Technology Assessment and Delivery (TA&D) - Accelerating Technology Transfer of EPIC Research for Southern California Edison

Julie Hayes, Julie Hayes Consulting
Mark Martinez, Southern California Edison
Alekhya Vaddiraj, Electric Power Research Institute
Ammi Amarnath, Electric Power Research Institute

ABSTRACT

The Electric Power Research Institute (EPRI) developed a research framework in 2013 with leading electric utilities across the US to evaluate the readiness of emerging end-use technologies for utility programs. This initiative was known as the EPRI Coordinated Early Deployments (CED) program and was intended to reduce the cost of accelerating emerging technologies by deploying multiple technologies in parallel and enabling collaborators to share results. The CED program identified a number of technology transfers that were advanced by the participants, and the collaboration was successfully concluded in 2016.

In 2018, Southern California Edison (SCE), and specifically the Emerging Markets and Technology (EM&T) program, requested that EPRI enhance the CED framework to help SCE accelerate selected demand response (DR) emerging technologies currently ongoing (or recently completed) with the California Energy Commission's (CEC) Electric Program Investment Charge (EPIC) program. This revised approach was identified as the Technology Assessment and Delivery (TA&D) framework and was designed to assist the EM&T program in prioritizing the most transferable DR emerging technologies, determine the market potential of these technologies and provide an awareness platform for SCE leadership to develop cross-functional collaboration efforts between SCE business units that could lead to mass market implementation.

The EM&T team has now adopted the TA&D framework as an enhanced process for identifying innovative emerging demand response technologies with the greatest potential for integration and market adoption. This paper details the process used to develop the TA&D framework and dives deeply into the purpose of this innovative process, key learnings from the research, and how the TA&D framework is helping SCE accelerate the market readiness of new customer-based, grid modernization technologies.

Introduction

The California Energy Commission's (CEC) Electric Program Investment Charge (EPIC) program was established in 2012 to help fulfill a vision of a future electricity system that consists of near zero net energy buildings, highly efficient businesses, low-carbon generation, sustainable bioenergy systems, more localized generation, and electrification of transportation, supported by a highly flexible and robust distribution and transmission infrastructure[1]. The CEC, through EPIC, is working to fill critical funding gaps within the energy innovation pipeline in order to advance new technologies, tools and strategies that could provide California ratepayers with clean, affordable, and reliable electricity through a safe and sustainable 21st century power grid.

[1] California Energy Commission. 2014. *The Electric Program Investment Charge: Proposed 2015-2017 Triennial Investment Plan*. California Energy Commission. Publication Number: CEC-500-2014-038-CMF

SCE's Emerging Markets and Technology (EM&T)[2] program is chartered to assess next-generation demand response (DR) technologies in laboratory and real-world operational settings, recommending the most promising for deployment within SCE's demand response portfolio or for pilot assessments for new DR customer programs. By discovering best-of-breed, innovative technologies early in their development, and assessing them strategically in laboratory and field studies, the EM&T program helps ensure SCE's leadership position in DR customer research and contributes to the State's sound investment in innovative energy management solutions for customers and for society as a whole.

The EM&T program has been actively interested in the DR specific innovative studies that are being researched and developed through the EPIC program. This State-funded research includes assessment of DR enabling technologies, as well as integration software, whole building systems, new models of secure communications, and market-based assessments of early technological deployments. As a result, EM&T staff wanted to know what innovative DR solutions were currently being uncovered through EPIC projects already in progress, capture key learnings from these projects and possibly actively engage researchers during the studies to explore accelerating technology transfer into the utility's DR program, if feasible.

As a long-standing research partner with SCE, EPRI was well positioned to support EM&T in learning more about current EPIC research that was underway. At the time, EPRI was leading five EPIC projects focused on DR, all of which were of key interest to the SCE EM&T team. But many of these projects were still in process and results were not yet available. And while the viability of the technologies was currently being proven through extensive testing, an "early review" framework was needed to determine the market potential of these technologies for both current programs and possible new DR policy concepts in the future.

