Tool Lending Library Program Evaluation

Energy Division
California Public Utilities Commission

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Prepared by

Opinion Dynamics Corporation

Tool Lending Library Program Evaluation

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Submitted by:

Ellen Steiner, Ph.D., Study Director
Opinion Dynamics
1999 Harrison Street, Suite 1420
Oakland, CA 94612
esteiner@opiniondynamics.com
(720) 262-5857

Additional contributors to the study

Reese Rogers, CPUC Project Manager
reese.rogers@cpuc.ca.gov
(415) 703-2168

Matt Drury, Opinion Dynamics Engineering Lead
mdrury@opiniondynamics.com
(617) 301-4611

Paul Wasmund, Opinion Dynamics Lead Analyst
pwasmund@opiniondynamics.com
(617) 301-4626

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1. Executive Summary

As outlined in the Workforce Education and Training (WE&T) Research Roadmap, the California Public Utilities Commission (CPUC) tasked Opinion Dynamics with evaluating PG&E's Tool Lending Library (TLL) provided through PG&E's Pacific Energy Center (PEC). This study investigated whether loans offered through the PEC's TLL contribute to energy savings and, if so, which types of projects and tools have the most savings potential. This study also conducted a participant survey to characterize projects completed during 2016 with the assistance of tools loaned through the PEC, and the other three Program Administrator (PA) sponsored TLLs—PG&E's Energy Training Center (ETC) in Stockton, SCE's Agricultural Technology Application Center (AgTAC), and SDG&E's San Diego Energy Resource Center.

The objectives of this program evaluation are to:

- Characterize projects initiated through a TLL loan across all 4 PA TLLs in 2016;
- Quantify the savings potential for two projects supported by the PEC's TLL and assess the tool's contribution to those savings; and,
- Explore if and how the PEC TLL may claim savings in the future.

Opinion Dynamics employed several different primary and secondary data collection and analysis activities to address the research objectives and associated research questions. These included a review of secondary data sources and program tracking data from the PEC; a 2016 participant survey of borrowers from all four TLLs; case studies of 2 specific projects supported by the PEC's TLL, and in-depth interviews (n=3) with PEC staff. With the exception of the participant survey, we focused the majority of these research activities on the PEC. Further, the scope of this study was focused on reviewing the impact potential of the PEC, and other TLLs, at a high-level to determine if deeper impact-related research may be necessary in the future.

1.1 Findings

- **A large share of those initiating loans through the TLLs are repeat borrowers.** Based on responses from the participant survey, half of all of those that borrowed a tool in 2016 had taken out a tool loan previously. Further, 63% of borrowers used their tool loan for their work, and roughly 85% of those borrowers work in the energy services or building science fields. These statistics not only support the high-level of energy-related knowledge that borrowers reported, but also indicate that the TLLs help support California's energy efficiency and renewable energy industries. While, in the absence of the TLLs, some of these borrowers may purchase some these required tools, the TLLs are seemingly fulfilling a need within these industries.
- **The largest share of borrowers used their tool loan to support energy measurement activities.** Forty-four percent of survey respondents said they used their tool loan for energy benchmarking, while 33% said they used their tool to support Measurement and Verification (M&V). While it is unclear if the use

of tools loaned through the TLLs enabled direct energy or demand savings, it is evident that most borrowers use their tools to enable measurement of pre- and post-building conditions. Such activities are vital to any energy efficiency, demand response, or renewable energy project and may contribute to savings indirectly.

- **The TLLs play some role in moving energy efficiency, demand response, and renewable energy projects forward.** Of those projects that produced direct energy savings (see Table 5-2) where borrowers said they used the tool before the project was implemented, 88% said the TLL was very influential in their decision to move the project forward. Further, 52% of those borrowers maintained that they were not likely to implement the project if they had not received their tool loan (see Figure 6-3). While this is not necessarily a reliable estimate of borrower free-ridership (which would be required to conduct an appropriately rigorous impact evaluation), it does suggest that TLL staff, and tool loans specifically, provide a valuable service to the energy efficiency and renewable energy industries in California.

- **Education and training offered through the TLLs is of high value to tool borrowers.** Eighty-five percent of borrowers that received application notes and 89% of borrowers that received additional training, said the information that they gleaned was very useful (providing a rating of 7 or higher on a scale from 0 to 10). Though borrowers report that application notes do not necessarily contribute to their projects energy or demand savings (see Figure 4-8), borrowers do find the training beyond application notes offered by the TLLs very useful.

- **Tool loans may contribute to project savings claimed through other PA resource programs.** While it is unclear if TLLs are helping facilitate additional participation in these programs, borrowers report that their tool loans do affect the size of rebates from other PA programs, along with their ability to obtain them. Fifty–five percent of borrowers that received a rebate from a different PA program said that, without the TLL, they likely would not have received that rebate. Further, 58% said they would not have received the same rebate amount. Measuring pre- and post-building conditions is a crucial aspect of any rebate program application and, as such, it is clear that the TLLs are fulfilling an important need in this process.

- **Tool loans support a range of project types and, as such, the types of information that TLL staff would need to estimate ex ante savings may differ for each individual project.** As discussed throughout this report, tool loans support a wide variety of projects, each of which may require a different set of data for TLL staff and evaluators to estimate program impacts. While PAs may be able to create some standard documentation (e.g., scope of work template or program applications), borrowers would still need to submit information specific to each project's scope and the activities that they carried out as a result of their tool loan.

- **Program Administrators would need a clear process and build out more robust project tracking infrastructure to avoid double counting savings.** Nearly half (45%) of all projects with direct energy savings participated in another PA programs. Additionally, just over half of the projects (56%) supported by 2016 tool loans realized indirect energy savings. To claim savings, decision makers would need to expand on the project-level data tracked by TLLs and likely establish a framework for evaluating the TLLs as an indirect energy saving program. There are other examples of behavioral

programs (e.g., Strategic Energy Management or Home Energy Report programs) that have successfully avoided double counting savings that decision makers can look to for guidance on developing such a framework.

1.2 Recommendations

- **The PEC should consider tracking additional categorical details at the project-level for each tool loan.** Based on our review of the program tracking database, it is clear that the PEC has a robust database that tracks information on tool borrowers, tools, loans, job classifications of borrowers, and projects. While these data are extremely valuable and PEC has a well-designed TLL database, structurally speaking, much of the project information is presently captured in open-ended variables. As such, the PEC should consider tracking the following information using categorical multiple response variables, all of which would be invaluable for future research and evaluation efforts:

  - **Project Types:** TLL staff should consider creating a variable that allows borrowers to select the various activities that their tool loan will support—such as, energy benchmarking, retrofit or replacement of existing equipment, measurement and verification, operations and maintenance, retrocommissioning, solar PV, and educational and training. This will enable program staff and decision makers to quickly and easily determine which tool loans supported projects likely to produce direct savings or renewable generation, and which may lead to indirect savings (see Section 5.2).

  - **End-use Equipment:** Tracking the different end-uses (e.g., lighting, space heating, hot water, or ventilation) will add more detail to the types of projects that loans support. Additionally, tracking the combination of end-uses supported by different loans may help decision makers identify trends, such as packages of measures frequently supported by tool loans. These data may help inform future educational and program offerings that could help drive deeper savings.

- **If TLL staff and decision makers choose to claim savings from the TLLs, they should take the following considerations into account.** The decision to claim savings from the TLLs in the future may have implications on the types of loans TLLs issue, administrative costs and burdens for TLL staff and borrowers, and challenges with claiming savings for a single project in multiple programs. As such, TLL staff and decision makers should consider the following:

  - **Whether to move forward with an indirect impact evaluation, which would require additional data collection from TLLs.** Close to half (44%) of all projects supported by 2016 tool loans did not realize direct savings or lead to renewable energy generation as a result of their tool loan. There may be opportunities to claim indirect savings from these, and other TLL supported activities. As such, decision makers may consider moving forward with an indirect impact evaluation combining survey data collection with secondary research to match specific TLL-induced activities and energy savings. Any such effort would require an investment in additional data collection activities by TLL staff as expressed above.

- **Added transaction costs.** As noted above, claiming savings from TLL supported projects may require additional resources for TLLs, such as additional dedicated staff to verify application materials, review savings calculations, provide guidance on best practices, and, where necessary, perform on-site verification. Additionally, TLL staff would need to track all information from all projects and activities supported by a particular tool loan, as loans may support more than one project. This would also increase the administrative burden on tool borrowers and could even delay project implementation, in the event that program staff need to review and verify the specifics of the project.

- **Claiming savings from multiple programs.** Forty-five percent of all borrowers surveyed representing projects with direct savings received a rebate from another PA demand-side program. In the event that the TLLs claim savings, stakeholders will need to develop an appropriately rigorous set of protocols for differentiating between the savings attributable to the TLL and those induced by the other PA program. Such methods may also involve sharing savings between multiple different PAs as some tool loans support projects in a different PA's service territory. There are other examples of behavioral programs (e.g., Strategic Energy Management or Home Energy Report programs) that have successfully avoided counting savings. Decision makers and program staff would therefore need to carefully develop a process for tracking cross-participation.

- **TLL decision makers and staff should build on education and support offered to tool borrowers.** Education and training offered by TLL staff are a central component of the services that TLLs offer. Of those that received training through their TLLs--beyond their application notes--in 2016 (n=37), 89% found the information "very useful," indicating that TLLs are very effective in this area. Further, the PEC's dedicated technical staff provide training and technical assistance on an "as needed" basis to borrowers. However, only 35% of all borrowers in 2016 received this additional training, which included energy center courses and ad hoc training from dedicated TLL staff. While providing education and training is clearly a strength of the TLLs and energy center staff, the majority of borrowers do not take advantage of these offerings beyond the applications notes and basic instructions they receive with their loan. Energy center stakeholders should consider building on existing strategies to deliver this component to a larger share of borrowers. Similar to the PEC, dedicating technical staff to be available to provide advice, technical assistance, and publish training materials may help TLLs maximize any indirect savings resulting from tool loans.

2. Background

As outlined in the Workforce Education and Training (WE&T) Research Roadmap, the California Public Utilities Commission (CPUC) tasked Opinion Dynamics with evaluating PG&E's Tool Lending Library (TLL) provided through PG&E's Pacific Energy Center (PEC). The PEC is one of four TLLs in California funded through the Program Administrators (PAs) providing borrowers with access to a select inventory of tools, as well as staff guidance on the function and appropriate application of those tools. The primary goals of the tool lending program are to enable borrowers to gain hands-on experience with energy efficiency building diagnostic tools, learn about energy efficiency practices, and identify energy efficiency project opportunities that may not be initiated otherwise by using information gathered through the use of the tools.

Table 2-1 below includes definitions of terms used throughout this evaluation report.

Table 2-1. Definitions

Term	Description
Application Notes	Operating instructions specific to each tool that are provided at the time the loan is issued to assist with setup, operation, and data retrieval
Borrower	The specific individual to whom each loan is issued
Loan	A transaction where one or more tools is provided to a borrower for a designated period of time, which may be used to support one or more projects
Project	Work on one or more end-uses at a designated site that is supported by a loan issued by an IOU sponsored TLL
Project Type	A category of project based on the building type, the type of work completed (e.g., retro-commissioning versus retrofit), and the end-use(s) serviced
Site	The specific building or location where a project is implemented
Tool	A specific piece of equipment loaned out through an IOU-sponsored TLL
Tool Use	The method in which a tool loaned through an IOU sponsored TLL is used by a borrower, which may be influenced by application notes or training provided by TLL staff (e.g., for monitoring and evaluation post-installation versus pre-installation measurements)

Opinion Dynamics investigated whether loans offered through the PEC's TLL contribute to energy savings and, if so, which types of projects and tools have the most savings potential. This study also conducted a participant survey to characterize the projects and activities completed during 2016 with the assistance of tools loaned through the PEC, and the other three PA sponsored TLLs—PG&E's Energy Training Center (ETC) in Stockton, SCE's Agricultural Technology Application Center (AgTAC), and SDG&E's San Diego Energy Resource Center.

The objectives of this program evaluation are to:

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- Quantify the savings potential for two projects supported by the PEC's TLL and assess the tool's contribution to those savings; and

- Explore if and how the PEC TLL can claim savings in the future.

2.1 Previous Research

As part of this study, our team compiled past evaluations and other relevant research. In the remainder of this sub-section, we provide some background information on California's TLLs by detailing the key findings from the most applicable past studies.

2.1.1 California Energy Centers: Tool Lending Library Case Study (Opinion Dynamics, 2009)

As part of an evaluation of CPUC's Workforce Education and Training program completed in 2009, Opinion Dynamics reviewed TLLs housed in each of the PAs four Energy Centers. As part of this review, Opinion Dynamics conducted a telephone survey with 191 individuals that borrowed tools from any of these Centers between January of 2006 and June of 2007. The study presented the findings below based on this survey effort, which suggested that there are potential for energy savings associated with the TLLs.

- Borrowers reported substantial knowledge acquisition as a result of borrowing a tool or tools. **Overall, 69% of respondents reported learning something new about how to save energy by using the tools** and in general, borrowers affirmed that they learned how to improve energy efficiency at their homes, places of business, or client facilities.
- About 89% percent of market actors changed their services as a result of what they learned from borrowing the tool(s). In particular, almost half of market actors modified the way in which they size, specify, and maintain energy consuming equipment. In addition, the changes made by market actors appear to be persistent. **According to survey respondents, 83% of the market actors that made changes report that they have become standard practice**.
- Market actors also believe that their actions have an impact on their customers' energy usage. In fact, 87% of market actors participating in the survey believe the changes they have made to the service they provide to their clients as a result of borrowing a tool(s) has resulted in measurable energy savings at their clients' facilities. **Roughly one third (32%) characterize these savings as significant while another 40% describe the savings as moderately significant.**
- Tool loans also had an effect on commercial and residential end-users. **About 79% of commercial borrowers implemented measures to save energy at their facilities, and 63% of residential borrowers made an effort to save energy at their home using information acquired by using the tools**. The tool loans also facilitate participation in other utility programs. Among the borrowers who took energy saving actions as a result of the tool loan, 34% of commercial and 23% of residential borrowers received additional assistance from another utility program.

2.1.2 Evaluation of the 2003 Statewide Education and Training Services Program (Wirtshafter Associates, Inc., 2005)

Wirshafter Associates, Inc. completed a study in 2005, which involved an interview with program staff, a survey of 104 tool borrowers, and follow-up interviews with 11 of the largest energy savers. Key findings from this study included:

- The evaluation team obtained annual dollars-saved figures from 29 respondents and calculated two more from their kWh responses. The values ranged from $3 to $1,000,000 per year. The average savings was $68,929 with a standard deviation of $198,888, and the median savings was $3,824.
- The study suggested that a total of $2,100,000 will be saved annually. At $0.10/kWh, which is more than 20 million kWh per year.
- The research team categorized the savings according to whether borrowers were part of a utility or a government program, what they would have done if the TLL tools were not available (75% of the total savings were achieved by respondents who said they would not have implemented the project without the TLL), and those borrowers who would have bought or rented equipment in the absence of the TLL.

2.1.3 PG&E Energy Center Market Effects Study (TecMarket Works, 1998)

TecMarket Works completed a study examining the effects that the PEC had in the commercial building sector since its inception in 1991. Specifically, the research described the role of the PEC in educating stakeholders in the building and energy services industries, and detailed the extent to which the PEC transformed the market. The study included an analysis of participant data, in-depth interviews with key PEC stakeholders, and a phone survey of 216 PEC users. The following are the findings from the resulting report pertaining to the TLL within the PEC.

- The reasons for borrowing tools were primarily related to improving operations and maintenance of existing equipment, evaluating equipment efficiency, determining building and energy system utilization patterns, and improving the process efficiency of systems.
- The largest percentage of tool borrowers (Table 2-2) reported installing more efficient equipment of the same type (44%); others added controls and adjusted equipment for better operations.

Table 2-2: Changes made as result of measurement and monitoring (multiple responses)

Change	Percent (n=39)
Install more efficient equipment of the same type	44%
Add controls	38%
Adjust equipment for better operations	36%
Change maintenance practices	30%
Reconfigure the system to better meet part loads	28%
Reduce amount of equipment	26%
Change operating practices and procedures	26%
Resize equipment	8%
Install different type of more efficient equipment	5%

- While reducing energy use was the most frequently expected result of the projects (Table 2), reducing demand, improving comfort, and improving system operations were also frequently expected results.

Table 2-3: Expected results from the measurement projects (multiple responses)

Result	Percent (n=39)
Reduction in energy use	54%
Reduction in peak demand	46%
Improve comfort	44%
Improve system operation	44%
Change use patterns	23%
Save money	4%
Lower maintenance	2%
Satisfy customer	2%

3. Methodology

As outlined in the research plan,[1] Opinion Dynamics employed several different primary and secondary data collection methods to address the research objectives and associated research questions. These include a review of secondary data sources and program tracking data from the PEC; a participant survey of 2016 borrowers from all four TLLs; case studies of 2 specific projects supported by the PEC's TLL, and in-depth interviews (n=3) with PEC staff. With the exception of the participant survey, we focused the majority of these research activities on the PEC. Further, the scope of this study was focused on reviewing the impact potential of the PEC, and other TLLs, at a high-level to determine if deeper impact-related research may be necessary in the future. Table 3-1 below shows how each of these methods correspond with the research objectives and questions identified for this program evaluation. The section that follows describes each of these activities in detail.

