# DG-Store:
# A changing energy system requires new solutions

The energy system in Northern Germany and Denmark is greener than ever. As we transition to an energy system, where renewable energy is the primary source of energy supply, we are faced with new challenges. Wind and solar power fluctuate in their production throughout the day, and often we produce more renewable energy than we can utilize regionally at a given moment throughout the day.

To balance the electricity grid, we transmit exceeding electricity to other parts of the country or neighbouring countries. However, our electricity grids are not designed for the increasing amounts of renewable energy. Nationally, 2% of the annual wind production in Denmark was stopped in 2018 as a result of grid bottlenecks (Danish Energy, 2019). Regionally, this is an even bigger problem: The national Transmission System Operator (Energinet.dk) expects to down-regulate electricity production on the Danish island of Lolland by 200 GWh / year in 2022 – almost the entire energy usage in the municipality.

## AN INTEGRATED ENERGY SYSTEM BASED ON FLEXIBLE DEMAND

A flexible, smart energy system, where demand follows production, is therefore essential to efficiently using renewable energy, instead of stopping wind turbines. Due to reductions in energy production, trade and savings on grid enhancements, the Danish Transmission System Operator estimates that a flexible energy system has a socio-economic benefit of 113 mil. EUR pr. year until 2035 in Denmark alone (Energinet.dk, 2015).

## DANISH-GERMAN STORAGE OF RENEWABLE ENERGY

The transition from today's production-based energy system requires innovative solutions and an integration of electricity in the heat and transportation sectors. With funding from the Interreg Germany-Denmark program, partners in the DG STORE project will pilot various flexibility and storage solutions and analyse their effect on stabilising the electricity grid. Doing so will allow us to analyse the feasibility of showcased solutions at market conditions and identify possible policy barriers for a transition to a flexible energy system.

**ENERGY SYSTEM ANALYSIS & SIMULATION**

- **CASE 1:** Immersion heaters in district heating as a flexibility solution
- **CASE 2:** Flexibility solutions in retail
- **CASE 3:** Electric busses as a storage solution
- **CASE 4:** Charging and discharging of companies' EV fleet
- **CASE 5:** Heatpumps and energy storage in buildings
- **CASE 6:** Displacement of load from refrigerators and freezers
- **CASE 7:** Controlled charging of private EVs

**BUSINESS MODEL DEVELOPMENT**

**&**

**POLICY RECOMMENDATIONS**

## Energy system analysis & simulation

The cross-border energy system is modelled and simulations on the potential influence of the showcases on the energy system are run. With a high spatial and temporal resolution, the simulation will allow to identify grid bottlenecks and providing an important foundation for developing optimised management strategies and business models.

## Case 1: Immersion heaters in district heating as a flexibility solution

Stadtwerke Flensburg examine how their existing immersion heater can supply flexibility to the electricity grid by using surplus renewable energy. Similarly, Lolland Utility analyses the potential of an immersion heater in their district heating grid and how this can supply flexible demand at market conditions, esp. with regards to fees and taxes.

## Case 2: Flexibility solutions in retail

Salling Group examines together with Vitani Energy Systems the potential of smart heating and cooling controls at two supermarkets on Lolland. Supermarkets are large consumers of energy with a demand for both heating and cooling in their operations. Based on the energy system analysis and by applying IoT enabled sensors and intelligent software, they analyse the potential to supply flexibility to the energy grid.

## Case 3: Electric busses as a storage solution

AktivBus Flensburg is in a transition to fully electric bus fleet and is building a completely new bus depot for this purpose. In order to avoid additional strain on the electricity grid and possibly supply flexibility to the grid, an intelligent charging system is developed, so that the buses are charged with surplus renewable energy and can possibly be discharged in peak electricity demand situations.

## Case 4: Charging and discharging of companies' EV fleet

In this case study, Stadtwerke Flensburg tests controlled charging and discharging of the company's electric vehicle fleet to supply flexibility and storage capacities to balance the electricity grid. Having full control of the cars, the company has a direct influence on usage and charging patterns in contrast to private electric cars. However, the economics of additional battery cycling may be a possible barrier for implementation.

## Case 5: Heatpumps and energy storage in buildings

Lolland municipality and Neogrid Technologies cooperate on testing heatpumps with heat storage in buildings to enable a flexible usage to reduce demand peaks and use surplus renewable energy. Based on the energy system simulation, the possibility of pooling intelligent heatpumps on a future aggregator power market is analysed.

## Case 6: Displacement of load from refrigerators and freezers

Residential refrigerators and freezers constitute a major part of private electricity consumption. To reduce peak loads and supply flexibility, Selbsthilfe Bauverein Flensburg tests the displacement of loads through IoT enabled fridges and freezers in their condominiums.

## Case 7: Controlled charging of private EVs

Selbsthilfe Bauverein Flensburg tests the controlled charging of residents' private electric vehicles. In contrast to case 4, the housing society does not own the vehicles and has no direct influence on usage patterns of the vehicles. Therefore, the social and behavioural aspects of the case are especially interesting, as well as possible economic incentives for user acceptance.

## Business model development & policy recommendations

Based on the results and experience gained in the case studies and energy system analysis, possible business models for the individual technology are developed. It is expected that energy policy may constitute a barrier for some of the cases, esp. with regards to fees and taxes. On that basis, policy recommendations will be developed, to support a swift and broad transition to a fossil-free, flexible energy system.