Chapter 14
Decision Making for Energy Management in Smart Grid

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ABSTRACT
The chapter discusses the problem of energy management in Smart MicroGrid. The strategies of Smart MicroGrid energy management and objectives of Smart MicroGrid operation have been analyzed. The chapter emphasizes the potential of information technologies implementation to achieve energy management goals and provide a description of energy management information system which is used for MicroGrid planning and operation. The information flows which are used for making decision on Smart MicroGrid energy management have been analyzed.

INTRODUCTION
Nowadays there is a trend of Industry 4.0 concept’s implementation in manufacturing and production. It involves the usage of intelligent technologies to increase the degree of automation and digitization of these processes. Industry 4.0 solutions are intended to improve operations efficiency, productivity, product quality, inventory management, asset utilization and environmental sustainability.

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In the Industry 4.0 development, energy management and energy efficiency overall have taken center stage. The rising of energy costs and strict environmental regulations cause the growing need for increased efficiency in the use of resources and make energy-efficient solutions essential. So, the significance of technology-driven innovations intended to energy saving such as Smart Grid is growing.

Smart Grid is not just a compilation of smart meters or other electric devices. It is rather a series of technologies that allow government and companies to integrate, interface with and intelligently control all these innovations. As the technology evolves, the Smart Grid will allow a two way flow of electricity and information that is capable of monitoring everything from power plants to customer preferences and individual equipment.

Smart Grid is intended to provide real-time data about near instantaneous balance of energy supply and demand. Managing the data used to operate and maintain the Smart Grid system requires data analysis and decision making support tools to achieve the reliability of the energy network by easing peak demands and improving energy efficiency.

One of the ways to increase the energy efficiency of Smart Grid implementation is its integration with renewable energy sources (RES). The planning and operation of renewable energy based Smart Grid requires development energy management tools which are information systems for decision support of planning the optimal structure of renewable energy system and analysis energy production and consumers’ energy demand.

The Chapter will cover the wide range of the investigation of the state of the subject field “Decision making for energy management in Smart Grid”. It will focus on determination the relevance of renewable energy based Smart Grid implementation. It will explore existing approaches to energy management of Smart Grid and analyze information flows in Smart Grid. The IT solutions for making decision support on Smart Grid planning and operation will be presented.

The chapter is organized as follows. In background section the current state of Industry 4.0 concept implementation for energy management is given. The overview of Smart Grid as a part of Industry 4.0, the analysis of energy management strategies of renewable energy based Smart Grid, the identification the uncertainty and risks in decision-making at management of information flows in the Smart Grid, the description of existing methods and intelligent solutions which can be applied in the Decision Support System for planning and operation of Smart Grid are presented in next sections.

BACKGROUND

Over the last years technical, economic and market transformation of the electric power sector connected with development concept of renewable energy Smart Grid have accelerated around the world. It is caused by growing energy demand in developing and emerging economies and trends in energy saving. Many countries have begun to respond to the challenge of power grid change. Consequently, new markets for both centralized and distributed renewable energy are emerging in all regions. Usage of renewable energy sources aims to meet a higher share of energy demand and provide reducing pollution and fuel poverty. According to Renewables Global Status Reports of REN21, renewable energy has growing in capacity and production for last several years. The estimated renewable energy share of global electricity production for recent fifteen years year is shown in fig.1 (Energy Efficiency Market Reports, 2002-2017).