PowerLabDK

We facilitate energy system research and testing. Access customizable labs and real-world energy data. We support technology development, testing, training and validation that contribute to the development of a reliable, cost efficient and sustainable energy system

VELTEK Årsdag

Welcome to PowerLabDK

2026-08-26

Presentation:

1. Introduction to DTU
2. Introduction to PowerLabDK
3. Introduction to SYSLAB, Example of use
4. Motivation for building a Sector coupled energy System research facility
5. Extension to a DH distribution system, Example of use
6. Common ideas, hope for future collaboration

DTU PowerLabDK

Per Munch Jakobsen

Head of Laboratories

pmja@dtu.dk

www. Powerlab.dk

>20 Years in the industry

- Sales and construction, switchboards and industrial control
- Development HVAC control and systems
- Automation and Control: production, waterworks…
- Construction and commissioning Combined Heat and Power plants

15 years at DTU

- Senior Engineer
- Group Leader
- Head of Laboratories

Tildelt DTU Arbejdsmiljøpris 2026

STRATEGY 2026-2031

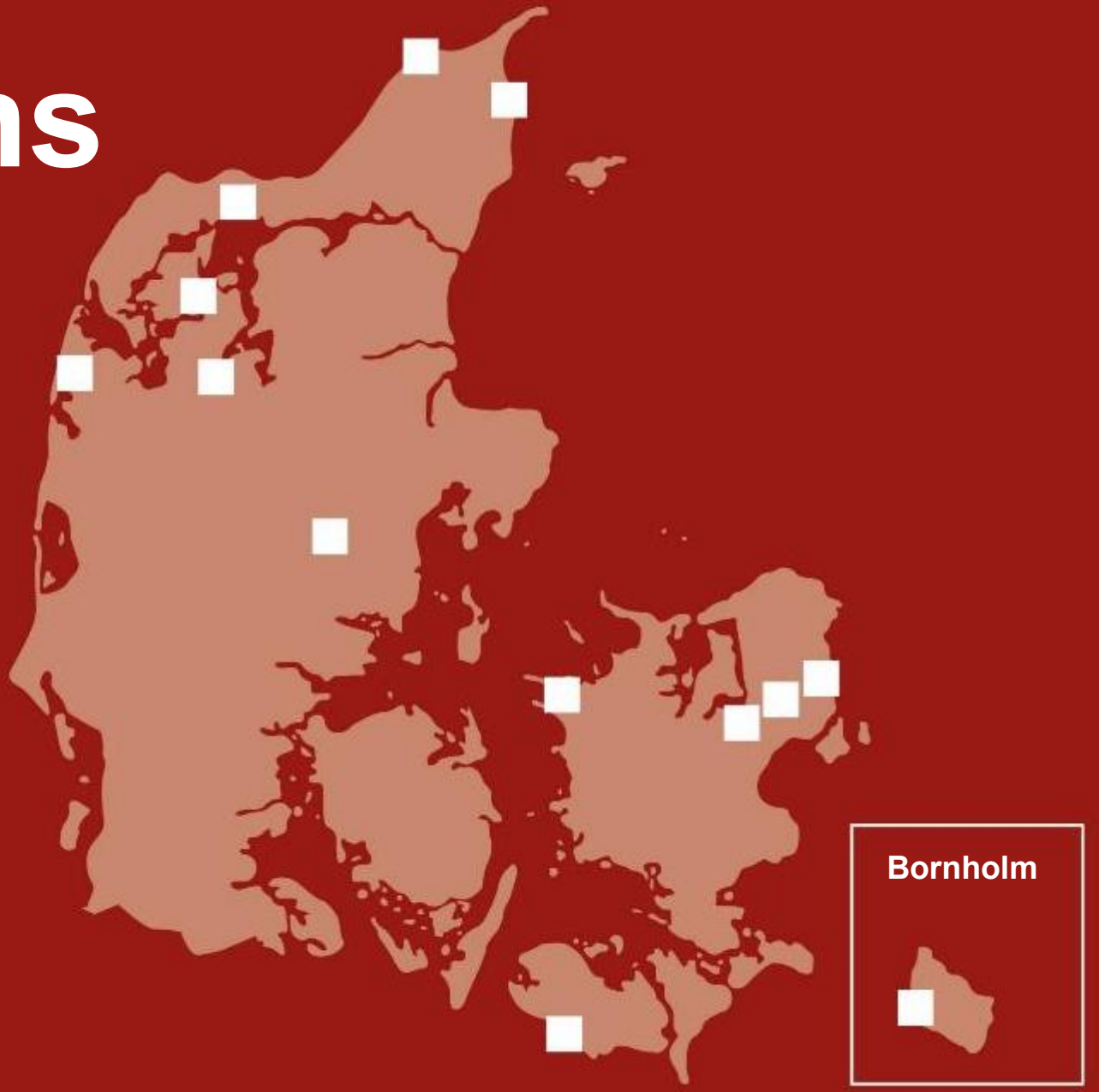
FOR THE BENEFIT OF SOCIETY

since 1829

FOCUS AREAS

1. Sustainable technological transition
2. European leadership in critical technologies
3. Educating Europe's most competent engineers
4. From knowledge to business
5. Scientific leadership and democratic responsibility

Locations



Rankings*

	Nordic region**	Europe	World
EngiRank EU Ranking	1	1	--
Leiden Ranking Citation Impact Indicator (top 10% publications) All sciences	2	45	125
Leiden Ranking Collaborative Publications with Industry Indicator	2	5	20
QS World University Rankings	5	41	109
THE World University Rankings	8	50	124

* As per 10 April 2025
** The Nordic region consists of Denmark, Sweden, Norway, Finland, and Iceland

Research facilities

Teaching methods

Stimulates individual and collaborative learning

DTU Blue Dot Projects

Students work across semesters, curricula, and study programmes on extra-curricular sustainable projects that will benefit society

DTU Wind and Energy Systems

Department Presentation

Merger

A new organization to meet the new energy reality

1 March 2022 DTU Wind Energy merged with Centre for Electric Power and Energy (CEE) and became Department of Wind and Energy Systems

From three to four divisions

20 sections under 4 divisions will enable:

