Technical Reference Manuals Best Practices from Across the Nation to Inform the Creation of the California Electronic Technical Reference Manual (eTRM)

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ABSTRACT

This paper presents the findings of a best practices analysis of over 20 Technical Reference Manuals (TRMs) currently in use across the United States.[1] TRMs are a commonly used tool for compiling deemed energy efficiency measure values that are used in planning, reporting, cost effectiveness analysis, and evaluation. The authors of this paper reviewed the technical content, form and organization (referred to in this paper as structure), and process by which energy efficiency values are developed for the all public TRMs in the US and conducted in-depth interviews with key actors in several leading jurisdictions.[2] This work revealed that the most successful jurisdictions use clear, written technical guidelines and effective processes concurrently to address complex technical questions and create effective frameworks for creating deemed values. Key best practices that were repeatedly found in leading jurisdictions and are described in this paper include clear, concise, publically available measure narratives directly linked to all parameters and sources (well-documented and transparent measure information), measure review through a public peer review process that includes regulatory staff, regulatory Commission approval of final values, and regular measure parameter updates using the results of evaluation research. The conclusions presented in this paper were used as the foundation of the California Technical Forum's (Cal TF) Database for Energy Efficiency Resources (DEER) Alternative initiative for the creation of an Electronic Technical Reference Manual (eTRM).

Introduction

Throughout much of California's long history as the standard bearer of energy efficiency (EE), DEER has provided the state's deemed savings estimates and other measure parameters used in cost effectiveness analysis.[3] However, DEER no longer conforms to the California Public Utilities Commission's longstanding policy goals (Mejia 2014a): The repository of values is not transparent, source documentation is not easily available, and the value development process is not collaborative. This paper presents key ex ante best practices that are being used to inform a new, best in class Electronic Technical Reference Manual (eTRM) alternative to DEER.

The History of DEER

DEER was initially developed through a collaborative process under the auspices of the California Energy Commission (CEC). In 1990, the CEC convened a broad coalition of

[1] The TRMs considered in this analysis, and the version of each TRM used (some may have been updated since the analysis was done) are contained in the reference section in this paper.
[2] The term "leading jurisdictions" in this context refers to jurisdictions with well-developed, long-standing TRMs.
[3] http://www.energy.ca.gov/deer/

stakeholders, known as the California Conservation Inventory Group (CCIG), and tasked that initial collaborative with identifying the energy efficiency data and methodologies to be developed and tracked in California.[4] The initial CCIG dataset became the framework for DEER. For years, much of the analytical and consensus-building work to populate and build the database was performed through public collaboratives: CADMAC, Calmac, and the California Board for Energy Efficiency. Throughout this time, technical questions concerning DEER methods, values and assumptions were discussed and debated in an open, peer review process. (Mejia 2014b). The CEC transferred responsibility for DEER to the California Public Utilities Commission (CPUC) in 2005.

Challenges with DEER and the Need to move to a new eTRM

In recent years, the DEER ex ante process and product has not achieved the core CPUC policy objectives. The deemed values have been developed and approved without a meaningful and effective collaborative process. During this time, contention and disagreement over technical values has been the norm, rather than the exception. The size of DEER has increased to over 600,000 measure combinations with poorly labeled and organized source documentation, which makes DEER values, methods and assumptions difficult, if not impossible, to locate, understand and effectively use; DEER is certainly not transparent. The values in DEER are not linked to their source documentation. Attempts to "reverse engineer" measures in DEER, meaning identifying and organizing into workpaper format source documentation for energy savings values and other measure parameters have been extremely time-consuming, expensive and not fully successful. (Melloch 2015) Also, unlike all other TRMs, DEER measure parameters (such as measure savings, expected useful lives and incremental measure costs) are not clearly linked, so it is not always possible to clearly and correctly identify all elements of a measure needed to conduct a cost-effectiveness analysis.

