Enhanced simulation methods and tools

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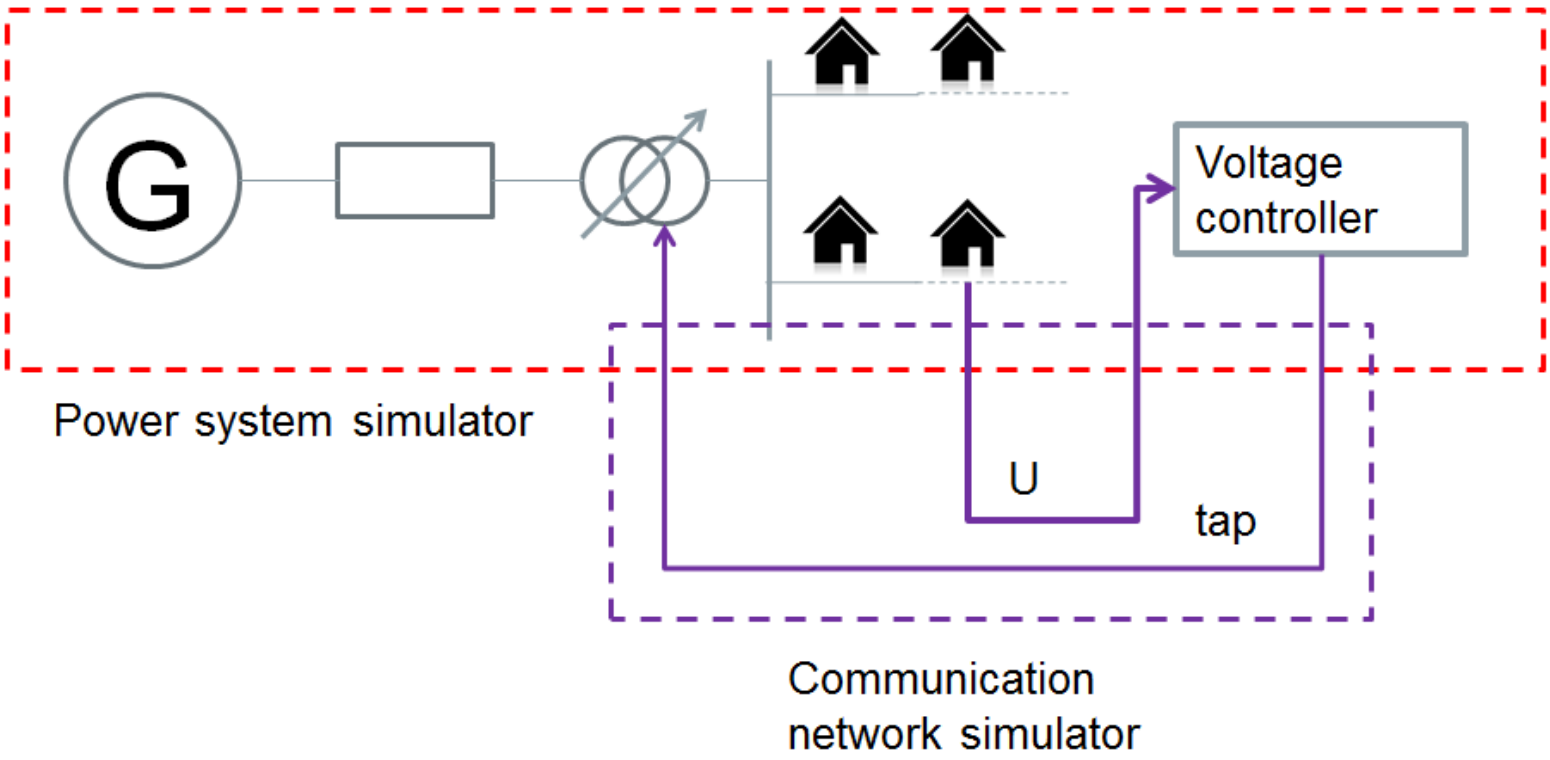
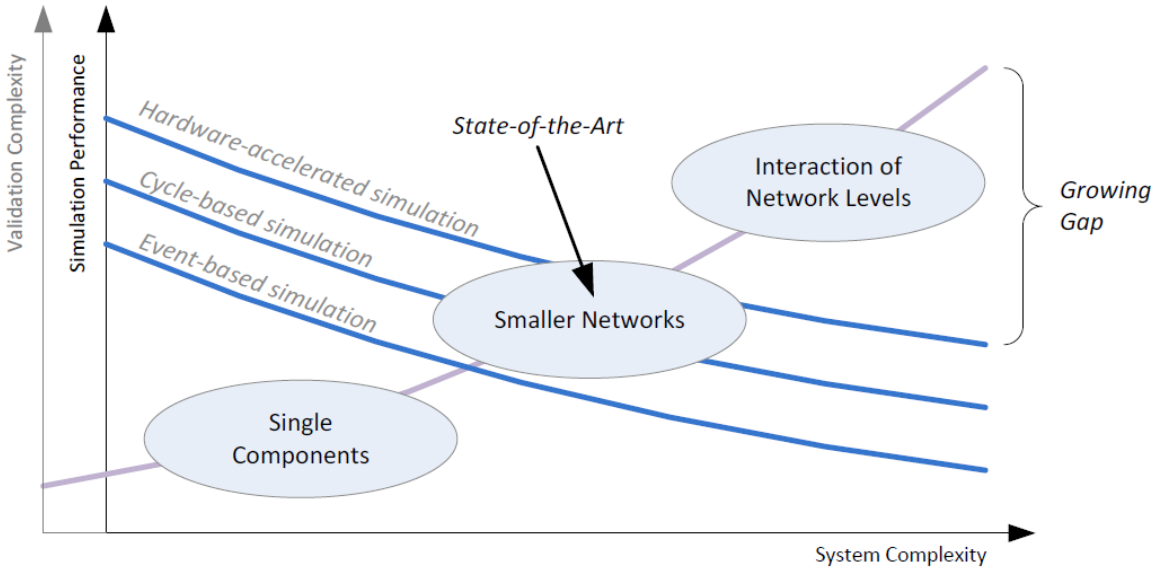
Motivation Example
Coordinated Voltage Controller (CVC)



