PORT AUTHORITY
OF NEW SOUTH WALES

CONSIDERATION FOR SHORE POWER PROVISION

Monday 21 March 2022
Bays Port Precinct

Contents

1 Introduction....3

1.1 What is shore power....3

1.2 The drivers for shore power....4

1.3 Alignment with Bays West Place Strategy....4

2 Benefits from shore power....5

2.1 Carbon reduction benefits....5

2.2 Benefit estimation....6

3 Stakeholder consultation....7

3.1 Vessel and fleet considerations....7

4 Estimated costs....8

5 Stakeholder engagement....9

5.1 Maximising shore power use....9

6 Delivery and timing....10

7 Next steps....10

8 Conclusion....11

1 Introduction

This report outlines the considerations regarding the provision of shore power infrastructure at the Glebe Island and White Bay port precinct (Bays Port Precinct).

Shore power is being considered for the following vessel types and locations in the port:

- Cruise ships: White Bay Cruise Terminal (located at White Bay berth 5)
- Bulk ships: Glebe Island berths 1 and 2, and 7 and 8.

Port Authority of NSW (Port Authority) has previously undertaken a review of costs, feasibility and emissions benefits regarding shore power for cruise ships published in 2017.

Whilst there has been detailed consideration of shore power for the cruise facility at White Bay over recent years, Port Authority is now considering the future of the entire Bays Port Precinct and aligning its sustainability goals to ensure the future of the Precinct as a working port.

In recognition of Port Authority's overarching sustainability goals and net zero targets, the provision of shore power to the area is under consideration on a whole-of-precinct basis, with provision of 100% certified renewable energy rather than the standard (largely coal fired) electricity supply.

The considerations of this report include:

- Summary of benefits of shore power
- Consultation with tenant / vessel operators in both the cruise and bulk sectors
- Outline of potential CO_2 emission reduction benefit
- Considerations for maximising use of shore power
- Outline of infrastructure costs and estimated timeframe to deliver
- Further stakeholder engagement
- Risks
- Next steps

1.1 What is shore power

Shore power is an emissions control measure used in ports that provides ships with a connection to the local land-side power grid, rather than utilising the ship's engines when at berth.

Shore power has been implemented at around 35 cruise berths at 14 ports globally. The first port to provide shore power was Juneau, Alaska, in 2001. The number of ports around the world implementing shore power is rising, although this is gradual. Given the increasing response to climate change globally, it is anticipated that the growth in shore power availability at ports will increase in coming years.

From a shipping perspective the latest CLIA Australasia Environmental Technologies and Practices overview[1] of 2021 provides a very positive update of the shoreside electricity investments on board (noting that these are global figures and may likely be lower for vessels visiting White Bay now and in the future):

- 35% of global capacity are fitted to operate on shore power (up 2.3% over 2020);
- 22% of global capacity are to be retrofitted with shore power systems;
- 82% of new ships on order will be fitted with shore-side electricity systems.

While there is no known bulk shipping precinct supplied by shore power in the world, the operations at Glebe Island provide a leading opportunity to utilise shore power for its bulk shipping activities. This is due to a number of unique factors:

- There are relatively few tenant operations (up to 5 potential tenants);

[1] CLIA Releases 2021 Environmental Technologies and Practices Inventory and Oxford Economics Environmental Report | CLIA (cruising.org)

- The tenants have secured tenancy for between 5 and 10 years and have entered or proposed to enter into long term shipping contracts;
- The major shipping operator has a complementary sustainability appetite, having already invested significant capital to achieve reductions in noise from ships required under the Glebe Island and White Bay Port Noise Policy and committed to an overall reduction in carbon emissions;
- The shipping operator utilises a discrete number of ships to service its tenants;
- The duration of bulk vessel stays at each berth are relatively long at around 2-3 days per ship;
- The proposed tenants anticipate utilising either a dedicated or discrete number of ships to service their operations.

1.2 The drivers for shore power

The drivers for shore power in ports where it has been implemented have generally been community and environmental reasons (air emission and noise reduction), sustainability (to meet carbon reduction goals) or where there is a cheap supply of 'green' power such as hydro-electric power.

