# Portland energy recovery facility

Updated
Shore power strategy report
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Powerfuel Portland Ltd

# Powerfuel Portland ERF

Shore Power Strategy Report

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# 1 Introduction

This report is prepared in support of Powerfuel Portland Ltd's (Powerfuel) application for planning consent for an ERF at Portland Port. The report describes Powerfuel's proposals for provision of Shore Power (also referred to as cold ironing) – electricity for docked ships, which will avoid the need for ships to operate fossil fuelled generators while docked. The report has been updated to provide the additional information and clarification in relation to Shore Power requested by Dorset Council in its letter dated 30 April 2021.

The report is separated into the following chapters:

Chapter 2 considers the case for Shore Power. It describes the current situation with docking shipping and highlights the need for a Shore Power solution. It estimates the likely use.

Chapter 3 considers options for delivery of Shore Power. It assesses the options available from provision of grid electricity, the potential for on-port generation solutions and the potential for other forms of local generation and associated electricity storage.

Chapter 4 describes Powerfuel's plan for delivery of Shore Power. How electricity is provided and distributed from the Energy Recovery Facility (ERF) to the dockside.

Chapter 5 considers the benefits that Powerfuel's plan will provide. It covers emissions reductions and economic benefits to the port and surrounding areas.

Chapter 6 summarises the report with a conclusion.

# 2 Case for Shore Power

## General Case

Shipping is an essential element of the UK economy, however, as with most other elements, it is required to reduce greenhouse gas ($CO_2$) emissions and pollutants harmful to human health: nitrogen oxides ($NO_x$), sulphur dioxide ($SO_2$), particulate matter (PM2.5 and PM10), volatile organic compounds (VOCs) and ammonia ($NH_3$).

The UK's Clean Maritime Plan[1] indicates that in 2017 UK's domestic and international shipping together were responsible for 13.87MT/$CO_2$. This is 3.4% of UK's overall greenhouse gas emissions.

In 2016 UK's domestic shipping accounted for 11% of UK's $NO_x$ emissions, 2% of primary PM2.5 and 7% of $SO_2$. International shipping with the UK as a destination has been estimated to be three times larger.

[1] Department for Transport, 'Clean Maritime Plan', UK Government, July 2019

The UK Government's Clean Maritime Plan sets out how the UK will transition to zero emission shipping. In the short term, this includes Shore Power as an interim measure to avoid vessels operating diesel engines to run non-propulsion electrical system whilst in port. In the longer term, Shore Power could be used for charging fully or partially battery powered shipping.

The Commission on Climate Change's (CCC) The Sixth Carbon Budget[2] published in December 2020, sets out scenarios for the UK to reach net zero carbon by 2050. It reinforces the view on Shore Power in the Clean Maritime Plan. It states:

> "The emissions reductions in our scenarios result from some acceleration in efficiency improvements and electrification"
>
> "By 2050, 3 TWh/year of electricity is used in electric propulsion and shore power"

The Sixth Carbon Budget also indicates that whilst is sees ammonia as the main zero carbon fuel, its commercial deployment will not even start until 2030.

UK Government has recently published Decarbonising Transport[3]. It includes a commitment: "We will consult this year on the appropriate steps to support and, if needed, mandate the uptake of shore power in the UK." This commitment is justified by the following statements:

> "Plugging in domestic and international vessels while in port and ensuring charging capacity is provided for the roll out of electric ships has the potential to quickly reduce greenhouse gas and pollutant emissions from the ports and shipping sector.
>
> Shore power has a role to play in immediately reducing emissions from vessels visiting ports, and is an option that is likely to be 'low/no regrets' as vessels utilising the less energy dense alternatives will look to plug in where they can."

Policy is moving to adopt Shore Power as a means to "quickly reduce greenhouse gas and pollutant emissions". Shore Power's role in early reduction of greenhouse gases will have a disproportionate benefit in climate change mitigation compared to other solutions which will take longer to be introduced and to be adopted.

