Periscope Network

Market Opportunity Report

Microgrids at Large Ports

Interreg North Sea Region PERISCOPE European Regional Development Fund

EUROPEAN UNION

PERISCOPE reaping the potential of the oceans

Dear reader,

This report provides an assessment on the prospects for the microgrids at large ports. A survey has been developed to this end and has been evaluated by respondents to crowdsource a forecasted time horizon to implementation and its potential as an opportunity for the maritime and offshore industries.

This report is produced by the PERISCOPE Group at Aarhus University for the PERISCOPE network.

Photographs
unsplash.com; pixabay.com

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PERISCOPE

PERISCOPE is an initiative of the Interreg VB North Sea Region Programme working to catalyse entrepreneurial discovery and promote trans-regional partnerships to unlock Blue Growth. We are supporting the combined maritime and marine innovation ecosystem in the North Sea re-gion to accelerate innovation for sustainable business development in emerging blue markets.

The PERISCOPE network has identified more than 60 future business opportunities for the blue economy, developed these into venture concepts, and built an engagement tool for each of these. These studies include crowd-based forecasts about when these are expected to be real-ized. This information supports planning activities with the intention to orchestrate action to-wards the realization of said opportunities, and, indirectly, to a transition to a more innovative and sustainable character of the blue economy.

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1. ABSTRACT

The transition of the North Sea Region's maritime and offshore industries toward a sustainable "Blue Growth" future is driven by incentives to unlock new growth areas, develop and apply new technologies, and increase productivity. The development and utilization of microgrids provides an opportunity to accomplish these goals. The rapid development in infrastructure and the trend toward the electrification of the seas has provided a context for growth, and microgrids pose a module to couple to existing infrastructure; a retrofit to improve the utilization of renewable energy sources. This report presents the outcome and analysis of a survey taken by 22 respondents. Respondents expect microgrids at large ports to emerge in 10 years and respondents rated the business potential at 3,77/5. Political factors are mentioned by most responses (40%), followed by social (30%), economic (16%), and technological factors (14%).

2. INTRODUCTION

Ports are the sites of major pollution, where large vessels continue to run their engines even while at berth, and heavy-lifting work is being performed by diesel-powered cranes.[1,2,3,4] As the maritime industry explores ways to decarbonize, microgrids that at ports can play a supplementary role to existing electric grids with an enhanced energy storage systems.

Microgrids-originally developed to manage industrial operations in remote areas-are designed to draw and manage energy from renewable sources such as solar, tidal, wind, hydrogen or other electrofuels that is generated around the clock.[5,6] Microgrids at ports will enable the electrification of lifting and transport machinery, and will also enable large cruise ships to transition to cold ironing, a practice that is currently limited because city-grids cannot bear the load.

The global microgrid market is growing at annual rate of 11.26%, and projected to reach $46bn by 2025.[7,8] Ongoing challenges at ports include the space, cost, and installation of renewable energy generating technologies and microgrid control systems, and the know-how to manage it all.

3. METHODS

The opening text above in the introduction was used as a prompt in a survey that was posted online and distributed to respondents identified as having a qualified opinion. The first question that was asked concerned the question of time to implementation, “On the sliding scale below, please estimate when retrofitting large ports with microgrids will become an accepted practice, i.e. commercially available (0= already here)” with the scale spanning a maximum of 30 “years from now.” In this question, respondents were also offered an option to answer “it will never happen.” The second question was ”What is needed to make this happen?” and offered respondents an open text box in which they could write their answers. The third question asked respondents to rate the opportunity described on a likert scale out of 5. Finally, respondents were offered another open text box to write any additional comments.

4. RESULTS

4.1 FORECAST TO IMPLEMENTATION

The data is then analyzed to find the median estimation for the opportunity. Median, rather than the mean (average), is used for this analysis to prevent the conclusion to be skewed by outliers. This analysis is represented in figure 1 below, which shows that the median, i.e. the value separating the lower and upper half of the data samples. According to the respondents, microgrids at large ports will become an accepted practice in 10 years.

When asked for the time to accepted practice, the respondents had to option to choose “will never happen”, none of the respondents selected this option, indicating that it is a question of *when* microgrids will be installed/retrofitted at large ports rather than a question of *if* it will happen.