DEER's current structure presents challenges for achieving important state energy policy objectives. Measure values can't be credible if the source and calculation of those values are not transparent and readily reproducible. DEER values are not used statewide – the public utilities use different deemed values for planning, reporting, cost effectiveness analysis and evaluation because DEER is opaque, complex and difficult to use. Furthermore, the CEC and CPUC use different modeling tools to calculate energy savings; the CEC uses EnergyPlus for Title 24 compliance (non-residential) and the CPUC uses DOE-2.2 for developing DEER energy savings values. It will be hard for policy-makers to accept energy efficiency as a resource and "first in the loading order" if investor owned utilities (IOUs) and publically owned utilities (POUs) use different approaches and values for calculating savings from energy efficiency. Furthermore, the protracted review and approval of new/updated measures will make state goals to double energy efficiency savings by 2030 more difficult to achieve. Finally, DEER is also not compliant with the U.S. EPAs draft EM&V guidelines to ensure that EE measures are "quantifiable and verifiable" for Clean Power Plan purposes.[5]

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[4] The CCIG included members from the following organizations: the CEC, the CPUC, California's Investor-Owned Utilities (IOUs), the Natural Resources Defense Council (NRDC), Lawrence Berkeley National Laboratories (LBNL) and the California Institute for Energy Efficiency (CIEE).

[5] Section 2.4.2. states: Deemed savings values must be "based on measure definitions, applicable conditions, assumptions, calculations, and references that are *well documented in work papers that are publically available*." [Emphasis added.]

The California Technical Forum and Cal TF Staff's TRM Best Practices Research

By early 2015, discussions about the cost and benefits of the DEER database led the Administrative Law Judge (ALJ) then assigned to the CPUC's energy efficiency rulemaking to formally question the long-term value of continuing to maintain DEER (Edmister 2015). The California Technical Forum (Cal TF) staff responded to the Judge's question by describing its unsuccesful attempts to document assumptions and data underlying several DEER values; Cal TF staff then launched a "DEER Alternative Subcommittee' to produce forward-looking recommendations to identify a "best in class" approach to organizing and storing measure information as an alternative to DEER.

The Cal TF is a collaborative of experts who use independent professional judgment and a transparent, technically robust process to peer review technical information related to California's integrated demand side management portfolio.[6] Cal TF staff performed primary research to inform recommendations for an alternative to DEER. That research included a review of existing literature on TRMs, detailed analyses of over 20 TRMs across the nation, and interviews with key actors involved with "leading jurisdiction" TRMs. The findings of this work are described in the following sections.

Literature Review on TRM Best Practices

In the past five years, several studies and presentations have reviewed, compared and analyzed TRMs. Key findings on best practices are summarized here and were used as starting points for identifying best practices.

TetraTech Study for the Texas Public Utilities Commission

Prior to developing its own TRM, the Public Utilities Commission of Texas commissioned a study of TRM best practices so that the newly-developed Texas TRM would reflect best practices. The independent EM&V firm TetraTech reviewed 15 TRMs and identified the following best practices:

- Clear Roles and Responsibilities
  Clearly define organizational roles and responsibilities for developing and maintaining the TRM.
- Minimize Potential for Systematic Bias
  Do not strive for perfection, instead minimize potential for systemic bias.
- Well-Documented
  Provide publically accessible documentation of all of the sources used to develop proposed savings values, inputs, and algorithms.
- Regular Update Schedule
  Publish a schedule for maintaining and regularly updating TRM inputs and algorithms, and resist efforts to change it.

[6] www.CalTF.org.

- Clear/Consistent Guidelines for Measure Development
  Provide measure development guidelines, clear criteria about when a measure should be deemed or custom, and what level of documentation is needed to support a new or updated measure.
- Clear Demand Savings Approach
  Clearly define how peak demand savings should be calculated. (TetraTech 2013)

ACEEE Paper: Status and Opportunities for Improving the Consistency of Statewide Technical Reference Manuals[7]

The primary purpose of this paper was to review the consistency of savings calculations across TRMs. The authors reviewed select, high impact measures in 17 TRMs, and found that the algorithms used in savings calculations generally are correct and accepted by energy efficiency practitioners, but the input parameters vary widely in level of detail and documentation. Although the primary purpose of the paper was not to identify best practices, per se, the paper did have several recommendations related to best practices:

