## Guidance document – Onshore Power Supply[1]

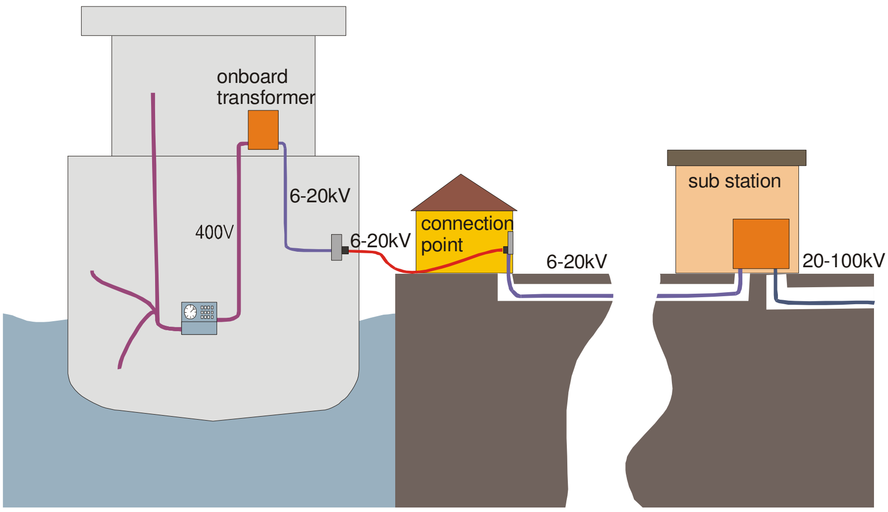
## 1. Background

Onshore Power Supply[2] (OPS) replaces onboard generated power from diesel auxiliary engines with electricity generated on-shore. OPS is a measure to improve air quality in ports and port cities. It could also reduce the greenhouse gas $CO_2$ to a minimum, if using renewable energy such as wind power.

Ports are not normally equipped to supply vessels with electricity from the shore, nor are vessels usually equipped to receive power in this way. However, this could be set to change. Around the world, many activities are taking place and interest in the technology is increasing quickly, due to tougher environmental legislation, increased focus on emissions from ports and shipping, and more recently, rising fuel prices.

Collaboration between a wide range of stakeholders at an early stage - for example, when planning for new quays and ordering new ships - is vital if the technology shall be implemented in a cost efficient way.

This guidance document describes how to implement the technology in your own port.




Connection principles, Onshore Power Supply with high voltage, for a roro-vessel in the Port of Göteborg.

## 2. Guidance for implementation

When implementing OPS it is important to include stakeholders, i.e. potential shipping lines, goods owners, local environmental authorities, suppliers of the technology, local power supplier, ship builders and the port authority/terminal operator. Some of these stakeholders should be included at a very early stage in the process, such as when planning for new quays and ordering new ships, if the technology is to be implemented in a cost efficient way.

[1] Disclaimer: the information in this document is not binding and is intended for guidance. It should not be taken as the only means of implementing such a project.
[2] There are many names for the same technology: Alternative Maritime Power (AMP), Cold Ironing, Shore Side Electricity, Onshore Power Supply, Shore Power

**PLAN- plan your implementation of Onshore Power Supply by doing a feasibility study**

1. Take advantage of the experience and knowledge in other ports, reports, authorities on OPS.
2. Find out what vessel fleet in your port would be most suitable for OPS, preferably vessels frequently calling the port, with long port stays and that provide the highest emission reduction potential.
3. Determine the technical approach by learning about electrical systems, voltages, frequencies, fuel quality and fuel consumption on the vessels.
4. Estimate the emission reduction potential using various scenarios:
   a. Vessels burning heavy fuel oil (where it is legal) compared to using preferably alternative energy like windpower or the available energy mix from the local utility company.
   b. Vessels burning low sulphur distillate fuel compared to using preferably alternative energy like windpower or the available energy mix from the local utility company.
5. Estimate the cost-effectiveness and environmental-effectiveness (including noise reduction potential for the dock workers and people working on board) by introducing this technology. Take into account current/future legislation, ISO-standard in progress, ongoing work within PIANC, increased fuel prices, possible tax reductions/incentives, state aid, the emission reduction obtained related to total emissions in the actual port/city. Separate the costs in shore investment and ship investment and make a comparison between the fuel costs and electricity costs per year.
6. Present your findings and check the interest among important stakeholders like shipping lines, ship builders, suppliers of the technology, local power suppliers and interested goods owners to start up a project on OPS.
7. Long term PLAN - Incorporate OPS when constructing new quays/wharfs, to keep the costs at a minimum.