SCE requested that the current EPRI team adapt an assessment tool previously developed by EPRI and a select group of utilities from across the country in 2013, known as the Coordinated Early Deployment (CED)[3] framework. By developing a new approach to accelerate the *"technology transfer"* process, EPRI would capture key learnings from these EPIC projects as they were discovered. This would provide an opportunity for EM&T team members to discuss the potential for these technologies to integrate into the utility's emerging technology pipeline prior to publication of the final CEC reports. SCE was looking for "real time" intelligence on potential opportunities and a means for accelerating the current technology transfer process used in the EPIC program. In response to SCE's request, EPRI re-engaged Milepost Consulting, who had facilitated the development of the CED framework, to support the development of a new assessment tool that could meet SCE's research needs. The new systematic analysis tool was named Technology Assessment and Delivery (TA&D).

The Value of Compounded Technology Transfer

"Technology transfer", also known as tech transfer or knowledge exchange, is defined simply by the Vortechs Group as "the process by which valuable research, skills, knowledge, and/or technology is delivered from government, colleges and universities, or other research

[2] http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/DD5EFFA730C0C91388258263007E1B51/$FILE/A1103001_R1309011-SCE%20EMT%20Semi-Annual%20Q3-Q4%202017%20Cover%20and%20FINAL%20Rprt.pdf

[3] Coordinated Early Deployments Guidelines: Template, Instructions and Example Assessment. EPRI, Palo Alto, CA: 2016. 3002009302.

institutions into the corporate environment where it can be nurtured and developed into a commercial product or service with wider application and distribution."[4]

The EPIC program's charter requires that both EPIC and the grant awardees make available the knowledge gained, experimental results, and lessons learned from every EPIC project to the public and key decision makers across California. The program is funded by utility rate payer dollars and research projects are selected specifically to meet the energy challenges of California, with the goal that the research ultimately benefits the ratepayers and society in California. As a result, each funded EPIC project is required, as part of the Scope of Work, to include a plan for technology transfer of the research outcomes. This plan includes written periodic updates on the status of the project, participation in the EPIC Annual Symposium, periodic presentations to the CEC (if instructed to do so by the CEC contract agreement manager) and a final report, all of which is made public through the CEC EPIC website.

In reality, due to the nature of the research conducted, many of the EPIC projects follow a two to four year timeline and outcomes are sometimes delayed, so ultimately, research results are published in detailed technical reports that are often only finalized up to a year after the project is completed. The EM&T team was aware of this, and given the accelerated need to capture innovation as soon as possible, the main goal for TA&D was to expedite the information transfer process for EM&T by not waiting for the final report but to work with EPRI/EPIC project managers to transfer knowledge midway or at least prior to the end of the project.

The EM&T program manager also knew there was a potential for TA&D to facilitate "compounded value" for technology transfer if delivered not only in advance of the final reports, but while researchers were gaining valuable knowledge from their work. If knowledge transferred closer to real time, TA&D deliverables could inform the design and direction of strategic planning, program design and technology investments for multiple DR stakeholders. "Compounded technology transfer" is a concept that moves beyond merely sharing information, in that it builds upon the existing knowledge base by moving from one technology transfer phase to the next. The following steps show how technology transfer can be enhanced through an *interactive* process, compounding its beneficial effects through several steps:

1. Awareness – 'I now know it exists' or 'I was not aware of this research'
2. Personalization – 'I can see how this might benefit me,' or 'I want to know more and possibly share with others'
3. Understanding – 'I want to understand the specific outcomes and technical details'
4. Adoption – 'I want to apply this knowledge to what I am working on, which can include other research projects.'

Five EPRI-lead EPIC projects were ultimately selected for assessment by the TA&D framework for the first phase of the project. For an in-depth explanation of the process, the EPIC project selected for this paper to best illustrate the value of TA&D to accelerate the potential for compounded technology transfer is EPC 15-045: Transactive Incentive Signals to Manage Electricity Consumption for Demand Response, named "TIME" by the grant awardee, EPRI. This project designed a grid-integrated, Transactive Load Management (TLM) signaling framework, using open standards (OpenADR 2.0), that calculates and communicates an incentive (economic) price (TLM) signal for end resources that reflects the electric grid needs[5]. This EPIC project

[5] *Transactive Incentive-signals to Manage Energy-consumption (TIME): The System- and Market-*

demonstrates the TLM signal and provides a foundation for further research around TLM strategies. SCE's EM&T program is using the TA&D process for the TIME project to assess the TLM framework, signals, and the results as they align with SCE's strategies for new rate designs.