Locally, community and local government members have requested that Port Authority and the NSW Government consider the implementation of shore power at White Bay Cruise Terminal for a number of years. These reasons focus primarily on environmental and local community impacts, specifically to reduce air emissions within the local region and to further reduce noise from cruise ships.

A recent (July 2021) state significant development condition of consent at Glebe Island has required the installation of shore power to service a tenant within 5 years of commencement of operations (Hanson Construction Materials Pty Ltd SSD8544[2]).

From the waterside perspective, vessel operators are increasingly being required to reduce carbon emissions and increase efficiency to achieve short and longer term reductions. With the Greenhouse Gas Strategy towards 2050 released in 2018, the IMO has set the goal to reduce carbon intensity by 40% within the next decade up to 2030 and by 50% in total (70% intensity) up to 2050.

In June 2021 the IMO adopted amendments to MARPOL Annex VI, introducing an Energy Efficiency Design Index for existing ships (EEXI), in addition to the requirement for new builds via the Energy Efficiency Design Index (EEDI) which has been mandatory since 2011. The Carbon Intensity Indicator (CII) also require ships to reduce operational carbon emissions for all vessels above 5,000GT. Carbon intensity links the greenhouse gas emissions to the amount of cargo carried over distance travelled. These measures combine technical and operational approaches to improve the energy efficiency of ships[3].

1.3 Alignment with Bays West Place Strategy

In November 2021, the Department of Planning and Environment released the final Bays West Place Strategy (Place Strategy) to guide the transformation of Bays West into the future. The Place Strategy creates a long-term vision for Bays West to be delivered over time and to evolve into a mixed-use precinct integrated with enhanced port and working harbour activities to create a precinct that is innovative and sustainable. The transformation of this precinct offers the opportunity to support 'blue' economic activities, leveraging the unique maritime context and related value chains, including the deep-water berths of Bays Port, integrating with more traditional port and maritime industries and urban renewal centred around the new Bays West metro station.

One of the 14 directions set out for Bays West by the Place Strategy is to "deliver a world-class sustainable precinct which is carbon neutral and delivers efficient management of energy and water, and the elimination of waste". Provision of 100% renewable shore power for ships using the five major berths of Bays Port would

[2] https://www.ipcn.nsw.gov.au/resources/pac/media/files/pac/projects/2021/04/glebe-island-concrete-batching-plant-and-aggregate-handling-facility-ssd-8544/determination/210723_glebe-island-development-consent.pdf
[3] https://imo.org/en/MediaCentre/PressBriefings/pages/DecadeOfGHGAction.aspx

align with the Place Strategy and be a significant element in the ambition of the future Bays West to be carbon neutral.

2 Benefits from shore power

The key benefits from the use of renewable energy shore power are:

- reduction in emissions from the vessel's diesel engines/generators once the engines are turned off, this includes air emissions (sulphur oxides, particulate matter and nitrogen oxides) as well as odour;
- reduction in noise emissions, although noise from equipment required (such as cargo extraction equipment, or heating/ventilation) will continue to occur;
- reduction in carbon emissions related to the use of clean energy rather than combustion of fuel in engines.

The benefits of shore power are provided to the local community (in terms of a reduction in local air emissions and noise); to Greater Sydney for regional air quality improvements and globally in relation to reduced carbon emissions.

A commitment to renewable energy shore power would address a commitment to reduce Port Authority's Scope 3 carbon emissions (outlined further in Section 2.1). This reduction is critical to becoming a leader in our sector and in meeting our net zero goals.The implementation of the 2020 International Maritime Organization (IMO) global fuel sulphur cap regulation (IMO 2020) lowers the allowable content of marine fuels from 2.7% to 0.5%, which significantly reduces sulphur oxides and associated particulate matter emissions. These requirements and the resulting benefits were immediate starting 1 January 2020 and extend across all ship types. This is in addition to the Australian Maritime Safety Authority (AMSA)'s Low Sulphur Fuel Requirements that apply to all cruise ships in Sydney Harbour limiting 0.1% sulphur content in fuel whilst at berth.

