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The Urban Lab of Europe !

The FED Project
Journal N°2

*Project led by the **City of Gothenburg***

ENERGY
TRANSITION

European Union
European Regional Development Fund

Région
Hauts-de-France

The FED project

With this project, the city of Gothenburg aims to develop, demonstrate and replicate a novel district level energy system, integrating electric power, as well as heating and cooling. This solution embraces and enhances the use of technologies such as PVs, heat-pumps and wind into a larger system. To overcome the main challenges, the proposed solution contains advancements in system development and operation, business logistics, legal framework as well as stakeholders' acceptance.

The FED solutions consists of three cornerstones:

FED demonstrator area – the selected demonstration is located at a campus with about 15,000 end-users. It has a well-balanced set of property owners, energy infrastructure, and users, including prosumers as well as buildings with different needs and usage profiles. The area is exempted from the law of concession for electricity distribution, providing the opportunity to test and validate a local energy market. The prerequisites to optimize the use of primary and secondary energy using intermediate storage are well developed, as they are for generation, storage and distribution.

FED System solution – our solution will optimise the use of low-grade energy to replace primary energy. Adding fossil-free energy sources while optimising different buildings usage profiles; one building's energy needs will be balanced with the surplus of another. Intermediate storage, fundamental to be a success, consists of heating/cooling storage in the building's structure, accumulation tanks or geothermal heat pumps, and batteries for electricity. An ICT service will support future volatile energy markets.

FED Business solution – create new sustainable markets. The success of FED depends on cooperation and energy exchange between several stakeholders. To make it happen, a local energy market creating business value for each stakeholder will be developed.

Parthership:

- Göteborg Stad
- Johanneberg Science Park AB - Public/Private Company
- Göteborg Energi AB - Public Company
- Business Region Göteborg AB - Public Company
- Chalmersfastigheter AB - Private Company
- Akademiska hus AB - Private Company
- Chalmers - Research Centre
- RISE - Research Centre
- Ericsson AB - Private Company

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1. Executive summary

Dear reader,

In my daily work at the Technical University in Delft I am surrounded by students and scientists who get better and smarter every day.

On my visit to the Johanneberg / Chalmers Campus I wonder what makes the FED Smart Grid solution so smart, and how its process to get smart is managed. The end-result will be rather, metamorphosis of course, but I want to understand the different aspects of the process and the roles of the stakeholders.

I look back at the main goals that I noted during my earlier voyage:

A. Reducing the fossil energy peak loads with 80% in the campus area

B. Operate the energy systems 100% fossil free by using various system solutions in storage, generation, and distribution

C. Reducing energy imports from the overlaying energy systems with 30%

D. Introduction of a local energy market

E. Implementation of a FED system that is economically and socially sustainable

and I understand that I have introduced the project and focussed on goal D in *my first Journal*. This second report will focus on goal B, in particular the various system solutions in storage, generation and distribution.

The project is more than a year old now and the final investment decisions are being made. The academics from Chalmers are proud of their models and results. Akademiska Hus, the building owner, shows me its choices and ambitious implementation Gantt-chart.

What a great opportunity to mix the science and the operational!

Zeno Winkels

2. The academic model

Academic modelling: one of the characteristics of the FED project is that scientists cooperate with real estate owners and run their models with a strong connection to the actual situation

The FED model has been developed by scientists from Chalmers University. It is used in the project to analyse the optima of the grid description of the first version of the simulation model of the energy supply systems of Chalmers. The model aims to serve as input to the investment decisions to be made.

However, to design a model one needs to look at the crucial questions such as:

- How does the FED system relate to and fit in a larger energy system context?
- How is the FED system structured and decomposed in terms of components, systems, interconnections, subsystems, participating actors and their business goals, neighbouring systems, control and functionalities, data streams, communication networks, etc.?
- How and where do the developed KPIs connect to the FED system, e.g. at what aggregation level, in which subsystems, etc.?
- Where and at what aggregation level is (or should) data be generated, stored and communicated in the FED system?
- Where are the controllers in the system located, and at what system hierarchy levels do these controllers operate (high level controller/low level controller)?
- Where are the different system actors located? How do these actors interact with the systems and each other, and what kind of results are produced due to these behaviours and interactions?

Clear boundaries needed to be set. These are based on the Smart Grid Architecture Model (SGCG, 2012). Presented in the shortest way possible they are divided in three modules, (1) a boundary to the smartness, (2) a boundary to the system and (3) a boundary to the population.

In depth: Module 1, Initial delimitations of intelligent energy systems

Three delimitation decisions are being made in this step, which pinpoints and focuses the scope of the system boundaries in the upcoming step. In condense form, these delimitation decisions are:

- Energy system domain (energy system, energy markets and regulatory bodies)
- Energy carriers (district heating, district cooling and electricity)
- Control approach (direct control, indirect control, agent based control)

The most complex one, control, consists of three sub-types, passive systems, passive intelligent systems and active, agent based systems.

In depth: Module 2, Defining the scope and structure of the system boundary framework

This is the part where the system boundary framework takes input from the SGAM framework (SGCG, 2012), which is a generic method for decomposing and architecting technologies and solutions in smart grids. Here the FED adapts its content and structure to make it more compatible with the scope and direction of the FED project.

We start to recognize the human tendency to split groups into three dimensions and here they are, interoperability (1), domains (2) and zones (3).

