



FER

UNIVERSITY OF ZAGREB
FACULTY OF
ELECTRICAL
ENGINEERING
AND COMPUTING

Smart Grid Projects at FER

Tomislav Capuder, Hrvoje Pandžić

Smart Grid viewed from the regional cooperation perspective

Brussels, November 28, 2017

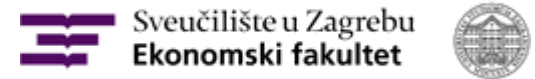
Relevant Projects

- EVBASS evbass.fer.hr/en/evbass
- SIREN siren.fer.hr/en/siren
- uGRIP www.ugrip.eu
- 3Smart <http://www.interreg-danube.eu/3smart>
- SUCCESS <http://success.fer.hr>

EVBASS (2015-2018)



- Electric Vehicle Battery Swapping Station is a project at the Faculty of EE and Comp. Univ. Zagreb funded by the Croatian Science Foundation
- Partner institutions:
 - Faculty of Economics Univ. Zagreb
 - Aalborg University
 - Croatian DSO

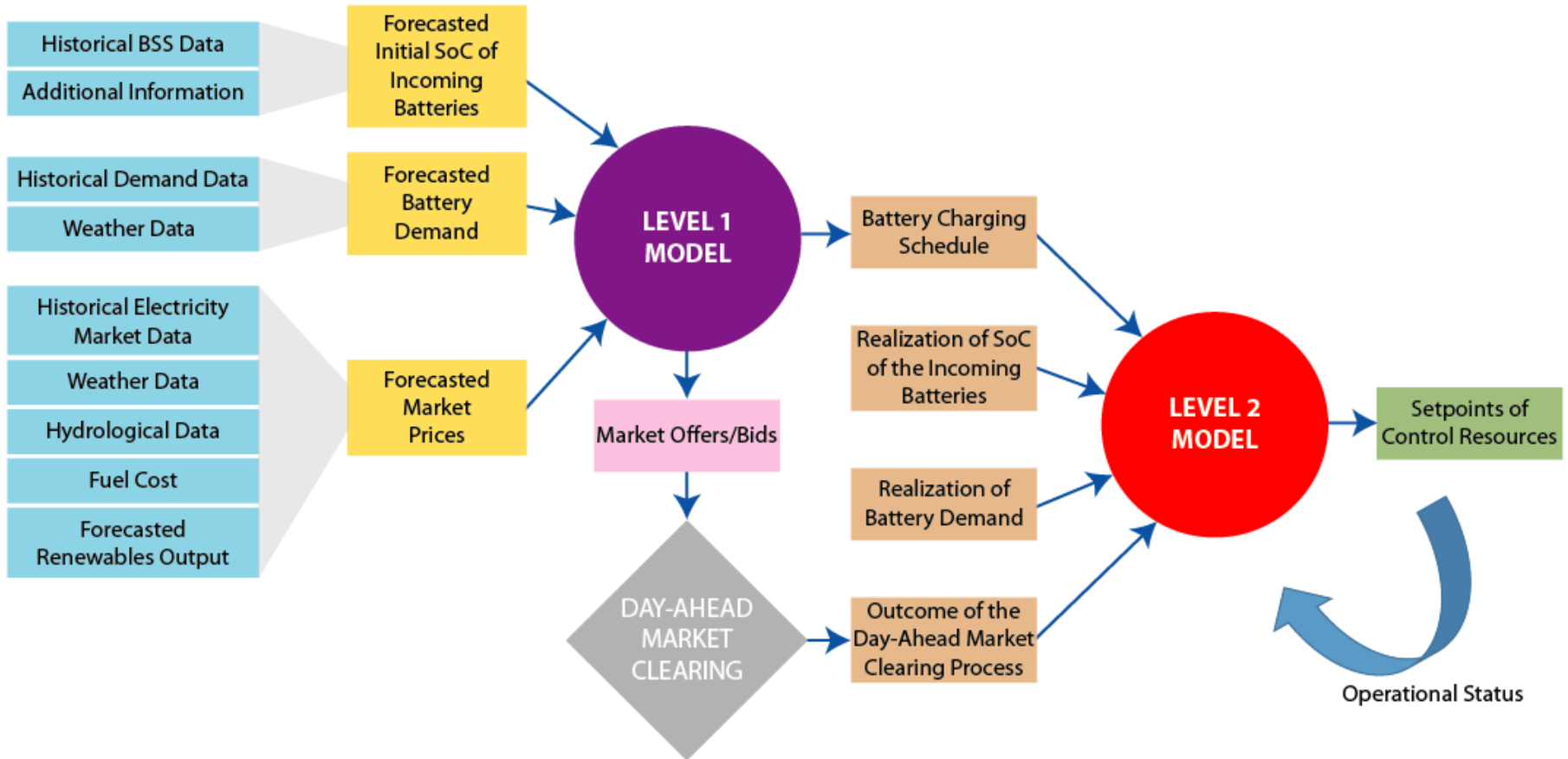




EVBASS (2015-2018)

- Objectives:
 - To develop detailed business model(s) of a BSS that fit the current practices and legislative.
 - To develop a robust framework that optimizes scheduling process of a BSS while actively participating in electricity markets.
 - To develop and propose standardized communication protocols between i) large amount of batteries and a central computer in charge of the BSS operation, ii) BSS central computer and electricity markets.
 - Integration of BSSs into existing distribution/transmission systems.