General Setup of CVC system

Co-simulation

- Smart grid system comprises of complex infrastructure, involving interaction among various domains
- This continuous interaction among the various components, devices and domains leads to huge amounts of data being exchanged
- Co-simulation helps in coupling among these domains to create a realistic representation of any smart grid infrastructure and its behaviour



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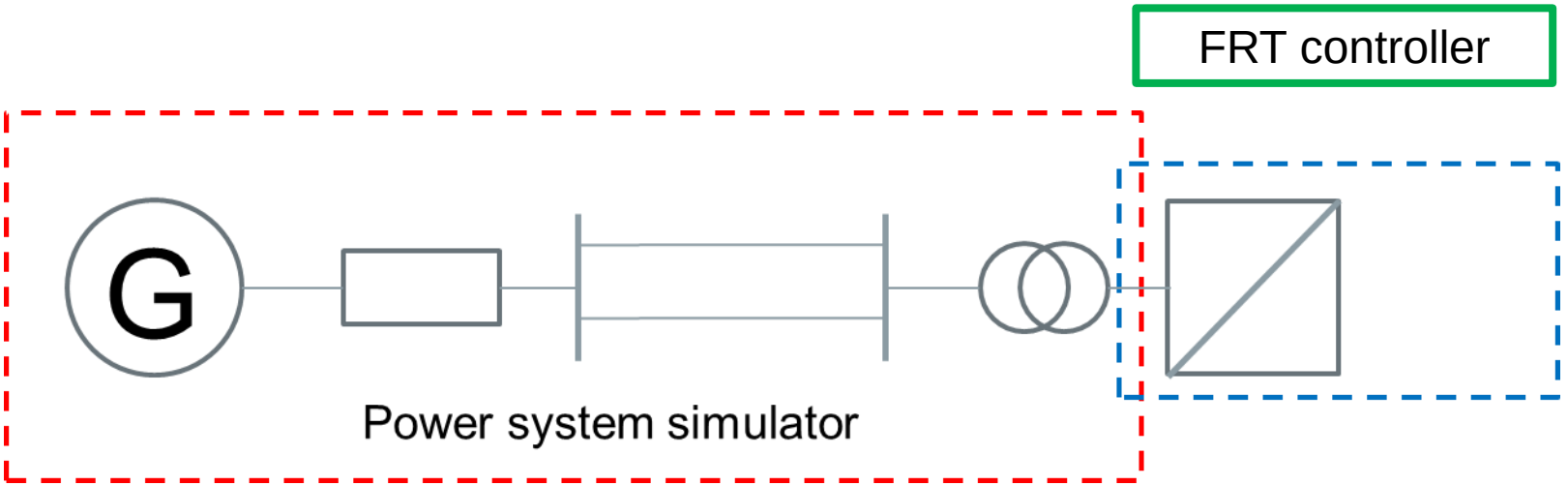
Research Challenges (1/3)

