The Urban Lab of Europe!

JOURNAL

PROJECT

FED - Fossil Free Energy Districts (Closed)

Gothenburg, Sweden

TOPIC

Energy Transition

EDIT 23 FEBRUARY 2021

BY ZENO WINKELS, UIA EXPERT

FED Journal 6: A view on the functioning FED system

See on UIA website

UIA Expert Zeno Winkels provides insights on the legacy of the FED project one year after its successful end. As he mentions: "The main legacy of the project will be that it is one of the first to address the truly systemic change that is needed when different innovative technologies need to find a place on the market. The FED built a system and market mechanism to do that and proved that this is possible."

Executive summary

This sixth journal on the FED project in Gothenburg is written in the autumn of 2020, almost a year after the project was closed.

From 2017 to 2019 the FED project developed a local energy system and a local, digital marketplace with three energy carriers: electricity, district heating and district cooling. It optimized use of energy storages and renewable production to the specifics local agents demands and produced 305.766 market exchanges, consisting of buys and bids and production and usage at Chalmers campus in Gothenburg.

The project group consisted of nine partners: The City of Gothenburg, Johanneberg Science Park, Göteborg Energi, Business Region Göteborg, Ericsson, RISE Research Institutes of Sweden, Akademiska Hus, Chalmersfastigheter and Chalmers University of Technology. The partners built a strong, local and multidisciplinary team for implementation.

Although study visits haltered in 2020 due to the Covid-19 crisis, the infrastructure supplied by the Science Park sees to the legacy of the project and implementation of its results and visions in other projects.

The main legacy of the project will be that it is one of the first to address the truly systemic change that is needed when different innovative technologies need to find a place on the market. The FED built a system and market mechanism to do that and proved that this is possible.

Project's progress

1. What has happened with the project since its end date?

The FED-system created a testbed to be used after the project ends. Five companies have already tested their products in the FED-system. This includes advanced control systems for buildings, smart charging of cars, advanced battery control systems, phase shifting material storages, prognosis of the production in the electricity system, heat pumps in co-operation with district heating and cloud services for energy data.

Currently twelve new projects are based on the FED-testbed. Six of these projects are large EU-funded projects that will use the FED results in various ways. It is interesting to see that these projects cater many different EU programs. In the Smart Cities Lighthouse Iris had a record evaluation and also under H2020, are Micro to megagrids, Era-Net Smart Grid Plus & United Grid, as is Flexi-grid. The ACCESS project is financed under the Interreg North Sea region. CELSIUS is a collaboration hub for efficient, integrated heating and cooling solutions supporting cities in their energy transition to carbon-neutral systems. The projects is funded by the Swedish Energy Agency and the EIT Climate-KIC.

---

2. What is the project's plan for long-term sustainability?

Rather than the project being the grand-plan, it fits into the strategy of the Johanneberg / Chalmers campus. Several other projects on smart grids have also started, either in the FED system or in the testbeds HSB Living Lab and Riksbyggen Positive Footprint Housing in Johanneberg. The campus area of Johanneberg together with nearby buildings are planned to be a testbed for local sustainable energy systems for years to come. The objective of the project to help create an urban lab for these questions is fulfilled.

It's essential to see that the FED solutions were set in a business-to-business situation and the replication opportunities are much in that field too. Moving to consumers' social acceptance is important, but the threshold is lower in premises and multi-family houses than single-family households due to aspects regarding personal integrity. Furthermore, knowledge about these solutions is low, so education is needed, first at business level. For example, mobile telephone providers often use the same infrastructure providing services to customers, with the customers unaware of the 'work behind the scenes'.

The license cost of an IoT-platform do seem to be affordable, at least for larger communities. Other conclusions point in the direction of starting with the easy steps and connecting the most beneficial market participants, should one replicate. Decision makers should pay attention to the question: who will be the market operator?

