

University of Vaasa

Research Group

Smart Electric Systems

Faculty of Technology

University of Vaasa

- 700 km to east from Trondheim
- 5000 students
 - 1200 in the faculty of technology
- Industry in Vaasa
 - Relay manufacturers
 - ABB, Schneider (vamp), Arcteq



Research groups

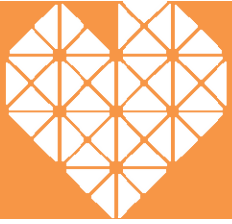
- **Research groups at the Faculty of Technology:**
 - Mathematics and Statistics
 - SC-Research
 - Networked Values Systems
 - Renewable Energy
 - **Smart Electric Systems**



Smart Electric Systems

- Automation
 - **Electrical Engineering**
 - Communication and Systems Engineering
 - Computer Science
-
- **Group leader: Professor Kimmo Kauhaniemi**





Vaasan yliopisto
UNIVERSITY OF VAASA

Research in Electrical Engineering

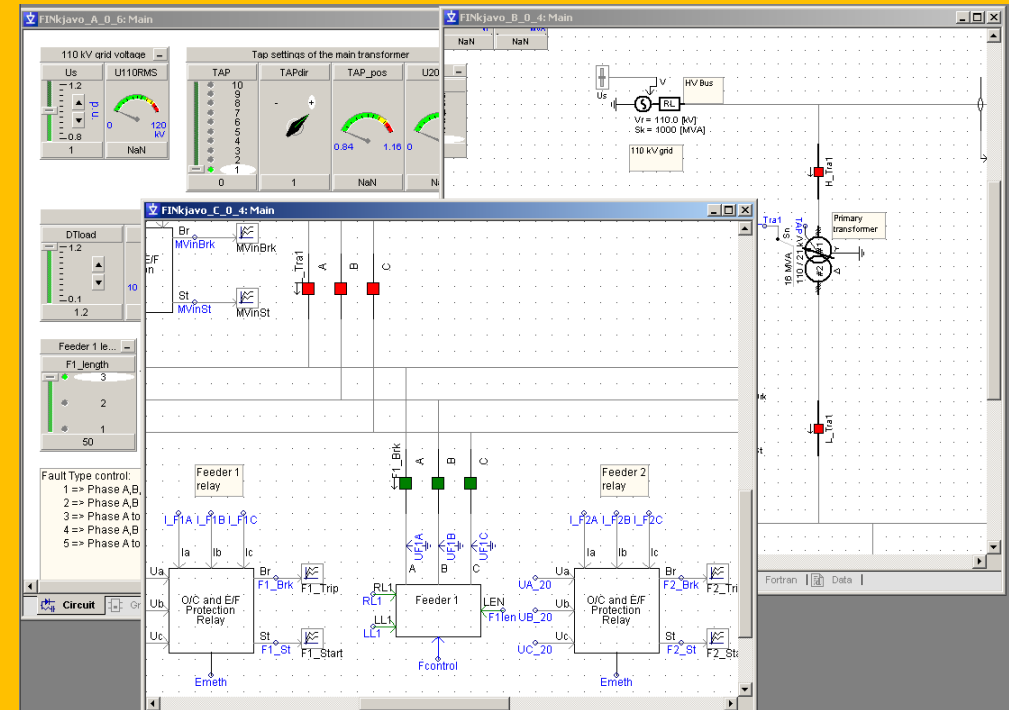
Research Areas in Electrical Engineering

- Power systems transient simulation (converters, protection relays)
- Distributed energy resources (grid interconnection issues)
- Electricity distribution systems (Smart Grids, microgrids, IEC 61850)



A simulation environment for grid connection of distributed generation

- Two parts
 - Simulation environment
 - In cooperation with VTT Processes (Vaasa)
 - 1.3.2003 - 31.3.2005
 - Electricity distribution and distributed generation (ELDIG)
 - In cooperation with other Universities and VTT
 - 1.3.2005 – 31.7.2007
- Part of the Densy program of TEKES
- Result: a library of simulation models
 - Electricity distribution networks
 - Generators
 - Protection relays



Smart Grids and Energy Markets (SGEM)

