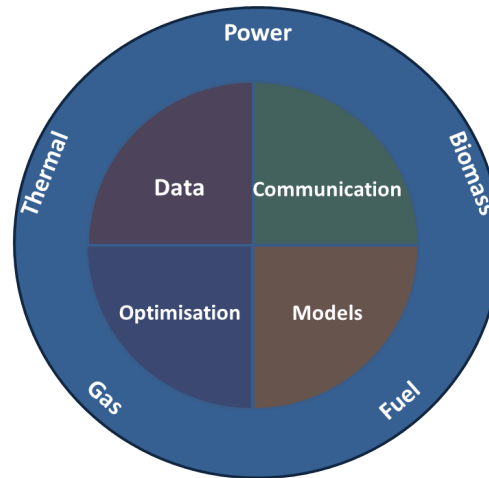


CITIES

Center for IT-Intelligent Energy Systems



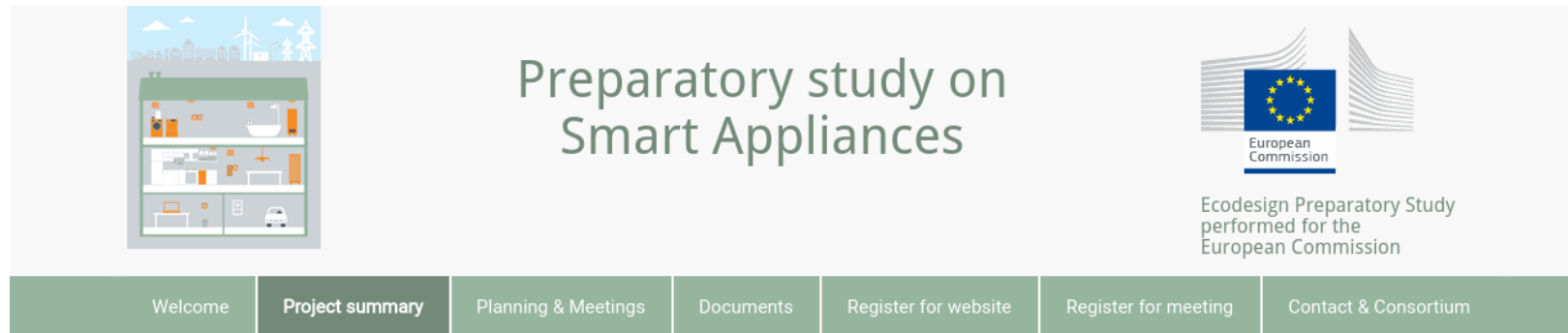
Henrik Madsen

Matematik og Computer Science, DTU

<http://www.smart-cities-centre.org>

<http://www.henrikmadsen.org>

Challenges (example)



[Home](#) > [Project summary](#)

Report: Almost no flexibility

Project Summary

The Ecodesign Preparatory Study on Smart Appliances (Lot 33) has analysed the technical, economic, market and societal aspects with a view to a broad introduction of smart appliances and to develop separate smart appliances standards for such products.

The study deals with Task 1 to 7 of the Methodology for Energy related products (MEErP) as follows:

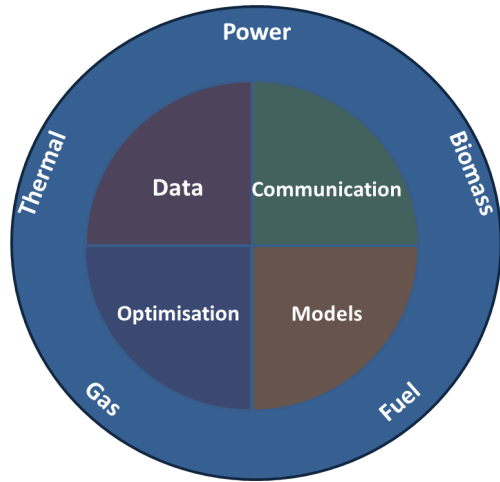
- Scope, standards and other issues (Task 1, Chapter 1);
- Market analysis (Task 2, Chapter 2);
- User analysis (Task 3, Chapter 3);
- Technical analysis (Task 4, Chapter 4);
- Definition of Base Cases (Task 5, Chapter 5);
- Design options (Task 6, Chapter 6);
- Policy and Scenario analysis (Task 7, Chapter 7).

