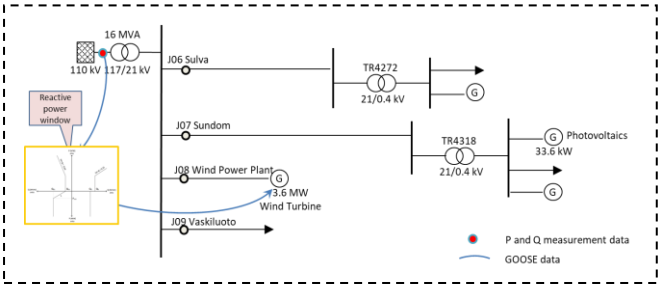
TRANSNATIONAL ACCESS
USER PROJECT FACT SHEET

USER PROJECT	
Acronym	**SunHILL**
Title	**Sundom Hardware-In-the Loop Living Lab**
ERIGrid Reference	
TA Call No.	**4th**

HOST RESEARCH INFRASTRUCTURE			
Name	**OFFIS e.V.**		
Country	**Germany**		
Start date	**27.7.2018**	**Nº of Access days**	**25 Katja / 5 Mike**
End date	**16.9.2018**	**Nº of Stay days**	**52 Katja / 15 Mike**

USER GROUP	
Name (Leader)	**Kimmo Kauhaniemi**
Organization (Leader)	**University of Vaasa**
Country (Leader)	**Finland**
Name	**Katja Sirviö**
Organization	**University of Vaasa**
Country	**Finland**
Name	**Mike Mekkanen**
Organization	**University of Vaasa**
Country	**Finland**
Name	
Organization	
Country	

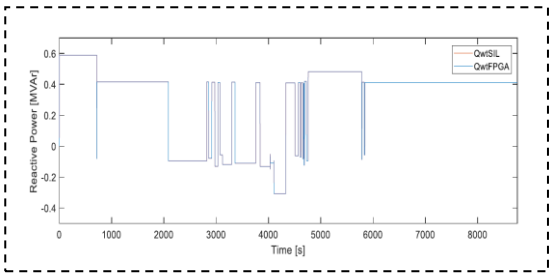
1. USER PROJECT SUMMARY (objectives, set-up, methodology, approach, motivation)



The aim of this research was to build up a real-time co-simulation platform for a sub-urban area, Sundom Smart Grid (SSG) in Vaasa, Finland. The case studies performed with the developed platform were related to technical ancillary services (AS), particularly to reactive power control. The developed reactive power window (RPW) control algorithm was implemented as a controller for the MV connected 3.6. MW wind turbine (WT) converter to control reactive power flow at the HV/MV connection point of the simulated power system. The behaviour of the controller was studied offline as well as real-time as a software-in-the-loop (SIL) and as a controller-hardware-in-the-loop (CHIL) in several different network scenarios that were Scenario 2018, 2028 and 2035.

The developed real time co-simulation platform is based on OPAL-RT's real-time simulation system OP5600, consisting of power system simulations with ePhasorsim (frequency domain/phasor or RMS type), control and communications simulations with eMegasim (time domain/EMT or discrete type). More specifically, ePhasorsim is a block presenting the electric power grid behaviour in phasor mode in the eMegasim platform. eMegasim runs on the RT-LAB real-time simulation platform, which is OPAL-RT's real-time simulation software, fully integrated with MATLAB/Simulink. The communication between controllers and simulated power system interfaces was implemented by IEC61850 Goose on Ethernet. The hardware imlplemented as CHIL were BeagleBoneBlack as well as FPGA.

2. MAIN ACHIEVEMENTS (results, conclusions, lessons learned)



The outcome of the research work is a number of scientific papers from the developed test platform, framework and control schemes for future AS that microgrids could offer in developing sub-urban areas, as in the case example of SSG. Further, the developed use cases and framework, as well as the developed test bed for them, could be utilized in future research projects as well as improve the co-operation between academia and industry. Future studies could consist of different microgrid control strategies during utility grid connected operation. In other words, the developed test bed offers a flexibility platform to enable the operation of microgrid flexible resources in different technical service markets.

3. PLANNED DISSEMINATION OF RESULTS (journals, conferences, others)

The results will be presented as scientific publications and will be attached to Katja Sirviö's doctoral thesis. The publications will be conference paper(s) and a journal paper. The conference paper will comprise of the development and testing of the RT co-simulation platform. A possible conference could be ISGT Europe 2019. The journal paper will contain the results of the developed simulation cases, Q/U controller as SIL and CHIL for technical AS in the SSG case.

The project has been presented in a one-day international workshop in OFFIS on "Resilience and security in digitalized energy system" in September 2018. University of Vaasa and Offis could get benefits from the developed RT smart grid simulation platform for future research and collaboration.