Facts about the onshore power supply at the Port of Oslo

Power from the onshore low-voltage power grid to small vessels is supplied on a daily basis at the Port of Oslo. Supplying high-voltage onshore power, however, is another matter. Our definition of onshore power supply is the supply of onshore high-voltage electrical power to ships at berth. Supplying high-voltage onshore power requires good planning, heavy investments, and good dialogue with users in order to succeed. Onshore power supply is important because it means cleaner air, less noise pollution and a reduction of greenhouse gases when green power is used.

- Color Line and the Port of Oslo were among the first in the country to build a high-voltage shore connection system. The Port of Oslo wishes to increase use of onshore power supply.

- The onshore power supplied to larger ships must be high-voltage electricity. The Port of Oslo is planning to supply large passenger ships with 11 kilovolts because this gives the biggest reduction of greenhouse gas emissions, improves the local air quality, and reduces noise pollution in the city harbour.

- Large passenger ships (cruise ships and international ferries) require of course large amounts of electricity. The Port of Oslo has sufficient cabling for future use at our passenger terminals to provide onshore power supply to two cruise ships, and ferries at the same time.

- In 2012, an ISO-standard was issued setting requirements for high-voltage shore connection systems. This standard will be used at the Port of Oslo.

- Most ships in international maritime traffic and almost all cruise ships use a different frequency (60 Hz) to that supplied on shore (50 Hz) in Europe. This means that the current has to be converted before it can be used on board these ships.

- Converting electricity requires onshore power stations. The Port of Oslo has begun zoning plan for our passenger terminal, which includes the installations necessary for - onshore power supplies.

- The cables are there, and the Port of Oslo is currently planning to provide passenger ferries scheduled to visit the port with the opportunity to connect to onshore power supply.

- In 2013/2014 international ferries at our passenger terminal will have the opportunity to connect to onshore power supply.

- Our goal is to offer onshore power to cruise ships berthed at our cruise terminal from 2015.

- Supplying onshore power to ships involves heavy investments. The Port of Oslo has estimated the cost of building a high-voltage shore connection system at our passenger terminal to be 60 million NOK. In 2013, consultants will provide more accurate information regarding technical solutions and costs.

- The regulations and system of charges needs to be adjusted to the onshore power supply for ships in international traffic. The Port of Oslo offers environmentally differentiated port charges already. We offer discounts to ships that use onshore power, but this is not enough. Tax on electricity must be reduced to compete with bunker fuel.

The action plan presents information on the future work on onshore power supply at the Port of Oslo. We also share our experiences and knowledge about onshore power. We hope that the action plan will help spread knowledge about onshore power supply and lead to more ports offering this solution to more ships in the future.

Onshore power supply is not new technology

The running of cables from an onshore electricity grid to small ships and boats at berth is no new phenomenon. Onshore power has been used for lighting, heating and for charging batteries on ferries and tugboats that are berthed overnight.

The power supplied makes it possible to shut down engines and still having electricity on board. This has mostly been a case of some kilowatts, perhaps up to 50 kW, which is about the equivalent for a house or a small apartment block. This is power with the same voltage and frequency found on the regular grid, either 230 or 400 volts at 50 Hz.

As an example, the Royal Yacht *Norge* has been using onshore power for many years during winter storage at the Port of Oslo. The same applies to the ferry boats to Nesodden and Bygdøy, and charter boats and tugboats that berth at the Port of Oslo.

Why is onshore power supply so complicated?

One challenge is that large passenger ships need a lot of electricity. It can be a matter of many megawatts (1000 kW). This requires many cables if it has to be supplied at the regular voltage of 230 volts. Connecting 15-20 heavy cables is neither time-efficient nor effective, especially when it comes to ships that are berthed for a short period of time.

No regular electrical outlet. Electrical connection to the ship is fully automated.

A high-voltage system is the solution

A high-voltage connection can easily supply sufficient electricity through one cable. This, however, also represents new challenges and stringent security requirements. Ships must have or install equipment for receiving high voltages and for transforming the voltage to the appropriate level for on-board usage.

For many ships this requires investments that could run into millions. Another challenge has been the lack of a uniform standard for designing such systems. This challenge has now been resolved by the recent adoption of the new ISO standard.

