Virtual Research Services in ERIGrid 2.0

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Webinar "Remote Testing & EIRIE Platform"
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Outline

1. Virtual Access Definition
2. Virtual Access in ERIGrid
3. Howto access ERIGrid Virtual Access Facilities
4. Virtual Access Facilities in ERIGrid
5. Outlook

👉 **Next:** 2 Demonstrations of ERIGrid VA facilities

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Virtual Access – A definition

- Virtual Access ensures free of charge access to e-infrastructure, namely to:
  - Sophisticated computer services
  - Powerful computers, networks, grids, repositories, databanks
  - Safely storing large quantities of scientific data
  - Participation in virtual research communities
  - World-class operational communication and computing infrastructure to facilitate scientific research
- Not to be confused with "remote access"

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Virtual Access

- Requires no application
- No user proposals are not submitted to a selection process
- **You can access the free virtual services right away taking the following points into account:**

Openly and freely available virtual data and services.
Resources are under open access licenses through communication networks.

Quick, easy and casual access to existing virtual resources by eliminating administrative obstacles.

Users can try the provided virtual services without obligations.

No individual support or supervision is offered to the users.

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Virtual Access in ERIGrid 2.0

- Novelty in ERIGrid 2.0
- **8 partners** provide access to **9 virtual access facilities**
- Offered during complete project lifetime
  - April 2020 – September 2024

- Largely built using open-source software solutions
  - Grafana, Jupyter, Docker, Heroku, Mosaik

- Interweaved with other project activities
  - Joint Research Activities: Development of new tools
  - Network Activties: Education and Training of Professionals, Researchers, and Students

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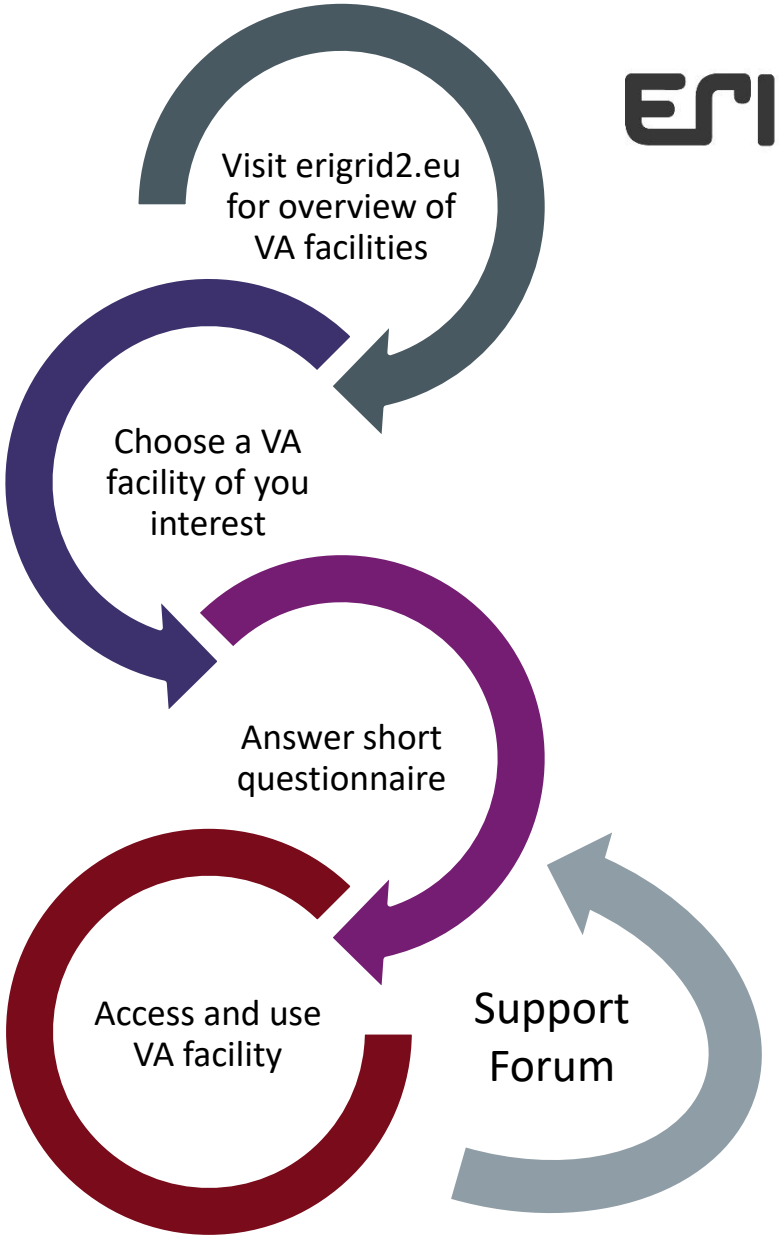
Accessing Virtual Access facilities

- ERIGrid website as entrypoint
- User Questionnaire
- Discussion Forum
  - Exchange experiences
  - Receive support and help
  - Showcase results

- **Not:** Application or Reporting process



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PHYSICAL LABS AND VIRTUAL SERVICES

Access to physical labs can be on-site or remote, depending on the conditions of specific laboratories. To know if remote access can be organised in your case please contact the laboratory staff through corresponding subpages below.

ALL | ON-SITE AND REMOTE TRANSIENT POWER SYSTEM DYNAMICS AND CONTROL VALIDATION | ON-SITE AND REMOTE SMART ENERGY SYSTEMS INTEGRATION AND VALIDATION | VIRTUAL FACILITIES

DER-TF DaaS of RSE

Virtual Lab of ICCS-NTUA

SmartEST Sim Lab of AIT

OpenAFM of ICCS-NTUA

SESA Virtual Sim of OFFIS

VLab of RWTH Aachen

Smartgrid MVP of University of Strathclyde

RMO Database of HEDNO

Digital Energy Lab of DTU

https://erigrid2.eu/lab-access/#virtual

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User Questionnaire

- Collects basic user information
  - Affiliation
  - Country
  - Mail Adress
- Voluntary
- Mainly for EU reporting

ERIGrid 2.0 - Virtual Access

SmartEST Sim Lab

AIT's SmartEST Sim Lab is a simulation-as-a-service platform that is open to the public and can be used free of charge. It provides a web-based co-simulation platform based on mosaik, Docker, JupyterLab and JupyterHub.

- Description
- Documentation
- Discussion Forum / FAQ

Company / Institution / University

University of ...

Type

Please select

Country

Please select

Email address

Enter email

We'll never share your email with anyone else.

I consent to be contacted for the evaluation of ERIGrid's Virtual Access programme (optional).

