energy consumption and therefore tend to reduce capacity costs more than energy costs.

These differences are presented in the tables below using circle icons. The greater the shading of the circle, the more often the costs or benefits are typically associated with the resource.

Table 33 below shows the costs and benefits to the utility system typically associated with EE, demand response, distributed generation, and distributed storage.

Table 33. Utility System Costs and Benefits of DERs

		Energy Efficiency	Demand Response	Distributed Generation	Distributed Storage
Costs					
Utility System	Measure costs (utility portion)	●	◐	○	○
	Other financial incentives	●	●	◐	◐
	Other program and administrative costs	●	◐	◐	◐
	Evaluation, measurement, and verification	●	●	●	●
	Performance incentives	◐	◐	◐	◐
	Interconnection costs	○	○	●	●
	Distribution system upgrades	○	○	●	●
Benefits					
Utility System	Avoided energy costs	●	◐	●	◐
	Avoided generation capacity costs	●	●	●	●
	Avoided reserves or other ancillary services	●	●	●	●
	Avoided T&D system investment	●	●	●	●
	Avoided T&D line losses	●	●	●	●
	Wholesale market price suppression	●	●	●	●
	Avoided RPS or EPS compliance costs	●	◐	●	◐
	Avoided environmental compliance costs	●	◐	●	◐
	Avoided credit and collection costs	◐	◐	◐	◐
	Reduced risk	●	●	◐	◐

This table is presented for illustrative purposes and is not meant to be an exhaustive list.

One of the most notable differences between EE and other DERs is the potential for distributed generation and storage to impose additional distribution system capacity costs and integration costs on the utility system. EE simply reduces energy consumption, while distributed generation and storage often feed electricity into the grid. While low levels of distributed generation and storage are unlikely to impose additional costs on the system, beyond a certain level of penetration, utilities may need to invest in distribution system capacity upgrades. They may also incur integration costs to manage the presence of DERs on the system on a day-to-day basis. For example, system investments may be required to support voltage regulation, upgrade transformers, increase available fault duty, and provide anti-islanding protection (NREL 2013). Integration costs may include scheduling, forecasting, and controlling DERs, as well as procurement of additional ancillary services such as reserves, regulation, and fast-ramping resources.[51]

Table 34 provides an indication of the non-utility system costs and benefits associated with different types of DERs. One type of cost that differs from EE is interconnection fees for distributed generation and distributed storage.

[51] The need to procure fast-ramping resources or reserves is due to both the inflexibility of many fossil-fired units and the variability of most renewable generation.

Table 34. Non-Utility System Costs and Benefits of DERs

		Energy Efficiency	Demand Response	Distributed Generation	Distributed Storage
Costs					
Non-Utility	Measure costs (participant portion)	●	●	●	●
	Interconnection fees	○	○	◕	◕
	Annual O&M	○	○	●	●
	Participant increased resource consumption	◑	◑	◑	◑
	Non-financial (transaction) costs	◔	●	○	○
Benefits					
Non-Utility	Reduced low-income energy burden	◑	◑	◑	◑
	Public health benefits	●	◑	●	◑
	Energy security	●	◑	●	◑
	Jobs and economic development benefits	●	●	●	●
	Environmental benefits	●	◑	●	◑
	Participant health, comfort, and safety	◑	○	○	○
	Participant resource savings (fuel, water)	◑	○	○	○

This table is presented for illustrative purposes and is not meant to be an exhaustive list.

Appendix C. Accounting for Rate and Bill Impacts

The Rate Impact Measure test is not appropriate for cost-effectiveness analyses for several reasons. Nonetheless, the impacts of EE resources on customer rates and bills is sometimes of great interest to regulators and other stakeholders. This appendix describes a better approach for assessing rate and bill impacts of EE resources through long-term independent assessments of rate impacts, bill impacts, and participation rates.

C.1 Multiple Factors Affecting Rate Impacts

Efficiency resources can affect electricity and gas rates in several ways. First, they will create upward pressure on rates as a result of (a) the recovery of efficiency program administration and implementation costs; and (b) the recovery of lost revenues resulting from EE programs.

