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Analyis of a Potential Single and Combined Business Model for Stationary Battery Storage Systems

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Abstract

With regard to a successive penetration of renewable energies and the implied need for system flexibility, stationary battery storage systems (BSS) are seen as hybrids, which can manoeuvre either on the demand or on the supply side, due to the bidirectional transformation process. In the scientific debate, the revenue side for BSS are often just titled and partially mapped for individual markets, which frequently leads to the conclusion that the investment in BSS does not pay off. Therefore, the core concept of the paper is the strategy to combine applications and their values, in order to extend the financial attractiveness. To specify and exemplify monetary value propositions (applications) and value networks (benefits) as well as the combination theory, a single and combined revenue model is examined: energy trading via day-ahead market (arbitrage) and energy trading in combination with frequency support via secondary control. The results show, that depending on the technology, the combined revenue model reduces the load factor and thus theoretically expands the BSS lifespan. Moreover, with modified market rules and individual bidder strategies there is a potential to generate higher proceeds with the combined revenue model.

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Keywords: Battery storage systems, Optimization, Business model, Arbitrage, Day-ahead market, Frequency support, Secondary control reserve

1. Introduction

In the future German power system, characterized by high penetration of intermittent renewable energy sources (RES), the demand and the importance for flexibility options will rise. However, in this setting the main flexibility

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shares can be covered with other more cost effective measures than stationary battery storage systems (BSS), but there is still a projected, quantity-wise uncertain market-based demand for electrical storages – especially, when intermittent RES become the pre-dominant generation technique [1], [2], [3]. Consequently, a market and technology progress as well as commercialization of appropriate battery storage options is obligatory for the future electricity system in Germany. Therefore, the scientific debate about BSS is progressively intensive concerning technical, legal, and economic issues. Currently, the economic analyses are mainly focusing on the cost side [4], [5], [6], the revenue side is often just titled and only partially mapped for individual applications, which frequently leads to the conclusion that single application areas often do not achieve the necessary margins to operate economically. However, due to bidirectional transformation process, batteries are multi-application technologies: They are applicable in many different ways by diverse shareholders and thus, have different potential value creation sources [7]. In broad terms, there are two forms how to gain monetary benefits along the electricity value chain with existing BSS applications in the German electricity market: First, revenues received by the storage owner or operator and second, cost reduction or avoidance by the storage owner or operator [8]. Generally, revenues can be realized over existing markets and bilateral contracts. Whereas cost reduction or avoidance is highly based on individual use cases. Figure 1 illustrates estimations of value potentials along the electricity value chain for the German power segment of 2013.

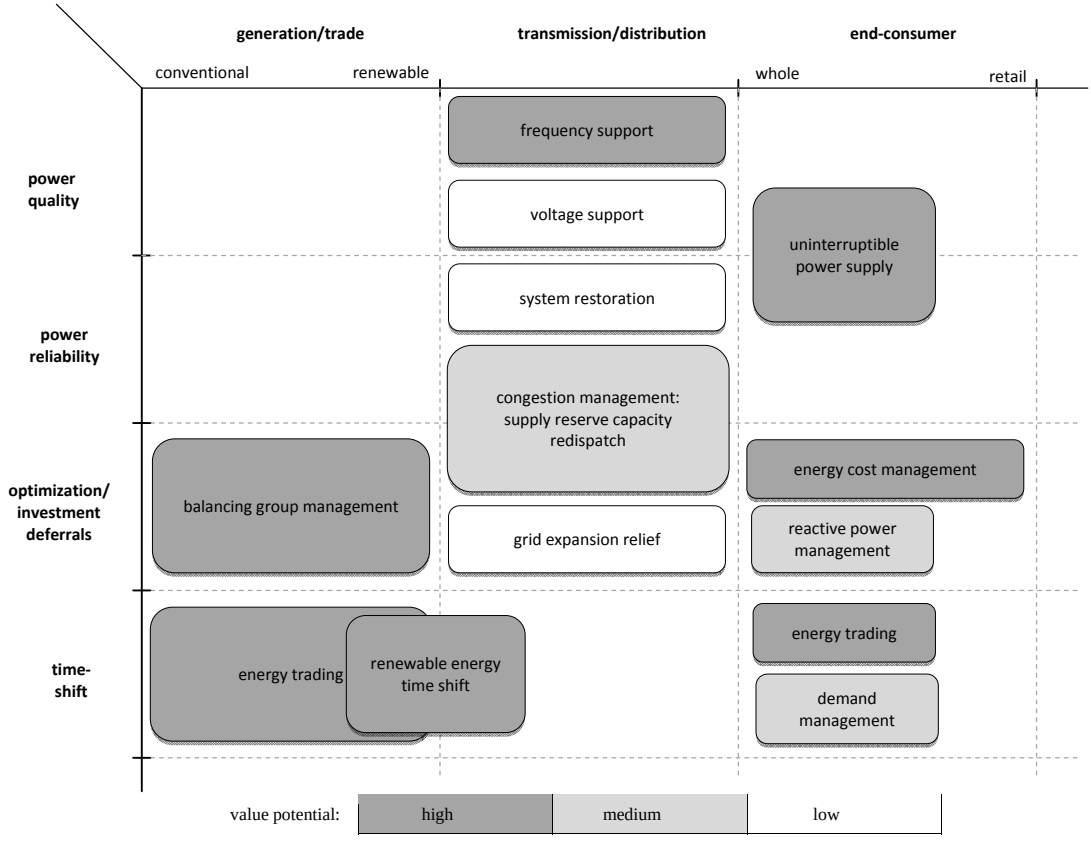

Fig. 1. BSS value propositions (applications) and value networks (benefits) along the electricity value chain.

According to the results of the benefit analysis, battery applications with a high value potential (with regard to benefit potential, good applicability, and favorable legal environment) are: energy trading at the day-ahead and

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