Center Denmark

The Digital Data Platform

Figure 1: The planned control room at Center Denmark.

Summary of project

The vision of Center Denmark (CDK) is to accelerate the green transition towards 100 % renewable energy in Denmark and Europe through digitalization and sector coupling and thereby unlocking flexibilities needed for an efficient implementation of the weather-driven energy system for the future low-carbon society. CDK is an independent and non-profit organization.

CDK provides a Trusted Data Sharing platform with 24/7 access to energy related data and digital tools. The platform provides access to historical data using a data lake setup, and bi-directional streaming data for providing smart energy services like forecasting of electricity prices and control of heat pumps. Using digital tools at the platform, CDK is able to facilitate and support tests and demonstrations in representative and scalable settings. Consequently, CDK is an incubator for digital business models aimed at providing new data-driven services for the energy and water sectors.

The EU Commission has selected CDK as a European Digital Innovation Hub (DIH). CDK is also an ERA-NET Smart Energy Systems Digital Platform Provider. Consequently, CDK is now acting as a central data and cloud hub for a large number of European projects (see the homepage of Center Denmark for an updated list of ongoing projects). As of today, CDK provides cloud/fog/edge based computing facilities and services for around 11 countries in Europe, and in several cases heat pumps are important elements of the project related demonstrations.

The ambition of CDK is to enable the development of digital solutions that are capable of adjusting the power consumption to fit the power production – among other things by use of Data-driven Digital Twins, Grey-box Modeling, Machine Learning and various tools for handling Big Data. Today, CDK provides methods for an efficient integration of wind and solar power by providing a next generation of methods for forecasting as well as methods for optimized operation of heat pumps, wastewater treatment plants, district heating, Power-to-X plants, supermarket cooling, etc.

A key focus of the Center Denmark platform is to deliver a next generation of smart grid solutions, such that the flexibility in integrated energy and water systems can be used for providing low cost grid and balancing services. The software used by CDK is based on open source technologies such as SPARK MLib, Python, Java, and Grafana. The interface with end-users is typically set up using APIs.
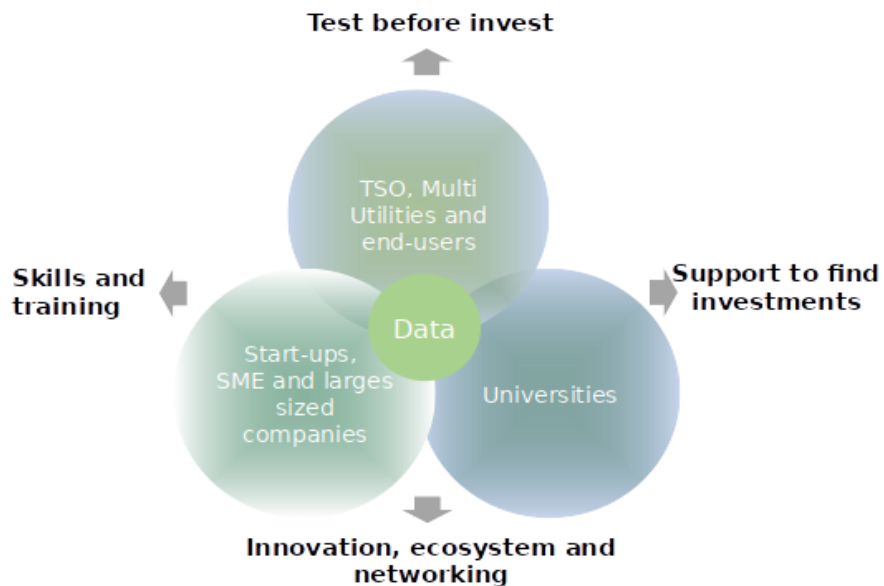
Figure 2: Data is at the core of the development, innovation and business thinking at Center Denmark.

Smart-Energy Operating-System

At Center Denmark the core idea is to adopt a spatio-temporal thinking where the models, forecasts, etc. are coherent across all spatial and temporal aggregation levels; see Figure 3. This is also reflected in the layout of the control room (see Figure 1). The setup is taking advantage of a so-called Smart-Energy Operating-System (SE-OS) framework, which is an operating system for testing and implementing integrated energy systems for data-driven operation at all aggregation levels.

Conventional electricity markets are static curves relating the prices to the volume of produced or consumed electricity, and the flexibility is described by the elasticity, which then presumably is assumed constant over time. However, if a supermarket has provided flexibility for, say, 30 minutes, then it might not be able to provide the same flexibility for the coming 30 minutes due to e.g. temperature constraints of the products in the freezer.

At Center Denmark the Smart-Energy OS facilitates a link between the high-level conventional energy and electricity markets, based on bidding and clearing, and the low-level flexibility at supermarkets, houses, industry, etc. The concept of a flexibility function, based on models and optimization, is used to establish the link between the high-level markets and the low-level physics; see Figure 3.
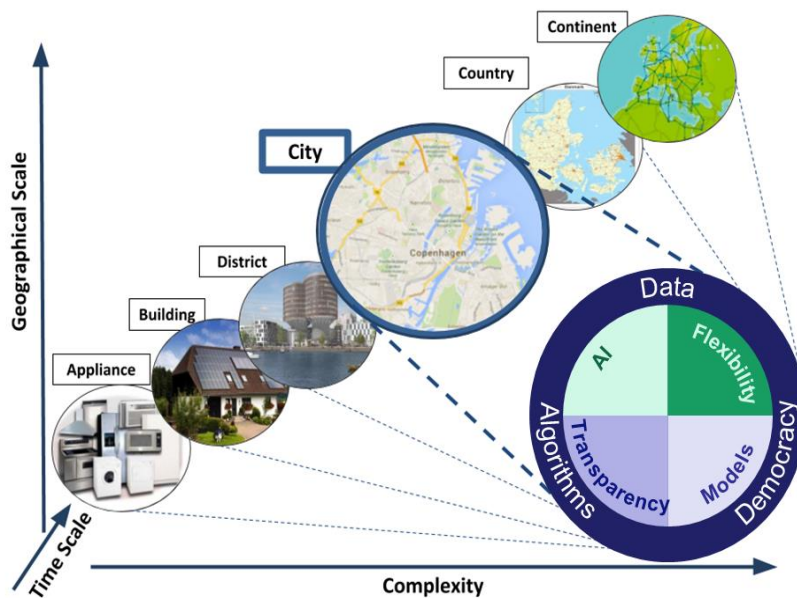
Figure 3: A spatio-temporal hierarchy is the core of the Smart-Energy Operating-System.

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