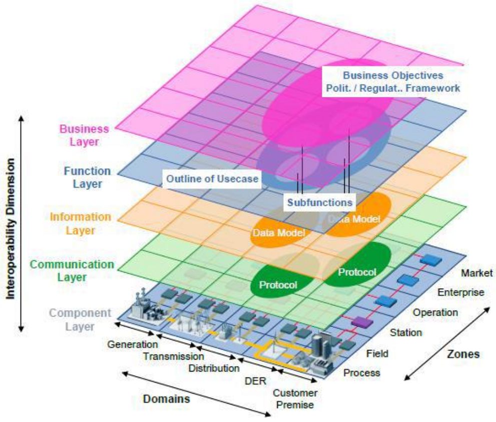

Figure 1: The SGAM model constituted by the dimensions interoperability, domains and zones

In the interoperability part then, each layer has its own subset of boundaries, in which for example the different actors have business-goals, which need to be fulfilled through desired functionalities, within a certain control and management system which exists out of components.

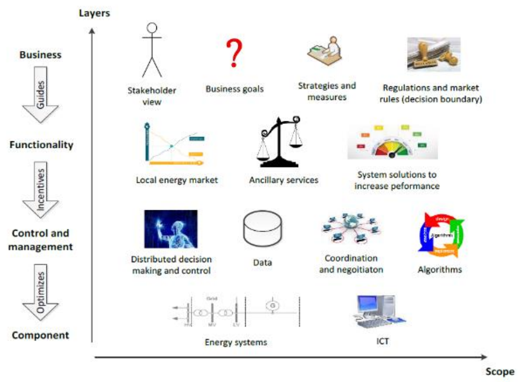

Figure 2: The interoperability layers in the framework

The domains-part, divides the energy conversion chain into distinct sections based on roles, responsibilities and ownerships of various market actors. Hence, the domain creates specific system boundaries based on the energy market roles, which on a high level includes the roles of supplying, transmitting, distributing or demanding energy. Three domain levels are proposed in the framework, namely: production systems, local energy systems (LES), and customer premises.

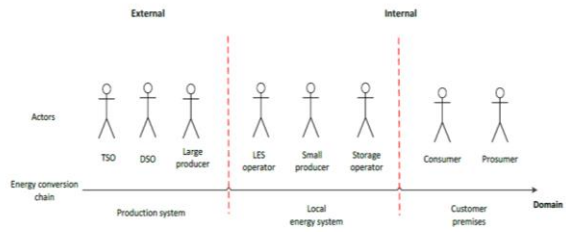

Figure 3: The different domains in the system boundary

The zone level covers the different levels of information management in the various interoperability layers and domains. The process level is the lowest zone level and is connected to the actual energy carrier processes in the energy systems, e.g. energy import from the external grid, pipe pressures in district heating networks, voltage levels and power flows in the electricity grid, electricity use from heat pumps, energy injection by supply units, and indoor temperature variations in buildings. It may be of interest of the responsible actor to measure, communicate, and/or control the different energy carrier processes for optimization purposes. These types of actions can be made at field level. This level is represented by a process data device which is connected to individual physical energy system components, and, thus, have the capability to handle information about an energy carrier process (physical flows for control purpose, or energy data for billing applications).

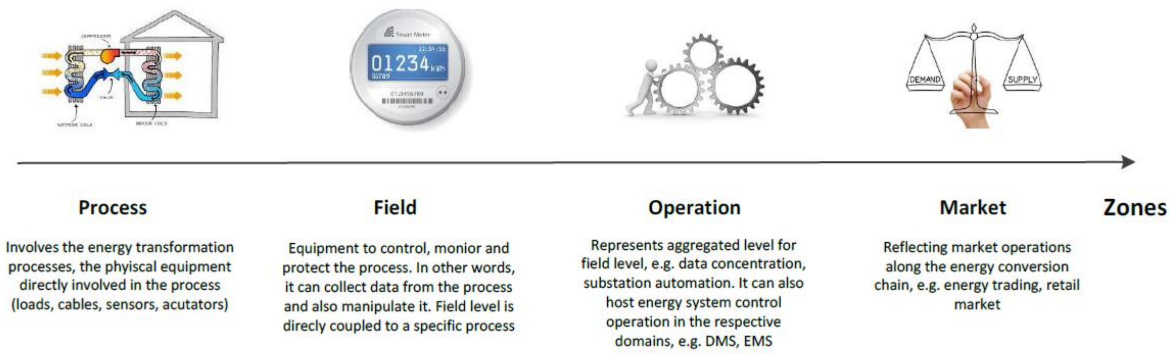

Figure 4: The different levels of the zone dimension (information management)

In depth: Module 3, Listing the available objects and entities in the system boundary framework

Module 3, in fact, is the most visible part of the FED system. In this section the available objects and entities in the system boundary framework are presented. The objects can be described with respect to their location in the system boundary (i.e. in which dimension and level they are located in), their attributes, functionalities, and interconnections with other objects.

We start with external grid, grid interface and local energy system, followed by distributed energy resource, building, process meter device and market system. Then in the control & management layer we have agent, data, process and interaction.