EVBASS (2015-2018)



Three operating modes:

B2B – Battery-to-Battery; B2G – Battery-to-Grid; G2B – Grid-to-Battery



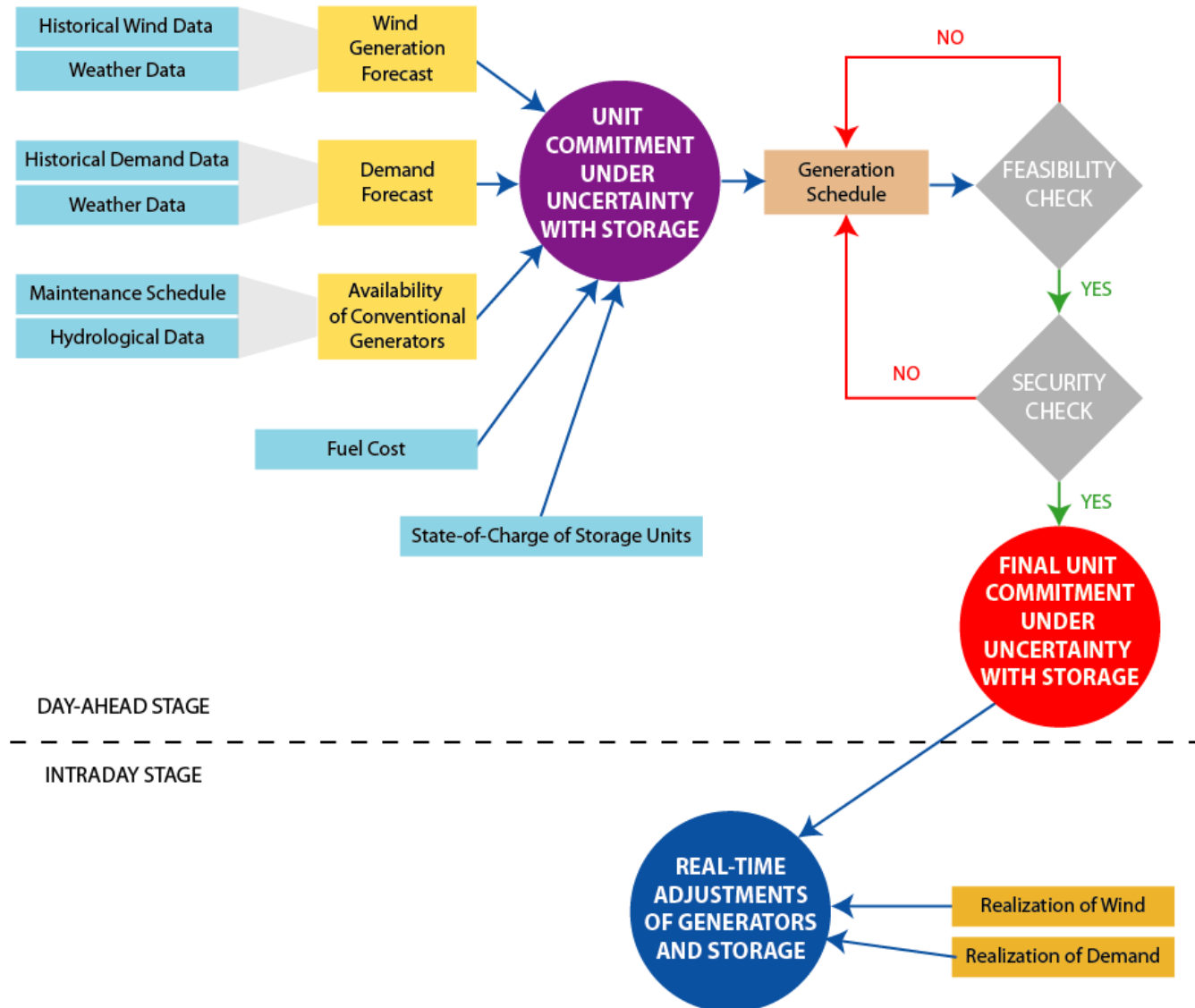
SIREN (2015-2018)

- Smart Integration of RENewables is a project at the Faculty of EE and Comp. Univ. Zagreb funded by the Croatian TSO and Croatian Science Foundation
- Objectives:
 - Investigate operating procedures of running the Croatian power system with high level of uncertain wind generation.
 - Derive investment strategies that will enable high penetration of wind energy into Croatian power system.
 - Determine requirements for connection of new wind power plants to the Croatian transmission network.
 - Analyze the needs for storage in Croatian transmission network. This analysis includes the services that storage needs to provide to the system, as well as suitable storage technologies (primarily batteries).
 - Define regulations for utilization of such storages depending on the ownership (TSO vs. third parties).

