



University of Vaasa

Research Group

# Smart Electric Systems

Faculty of Technology

LEISURE

BUSINESS

RESTAURANTS

JOBS

STUDY

LIVING

ENERGY VAASA

SHOPPING

VAASA REGION

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EnergyVaasa


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SOME

CALENDAR

MAP


## ENERGY VAASA




**ENERGYWEEK**  
EnergyWeek 2017 in March was a great success! See you again 19th – 23rd March 2018.




**VAASA - WORK RIGHT!**  
Vaasa has the vision and the ecosystem for a gigafactory, and much more.



**ENERGYVAASA SHORTLY**  
EnergyVaasa information and background – download material



**R&D INVESTMENTS**



### ENERGYVAASA IS THE LEADING ENERGY CLUSTER IN THE NORDIC COUNTRIES

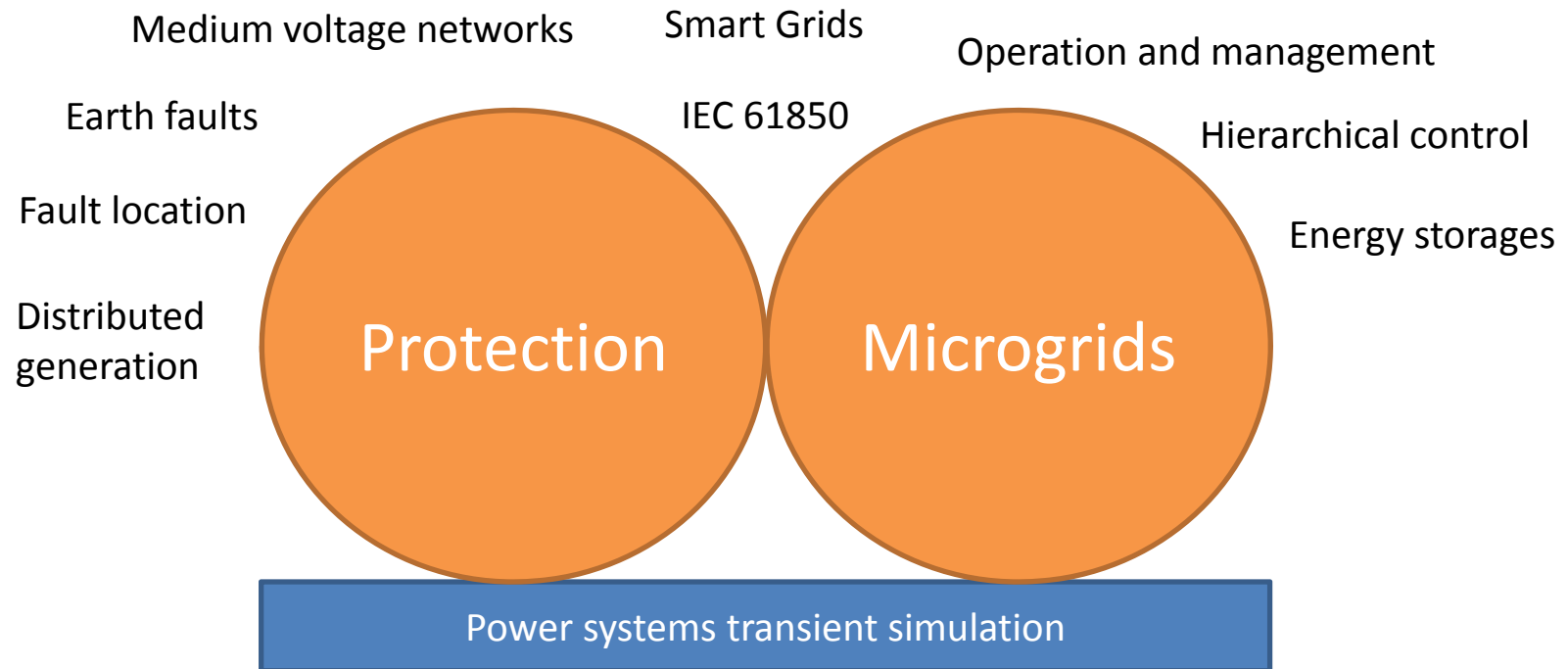
More than 140 businesses, several of which are global market leaders in their field – Total business turnover some EUR 4 billion annually, export rate over 80% – 30% of Finland's total export in energy technology – Number of employees 10,000

