International Approaches to Measurement and Verification of Continual Improvement in Industrial Facilities

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ABSTRACT

Effective measurement and verification (M&V) protocols and processes are critical to the successful implementation of continual improvement in industrial facilities. For *ISO 50001-Energy management system standard*, national and ISO guidance documents are addressing M&V in the continual improvement context. An M&V protocol for energy management has been developed for Superior Energy Performance (SEP), a U.S industrial initiative with growing international interest that combines ISO 50001 and a specified requirement for energy performance improvement. Issues that M&V needs to address to support an energy management program such as ISO 50001 include the following: defining boundaries for which improvement is to be measured, defining improvement metrics, creating appropriate baselines, determining what should be normalized for and how it should be done, reporting and potentially setting requirements for accuracy and reliability of data, specifying data quality requirements and accounting for total consumption across multiple energy sources.

This paper reviews a number of existing guidance documents from the six countries involved in Global Superior Energy Performance (GSEP), in terms of how they address the issues above, what context they're designed for, and what elements might be needed to extend them to address other contexts. This analysis identifies areas of commonality across the M&V documents and programs, and considers the challenges for developing standardized M&V documents. Common themes include the availability of guidance documents and a consistent basis for M&V planning. Understanding the context and constraints of the diverse existing approaches can help us move toward a common approach that will support and enhance their values.

Introduction

Many individual countries have developed standards, laws, regulations, programs, protocols and guidance documents to encourage the adoption of greater energy efficiency in the industrial sector. In 2011, the International Standards Organization (ISO) adopted *ISO 50001-Energy management system standard*, to provide a common standard for industry. As indicated by work currently in ISO technical committees to develop supporting guidance documents, there is significant international interest in improving the consistency for measuring improved energy performance. The international community seeks to create a common vocabulary for defining energy performance improvement which will increase transparency, thus creating more market value for these improvements. The challenge is to define the improvement metrics such that they support and embrace the efforts already begun by individual countries. Comparing key measurement and verification concepts across programs in several countries provides an indication of which areas can be aligned relatively easily, and helps to assess what is needed for a common vocabulary.

One of the efforts to compare and consider alignment is the ongoing work under the GSEP. This effort began in 2010 with the Clean Energy Ministerial (CEM), which was established to provide a global forum to advance clean energy technology. At the first CEM in Washington DC, government and corporate leaders announced the GSEP initiative to accelerate energy efficiency improvements in industrial facilities and large buildings. Within the GSEP, there are six working groups, each focused on a particular practice area, all working together toward reducing global energy use. One of these six groups, the Energy Management Working Group (EMWG), seeks to share strategies and best practices among participating members to foster and accelerate energy management and continual energy performance improvements in industrial facilities and buildings. At its first workshop in 2011, the EMWG's participating members formed three task groups that align with the group's primary goals:

- Increase energy management implementation in industrial facilities and buildings sectors to improve energy efficiency and energy performance
- Measure and verify energy performance improvements on a consistent basis
- Build a qualified workforce of energy professionals

The Measurement and Verification Task Force (MVTF) agreed on primary activities that would facilitate meeting its goals, focusing on sharing information with participating members related to developing M&V protocols, compiling best practices and inventorying resources. The task force meets via webinar every 4 to 6 weeks. In 2011 and 2012, the MVTF identified and analyzed common elements of M&V as applied at the facility or organizational boundary, consistent with energy management systems (EnMS) such as ISO 50001. The group also decided to review results of information sharing to understand more specific needs of a GSEP approach to M&V. In 2013, the MVTF is addressing data quality and energy accounting.

A crosswalk analysis was developed to assist in understanding the key characteristics, similarities and differences of M&V approaches across countries. Opportunities for alignment were also assessed. Six countries participated in the crosswalk - Australia, India, Japan, Korea, South Africa and the United States. This paper discusses the results of the crosswalk analysis, comparing the legal, regulatory, and programmatic frameworks used by these countries in the area of measurement and verification. Each of the participant countries provided details on their measurement and verification actions (Lawrence Berkeley Laboratory, 2012a).

Monitoring and Verification Issues

Issues that M&V needs to address for EnMS include defining boundaries, metrics, creating baselines for energy consumption, providing a means for normalizing, accuracy and reliability, data quality and accounting issues. M&V associated with EnMS is different than project-specific M&V alone because it must consider energy performance improvements from specific projects as well as additional energy performance improvements resulting from ongoing operational control of significant energy users.

