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Executive summary

This report provides insight in one of the thirteen Smart Solutions (D2.12) that were planned to be implemented in the Heart of South area in the City of Rotterdam. These innovative solutions are part of the RUGGEDISED program, which is subsidised by the European Commission, and aims to test, implement and accelerate the Smart City model across Europe. Smart Cities include places where traditional networks and services are made more efficient with the use of digital technologies, for the benefit of its people. The smart solution this document further elaborates on is ‘the implementation of Smart Charging in new parking lots in Heart of South’.

First is explained what the solution includes. In short, the plan was to provide Smart charging facilities in the Heart of South, in order to do load balancing on the electrical grid, combined with the large solar installations.

The second part of this document contains a detailed description of which challenges we faced within this study, and the reasons why we have not been able to implement this solution.

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1. Introduction

RUGGEDISED is a Smart City project funded under the European Union's Horizon 2020 research and innovation program. The European Commission defines a smart city as: “A place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses”. The goal of the project is to test, implement and accelerate the Smart City model across Europe.

1.1 Lighthouse cities

The current period in which we live, is characterised by rapid technological development, strong globalisation of (social and economic) activities, a need to protect our living environment and to ensure social stability. In the European-funded Smart City project RUGGEDISED, the three lighthouse cities of Rotterdam, Umea, and Glasgow work together with a number of partners from academic, business and consultancy backgrounds to develop and test solutions to exploit and explore sustainable urban development opportunities offered by smart solutions.

The three overall aims of RUGGEDISED are:

- Improving citizens' quality of life by offering a clean, safe, attractive, inclusive and affordable living environment.
- Reducing the environmental impacts of activities, amongst others by achieving a significant reduction of CO2 emissions, a major increase in the investment and usage of renewable energy sources and an increase in the deployment of electric vehicles.
- Creating a stimulating environment for sustainable economic development, by generating more sustainable jobs, stimulating community involvement in smart solutions (as consumers and as producers) and to boost start-up and existing companies to exploit the opportunities of the green digital economy and Internet of Things.

Within Rotterdam the main focus is on Smart Energy systems, with as goal to reduce import of energy from outside the area and produce as much as possible energy within the area itself.

Two grids are designed, one Smart Thermal Grid (STG) and one Smart Electric Grid (SEG) as shown in the drawing below.