## LATEST NEWS

- 30.1. **Ministry: Vaasa competing for Tesla Gigafactory in Finland**
- 17.11. **Slush Energizing Fireside Breakfast**
- 7.10. **Finland's power of innovation and innovation of power**
- 27.7. **Apply now: EU Affairs Manager**
- 9.3. **Vacon's AC drives helped save 24 hours of global electricity production in 2014**
- 17.2. **Wärtsilä exhaust scrubber systems to achieve emissions compliance for two Stena Line ferries**
- 11.2. **Continued success for Wärtsilä dual-fuel engines with yet another order to power icebreaking LNG carriers**
- 10.2. **Wärtsilä Corporation's annual report 2014 published**

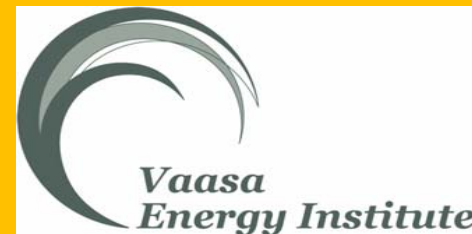
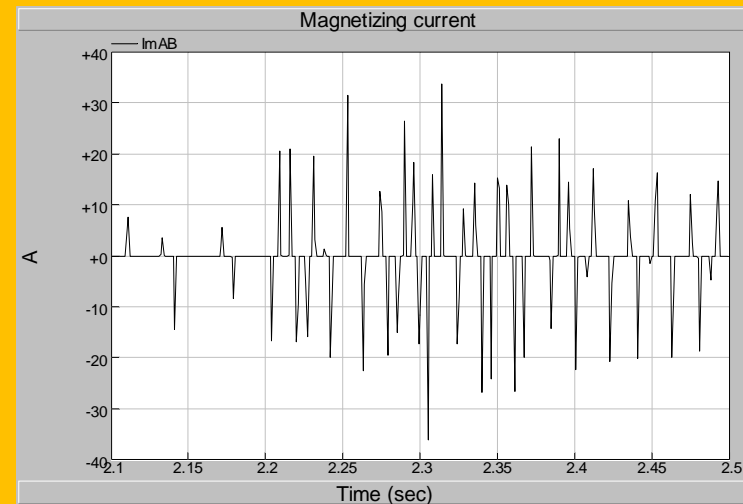
<http://energyvaasa.vaasanseutu.fi/>

# Research focus in Electrical Engineering



# Simulation of electric power systems

- Electromagnetic Transient Simulation
  - Power system is simulated with time step ranging down to nanoseconds
  - Commercial software applied: PSCAD ([www.pscad.com](http://www.pscad.com))
- Ideal for studying
  - Faults
  - Switchings
  - Harmonics
- History:
  - Started as a competence building project with ABB in 1996
  - VEI simulation group provides now simulation services to companies
  - Simulation expertise has been used in several national research projects



# Protect-DG

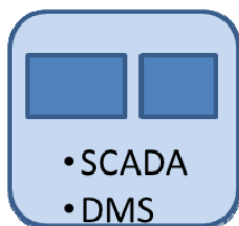
New techniques for the management of power system faults and distributed generation



