

Accelerating Market Transformation with Energy Program Data Visualizations

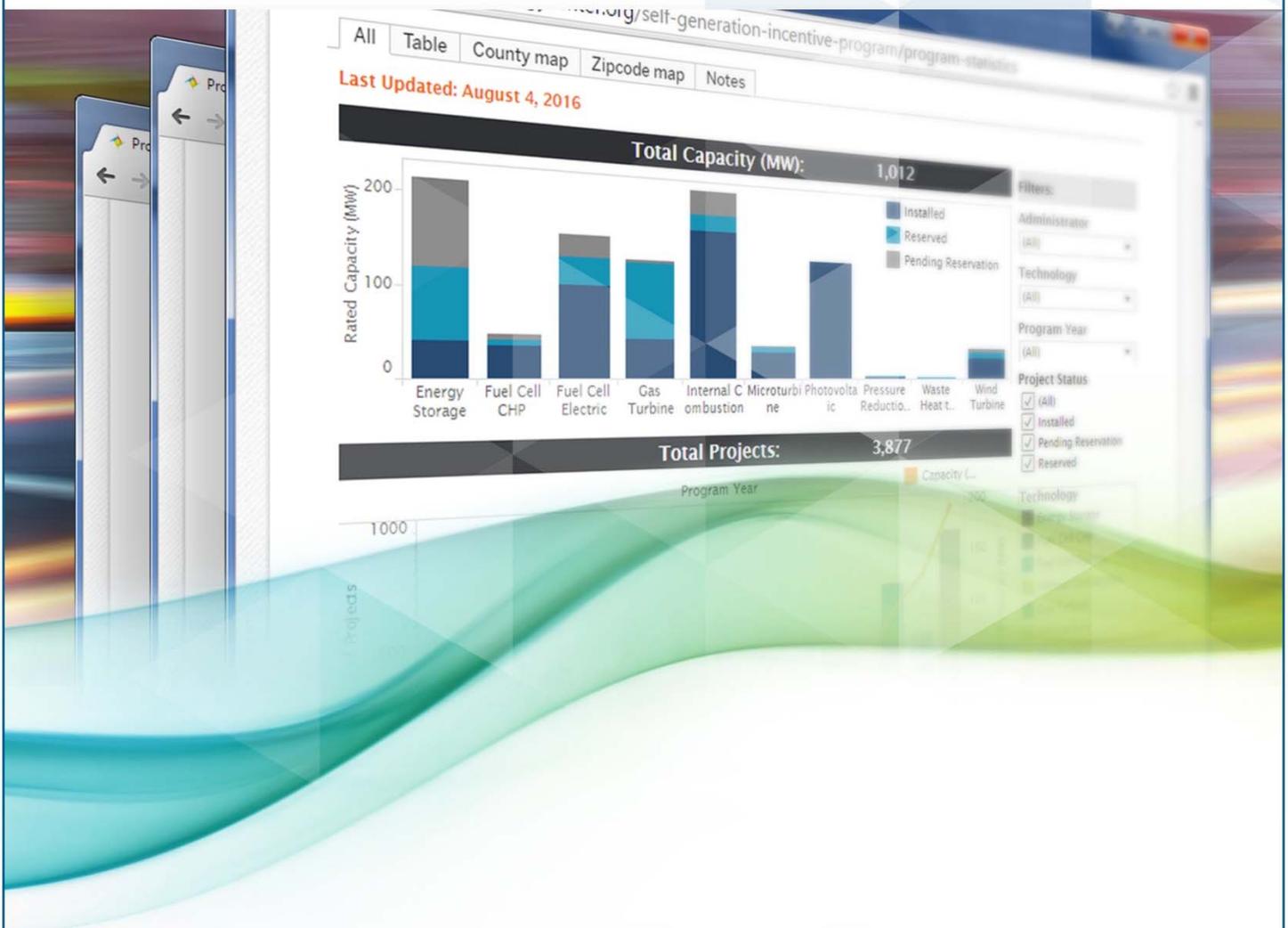
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ABSTRACT

A decade ago, energy program implementers would reference spreadsheets of raw data to evaluate program impacts and refine their design. External stakeholders would wait months or years to read a published report. Today, data visualization tools such as online, public-facing dashboards are providing near real-time data access and transparency for all market actors. These advanced interactive dashboards provide more than just a static display of aggregated numbers; they allow users to compare variables across time and geography, thereby enabling the user to form connections between variables and with other differentials. As such, interactive dashboards serve as new and evolving intermediary information tools – bridging the gaps between raw data and full reports. This paper analyzes how the use of interactive web-based dashboards can inform program evaluation and market transformation efforts for sustainable energy technologies. The paper will present insights into the impacts of dashboards based on stakeholder interviews, Google Analytics and perspectives from the administrators of four program dashboards.

Introduction

Sustainable energy programs, typically funded by utility ratepayers, taxpayers or cap-and-trade revenues to incentivize adoption of energy efficiency retrofits or emerging technologies, are subject to reporting requirements for evaluation, measurement and verification (EM&V) purposes. Historically, funding agencies evaluate the results of their investments and provide program transparency via periodic impact reports from program administrators and a final EM&V report published a year or more after the program ending. These reports provide a valuable retrospective, but do not offer program administrators the opportunity to refine program design and operations in rapidly evolving markets (Rosenberg and Hoefgen 2009). Furthermore, if funding agencies are interested in understanding more specific aspects of the program – for example, *How many incentive dollars have been applied to projects in a particular community?* or *In what year did the market start to adopt a particular emerging technology?* – either the agency or the program administrator must dedicate staff time to analyzing raw data in spreadsheets to find the answers.