An executive summary of the project results can be downloaded [here](#).

Throughout the study, new relevant aspects have come up which will be covered in a second phase of the Preparatory Study:

- Chargers for electric cars: technical potential and other relevant issues in the context of demand response.
- The modelling done in the framework of MEErP Task 6 and 7 will be updated with PRIMES data that recently became available, and with the EEA-countries.
- The development and assessment of policy options that were identified in the study will be further elaborated and deepened.

Hypothesis



The **central hypothesis** is that by **intelligently integrating** currently distinct energy flows (heat, power, gas and biomass) using **ICT solutions** we can **balance** very large shares of renewables, and consequently obtain substantial reductions in CO₂ emissions.

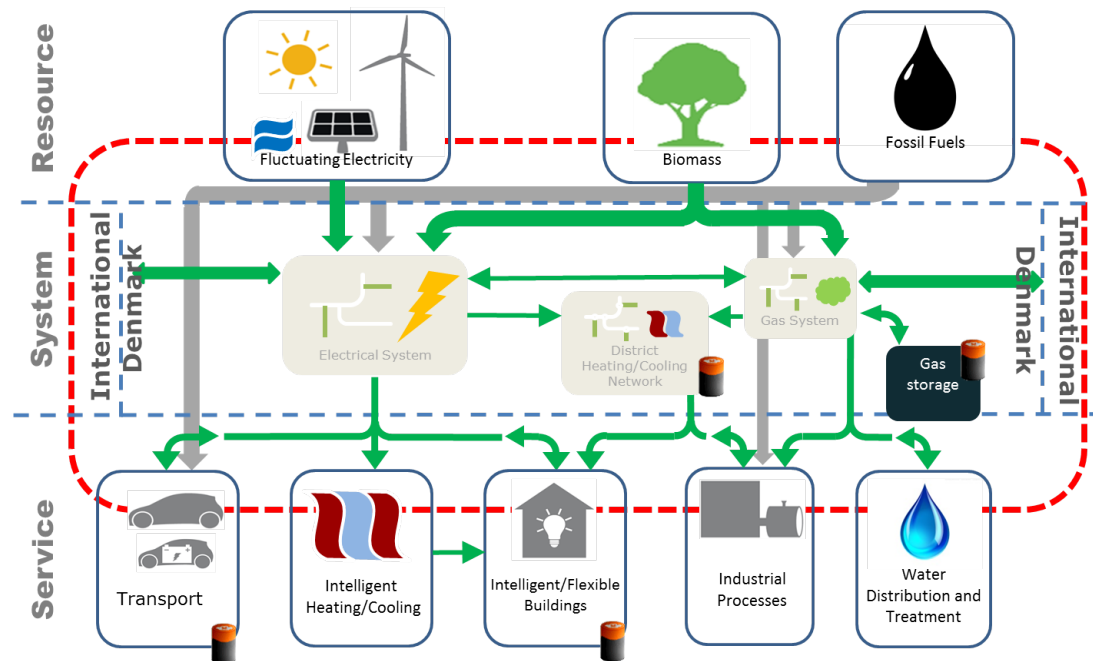
Objectives

- The Societal objective is to establish a realistic and concrete pathway to a fossil-free society
- The Scientific objective is to establish methodologies and solutions for the future intelligent and integrated energy system at all scales
- The Commercial perspective is to identify and develop solutions which can form the background for commercial success stories

