ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM SMART NETWORKS FOR ENERGY TRANSITION

PLAN.
INNOVATE.
ENGAGE.

WG1: "Reliable, economic and efficient smart grid system"

VINPOWER

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VINPOWER

VINPOWER – Vaasa Innovation Platform for Future Power Systems (1.9.2017 – 31.10.2019)

Project manager: prof. Lauri Kumpulainen (member of WG 5 in ETIP SNET)

Budget: 337 k€ (European Regional Development Fund 80 %, Private funding 15 %, University of Vaasa 5 %)

- Public: Regional Council of Ostrobothnia
- 17 companies: Sähkötutkimuspooli, ABB, Ensto, Arcteq, Schneider(VAMP), VEO, Elkamo, Finnkumu, Maviko, Emtele, Netcontrol, Wapice, Helen Sähköverkko, Vaasan Sähkö, Tampereen Sähköverkko, Lahti Energia, and Turku Energia

Overarching objectives

- **Development of expertise and co-operation** on relevant research topics related to Smart Grids – creating an innovation environment at the University of Vaasa
  - Provide knowledge and concepts for the industry
  - Promote the utilization of new technology in power distribution

Key exploitable results addressing energy system integration

WP 1: CABLED MV NETWORKS

1. Improved solutions to the protection and fault location of long MV cable feeders; the principles of a method to locate intermittent fault have been developed → ***Improved reliability (Beneficiary: consumers)***
2. **Alternative solutions to extensive undergrounding of long rural feeders** for advanced security of supply → ***Lower transfer prices (consumers)***
3. Compensation of the earth fault current (in progress)
4. **Compensation concept for reactive power** in distribution grid that is combination of centralized and distributed compensation → ***Lower costs and losses (DSOs)***
5. Preliminary functional requirements for smart secondary substations for urban and rural areas were developed → ***future concepts, RDI needs (University, manufacturers, DSOs)***

Key exploitable results addressing energy system integration

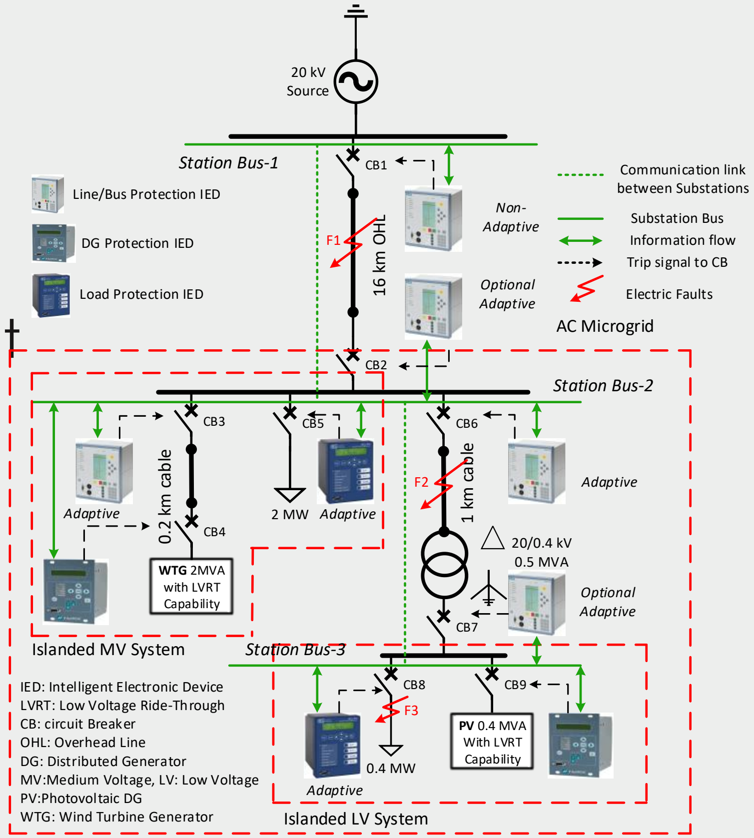
WP 2: MICROGRIDS – For the implementation of the microgrid concept

1. **Microgrid controller functionalities** in general to be analyzed based on the standardization and relevant use cases developed for Sundom Smart Grid (SSG) living lab
2. **Smart Home integration** to the microgrid control functions, relevant use cases developed for Sundom Smart Grid living lab
3. **Real-time models** for testing following use cases (developed algorithms in SIL):
   1. Microgrid control functions
      - ✓ Smooth transition to and from grid-connected and islanded modes
      - ✓ Activation/deactivation of BESS (Central + parallel with DG)
      - ✓ Voltage and frequency control with different operation modes

