

EXTENSIVE IMPACTS OF SUNHILL

ERIGRID FINAL CONFERENCE
(VIRTUAL)

1 APRIL 2020

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SunHILL

TA access 4th call
to OFFIS SESA Lab
8-9/2018 (7 weeks)



SUNDOM HARDWARE IN LOOP LIVING LAB



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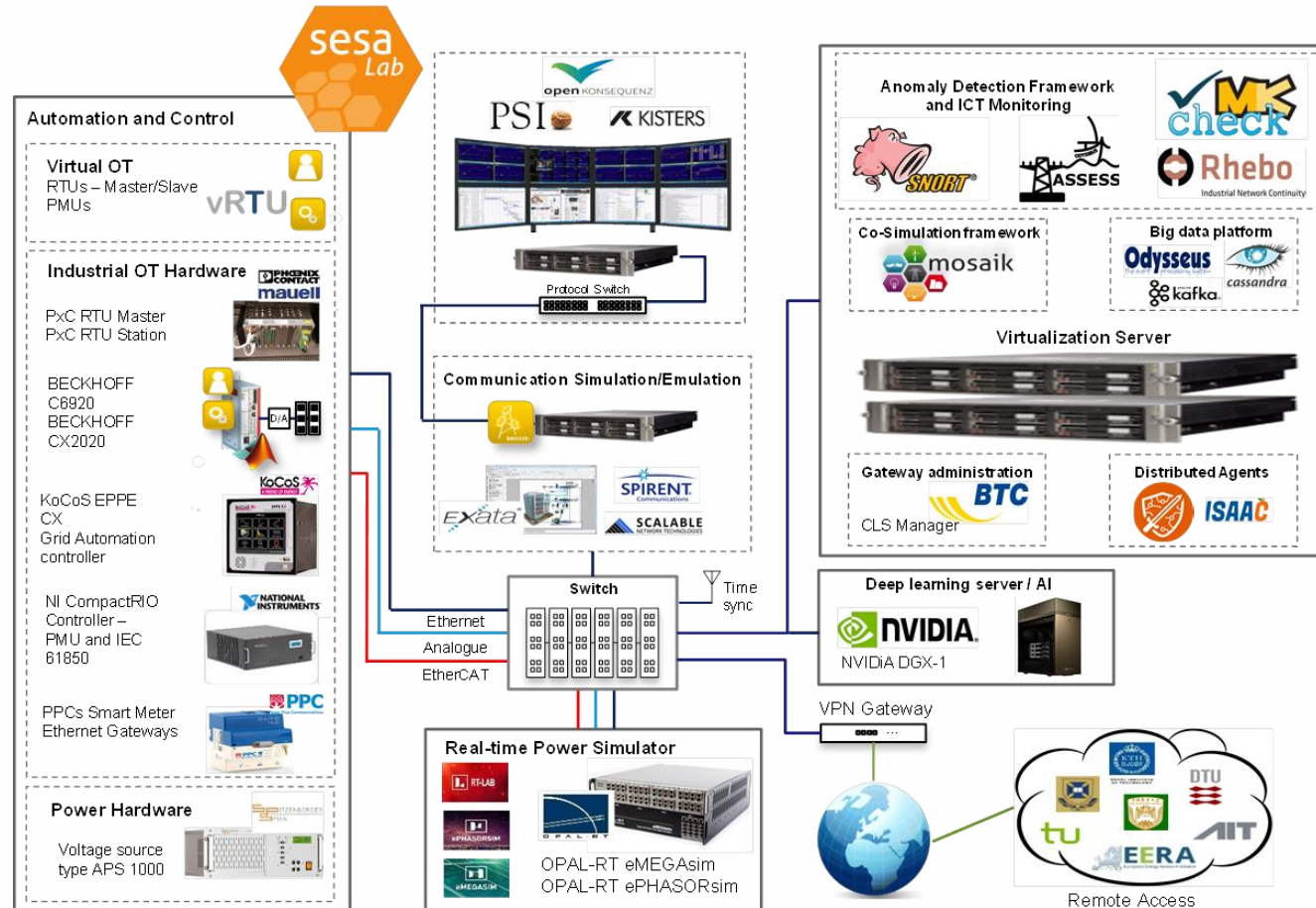
Project Overview