**For more information see:**

- Evaluation of Cold-Ironing Ocean-Going Vessels at California Ports, 2006, http://www.arb.ca.gov/ports/shorepower/feasibilityreport/feasibilityreport.htm
- Shore-side electricity, Entec, 2005, http://ec.europa.eu/environment/air/pdf/task2_shoreside.pdf
- Case studies with estimate of internal and external costs, Mariterm, 2004, http://www.portgot.se/prod/hamnen/ghab/dalis2b.nsf/vyFilArkiv/Coldironing_NorthSea.pdf/$file/Coldironing_NorthSea.pdf

**DO – implementing your OPS project**

1. Select the vessel fleet/shipping line with highest cost effectiveness and environmental benefit (including noise reduction potential).
2. Choose the appropriate technical solution, make sure that all important issues are considered such as: costs of retro-fitting vs. incorporating OPS in new builds, the cost implications if the electricity infrastructure supplying the port needs to be upgraded to cope with the increase in electrical demand, the potentially lower cost of fixed cable systems used to supply vessels which dock at the same position each time vs. electrical connections for vessels which dock at different positions at a berth and/or that the use of cranes have been considered.
3. If possible, purchase energy produced from a renewable energy source to achieve a maximum environmental net benefit.
4. Establish/agree on the commercial set up in between port authority, terminal operator and shipping company. Who is paying what (investment on the quayside, on the vessel, the electricity etc)? Economic incentives offered by the port (port tariff)/state? etc.
5. Establish a Memorandum of Understanding with your client or mandate OPS as a requirement in new contracts/leases with new terminal operators.
6. Implement the technology on both the quay side/s and on the vessel/s.
7. Set up a communication plan and share your work/efforts with community, customers, employees, local authority etc.

**CHECK – measure the results**

1. Monitor the progress (economically/environmentally).
2. Evaluate how OPS was implemented (pros and cons).

**ACT – do potential improvements**

1. Introduce necessary improvements based on the evaluation and monitoring.
2. Keep on communicating the results and achievements with the port community, stakeholders.
3. When possible, prepare new quays/wharfs with the technology.
4. Whenever possible discuss the development of OPS, the environmental potential and economic incentives with authorities, politicians, shipping industry and maritime organizations.
5. Collaborate with other ports and share experience.
6. If possible enlarge the use of OPS to other vessels in your port.
7. Combine OPS with other emission reduction solutions like train shuttles, ecodriving for working machines, etc. OPS is not the sole environmental mitigation measure.

## 3. Best practices and case studies

Several OPS projects are already established or underway in Europe, North America and around the world, demonstrating the feasibility of the technology. Göteborg, Lübeck, Zeebrügge, Kotka, Kemi, Oulu (ferry and/or ro/ro), Juneau (cruise), Seattle (cruise), Port of Los Angeles (container), Port of Long Beach (container) are some of the ports that have already introduced OPS with high voltage.

**For more information see:**

- www.portgot.se (environment – shore-to-ship, links to useful documents and articles)
- http://www.c40cities.org/bestpractices/ports/
- http://www.cleanports.org/shoreside_power

## 4. Pros and cons

There are several advantages of using OPS:

- A significant reduction of local air emissions is achieved, which will benefit both the dock workers, people working on board and the neighboring communities, see table 1 below[3]:

**Table 1 Emission reduction efficiencies**

| Measure | % Emissions reduction (-) / increase (+) per vessel | | | |
|---|---|---|---|---|
| | NOx | $SO_2$ | PM | VOC |
| Shore-Side Electricity (compared with 2.7% S Residual Oil (RO)) | -97% | -96% | -96% | -94% |
| Shore-Side Electricity (compared with 0.1% S Marine Distillate (MD)) | -97% | 0% | -89% | -94% |

- When renewable power sources are used OPS can almost neutralize $CO_2$ as well as other emissions. The $CO_2$ reduction varies a lot depending on the energy source. To calculate the $CO_2$ reduction for a specific OPS case the energy source has to be considered.
- An additional benefit from using OPS instead of onboard power generation is the elimination of noise and vibration from the auxiliary engines whilst at berth, which improves the working conditions for both the people on board as well as those working on the quayside.