External stakeholders often have limited access to this information, with the exception of those motivated and resourceful enough to read the public EM&V report or data posted in spreadsheet format. Those stakeholders who can afford to do so may spend thousands of dollars purchasing data from private sources and/or use dozens of staff hours manipulating spreadsheets to identify trends and actionable information.

While public data and information are useful for all sustainable energy programs, they may be particularly important for those with the goal of *market transformation* – described in the California Energy Efficiency Strategic Plan as long-lasting changes in the structure or functioning of a market to the point where further publicly funded intervention is no longer

appropriate. Market actors – including manufacturers, installers/developers, consultants, consumers, policymakers and others – are not likely to make long-lasting changes to their way of doing business without access to market intelligence. These stakeholders are all interconnected and make decisions based on the best available information on supply, demand, competitor activity and available incentives, among other factors. Whether that information is current or stale, filtered in useful ways or not, can significantly impact the quality and speed of these decisions.

A typical energy efficiency technology market scenario is described in a paper by Welker and Orsini (2010): Distributors make inventory decisions based on the assessed demand from contractors; manufacturers similarly make production decisions based on demand from suppliers and contractors; contractors target sales to market segments with awareness of a technology. Each of these market actors must observe reliable changes in the others' actions to make long-lasting changes to their own business models, as opposed to short-term adaptations to take advantage of the latest rebate or incentive. The more an individual business learns of increased demand, improved supply or other positive market forces, the more likely it is to change its own operations – in turn nudging others to adjust to these advancements. Thus, by making timely intelligence accessible to the entire spectrum of market actors, program administrators can spur a positive feedback loop extending well beyond the confines of the program and transform a market.

In recent years, the emergence of data visualization software packages that can be used by administrators without computer programming expertise has allowed several programs to offer freely accessible, interactive, near real-time dashboards. These dashboards provide more than just a static display of aggregated numbers; they allow users to compare variables across time and space, thereby enabling the user to form connections between market factors and with other differentials (Aberdeen Group 2014). Some focus on statistics such as projects completed and incentives issued; others include survey data that reveal program participant motivations and demographics. As such, interactive dashboards serve as new and evolving intermediary information tools – bridging the gaps between raw data and full reports. And yet, while the potential of interactive dashboards has been discussed for decision-making in the sustainability field (e.g., Reul and Michaels 2012), there are no accounts to date that describe how and by whom these dashboards are used.

This paper seeks to inform program evaluation and market transformation efforts by investigating how stakeholders use interactive data visualizations to inform their decision-making using the examples of four sustainable energy programs. The report is divided into two sections. The first gives an overview of the interactive program dashboards and insights into their development process. The second will present user statistics and findings from interviews that were conducted with stakeholders that use the interactive dashboards.

Overview of Programs and Interactive Dashboards

In this study, we investigate the use of interactive dashboards associated with four sustainable energy and transportation programs administered by the Center for Sustainable Energy (CSE). Table 1 provides an overview of programs and dashboards discussed in this report.

Self-Generation Incentive Program (SGIP)

SGIP is a ratepayer-funded rebate program for the installation of clean and efficient distributed generation and energy storage technologies. SGIP is overseen by the California Public Utilities Commission (CPUC) and available to retail electric and gas customers of the four California investor-owned utilities (IOUs). CSE administers the program in San Diego Gas & Electric territory. The program currently incentivizes wind, waste energy recovery, pressure reduction turbines, fuel cells, advanced energy storage and combined heat and power technologies. The CPUC mandated the program to make data publicly available in a database format and directed the administrators to work with a third-party data administrator to manage and report the data. A spreadsheet of public data can be downloaded on each of the program administrators' websites and the CPUC website as well as on a separate application portal. In 2014, CSE developed an interactive data visualization that allows users to track capacity, number of projects and incentive amounts over time and geographies while enabling the user to filter by administrator, technology, program year and program status. The views can be shared and the dashboard downloaded for additional data handling.

California Solar Initiative (CSI)

CSI is a rate-payer funded solar rebate program¹ for customers in California's three major electric IOU territories. At its onset, the CPUC required the program to make data publicly available in database format and directed the administrators to work with a third-party data administrator to manage and report the data. This evolved into the California Solar Statistics (CSS) website, which contained a first-of-its-kind effort to report program data to the public using an interactive data visualization format. CSS offers downloadable spreadsheets, a variety of interactive data visualizations displaying rebate information and a tool to find contractors within a specified radius using CSI-reported contractor information. The user can view rebate data in various aggregations and filters such as capacity, costs and geography (Figure 1). The CSS site is currently transitioning from reporting weekly CSI program data to providing monthly IOU-reported data on all interconnection of residential and commercial solar PV systems with up to 1 MW capacity in California.