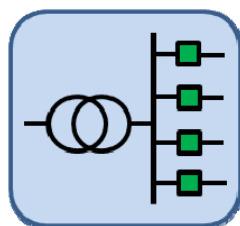
IEC 61850

LoM protection

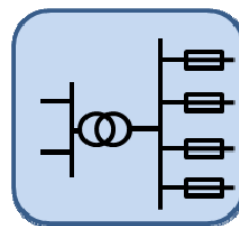
Fault locating



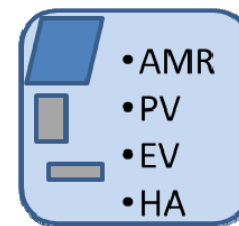
**Control Center**  
- Fault locating



**Primary Substation**  
- Signal transmission  
- IEC 61850



**Secondary Substation**  
- Fault detection  
- Signal detection



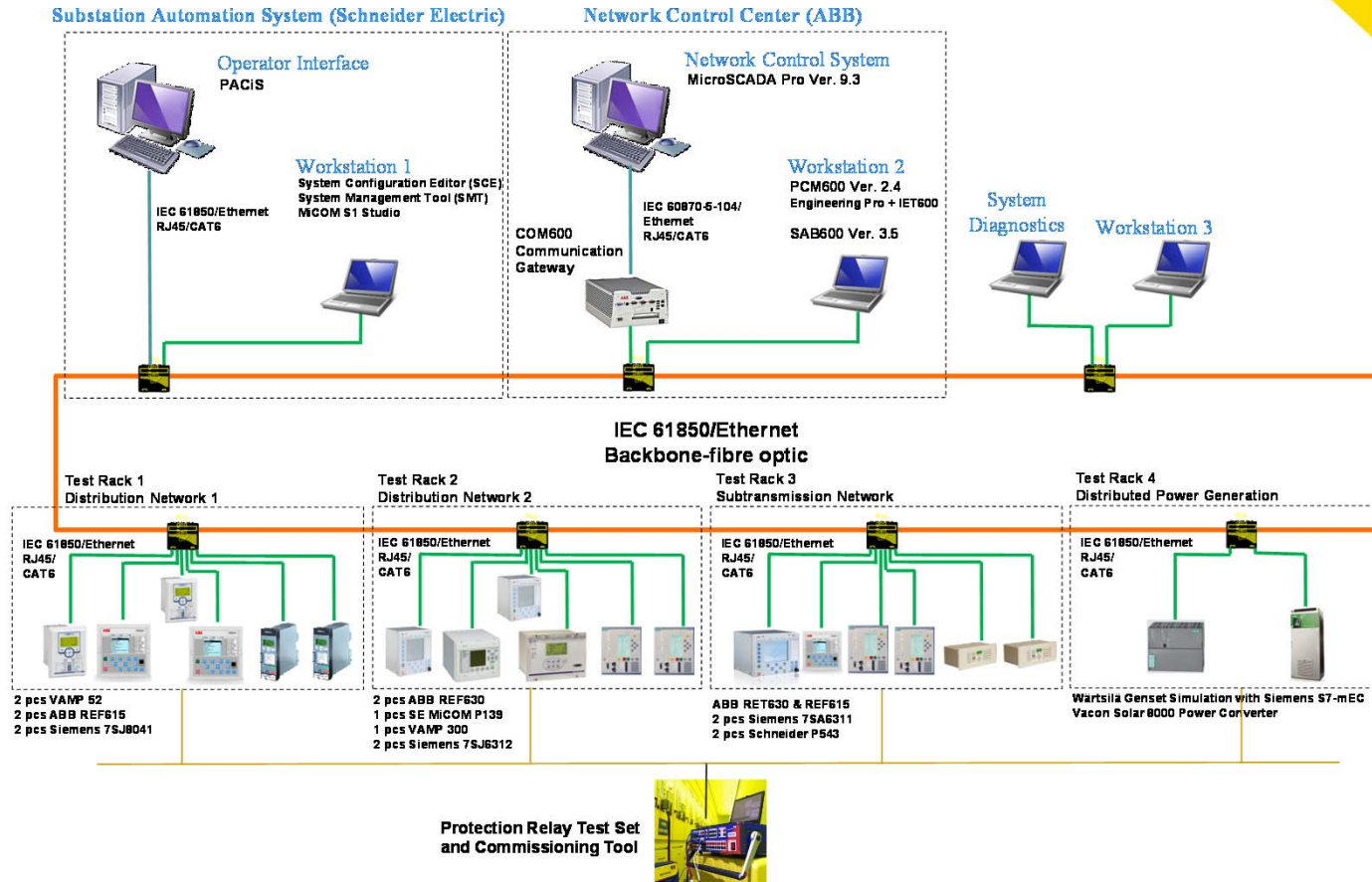
**Customer**  
- 61850 comm.  
- PV or other DG  
- LoM



Industrial partners: ABB, Arcteq, Elenia, Emtele, Helen, Maviko, ST-pooli, Tekla, Vamp, Vaspec

# IEC 61850 multi-vendor environment

Projects: DEMVE (2011-2014), eDEMVE (2015-2016)