An international standard helps

The International Electrotechnical Committee (IEC) has developed a proposal for a brand new standard for high-voltage shore connection systems (HVSC).

This ISO standard was implemented in August 2012. It specifies how high-voltage shore connection systems (HVSC) to ships should be designed voltage to be used, 6,6 ang 11 kV. It applies to systems supplying voltages higher than 1000 volts.

The international standard does not resolve the challenge of different frequencies and voltages

Despite an international standard, the fact remains that the distribution voltage in different cities and ports can vary. Oslo uses an 11 kV distribution grid, which fits with the international standard.

When it comes to frequency, the power produced for the public grids in Europe normally has a frequency of 50 Hz. In the US, Canada and many other large countries in South America and Asia, electricity is produced at 60 Hz. In addition, 230-volt voltage is normally used for 50 Hz in public systems in Europe, while 120-volt voltage is often used for 60 Hz in corresponding systems in the US.

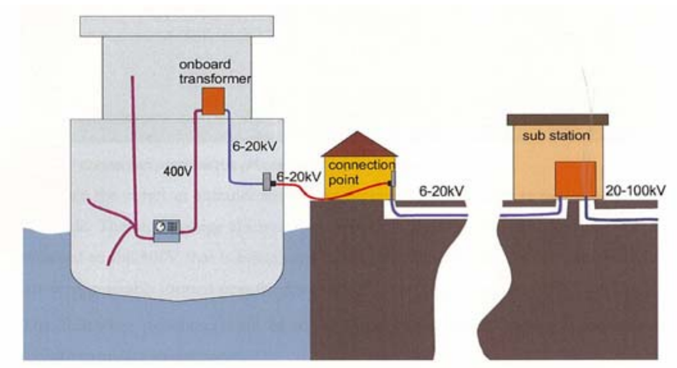
Electric engines and other electrical equipment designed to use 60 Hz and 120 volts can be destroyed if 50 Hz and 230 volts are used.

A large number of ships use 60 Hz because it allows more power to be carried in cables of the same dimension than at 50 Hz. Since the ships produce electricity using their own generators, there has been no need to take onshore frequencies into consideration. Cruise ships consume a great deal of electricity. Traditionally, cruise ships have used 60 Hz - frequency in their on board power grids. Consequently, the power systems on approximately 99 per cent of all cruise ships are based on 60 Hz.

Some large passenger ships designed for the northern European market are based on 50 Hz. An example of this is Color Line's cruise ferries that sail between Oslo and Kiel, and ferries in the Baltic sea.

Converting voltage from 50 Hz to 60 Hz requires a frequency converter. Onshore power supply to large passenger ships, particularly cruise ships, is a considerable investment, since - they use - 60 Hz and thus need a frequency converter.

The capacity of a frequency converter is proportional to the size. The space required for a frequency converter that should convert between 15 and 20 megawatts, is estimated to be between at least 150 and 200 m².



General design of a high-voltage shore connection system.

Standard plug for high-voltage onshore power supply.

1 ONSHORE POWER SUPPLY IS GOOD FOR THE ENVIRONMENT

All ships use combustion engines to run generators for producing electricity. All ships have their own systems for this. All combustion engines release emissions into the air. What is emitted depends on the fuel that is used.

Ships use either marine diesel oil or bunker fuel of varying quality. They both contain different amounts of sulphur and other chemicals.

Emissions from combustion engines generally contain carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxide (NOx), sulphur dioxide (SO_2) and particles. If combustion is incomplete, hydrocarbons (methane) are also emitted.

Greenhouse gas emissions

Onshore power represents significant benefits for the environment compared to producing electricity from fossil fuel. Using fossil fuels give maximum 40 per cent electric energy and the remaining 60 per cent is emitted heat. This is a key element in the environmental audit for onshore power supply. Bunker fuel has an effective capacity of approximately 40 per cent, compared to almost 100 per cent effective capacity using electricity. This environmental audit gives best results when the electricity comes from hydroelectric power rather than fossil fuel.