- A common strategic programme
- Cross-sections synergies
- Stakeholder focus

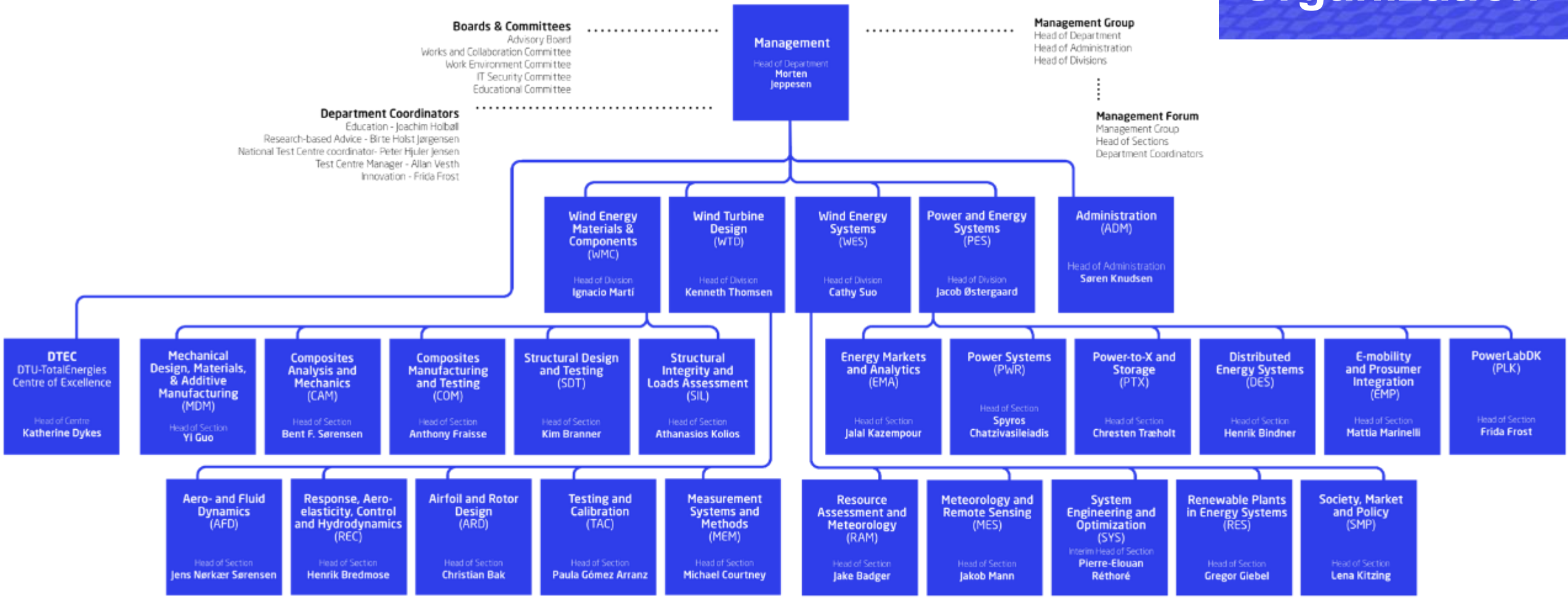
Wind Energy Materials and Components

Wind Turbine Designs

Wind Energy Systems

Power and Energy Systems

Organization



PowerLab

Power and energy research

PowerLabDK

- Bornholm Smart Energy Community
- Control Center Lab
- Converter & Drives Lab
- Electric Vehicle Lab
- Electric Lab
- Energy System Simulation Lab
- Power Flex Houses
- Power Student Lab
- High Power Lab
- High Voltage Lab
- SYSLAB (Energy System Integration Lab)

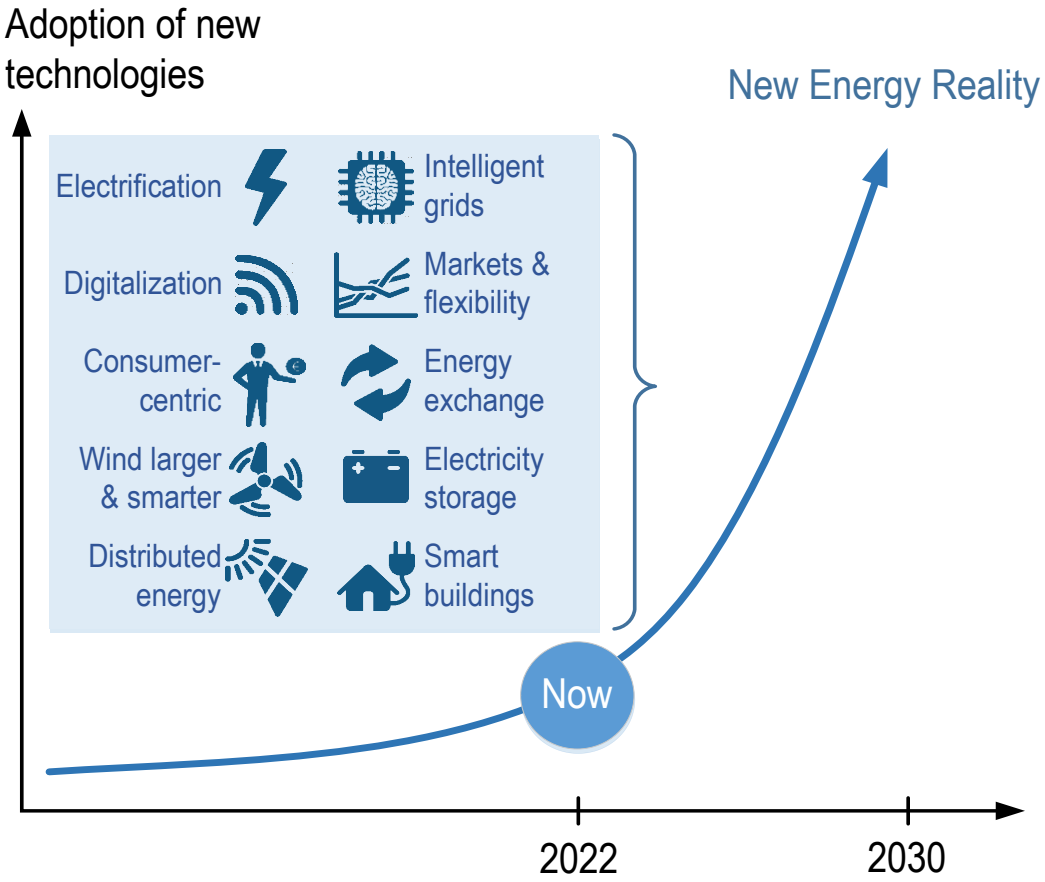
A world-class experimental platform for research and technology development of sustainable electric power and energy solutions.

The PowerLab consists of 5,000 m2 research infrastructure including a full-scale experimental control centre, Europe's most powerful university real-time simulator, advanced hardware-in-loop testing, large-scale energy system integration facility, computing facilities, real-time living labs data hub, and the Bornholm full-scale 100% renewable energy island w. 40,000 inhabitants.

A New Energy Reality

Global development trends

1. **Electrification (mobility etc.)**
2. **H_2 & PtX for hard-to-abate sectors**
3. **Massive RE-based power system**
4. **Sector coupling and flexibility**
5. **Digitalization**