Clean Vehicle Rebate Project (CVRP)

California's CVRP provides financial incentives and outreach to spur the adoption of zero-emission vehicles. CSE administers the CVRP statewide for the California Air Resources Board (ARB). The program is funded by vehicle registration fees and cap-and-trade auction proceeds through the Low Carbon Transportation Investments of the Greenhouse Gas Reduction Fund. The CVRP was not required to publish its rebate statistics when it first launched in 2010. However, several public-facing products were developed, including yearly reports and infographics depicting the results of a longitudinal survey study of rebate recipients. The program developed three dashboards, two of which display rebate data. The rebate statistics are displayed both in a map format and in chart format; the latter has extensive filtering options allowing the user to view data by vehicle make and model as well as legislative districts and by

¹ The program is no longer issuing rebates for most of its program components.

disadvantaged community status.² The third dashboard displays results of the longitudinal EV rebate recipient survey (Figure 2).

Massachusetts Offers Rebates for Electric Vehicles (MOR-EV)

MOR-EV provides financial incentives to spur the adoption of zero-emission vehicles in Massachusetts. It is overseen by the Executive Office of Energy and Environmental Affairs' Department of Energy Resources (DOER), administered statewide by CSE and funded by Regional Greenhouse Gas Initiative (RGGI) cap-and-trade revenue. Shortly after the program began, CSE published a dashboard showing EV rebate statistics, including retailer and manufacturer data across time and space (Figure 3). In contrast to the other programs discussed here, the MOR-EV website does not provide an export of the raw program data.

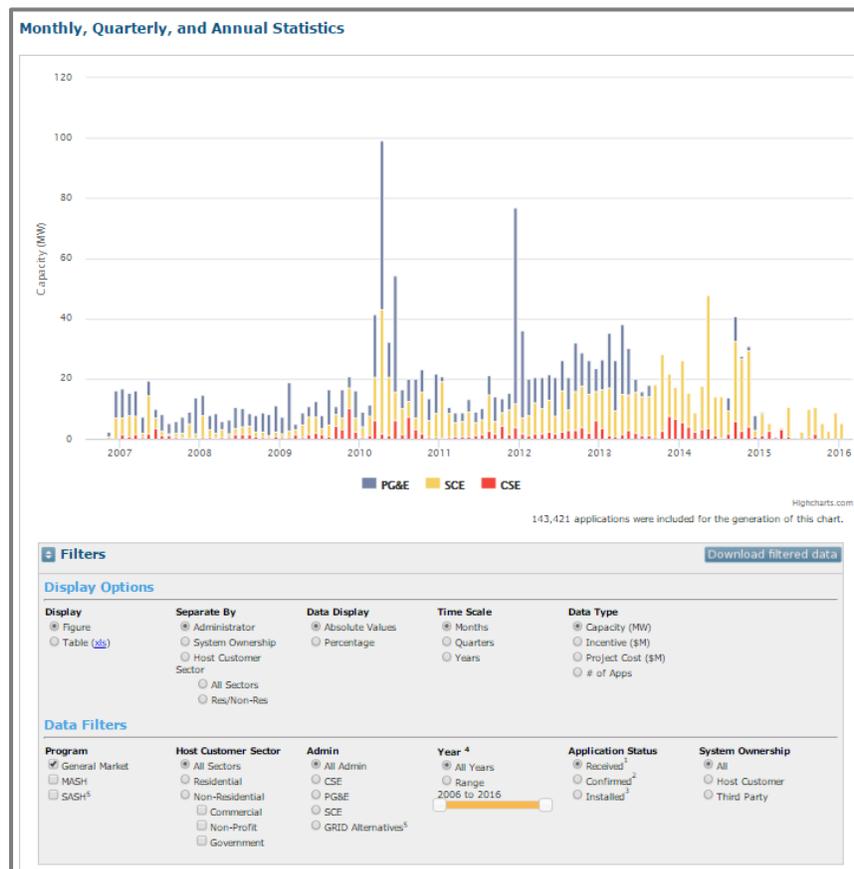


Figure 1. California Solar Statistics. Monthly, Quarterly and Annual Statistics. This figure shows the trend for applications and capacity (MW) by month, quarter or year that have either been received or installed over the course of the CSI Program. The figure can be further refined to display information by program administrator, host customer sector or system owner. Using the table view will display totals for each data type. *Source:* https://www.californiasolarstatistics.ca.gov/reports/monthly_stats/. Accessed on Jan. 27, 2016.

² Disadvantaged communities in California are specifically targeted for investment of proceeds from California's cap-and-trade program. They are determined through a tool (CalEnviroScreen) that assesses all census tracts in California to identify the areas disproportionately burdened by and vulnerable to multiple sources of pollution.