GENERAL



- ▶ SunHILL project in OFFIS SESA laboratory in Oldenburg, Germany within the ERIGrid program for accessing to EU's top level Smart Grid labs
- ▶ SESP (Smart Energy Systems Platform) program for establishing an initial real-time simulation laboratory environment
- ▶ Develop a controller for reactive power control for technical ancillary services (AS) with help of the developed real-time simulation platform
 - ▶ Power system model in phasor mode
 - ▶ Controllers as SIL as well as CHIL
 - ▶ Communications IEC61850 GOOSE
- ▶ Case studies for a sub-urban area, Sundom Smart Grid (SSG) in Vaasa, Finland
 - ▶ One year case studies based on real measurement data
- ▶ Performance tests of a reactive power control scheme developed on a light-weight Intelligent Electronic Device (IED) – on FPGA and BBB

OFFIS SESA (Smart Energy Simulation and Automation) Lab

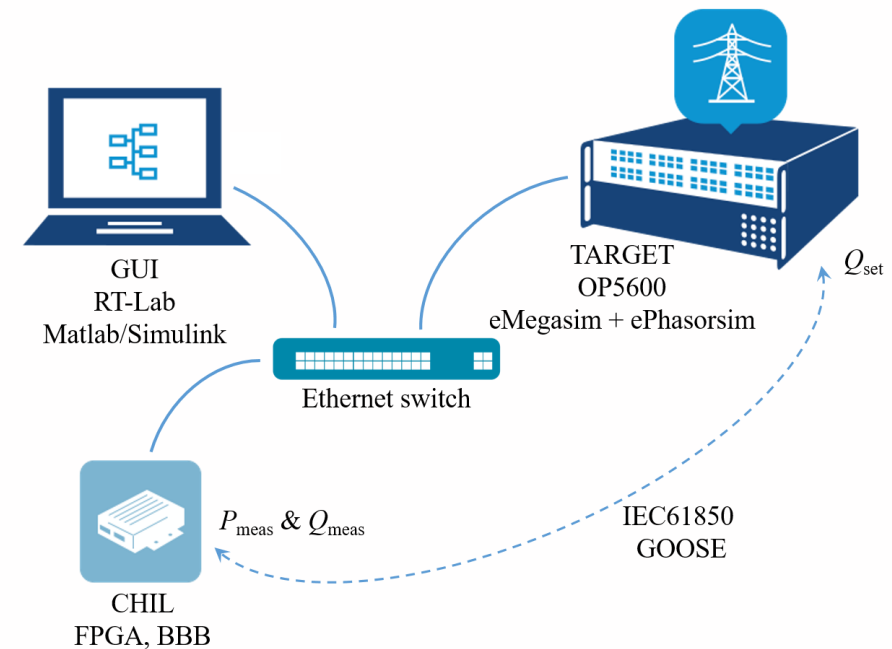


Project Overview

PLATFORM AND OUTCOME



- ▶ A real-time simulation model of Sundom Smart Grid (SSG)
- ▶ A reactive power window (RPW) control tested as
 - ▶ Software-in-the-loop (SIL) / a software controller
 - ▶ Controller-hardware-in-the-loop (CHIL) / a hardware controller (on FPGA as well as BBB)
 - ▶ With IEC 61850 GOOSE communication