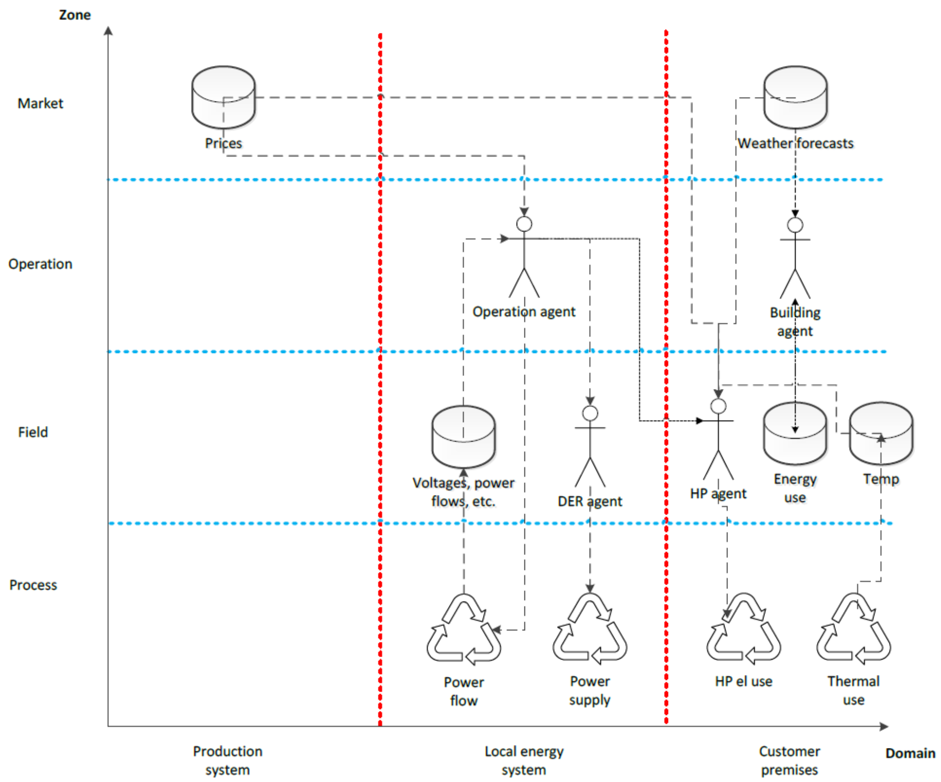

Figure 5: The control and management layer of the example system.

Finally we find the functionality and business layer in all domains and zones – please refer below to Figure 6, showing the business layer of an example heat pump example system.

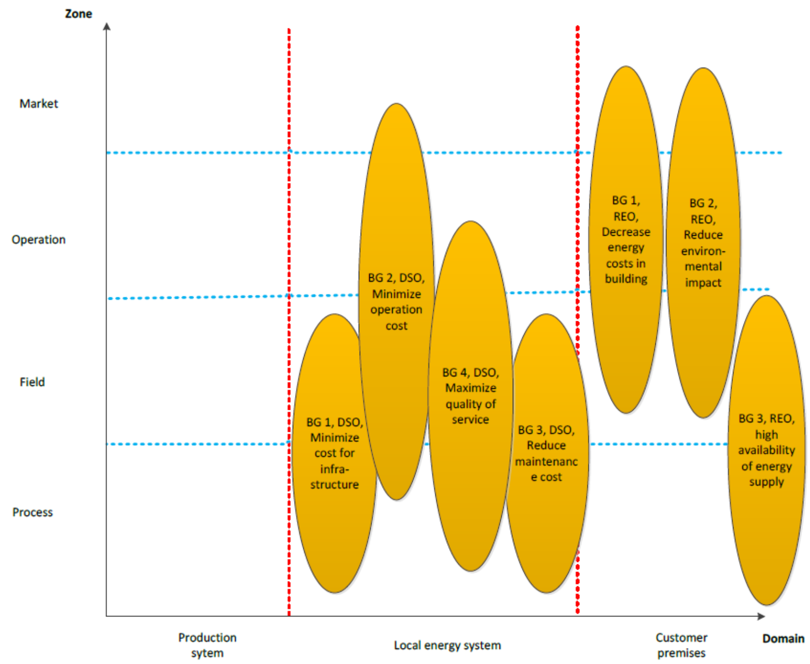

Figure 6: The business layer of an example heat pump example system. REO is an abbreviation for real estate owner

3. The building owners' perspective: Akademiska Hus

Akademiska Hus obviously looks from a totally different perspective to its energy system. It has a long and solid understanding regarding all matters in the operative energy questions within the local grid. It has knowledge regarding all technical requirements of the buildings within the area as well as the specific supply abilities. AH internal personnel is also, together with Chalmers university, responsible for the daily operation of the "Kraftcentralen", a local district heating, cooling plant and electric grid for high voltage system for Campus Chalmers. The regional organisation of Akademiska Hus is running the local district system on a daily basis in symbiosis scientists from Chalmers University.

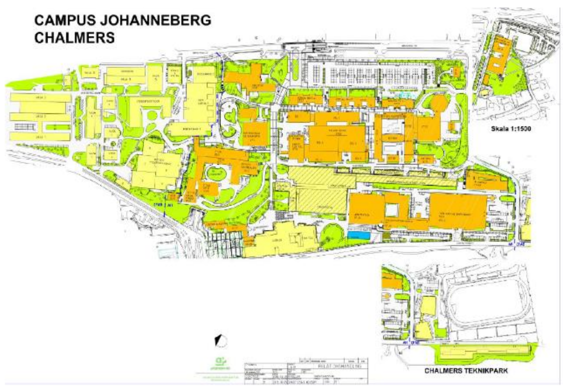

Figure 7: Chalmers Campus Map, Akademiska Huset, The building complex included in the FED system. Yellow coloured buildings are owned mainly by Chalmers Fastigheter, Orange by Akademiska Hus, and hatched yellow by SSPA or Chalmers Studentbostader

Hardware investments foreseen in the FED project include additional infrastructure, adaptation and reconstruction of district heating and cooling systems in the test area (e.g. new storage capacity), and development of the electric system (e.g. increased non-fossil electricity generation), PVs and a bio-fuelled CHP-turbine, and battery storage capacity. Furthermore hardware to connect electricity / heating and cooling system infrastructure to the energy market trading system will be installed, which will also be made visible.

