How information and communication technologies will change the evaluation, measurement and verification of energy efficiency program performance

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Abstract
Information and communications technologies (ICT) can automate and improve the evaluation, measurement and verification (EM&V) of energy savings by energy efficiency programs. Improvements include greater accuracy and increased speed of analysis, reduced costs of administration, and improved accounting of market forces. Our research examined the current state of technology and practice and explored the features and benefits of future automated capabilities. We discovered technical, economic and policy limitations and barriers that need to be addressed for widespread adoption to occur.

This paper is intended to help many stakeholder groups associated with energy efficiency programs understand the features and benefits of these new analytical methods for evaluating the performance of programs. For private sector implementers of energy efficiency projects use of ICT to facilitate automated EM&V has the ability to automate the collection and analysis of energy performance data and to present it to decision makers in an actionable form.

Our thesis that ICT will improve and expand EM&V within North American energy efficiency programs has been supported by the research of other energy efficiency organizations and our own analysis of existing best practices and interviews with industry experts. This research has documented several examples of private and public sector use of ICT-enabled EM&V practices reducing the cost of tracking energy savings, improving the timeliness and accuracy of reporting, and enabling the rapid scaling of programs.

Our analysis concludes with recommendations for overcoming barriers to greater adoption of these technologies and practices, and suggestions on how energy efficiency program developers can build ICT-enabled EM&V into the design of new programs.

Introduction
Energy efficiency policies and programs exist to compensate for the failure of the market to give value to the benefits provided to all energy sector stakeholders by individual investments in energy efficiency. Programs encourage energy utility customers to invest in efficiency and the benefits such as reduce infrastructure requirements and lower operating costs that the electric system realizes from such investments can be enjoyed by all stakeholders. In this adjusted market structure, efficiency programs function as an alternative to conventional utility investment in generation, transmission, and distribution assets and contribute to lower system and individual customer costs.

Since energy efficiency is such an important resource, it is important to measure it in an accurate and timely manner. As the delivery mechanism of this resource, energy efficiency programs must be effective and well managed. Information and communications technologies (ICT) are helping to improve many features of efficiency programs by expanding customer engagement, improving the collection and analysis of energy savings data, and accelerating the documentation of program performance. ICT is even changing the design of programs and how they encourage customer energy savings. In this paper, we explore these new ICT-enabled techniques and give special attention to how they are changing the measurement of energy efficiency and the evaluation of the programs that provide it.

In North America, a majority of the energy efficiency programs are paid for by fees collected from utility ratepayers. Most often a volumetric fee is assessed on energy consumption and is paid as part of a utility bill. Public utility commissions (PUC) which are quasi-judicial government agencies with regulatory authority over utilities, usually require independent third-party evaluators to assess the performance and effectiveness of efficiency programs[1] (RAP 2011). In addition to the performance evaluation required by commissions to determine overall program effectiveness, many program administrators perform their own measurement and evaluation to determine the effectiveness of specific energy measures, the performance of implementation subcontractors, and their own effectiveness at managing individual programs and portfolios of programs.

The requirement for and of programs varies by state or province. Some state commissions may require utilities to have programs and set specific annual energy savings targets while others may only recommend the creation of programs and create only aspirational goals. In the former, utilities may face financial penalties for not achieving their targets. In either scenario, commissions may further encourage utilities to embrace energy efficiency by authorizing utilities to realize a favourable return on their investments in efficiency. In such instances, it is not unusual for utilities to routinely exceed their targets.

Programs offer financial and technical assistance in a variety of forms including rebates, fixed and volumetric incentives, low-interest loans, engineering assistance, and workforce training. Programs are often organized in portfolios with individual programs targeting specific customer classes or end uses.

Measurement and verification of savings is critical to program performance evaluation, documenting the achievement of goals, and justifying performance payments. As a result, ratepayer-funded programs expend considerable effort forecasting the future savings from their customer's investments in efficiency and later invest more time and effort verifying that those savings occurred. Known as evaluation, measurement, and verification (EM&V) within the energy efficiency sector, these tasks can be a challenging, time-consuming, and expensive. As a result, programs are continuously seeking ways to improve the accuracy and efficacy of their evaluation efforts. Many programs have recently uncovered the potential of ICT to help them with these goals. This paper explains and gives examples of many of the new techniques that they are using and are likely to use in the near future.