Access Installation

https://va.erigrid2.eu

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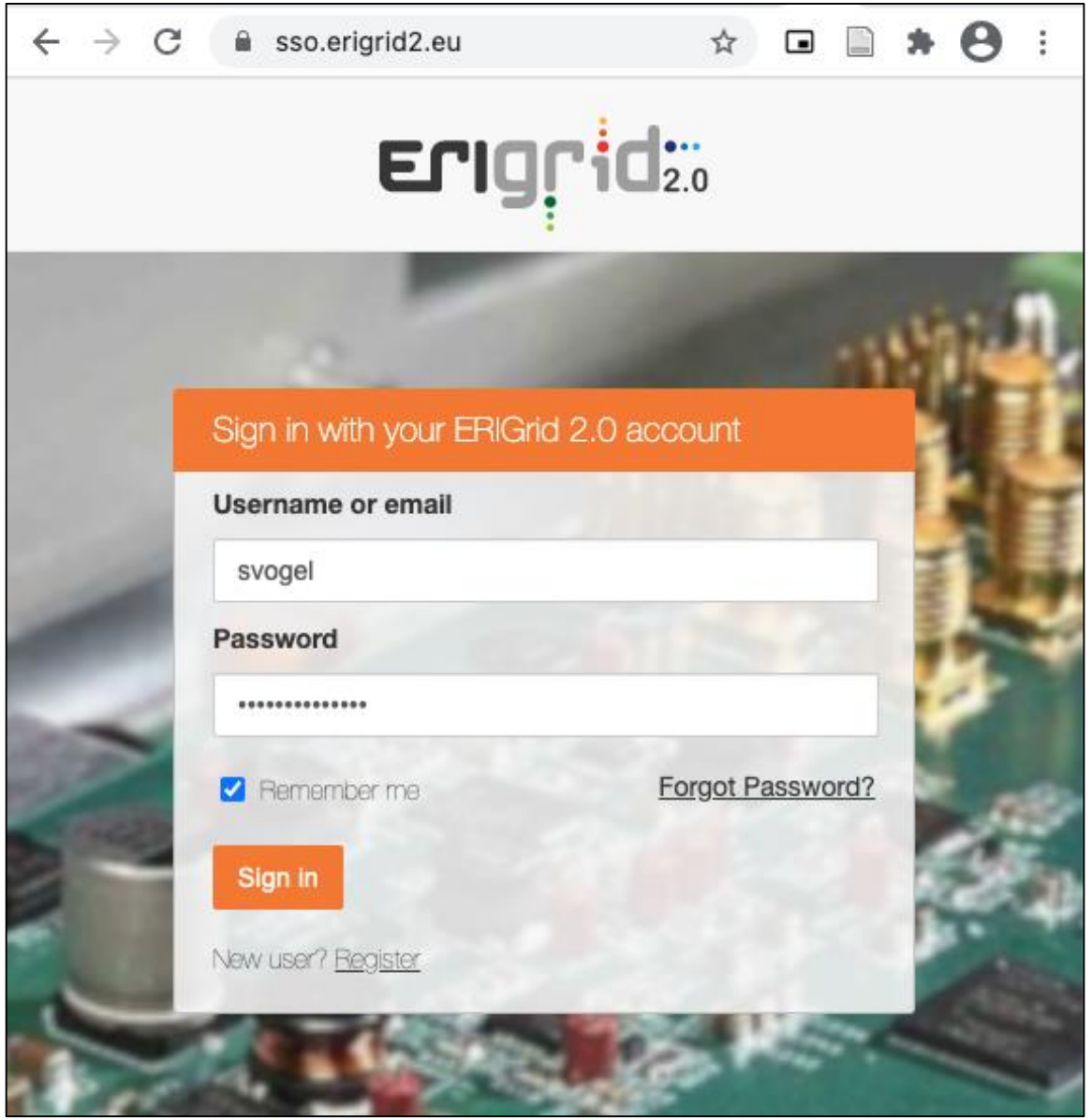
Project-wide Single-Sign-On

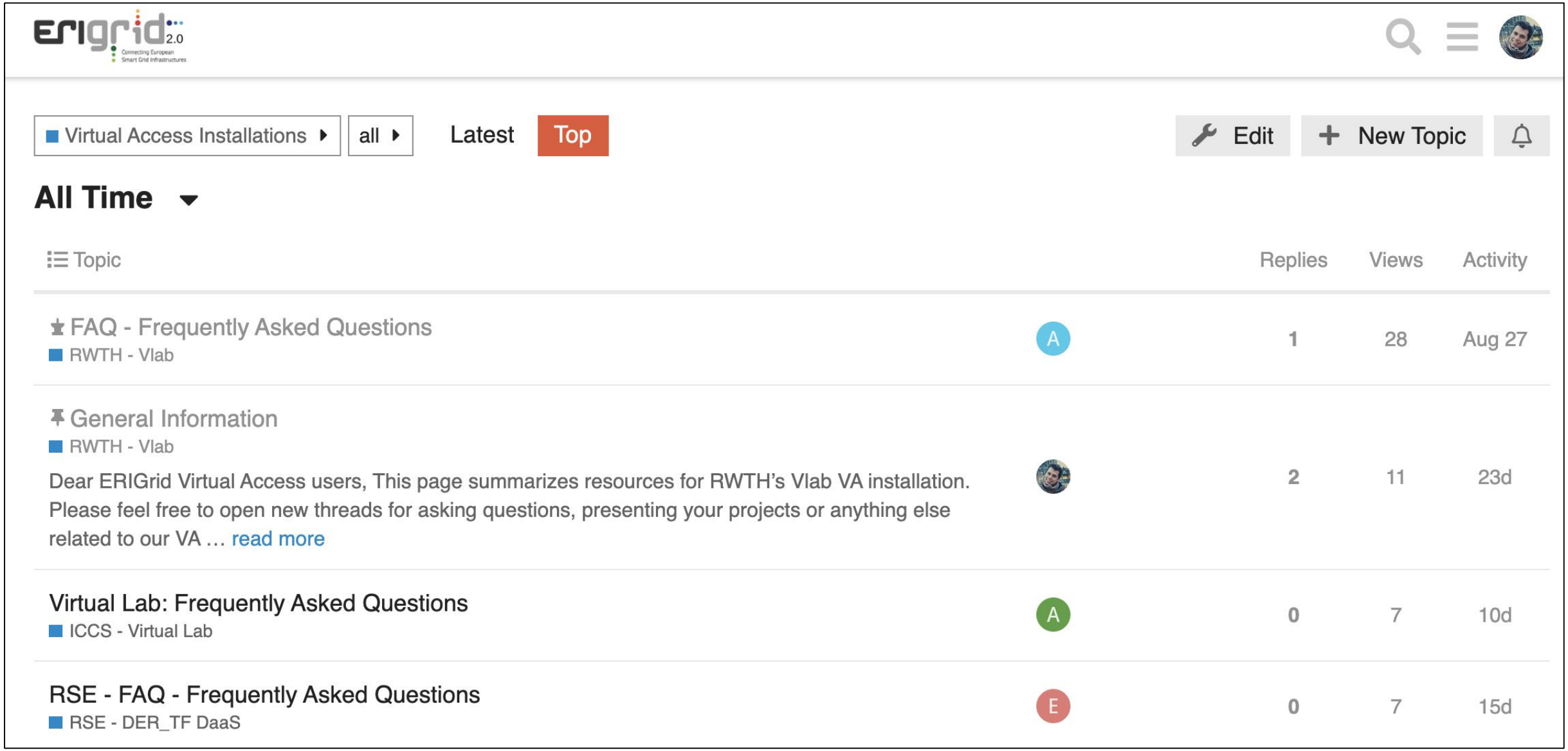
- Unifies user accounts for
  - ERIGrid discussion forum
  - RWTH and AIT VA facilities