Second, they will create downward pressure on rates as a result of avoided costs, including:

- reduced generation capacity costs
- reduced T&D costs, including reduced line losses;
- reduced environmental compliance costs;
- reduced utility credit and collection costs;
- reduced wholesale market prices from price suppression effects, in regions with wholesale electricity markets; and
- reduced average fuel costs, in regions without wholesale electricity markets, as a result of reducing the consumption of the marginal fuels.

The net impact of efficiency resources on electricity and gas rates will be a result of all these different factors combined. Some of these impacts (such as recovery of program costs, wholesale market price suppression effects, and reduced average fuel costs) might occur over the short term, while others (such as reduced generation, transmission, and distribution capacity costs) might occur over a longer time period.

Understanding the impact of lost revenues is essential to understanding the impact of efficiency resources on rates. Lost revenues are the main reason why efficiency resources can be highly cost-effective and yet still result in rate increases. An efficiency resource might pass the UCT, where the long-term utility system benefits are significantly greater than the long-term utility system costs, but still result in increased rates if the lost revenues are high enough. This is often the case in practice where many efficiency programs are cost-effective according to the UCT, but not according to the RIM test.[52]

The recovery of lost revenues is one of the factors that distinguish the impacts of supply-side resources from those of EE resources (as well as all DERs). Supply-side resources do not create lost revenues, because they do not reduce customer consumption.

[52] The only difference between the Utility Cost test and the RIM test is that the latter includes lost revenues as one of the costs of EE resources.

Therefore, an EE resource might be much more cost-effective than a supply-side resource, but still result in upward pressure on rates as a result of the lost revenues.

Furthermore, the timing and impact on rates due to the recovery of lost revenues will depend upon the frequency of utility rate cases. In the years in between utility rate cases, the base rates are typically not increased to allow for the recovery of lost revenues. Instead, the lost revenues will result in reduced earnings for the utility, all else being equal. However, in those cases where the utility has some form of a decoupling mechanism, rates will be adjusted between rate cases and utility earnings will not be affected by the lost revenues.

The RIM test was originally intended to indicate the impact on rates from EE resources (CPUC 2001, 13). However, this test does not provide useful information regarding efficiency resource cost-effectiveness, as described below.

C.2 Limitations of the Rate Impact Measure Test

One of the main limitations of the RIM test is that it does not provide useful information about what happens to rates as a result of efficiency resource investments. A RIM benefit-cost ratio of less than one indicates that rates will increase (all else being equal), but says little to nothing about the magnitude of the rate impact, in terms of the percent (or ¢/kWh) increase in rates or the percent (or dollar) increase in bills. In other words, the RIM test results do not provide any context for utilities and regulators to consider the magnitude and implications of the rate impacts.

Another significant problem with the RIM test is that it typically does not result in the lowest cost to customers. Instead, it may lead to the lowest rates (all else being equal, and if the test is applied properly). However, achieving the lowest rates is not the sole or primary goal of efficiency resource assessment. Maintaining low utility system costs, and therefore low customer bills, often has priority over minimizing rates. For most customers, the size of the electricity bills that they must pay is more important than the rates underlying those bills.

In addition, a strict application of the RIM test can lead to perverse outcomes. The RIM test can lead to the rejection of significant reductions in utility system costs to avoid what may be insignificant impacts on customers' rates. For example, a particular efficiency program might offer hundreds of millions of dollars in net benefits under the UCT (i.e., net reductions in utility system costs), but be rejected as not cost-effective if it fails the RIM test. It may well be that the actual rate impact is likely to be so small as to be unnoticeable. Rejecting such large reductions in utility system costs to avoid *de minimus* rate impacts is not in the best interests of customers overall.

Another important problem with the RIM test is that it is not consistent with basic economic theory. The lost revenues from EE are not a new cost created by investments in efficiency resources. Price impacts from lost revenues are caused by the need to recover existing costs over fewer sales. These existing costs that would be recovered through rate increases are not caused by the efficiency resources themselves, they are caused by historical investments in supply-side resources that become fixed costs. In economic terms, these existing fixed costs are referred to as "sunk" costs. In economic theory, sunk costs should not be considered when assessing future investments because they are incurred regardless of whether the future investment is undertaken.