- Uniform Methods and Algorithms: Standardize methods for estimating savings.
- Increase Transparency: Ensure transparency and clearly document all source parameters.
- Regularly Incorporate Evaluation Results: Use impact evaluation results to regularly update the assumptions for specific measures or programs. (Jayaweera et. al. 2010)

Draft Clean Power Plan Guidelines

On August 3, 2015, the US EPA released draft guidelines to ensure EE measures are "quantifiable and verifiable" for Clean Power Plan (CPP) compliance purposes. The draft CPP Guidelines represent "best practice" concepts in that they reflect "best practice" thinking from policy-makers informed by practitioners. Several of the guidelines related to standards for creating deemed values for CPP compliance purposes.

- Well-Documented Values/Publically Available
  Section 2.4.2. Applicable Guidance: "Based on measure definitions, applicable conditions, assumptions, calculations, and references that are *well documented* in *work papers that are publically available*." [Emphasis added.]
- Realistic, not Conservative or Optimistic Savings Values
  Section 2.6.2 Applicable Guidance: "Should be designed neither to provide optimistic savings estimates… nor to provide conservative estimates."
- Collaborate to Develop/Update Values
  Section 2.8.2. Applicable Guidance: "Participate in collaborative and joint research to improve breath and quality" of data and approaches. (US EPA 2015)

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[7] Findings in this paper were from a SEE Action report focused on the broader question of whether to create a national database of energy savings values (a national TRM, in essence) and a national EM&V repository (Jayaweera et. al. 2011). The paper cited many barriers and general practitioner resistance to establishing a national TRM database, but did indicate that regional TRM databases could be feasible if the database allowed for differences in inputs to algorithms and models that are often jurisdiction-specific, such as climate zones, heating and cooling degree days, building prototypes, baselines, measures saturation, etc.

Findings from Primary Research

Cal TF engineering and policy staff reviewed the processes used to create and update over 20 TRMs, the TRM's overall structures, and the content underlying the measure characterizations within them. This first round of analysis revealed a general set of common practices, structures, and methodologies used by most jurisdictions. Cal TF policy staff then selected five well-developed and established TRMs for further investigation in the form of detailed interviews with one or more key actors involved with each (Illinois, Massachusetts, Mid-Atlantic, New York, Pennsylvania). These interviews were used to cross validate the initial findings from the document review as well as to gain further understanding of the context of and reason for individual best practices.

One key goal for this work was to identify how other jurisdictions deal in a consistent and efficient manner with the many complicated questions facing measure developers in California. For instance: when is available data not enough to establish a savings estimate or how many versions of one measure are needed to cover all possible savings scenarios? The TRM review and key actor interviews found that successful jurisdictions use clear, written technical guidelines, consolidated repositories, and effective processes *concurrently* to address those complex technical questions and create effective ex ante frameworks. Per that finding, all three of the key components of an ex ante framework—process, structure, and content—must be designed to support a common set of mutually understood assumptions and estimates. Best practices in each of the three categories are described below.

Process

As is demonstrated by the successful councils in Massachusetts, Connecticut, and Rhode Island, the Mid-Atlantic EM&V forum, and Illinois' Stakeholder Advisory Group, the process by which energy efficiency values are developed is vitally important in developing rigorous, well-understood and widely accepted values, methods, assumptions and data. Such collaboratives provide peer review, a practice generally viewed as critically important for establishing scientific truth and ensuring rigor in both data and analysis. Effective peer review is fostered when a broad collaborative comprised of qualified technical representatives from different organizations can bring different perspectives, ideas, analytic tools and data to the discussion. A public, broad collaboration process helps ensure that all industry participants understand and respect the resulting values. Some technical collaboratives allow all interested parties to participate, and participants may choose only to engage in select issues of interest to them (IL). Other technical collaboratives select members for a defined period of time through a competitive solicitation process (Northwest Regional Technical Forum (NW RTF); Cal TF). Meetings are generally open to the public, and members of the public are given structured opportunities to provide input to the collaborative. A defined membership ensures that the collaborative participants, collectively, have sufficient technical expertise to meaningfully consider the issues before the collaborative. Also, a defined technical membership likely leads to higher quality measures as members will be more committed to rigor and quality as their names are associated with the results. Finally, a defined membership will likely yield more consistent measure development as members will be informed about the jurisdiction's specific measure development standards and processes.