Table 3-1. Methods by Objective and Research Question

Research Objectives and Questions	*Secondary Data Review*	*Participant Survey*	*Case Studies*	*In-Depth Interviews*
Objective 1: Characterize projects initiated through a TLL loan across 4 PA TLL's in 2016				
1) What types of individuals are borrowing are utilizing the TLLs?	☑	☑		
2) What knowledge and behavior changes do borrowers report?	☑	☑		
3) What role, if any, do the TLLs play in contributing to other IOU demand-side energy programs?	☑	☑		
Objective 2: Quantify the savings potential for two projects supported by the PEC's TLL and assess the tool's contribution to those savings				
4) How do borrowers use tools loaned by the PEC?	☑	☑		☑
5) How do tools loaned through the PEC enable energy or demand savings, and are those savings already captured by other PA programs or funding sources?		☑	☑	☑
Objective 3: Explore if and how the PEC TLL can claim savings in the future				
6) How do the PEC application notes for tool use (e.g., measurement technique descriptions and step-by-step instructions) lead to energy or demand savings, and do borrowers follow those procedures?		☑		☑

[1] March 2017. Opinion Dynamics California WE&T Tool Lending Library Study Research Plan. Prepared for the California Public Utilities Commission Energy Division.

Research Objectives and Questions	Secondary Data Review	Participant Survey	Case Studies	In-Depth Interviews
7) What project-level information is needed to claim savings in the future?	☑		☑	☑
8) What attribution rules set by the CPUC present a barrier to claiming energy savings?	☑			

3.1 Interviews with PEC Staff

The evaluation team conducted three interviews with the PEC's program staff on September 1, 2016, September 6th, 2016, and March 8, 2017 to assist with development of the evaluation plan, and to provide perspective on how the PEC's TLL operates. These interviews outlined both the process that the PEC follows when issuing loans and how staff provide training and support materials to first time and repeat borrowers. These interviews also highlighted the different data that program staff collects and how the TLL database is structured.

The PEC staff interviews provided context and assisted the evaluation team in determining the types of loans that may lead to projects that produce direct and indirect energy or demand savings. PEC staff shared that they issue between 800 and 900 loans annually and roughly half of those loans are likely used for projects that do not receive rebates through a PA program.

3.2 Secondary Data Review

To address several of the research questions outlined above, our team also completed a review of secondary data sources. These included the PEC program tracking data, previous TLL studies, and California's EM&V protocols. In this section we discuss our approach to each.

3.2.1 Review of Program Tracking Data

Opinion Dynamics completed a review of PEC TLL program tracking data. In addition to completing some standard data cleaning and a review of application notes, our team's goal was to use the open ended project descriptions to develop a framework for categorizing the different types of projects supported by the TLLs.

Our team categorized projects based on how borrowers used tools loaned through the PEC. Specifically, we differentiated between the following broad types of tool uses:

- Measuring energy usage or renewable potential before installing measures;
- Verifying savings from previously installed measures; and
- Tools used for other purposes (e.g., educational activities, energy benchmarking, or maintenance).

3.2.2 Review of CPUC EM&V Documents

Opinion Dynamics also completed a review of literature concerning California's energy efficiency policy and program evaluation protocols. Our team reviewed secondary sources for any protocols or requirements that may affect the TLLs ability to claim savings in future programs years, including specific protocols that may present barriers to claiming savings.

Our team reviewed the following documents specifically:

- California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals. TecMarket Works (April 2006);
- The California Energy Efficiency Policy Manual, version 5. CPUC (July 2013);
- The California Evaluation Framework, TecMarket Works (June 2004); and
- The International Performance Measurement & Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume I (Revised March 2002).

3.3 Participant Survey

One of the key research tasks involved in this study was a participant survey of 2016 tool borrowers from the four PA's TLLs in 2016. The purpose of the survey was to characterize projects supported by TLL loans, and the types of individuals and organizations who initiated those loans. Additionally, we use survey responses to describe the knowledge and behavior change that tool borrowers reported and the degree to which the TLLs contribute to their understanding of demand-side management and renewable energy.

Opinion Dynamics fielded the participant web survey between June 8th and July 7th of 2017. We attempted a census of tool borrowers from 2016 from the four TLLs. As shown in Table 3-2, we received program tracking data from the four TLLs containing 558 distinct tool borrowers from 2016.[2] Several of those contacts either had no email address associated with the tool borrower, or the email address provided was undeliverable (n=144). Of the 414 borrowers with contact information, 107 completed surveys resulting in a final response rate of 27%. Given the low number of completes from each of the four TLLs, we largely present survey results for the four TLLs combined in the sections that follow. Further, given the broad scope of this impact study and the range of different projects supported by the TLLs, we kept survey questions to a relatively high level in an effort to avoid overburdening borrowers with an excessively lengthy survey as they are already a well-surveyed population. We have included our complete web survey instrument as Appendix A.

[2] Given the limited number of recent borrowers available for SCE's Agricultural Technology Application Center, we included 32 contacts with loan dates through the second quarter of 2017.

Table 3-2. Tool Borrow Contact Counts and Survey Completes

Energy Center	Distinct Tool Borrowers	Borrowers with Bad Email Contact	Borrowers with Good Contact Information	Completed Surveys
Pacific Energy Center (PEC)	245	18	227	67
SDG&E San Diego Energy Innovation Center (EIC)	175	58	117	23
SCE Agricultural Technology Application Center (AgTAC)	123	64	59	15
PG&E Energy Training Center (ETC)	15	4	11	2
Total	*558*	*144*	*414*	*107*

Table 3-3 below shows the average percent of respondents with contact information that completed the survey for each of the four TLLs. We calculated the final response rate in accordance with AAPOR guidelines[3] and, as such, it is not the average of the individual response rates.

Table 3-3. Response Rate by Energy Center Tool Lending Library

Energy Center	Response Rate
Pacific Energy Center (PEC)	30%
SDG&E San Diego Energy Innovation Center (EIC)	20%
SCE Agricultural Technology Application Center (AgTAC)	25%
PG&E Energy Training Center (ETC)	18%
Final Response Rate	*27%*

3.4 Case Studies

Opinion Dynamics also completed an in-depth analysis of two projects supported by tools loaned through the PEC. These case studies highlight two different common types of projects that likely will produce direct energy savings, reduce peak demand, or generate renewable energy. We used these case studies to support our understanding of how tools enabled energy savings and renewable energy generation (see Section 5.2.2) and to inform what data TLLs would need to collect to claim savings in the future (see Section 6.2). Our team selected both cases using the criteria outlined below and completed an in-depth engineering analysis, which included additional email and phone correspondence to obtain specific details as needed. We have included details on all projects that we considered for case studies as Appendix B.

[3] Opinion Dynamics calculated the final response rate in accordance with AAPOR guidelines and best practices. Source: http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf

3.4.1 Selection Criteria

When selecting these two projects for deeper case study analysis, Opinion Dynamics employed the following criteria:

- **Data availability:** Through the participant survey, we ensured that borrowers documented pre- and post-installation equipment specifications, environmental conditions, and other parameters necessary for estimating savings. Further, we confirmed that these data were available and that borrowers were willing to share project information with our engineering team.
- **Projects using loans from 2016:** We also selected projects from calendar year 2016 to ensure the borrower used the current stock of tools and application notes. Further, this helped to mitigate issues associated with customer's ability to recall project details.
- **Projects with direct savings:** As part of our initial review of the program tracking data, Opinion Dynamics categorized projects according to the likelihood that they produced savings and that their tool loan contributed to those savings directly—that is, the project resulted in direct energy or demand savings, or renewable generation, and that the borrower used the tool prior to, or during, the project's implementation. We assigned similar categories to projects through the participant survey, only selecting from those that met the criteria for our engineering case study development.

3.4.2 Engineering Analysis

For the two TLL loans selected for case studies, our engineering team performed an in-depth analysis to estimate energy savings. For both projects, this included multiple discussions with the customer to learn more about their project and to request any project-specific documentation that could help our team estimate savings resulting from each project. For both case studies, we generated project-specific calculations to estimate energy savings.

Case Study 1 is a large central plant upgrade project that the customer submitted to PG&E for a rebate through a different program. The project included optimization of the economizer, supply air temperature reset, and schedules across several buildings on a large campus to reduce demand on the chillers and hot water system. The borrower provided energy savings calculations they performed as part of preparing their rebate submission. At the time of this report, the project was nearing completion, but did not yet have any post-project measurement and verification data. Therefore, our energy savings estimates reflect those the borrower generated for the project-rebate submission. We reviewed the scope of the project and the energy savings estimates, but were unable to obtain access to all underlying data and assumptions for the energy savings estimates, as the customer did not want to share any detailed project- or customer-specific information owing to customer privacy requirements. Through our discussions with the borrower, we learned that the project has not undergone any significant changes since the original rebate submission, and they anticipate the original energy savings estimates to be accurate once the project is complete.

Case Study 2 was a solar photovoltaic (PV) project completed by a residential borrower at their home. For this project, the borrower provided access to the solar generation data online, which allowed our engineering team

to monitor hourly, daily, monthly, and annual energy production from their solar PV system. We monitored the system and used the monthly estimates to generate an annual estimate as the system had only been in operation for 11 months as of this report.

4. Project and Tool Borrower Characterization

One of the primary objectives of this evaluation was to characterize the projects supported by TLL loans across all four TLLs. Opinion Dynamics addressed this objective primarily through the participant survey, but also completed a literature review of previous studies and evaluations on California's TLLs and a review of the PEC's program tracking data to provide additional detail on those projects. In the sections that follow, we describe the types of individuals that borrowed tools in 2016, the knowledge and behavior that they reported, and the role that TLLs played in contributing to other demand-side programs.

4.1 PEC Tool Loan Characteristics

As discussed previously, Opinion Dynamics completed a review of PEC TLL program tracking data as part of this evaluation. In addition to standard data cleaning and review application notes, our team's goal was to provide descriptive statistics on tools and loans offered through the program, and to categorize the various types of projects that tools loaned through the PEC supported. Our team did not conduct a review of other TLL's program tracking databases and therefore can only attribute these results to the PEC.

Through this review, our team identified 6,952 tools available to PEC borrowers, representing 649 different types of tools used from 2011 to 2016. The PEC loaned tools out for different durations based on the borrower need and the type of projects—that is, short term loans (1-2 weeks) for spot measurements and longer loans (up to 3 months) for metering and logging equipment. Over the 5 year period, the PEC loaned tools an average of 12 times, though the PEC loaned several tools out over 100 times[4]. Additionally, loans usually include multiple tools. On average, one loan included 14 tools, though some loans included over 300 tools. These were not necessarily unique tools, but may have included several different pieces of similar monitoring equipment. Table 4-1 shows descriptive characteristics of the PEC's TLL from our team's review of program tracking data from 2011 through 2016.

[4] Different types of light loggers were the most popular tools loaned from 2011 to 2016; however, current transducers and carbon monoxide meters were also among the most popular tools loaned during the same period.

Table 4-1. Descriptive Statistics form 2011 - 2016

Tools Available	6,952
Unique Tool Types Available	649
Loans Initiated	5,822
Average Loan Duration (Days)	34
Tools Borrowed	6,431
Average Loans per Tool	12
Average Tools per Loan	14

4.2 PEC Project Categories

Borrowers used tools loaned through the PEC in a variety of contexts. Loans included tools that would be useful alone (e.g., a cordless drill) and tools that may require an additional tool to be of value—for example, specific data loggers and current transducers may be of little use without one another. Tools most frequently loaned out by the PEC from 2011 to 2016 were different types of data loggers used for measuring relative humidity, temperature, light levels, and external input for current or voltage measurement. Other tools loaned with the highest frequency were typically those borrowed in conjunction with data loggers, such as current transducers or cables for transferring data from specific loggers. Examples of other tools loaned through the PEC are current transformers, instruments for measuring shade and solar access, and thermal imaging cameras. End-uses served through tool uses ranged from HVAC systems to lighting and domestic hot water systems, among a variety of others.

Table 4-2 below outlines the groupings that our team used to categorize projects. We based these categories primarily on our review of the 2016 PEC program tracking data, though our team also referenced past research that Opinion Dynamics conducted on California's WE&T program which encompasses the PEC and the other three energy centers that house the TLLs.[5]

[5] California Energy Centers: Tool Lending Library Case Study (Opinion Dynamics, 2009)

Table 4-2. Project Categories

Category	Description
Baseline Usage Measurement	Measuring baseline usage of an existing system or a space, or assessing potential equipment upgrades (e.g., shading or light-level analysis), but not specifically with the intent to take immediate energy saving action.
Pre-Installation Measurement	Using the tool to measure a system's performance with the intent to take immediate energy saving action (e.g., upgrade or system commissioning). Many of these projects cited the borrower's intent to seek an energy efficiency rebate from a different PA program.
Health, Safety, and Maintenance	Maintaining a systems' functionality or determining if equipment is functioning within required parameters. These projects may relate to health and safety standards (e.g., flowrate, temperature, ventilation standards, etc.).
Post-Installation Measurement	Verifying savings, or other usage characteristics, from past energy saving equipment upgrades.
Training, Education, and Outreach	Tools used for education, training, or outreach projects. These may be for course assignments, certification requirements, or for advancing building science through research. Additionally, these tools may be used for outreach and demonstration projects illustrating the savings potential from certain actions or technologies.
Unknown	Projects with insufficient, or no information

Opinion Dynamics reviewed the project description field collected by the PEC during initial loan application to categorize projects using projects from 2016. Table 4-3 below contains our categorization of each of the projects in the program tracking database during this time.

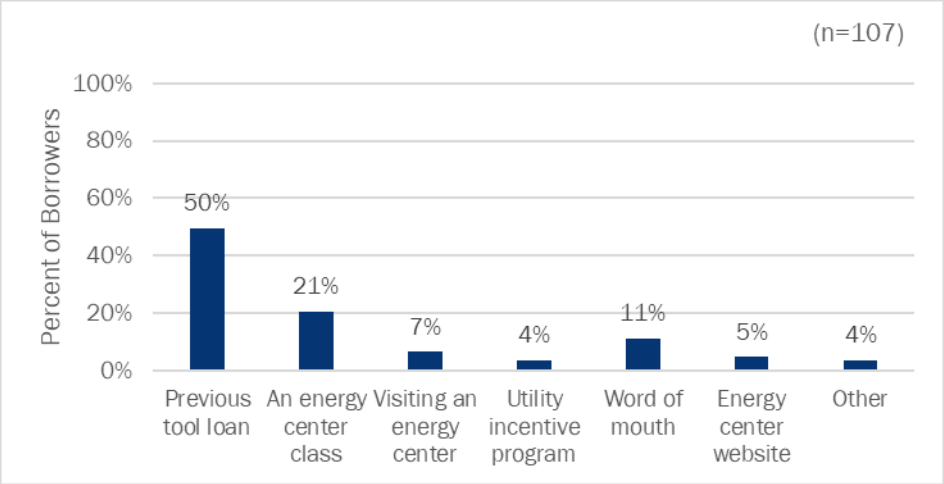
Table 4-3. Unique Loan and Project Counts by Category

Category	Count of Projects	Percent of Projects
Baseline Usage Measurement	174	35%
Pre-Installation Measurement	169	34%
Health, Safety, and Maintenance	49	10%
Post-Installation Measurement	46	9%
Training, Education, and Outreach	43	9%
Unknown	20	4%
Total	***501***	

4.3 Tool Borrower Characterization

Another key objective of the survey was to characterize the types of individuals and businesses that borrow tools from all four TLLs. Most borrowers that responded to this survey reported that their 2016 tool loan was not their first experience with their energy center's TLL. Half of all respondents borrowed a tool from one of the four PA TLLs in the past, while 21% said they learned about the program through a class that they took at one of the energy centers. Figure 4-1 shows how borrowers said they learned about the tool lending programs.

Figure 4-1. How Tool Borrowers Learned About the TLL Program



As shows in Table 4-4 below, the majority of respondents used their tool loan to support their work (63%), while almost a quarter of borrowers (23%) used their loan at their home. Borrowers also used their tools for courses, when testing a tool before purchase, or for other purposes. These results indicate that the majority of borrowers are employed in energy-related fields (e.g., energy services or building sciences) and may use tool loans to support one piece of a larger project.

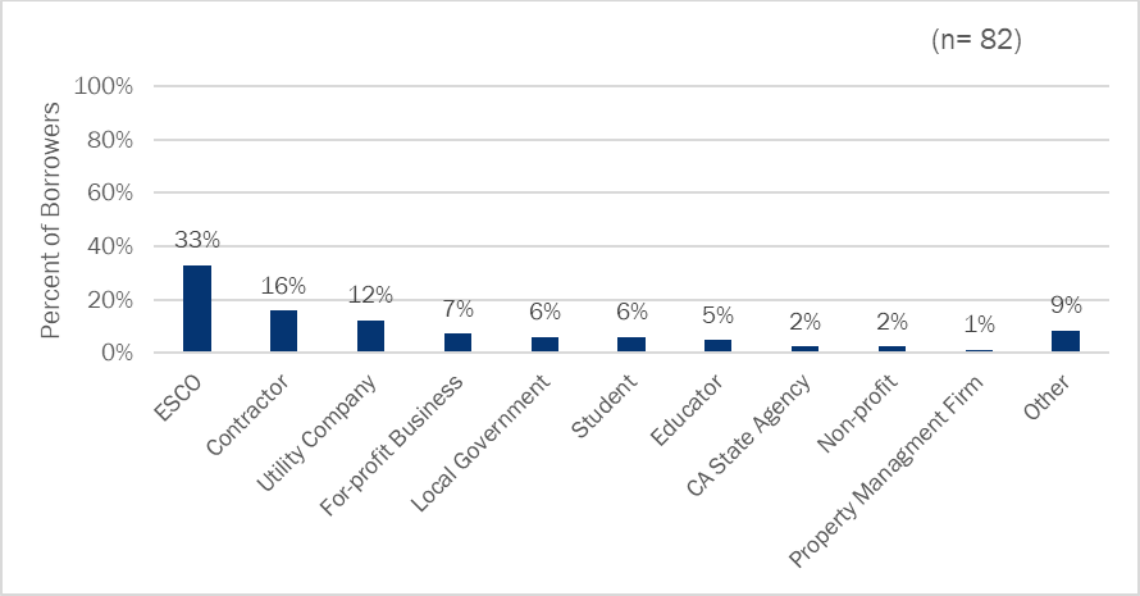
Table 4-4. How Borrowers Used Tool Loans

Tool Use	Percent of Borrowers
For my work	63%
For my home	23%
For a course I took	5%
Tool testing or evaluation	3%
For a course I taught	2%
Other	5%

Note: Percentages do not add up to over 100% due to rounding

Of those borrowers that said they used their tool loan either for their work, or educational purposes (i.e., not for use on their own home), one-third said they worked for an energy services company (ESCO). As illustrated in Figure 4-2 below, 16% of borrowers surveyed characterized themselves as “contractors” and 12% said they worked for one of California’s utility companies. Borrowers also said they were employed by other for-profit businesses, state or local governments, by non-profits, property management firms, some sort of other type of organization, or they were students or educators.