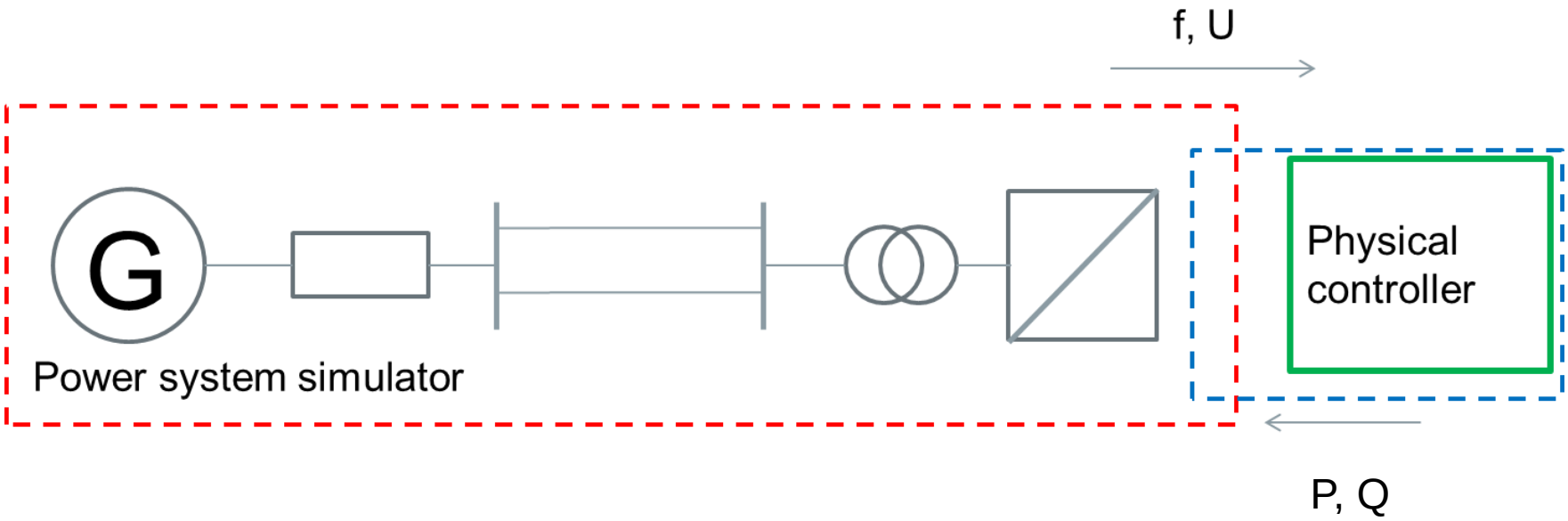
- Handling of cyclic dependencies
  - A physical model, split into several sub-models for co-simulation is more convenient but the main problem is that the state equations of the individual sub-models are mostly interdependent



