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New electricity markets. The challenges of variable renewable energy

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Summary

The growth of new and variable renewable technologies in developed countries, led by Europe, began in 1990 and was supported by financial incentives such as feed-in tariffs. These incentives minimized financial risks and made investing in the renewable sector more attractive for private companies. Today, the renewable energy sector is mature and cost-competitive with conventional technologies, but challenges still exist in transitioning to a fully renewable, carbon-free power sector, particularly in terms of the negotiation and management of the variable and unpredictable power generated. This chapter discusses these challenges and potential solutions within the context of competitive electricity markets.

Section 2 provides an overview of the physical characteristics of renewable generation, including the temporal variability of these power sources, and how they can be exploited to maximize the vRES value in electricity/market environments. Section 3 presents different concepts to increase the value of vRES generation, while Section 4 addresses the challenges of current market designs. Section 5 discusses the specifications for new market designs under high levels of renewable penetration.

Highlights

- The current design of electricity markets is not well-suited to the operating characteristics of time-variable renewable sources (vRES) generation such as wind and solar power → have low predictability and reduced power guarantee, which poses significant risks for market participants.
- Non-disruptive modifications such as reducing negotiation periods and changing market gate-closure time frames can be made to increase the penetration of renewable power sources.
- For high levels of vRES integration, new players and concepts such as spatiotemporal smoothing, generation aggregation, and virtual/hybrid renewable power plants are necessary, along with innovative market structures and operating rules.