The investments will enable functions needed to meet the system requirements of controlling the integrated energy systems, and to enable the local energy market trading system.

This includes for example a metering systems enabling real-time measuring (electricity and district heating/cooling), a control system, for the PVs and connected battery storages as well as the CHP-turbine, and interfaces/applications to connect the local electric, district heating and cooling system to the local energy market trading system.

Planning

An overall schedule has been developed for the implementation of all the physical assets and control system. The purpose of this plan is to include all projects and assets in one overall schedule in order to coordinate and provide an overview of the required work. The individual projects have their own, more detailed, schedules.

Heating & cooling

With regards to heating and cooling energy the bulk of the installations and facilities for FED is existing buildings and infrastructure. The main energy production units are in operation as part of the heating and cooling system of the campus. The required work mainly corresponds to additional measurement capability and to control system updates. This work is in progress and will be completed during the first semester of 2018 and should not present any risk for delay of other work packages or having a first version of the market system in operation before the third trimester of 2018.

Figure 8: Current vacant slot for the new CHP

Connections to the city overlaying grids (electricity, district heating and cooling) are also already in place and in operation.

Additional heat pump for Friskis and Svettis and connection of MC2 cooling system to campus local cooling system are planned to be completed and commissioned by end of Q2 2018. There are some additional facilities that will be connected at a later stage, these include new boiler at KC and PCM cold storage. These installations are on schedule for their respective projects and it has been known that connection to market will be at a later stage. These activities are included in the schedule and are planned to be commissioned and ready for connection to the market system by end of Q3 2018.

Possible delay is due to need to change plan and investments since the large heat storage tank will not be built. The new investments will include an additional heat pump for production of both heating and cooling. Planning and design for this project is still in early initiation stage but a preliminary estimate is that the new heat pump can be connected and in operation approximately at the same time as the previously scheduled heat storage tank. In other words, this new investment and installation should be ready for connection to market system Q3 2018.

Electricity

For electrical energy storage and production units the project schedule shows that parts of planned facilities will be ready for connection to the market system by 2018-06-30.

Figure 9: Dismantled turbine, ready for a rebuild to perform another 10 years

Work with updated control systems and additional measurement capabilities is ongoing as planned. Update of PLC has been implemented in two buildings and the remaining buildings are in process of procurement or scheduled for installation. This work as well as required updates of the overall control system is planned for Q1/Q2 2018 but with some buildings / facilities ready for connection to market system in early part of Q1 2018.

The fossil free electricity production is further enhanced by both Akademiska Hus and Chalmers Fastigheter as shown in table 1.

Building	*Power [kW]*	*Yearly Energy [MWh]*
O7:26 SB 1	50	42
O7:23 SB 2	42	38
O7:8 KC	16	2
O7:27 Norra Hallen	138	120
O7:27 Södra Hallen	115	103
AWL (JSP 2)	57	51
O7:17 Biblioteket	80	72
O7:6 Mat. Vetenskaper	95	86
O11 Fysik	44	40
O7:19 Central admin	30	27
Palmstedtsalen	19	17
Kårhusrestaurangen	115	104
Kemi	248	223

Table 1: Overview planned PV Installations

Another major milestone is achieved with the installation of a new data server for Akademiska hus allowing for logging data for communication to the market system. This server is installed and will be ready for operation early part of Q1 2018. It should also be noted that many facilities are commissioned and ready for connection to the market system as of this date. Connection to the market system will not be done as one single action but will rather consist of separate activities (commissioning) for each installation / facility done in sequence. At this stage work with connection to market system can start and continue while remaining installations and facilities are being completed and made ready for commissioning.

Figure 10: Current system operating room

Challenge

One major challenge was the cancelling of the water storage. It is in fact the major change[1] in the program so far. The point is that the 285 m3 heat storage tank was planned but bids received showed that costs would exceed the planned budget. Several alternative solutions were investigated including using a PCM thermal storage based on salt. But this alternative was not chosen both because of risk of delivery & robustness and limited time. Since the heating storage tank was removed the budget was reallocated and a number of items added. These are listed in the following table.

[1] According to the researchers this is a positive change as one should get much more storage for the price using the building inertia thermal energy storage!

Change	*Owner*	*Comments*
Building Kårhuset will not be connected to the FED system	CFAB	This building is partly owned by several Owners resulting in complications regarding technical system limits and how to implement the FED market system.
Buildings JSP 1 and Teknikparken will not be connected to the FED system	CFAB	These buildings are not connected to the local energy grids and after consideration it was decided not to connect these buildings and thereby they will not be part of the FED project.
Heat storage tank – KC will not be installed.	AH	Due to budgetary restraints the planned heat storage tank had to be removed from the project. Received bids to RFQ significantly exceeded the planned budget. Alternative solutions has been considered; including changes to reduce cost of storage tank and different technology using salt.
New heat pump for heating and cooling - KC	AH	Added heat pump to deliver heating and cooling to the local heating (VP01) and cooling (KB0) nets.
Added energy storage in buildings using a simplified control system	AH	In addition to the advanced building control system already included a simplified control system for energy storage in approx. 15 buildings will be implemented.
Added functions to steam turbine in order to provide new services	AH	As part of the control system for the steam turbine it is planned to include functions for added services regarding reactive power.
Heating storage in existing storage tanks for tap water	AH	In order to add storage capacity and investigate the possibility to utilize smaller storage tanks a function will be added to the building control system allowing for control of loading heating energy in existing storage tanks for tap water. This will be part of the work with a simplified control system for building energy storage.
FED adaption of functions and usage of storm charge batteries	AH	Storm charge battery project is to provide a quick charging station for electric cars. To ensure that this storage can be used for FED project there is a need for investigating options and implementing functions allowing for FED control of the storage while maintaining function of the charging station.

