

# Capacitating capacity markets

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**Abstract—**As cities grow and electricity use increases, electricity grids are running out of capacity, affecting the ability of businesses to grow. Industry and other commercial stakeholders are crying out for solutions from grid companies to ensure their safety of income. One of the most popular solutions today is the so-called flexibility market, where you can earn money by not using electricity during peak hours in order to decrease the peak demand. This however can, if poorly implemented, cause even worse problems than those already existing. Therefore, this report aims to investigate these indirect impacts that flexibility services might have on the grid and propose solutions for a successful implementation of flexibility markets.

Climate ambitions are shifting demand from fossil fuels to renewables, from gasoline to electricity. At the same time we find ourselves in a time of digitalization, urbanization and economic growth with a potential of driving the electricity demand, in certain areas, off the charts. This will put great pressure on the existing electricity infrastructure, which is already heavily congested in some of these areas. Reinforcement and construction of power system components would be the obvious solutions to these problems, but these processes are lengthy and costly, which is why other solutions are being sought.

Flexibility markets have been identified as a part of the solution towards an uncongested electrical grid. These markets allow electrical grid owners i.e. system operators (SOs) to purchase capacity from their customers offering these services by refraining from using electricity during heavily loaded hours. Previous research shows that this might lead to so-called *rebound effects* if the flexibility service providers start recovering the energy they previously refrained from without coordination. Rebound effects might lead to longer and amplified overloads if electricity demand

is shifted between two heavily loaded hours, making the situation worse. This points to the importance of having a good market structure and understanding how different activated resources will impact the grid.

This report aims to work towards this by investigating the indirect impact of flexibility services and providing proposals for a successful implementation of flexibility markets. An already existing demonstration project of flexibility markets in Sweden called Coordinet was examined, from which different flexible resources such as electric vehicles, industrial loads and heat pumps were identified and thereafter modelled to resemble activation of real flexible resources. Simulations were thereafter performed on a network model in order to see how the resources' characteristics affected the loading of different components in the network.

The models used in this study were quite unrealistic and could unfortunately not be used to represent how different resources impact the grid. The results could however, be used to indicate what risks activation of different flexible resources could infer. For example, by activating a resource in order to solve problems in your own grid, could cause overloads for other SOs connected to the same network. To avoid these conflicts of interest, the report was concluded with a proposal of implementing a requirement for the flexibility service providers to specify their time of recovery, as it could lead to greater transparency and a deeper understanding of how flexibility markets actually affect the grid.

For further reading please see *Analysis of Market-Based flexibility Services* by Tobias Gunneberg (2021).