- Identity provider (IdP)
  - Open-source KeyCloak
  - Hosted by AIT



https://sso.erigrid2.eu:8443/

doi:10.5281/zenodo.4573000



https://forum.erigrid2.eu

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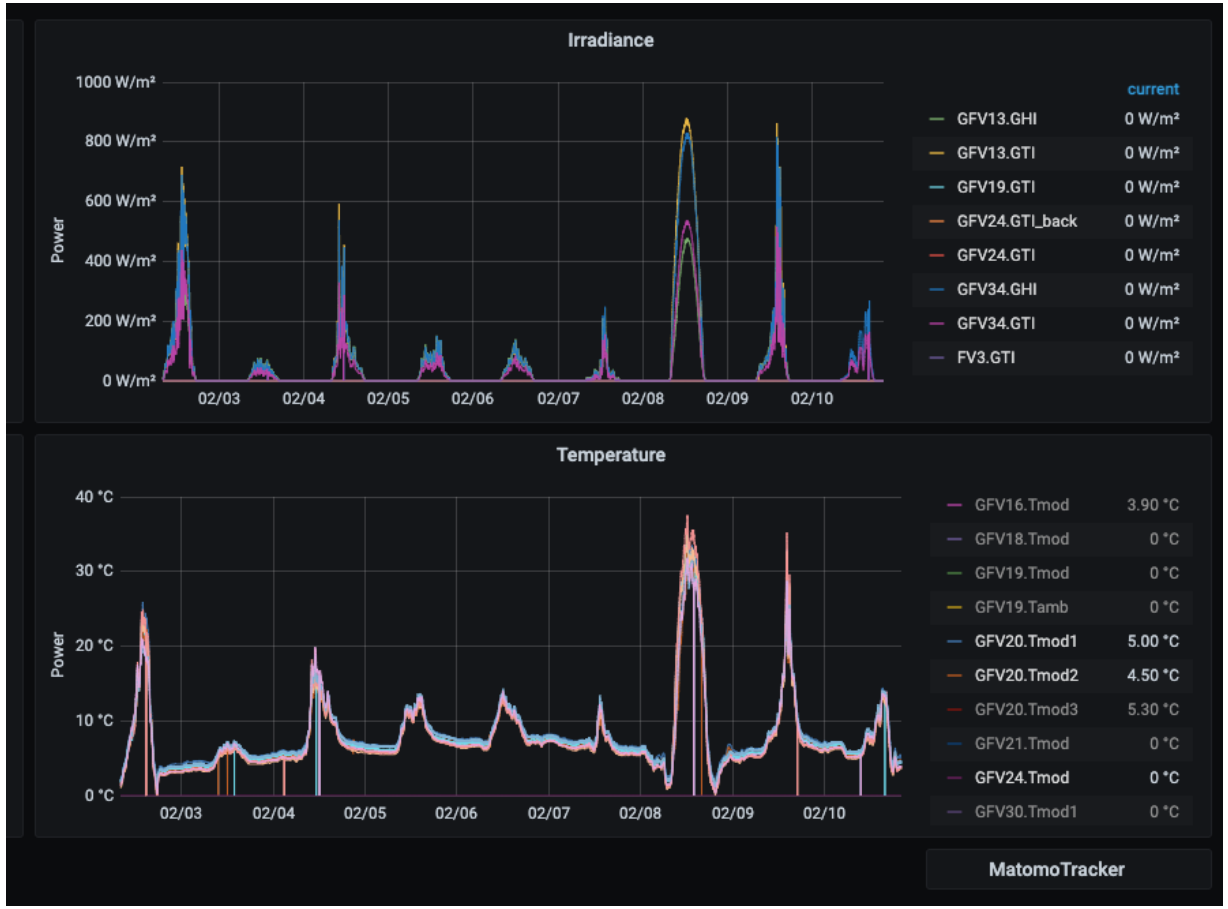
RSE: DER-TF DaaS

- Cloud database platform
- Provides access to historical and real-time data of a real low voltage micro-grid
- Time-series database
  - Historical measurements
  - Grafana web-interface
- Object storage
  - Topology assets
  - Test case descriptions