Active regulatory staff participation in the collaborative value development process is also vitally important since regulators ultimately approve the values. Active staff participation fosters more timely, informed and collegial regulatory review of resulting values. Furthermore, regulatory staff participation in the collaborative process can help speed issue resolution since the collaborative dialog creates a greater understanding of various approaches, data sources, and underlying assumptions, and often leads to consensus agreements resulting from robust and evidence-based debates about the strengths and weaknesses of different approaches. In addition, the open process, ability to share and debate competing views, and the often consensus-based agreements that emerge fosters technical understanding between regulators, their staff, and other stakeholders and further bolsters regulatory and industry confidence and support of the resulting values. In many jurisdictions—including Illinois and New York State before the current regulatory overhaul—consensus TRMs developed via a transparent, open, public collaborative process are generally adopted by the final decision maker quickly and with little change. This drastically reduces the amount of time that would otherwise have been spent on adversarial regulatory filings by all parties and makes the process for adopting new or updated values faster and less expensive.

Several other process elements are key and common in “best practice” TRMs. A clear schedule is needed for adding new measures, updating existing measures, and removing measures that are no longer used or valuable. Some leading jurisdictions update deemed values as frequently as on a yearly basis, which helps data and estimates from becoming outdated [IL, WI]. Even if methods don’t change (engineering equations or building modeling), data used to calculate and update savings (such as baselines) and other measure parameters (such as incremental measure costs and, less frequently, expected useful lives)[8] must be updated through timely and current EM&V and/or market data collection during program implementation.

The final approval of TRMs and TRM updates, on the other hand, should be by regulators (by far the most common practice) and not delegated to regulatory staff for several reasons. First, since regulatory staff should be an active participant in the technical collaborative, they should not also be the final approving authority for the TRM. Second, formal regulatory approval of the TRM provides important legal process protections: due process (notice to all interested parties and the opportunity for all interested parties to state their positions and be heard) and decision making that is to be based on a formal evidentiary record and that is not “arbitrary and capricious.” These process protections may not exist if regulatory staff has the ability to make final decisions. Finally, if the final arbiter is the regulatory commission, not staff, staff will have greater incentive to thoughtfully listen to and consider other methods, assumptions and data, which leads to greater consensus and less litigation.

If the collaborative peer review process does not yield consensus positions on any issues, non-consensus items should be clearly memorialized and described in a “Comparison Exhibit” that succinctly sets forth non-consensus issues (methods, assumptions, data, values), with a clear rationale for each position and any associated data. Comparison Exhibits often, but not always, include names of person(s) or party(s) that support each position. Comparison Exhibits serve to refine and clearly explain non-consensus items to regulators, allowing them to make informed, high-quality and expedient decisions on complex technical issues. Comparison Exhibits also preserve minority positions compared to a “voting system” that some collaboratives use. As the majority is not always right, it is beneficial to fully document minority positions as well as

[88] The Clean Power Plan draft EM&V guidelines recommend that expected useful lives be updated every five years. Cal TF staff’s review of EULs in multiple TRMs found that many EULs still come from DEER even if other measure parameters are regionally developed and specific. When Cal TF staff traced the source of select EULs in DEER back to their original source, several dated from the 1980s, and none appeared to be less than ten years old.

majority positions for fully-informed regulator adjudication of competing positions and also for future consideration by the collaborative during measure updating, when additional data could provide support for the correctness of the minority position.