General physics simulator

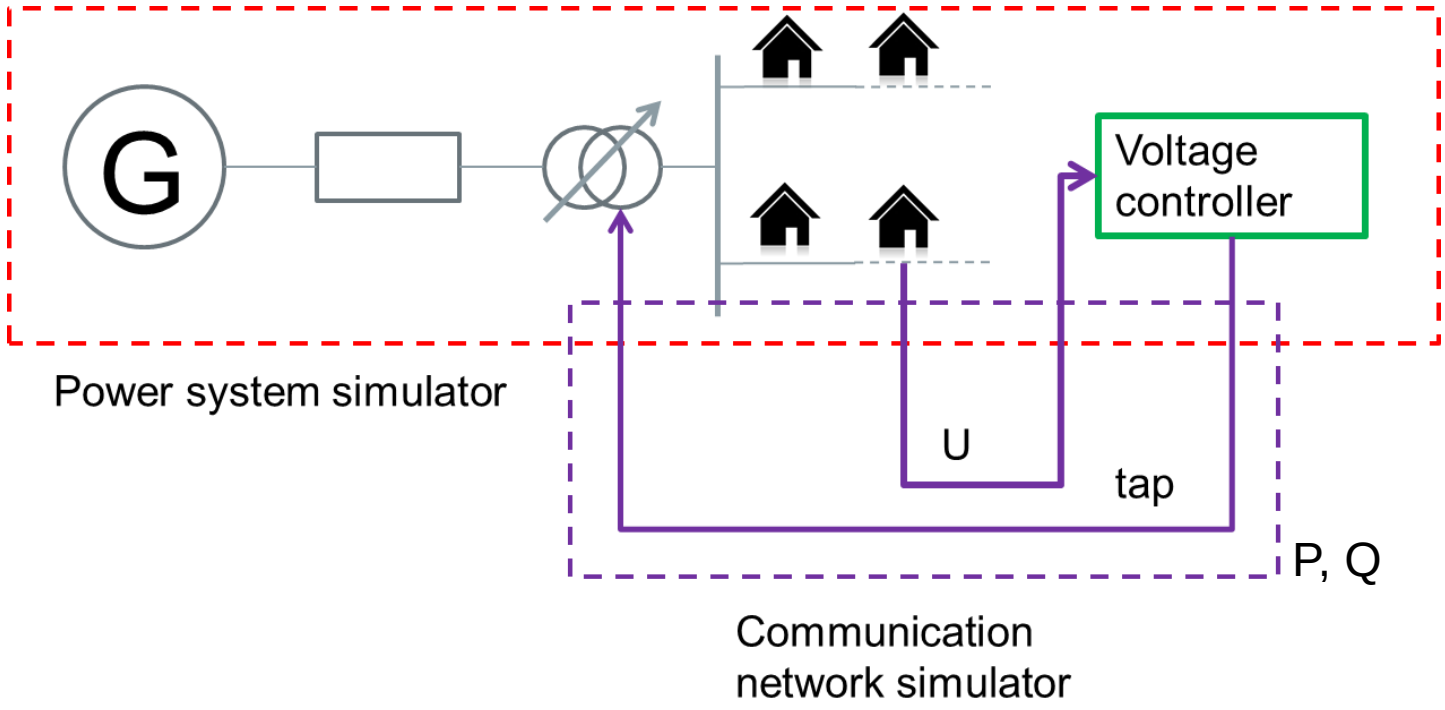
Research Challenges (2/3)

- Coupling with hardware setups
  - Interfaces for coupling power hardware and simulation software are not properly standardized