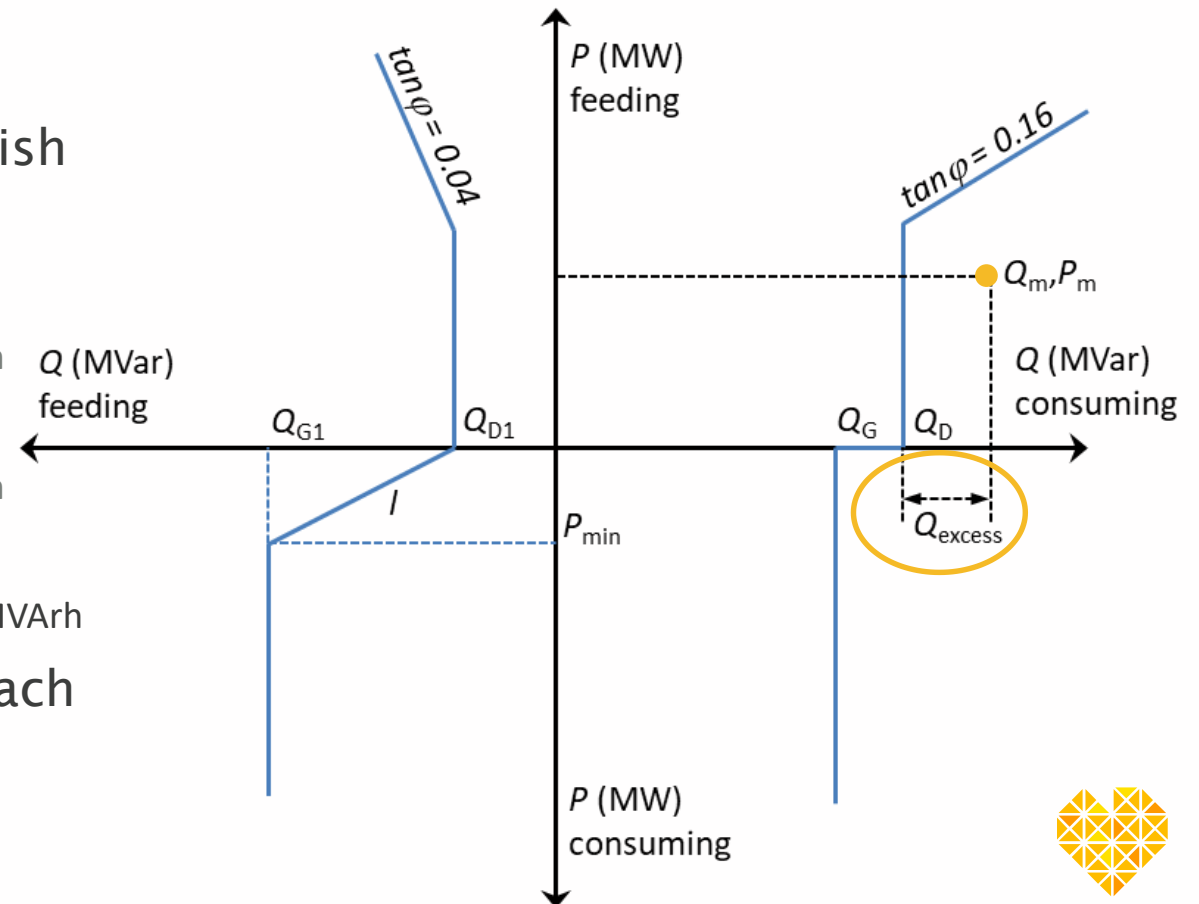


Background