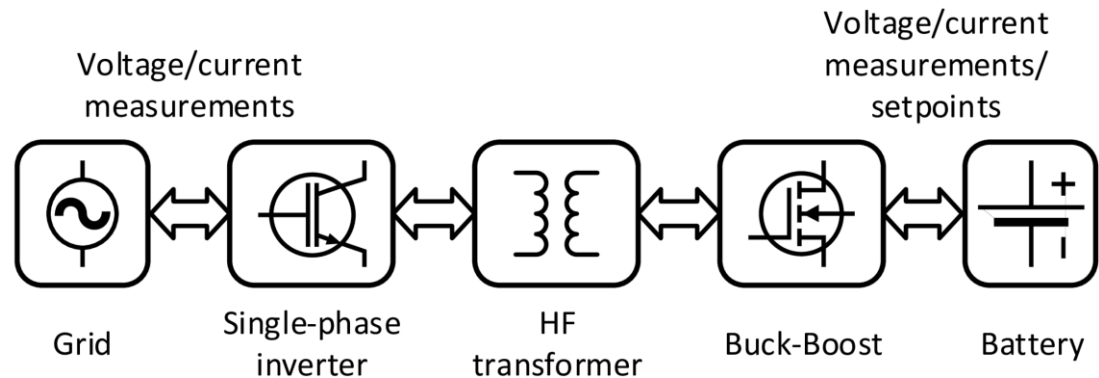
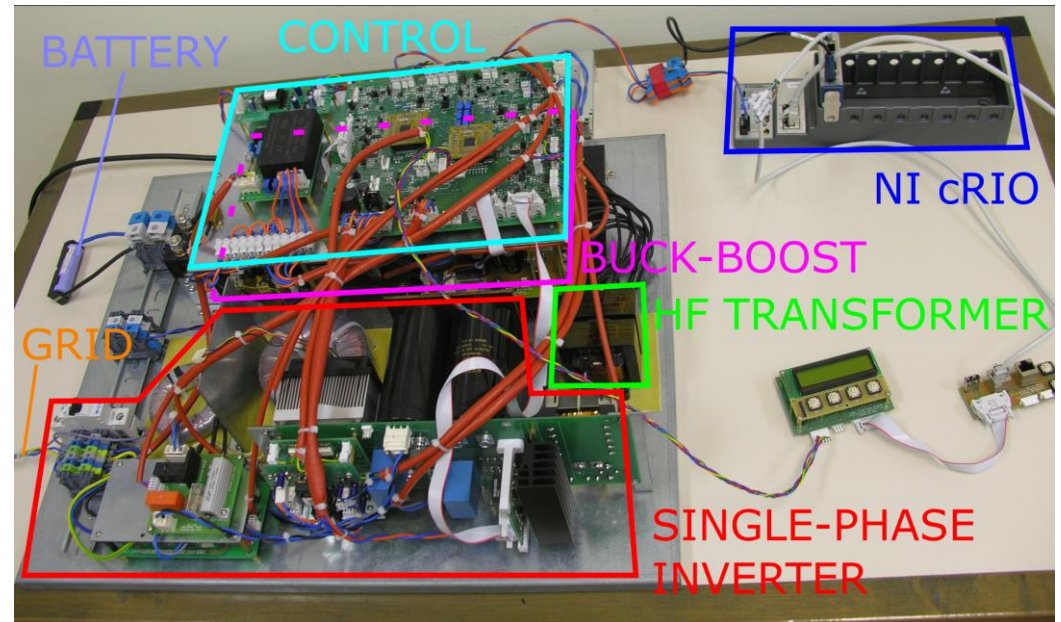
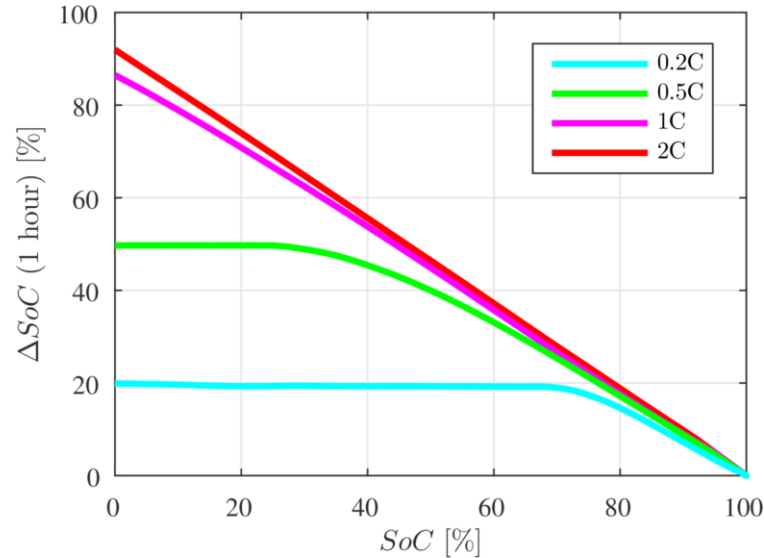
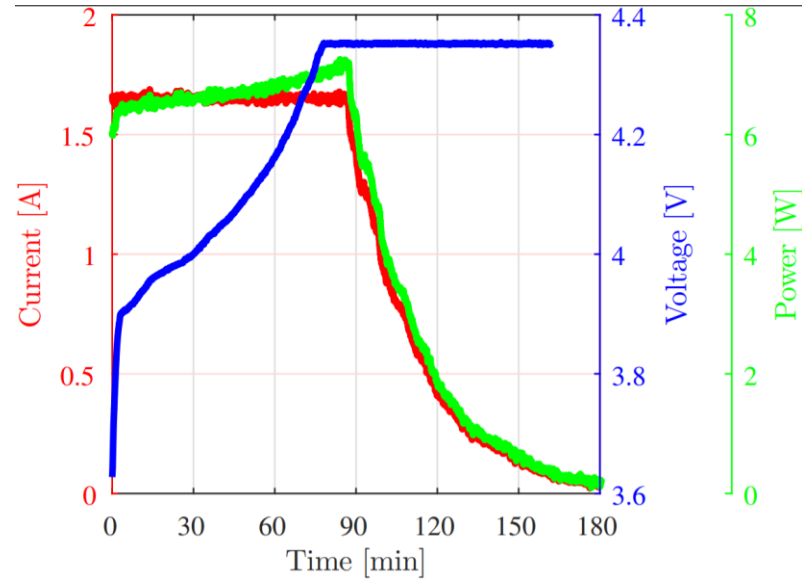
SIREN (2015-2018)