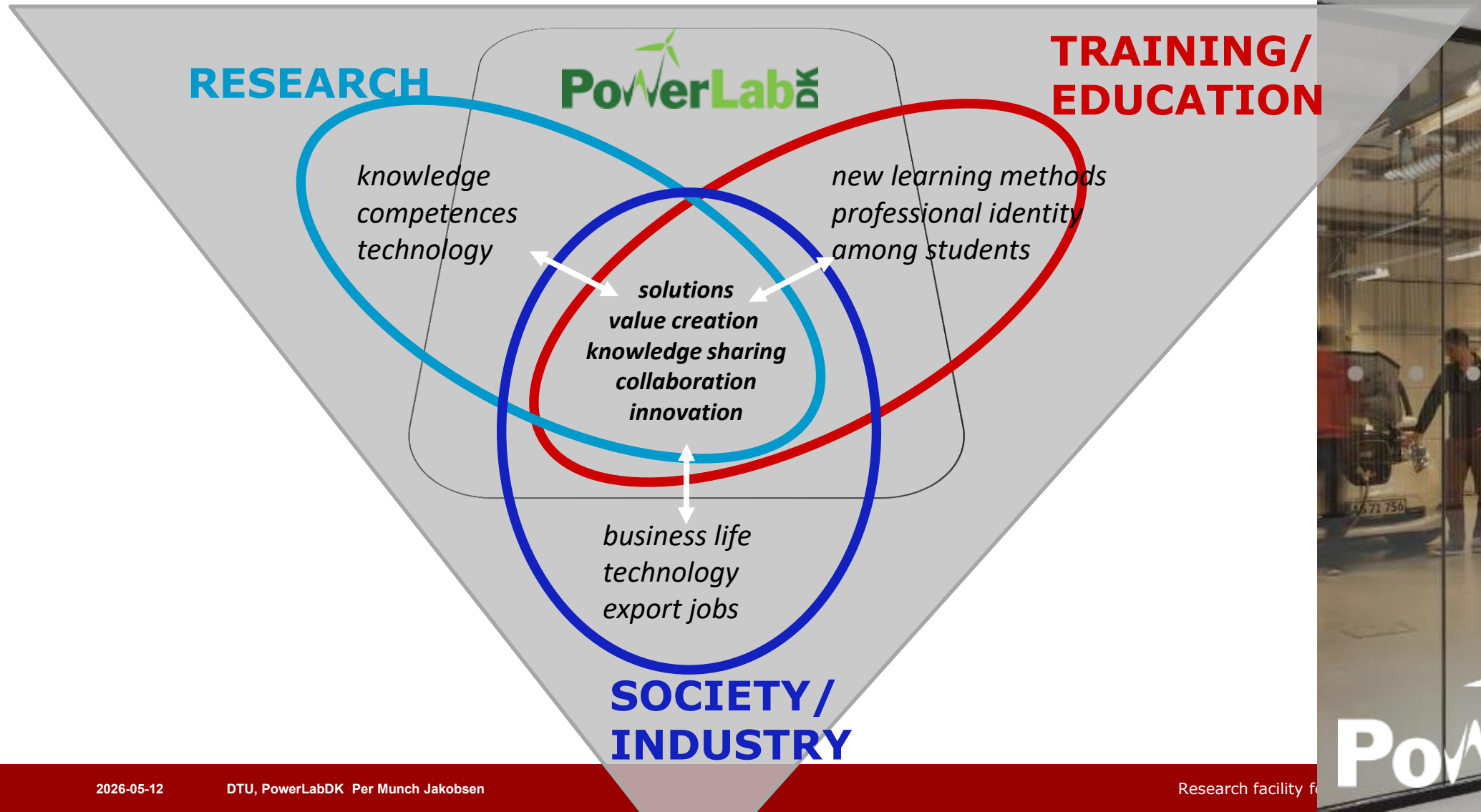


DTU Wind and energy systems

Division for Power and Energy Systems

Digital Energy Solutions	Interconnected Energy System	Optimised Electric Energy Technologies
• New business models • Data-driven solutions • Active grids • Control centers	• Infrastructure integration • Smart energy • Market flexibility • System optimisation	• Novel equipment concepts • Electric vehicle integration • Prosumer solutions • Cost-effective wind

Platform for synergy and collaboration



PowerLabDK Steering Committee

Jørgen S. Christensen
CTO, Danish Energy Association

Charlotte Søndergren
Head of Department, Energy Planning, HOFOR A/S

Peter Weinreich-Jensen
CEO, Siemens Energy

Claus Madsen
CEO, ABB A/S

Torben Glar Nielsen
Executive Vice President, Energinet.dk

Troels Stybe Sørensen
Director, Chief Specialist Electrical Engineering, Ørsted

Charles Nielsen
CTO, TREFOR

Anders Jensen
EVP & CTO, NKT A/S

Representatives from partners:

Jacob Østergaard
Professor, Head of Division for Power and Energy Systems,
DTU Wind and Energy Systems

Morten Jeppesen
Head of Department,
DTU Wind and Energy Systems

Claus M. Andersen
Managing Director,
Bornholms Energi & Forsyning

Frida Frost
Head of innovation
Head of PowerLabDK

PowerLabDK, Safety in a dynamic Laboratory

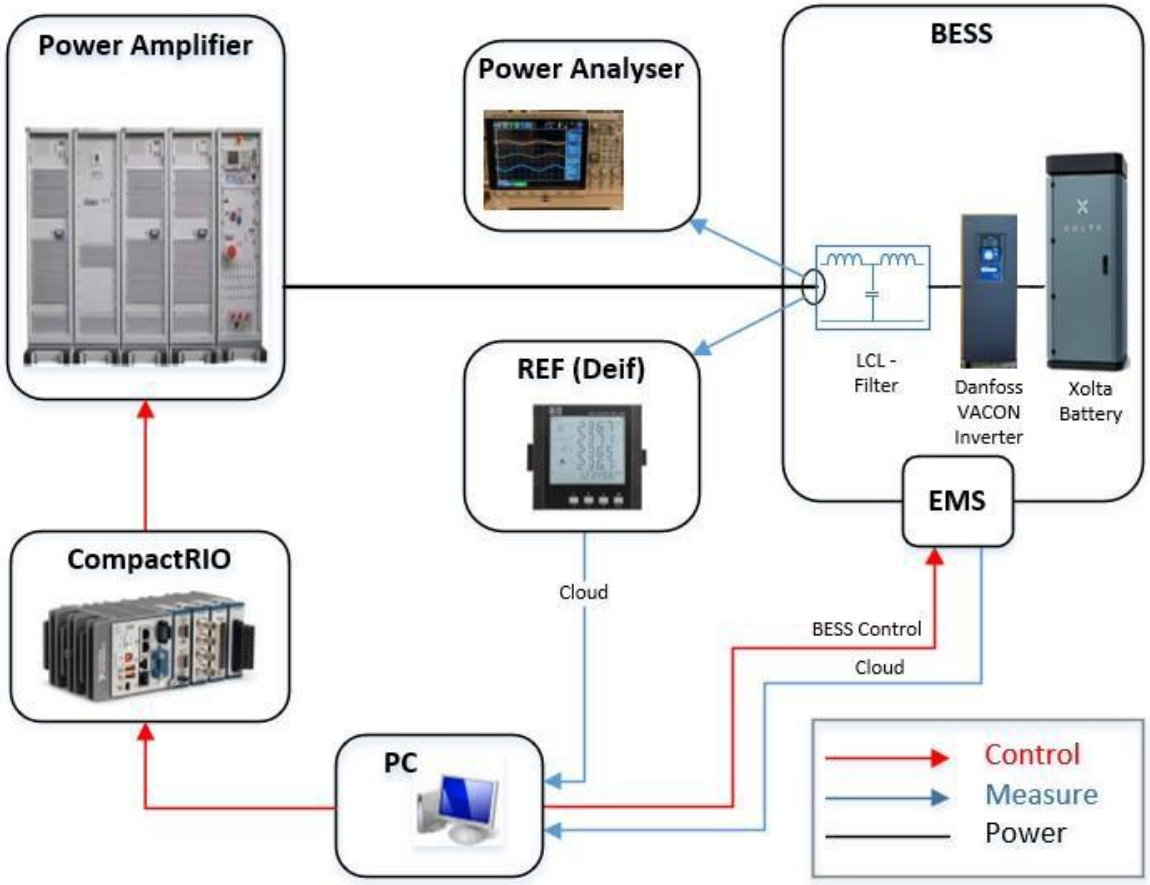
Challenges for health and safety in PowerLab:

- Extreme Magnetic Fields
- Liquid Nitrogen
- Extreme Voltages/current
  - 800 kV AC test
  - 1,2 MV impulse test
  - 50 kA, 1 sek
- Batteries and BESS
  - High Short circuit current
  - Thermal run-away
- PtX
  - Explosion, ATEX,
  - Lightning Protection
- Chemicals

- Prototypes
  - Hard to examine, industrial secrets
  - Lack of documentation
- Device from all over the world
  - Different voltages
  - Grounding system
- ”Border to the unknown”
- Entusiastic and busy