What is TA&D?

TA&D is a technology transfer framework developed by SCE, EPRI and subcontractor Milepost Consulting that reviews the current activities and in-progress early findings from selected EPIC projects, hypothesizes potential market capabilities and presents potential opportunities for utility program integration. These opportunities are then delivered to stakeholders through engaging presentations and collateral to provide real-time updates on the latest advancements in emerging technologies (ET) for electric systems and distributed energy resource (DER) innovation through the EPIC program. The framework consists of six steps as illustrated in Figure 1.

Figure 1. The TA&D Framework

The TA&D Team started with a single EPIC project to build out the design for the TA&D framework, that would then be used to assess the other four EPRI-lead EPIC projects. As each of the selected technologies completed the TA&D process, findings were presented to DR stakeholders and members of the EM&T group at SCE in the form of two discovery sessions. The first session provided an overview and discussion around the value of the TA&D framework. A second discovery session presented key findings on all five EPIC projects, where SCE stakeholders learned about the projects first-hand, with the EPRI project managers present for questions,

---

Based Transactive Load Management (TLM). EPRI, Palo Alto, CA: 2017. 3002012290

followed by a deeper discussion and cross pollination of ideas. Participants were encouraged to utilize the TA&D process via a series of five key steps:

1. **Attend TA&D update meetings** to gain valuable insights into the innovative research and development of current EPIC projects.
2. **Participate in technical discussions** focused on how EPIC projects can contribute to SCE's current technology strategy.
3. **Collaborate with other SCE teams** to deploy innovative technologies that support SCE's overarching corporate mission and goals.
4. **Integrate the learnings** from these projects into your work and strategic activities that cut across SCE's business units.
5. **Transfer the outcomes** from these research projects to SCE's current and future distributed energy resource (DER) product development activities.

EPIC Projects Assessed by TA&D

The five EPRI-lead EPIC projects were chosen based on relevance to the EM&T program's research focus on demand response technologies and the fact that EPRI was managing these projects. This would give EM&T direct access to the latest information through the EPRI project managers and facilitate a smoother delivery of the TA&D process. The goal was to develop a process and set of deliverables that effectively facilitated technology transfer and engaged participants in market potential discussions. Once the process and outputs were proven to be of value, EM&T would then have the option to approach DR focused EPIC projects lead by organizations beyond EPRI. The five projects selected for the first implementation of TA&D were:

1. **Transactive Incentive Signals (EPC 15-045)**
   Developing Transactive Incentive Signals to Manage Electricity Consumption for Demand Response
2. **Smart Inverters/Smart Consumer Devices (EPC 14-079)**
   Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable More Residential Solar Energy
3. **EV-Grid Solution (EPC 14-086)**
   Developing Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability
4. **Demand Side Resource Integration (EPC 15-075)**
   Developing Customer-centric Demand Management using Load Aggregation and Data Analytics
5. **DR Control Strategies (EPC 16-026)**
   Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants

Applying the TA&D Framework

The TA&D framework is shown in Figure 1, and illustrates the process used to engage key stakeholders in technology transfer. The framework results in four core deliverables that facilitate

the transfer of technical knowledge in near real time through engaging collateral, facilitated presentations and follow up discussions. The four core deliverables for TA&D are:

1. **Narrative** – the "story" of the project, synthesized from existing reports and documentation that includes project goals, current findings and emerging opportunities.
2. **Logic Model** – customized for TA&D to identify missing pieces, leverage points, possible outcomes and recommended actions.
3. **Presentation** – an engaging infographic PPT to share real-time findings and suggested next steps with key stakeholders at SCE.
4. **Handout** – graphically engaging collateral to inspire additional engagement and facilitate continued technology transfer.