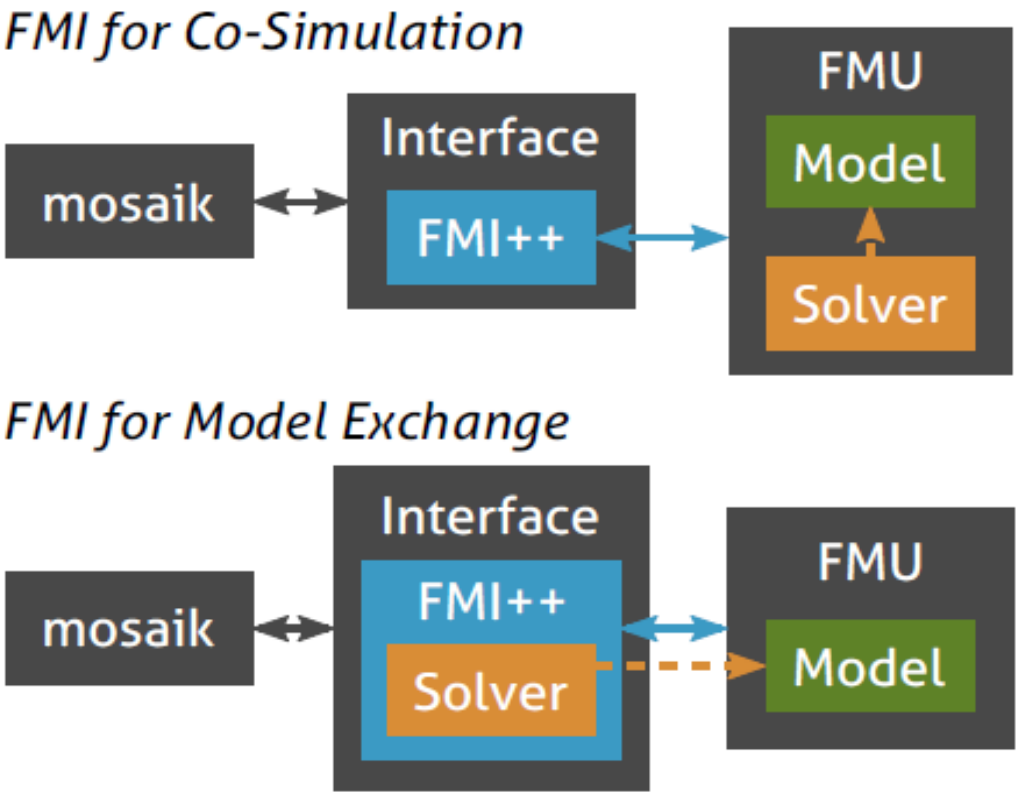
Research Challenges (3/3)

- Signal-based synchronisation
  - Interfacing of power system & ICT simulators has become a very important part of smart grids in recent years but existing coupling tools are inflexible



Functional Mock-up Interface (FMI)

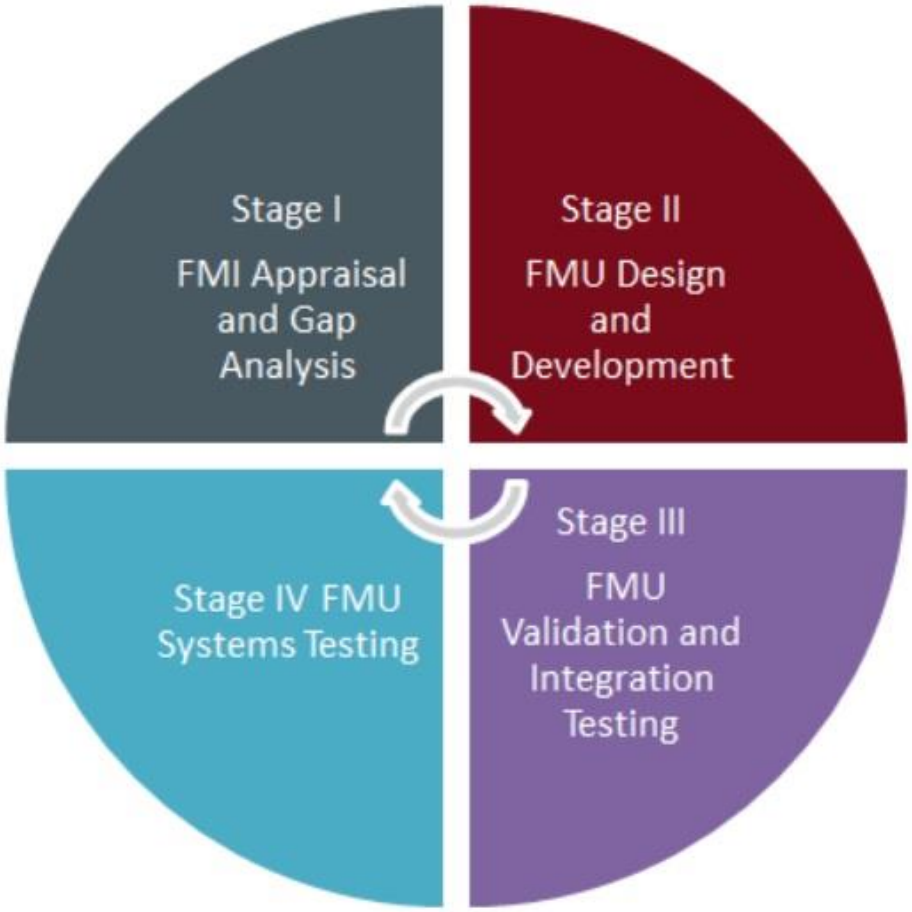
- FMI is a tool independent standard to support
  - Co-simulation of dynamic models
  - Model exchange
- FMI is supported by more than 100 tools and is being used extensively by automotive organisations



