



Energy and Energy Management System (EnMS) Performance and Evaluation: *A Simple Framework to Identify the Progress-to-Goals of Companies*

BACKGROUND

Energy management systems (EnMSs) are a critical requirement of China's Top 10,000 Enterprise program, a pathway to fulfill the 12th Five-Year Plan and energy-intensity-reduction targets of 16% by 2016. As provincial governments establish energy conservation agreements with the largest energy-consuming enterprises, they are also seeking straightforward evaluation frameworks for successful EnMS implementation in enterprises, which will help all participating stakeholders determine progress and success in achieving energy-saving targets.

The Chinese central government has left provinces with the flexibility to make EnMS certification voluntary or mandatory. As such, Chinese provinces are faced with decisions to require enterprises to receive certification of EnMS compliance as one of the many requirements needed to score well as a Top 10,000 enterprise, or to require enterprises to pass another test that provinces will need to design and ensure that these standards are being followed by relevant agencies or experts conducting evaluations of EnMS performance.

Chinese provincial governments are currently looking for specific ideas on how different countries evaluate the energy performance of enterprises as well as how they have dealt with the evaluation of EnMSs. This memo provides information on the evaluation of an enterprise's energy performance and EnMS, as well as on the relationships between certification and other performance evaluation tools and approaches.

KEY POINTS

- As it considers how to evaluate the energy performance of companies, the Chinese government has several complementary options. The energy performance of industrial companies can be measured by looking at three elements: energy consumption and intensity; technology best practice implementation and energy management processes.
- Focusing on the energy management process, three different and complementary approaches have been developed in the United States and Ireland to evaluate energy management system (EnMS) performance: 1. self-reporting or self-declaration; 2. third-party certification of an EnMS standard; and 3. evaluation of an enterprise's EnMS maturity. Self-reporting or self-declaration is basically the first step before certification, and although certification is not required, companies that self-report their energy data are randomly audited by government agencies or mandated third parties.



- Chinese provinces are considering whether to require enterprises to receive certification of EnMS compliance or instead, to require enterprises to pass another other test that provinces will need to design.
- Evaluation of EnMS implementation through certification (or a similar governmental verification process) is recommended, because it gives provinces and the central government assurance that management and staff across a company are paying greater attention to energy and identifying opportunities for energy savings.
- Other EnMS performance evaluation methods, such as those used in the United States and in Ireland, demonstrate that the Chinese authorities could consider other approaches in lieu of, or as well as, EnMS certification. Enterprises in the United States and Ireland have the option to self-report or self-declare EnMS compliance according to specific guidelines provided by the government agency. However, the government agency reserves the right to audit the enterprises and verify that their reporting is accurate. Companies are randomly chosen for auditing.
- Although certification (or a similar governmental verification process) is a guarantee that EnMS has been implemented, Chinese authorities might also wish to evaluate and understand how sophisticated and mature enterprises are becoming with their energy management techniques (and encourage them to do so). Chinese provinces could evaluate this so-called “EnMS maturity” using a checklist or model that allows companies to gauge their current practices and where they can further enhance or optimise their energy management practices. While still in its early stages, the Ireland “Maturity Model” allows companies to assess the maturity of their EnMS.

CONTEXT

The world’s first international EnMS standard, ISO 50001, was launched in August 2011. As countries around the world begin encouraging or mandating the standard for enterprises – often as part of energy-savings agreements between enterprises and the government—it is widely seen as a mechanism for energy-efficiency best practice adoption and investment, and will help address national priorities for energy security, carbon reduction, and economic competitiveness.

The standard helps enterprises outline:¹

- Energy use and consumption
- Measurement, documentation, and reporting of energy use and consumption, including the establishment of benchmarks and key energy performance indicators (KEnPIs) of progress towards energy improvements
- Design and procurement practices for energy-using equipment, systems, and processes
- All variables affecting energy performance that can be monitored and influenced by the enterprise.

Enterprises introducing EnMSs will experience enhanced returns on energy investment in the form of improved business processes (*e.g.* production), waste reduction, labor efficiencies and capital

¹ ISO 50001 Energy Management Standard, <http://www1.eere.energy.gov/energymanagement/about.html>.



expenditures (e.g. a company’s management program may result in a need for a smaller, less expensive and energy-intensive piece of equipment based on reduced energy needs by the company). Therefore, the initial focus on energy management demonstrates the intrinsic link between energy use and productivity gains.

The pathway to reaping these enhanced returns and productivity gains begins with a straightforward assessment “checklist” to assist enterprises in understanding their current energy performance and landscape and how they are progressing throughout EnMS implementation.