A process and set of activities were developed for each stage of the TA&D framework. Here is an overview of these activities and what some of the deliverables look like, using the TIME project to illustrate.

1. Developing The TA&D Narrative

The TA&D Narrative, or "story" of the project begins with a review of every update document, report and presentation related to the project, starting with the grant request form that outlines the purpose of the project along with the tasks and deliverables in the Scope of Work. Once all of the literature has been reviewed, the TA&D Narrative template was used to help build the potential future for the technology but also help identify the gaps that the literature does not address. Key questions in the TA&D Narrative Template are described below in Table 1.

Table 1. Key project components gathered during the Narrative Development of the TA&D framework.

Project Details	Market Potential	Key Learnings to Date	Next Steps for Project
• Name of the Project • Issue driving the need for the Project • Research Overview • Key Research Questions • Description of the technology(s) and the potential it holds for solving the issue • Goals for the Project – what do	• Target Audiences – Primary and Secondary • Potential Benefits if the technology is adopted by the target market • Potential Market Challenges currently exist that may affect adoption • Delivery Channel – which key delivery channels have	• Have any unexpected or additional opportunities been identified during this project? • Future Recommendations outside the scope of this EPIC project	• How can results be applied? • What activities are involved in the next stage? • Who owns these activities? • Any additional comments or information related to Next Steps?

we hope to learn/develop/solve • Approach or Methodology being used • Project Participants – who is involved and what are they looking to accomplish?	been engaged to date? What opportunities or challenges currently exist?		

Working through these questions resulted in additional questions that could not be answered in the existing literature and were then brought to the Project Manager of the EPIC project being assessed through TA&D for further clarification. The result was a set of detailed information that reflected the current state of the project along with preliminary areas to explore future state scenarios.

2. Building The TA&D Logic Model

The TA&D Logic Model is a key informational element of the TA&D framework as it provides a methodical tool for a deeper assessment of the future potential of a technology beyond the current testing phase. The TA&D Logic Model was modified from EPRI's Coordinated Early Deployments Logic Model, which provided participants in that study with a way to identify market barriers to deployment for new technologies and a path to finding solutions to those barriers.

The TA&D team was very interested in finding a way to help SCE stakeholders explore the future market potential of each technology and eliminating rush to judgements such as "it works" or "it doesn't work." The goal was to utilize TA&D as a discussion vehicle for larger and more creative thinking when it came to deployment of new technologies that could solve critical issues facing DR program and policy advocates. While most of the EPIC projects being assessed through the TA&D framework were still in process, there were enough data to support future scenario hypotheses around market potential and how those scenarios might affect existing strategies already deployed or future strategies currently under consideration.

The TA&D Logic Model addressed five key areas, as exhibited in the TIME Logic Model for Figure 2.