To summarize, the key process best practices are:

- Use of an open and transparent technical collaborative.
  - Non-consensus items memorialized in a “Comparison Exhibit” to foster informed, effective and expedient decision-making by regulators and future measure updating.
- Clear roles and responsibilities for key work, including developing and maintaining the TRM and managing the collaborative.
- Predictable and regular update processes.
  - Existing measures must be updated regularly; unused and out-of-date measures must be systematically removed.
- Key measure parameters must be updated with current and timely EM&V.
  - It is important to analyze which measure parameters have the greatest impact on key EE metrics such as savings and cost effectiveness, and spend greatest data collection resources on refining the most impactful measure parameters.
  - Measure parameters that may require more frequent updates include baseline and costs.
  - Nationwide effective useful life estimates (EULs) generally appear to be quite old (over ten years), are commonly drawn from the same source (DEER), and should be updated.
- Participation by regulatory staff is key.
  - Speeds issue resolution.
  - Speeds regulatory review.
  - Fosters technical understanding between regulators and other stakeholders.
  - Builds regulator confidence in results.
  - Results of collaborative consensus-building process are generally adopted by decision makers with little change.
- Regulatory commissions, not staff, approve final values.
  - Regulators approve final values but are informed by a robust, transparent public process.

Structure

TRM structure (how measures, measure parameters and source material are organized and linked) has received little attention in prior best practice TRM assessments, yet a TRM’s structure is vitally important for its usability, credibility, quality, accuracy, and for preventing systemic bias. A logical and clear organization facilitates the use of the information by all industry stakeholders, including advocates and regulators. The TRM’s structure needs to allow for ready access to all savings estimates, key parameters, source data, methodologies, and all other underlying assumptions. Also, a well-organized and transparent TRM will yield greater accuracy and is a ratepayer protection tool, because the more transparent a TRM is, the more it enables users and reviewers (including regulators and advocates) to identify errors, be they unintended miscalculations, outright omissions, or biased manipulations of data. Furthermore, transparency discourages poor quality data, flawed methods or miscalculations and deliberate attempts to bias outcomes because such behavior will be subject to public scrutiny and judgment by technical peers.

In keeping with the goal of ensuring rigor through transparency, all of the TRMs reviewed use a standard format for each measure characterization. Standard measure characterization formats include a narrative measure description, baseline and measure case technical specifications, energy and demand savings algorithms, clearly stated assumptions, other key parameters (measure life, cost, etc), and any pertinent program implementation details (i.e. qualification requirements and exclusions). TRMs may need to include information that relates to policy directives. For example, California has a policy of applying "dual baselines" for early retirement measures, which requires that two sets of costs and savings are associated with a single measure. The best measure characterization formats also include a revision history, thorough reference sections, and embedded look up tables for certain measure parameters, such as climate zones and building type.

Thorough documentation is one of the core tenets shared by all of the leading jurisdictions, and appeared consistently as a best practice in TRM best practice studies. As jurisdictions have developed their own specific savings values and moved away from simply referencing DEER estimates, footnoted source documents in TRMs have increasingly led directly to either data spreadsheets or primary research reports. In some cases, TRM citations were to secondary reports or other TRMs, which required further research to arrive at the primary source-a substandard practice. In other cases, citations referred to primary sources, but without the specificity to readily identify the cited material (for example, a citation to a whole report rather than a specific page or table.) Finally, some of the citations were simply incorrect or inapplicable – citation to a similar, but not identical measure. However, none of the TRMs reviewed allowed the "thorough documentation" mandate to render the document unwieldy. No single measure characterization was longer than five pages.

Readily usable TRMs ensure that all applicable parameters are clearly linked to each measure. In traditional paper-based TRMs, this is accomplished by the inclusion of single point values or look-up tables within the measure characterization or by clear references to additional supporting materials (such as interactive effects tables) appended to the TRM. New York State's TRM is an excellent example of thorough inclusion of all applicable background materials, including clear descriptions and illustrations of all building prototypes used for modeled measures (TecMarket Works 2014).

In the last few years, commercially available electronic tools have enabled the TRMs to be hosted in more dynamic, easily searchable, even more accessible web-based platforms. The web-based tools allow measure parameters, source materials and look-up tables to be directly linked. Also valuable is the ability of the commercially available platforms to host all source documentation within the electronic TRM itself. This further reduces user time spent tracking down primary data and prevents the likelihood of broken web links to documents hosted elsewhere. Electronic TRMs can also be useful in the quality assurance and quality control process, as decision rules can be created to automatically identify errors rather than rely solely on a manual, human-based process.