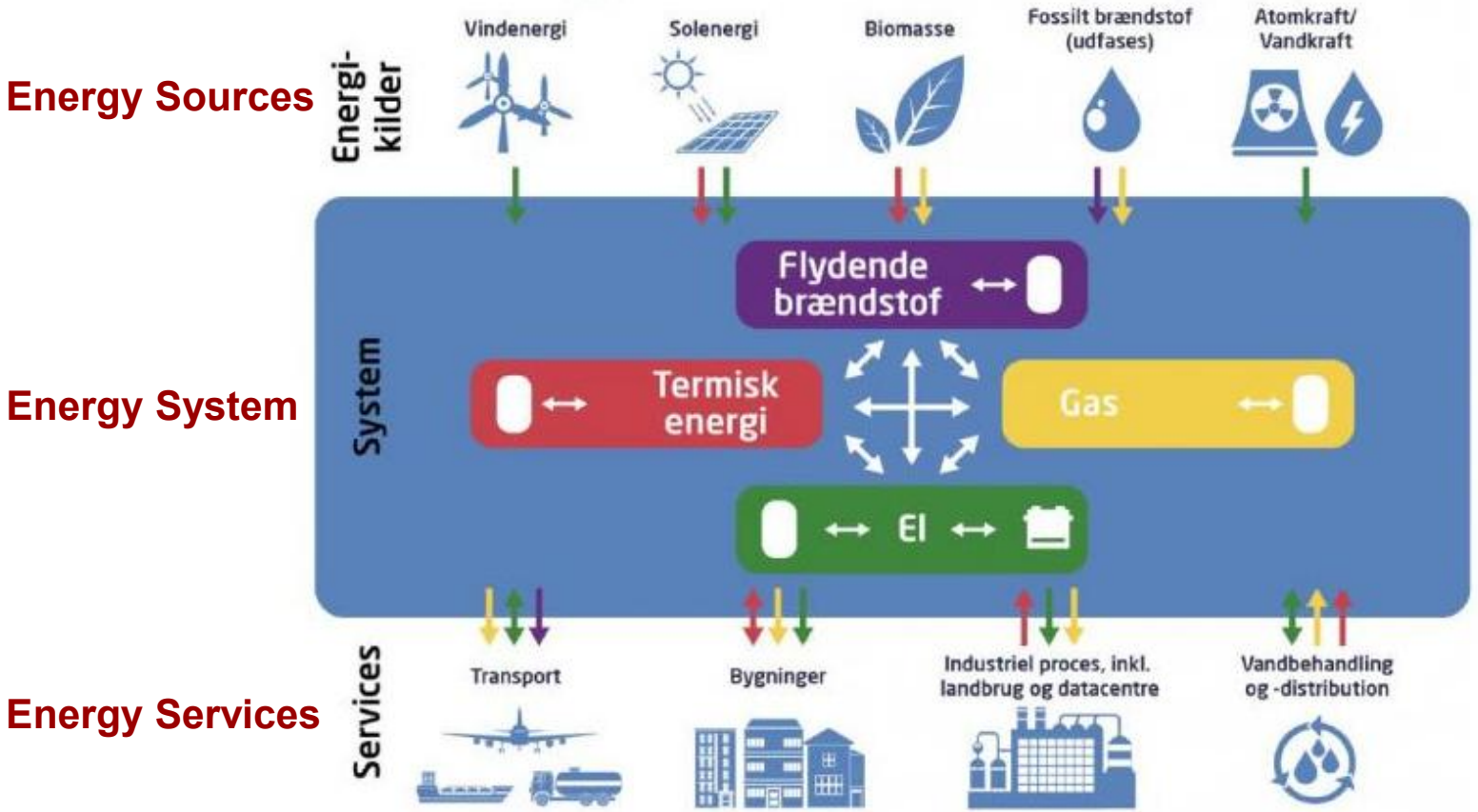
BESS Grid Code compliance test

- BESS Grid code compliance test (Energinet TF 3.3.1)



Sector coupling - a strategy for DTU

Sector coupling model



Motivation

Design and validate a smart energy system

- If you develop Wind turbines, you need a windturbine

Motivation

Design and validate a smart energy system

- If you develop energy systems, you need SYSLAB

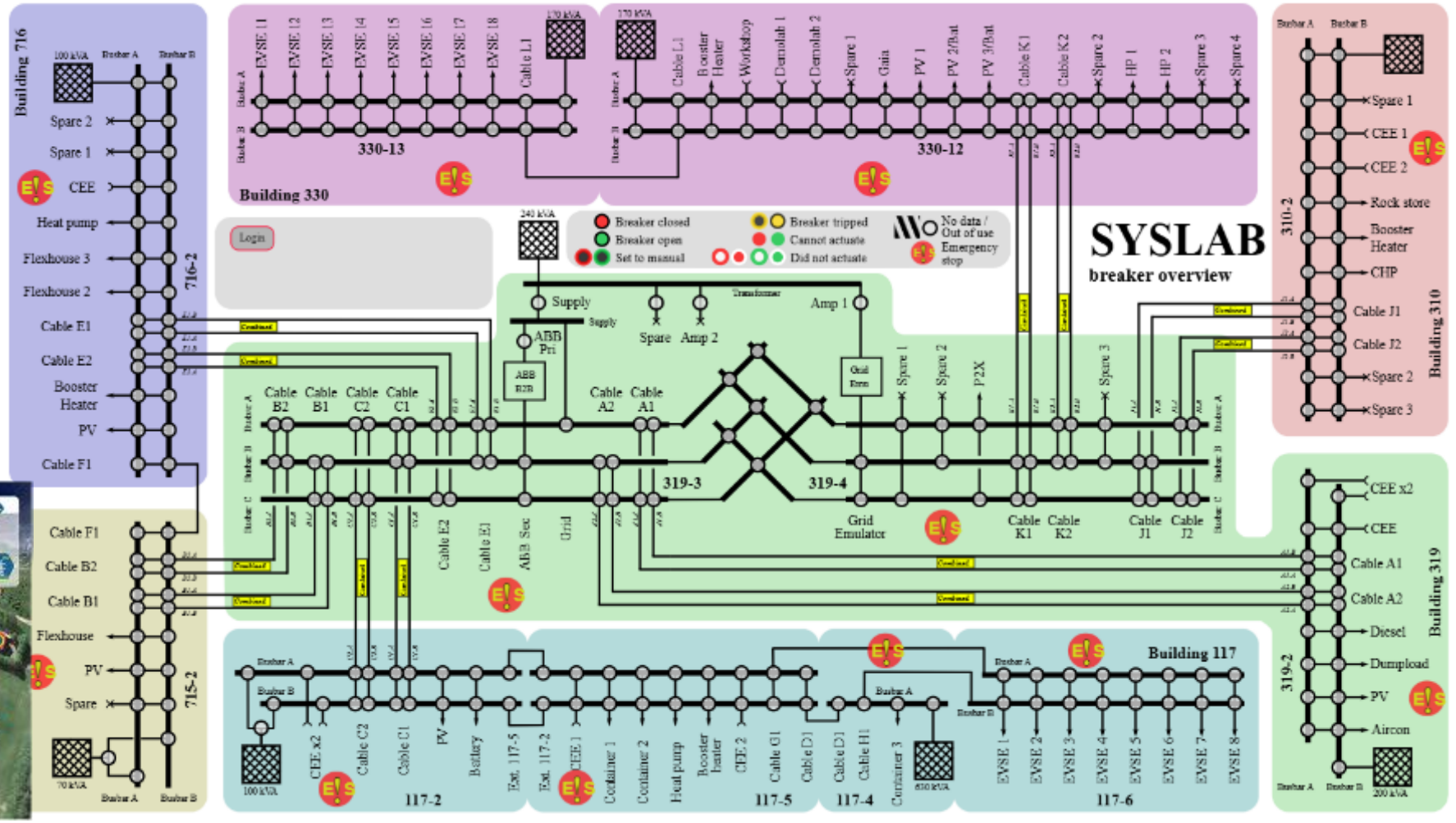
Motivation

Design and validate a smart energy system

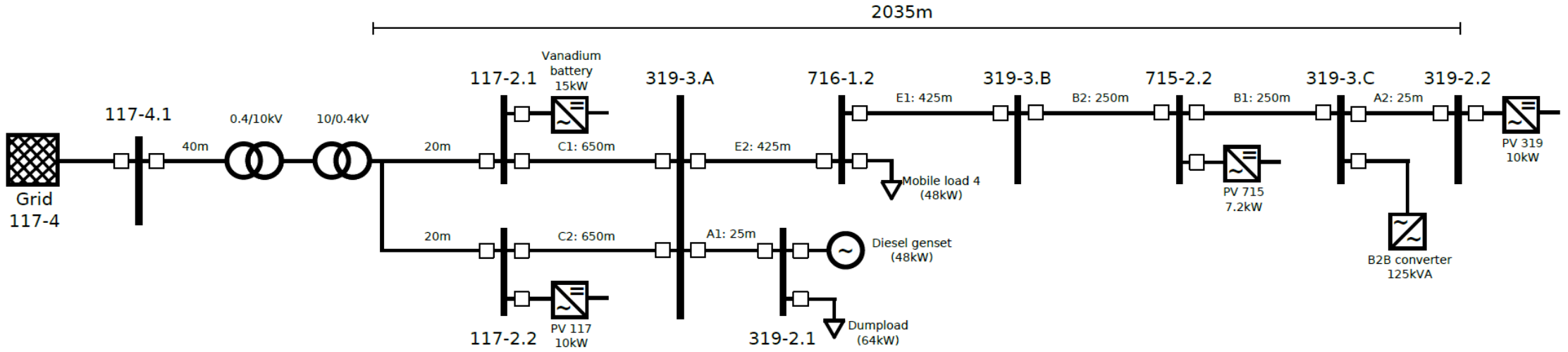
- If you develop energysystems, you need SYSLAB