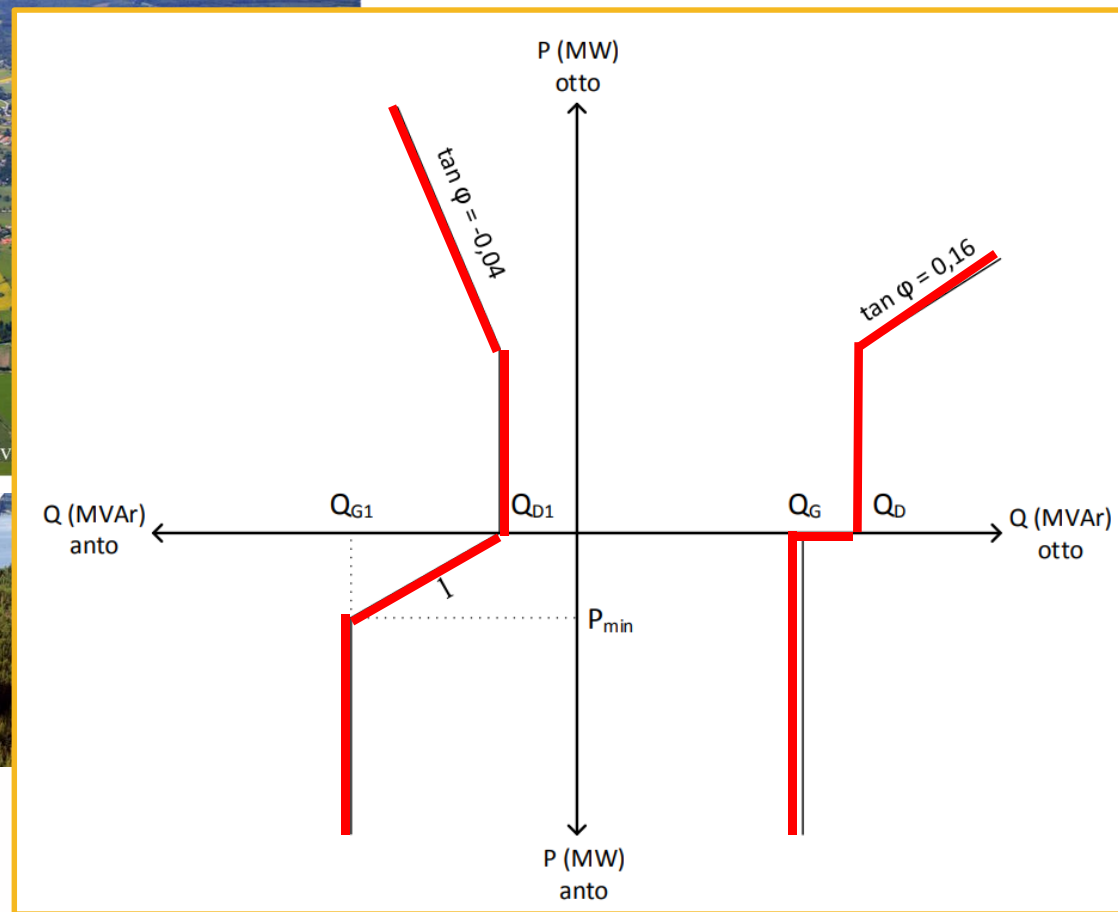
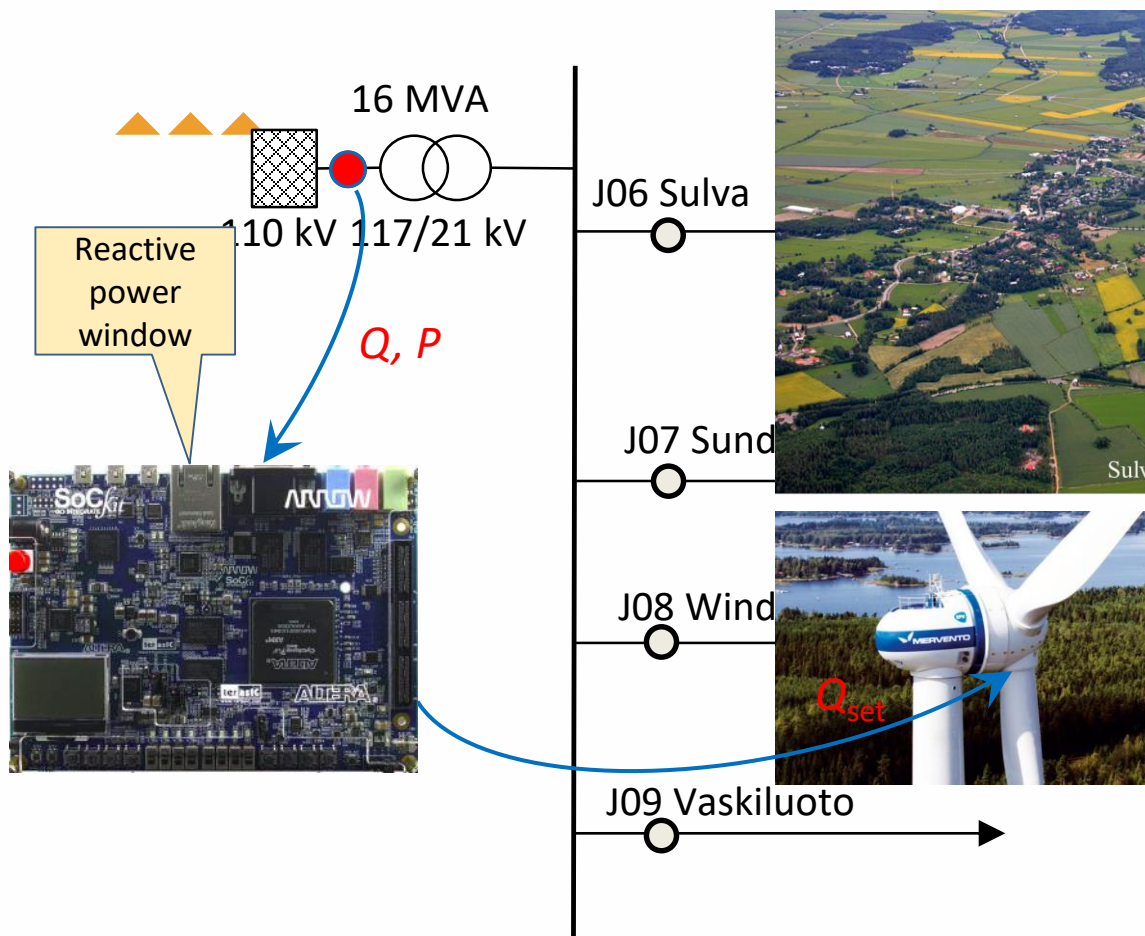
REQUIREMENTS FOR REACTIVE POWER FLOW



