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The Urban Lab of Europe !

Zoom-in 2: Upscaling the FED project

First stop: Netherlands



**ENERGY
TRANSITION**

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 energy storage 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 solution 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 – The 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 storage in the building's structure, an innovative cooling storage using phase changing material and batteries for electricity. An ICT service will host the local market and provide the connection to the outside world of spot prices and weather forecasts. The smart agents connect and trade within the system that provides the flexibility to 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.

Partnership:

- Göteborg Stad – City of Gothenburg
- Johanneberg Science Park AB - Public/Private Company
- Göteborg Energi AB - Public Company / Local energy utility
- Business Region Göteborg AB - Public Company for business support
- Chalmersfastigheter AB - Private Company and local property owner
- Akademiska hus AB - Private Company, national property owner
- Chalmers University of Technology - Academia
- RISE - Research Institute
- Ericsson AB - Private Company in ICT

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Introduction

This is the second Zoom-in of the FED-project. The first was a video-report of a visit to the Johanneberg campus in collaboration with a visit from the UIA staff. It is available [here](#). This second Zoom-in report focusses on another visit. It is the visit of representatives from Johanneberg Science Park (JSP) and the Business Region Gothenburg (BRG) to the Netherlands, to discuss *replication and upscaling* of the FED-model, on May 14 & 15, 2019, at the Technical University in Delft.

The FED project in a way leads the piloting of smart grid technologies & renewables to decarbonise grids. However, in general, when successes are scaled up, projects like these encounter new challenges such as: 1) governance, 2) business, and 3) data challenges. On the one hand, energy distributors may lose business through grid decentralisation. On the other hand, new market models may increase investments by citizen prosumers. No framework exists to jointly address these issues for the transition to a sustainable, future-proof grid at scale. This hampers the €600B challenge of grid modernisation, and decreases a regional adoption of low-carbon products and services.

It is therefore that the FED project has reserved specific capacity to invest in replication and upscaling of its learnings. Designated countries to do so are Denmark and the Netherlands. They have been chosen because both countries have similar electrical infrastructure and legal frameworks. Furthermore, the networks within the project contained contacts in both countries, which made Aalborg (DK) and Delft (NL) final destinations in this respect.

Workshop replication and upscaling

Program

The first day contained a workshop with 28 attendees and the following agenda:

- Presentation of the FED system by -JSP Head of projects- Claes Sommansson¹ + time for questions
- Interactive workshop about Sweden to the Netherlands – replication drivers and barriers

Networking coffee and break

Presentations from TU Delft Thermo-X Platform²:

- Dutch heat networks by Ivo Pothof³
- Energy plan for TU Delft Campus by Sander Snelleman⁴
- Deep geothermal as a heat source for TU Delft by Philip Vardon⁵
- The Planheat project by Michiel Fremouw⁶



The participants were mostly from the TU Delft although the odd city-representative, subsidy-advisor and innovation-consultant were quickly identified. Their active involvement gave the workshop a

¹ <https://www.linkedin.com/in/claes-sommansson-9294b9136/>

² <https://www.tudelft.nl/en/thermo-x/>

³ <https://www.linkedin.com/in/ivo-deltares/>

⁴ <https://www.linkedin.com/in/sander-snelleman-31233411/>

⁵ <https://www.linkedin.com/in/phil-vardon-54639122/>

⁶ <https://www.linkedin.com/in/michiel-fremouw/>

triple helix character. It was also noted that there was non-academic staff from the TU Delft present, from CRE, its real estate & energy department.

Outcome

Since we can assume that readers of this Zoom-in are familiar with the project⁷, the outcome can focus on the replication drivers and barriers. This part of the workshop was organized by Sandra Greven⁸ who is using the information gathered as part of her internship at JSP. She is a master student at Eindhoven University of Technology. The replication drivers and barriers were pre-selected and provided to the participants who were asked to reflect on them. One group focused on the uptake of Heating & Cooling in general in the Netherlands, one group on small-scale storage and three groups reported on the theme of IT-solutions.



With regards to general uptake of district heating & cooling, it was reported back that it is very hard to find the investment opportunity at the moment due to:

1. The institutional design of the Dutch networks
2. Lack of logical organization to take ownership
3. The excellent availability of a gas-network
4. The governments' desire to let go of natural gas
5. The governments' emphasis on heat-pumps
6. The lack of space in the ground.