Overview of Energy Efficiency Program Evaluation

In the United States and Canada, a utility may operate an energy efficiency program on its own or subcontract it to a third party administrator. In this report, we will refer to the organization responsible for managing an energy efficiency program as a program administrator. The program administrator will usually have a portfolio of different types of energy efficiency programs, each targeting a specific customer group and focusing on a set of efficiency technologies. Administrators may implement some or all of the programs themselves, or they may contract out the day-to-day operation of a program to an implementer. The organizations that engage with customers and implement projects are referred to as "program implementers". Implementers seek out customers with potential for saving energy and encourage them with financial and technical assistance to invest in additional energy efficiency measures (EEMs) and collections of measures (energy efficiency projects). A measure may be a device (high-efficiency lighting), control technology (learning thermostat), or practice (pre-cooling).

Many customers conduct post-implementation analysis on their own investments to determine if anticipated energy savings have materialized, but there is no legal requirement to do so. However, if a project is funded at any level by utility ratepayer funds or taxes, there is a responsibility of the program administrator to account for those funds and demonstrate that they have been properly used. To provide an independent analysis of program performance, third-party evaluators are contracted to determine if claimed energy savings are legitimate, that programs have been run effectively and that funds were expended properly. Table 1 captures the breadth and scope of the many aspects of EM&V.

The EM&V acronym has become a catchall term used to describe everything from the performance of a specific energy measure to the performance and cost effectiveness of a portfolio of efficiency programs. In this paper, we use the term measurement and verification (M&V) to refer to the determination of energy savings, and the term evaluation to refer to the determination of program effectiveness.

M&V is often referred to as impact analysis and can be performed on individual energy efficiency measures, a group of measures or project, and an entire program or a portfolio of programs. Evaluation, often referred to as process evaluation, examines the efficacy of a program, portfolio of programs, or various subcomponents or administrative elements of either. One of the most common forms of process evaluation is a cost effectiveness analysis: an examination of whether the cost of a program is less or more than the economic benefits it facilitates.

Impact analysis is done by program administrators, implementers and evaluators, each for a different purpose. Implementers benefit from tracking their performance and administrators need to know how their vendors (implementers) are performing. Both may perform the analysis themselves or contract a third-party to do it for them. Utility regulators will either contract directly with evaluators to verify program performance or require administrators to do so.

Regulators usually require independent evaluation of program efficacy. It is not sufficient that a single project saves energy, it is often required that program administrators be cost effective at the program level (multiple projects) and it is always required at the portfolio level (multiple programs). Programs are evaluated for their overall success at achieving energy savings, saving customers' money, effectiveness at engaging customers, managing funds and documenting performance properly, facilitating desired changes in the market such as growing the demand for energy-efficient devices, and environmental impacts. Table 1 summarizes the various types of analyses.

1. This is a simplified explanation of the utility-regulatory framework for North America. Utilities can be investor owned, part of a municipal government, or a cooperative owned by its members, each with its own type of oversight. For more information, see RAP 2011.

Table 1. Program evaluation types.

Analysis Type	Description	Examples of use
Impact (M&V)	Quantifies direct and indirect changes associated with the subject program(s)	Determines the amount of energy and demand savings
Process evaluation	Indicates how the procedures associated with program design and implementation are performing from both the administrator's and the participant's perspectives	Identifies how program designs and processes can be improved
Market effects evaluation	Analyses how the overall supply chain and market for energy efficiency products have been affected by the program	Characterizes changes that have occurred in efficiency markets and whether they are attributable to and sustainable with or without the program
Cost-effectiveness evaluation	Quantifies the costs of program implementation and compares them with program benefits	Determines whether an energy efficiency program is a cost-effective investment compared with other program and energy supply resources

Source: SEE Action 2012.