- ▶ Reactive power window of Fingrid, Finnish TSO
 - ▶ 2017
 - ▶ 333 €/MVar/month, reactive energy 5 €/MVarh
 - ▶ 2018
 - ▶ 666 €/MVar/month, reactive energy 5 €/MVarh
 - ▶ From 2019 onwards
 - ▶ 1000 €/MVar/month, reactive energy fee 5 €/MVarh
- ▶ The fifty highest exceeding hours for each month are excluded



Outline of SIL and CHIL



Impact



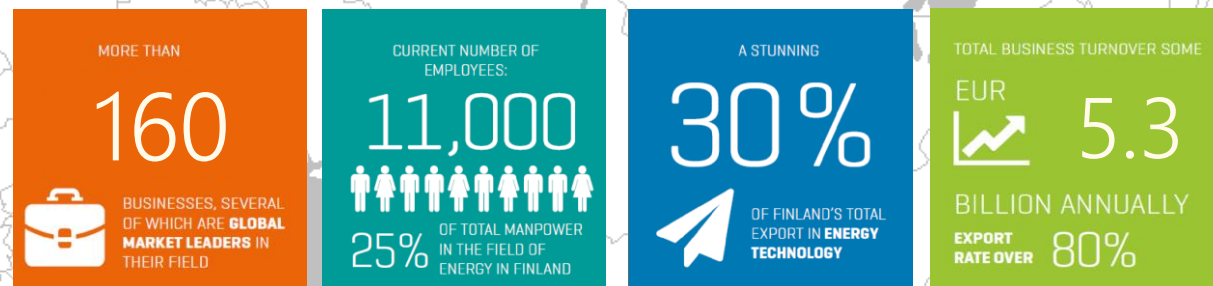
AND LESSONS LEARNED



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Vaasa

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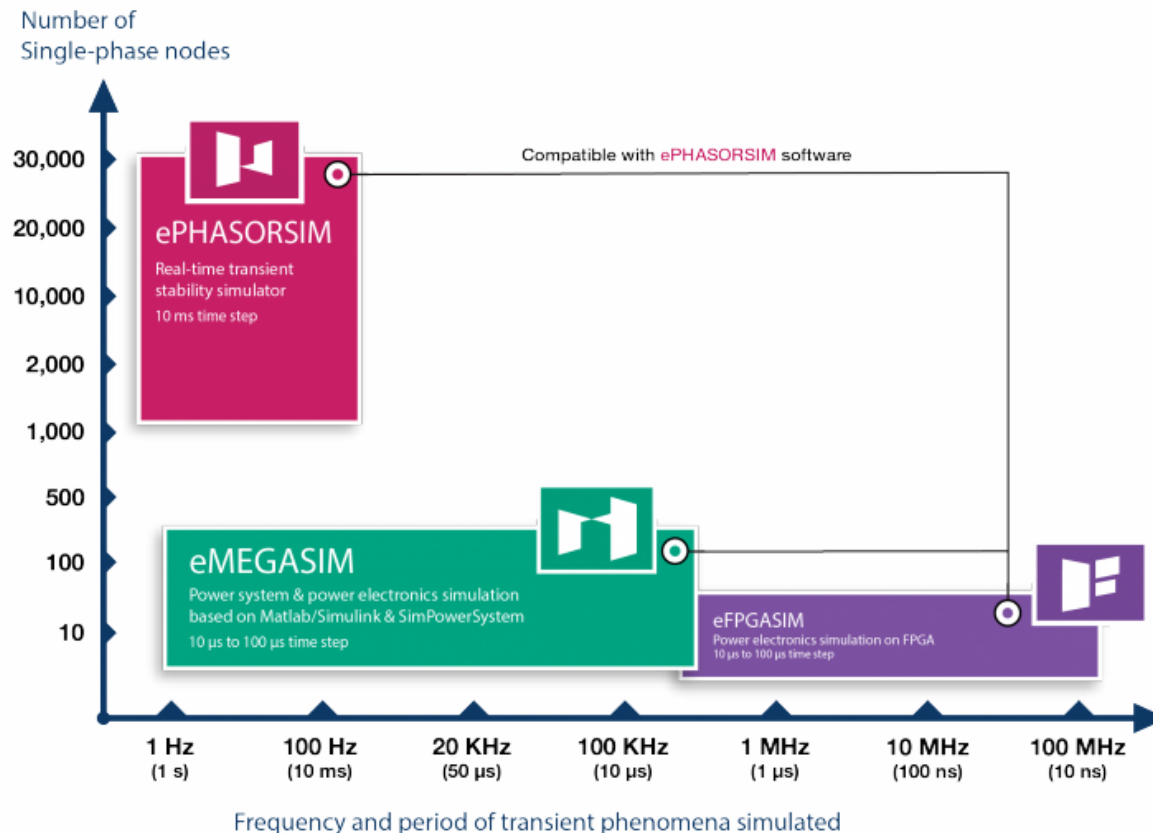