There are challenges to the introduction of Shore Power. In 'Barriers and Solutions for UK Shore-Power'[4], Tyndall Centre for Climate Change Research has considered how these challenges can be addressed. It identifies practical advantages of Shore Power:

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[2] 'The Sixth Carbon Budget' *The UK's path to Net Zero,* Committee on Climate Change, December 2020

[3] Department for Transport, 'Decarbonising Transport', *A Better, Greener Britain* UK Government, July 2021

[4] Barriers and solutions for UK shore-power. Bullock, S, Tyndall Centre for Climate Change Research, University of Manchester, December 2020

> “shore-power is a proven technology that can be implemented now. Many of the other highly-touted alternatives in shipping to tackle air pollution or climate change, such as ammonia and hydrogen, are years away at best from commercial deployment at scale.
>
> “it is one of the few technologies which deliver strongly on both air quality and climate change. For example, ammonia could be net-zero GHG, but has issues with $NO_x$ pollution; LNG cuts local air pollution, but as many interviewees pointed out, is still very high carbon”
>
> “it fits with the general drive in ports and shipping towards greater electrification”

Two challenges identified in Barriers and Solutions for UK Shore-Power relate to grid electricity.

> “The UK’s industrial electricity prices are among the highest in Europe, in part due to electricity network charges, environmental taxes and VAT.”
>
> “…there may not be grid capacity to supply sufficient power.”

Both these matters are addressed by the Portland proposal.

There are also international drivers for Shore Power. The International Maritime Organ (IMO) included Shore Power as a candidate short-term measure in 2018.[5] In addition the European Union (EU) has recently produced proposed regulations on the use of renewable and low-carbon fuels in maritime transport. If adopted, for container ships and passenger ships, with limited exceptions, the regulations will be “a ship at berth in a port of call under the jurisdiction of a Member State shall connect to on-shore power supply and use it for all energy needs while at berth”[6]. It is proposed for this to come into effect from 1st January 2030, and in the interim will drive forward provision for on-board Shore Power connection facilities on shipping in EU and UK waters.

It is important that Shore Power is provided through low carbon electricity. Whilst the carbon content of grid electricity is declining, using electricity with a lower carbon content than grid is a benefit.

Shipping sectors have different drivers for moving to Shore Power. The cruise industry has strong customer-based pressure to improve emissions; there are already signs that it is at the vanguard of the use of Shore Power. Military shipping, being government owned, is also incentivised. The UK Government plays a major role in the process of reducing emissions through legislation and as owners of shipping needs to be seen to be at the forefront. Whereas commercial shipping is likely to lag behind other shipping sectors, driven by legislation alone.

[5] Note by the International Maritime Organization to the UNFCCC Talanoa Dialogue: Adoption of the Initial IMO Strategy on Reduction of GHG Emissions from Ships and Existing IMO Activity Related to Reducing GHG Emissions in the Shipping Sector, IMO, April 2018
[6] Proposal for a Regulation of the European Parliament and of the Council on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC, European Commission, July 2021

# Case for Portland Port

Portland Port has provided information on shipping. In 2019 there were 794 calls by shipping of which 41 were cruise ships. The port had 43 bookings for 2020 and already 45 for 2021. The port is planning for expecting cruise ship visits to increase to 65 by 2025. This is driven by multiple factors, including the UK's departure from the European Union, which will diminish the current benefits of visiting the Channel Islands.

Currently just over half the cruise ships visiting Portland have the facilities for connecting to Shore Power. There is a strong trend for new cruise ships to have such facilities and as new ships tend to serve European, Caribbean and North American cruise voyages, this proportion will increase.

Portland Port has a contract with the UK Navy to provide berthing for Royal Fleet Auxiliary (RFA) ships. All thirteen RFA ships which use the port are equipped with facilities for connecting to Shore Power.

Given the already strong availability of shipping docking at Portland Port with facilities for connecting to Shore Power, there is a ready-made market for a Shore Power service. Such a service would offer a cheaper means of providing electricity to docked ships, than operating marine diesel fuelled generators, and one that has environmental benefits to the port and surrounding area.