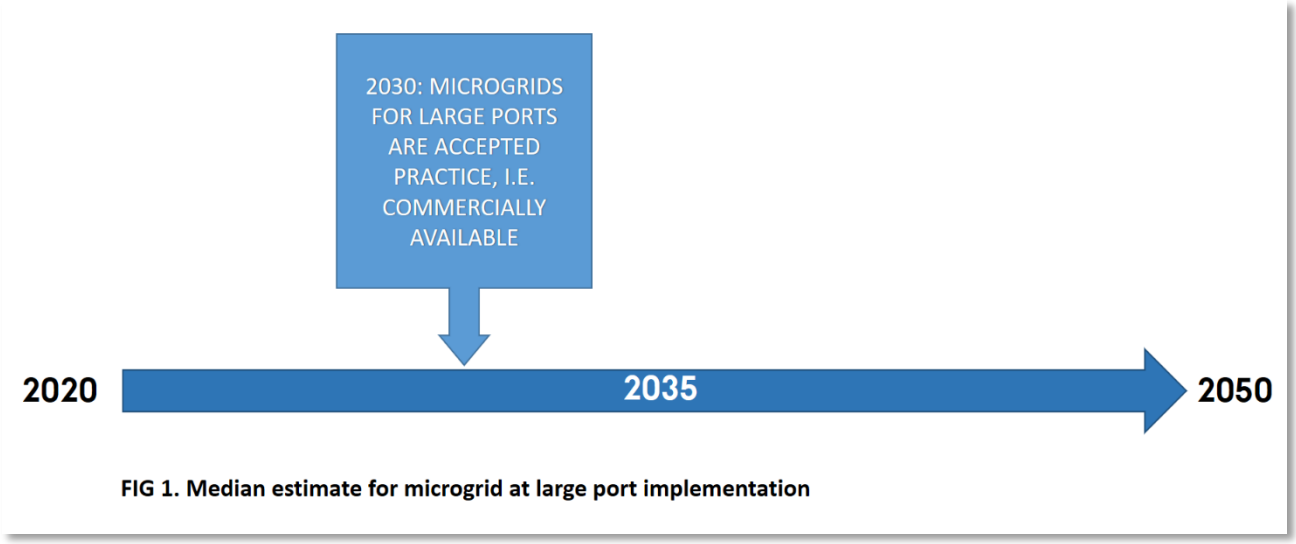

FIG 1. Median estimate for microgrid at large port implementation

4.2 WHAT IS NEED TO MAKE THIS OPPORTUNITY HAPPEN?

Respondents, in connection to their estimates, were asked to write what is needed to make this opportunity happen. This question was open-ended, so the respondents were not restricted and provided a better way to gain access to the underlying reasoning behind their estimates.

The comments from the respondents are presented below and have been divided into 4 categories, representing a Political, Economic, Social, and Technological (PEST) analysis. The text in the table are the responses. In some cases, spelling, grammatical improvements, and changes to improve comment clarity have been made. Furthermore, some comments were split in order to categorize them accordingly to their parts. These appear in no particular order.

POLITICAL
• Legislation needs to change to favour systems like microgrids, that would make it economically viable to switch to this system, and more costly to maintain than the current system using diesel fuel. • Maybe a tax can be imposed on ports to help pay for the microgrid. • The driving force here as I see it is government driven and regulation on consumption and emissions. If there is a core guidance to reduce emissions then the businesses will invest in this technology which I believe already exists • There needs to be a major shift from traditional methods to sustainable energy from government to encourage the industry to move to new technologies. • Increased costs associated with environmental impact reduction will lead to ports gradually adopting these technologies. • Financial incentives whether more tax on the shipping and port companies to deter the use of fossil fuels or even reducing tax in areas where a retrofit happens. • There will have to be political pressure as it is likely not be disruptive and expensive. • Government money. • From my point of view, this implementation will depend on port authority. This technology is expensive, so, it is necessary to have extra financial support. • The amount of time really depends on government policy/incentives. • The opportunity is completely linked to the regulations in place for each country. • Need to find the space and install the microgrids. • Locating the space. • Microgrids need to be more space-effective. • Logistical installation issues need to be resolved. • The space to deliver this.
ECONOMIC
• It basically requires the running of the microgrids to be cheaper than existing methods of power, otherwise it will never happen; the industry needs to be happy to move away from fossil fuels to power the ports.

• Reducing cost. • Technology to harness renewable energy needs to become cheaper. • Microgrids needs to be more cost-effective. • It has to be financially viable. • The cost. • Growth of throughput on the equal terminal surface.
SOCIAL
• More focus and support from all involved to make this a reality. • Once again I believe the biggest hurdle to overcome is the human factor and "this works, why change it." • It would be accepted by the public. • Patience. • People that know what they are doing. People willing to train in the procedures and do it correctly. Not slap dash. • Uptake. • More widely accepted as an alternative to fossil fuels. • People also need more education to be able to develop and manage such grids. • With groups of companies involved, the projects to retrofit may not start without an overarching responsible person. • Need to ensure the installation is seamless. • Due to a lot of ports are using old tech - revolutionising the ports to new microgrid format may look great on paper but trying to make this an actual standard practice may be hard. • More media spotlight is required to highlight this opportunity. • A driving force to become carbon neutral.
TECHNOLOGICAL
• Implementation and retro-fitting old ports with new technology will take time, even if it's a technically possible solution to implement. • It needs the infrastructure to change at ports • Installation. • Further advances in renewable technologies. • This could also help keep a standard interface to ships when cold ironing for example. • The ongoing tests in GreenLab Skive (Denmark) and other places need to reach maturity that the technology of microgrids can be widely used.