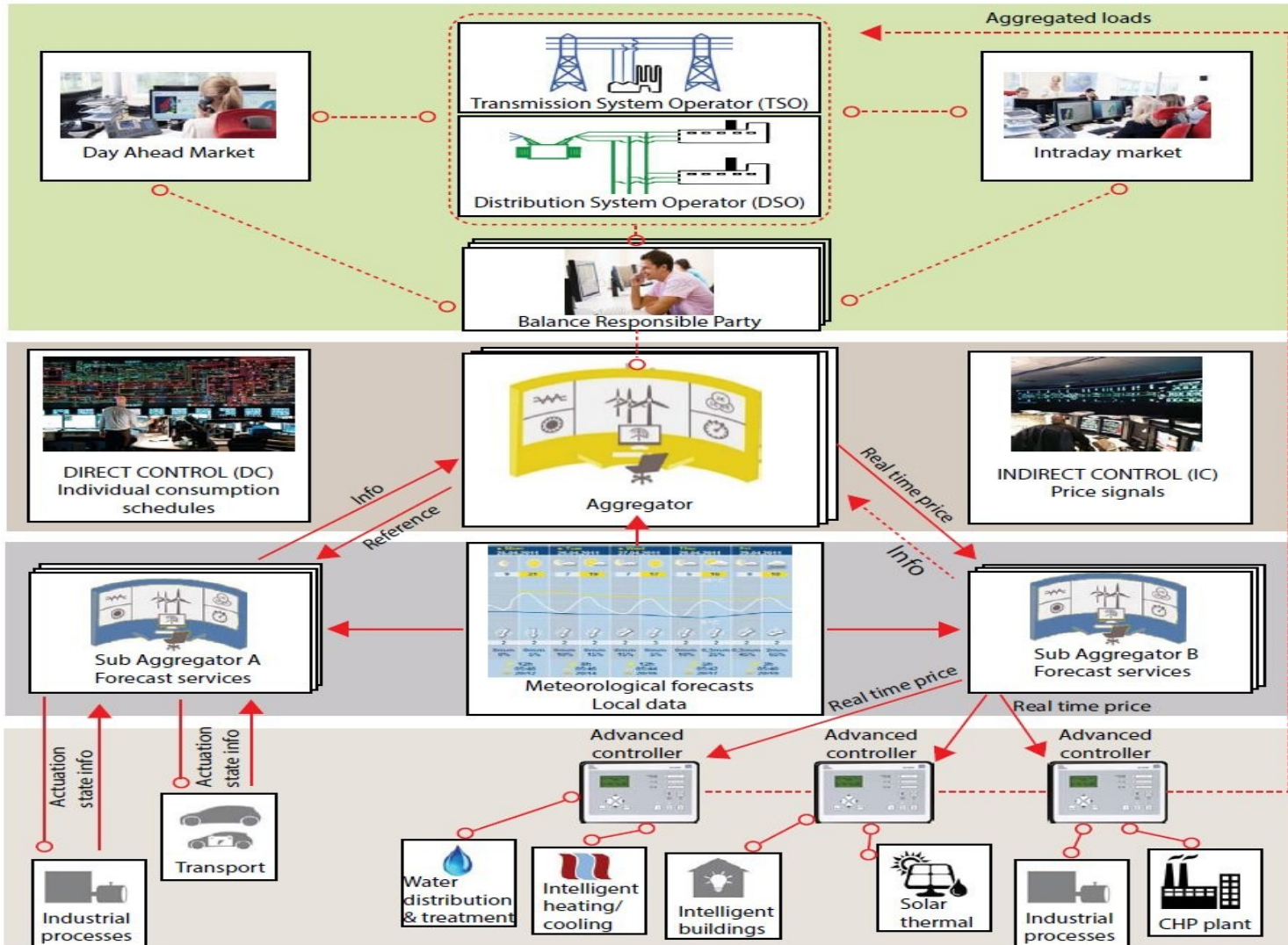


Concepts

Integration based on **ICT solutions** (Data Analytics, Cyber Physical Models, Forecasting, Control, IoT, IoS, AI, automated learning, ..) leading to methods for **operation** and **planning** of future energy systems



