

Recommendations on Job-Specific Knowledge and Skill Areas for Energy Management System Implementation in Industry and Commercial Buildings: Results from a Global Superior Energy Performance Multi-Country Analysis

*Graziella Siciliano, U.S. Department of Energy
Vestal Tutterow, Project Performance Company
Pamela de los Reyes, Energetics Incorporated*

ABSTRACT

The Global Superior Energy Performance Partnership (GSEP) works to significantly cut global energy use by encouraging industrial facilities and commercial buildings to pursue continual improvement in energy efficiency through energy management systems (EnMS) implementation (CEM, 2013). One key challenge is that many companies lack the specialized in-house expertise needed to implement quality EnMS. To address this challenge, GSEP offers recommendations on the specific knowledge and skill areas needed by personnel in positions likely to influence energy decision-making within a company. These job-specific recommendations are based on an inventory of relevant knowledge and skill areas prescribed by existing workforce training programs in five GSEP member countries: Australia, Japan, Korea, South Africa, and the United States.

Key audiences for these recommendations include national or local government agencies, academia, professional associations, and companies seeking to develop or improve education or training programs for a range of company personnel. Ultimately, a skilled and informed workforce will find and capture more opportunities to save energy, which can contribute greatly to achieving national energy efficiency goals. Further international collaboration through GSEP will disseminate and expand on this guidance to help to build workforce capacity to successfully implement EnMS and capture savings.

Introduction

The Global Superior Energy Performance Partnership (GSEP) is one of 13 ongoing initiatives of the Clean Energy Ministerial (CEM). GSEP's Energy Management Working Group (EMWG), which has eleven member countries¹, encourages industrial facilities and commercial buildings to continually improve their energy performance by implementing energy management systems (EnMS), such as ISO 50001. A key focus of the GSEP EMWG is helping countries better prepare their workforces to successfully implement and manage an EnMS.

Energy management represents a significant opportunity for organizations to reduce energy use while maintaining or boosting productivity. Industrial facilities and commercial buildings account for almost 30% and 9% of global energy end use, respectively (EIA, 2011; IEA, 2007). These sectors can potentially reduce their energy use by 10% to 40% simply by adopting effective EnMS (Duarte et al. 2011; IEA and IIP, 2012). EnMS allow commercial, institutional, and governmental facilities; industrial plants; and entire organizations to

¹ Australia, Canada, Denmark, European Commission, India, Japan, Mexico, Republic of Korea, South Africa, Sweden, United States

systematically track, analyze, and plan their energy use—enabling greater control of and continual improvement in energy performance.

Specific expertise and skills are required to effectively implement ISO 50001 or other EnMS standards. Organizations will increase the effectiveness of their EnMS and their energy savings by seeking specialized outside assistance *or* enhancing the relevant skills of a range of their employees. While energy management expertise is typically concentrated in technical and engineering positions within an organization, a variety of non-technical personnel also exert significant influence on energy decision-making, e.g. executive staff, accountants, and financial managers. While these non-technical staff members need not be knowledgeable in all aspects of energy management, they are critical to the success of an EnMS within their organization.

Many longstanding professional training or credentialing programs cover some skills or knowledge areas relevant to energy assessment and management, but most fall short of providing the entire spectrum of skills and expertise for effective decision-making in these areas. Workforce development programs that focus specifically on EnMS implementation, for instance those established in response to the 2011 publication of ISO 50001, remain in the early stages of development or release, and most do not provide training for the broader range of personnel involved in instituting energy management at the organizational level. To assist these and future programs in developing comprehensive curricula, GSEP has identified relevant skill sets and knowledge bases for individuals in a variety of positions critical to the success of EnMS in industrial facilities and commercial buildings.

GSEP member are working to encourage curriculum developers, including national or local government agencies, academia, professional associations, and companies in their countries to use the recommendations and source materials in this report to develop or improve their education and training programs on energy management. GSEP plans to continually expand on these resources and will look for ways to bolster efforts to enhance workforce training.