Portland Port is very supportive of the ERF and considers Shore Power as an aspect of the proposal that is important for the port's future prosperity. In its first letter of support dated 23rd November 2020[7], it indicates (referring to the ERF as a power station) that "without the power station the port will not be able to provide shore power to the cruise lines". It goes on to say that based on discussions it has had with its cruise line customers that "in the next few years they will reach a point where they start to plan their itineraries around the port which can provide shore power".

In the port's second letter of support dated 30th July 2021[8], it provides further evidence of the importance of Shore Power as part of the "Portland Port's future operational needs… as an alternative to on-board diesel generation with its attendant airborne pollution and $CO_2$ contribution". It notes that RFA's driver for using Shore Power is "governmental policy to reduce $CO_2$ emissions from the HMG Estate and activities", and that for cruise line operators the driver "is a commercial one with their cruising clientele demanding a "greener" experience, which is underscored by rapidly changing legislation on fuels and emissions."

Portland Port's second letter of support indicates that there has been a surge in cruise ships visits for 2021 and bookings for 2022. In addition, it confirms that the number of berth days per annum used for RFA shipping in our estimates referred to later in this report, is below actual berth days over recent years.

[7] Letter from Portland Port Ltd to Head of Planning Dorset Council, November 2020
[8] Letter from Portland Port Ltd to Head of Planning Dorset Council, July 2021

# 3 Shore Power Options

Shore Power requires significant new electrical infrastructure at any port and, in most cases, significant additional electricity capacity (as indicated in Barriers and Solutions for UK Shore-Power). Both these are the case with Portland Port.

Shipping being considered for Shore Power at Portland Port, cruise and RFA, typically have electricity demands of 8MW (with a maximum of 12MW) and 2.75MW respectively.

There are principally two options, Grid Connected (whether directly from the grid of through generation connected to the grid) or Island Systems where connection to shipping from dedicated generation is totally independent of the grid.

## Island System Options

Island System options consist of generation and electrical infrastructure totally independent of grid and dedicated to Shore Power.

Shipping typically uses electricity at a frequency of 60Hz, so electricity generated has to be at 60Hz. This is a non-typical frequency in UK.

Shipping will require connection at different voltages, often depending upon the size of vessel. Generation schemes do not typically have different voltage options so Island System options either require substations to transform voltage or generators with different voltage outputs.

There are two options for Island Systems:

- Generation located at dock side for direct connection to vessels
- Remote generation with associated electrical distribution to dock side for connection to vessels.

Given the high electrical demand from docked ships, the only current feasible dockside generation is from containerised internal combustion engines. Such engines typically operate on diesel or potentially bio-diesel. Providing Shore Power through a diesel generator would have no benefit in reducing greenhouse gas ($CO_2$) emissions or reducing the emission of other pollutants, it would effectively just be relocating the source from ship to shore. Bio-diesel would be considered to have some greenhouse gas ($CO_2$) emissions reduction from a global perspective, though not the port's emissions. It provides no reduction in the emission of other pollutants.

Hydrogen fuelled internal combustion engines are feasible, but are currently produced in limited numbers and with outputs well below that needed for shipping at Portland. They would provide greenhouse gas ($CO_2$) emissions reduction at the port, though whether they provide global reduction would depend upon the production and transportation methods of the hydrogen. There would be reduction of other pollutants.

Remote generation has the potential for other forms of generation and renewable generation in particular, for instance wind, solar photo voltaic and tidal. All of these forms of generation are intermittent and without grid connection require electricity storage to be able to provide a continuous Shore Power service. With the annual energy required of between 20GWh and 25GWh, the scale of generation required is 9MW to 11MW wind or 13MW to 15MW solar photo voltaic. Both would require substantial battery storage. There is insufficient suitable unallocated space on the port for such installations. Tidal generation is not sufficiently developed to be considered.

Island System are not feasible options for Shore Power at Portland Port due to latent emissions or scale of renewable generation required.

## Grid Connected Options

Grid Connected options are connected to the UK electricity grid and may in addition have generation providing electricity for Shore Power.

Shipping typically uses electricity at a frequency of 60Hz; UK grid frequency is 50Hz. Therefore, conversion of electricity from 50Hz to 60Hz is required.