The future operation flow chart of the Croatian power system with storage units



Accurate Modeling of Batteries



uGRIP (2016-2019)

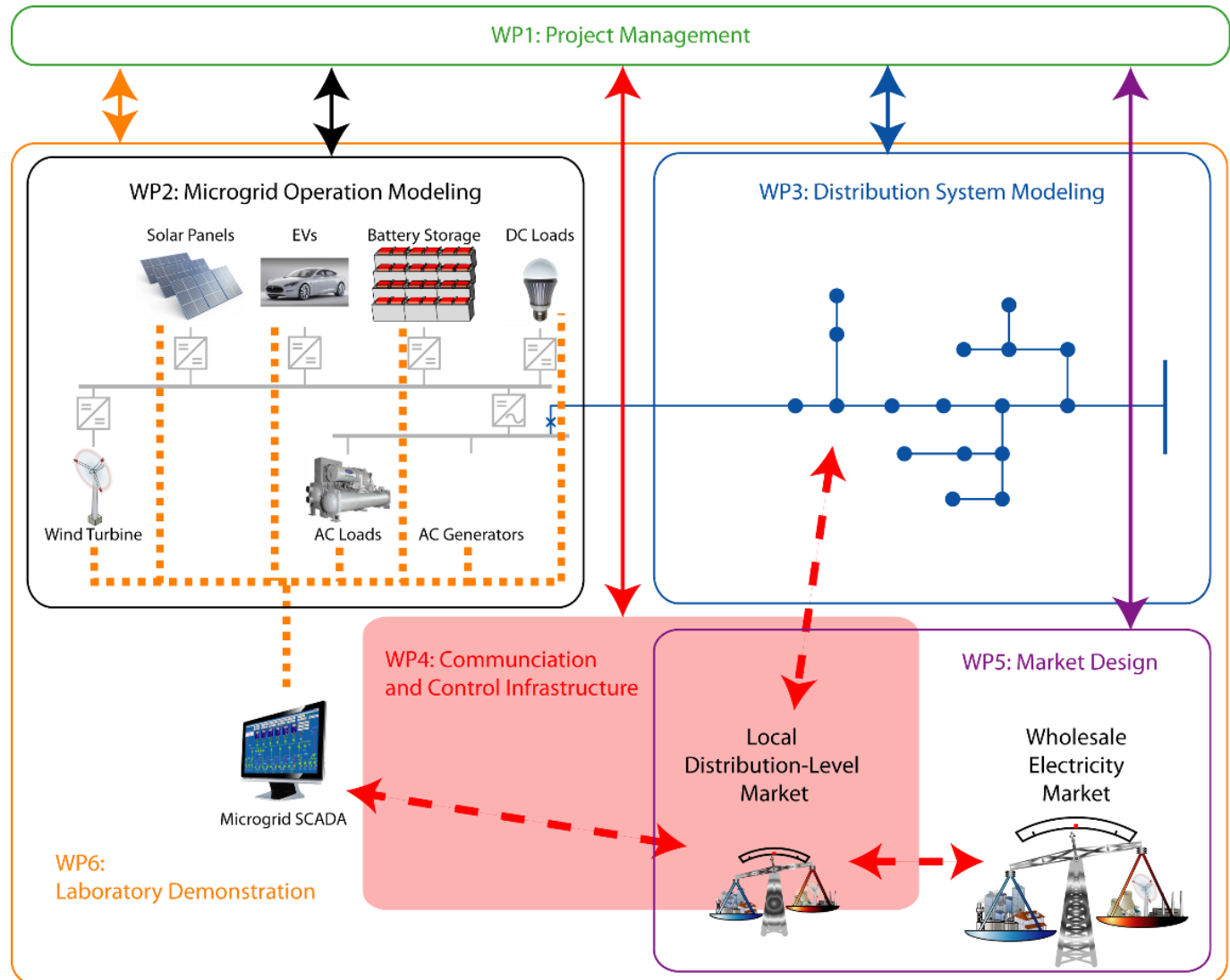
- Funded by the Croatian Environmental Protection and Energy Efficiency Fund through ERA Net Smart Grid + funding scheme
- Project coordinator is the Faculty of EE and Comp. Univ. Zagreb
- Partners: DTU (Denmark) and OFFIS (Germany)
- Supporting institutions: HEP Group and KONČAR - Power Plant and Electric Traction Engineering Inc.

