The ENSURE Co-Demonstration Platform – Approach, Feasibility and Working Status

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2023 EUROPEAN RTDS TECHNOLOGIES INC. USER'S GROUP MEETING 2023

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RTDS Technologies AMETEK

INTRODUCTION

- The idea of a large distributed real-time co-simulation platform with Hil and PHiL capabilities across Germany was born in the project Kopernikus ENSURE I in 2018

- With the transition from ENSURE II to ENSURE III, we are entering the final phase of building the platform.

- However, let us start from the beginning:

What is Kopernikus ENSURE, and why do we want to build a real-time platform?

KOPERNIKUS ENSURE

KOPERNIKUS ENSURE PROJEKTE
Die Zukunft unserer Energie

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The Kopernikus projects are currently among the largest research initiatives in Germany and certainly leading the way in terms of the energy transition. They make a significant contribution to Germany's capacity to achieve its climate goals[1].

***Kopernikus ENSURE** is developing the power grid of the future:*

Phase 1: Concepts and theory

Phase 2: Validation and preparation

*Phase 3: Implementation in **large-scale demonstrators***

[1]**https://www.kopernikus-projekte.de/en/projects**

Scenarios

What could the energy system look like in 2050?

Challenges

What does the electrical grid need to be prepared for?

Solutions

New network resources, new modes of operation, new framework conditions

KOPERNIKUS ENSURE III - CONSORTIUM

Industry

SIEMENS

OPAL-RT TECHNOLOGIES

Hitachi Energy

PSI

MR

Research

RWTH AACHEN UNIVERSITY

FAU Friedrich-Alexander-Universität Erlangen-Nürnberg

ewi

KIT Karlsruher Institut für Technologie

C A U Kiel University Christian-Albrechts-Universität zu Kiel

BERGISCHE UNIVERSITÄT WUPPERTAL

DVGW ebi

TECHNISCHE UNIVERSITÄT ILMENAU

HM Hochschule München University of Applied Sciences

Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology

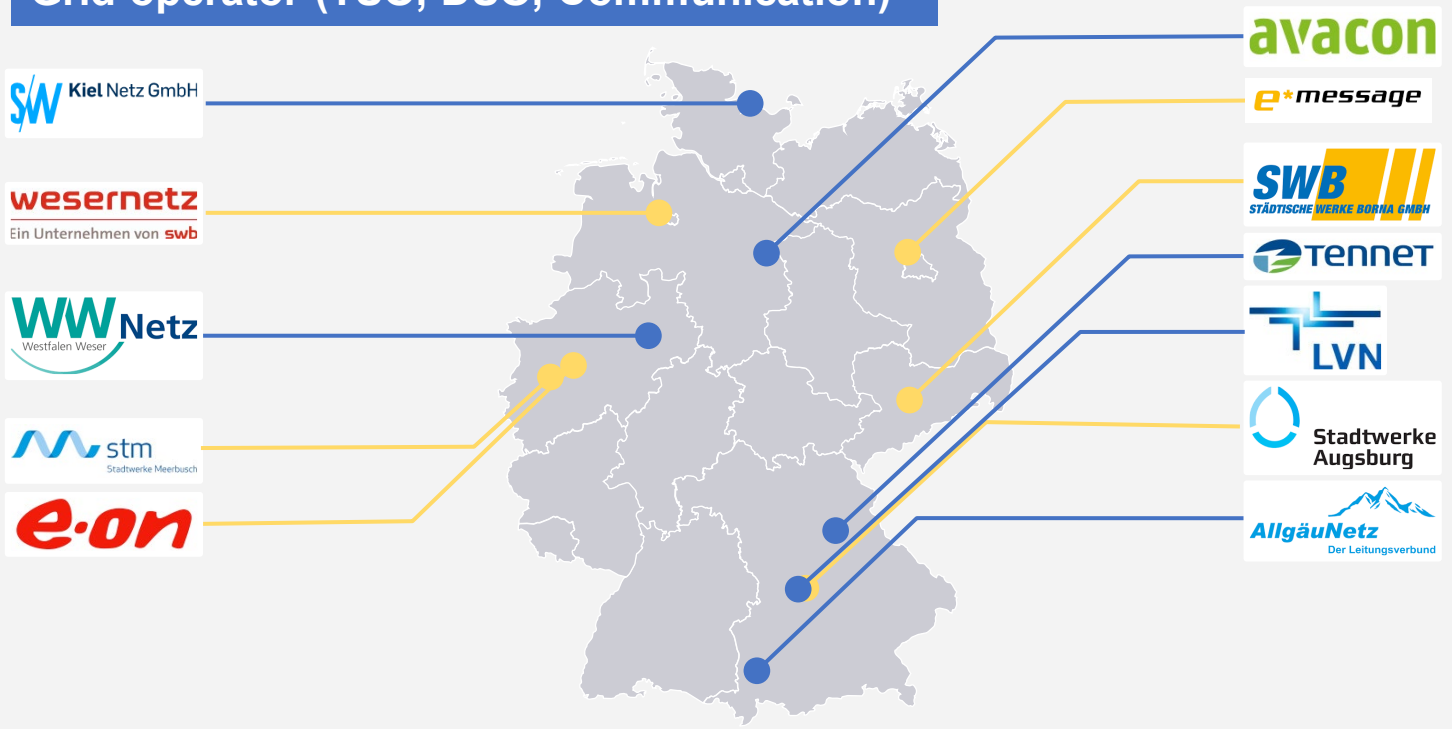
technische universität dortmund

Society

Deutsche Umwelthilfe

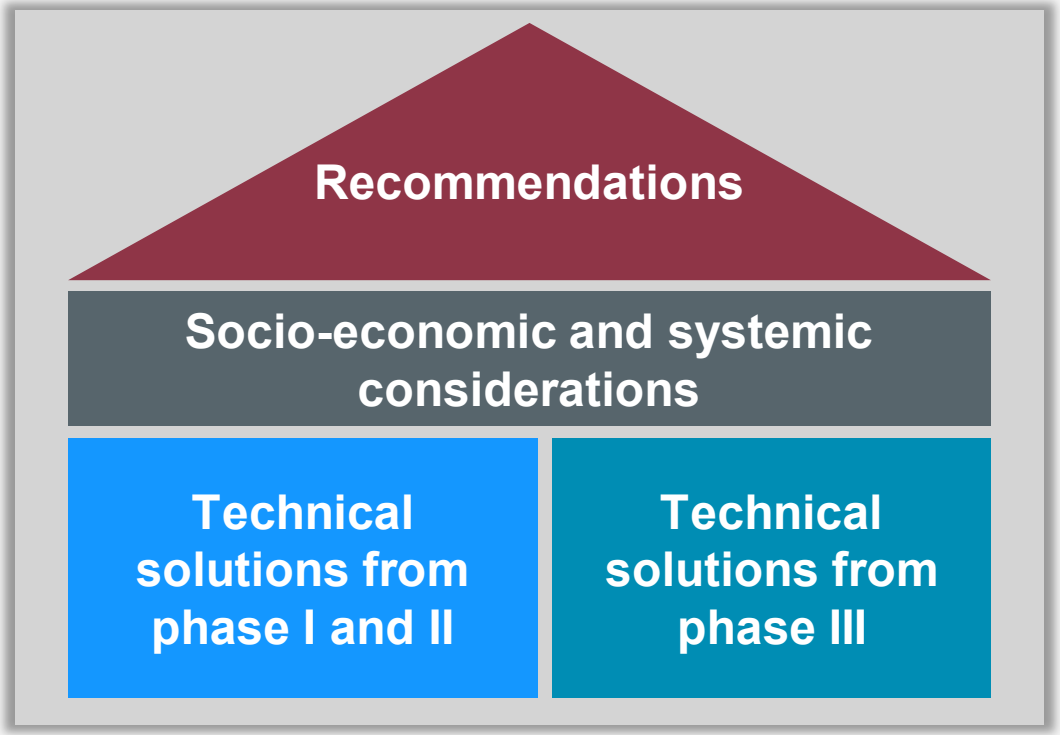
GERMANWATCH

Grid operator (TSO, DSO, Communication)