Table 2: Planned changes compared to D4.2.1 Pre-study Report

Connection to the Grid

Currently infrastructure for the connection of the local energy grids to the city energy grids exists. For electricity there is a local, so called, non-concessionary grid (IKN) that is connected to the city electric grid at four locations.

For heating the local energy grid is designated VP01. This is connected to the city district heating grid at KC. VP01 distributes heat to all the buildings and facilities within the FED system. At KC there is a possibility both to import and export heat to/from the city district heating system to VP01.

For cooling energy, there is no city grid available to connect to the local grids. However, Göteborg Energi has two absorption chillers located in KC that can provide cooling energy that is distributed through the local KB0 grid. For cooling both Chalmersfastigheter and Akademiska Hus have their own local grids. The two real estate owners cooling grids are connected but the connection shall be updated and the capacity increased. Currently this connection is not used but after update it will be commissioned and connected as part of the FED system.

Figure 2-1: Connections for local energy grids.

1: Electric power connection from city grid to local IKN grid

2: Connection between Chalmersfastigheter's and Akdemiska Hus cooling energy grids

3: Connection between city district heating grid and VP01 system

4: Absorption chillers connected to local cooling energy grid KB0.

Figure 11: Sketched location of the described connections

4. When academics meets operational

When Chalmers ran its models it noticed a peculiar situation. The projected CO2 emission reduction and the projected primary energy use reduction varied under different investments scenarios. Or in other words: depending on an emission reduction target, or on a reduction of primary energy target, would lead to a different set of investments. Or: the total imported primary energy is difficult to reduce and minimization of primary energy will at the same time increase carbon dioxide emissions.

Minimizing total costs

Based on the primary energy usage in the base case, a scenario where the objective is set to minimize the total costs while achieving the FED objectives and synergistic already planned investments.

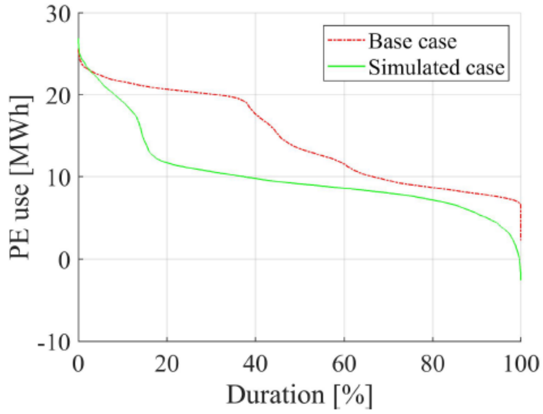

Figure 12: Primary energy curve

Figure 12 presents the duration curve of the hourly primary energy for the scenario. As can be seen the primary energy has decreased for all hours and a decrease in primary energy usage was achieved.

However Figure 13 presents the duration curve of the CO2 emissions under that case. The peak demand has decreased but that's about it.

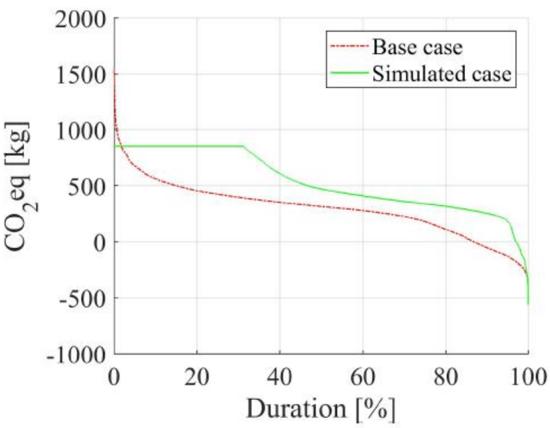

Figure 13: Duration curve CO2 reduction

The main reason for the increased total CO 2 emission in this scenario is due to higher heat import from the DH which is partly stored in the large accumulator tank. This then has to do with the specific FED goals of reducing the peaks. However, the total emission has increased for this scenario.

Conclusion

The crux of the problem with co-minimization of carbon dioxide and primary energy being incompatible goals lies in the fact that the primary energy per unit energy of the district heating system is lower than that of the electricity system during many of the hours when carbon dioxide emissions are higher per unit energy. Thus, changing the energy carriers used for heating, and cooling (from district heating/cooling to electricity via heat pumps for instance) to minimize carbon dioxide emissions does not at the same time decrease primary energy[2].

Furthermore the simulations indicated that investments in thermal energy storages and solar PVs will be the most attractive investments to consider in order to attain the goals of the FED project. The results also indicated one could achieve a maximum of about 20% reductions by investing in BITES (17 buildings), BAC (11 buildings), and PV (1.8 MW).

Akademiska Hus

So… what did Akademiska Hus do with this – not necessarily easy to digest – information? Well first of all, it had to make sure that its buildings can actually act smart. In synopsis they need to be equipped with a system that can lift them from the old situation to a new one in which they act not only smart, but also flexible.