# PAC laboratory

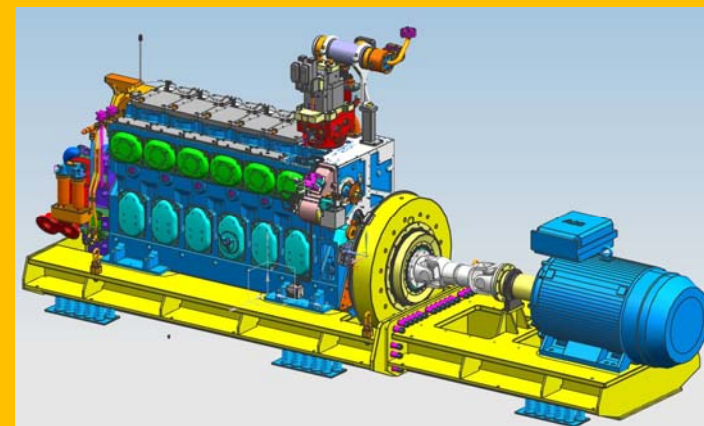
## PROTECTION AUTOMATION COMMUNICATION



# VEBIC

## Vaasa Energy Business Innovation Centre

- A multi-disciplinary research platform bringing together knowledge from all faculties of the University of Vaasa
- Laboratory facilities
  - 1st phase (now under commissioning):
    - Engine and fuel laboratories
  - 2nd phase (in future):
    - Smart Grid laboratory





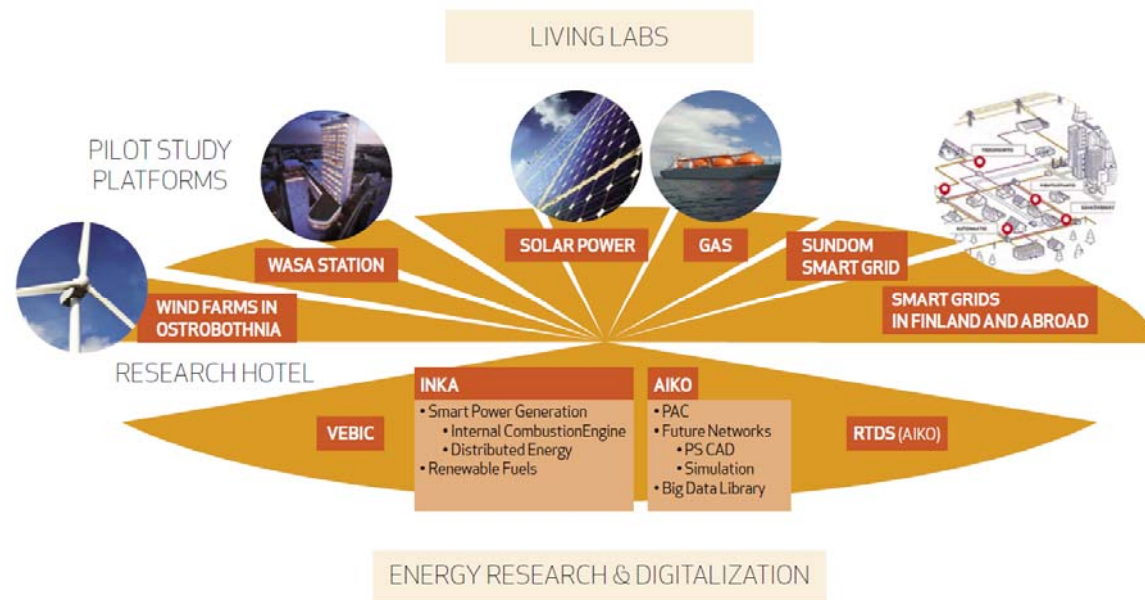
# Engine laboratory

- Two medium-speed gas and diesel engines
  - One complete or “all-cylinder” engine
  - One single-cylinder research engine, “SCE”
- One to three high-speed gas and diesel engines
- Electric equipment
  - Generators
  - Frequency converters
  - Transformers
  - Switchgears
- Automation systems
  - Process (engine) automation
  - Protection relays
  - Data acquisition systems