The distribution of comments among the 4 categories in the PEST analysis is depicted in figure 2 below. This figure shows that 40% of the comments can be considered political by nature, and of these, 29% are related to logistics. 30% of the comments point to social factors as driving forces, while economic and technological factors amount to 16% and 14% of the comments, respectively.

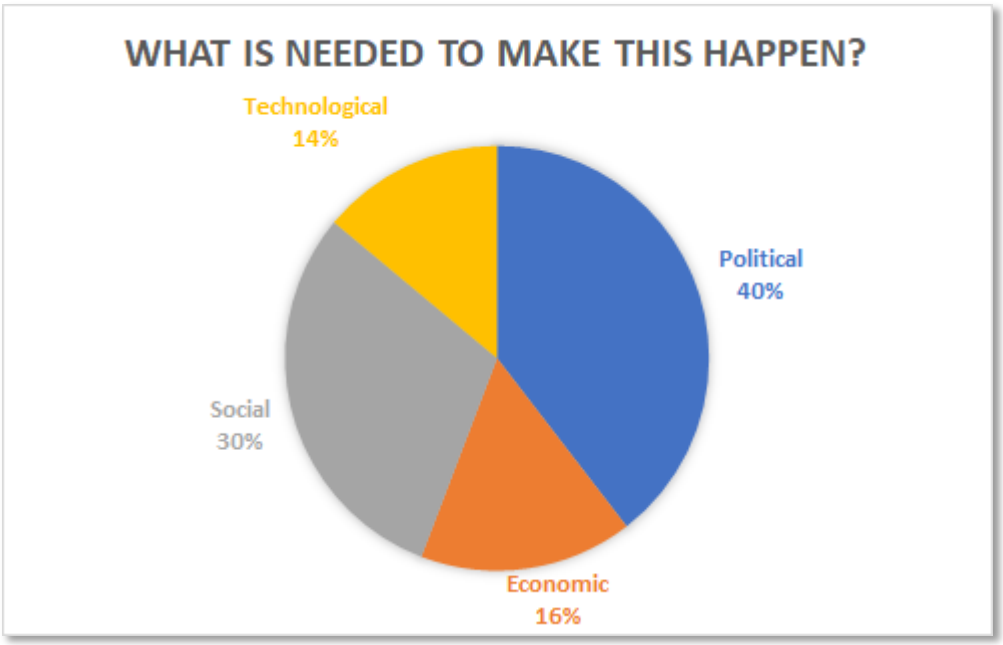

Figure 2 (above) Respondents' comments to the opportunities, categorized.

4.3 BUSINESS POTENTIAL

On the question of the business potential of microgrids at large ports, respondents, on average, rated it 3,77 out of 5.

1. ANALYSIS

This section reviews and provides commentary based on the responses.

In order to realize microgrids at large ports, respondents identified political factors as the primary driver. Respondents suggest a wide range of policies and incentives, including legislation and regulation on emissions and environmental impact, and subsidies. Taxes are furthermore suggested as a mechanism, both increasing taxes on older systems and reducing taxes on new systems.

Social factors point to the cooperation that is necessary to make microgrids at large ports accepted practice. Importantly, because of the "groups of companies involved, the projects to retrofit may not start without an overarching responsible person." But change does not happen without letting go of older practices and systems, that "revolutionising the ports to new microgrid format may look great on paper," "the biggest hurdle to overcome is the human factor and 'this works, why change it.'" Social factors also mentioned include "training," "education," and finding

people that “know what they are doing” which then indicates the potential for job creation from this opportunity.

Economic factors suggested by respondents indicate that, in the absence of policy, the technologies must become cheaper in order to make this a viable opportunity—both the microgrid systems and the renewable energy generation systems. On the other hand, if the ports can grow their “throughput on the equal terminal surface” at the port, then the increased energy requirements would make large port microgrids investments viable; however, microgrids have thusfar only been installed at smaller ports in the North Sea Region, making this counterintuitive.

Technological concerns indicate that the retro-fitting to new systems will take time, but the technology is currently feasible, but lacking scale. Microgrid installations may not only increase the practice of cold-ironing, but could help the establishment of a “standardized interface for cold-ironing,” that could allow the practice to spread across ports, where vessels can plug-in to the grid at different ports of call, and thereby reducing the need for vessels to operate their engines or auxiliary engines while not at sea. One respondent challenges the readiness of the technology, indicating that “ongoing tests in GreenLab Skive (Denmark) and other places need to reach maturity that the technology of microgrids can be widely used.”