Air pollution

Air pollution from ferries and cruise ships berthed in the port is one of many sources of emissions that contribute to degraded air quality in the Oslo city centre. Reduced air quality due to emissions of particles, sulphur dioxide and nitrogen oxide increases health risks.

Due to the stronger focus on emissions into the air from ships in the port, it is a City goal to reduce these emissions. It is only natural that Oslo, as the largest public port in the country, should take the lead in adopting onshore power supply.

Noise pollution

Engines and loading and unloading of goods and vehicles all create some noise. - Noise from auxiliary engines (generators) in a modern ship poses a marginal problem, particularly in the case of modern cruise ships. In the case of older ships, it can be a nuisance. Noise from auxiliary engines is avoided with onshore power supply.

Stringent environmental requirements for shipping

Up to now, few restrictions on emissions have been imposed on the international shipping industry. This situation is changing in line with the global consensus to mitigate greenhouse gas emissions. The issue of connection large ships to onshore power when berthed in ports has been a subject of debate for the past 15-20 years.

The shipping industry is facing further restrictions of international regulations on air pollution (acidification and local air quality). Since 2010 most ships berthing in EU port must either use fuel with a maximum sulphur content of 0.1 per cent or connect to an onshore power supply. The EU strongly encourages ports to facilitate the use of onshore power supply because it also helps to reduce greenhouse gas emissions.

On the 20th of November 2002 the European Commission presented a strategy for reducing the level of emissions from ships into the air. The directive was adopted on 6 July 2005. With effect from 1 J 2010, the directive prohibited the use of all marine fuel with a sulphur content higher than 0.1 per cent while ships were at berth in ports inside the EU area. Any necessary transition to low-sulphur fuel must take place as soon as possible after arrival at berth and as late as possible before departure.

Exceptions are made for:

- Ships in regular service that berth for less than two hours.
- Ships that switch off all engines and use onshore electricity while at berth in ports.

The EU directive opens the way for trials with and use of exhaust gas cleaning systems. It is, however, assumed that emissions of sulphuric compounds into the air are at least as low as they would have been in the case of fuel types that are mandatory in the area in question, and that this can be documented.

Onshore power supply is not the only environmentally friendly solution

Creative environmental solutions are emerging because bunker fuel with low sulphur content is expensive. The IMO and the EU have already introduced stricter regulations for marine fuels in the sea areas southwards of latitude 62° N. In these areas, the Baltic Sea, the English Channel, and areas referred to as SECO (Sulphur Emission Control Area), ships must not use bunker fuels with a sulphur content exceeding 1.5 per cent. When ships are at berth in ports in these areas, the sulphur content of fuels must not exceed 0.1 per cent. This has led to significant reductions in sulphur dioxide emissions from ships at berth.

Regulations have also been introduced requiring that from 2015, ships sailing in the Baltic Sea, the North Sea, and the English Channel must use bunker fuels with a sulphur content of 0.1 per cent, reduced from 1.5 per cent.

It is possible to clean exhaust gases so that emissions are made equivalent to those emitted by low-sulphur bunker fuels. Extensive development work on such cleaning systems (known as 'scrubbers') is currently on-going, and there is reason to believe that by 2015 systems that meet these requirements will be in place.

This method generates sulphur scrubber waste that will probably have to be handled in compliance with hazardous waste regulations. The use of scrubbers will thus lead to increased waste management at ports.

Even if emissions of sulphur dioxide were reduced to almost zero, ships would still emit NOx and significant levels of CO_2. Development work is also being conducted to find methods in which the scrubbers can remove most of the NOx.

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2 THE PORT OF OSLO'S STRATEGY FOR ONSHORE POWER SUPPLY

In 2008 the Port of Oslo received the report Environmental Audit on Onshore Power Supply, prepared by the consultancy group Civitas. The report concluded that it could make good environmental-economic sense to connect international ferries to onshore power supply when at berth in the Port of Oslo.

Presented below are some of the conclusions reached in the report Environmental Audit on Onshore Power Supply (Civitas 2008):

Onshore power supply to four ferries in the Port of Oslo is undoubtedly environmentally positive. It is also a socioeconomically profitable measure. The shipping companies also end up with a small profit, even when one takes into account that fact that, under the current schedule of charges, a charge is levied on electric power supplies.