Furthermore, the RIM test results can be misleading. For an efficiency program with a RIM benefit-cost ratio of less than one, the net benefits (in terms of PV$) will be negative. A negative net benefit implies that the investment will increase costs. However, as described above, the costs that drive the rate impacts under the RIM test are not new incremental costs associated with efficiency resources. They are existing costs that are already in current electricity or gas rates. Any rate increase caused by lost revenues would be a result of recovering those existing fixed costs over fewer sales, not as a result of incurring new costs. However, efficiency planners frequently present their RIM test results as negative net benefits, implying that the efficiency resource will increase costs, when in fact it will not.

Finally, all electricity and gas resources can result in some form of cross-subsidy. Applying the RIM test to EE resources is inconsistent with how other electricity and gas resources are evaluated for cost-effectiveness.

C.3 Rate Impacts and Customer Equity

In general, efficiency resources will result in lower average customer bills, despite any increase in rates.[53] Those customers that participate in an efficiency program will typically experience lower bills, while those that do not participate may experience higher rates and therefore higher bills.[54] Therefore, the rate impacts of EE resources are not a matter of cost-effectiveness. Instead, they are a matter of customer equity; between customers who participate in efficiency programs and those who do not.

Another limitation of the RIM test is that it does not provide the specific information that efficiency planners and regulators need to assess the equity impacts of efficiency resources. In order to understand equity impacts, it is necessary to simultaneously assess (a) the impacts of efficiency resources on long-term average rates; (b) the impacts of efficiency resources on long-term average customer bills; (c) and the extent to which customers participate in efficiency resource programs (over time) and thereby experience lower bills.

Put another way, regulators and other policymakers need to be able to compare the magnitude of bill reductions to the participating customers against the magnitude of any rate and (therefore) bill increases to non-participating customers and the portion of customers expected to experience such adverse effects. The RIM test does not provide this essential information. It only assesses whether rates will go up or not. It does not divulge the magnitude of the increase; nor does it indicate how many customers will experience the impact as an increase in their bills.

Some of the problems of the RIM test stem from the fact that it attempts to combine cost-effectiveness issues and equity issues into a single calculation. It combines the lost revenues (which are historical, unavoidable costs that drive equity issues) with the resource costs and benefits (which are future, avoidable costs that drive cost-effectiveness issues). By combining cost-effectiveness and equity issues into a single

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[53] This is not always the case. Many demand response programs can lead to reduced rates, because they involve very little lost revenue recovery. Some EE programs can lead to reduced rates, depending upon program costs, avoided costs, and lost revenue recovery.

[54] It is important to note that all customers experience some of the benefits of efficiency resources—regardless of whether they participate in the programs. In particular, efficiency resources can reduce the need for new generation capacity, reduce wholesale capacity prices, reduce wholesale energy prices, reduce T&D costs, improve system reliability, reduce risk, and more. All of these benefits accrue to all customers. Nonetheless, it is also generally true that efficiency participants will experience greater benefits than non-participants, due to the immediate reduction in their electricity bills.

calculation, the RIM test actually conflates the two issues and provides results that are not meaningful for either one.

The solution to this problem is to undertake two separate analyses. The cost-effectiveness analysis should account for all the future, avoidable costs and benefits, using the principles and concepts described in this manual. A separate rate impact and equity analysis can be used to assess the distributional impacts of the EE resource (US OMB 2003, 14), by analyzing the likely long-term impact on rates, bills, and customer participation.

C.4 A Better Approach for Analyzing Rate Impacts

A thorough understanding of the implications of efficiency rate impacts requires analysis of three important factors: rate impacts, bill impacts, and participation impacts.