Example: Smart-Energy OS



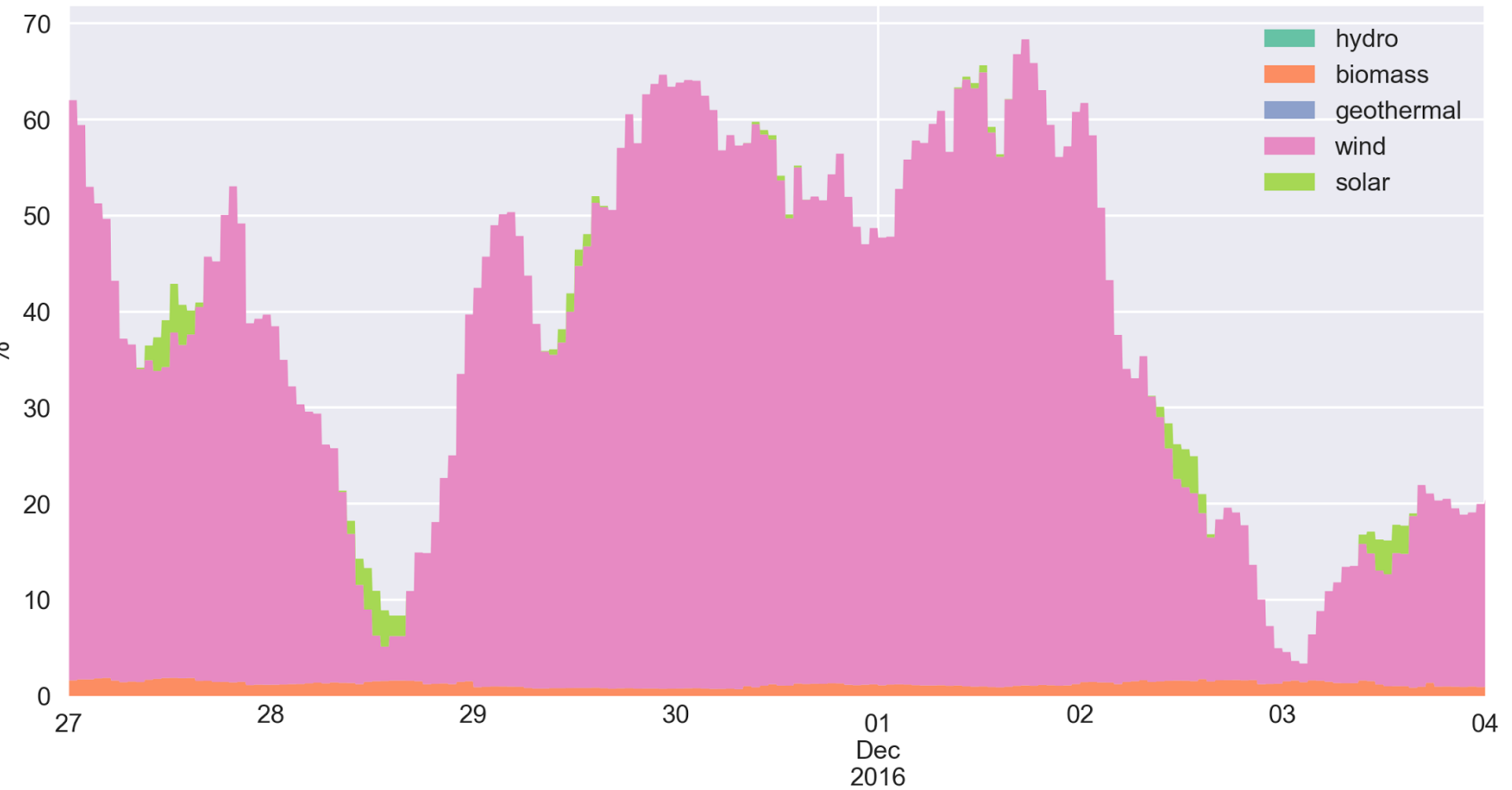
Case study No. 1

Control of heat pumps (CO₂ minimization)