These improvements of building management systems are of course scattered of the whole campus. Next to that, the larger investments appear on the radar, as shown in figure 14.

[2] This is a situation rather specific to Sweden, which has a large fraction of electricity generation from nuclear and hydro power at the same time that the district heating system is run very much on waste heat with low primary energy, and thus should not be assumed to be generally true in the rest of Europe.

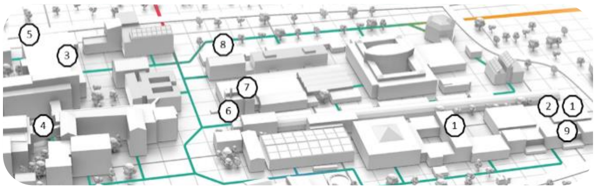

*Figure 14: Planned investments AH: **1**. Solar PV Modules, JSP 2 and SB 2, in construction – to be connected to IKN network; **2**. Battery Storage, JSP 2, in construction – to be connected to IKN network; **3**. Solar PV Modules, O7:4 Kemi – to be connected to IKN network; **4**. Cooling system for MC2 – upgrade of connection to KB0 network; **5**. Hot Water heat pump, O7:4 Kemi – to complement VP01 network; **6**. Heat Storage tank, KC – to be connected to VP01 network; **7**. Steam Boiler and Steam Turbine, KC, to be used for production of heat and electric power – to be connected to VP01 and IKN network respectively. (Also one other heat pump that will be installed in kraftcentralen, called "new heat pump KC" in figure 18.); **8**. Quick-Charging Battery storage – to be connected to IKN network; **9**. PCM Cooling Storage, JSP 2, in construction – to be connected to KB0 network.*

The costs of the investments have been estimated and are shown in the following table. It also addresses the part covered by the UIA grant to the FED project. For your convenience you can use the formula that 10 SEK is about 1 Euro.

Preliminary Investments	*FED - Funding*		*Co. - Funding*	
	AH	*CFAB*	*AH*	*CFAB*
200 kWh Battery Storage – AWL (JSP2) – located in O7:27 SB 3	x	x	1 200 000 SEK	x
248 kW Solar PV Modules – O7:4 Kemi	x	3 200 000 SEK	x	x
125 kW Solar PV Modules – AWL (JSP2) – located on O7:27 SB3	x	x	2 000 000 SEK	x
≈ 500 – 550 kW Solar PV Modules – O7:27, O7:17, O11, O7:28, Kårhusrestaurang, CA-huset, Palmstedtsalen	x	x	4 800 000 SEK	2 300 000 SEK
Storm charge (Quick-charging battery storage) – with added functionality for market system	200 000 SEK	x	2 000 000 SEK	x
Electric Power Turbine – KC 4.0	x	x	1 800 000 SEK	x
Control system Electric Power Turbine – KC	500 000 SEK	x	x	x
New Steam Boiler – KC 4.0	x	x	46 000 000 SEK	x
New Heat pump – KC	4 300 000 SEK	x	x	x
Control system update and connection to the market system – KC	500 000 SEK	x	x	x
Simplified control system for power reduction in buildings and existing hot water accumulation tanks	700 000 SEK	x	x	x
PCM Storage – AWL (JSP2)	x	x	3 000 000 SEK	x
Connection MC2 – KB0	x	500 000 SEK	x	X
Completion with Energy Meters MC2	x	x	x	430 000 SEK
Hot Water Heat Pump – F&S	x	270 000 SEK	x	x
Control systems (power reduction) – four buildings AH	990 000 SEK	x	x	x
Control systems (power reduction) – two buildings CFAB	x	1 110 000 SEK	x	420 000 SEK
Control system – Connection to the market system AH	590 000 SEK	x	x	x
Control system – Connection to the market system CFAB	x	300 000 SEK	x	x
New server for measurement data	100 000 SEK	x	150 000 SEK	x

Figure 15: Cost estimations of the investments

Considering that the new steam boiler is a part of system that had to be replaced anyway the following diagram gives an overview of the investments without it, arguably the investments that make the grid smart.