uGRIP (2016-2019)

- Objectives:
 - Assessment of the role of storage and the price responsiveness on the consumer side
 - Assessment of microgrid business cases for different countries, i.e. Croatia, Denmark and Germany, based on their respective grid codes and incentive policies
 - Development and definition of standardized communication protocols between the microgrid elements and the central computer in charge of the microgrid operation, as well as the microgrid and local (distribution level) electricity markets
 - Design and development of a local market to manage the microgrid at the FER-UNIZG laboratory

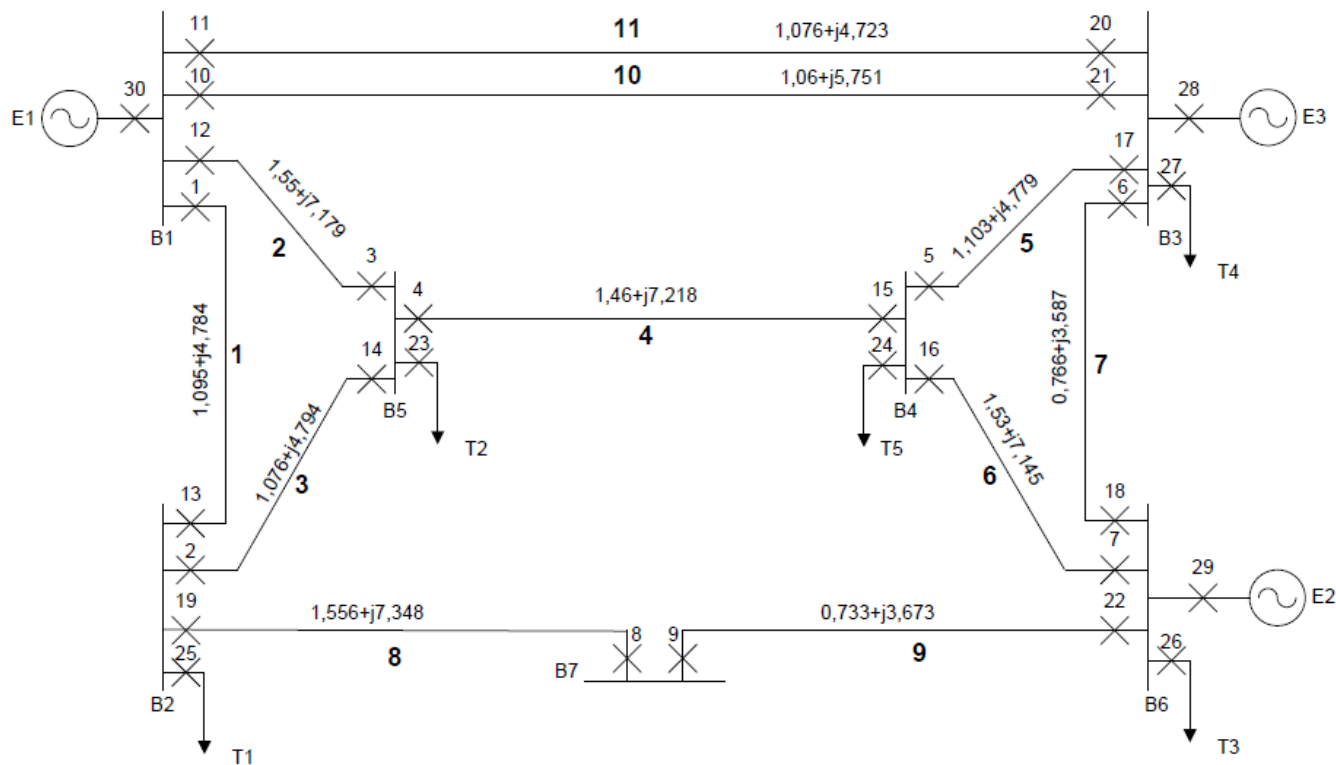
uGRIP (2016-2019)