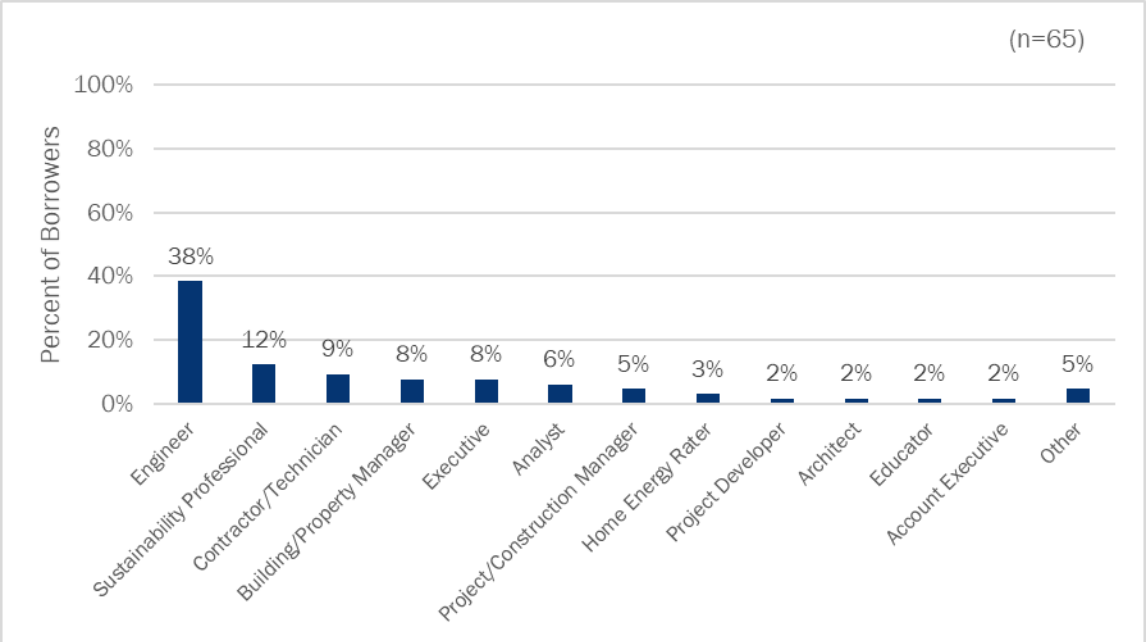
Figure 4-2. Tool Borrower Organizations



Note: Borrowers offered multiple responses and, as such, the sum of percentages exceeds 100%.

Of those 63% of borrowers that said they used their tool loan for their work, the largest share of respondents described themselves as engineers (38%). Though borrowers characterized their job title in many different ways (see Figure 4-3 below), 85% of those job titles were either technical in nature (e.g., engineer, technician, architect, or analyst) or directly related to the energy efficiency or renewable energy industries (e.g., sustainability professional).

Figure 4-3. Tool Borrower Job Title

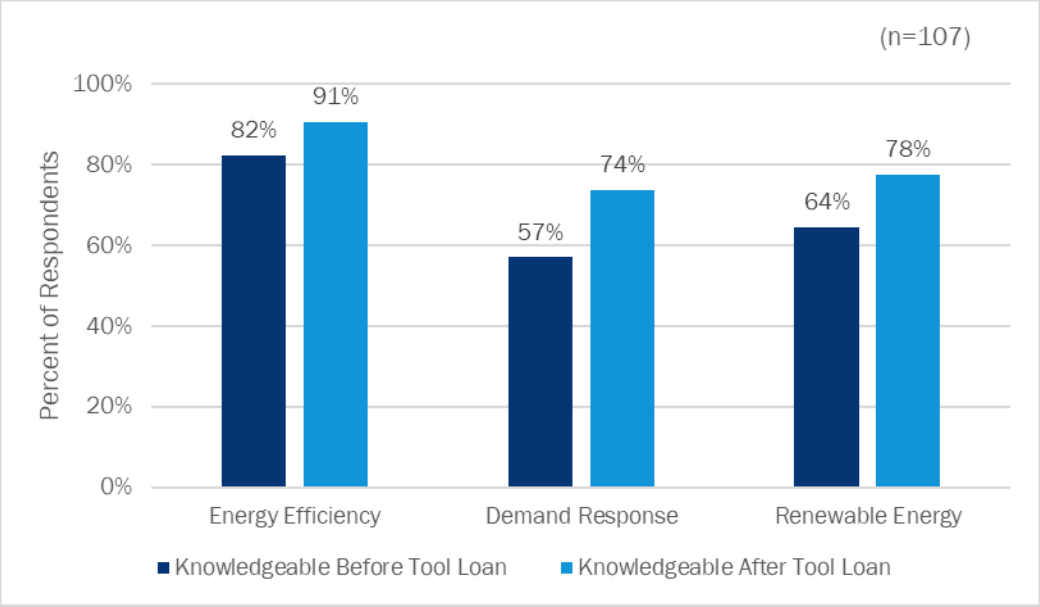


4.4 Knowledge and Behavior Change

Through the survey, Opinion Dynamics also explored all four TLLs' educational and training components. In this section we will discuss the level of knowledge of energy efficiency, renewable energy, and demand response that borrowers reported. Additionally, we highlight the different types of training and educational programs that TLLs offer, and if those offerings may prompt borrowers to take additional energy saving actions.

Overall, tool borrowers reported very high levels of knowledge on these topics. However, a slightly larger share of respondents reported that they were more knowledgeable about these topics after borrowing a tool through the one of the TLLs. Figure 4-4 below shows the difference between those that rated themselves as "very knowledgeable" (between 7 and 10, on a scale from 0 to 10) in each of the three areas before and after they initiated their tool loan. Most notably, roughly 17% more borrowers rated themselves as very knowledgeable about demand response, along with 13% more about renewable energy, after completing their tool loan.

Figure 4-4. Respondent Knowledge before and after their Tool Loan

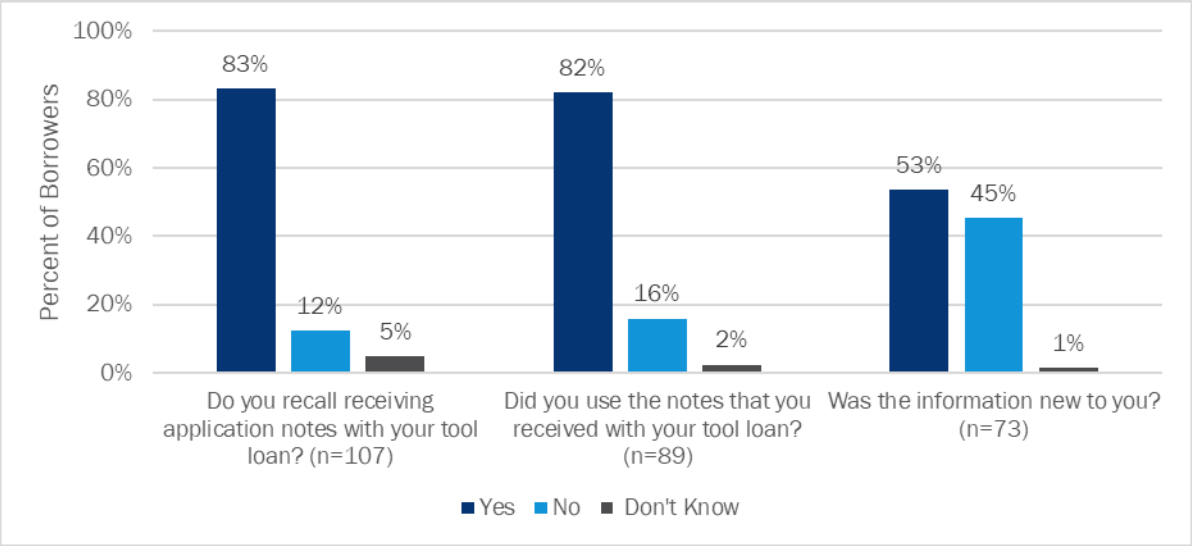


As part of their tool loan, most borrowers typically receive some sort of additional education either through energy center staff or printed materials that correspond to the tools that they borrowed. In particular, the PEC's dedicated TLL staff provide training and project advice as needed to borrowers. Educational opportunities for borrowers may include application notes, individual training from energy center staff, an energy center class, or some combination of these. In the paragraphs that follow, we characterize which types of education and training borrowers generally received along with their loan, and the extent to which these opportunities enhanced any energy and demand savings resulting from the associated projects.

We first asked borrowers a series of succeeding questions about the application notes provided by the TLLs. These notes generally offer operating instructions for the tools included in the loan and best practices for tool use. Figure 4-5 below illustrates that the vast majority of borrowers both receive and use application notes

(83% and 82% respectively). Additionally, 53% of borrowers said that the information was new to them, indicating a lower level of familiarity with the tools loaned through the energy centers.

Figure 4-5. Percentage of Borrowers who received and Used Application Notes



We asked similar descriptive questions about additional training that borrowers may receive through the energy centers. As shown in Figure 4-6 below, only 35% of tool borrowers surveyed received additional training (e.g., individual training from TLL staff or an energy center course). However, of the 35% that received additional training, the vast majority (81%) said that the information gleaned through that training was new to them. Additionally, Table 4-5 shows the breakdown of the different types of additional training that those tool borrowers received.

Figure 4-6. Percentage of Borrowers who received additional Training

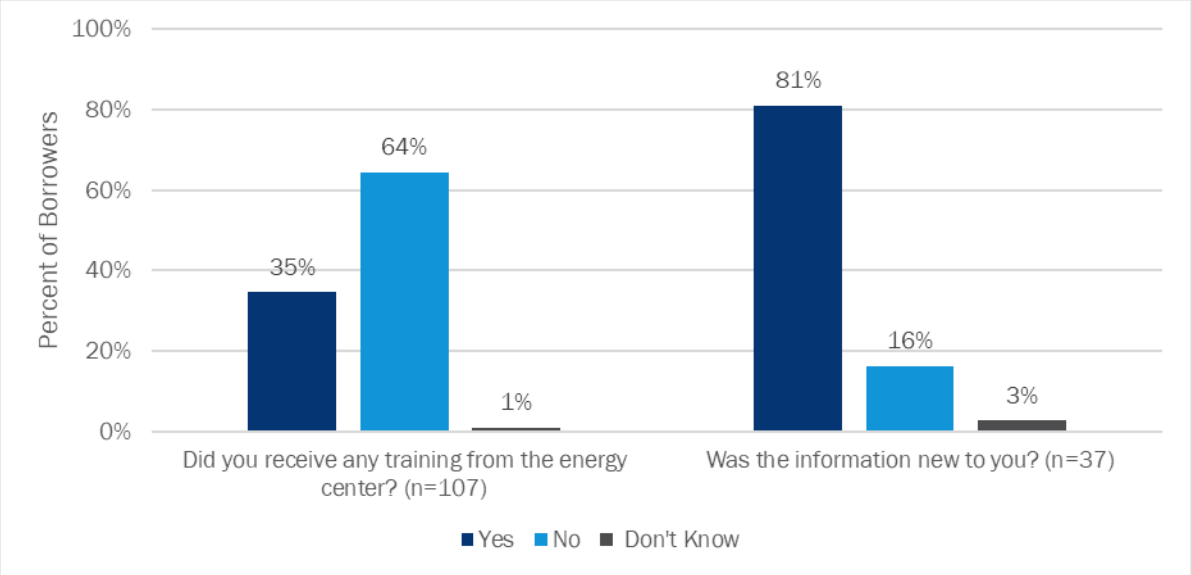
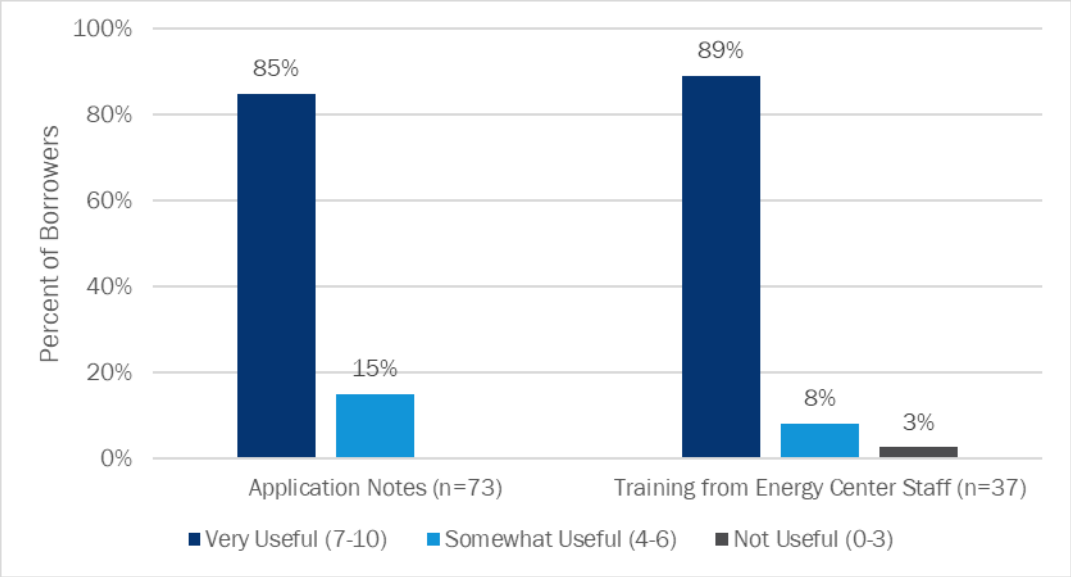


Table 4-5. Types of Trainings received by Tool Borrowers

Type of Training	Count	Percent
An Energy Center Course	15	41%
Training from Energy Center Staff	15	41%
Both	7	19%
Total	**37**	

We also asked borrowers to characterize how useful the information in both the application notes and the additional training they received was in supporting their projects. As shown in Figure 4-7, borrowers generally found the information offered through the application notes and the additional training very useful (85% and 89% of borrowers respectively). These results are similar to those included in our 2009 research—69% of respondents said they learned something new about how to save energy from their experience with the PEC.[6] Both of these results suggest that the PEC, and the TLL staff, consistently offer very high quality training and educational assistance to tool borrowers.