Key exploitable results addressing energy system integration

WP 2: MICROGRIDS - For the implementation of the microgrid concept

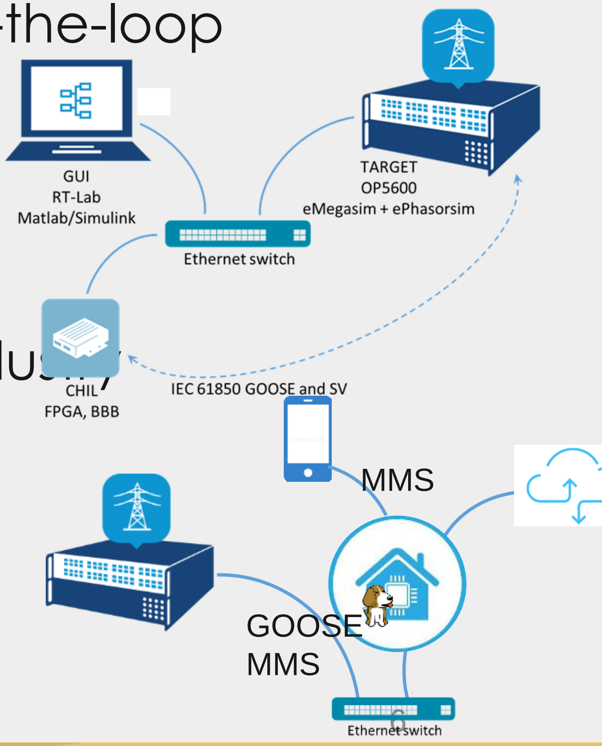
2. Microgrid protection functions
   - ✓ Loss-of-Mains, transfer trip, interlocking using IEC 61850-GOOSE
   - ✓ IEC 61850 based interoperability of IEDs from different vendors
   - ✓ Definite time vs Inverse definite minimum time (IDMT) OC relay for adaptive protection
   - ✓ Adaptive OC protection algorithms based on IEC 61850-GOOSE



Key exploitable results addressing energy system integration

WP 3: BIG DATA APPLICATIONS

1. **National disturbance recordings and field test data library** (Beneficiaries: Relay manufacturers, DSOs, universities
2. **FPGA based solution for local data processing**: IEC61850 communications between HEMS (implemented in FPGA) and sensors, controller-hardware-in-the-loop



WP 4: INFORMATION AND NETWORKING - WORKSHOPS

✓ Excellent networking events: University / DSOs / Manufacturing indus

⇒ ⇒ **Needs for future R&I activities coming out of the project**

- ✓ Preliminary concepts for future secondary substations
- ✓ A number of research topics (for joint projects)
- ✓ Several product development ideas

Lessons learned and barriers to innovation deployment

Lessons learned from the project

1. University – Industry cooperation is fruitful and inspiring.
2. New technology (new simulation tools, AI, 5G, Big Data etc.) creates a lot of opportunities for e.g. secondary substations, microgrids and protection solutions.
3. There are alternatives for massive undergrounding of medium voltage network in rural areas. **A regulation based barrier has been identified, and an initiative to change the law (→ looser regulation) has been given.**

Deployment prospects of the most promising solutions

- National disturbance recordings and field test data library could be utilized for:
  - ✓ R&D of protection relays
  - ✓ Verification of relay algorithms, sales purposes
  - ✓ Education (universities), customer training (companies)
  - ✓ AI for proactive fault detection
- General real-time microgrid network model for hardware-in-the-loop (HIL) case studies.
- Light-weighted IEDs with IEC61850 for EMT as well as transient stability studies