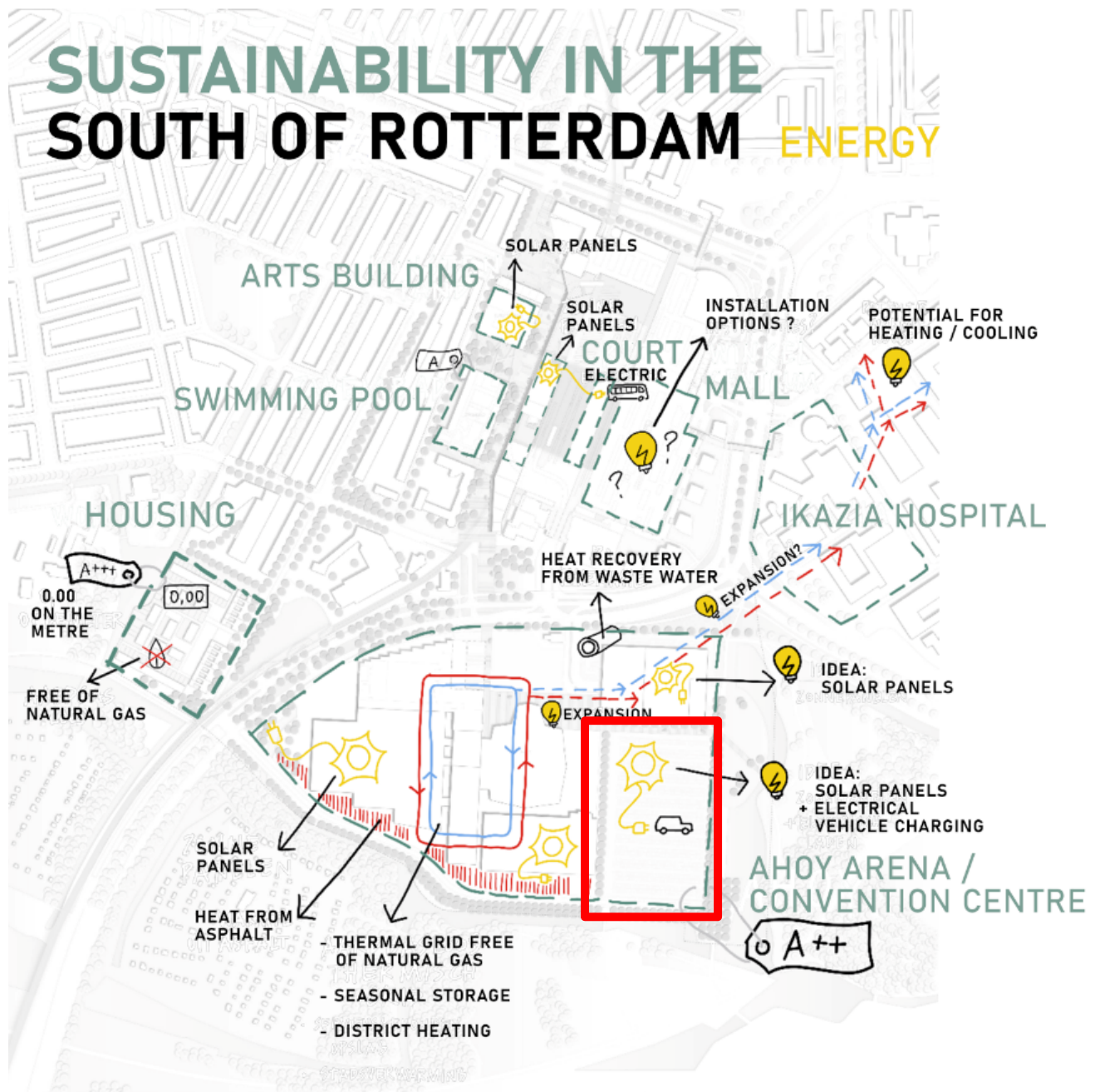


Figure 1: An overview of the Heart of South implementations, The goal parking lot for smart charging has been highlighted in red

1.2 Smart Electric Grid in Rotterdam

The City of Rotterdam played an important role in the RUGGEDISED project. Rotterdam is the Netherlands second-largest metropolis and is characterised by its diverse, multi-ethnic community and Europe's busiest port. The City of Rotterdam introduced the Heart of South, the city centre of the South side of Rotterdam, as their lighthouse district. Through RUGGEDISED, the area is undergoing a transition, consisting of renovating event centre Ahoy and building new facilities like a shopping mall and a cinema.



Figure 2: Map of the city of Rotterdam



Figure 3: An overview of the Heart of South area and the Ahoy complex.

One of the main goals of the project in Heart of South is to connect several smart electric solutions in order to reduce the environmental impacts of activities, amongst others by achieving a significant reduction of CO₂ emissions, a major increase in the investment and usage of renewable energy sources and an increase in the deployment of electric vehicles.

In total, thirteen innovative solutions are implemented in the area, from which several solutions contribute to the establishment of the SEG. The solutions are highly related to one another; for example, some solutions focus on generating electricity energy, while other solutions focus on the storage of electricity.

This deliverable elaborates on one of the solutions that contributes to reducing the peak in electricity generation by solar PV by introducing smart parking lots. Charging electric vehicles with electricity that is being produced by solar PV panels instead of feeding this electricity back into the grid is the way in which the objective was supposed to be achieved.