Research program

Cleen Oy

- **Timetable (whole program):**
18.9.2009 – 28.2.2015
- **Research institutes:**
 - Aalto University
 - University of Eastern Finland
 - Lappeenranta University of Technology
 - MIKES, Centre for metrology and accreditation
 - Tampere University of Technology
 - University of Vaasa
 - VTT, Technical Research Centre of Finland
 - Oulu University



sgem

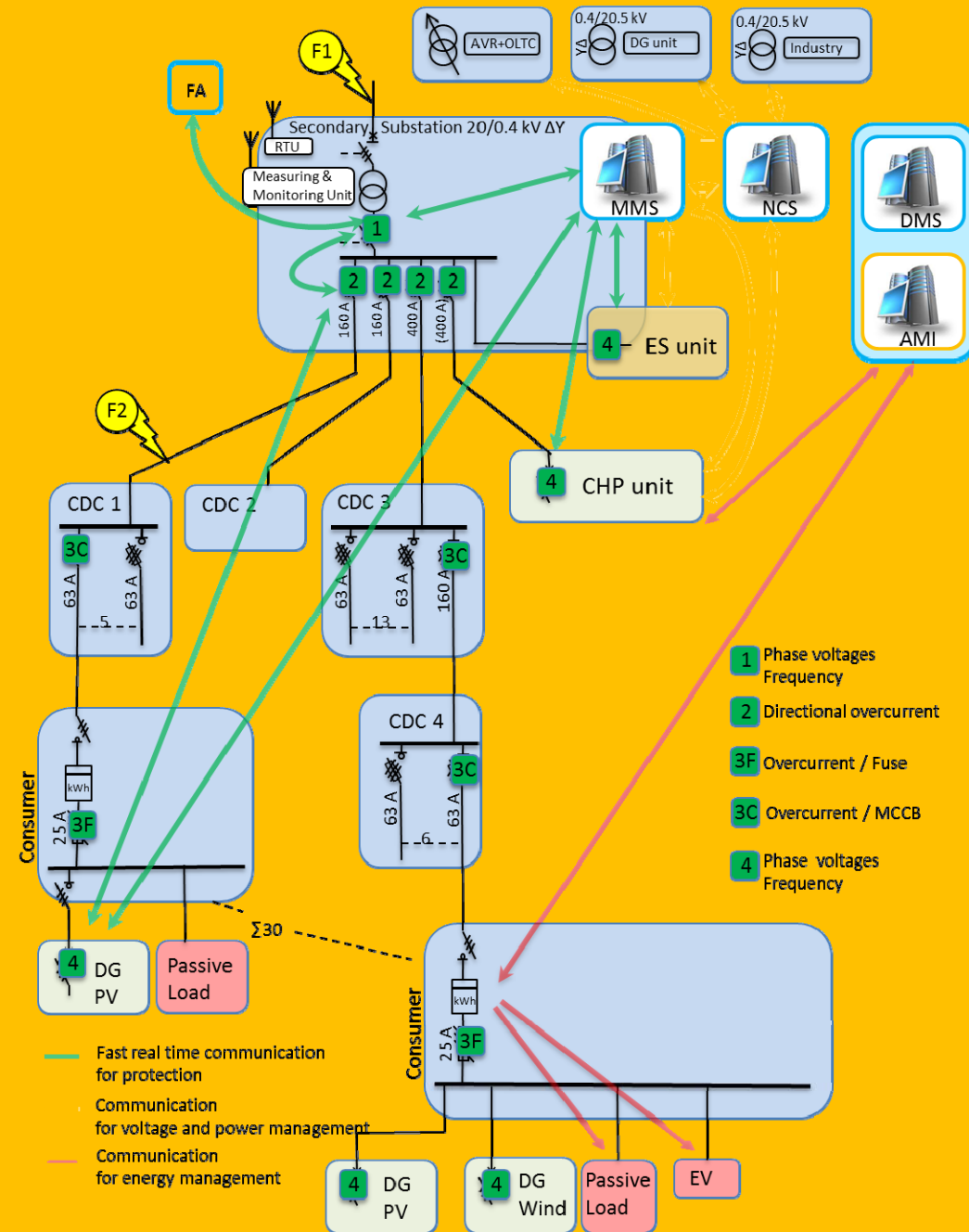
Smart Grids and Energy Markets

- **Companies:**
 - ABB
 - Aidon
 - Alstom Grid
 - Elektrobit
 - Empower
 - Emtele
 - Fingrid
 - Fortum Sähkösiirto
 - Helen Sähköverkko
 - Nokia Siemens Networks
 - Cybersoft
 - Suur-Savon Sähkö
 - Tekla
 - Telia Sonera
 - The Switch
 - There Corporation
 - Vantaan Energia Sähköverkot
 - Viola Systems