KOPERNIKUS ENSURE III - GOALS

Transfer



Co-Demonstration-Plattform

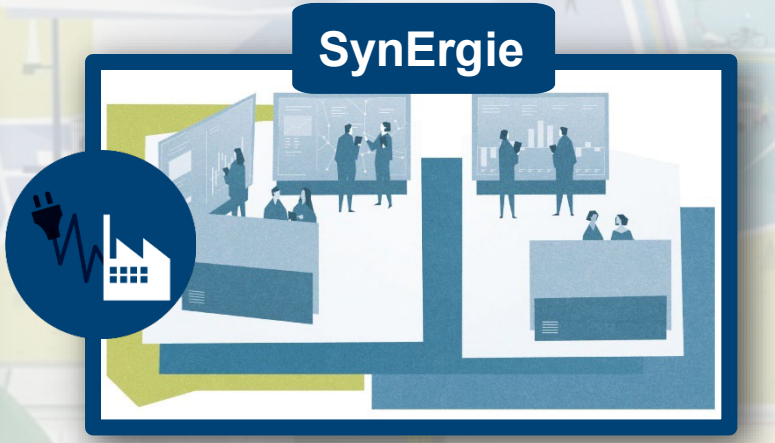
demonstrates the systemic interaction and

is available to society in the long term

ENSURE - PART OF KOPERNIKUS PROJECTS

P2X

SynErgie



ENSURE

Ariadne

WGs

- Vision
- Scenarios
- Acceptance
- Regulation
- Demonstration

CO-DEMONSTRATION PLATFORM

- The project aims to build **Europe's largest real-time platform**
- Essential tools for the platform are **co-simulation** via VillasNode and various **power system models**
- Coupling of **laboratories** at different locations in Germany allows access to local resources and competencies
- An essential task of ENSURE III is developing of the platform and its use to **validate and demonstrate** solutions for the energy transition, individually and in interaction
- Platform shall be **open for user** outside the ENSURE project