Multi-Country Analysis Sources and Methodology

The GSEP EMWG Qualified Workforce Task Force inventoried the knowledge and skill areas addressed by existing workforce training programs related to energy assessment and management in five member countries: Australia, Japan, Korea, South Africa, and the United States (Table 1). Task force members shared workforce training program documents, existing legislation, and reports identifying the required or desired skills, then identified the common knowledge and skill areas. Based on this inventory, the task force recommends the most relevant knowledge and skill areas for individuals in a variety of positions that could be critical to the successful implementation of an EnMS.

Table 1. Workforce Training in the GSEP EMWG Qualified Workforce Task Force Inventory/Analysis of Energy Management Knowledge and Skills

GSEP EMWG Country	Workforce Training Topic, Program, or Document
Australia	Australian Functional Skills for an Energy Efficiency Assessment http://eex.gov.au/files/2012/01/33-Functional-Skills1.pdf
	Leadership & Change for Energy Efficiency in Accounting & Management: Training Needs Analysis http://www.business.uts.edu.au/energyefficiency/documents/training_needs_analysis.pdf
	Accounting for Climate Change: How management accountants can help organisations mitigate and adapt to climate change http://www.cimaglobal.com/Documents/Thought_leadership_docs/Sustainability%20and%20Climate%20Change/CIMA_Accounting%20for%20sustainability%20amended%20Feb%202010%20FINAL.pdf
Korea	Training course for energy practitioners*
Japan	Qualified Energy Manager* according to Energy Conservation Law, Japan http://www.eccj.or.jp/law/e-law.html
	Japan Energy Conservation Handbook 2011 http://www.asiaeec-col.eccj.or.jp/databook/2011/index.html
South Africa	Needs Analysis for Training of Energy Auditors, Energy Managers and M&V Professionals in the Building Sector*
	Green Skills: Baseline Overview for Skills Development for Renewable Energy and Energy Efficiency*
United States	Certified Practitioner in Energy Management Systems: Body of Knowledge http://ienmp.com/Body%20of%20Knowledge.pdf
	U.S. Department of Energy (DOE) draft Job Task Analysis (JTA) for energy/sustainability manager http://www.eere.energy.gov/buildings/commercial_initiative/pdfs/energy_manager_jta_comment.pdf
	U.S. DOE draft JTA for a Facility Manager http://www.eere.energy.gov/buildings/commercial_initiative/pdfs/facility_manager_jta_comment.pdf
	Study guide for Association for Energy Engineers Certified Energy Manager, CEM® http://www.aeecenter.org/files/certification/cem-studyguidepartc.pdf
	ASHRAE Building Energy Assessment Professional Certification Exam Outline https://www.ashrae.org/education--certification/certification/building-energy-assessment-professional-certification
	ASHRAE Operations & Performance Management Professional Certification Exam Outline https://www.ashrae.org/education--certification/certification/operations-and-performance-management-professional-certification
	Building Owners and Managers Association (BOMA) Energy Efficiency Program (BEEP) Curriculum outline http://www.boma.org/education/onlinelearning/beep/Pages/Curriculum%20and%20Registration.aspx
	BOMI International Facilities Management Certificate course requirements http://www.bomi.org/Students/Educational-Offerings/Designations-and-Certificates/Certificate-Programs/Facilities-Management-Certificate-%28FMC%29.aspx
	International Facility Management Association (IFMA) Facility Management Professional credential course outline http://www.ifmacredentials.org/fmp/ IFMA Sustainability Facility Professional credential http://www.ifmacredentials.org/sfp/webinars/sfp-webinar-slides.pdf

Note: Many of these materials are publicly available. An asterisk (*) indicates materials that were shared by members of the GSEP EMWG Qualified Workforce Task Force for this initial analysis but that may not be widely available at this time. Additional countries and workforce training efforts may be added to subsequent GSEP EMWG analyses and activities.