 - Cleen

SGEM focus areas at the University of Vaasa

- Earth fault compensation and protection of cabled networks
- Simulation model library
- LV network management
- Smart Grid protection
- Microgrids
- Customer surveys: energy monitoring and small scale production

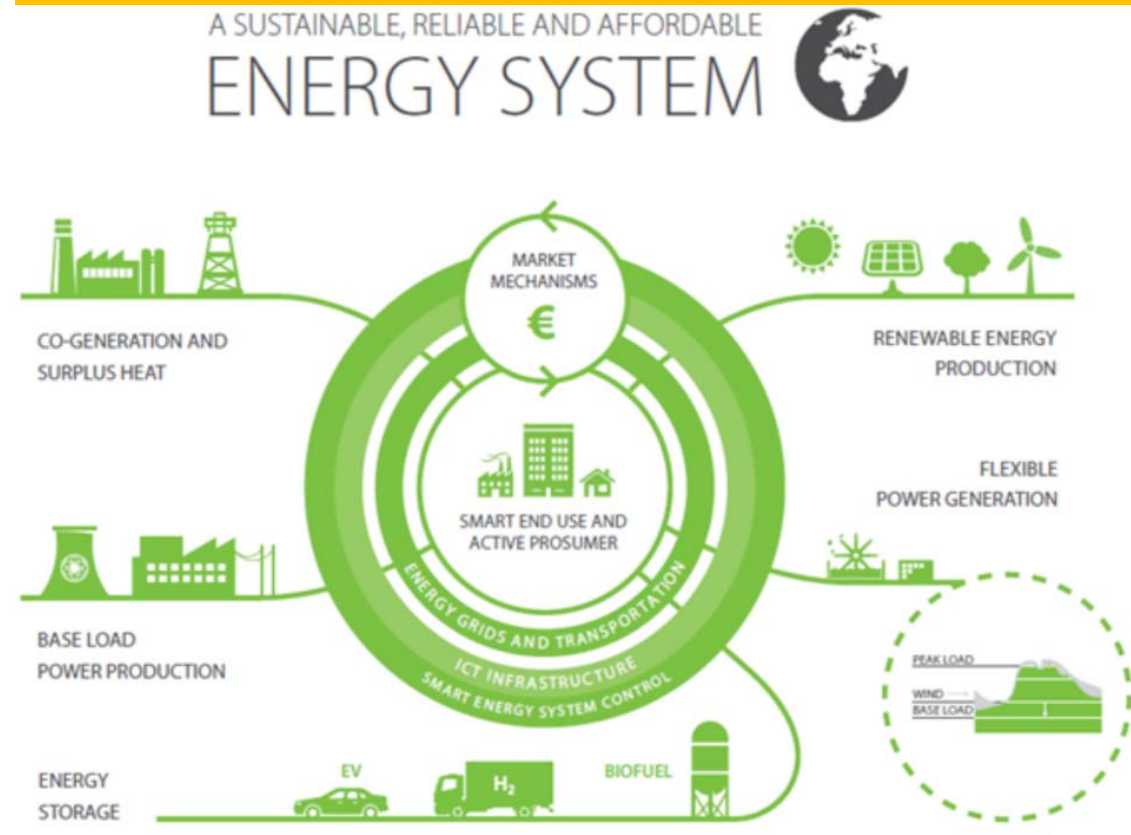


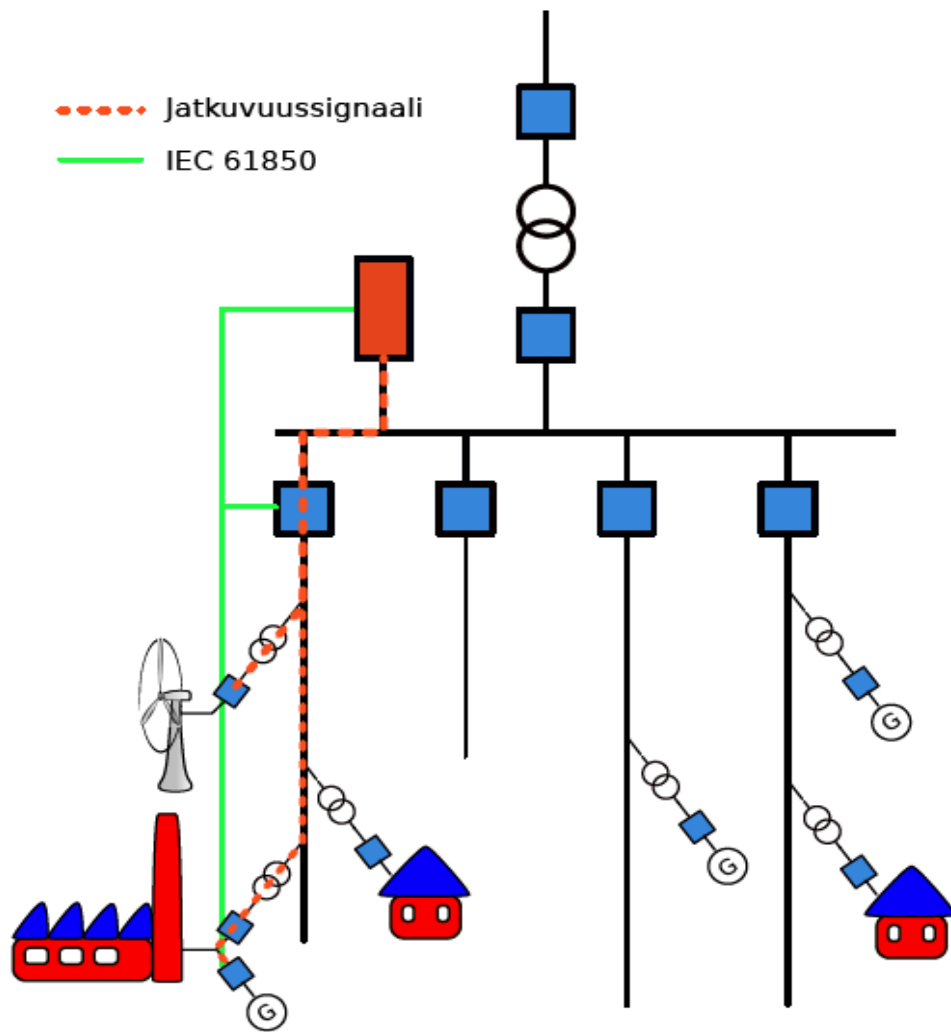
FLEX^e – Flexible Energy Systems

Research Program of Cleen Oy

UV participation:

- Protection of cabled networks and telecommunication based adaptive protection methods
- Research on modelling of flexible energy resources
- Optimization of energy production systems
- Assessment of the features of a beyond-state-of-the art control system for flexible power generation
- Flow modelling and measurements
- Novel approaches to minimize THC emissions – literature review and experimental work