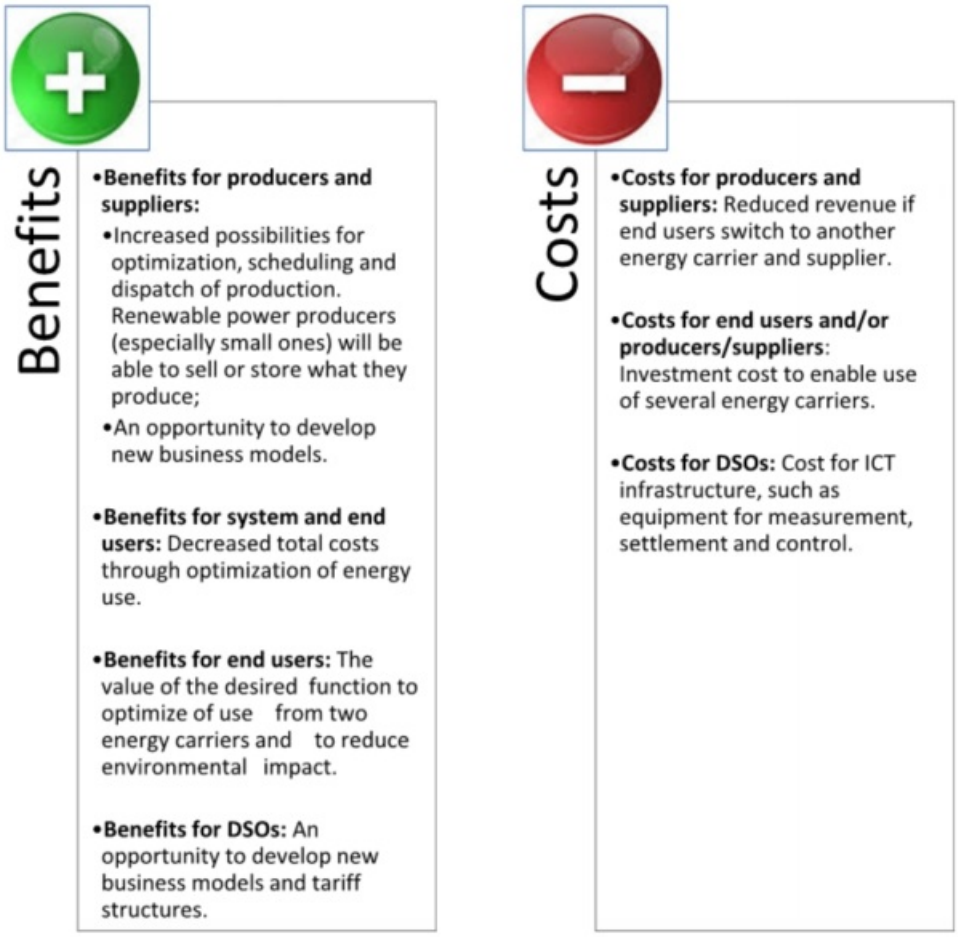
Finally, some of the benefits of FED might be blocked today due to regulation, but the rules can change in the near future. New possibilities to trade with flexibility can occur.

FED has been a collaborative project and the product is also about collaboration, between local grids and overlying markets, all types of local production and storages, heating, cooling and electricity, small scale and large scale, house owners and energy companies. Collaboration is needed to phase out fossil fuels.

Generated knowledge

1. Lessons learned in the light of the UIA challenges

The main lesson from the FED exercise is that it can in fact be done. A fossil free energy district could be built! A multi-commodity-grid can indeed be built, function and contribute to goals in the area of energy efficiency, use of different renewable energy sources and trading to specific agents' demands. In the demonstrative setting, the technical KPIs were met. It's too early though, to expect a smooth transition into society. There are social barriers and legislative ones but it is also important to see the economic restrictions to a smooth transition to FED-like usage of infrastructures. The following picture shows an indication of the plusses and minuses of any FED-like system compared to conventional (and existing) one. Somehow society will have to find a way to accommodate the winners and losers in this.



The FED project in the light of the UIA challenges

Challenge	Observation
Leadership for implementation Challenge level ●	In the UIA field, we look at the municipality for leadership. In the FED-project the city used the opportunity to have Johanneberg Science Park, to take the leadership role. This obviously worked for the project, but may be difficult to replicate outside business parks. In September 2020, I have looked back at the implementation with project leads Stina Rydberg and Claes Sommansson and we discussed how an independent coordinator can be a real asset to projects like these, with many partners. The other side of the medal may be that the municipality has not learned so much from the project as the most active partners. From the learning point of view, it seems that Gothenburg Energi, Gothenburg Business Region and Johanneberg Business Park will be the ones that bring the new knowledge further.