To summarize, the key best practices for structure include:

- Standard format for each measure characterizations, including:
    - Narrative explanation of measure (base case and measure case).

    - Base and measure case technical specifications.
    - Energy and demand savings algorithms or values from building models or other sources.
    - Other key parameters (measure life, costs, etc.).
    - Pertinent implementation details (e.g. both requirements and exclusions).
- All measure parameters clearly linked to the measure.
- Measures are well documented and values are reproducible.
    - Specific citations to primary sources, not other TRMs or secondary sources.
    - Primary sources well maintained and readily available.
    - Measure values linked to embedded calculators, look up tables, and simulation models that are used to generate savings and other values.
- Appendices contain additional relevant information that relates to multiple measures
    - Detailed descriptions of building prototypes, climate zones, interactive effects, non-energy benefits, equipment full-load hours (EFLH), etc.

Content

The content of the best TRMs reviewed seeks to strike a balance between achieving measure accuracy within a reasonable cost and without introducing unnecessary complexity. This is often accomplished by the use of written guidelines for measure development. These guidelines include guidance for when measures must be modeled and when simplified engineering equations are sufficient and therefore preferable. Other written guidelines on such topics as the definition of “Best Available Data” depend on the transparent collaborative process to ensure they are applied correctly in every case.

All TRMs strive to use “Best Available Data” for developing and updating measures; however, the “best available” guidelines still require judgment to be used when they are applied. The NW RTF has specific process guidelines for developing measures to fit the “best available” goal. Those guidelines include the use of reproducible methods, “diligent review of relevant data sources and estimation methodologies, and the preparation of complete and transparent documentation” (NW RTF 2015, 8). The Mid-Atlantic TRM has similar process-focused language that describes the TRM measures as “consensus agreement and best judgment of project sponsors, managers, and consultants on information that was most useful and appropriate to include within the time, resource, and information constraints of the study." The document also states that “credibility, accuracy and completeness, transparency, and cost efficiency” (NEEP and Shelter Analytics 2014, 10) are used as criteria in reviewing TRM measures.

Lastly, to ensure that data remains pertinent and measure estimate accuracy is maintained, key parameters should be regularly updated with empirical data. This is increasingly the case in most leading jurisdictions. For example, the Illinois TRM yearly updates are timed to be informed by the also yearly program evaluation reports. In accordance with this principle, references to existing DEER values have significantly declined from original first generation TRMs. The vast majority of current TRMs only reference DEER estimated useful life and measure cost values; the New York State, the Tennessee Valley Authority, and Hawaii TRMs are notable exceptions to this trend.

To summarize, the key best practices for structure include:

- Written guidelines for recurring issues to ensure consistent measure development.
  - NW RTF and Mid-Atlantic use process language (e.g. use of reproducible methods, diligent review of all sources…).
  - Pennsylvania and Illinois identify what data will receive greater weight (e.g. local data superior from data that is not local/regional).
  - NW RTF has several guidelines on measure complexity, statistical significance, and other measure development guidelines.
- Seek to identify and minimize sources and causes of systematic bias.
- Balance cost and accuracy—don't "let the perfect be the enemy of the good."
- Strive for realistic, not conservative or optimistic savings values.
- Careful consideration of modeling vs. engineering equations vs. field data.
  - No "one size fits all;" consider pros and cons of different approaches.
- Key parameters (from modeling or engineering equations) should be validated with empirical data.
  - Field conditions and human behavior may alter forecasted savings.
  - Collect data through implementation or early EM&V.
  - Consider using data from advanced meters to validate savings, but need to consider how to interpret data to determine savings.