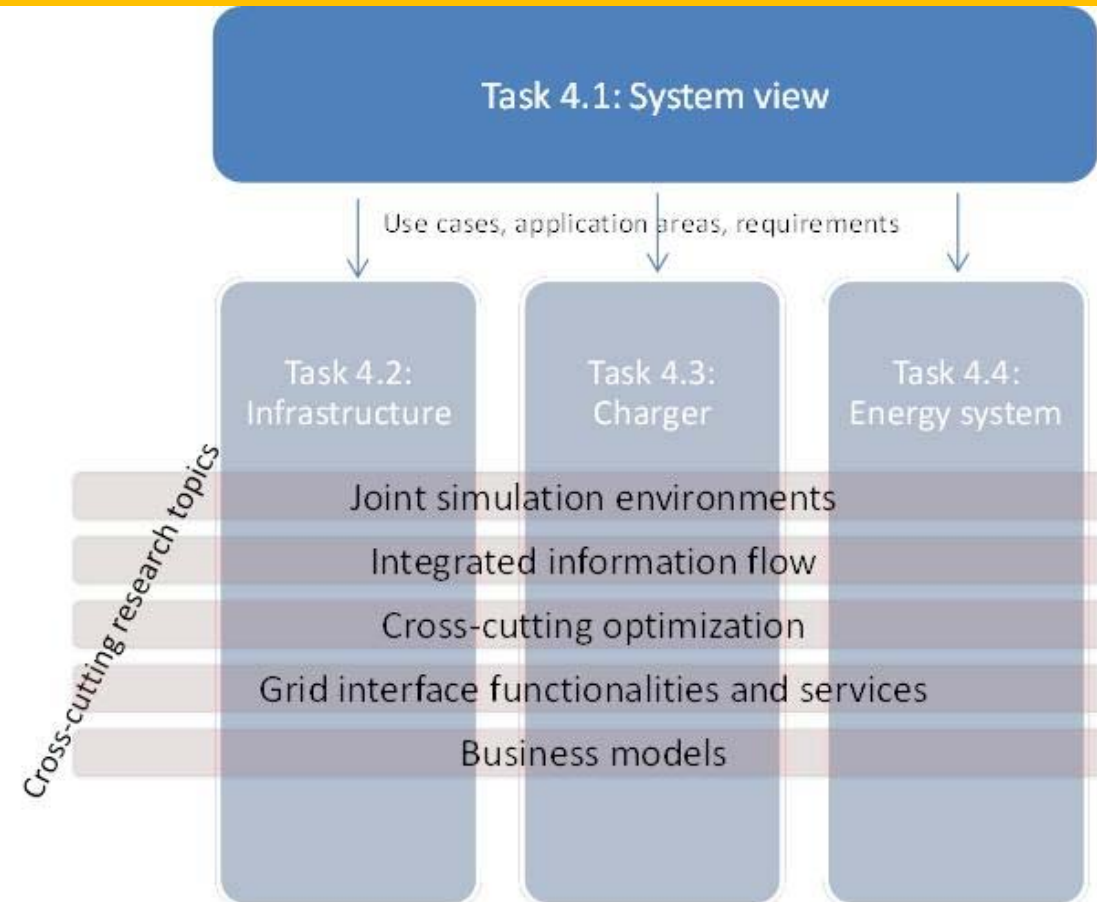
RE-FORM - Renewable energy and business in energy chain

Protection of distributed generation

- Power line signal based loss-of-mains protection – simulations and testing
- Development of the protection of inverter interfaced distributed generation