The previous shore power studies have identified that the air quality benefits, whilst important, are in addition in what has been achieved through the use of low sulphur fuels by vessels which has realised significant air emissions reductions. Further, the carbon emission reduction while at berth while significant, is not absolute, There will always be some air emissions from a ship at berth, even with shore power connected. This is from the operation of on-board boilers which are required to operate to provide a source of heat, and as a ship will also burn fuel during connection and disconnection periods of up to 3 hours (total) each visit. Thus, shore power does not eliminate all fuel-related emissions at berth.

While the maritime sector is investing significant funding in new technologies to result in emission free or low emission shipping, a full global solution has not yet been determined which means a continued reliance on current vessel fleet and fuels. Shore power infrastructure therefore remains an important component of reducing carbon emissions.

A further significant benefit identified by Port Authority is providing leadership to the port sector and the NSW government. Should shore power proceed at the Bays Port it would be the first port in southern hemisphere committed to implementing shore power for cruise ships, and the first port globally committing to shore power for a bulk precinct. The move to implement shore power in Sydney may encourage other ports in the region to install shore power infrastructure within their own ports allowing further improvement in global carbon emissions and potentially leading to an increase in the deployment or retrofit of shore power capable vessels visiting Sydney.

2.1 Carbon reduction benefits

Port Authority intends to commit to a series of Net Zero Targets including:

- 75% reduction in absolute Scope 1 and Scope 2 emissions by 2030
- Net Zero by 2040

- 100% certified renewable electricity by 2024 (Port Authority consumption)
- Define, measure and commit to reduction in Scope 3 emissions by July 2023

A commitment to renewable energy shore power would form part of a reduction in Port Authority's Scope 3 emissions. Scope 3 carbon emissions include those related to indirect sources, and for a port this includes shipping related emissions, which is primarily due to fuel combustion[4].

2.2 Benefit estimation

Estimations of carbon reduction benefits from renewable shore power have been calculated and are provided by berth/ship type in Table 1.

The assumptions made in predicting these emission benefits include:

- Emissions calculations are based on the total generated by one year of ship visits to the Bays Port Precinct;
- Berths included in the model are Glebe Island 1, 2, 7, and 8 (including the future Hanson and multi-user facilities) and White Bay Cruise Terminal (White Bay berth 5). White Bay berth 4 (cruise overflow berth) has not been considered at this stage due to its relatively lower number of visits and similarly White Bay berth 3 has been excluded as not it is currently frequented by commercial ships;
- Annual visit numbers have been based on anticipated cargo tonnages approximately 10 years into future, this being close to capacity for the bulk berths (including projections from tenants);
- Annual cruise visit numbers have been based on the pre-pandemic visits as was scheduled for 2021, which is expected to be a reasonable projection of future visits;
- Vessel stays are based on current durations at berth (or predicted future stays for proposed developments) ;
- All shore power connection is based on the use of 100% clean energy;
- Assumptions are made regarding the proportion of ships which connect, this scenario assumes
    - 100% of bulk visits are connected to shore power
    - 85% of 'frequent' cruise ship calls and 50% of 'infrequent' calls are connected to shore power. This is based on a reasonable assumption of the number of shore power capable ships calling to Sydney in near future from information available from stakeholder consultation to date, and review of approaches used in other ports that have implemented shore power. It represents a reasonably high scenario of shore power connected calls.
- To allow for the time to connect/disconnect the power supply, it is assumed fuel is burned for 2.5 hours in each stay, so overall 'connected' time is less than the total time at berth.

Table 1 - Summary of Annual CO_2-e benefit by vessel type

Type	Berth	Power (kWh)	CO2-e (tonnes)
Cruise	WB5	5,617,900	4,109
Bulk	GI 1, 2, 7, 8	14,396,450	10,530

It is noted that Port Authority's total annual baseline Scope 1 and Scope 2 carbon emissions is of the order of **5,500t** CO_2-e per annum.

To put the carbon emission benefits of shore power in perspective:

[4] Scope 3 emissions are indirect emissions that occur in the value chain of the organisation, both upstream and downstream. For Port Authority this would include emissions from, for example: employee business travel; employee commuting; emissions associated with contracted waste disposal and water supply; leased assets such as our commercial tenancies; operational waste; capital goods; and shipping.

