

Innovation type:  
Digital Technology

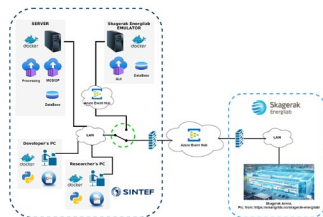
TRL: 4

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Target group:

Actor/ purpose	x
DSO, TSO	x
Technology provider	x
Member organisation	
Market operator	
Research/ Consultancy	x
Teaching	



High-level architecture for the  
Energy Management System  
Software as a Service  
(EMS²aaS) framework.

## Framework for remote EMS deployment – Skagerak Energilab

*A framework for remote deployment of Energy Management System (EMS) is established in connection with the Skagerak Energilab pilot project.*

### Challenge

The deployment of an Energy Management System (EMS) on a real system is time-consuming and may be hard to implement. To overcome this challenge, this work draws inspiration from the Software as a Service (SaaS) business model to propose an Energy Management System Software as a Service (EMS²aaS) framework.

### Solution

The following modules have been developed and integrated in a software framework for modelling and testing EMS:

1. probabilistic load forecast models,
2. an EMS implementation based on Stochastic Model Predictive Control (SMPC),
3. a communication solution that Skagerak Energilab can use across different research activities as a central access point for historical data.

Simulation studies showed how SMPC can use load forecast probability information to suggest battery charging schedules that both i) reduce the expected operational costs and ii) control the probability of security constraint violations for the battery to an acceptable level.

### Potential

This is a systematic approach that serves as starting point for researchers and developers that would need to implement and test an EMS on a real pilot facility.

### References in CINELDI

G. Marafioti, S. Fossøy, J. P. Maree, and I. B. Sperstad: "[EMS²aaS: A Dockerized framework for remote EMS deployment](#)", in 2021 International Conference on Smart Energy Systems and Technologies (SEST), 2021.

J. P. Maree, S. Gros and V. Lakshmanan: "[Low-complexity Risk-averse MPC for EMS](#)", 2021 IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm), 2021, pp. 358-363.