

Digital solutions are essential to provide an efficient and flexible energy system that increases the use of renewable energy.

Key research areas at the Department of Computer Science at Aalborg University (CS) offer a wide range of foundational technologies and methods that – in close collaboration with domain experts and colleagues from other scientific disciplines – support the development of such a sustainable energy system.

### CORE AREAS

- Data Engineering, Science and Systems
- Data, Knowledge and Web Engineering
- Distributed, Embedded and Intelligent Systems
- Human-Centered Computing
- AI and Machine Learning

## SELECTED TOPICS WITHIN DIGITAL ENERGY



### MAKING ENERGY CONSUMPTION FLEXIBLE

In the future, we will see continuous electrification of society. In the Flexible Energy Denmark (FED) project, partners across the Danish energy system develop solutions to use green electricity flexibly.

This includes converting electricity into heat if that is more optimal, and using the existing grids far more efficiently, thereby avoiding spending billions on expanding them.

Two research groups from CS are part of the project. On the one hand, they focus on handling large amounts of data and data analysis for optimizing flexible consumption and, on the other hand, modeling and optimal control of energy-aware buildings using AI and machine learning.

**KEYWORDS: DATA SCIENCE, BIG DATA, ENERGY FLEXIBILITY, AI AND MACHINE LEARNING**

*Project: FED: Flexible Energy Denmark*



### DIGITAL TRANSFORMATION OF DISTRICT HEATING

Many public organisations are taking action to reduce their carbon footprint by, for example, transitioning to more sustainable energy forms. In this process, digital transformation is reshaping the way citizens interact with the public sector and its underlying physical, digital and human infrastructure.

Researchers from CS have been part of a project studying the transformation of district heating in Aalborg municipality.

This included a two-year action case study of a district heating provider and their ongoing work to make consumers engage in and change their consumption to better support sustainable and renewable heating sources.

**KEYWORDS: DIGITAL TRANSFORMATION AND ACTION CASE STUDIES**

*Project: Synchronizing energy consumption with energy production*



### DIGITALISATION TO TURN BUILDINGS ENERGY-SMART

Society is undergoing comprehensive digitalisation. But digitalisation has not yet made a significant entry into our buildings. In the European project domOS, researchers from CS develop a joint platform to ensure that devices and sensors in our homes can be controlled and interact intelligently using common standards.

This means developing models of data and devices (ontologies) and safe methods for publishing data without compromising privacy. The researchers also design, implement and evaluate a series of services, incl. the FlexOffer concept, developed at AAU, which models, aggregates, and optimises energy demand and flexibility for all types of processes and devices.

**KEYWORDS: DATA SCIENCE, BIG DATA, ENERGY FLEXIBILITY AND IOT**

*Project: domOS – Operating system for Smart Services in Buildings*

# PROJECTS WITHIN DIGITAL ENERGY

## **Behavioural change support systems in citizen-driven initiatives in the green transition with Human Machine Interaction**

Nicolai Brodersen Hansen with the Department of Politics and Society (AAU) and the Department of Architecture, Design and Media Technology (AAU)

## **Bus driving support system**

Kim Guldstrand Larsen, Mikael B. Skov and Anders R. Bruun with the Department of the Built Environment (AAU), NT, AKK Kollektiv Trafik, AKK Plusbus, MultiQ and Keolis

## **DiCYPs: Center for Data-Intensive Cyber-Physical Systems**

Kim Guldstrand Larsen, Arne Skou, Torben Bach Pedersen, Christian S. Jensen, Jesper Kjeldskov, Mikael Skov, Brian Nielsen and Dimitrios Raptis with the Department of Build Environment (AAU) and AAU Energy

## **Digital Energy Hub**

Kim Guldstrand Larsen and Torben Bach Pedersen with Center Denmark, Energy Cluster Denmark, DigitalLead, Innovation Centre Denmark, SDU, DTU Compute and AU plus strategic partners: Energinet, EWII and KMD