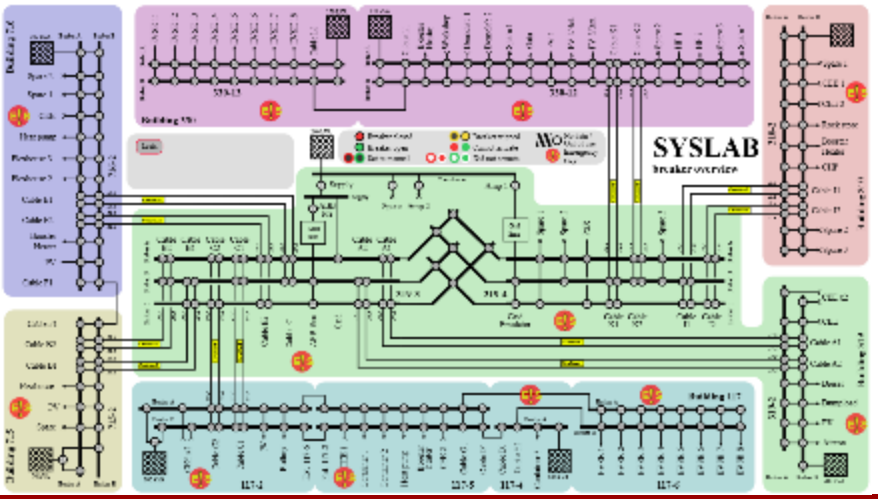
Energy System Integration Lab – SYSLAB facilities

6 substations
6 Crossbars
>20 Busbars
>200 breakers and powermeters
>25 cables, 8000 m
>10 2” twin-pipes, 4500 m
>25 SYSLAB node computers
10 Auxillary computers
1 database server