- **Rate impacts** provide an indication of the extent to which rates for all customers might increase due to efficiency resources.
- **Bill impacts** provide an indication of the extent to which customer bills might be reduced for those customers that install efficiency resources.
- **Participation impacts** provide an indication of the portion of customers will that will experience bill reductions or bill increases. Participating customers will generally experience bill reductions while non-participants might see rate increases leading to bill increases.

Taken together, these three factors indicate the extent to which customers as a whole will benefit from efficiency resources, and also the extent to which efficiency resources may lead to distributional equity concerns. It is critical to estimate the rate, bill and participant impacts properly, and to present them in terms that are meaningful for considering distributional equity issues (SEE Action 2011a).

Rate Impact Estimates

Rate impact estimates should account for all factors that impact rates. This would include all avoided costs that might exert downward pressure on rates, as well as any factors that might exert upward pressure on rates. Any estimates of the impact of lost revenue recovery on rates should (a) only reflect collection of lost revenues necessary to recover fixed costs, and (b) only reflect the actual impact on rates according the jurisdiction’s ratemaking practices.

Rate impacts should be estimated over the long term, to capture the full period of time over which the efficiency savings will occur. The study period should include all of the years in which efficiency resources are implemented, plus enough years to include the full measure lives of the last efficiency resources installed. This is necessary to capture the full effect of the downward pressure on rates from avoided generation, transmission, and distribution costs.

Rate impacts should also be put into terms that place them in a meaningful context, so that they can be properly considered and weighed by efficiency planners and regulators. For example, they should be put in terms of ¢/kWh impacts, dollars per month, percent of total rates, or percent of total bill.

Rate impacts can be markedly different across different customer types. Therefore, it may be necessary to analyze the rate impacts for different customer sectors. Conducting a rate impact analysis for every customer class is probably too burdensome and not necessary. Instead, analyses can be conducted for key customer types such as residential, small commercial, and large commercial and industrial.

Bill Impact Estimates

Bill impact estimates should build upon the estimates of rate impacts. While rate impacts apply to every customer within a rate class, bill impacts will vary between participants and non-participants. Further, bill impacts will vary depending upon the type of efficiency program and the amount of efficiency savings from the program. For these reasons, it may be appropriate to estimate bill impacts by efficiency program, or at least the key efficiency programs.

As with rate impacts, bill impacts should be estimated over the long term, to capture the full period of time over which the efficiency savings will occur. The study period should include all of the years in which efficiency resources are implemented, plus enough years to include the full measure lives of the last efficiency resources installed. This is necessary to capture the full effect of the downward pressure on bills from avoided generation, transmission, distribution, and other costs collectively born by ratepayers.

As with rate impacts, bill impacts should also be put into terms that place them in a meaningful context, so that they can be properly considered and weighed by efficiency planners and regulators. For example, they should be put in terms of dollars per month or percent of total bill.

Participation Estimates

Participation estimates should be put in terms of participation rates, measured by dividing efficiency program participants by the total population of customers eligible for the program. Participation rates provide context and more meaningful information relative to a simple number of program participants. Participation rates can also be used to compare participation across programs, across utilities, and across jurisdictions.

Participation rates should be estimated for each year of efficiency resource implementation. They should be compared across several years to indicate the extent to which customers are participating in the programs over time. Participation in multiple programs and across multiple years should be accounted for, and the impacts of participation in multiple efficiency programs by the same customer should be accounted for to the extent possible.

If program participation information is not currently available, it should be collected as soon as possible, so that meaningful estimates can be developed in future years. This type of information is critical for assessing the customer equity issues, and hence the rate impact issues, of efficiency resources.

Many equity concerns driven by rate impacts can be mitigated or even eliminated by promoting widespread customer participation in efficiency programs. Program participation information can be used to ensure that most, and potentially all, customers eventually install efficiency resources of one form or another, and thereby experience net lower bills. Efficiency program administrators could be charged with the responsibility to identify those customers that do not install efficiency resources, and to find ways to reach those customers that have not yet implemented some form of efficiency measure.

C.5 Relationship to the Cost-Effectiveness Analysis

The efficiency resource assessment described in Chapter 3 should provide a comparison of the costs and benefits of certain EE resources. The rate and bill impact analysis should provide an indication of the rate, bill, participation, and equity impacts of those efficiency resources.