ENERGY PERFORMANCE ASSESSMENT

In the development of enterprise performance assessment models, both Irish and U.S. experiences point consistently to an emphasis on management, technology and performance improvements determining the greatest results in both energy operational cost savings and greater business productivity. A company’s energy performance (see Table 1) can be assessed by looking at:

- energy consumption and performance
- technology best practice implementation
- management processes

A basic evaluation approach, illustrated in Table 1, introduces the enterprise to the concept of energy management, providing both self-assessment and third-party (or government) evaluation as enterprises progress through energy management and implementation activities. As shown in Table 1, a simplified approach to energy performance assessment may begin with three central categories and corresponding criteria for government review and/or enterprise self-assessment. In both the Irish and U.S. models, enterprises are also encouraged to freely share with other companies how they moved through the process, developing best practices and case studies along the way. The collection of actions and experiences is accumulated and promoted to encourage other enterprises to participate in EnMSs.

Table 1: Simplified approach to energy performance assessment

Program Element	Criteria	Yes	No
Energy Management System (EnMS)	Enterprise has set a goal related to energy savings/consumption.		
	Enterprise top leadership has dedicated resources (e.g. staff, budget, training, capital improvements) to achieve the energy goal.		
	Enterprise staff responsible for the goal regularly reports to top leadership on progress toward the goal.		
	Enterprise has conducted energy audit.		
	Enterprise is seeking (or achieved) EnMS standard (e.g. ISO 50001) certification.		
Technology	Enterprise made technology retrofits and has optimised energy systems.		
	Enterprise implemented technology best practices.		



Energy Savings Performance ²	Enterprise has data collection protocol and MRV system in place.		
	Enterprise defined energy intensity (EI) benchmark (energy use/product output).		
	Enterprise saved energy (annual percentage or EI factor)		

The set of criteria highlighted in Table 1 are recommended as early indicators of successful energy management corporate programs, and help support the enterprise to track and demonstrate how energy performance may have improved and is connected to the enterprise's capabilities. In the measurement of energy **savings** performance, a common metric is energy intensity, or the tonnes of coal equivalent (TCE) per unit of product output.

EnMS performance assessment varies around the world, with some countries mandating certification and others employing sophisticated methodologies and frameworks to gauge and encourage greater energy management innovation.

ASSESSING ENMS PERFORMANCE

An essential part of the process involves data collection and review, which provide a quantitative means for governments to measure compliance and verify progress toward meeting the EnMS requirements (if any) and effective adoption of EnMSs and EnMS components. Three methods may be used to assess the performance of an EnMS in an enterprise:

1. **Self-reporting or self-declaration that is auditable by government agencies and/or third parties**, whereby enterprises report their energy performance, consumption and other key performance indicators. This is often used for small and medium-sized enterprises.³
2. **Third-party certification of an EnMS standard** or verification of compliance (third party or governmental), whether voluntary or required by the government.
3. **Evaluation of an enterprise's EnMS maturity** and its integration within overall business operations (see section below).

Self-reporting is basically the first step before EnMS certification, and certification is the intermediate step towards evaluating a company's EnMS maturity. Certification gives assurance that a company has implemented an EnMS according to an international or governmental (or other agreed) standard. However, certification does not assess enterprise maturity to EnMSs nor its integration within overall business operations.

² When measuring energy savings performance, a company can measure progress against itself (historical benchmarks) or against other companies.

³ The Danish programme is built on self-reporting, with external verification and special investigations. Each enterprise submits data to the Danish Energy Agency on energy consumption and a number of other key performance indicators, either manually or through an online system. The annual reporting and follow-up on the agreements and interim targets ensure close monitoring of the progress in each individual enterprise. This approach is complemented by detailed random sample checks by independent verification agents of the enterprises' EnMSs and compliance with the agreement.



1. ENMS CERTIFICATION

One way of assessing whether enterprises have implemented EnMSs is third-party certification or verification of compliance (third party or governmental), whether voluntary or required by the government. A brief review of global protocols for certification reveals a variety of approaches to ensure EnMS adoption by enterprises.