Public procurement

Challenge level ●

Many parts of the project were standardized technical equipment and fitted into the procurement processes of Chalmerfastigheter and Akademiska Hus, which are standardized but not necessarily public. BRG and Göteborg Energi work with public procurement (since they are municipal) and the procurement processes they have done, have been according to this.

This was not the case of the work provided by the programmers of Ericsson. Since Ericsson was part of the project this was possible. This is not uncommon in the case in EU funded projects in which the partners are preselected to develop innovation together in a triple or quadruple helix setting.

Integrated cross departmental working

Challenge level ●

As noted earlier the project benefited from many long-term relations both in the real estate as in the project field. Gothenburg is not the largest city in the world and the people will stay in their networks for considerable time and may even have inside knowledge of the departments or other partners by being an ex-employee.

In the talks with Claes and Stina, we discussed how the knowledge stayed across different companies / departments but became more shared, or holistic, when people were brought in the same rooms, to work together and give input that was necessary for the development of the project parts.

Adopting participative approach

Challenge level ●

The institutionalized participation by means of the board of Johanneberg Science Park of almost all partners and having the FED project-management residing under the JSP flag helped in the steering of the project.

More detailed is that in the beginning WP4 (energy hardware) and WP5 (software agent development) needed to talk and connect to each other. The energy staff needed to be close to the programmers that make the agents, and that happened only later in the project. It took about 12 months to recognize this! This was a very relevant connection to make because the Ericsson programmers are normally not in contact with the boiler guys. It was concluded that a good contact at a lower level than just the FED steering group in the project was necessary to work together.

Compared to other projects with EU funding, the project did not have a kick-off meeting that lasted two days in some venue that is foreign to most partners. The alignment of resources at local level took a bit more time, perhaps for that reason, as it started to sink in that the project was absolutely not a business as usual project.

Monitoring & evaluation

Challenge level

The monitoring and evaluation were rather academic from the beginning as a lot of capacity was invested in the description of the model to run the system on and make predictions about its efficiency and results. The simulation tool was in fact one the main deliverables.

This is natural at a campus of course but in retrospective the more simple analysis on good working parts of the project and perhaps not so good working parts was not as developed as it could have been. In other words, there was more attention to the complex, then to the simplicity. In retrospective, it may have been wiser to set the simple standards first to reduce risks in the monitoring and evaluation.

One of the culprits for this situation was the fact that one of the upscaling ideas was to make a virtual representation of the FED system at another place in the world and synthesise what its results would be under those circumstances. Given the different parameters and market deals that were closed all the time at the system in Gothenburg and the timed -and sometimes slightly delayed- introduction of more system parts, the whole complexity, combined with usage of the buildings and the local climate, of the system grew in a manner that is hard to 'mirror' by changing a few functions/parameters and say it represents a Dutch, or Danish FED project.

Financial sustainability

Challenge level

It is quite probable that some of the best working parts of the FED system will be replicable and Ericsson's pride in the project highlights this from their perspective.

Other comments with regards to financial sustainability must be seen in the interconnections between systems that are more and more common anyway. This will mean that one day the new usage of the inertia of buildings will be possible and financially attractive at the same time, provided some technology that is similar to FED's is available and implemented.

Communicating with target beneficiaries

Challenge level

The project has been a technical demonstration project and the local stakeholders have been embedded in the project from the beginning. Much time has been spent on external communication and the number of articles in external news media exceeded all expectations. The number of study visits to the area was also sometimes overwhelming – the project leaders had to arrange with extra manpower into the project in order to handle the external interest.

Replication & upscaling

Challenge level

Now that the project is closed, Johanneberg Science Park and Business Region Gothenburg will share the responsibility of replication and upscaling. This is however no longer specified at project level but much more recognizable in their organisations' missions.

The replication of the FED is difficult because the innovation is a system. The innovations or technologies introduced add value in the FED system, but not necessarily under other circumstances.

At a system level, it only makes sense for a building to be used as prosumer if there is infrastructure to sell its production and if there is a buyer. An investor in infrastructure needs to install the right capacity, but also needs to regather investments during the lifespan. This may be more unpredictable if the system changes. PV-systems and heat pumps can be more or less profitable and services like energy storage may blossom in a new system. This all has been tested in the FED. The problem of the upscaling of an innovative system is that there are many components and although the component owners have been very supportive in the project, the system itself is not their core business and after the project, well, life goes on. Perhaps there can be a specific component push, by an enthusiastic advocate or perhaps even patent-holder (like with linear innovation), but there's no 'natural' carrier of the burden of the responsibility (or budget) of upscaling and replicating a systemic innovation.