Issues to Address Prior to Starting TRM development

Many issues will repeatedly arise during TRM and measure development. How these issues are addressed varies across jurisdictions. Measure development guidelines should be created early in the TRM development process to ensure measures are developed according to a common set of principles. Table 1 lists issues to consider during measure guideline development

Table 1: Threshold Technical Issues to Consider

	Issue
Individual Measure Development	What is a discrete measure?
	When should a measure be deemed, custom or "hybrid"?
	When should measure savings be determined through building modeling vs. engineering algorithms?
	How complex should measures be, and when should parametric analysis be conducted to identify a reasonable number of measure permutations without creating "false precision."
	When and how does measure characterization need to vary based on field conditions and/or implementation strategy?
	Create standard format and data structure for all measures.
	Develop guidelines/standard approaches for determining "best available data", "industry standard practice" and other recurring technical issues.
	Establish written QA/QC process and standards to ensure high quality, error free measures characterizations.
	Identify process for prioritizing measures for development or review.
Parameter Development	Identify which measure parameters most impact key measure values (e.g. savings and cost effectiveness); prioritize resources to refine most impactful inputs/parameters.
	Identify which parameters need more certainty – develop data collection plan to refine values during program implementation.
	How should interactive effects be derived and applied?
	Identify how and whether program implementation strategy will affect the parameter.
	How should EULs be determined and updated?
TRM Structure	How should technologies or measure be grouped or organized?
	What tables/appendices are needed that contain information used across multiple measures?
	Should TRM be hard copy or housed in an electronic repository (emerging trend)?
	Determine what source(s) will be used for building prototypes.
	Identify information that will be used for multiple measures; create readily accessible appendices and/or look-up tables with clear, well-documented common methods, assumptions and values, including: 1. Building prototypes used to model energy and demand savings, including the sources for building prototypes assumptions. 2. Climate zones or weather stations. 3. Interactive Effect Values – which may vary based on utility and climate zone. 4. Non-Energy Benefits (NEBs) – in jurisdictions that include NEBs, NEBs often vary by measure, but also may be the same across a class of measures (such a low-income weatherization measures.) 5. Standard Formulas: Standard formulas for calculating values consistently, such as the Coincident Demand Factor Formula. 6. Load shape curves for common measures, and the sources for those load shape curves. 7. Common Variables: hours of operation, coincidence factors, flow rates, temperature (water), interactive effects, heating and cooling degree days. 8. Common approach to defining how peak demand savings should be calculated.
Building Modeling	Identify modeling tool(s) that will be used to model measures savings.
	Identify or construct building prototypes that will be used for modeled measures. Ensure building prototypes reflect jurisdiction – specific building stock and operational characteristics. Building models also need to have source documentation for all key assumptions to ensure they are appropriate representation of jurisdiction-specific building stock and operational characteristics.
	Determine consistent process for validating modeled measures.
Process	Determine the process by which participants will be selected for the technical collaborative; include regulatory staff.
	Establish process rules and website or other public repository to ensure work is public and transparent.

Conclusions

High quality TRMs are crucial for supporting rigorous, credible deemed savings and cost effectiveness estimates—California recognizes this and has already taken the first important steps towards creating a best-in-class Electronic Technical Reference Manual. The new eTRM will be informed by national best practices and tailored to fit the state's specific needs. It will be a resource that all California stakeholders can use and understand. As such, the new eTRM will be a valuable tool as California works to achieve its ambitious energy efficiency goals.

Best practices research indicates that high quality TRMs result from thoughtful consideration and effective implementation of key process, structure, and content elements. Any entity creating a new TRM or overhauling an existing deemed structure should consider drafting a guiding document that incorporates these best practices. This guiding document can then be tailored to the needs of the specific jurisdiction. In California, this work of drafting and refining guiding documents for the eTRM development has increased understanding of the need for improvements and the path forward. The resulting consensus support has been essential for the California process, as would be the case in other jurisdictions.

References

T. Jayaweera, H. Haeri, A. Lee, S. Bergen, C.Kan, A. Velonis, C. Guirin, M. Visser, A. Grant, and A. Buckman. 2010. "Status and Opportunities for Improving the Consistency of Technical Reference Manuals." In *Proceedings of the 2012 ACEEE Summer Study of Energy Efficiency in Buildings*. 5-223. Washington, DC: ACEEE.

__________. 2011. "Scoping Study to Evaluate Feasibility of National Databases for EM&V Documents and Measure Savings. Portland: SEE Action Network.