- The estimated benefit from use of shore power for cruise ships at WBCT is ~ 4,000 t CO_2-e per annum. Bulk shipping is approximately 2.5 times this amount at about 10,500 t (although it is noted a higher assumption in percentage connected has been made for bulk ships).

Thus at a whole of precinct level there is a significant potential carbon reduction benefit (Scope 3) from renewable shore power which surpasses Port Authority's total Scope 1 & 2 emissions by at least double.

3 Stakeholder consultation

Initial informal consultation with tenants, vessel operators and the cruise industry association has been conducted to ascertain their overall interest in shore power as a potential initiative at the Bays Port Precinct, and how this aligns with their own sustainability goals.

Further ongoing consultation with stakeholders is also required to work through the many factors around implementation, should the commitment to shore power be progressed.

3.1 Vessel and fleet considerations

Cruise

Over time the number of shore power capable ships that visit White Bay Cruise Terminal has grown. In the 2016-2017 cruise season only 26% of calls were made by shore power capable ships. That percentage now ranges between 36% to 51% and an average of just under 45%, from 2018-2019 through to the pre-COVID scheduled ships for the 2020-2021 and 2021-2022 years, as illustrated in Figure 1.

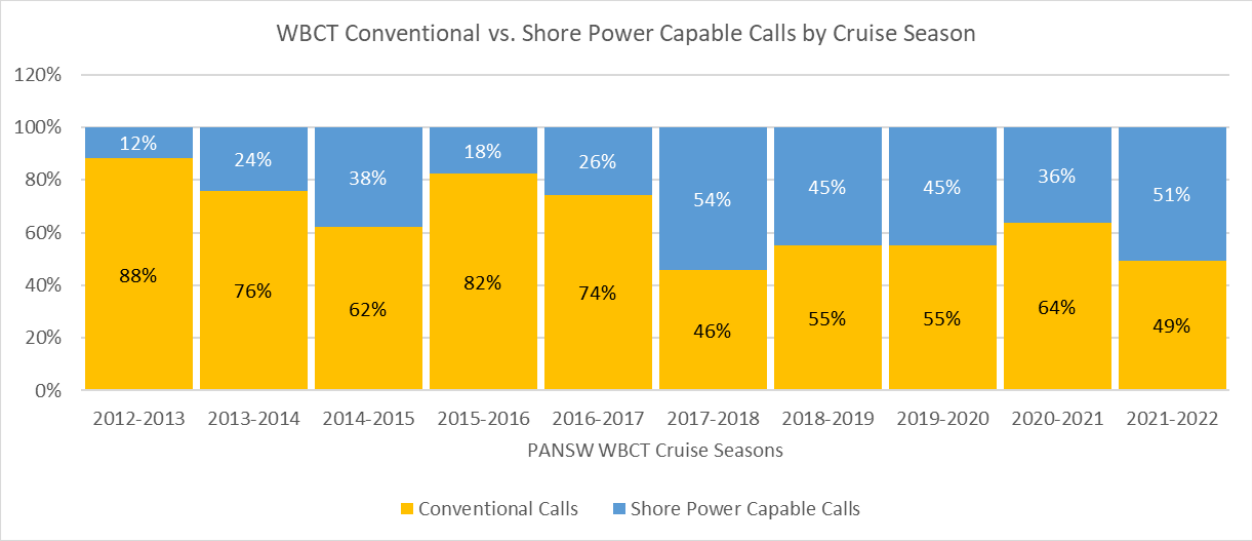

Figure 1 - WBCT Fleet Transformation – Conventional vs Shore Power Capable Calls

To date, there are seven shore power capable ships that have called or will call at WBCT through the 2021-2022 cruise season (as scheduled pre-COVID), and their associated number of calls are presented in Table 2. It is apparent that there are generally no patterns to calls, and only two cruise ships have called each year over that time, with their combined calls ranging from <1% to 34% of all calls and averaging just over 9 combined calls per season. Note that some of these systems may need to undergo re-commissioning since they have not been operated for an extended period.