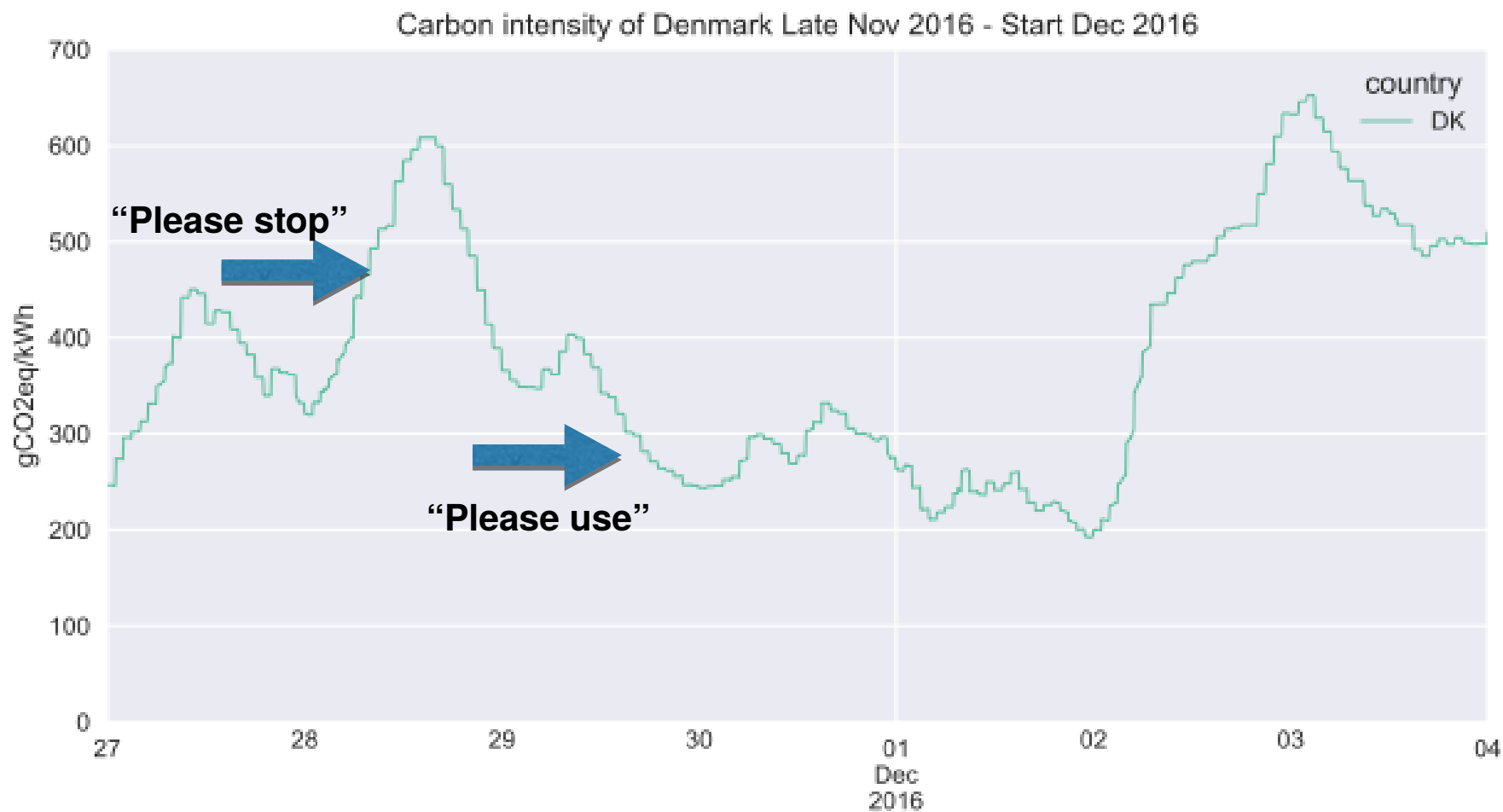




Share of electricity originating from renewables in Denmark Late Nov 2016 - Start Dec 2016