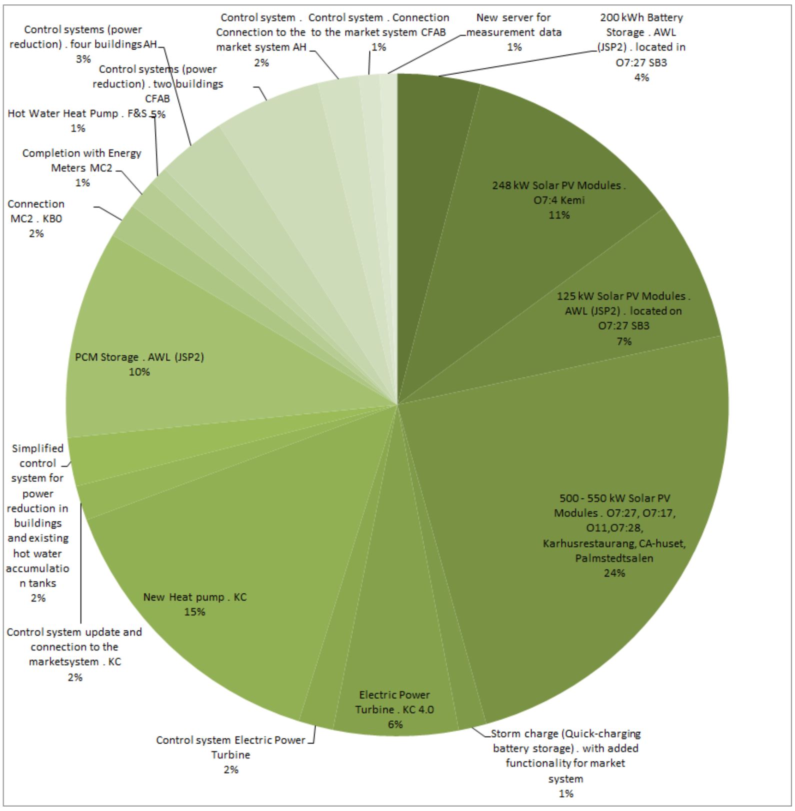

Figure 16: Share of investments without steam boiler

5. Interview Chalmers & Akademiska Hus & Chalmers Fastigheter

Zack, what is an American guy from Rice University (Houston) doing in Gothenburg?

Zack: I'm from Rhode Island originally, born and raised. I most recently lived in California where I come from the University of California, Berkeley, Energy and Resources Group before I moved to Sweden and did my PostDoc at Chalmers and began working as a researcher, now at Johanneberg Science Park. What can I say, I needed a break from the US, and what better escape from those politics than Sweden?

Zack Norwood

I understand that you have used the Smart Grid Architecture Model (SGCG, 2012) in this case. Are there many more models for these type of grids and why did you choose this model?

Zack: The Smart Grid Architecture Model is more of a conceptual framework used in WP7 for describing the system at a high level. I have not worked too much with that concept personally. The model we developed in WP4 is a perfect foresight linear optimization model based on the GAMS software and Matlab. The concept itself is similar to many other investment and dispatch models used in energy system modelling, but in this case very specific to just the Chalmers campus and the investments we had available to us. We had no "reference" model to use so we built up this model based on physical principles (e.g. thermodynamics) and economics of our system in particular, relying heavily on historical data sets provided by the building owners to use as a baseline on which to optimize investments (and dispatch). The solar PV model is based on earlier work described here (Norwood, Z., Nyholm, E., Otanicar, T., & Johnsson, F. (2014)). A geospatial comparison of distributed solar heat and power in Europe and the US. PloS one, 9(12), e112442) and collaboration with a company at Johanneberg Science Park that prepared the 3d solar irradiation and shading model of campus.

Are there any drawbacks that we need to take into account?

Zack: Because the model is perfect foresight and based on a limited amount of historical data (in this case only one year) there is definitely a limitation on how optimal the investment choices made by the model actually are. Ideally, one would like to have say 10-15 years of data on an unchanging building stock to be able to predict optimal investments, but such data doesn't exist in this building stock at the time resolution we needed. Furthermore, when we see how we will operate the FED system in reality, there will only be a short (maybe 10 hour) window of forecast data available. That is why our next version of the model due out in a month or so will focus on dispatch and use forecast data as well as marginal pricing and emissions factors for electricity and district heating to try to improve the modelled representation of the actual FED system.

It seems that the model drives to decision making process in which CO2 emission reduction and primary energy reduction are something dissimilar. Can you explain if this is really the case or how we must interpret that?

Yes, I think you summarized it well in the text, and I cannot add much to that. The problem is simply that primary energy is low in the district heating system at the same times that carbon dioxide is lower in the electricity system in Sweden. So you can't have an optimization that leads to both goals when most of the time it is better to run heat pumps on electricity from a carbon dioxide perspective while district heating would have been better from a primary energy perspective. Also, I can mention that the different allocation methods and varying definitions make it difficult to agree on how primary energy should be accounted for at all, while CO2 is a much easier metric to agree on. This is something we are tackling now in a working group in the project and may update our metrics/goals based on those results.

Is Anitra Steen, president of the board of Akademiska Hus family? What does she think about your efforts?

David Steen

David: Haha, no we are not relatives but I think she is happy with the work we are doing. Akademiska Hus strive to become more sustainable and to cooperate with their customers to achieve this. The FED project is really in line with this ambitions as the project aims to provide sustainable solutions in collaboration with their customers.

Per, you have been working at the Campus for a long time. Have you seen a big upscaling of the energy initiatives and when did that start?

Per Loveryd

Per: With the FED project we will together learn a lot better in how different energy systems can work together. FED is the start of the test bed campus Chalmers at that integrated level, which may be a global premiere.

Where do you see it going over the next decade?

We expect a lot more if this and different, new, innovations plugging in, for example from the HSB Living Lab.

What is the difference between Chalmers Fastigheter and Akademiska Hus?

Bengt Bergsten

Bengt: Chalmersfastigheter and Akademiska Hus are both real estate companies. Akademiska Hus is a nationwide real estate company specialized in academic buildings and campus development whereas Chalmersfastigheter is Chalmers own real estate company. We focus on maintaining, optimizing and developing the buildings on Chalmers three different campuses.

Do you appreciate the combination of the academic analysis and operational implementation and do you see other opportunities were it might be developed further?

It is a great challenge that a simulation model of the FED-system, both physical grids and the economic solver, is developed. This makes the decision process easier and weeds out a lot of guessing on specific issues.

Any type of complex development and innovation project should include some sort of simulation model to support the decision process.

6. Challenges & upscaling

Just like in the first report it is worthwhile to have a look at the challenges encountered in the FED project. The following table provides an overview of the relevant issues, as an introduction to future Journals which will offer a closer look as to how the FED project addresses them.