Defining the Boundaries for Which Improvement Is To Be Measured

The unit of study and its boundaries vary depending on the approach to energy performance. ISO 50001 considers a facility, a building, multi-building campus, or a business enterprise. For defined energy efficiency measures, the boundaries may be narrowly defined to a system, process, piece of equipment or a unit operation.

Defining Improvement Metrics (Energy Performance Indicators or EnPIs)

ISO 50001 measures energy performance by an Energy Performance Indicator (EnPI), selected by the complying organization (ISO 2011). The EnPI could be energy consumption divided by production or another business metric, such as occupancy, normalized energy consumption compared to a correspondingly normalized baseline, or other metrics developed to track and communicate energy performance improvements, especially for those uses designated as significant.

Energy savings, monetary savings, and percent improvement in performance are also common metrics used to determine progress in energy efficiency. The SEP program selects the EnPI as the ratio of the adjusted reporting period consumption and the adjusted baseline consumption, where adjustments are made so that both the reporting period and baseline period consumption are based on consistent conditions (Lawrence Berkeley National Laboratory 2012b). Adjustments for variations in production level, product mix, weather, raw material characteristics and other conditions that affect energy consumption allow the baseline and reporting period comparison to be meaningful.

Depending on the objectives of the program, the EnPI could be developed at different levels. Some programs focus on facility or sub-facility level, where others are more interested in the total energy performance improvement across a business enterprise. One of the ongoing challenges of developing metrics is to have sufficient granularity that the effect of actions designed to improve energy performance can be determined while at the same time minimizing the effort to generate and track metrics. EnPIs that are developed for the most significant energy sources consumed can be summed to generate an overall EnPI. For example, a facility where steam consumption drives most energy use may want to develop an EnPI for consumption of this energy source. This may assist the facility in improving performance as the team focuses on ways to reduce consumption per product output. However, the facility ultimately will need to incorporate the energy consumed to generate the steam as part of the facility EnPI, as well as other sources of energy consumed such as electricity.

Creating Appropriate Baselines

Defining the baseline condition against which change is measured is fundamental to any measure of savings or improvement. For continual improvement processes, the baseline conceptually is the condition that would exist if the stream of improvements from some point in time had not happened. The reference against which improvement is measured is the baseline period. To compare energy consumption in the current period with energy consumption in the baseline period, typically some type of normalization is used. That is, energy consumption is compared "as if" production levels and other factors were the same in both periods. What other factors may be considered and how the normalization is accomplished vary among different guidance documents and EnPI formulations.

This normalization requires sufficient measurement to know the conditions affecting energy use. In addition to collecting energy consumption data for each energy source, organizations will need data on key variables such as production level, product mix, weather, and raw material characteristics for the baseline period. This additional information will support normalization of the comparison between baseline energy consumption and the reporting period energy consumption.

Normalizing Energy Consumption over Time

The energy used in the reporting period and the energy used in the baseline period must reflect the same conditions. For example, the measured energy consumption in the baseline period can be normalized to reflect the conditions in the reporting period. Another approach is normalizing both the measured energy consumption in the baseline and reporting periods to a standard set of conditions (eg production, weather). Adjustments may also be needed for one-time events, such as mergers, acquisitions, shut downs, and additions of product lines.

Accuracy and Reliability of Normalization

When statistical methods are used for normalization of the baseline and reporting period conditions, accuracy measures can also be reported. These include the coefficient of determination for regression analysis, (R^2), the significance level (p value), Fisher's exact test to compare the spread in two sets of data (F-test), and other statistical tests.

Data Quality Requirements

Criteria for defining data that is acceptable for the energy performance measurements used to define progress should be defined. For example, data could be required to be from verifiable sources, such as utility meters and calibrated sub-meters.

Accounting for Total Consumption across Multiple Energy Sources

Energy consumption may involve a range of different fuels and sources, such as natural gas, electricity, propane, diesel fuel, biomass, solar energy, purchased steam or chilled water, etc. One key area is how electricity is accounted for, given that the electricity purchased from the grid may require the consumption of fuels. In general, a choice must be made whether to account for energy use at the site or at the source. For most purchased fuels, there is no difference in site versus source values, but for electricity the values are different because source energy accounts for fuel consumed to create the electricity, while site energy only considers the embodied energy in the electricity, a difference of about a factor of three. Other energy sources may require conversion to source, such as purchased chilled water. Source energy may also be referred to as primary energy.