[3] http://ec.europa.eu/environment/air/pdf/task2_shoreside.pdf, page iii.

- As fuel prices are rising rapidly and new legislation entering into force, the economic advantages for many shipping lines are also becoming more and more obvious when considering OPS as an alternative to marine gas oil.

The major concerns when implementing OPS are:
- The use of OPS offers environmental benefits when the vessel is at berth, but not during the journey. The technology should therefore be combined with other solutions reducing air emissions.
- The electricity frequency produced by the grid may not be compatible with the electricity required by the ships. Electricity supply in the USA and some parts of Japan has a frequency of 60 Hz, while the rest of the world is offering 50 Hz. Ships are built exclusively to either 50 or 60 Hz, pending the vessel size/type. Equipment for converting in between 60 and 50 Hz would raise the costs significantly for either the port or the shipping company.
- Safety in handling high voltage cables is another important concern.
- The ISO and IEC have established working groups with the intent to develop "Publicly Available Specifications" for OPS, which will take care of the above mentioned concerns. Those specifications address OPS components for both the vessel and shore equipment.

## 5. Frequently asked questions

What is the cost for the port?
The cost of supplying high voltage electricity to the port and then to the berth can differ significantly from one port to another. This is mainly because of variations in the distance to the nearest high voltage supply, and more importantly, the number of transformer stations/connections that require upgrading. Other costs that differ include the need of additional overhead electricity lines, poles and cables underground. In addition, the cost of retrofitting cables into a terminal is usually significantly higher than installing cables in a new build terminal.

How much power is needed for an average stopover in a terminal?
That depends very much on the type of vessel and the time at berth. According to available information, a cruise vessel requires up to 15 MW load; a container vessel up to 7.5 MW load; and ferry and ro/ro vessels up to 3 MW load. The energy use is calculated by multiplying the hours the vessel is at berth.

Who benefits most from the implementation of OPS?
Apart from achieving a much better work environment onboard and in the port, the environmental benefits are the great driving force. Studies show that society is the big winner. At a rough estimate, the external costs for society are reduced by 15-75 times the cost of the system[4]. This means OPS can help ports demonstrate they are local environmental leaders and responsible citizens whose activities take place for the benefit of local communities. This helps counter any perceptions of the port as a "dirty neighbor" and can provide a platform for the port to intensify both its environmental activities and its cooperation with the local communities. Putting environmental interests at the heart of port activities affirms a port's place in the heart of its community – a "win-win" scenario for all concerned.

Is burning bunker fuels better than using electricity produced from a coal plant?
Emissions (except $CO_2$) from production of electricity in a generic EU coal power plant, are significantly lower than emissions from auxiliary engines on a non abated ship[5]. This indicates that it is not a prerequisite to use "Green Power" in order to reach a significant net environmental benefit from using OPS. It is however recommended to supply alternative energy to the connected ships when possible, to achieve the maximum reduction of $CO_2$.

[4] http://www.portgot.se/prod/hamnen/ghab/dalis2b.nsf/vyFilArkiv/Coldironing_NorthSea.pdf/$file/Coldironing_NorthSea.pdf, page 15.
[5] http://www.portgot.se/prod/hamnen/ghab/dalis2b.nsf/vyFilArkiv/Coldironing_NorthSea.pdf/$file/Coldironing_NorthSea.pdf, page 12.

In addition, stationary power plants are typically located at some distance from densely populated areas, whereas shipping emissions at quay often will occur close to city centres as a consequence of a port´s typical location. Therefore, human exposure to air pollutants should also be considered.

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*This guidance document was prepared by the Port of Göteborg, Sweden, in partnership with Port of Los Angeles and Port of Shanghai during spring/summer 2008, presented at the World Ports Climate Conference in Rotterdam 9-11 July 2008.*

*Valuable comments have also been received from the Clinton Climate Initiative, Port of Oslo, Port of Rotterdam and Stena Line.*