## **domOS: Operating System for Smart Services in Buildings**

Arne Skou, Torben Bach Pedersen, Brian Nielsen and Christian Thomsen with HES-SO, CSEM, FENIX TNT, EDF, Aliunid, Neogrid Technologies, Suntherm, Oiken, Inea and Aalborg Forsyning

## **DREAMS: Digitally supported Environmental Assessment for Sustainable Development Goals**

Peter Axel Nielsen, Katja Hose, Ashna Mahmood Zada, Johannes Bjerva, Eike Schneiders and Dario Garigliotti with DCEA, Danish Environmental Portal, DTU Compute, SDU, The Ministry of Environment and Food of Denmark, Danish EPA, BaneDanmark, Cowi, Rambøll, DinGeo, Istituto Superior Tecnico, The Danish Road Directorate, EnergiNet and The Copenhagen Metro

## **Energy Certification of Software**

Bent Thomsen with Edora, Digiplex Copenhagen 1, Infra-team, RUC and DTU

## **Energy Certified DevOps**

Bent Thomsen and Junior Dongo with RUC, DTU, Edora, Digiplex 1 and KMD

## **FED: Flexible Energy Denmark**

Kim Guldstrand Larsen, Arne Skou, Torben Bach Pedersen, Brian Nielsen and Christian Thomsen with Center Denmark, Centrica Energy Trading, Danfoss, DTU Com-

pute, DTU Management, EMD International, ENFOR, EWII, FlexShape, Fredericia Fjernvarme, Høje-Taastrup Municipality, KONSTANT, Neogrid Technologies, NOVASOL Blåvand, Center for Energy Informatics (SDU), Tomorrow, TREFOR, Xtel Wireless, Aalborg Energi Holding, AU and Technological Institute

## **FEVER: Flexible Energy Production, Demand and Storage-based Virtual Power Plants for Electricity Markets and Resilient DSO Operation**

Arne Skou, Torben Bach Pedersen, Mikael B. Skov, Rikke Hagensby Jensen and Dimitrios Raptis with B.A.U.M, CERTH/ITI, Es-Geht, Estabanell y Pahisa Energia, Estabanell y Pahisa Mercator, FOSS, FlexShape, HEnEx, INEA, Intracom Telecom, Stadtwerk Haßfurt, SWW Wunsiedel, Universitat de Girona, CitCea, UCLouvain and University of Patras

## **GOFLEX: Extracting, aggregating and trading flexibility based on FlexOffers for 500+ prosumers in 3 European cities**

Torben Bach Pedersen, Bijay Neupane, Laurynas Siksnys and Rikke Hagensby Jensen with B.A.U.M, EAC, ETREL, FOSS, IBM, INEA, ESR, Robotina, TUD and HES-SO

## **LightHouse South (Fyrtårn Syd)**

Torben Bach Pedersen and Kim Guldstrand Larsen with Center Denmark, DTU, SDU, work-live-stay Southern Denmark, Copenhagen Capacity, The Triangle Region Denmark, Business Esbjerg and The Development Council of Southern Denmark

## **S4OS: Scalable analysis and Synthesis of Safe, Secure and Optimal Strategies for Cyber-Physical Systems**

Kim Guldstrand Larsen, Andreas Holck Høeg-Petersen, Anton Christensen, Asger Horn Brorholt, Martijn Goorden, Nikolaj Jensen Ulrik, Pieter Jan Laurens Cuijpers and Sean Kristian Remond Harbo

## **Sector coupling via energy communities**

Rikke Hagensby Jensen with Department of Planning (AAU), FlexShape, Energifællesskab Avedøre A.M.B.A. and EBO Consultant

## **Synchronizing energy consumption with energy production**

John Stouby Persson, Peter Axel Nielsen, Michael Kvist Svangren and Alisa Ananjeva with the Department of Planning (AAU) and the Department of Architecture Design and Media Technology (AAU)

Want to know more?  
Contact research  
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