6. BUSINESS OPPORTUNITIES

While there is a general belief that microgrids will be implemented in large ports, the cost effectiveness is a question which is also brought up by the respondents in the survey. There is a general push for renewable energy within the region, as well as from EU with minimum target of 32% renewable energy by 2030 [9], the time where the respondents expect microgrids to be implemented. Furthermore, countries in the region are expected to have an even higher share of renewable energy, e.g. Germany and Denmark.

Microgrids are currently expensive to implement. An example is the Port of San Diego who is installing a 700KW generation and 700KW storage at an estimated cost of USD 9.3 million. They expect to save on energy costs; however, half of the investment is provided as a government grant.

Another often mentioned advantage of microgrids is that it creates a secure energy supply to the port, so the disruption of electricity does not disrupt the operation of the port. While this is the case in many parts of the world where there might not be a stable electricity supply, this does not apply to the North Sea region as all the countries around the North Sea have stable and reliable electricity supply.

An important part of the reason for the investment includes the environmental advantages as discussed previous [11]. Ports has been under scrutiny for being lax about pollution and not taken responsibility by trying to improve the situation. A microgrid would help changing this perception, as there would be a focus renewable energy and the reduction of pollution [12].

We already observe periods with excess renewable energy and negative prices [10], something which might become more frequent in the future as the share of renewable growth. This would make storage like microgrids attractive. It would also allow microgrids in ports to sell electricity back to the grid at peak price if they do not have use for it themselves for a period, and in that way create an arbitrage opportunity.

On the negative side, the question remains if lower prices—which have been seen in some markets with a large share of renewables—make the business case for installing microgrids less attractive, as the savings from storage would be significantly lower. A second consideration is the current extensive research in electricity storage, e.g. Power-to-X, which might be considerably cheaper than a microgrid, making it difficult to make the projected return on existing microgrids. As a note of caution, the only country who currently has a significant capacity for storage is Switzerland. Here they use cheap electricity to pump water back up into the reservoirs to refill them. The operators of these are currently losing money due to the emergence of large amounts of renewable energy [13[.

Top 25 North Sea Ports

(thousand tonnes of gross goods weight)

1	Rotterdam	439.633
2	Antwerpen	214.030
3	Hamburg	117.152
4	Amsterdam	103.913
5	Le Havre	60.172
6	Immingham	54.081
7	London	54.035
8	Bremerhaven	47.586
9	Bergen	44.173
10	Dunkerque	42.558
11	Zeeland Seaports	38.911
12	Göteborg	38.891
13	Gent (Ghent)	33.336
14	Southampton	33.151
15	Zeebrugge	28.994
16	Wilhelmshaven	28.867
17	Tees & Hartlepool	28.156
18	Felixstowe	25.344
19	Forth	25.221
20	Dover	23.433
21	Calais	18.099
22	Medway	13.141
23	Bremen	12.125
24	Porsgrunn, Rafnes, etc	11.864
25	Tønsberg	10.709

Figure 1: Top 25 ports in the North Sea region by gross weight of goods. Source: Eurostat (2020).

Given this, it might be important to not only look at the economic case, but also include the environmental benefits, however, in such a case there will then be a need to monetize these to make microgrids more attractive, and possibly, increase the number of installations.

If these negative consequences can be overcome, there is potentially a large market for microgrids in ports. There are almost 1700 ports in the EU alone. While it is unlikely that many small ports have the financial resources or the volume large enough to justify a microgrid, this leaves still a large number [14]. Table 1 lists the largest 25 ports in the North Sea region, and one could assume that these ports should be large enough to be able to benefit from microgrids. Furthermore, it is likely that the price will decline as they become a more commonly accepted technology, making it more attractive and at the same time opening up for more (smaller and or more remote) ports being able to afford and install them.

7. CONCLUSION

The development in critical infrastructure and the trend toward the electrification of the seas provides a new context for blue growth. Large port microgrids can support this development by balancing loads in ports, allowing for improved use of renewable energy. Such large-scale opportunities would test human ingenuity, should accelerate learning and innovation, enable the establishment of new market opportunities and exports, and create jobs.

Based on the data acquired through the surveys we see that the respondents estimate implementation of large port microgrids to happen in 2030, with no respondents doubting “if” it will happen, rather, making it a question of “when” it will happen.

However, political, economic, social, and technological barriers remain. Among the political factors is a need for legislation toward environmental sustainability practices and incentives to transition away from older systems. While social pressure to transition to green energy is strong, an increase the demand for electricity will put pressure on the demand for renewable energy.

While the technological feasibility is seemingly mature, costs need to come down, and the unaddressed issues concerning logistics remain—ports may struggle to implement microgrids at their current size and footprint requirements. Over time, these should decrease in size as batteries and/or other forms for electrical storage become smaller.

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9. RESPONDENTS

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