Concerning the challenge for small-scale storage implementation in the energy system within the Netherlands, it was reported that:

1. Electric battery is (too) expensive

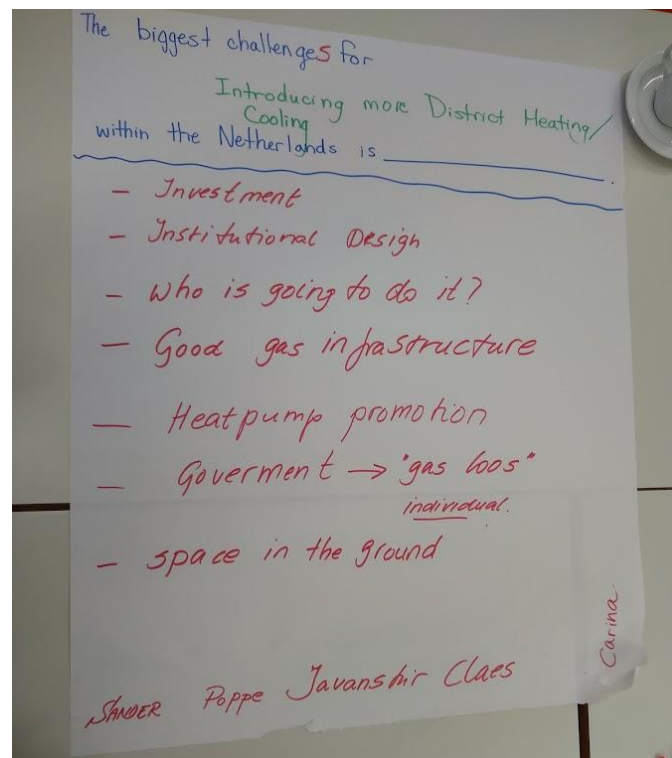
⁷ <https://www.uia-initiative.eu/en/uia-cities/gothenburg>

⁸ <https://www.linkedin.com/in/sandragreven/>

2. Physical installation of battery is a problem (safety, space)
3. District heating and cooling systems are not widespread within the Netherlands leaving little opportunity for exchange within district
4. There is no market because of a monopoly style situation

With regards to the IT solutions, the teams reported:

1. Privacy / transparency / trust are issues
2. Poor storytelling about quality of heating grids
3. Too complicated system for consumers
4. Lack of scale
5. Regulatory framework does not fit
6. Robustness of the system unproven
7. Investment costs too high compared to gain
8. Usability
9. Standardization not clear
10. Low financial initiative per consumer



Conclusion

Overviewing the sheets and post-its that were used, these can be aggregated to three groups:

- Governance / Social
- Data / Technological
- Financial / Business

This positions the FED project rather clearly. The project has provided the knowledge that such a system is possible and it has therefore taken a step in the field of Data / Technical. This set up was possible thanks to governance (exemption from the electricity law and no monopoly) and extra finance (funding through UIA). However, for genuine upscaling all parts of the system must be

addressed. This implies that governance (rules) would have to change rather than be exempted and that the solutions would have to be socially accepted. Or vice-versa, that social pressure changes the rules. Of course, business models and their financing will have to adjust to such a systemic change, outside the field of this pilot.

Because the efficiency results of the project are not known yet, it is not possible to give an indication of the efficiency value of implementing the system at scale. However, it is very clear that the future of grids will be a digital one and the FED sets clear steps in that direction. The interest of the building managers from TU Delft, asking which building management systems were needed for the FED is an operational indicator of that. The outcome of projects like STORM⁹ are another indicator, as is the potential for digitalization in general.

The FED project has reported some policy recommendations that are in line with this analysis. These are:

- Strive for social acceptance
- Direct investments towards replication of FED through the European Investment Bank and the cities and direct incentives towards cities in order to reduce CO2 emissions
- Define the role of the city/municipality in decision making processes and local energy plans
- Enable the DSO to trade with flexibility
- Enable the possibility to test, make demos and proof of concepts in several places

Sander Snelleman:

'There are opportunities for systems like these because they are a precondition for the energy-system of the future. The operational link between heat and electricity for example, is one we have not worked on so much yet'.