Job-Specific Knowledge and Skill Areas in EnMS

Some organizations appoint a Corporate Energy Manager or other individual dedicated to energy management or energy efficiency, though this position is less common at many small- and mid-sized organizations. Whether or not an organization has a dedicated energy manager, other key personnel can also greatly affect energy management planning, review, and implementation. Individuals in these positions who are knowledgeable in certain aspects of energy management can be critical to the success of an energy management program. The GSEP EMWG Qualified Workforce Task Force identifies the following positions commonly held by these influential personnel:

- Chief Financial Officer
- Sustainability Officer
- Accountants and Financial Staff
- Environmental, Health, and Safety Professionals
- Engineers: Industrial, Mechanical, and Electrical
- Tradespeople and Technicians

The following pages identify the primary knowledge and skill areas that are essential for these key personnel to adequately understand EnMS and effectively contribute to an organization's energy management efforts. Secondary knowledge and skill areas are also identified.

Chief Financial Officers

Chief Financial Officers (CFO) play a variety of roles within organizations and are responsible for ensuring that capital investments are based on sound financial criteria (Ernst & Young, 2012). Implementation of an EnMS may lead to identification of capital projects, requiring the CFO to make capital investments based on a foundation of financial principles and financing options for these types of investments.. Risk management skills are essential when companies consider long term fuel procurements, energy service contracts, or the adoption of new technologies, for example.

CFOs should also be able to establish policies and lead new initiatives to finance aspects of energy management (Ernst & Young, 2012). The CFO should provide leadership to the energy team as it develops financial analyses, including methodologies to normalize energy investments for comparison with other capital investments. Environmental impacts, maintenance, and other factors must be properly considered.

The GSEP Qualified Workforce Task Force identifies the following energy management knowledge and skill areas as relevant to CFOs (Table 2). Duties will vary among organizations and among personnel within finance departments, but these areas are broadly relevant to these professionals.

Table 2. Primary Knowledge and Skill Areas in Energy Management Relevant to Chief Financial Officers

Management Skills		
Business case development	Change management	Innovation
Integrating energy management into operational procedures and KPIs		
Financial and accounting skills		
Financial management	Accounting principles	Energy management economics
Risk management	Financial decision-making	Energy efficiency tax incentives
Financial analyses	Cost-benefit analyses	Financing of capital projects
Interpreting forecasts	Energy accounting	
Analytical skills		
Identifying “out-of-box” solutions		
Procurement knowledge		
Energy procurement	Electricity markets	Utility contracts, tariffs, rate structures

Sustainability Officers

Many large organizations now designate a senior-level executive with the broad responsibilities to improve the sustainability of the overall organization. These executives tend to have such job titles as Chief Sustainability Officer, Sustainability Manager, or Vice President for Sustainability. The roles of individuals in these positions and the definitions of sustainability are evolving; they can vary widely by company according to priorities. Key responsibilities typically include energy management, environmental compliance, waste management, water conservation, carbon management, environmentally preferred purchasing, and supply chain engagement.

Sustainability Officers need to understand all aspects of energy management and the effects of energy decisions on the organization, especially if the company does not have a designated Corporate Energy Manager. When appointing a Sustainability Officer, companies typically seek a long-term employee who understands the organization’s operations, structure, culture, and products. Although specific roles and responsibilities may vary across organizations, common competencies are listed in Table 3.