To eventually go to consumer level with a multicommodity grid that uses flexible pricing, may need larger steps and different strategies but is not impossible at all. As said, many mobile-phone operators use the same frequencies -infrastructure- and not many clients complain about it. The FED recommends though, to give very careful considerations to social acceptance in its policy recommendations.

2. Recommendations to other urban authorities who wish to implement similar innovative projects

At the end of the project, the FED has published the following policy recommendations:

1. Strive for social acceptance
2. Direct investments and incentives
3. Define the role of the municipality
4. Enable trading with flexibility
5. Enable testing, demos and proof of concepts

These have been discussed in earlier journals but it is interesting to see what kind of initial barriers have been identified for replication in the Netherlands, a country that from a distance, may seem rather comparable to Sweden.

Category	Barrier	Opportunity
Regulatory	- Incumbent of policy - Focus on energy efficiency - Government look to industry and vice versa - Allocation of benefits and costs (also non-monetary) - Technology non-neutrality - Focus is on individual solutions - Long term energy contracts	- Mandatory individual metering - Expand role of Authority for Consumer & Market - DSO to collect smart meter data - Green Deal - Focus on CO_2 reduction - Focus on innovation - Focus on natural gas free
Administrative	- Lack of definition of responsibility and ownership for the FED system - High level of bureaucracy - Distrust of energy companies	- Energy cooperatives
Environmental	-	- CO_2 reduction - Phasing out natural gas
Public acceptance	- Lack of awareness and knowledge in general population - Privacy highly valued - Clear communication of concept - Black box solution - Misinformed politicians leads to misinformed public - Turning off of the smart energy meter - Males as primary decision makers within energy sector and industry	- Trend setters - Increasing awareness in general population (and coming generations) - Reduced costs - Community feeling or bond
Economic	-	- Product based to service-based - Profit driven on all levels - New business models
Market	- Lack of knowledge within industry - Lack of incentives for change - Unstable market for innovative technology - Powerful lobbyists	- Smart Grid research
Financial	- Increased cost of customer support	

Category	Barrier	Opportunity
Technical	- Adaption of FED Market place (algorithms) to Dutch standards - Complexity and connectivity - Technology designed for continuous operation	- Decentralised home heating common - FED can incorporate any energy carrier - Standardisation trend - Smart meter roll-out - Development and improvement of technology
Infrastructure	- Current energy system highly efficient and functioning	- Transition to renewable energy production - Large scale renewal

Source: s. Greven, G. Verbong, S. Rydberg; Internship Report: Replication Study of the Fossil Free Energy Disctircs project to a location within the Netherlands; TU Eindhoven / Johanneberg Science Park; 2019.

The conclusion is that, like the Swedish, the general Dutch neighbourhood is not ready for the FED system. Proof of concept is still a possibility though. To get a proof of concept up and running the FED project needs to address the following:

• Adaption of FED system input values to Dutch standards and context

• Connectivity issues

• Ensure that hourly metering is available and legal

• Communication materials to bridge any and all cognitive gaps, increasing transparency and decreasing complexity

• Finding a suitable location, possible a cluster region

• Define and clarify responsibilities and roles: owner, client, operator and so on

• Define and clarify a business model

Helped by the contact of the UIA Expert, the FED project has been introduced at the campus of the Technical University in Delft. This supplies access to the Dutch academic world, some other intriguing similarities like exemption from the electricity law, and possibly more knowledge sharing in the future as the University is ready to develop a geothermal heat source its own.

Conclusion

1. The expert's final reflection and "evaluation" of the project

Location and operation

I think it is good to realize that projects go through phases and I guess it is hard to argue that the inception is an important one. The FED project was among the first tranche of UIA projects that started back at the end of 2016, which meant that the actual inception and writing took place in 2015 and conceptually even earlier. If we look at predecessors of the FED we may think of the Horizon 2020 project named Celsius, which became famous for supplying district heating to a ship. This is relevant because it shows that the creativity around heat and heat networks in Gothenburg shown in the FED project, was not a special, once in a lifetime, situation. The area is very suited for projects like this one. It was not the first project, and it will not be the last, since creativity and the right partners will bring new inception.