Smart Grid Laboratory 1.0

OPAL-RT'S REAL-TIME SIMULATION PLATFORM



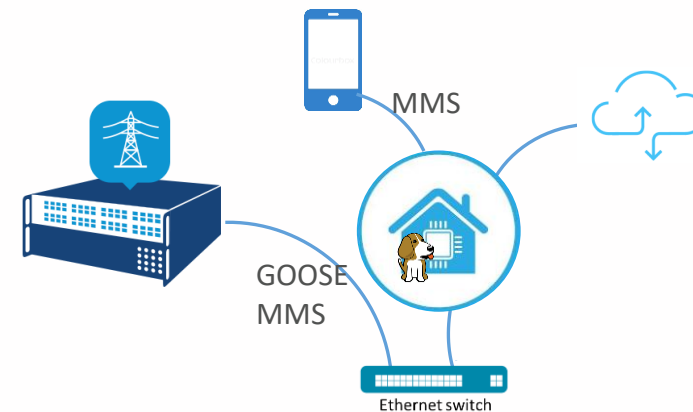
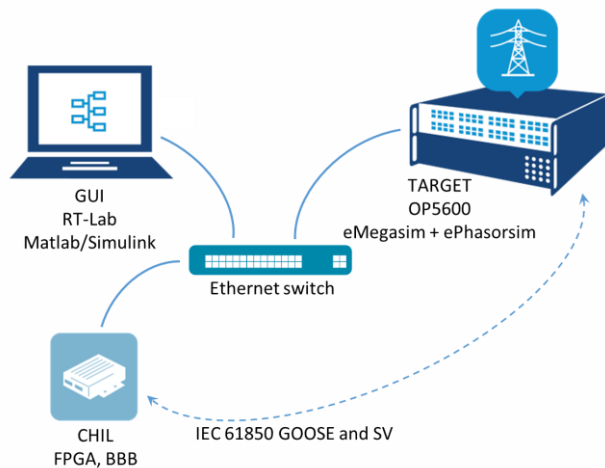
1. Electromagnetic Transient Simulation eMEGASIM
2. Transient stability simulation ePHASORSIM (phasor domain)