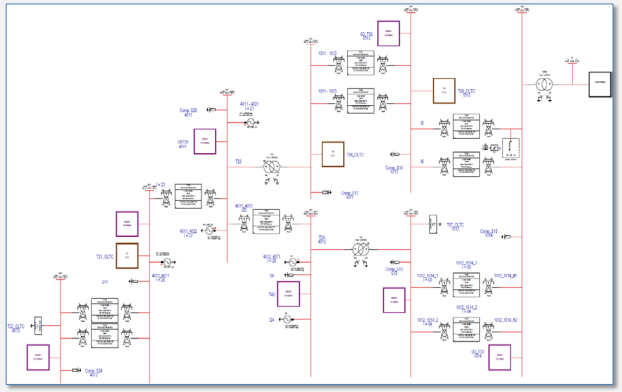
CO-DEMONSTRATION PLATFORM

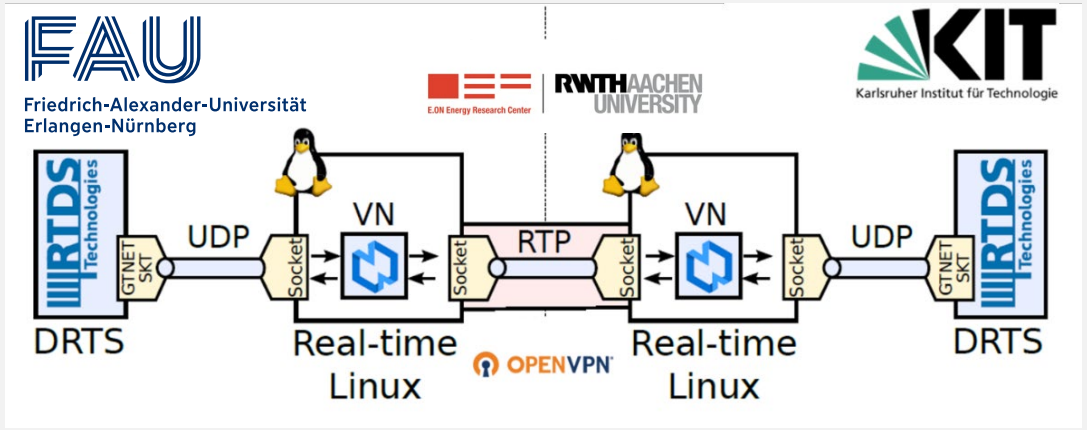
- Real-time simulators form the interface between power system simulations and hardware

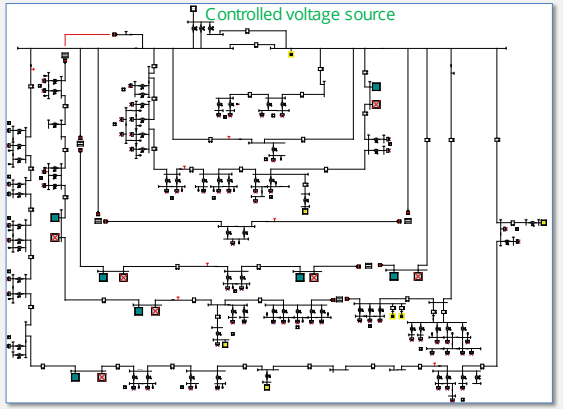
- Simulators distributed across Germany can simulate a common power system
  - Increase in computational power
  - Integration of laboratories
  - No exchange of confidential models necessary

Image sources: RWTH, KIT, FAU, OFFIS

CO-DEMONSTRATION PLATFORM







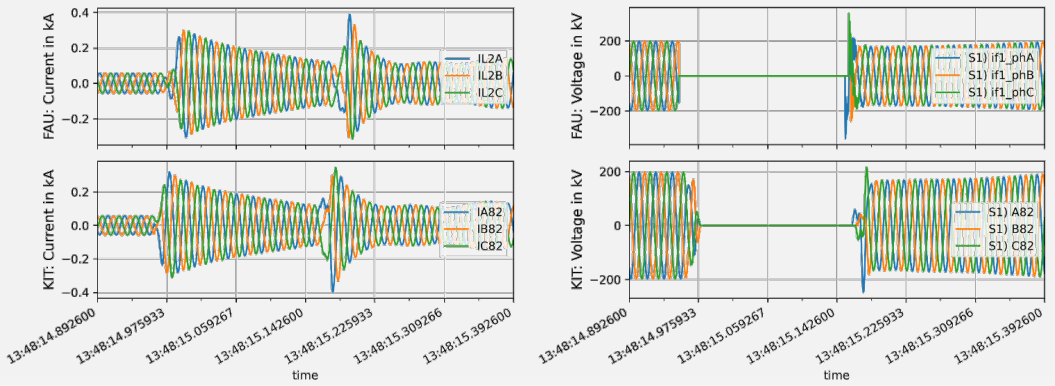


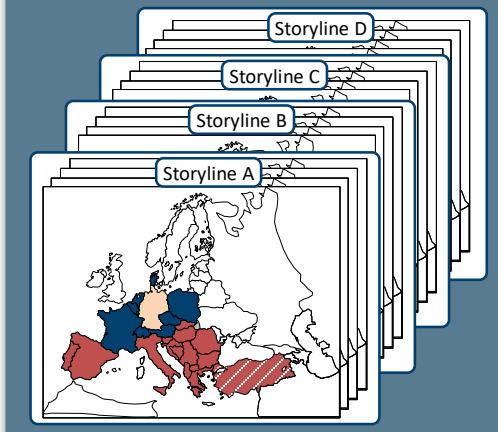
Image sources: RWTH, KIT, FAU

For more information:

"*Development of a Co-Simulation Test Bench for Power System Studies with HiL and PHiL*", RTDS User Spotlight Series 2022

Download: https://github.com/VILLASframework

Power System data (offline model)

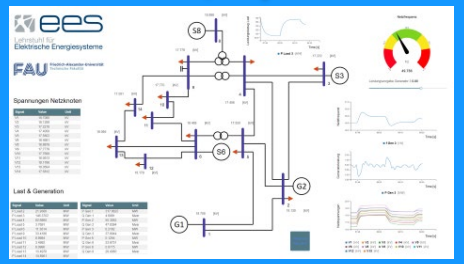


Transmission system model
4x8760 snapshots

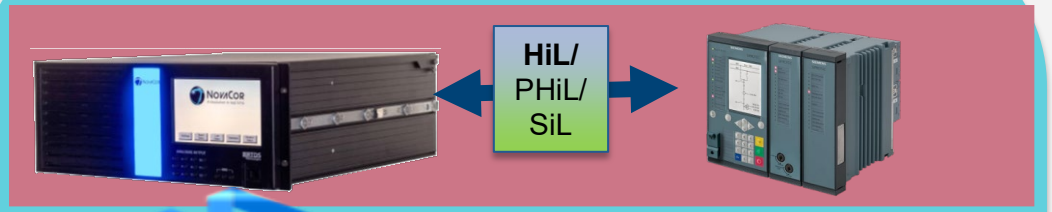
Real-time Model of Germany and neigbouring countries

Import of snapshots from PowerFactory to ePhasorsim

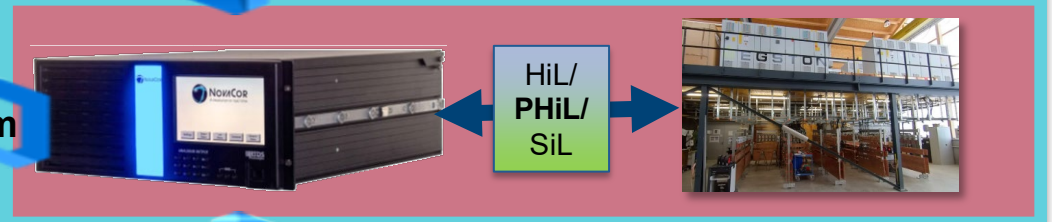
Visualisation and control



AoI simulators and technical solutions



CoSim



CoSim

Image sources: RWTH, KIT, FAU, TUIL, SIEMENS, OPAL-RT, RTDS

Area of Interest (AoI) simulators:

- Multi-domain approach: EMT, RMS, dynamic phasors
- Can be part of transmission system, distribution system or only PCC
- Sofware-in-the-Loop (SiL) can also be integrated directly in the blue section (e.g. control rooms, SSOT)
- Flexible couplings of the AoI simulators with each other or with the blue section
- Continuous simulations or snapshot simulations

CO-DEMONSTRATION PLATFORM

Regarding the working status:

- Feasibility studies are completed, and interfaces are available
- Various real-time power system models have been developed and are still under development
- Distributed real-time simulation is working
- First solutions are already run on the platform

(User Presentation 11: A Modular Hardware-in-the-Loop Testbench for the Investigation of Converter Control Interactions and Interoperability)

Nevertheless, there is still much work to do until the end of 2025…

OUTLOOK

- For power system simulations, large co-simulation platforms will emerge in the next few years or are currently under construction
- In the Kopernikus ENSURE project, the platform will demonstrate the systemic interaction of several solutions
- In ENSURE III, strong partners are participating in the development of the platform, and many more will use the platform
- The platform is to be available to society in the long term
- For further questions: gert.mehlmann@fau.de