Regulators and efficiency planners may wish to consider both analyses to determine whether to invest ratepayer funds in those efficiency resources. This determination could include a qualitative comparison of the trade-offs between cost-effectiveness and rate impacts. For example, regulators and efficiency planners could assess whether any expected long-term rate impacts are warranted in light of the cost-effectiveness results, the bill reductions, and the participation rates.

There is no bright line to determine how to balance these different impacts. Instead, this balance will need to be drawn by efficiency planners, ultimately with guidance and final approval of regulators.

Regulators and efficiency planners may choose to modify proposed efficiency programs or portfolios in order to strike a better balance between cost-effectiveness and equity issues. As noted above, one option would be to expand efficiency programs to include more participants and mitigate equity concerns. Another option would be to shift priority from programs that have low participation rates to those that have higher participation rates.

Utilizing Rate, Bill, and Participant Information

A recent study in Vermont estimated that an aggressive, long-term efficiency strategy would produce an average 7 percent reduction in electric bills (net of rate increases) for the more than 95 percent of residential customers who would be expected to participate in programs. The corresponding average increase in bills would be 4–5 percent for the fewer than 5 percent of customers who would not participate (VT DPS 2014).

The Vermont Public Service Board concluded that the estimated rate impact on that portion of customers was acceptable in light of the reduction in bills for participants and the other benefits of EE (VT PSB 2014).

Decision-makers in different jurisdictions might reach different conclusions regarding whether that trade-off would be worth making. However, they cannot make informed decisions unless they see data in this way.

Appendix D. Glossary of Terms

This manual uses several key terms that have specific meaning in the context of the concepts described here.

Avoided costs, refers to the costs of those electricity and gas resources that are deferred or avoided by the energy efficiency resources being evaluated for cost-effectiveness. The avoided costs are what make up the utility system benefits of EE resources.

Distributed energy resources (DERs), refers to electricity and gas resources that are installed on customers' premises (behind the meter), often to improve customer consumption patterns. These include EE, demand response, distributed generation, storage, plug-in electric vehicles, and more.

Energy efficiency resource, refers to EE technologies, services, measures, or programs funded by, and promoted on behalf of, electricity and gas utility customers.

Impacts, refers to both the costs and the benefits of a supply-side or demand-side resource.

Jurisdiction, refers to states, provinces, utilities, municipalities, or other regions for which EE resources are planned and implemented.

Primary cost-effectiveness test, refers to the cost-effectiveness framework that a jurisdiction most relies upon when choosing the efficiency resources in which to invest ratepayer money.

Regulators/decision-makers, refers to institutions, agents or other decision-makers that are authorized to determine utility resource cost-effectiveness and funding priorities. Such institutions or agents include public utility commissions, legislatures, boards of publicly owned utilities, the governing bodies for municipal utilities and cooperative utilities, municipal aggregator governing boards, and more

Regulatory perspective, refers to the perspective of regulators or other decision makers that oversee efficiency resource investment choices. This perspective is guided by the energy and other applicable policy goals—whether in laws, regulations, organizational policies or other codified forms—under which they operate.

Resource Value Framework, refers to a series of seven steps that can guide any jurisdiction to develop its primary test for assessing EE (and other DERs) cost-effectiveness. The Framework embodies the key principles of cost-effectiveness analyses described in Chapter 1.

Resource Value Test (RVT), refers to the primary cost-effectiveness test that a jurisdiction has developed using the Resource Value Framework. It embodies all of the key principles of cost-effectiveness analyses, and accounts for that jurisdiction's applicable policy goals.

Utility system, refers to all elements of the electricity or gas system necessary to deliver services to the utility's customers. For electric utilities, this includes, generation, transmission, distribution, and utility operations. For gas utilities, this includes transportation, delivery, fuel, and utility operations. This term refers to any type of utility ownership or management, including investor-owned utilities, publicly-owned utilities, municipal utility systems, cooperatives, etc.