In my third journal on the FED project I concluded that it is embedding in the Johanneberg Science Park innovation system with its cornerstones of (1) Interconnecting and networking between participants, (2) emphasis on creating and sharing of knowledge and technology, (3) diversity in financial sources and (4) boosts for business climate, was an extremely important asset. Most of the challenges identified by the UIA for their projects would find their way along the soft/networked infrastructure supplied by the science park. And such has been the case for the last 4 years.

So, if we consider the city Gothenburg and its partners a good place for projects and their creative inception and if we consider Johanneberg Science Park an advanced innovation park where multi-stakeholder projects can be managed and operationalized, then it makes perfect sense for the EU to invest in demonstration projects like these.

Smart grids

The societal perspective on European demonstration projects rooted in the EU's Lisbon strategy to become the most competitive economy in the world can be seen from the point of a singular project and analysis of its contribution to the mission or theoretically, into an alternative use of the budgets involved.

We can be short on the singular project evaluation. As a proof of concept, the FED project has been simply outstanding.

Unfortunately, it is common knowledge that the implementation of smart grids in Europe is slowThe reasons for this are manifold. The need for smart consumers was tackled in the FED project via the building in which they work and the engaging of businesses that run the building at the campus. The often cited lack of stakeholder engagement, in particular the lack of two-way communication was not the case in the FED project itself due to the business to business character. The attitude of end-users to energy was also not part of the project.

FED did facilitate that all stakeholders could gain, or at least participate on their terms. With regards to funding & incentives all stakeholders had strong business reasons to participate be it for energy efficiency, academic, environmental, or technological innovation reasons. The open market, often a barrier to the implementation of smart grids, was specifically arranged at the (energy law exempted) campus and part of the project, though not easily repeated in non-similar surroundings. There are no clear standards for smart grids yet. The FED itself was more angled at showing the world that something could be done, then on the design of legal standards.

---

2. The main legacy of the project, both in terms of knowledge generated and the solution

implemented

As the dedicated UIA expert, I have been asked to be the 'critical friend' of the project and this has been an interesting and sometimes challenging position. Interesting because the complexities and the ambitions of the project from the academic analysis to the implementation in the boiler room and usage of the digital market place were over such a wide spectrum. Challenging because the dissemination output of the project was already at a high level and it was sometimes difficult to shine a new light on project-parts among the already existing videos, articles and conferences.

Among the legacy may be the particular topic of replicability. The FED suggested to policymakers: strive for social acceptance, direct investments and incentives, define the role of the municipality, enable trading with flexibility, enable testing, demos and proof of concepts. I think, however that these recommendations are still very abstract in their formulations and although policymaker will like that, they will not be remembered as the legacy of the project.

The technology aspects of the project will certainly be remembered and the wise use of different types of batteries, as well as their technical optimization will no doubt be further developed at the campus and elsewhere in the world. This is the global development of innovation and technology that is happening at the beginning of the 21 century.

However, in real life, the individual people that work on projects like these, they find each other in projects like the FED. This starts when they find each other at breakfast conferences in Gothenburg, or EU-conferences in Brussels for that matter. Or at lectures in Delft. And they meet people that are similar to them. And they talk about their projects. And they read about them, or watch videos. And every once in a while there's a spark, or window of opportunity, and the people that meet manage to formulate a project. A project that can be an incremental innovation. Or like the FED, a project that is a little bit larger, and innovates at system level, because it develops and combines innovations.

I would argue that the legacy of the project is simply its systemic character. Basically, the legacy of the project is that a bunch of dedicated people across different organisations -which share a passion for technology and sustainability- built something completely new based on their latest insights. This is the important legacy of the project. It is one of the first truly systemic innovation projects in the field of grids and smart-grids and that's why it will not be replicated at the speed of the iPhone. It's systemic, not a product.

Now a lot of the interest in the project I have, is in the people that worked on it. It is not without reason that most journals ended with interviews and so did the video I reported. I am extremely interested in the people that manage to go beyond incremental improvement. Jealous perhaps.

Energy Transition

See on UIA website