Project structure



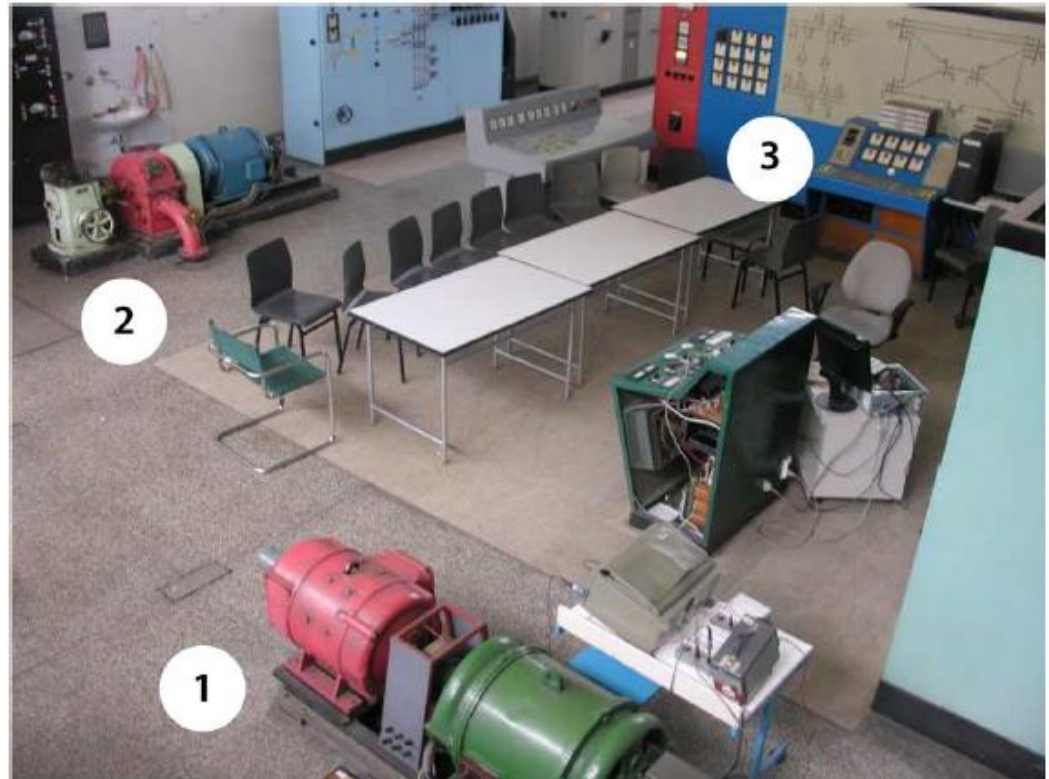
uGRIP (2016-2019)

- In this project, the FER-UNIZG lab will act in two ways: as a microgrid and as a distribution system



Laboratory Testing

- Model of a thermal power plant (1) with primary equipment:
 - motor simulating a thermal turbine,
 - generator with busbars,
 - circuit breaker,
 - feeder disconnecter,
 - secondary equipment: current and voltage transformers, protective relays, and power plant control system, including network synchroscope.
- Model of a run-of-river hydro power plant with a Pelton turbine (2) with nominal flow of 27 l/s. Underneath the turbine is a water reservoir with 7000 liter capacity. Water from the reservoir is pumped to the turbine, thus simulating the penstock.



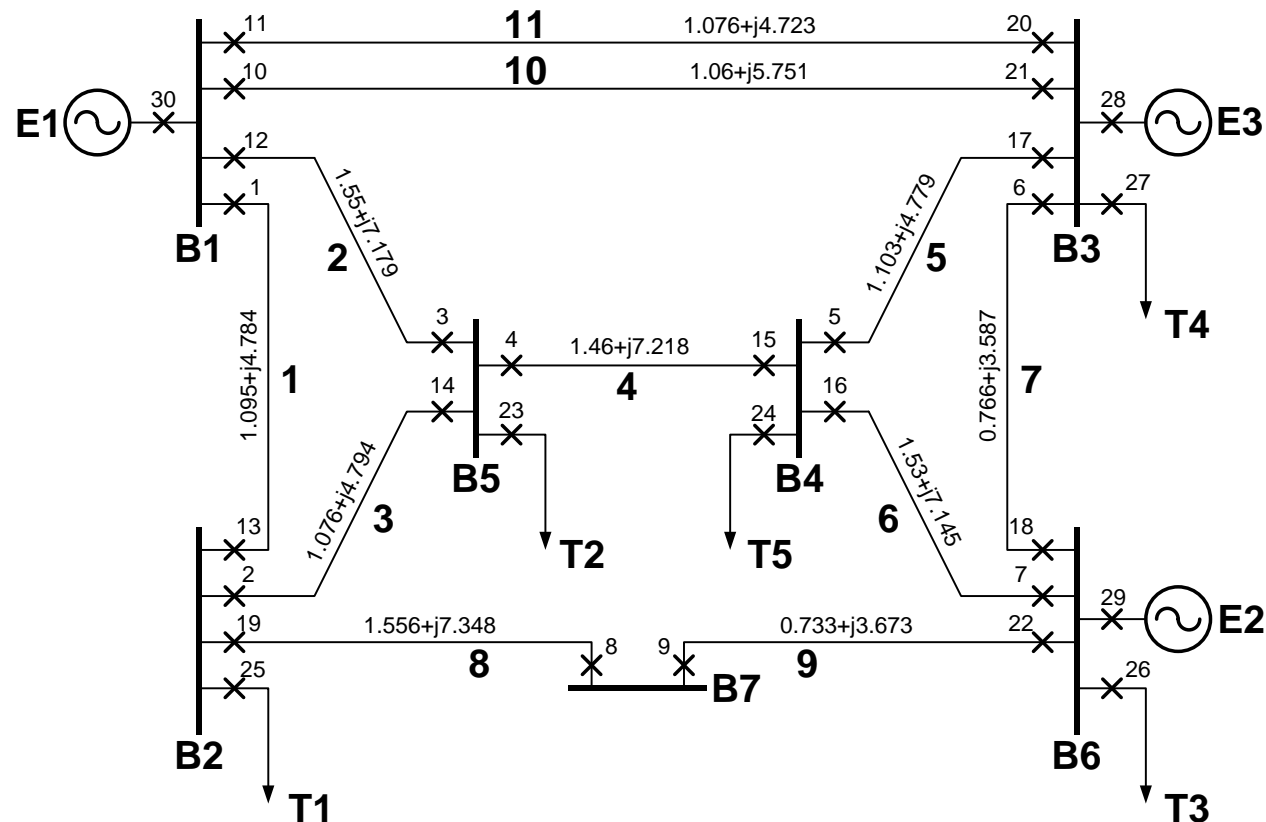
Laboratory Testing

- The rigid network (3) is the utility grid, to which the two power plants can be synchronized.
- Transformer substation, fully equipped with circuit breakers, feeder disconnectors, current and voltage transformers, protection devices and control circuits.
- Different loads connected to the power system model.