Determination of energy savings is challenging because it is an attempt to measure something that did not happen, a counterfactual. Since it is not possible to meter or reproduce something that did not happen, other methods of determining the benefits of an energy measure or project must be employed. To do this, program evaluators use a variety of analytical methods to differentiate impacts of energy measures from such things as the effects of weather and changes in business hours, production levels and building occupancy.

The M&V for custom program projects in the commercial and industrial sectors has historically been a manual process that involves the dispatch of technicians to customer locations to determine a pre-installation energy consumption baseline, which often requires the installation of portable meters to take measurements and the creation of spreadsheets to record and interpret data. Post implementation, this process is repeated. Such a labour-intensive effort can be expensive and M&V for a single project can range from $5,000 to $50,000 (Nagappan 2012). As previously described, there are multiple layers of analysis. Utilities, commissions, program administrators, implementers and evaluators all invest some level of staff time and expense in EM&V tasks. It is not unusual for multiple analyses to be done in parallel on the same data at the same time. The US Department of Energy's Federal Energy Management Program (FEMP) M&V Guidelines for performance contracting projects estimate that the average, all-in cost of M&V can range from 3 % to 5 % of total project costs (DOE 2008). A review of program expenditures for the evaluation of large demand-side management programs found that they range from 2 % of portfolio costs in Indiana to 4 % in California (Haeri 2015).

Of course the cost of conventional EM&V varies with the frequency, complexity, and scope of data collection and analysis. Depending on the desired or required level of certainty in the results, measurements may be taken on an entire system or a single parameter, on every measure or a sampling of projects. Generally speaking, the greater the level of detail and certainty, the greater the cost. Nevertheless, many stakeholders are keenly interested in reducing the costs of EM&V while maintaining the assurances that current practices provide. They are investigating whether or not ICT may be able to change this calculus and enable stakeholders to collect and analyse more savings data, achieve greater certainty, and incur lower costs.

New ICT-enabled EM&V Technologies and Practices

Several new technologies are changing the way utilities and programs engage their customers, and how they determine and track energy savings. New, faster and oftentimes more accurate and effective M&V techniques are creating a new foundation for how energy efficiency is measured, monitored and managed in the future. Smart meters, smart thermostats, building management and process control systems, cloud computing, the Internet of Things (IoT), and remote analytics and simulation all offer new capabilities for gathering and analysing energy data. Programs can use these technologies to automate data collection and analysis (Grueneich and Jacot 2014). New analytical techniques are giving evaluators the ability to target customers with greater potential for savings, identify potential opportunities to save energy, establish a pre-installation baseline, meter and monitor energy use post-implementation in real-time and then determine savings in near real-time.

The data needed for all of the advanced analytics can come from many sources. Many commercial buildings have building management systems and networked devices that can provide real-time or routine updates on their energy consumption. However, most of the efficiency programs are using utility meter data. Many utilities have invested in advanced metering infrastructure (AMI) that uses various communication protocols to facilitate two-way communication between the utility meters and the grid infrastructure. These are often referred to as "smart meters" and are usually the first component of AMI deployed by an electric utility in a smart grid rollout (EPRI 2011). Unlike conventional meters, which must be manually read, smart meters can automatically provide very high-resolution interval data (usually at 15-minute intervals) of multiple parameters, and often communicate through a utility's wireless network (Eckman and Silvia 2014). Utilities have deployed meters with the ability to provide interval data for decades, but their use has previously been restricted to research projects and to larger customers. Smart meters are now being used to track facility energy use in all customer classes.

INDUSTRIAL ENERGY EFFICIENCY PROGRAMS

Determining an energy baseline at an industrial facility can be challenging and has traditionally required an expert with an understanding of the facility, knowledge of energy management and experimentation with multiple variables (Crowe et al. 2014). Many advanced automated manufacturing process control systems and energy information management systems (EMIS) are simplifying this process by collecting, storing and analysing energy information on a continual basis. These systems harvest data from devices throughout a facility, combine it with production information and outside data such as weather information, analyse it, compare it to past performance, and provide operators with contextualized energy consumption information that enables them to make informed decisions.