The scale of demand from shipping at Portland, up to 12MW requires substantial distribution infrastructure to the docking points at high voltage, and transformation to connection voltages at the docks.

The electricity infrastructure at the port will be required whether electricity is supplied from the grid, generation or both.

Docks are typically supplied with electricity from the UK transmission and distribution grid (grid). Substantial additional capacity above that needed for general port operation is needed for Shore Power. This can be provided by one of the following ways:

- Upgrading of the existing port grid connection.
- New grid connection and independent infrastructure for Shore Power.
- On or near site generation, connected to existing port electrical infrastructure.
- On or near site generation, connected to independent infrastructure for Shore Power.

For Portland Port to deliver Shore Power to the largest cruise ship and an RFA ship simultaneously, additional capacity of circa 15MW would be required.

Electricity on Portland is distributed by local distribution network operator (DNO) Scottish and Southern Energy (SSE). Portland is supplied from Chickerell Bulk Supply Point, which feeds nine other primary substations: Cerne Abbas, Charminster, Chickerell, Dorchester, Maiden Newton, Piddletrentide, Puddletown, Redlands and Weymouth. SSE’s forecast data indicates that Chickerell Bulk Supply Point will have just 15.97MW spare capacity by 2023/24. Adding 15MW for Shore Power will have a significant impact upon SSE’s network which will require investment by future parties requiring further electricity capacity.

Upgrading of the port's existing grid connection to circa 20MW will have serious impacts upon the port. SSE will require the port's existing connection to be upgraded from 11kV to a new primary substation connected at 33kV. This in turn will require significant upgrading of the existing port electrical infrastructure. The cost for such an arrangement is likely to be prohibitive.

For a new grid connection for 15MW, SSE will offer a connection at 33kV from its circuit which feeds Portland Primary Substation from Chickerell Bulk Supply Point. The cost for such an arrangement is likely to be between £20,000,000 and £26,000,000 and will make provision of Shore Power by the port uneconomic.

Generation, whether connected directly to grid or connected to Portland Port infrastructure requires approval from SSE as local DNO. It is understood from SSE that Chickerell Primary Substation has little or no capability for further generation to be connected to it without the addition of an additional 132/33kV transformer. The cost for such an arrangement is likely to be prohibitive.

The proposed Energy Recovery Facility (ERF) already has a connection contract with SSE for a 33kV connection. Its generation capacity of 15.2MW enables it to supply the Shore Power infrastructure at 33kV with a simple cable connection.

There are currently no commercially viable alternative options to provide grid connected Shore Power for Portland Port other than from the proposed ERF.

# 4 Powerfuel's Shore Power Delivery Plan

Powerfuel's delivery plan is based upon utilising electricity generated by the ERF to provide Shore Power to docked shipping.

Powerfuel will provide high voltage (33kV) electricity infrastructure from the ERF to the Coaling Pier and Queens Pier. This will consist of a cable connection from the ERF to a Converter Station to convert 50Hz grid connect ERF electricity to 60Hz, which is required by most shipping. This will be located between Main Road and Old Depot Road.

There will be two cable connections from the Converter Station. One to the Coaling Pier where a substation will be installed to provide up to 12MW capacity. The other to the Queens Pier where a substation will be installed to provide up to 10MW capacity.

The 12MW substation will be able to provide capacity for the largest cruise ship that can dock, or several smaller ships simultaneously. The 10MW substation is designed for smaller ships and can provide connection for several. Temporary cabling will be used to connect the substations and shipping.

The ERF will have a 5MW grid import connection, so Shore Power will be delivered from the grid during the ERF's annual maintenance shutdown. In addition, in the unlikely short-term event that more Shore Power capacity is needed that the ERF can generate, the grid will be able to supplement the capacity. However, for most of the time the ERF will export to the grid as well as provide Shore Power for shipping.

The equipment locations and cable route for Powerfuel's delivery plan are included within the application red line and shown on the application drawings.

# 5 Benefits of Shore Power Solution from ERF

Shipboard diesel generators produce emission of $CO_2$, $NO_x$ particulates and $SO_2$. A Shore Power solution from the ERF will eliminate these emissions whilst ships are docked.