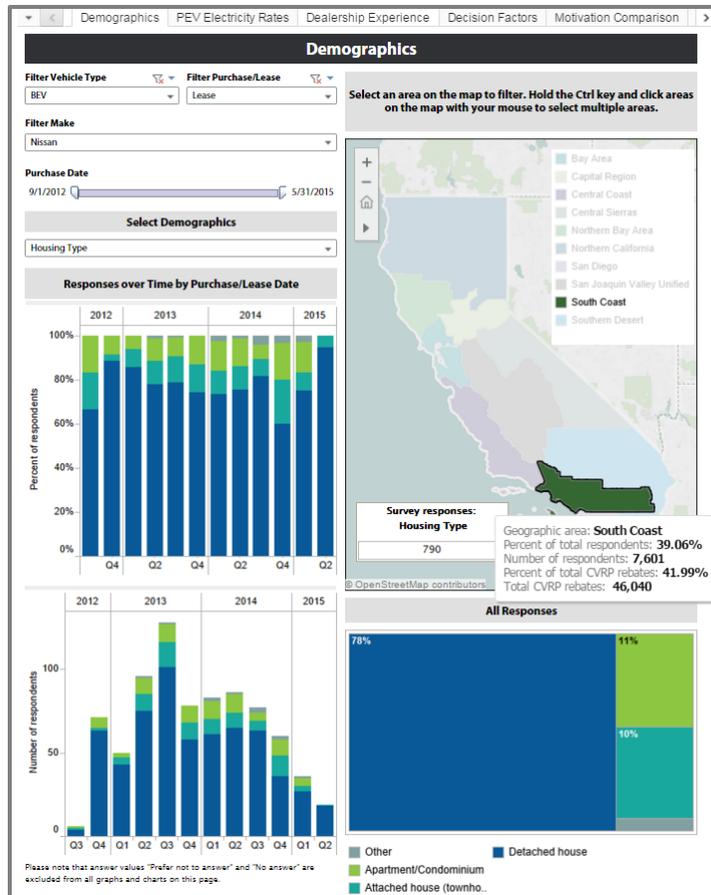


Figure 2. CVRP Consumer Survey Dashboard. Demographics Tab. The voluntary Electric Vehicle (EV) Consumer Survey gathers data from CVRP rebate recipients, providing information on a variety of demographic and behavioral topics. The user can explore various market factors on different tabs of the dashboard (demographics, dealer experience, motivations to purchase, decision-making process, etc.) and sort the data by fields such as vehicle type and location. Source: <https://cleanvehiclerebate.org/eng/survey-dashboard>. Accessed February 29, 2016.

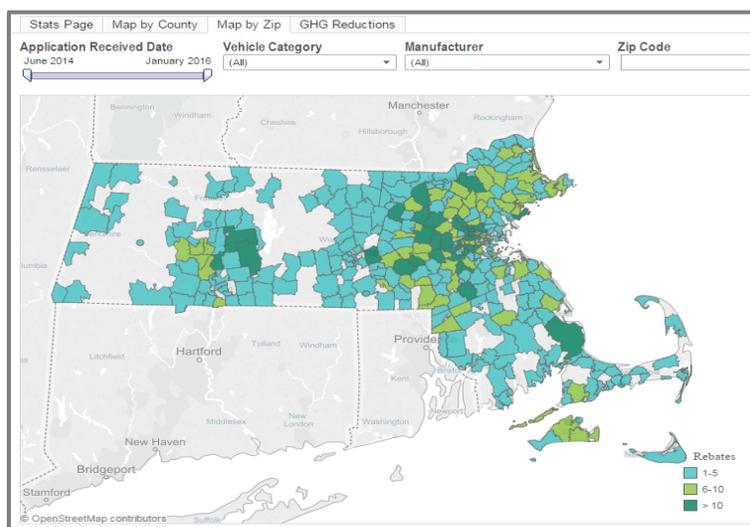


Figure 3. MOR-EV Program Statistics. Rebates represented by ZIP code. Source: <https://mor-ev.org/program-statistics>. Accessed February 29, 2016.

Insights from Program Administrators

Managers of the four programs completed questionnaires that shed light on the decisions and processes involved in developing their dashboards.

Intended Audience

All program managers indicated that the dashboards were designed for use by a variety of stakeholders. Policymakers, regulators, program administrators, advocacy groups and industry actors (such as contractors, developers, manufacturers and industry associations) were mentioned by all teams. In addition, the CSI, CVRP and MOR-EV program managers added that the targeted audience includes researchers, consumers and media stakeholders.

Table 1. Overview of programs and dashboards discussed in this report.

| Program and URL | Geo- graphy | Program launch | Dashboard launch | Format * | Update frequency | Raw data available for download |
|---|--------------------|-------------------|--|-------------|---|--|
| Self-Generation Incentive Program (SGIP) www.energycenter.org/programs/self-generation-incentive-program/program-statistics | CA IOU territories | 2001 | 2014 | 2 | Monthly (dashboard); weekly (raw data) | Yes |
| California Solar Initiative (CSI) www.californiasolarstatistcs.ca.gov | CA IOU territories | 2007 | 2010 | 1 | Weekly | Yes |
| Clean Vehicle Rebate Project (CVRP) https://cleanvehiclerebate.org/eng/rebate-statistics https://cleanvehiclerebate.org/eng/cvrp-rebate-map https://cleanvehiclerebate.org/eng/survey-dashboard | CA | 2010 | 2012 (rebate statistics and map); 2013 (consumer survey data) | 2 | Semi-monthly (rebate statistics); Monthly (survey, when it was active) | Yes |
| Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) https://mor-ev.org/program-statistics | MA | 2014 | 2014 | 2 | Biweekly | No |
| *Format key: 1=The website contains different data visualizations that were created with a charting framework written in JavaScript. The data visualizations are located on different web pages that the user can navigate to from a menu on the main page. 2= An enterprise dashboard application with a user interface was used to build the dashboards. For each dashboard, all data visualizations are contained within a single frame. | | | | | | |

Information Displayed

Each dashboard contains several charts and tables displaying basic program metrics such as megawatts installed, the number of projects or vehicles incentivized and the number and amount of incentives paid and reserved by region/territory and technology type. In addition, the CVRP, MOR-EV and SGIP managers integrated geographic displays to allow users to view technology adoption across space and time. This decision was partly influenced by the availability of mapping tools in the data visualization software utilized. One of the program managers

highlighted the importance of program administration transparency: “Ideally, we’ll make as much data publicly available as we can without jeopardizing the privacy of the program’s participants.” To ensure individual rebate recipients cannot be identified, data for geographic displays are aggregated to census tract or larger geographic units.