Figure 4-7. Usefulness of Application Notes and Training

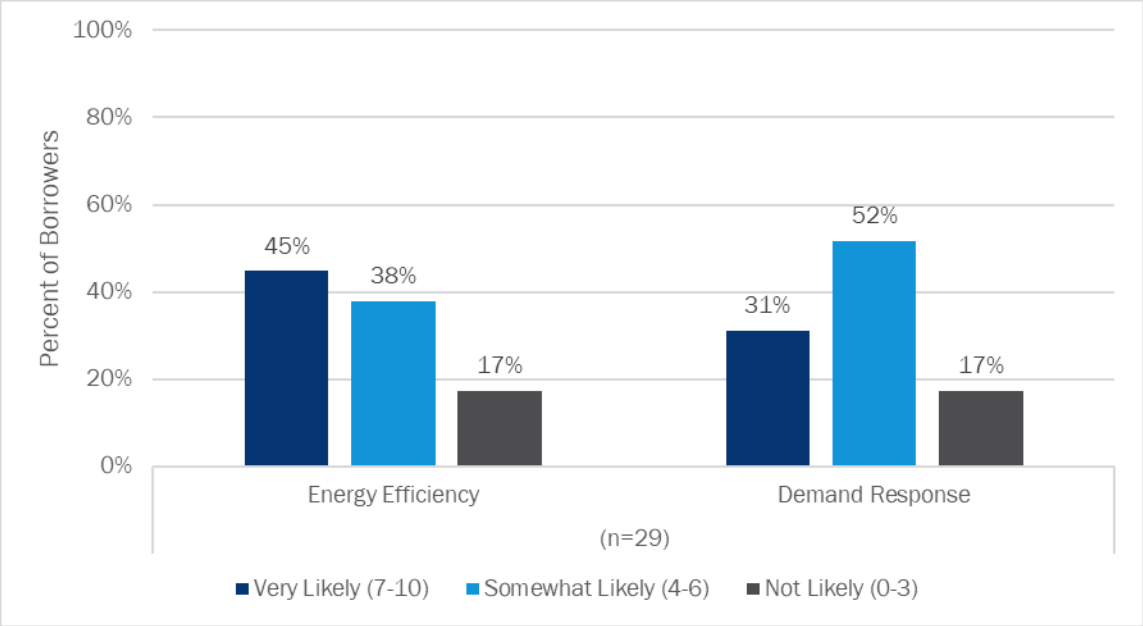


We asked a sub-set of borrowers—that is, those representing projects with self-reported energy savings, demand savings, or renewable generation that used their tool loan prior to the project's implementation—to rate the likelihood that, if they had not received the application notes, the project would have generated the same amount of savings. As illustrated by Figure 4-8 below, most tool borrowers believed that the application notes, while useful in helping them operate their tool, did not have a marked impact on energy or demand

[6] California Energy Centers: Tool Lending Library Case Study (Opinion Dynamics, 2009)

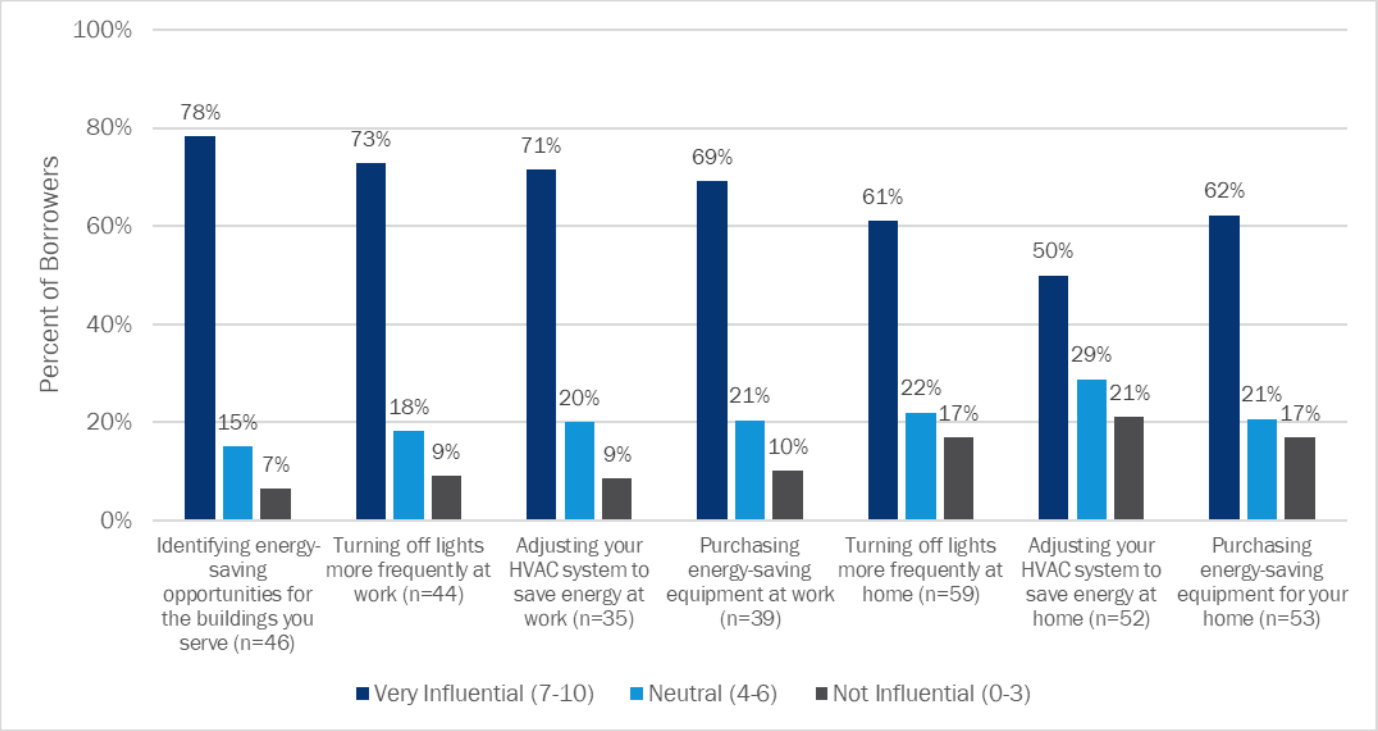
savings. Eighty-three percent of borrowers said the project in question was either "very" or "somewhat likely" to have the same amount of energy savings if they had not received application notes 4 or higher on a 0 to 10 scale).

Figure 4-8. Likelihood that Projects would have the same Energy or Demand Savings without Application Notes



Opinion Dynamics also asked survey respondents if they had taken a number of energy-saving actions since borrowing a tool through one of the TLLs. Figure 4-9 describes each of these actions, along with how respondents that took that action rated the influence of their TLL loan (on a 0 to 10 scale, where 10 is "very influential" and 0 is "not influential at all"). Although, in most cases, less than half of all respondents said they took additional energy saving actions, those that did said that the TLL was "very influential" on their decision to do so. One notable exception is respondents that said they identified additional energy-saving opportunities in the buildings they served. Seventy one percent of eligible respondents (i.e., those that worked in the energy services or building sciences field) said they did identify additional opportunities and 78% of those said their TLL was "very influential" in helping them to do so. Similarly, in our survey of 2006 and 2007 tool borrowers (see Section 2.1), 79% of commercial borrowers said their experience with the TLL helped them to identify and implement additional energy conservation measures (ECMs), as did 63% of residential borrowers. Our 2016 result, combined with results from our previous research, suggest that TLLs are reliably providing effective educational and training content to one of their core constituencies.

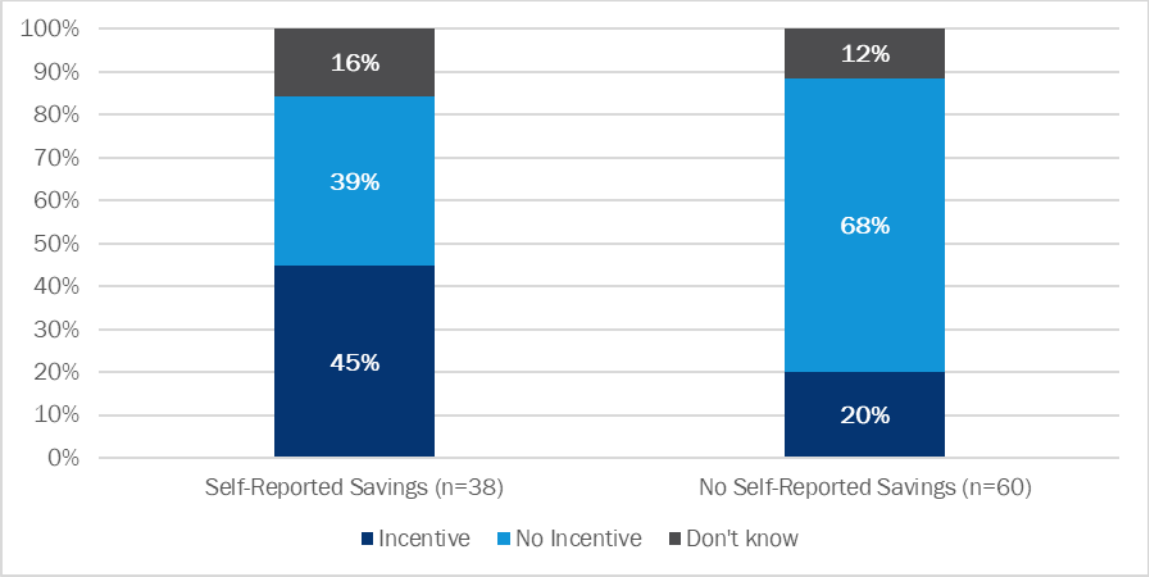
Figure 4-9. TLL Influence on Additional Energy Saving Actions



4.5 Contribution to PA Demand-Side Programs

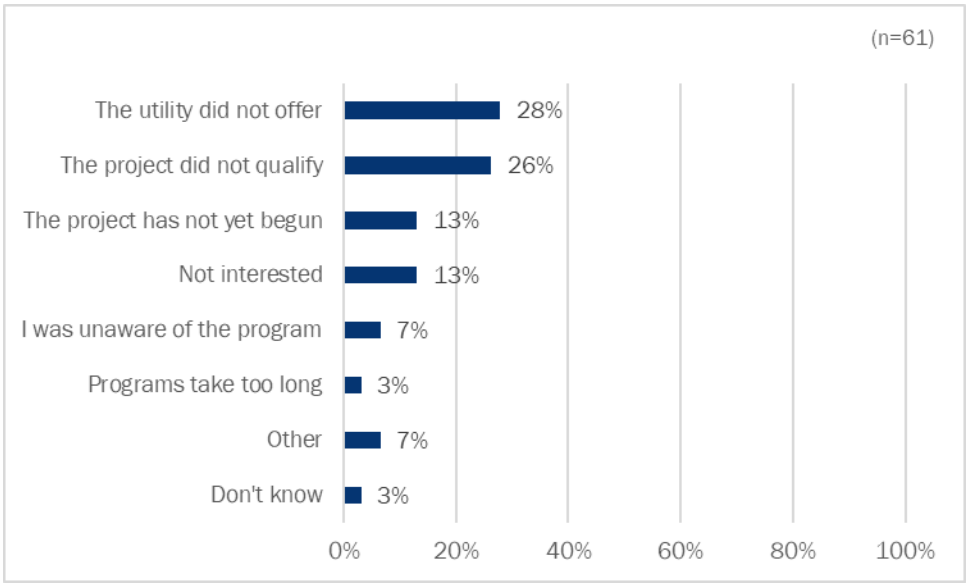
Opinion Dynamics also investigated tool borrower participation in other PA demand-side programs. Overall, 29% all borrowers surveyed said their project did receive a rebate through a different PA program, while 57% said they did not, and 14% did not recall. Further, of the TLL-supported projects that achieved direct energy or demand savings (see Table 5-3), 45% received a utility rebate, while 39% did not. Figure 4-10 separates projects with self-reported savings, from those without. Within each of those groups, the figure also shows the percentage of tool borrowers that said their project received a rebate from a different PA program, those that did not, and those borrowers that could not recall.

Figure 4-10. Projects that received a Rebate from a Separate PA Program



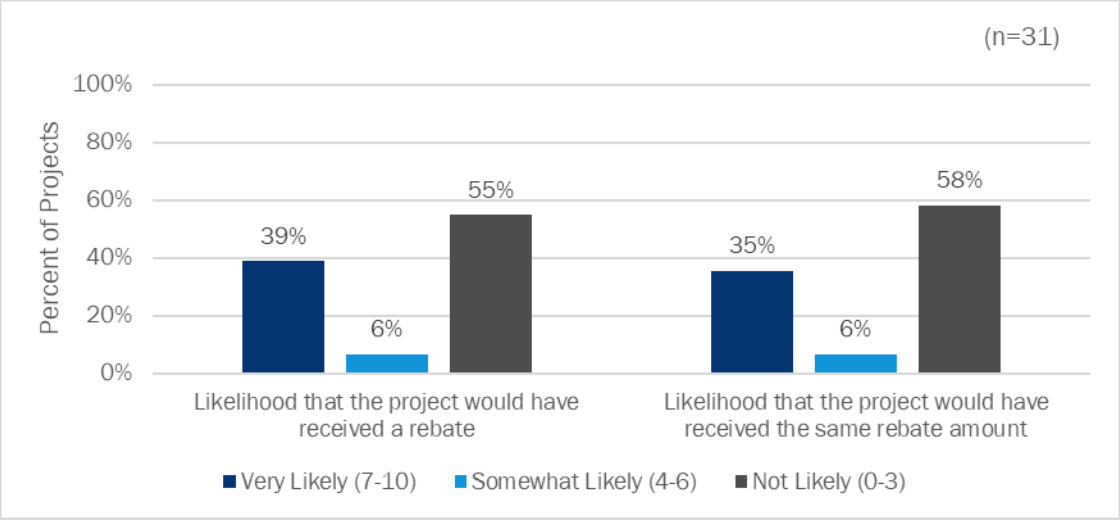
For those borrowers, we also asked why they did not receive a rebate for their project through a different PA program. As shown in Figure 4-11, the most common reason was that the utility company did not offer a rebate for energy or demand savings measures (28%), while 26% of borrowers that did not receive a rebate said their project did not qualify. Another 13% of borrowers said their project did not receive a rebate because the project had not moved forward yet, indicating that some of these borrowers may apply for a rebate later in that project's lifecycle.

Figure 4-11. Reasons for Not Receiving a Rebate from a PA Program



We also asked borrowers about the impact that the TLL had on the rebate they received. For those borrowers that said they did receive a rebate from a different PA program, we asked the likelihood that they would have received that rebate and that it would have been the same amount if they had not borrowed from one of the TLLs. The majority of those borrowers (55%) said they likely would not have received the rebate if they had not borrowed their tool(s) from a TLL, while 39% maintain they still would have. Further, 58% of those borrowers said that, without their tool loan, they would not have received the same rebate amount. These results indicate that the TLLs play some role in helping project managers, building owners, and others that submit projects for rebates for energy efficiency or demand response measures.

Figure 4-12. Likelihood a Project would receive the Same Rebate without the TLL



5. Savings Potential

Tools loaned through the PEC have a range of uses. Some of these support projects that intend to reduce energy use or generate renewable energy, while borrowers use other tools for educational purposes or to calculate a building's baseline energy consumption. As many of the tools loaned by the TLLs are data loggers or meters, these tools may enable savings or renewable generation by helping borrowers obtain diagnostic information on energy usage or renewable potential. Borrowers may use their tool loans to help develop a new project scope, refine an existing scope, add ECMs to an existing project, or simply gather additional data to support decision making for building improvements.

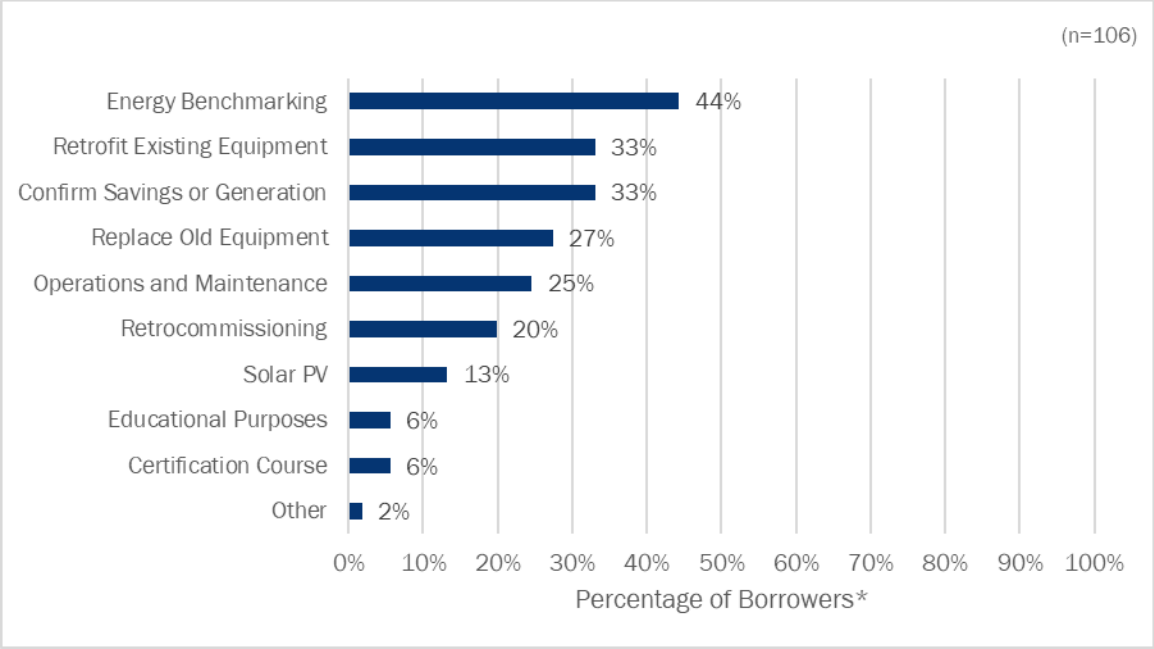
Later in this section, we also provide more detailed examples of two typical projects supported by loans from the PEC. The first features a large central plan project with multiple measures. For this project, the tool loan helped to gather data on the temperatures within the building and the existing operating parameters to design an upgrade that met the needs of the building owner. The second project involved installing solar PV panels on a residential property. The borrower used the tool loan to understand which potential sites on the property yielded the highest energy generation. In the remainder of this section, we describe the different types of projects enabled by the TLLs and how tool loans supported those projects.

5.1 How Borrowers Use Tools

Through the participant survey, we characterized how borrowers use their tool loans and if borrowers believe their project produced measureable energy or demand savings. As borrowers use some loans for multiple projects, we asked borrowers to limit their responses to their most recent project captured in the TLL program tracking data. Borrowers may also use their tool for multiple different purposes on a single project. As such, we asked borrowers to describe the various different uses for their tool loan for the associated project.

Forty-four percent of borrowers surveyed said they used their tool, at least in part, to support energy benchmarking efforts. Also, 33% of borrowers used their loans to support the retrofit of existing equipment, while 27% said they used their tool loan to replace old equipment. It is also important to note that 33% of borrowers said they used their tool in part to confirm energy savings or generation (i.e., monitoring and verification activities). Other notable tool uses were operations and maintenance activities (25%), retrocommissioning (20%), and solar PV installations (13%). Figure 5-1 provides the complete list of the different activities that borrowers said they used their loans to support.

Figure 5-1. Tool Loan Purpose



* Percentages will add up to more than 100% as loans may have been used for more than one purpose listed

As discussed in Section 2.1, our team reviewed previous TLL research and program evaluations. As part of a broader WE&T survey effort, Opinion Dynamics surveyed tool borrowers from 2006 and 2007. Our team asked respondents to describe how they used their tool loan in term of the categories listed in Table 5-1. Though it is difficult to make direct comparisons between the categories from Table 5-1below and our 2016 participant survey, there are some trends worth noting. First, the largest share of tool borrowers appear to use their tool to measure existing equipment, both for benchmarking and determining the feasibility for retrofits or replacement. Also, roughly one-third of borrowers from both survey efforts said that they used their loan for monitoring and verification activities of newly installed ECMs. Finally, both survey efforts also indicate that the TLLs have consistently supported educational, training, and research activities. Though a larger share of borrowers said they used their tool for these purposes in 2006 and 2007 (31%), borrowers in 2016 still identified these areas as important attributes of the TLLs (see Section 4.4).

