

# The Danish Smart Grid Model – Integrating 100 % Renewables

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## *Abstract*



The topic of this talk is the Danish electrical power system with special focus on integration of fluctuating renewable energy sources. The Danish system made a world record in December 2013 when more than 50 % of the electricity consumption for an entire month was powered by wind. In this talk, we look into the developments made over the past years making it possible to handle such massive wind penetration; further, we will discuss some of the unfortunate effects that the high wind penetration causes. As the wind penetration continues to increase according to Danish renewable energy goals over the coming years, it is expected that the electrical grid will be even more challenged. This calls for new, smart solutions to ensure a functioning and economically efficient system – including in periods of high and low wind. For this reason, Denmark is the country in Europe with the largest number of smart grid projects. In this talk, we present some of the main findings and field-test results from these projects. Finally, we summarize the results by presenting the Danish smart grid model which is our projection of how the Danish electrical system in 2035 with 100 % renewables will look.

## *Biography*



Benjamin Biegel holds a Master of Science degree in automation and control with a primary focus on wind energy. He completed several large projects during his master's studies, including a research study at Stanford University in collaboration with Stephen Boyd and at Lund University in collaboration with Anders Rantzer. Currently, Benjamin is working as a PhD student at Aalborg University in the field of smart grid. Here, Benjamin collaborates with a large number of players within the Danish energy system including the power producer DONG Energy, the wind turbine manufacturer Vestas, and the Danish Energy Association. The main focus of Benjamin's research is the integration of renewable energy in the Nordic electrical power system via optimization and process control.