eCharge – EV systems and grid integration

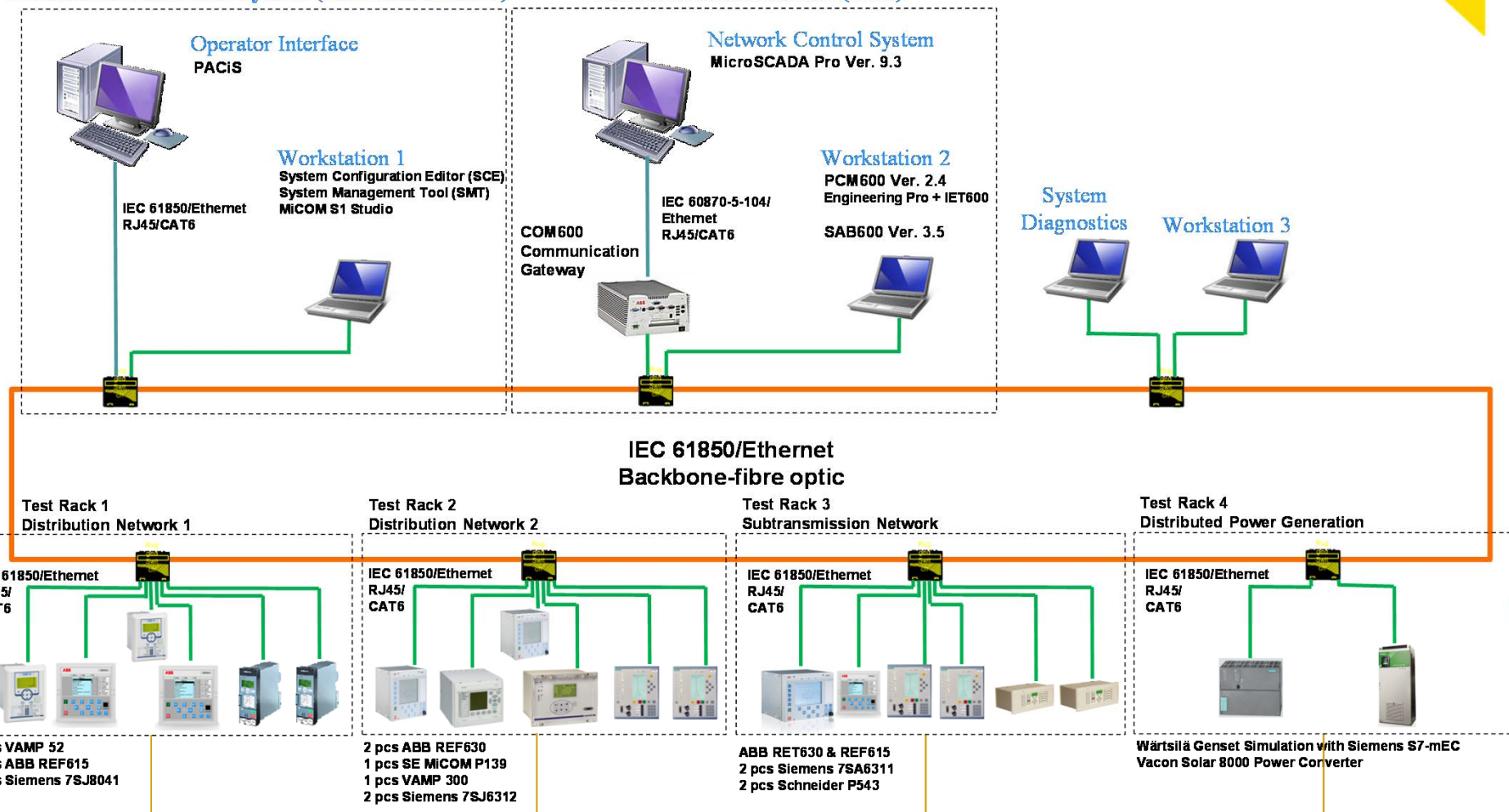
- Part of the ECV network
- Funding from TEKES EVE program
- Partners
 - VTT, LUT, TUT, UVA
- Tasks at UVA
 - Modelling of different charger topologies
 - EV integration to grid
 - Communication protocol interfaces to grid management