Table 5-1. Tool Loan Categorization from 2006-2007

Tool Use–multiple response (n=191)	Percent of Respondents
Measure energy use of existing equipment	57%
Site analysis to check feasibility of new equipment	47%
Confirm energy savings from new equipment	37%
For research	31%
Obtain general information about equipment in my home	13%
Other	2%
Don't know	1%

Source: California Energy Centers: Tool Lending Library Case Study (Opinion Dynamics, 2009)

5.2 Projects with Savings

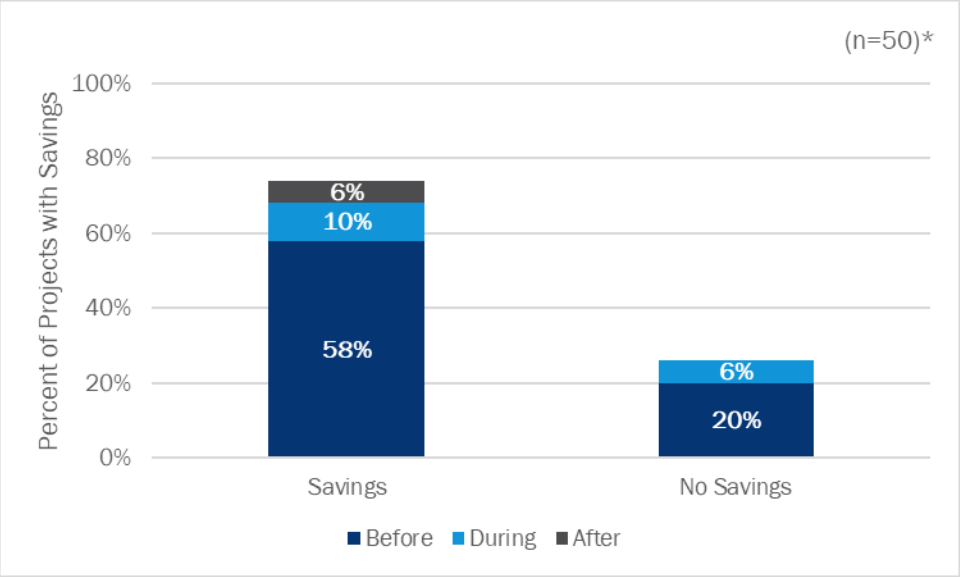
We also used data from the 2016 participant survey to characterize which borrowers, and by extension projects, may be more likely to produce direct energy savings, demand savings, or renewable generation. Of the 107 borrowers surveyed, 56% said they used their tool loans to support at least one of the following actives: retrocommissioning (RCx), retrofitting existing equipment, replacing old equipment, or installing solar photovoltaic (PV) panels. Forty-four percent of borrowers said their tool loan supported other types of projects, such as energy benchmarking, operations and maintenance (O&M), verifying energy generation or savings (M&V), or those used for educational reasons. We assume that the first group of activities are far more likely to produce direct savings or renewable generation, while the second group may lead to indirect savings through behavior change, or other types of spillover. Table 5-2 below shows the percentage of borrowers that used their loans to support each of these two different categories of projects.

Table 5-2. Percent of Borrowers and Simplified Project Categories

Category	Project Descriptions	Count	Percent
Direct Savings Potential	RCx, Retrofit, Replacement, or Solar PV Projects	60	56%
No Direct Savings Potential	Other (e.g., Benchmarking, O&M, Educational, or M&V)	47	44%
Total		**107**	

We asked questions related to energy, demand, savings, and renewable energy generation only of those borrowers representing projects with potential direct energy savings as described above (see Table 5-2). For this group of borrowers, we asked if they used their loan before, during, or after the project's implementation. Additionally, for those that were not solar PV projects, we asked borrowers if their project had produced direct energy or demand savings. Of the 50 borrowers that met the criteria described in Table 5-2 that did not install solar PV panels, approximately 74% said their project produced measurable energy or demand savings. Of those projects, borrowers representing 58% of projects said that they used their tool loan to support their energy-saving project before it was implemented. Figure 5-2 below provides additional detail on when borrows used their tool in relation to their project's implementation and if their project produced energy or demand savings.

Figure 5-2. When Tool was used in Project Lifecycle–Projects with Direct Savings Potential



* Nine respondents said they did not know if their project lead to measurable energy or demand savings and one respondent said they did not recall when in the project's lifecycle they used their tool loan.

Though a large share of borrowers supporting projects with potential direct energy savings (n=50) did use their loan before the project's implementation and said their project produced savings (58%), this still only accounts for a small portion of 2016 borrowers overall. As shown in Table 5-3 below, of the 36% of borrowers that used their loans to support projects producing direct energy or demand savings, 27% of borrowers (n=29) used their loan before the project's implementation. These 29 borrowers represent the projects that would potentially be eligible for PAs to claim direct savings—that is, they are projects with measureable savings or renewable generation and the borrowers used their tool loan prior to the project's implementation. As we discuss below, several of these projects already received a rebate from one of the four PAs through a different program while others did not for a variety of reasons.

Table 5-3. Self-Reported Savings Characteristics of TLL Supported Projects

Revised Project Categorization	Count	Percent
Projects with Self-Reported Savings*	38	36%
Tool Used Before Implementation	*29*	*27%*
Tool Used After Implementation	*9*	*8%*
Projects with No Self-Reported Savings	55	56%
Unsure if Project lead to Savings	9	8%
Total	**107**	

* Nine of these projects were solar PV projects that produced measurable renewable energy

5.2.1 Savings Not Captured through other PA Programs

Borrowers representing 16 of the 29 eligible projects listed in Table 5-3 said they have not yet received a rebate from one of the four PAs through a different program, though three were in the process of doing so. Table 5-4 provides reasons why each of those projects did not receive, or apply for a rebate.

While there may be some limited opportunity for the TLLs to claim savings from these 13 projects, several reasons that borrowers reported for not receiving a rebate through a different program may present similar obstacles to going through a similar process for the TLL. Five of the 13 projects did not receive a rebate as those projects were implemented in a utility's service territory that did not offer rebate programs (i.e., not within one of the four PA's service territories). Assuming that the TLLs are only able to claim savings for projects completed within the associated PA's service territory, the same barrier would apply. Further, some share of the 3 projects that have not yet begun implementation may still apply for a rebate through a different program. As such, there may be very limited opportunities for TLLs to claim direct savings from projects not already enrolled in other PA demand-side programs.

Table 5-4. Qualifying Projects with that did not receive a Rebate from a separate PA Program

Reason	Count of Projects
The utility did not offer a rebate	5
Project has not started yet	3
The project did not qualify	2
I was unaware of the rebate	1
I was not interested--participating takes too long	1
Other	1
Total	*13*

5.2.2 Case Studies

In this sub-section, we provide examples of two projects with measurable impacts supported by the PEC. The first case describes a large multi-measure energy efficiency project at a central plant for a campus, and the second is a residential solar PV project. Both of these cases show typical projects supported by the PEC and illustrate how tools loaned through the TLLs may enable direct energy savings and renewable generation. For both projects, tools were diagnostic and therefore helped borrowers collect data on existing system energy consumption, buildings' environmental conditions, and solar generating potential. In Case Study 1, the data from the borrowed tools allowed the borrower to determine which buildings on the campus were ideal candidates for the energy improvements through the measurement of air and hot water temperatures. Recording these measurements enabled the borrower to locate potential problem areas and more cost-effectively implement the project. In Case Study 2, the borrower leveraged their tool loan to select the optimal location for installing solar panels at their residential property. Measuring the path of the sun with the tools and using existing structures enabled the borrower to identify the most ideal location and maximize solar potential for the project.

As discussed in Section 4.4, with their tool loans, borrowers typically receive application notes with operating instructions and best practices for tool use. While borrowers generally find these notes very useful, there is little evidence that they contribute directly to energy or demand savings, or renewable energy generation. The borrower representing Case Study 2 did receive application notes with the tool loan and found them extremely useful, rating the notes a 10 on a scale from 0 to 10, where 10 represented "extremely useful." The same borrower, however, reported that the project was likely to achieve the same amount of energy savings, a 7 out of 10 where 10 is "extremely likely." Neither borrower representing the two projects received any additional training or participated in any courses at the PEC.

Though tools loaned by the PEC do not typically lead directly to energy savings—that is, they are seldom used in the physical installation of ECMs—loans generally support decision makers when determining which measure may be of the most value. As such, tools loaned through the TLLs are often indispensable when installing energy saving equipment that require measurement, site selection, or other critical pieces of information for these types of projects. Additionally, particularly for solar PV projects, tool loans may assist borrowers in determining the most appropriate site for measures or assist in equipment calibration. As discussed further in Section 6.1.2 during the participant survey we asked borrowers about the influence of the TLL on the projects that their tool loans supported. Table 5-5 below shows how the borrowers representing both case studies responded to these questions, and how each compared to the mean ratings of all 2016 respondents. Both borrowers said that the PEC was very influential on their decision to implement the project, though both remained more neutral when asked about the likelihood that each would have been implemented and generated the same energy savings or capacity without their tool loan.

Table 5-5. TLL Influence on Project Implementation

Survey Question	Case #1	Case #2	TLL Mean Rating
Influence on decision to implement the project *(0-10 Scale, where 10 = "extremely influential")*	9	8	8.4
Likelihood that the project would have been implemented without the TLL *(0-10 Scale, where 10 = "extremely likely")*	5	4	3.5
Likelihood that the project would have generated the same capacity without the TLL *(0-10 Scale, where 10 = "extremely likely")*	7	5	3.8

Tools loaned through the PEC enabled energy savings by allowing the customers to scope out the best options for their projects. For Case Study 1, the tool loan allowed the customer to understand the temperatures within their building and the existing operating parameters to design an upgrade that met the needs of their customer. For Case Study 2, the borrower used the tool to understand the most ideal location on his property for installing the solar PV panels and maximize on-site renewable generation.

Case Study 1—Energy Efficiency Upgrade at Central Plant

For this project, the borrower optimized controls and scheduling throughout several buildings on a campus to reduce energy use at the central plant. As described previously, the data from the tool loan allowed the borrower to determine which buildings on the campus were ideal candidates for the energy improvements through the measurement of air and hot water temperatures. Recording these measurements enabled the borrower to locate potential problem areas and more cost-effectively implement the project. The borrower used Hobo data loggers to record zone temperature readings in buildings and ultrasonic flow meters to estimate hot water temperature reset. These measurements helped to scope out the following upgrades:

Project Summary	
Energy Savings	
kWh per year	*652,606*
Therms per year	*125,814*
Demand Savings	
kW per year	*91*
Project Began	Unknown
Project Completed (estimated)	September 2017
Tool Loaned	▪ Hobo data loggers ▪ ultrasonic flow meter(s)
Rebate Applied for	Yes

- Economizer optimization/recommissioning: This measure optimizes the existing air handler operation in two separate buildings to take advantage of free cooling when outside air conditions are favorable. The measure reduces cooling demand on the chillers resulting in cooling energy savings. This is a low-cost measure involving updates to the existing control system programming with no additional hardware upgrades.

- Supply air temperature (SAT) reset optimization: This measure applies to all buildings on the campus. It optimizes the existing supply air temperature (SAT) reset strategy to reduce the amount of reheating done at the variable air volume (VAV) boxes. This measure results in natural gas savings by reducing the heating load at the boilers. This is a low-cost measure involving updates to the existing control system programming with no additional hardware upgrades.

- Schedule optimization of heating hot water valve: This measure applies to one building where air handlers operate from 5 AM to 7 PM and it includes reprogramming the heating hot water (HHW) system schedule to match the operation of the air handling units (AHUs). With this change, the operation of the HHW system is synced with the AHU supply fan operation. This optimization reduces the hours of operation of the HHW system resulting in both electrical and natural gas savings.

The borrower indicated that the building owner submitted this project for, and eventually received a rebate through PG&E's custom program. We based the descriptions of the project and all energy savings estimates on preliminary savings estimates calculated by the borrower for submission of the project's program application. The project was in the final stages of completion as of September 2017.

Borrower Description

This borrower works for an implementation company that identifies energy efficiency projects for the PG&E custom program. They semi-regularly borrow tools from the PEC as needed to support baseline and post installation calculations and energy savings estimates.

Tool Description

The borrower used Hobo data loggers to record zone temperature readings in buildings and ultrasonic flow meters to estimate hot water temperature reset.

Figure 5-3 below shows examples of both tools used for this central plant project—a Hobo data logger, used for collecting relative humidity, temperature, and light levels, and an ultrasonic flow meter.

Figure 5-3. Examples of Hobo Data Logger and Ultrasonic Flow Meter

Hobo logger source: http://www.onsetcomp.com/products/data-loggers/u12-012
Flowmeter source: http://www.instrumentsdirect.com/products/13303/ge-panametrics-transport-pt878-ultrasonic-flow-meter-system

Case Study 2—Residential Solar PV Case Study

To support this residential solar PV project, the borrower leveraged their tool loan to select the best location for installing solar panels at his residential property. Measuring the path of the sun with the borrowed tools and using existing structures enabled the borrower to identify the most ideal location and maximize solar potential for the project. The borrower received a Solmetric SunEye tool from the PEC to conduct readings and measure projected solar PV output from three buildings and several ground based locations on their property before selecting the most appropriate location to install the solar panels. Based on

Project Summary	
Energy Generation	
*kWh per year**	*12,600*
Project Began	September 2016
Project Completed (production began)	November 2016
Tool Loaned	Solmetric SunEye
Rebate Applied for	No

*The solar project was in operation for only 11 months at the time of this report so we estimated the remaining month using projected data to obtain an annual estimate.

the readings from the Solmetric SunEye tool and other factors[7], the borrower chose to install the solar panels on the roof of a shop, separated from their home.

Borrower Description

This borrower is also the homeowner and a retired PG&E employee. They indicated some familiarity with the TLL prior to starting the project. The borrower learned more about the TLL through a current PG&E employee who also told them about the Solmetric SunEye tool.

Tool Description

The Solmetric SunEye tool is used to measure shade and to optimize solar production by providing the user with the optimal location for installing solar panels at a given location. For this project, the homeowner used the tool prior to installing solar panels to determine the most practical location on their residential property. Output of the tool includes elevation, azimuth, orientation, tilt, solar access, and several other parameters to allow for an easy comparison between various sites. Figure 5-4 shows the output elevation and azimuth of one of the tested locations using the Solmetric SunEye tool. Having data on the azimuth angle versus the elevation allowed the borrower to select the optimal location as this information provides the projected solar PV output of panels should they be installed at that location.

Figure 5-4. Example Output of Elevation and Azimuth

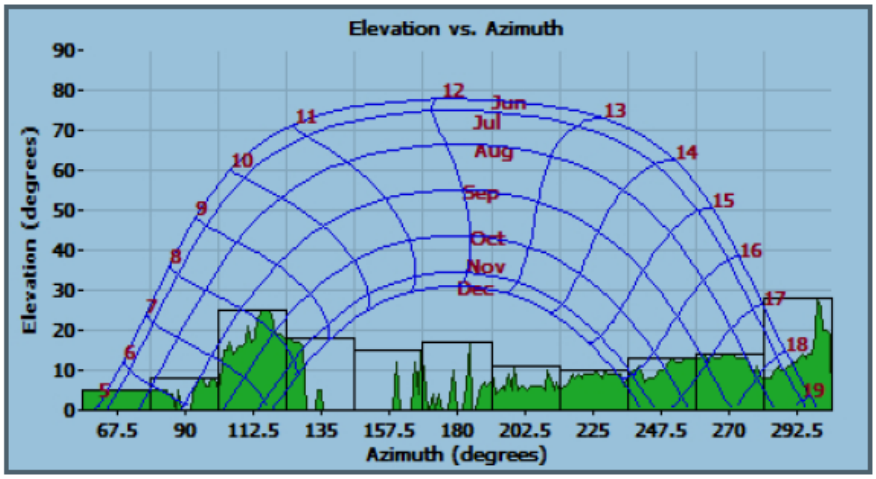


Figure 5-5 the projected solar access data for one of the tested locations over the course of a year. This information allows the borrower to make informed decisions on whether any obstructions (other structures, foliage, etc.) will interfere with the path of the sun as it moves throughout the day and year at a given location.

[7] The homeowner indicated that permitting was also a factor, as placing the solar panels on an uninhibited building was a more straightforward permitting process than if he was to install them on his home or garage.