Table 3. Primary Knowledge and Skill Areas in Energy Management Relevant to Sustainability Officers

Management Skills		
Business case development	Change management	Decision-making fundamentals
Developing multi-disciplinary teams	Bridging organizational barriers	Organizational & leadership skills
Communications planning	Stakeholder engagement	Determining stakeholder roles
Contract management	Facilitation & negotiation	Project planning & management
Financial and accounting skills		
Financial management	Accounting principles	Energy management economics
Risk management	Financial decision-making	Energy accounting
Financial analyses	Cost-benefit analyses	Financing of capital projects
Analytical skills		
Problem-solving	Benchmarking	Identifying “out-of-box” solutions
Interpreting forecasts	Life cycle cost analyses	
Energy Management Knowledge		
Energy fundamentals	Energy project planning	Energy review and analysis
Energy management policy development	Energy awareness-building	Energy data management, tracking and reporting
Energy metrics	Energy data analysis	Utility incentive programs
Energy optimization		
Technical Knowledge		
Facility planning	Building operations	Systems interoperability
Operations & maintenance practices	Energy-using systems	Building energy audits
Building energy modeling	Systems optimization	
Regulatory, Standards, and Best Practices		
Federal, state, and local energy legislation & policies	Environmental regulations	Building codes
Federal, state, and local green building standards & programs		
Procurement knowledge		
Energy procurement	Electricity markets	Utility contracts, tariffs, rate structures
Other Knowledge and Skill Areas		
Communication	Integrating energy management into operational procedures and KPIs	Critical thinking
Personnel motivation	Report development	Information management

Secondary areas.

- *Greenhouse gases/carbon:* risks associated with climate change; calculating GHG and carbon emissions; carbon markets, carbon finance, and the carbon project development process
- *Regulations, standards and best practices:* local sustainability codes and requirements; sustainability standards and best practices; water management best practices
- *Other knowledge and skill areas:* corporate social responsibility; economic regulation of utilities; building commissioning; policy interventions to promote renewable energy value chains; local recycling and waste management operations; greening of office space (recycling, cleaning, supplies, transport and commuting)

Accounting and Financial Professionals

Accounting and financial professionals can provide critical skills, such as quantifying the economic costs and benefits of energy optimization measures (Table 4). They also maintain direct communication with top management and can convey the importance of energy-related expenditures. With the growing importance of energy management, sustainability, and corporate social responsibility (CSR), accounting and financial professionals will need to become more informed about the basics of EnMS, energy optimization strategies, and energy accounting. To build the business case for energy projects, they may need to conduct life-cycle cost analyses and show how the projects lower exposure to risk. These personnel are also often expected to contribute to annual reports, CSR reports, and other reporting documents that should include energy performance or savings.

Table 4. Primary Knowledge and Skill Areas in Energy Management Relevant to Accounting and Financial Professionals

Management Skills		
Business case development	Stakeholder engagement	Decision-making fundamentals
Bridging organizational barriers		
Financial and accounting skills		
Financial management	Accounting principles	Energy management economics
Risk management	Financial decision-making	Energy accounting
Financial analyses	Cost-benefit analyses	Financing of capital projects
Cost control and budgeting		
Analytical skills		
Problem-solving	Statistical modeling	Life cycle cost analyses
Cumulative sum control charts		
Other Knowledge and Skill Areas		
Communication	Organizational skills	Critical thinking
Energy metrics	Energy procurement	Information management
Energy project costing	Integrating energy management into operational procedures and KPIs	

Secondary areas. Understanding ISO management systems; energy management basics; ISO 50001 concepts; system optimization fundamentals; energy economics fundamentals

Environmental, Health, and Safety (EH&S) Professionals

The roles of Environmental, Health, and Safety (EH&S) professionals vary according to the type and size of their organization. Some organizations place energy management responsibility within the EH&S department. EH&S professionals need to understand federal, state, and local environmental regulations and reporting requirements relevant to their organization's processes, as well as the regulatory implications of energy optimization projects (e.g., boiler system replacement). These professionals should also understand and be able to assess the built environments within their organizations, such as the impact of heating, ventilating, and air conditioning renovations on indoor air quality. In addition, EH&S professionals may be expected to collaborate across departments and communicate with all levels of personnel in the organization.

Over time, ISO 50001 is expected to increase the overlap between energy- and environment-related duties and responsibilities. Professionals using the ISO 14001 framework are more likely to be assigned responsibility for implementing ISO 50001. Relevant expertise and skill areas are listed in Table 5.