In Ireland and the United States, voluntary government-enterprise energy-saving agreements incorporate the ISO 50001 standard as an indicator of enterprise progress toward energy-saving goals. Enterprises participating in Ireland's Energy Agreements Program (EAP) and the voluntary agreements in the United States (U.S. DOE Superior Energy Performance, SEP; Pacific Northwest U.S. agreement) are encouraged to embed energy management into long-term strategic business planning and be ISO 50001 certified to fulfill energy consumption and CO₂ reductions and corporate social responsibility goals. However, these governmental programs also allow for companies to adopt EnMS without being certified. In such cases, the enterprise self-declares its conformity with the simplified EnMS or the EnMS standard. In Ireland, the wider Large Industry Energy Network (LIEN), of which EAP is a subset, does not mandate ISO 50001 certification), but requires enterprises to declare their conformity to a simplified EnMS (Plan Do Check Act). In the U.S. SEP, so-called "Partners" can also declare that they have conformed to EnMS (as opposed to "Certified Partners" that have had their EnMS certified according to ISO 50001).

While certification standards like ISO 50001 indicate that an energy management system is in place, certification as a stand-alone is not a guarantee of complete, enterprisewide EnMS integration or continuous energy performance improvements. Nor does certification account for ongoing innovation. In some countries, notably Ireland and the United States, "maturity models" are providing useful added insights into how the continuous improvement to the EnMS itself can help companies achieve greater outcomes year over year (*i.e.* understand how the EnMS itself can be continually improved, which is a new requirement of ISO 50001).

2. ENMS MATURITY ASSESSMENT AND CORRELATION TO PERFORMANCE

The Irish and U.S. programs' greatest emphasis is on continuous energy improvement that is audited, monitored and measured over time to determine EnMS efficacy and enterprise progress. The evaluation process provides both the enterprise and the evaluator (*e.g.* third-party auditor or governmental organisation) with a consistent feedback loop on energy performance results, including areas to focus greater effort and attention. Enterprises committing to certification and continuous improvement of EnMS activities receive additional assistance in the form of technical assistance from the government.

In addition to evaluating an enterprise's compliance to the ISO 50001 standard, the Sustainable Energy Authority of Ireland (SEAI) created an EnMS maturity model. The Northwest Energy Efficiency Alliance (NEEA) in the Pacific Northwest United States developed an Industrial Energy Roadmap. The U.S. SEP programme silver, gold, or platinum designations are awarded according to the level of energy performance improvement as well as the maturity of the EnMS. Each of these models serves a diagnostic function to:

- Determine the uptake and proficiency of EnMS implementation and
- Correlate enterprise maturity to EnMS integration within overall business operations to increase (and improve) EnMS performance over time (in other words, evaluating the *process* used to manage energy, not just the energy savings alone).

The premise is that return on energy investment (and enterprise-wide energy behavior) is continuously challenged and improved when EnMS is seamlessly integrated into enterprise business operations and



management activities (e.g. workforce development and training on energy protocols). As the enterprise EnMS investment matures over time – as the company is implementing new technologies, replacing outdated technology with newer, more energy-efficient systems, and investing in energy management assets throughout the organisation – the EnMS itself becomes more sophisticated and energy savings persist.

The Irish maturity model essentially identifies how companies are progressing through different stages of EnMS adoption – aligned with the “Plan Do Check Act” (PDCA) framework – and assesses how well the enterprise is doing in each of the PDCA components. For each component, a score from 1 to 5 is given (see Table 2), ultimately resulting in a maturity map (Figure 1). Level 2 is achieved once the enterprise is certified ISO 50001.

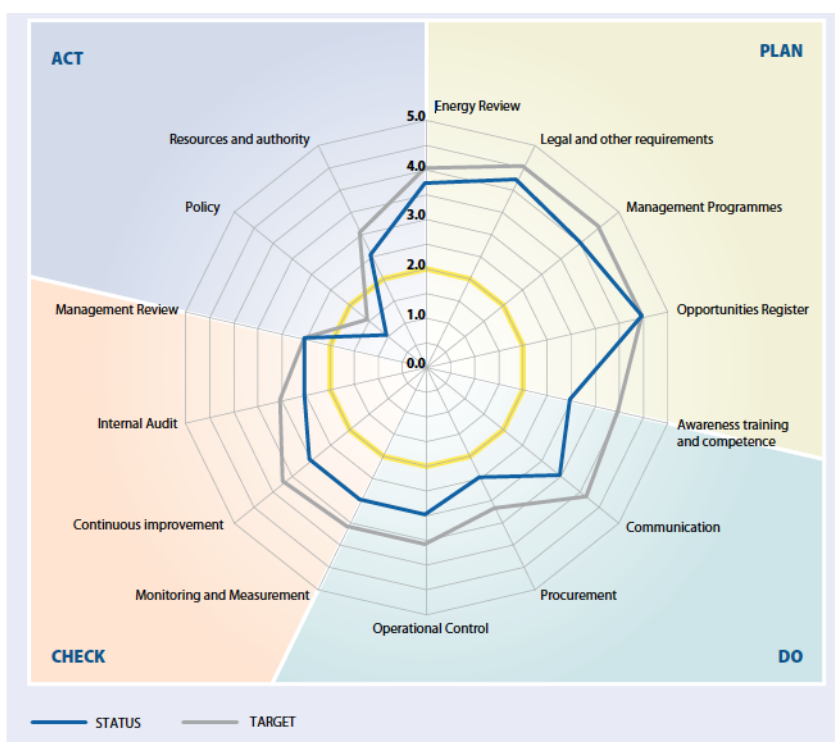
It also allows comparing differences and similarities among companies participating in the EAP. The EAP program annually collects a company questionnaire seeking information on items such as energy use and type (e.g. electricity, natural gas, etc.); level of product output; management practices; energy planning content. Companies are given an energy performance indicator (ENPI), which helps them determine their progress from the baseline year.