Source: pro.electricitymap.org



Source: pro.electricitymap.org

Case study No. 2

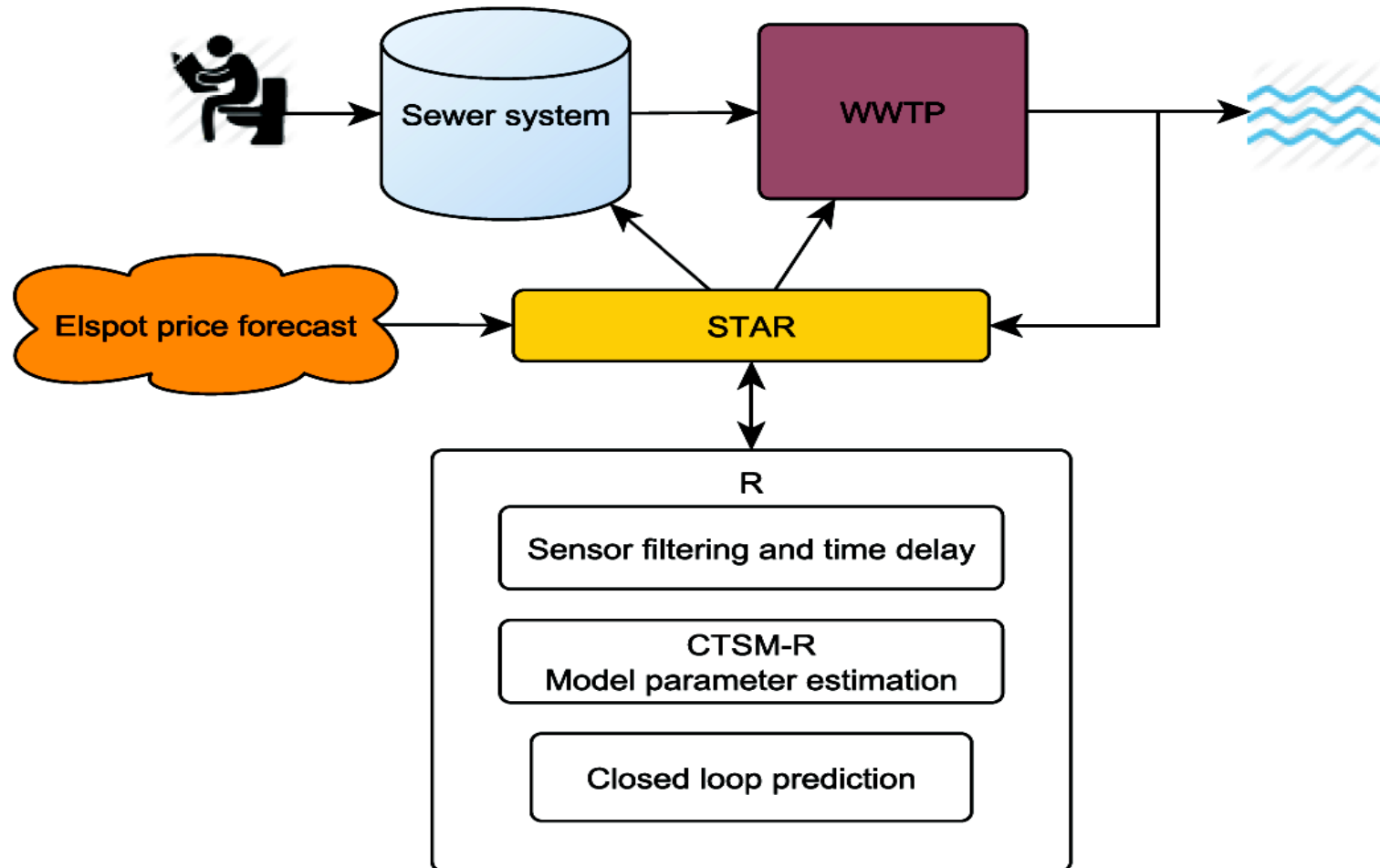
Wastewater Treatment Plants (cost minimization)