Table 2 - WBCT Shore Power Capable Ship Calls, by Cruise Season

Shore Power Capable Ships	Cruise Season Calls									
	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022
Total Annual Calls	**4**	**28**	**37**	**20**	**30**	**70**	**46**	**46**	**41**	**50**

Bulk

There are no existing shore power capable ships in the existing bulk fleet that visit Glebe Island. All vessels require retrofit, or a new purpose-built vessel to be designed, to enable shore power connection.

Port Authority is aware that certain vessels that previously visited Glebe Island 8 (cement carrier) did use shore power to provide additional power during unloading (ie the vessel utilised shore power while also running its ship generators). This additional supply is currently used in the Port of Melbourne. Hence whilst full connection to shore power by a bulk ship is not currently implemented, the use of shore power connection is not an untested practice in the industry.

4 Estimated costs

Port Authority contracted Navari Pty Limited to prepare a feasibility study to investigate the feasibility, estimated cost and timeframe for providing shore power to the WBCT and Glebe Island bulk berths.

A shore power rating of 15 mega-volt amperes has been modelled at the WBCT site, which is compatible with the products currently available from shore power equipment manufacturers.

Based on information received from the electricity provider (Ausgrid Pty Limited), the optimum connection point is a 33 kilovolt (kV) connection from Rozelle Sub-transmission Substation, which would require an underground cable from Rozelle to the WBCT site, at an estimated length of 2.9 kilometres.

Investigations to date have not identified any issues that would preclude the upgrade of the local electricity network. Installation of shore power infrastructure at WBCT and Glebe Island also appear physically and technically possible.

Landside Costs – WBCT & Glebe Island

The total budget cost estimate for a complete shore power facilities at WBCT and Glebe Island, including design and investigation costs, 33 kV cable, shore power equipment, and cable system is estimated to be $46 million–$55 million, allowing for a potential range in cost estimates due to factors which require confirmation during the development phase of the project.

The estimate is pre detailed site investigation and pre-design, and assumes that power can be supplied to the precinct, without the need for upgrades at the feeding substation.

Electricity supply and operational costs

Operational costs would also need to be determined. These include for example ongoing maintenance and provision of labour during connections.

Electricity supply costs would need to be determined based on the provision of renewable energy to the Bays Port Precinct. Initial investigations have indicated that this is possible via a number of methods including sourcing of Large Scale Generation Certificates (LGCs) which allow a business to demonstrate that its electricity came from renewable energy source, which would need to be procured at rates that are commercially competitive. Alternative options include Power Purchase Agreements (PPAs) which are agreements between an independent power generator (or vendor) and a purchaser (often called the 'off-taker') for the sale and supply of energy; and Behind Meter Solar PPAs which are direct connections

between a facility and a solar installation without using power lines or meters owned by the local energy provider. It appears that LGCs are most viable, however these options would all require further detailed investigation and consultation before progressing further.

Ship Costs

The costs for retrofitting a vessel to be shore power capable have been identified based on available information from customers. These costs are as follows:

- Cruise ships – between $700K and $2.5M per ship
- Bulk ships – of the order of $1.3 million per ship

5 Stakeholder engagement

The effective use of shore power requires cooperation by industry and particularly as no bulk vessel is currently shore power enabled, the uptake of shore power for bulk vessels will require particular engagement.

Further consultation around timing, pricing and schemes to increase uptake of shore power connections and specific detailed requirements should be undertaken.

Specific cruise operators should be approached early in the process when considering development of shore power for cruise. Such coordination could address:

- Average and Peak demand (kW),
- Frequency demand (Hz),
- Time spent at berth (hrs),
- Voltage (kV), and
- Expected start year (yr) as well as confirmation of the cruise line's intention to use shore power when available

5.1 Maximising shore power use

The nature of shore power projects globally is that they are predominantly bespoke projects due to existing conditions at the terminals and berths where they have been designed or retrofitted. All but a few installations have had significant government subsidies to be progressed.