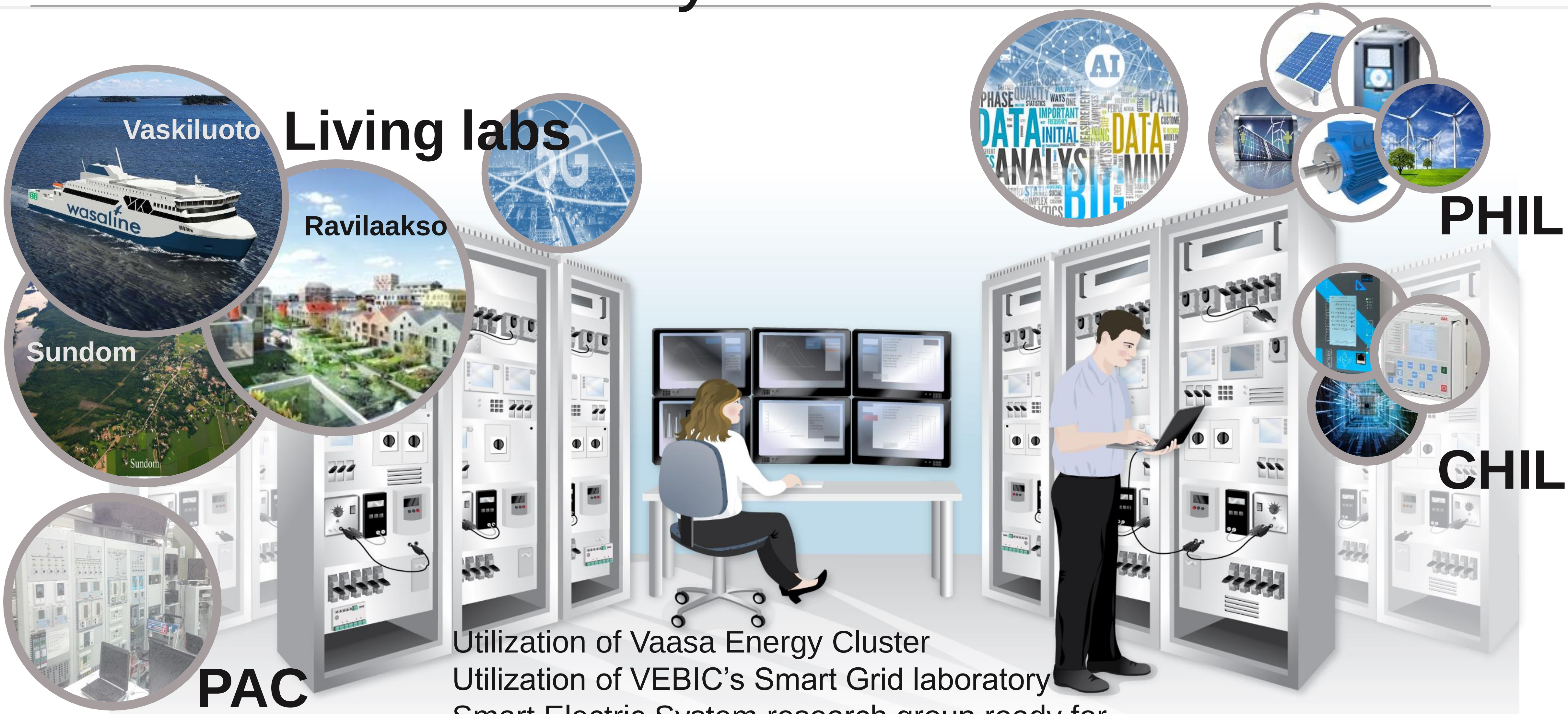
Needs for future R&I activities coming out of the project

Preliminary functional requirements for smart secondary substations for urban and rural areas were developed ⇒ **New project: Smart Power Node 2030**

Scenario 2030	ICT	MONITORING & RELIABILITY	POWER QUALITY	FLEXIBILITY	SAFETY, PROTECTION & FAULT LOCATION
	Information amount increase Digitalization	Information amount increase, where to handle (not in the control room) Urbanization/Depopulation Differentiation of urban areas Smart metering upgrade	Cabling increase Electricity dependence increase Weather-dependent production Urbanization/Depopulation	Distributed resources increase Weather-dependent generation Energy efficiency requirements	Distributed generation challenges the fuse-based system Effect of distributed compensation to fault location Cost-efficiency
FUNCTIONS					
CONCEPTS					
TECHNOLOGIES					
REGULATION & GEOGRAPHY					
CUSTOMERS					
MARKETS					

Smart Power Node 2030 Cost-effective, Modular, Adaptive, Retrofittable, Service Provider, Strategic and Structural Node

Smart Grid Laboratory in University of Vaasa



Utilization of Vaasa Energy Cluster
Utilization of VEBIC's Smart Grid laboratory
Smart Electric System research group ready for collaboration ☺