Figure 5-5. Example Output of Solar Access Data

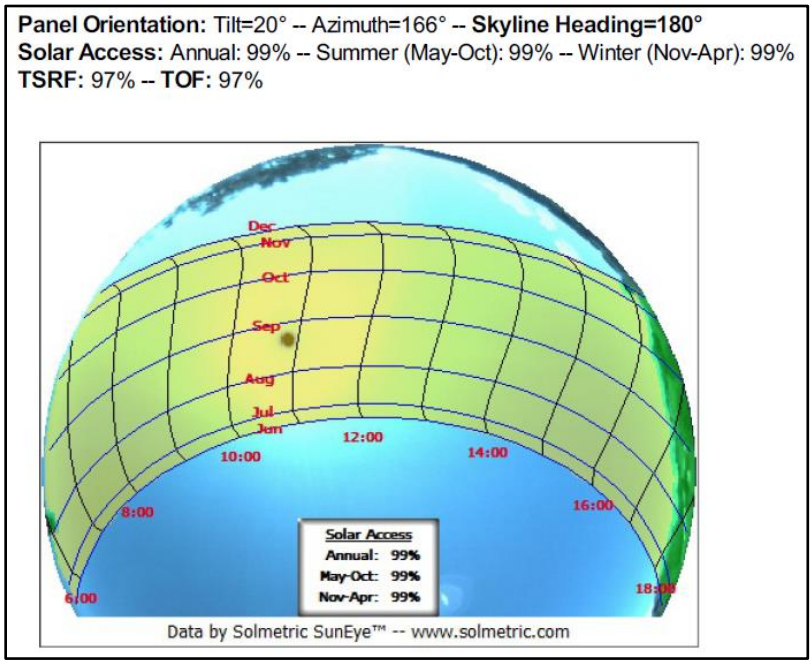
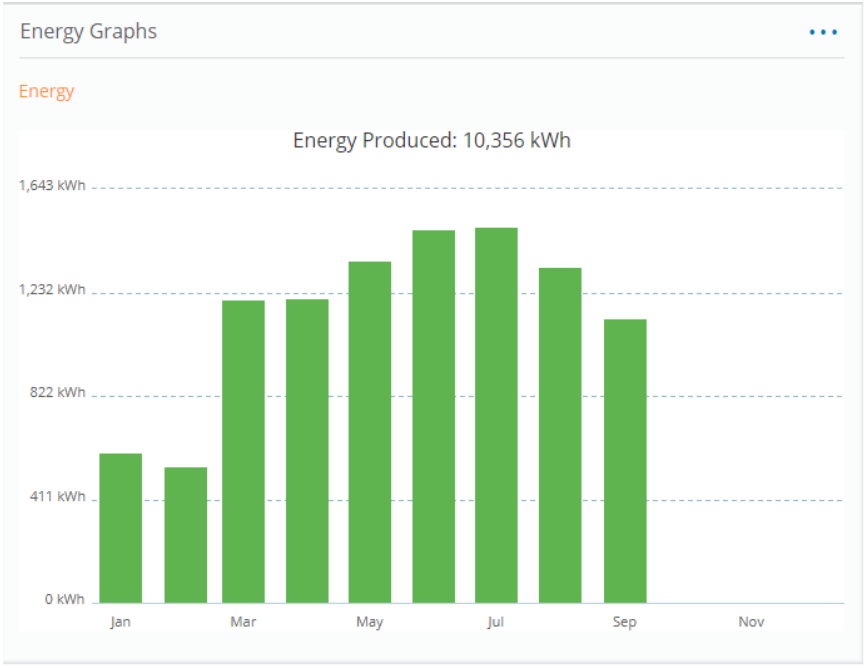


Figure 5-6 shows a screenshot of the online tool that tracks actual solar output from the system after installation. We pulled this screenshot in mid-September, which was prior to the system being in place for a full year.

Figure 5-6. Output from Online Solar Production Tool



6. Claiming Savings in the Future

A variety of factors dictate if and how the TLLs may claim savings in future program years. Decision makers must first consider how TLL staff can track data to calculate ex ante savings—that is, savings estimates prior to completing a program evaluation. Along with the project-specific data required to calculate ex ante savings (see Section 6.2), decision makers need to consider the relative uncertainty of those savings estimates, particularly given the wide range of ECMs and end-uses tool loans support. Another related issue is determining if the tool loans, or other TLL program activity, achieves direct energy or demand savings. According to California's Evaluators' Protocols, "producing savings directly means that the link between the program activity and the savings is clear, straightforward and relatively fast."[8] These considerations, among others detailed in the remainder of this section, are paramount when considering if the TLL should claim savings.

6.1 Evaluation Protocols

There are two broad types of programs offered by the California PAs, resource and non-resource programs. The CPUC's Energy Efficiency Policy Manual[9] defines resource programs as "energy efficiency programs that generate energy savings that are quantified and tracked by program administrators," while non-resource programs are those "that do not directly procure energy resources that can be counted, such as marketing, outreach and education, workforce education and training, and emerging technologies." The TLLs currently operate under the Workforce Education and Training Program, and, as such, fall within a non-resource program.

There are three crucial protocols that TLL staff and PAs would need to adhere to be able to claim savings from the TLLs. These key protocols—the measurement and verification (M&V), impact evaluation, and indirect impact evaluation protocols—are related in that the M&V protocols ensure rigorous data collection and analysis, creating a framework to meet the appropriately rigorous impact and indirect impact evaluation protocols.

The M&V protocols requires either partial or complete on-site data collection. Additionally, some projects require physical inspections to verify installation and calibration of ECMs as noted in other project documentation and program application materials. We provide a summary of the various requirements that program staff and program evaluators would need to require in Table 6-1. Meeting the basic or enhanced requirements are largely based on the type of project and ECM. For example, larger projects with multiple measures that may experience interactive effects, would likely require field assessment or on-site data collection, while other simpler projects would rely on partial field assessments or engineering desk reviews.

[8] California Energy Efficiency Evaluation Protocols, State of California Public Utilities Commission, April 2006. pg. 10.

[9] CPUC EE Policy Manual, Version 5 (July 2013)

Table 6-1. Measurement &Verification Protocols for Basic and Enhanced Rigor

Provision	Requirements for Basic Rigor	Requirements for Enhanced Rigor
Verification	Physical inspection of installation to verify correct measure installation and installation quality	Physical inspection of installation to verify correct measure installation and installation quality. Review of commissioning reports or functional performance testing to verify correct operation
IPMVP Option*	Option A	Option B or Option D
Monitoring Strategy and Duration	Spot or short-term measurements depending on measure type	Sufficient to capture all operational modes and seasons
Calibration Criteria	Not applicable	Option D building energy simulation models calibrated to monthly billing or interval demand data. Optional calibration to end-use metered data
Additional Provisions	None	Hourly building energy simulation program compliant with ASHRAE Standard 140-2001
Same for requirements for basic and enhanced rigor		
Source of Stipulated Data	DEER assumptions, program work papers, engineering references, manufacturers catalog data, on-site survey data	
Baseline Definition	Consistent with program baseline definition. May include federal or Title 20 appliance standards effective at date of equipment manufacture, Title 24 building standards in effect at time of building permit; existing equipment conditions or common replacement or design practices as defined by the program	
Weather Adjustments	Weather dependent measures: normalize to long-term average weather data as directed by the Impact Evaluation Protocol	

* IPMVP (International Performance Measurement & Verification Protocol) options refer to the acceptable methodologies for measuring and verifying energy savings from ECMs

Source: California Energy Efficiency Evaluation Protocols, State of California Public Utilities Commission, April 2006

The impact evaluation protocol describes the different methods that are acceptable for estimating program-level impacts. This protocol outlines the acceptable methods for estimating direct impacts—that is, those energy or demand savings typically resulting from a program that provides a rebate for the installation of energy efficiency measures. Within the impact evaluation protocol, the TLL would also need to meet the minimum necessary requirements for a net impact evaluation. Table 6-2 describes appropriate methodologies for an impact evaluation in California. Based on the type of project and the ECMs included, the basic level of rigor requires either a simple engineering model, or regression modeling using pre- and post-participation billing data.

Table 6-2. Impact Evaluation Protocols for Basic and Enhanced Rigor

Rigor Level	Minimum Allowable Methods for Gross Energy Evaluation
Basic	■ Simple Engineering Model (SEM) with M&V equal to IPMVP Option A and meeting all requirements in the M&V Protocol for this method. Sampling according to the Sampling and Uncertainty Protocol. ■ Normalized Annual Consumption (NAC) using pre- and post-program participation consumption from utility bills from the appropriate meters related to the measures undertaken, normalized for weather, using identified weather data to normalize for heating and/or cooling as is appropriate to measures included. Twelve (12) months pre-retrofit and twelve (12) months post-retrofit consumption data is required. Sampling must be according to the Sampling and Uncertainty Protocol.
Enhanced	■ A fully specified regression analysis of consumption information from utility bills with inclusion/adjustment for changes and background variables over the time period of analysis that could potentially be correlated with the gross energy savings being measured. Twelve (12) months post-retrofit consumption data are required. Twelve (12) months pre-retrofit consumption data are required, unless program design does not allow pre-retrofit billing data, such as in new construction. In these cases, well-matched control groups and post-retrofit consumption analysis is allowable.+ Sampling must be according to the Sampling and Uncertainty Protocol utilizing power analysis as an input to determining required sample size(s). ■ Building energy simulation models that are calibrated as described in IPMVP Option D requirements in the M&V Protocols. If appropriate, may alternatively use a process-engineering model (e.g., AirMaster+) with calibration as described in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol. ■ Retrofit Isolation engineering models as described in IPMVP Option B requirements in the M&V Protocols. Sampling according to the Sampling and Uncertainty Protocol. ■ Experimental design established within the program implementation process, designed to obtain reliable net energy savings based upon differences between energy consumption between treatment and non-treatment groups from consumption data.++ Sampling must be according to the Sampling and Uncertainty Protocol.

+ Post-retrofit only billing collapses the analysis from cross-sectional time-series to cross-sectional. Given this, even more care and examination is expected with regard to controlling for cross-sectional issues that could potentially bias the savings estimate.

++ The overall goal of the Direct Impact Protocols is to obtain reliable net energy and demand savings estimates. If the methodology directly estimates net savings at the same or better rigor than the required level of rigor, then a gross savings and participant net impact analysis is not required to be shown separately.

Source: California Energy Efficiency Evaluation Protocols, State of California Public Utilities Commission, April 2006

California's impact evaluation also specifies the minimum levels of rigor required to conduct a net impact evaluation. Meeting the basic level of rigor requires collecting primary data to calculate 300 site-level net-to-gross ratios (NTGRs), an assessment of the portion of the participating population that would have adopted

the ECMs in the absence of the program. According to the California's Evaluation Framework[10], there are a variety of acceptable survey-based or econometric-based methodologies to estimate participant NTGR. The framework allows some flexibility when selecting a specific method; though encourages evaluation staff to consider issues of potential bias, data availability, and other practical issues associated with data collection and analysis. Table 6-3 describes the different acceptable methodologies for net impact evaluations and their associated level of rigor.

Table 6-3. Minimum Acceptable Methodologies for Net Impact Evaluation

Rigor Level	Methods
Basic	■ Participant self-report.
Standard	■ Participant and non-participant analysis of utility consumption data that addresses the issue of self-selection. ■ Enhanced self-report method using other data sources relevant to the decision to install/adopt. These could include, for example, record/business policy and paper review; examination of other similar decisions; interviews with multiple actors at end-user, interviews with mid-stream and upstream market actors; Title 24 review of typically built buildings by builders and/or stocking practices. ■ Econometric or discrete choice+ with participant and non-participant comparison addressing the issue of self-selection.
Enhanced	■ "Triangulation" using more than one of the methods in the Standard Rigor Level. This must include analysis and justification for the method for deriving the triangulation estimate from the estimates obtained.

6.1.1 Indirect Impact Evaluations

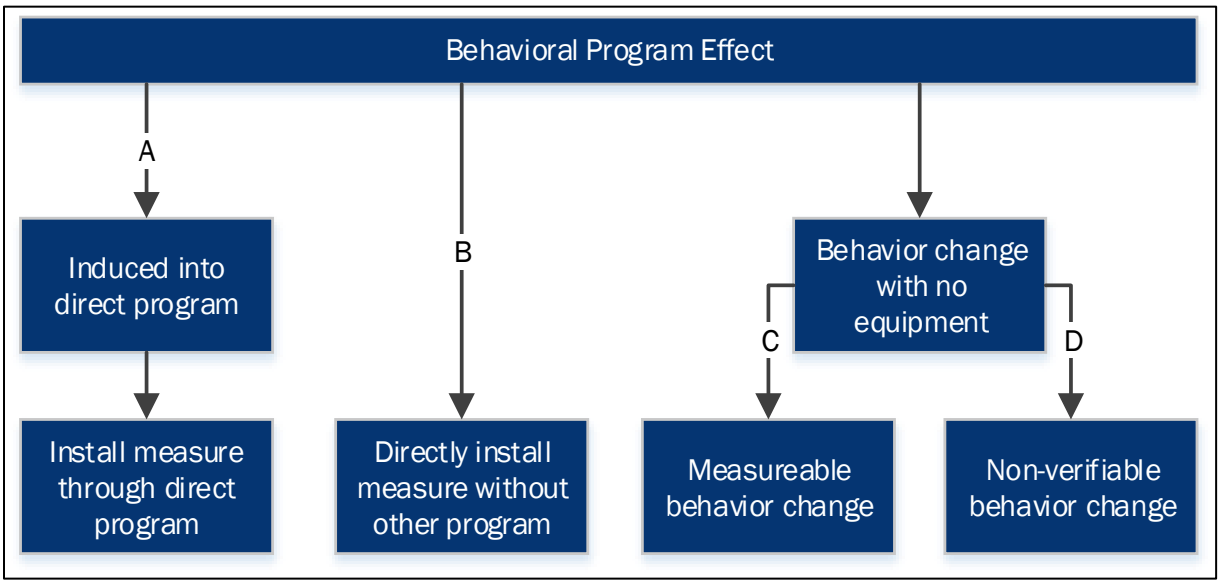
The other key protocol that decision makers should consider when determining if and how to claim savings in the future program years is the indirect evaluation protocol, which defines the standards for estimating impacts from programs designed to induce energy-saving behavior change. In contrast to direct energy savings programs, the indirect impact evaluation protocol describes acceptable practices for estimating savings typically resulting from information, education, marketing or outreach programs where the goal is to drive participants to make energy-saving changes to their behavior.

In Figure 6-1, we illustrate the different paths that projects or activities supported by the TLLs may take that lead to indirect savings. Any impact evaluation would need to eliminate projects that traveled through path A,

[10] California Evaluation Framework. TecMarket Works. June, 2004.

as those savings would be claimed by another PA program. This would require PAs and program staff to establish a clear process for tracking cross-participation at the project-level. The most feasible indirect impact evaluation would likely include a deeper survey effort that would first differentiate between projects that follow path D from those that follow paths B and C (i.e., would likely lead to indirect savings). Further, such a survey effort would require several rigorous batteries of questions designed to estimate TLL attribution—that is, if and to what degree tool loans induced the energy saving behavior (see Table 6-3). Finally, this survey effort would need to be combined with an engineering analysis, or detailed secondary data review, to determine what savings the range of different activities that TLLs support may produce. This may include site-level data collection for certain types of projects, or more in-depth secondary research to match energy savings activities with previous research that estimated those impacts.

Figure 6-1. Potential Alternative Behavioral Impact Paths



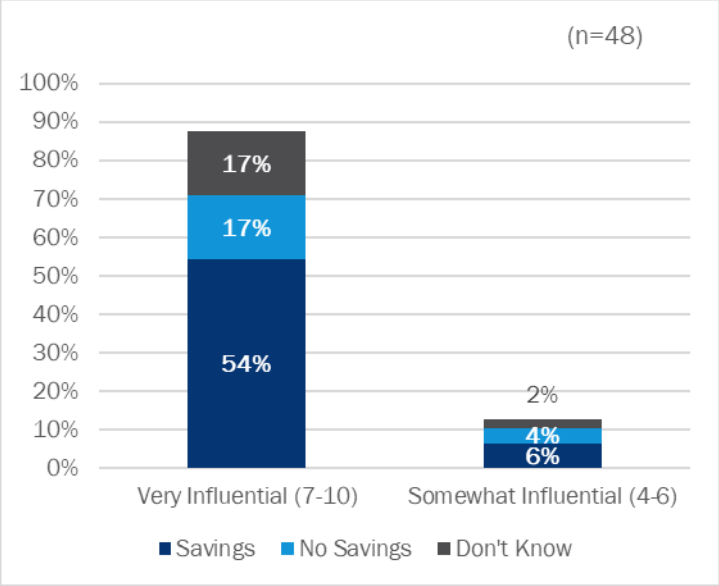
Source: California Energy Efficiency Evaluation Protocols, State of California Public Utilities Commission, April 2006

6.1.2 Evaluation Protocol Barriers

There are several factors to consider when determining if the TLL should claim savings in the future. First, there are added transaction costs associated with programs that claim energy savings. Program staff would need to track additional data for each participating site (see Section 6.2). For example, TLL staff would need to capture additional detail on each project that tool loans supported beyond an open-ended project description. One loan may support several different projects and, as such, program staff would need to track specific information about each. Also, given the wide range of ECMs and projects supported by the TLLs, the program design would likely need to mirror a custom program in terms of data collection and verifying ex ante savings estimates presented by borrowers. This would likely require additional program engineering staff to review and verify custom scopes of work, equipment specifications, and other technical data. Further, this would place added burden on tool borrowers to present additional data to TLL staff for technical review and project-level tracking.