On a global scale shore power is still not a strategy being implemented by a significant number of cruise ports, and not yet occurring in bulk ports. Compounding the challenges even more, ports with shore power infrastructure have relatively low usage rates when participation is voluntary. The potential costs to industry for their vessel modifications have been outlined above. Further it is noted that the costs of burning diesel fuel is lower than the anticipated costs of supply of electricity.

There are a number of options that can be applied by ports to increase uptake of shore power where it is made available. These options all require further detailed consideration.

Mandatory Requirements

Globally, the California Air Resources Board was the first regulatory agency to mandate shore power use for specific ports and those rules have now expanded to two additional ship classes and a broader set of call criteria. The regulation only applies to passenger ships that cumulatively make five or more visits annually to a single port. However from the implementation of a mandatory requirement in California to date, this doesn't necessarily lead to high percentages of ships connecting to shore power.

It appears that by 2021 China[5], and in 2023 California, will mandate shore power on every cruise call where landside shore power infrastructure exists. By 2025, the European TEN-T Core Network ports[6] that determine there is demand and the costs are warranted, will have shore side electricity installed, and presumably available for cruise ships, and by 2026 Norway will install shore power for all cruise ships[7].

The implementation approach and business case are the predominant drivers of how successful a shore power strategy will be. Mandatory use through state or national regulation creates a 'level playing field' which avoids the potential of relocation of vessel operations. Alternatively, if the business case is beneficial for all parties then shipping lines may be more enticed to use the facilities; however, there are limits to installing equipment or repositioning shore power capable ships. Voluntary-based implementation approaches have resulted in mixed results globally.

Pricing and Incentive Schemes

It is considered that a price-based scheme to increase usage by ships, or alternatively non-price incentives such as berth priorities and the like may lead to better update of shore power use. The future investigation and development of such schemes will be key to the successful implementation of any shore power project progressed in the Bays Port.

6 Delivery and timing

With commencement of the shore power project in 2022, it is possible that all berths at Bays Port Precinct may be provided with shore power connections, within 4-5 years, with the first berth in operation by 2025. The completion of each berth would occur at different stages. The delivery would need to be investigated to balance cost efficiencies, procurement, community (local emission) benefits, and to deliver global carbon reduction benefits.

It may be cost effective to provide the electricity infrastructure in one combined project across all berths, maximising use of common cabling and infrastructure. Similarly the landside electrical infrastructure may be more cost effective to procure and provide as one single commission. These matters would be investigated in further stages.

It is understood that there is significant interest in shore power being made available for WBCT, however stakeholders must understand there will be the need to allow greater time for cruise industry alignment, understanding of technical requirements for a greater range of vessels, significant offsite works for upgrading of electricity supply, and to allow time for any vessel retrofitting to occur/redeployment before commission would be realised.

7 Next steps

The next steps in progressing implementation of shore power at the Bays Port Precinct are outlined below:

- further stakeholder consultation across customer groups including local customers, other ports in our region, state and federal government. Initially this may include development of MOUs or Letters of Intent to work in partnership to develop and utilise shore power facilities in the Bays Port Precinct;
- further investigations into technical design, risks, costs and delivery pathways;

[5] https://theicct.org/publications/action-plan-establishing-chinas-national-emission-control-area
[6] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t_en
[7] https://www.dnv.com/expert-story/maritime-impact/Norway-challenges-the-cruise-industry-to-operate-emission-free.html?utm_campaign=MA_19Q1_ART_Cru_109_Environmental+restrictions+Norwegian+fjords&utm_medi

- structure of potential schemes for appropriate pricing/incentivising of the uptake of shore power;
- investigation in to sourcing renewable electricity for shore power (and potentially for the Precinct as a whole)
- investigation into financing, and specifically availability of grants for this initiative to help offset Port Authority expenditure;
- consideration of other berths in Sydney eg OPT, and NSW cruise berths including Eden; container and other bulk ports, including understanding of costs, timeframes, interested stakeholders and potential emission benefits.

8 Conclusion

It is considered that following review of the factors considered in this report, that Port Authority makes a commitment to install shore power at the Bays Port Precinct to be provided by “carbon neutral” landside power commencing within 5 years.

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