Use of these technologies in efficiency programs is in its infancy and the ability of programs to fund such investments varies by region. Some regulators accept the indirect benefits of additional metering and control while others are unsure of how to attribute the savings. The former tend to focus on the overall performance of a portfolio of programs while the latter often require each energy measure to have attributable and cost-effective energy savings. Meters and automated control systems do not themselves save energy. Meters provide information that can induce better energy management. Automated and networked control systems enable superior control of systems and processes which usually leads to more efficient operations. A holistic approach to energy efficiency recognizes the value in meters and controls and encourages them in program offerings. As demonstrated in the examples below, there is considerable potential for intelligent systems to contribute to energy savings and the evaluation of project savings.

Case Study: ComEd, Silver Beauty, and Digital Lumens Intelligent Lighting System

ComEd, the Illinois operating unit of Exelon Corporation, offers a custom incentive program called Smart Ideas for Your Business that provides businesses $0.05 per kWh saved, up to 50 % of costs, for projects that reduce energy consumption. Silver Beauty, a warehouse management company in the Chicago area, took advantage of this program to retrofit the lighting in its 177,000-square-foot warehouse to include LED lights controlled by a reactive and predictive intelligent control system provided by Digital Lumens. The system can track its energy use, and has historical data collection capabilities that enable it to determine a dynamic baseline and report energy savings in near real time. The system reduced energy use by about 1.2 million kWh per year, which was 92 % of previous consumption. (This reduction may seem extreme, but it is not unusual to see significant energy savings from lighting projects that replace old, very inefficient systems with high operating hours with new LED systems that operate only when workers are present.) The accuracy of the savings reported by the lighting system was confirmed by ComEd's third-party evaluator, which conducted a traditional pre- and post-project analysis (Digital Lumens 2013).

Having access to historical information enables an EMIS to assess the energy intensity of an operation relative to current conditions. For example, an EMIS can help answer the question "Is this facility using more or less energy today than it would have on an identical day two years ago" and that information can be used to determine if a change in equipment or practices has been effective (Friedman et al. 2011). An EMIS can make this information available to the process operator and some or all of it to other stakeholders. Some EMISs can be linked to the outputs of supervisory control and data acquisition (SCADA) systems and in combining the information of the two systems make connections to energy use and various processes and outputs. Such information is very useful for production and cost control.

Case Study: Efficiency Nova Scotia's EMIS Program

Efficiency Nova Scotia, a Canadian electricity efficiency utility[2], has been running an EMIS-based energy efficiency program since 2012 that targets industrial and institutional facilities. As of 2015, the program had engaged five organizations, four of them industrial. The program's goal is to maximize and sustain energy savings by creating a management infrastructure and by training facility staff in the use of EMIS software. Efficiency Nova Scotia offers financial incentives to cover up to 50% of the cost to develop, design, and deploy an EMIS and its team works with customers to implement the EMIS. The implementer, Energy Performances Services (EPS), carries out a comprehensive audit of a facility for the purpose of identifying opportunities and strategies to identify, collect, and transmit the data required by the EMIS. The facility receives an incentive if it decides to go ahead with the EMIS implementation. Once deployed, the EMIS translates various data streams into actionable information that operators and management can use to develop and carry out operational energy efficiency measures. These efficiency measures are identified and their performance measured using the data collected from the facility. Program savings are evaluated by a third-party evaluator following M&V protocols for the Superior Energy Performance® (SEP™) program.[3] Efficiency Nova Scotia's evaluator accepted the savings reported by the EMIS program, which totalled more than 4.5 million kWh after three years (Henwood and Bassett 2015).