Once launched, the dashboards underwent changes based on conversations with stakeholders and the respective funding agencies. For example, based on feedback from environmental justice groups, CVRP implemented a filter to allow users to identify rebate activity in disadvantaged communities. Other groups requested higher geospatial resolution and the addition of a temporal dimension. In some cases, these features were added.

Internal Use of Dashboards

The program managers reported that their internal teams frequently use the dashboards to evaluate and report progress toward program goals, often on a weekly or even more frequent basis. They also use the dashboard to answer inquiries from stakeholders, support public comments on policy reform and inform the development of related programs in new markets.

Dashboard Usage Behavior

Google Analytics Findings: Magnitude of Use

We analyzed the magnitude of dashboard use through Google Analytics website statistics, using unique page views³ as a proxy for dashboard usage. As evident from Figure 4, each dashboard quickly gained popularity after its inception. The magnitude of user sessions differs among dashboards; most notably, the use of the SGIP dashboard is much lower compared to the other programs. This may be due to the frequency of dashboard updates (monthly for SGIP) and the type of customers participating in the incentive program. SGIP provides large incentives for technologies deployed primarily in commercial and industrial applications; other programs provide incentives to individual residents or car buyers. It is likely that programs providing incentives to individual residents have larger dashboard audiences as the pool of incentive recipients is considerably larger. Clearly, outreach efforts increase the usage of dashboards. Spikes in usage of the CVRP statistics dashboard are likely influenced by media coverage of the program with reference to the dashboard, announcements and press releases from state agencies and webinars about the dashboard.

³ *Unique Page Views* reports unique user sessions per page, with each session potentially representing multiple views of the page but a minimum of one view per session. In contrast, *Page Views* is a single viewing of a web page. Each time a user enters the page during a session counts as a page view. The average user session exceeds 2.5 minutes for all dashboard websites, which indicates a significant user engagement with the information presented.

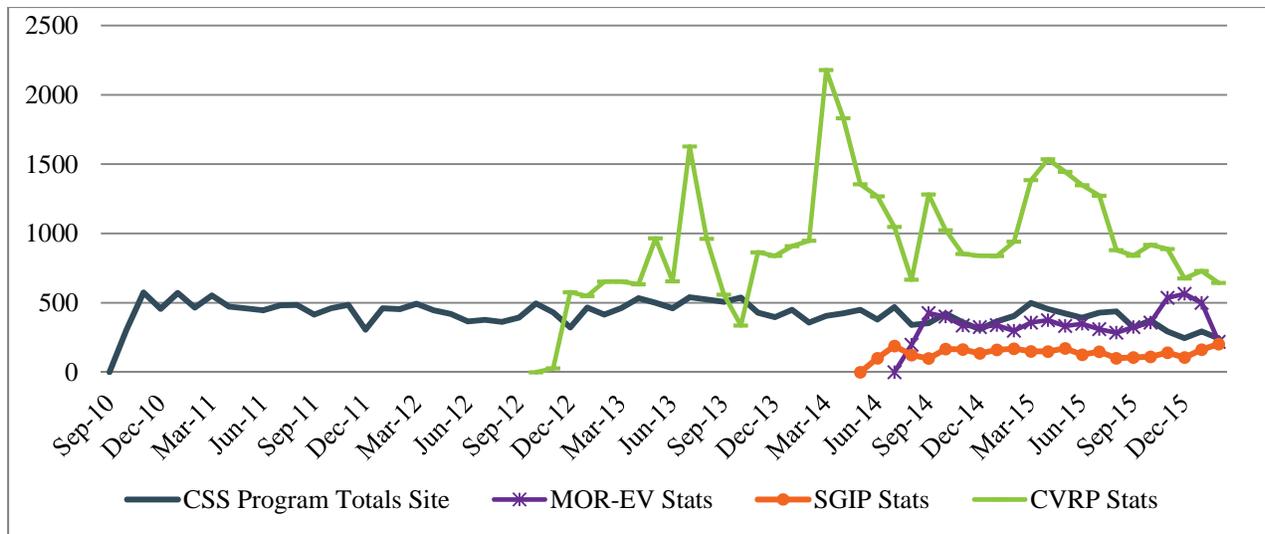


Figure 4. Number of user sessions per dashboard per month. Note: The CSS curve shows the usage of the ‘Program Totals’ visualization. It is the most frequently visited data visualization website of all CSS’s visualizations.

Interview Findings

Between January and March 2016, we conducted 24 semi-structured phone interviews with stakeholders (Table 2) to understand how they use and value the data visualizations. The interviewees represent local and state agencies, industry, utilities, nonprofits and researchers. These types of stakeholders were chosen because they have a vested interest in program administration and market development. Interviews were conducted with individuals in organizations known to program administrators and who had at least occasionally used the dashboard in their work. A noteworthy limitation to this study design is that the data from which the findings are drawn shed light solely on the experiences of consumers who use the dashboard, without identifying why people are *not* using it. Furthermore, based on this sample, findings cannot be generalized to the entire target population.