Recommendations
Ferries (1): *Negotiate and agree with the ferries' other ports of call in choice of onshore power solution.*

Ferries (2): *Proceed with establishing a onshore power supply for the ferries because it offers significant environmental benefits, it is socioeconomically profitable, and financially balanced.*

Cruise ships: *Await international standardisation of solutions before proceeding with establishing -onshore power supply for cruise ships.*

Container ships: *Proceed with studies on container ships. The preliminary studies we have conducted indicate that a solution based on 400 V has the best potential, given the size of the container ships that pass through the Port of Oslo. The solution is financially reasonable and, from a practical perspective, simple to implement. The environmental costs and benefits should be clarified before the final decision is made.*

The strategy for establishing onshore power supply at the Port of Oslo is therefore to begin with the largest sources of emissions. Establishment of onshore power supply systems to replace diesel generators has the greatest impact for ships that produce most emissions. The ships producing the most emissions also have the greatest need for power when at berth.

Passenger ferries - the first to be offered onshore power supply

The report by Civitas shows that the most environmentally economic solution was to connect the passenger ferries Color Magic, Color Fantasy, Crown of Scandinavia and Pearl Seaways to an onshore power supply system. These ships call at the Port of Oslo at Hjortneskaia and at Utstikker II at Vippetangen on a regular basis.

The ferries have predictable and scheduled visits. From a practical perspective, this is a key requirement for being able to benefit from onshore power supply.

Color Fantasy and Color Magic, which sail between Oslo and Kiel, make two-day round trips, so each ship is scheduled for arrival every other day, and berth between 10.00 and 14.00 in the Port of Oslo.

The total weekly lay time in the Port of Oslo for the two ships together is 28 hours. The pilot project on onshore power supply to Color Line's ferries was formally launched on 10 October 2011. At that time, one of the ships, Color Magic, was altered to receive onshore power supply. The other ship, Color Fantasy, was altered during a shipyard stay in the spring of 2012, and the system on board was put into operation in the autumn of 2012.

Pearl Seaways and Crown of Scandinavia, which sail between Oslo and Copenhagen, also make two-day round trips. These ships arrive at the Port of Oslo (Utstikker II) every other day, and berth between 09.45 and 16.45. With the exception of a two-week period in January/February, when the ships are normally in dock, their daily lay time is 7.5 hours.

Stena Line operates the Stena Saga between Oslo and Frederikshavn. These ships normally berth for only one hour a day at the Port of Oslo. It is less expedient to set up an onshore power supply system for ships with such short berth times.

Conclusion: *From an environmental perspective, it is currently DFDS ships Pearl Seaways and Crown of Scandinavia, which sail between Oslo and Copenhagen, that are best suited to use the new onshore power supply. It is interesting to open a dialogue towards DFDS to consider facilitating onshore power supply for these ships.*

Supplying onshore power to cruise ships is complicated and new in Norway

An international standard for high-voltage shore connection systems is now in place. It is therefore also relevant to consider onshore power supply to cruise ships. Because cruise ships do not make regular calls in the same way as the international ferries, they pose additional challenges.

Onshore power supply to cruise ships would undoubtedly be a great step forward, but few cruise ships today are able to receive onshore power. It seems as if the industry is waiting for suppliers to offer this solution. On the other hand, we must keep in mind that this will be considered as a pilot project, since nothing like this has been done in Norway before.

There are ports with onshore power supply for cruise ships, but so far there are none in operation in Europe. Some of these systems are in operation on the West Coasts of the US, Canada and Alaska. Since the USA and Canada use 60 Hz there is no need to convert the voltage.

The power requirements of the cruise ships will vary depending on size. They can use as much as 8,000 kW per ship. At the Port of Oslo a significant proportion of the ships require 60 Hz, which differs to the nominal 50 Hz on shore. We hope to be able to provide onshore power supply to two cruise ships and a ferry at the same time in our passenger terminal. This is demanding, but we believe it’s possible.