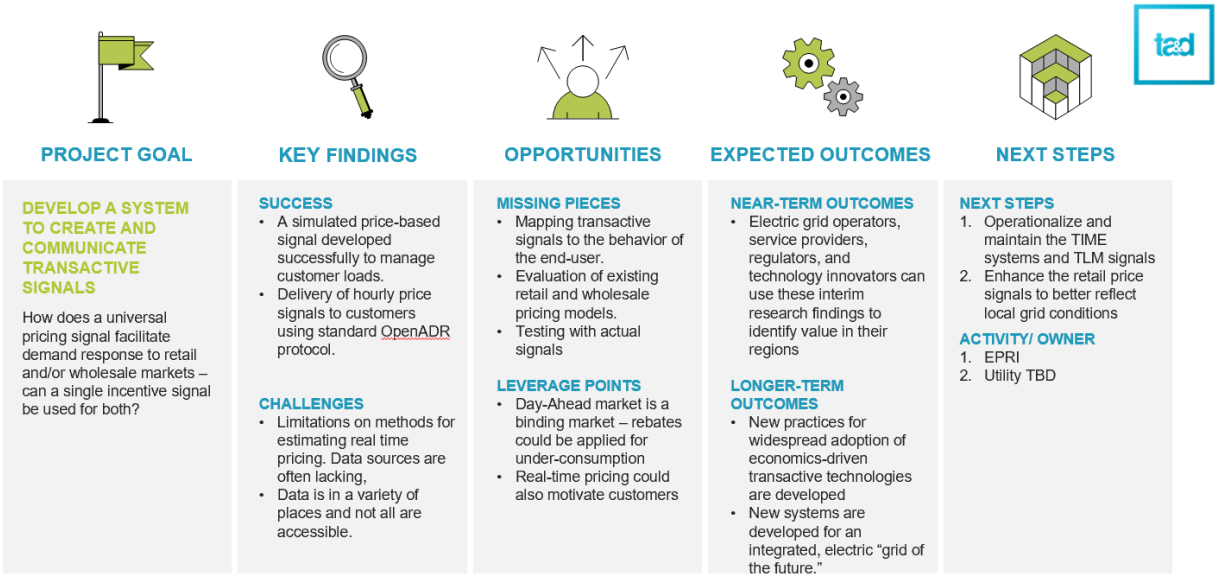

Figure 2. TIME Logic Model

Logic Model enabled the TA&D team to think beyond the current state of the project to envision potential long-term outcomes if the technology were to be deployed, helped identify activities and leverage points required to achieve these outcomes and provided future state scenarios that broadened the discussion with the EM&T team.

3. Designing the Presentation of TA&D Assessment Findings to Key Stakeholders

The TA&D team understood the dynamics of the organizational structure of the EM&T group at SCE and knew that an in-person presentation and facilitated discussion would be the best strategy to share key findings and recommendations for all the projects assessed through the TA&D Framework. Another element the TA&D team felt was important for successful technology transfer was to make these presentations and any accompanying materials informative but also visually engaging, with colorful graphics that would help make these discussions more interesting for participants.

As they did for the Coordinated Early Deployments project, Milepost Consulting created a brand and presentation style that was used for each project and then facilitated the in-person discussions at SCE. Attendees included SCE's EM&T team as well as the EPRI project managers for each project being presented. The intention of the discussions and the consistent brand was to provide enough detailed information through the presentations for the EM&T team to understand the potential value of the project but to then have the project managers present for deeper, more technical questions and discussion. The TA&D brand also gave a consistent perspective and identity that "packaged" the different EPIC projects in a way that SCE could categorize them as a DR innovation portfolio. Figure 3 and Figure 4 illustrate some of the design and information architecture in the TIME project presentation deck.