Table 2. Type of stakeholders interviewed by program dashboard

| Stakeholder Type | CSI | CVRP | MOR-EV | SGIP | Total |
|---------------------------------|----------|----------|----------|----------|-----------|
| Academic/Research Organization | 1 | | | | 1 |
| Advocacy Group/Nonprofit | | 3 | 2 | | 5 |
| Consultant | 1 | | | 1 | 2 |
| Contractor/Installer/Developer | 1 | | | 4 | 5 |
| Manufacturer | 1 | | 1 | 1 | 3 |
| State/Regional/Local Government | 1 | 3 | 1 | 1 | 6 |
| Utility | | 2 | | | 2 |
| Total | 5 | 8 | 4 | 7 | 24 |

Frequency of dashboard use.

The interviews provided insights into user behavior with the dashboards. More than half of the respondents reported using the dashboards on a regular basis (e.g. weekly or monthly; see

Table 3). Except for the research organizations, the dashboards are used regularly by members of all stakeholder groups (Figure 5). The high engagement of market actors with timely information can result in a more fluid discourse within organizations and among market actors, benefitting program and market development of these technologies. In turn, easily comprehensible and frequently updated data might also be the reason why users go to a dashboard on a regular basis. The availability of the tool can thus increase the number and/or engagement of actors involved in the development of the market.

A smaller set of respondents reported to use the dashboards to a high degree for specific activities. Several respondents referred to staff proposal comment periods as examples of those activities.

Table 3. Frequency of dashboard use reported by participants in interviews.

| Weekly | Monthly | Few times a year | Weekly during specific events |
|--------|---------|------------------|-------------------------------|
| 16% | 46% | 29% | 13% |

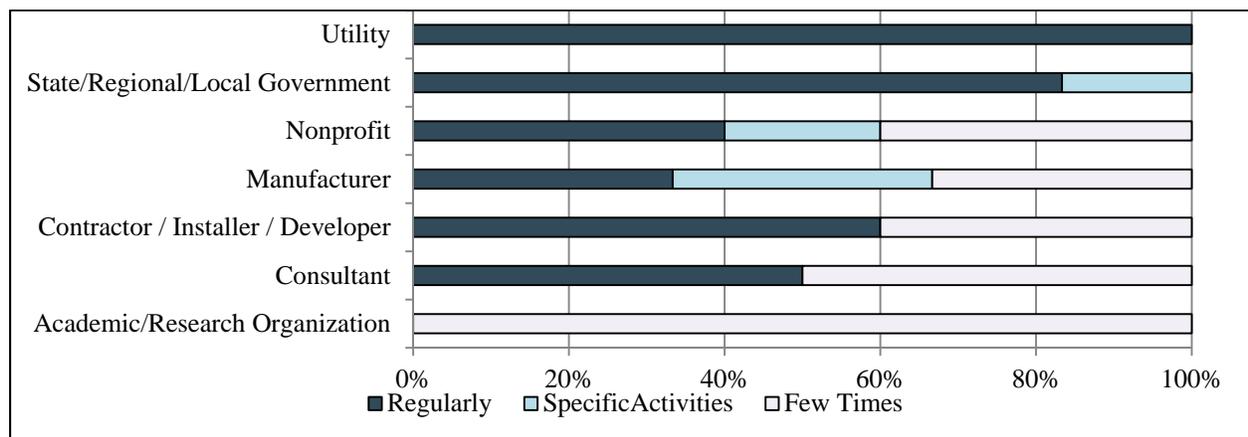


Figure 5. Frequency of dashboard use by stakeholder type.

Of the 20 stakeholders who use the dashboards with raw data available for download, 30% do not use the raw data at all and use information presented in the dashboard only. The majority of respondents that use both raw data and dashboards explained that they use the raw data to perform a more granular analysis and customize layout of charts and tables to their own needs. A few also mentioned that they perform forecasts, join program data to other data and create snapshots of the market in the past.

Applications and value of interactive dashboards.

To understand how access to program data facilitates market development, we asked stakeholders for what purposes they use the dashboard and the raw data. Table 4 shows a list of activities and reported use of program data for those activities. Our findings show that both raw data and dashboards inform a variety of activities across all stakeholders, confirming the extensive role that public program data provides in the market transformation process. In particular, the use of dashboards is supporting efforts across all activity categories. Two stakeholder types, consultants and utilities, reported to solely rely on the dashboards (as opposed to the raw data) to inform their work activities.