Conclusion:

Onshore power supply to cruise ships is cost-intensive. The Port of Oslo is currently obtaining more accurate costs and technological solutions for a good and flexible onshore power supply for cruise ships. There are several needs we need to take into consideration, and the final decision on how many ships the Port of Oslo will be able to simultaneously provide onshore power to have not yet been concluded. However, we have taken this into account, and have feeder cables in place along our passenger terminal (Akershusstranda) in order to be able to supply onshore power to passenger ferries and several cruise ships simultaneously.

Container ships have little impact

The container ships that call at the Port of Oslo are relatively small by international standards. In connection with the development of the South harbour (at Kneppeskjær and a new container terminal at Sjursøya), pipes for cabling are in place to the quay edge for possible future establishment of onshore power supply. This means that the Port of Oslo has allowed for the possibility to facilitate onshore power supply in these areas of the port as well.

Many of the ships have primary power systems of 230, 400 or 690 volts; in other words, they are not high-voltage. Supplying these ships with high-voltage power at ISO standards are thus unnecessary and far too costly. In addition, the ships have no equipment for handling such voltages, and most of them are not prepared to receive onshore power supply. No ISO standard exists for systems that supply onshore power with voltages lower than 1000 volts. This also presents a challenge in our work.

Conclusion:

Based on earlier conclusions, it seems useful to proceed with studies on container ships. Relevant solutions, and the environmental costs and benefits, should be clarified before a final decision regarding onshore power supplies to this group of ships is made.

Cargo ships consume little electricity

Most cargo ships have limited power consumption, thus have far less need for electricity when they berth. Furthermore, when these ships berth, they will have switched off their engines. This means that emissions are far less than those produced by large international ferries and passenger ships, and the environmental effect to give them onshore power supply is therefore less interesting for these ships.

Conclusion:

A cost-benefit analysis must be conducted on onshore power supply to ships that generate less or little of their own electricity. Preliminary evaluations show that the environmental benefit from cargo ships is currently very limited in relation to the investment that would be required.

The zoning plan includes a long-term strategy for onshore power supply

We have initiated a zoning plan for our passenger terminal (at Vippetangen). The aim is to elucidate the ferry terminal and cruise ship solutions, as well as traffic solutions, including a possible fjord tram and harbour promenade. This work will also involve discussing possible urban development and popular attractions in light of the fact that the area is subject to stringent constraints due to cultural heritage sites.

Existing and possible future buildings is evaluated as part of this work. The location of the main power station and other installations with regards to the onshore power supply will need to be elucidated in the zoning plan. It may be an advantage to decide on a location for the main power station since it needs to meet the requirements for three terminals. With respect to the technical installations associated with onshore power supply, the main power station should perhaps be given a central location at our passenger terminal (Vippetangen). The space requirements are currently estimated to be between 150 and 200 m². As in all harbours, the demand for areas accommodated for public usage causes a potential conflict of interest when it comes to other harbour related activities. Therefore, it is important to find a good architectural solution that can be integrated in the surrounding areas.

Conclusion:

The work on the zoning plan is extensive, and is expected to proceed for several years. A decision on the zoning plan is expected to be made in 2014/2015 at the earliest. This may therefore have an impact on the progress of the onshore power supply project in the Port of Oslo.

3 PROGRESS IN THE ONSHORE POWER SUPPLY PROJECT

The Port of Oslo plan to build a main power station at our passenger terminal (Vippetangen) that can provide high-voltage onshore power supply with a frequency of both 50 Hz and 60 Hz. This will provide flexibility, give us a leading position in Europe in this field, and offer good possibilities to provide onshore power supply in the future. Such flexibility makes the system complex and relatively costly, but this is the long-term solution. The complexity also makes it difficult to estimate the date of completion.

Phase 1

> ***Status:***
>
> *See the map for details. Four feeder cables have been laid to date, from Pipervika, point A to point C. One of the cables was extended to the other side of Skippergata. A 'private' cable and one 160 mm pipe were laid from point C to the other side of Skippergata. Two 'private' cables and one 160 mm pipe were laid from point C to point E. Two 'private' cables and one 160 mm pipe were laid from point C to point B.*

Phase 2

- Feeding of cables to the DFDS terminal, which can be located either in a building or as a freestanding structure, must be further elucidated. Especially in relation to the work on the zoning plan for the whole passenger terminal (at Vippetangen).