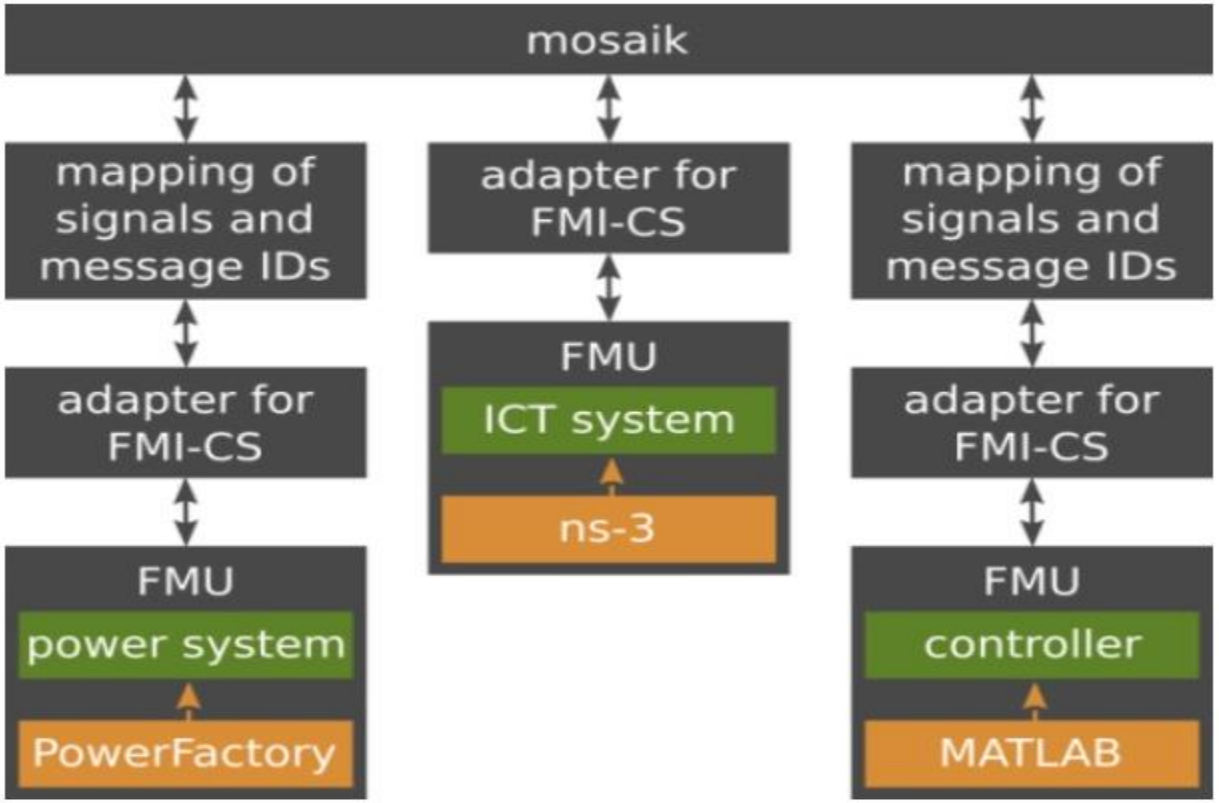
ERIGrid Co-Simulation Approach

- *FMI compliance*
  - The tools selected in each domain (power system, ICT, etc.) should have a FMI-compliant simulation interface or have an API (or equivalent mechanism) that allows to control the execution of the tool
- *State-of-the-art approach*
  - The selected tool has to represent the state-of-the-art for its respective domain and ideally available to all partners
- *Model libraries*
  - A model library is setup to select and develop models for validation
  - They can be exported as FMU's (Functional Mock-up Units) compliant to FMI specifications across different domains

ERIGrid Work Methodology



Validation Example
Coordinated Voltage Controller (CVC)



Experimental setup of CVC system

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Next steps and future work

- Scalability assessment methods of smart-grid co-simulations
- Scalability improvements for smart-grid co-simulations