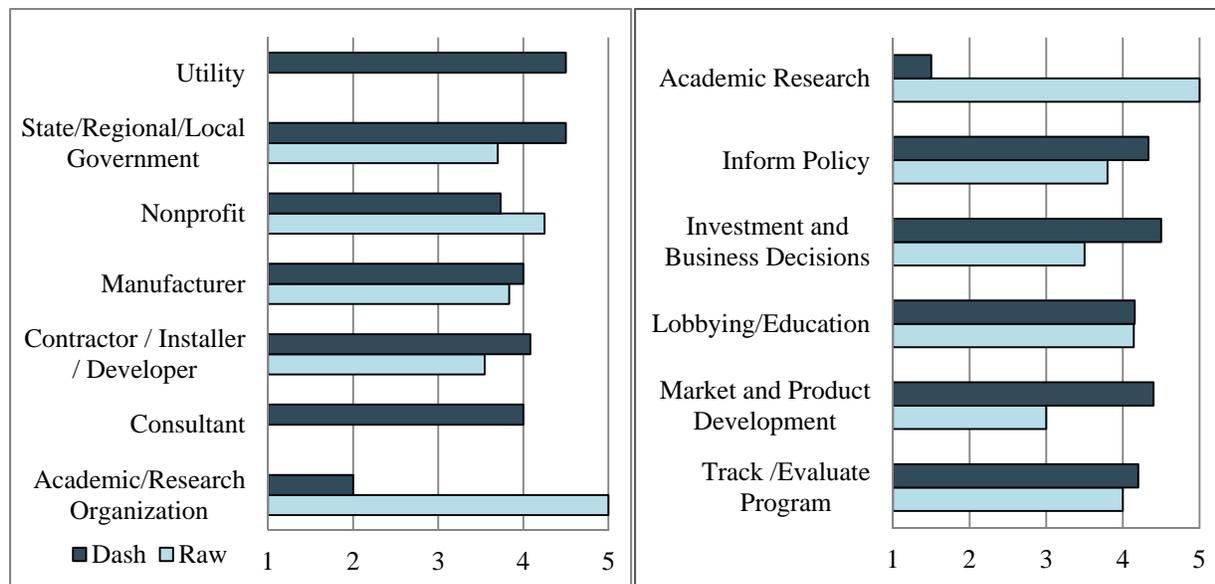
Table 4. Applications of dashboards and raw data usage by stakeholder. The chart displays responses to the question: “For what purpose do you use the dashboard and the raw data?” Purpose is indicated if at least one member of that group reported it.

| | Inform Policy | Lobbying/Education | Track/Evaluate Program | Market and Product Development | Investment and Business Decisions | Academic Research | Other* |
|------------------------------------|---------------|--------------------|------------------------|--------------------------------|-----------------------------------|-------------------|--------|
| Academic/Research Organization | | | | | | x | x |
| Consultant | | | | | | | |
| Contractor / Installer / Developer | x | x | x | x | x | | x |
| Manufacturer | x | x | x | x | x | | |
| Nonprofit | x | x | x | | | | |
| State/Regional/Local Government | x | | x | | x | | |
| Utility | | | | | | | |

*Other includes general interest in market and interest in data visualization

■ = Dashboard X = Raw Data

We also asked participants to rate the *value* that a dashboard and raw data provide to their work. On average, dashboards were rated moderately to highly valuable for different work purposes (Figure 6a). The respondents valued use of the dashboard higher than the use of raw data for work activities in which they inform policy, inform market and product development, inform investment and business decisions, and track and evaluate program development. Not surprisingly, dashboards are not deemed very valuable for academic work for which granular data is typically required. Government respondents valued the dashboards most highly of all stakeholders, followed by the utilities and contractors (Figure 6b).



Figures 6a, 6b. Value of dashboard and raw data sorted by a) stakeholders b) activities. Value is measured on a scale from 1-5, with 1 indicating no value and 5 indicating very high value.

Benefits of dashboard use.

Interactive data visualizations provide many user benefits. We created a list of themes describing benefits of using program dashboards as information tools (Figure 7) and counted the number of interview participants who mentioned them.⁴ Many stakeholders alluded to the dashboards as sources to quickly identify market trends and patterns at a glance (“Fast Comprehension”). Some stakeholders specifically mentioned that they used this quick-reference snapshot to track progress of the program itself (“Track Program Milestones”), while others used it as a source to inform actions that contribute to the development of the market (“Inform Market Actions”). For example, a manufacturer participating in SGIP shows potential customers the dashboard as part of its sales process – both to explain the rebate program and to provide a sense of urgency to cash in on the rebates before the funding pool is exhausted. A consultant reported using the CSS dashboard to track solar pricing trends. A utility representative reported using the CVRP dashboard to forecast load impacts on transformers. A nonprofit organization used CVRP dashboard data to support proposals for electric vehicle charging infrastructure grants.

Another popular benefit of dashboards identified was the ability to advance collaboration among stakeholders by setting a common baseline of knowledge (“Common Understanding/Improved Collaboration”). Indeed, several participants told of when they pulled up a dashboard on the spot to combat misperceptions among stakeholders chatting at a conference, answer press inquiries or calls from legislators, provide credibility during a sales pitch or support a policy argument. Whereas previously these conversations may have stalled due to uncertainties around existing market conditions, the dashboard moved stakeholders one step closer to taking action.

Efficiency was mentioned by several stakeholders. A local government representative recalled the days before the CVRP dashboard existed, when his staff would spend long hours manipulating vehicle market data into usable information. Such efficiency benefits can take on an impressive scale when extrapolated across the many market actors who no longer need to conduct such analysis on an individual or organizational basis.

While transparency may be a prominent reason for funding agencies and program administrators to create dashboards, only one stakeholder mentioned this benefit. However, stakeholders’ trust in program operations and data accuracy may be implied in some of the other benefits. Democratization of data access was another benefit not explicitly mentioned in our interviews, although one stakeholder mentioned that his alternative data source would cost thousands of dollars.

