

The Potential for Microgrids in Smart Energy Port Systems

White paper report

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Abstract

This white paper is set to communicate the contents and valuable insights from the discussions held during the practical case study workshop on Microgrids in Smart Energy Port Systems at the Living Energy Conference 2019 in Rotterdam, The Netherlands. Presented by Jaron Reddy, Energy Exchange Enablers to the participants. [\[link to presentation\]](#) And moderated by Dr. Yashar Ghiassi - Farrokhfal

Outline

This whitepaper aims at conveying some of the key issues that need to be taken into account when realising microgrids in a smart energy port system. These issues are based on discussions during the Living Energy Conference 2019, held on 12 April 2019 in Rotterdam. The remainder of this whitepaper is organised as following. Section 1 discusses the context of this whitepaper and sets the scene. Section 2 discusses the audience for which this whitepaper is created. Section 3 summarises three identified challenges of microgrids. Section 4 delves into each of these challenges and Section 5 provides conclusions of this whitepaper. This white-paper report will be used as a basis to set up follow-up innovation projects with the stakeholders and to reach a wider international community.

Section 1: Introduction

The rise of renewable energy sources and the rising impact of data foster a closer look on how energy systems can operate. The need for flexibility increases, due variability of renewable energy sources such as wind and solar energy, increasing load and generation connected at the distribution grid level and more coincidence of peak in demand. In particular for the Port of Rotterdam, which use high levels of

energy, these issues can raise critical attention. Microgrids are proposed as one way to mitigate this. Microgrids provide an infrastructure to absorb disturbed renewable energy generation without the need for additional investments on capacity and the grid. This also reduces energy loss when transferring energy from generation to the end consumers. This whitepaper explores the potential for microgrids in port settings, raises challenges for their implementation and explores some potential solutions for grid-related problems.

Section 2: Audience

This whitepaper benefits the research and business community. A variety of challenges are identified that could foster and contribute to the energy transition in a smart energy port system. These could serve as relevant inputs for researchers in designing, conducting or facilitating research around this topic. Furthermore, for the business community this offers insights in what challenges are currently perceived in both industry and academics. These could serve as starting point in combatting those with contributions of other involved parties.

Section 3: Challenges

As industry is still assessing the potential of microgrids, various challenge arise in their implementation. Based on the discussions, three key challenges were selected and will be discussed in this whitepaper:

- The role of microgrids

Microgrids can be used in many forms. They can for instance be used without interacting with other energy systems, or they can be used

while connected to the grid. What is the role of microgrids in ports and in an energy system such as the Netherlands?

- Designing a market place for microgrids

If decided to include microgrids, how is it ensured that participants will interact and that this interaction is efficient?

- Energy sources and information exchanges on microgrids

Microgrids offer great potential to include various types of energy demand and supply. Which ones do we use? What information do we need to ensure this is realised?

Section 4: Contents

Challenge 1: The Role of Microgrids

Microgrids offer a wide range of benefits, such as the ability to combine heat, gas and electricity networks and the mitigation of risks in case of contingency or emergency energy. Yet, the scale on which this is done is crucial. The participants agreed that the design of the current national Dutch energy system is of such a high level that breaking this into various microgrids might only decrease stability, and therefore a combination of islandic microgrids on a national level might not have desirable results. However, for the port itself it might offer substantial benefits. The Port of Rotterdam is working with substantial offshore wind parks and they are planning on building an energy island. Facilitating energy exchanges with the help of microgrids in this regard might be a plausible option. The main strength of a microgrid in a port setting is the local use of inter-central flexibility instead of unnecessarily moving it back and forth on the grid.

Challenge 2: Designing a Market Place for Microgrids

One of the key advantages of microgrids resides in the potential to exchange electricity between several actors. Yet, in an industrial environment, a main challenge resides in the motivation for companies to participate in such an energy exchange, as can be seen in the example of the steam pipeline discussion in the Rotterdam area. Multiple factors contribute to this lack of motivation. Firstly, for a (industrial) company, energy supply is generally fixed. By using such variable electricity supply and prices as is imposed by these exchanges, energy becomes an uncertainty for a company. This is further strengthened by the priority of energy for most industrial applications. Energy usually contributes 7-8% to the total cost of an industrial company, and therefore is not on top of the list for a company.

From a regulatory perspective, the question arises whether energy is a commodity or whether it may be commercialized. If it is opted for to create a local market with a gateway to the larger energy grid, referring to a design wherein the microgrid is not self-sustaining, the role of aggregator could become a business model for an independent commercial party. However, regulators like DSOs and municipalities worry that if the aggregator fails to deliver, microgrid participants will look at regulators to take responsibility (Eid et al. 2016).

The ability to exchange electricity can become important for companies however because it can act as a secondary revenue stream. In order to achieve this, a successful design of such an exchange system is required to ensure that all participating parties are on board. One of the solutions proposed for this comprises the design of a market place that works with distributed service operators (DSOs) and transmission service operators (TSOs). These software-based systems could contribute to fostering successful energy exchanges. An interesting area to realise

these systems is identified as well. Areas such as the Botlek area or other areas where rapid electricity expansion happens require extensive forms of flexibility, and efficient market designs can contribute to this. More research is needed to determine the particular technical design, financial feasibility and regulatory challenges of such a tailor-made system.

Challenge 3: Energy Sources and Information Exchanges on Microgrids

Besides serving electrical demand, microgrids can also be used to serve other types of demand, and preferably combine multiple energy sources. In its design of offshore wind parks, the Port of Rotterdam does not only include electricity generation, but also heat and hydrogen generation facilities. Other propositions were made to for instance connect waste incineration to fulfilling heat demand, and a large geothermal potential exists in this area of the country. Microgrids can connect all these different types of demands and supplies, but integration of these elements are location and investment dependent.

Therefore, there is a tendency towards the inclusion of multiple energy sources and multiple types of demand. Yet, currently 'behind the meter' systems are deployed most often, in which only the net demand of an actor is taken into account. The inclusion of multiple energy sources, such as sustainable gasses and district heating, requires more insights into elements such as the space and certification of installation in order to ensure efficient operation. As a result, it is crucial to design flexible microgrid solutions, which are able to accommodate different technologies without a relatively low transition cost, to accommodate future establishment of technologies.

Section 5: Conclusions

The discussions have provided relevant insights. In particular, the following conclusions can be drawn.

The Role of microgrids

Microgrids offer potential in a port setting, yet it should be very clear how benefits can be realised with the already well-developed Dutch system.

Designing a Market Place for microgrids

- Designing a software-driven market place for energy exchanges on a microgrid can offer substantial benefits, with the inclusion of DSOs and TSOs. Yet, clear measures should be in place to ensure motivation of the parties involved.
- These software-driven market places for energy exchange can contribute to managing areas in which rapid electricity expansion happens.
- These systems tend to be tailor-made and require case specific research on the design, financial feasibility and regulatory challenges.

Energy sources and information exchanges on microgrids

- There is much potential for combining other energy systems to the electricity energy systems, yet no clear propositions have been made and a clear need for transparency and thus more data sharing is required in order to successfully achieve this.

Section 7: Additional resources

C. Eid, P. Codani, Y. Perez, J. Reneses, R. Hakvoort (2016). Managing electric flexibility from Distributed Energy Resources: A review of incentives for market design, pages 237-247.