From information provided by Portland Port, it is estimated that 36 cruise ships will use Shore Power in 2024, rising to 65 from 2044. In addition, Portland Port's contract with the Royal Navy provides for RFA ships to be docked for a large proportion of days per year. Between these two vessel types it is estimated that 20GWh electricity will be supplied to shipping in 2024, rising to over 24GWh in 2045.

The use of Shore Power will add to the ERF's carbon emission saving by 4,500 to 5,500 $tCO_2$/annum (refer to Fichtner's Carbon Assessment Report[9], Revision 01).

In addition, Shore Power will eliminate emissions of $NO_x$, particulate matter and $SO_2$ whilst ships are connected to it. Furthermore Fichtner's Additional Dispersion Modelling Report which plots emissions of particulate matter, $NO_2$ and $SO_2$, describes the overall emission impact of the ERF taking Shore Power into account. It shows that Shore Power use alongside the ERF will provide a net benefit in the emission of particulate matter throughout the modelled area, as the reduction in vessel diesel generation more than off-sets emissions form the ERF. For $NO_2$ reductions the report shows Shore Power use will provide a net benefit in the majority of the modelled area, leaving an extremely small increase over the remaining. There is a similar conclusion for $SO_2$, Shore Power use will provide a net benefit in the majority of the modelled area, leaving an extremely small increase over the remaining.

Portland Port's second letter of support dated 30th July 2021[10], indicates that a surge in cruise ships visits for 2021 and bookings for 2022 has outstripped the estimates used. In addition, it confirms that the number of berth days per annum used for RFA shipping is an underestimate compared to actual berth days over recent years. The estimates of electricity supplied to vessels and emissions benefits from Shore Power are therefore likely to be surpassed.

By taking electricity generated locally at the ERF, the pricing will be lower than both electricity generated from diesel and grid electricity (which addresses a barrier identified in Barriers and Solutions for UK Shore-Power). The pricing will act as a significant incentive for shipping to connect, and in the case of the RFA ships represents a saving to the public purse. Dialogue has commenced with the Royal Navy through the port regarding the RFA ships using Shore Power.

As indicated in the Economic Impact Assessment, Shore Power has beneficial impact upon local tourism spend and associated jobs. The proposed solution from

[9] Carbon Assessment Report, revision 01, Fichtner, 2021
[10] Letter from Portland Port Ltd to Head of Planning Dorset Council, July 2021

the ERF will enable this. There is also a risk to the port if Shore Power cannot be provided. It will potentially reduce the number of cruise ships visits which would impact port income and potentially reduce employment.

Whilst Shore Power is a benefit in Portland and for climate change mitigation now, it will continue to be a benefit in the future when other propulsion fuels become available. It can supply shipping with electric propulsion, it can allow engines supplied by carbon-based fuels such as Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG), to be shut down when in port, removing their emissions. It may even be used to avoid $NO_x$ emissions from net-zero carbon ammonia fuel, an issue noted in Barriers and Solutions for UK Shore-Power.

# 6 Conclusion

Should Powerfuel's application for consent for an ERF at Portland Port be successful, Powerfuel will be able to provide Shore Power to the port. There is currently no viable alternative for provision of Shore Power.

Through provision of Shore Power for cruise and RFA ships, the ERF will save at least an extra 4,500 to 5,500t$CO_2$/annum (refer to Fichtner's Carbon Assessment Report, Revision 01) and eliminate emissions of NOx, particulate matter and $SO_2$ while ships are connected to Shore Power. Shore Power use with the ERF will mean an overall reduction of particulate matter across the area of Fichtner's dispersion model (refer to Fichtner's Additional Dispersion Modelling Report). For $NO_2$ and $SO_2$ there is an emissions reduction over the majority of the modelled area with an extremely small increase over the remaining.

By being connected to the ERF, Shore Power electricity can be sold at a lower cost than either grid electricity or electricity generation from diesel, making it significantly commercially attractive to incentivise shipping.

As indicated in the Economic Impact Assessment there is a net benefit to the local economy from Shore Power and a potential loss without it.