⁴ The question was framed as: “Using a few keywords, please explain the value the dashboard provides to you.” The themes were informed by Aberdeen Group (2014), Reul and Michaels (2012) and Rothwell (2011).

| Benefit Type | Number of Stakeholders Citing Benefit |
|---|---------------------------------------|
| Information and Decision Benefits | |
| Fast Comprehension: The dashboard allows thousands of rows of data that do not have a meaning without analysis to show trends and patterns at a glance. Users are presented with only the key elements that enable them to get both the big picture and the details in one data visualization. | 17 |
| Track Program Milestones: The visualization of data helps stakeholders learn how far along a program is in reaching certain milestones. | 8 |
| Inform Market Actions: The data visualization can help the user understand the lay of the market (e.g., region) and market players (e.g., competitors, consumers, suppliers), which can lead to specific decisions and actions. | 10 |
| Up-to-date Information: The dashboard provides information on the current state of the program. | 1 |
| Benefits of Online Dashboard Interface | |
| Easy to Use/Self Service: The interaction with the dashboard is intuitive and does not require training (e.g., with spreadsheet manipulation techniques). | 5 |
| Efficiency: Users do not have to spend time on manipulating raw data, obtaining external data or reading a long report. Users have instant access to key information when they need it. | 10 |
| Allows User Analysis: Interactive dashboards allow the user to perform simple analysis. The users can view data in aggregated form and further manipulate the charts and table to analyze the data further. | 3 |
| Sharable: The dashboard's charts and tables can be recorded by the user for his/her work purposes. The data visualizations can easily be shared via email and social networks. | 2 |
| Credibility Benefits | |
| Common Understanding/Improved Collaboration: The dashboard can help create a shared view of a situation and align market actors on existing conditions and improve communications and collaborations. | 11 |
| Transparency: The availability of public data can help build trust between market actors and administrators and funding agencies about how ratepayer funds are being spent. Secondly, dashboard users trust that the reported data is accurate. | 1 |
| Resource Equality Benefits | |
| Democratization of Data Access: The dashboard creates a space for public discourse where everyone has access to the same data and data quality. Moreover, the information is provided at no cost. Thus, the dashboards mitigate information inequality, which creates a more level playing field for competitors, encouraging competition and participation of market actors with limited resources. | 0 |

Figure 7. Benefits of interactive data visualizations as information tools.

Conclusions

Public reporting, and in particular public-facing interactive visualizations of program data, present valuable discourse instruments for program evaluation and market development of sustainable technologies. The benefits go beyond data transparency. Dashboards are used by a wide spectrum of market participants – including those who may not directly participate in programs – and across a variety of activities, creating a positive feedback loop that can effect market transformation. Thus, the authors argue that more energy program funding agencies and administrators should build data visualization tools into their program design, budget and reporting requirements. As energy programs work to develop interactive data visualizations, they may wish to incorporate the following recommendations based on the lessons learned from this study.

Lessons Learned and Recommendations for Developing Dashboards

- Data quality is important. The information is more powerful if the data is cleaned (e.g., geocoded to provide accurate geo-aggregated data on census tract or ZIP code level, consistently spelled installer names). Ensuring data quality can be particularly challenging when multiple program administrators are contributing data to a dashboard or when market actors (e.g., contractors) are self-reporting data. Processes for data cleaning and quality control should be incorporated into dashboard plans.
- Different stakeholders have different information needs. Metrics such as number of projects or vehicles, amount of rebates issued, amount of funding remaining, kW capacity, names of contractors/installers or manufacturers, average project costs, consumer motivations and participant demographics are used for varying purposes and degrees by different stakeholder types. The more data points that can be shared publicly, the more market actors will find value in the dashboard. In the end, creating a dashboard that creates high value for *all* stakeholders may not be feasible. However, with the evolving software tools that become available, dashboard developers can create customizable views of the data, thereby tailoring information to different user types (e.g., aggregated snapshot for homeowners, extensive filter and aggregation options for industry stakeholders).
- Our interviews revealed that the value of a dashboard to a user depends to some extent on the user-friendliness and design of the dashboard. We observed that values are higher for dashboards that live on one web page and have different data visualizations and filtering options in the same display.
- Geographic visualizations, along with demographic information when appropriate, are particularly useful for elected officials, local jurisdictions or organizations interested in identifying impacts across different communities.
- Program participant survey data is highly valued by stakeholders and, if available, should be considered for inclusion in program dashboards. Survey data provides insight into consumer motivations and intentions and can be used to inform marketing and outreach plans, plan for future infrastructure or policy needs, or justify continued funding for a program.
- Dashboards are only beneficial if they are known to the audience that can use them. Programs should include a marketing and outreach plan to build awareness among market

actors of dashboard capabilities (and funding agencies should provide a budget for these outreach activities). This could include articles in industry newsletters, blogs or webinars. Providing a clear, one-click route from a program home page to the dashboard is also important.

- Dashboard administrators should be careful that dynamic data presented in the visualization does not conflict with static web content. It may be appropriate to minimize the presence of program statistics outside of the dashboard.
- Feedback is essential. Program administrators can improve the impact of their dashboards by soliciting stakeholder feedback during the design phase as well as periodically during the operation of the dashboard. This can be achieved by implementing a short feedback survey on the dashboard website itself or sending an email to known stakeholders.
- Raw data still provides value for stakeholders with specific or unique information needs; providing an option to download the raw data is a valuable practice for dashboard administrators.

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