Chapter 90
Contemporary Energy Management Systems and Future Prospects

Amir Manzoor
https://orcid.org/0000-0002-3094-768X
Bahria University, Pakistan

ABSTRACT

The transformation of electric grid into smart grid has improved management of available resources and increased energy efficiency. Energy management systems (EMS) play an important role in enhancing user participation in control of energy management. Using such systems, consumers can obtain information about their energy consumption patterns and shape their energy consumption behaviors for efficient energy utilization. Contemporary EMS utilizes advanced analytics and ICT to provide consumers actionable feedback and control of energy management. These systems provide high availability, an easy-to-use user interface, security, and privacy. This chapter explores the contemporary EMS, their applications, classifications, standards, and frameworks. The chapter defines a set of requirements for EMS and provides feature comparison of various EMS. The chapter also discusses emerging trends and future research areas in EMS.

1. INTRODUCTION

Energy management is a term that has a number of meanings. In this chapter, we define energy management as saving energy in businesses, public-sector/government organizations, and homes. According to this definition, energy management is the process of monitoring, controlling, and conserving energy in a building or organization. Typically, this involves the following steps:

1. Metering energy consumption and collecting the data
2. Finding opportunities to save energy, and estimating how much energy each opportunity could save
3. Taking action to target opportunities of saving energy
4. Tracking progress by analyzing meter data to see how well energy-saving efforts have worked

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Energy management, as the means to controlling and reducing energy consumption, is important because it enables consumers to:

1. Reduce costs – this is becoming increasingly important as energy costs rise.
2. Reduce carbon emissions and the environmental damage that they cause - as well as the cost-related implications of carbon taxes and the like. Organization may be keen to reduce their carbon footprint to promote a green, sustainable image. Not least because promoting such an image is often good for the bottom line.
3. Reduce risk – the more the energy consumed, the greater the risk that energy price increases or supply shortages could have serious impact on profitability, or even continuation of business. With energy management, the risk can be reduced by reducing demand for energy and by controlling it making it more predictable.

Today's global environment is characterized by soaring energy prices and increasing environmental regulations. To remain competitive in today's global and competitive economy, a quick analysis and close control of operating costs is critical. A common approach is to lowering energy costs while reducing energy consumption and minimizing the environmental impact of energy use. In USA, various policy initiatives (such as the Energy Policy Act, the American Competitiveness Initiative and the Advanced Energy Initiative) have been taken as part of an aggressive strategy for tackling the long-term energy challenges (US Energy Department, 2005). Under the Energy Policy Act, businesses can get deductions for new or renovated buildings that save 50% or more of projected annual energy costs for heating, cooling, and lighting compared with model national standards. Businesses can also get partial deductions for efficiency improvements to individual lighting, HVAC and water heating, or envelope systems (US Department of Housing, 2006). The US Energy Policy Act of 2005 requires that federal buildings be energy efficient and strongly recommends that private enterprises follow suit. Its strong emphasis is on implementing energy-efficient and savings processes and equipment. The American Recovery and Reinvestment Act provide the details and envision a modernized, more energy-efficient America through targeted investments in updating infrastructure. Sweeping privatization, deregulation, and re-regulation initiatives have radically altered the competitive landscape of the electric utility business. Deregulation in wholesale power markets has resulted in a tenfold increase in the number of interchange transactions. The combined effects of weather and forced outages have created congestion driving wholesale spot prices to all-time highs. Competition is fierce and there exist great security challenges to security of critical infrastructure and IT systems used to manage power systems. The electric utilities are facing greater challenges having a critical balance among cost reduction, maximization of existing assets, and maintenance of adequate security margins (Bose, Wu, Wierman, & Mohsenian-Rad, 2014). Energy management is a common practice for larger buildings. Energy management at homes is a recent trend. Many home users still follow a haphazard energy management. However, most of the energy management principles that apply to businesses and other organizations are also applicable to homes (Energylens.com, 2015).

Evolution of the smart grid has attracted energy professional worldwide. It is a modern power grid capable of supporting two-way communication between energy providers and consumers. Its significant features include fine-grained metering, control, and feedback, and enhanced energy efficiency, and management of available energy resources. Energy management systems (EMS) are an important tool to control home energy consumption. EMS often integrated with home automation systems and allows consumers to understand, control, and optimize energy consumption e.g. energy consumption control