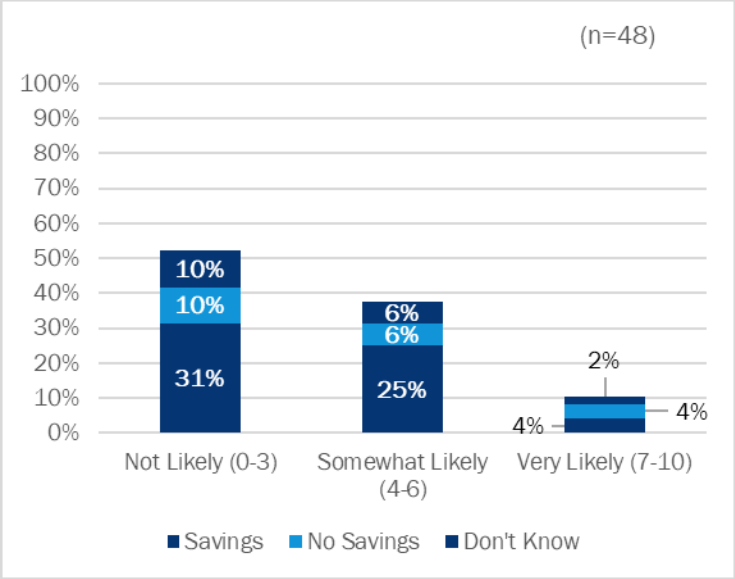
Another issue to consider is the potential for high-levels of free-ridership. As indicated in Section 4.3, 64% of borrowers used their tool to support their work and nearly half (49%) of these respondents described their company as either an ESCO or a contractor. As part of the participant survey, we asked borrowers representing projects most likely to produce direct energy savings about the TLLs influence on their overall decision to implement the project. The vast majority of borrowers (88%) said the TLL was very influential in the decision to move the project forward. Notably, no borrowers said that the TLL was "not influential," providing a rating below 4 on a scale from 0 to 10. Figure 6-2 below shows the percentage of borrowers representing projects with and without savings, and how each group rated the influence of the TLL on the decision to implement the associated project. Though borrowers do report high-levels of program influence generally, we did not tabulate these results based on an appropriately rigorous battery of survey questions designed to estimate participant free-ridership—that is, deriving an estimate of the percentage of borrowers that would have implemented their project in the absence of the TLL. Given that a large share of borrowers that represent companies whose core business involves energy efficiency and renewable energy projects, it is reasonable to believe that a large share of borrowers would gain access to diagnostic tools, and therefore implement their project, if they had not done so through the TLLs.

Figure 6-2. TLL Influence on Project Implementation



Through the participant survey, we also asked borrowers representing projects most likely to produce direct energy savings the likelihood that their project would have been implemented in the absence of their tool loan. Just over half of those borrowers (52%) said that their project was not likely to move forward without their tool loan—that is, they provided a rating of 3 or less on a 0 to 10 scale where 10 is "very likely" and 0 is "not likely at all." This also means that nearly half of these projects (48%) were either "somewhat" or "very likely" to move forward without the TLL, introducing the possibility of fairly high free-ridership. While we did not conduct an appropriately rigorous attribution analysis as part of this impact study, and there may be other indirect savings resulting from TLL-induced activities, there is certainly a risk that many of the projects and activities supported by the TLL would continue in the absence of the TLLs.

Figure 6-3. Likelihood Projects would Move Forward without TLLs



Finally, at least 29% of all 2016 borrowers received a rebate from another PA resource program. As such, the evaluation staff would need to develop an acceptable process for tracking the proportion of projects attributable to the TLL versus another resource program. There may be some precedence for such a process in other behavioral programs, such as the Strategic Energy Management (SEM) and Home Energy Report (HER) programs, that decision makers can look to for guidance on avoiding double counting savings. Further, TLL decision makers and staff would need to develop more robust project-level tracking to differentiate between the portion of projects that may actually have indirect impacts and those that would not (see Figure 6-1). As only a portion of tool loans may support projects with direct or indirect energy savings or renewable generation, decision makers would need to differentiate between these two broad types of projects and activities to effectively plan and set TLL goals.

6.2 Project-Level Data Tracking

There are a range of data fields that TLLs would need to track, were the PEC (and other TLLs) to claim savings from the TLL program. Currently TLL staff track loans, and some project details; however, these data are not sufficient for program staff to estimate ex ante impacts. To claim savings, TLLs would need to collect additional categorical details on projects (see Table 4-2)—that is, track the types of loans that support projects that have the potential to produce direct or indirect savings or renewable generation.

We developed 5 broad categories of project-level data that staff would need to collect in the event that the TLLs decide to claim energy savings. Our team based these categories on our review of California's Evaluators' Protocols, which provided a framework for which data are required to complete an appropriately rigorous evaluation. Further, we also used the information that we collected to develop both case studies to inform which types of data would be most useful, given the range of different projects and end-use retrofits the TLLs support. Our team required different types of data for each case as both represented vastly different projects

installing different types of equipment (see Section 5.2.2). For Case Study 1, which is an energy efficiency project, our team requested pre-installation equipment conditions and usage information, along with projected savings based on specifications of ECMs. For Case Study 2, a residential solar PV project, we requested information on the site layout and generation projections from different locations that the borrower considered throughout the property. We also requested system capacity specifications and obtained real-time generation information. Given the diversity of projects that tool loans support, data necessary to estimate ex ante and ex post impacts would likely not be consistent for most projects (similar to our two case studies).

To claim savings in the future, our team recommends that TLLs collect the following:

- Pre- and post-installation energy usage data;
- Pre- and post-specifications (i.e. product cut sheets);
- Detailed scope of work, including measures installed, measure locations, any engineering assumptions, or other technical details pertaining required by a typical custom program;
- Demographic characteristics (square footage, presence of air conditioning, heating fuel, etc.); and
- Other administrative documentation as needed (e.g., electric utility account number, certificate of liability insurance, engineering qualifications, etc.).

7. Findings and Recommendations

The following sections outline the key findings and recommendations for the TLL program. We outline several of the TLL's key strengths and considerations for claiming savings in the future.

7.1 Findings

- **A large share of those initiating loans through the TLLs are repeat borrowers.** Based on responses from the participant survey, half of all of those that borrowed a tool in 2016 had taken out a tool loan previously. Further, 63% of borrowers used their tool loan for their work, and roughly 85% of those borrowers work in the energy services or building science fields. These statistics not only support the high-level of energy-related knowledge that borrowers reported, but also indicate that the TLLs help support California's energy efficiency and renewable energy industries. While, in the absence of the TLLs, some of these borrowers may purchase some these required tools, the TLLs are seemingly fulfilling a need within these industries.

- **The largest share of borrowers used their tool loan to support energy measurement activities.** Forty-four percent of survey respondents said they used their tool loan for energy benchmarking, while 33% said they used their tool to support Measurement and Verification (M&V). While it is unclear if the use of tools loaned through the TLLs enabled direct energy or demand savings, it is evident that most borrowers use their tools to enable measurement of pre- and post-building conditions. Such activities are vital to any energy efficiency, demand response, or renewable energy project and may contribute to savings indirectly.

- **The TLLs play some role in moving energy efficiency, demand response, and renewable energy projects forward.** Of those projects producing direct energy savings (see Table 5-2) where borrowers said they used the tool before the project was implemented, 88% said the TLL was very influential in their decision to move the project forward. Further, 52% of those borrowers maintained that they were not likely to implement the project if they had not received their tool loan (see Figure 6-3). While this is not necessarily a reliable estimate of borrower free-ridership (which would be required to conduct an appropriately rigorous impact evaluation), it does suggest that TLL staff, and tool loans specifically, provide a valuable service to the energy efficiency and renewable energy industries in California.

- **Education and training offered through the TLLs is of high value to tool borrowers.** Eighty-three percent of borrowers reported receiving and 82% said they used the application notes providing instruction on best practices for their tool use. Additionally, over a third of borrowers reported receiving additional training, either through an energy center course or hands on training from staff. Eighty-five percent of borrowers that received application notes and 89% of borrowers that received additional training, said the information that they gleaned was very useful (providing a rating of 7 or higher on a scale from 0 to 10). Though borrowers report that application notes do not necessarily contribute to their projects energy or demand savings (see Figure 4-8), borrowers do find the training beyond application notes offered by the TLLs very useful.

- **Tool loans may contribute to project savings claimed through other PA resource programs.** While it is unclear if TLLs are helping facilitate additional participation in these programs, borrowers report that their tool loans do affect the size of rebates from other PA programs, along with their ability to obtain them. Fifty–five percent of borrowers that received a rebate from a different PA program said that, without the TLL, they likely would not have received that rebate. Further, 58% said they would not have received the same rebate amount. Measuring pre- and post-building conditions is a crucial aspect of any rebate program application and, as such, it is clear that the TLLs are fulfilling an important need in this process.

- **Tool loans support a range of project types and, as such, the types of information that TLL staff would need to estimate ex ante savings may differ for each individual project.** As discussed throughout this report, tool loans support a wide variety of projects, each of which may require a different set of data for TLL staff and evaluators to estimate program impacts. While PAs may be able to create some standard documentation (e.g., scope of work template or program applications), borrowers would still need to submit information specific to each project's scope and the activities that they carried out as a result of their tool loan. Similar to the PEC, all TLLs may need dedicated engineering or technical staff time to provide technical assistance and custom reviews for different projects and activities to maximize any direct or indirect savings potential resulting from tool loans.

- **Program Administrators would need a clear process and build out more robust project tracking infrastructure to avoid double counting savings.** Nearly half (45%) of all projects with direct energy savings participated in another PA programs. Additionally, just over half of the projects (56%) supported by 2016 tool loans realized indirect energy savings. To claim savings, decision makers would need to expand on the project-level data tracked by TLLs and likely establish a framework for

evaluating the TLLs as an indirect energy saving program. There are other examples of behavioral programs (e.g., Strategic Energy Management or Home Energy Report programs) that have successfully avoided double counting savings that decision makers can look to for guidance on developing such a framework.

7.2 Recommendations

- **The PEC should consider tracking additional categorical details at the project-level for each tool loan.** Based on our review of the program tracking database, it is clear that the PEC has a robust database that tracks information on tool borrowers, tools, loans, job classifications of borrowers, and projects. While these data are extremely valuable and PEC has a well-designed TLL database, structurally speaking, much of the project information is presently captured in open-ended variables. As open-ended descriptions of projects rely on tool borrowers to adequately explain various project details, this creates some inconsistency in terms of which specific information are tracked for any given project. Further, tracking additional data fields during the tool loan process will aid in streamlining evaluations and limited the additional survey burden on borrowers. As such, the PEC should consider tracking the following information using categorical multiple response variables:

  - **Project Types:** TLL staff should consider creating a variable that allows borrowers to select the various activities that their tool loan will support—such as, energy benchmarking, retrofit or replacement of existing equipment, measurement and verification, operations and maintenance, retrocommissioning, solar PV, and educational and training. This will enable program staff and decision makers to quickly and easily determine which tool loans supported projects likely to produce direct savings or renewable generation, and which may lead to indirect savings (see Section 5.2).

  - **End-use Equipment:** Tracking the different end-uses (e.g., lighting, space heating, hot water, or ventilation) will add more detail to the types of projects that loans support. Additionally, tracking the combination of end-uses supported by different loans may help decision makers identify trends, such as packages of measures frequently supported by tool loans. These data may help inform future educational and program offerings that could help drive deeper savings.

- **If TLL staff and decision makers choose to claim savings from the TLLs, they should take the following considerations into account.** The decision to claim savings from the TLLs in the future may have implications on the types of loans TLLs issue, administrative costs and burdens for TLL staff and borrowers, and challenges with claiming savings for a single project in multiple programs. As such, TLL staff and decision makers should consider the following:

  - **Whether to move forward with an indirect impact evaluation, which would require additional data collection from TLLs.** Close to half (44%) of all projects supported by 2016 tool loans did not realize direct savings or lead to renewable energy generation as a result of their tool loan. There may be opportunities to claim indirect savings from these, and other TLL supported activities. As such, decision makers may consider moving forward with an indirect impact evaluation combining survey data collection with secondary research to match specific TLL-induced activities and energy

savings. Any such effort would require an investment in additional data collection activities by TLL staff as expressed above.

- **Added transaction costs.** As noted above, claiming savings from TLL supported projects may require additional resources for TLLs, such as additional dedicated staff to verify application materials, review savings calculations, provide guidance on best practices, and, where necessary, perform on-site verification. Additionally, TLL staff would need to track all information from all projects and activities supported by a particular tool loan, as loans may support more than one project. This would also increase the administrative burden on tool borrowers and could even delay project implementation, in the event that program staff need to review and verify the specifics of the project.

- **Claiming savings from multiple programs.** Forty-five percent of all borrowers surveyed representing projects with direct savings received a rebate from another PA demand-side program. In the event that the TLLs claim savings, stakeholders will need to develop an appropriately rigorous set of protocols for differentiating between the savings attributable to the TLL and those induced by the other PA program. Such methods may also involve sharing savings between multiple different PAs as some tool loans support projects in a different PA's service territory. There are other examples of behavioral programs (e.g., Strategic Energy Management or Home Energy Report programs) that have successfully avoided double counting savings. Decision makers and program staff would therefore need to carefully develop a process for tracking cross-participation.

- **TLL decision makers and staff should build on education and support offered to tool borrowers.** Education and training offered by TLL staff are a central component of the services that TLLs offer. Of those that received training through their TLLs--beyond their application notes--in 2016 (n=37), 89% found the information "very useful," indicating that TLLs are very effective in this area. Further, the PEC's dedicated technical staff provide training and technical assistance on an "as needed" basis to borrowers. However, only 35% of all borrowers in 2016 received this additional training, which included energy center courses and ad hoc training from dedicated TLL staff. While providing education and training is clearly a strength of the TLLs and energy center staff, the majority of borrowers do not take advantage of these offerings beyond the applications notes and basic instructions they receive with their loan. Energy center stakeholders should consider building on existing strategies to deliver this component to a larger share of borrowers. For example, the PEC has recently created a set of printed materials referred to as Measurement Protocols that go beyond basic operating instructions and discuss best practices for maximizing savings through the types of activities that tool loans generally support. Additionally, similar to the PEC, dedicating technical staff to be available to borrowers to provide advice and technical assistance may help TLLs maximize any indirect savings resulting from tool loans.

Appendix A. Tool Lending Library Participant Survey Instrument

The remainder of this appendix provides the survey instrument that Opinion Dynamics used to complete the web survey of tool borrowers completed between June 8th and July 7th of 2017 referenced throughout the body of this report.

Sample Variables

ENERGY CENTER: *The California energy center associated with the specific tool loan in this survey sample*
PROJECT: *The name of the project associated with the tool loan, according to the energy center's database*
ADDRESS: *The project site address associated with the tool loan, according to the energy center's database*
LOAN DATE: *The date that the borrower initiated the tool loan, according to the energy center's database*
MULTI_TOOL: *This variable indicates if the loan contained only one tool, or multiple tools*

Generated Variables

PROJECT_NEW: *The most appropriate project name, according to the tool borrower and other project representatives*

Introduction Screen

Thank you for taking the time to complete this survey about the [ENERGY CENTER] tool-lending program! The information we gather through the following questions will help us learn more about borrowers like yourself, how tools are typically used, and how the [ENERGY CENTER] can keep offering useful programs.

Screener

[SKIP IF PROJECT_NAME=BLANK]

S1. Our records indicate that you borrowed [DISPLAY "tools" IF MULTI_TOOL = Y, ELSE "a tool"], in [LOAN DATE] from the [ENERGY CENTER] to support the [PROJECT NAME] project, is that correct?

1. Yes, that is correct
2. Yes, but that is not the correct project name
3. No, I did not use the tool loaned to support any project
8. Don't Know

[ASK IF PROJECT_NAME=BLANK]

S1A. Our records indicate that you borrowed [DISPLAY "tools" IF MULTI_TOOL = Y, ELSE "a tool"], in [LOAN DATE] from the [ENERGY CENTER]. Is this correct?

1. Yes, that is correct
2. No, I did not use the tool loaned to support any project
8. Don't Know

[TERMINATE IF S1 = 3,8 OR S1A = 2,8]

[ASK IF S1 = 2 OR S1A = 1]

S2. What is the correct name for this project that your loan supported? (*Please include a short project name that may include site and end-use information. For example, 83 Windsor HVAC or 267 Main St Comprehensive*) [OPEN END]

[GENERATE PROJECT_NEW = PROJECT NAME, IF S1 = 1; REPLACE PROJECT_NEW = S2, IF S1 = 2 OR S1A=1]

Although you may have used the tool for more than one project, please only think about the [PROJECT_NEW] for the remainder of the survey.

S3. How did you first learn about the Tool Lending Library?

1. I have borrowed a tool before through the [ENERGY CENTER]
2. I have borrowed a tool before through a different one of California's energy centers
3. By participating in a training/class at the [ENERGY CENTER]
4. By participating in a training/class through a different energy center
5. By visiting the [ENERGY CENTER]
6. By visiting a different Energy Center
7. By participating in a utility incentive program
8. Word of mouth
9. Internet Search
00. Other-Specify
98. Don't Know

[ASK IF S3 = 1 OR 2]

S4. Other than the tool that you borrowed from the [ENERGY CENTER] in [LOAN DATE], have you ever borrowed another tool from any of California's energy centers?

1. Yes
2. No
8. Don't know

Borrower and Project Characteristics

B1. Which of the following best describes where you used the tool(s) that you borrowed from the [ENERGY CENTER]?

1. For my work
2. For my home
3. For a course I taught
4. For a course I took
5. Tool evaluation (tool testing)
0. Other-Specify
8. Don't know

[ASK IF B1 = 1, ELSE SKIP TO T1]

B2. Which of the following best describes the type of organization you work for?

1. Energy services company (*a company that provides energy efficiency, renewable, or other energy-related facility upgrade services*)
2. Property management firm
3. California state agency
4. Contractor
5. Local government
6. Utility company
7. Electrician
8. Non-profit
0. Other-specify
98. Don't know

B3. Which of the following best describes your job title?

1. Facility/Building Operations Manager
2. Builder or developer
3. Code Official
4. Home Energy Rater Specialist (HERS)
5. Architect, Designer professional
6. Engineer
7. Project Manager/Construction Manager
8. Building Modeler
9. Contractors/Trades (carpenters, roofers, electricians, HVAC, plumbers, painters, etc.)
10. Educator
11. Property Manager
12. Account Executive/Manager
13. Analyst
14. Chief Executive/Vice President
15. Sustainability professional
16. Student
00. Other-Specify
98. Don't know

B4. What type of building did the [PROJECT_NEW] project occur in?