⁹ <https://storm-dhc.eu/>

Presentation at Urban Energy Platform

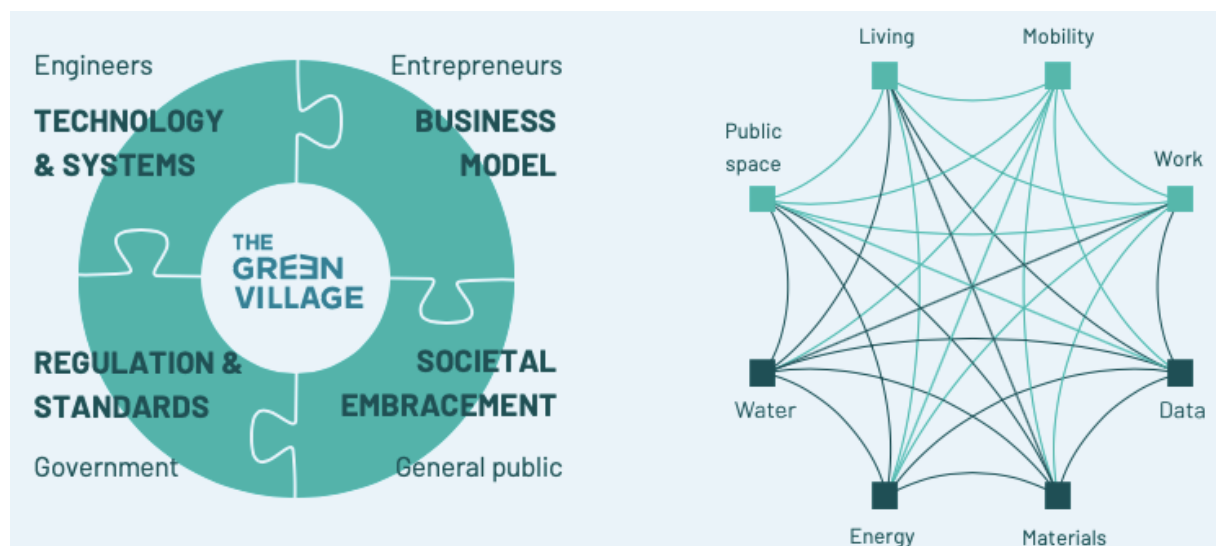
Program

The second day of the replication & upscaling mission had two parts:

- A visit to the Living Lab, named Green Village¹⁰
- A lunch lecture for the TU Delft's Urban Energy Platform¹¹

Outcome Green Village

The Green Village is a living lab for sustainable innovations in home, work and living environments. Located at the center of the TU Delft campus, this test site offers opportunities for entrepreneurs and researchers to develop, test and demonstrate their experimental projects in close collaboration with government bodies and the public. The site offers a specific opportunity for replication of the FED system because it has many experiments with renewable energy, batteries and also its own infrastructure, connecting experiments. Furthermore, it has an exemption from the building code and specific method to work on systemic innovation, so more than only the technological field.



The discussion with Rene Tamboer¹² was obviously one of the highlights of the day since he could show numerous possibilities to connect projects. Process-wise the Green Village asks researchers to fund the experiments themselves, which made a clear connection towards the work done on the first day.

'It is clear that the Green Village is open for the idea of hosting project initiatives like the FED from Universities and research institutes or companies from abroad when the facilities strengthen the project, the outreach or in any other form can accelerate the uptake of the addressed technology to the (European) market.' Rene Tamboer summarized the morning.

¹⁰ <https://www.thegreenvillage.org/>

¹¹ <https://www.tudelft.nl/urbanenergy/>

¹² <https://www.linkedin.com/in/renetamboer/>



Outcome lunch lecture

The TU Delft Urban Energy Platform consists of six pillars. It is interesting to recognize each of these in FED project. They are:

Urban Energy Platform	FED project
Towards zero energy buildings and beyond	Connection to the positive footprint house
Fast transition of the building stock	New services + production can connect
Thermal Urban Energy systems	District heating and cooling
Solar Urban	PV
Smart monitoring & management & control	At the heart of the FED project
Transforming the cities	Depending on other system changes

JSP Project Lead Stina Rydberg¹³ gave the presentation to some 50 attendees that were a mix from students and consultants as well of one of the citizens from the city of Delft that has an active role in the local energy transition citizen movement¹⁴.