PV Field Irradiances and Temperatures

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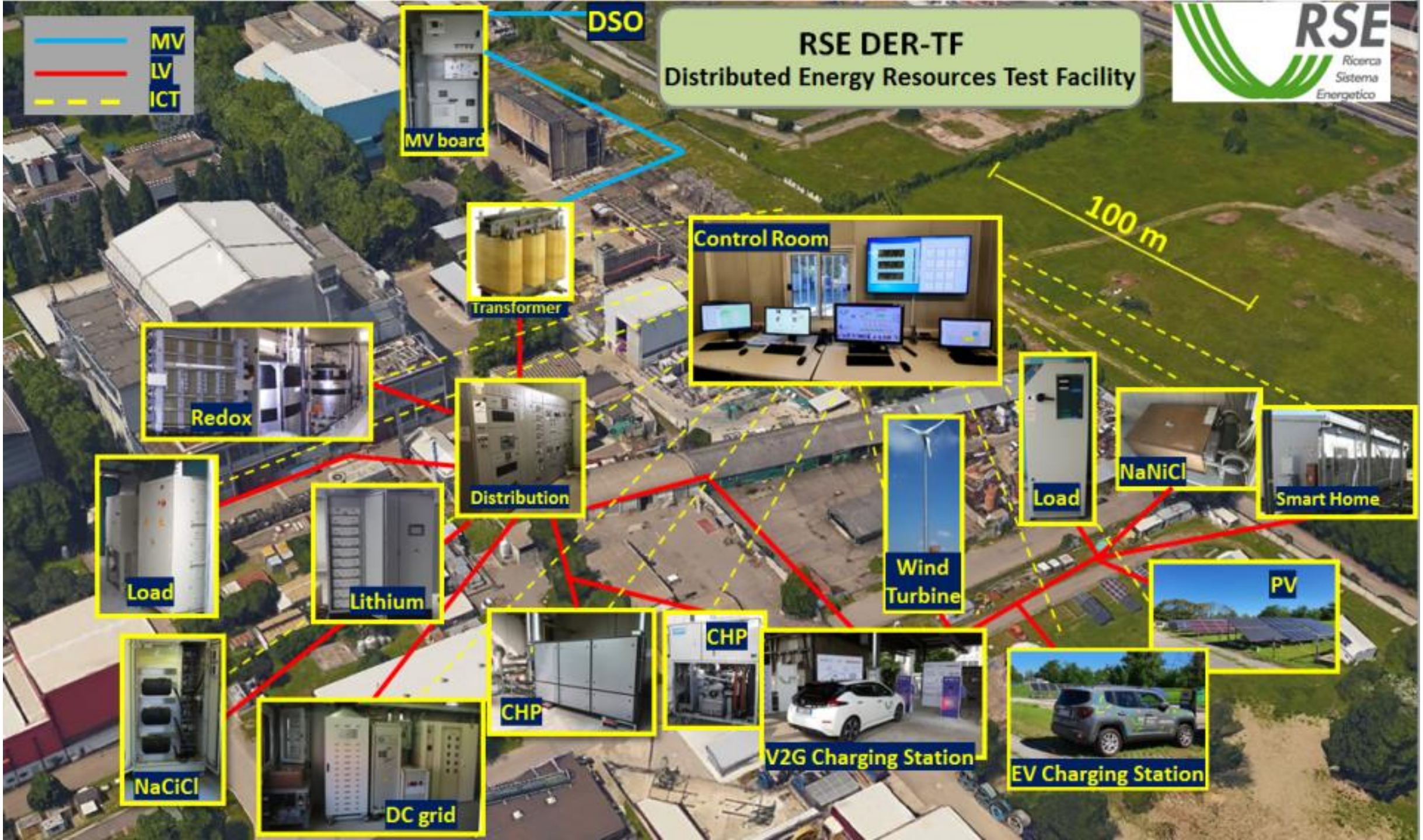
RSE DER-TF
Distributed Energy Resources Test Facility
RSE
Ricerca Sistema Energetico
MV
LV
ICT
DSO
MV board
Transformer
Control Room
100 m
Redox
Distribution
Load
Lithium
Load
NaNiCl
Smart Home
Wind Turbine
PV
CHP
CHP
V2G Charging Station
EV Charging Station
NaCiCl
DC grid

AIT: SmartEST Sim Lab

- Simulation-as-a-service platform
- Mosaik Jupyter Extension
- Integration into ERIGrid Single-Sign-On
- Built on:
  - Mosaik
  - Docker
  - JupyterLab and JupyterHub