Since the electricity grid in the Heart of South area is almost at its maximum capacity, it is deemed effective to have smart charging points which can cope with 2-way energy flows (grid to vehicle and vehicle to grid) to minimize peak loads. In the Heart of South area, 25 smart car charging points were planned to be realized.

2. New parking lots implemented for Smart Charging

2.1 What is Smart Charging?

Smart charging is simply the usage of electric cars as storage for electricity, so that the electricity grid can be designed at lower dimensions thereby leading to lower grid costs for construction and maintenance. This effect is caused by Smart balancing on the grid instead of accepting highest peaks in both demand and supply of electricity.

2.2 How does the system work?

Eneco conducted a feasibility study in the Q2 2018 until Q1 2019 for the smart charging plan in RUGGEDISED. A lot is written and said about Smart charging, especially about Direct Current (DC)-based solutions and / or Vehicle to Grid (V2G) solutions. Eneco investigated both in order to realize a pilot in RUGGEDISED, but encountered the following practical challenges:

2.2.1 Substantive challenges DC based smart charging

The original plan contained a DC based Smart Grid. Generating electricity with solar panels produces Direct Current. Most users of electricity also use Direct Current, such as laptops. Finally, when building charging points for electric vehicles, you can decide to design them so that Direct Current is delivered. It was therefore concluded that DC was the way to go in Heart of south.

During the feasibility study as mentioned in 2.2, the options of an Alternating Current (AC) grid were explored. In short, the question was asked: “So why go from DC to AC and back to DC?”. Every conversion from DC to AC or vice versa results in conversion losses. It was therefore concluded that a DC based grid system has less conversion losses and therefore is more energy efficient.

Both within the RUGGEDISED project, as well as other (non public) smart charging projects Eneco has come to the conclusion that this assumption appears to be incorrect.

One of the reasons that the assumption of less losses with a DC based smart charging solution was proven wrong can be found in the fact that a DC charging station has a continuous no-load losses, which cancels out all avoided energy losses during AC / DC conversion. Also, apparently a DC-DC conversion is still needed and the energy loss of this conversion is only slightly better than DC -AC conversion.

2.2.2 Procedural Challenges

The original idea of an electricity smart grid within the RUGGEDISED project would make it possible to connect different buildings or lots, sustainable energy generators (solar and wind) and charging points. This has been ruled out during the project due to Dutch Energy Laws regarding safety. The Netherlands Authority for Consumers & Markets (ACM) monitors these rules. Only very few pilot projects are allowed, but only after an extensive application process. It was decided NOT to start such a process within the RUGGEDISED project. The main reason why the application process has not been started can be found in the fact that Eneco was not granted the assignment to install charging points.

3. Implementation

This Smart Solution has not been implemented in Rotterdam. The original idea was to implement this solution in the Heart of South district in the vicinity of Ahoy. The reason for not implementing lies in the challenges as described before in chapter 2.2.

3.1 How would it have been implemented

The original claim / idea of ‘DC believers’ was that with DC Smart grid, including DC current routers the local smart grid would automatically balance based on a fixed priority setting. In this case no expensive software would be needed. This assumption, however, does not take into account the fact that individual charging station users suddenly have to be given priority (in case of accelerated return). It also does not account for the benefit of energy trade. The benefit of energy trade can be described as the margins which an energy company can make on trading both in the demand and supply of energy on the open market. In order to make this work, the priorities must be adjusted and a software system at grid level is required which can influence load per charging station or battery.

The original idea that DC grid cables would be more expensive in construction than AC grid cables, but that the DC grid would not have to be expanded every time, is concluded to be false. Solar power cannot be supplied directly to the charging stations, because of Dutch subsidy rules and regulations. These rules state that a production meter has to be installed in far too many places in order to be granted subsidy (SDE). This in turn results in too high investment costs in the already difficult business case. Also, the solar subsidy behind the meter is yielding less and less due to new government policy. Finally, in the Netherlands there is not enough solar energy in the winter and the grid must therefore be dimensioned at the winter usage peak of supply to the charging stations, regardless of the solar energy.