Energy System Integration Lab - SYSLAB
Example of use

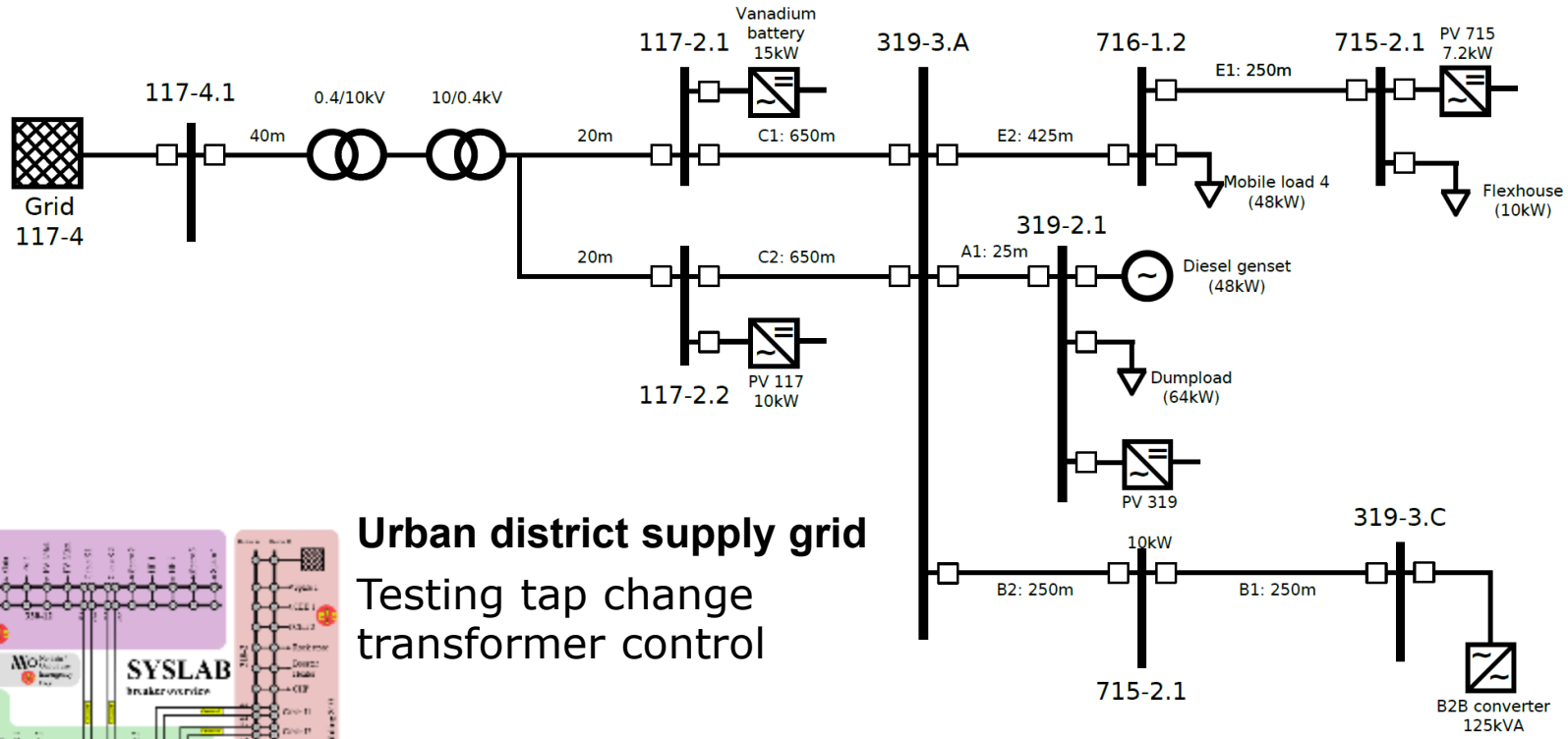


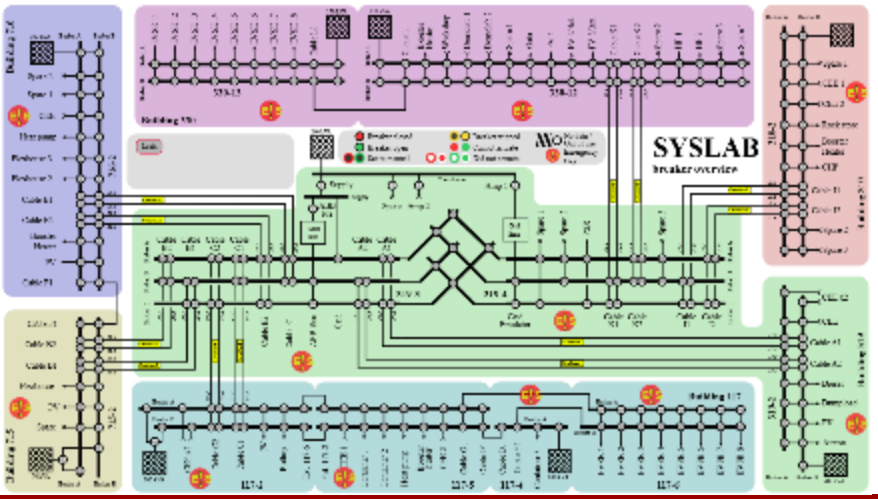


Rural district supply grid

Testing tap change transformer control

Energy System Integration Lab - SYSLAB
Example of use

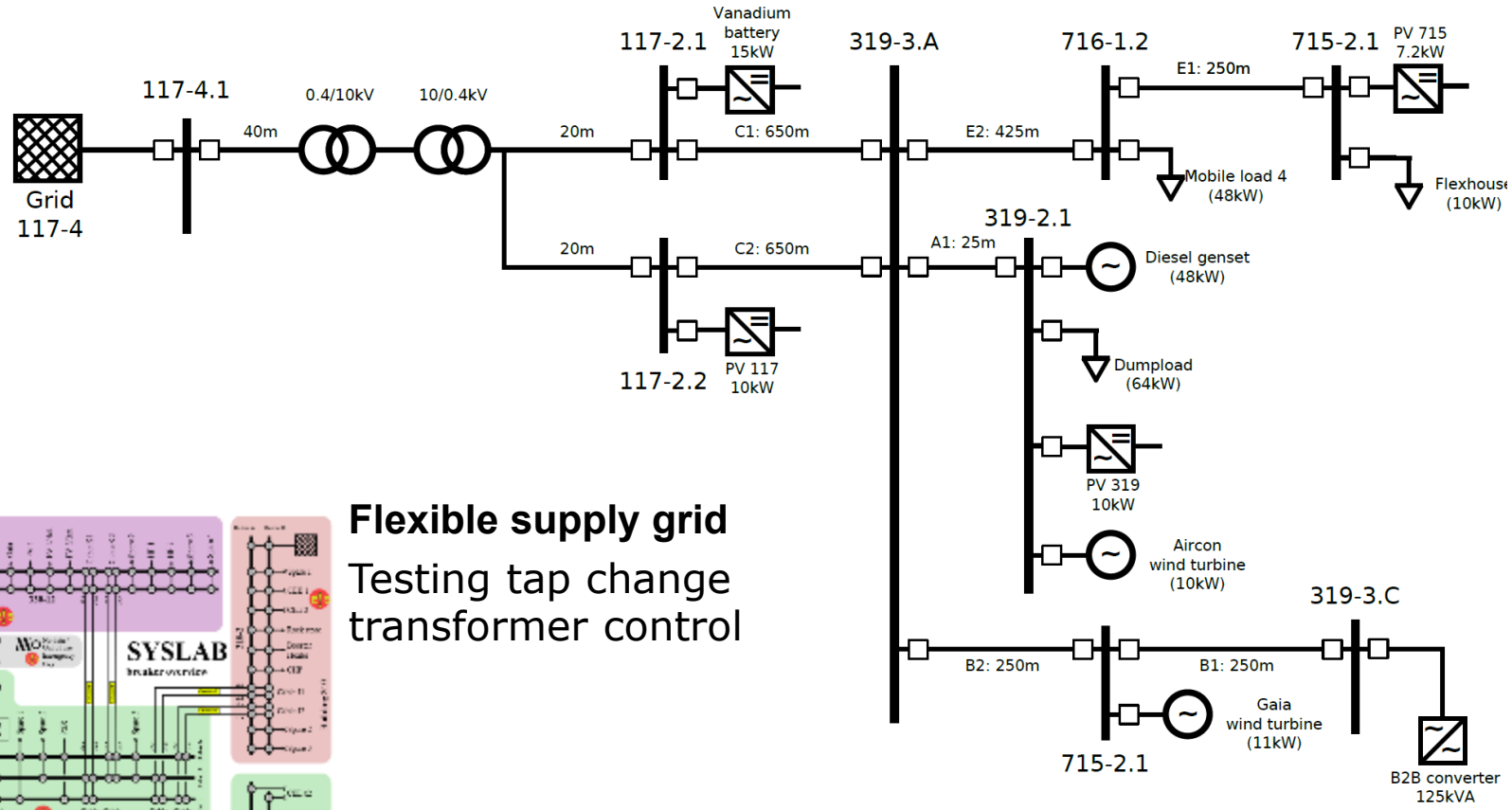


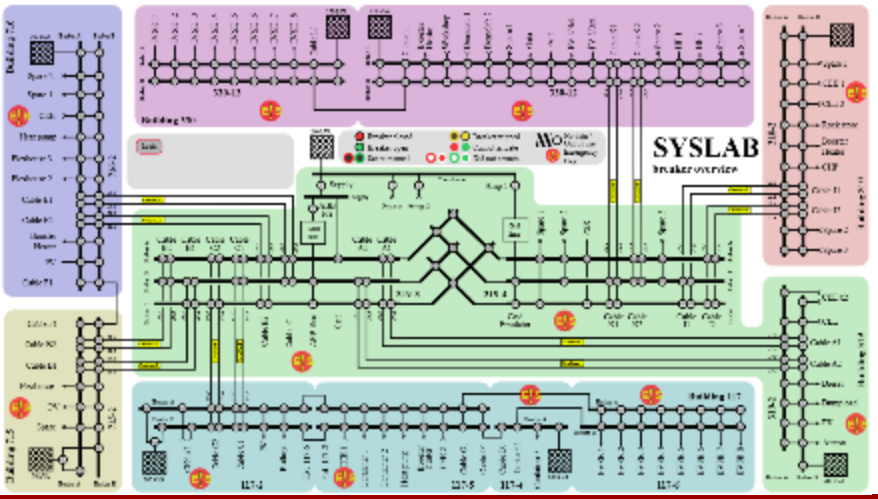


Urban district supply grid

Testing tap change transformer control

Energy System Integration Lab - SYSLAB
Example of use





Flexible supply grid

Testing tap change transformer control

Energy System Integration Lab - SYSLAB

Sector coupled energy system research facility

Our challenge:

1. Build and demonstrate a Flexible Heating system
2. Extend with at transmission and distribution system

Why do it?

Motivation:

- District heating is a large part of Danish energy sector and industrial activities
  - Danfoss, Flowcon, Logstor, Grundfos, Kamstrup…
- Electric energy sector has changed a lot. Energy ressources are distributed and controlled
  - Learnings can be transferred between sectors
- Energy sectors are decoupled, - huge potential in integration:
  - Common control system or interfaces
  - Flexibility
  - Heating systems as energy storage
  - Taxation system

Energy System Integration Lab - SYSLAB
The needs we address

SYSLAB - All electric DER!

Our challenge:

1. Build and demonstrate a Flexible Heating system
2. Extend with at transmission and distribution system

Why do it?

The needs we address:

- Better models, simulations and ways to do verification tests
- Full control over DER and system setup,
- Well known measurements, with high resolution and low timescale
- Do experiments with behind the meter systems
- No responsibility for customers regarding quality of supply

Energy System Integration Lab – SYSLAB
Future Sector coupled energy system

Energy System Integration Lab – SYSLAB
Future Sector coupled energy system

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Future Sector coupled energy system

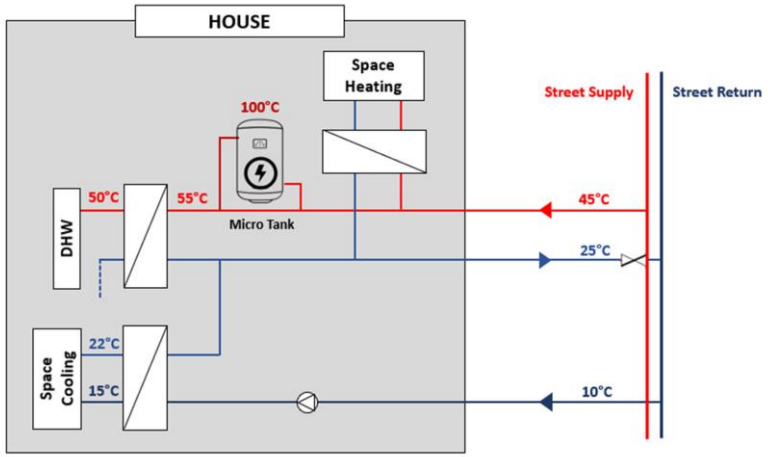
Energy System Integration Lab – SYSLAB
Future Sector coupled energy system

Energy System Integration Lab - SYSLAB
The needs we address

Develop new District heating/cooling systems

Example:

Double-loop network



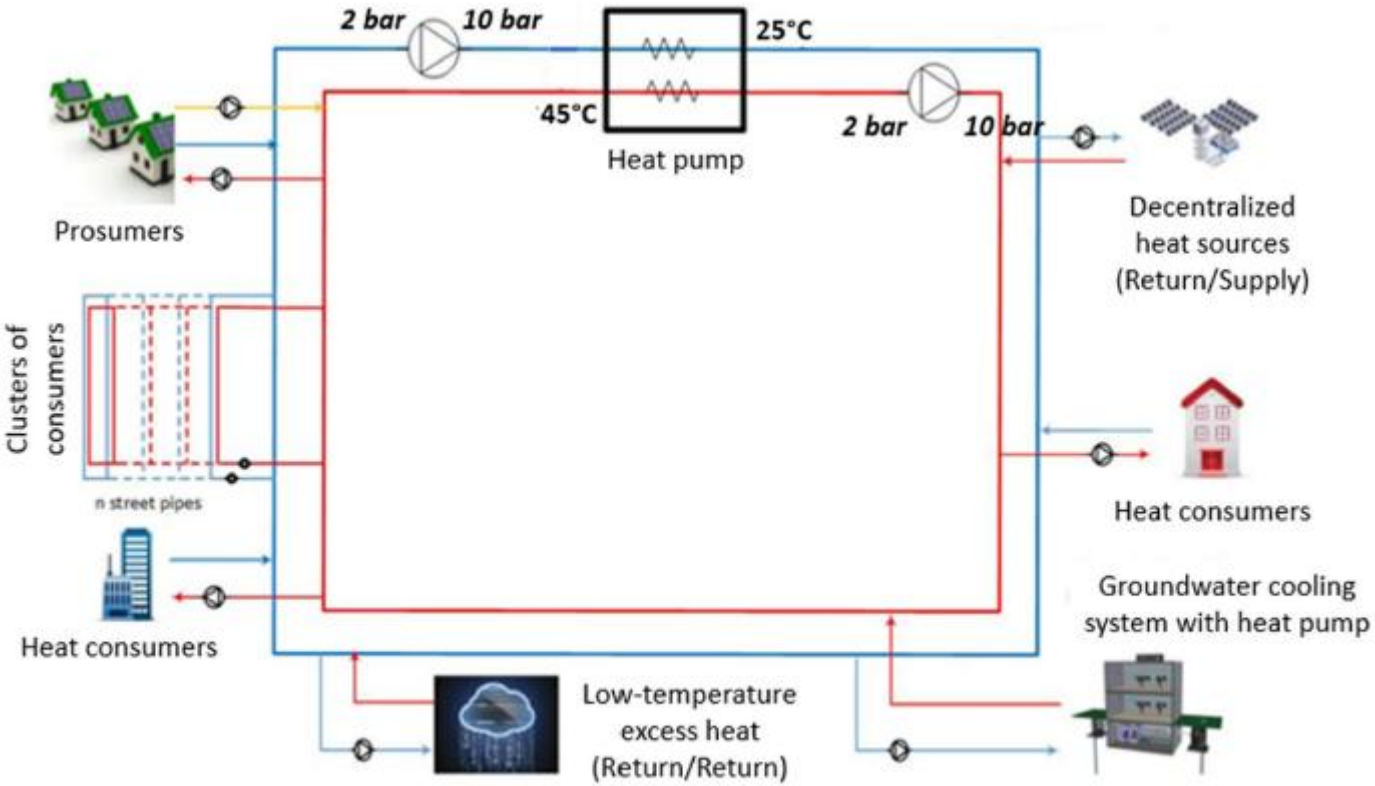


Figure 1. General schematics for the double loop concept.

Energy System Integration Lab - SYSLAB
Example of use

Energy 193 (2020) 116729

Contents lists available at ScienceDirect

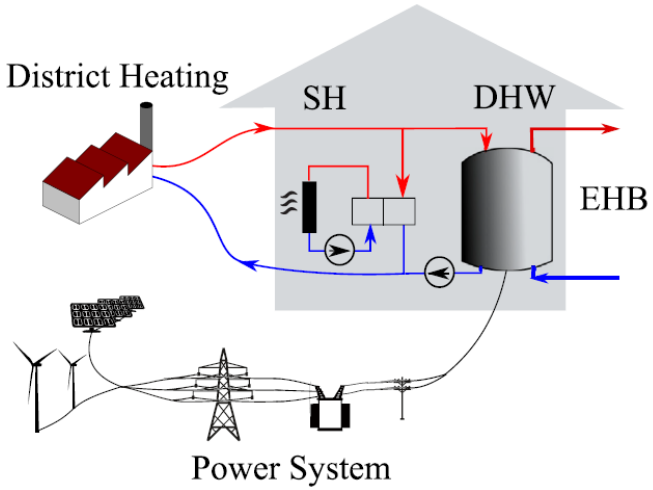
Energy

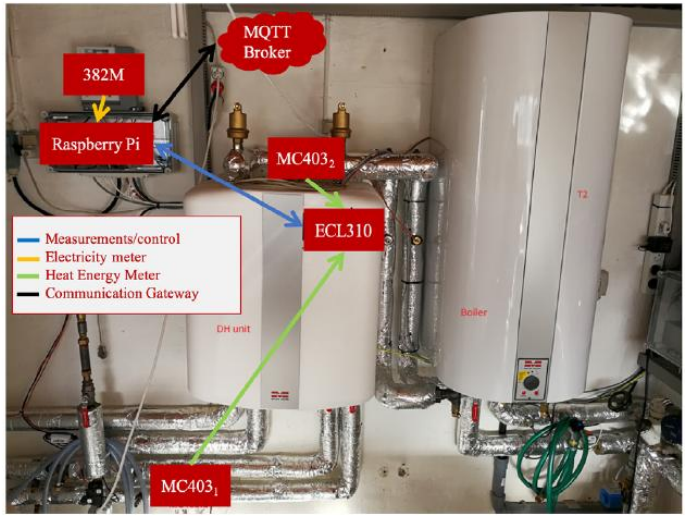
journal homepage: www.elsevier.com/locate/energy

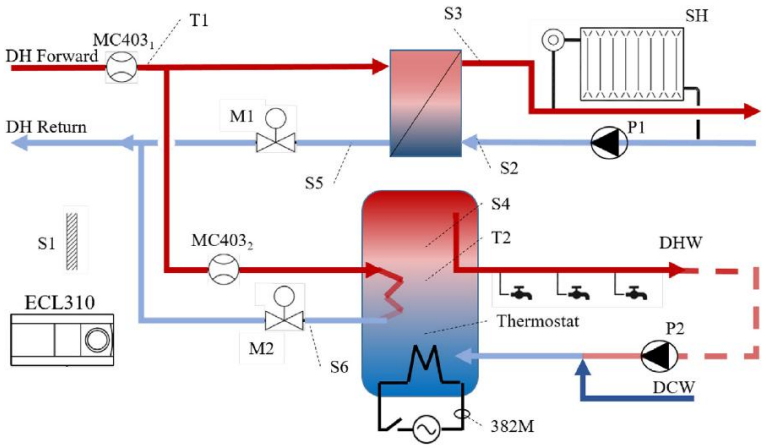
Experimental evaluation of an integrated demand response program using electric heat boosters to provide multi-system services

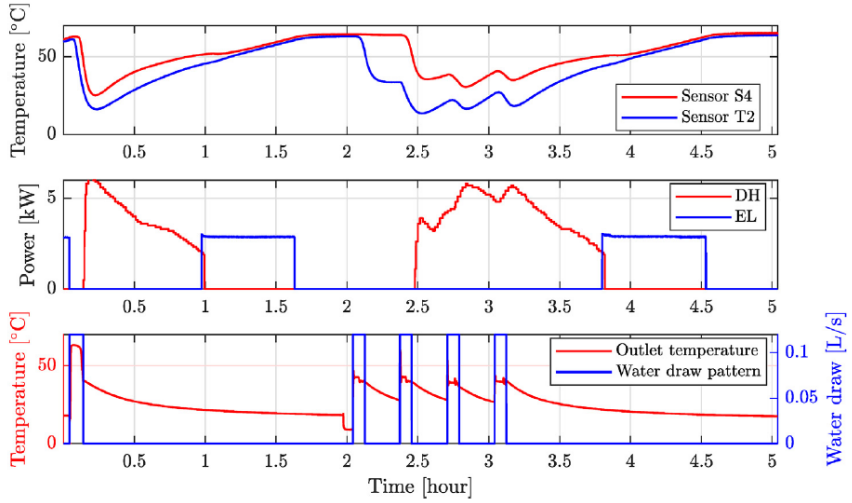
Hanmin Cai, Andreas Thingvad, Shi You*, Mattia Marinelli

