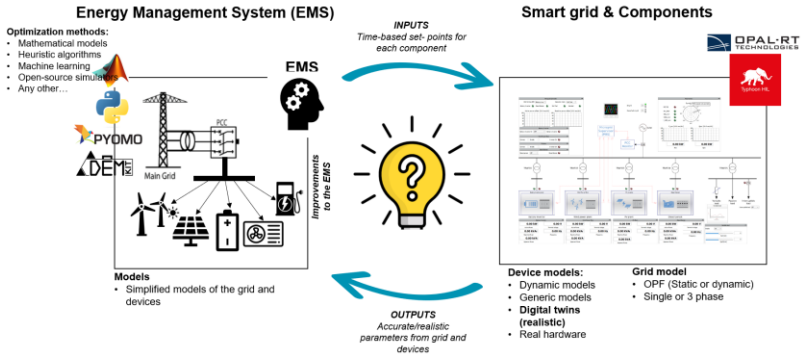
Project title

Interfacing Energy Management Systems with Real-Time hardware-in-the-loop (HIL) Simulations



Summary:
This bachelor thesis investigates the interaction between external Energy Management Systems (EMS) algorithms and real-time hardware-in-the-loop (HIL) simulation platforms, which accurately simulate power hardware behaviour (such as Typhoon-HIL) to provide insights into the challenges and requirements to interface different timescale simulations.

Problem definition:
Energy Management Systems are essential in the energy transition as they allow the coordination of several energy sources for differences purposes, e.g., reducing energy consumption at home or solving congestion issues in our electricity grid. They work based on a high-level control structure to coordinate energy usage at large, where signals are defined in larger timescales e.g., every 15 minutes or every hour. Devices that respond to these signals are usually inverter-based resources (e.g., electric vehicle chargers, batteries, PV inverters), which usually have lower-level controllers that need to be simulated in real-time due to their dynamic behaviour. If we put them together, these two control layers happen at the same time but at different time scales, and therefore, this interaction needs to be investigated.

Method:
Using a existing microgrid model in Typhoon-HIL, the student will have to investigate how to interface the existing HIL model with and external (existing) EMS algorithm (developed in Python by the research group), define testing scenarios and perform simulations. Challenges in this EMS-HIL interaction should be identified and recommendations on how to deal with such issues should be reported.

Research objectives:
Main research question is: What challenges arise when integrating external EMS algorithms with HIL platforms (e.g. Typhoon-HIL), and how can these challenges be addressed to ensure multi-timescale analysis?

Courses and supervision:
The Energy Transition Perspectives minor is a good base to start, but not required. Programming skills are required. Interest on hardware-software interaction is a plus!

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