Table 5. Primary Knowledge and Skill Areas in Energy Management Relevant to Environmental, Health, and Safety Professionals

Management Skills		
Communications planning	Change management	Decision-making fundamentals
Developing multi-disciplinary teams	Bridging organizational barriers	Organizational & leadership skills
Project planning & management		
Financial and accounting skills		
Financial decision-making	Cost-benefit analyses	Financial analyses
Risk management		
Analytical skills		
“whole-of-systems” analysis	Identifying “out-of-box” solutions	
Technical Knowledge		
Facility planning	Energy-using systems	Indoor air quality control
Systems optimization		
Regulatory, Standards, and Best Practices		
National energy reporting systems	Federal, state, and local environmental regulations	HVAC and indoor air quality standards and best practices
Procurement knowledge		
Energy procurement	Electricity markets	Utility contracts, tariffs, rate structures
Other Knowledge and Skill Areas		
Communication	Integrating energy management into operational procedures and KPIs	Critical thinking
Personnel motivation	Report development	Information management

Secondary areas.

- *Greenhouse gases/carbon*: carbon markets, carbon finance, and carbon project development process; national greenhouse gas reporting systems; reducing risks associated with climate change; calculating GHG emissions and carbon footprints
- *Regulations, standards, and best practices*: sustainability statutes, codes, and requirements; sustainability standards and best practices; water management best practices
- *Other knowledge and skill areas*: corporate social responsibility; local recycling capabilities; local waste management operations; environmentally responsible office spaces

Industrial, Mechanical, and Electrical Engineers

Industrial, mechanical, and electrical engineers responsible for the operation of commercial buildings and industrial facilities must possess a variety of technical skills, understand the operation of several systems, and the effects of operation on production, energy use, and EH&S issues. Engineers are often responsible for measuring and monitoring energy use in buildings and industrial processes and performing analyses of the collected data to identify

maintenance, reliability, and safety issues—in addition to identifying energy optimization opportunities.

The growing complexity of organizations and facilities makes it increasingly important for engineers to communicate effectively with other personnel within their organizations, such as facilities managers, EH&S professionals, and corporate decision-makers. A significant portion of the workforce training programs reviewed in this analysis focus on the skills and knowledge areas required by industrial, mechanical, and electrical engineers, indicating the critical roles of these personnel in successfully implementing an EnMS (Table 6).

Table 6. Primary Knowledge and Skill Areas in Energy Management Relevant to Industrial, Mechanical, and Electrical Engineers

Management Skills		
Stakeholder engagement	Facility planning	Project planning & management
Financial and accounting skills		
Energy accounting	Cost-benefit analyses	Energy management economics
Analytical skills		
“whole-of-systems” analysis	Statistical analyses	Identifying “out-of-box” solutions
Energy Management Knowledge		
Energy fundamentals	Energy project planning	Energy review and analysis
Systems optimization	Energy data analysis	System assessments & planning
Energy metrics	Energy mass balance diagrams and models	Industry scorecards and dashboards
Energy data management, tracking and reporting		
Technical Knowledge		
Facility planning	Building operations	Systems interoperability
Operations & maintenance practices	Energy-using systems	Building energy audits
Equipment operation	Power systems analysis	New and emerging technologies
Energy data measurement, collection and analysis	Energy metering, monitoring, and verification	Thermodynamics and heat transfer
Building energy modeling	Systems optimization	Instrumentation and controls
Commissioning principles	Combined heat & power	Electrical systems evaluation
Regulatory, Standards, and Best Practices		
Federal, state, and local building regulations and codes	Federal, state, and local energy regulations and laws	Federal, state, and local green building programs
Energy management systems	HVAC and indoor air quality standards	Energy measurement and verification guides and protocols
Other Knowledge and Skill Areas		
Communication	Problem-solving skills	Critical thinking

Secondary areas. Renewable energy fundamentals; indoor air quality control; sustainability standards and best practices; water management best practices

Technicians and Tradespeople

Technicians and tradespeople, such as electricians, HVAC technicians, and maintenance personnel, are responsible for the daily operation of energy-using equipment and processes. At many small and medium-sized facilities, these technicians need a wide range of skills as they often shoulder many of the responsibilities that an energy manager would have at a larger facility.