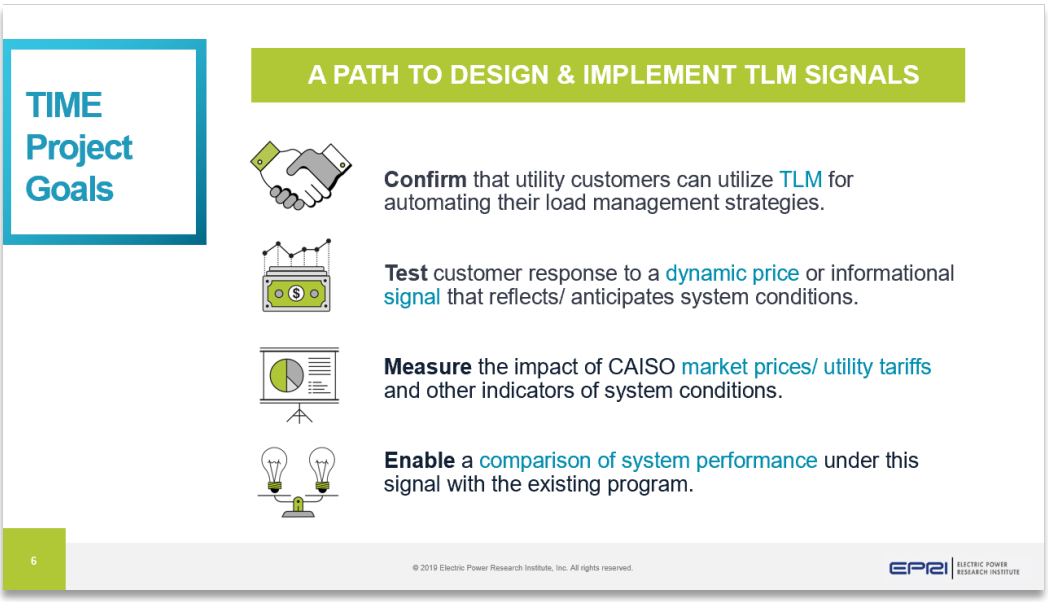

Figure 3. TIME presentation - Goals Slide

Figure 4. TIME Presentation - Key Findings Slide

The presentations provided an engaging, high-level guide for discussion at the working sessions with EM&T. The goal was to provide enough information to enable a collaborative dialogue between SCE staff and the EPRI project managers for each EPIC project and an opportunity to go deeper into details if desired.

4. Creating Engaging Collateral to Keep the Conversation Going

The final deliverable in the TA&D framework is engaging, easy to skim informational collateral handouts designed to be given to presentation participants with the goal that they will

use them to continue the conversation beyond the presentation date. The TA&D team again wanted to provide enough information to interest readers and a path to learning more if they so desired. The handouts were essentially collapsed versions of the presentations in a booklet format. Figure 5-Figure 7 illustrate two-page spreads from the TIME project handout.