Connecticut Light & Power and The United Illuminating Company. 2012. Connecticut Program Savings Document.

DNV Kema Energy & Sustainability. 2015. Tennessee Valley Authority Technical Reference Manual, Version 3.0.

Edmister, T. 2015. "Administrative Law Judge's Ruling Regarding Comments on Phase II Workshop I." San Francisco: CPUC.

Efficiency Maine Commercial and Residential Technical Reference Manuals. 2013. www.efficiencymaine.com/about/library/policies/

Energy and Resource Solutions. 2014. Savings Estimation Technical Reference Manual for the California Municipal Utilities Association. www.cmua.org/energy-efficiency-technical-reference-manual

Frontier Associates on behalf of Parties Working Collaboratively. 2015. Arkansas Technical Reference Manual. www.apscservices.info/EEInfo/TRM4.pdf.

Franklin Energy Services. 2015. State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs, Version 1.2. St. Paul: Minnesota Department of Commerce.

GDS Associates. 2015. Pennsylvania PUC Technical Reference Manual. Hawaii Energy. 2014. Technical Reference Manual No. 2013. www.hawaiienergy.com/about/information-reports

Illinois Stakeholder Advisory Group and VEIC. 2015. Illinois Statewide Technical Reference Manual for Energy Efficiency Version 4.0. ilsag.info/technical-reference-manual.html

Indiana Statewide Evaluation Team and TecMarket Works. 2013. Indiana Technical Reference Manual, Version 1.0. Indianapolis: Indiana Demand Side Management Coordinating Committee.

Mejia, Alejandra. 2014a. "Cal TF and Consistency with CPUC Directives on Ex Ante Values/DEER." http://static1.squarespace.com/static/53c96e16e4b003bdba4f4fee/t/54a331c6e4b03ccd29f8dc1b/1419981254762/CPUC+Directives+on+Ex+Ante+and+DEER+memorandum.pdf

__________. 2014b. "California Technical Forum's Support of California's Broader Energy Policies." http://static1.squarespace.com/static/53c96e16e4b003bdba4f4fee/t/54a3371be4b057f9e3888e TRM and 74/1419982619154/California+Policy+Context+Memo.pdf

Melloch, T. and J. Roecks. 2015. Measure Review of the CMUA Technical Reference Manual and the CPUC's Database for Energy Efficiency Resources. caltf.org/2015-subcommittees/

National Grid. 2014. Rhode Island Technical Reference Manual for Estimating Savings from Energy Efficiency Measures.

New Jersey Clean Energy Protocols to Measure Resource Savings. 2014.

New York Evaluation Advisory Contractor Team, TecMarket Works. 2014. New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs – Version 2.

Northeast Energy Efficiency Partnerships (NEEP) and Shelter Analytics. 2014. Mid-Atlantic Technical Reference Manual, Version 4.0.

Northwest Regional Technical Forum (NW RTF). 2015. "Roadmap for the Assessment of Energy Efficiency Measures." Portland. http://rtf.nwcouncil.org/subcommittees/Guidelines/Complete%20Operative%20Guidelines%20%28Released%202015-12-08%29.pdf

Opinion Dynamics. 2012. Delaware Technical Reference Manual – An Update to the Mid Atlantic TRM.

Optimal Energy. 2013. Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures.

Public Service Company of Colorado (Xcel) 2012/2013 Demand-Side Management Plan – Technical Reference Manual Approach. 2011. http://www.xcelenergy.com/staticfiles/xe/Regulatory/2012-2013 Biennial DSM Plan.pdf

TetraTech 2013. "Approach to Texas Technical Reference Manual." Austin: Public Utility Commission of Texas.

___________. 2014. Texas Technical Reference Manual, Version 2.0, Volumes 1-3.

US EPA. 2015. "EM&V Guidance for Demand-Side EE." http://www.epa.gov/cleanpowerplantoolbox/evaluation-measurement-and-verification-emv-guidance-demand-side-energy

VEIC. 2010. State of Ohio Technical Reference Manual.

_____. 2013. Efficiency Vermont Technical Reference User Manual (TRM).