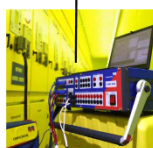
IEC 61850 multi-vendor environment

Substation Automation System (Schneider Electric)

Network Control Center (ABB)



**Protection Relay Test Set
and Commissioning Tool**



PAC laboratory

- protection
- automation
- communication
- IEC 61850 enabling seamless integration of devices from different vendors



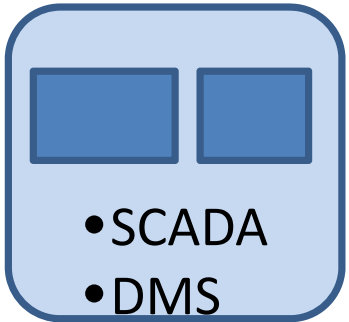
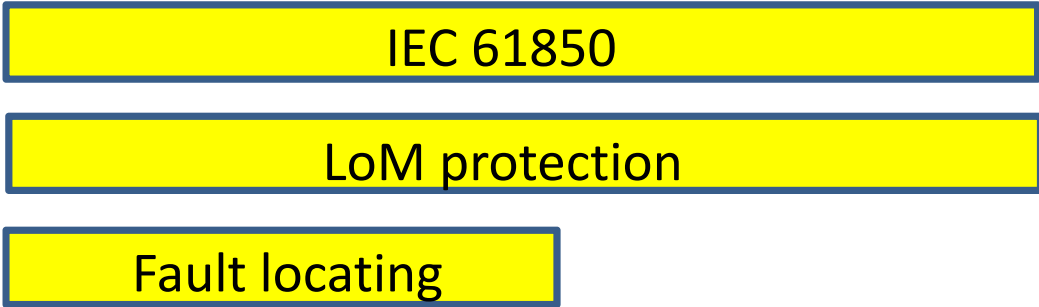