COMMERCIAL ENERGY EFFICIENCY PROGRAMS

Serving large energy-consuming facilities has often been a challenge for programs because of the heterogeneity of their energy use profiles. However, the energy use and associated savings opportunities of large commercial and industrial facilities is sufficient that facility-specific energy efficiency M&V can be cost-effective for many programs. The same is often not the case for medium and smaller facilities. As a result, some programs such as in the Pacific Gas and Electric Company (PG&E) example below, are looking to automated M&V techniques to enable them to reach a greater ratio of customers. Program ad-

2. An energy efficiency utility is an organization sanctioned by the government to provide energy efficiency services for a defined territory, often an entire state or province. They are managed and regulated much like a conventional utility only the services provided are related to energy efficiency.

3. SEP is a systematic protocol for managing and reducing energy use through goal setting, measuring, and tracking and managing energy consumption.

ministrators are piloting programs in order to determine if new Software as a Service (SaaS)[4] analytical models can more cost-effectively identify opportunities for commercial sector energy efficiency projects and then determine the resulting savings. If successful, such programs will scale more easily than existing labour-intensive approaches and as a result, more customers engaged and more energy saved.

Case Study: PG&E Commercial Whole Building Demonstration

Pacific Gas and Electric (PG&E) launched a commercial whole-building (CWB) demonstration program in 2014 to establish proof of concept for an analytics-enabled whole-building performance approach to unlock energy savings in existing commercial buildings. If successful and accepted by the California Public Utilities Commission (CPUC), it is anticipated that additional use of these techniques will help California achieve its ambitious zero-net-energy targets for existing commercial buildings.

PG&E is the program administrator for the demonstration, data analysis is being handled by third-party software vendors and a technical evaluator, and an engineering analysis is handled and reviewed by consulting engineers. As part of the demonstration, the energy consumption of qualified buildings is being analysed using conventional onsite assessment and energy modelling techniques in parallel with methods using interval meter data, cloud-based data analytics weather, and other data. These techniques are applied to identify energy efficiency measures, track energy consumption, and verify the savings of participating buildings.

Implemented energy efficiency measures have been a mix of retrofitting, retro-commissioning, operational, and behavioural measures. Data analytics were used to help establish an energy-use baseline from which customer savings will be determined. Project implementation for the current 12 participating buildings was largely completed at the end of 2015. Monitoring and analysis will continue through 2016 (Bode et al. 2014).

A recent Lawrence Berkeley National Laboratory (LBNL) research project developed an analytical tool to evaluate the ability of several off-the-shelf remote building analysis (RBA) tools to determine the savings from commercial buildings and found the results to be promising. Using actual field data sourced from hundreds of buildings, the research team found that for a quarter of the population of buildings in the data set, the energy savings resulting from program activities could be determined within a 6.5 % margin of error, and that was without close inspection of the facilities or adjustments for non-routine variations in energy use (Granderson et al. 2015). The other three-fourths of the buildings did not operate in a sufficiently steady state for the analytics to work without higher levels of inspection and the identification of critical events, which is likely to require on-site technical presence. Analytical techniques such as RBA can be used to identify buildings that operate in a steady state and categorize the level of variability in those that do not. These techniques can enable programs to engage a much greater percentage of their customers than current practices.

4. Software as a service is an alternative to purchasing software outright. Instead, software is provided through a subscription that covers access to the software via the Internet. Automatic updates of the software are often part of the service.

Benefits of ICT-enabled EM&V practices

Some of the applications of ICT in energy efficiency program will sustain and improve existing program models. Other applications will disrupt current practices and replace them with new techniques. ICT-enabled evaluation methods can provide M&V practitioners a single, near-real-time stream of data from which they can determine energy savings and identify projects that work best. This capability can enhance each stage of the EM&V process starting with program design and ending with program evaluation.

PROGRAM DEVELOPMENT AND DESIGN

ICT-enabled technologies are not only changing how programs are operated and energy savings are measured, they are also changing how programs are designed. Program developers are taking into consideration the ability to now build M&V into the design of a program so that project and program performance can be determined on an ongoing basis.

Programs are using SaaS products to determine the consumption and demand savings potential of customer groups so that they can focus their limited resources on facilities with the highest savings potential and on those that can help reduce grid congestion in capacity-constrained areas (Craft and Fisher 2014).