The whole strategy of using slow-charging DC-DC powered bi-directional charging points for the parking at RUGGEDISED turns out to be unfeasible in practice. The main reason for this is that there are hardly any DC-DC powered bidirectional charging stations available. This also makes them still much too expensive. The fact that they are expensive makes that they would only be placed individually or in pairs, which is at odds with delivering as many charges as possible to as many e-drivers as possible. This makes the business case not feasible. These circumstances were noticed during the period in which this deliverable was explored. Obviously circumstances might change. When considering future smart charging networks, it is always recommended to test these findings against current circumstances.

The alternative strategy, which is to get charging stations as cheaply as possible and therefore installing AC charging stations for the parking lots which were intended within the RUGGEDISED project, is a more feasible strategy because the costs are better in proportion to the charging deliveries per year. The business case per charging point therefore is more feasible.

During the study for DC based charging points and/or V2G charging solutions within RUGGEDISED, Eneco has attempted to implement AC based smart charging solutions. Unfortunately, again, there are practical challenges that have been faced. The most confronting challenge was the observation that many car owners (e.g. private and leasing companies) appeared not to be willing to use the battery of the car for load balancing. We have concluded that e-driving is still a new technology in the Netherlands. V2G battery usage for load balancing has been proven to be just ‘a bridge to far’ at the moment.

Within the Heart of South area, therefore the scope of RUGGEDISED in Rotterdam, there are 2 parties that own parking lots, which can potentially be transformed into Smart Charging lots. These parties are:

- The municipality of Rotterdam
- Ahoy convention center

D2.12 New parking lots implemented for smart charging

Regarding the municipality of Rotterdam, it was decided by way of a European tender, that a competitor of Eneco was granted the assignment of implementing electric charging stations for electric vehicles in the entire city of Rotterdam. Due to this decision, Eneco has not been able to implement any Smart Charging points in the parking lots owned by the municipality.

After above mentioned decision, Ahoy was contacted with the question regarding implementation of Smart Charging points for their parking lots. Ahoy has indicated that they have no interest at all in Smart charging facilities at the moment.

As a final effort, Eneco also contacted Ballast Nedam / Heijmans about the new parking garages planned on the Leisure Plot in the Heart of South. Both parties were interested in a cooperation with Eneco on this. At the moment the development of this new parking garages is delayed by several years and potential realization of a pilot for smart charging therefore falls beyond the project timeline of RUGGEDISED.

4. Business plan

Due to the fact that the original plan, and plan B have not been implemented, we have unfortunately not been able to set up a proper business plan for Smart Charging.

Initially conceptual business plans were made on the total package of:

- A) Generating electricity with solar PV
- B) Storing electricity in batteries
- C) Charging electric vehicles with electricity generated via solar PV, possibly after being stored in the battery

This total concept would contribute to the overall goals of RUGGEDISED, being the reduction of (peak) demand to the electricity grid, and reducing CO2 emissions. Since the solar panels have been installed, the CO2 reduction has been realized. The reduction of (peak) demand from the grid, however, has not been further explored due to factors mentioned in this report.

Above mentioned conceptual business plan needs to be completely re-made in the future when Smart Charging is being considered. Whether assumptions/conditions are still the same at that point in time needs to be evaluated.

5. Conclusions and recommendations

In conclusion we can say that

- A) the selection by the municipality of a competitor of Eneco for the public parking spaces in Rotterdam, and
- B) the delay of the development of new parking garage at the leisure plot, and
- C) the lack of interest of Ahoy for extending the existing charging facilities at Ahoy, and
- D) the practical difficulties of V2G

made the realization of a Smart Charging socially and financially unfeasible.

Eneco expects this to change in the future. At that time, Smart Charging will be reconsidered, and several business plans will be explored at that time.



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