Guidance Documents and Protocols Reviewed

Six countries participating in the GSEP MVTF agreed to share information related to the development of M&V protocols and guidance documents, with the goal of combining best practices and resources. The existing guidance and protocol documents were reviewed and compared for their approach to M&V issues listed in the previous section. The six countries also provided documents and participated in an ongoing dialogue about M&V issues.

Table 1. M&V Documents Reviewed

Country	Key Documents	Publishing Organization	Context
Australia	Energy Savings Measurement Guide (ESMG)	Department of Resources, Energy and Tourism as part of the Energy Efficiency Opportunities Program (2006 Act)	Recommended practices, within a regulatory context. Largest energy-using corporations are required to participate in the program; facilities and organizations using more than 0.5PJ/yr must comply.
India	Perform, Achieve and Trade – Baseline Normalization, Energy Performance Indicators, Targets and M&V. (part of 2001 Indian Energy Conservation Act)	Bureau of Energy Efficiency, Ministry of Power	Recommended practices and required procedures. Regulatory guidance to support mandatory energy saving targets in energy intensive industries.
Japan	Energy Conservation Law of Japan	Ministry of Economy, Trade and Industry	Required Procedures, regulated by law
Korea	Guidance on the Operation of GHG and Energy Target Management Schemes	Ministry of Environment	Required Procedures, within a regulatory context
South Africa	South African National Standard (SANS)– Measurement and Verification of Energy Savings	South African Bureau of Standards	Description of existing practices and required procedures of guidance document. Tax consequences for some companies regulated by the standard.
US	Superior Energy Performance M&V Protocol	US Department of Energy	Required procedures for a voluntary program

Source Data: LBNL 2012a

Australia

Australia passed energy efficiency legislation in 2006, which requires corporations with annual energy consumption above 0.5 peta-joules per year to participate in the Energy Efficiency Opportunities (EEO) program (Australian Government Department of Resources, Energy and Tourism. 2007). The law requires these corporations to perform rigorous and detailed energy use assessments and identify energy efficiency savings projects with up to a 4 year payback. Public reporting of the results of the assessment, and the businesses choices as to completing any of the energy efficiency projects is required. These assessments are required every 5 years, following the EEO Assessment Framework. This framework seeks to remove barriers to energy efficiency by providing quality information, leading to greater scrutiny of energy use and more energy efficient actions (Australian Government 2011). The Department of Resources, Energy and Tourism also provides credentialing for verification teams.

The Energy Management Savings Guide provides guidance on key topics in the EEO program. These include: establishing a baseline, measuring energy consumption, developing an energy and mass balance, estimating savings from a given opportunity, assessing the accuracy of energy savings analyses; evaluating opportunities and energy monitoring and reporting (Australia 2008).

The EEO program is designed to save energy by requiring large energy users to seriously and comprehensively consider how they could improve their energy performance. Reporting the results is required, but each organization chooses whether any energy efficiency activities will be undertaken. The government verifies that the assessment requirements have been met and accurately reported to the public.

Projects and activities can apply narrowly (a specific piece of equipment or a unit operation) or encompass an entire enterprise. Thus the concept of baseline may refer to projects, processes, or to whole facilities. Organizations develop key performance indicators (KPIs) as part of their initial planning for the energy and mass balance. The form of these KPIs are not specified, and each organization may define them differently (Australia ESMG 2008). Similarly, adjustment to the baseline are not specified or mandated, although the guidance recommends adjusting to achieve accuracy, at a moderate cost. EEO requires that companies must be able to account for all of their energy (plus or minus 5%). For specific projects identified through the assessments, Australia requires that the savings calculations must be estimated at a minimum of plus or minus 30% (Australia ESMG 2008). Data quality requirements are not specific, but corporations must meet legislated accuracy requirements. Australia focuses on corporate energy use, which is usually site energy, rather than source energy.

