Flexi-Sync

Flexible energy system integration using
concept development, demonstration and replication

DELIVERABLE 4.3 – MINIMUM VIABLE OPERATIONAL CO-OPTIMIZATION TESTED IN LIVE OPERATION

VERSION 1.0

<Johan Kensby Utilifeed>

11 April 2021

ERA-Net Smart Energy Systems

This project has received funding in the framework of the joint programming initiative ERA-Net Smart Energy Systems, with support from the European Union's Horizon 2020 research and innovation programme.

Smart Energy Systems ERA-Net

INTERNAL REFERENCE

Deliverable No.:	D 4.3
Deliverable Name:	Minimum viable operational co-optimization tested in live operation
Lead Participant:	Johan Kensby
Work Package No.:	4
Task No. & Name:	Task 4.2 Platform integration (all sites)
Document (File):	2020-05-11
Issue (Save) Date:	2021-05-11

DOCUMENT STATUS

	Date	Person(s)	Organisation
Author(s)	2021-03-25	Johan Kensby	Utilifeed
	2021-04-09	Johan Kensby	Utilifeed
	2021-05-11	Johan Kensby	Utilifeed
Verification by	2021-05-11	Anna Nilsson	IVL
Approval by	2021-06-03	General Assembly	

DOCUMENT SENSITIVITY

☐	**Not Sensitive**	Contains only factual or background information; contains no new or additional analysis, recommendations or policy-relevant statements
☒	**Moderately Sensitive**	Contains some analysis or interpretation of results; contains no recommendations or policy-relevant statements
☐	**Sensitive**	Contains analysis or interpretation of results with policy-relevance and/or recommendations or policy-relevant statements
☐	**Highly Sensitive Confidential**	Contains significant analysis or interpretation of results with major policy-relevance or implications, contains extensive recommendations or policy-relevant statements, and/or contain policy-prescriptive statements. This sensitivity requires SB decision.

TABLE OF CONTENTS

About ERA-Net Smart Energy Systems

ERA-Net Smart Energy Systems (ERA-Net SES) is a transnational joint programming platform of 30 national and regional funding partners for initiating co-creation and promoting energy system innovation. The network of owners and managers of national and regional public funding programs along the innovation chain provides a sustainable and service oriented joint programming platform to finance projects in thematic areas like Smart Power Grids, Regional and Local Energy Systems, Heating and Cooling Networks, Digital Energy and Smart Services, etc.

Co-creating with partners that help to understand the needs of relevant stakeholders, we team up with intermediaries to provide an innovation eco-system supporting consortia for research, innovation, technical development, piloting and demonstration activities. These co-operations pave the way towards implementation in real-life environments and market introduction.

Beyond that, ERA-Net SES provides a Knowledge Community, involving key demo projects and experts from all over Europe, to facilitate learning between projects and programs from the local level up to the European level.

www.eranet-smartenergysystems.eu

1 DESCRIPTION OF CO-OPTIMIZATION

The purpose of this deliverable is to have first working version of the operational co-optimization solution working in a live environment. The philosophy behind this is that it is very valuable to have a minimum viable version ready to be tested as early as possible in the project before more advanced functionality is developed. This enables users to start interaction with the solution and provide valuable feedback for the continues development.

A major part of this deliverable is the release of Utilifeed Optimization Software (UOS) v0.1. In short, this version enables a user to, in a web interface, request a plan for the optimal dispatch of heat generation and use of flexibility resources. The plan is presented to the user as three graphs in the web interface. The user can then use this plan a support when controlling the DHC system and flexibility resources connected to it. Many more features will be added for the deliverable: D4.4 Feature complete operational co-optimization.

1.1 Major features included in solution for this deliverable

API connection to EnergyPredict: The optimization automatically requests a demand forecast for heating and/or cooling grid(s) in the system over API. The forecasts are provided by EnergyPredict and are based on machine learning and data from every single substation in the grid(s).

Component library: A component library with models for the following components have been created:

- Combined heat and power
- Heat only boiler
- Heat pump
- Absorption chiller
- Accumulator storage
- Dumping of excess heat
- Trading with neighbour DCH grid
- Heat recovery from subway tunnel
- Demand flexibility: Building thermal storage
- Demand flexibility: Building heat pump

Component from the library can be configured with a number of settings to accurately reflect the technical and economic conditions of each demo site. This is used as the foundation of the optimisation models that are created for each demo site. It is built as general as possible to replication at more sites after the project.