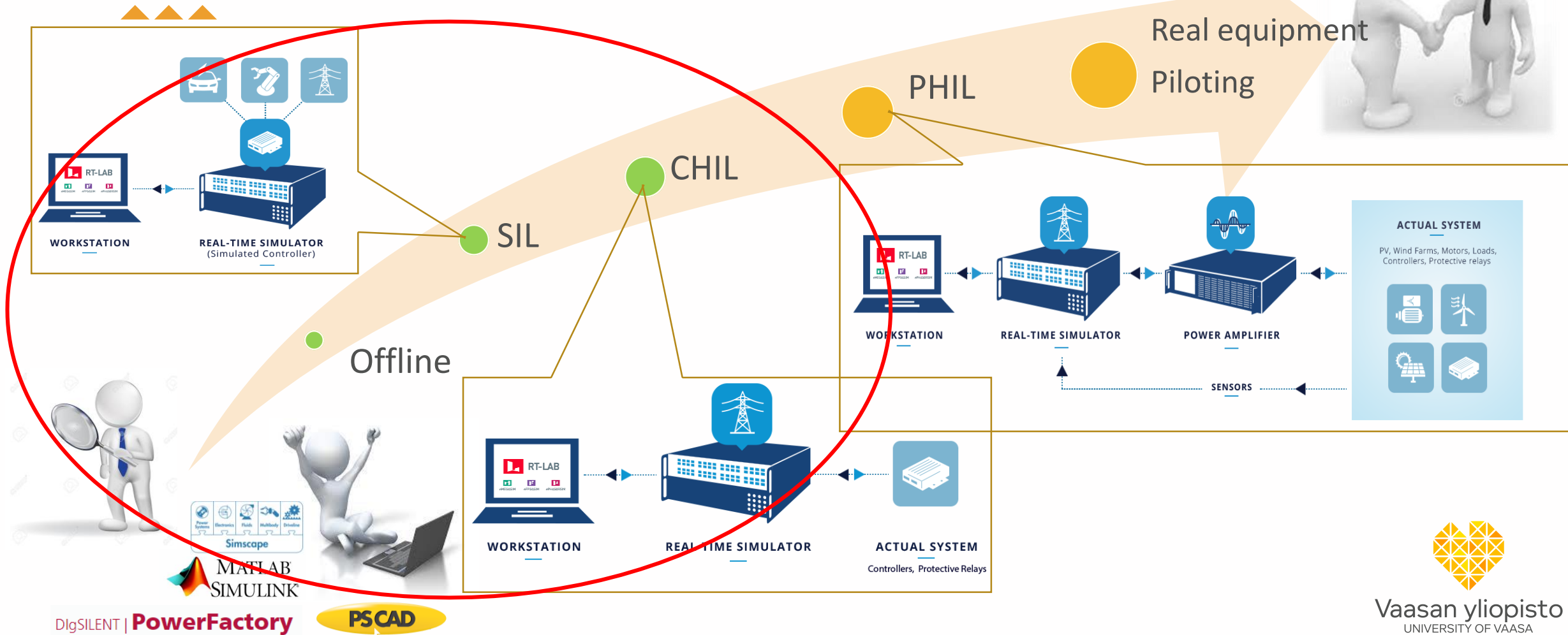
CHIL development



- ▶ Development of light weighted IEDs, IEC 61850
- ▶ Accelerated real-time simulations for testing a controller in long-term case studies



Simulation and testing in RDI



VISION of FREESI lab

Future Reliable Electricity Energy Systems Integration



Roadmap of the VEBIC laboratories

WITH RELATED PROJECT ACTIVITIES



2018
SESP
VINPOWER

**ICE &
Fuel labs**

2019
5G campus
VINPOWER
SolarX
Fleximar
FUSE

SG lab 1.0
CHIL

2020
5G Campus
SolarX
Fleximar
CR-DES

SG lab 1.1
PHIL
μG testbed 1

2021
HASG/Smart Port
Vaskiluoto harbor
Digital Grid

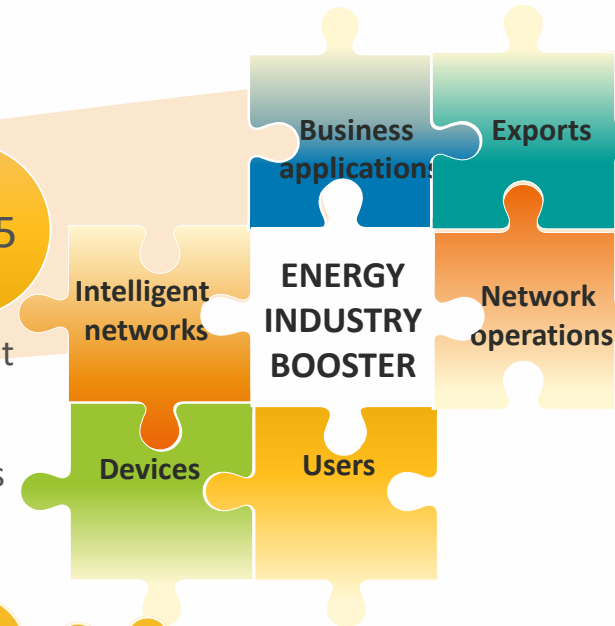
IoT lab
SG lab 2.0
PHIL
Digital Substation
μG testbeds 2 & 3
Smart home
Cybersecurity RTS

2023
Energy storages
Ravilaakso

RES lab

2025
Resilient
future
energy
systems

SG lab 3.0
Virtual
energy
systems



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Lessons Learned

RESEARCH VISIT FOR WORKING IN A DEDICATED LABORATORY



- ▶ Increases the competence and creates new networks
- ▶ Boosts the development of a laboratory environment
- ▶ Stay days should be long enough!



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THANK YOU!

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