Conclusion:

Supplying cables to the DFDS ferry terminal and setting up an onshore power supply at the terminal can possibly be carried out in the spring/summer of 2013. This is provided that the location of the power station on the quay has been clarified. The goal is to obtain speedy clarification on the location, and thus continue further work on feeding cable to the quay. The ferry terminal may be able to provide connection to 50 Hz in the course of 2014.

Phase 3

- Building of the main power station with frequency transformers requires clarification of the location. This is the difficult part of the project, because it may require as much as 150-200 m² of space in an existing or new building.
- After that, the remaining piping and cabling can be run from the main power station to the quays at Søndre Akershuskai/Revierkaia.
- Sufficient time must be allowed for procurements. A converter of this size has never been built before. This means that we must take this into account when preparing a realistic progress plan.
- Provided that the location of the main power station is clarified in the zoning plan and that the project is allocated the necessary resources, the goal is to be able to provide onshore power for cruise ships from 2015.

Conclusion:

While we would like to be able to facilitate onshore power supply for cruise ships immediately, experience shows that these processes take time. It is the clarification of the location that will have the greatest impact on the project progress. We therefore estimate that we will be able to provide onshore power to cruise ships at our passenger terminal (between Akershusstranda and Vippetangen) in 2015 at the earliest.

Future customers for the onshore power supply

The Port of Oslo works towards offering onshore power supply to those shipping companies that are interested in this solution. There is a clear environmental benefit to be derived from connecting many international ferries and cruise ships to an onshore power supply.

The Port of Oslo is conducting dialogue with DFDS with a view to establishing and using onshore power supply. The supply of onshore power DFDS can be executed as a separate installation, though using the same trenches as for onshore power supplied to cruise ships at a later phase. The most appropriate user would be DFDS, which has 7.5 hours in lay time in our passenger terminal.

With respect to cruise ships, the Port of Oslo has a good dialogue with Holland America Line Holland America Line has been using onshore power supply for its ships for many years, and has also been involved in planning and developing the onshore power supply in Seattle and ports in Alaska. Due to the environmental benefit, Holland America Line was very quick to realise that if a cruise ship must lie in the middle of a city or a nature reserve in Alaska, then connection to onshore power supply was the only solution. Holland America Line has been the largest provider of cruises to Alaska for many years.

"Holland America Line is pleased to work with the Port of Oslo on their plans to implement an onshore power supply," said Stein Kruse, President and CEO. "As a company, we are dedicated to reducing air emissions as part of our commitment to responsible environmental practices and support the efforts of our business partners to do the same."

"We have invested millions of dollars in outfitting our ships to take advantage of onshore power supply. We sincerely appreciate the leadership of ports like Oslo to set an example for others to follow."

Other shipping companies are also showing an interest in onshore power supply, but so far few of them have ships that can use this solution today.

4 FINANCE

Due to the decision on the Fjord City project, the Port of Oslo has undergone major changes in recent years. Areas which once were used for port activities have been relocated and developed. We have invested in new quays and installations in our core areas. As with other investments, it is prudent to invest in systems with long life spans.

Large shore connection systems will be implemented as independent projects. In connection with upgrading of seafront areas and building of new sections in the port, etc. onshore power supply can be included as part of a larger project and be budgeted for accordingly. The systems that are completed or started up are independent projects with their own financing.

The cabling has already taken in account the supply of onshore power to several ships simultaneously at Vippetangen. This means that large amounts of electricity will be available for ships to connect to. Reserving such large amounts of electricity can incur some costs on the Port of Oslo during the period before the system is ready to use. This issue has not yet been clarified.

Preliminary estimate of cost

The largest cost item in the project relates to the main power station, the transformer solution and necessary frequency converters.

In total, the cost of the onshore power supply at our passenger terminal (Søndre Akershuskai, Vippetangen to Revierkaia) is currently estimated to be 60 million NOK.