The planning of a future program is often dependent upon knowing the performance of past programmatic activity. If an evaluator waits until the end of a program period, usually a year or more, to analyse overall performance, that analysis will not be available for the design and development of the current program. With ICT-enabled M&V, program performance is continually monitored, and can be used in the management of the existing program and the planning of future programs (Ellis 2015; Oster, Guiterman, and Rigney 2015).

PROJECT PERFORMANCE MEASUREMENT

AMI data with and without BMS or EMIS data can be used to track facility energy use and savings. The automated nature of the data analysis facilitates greater and timelier access. It also enables easier tracking of the persistence of savings. Once a system that provides automated M&V is in place, it can begin providing feedback to programs within one month of measure installation. The savings or lack thereof will more readily be identified and in the case of the latter, the opportunity for corrective action will be earlier. Ongoing analysis can also be shared with third party evaluators. With an agreement in place on the data to be collected and how it is to be screened and accepted, the evaluator can use the same data streams as the implementer and administrator. Issues related to completeness of data between parties should be addressed much earlier.

The analysis of large volumes of data and of diverse contexts yields an advantage of more thoroughly vetting analytical software tools. Analytical tools can be tested on known datasets and their efficacy confirmed without knowing the details of their software code. The larger and more diverse the data within the test dataset, the more effectively the tool can be assessed (Goldberg et al. 2015).

Policymakers and regulators will benefit from more timely and accurate reporting and forecasting of future savings as it will enable them to better assess the impact of policies and programs. Performance information on the effectiveness of particular programs will help shape future program goals and offerings, which will in turn lead to more agile and informed policymaking that ideally treats efficiency as an investment-worthy resource and ultimately increases the amount of energy saved nationally. ICT will help evaluators to develop more robust analytical models that use energy data in conjunction with customer, market, and environmental information to help determine net energy savings. Statistical models that compare the energy use of participants and a control group of nonparticipants can do a better job of determining savings that are net of free riders and spillover.

The automated collection of energy data will help update the deemed savings values contained in technical resource manuals (TRM) that are used by prescriptive programs. The additional contextual information collected along with device energy savings can enable TRMs to factor in application, location, and other variables.

One of the many reasons end users are investing in ICT-enabled devices and systems is their ability to report performance in a timely manner. The cost of this benefit is often nominal since it is a feature of the automation and connectedness of the product that provides many other benefits. The cost effectiveness of extracting this information and transforming it into information that can be used to assess the efficacy of an energy efficiency program is less certain. There are many parts to the program EM&V process and although automated M&V appears to hold out the promise of reducing costs through scale, it is not guaranteed (Goldberg et al. 2015). The use of automated M&V techniques changes the equation for increasing the size of a program and its evaluation. In the past, they were linked in a linear and parallel fashion. With the ability to analyse twice as many customers with only marginally more resources, that connection is broken. While the cost of incentives is not directly affected and will continue to be linear, the cost of engaging a customer or analysing a project's performance decreases with each additional customer. Therefore programs can scale their customer engagement, project tracking and program performance reporting much more rapidly and inexpensively than was possible in the past.

The timeliness of performance data is more important to the facility than the program's evaluator however the same technology enables the ability to roll up the information at a programmatic level and to share the data with evaluators when they are ready.

In addition to automating the collection of energy savings, ICT can also automate the calculation of multiple (non-energy) benefits and the application of cost-effectiveness tests. Evaluators may eventually be able to compare cost-effectiveness results arising from multiple methodologies for determining cost-effectiveness and associated assumptions. The same tools that utilities used to determine energy savings can be modified to determine associated emissions reductions. Though beyond the scope of this paper, this is certainly an area that is likely to grow in the future with growing concerns about greenhouse gas emissions.

LIMITATIONS AND THE TECHNICAL, ECONOMIC AND POLICY BARRIERS

New technologies and techniques will not solve all problems, and not every feature is a benefit to every stakeholder. Many existing evaluation techniques are sufficient to document installation and net energy savings. The more elaborate and automated techniques may not provide evaluators any cost savings over simple billing analysis. And while the additional information made available by ICT may be helpful to the end user, it is often not necessary to determine program-induced savings.