European Union
European Regional
Development Fund

Leverage from
the EU
2014–2020

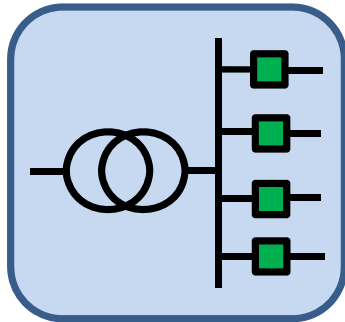
Protect-DG

INKA-project in cooperation with LUT



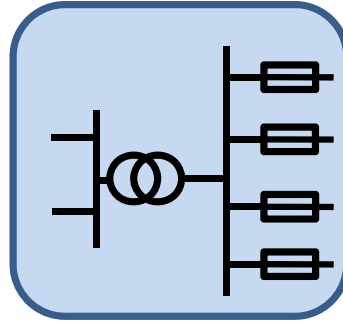
Control Center

- Fault locating



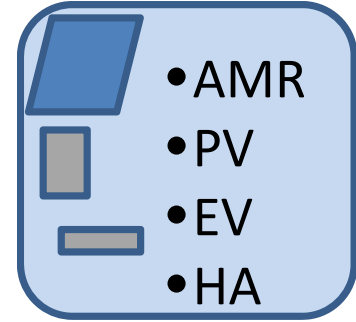
Primary Substation

- Signal transmission
- IEC 61850



Secondary Substation

- Fault detection
- Signal detection



Customer

61850 comm.

- PV or other DG
- LoM

FESSMI

Future energy storage solutions in marine installations

- Hybrid solutions for various types of vessels
- Integration to harbour system
- Energy storages and renewable power generation
- Cooperation project between UV and LUT
 - part of the INKA program, funding from Tekes/EU(ERDF)
- Industrial partners: Wärtsilä, Danfoss, VEO, CLS-Engineering



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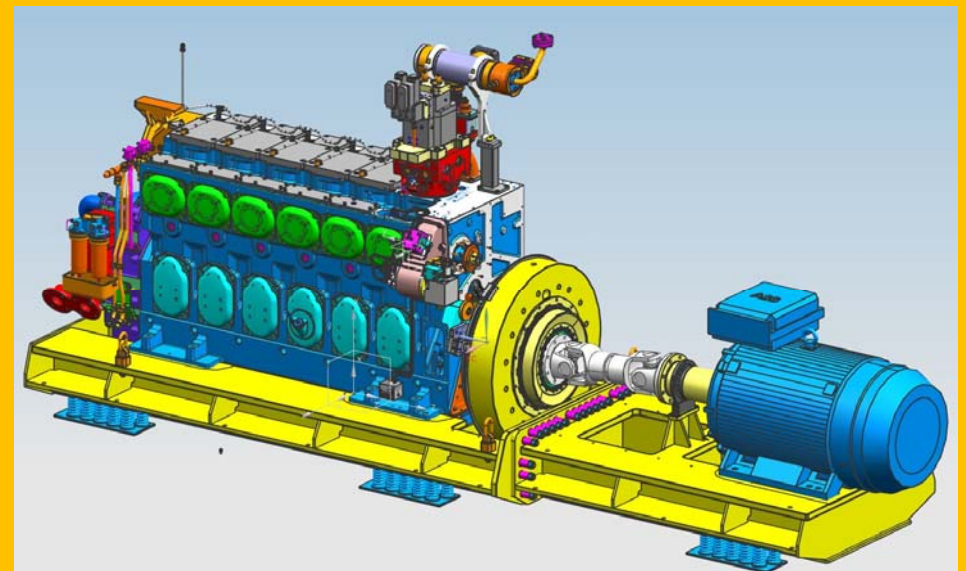


EnergyLab

“Smart Energy Labs”

“Energy Research Center”

- 1st phase:
 - Engine and fuel laboratories jointly with Wärtsilä
- 2nd phase:
 - Smart Grid laboratory
 - Geo-energy laboratory
 - Renewable energy laboratory
 - etc.



Elements of the Smart Grid lab



Medium voltage switchgear with Intelligent Electronic Devices for Smart Grid communication testing



Telecommunication laboratory offers state of the art facilities, IEC 61850 & CANopen



Supervisory Control and Data Acquisition system for monitoring, controlling and data collection (also from remote sites)

COMMUNICATION NETWORK

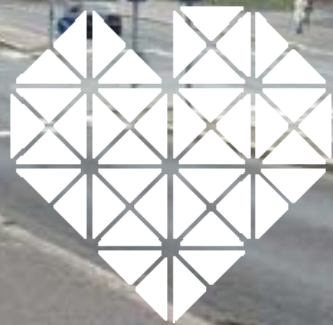
Real-Time Simulation equipment for testing future solutions and extending the system with virtual grid



Low voltage switchgear for microgrid modelling

Converters for connecting Distributed Generation and Energy Storages





Vaasan yliopisto

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