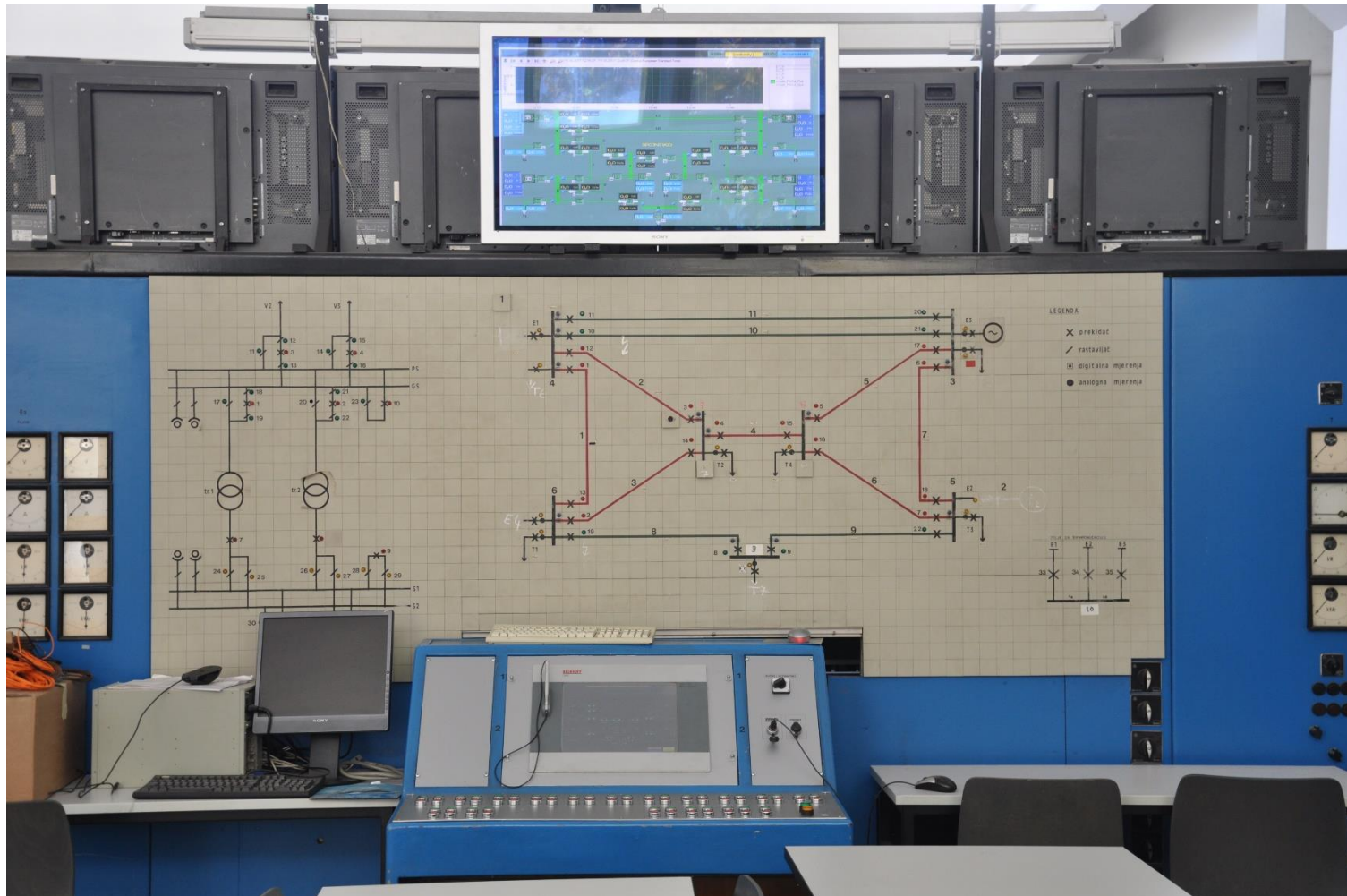


Laboratory Testing

- A series of line models with circuit breakers and feeder disconnectors simulating a high voltage power system network. Line parameters and network topology may be changed.