As illustrated in Table 2 and Figure 1, the companies participating in Ireland’s maturity model provide the enterprise as a whole with guidance on developing capabilities for EnMS – thereby demonstrating that energy performance is also improved and connected to those capabilities. Government authorities can evaluate and chart enterprise progress to facilitate needed next steps in the EnMS lifecycle.

Table 2 Energy management maturity model — levels of maturity

Level	Characteristics
1. Emerging	Contemplating an Energy Management System. Might have elements of EnMS deployed. Unstructured or informal approach in place. Very few participating in Energy management with limited or no tools.
2. Defining	Structured system in place. Management aware of Energy policy with at least one senior manager with formal responsibility. There is an Energy Management team in place. EnMS complies with Energy Management Standard.
3. Integrating	Energy Management now mainstream across organisation. Proactive management of significant energy uses. Energy considerations span functional interests with evidence of tangible site benefits.
4. Optimising	Energy managed very effectively leveraging all functions, processes and infrastructure. Culture of Energy Management embedded. Evidence of existing practices challenged and some state of the art solutions deployed. Evidence of collaboration with other participants in the supply chain or other corporate functions
5. Innovating	Innovative promotion of energy management practices is evident. Proactive Energy Management culture. External resources leveraged to develop state of the art /industry practices and solutions. Advocating Energy Management to external audiences and forming new Energy Management partnerships for innovation and R&D.

Source: SEAI Energy Management Maturity Model



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Figure 1 Energy management maturity model – output example

The NEEA Industrial Energy Roadmap⁴ defines the basic steps required to develop and implement a strategic energy management plan in participating companies (modeled after ISO 50001). The Roadmap functions at both an industry sector and individual company level. Sector monitoring and evaluation aggregate energy-intensity data of enterprises to illustrate industry-wide progress. At the same time, individual enterprises can implement and chart their own progress and measure energy productivity against the industry sector benchmarks.

The Roadmap outlines an Energy Efficiency Self-Assessment to help enterprises gauge their current level of energy-efficiency efforts and understand how energy is viewed within the organisation. Similar to the Irish model, the NEEA Roadmap Self-Assessment helps both enterprise and evaluator establish a level of sophistication with EnMS, to create a roadmap on EnMS implementation improvement.

FINDINGS FOR CHINA

- As the Chinese government is currently considering how to evaluate the energy performance of companies, several complementary options are available to them. Energy performance of industrial companies can be measured by looking at three elements: energy consumption and intensity; technology best practice implementation and energy management processes.
- Chinese provinces are also considering whether to require enterprises to receive certification of EnMS compliance, or instead, to require enterprises to pass another other

⁴ The Northwest Food Processors' Energy Roadmap is a tool developed collaboratively between NEEA and the NWFPA to ensure that member enterprises have a trusted guideline and available resources to set appropriate energy reduction goals, and the resources to implement an energy management program, http://www.nwfpa.org/images/pdfs/NWFPA%20Energy%20Roadmap_FINAL.pdf



test that provinces will need to design. EnMS performance evaluation methods used in the United States and in Ireland demonstrate that the Chinese authorities could consider other approaches in lieu of, or as well as, EnMS certification. Enterprises in Ireland and the United States have the option to self-report or self-declare EnMS compliance according to specific guidelines provided by the government agency. However, the government agency reserves the right to audit the enterprises and verify that their reporting is accurate. Companies are randomly chosen for auditing.

- Beyond the evaluation of EnMS implementation through certification (or a similar governmental verification process), Chinese authorities might also wish to evaluate and understand how sophisticated and mature companies are becoming with their energy management techniques (and to encourage this maturity). Chinese provinces could evaluate EnMS maturity using a checklist or model that allows companies to gauge their current practices and where they can further enhance or optimise their energy management practices.