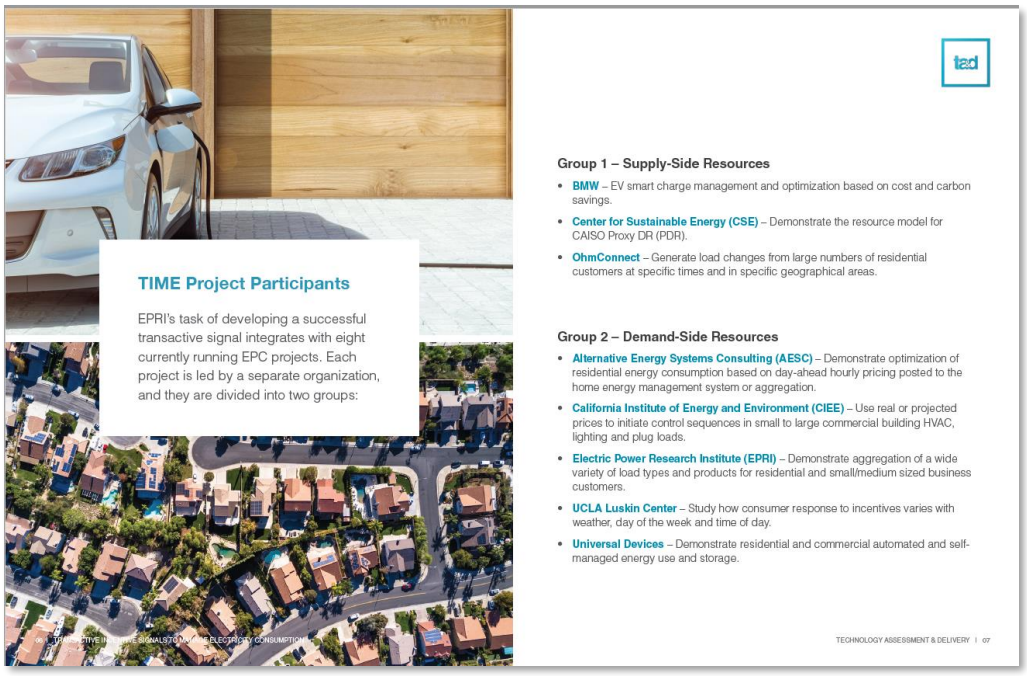

Figure 5. TIME Handout - Participants Pages

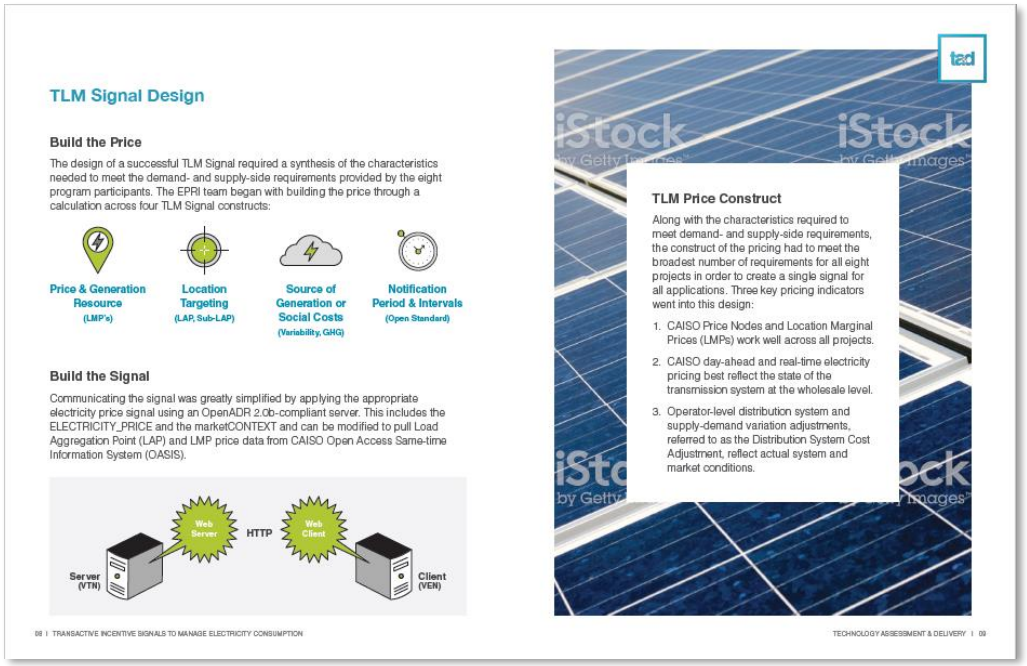

Figure 6. TIME Handout - Signal Design Pages

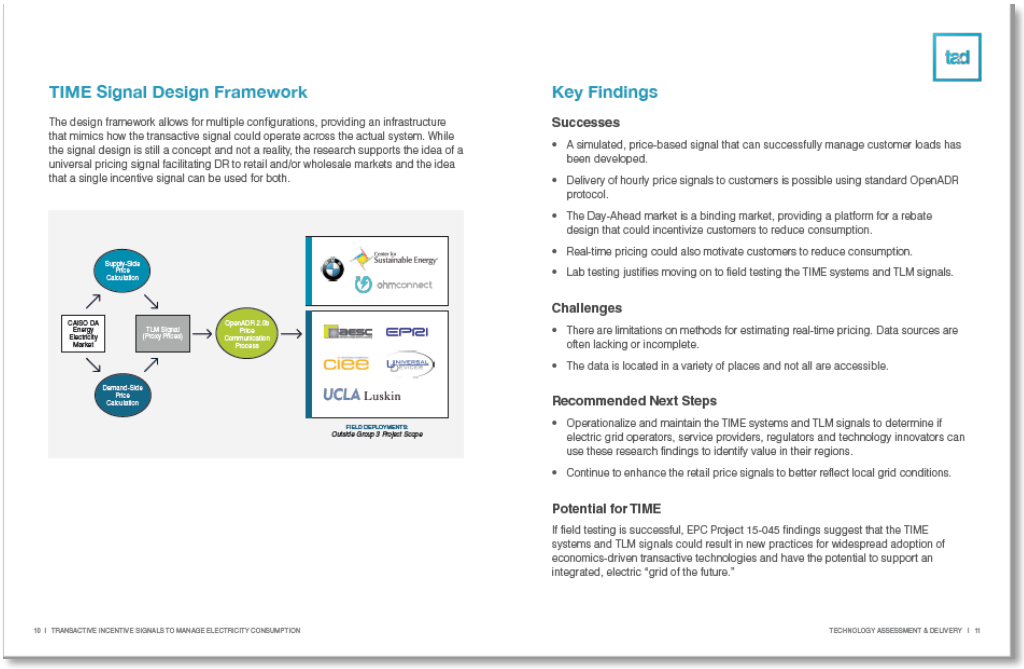

Figure 7. TIME Handout - Design Framework and Key Findings Pages

The TA&D Handouts provided working session participants with a physical takeaway that they could share with staff who had not attended the meeting and expand the dialogue across multiple departments.