# Kasvusoimus (Growth agreement) AIKO

- Government funding for promote innovations and business in selected areas



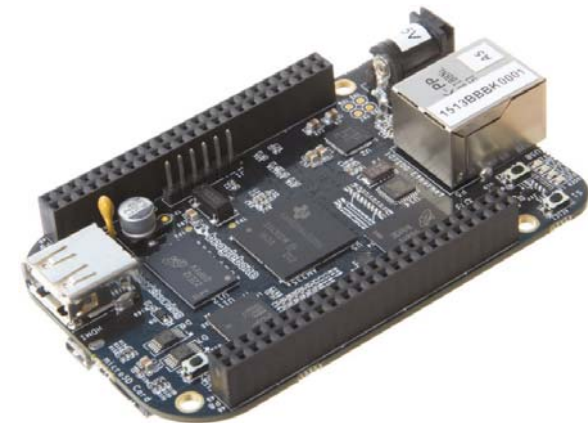
# SESP – Smart Energy Systems Research Platform

- Smart Grid laboratory
  - PAC laboratory
    - Protection and automation
    - Microgrids
    - Communication
  - Real time digital simulation
- Big Data
- Living lab sites
- New business concepts and models

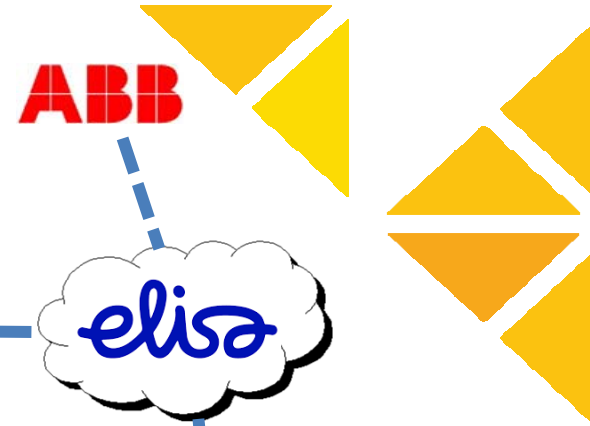


## Light-Weight IEC 61850 IED

- Single board computer (SBC)  
BeagleBone with open source IEC libraries (libIEC61850)
- Enables implementation and demonstration of applications with new LNs that are not yet available in commercial products



# Living lab site: Sundom Smart Grid

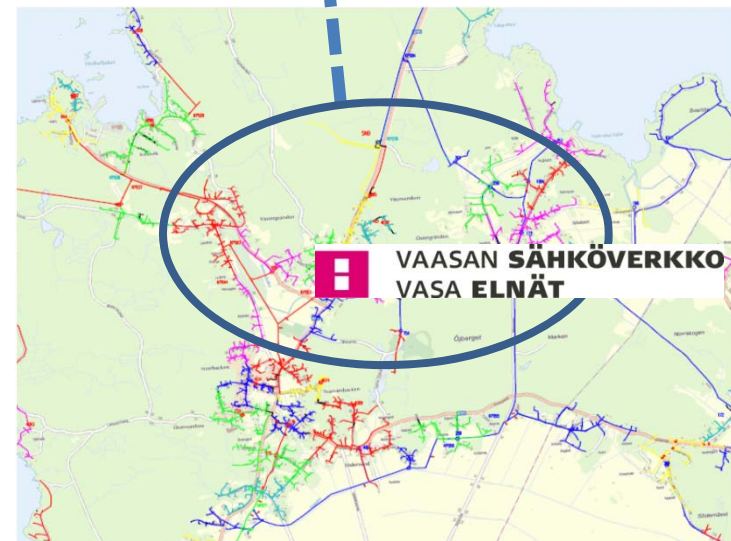


On-line measurements:

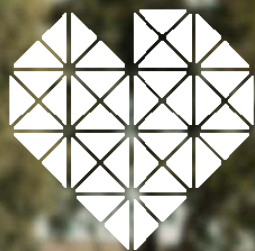
- One HV/MV substation (all feeders)
- Three secondary substations (MV/LV)

Total 20 measurement points

- IEC 61850-9-2 stream with current and voltage measurements, 80 samples/cycle
- Power, RMS voltages and currents etc. measurements with lower sampling rate (GOOSE)



Thank you!



Vaasan yliopisto  
UNIVERSITY OF VAASA