Laboratory Testing

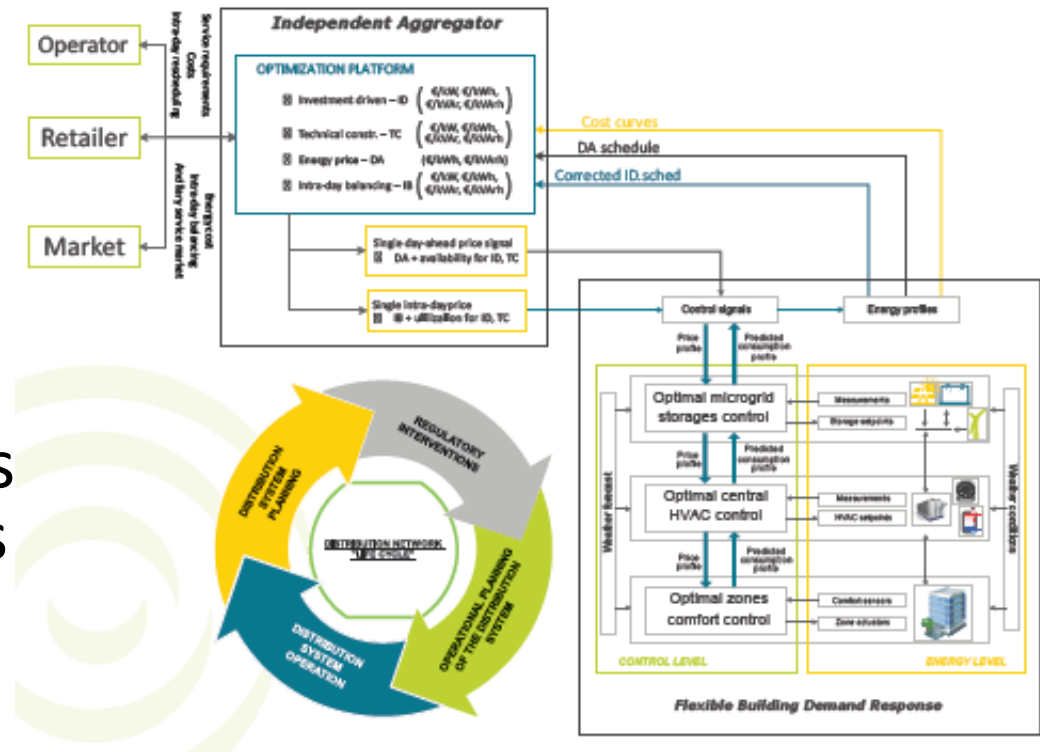


Laboratory Testing



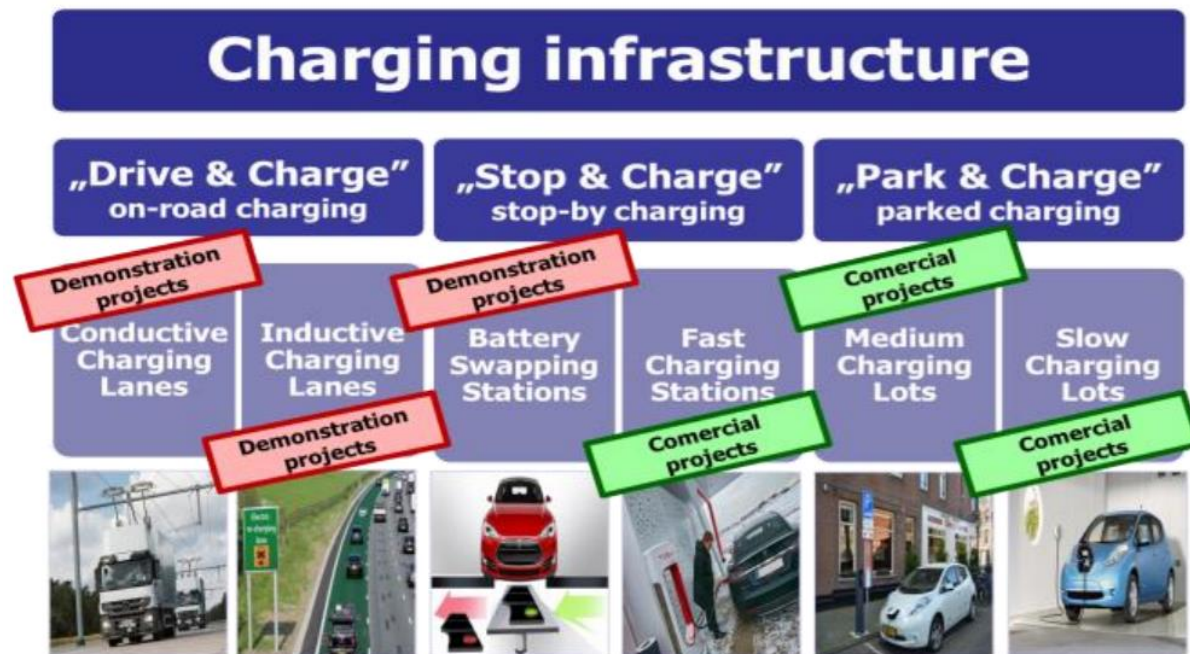
3Smart (2017-2019)

- Smart Building – Smart Grid – Smart City
- Integrated and modular energy management platform for buildings and distribution grids
- Interreg Danube Transnational Programme



SUCCESS (2017-2019)

- SUsustainable ConCept for integration of distributed Energy Storage Systems
- Battery storage for EV charging
- Technical, regulatory and market aspects



Upcoming Projects

- CROSSBOW (H2020)
- bigEVdata (IRI)
- Compact battery-powered cleaning vehicle (IRI)

Thank you for attention

Tomislav.capuder@fer.hr

Hrvoje.pandzic@fer.hr