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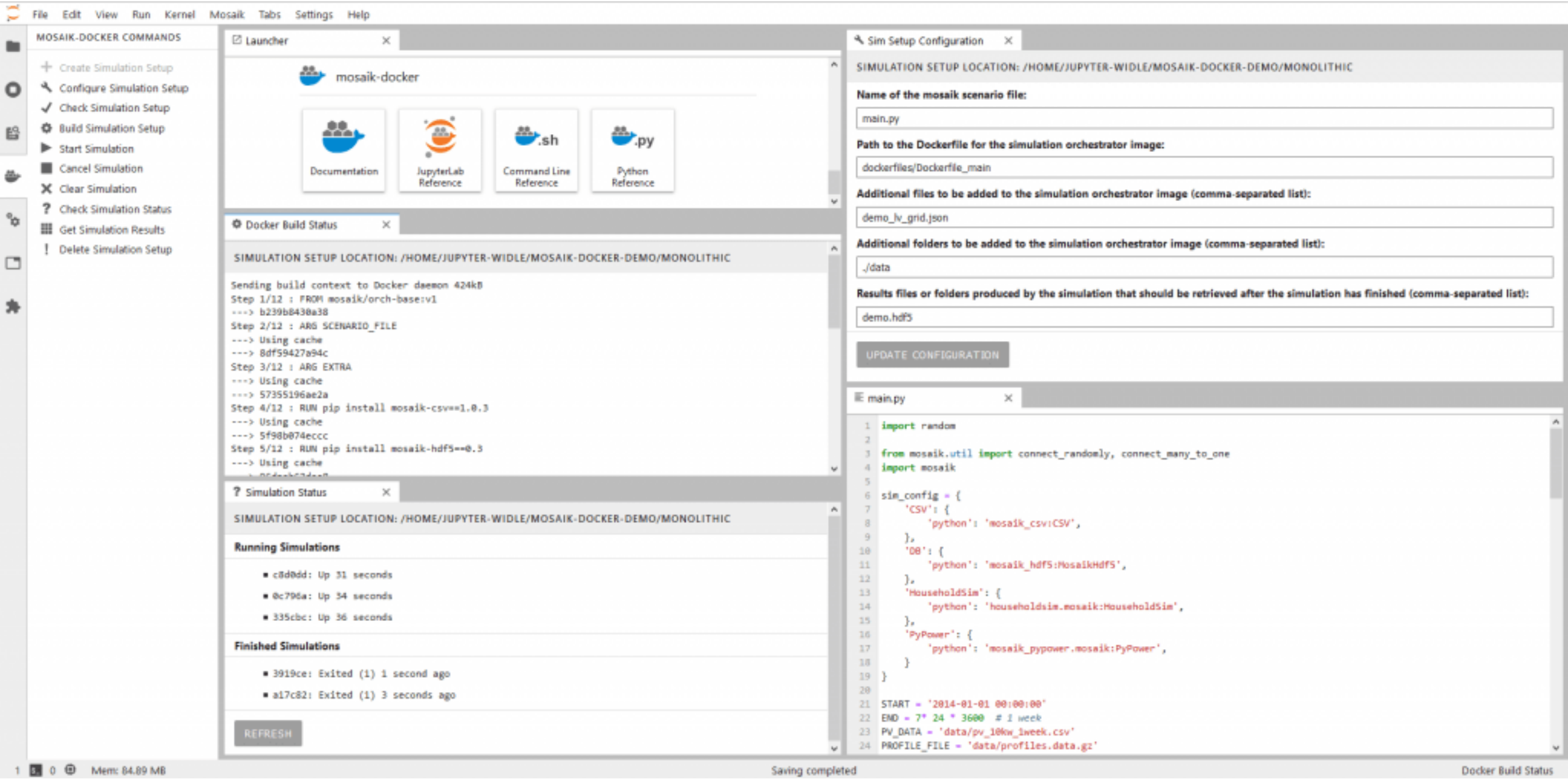
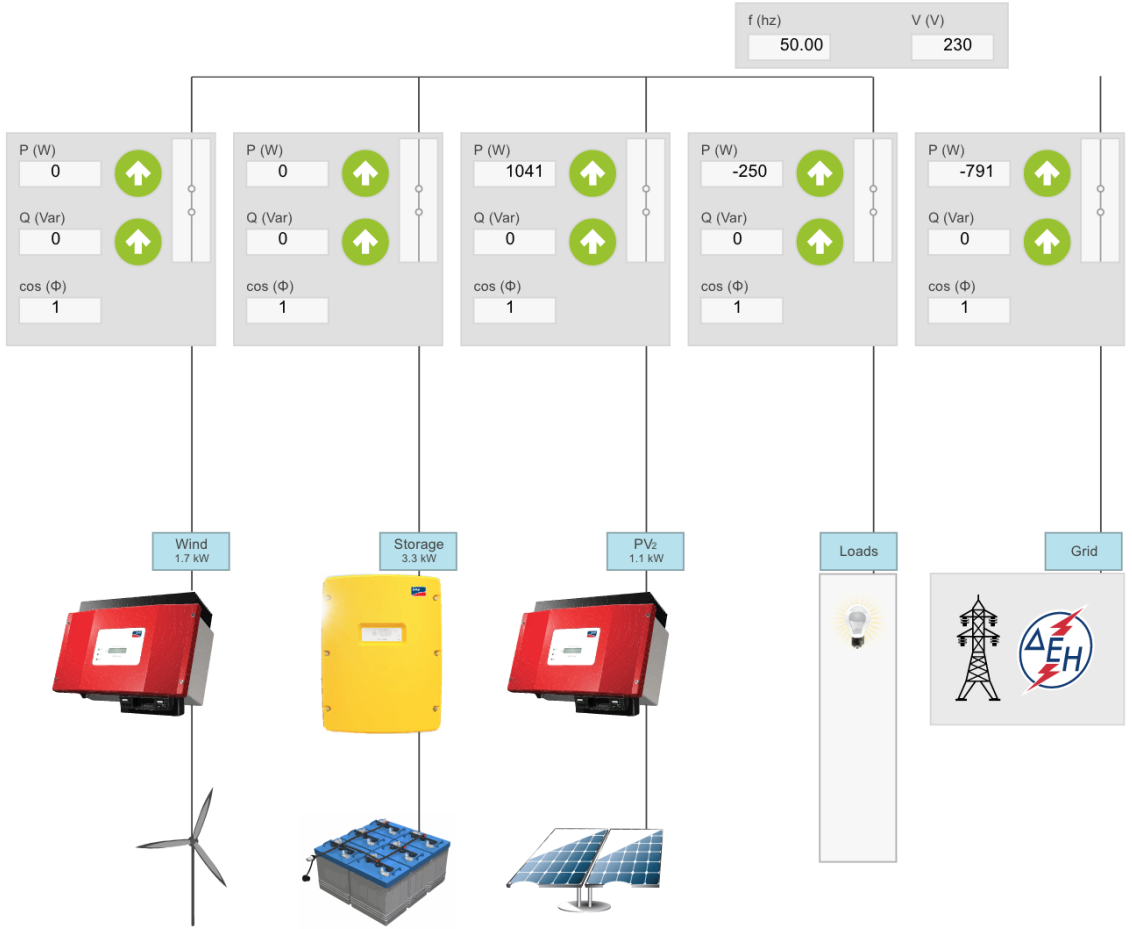

File Edit View Run Kernel Mosaik Tabs Settings Help
MOSAIK-DOCKER COMMANDS
Create Simulation Setup
Configure Simulation Setup
Check Simulation Setup
Build Simulation Setup
Start Simulation
Cancel Simulation
Clear Simulation
Check Simulation Status
Get Simulation Results
Delete Simulation Setup
Launcher
mosaik-docker
Documentation
JupyterLab Reference
Command Line Reference
Python Reference
Docker Build Status
SIMULATION SETUP LOCATION: /HOME/JUPYTER-WIDLE/MOSAIK-DOCKER-DEMO/MONOLITHIC
Sending build context to Docker daemon 424kB
Step 1/12 : FROM mosaik/orch-base:v1
---> b239b8438a38
Step 2/12 : ARG SCENARIO_FILE
---> Using cache
---> 8df59427a94c
Step 3/12 : ARG EXTRA
---> Using cache
---> 57355196ae2a
Step 4/12 : RUN pip install mosaik-csv==1.0.3
---> Using cache
---> 5f98b074eccc
Step 5/12 : RUN pip install mosaik-hdf5==0.3
---> Using cache
Simulation Status
SIMULATION SETUP LOCATION: /HOME/JUPYTER-WIDLE/MOSAIK-DOCKER-DEMO/MONOLITHIC
Running Simulations
c8d0dd: Up 31 seconds
0c796a: Up 34 seconds
335cbc: Up 36 seconds
Finished Simulations
3919ce: Exited (1) 1 second ago
a17c82: Exited (1) 3 seconds ago
REFRESH
Sim Setup Configuration
SIMULATION SETUP LOCATION: /HOME/JUPYTER-WIDLE/MOSAIK-DOCKER-DEMO/MONOLITHIC
Name of the mosaik scenario file:
main.py
Path to the Dockerfile for the simulation orchestrator image:
dockerfiles/Dockerfile_main
Additional files to be added to the simulation orchestrator image (comma-separated list):
demo_lv_grid.json
Additional folders to be added to the simulation orchestrator image (comma-separated list):
./data
Results files or folders produced by the simulation that should be retrieved after the simulation has finished (comma-separated list):
demo.hdf5
UPDATE CONFIGURATION
main.py
import random
from mosaik.util import connect_randomly, connect_many_to_one
import mosaik
sim_config = {
'CSV': {
'python': 'mosaik_csv:CSV',
},
'DB': {
'python': 'mosaik_hdf5:MosaikHdf5',
},
'HouseholdSim': {
'python': 'householdsim.mosaik:HouseholdSim',
},
'PyPower': {
'python': 'mosaik_pypower.mosaik:PyPower',
}
}
START = '2014-01-01 00:00:00'
END = 7 * 24 * 3600 # 1 week
PV_DATA = 'data/pv_10kw_1week.csv'
PROFILE_FILE = 'data/profiles.data.gz'
Mem: 84.89 MB
Saving completed
Docker Build Status