TABLE 1: MAPPING FED AGAINST THE ESTABLISHED UIA IMPLEMENTATION CHALLENGES

Challenge	Level	Observations
1. Leadership for implementation	Low	*We are talking about this topic when we discuss the actual goals of the project. The reasons to take part in the FED project are different for the different partners. These are linked to efficiency targets for building owners, academic ambitions for the scientists and overall ambition to develop better systems to contribute to a better society by all involved. In the stand-off between emission reduction and primary energy reduction the interpretation of how each other's roles, possibilities and values is articulated showed resilience.*
2. Public procurement	Low	*The chapter on the efforts of Akademiska Hus shows their tremendous effort in technical and financial sense. The procurements are technically very conventional to reach the quality and financial optimum.*
3. Integrated cross-departmental	Low	*The integrated cross-departmental working is a challenge identified in many UIA projects but not necessarily in the FED project. This is merely the case because many of the tasks & responsibilities of the –for example- landlord, of the tenant and of the*

working		*energy supplier are legally assigned to the single organization rather than residing under one administration which could have been the case in earlier stages of development. One may argue therefore that some of the challenges found under the leadership list will have similar characters as other projects identify under integrated cross-departmental working.*
4. Adopting a participative approach	Low	*A participative approach has already been implemented in the FED project. However for smart grids to become mainstream projects, partners will need to find ways to include all consumers and producers alike.* *The FED project works from the perspective of a group of organizations that know each other very well, trust each other and are not (or very little) competing during the FED project. However the outcome of the project may be a market place were new players pick new roles that do not fit automatically in the profile of the current participative organizations. An example could be a new energy supplier that can demand very low costs due to superior production, or perhaps due to strategic desire to get into the Campus-system.* *So although in the project itself the participation is not a very importance challenge, it may become so at the time of its final delivery and upscaling, during which the project partners may run into participation considerations.*
5. Monitoring and evaluation	High	*The academic models ran on historical data and had to rely on the availability of that for certain buildings and also on the granularity for national figures that may not always fit the models used for decision making at local grid level.* *As described one challenge was the cancelling of the water storage. It is in fact the major change*[3] *in the project so far. Other solutions were investigated like a PCM thermal storage based on salt but did not get green light both because of risk of delivery & robustness and limited time.* *It is expected that the measuring equipment in the buildings already available combined with the new installed and the market system that Ericsson is building leads to great unprecedented information. After a first test the market will be enriched with more buildings and more productions units during the year.*
6. Financial Sustainability	Low	*No changes in this period.*
7. Communicating with target beneficiaries	Medium	*The communication via Johanneberg Science Park and the UIA website has stepped up a gear, for example by making videos available. For a start see:* *https://youtu.be/rn7hhUJFOnM* *Johanneberg Science Park has also planned to highlight each partner via that medium starting with Ericsson:* *https://youtu.be/Q6uRllcIDXw* *Furthermore the project took part in the European Sustainable Energy Week, finding a place with the UIA, in the Energy transition Urban Agenda Partnership conference. The video report can be found here:* *https://youtu.be/jIUYdhduFGI* *Before that conference the project joined an UIA organised workshop to discover opportunities to enrich or combine knowledge with the other UIA projects on energy which are CoRDEES in Paris (France) and Vilawatt in Viladecans (Spain).*

[3] According to the researchers this is a positive change as one should get much more storage for the price using the building inertia thermal energy storage!

8. Upscaling	High	*The interest in the project is growing and the work Ericsson is doing to really make the marketplace work and realize the high volumes of trade that are necessary when lots of energy production units offer different energy streams at different times and different rates will be tested for the first time in the summer of 2018.* *The project lead are talking about then upscaling the model by applying more demand and supply. This can be done at a larger district level, or perhaps even at city level, if some boundaries (like the exemption of the electricity law) are changed, or perhaps one can simulate their removal. It is very good to start thinking about the upscaling now because the sharing of grids and innovative applications to trade on them may become an important backbone of the energy transition.*

7. Next steps

On my way back to the Netherlands I realize that I have not used the opportunity to speak to Henrik Jönsson, who works for Bengt Dalhgren AB. He is in fact the answer to the question: 'Per Loveryd from Akademiska Hus is not possibly doing all this work by himself, is he?' The answer is no, he gets great assistance from Henrik, who understands all the technical details about energy flows but also about the tendering procedures. So relevant as one needs to avoid getting locked-in by making – or buying – options that discourage later follow-up steps.

The meeting with the whole FED team was valuable as ever and I loved the presentation of Ericsson work that was just starting up. They were even hiring people.

So I make a couple of marks for my next visit:

- Who are these new people and what are they programming?
- What is the start-up tempo of a new system, or grid in the situation on using a mix of old and new parts?
- Can that be implemented anywhere? And I make a note to myself to check it out at my own Campus in Delft.

Zeno Winkels

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Urban Innovative Actions (UIA) is an Initiative of the European Union that provides urban areas throughout Europe with resources to test new and unproven solutions to address urban challenges. Based on article 8 of ERDF, the Initiative has a total ERDF budget of EUR 372 million for 2014-2020.

UIA projects will produce a wealth of knowledge stemming from the implementation of the innovative solutions for sustainable urban development that are of interest for city practitioners and stakeholders across the EU. This journal is a paper written by a UIA Expert that captures and disseminates the lessons learnt from the project implementation and the good practices identified. The journals will be structured around the main challenges of implementation identified and faced at local level by UIA projects. They will be published on a regular basis on the UIA website.