The public enterprise Enova has approved a grant of NOK 8 million (13.3 per cent of the estimated cost) for the project for the period 2012-2015. Enova provides financial support or grants for environmentally friendly reorganisation of energy consumption. The grant is paid as the project is gradually realised. Grants from other funds and support schemes will be considered. As this will be a pioneer project by Norwegian standards, we hope others will want to be involved in realising it with us.

Conclusion:

The total cost of completing a flexible, high-voltage onshore power supply is currently being mapped out in detail. We have at this point not yet finalised full financing of the project.

The principle of financial responsibility

Normally, the port should recoup its investments in its projects over time. This is known as the financial responsibility principle. The port's independent financial position, which is regulated by the Harbour Act, still applies, and that it should be self-financing. We are now working on establishing a clear overview of costs, but what is more uncertain is what aspects of the onshore power project will generate income. The Port of Oslo considers the establishment of onshore power supply as a vital project for Fjord City. The onshore power project has therefore been placed in a broader, socioeconomic perspective than one of financial responsibility alone.

Financial benefits of onshore power supply

A key prerequisite for enabling ships to use onshore power is that it is attractive to customers/users. It will be important that the financial benefits are favourable when compared to alternative options. Another important point is that it should be simple, both to connect to and to settle payment for power consumed.

This means that the Port of Oslo must arrange for supplying the power and for payment settlement, which can be done in conjunction with invoices for charges and fees that are submitted to the ship's agent. This will particularly apply for cruise ships.

This requires the Port of Oslo to be a customer of energy suppliers and the local/regional licensee for purchasing energy and for grid rental. The Port of Oslo will then be able to charge a mark-up to cover the costs of its investments over time.

Energy consumption while at berth in the Port of Oslo, per year

	Fuel consumption at quays in Port of Oslo tonnes/year	Power load kW	Energy consumption while at berth in the Port of Oslo kWh/year
Color Line			
Color Fantasy	555	3,525	2,467,156
Color Magic	555	3,525	2,467,156
DFDS			
Pearl of Scandinavia	577	1,998	2,622,441
Crown of Scandinavia	579	2,004	2,630,381
Stena Line			
Stena Saga	264	2,200	1,210,323

Which revenues can be expected through offering onshore power supply depends on:

- how many ships take up the offer of onshore power
- the price of energy
- what is considered a competitive price for onshore power

This is where the Port of Oslo's profit margin will lie. This is provided that tax issues related to the supplying of power to ships in international shipping are clarified.

Financial situation for the onshore power supply project for Color Line

Establishing onshore power supply is a costly undertaking. Color Line has borne the largest portion of the investments at their terminal (at Hjortnes), which are budgeted at 24 million NOK. Grants amounting to between 7 and 8 million NOK have been provided by Enova, Transnova and the Port of Oslo. The company has paid the remainder itself.

Jan Helge Pile, Project Director in Color Line Marine A/S, describes the situation as follows:

By switching to onshore power supply in the Port of Oslo, the ships use electrical energy from the Norwegian energy market instead of electrical energy generated by the ship's auxiliary engines burning marine gas oil. The price of electrical energy in the Norwegian (Nordic) market and the price of gas oil fluctuate over time. Since regular use of onshore power supply started up earlier this year (2012), the price of electricity in the Norway has been much cheaper than what we manage to generate with marine gas oil on board.

For example, the price we paid for electricity in August 2012 was NOK 0.42/kWh (with all variable and fixed charges included). With the current price of oil and the dollar exchange rate, the price of energy generated on board for the same month was NOK 1.26/kWh. (In June it was approximately NOK 1/kWh on board). This of course means significant savings at the moment, but in our budgets we take neither the currently very low price of electricity nor the high price of oil into account.

With an estimated annual consumption of up to 4 GWh, we expect to save up to 1 million NOK per ship per year in our budgets. Even if that figure could be slightly higher with today's prices, we don't have to go further back in time than the winter of 2010/2011, when the price of electric energy was so high that it was on the same level as the price for the energy we generated ourselves from marine gas oil.

With this relatively long repayment period, and from a purely business perspective, this is perhaps not an optimum project financially. Expecting the price of electric power to remain low for more than ten years ahead is a considerable business risk. But from the perspective of corporate social responsibility, this is clearly a positive initiative.