ICCS-NTUA: VIRTUAL LAB

- Educational simulation tool
- Mimics the operation of the actual laboratory mic
- Provides two different experiments / setups
  - Voltage Control
  - Microgrid Operation
- Implemented as an Heroku Application



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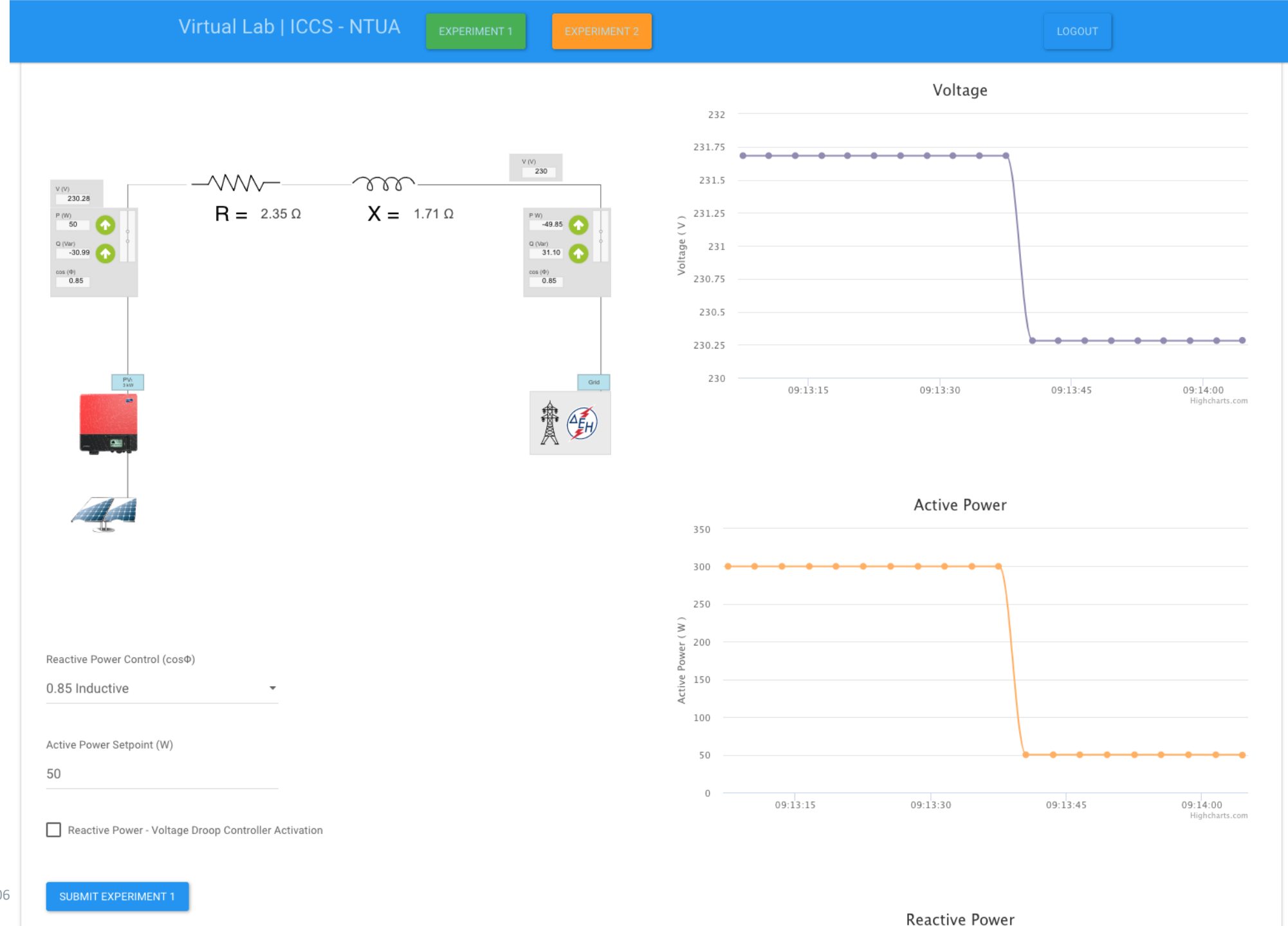
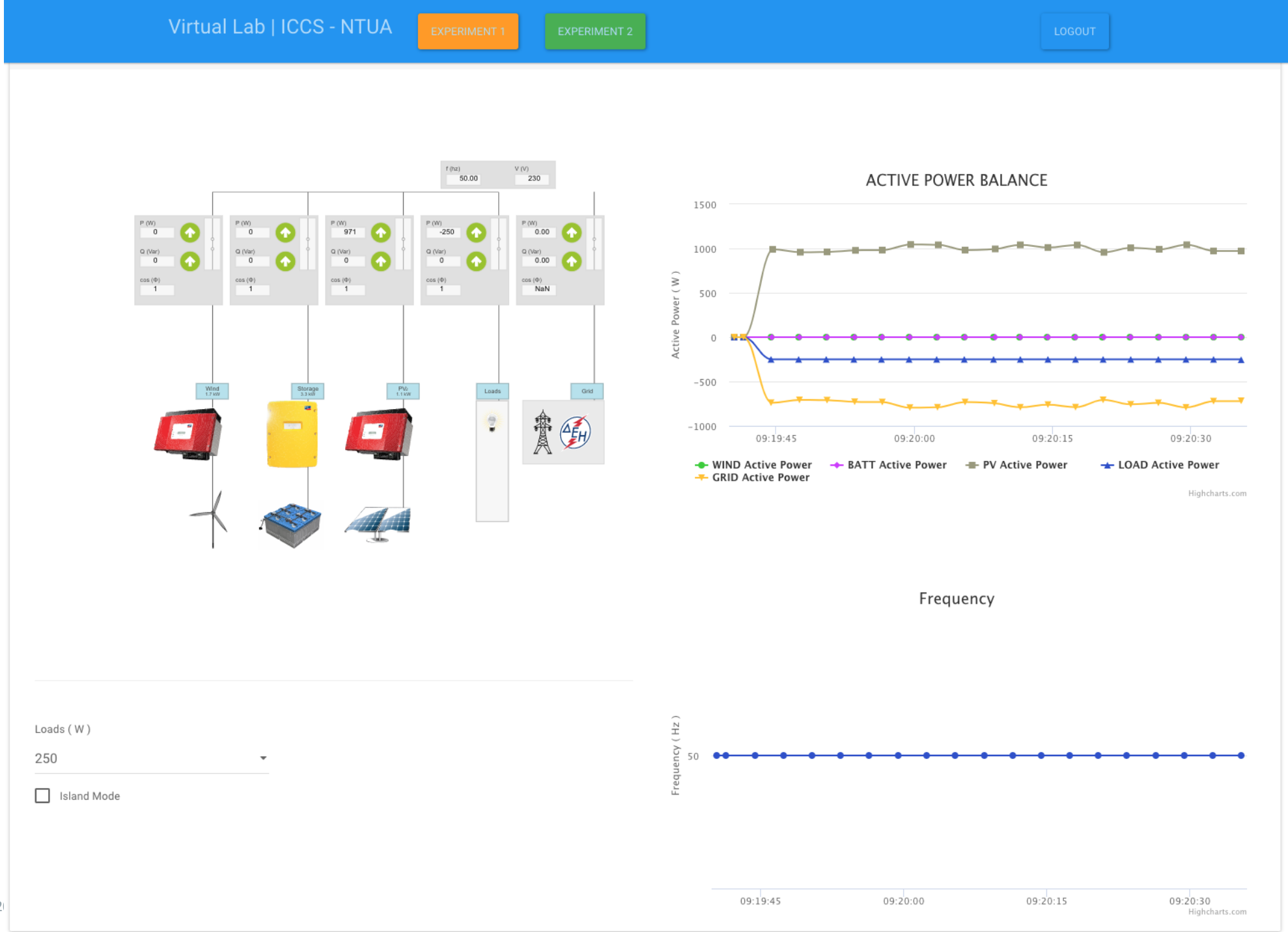
Experiment 1