Japan

Japan enacted its Energy Conservation Law in 1979, following the energy crisis of 1978 (Energy Conservation Center Japan 2008). This law required businesses to enact energy efficiency measures. Amended several times since then, the law now requires industrial enterprises above a minimum annual energy use threshold of 1,500 kiloliters (kl) of oil equivalent (57,000 gigajoules [GJ]) to appoint a qualified energy manager and to submit periodic reports on energy use. Larger facilities (over 3,000 kl oil equivalent or 115,000 GJ) must also submit mid- and long-term plans. In addition to submitting periodic reports, the energy manager is responsible for managing energy conservation activities at energy consuming facilities. The energy manager must report to a company executive. The energy manager develops internal documents such as internal energy management standards, policies, budgets, energy-saving plans with targets, energy intensity management charts, energy saving improvement plans, and education plans (EECJ 2008). The law requires striving to meet an annual improvement of 1% and explaining failure to meet the standard. Compliance with the law is determined by surveys performed by certified energy management professionals under the authority of the Energy Conservation Center of Japan. Non-complying facilities may be placed into a mandatory system of inspection.

Japan's approach requires that companies assign high level resources for energy conservation. Each organization can create its own systems for making improvements and tracking energy, but the success or failure of their approach depends on the ultimate improvement in energy intensity over the long term.

The surveys completed by the Energy Conservation Center in Japan form the basis for measurement and verification in Japan. The survey checks individual components compared to standard practice, such as the air ratio at a furnace, to determine if the facility is taking appropriate actions. The survey approach is different from developing a protocol, although individual energy conservation recommendations may be consistent with elements of other guidance documents and protocols. Issues such as defining the baseline, or determining accuracy and data quality are handled by the implementers of the survey. However, because the periodic reports are legal documents, the complying companies are essentially validating that the data quality is sufficient to meet the legal requirements.

Korea

South Korea's government developed targets to reduce greenhouse gas (GHG) emissions by 30% below business as usual by 2020. The government set specific targets by sector and negotiates with controlled entities to achieve the energy savings and GHG reductions. For industry, the Ministry of Knowledge Economy sets the targets, and the Ministry of the Environment performs compliance inspections. Companies or workplace units above an energy consumption threshold must meet targets. The threshold is declining from 500 Terajoule (TJ) in 2011 to 350 TJ in 2012 and 200 TJ in 2012 for companies. To support this effort, South Korea developed "Guidance on the Operation of GHG and Energy Target Management Scheme."

Each company negotiates an annual target with the government which is submitted to the Ministry of Knowledge Economy, and also submits annual reports on their performance. Baselines are determined based on the previous 3 years, and goals are set for 5 years. South Korea has established verification bodies to verify the performance and submit reports on their implementation. The Ministry reviews these reports, and can levy penalties for non-compliance. Tax incentives of 20% of investment are available for energy saving facilities.

The guidance document focuses on both GHG and energy savings. Baseline normalization includes accounting for production and hours of operation, which is similar to documents from other countries, except for the focus on GHG rather than strictly energy.

India

India enacted a National Action Plan on climate change in 2008 which outlined 8 missions. One of these is the National Mission for Enhanced Energy Efficiency. Under this mission, initiatives were established to address energy efficiency in different aspects of the economy, including energy intensive industries under the Perform Achieve and Trade (PAT) program. The eight sectors in the program are aluminum, cement, chlor-alkali, fertilizer, pulp and paper, power generation, iron and steel and textiles (Bureau of Energy Efficiency 2008).

The program establishes mandatory energy saving goals on the basis of a three year baseline of specific energy consumption. The key metric is specific energy consumption (SEC), which is defined as the sum of all forms of energy brought in over the plant boundary divided by the total production exiting the plant boundary. Energy performance over the compliance period is verified by independent auditors. Each business enterprise has a savings target from the established baseline. Overachievement of the target SEC results in generation of Energy Savings Certificates (ESCerts), while underperformance requires the purchase of ESCerts or payment of a penalty. The metric of specific energy consumption helps identify those facilities with inefficient or poorly maintained facility unit operations. The design of the program is flexible to encourage the lowest compliance costs for energy efficiency.

The PAT program allows the business to set the boundary as long as it encompasses the total energy input and the defined product output. The boundary must be consistent throughout the improvement process cycle. This approach requires a precise description of 'unit of product', as products that are similar in name may require significantly different levels of energy input.

Baseline normalization is performed for production levels, product type and energy values, using simple ratios, regression models, and engineering calculations under the PAT program. The normalization by major product type solves some of the issues related to the complexity of apportioning to numerous end products. Statistical methods or accuracy methods/standards are employed in the guidance.

There are no explicit data quality requirements contained in India's PAT program. However, data quality is assessed by the accredited energy auditor. The auditor completes a detailed process which includes a review of data and sources, independent technical review, site visits, staff interviews and a review of calculations.