The TA&D Effect on the TIME Project

All five EPIC projects previously identified were assessed using the TA&D framework and all five projects were presented to SCE's EM&T group and other stakeholders. While EM&T benefitted from key findings and recommendations for each of the projects assessed by TA&D, EPC 15-045, the TIME project, which was a software enhancement for secure DR communications, was extended into other DR areas as a result of the exposure facilitated by the TA&D process. As a result, the TIME project has become a prime example for compounded technology transfer throughout SCE.

The TIME project is also central for a larger project that is of great interest to EM&T, GFO-15-311: Advancing Solutions That Allow Customers to Manage Their Energy Demand[6]. The objective of the GFO, as stated in the original solicitation:

The main objective of this solicitation is to identify, inform and develop strategies for overcoming technical, institutional and regulatory barriers to expanding DR participation in California. The main purpose of this research is to enable high renewable resource penetration and to meet carbon emissions goals by facilitating a more effective use of DR and Distributed Resources by all sectors of California IOU customers. This effort supports the California Independent System Operator's (CAISO) Demand Response and Energy Efficiency Road Map.

[6] Grant Request Form; https://ww2.energy.ca.gov/business_meetings/2016_packets/2016-05-17/Item_17i_EPC-15-045.pdf

The successful development of transactive load management (TLM) through simulated pricing signals that work with both demand side and supply side resources has met the objective for most of GFO 15-311 and is now influencing EM&T's key areas of interest. As a result, EM&T has created a prioritization and planning framework for identifying new projects within the utility. Circling back to the phases of compounded tech transfer as presented earlier in this paper, we can see concrete examples of how the TA&D framework has helped facilitate TIME and how the key findings from TIME are influencing the EM&T program at a faster rate than traditional technology transfer. Here are the current results of the TA&D assessment and presentation of the TIME project, when applied to the four phases of compounded technology transfer:

1. **Awareness** (I now know it exists)
    - TA&D Presentation of TIME to the EM&T team
    - TA&D Presentation of TIME at EPRI Summer Symposium
2. **Personalization** (I can see how this might benefit me and I want to share with others)
    - Extension of the project to prove additional use cases
    - Additional pilots as a result of TIME
3. **Understanding** (I want to understand the specific outcomes and technical details)
    - T&D Grid Integration Team is exploring how key learnings from TIME could be applied
    - Rates design at SCE – they want to understand how to design prices to customers in the cloud lead by the Tariff Design Group
    - Informs and enhances the industry (electricity markets ecosystem) – demonstrates the feasibility of a transactive energy signal
4. **Adoption** (I want to apply this knowledge to what I am working on, which can include other research projects)
    - TLM has been successfully applied as a component in other EM&T projects
    - Improved OpenADR software technology enhancements for developers is a key outcome for the TLM use cases
    - Policy advancement – the CEC Load Management proceeding is examining TLM and other forms of advanced secure communications

Conclusion

Technology transfer of energy research in emerging technologies is vital to the development and implementation of new enabling software, systems, and innovative consumer devices for utility programs that in turn, can lead to market transformation. The TA&D framework was designed to accelerate technology transfer by providing SCE with an assessment, key findings, and recommendations on parallel research and development of new technologies funded by the EPIC program. The TA&D framework has proven to be both an effective tool for assessing the market potential of new technologies and a constructive process for sharing real time research information in a way that promotes discussion, creative thinking and an accelerated path to compounded technology transfer.

TA&D is providing SCE's EM&T program with an accelerated and cost-effective process that could benefit SCE's customers and other parts of California. The EM&T program is using the TA&D framework to dig deeper into the CEC's EPIC activities, with the goal of converting highly

valuable research and development occurring through the EPIC program into pilots and programs that meet California's clean energy goals.