Model generator and solver: Based on the input data for components and forecast for e.g. thermal demand, models are generated and sent to a solver that solves for the optimal dispatch each time an optimization is requested.

Front end: A basic web interface has been created where the user can request the optimization and view the result in three graphs. Screenshots from the interface are provided in section 2 Test case, Figure 1 and Figure 2.

Back end infrastructure: The service has been integrated in Utilifeed Data & Analytics Platform and adjustments to existing and development of new back end infrastructure has been carried out. The service now runs on a scalable back end in a cloud environment that enables it at a later stage to be used daily at all six demo sites. Model configurations are stored in the back end for each demo site.

2 TEST CASE

To demo as many features as possible the test case has been based on a fictional demo site that include all components that are present on at least one demo site, except for heat recovery from subway tunnel. The fictional demo site has been loaded with realistic data regarding configuration of components and heating and cooling demand.

A live test has been carried out in a cloud environment using where a user in the front-end interface requested a plan for optimal dispatch and optimal use of flexibility resources for the upcoming 168 hours. With "live" we are here referring to that the test was done on demand from a user, the model was automatically updated with the most recent demand forecast and the user could get the results presented within seconds. These are all requirements that need to be fulfilled for the service to be useable when planning the operation for the upcoming hours and days.

The results were presented to the user in the web interface and screenshots are shown in Figure 1 and Figure 2. The user interface in this first version of the application is very bare bone and significant improvements are planned during and after the project.

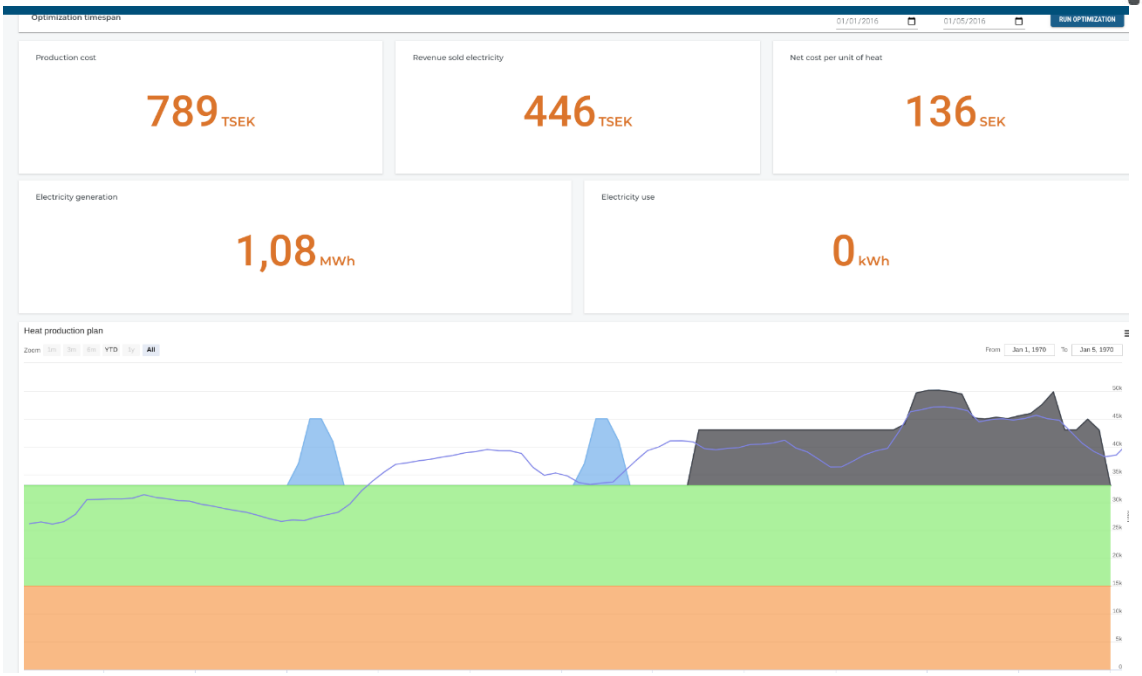

Figure 1: Results from requested optimization in test case. On top, five KPIs are presented for: Total cost of heat generation, Revenue from sold electricity (from combined heat and power), Net production cost per unit of heat, Total electricity generation, and Total electricity use.

Figure 2: Results from requested optimization in test case. Top graph shows the planned use of the demand flexibility type "Building thermal storage", in terms of charging and discharging. The bottom graph shows the plan for stored energy for the same flexibility resource.

FUNDING

This document was created as part of the ERA-Net Smart Energy Systems project Flexi-Sync, funded from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 775970 (RegSys).