Department of Electrical Engineering, Technical University of Denmark, 2800, Kgs. Lyngby, Denmark



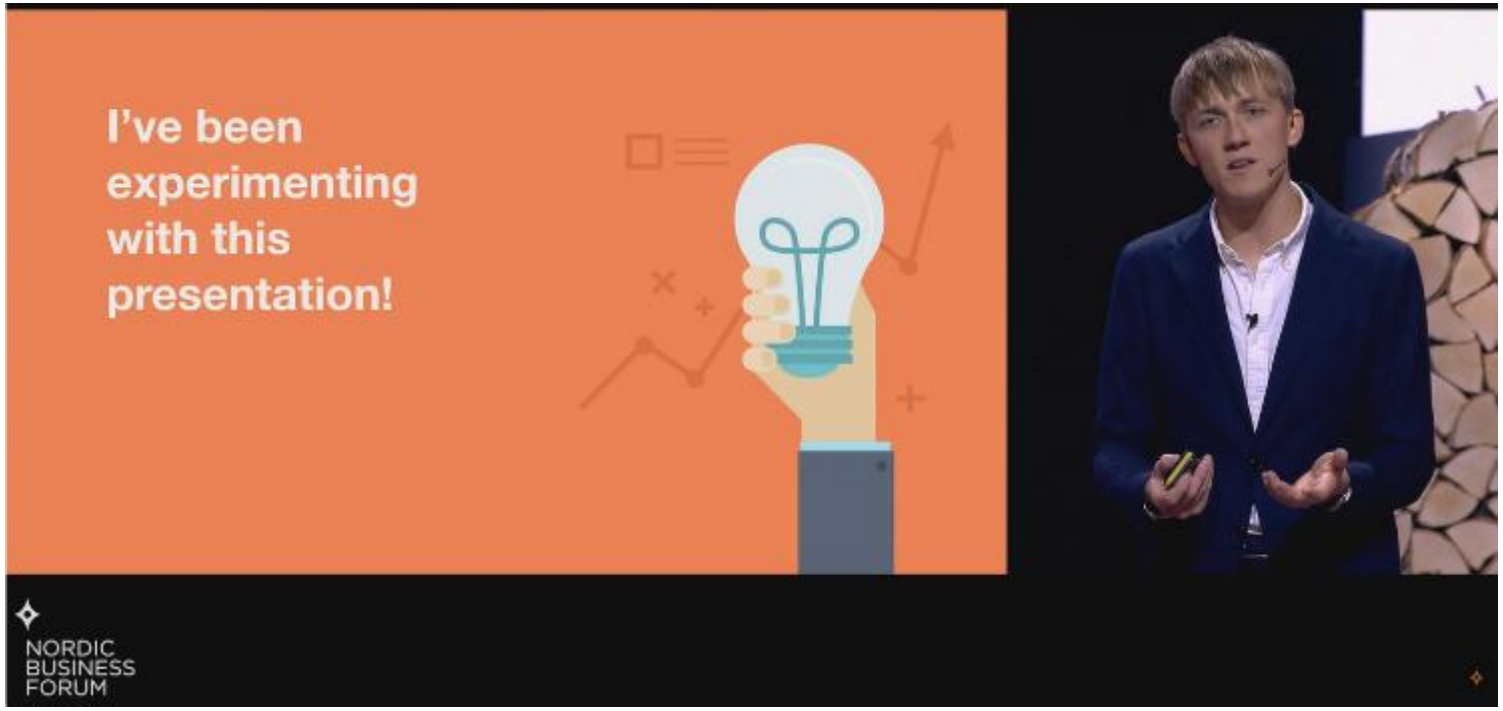






Eksperimenter som driver for markedsudvikling

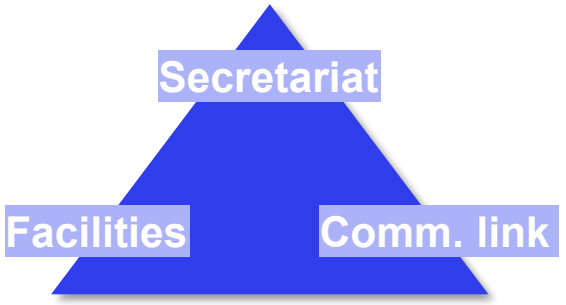
1. Vækst kommer fra læring –
   ikke fra store strategier
2. Hypoteser → test → data → beslutning
3. Data slår mavefornemmelser
4. Mange små forbedringer → stor effekt
5. Eksperimenter reducerer risiko
6. Bedre produkter/systemer gennem indsigt
7. Hurtigere innovation

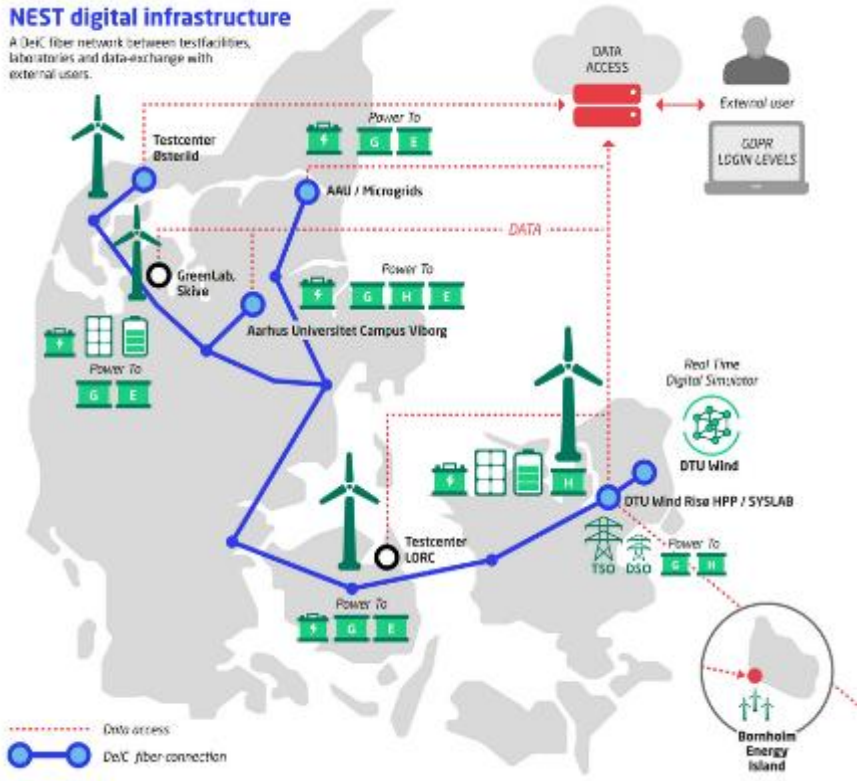


[Anssi Rantanen - Why Experimentation is the Future of Growth]

Anssi Rantanen is the winner of Nordic Business Forum's 2019 Speaker Contest

3.a.1 NEST in a nutshell





- Connects all major **Energy Transition Labs** in Denmark into **one facility** through high-speed optical data connections
- Enables experiments to **couple geographically distributed components** via a *virtual/physical* link (small-scale to full-scale)
- Mixes and matches capabilities of the different labs – eliminating existing gaps on all TRL levels
- Facilitates access to all labs through a joint secretariat and pricing model, monitors research projects

LABS	
	DTU PowerLabDK
	DTU HPP
	AU Campus Viborg
	AAU p2x
	AAU Microgrid
	DTU Østerild
	LORC
	GreenLab Skive

DeiC fiber connection

Total budget:
113 million DKr.

Platform for synergy and collaboration

Examples of use:

1. NKT superlink typetest (Commercial test)
2. Open Arc, High power short circuit prototypetest (Commercial test)
3. BESS grid code compliance test (Research + Commercial test)
4. Ormazabal, tap change transformer control test (Commercial test)
5. Metro Therm, electric heater, DS428 test (research project)