- Voltage Control
- Allows user to adjust
  - Reactive Power Control (phi)
  - Active Power Setpoint



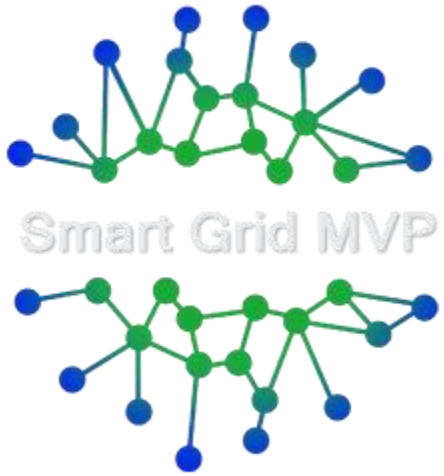
Experiment 2

- Microgrid Operation
- Allows users to adjusts loads in the MG



UoS: Smart Grid MVP

- Monitoring and Visualisation Platform by Dynamic Power Systems Laboratory (DPSL)
- Collects power systems measurement data from two Phasor Measurement Units (PMUs) at
  - University of Strathclyde
  - Power Networks Demonstration Centre
- Provides (near) real-time and historical access to
  - Grid frequency, RoCoF
  - Voltage Phasor Diagram
  - Generation composition
- Correlation with other datasets and power system events



Q. Hong et al., "Design of an Open Platform for Real-Time Power Grid Monitoring," 2019 IEEE 8th International Conference on Advanced Power System Automation and Protection (APAP), Xi'an, China, 2019, pp. 735-739.

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Smart Grid MVP

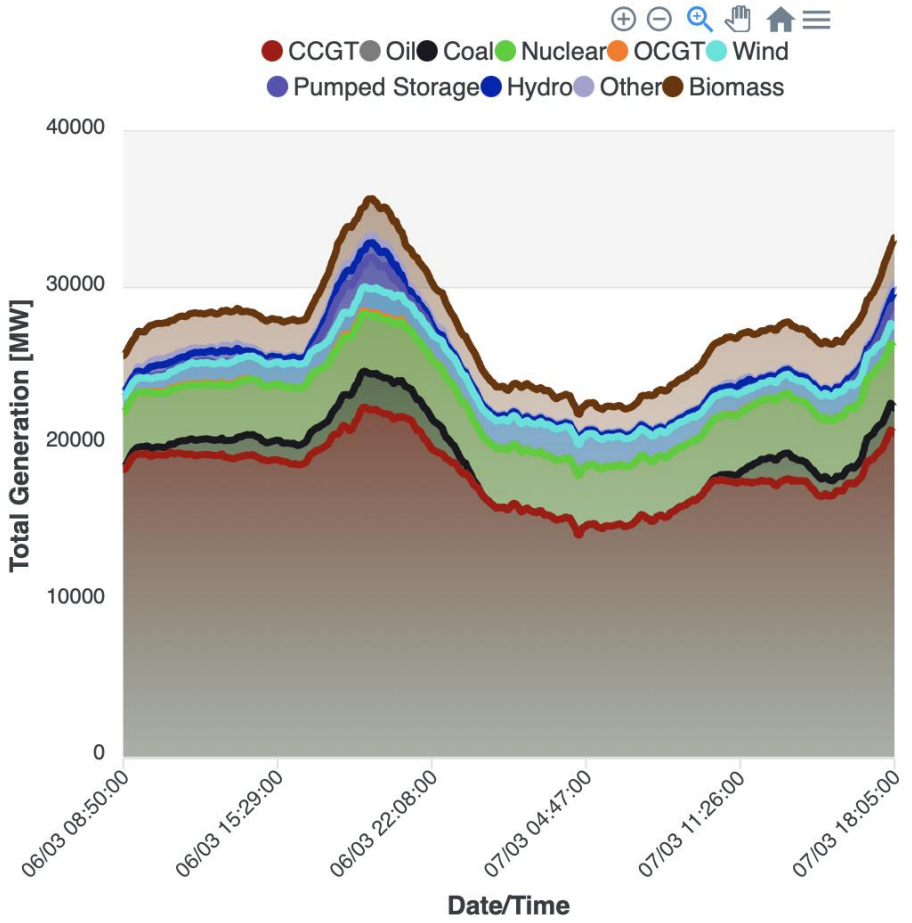
- Current Grid Status
- GB Generation Mix
- Historic Data
- System Event Log
- Future Live Monitoring
- About us