1. Assembly (e.g., an assembly hall or a church)
2. Primary or Secondary Education
3. University or College
4. Grocery
5. Health/Medical (e.g., a hospital or nursing home)
6. Lodging (e.g. hotel, motel)
7. Manufacturing/Industrial (e.g., Bio Tech, light industrial manufacturing)
8. Small office building (e.g. less than 25,000 square feet)
9. Large office building (e.g. greater than or equal to 25,000 square feet)
10. Restaurant
11. Retail
12. Storage
13. Refrigerated Warehouse
14. Single Family Residential

15. Multi-family Residential
16. Agricultural
00. Other—specify
98. Don't know

B5. Approximately when was the building that the [PROJECT_NEW] project occurred in built?

1. Before 1950
2. 1950-1959
3. 1960-1969
4. 1970-1979
5. 1980-1989
6. 1990-1999
7. 2000-2009
8. 2010 or later
98. Don't Know

B6. What type of fuel does the building that the [PROJECT_NEW] project occurred in use for space heating?

1. Natural gas
2. Bottled, tank or LP gas
3. Electric resistance
4. Electric heat pump
5. Oil, kerosene
6. Coal (coke)
7. Wood
8. Solar
0. Other, specify
96. No fuel
98. Don't know

B7. What type of fuel does the building that the [PROJECT_NEW] project occurred in use for water heating?

1. Natural gas
2. Bottled, tank or LP gas
3. Electric resistance
4. Electric heat pump
5. Oil, kerosene
6. Coal (coke)
7. Wood
8. Solar
0. Other, specify
96. No fuel
98. Don't know

B8. Does the building that the [PROJECT_NEW] project occurred in have central air conditioning?

1. Yes

2. No
8. Don't know

B9. What is the approximate square footage of the building that the [PROJECT_NEW] project occurred in? [NUMBERIC OPEN END] [9999998=DK]

[ASK IF B9=9999998]

B10. Would you estimate the square footage of the building to be:

1. Less than 5,000 sq. ft.
2. 5,000 to less than 20,000 sq. ft.
3. 20,000 to less than 50,000 sq. ft.
4. 50,000 to less than 100,000 sq. ft.
5. 100,000 sq. ft. or more
8. Don't know

Tool Use

T1. [IF T1 IF S4= 1, DISPLAY "Although you have borrowed other tools in the past, for", ELSE DISPLAY "For"] the rest of the questions in this survey, please **only** consider the tool loan that supported the [PROJECT_NEW] project, how you used that loan, and what you might have learned because of your experience.

T2. Was this the first time you had ever used this tool?

1. Yes, this was the first time I had used this tool.
2. No, I had used this tool before.
8. Don't know

T3. Which of the following describes **how** the loan issued by the [ENERGY CENTER] supported the [PROJECT_NEW] project? Select all that apply.

1. Building or equipment energy benchmarking
2. Retro-commissioning or building system optimization
3. Support the decision to **retrofit** existing equipment
4. Support the decision to **replace** old equipment
5. Scope a new solar PV system
6. Confirm energy savings or generation capacity from installing new equipment
7. Operations and maintenance (e.g., equipment repair, health & safety, etc.)
8. To support an energy certification course (e.g., energy auditor, building operator, commissioning)
9. For a college, university, or vocational school course
00. Other-specify
98. Don't know

[ASK IF T3 = 2, 3, 4, OR 5, ELSE SKIP TO NEXT SECTION]

T4. Did the [PROJECT_NEW] project produce measurable energy or demand savings? (*That is, installing or fine-tuning equipment to reduce a building or home's total energy consumption (kWh, therm), or energy consumption for a specific period of time (kW)*)

1. Yes
2. No
8. Don't know

[ASK IF T4 = 1, ELSE SKIP TO T6]

T5. Do you have documentation supporting those energy or demand savings?

1. Yes
2. No
8. Don't know

T6. Which of the following end-use(s) did the tool you borrowed service directly? Select all that apply.

1. Lighting
2. Building space cooling
3. Building space heating
4. Refrigeration
5. Solar PV
6. Solar water heating
7. Domestic hot water
8. Envelope
9. Motors
10. Energy management system/controls
11. Kitchen equipment
12. Plug load
00. Other-specify
98. Don't know

[ASK IF T3 = 2, 3, 4, OR 5]

T7. Which of the following best describes **when** in the [PROJECT_NEW] project's life cycle you first used the loan issued by the [ENERGY CENTER]?

1. I used the loan **before** the project's implementation
2. I used the loan to help **during** the project's implementation
3. I used the loan **after** the project's implementation
8. Don't know

[ASK IF T7 <> 1]

T8. Did you use a different loan from the [ENERGY CENTER] to support the [PROJECT_NEW] project **before** the project's implementation?

1. Yes
2. No

[ASK IF T7 = 1 OR T8 = 1, ELSE SKIP TO NEXT SECTION]

T9. How influential was your tool loan overall on the decision to implement the [PROJECT_NEW] project? [NUMERIC SCALE 0 -10 WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

T10. What is the likelihood that the [PROJECT_NEW] project would have been implemented if you had **not** received a tool loan from the [ENERGY CENTER]? [NUMERIC SCALE 0 -10 WHERE 0 = "not likely at all" AND 10 = "extremely likely"]

[ASK IF T4 = 1, OR T6 = 5]

T11. What is the likelihood the [PROJECT_NEW] project would have [IF T6 = 5, DISPLAY "the generated energy at the same capacity", ELSE DISPLAY "the same level of energy and/or demand savings"] if you had **not** received a tool loan from the [ENERGY CENTER]? [NUMERIC SCALE 0 -10 WHERE 0 = "not likely at all" AND 10 = "extremely likely"]

Application Notes and Training

A1. Please rate your knowledge of the following **before** you received your tool loan through the [ENERGY CENTER]. [NUMERIC SCALE 0 -10 WHERE 0 = "not knowledgeable at all" AND 10 = "extremely knowledgeable"] [Grid question] [ROTATE]

a. Energy efficiency
b. Demand response
c. Renewable energy

A2. When you received your loan from the [ENERGY CENTER], do you recall receiving application notes that described how to use the tool[s]? (NOTE: *These are user-guides, manuals, or other instructions provided by the [ENERGY CENTER] at the time of the loan that described the basics of how to use the tool, or tools, that borrowers receive.*)

1. Yes
2. No
8. Don't know

[ASK IF A2 = 1]

A3. Did you utilize the application notes you received with your tool loan?

1. Yes
2. No
8. Don't know

[ASK IF A3 = 1, ELSE SKIP TO A7]

A4. Was the information in the application notes that you received with your tool loan new to you?

1. Yes
2. No
8. Don't know

A5. How useful was the information in the application notes in helping you use your tool loan to implement the [PROJECT_NEW] project? [NUMERIC SCALE 0 -10 WHERE 0 = "not useful at all" AND 10 = "extremely useful"]

[ASK IF T4 = 1]

A6. If you had **not** referenced the application notes you received with your tool loan, what is the likelihood that the [PROJECT_NEW] project would have produced the same level of… [NUMERIC SCALE 0 -10 WHERE 0 = "not likely at all" AND 10 = "extremely likely"] [ROTATE]

a. Energy savings
b. Demand savings

A7. Did you receive any training from the [ENERGY CENTER] staff?

1. Yes
2. No
8. Don't know

[ASK IF A7 = 1, ELSE SKIP TO A12]

A8. What type of training did you receive from the [ENERGY CENTER] staff? Select all that apply.

1. A course at the [ENERGY CENTER]
2. Ad hoc training from [ENERGY CENTER] staff
0. Other-specify
8. Don't know

A9. Was the information during the training you received from the [ENERGY CENTER] new to you?

1. Yes
2. No
8. Don't know

A10. How useful was the training you received on the decisions you made while implementing the [PROJECT_NEW] project? [NUMERIC SCALE 0 -10 WHERE 0 = "not useful at all" AND 10 = "extremely useful"]

[ASK IF T4=1]

A11. If you had **not** received training from the [ENERGY CENTER] staff, what is the likelihood that the [PROJECT_NEW] project would have produced the same level of… [NUMERIC SCALE 0 -10 WHERE 0 = "not likely at all" AND 10 = "extremely likely"] [ROTATE]

a. Energy savings
b. Demand savings

A12. Please rate your knowledge of the following **after** you received your tool loan through the[ENERGY CENTER]. [NUMERIC SCALE 0 -10 WHERE 0 = "not knowledgeable at all" AND 10 = "extremely knowledgeable"] [ROTATE]

a. Energy efficiency
b. Demand response
c. Renewable energy

Behavior Change

C1. Since participating in the tool-lending program through the [ENERGY CENTER], have you…(1 = YES, 2 = NO) [SHOW IN GRID][ROTATE]

A. [IF B1 = 1] identified additional energy or demand saving opportunities in the buildings you serve more easily
B. [IF B3 = 3] Paid more attention to your facilities' operations to optimize building performance (e.g., controls, scheduling, etc.)
C. Turned off lights more frequently where you work
D. Adjusted the temperature set point on your HVAC system at work to save on energy
E. Purchased additional energy saving equipment for your workplace
F. Turned off lights more frequently when you are home
G. Adjusted the set point temperature on your HVAC system at home to save on energy
H. Purchased additional energy saving equipment for your home

[ASK IF C1A = 1]

C2A. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your ability to identify additional energy or demand savings opportunities in the buildings you serve? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1B = 1]

C2B. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to optimize building performance? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1C = 1]

C2C. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to turn off lights more frequently where you work? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1D = 1]

C2D. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to adjust the temperature set point on your HVAC system at work to save on energy? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1E = 5]

C2E. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to purchase additional energy-saving equipment for your workplace? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1F = 5]

C2F. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to turn off lights more frequently where you live? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1G = 6]

C2G. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to adjust the temperature set point on your HVAC system at home to save on energy? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

[ASK IF C1H = 6]

C2H. How influential was your participation in the [ENERGY CENTER]'s tool-lending program on your decision to purchase additional energy-saving equipment for your home? [0-10 SCALE WHERE 0 = "not influential at all" AND 10 = "extremely influential"]

External Funding Sources

E1. Did the [PROJECT_NEW] project receive an incentive from a utility company?

1. Yes
2. No
8. Don't know

[ASK IF E1 = 1, ELSE SKIP TO E5]

E2. Which utility company provided the incentive for the [PROJECT_NEW] project?

1. Pacific Gas & Electric—PG&E
2. Southern California Edison–SCE
3. San Diego Gas & Electric—SDG&E
4. Southern California Gas—SoCalGas
5. Sacramento Municipal Utility District—SMUD
0. Other—specify
8. Don't know

For the next two questions, please rate the likelihood of the following. What is the likelihood that…[NUMERIC SCALE 0 -10 WHERE 0 = "not likely at all" AND 10 = "extremely likely"]

E3. The [PROJECT_NEW] project would have received an incentive if you had **not** borrowed "the tool(s) from the [ENERGY CENTER]?

E4. The [PROJECT_NEW] project would have received **the same amount** of incentives if you had **not** borrowed the tool(s) from the [ENERGY CENTER]?

E5. Did the [PROJECT_NEW] project receive other external funding sources? (*For example, grants or other funding from local, state, or federal government agencies*)

1. Yes
2. No
8. Don't know

[ASKI IF E5 = 1]

E6. What other external funding did the project receive?

1. Funding from local government
2. Funding from state government

3. Funding from federal government
4. Non-government grant
0. Other-specify
8. Don't know

[ASK IF E1 = 2]

E7. Which of the following best describes why the [PROJECT_NEW] project did not receive a utility incentive?

1. The utility offered incentive programs, but the project did not qualify.
2. The utility did not offer any incentive program.
3. I was unaware of a utility program that offered an incentive.
4. The incentive process would have taken too long.
5. Never crossed my mind to look into incentives.
0. Other-specify
8. Don't know

Demographics

The following questions are for analytical purposes only and will greatly help us determine how well the Energy Centers are addressing California's training and educational needs.

[ASK IF B1 = 2, ELSE SKIP TO 9]

D1. Do you rent or own your residence

1. Rent
2. Own
9. Prefer not to respond

D2. Which of the following best describes your home/residence?

1. Single-family home, detached construction (Not a duplex, townhome, or apartment; attached garage is OK)
2. Single family home, factory manufactured/modular
3. Single family, mobile home
4. Row house
5. Two or Three family attached residence
6. Apartment (4 + families)
7. Condominium
0. Other, specify
9. Prefer not to respond

D3. Approximately when was your residence first built?

1. Before 1950
2. 1950-1959
3. 1960-1969
4. 1970-1979

5. 1980-1989
6. 1990-1999
7. 2000-2009
8. 2010 or later
9. Prefer not to respond

D4. What type of fuel do you use primarily to heat your home?

1. Natural gas
2. Bottled, tank or LP gas
3. Electric
4. Oil, kerosene
5. Coal (coke))
6. Wood
7. Solar
00. Other, specify
96. No fuel
98. Don't know
99. Prefer not to respond

D5. What type of fuel do you use primarily to heat water in your home?

1. Natural gas
2. Bottled, tank or LP gas
3. Electric
4. Oil, kerosene
5. Coal (coke)
6. Wood
7. Solar
0. Other, specify
96. No fuel
98. Don't know
99. Prefer not to respond

D6. Do you have central air conditioning in your home?

1. Yes
2. No
8. Don't know
9. Prefer not to respond

D7. What is the approximate square footage of your home? [NUMERIC OPEN END, 999998=DK]

D8. Would you estimate the square footage of your residence to be:

1. Less than 1,000 sq. ft. or less
2. 1,000 to less than 2,000 sq. ft.
3. 2,000 to less than 3,000 sq. ft.
4. 3,000 to less than 4,000 sq. ft.
5. 4,000 to less than 5,000 sq. ft.
6. 5,000 sq. ft. or more

D9. What is the highest level of education you have completed?

1. No schooling
2. Less than high school
3. Some high school
4. High school graduate or equivalent (e.g., GED)
5. Trade or technical school
6. Some college
7. 2 year College degree
8. 4 year College degree
9. Some graduate school
10. Graduate degree (Masters or Ph.D.)
00. Other (SPECIFY)
99. Prefer not to respond

D10. What is your current employment status?

1. Employed full-time (at one full-time job, or multiple part-time jobs)
2. Employed part-time (by choice)
3. Under-employed (working below your skill level or working fewer hours than you want or need)
4. Not employed at this time
00. Other, specify
99. Prefer not to respond

[ASK IF B1=1; SKIP IF D10=4]

D11. Approximately, how many people are employed at your company? If your company has locations outside of California, please limit your answer to just the number of people employed in the State of California. [OPEN END NUMERIC, DON'T KNOW]

Closing Section

P1. Thank you for taking the time to complete this survey!

[ASK IF T5 = 1 AND ENERGY CENTER=PEC]

P2. Would you be willing to discuss the [PROJECT_NEW] project with us in more detail?

1. Yes
2. No

CLOSING. Thank you for this information! [READ IF P2=1 You may receive an email within the next few weeks.] Please click the submit button below to submit your responses.

Appendix B. Case Study Project Selection

Table 7-1 below describes some additional detail for each of the projects identified for case study selection (see Section 5.2 for selection criteria). For each, we provide verbatim project descriptions from the PEC program tracking data, the building type, what the tool was used to support, and the measures that were included in the project. Additionally, we provide ratings to three of the scale questions asked through the participant survey about the influence of the TLL on their decision to implement the project, the likelihood they would have completed the project without the TLL, and the likelihood that the project would have achieved the same level of savings without the TLL. The first two projects (highlighted in light blue) are those used for the case studies described in Section 5.2.2. Projects 3 through 5 (not highlighted) all received rebates from other PA programs.

Table 7-1. Projects for Case Study Selection

Project No.	Project Description (PEC Database)	Building Type	Tool Use	Measures	Scale Questions (0-10)		
					Overall Influence	Complete without TLL	Same Savings
1	We have two separate structures on our three-acre property plus some large slopes that face the south. We want to determine the best roof surface or ground mount location to maximize solar panel output.	Single Family Residential	Solar PV	Solar PV	8	4	5
2	We are doing an energy efficiency study at a large central plant servicing four buildings. To best do this we require robust flow measurements to understand the heating/cooling load of the buildings. This requires an ultrasonic flow meter.	Large office	Benchmarking, RCx, O&M	Space cooling, Space heating	9	5	7
3	Solar site survey	Single Family Residential	Solar PV, Confirm savings	Solar PV	10	3	0
4	Establish the baseline of machines to be included in and energy efficiency incentive application	Industrial	Equipment Replacement	Lighting	7	5	7

Project No.	Project Description (PEC Database)	Building Type	Tool Use	Measures	Scale Questions (0-10)		
					Overall Influence	Complete without TLL	Same Savings
5	SImplivity Hyper-Converged solutions for IT equipment. Sierra College at Rocklin wants to replace their IT equipment with simplivity Box. Simplivity is proposing to provide better data computation and storage with less power consumption. This Pre M&V will compromise of power monitoring of UPS (output) and CRAC (input) power, along with the temperatures across the DX coil.	Higher Education	Benchmarking, RCx, Retrofit, Equipment Replacement, Confirm savings	Space heating, DHW, Motors	10	5	2

For more information, please contact:

Dr. Ellen Steiner
Vice President

(720) 262-5857 tel

esteiner@opiondynamics.com

1999 Harrison Street, Suite 1420
Oakland, CA 94612

Boston | Headquarters

617 492 1400 tel
617 497 7944 fax
800 966 1254 toll free

1000 Winter St
Waltham, MA 02451

San Francisco Bay

510 444 5050 tel
510 444 5222 fax

1 Kaiser Plaza, Suite 445
Oakland, CA 94612