Maintenance personnel must fully understand the impacts of maintenance on system efficiency and reliability. The roles of technicians and tradespeople are evolving with the increasing deployment of automation in buildings and facilities. These individuals operate increasingly sophisticated computerized energy monitoring systems, electrical distribution systems, HVAC systems, and metering equipment. At many facilities, these personnel must be familiar with local, state, and federal regulations, including those related to environment, health, and safety.

In addition to technical skills, technicians and tradespeople must possess good communication skills to maintain regular contact with equipment operators or office staff. They can play significant roles in creating awareness of the benefits of energy management as well as in facilitating culture change within an organization. Finally, as the responsibilities assigned to these technicians grow, their need for critical thinking and problem-solving skills also grows.

The areas listed in Table 7 are relevant to technicians and tradespeople. Due to areas of specialization (e.g., electricians or HVAC technicians), not every type of technician or tradesperson will need to be knowledgeable in all of these areas.

Table 7. Primary Knowledge and Skill Areas in Energy Management Relevant to Technicians and Tradespeople

Technical Knowledge		
Equipment & systems operation	Building operations	Systems interoperability
Operations & maintenance practices	Building construction techniques	Energy data measurement and collection
Energy fundamentals	Industrial processes	Energy auditing
Energy metrics	Systems optimization	Energy demand management
Energy metering, monitoring, and verification	Domestic water systems	Electrical systems evaluation
Instrumentation and controls	Power factor control	Combined heat & power
Regulatory, Standards, and Best Practices		
Federal, state, and local building regulations and codes	HVAC and indoor air quality standards	
Federal, state, and local energy regulations and laws	Energy measurement and verification guides and protocols	
Other Knowledge and Skill Areas		
Organizational skills	Energy project cost estimating	System operating costs

Secondary areas.

- *Technical knowledge*: commissioning principles; thermal energy storage systems
- *Energy management knowledge*: identifying significant energy usage; establishing energy performance indicators; develop and implement data management, tracking and reporting systems; facilitate and manage energy-efficiency opportunities identification process; energy savings calculation; manage energy efficiency opportunity implementation; performance improvement
- *Regulations, standards, and best practices*: environmental regulations; indoor air quality; plumbing systems and codes; water management best practices
- *Other knowledge and skill areas*: communication; critical thinking; interpersonal skills; information management principles

Conclusion

ISO 50001 and similar EnMS standards enable organizations to engage staff at all levels to assess and better manage energy on an ongoing basis. GSEP recognizes inadequate workforce knowledge and training as potential barriers to successful EnMS implementation. Through GSEP, member countries share their experiences and collaborate on efforts to strengthen national workforce capacity to implement EnMS. Collectively, these efforts will help countries foster continual energy improvement in the industrial and commercial buildings sectors and help meet national energy and climate mitigation goals.

As a first step in these efforts, GSEP has recommended specific knowledge and skill areas needed by personnel who can influence energy decision-making within an industrial facility or commercial building. Workforce development programs are encouraged to apply these recommendations to better prepare individuals to facilitate continual improvement in energy performance. In addition, this analysis should raise awareness that a variety of employees need to be engaged to create institutional change and meaningfully impact energy efficiency within an organization.

GSEP plans to further develop and expand these knowledge and skill areas based on supplemental information that becomes available from other countries and workforce training programs. In addition, future collaborative efforts will address broader opportunities to enhance workforce training programs, which may include developing supportive policies, incentives, training deployment, and workforce outreach strategies.

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