Chapter 14
Business Models for Energy Storage

Adrian Tantau
Bucharest University of Economic Studies, Romania

Laurenţiu Cătălin Frăţilă
Bucharest University of Economic Studies, Romania

ABSTRACT

Energy storage is an important component of the renewable energy system. Besides the economic advantages of this process, to delivery energy when have high price, there are diverse advantages: from the technical issues concerning network (frequency control, voltage control, management of peak demand) to development of performant industries (electronic industry, car industry). There are presented the main technologies of energy storage: mechanical, electromechanical, electrical, thermal and chemical technologies, with their advantages and limitations. Application of business-sided models, customer-sided and hybrid business models, models with theoretical and practical consistency, are analyzed in terms of their position towards the meter and the methods of settlements. The main objective of this chapter is to understand the concept of energy storage in its complexity, as important element of renewable energy system, applied in various business models and as element of influence over economic dynamics, by their opportunities and new business ideas.

ENERGY STORAGE AS COMPONENT OF RENEWABLE ENERGY SYSTEM

The objective of this subchapter is to make a classification of the energy storage sources, to present the technologies used in the domain and to underline the benefits of using energy storage devices.

The Concept of Energy Storage

Electricity is a consumable resource that is produced from fossil fuels or from renewable energy sources. In the production and distribution of electricity, it must consider two aspects: energy must be consumed when it is produced and often, the place of production of electricity is different from the consumption thereof. These issues are reflected on the way the electricity is produced and on its management.

DOI: 10.4018/978-1-5225-9615-8.ch014

Power demand varies during each day, depending on the demands of the consumers which are connected to the electricity grid. When the demand is higher, the electricity price increases and when the demand is low, the electricity price decreases. These price differences are significant and are determined by the cost of generated electricity in each period. These are reflected in the revenues of the implemented business model. During peak periods the electricity consumption increase significantly in comparison with the average consumption and the energy supplied by the base-load power plants (such as power plants based on coal-fired and nuclear) must be completed with the energy generated by other sources. These energy sources can be independent energy sources, such as diesel and gasfired generators or sources of electrical energy storage. The main criteria for selection are supplied energy costs and response time to demands on the grid.

When discuss about the ratio between demand and supply of electricity, an element that can not be underestimated concerns how this report will affect the quality of electricity, in terms of voltage and frequency, how can affect the functioning of equipment connected to the grid. Voltage or frequency of electricity supplied outside the accepted range can have negative consequences on the functioning of devices connected to the network. Moreover, in the conditions of using an older infrastructure, a very high energy demand at a specific location or consumer can cause an overloading or a congestion of one or more transmission lines. This can lead to temporary interruption of the transmission and other electricity supply interruption at that location.

During the off-peak period, will be consumed less electricity and different power plants may have various behaviors. Some of them may slow production or even stop production (power plants based on burning fossil fuels, hydro) but others will produce at the same parameters (nuclear power plants). In some cases, slowing or stopping the production can generate higher expenses for returning to the initial production parameters, than the energy production at constant parameters, even though the energy price is lower. In other cases, e.g. wind power plants, the energy will be produced depending on the speed and direction of wind, beeing independent on the energy demands. In this case we can talk about a power plant behavior that is independent of energy demands on the network. At this moment energy storage devices become very important. They act in two stages. In the first stage the energy storage devices are loaded with the energy produced by the power plant or energy from the network. In the second stage energy storage devices provides energy to network. The charging of storage devices happens during the off-peak period and when the network can not take the total amount of energy produced. Supplying energy to network is done during the on-peak period when the demand is higher and the price of energy is higher, too.

In terms of geographic location, these devices can be located near a power plant or another independent location from power source. During peak periods, if the power plant reacts slowly and cannot cover the power demands in the network, it is indicated that these devices to be located near them. Thus, the stored energy from the devices will supply the uncovered demand in the grid. It is a process more economical and easier to manage. If power plant react rapid and flexibly to the demands of energy, it is not require the localization of such devices near the power plant.

Technologies of Energy Storage

Taken into account the capability to dispatching electricity in time, combining with the flexibility of the sistem, the energy storage technologies are divided in two main types: *conventional*, capable to dispatching electricity in hours but less flexible in supplying energy, and *advanced energy storage technologies*,