South Africa

South Africa established a tax incentive for energy efficiency at large industrial developments in 2009. To claim the tax incentive, the enterprise must perform measurement and verification sufficient to demonstrate the energy savings of their actions or projects. South Africa developed national standards for "Measurement and verification of energy savings" and "General criteria for the operation of various types of bodies performing inspection" (South African National Accreditation System [SANS] 2011 and 2006). The International Performance Measurement & Verification Protocol (IPMVP) formed the basis for the standards. A range of projects and activities may comply with the standards.

A key aspect of the South Africa tax incentives is the M&V professional. These accredited professionals have broad responsibilities to determine the energy savings. They select the project boundaries, which could be isolated to a piece of equipment or a building, or established more broadly to an entire enterprise, or region. Key metrics are the energy and monetary savings, and other metrics may be selected depending on the project or program scope and objectives. For each incented action, the M&V professional will determine the baseline energy, the reporting or performance assessment period energy, and any adjustments required. Baseline adjustments are required for all relevant variables affecting energy use, including weather, production levels, number of occupants and operation hours under the SANS guidance for M&V. The M&V practitioner is responsible for identifying all variables likely to influence energy consumption and to develop an adjustment plan for each of those variables. Similarly, the M&V practitioner selects the best method for making routine adjustment, which could be simple ratios, statistical regression models, simulation models, or engineering calculations.

There is no set requirement for accuracy; rather what is required is a clear reasoning on why the results are credible and not overstated. When non-routine adjustments are necessary, the M&V practitioner is responsible to account for the changed conditions. The general data quality principal is traceability and credibility. Reasonable steps must be taken to ensure savings are not overstated.

United States

United States promotes better energy use practices in the private sector through voluntary programs with utilities, states, and the federal government. M&V in the US typically has focused on verifying the results of specific energy efficiency projects and measures. Many states and utilities have programs that provide incentives for successful implementation of these measures. The Superior Energy Performance (SEP) program is a voluntary program for plant certification to conformance to the ISO 50001 Energy management system standard, additional SEP program requirements, and demonstrated energy performance improvement (U.S. Department of Energy, Energy Efficiency and Renewable Energy, 2012a).

SEP has developed the Superior Energy Performance Measurement and Verification Protocol for Industry (SEP M&V Protocol)to establish a consistent methodology for verifying the results and the impact of the implementation of the program over time (Lawrence Berkeley Laboratory, 2012b). The methodology also provides a means to quantify energy savings from actions and projects, as well as to track performance improvements over time. The SEP energy performance indicator (SEnPI) is developed for a specific facility based on site-specific variables, such as energy consumption, production volumes, weather, and raw material characteristics. Each facility models their facility-wide baseline SEnPI for comparison to their SEnPI after a performance period (typically 3 years later), to determine their improvement. Thus SEP captures all changes in energy performance, from capital investments, maintenance, operational improvements and practices, and behavior. The certification process requires that the facility demonstrate their improvements in two ways, first, by SEnPI improvement, and second by a "bottom-up" cross-check of the energy reduction effects from itemized improvement activities.

The SEP M&V Protocol requires statistical models to calculate the energy performance improvement, the key program metric. Baseline energy consumption and reporting period energy consumption must be normalized for all relevant factors such as weather, production level, hours of operation, product mix, and other relevant variables. A facility may be the entire area occupied by an organization at a particular location, or it may be a subset.

The regression models used to demonstrate energy performance improvement must meet statistical tests for significance level. Variables should be included in the model if they affect energy consumption at more than a 10% significance level (p value less than 0.1). Non-routine adjustments, when required to develop and justify a best reasonable baseline and reporting period energy consumption, are typically based on an engineering analysis. The quality of all data sources must be sufficient to be verifiable. Calibrated utility revenue meters and calibrated sub-meters are acceptable. As part of the normative references for the certification standard for SEP (ANSI/MSE 50021) the protocol is available on the SEP website (http://www.superiorenergyperformance.net/pdfs/SEP_MV_Protocol.pdf).

M&V Summary

Table 2 provides a summary of the M&V approaches in documents reviewed.