More timely final analysis is not a given. Automated M&V methodologies can deliver useful mid-term analysis that will help understand project or program performance, but they will not necessarily reduce the time needed for final evaluation or the determination of savings persistence.

Large volumes of data bring new challenges to evaluators. The vendors of remote building analysis services may exclude up to 20 % of accounts based on data anomalies. Although this loss rate is not viewed by vendors as a problem for identifying sufficient opportunities, it could be a problem if the tools were used for comprehensive program evaluation (Goldberg et al. 2015).

Customization of M&V can be at odds with automated M&V since its ability to scale requires standardization. Rapid analysis of large volumes of projects precludes the opportunity to customize the analysis of a project in response to changing program conditions or emerging findings. High-quality evaluation cannot be a one-size-fits-all proposition but must have the flexibility to allocate resources to address changing customer realities and unique situations.

Lastly, automation will not eliminate the need for inspection by evaluators. Conventional techniques will still be needed to perform certain M&V activities, such as adjusting the model for non-routine changes in energy use, or verifying meters are measuring what they are assumed to be measuring. It is likely that ICT will change the tasks of evaluators rather than eliminate the need for them.

Recommendations

In light of the new evaluation capabilities made possible by ICT, past policies to balance the interests of stakeholders should be re-evaluated. Regulators should seek input from all stakeholders and create processes to determine if existing EM&V policies are still appropriate or if they are preventing innovation and market growth. Where they find existing policies wanting, they should establish a process to develop new policies that facilitate innovation and that continue to balance stakeholder interests.

As part of a broader effort to explore and demonstrate the potential of new M&V techniques, regulators should give program administrators the flexibility to experiment and invest in new technologies; in turn, program administrators should use this flexibility to test the capabilities of ICT-enabled evaluation practices and determine where and when they can add value (Grueneich 2015).

Pilot programs and demonstration projects should explore the ability of building M&V into program implementation and then using the output to track program performance and provide early feedback. Program developers should explore how the more granular performance information available with AMI data can be used to improve the features and benefits of programs.

There are many opportunities to improve the use of AMI, BMS and EMIS data to determine energy savings. M&V specialists, product developers, and program stakeholders should come together to establish guidance for best practices. Opportunities range from simple determination of facility energy savings to specific rules for using the disaggregated end-use energy or demand values that are now possible using AMI or energy management system.

Regulators are in the position to bring about greater confidence in automated M&V techniques by requiring transparency of evaluation methods. Issues remaining to be addressed include the process for making assumptions and interpreting data, protocols for data cleaning, best practices for incorporating external data sources such as building management system outputs, weather data, and production data into analysis of AMI data, and requirements by evaluation acceptance by third party evaluators.

The goal of all of these efforts should be to bring about some combination of improved cost effectiveness, increased accuracy, more effective program management and improved understanding of energy savings. Each convening of stakeholders needn't achieve all four but they should seek to bring about improvements in the use of new techniques so that they facilitate greater deployment and greater savings.

Conclusion

The energy efficiency program sector is being transformed by the availability of cost effective ICT and data analytics. These technologies are simplifying the harvesting of savings data, improving the accuracy and timeliness of reporting, and improving the contextualization of energy consumption data. Customer energy savings can now be harmonized with information on energy use and production schedules so that the benefits of specific energy measures can be discerned on a timelier basis.

This capability is changing how programs target customers, how opportunities are identified and customers are engaged. It will also soon change how energy efficiency programs are designed and monitored. By incorporating ICT into the design and management of a program, administrators and evaluators will be able to improve the effectiveness of their actions and reduce their operating costs.

ICT can provide greater transparency and confidence in the accuracy of efficiency efforts and in doing so provide important assurances to regulators and program administrators. In the long term, this technology also has the ability to radically change the energy efficiency sector by reducing the previously intractable market barrier of quantifying the counterfactual. When barriers are removed, markets open up to greater participation and in the case of energy efficiency that means greater savings.

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