Kolding WWTP



Energy Flexibility in Wastewater Treatment



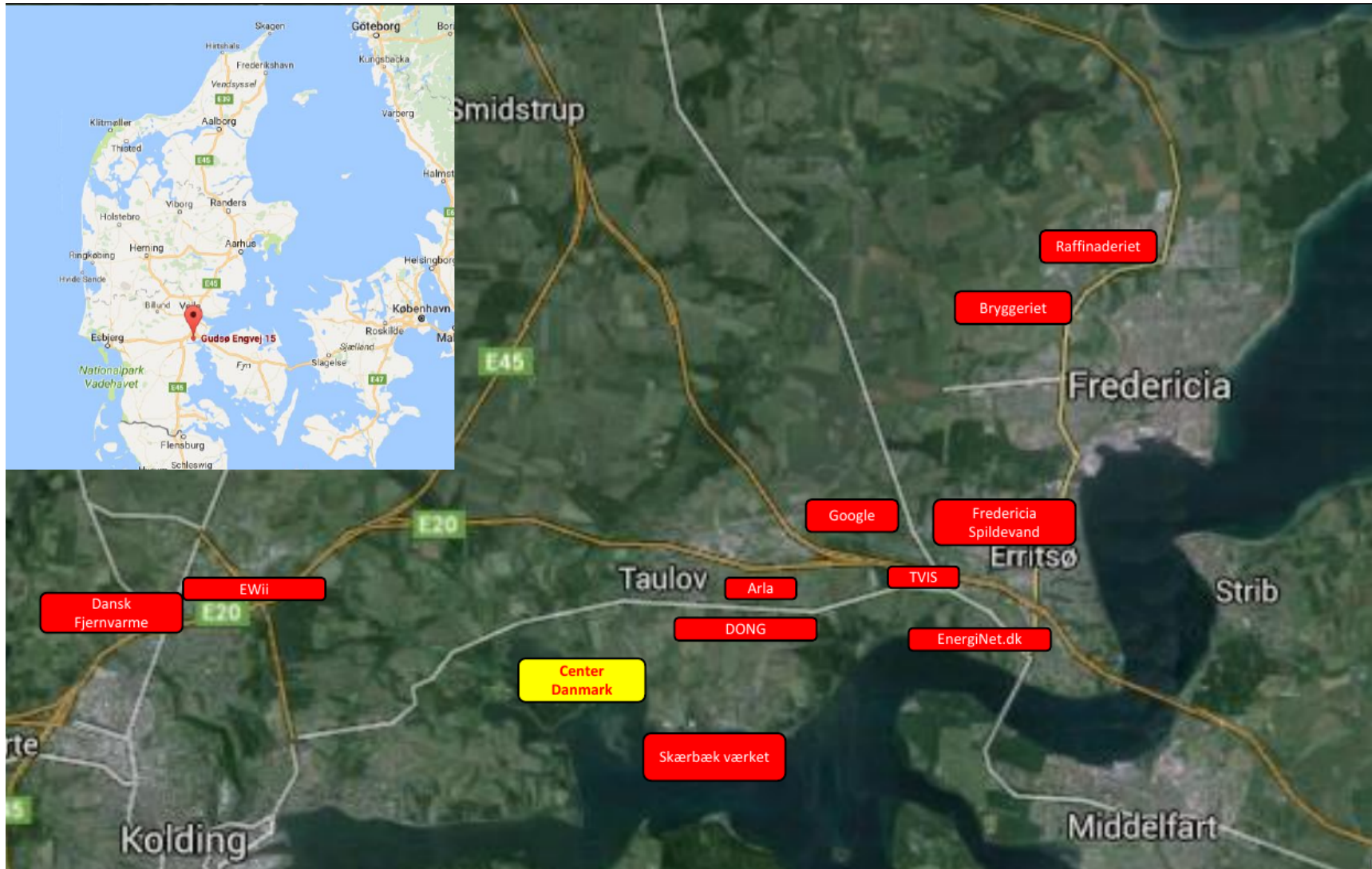


Topics



Center Danmark

Test Center for Intelligent and Integrated Energy Systems



Test i et mini samfund beliggende på 40 Hektar naturgrund

- Test i et fungerende driftsmiljø bestående af mange forskellige typer bygninger



Ældre bygninger :

1. Møllen: Urban Farmning
 1. Bygning 228 m²
 2. Bygning 590 m²
 3. Bygning 290 m²
 4. Bygning 230 m²
 5. Bygning 155 m²
2. Privathus, 183 m²
3. Privathus, 153 m²
4. Privathus, 166 m²
5. Gård 140 m²
6. Gård 4-længet 231 m²
7. Rækkehus 140 m²
8. Rækkehus 130 m²
9. Depot 140 m²
10. Kontor 110 m²
11. Lager 450 m²
12. Erhverv produktion 450 m²
13. Privat hus 160 m²
14. Vingården 110 m²
 1. Erhverv 70 m²
 2. Produktion Vin 25 m²
 3. Kølerum 5 m²
 4. Klimarum kaffe 10 m²
15. Shelter 60 m²



Nye bygninger :

1. Smart City 2030
 1. Urban Farmning
 2. Rækkehuse
 3. Parcel huse
 4. Kollegie værelser
 5. Undervisningsbygning
 6. Laboratorier
2. Center Danmark 4800 m²
3. Ny Gudsøgård 2600 m²
 1. Privat hus 280 m²
 2. Erhverv 280 m²
 3. Stald 280 m²
 4. Ridehal 1700 m²
 5. Produktion Gødning

Summary

- We have demonstrated a large potential in Demand Response. Automatic solutions and end-user focus important
- We have a strong team – Goal: From application 30-40 journal papers (2014-2020). Status: About 70 journal papers published now (May 2017)
- Controllers developed in CITIES can focus on
 - ★ Peak Shaving
 - ★ Smart Grid demand (like ancillary services needs, ...)
 - ★ Energy Efficiency
 - ★ Cost Minimization
 - ★ Emission Efficiency
- We see large problems with tax and tariff structures in many countries (eg. Denmark).
- Our plan is to establish sites for testing and demonstration near Fredericia plus Region Midtjylland

For more information ...

See for instance

www.smart-cities-centre.org

...or contact

– Henrik Madsen (DTU Compute)

hmad@dtu.dk

Acknowledgement - DSF 1305-00027B