Table 2. Summary of M&V Approaches in Documents Reviewed

Issue	Australia	India	Japan	Korea	South Africa	United States
Document Reviewed	Energy Savings Measurement Guide	Perform, Achieve and Trade	Energy Conservation Law of Japan	Guidance on the Operation of GHG and Energy Target Management Schemes	SANS– Measurement and Verification of Energy Savings	Superior Energy Performance M&V Protocol
Applicable Sector	Commercial, Industrial	Industrial	Commercial, Industrial	Commercial, Industrial	Commercial, Industrial	Industrial
Boundaries/ Unit of Study	Equipment, buildings, facilities, business enterprises, fleets or infrastructure	Industrial Enterprises	Equipment, buildings, facilities, business enterprises	Buildings, and business enterprises	Equipment, buildings, facilities, business enterprises	Industrial facilities; planned for commercial buildings
Metrics	Energy savings, monetary savings, key performance indicators	Specific energy consumption, energy use	Energy savings, percent improvement in performance	Energy savings, GHG reductions	Energy savings, monetary savings, other metrics	Percent improvement in energy performance
Normalization Factors	Production level and rate, occupants, hours of operation, weather	Production level, product mix, partially processed products	Production level, occupants, hours of operation, weather	Production level, hours of operation	Production level, hours of operation, any relevant variables	Production level, hours of operation, weather, any relevant variables
Accuracy Measures	No specific data calibration or data validity requirements. Confirm data through energy and mass balance	No explicit data quality requirements, but a detailed process must be followed by a certified auditor.	The business owner is responsible for data quality; government surveys assess data quality	Three tiers of data quality are applied, dependent on the capacity of the participants	Data quality must be sufficient for traceability and credibility	Quality of data must be sufficient for verification; calibrated meters and sub-meters necessary.
Source (primary) or site energy accounting	Site energy typically	Site energy	Source energy in units of crude oil equivalent	Site energy	Source energy	Source energy
Exported energy accounting	Exported energy is not subtracted.	Exported energy is subtracted	Energy by-products sold are subtracted	Exported energy is subtracted	Exported energy is subtracted from incoming.	Exported energy is subtracted when energy is passed through.
Onsite solar or wind generation accounting	Counted as incoming; only site energy is counted	Not counted, unless connected to the grid	Not counted	Not counted	Counted as incoming energy	Counted as incoming energy
Feedstock accounting	Excluded from total energy consumption	Excluded from total energy consumption	Excluded from total energy consumption	Excluded from total energy consumption	Stockpiles such as coal would be included	Excluded from total energy consumption

Several common themes can be derived from the review of these country's documents.

- Availability of M&V Guidance. Each participant country has developed detailed guidance to support the calculations necessary to meet regulatory, legal, or program requirements.
- Common basis for explicit M&V planning. The countries guidance documents involved use the same basic approach for determining improvements in energy consumption. Energy efficiency savings are calculated relative to an appropriate baseline, and consumption is normalized to ensure that the comparison of the pre-condition is comparable to the conditions in the post- energy efficiency measure condition.
- Boundary Interpretation. All countries guidance documents considered the physical boundaries of buildings and facilities as acceptable boundaries, and several also considered smaller units such as equipment. Most countries guidance documents also recognized a business enterprise as a boundary.

The aspects of data quality and metrics likely could be addressed with a common approach.

- Data quality. All reviewed documents agreed on the importance of calibrated data to properly assess energy consumption. The documents address different aspects of data quality. Considering the full set of issues addressed across these documents, definitions and standards for data quality could likely be agreed upon.
- Metrics. Most of the documents reviewed focus on energy performance improvements and/or energy savings. Although there are differences in approach, the similarities suggest that metrics related to energy savings could be standardized.

Other areas are more of challenge, and finding common ground may be more difficult.

- Energy Accounting. There are many inter-related issues for energy accounting, including source versus site energy, the types of units for which M&V is conducted, treatment of onsite generation, treatment of feedstocks, and treatment of energy consumption from onsite storage. Both terminology and methodologies appear to be different across the documents reviewed. This area is complex and will require effort to come to common understandings.
- Normalization and Adjustments. Like energy accounting, the range of approaches to normalization and adjustments to baselines was fairly broad across the documents reviewed. A question to consider is what aspects of baseline normalization can and should be standardized, and what latitude needs to be allowed.

This review of several different measurement and verification documents for energy efficiency indicates that a range of approaches to encourage energy efficiency still have many common elements. Further actions could strengthen this analysis, such as expanding the number of countries, or expanding the level of detail on data qualities and metrics issues. The analysis can be used to foster collaboration on challenging M&V issues, help inform policy-makers across countries, and assist in international consensus building. As previously noted, the GSEP MVTF has already initiated work in 2013 on data quality and energy accounting, led by South Africa and Australia, respectively.

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