GB Generation Mix

Generation by Fuel Type

Generation Mix Stacked Graph

From: 06/03/2021 - 08:50 To: 07/03/2021 - 18:05



Smart Grid MVP

- Current Grid Status
- GB Generation Mix
- Historic Data
- System Event Log
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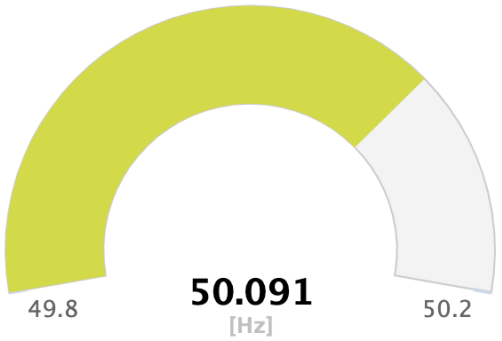
- About us

Developed by:
University of Strathclyde,
Glasgow, Scotland

Frequency Gauge - UK Grid

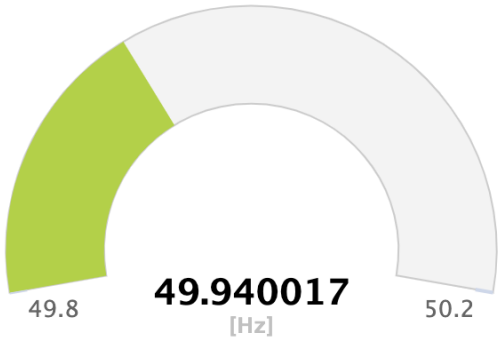
Instantaneous



Updated at: 18:22:36 - Data as of: 07/03/2021 - 18:18:15

Frequency Gauge - StrathPMU

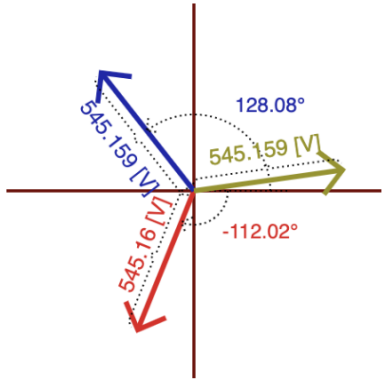
Instantaneous



Updated at: 18:22:50 - Data as of: 06/03/2021 - 06:13:06.56

Voltage Phasor Diagram - StrathPMU

Instantaneous



Update rate: 6.25 [Hz] - Delay: 61.44 [s]

Live UK Grid Data

Select time range...

ICCS-NTUA: OpenAFPM

- “Online Design Tools for Locally Manufactured Small Wind Turbines”
- Allows designing Axial Flux Permanent Magnet (AFPM) generators for wind electric systems
- Uses open-source tool “Finite Element Method Magnetics” (FEMM)

- (Sub-)Tools:
  - **MagnAFPM:** designs a generator for a specific set of rotor blades and permanent magnets
  - **UserAFPM:** validate the performance of a specific generator geometry using FEMM
  - **OptiFEMM:** uses the particle swarm optimization (PSO) to optimize the dimensions of the permanent magnets

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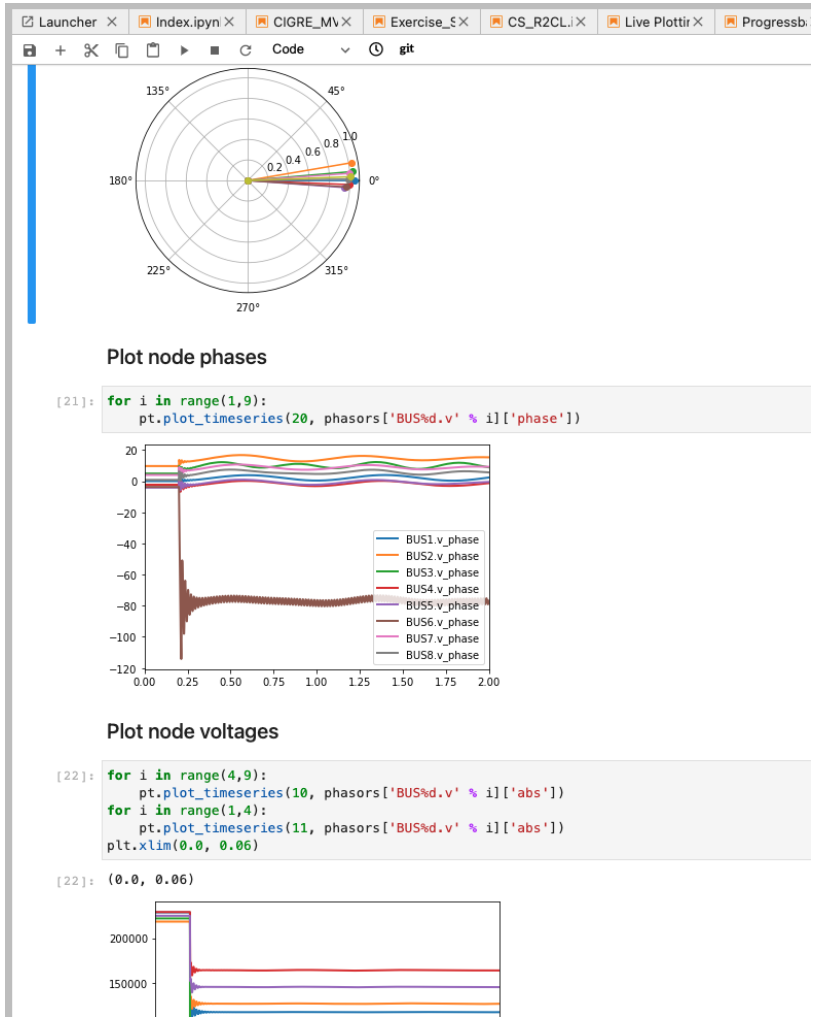
RWTH: Vlab

- Web-based simulation platform
  - Jupyter + DPsim
- EMT, Load Flow and Dynamic Phasor simulation
- Define grid models in
  - Python or C++
  - Common Information Model (CIM)
- Analysis / Scripting / Scenario definitions in Python
- **Soon:** Real-time dashboards and scenario/result management

Upcoming Demo!



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Outlook

- Three more Virtual Access facilities are planned to go live in 2021
  - **OFFIS:** SESA Virtual Sim
  - **HEDNO:** RMO Database
  - **DTU:** Digital Energy Lab?

- More in-depth webinars for individual VA facilities are planned
  - Video tutorials

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www.erigrid2.eu

@ERIGrid 2.0 Project

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RWTH Aachen University

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