¹³ <https://www.linkedin.com/in/stina-rydberg-74425a1/>

¹⁴ <https://platformenergietransitiedelft.nl/>



There were not so many questions after the presentation but a couple of remarks did stand out:

- The FED system is a digitalization of the net to make market efficient choices
- Because the net result of the FED system is not known yet, the current interest is in its design of the marketplace
- By the end of the year we will know more about the gains and losses

Conclusion

As stressed earlier, the application of the FED project in the Johanneberg area shows that such a system is possible. It has in fact been working 24/7 since January 9, 2019 with more than 31 agents and the market solver has approximately 500 cleared bids per hour. This demonstration is relevant because it shows that it is indeed possible to trade energy in different forms in the same system. And although already common in electricity grids, the FED also opens the door for heating grids with multiple suppliers of heat.

Therefore, from the viewpoint of relevance, there is certainly a demand for replication of aspects of the FED system. Aspects that could be a copied singular are:

- The market solution provider that was built
- The concept of adding consumer owned production
- The model for digitalization
- The concept of adding buildings as a heat battery
- The calibration of PV inverters at the system's optimum, not the suppliers
- The model of giving extra services such as storage a place in the grid design

It is clear however, that without changes in the governance/social sphere and changes in the financial/business sphere these technologies will only have incremental growth which of course also severely limits the upscaling & replication of the full FED system.

However, it is very well possible to further develop and optimize a FED-like structure in situations where the freedom to demonstrate is as big as it was in Johanneberg. In fact, many academic campuses are structured like the one in Gothenburg and the system could partly be copied in Delft where the Campus Real Estate Management (CRE) owns the grid for heating and electricity itself.

If that would be a rather large step without extra funding, the implementation of the FED at The Green Village seems less distant, since they already have much in place to have experiments interact and prosper in each other's proximity.

Finally it would be of interest to see if a simulation can be made where specific innovative sources or services that are in use elsewhere in the world -for example in the Green Village- can demonstrate their value in the future in systems' like the FED.

Summary and conclusion

The energy transition involves the accelerated deployment of energy efficiency and renewable energy technologies and energy efficiency. This requires systemic innovation, matching and leveraging synergies in innovations across all sectors and components of the system, and involving all actors. It includes innovations in information technology, policy frameworks, market design, business models, finance instruments, enabling infrastructure and sector coupling. Improved processes, research, development and deployment (RD&D) systems and cooperation networks are essential to overcome the barriers to a zero-carbon energy sector¹⁵.

In the replication and upscaling of the FED ambition, all these changes will play a role and although it is very unlikely that the FED will be the definitive solution, it is also clear that it touches more than a couple of the important ones. Important barriers to upscaling are found in non-technological spheres. The attention and active participation in the visit from the FED team to Delft proved an intrinsic interest and readiness for change by all involved.

In its report: Digitalization: Opportunities for heating and cooling¹⁶, the EUs Joint Research Centre concludes (May 2019): *Digitalization in heating and cooling has received less attention than digitalization in other areas, such as household appliances or transport. Yet heating and cooling accounts for around half of final energy consumption. Therefore, it is essential to better understand the potential of digitalization for these end uses, and the technologies with most relevance, in order to develop appropriate policies and prepare the ground for new investment*

Since the monitoring results of the project will be available by the end of 2019, estimations of the potential of upscaling will become available in the reports on the FED project, together with the policy recommendations.

Just like in the Aalborg visit, where a new meeting was immediately planned for June 2019, Johanneberg Science Park and Carina Nowak¹⁷, project Lead from Business Region Gothenburg invited Dutch staff to come to see the FED in real operation. There was immediate interest for this, from the academic level of developing the next calibration of a system to the operating level of what equipment to use in specific buildings.

¹⁵ <https://www.irena.org/innovation/Innovation-for-Energy-Transition>

¹⁶ <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC116074/kjna29702enn.pdf>

¹⁷ <https://www.linkedin.com/in/carina-nowak-36325b9/>



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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 Zoom-in, written by a UIA Expert, captures and disseminates the lessons learnt from the project implementation and the good practices identified. It is part of the capitalisation and dissemination activities of the UIA – Urban Innovative Actions Initiative.