Examining the Commercial Viability of Cold Ironing

- Shore-side electricity
- Shore-connected electricity supply
- Shore power
- Shore-to-ship
- Cold ironing
- Alternative Maritime Power (AMP)
- Onshore Power Supply (OPS)

- Introduction
  Technology
  Best practice of today
  Environmental benefits

- Commercial viability
  Internal costs
  External costs
  The Stora Enso case

- Further development
  Standardization
  OPS project

- Conclusion

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Port of Göteborg
will be an environmentally strong link in the logistics chain

1,220 employees
Turnover SEK 1.6 billion
Profit SEK 75 million after financial items
Member of West Sweden Seaports
100% owned by City of Göteborg

Ro/ro – 625 300 units
Containers – 862 500 TEU
Oil – 22.8 million tonnes
Cars – 271 500
International Passengers – 1.9 million

…largest in Scandinavia
Technology

• OPS replaces onboard generated power from diesel auxiliary engines with electricity generated on-shore (high voltages)

• Growing interest for implementing OPS due to
  - bad air quality in port cities
  - the climate crisis
  - predicted raise of oil price

Connection principles
OPS with high voltage, for a ro/ro-vessel

Wikipedia
Cold Ironing is the process of providing shore-side electrical power to a ship at berth while its main and auxiliary engines are turned off. Cold ironing permits emergency equipment, refrigeration, cooling, heating, lighting, and other equipment to receive continuous electrical power while the ship loads or unloads its cargo.
Current cases using OPS (high voltage)

Ports
Göteborg, Lübeck, Zeebrügge, Ro/ro and/or
Kotka, Kemi, Oulu, Ferries
Juneau, Seattle, Cruise
Antwerp, Container
Port of Los Angeles, Container
Port of Long Beach, Container
San Fransisco, San Diego ...

Ship owner/Goods owner/Line Management
NYK, China Shipping, Evergreen, MOL,
Princess Cruise, Stena Line, Stora Enso,
Wagenborg, TransAtlantic, SOL, TransLumni,
Cobelfret ...

Suppliers
ABB, ESL, Cavotec, Siemens, SAM, Terasaki,
Patton & Cooke, Callenberg Engineering ...

...please help us to make the list longer!
Ongoing investigations OPS in ports

Source: Shore-side power supply. A feasibility study and a technical solution for an on-shore electrical infrastructure to supply vessels with electric power while in port, Master of Science Thesis, Patrik Ericsson, Ismir Fazlagic (2008), ABB
Development of Onshore Power Supply (OPS) in Göteborg

- First equipment for high voltage OPS was installed in year 2000 by ABB
- High voltage makes it more convenient to operate
- Stora Enso the prime mover, “green” logistic chain
- Wind powered
- Zero emission of NOx, SOx, PM, CO2 and reduction of noise in port
- About 10 vessels are connecting, >20 % of the calls
- Ferries and Roro vessels, so far...
- All new quays are prepared with canalization for OPS
- Vision to connect all ferries and roro vessels!
Environmental benefits

Source: Entec, Shore-side electricity report (2005), Wind power statistics from the local supplier, Din el (2009)
Environmental benefits

NEA, Nuclear Energy Outlook (2008), Methodex Emissions calculator, grey bars
Not a life cycle analysis

Electricity for onshore power supply

Extraction of raw material ➔ Transportation of raw material ➔ Electricity production ➔ Transmission of electricity ➔ Electricity consumption onboard the ship

Oil for using auxiliary engine

Extraction of oil ➔ Transportation of oil ➔ Refinement of oil ➔ Transportation of oil ➔ Fuel consumption onboard the ship

Pink parts are included in the emission calculated
Commercial analysis - variables

- Bunker price
- Electricity price
  - tax
- Investment
  - Retrofitting or new built ship
  - Retrofitting or new built port
  - 50/60 Hz
  - number of calls
- CO2 – price?
- Cost sharing between port authority, port terminal and shipowner

ICE Gasoil price development

Oct 2009
640US$/tonne

Oct 2008
1000US$/tonne

Graph J: Composition of electricity prices for nonseasonal consumers on 1 January 2011 (in euro per 100 kWh)

Standard consumer Dc: annual consumption of 3 500 kWh

Source: EUROSTAT
# Commercial analysis of OPS vs Auxiliary engine

## Case ro/ro Sweden-today  Oct - 09

### General data
- **Exchange rate**: 0.62 €/$
- **Bunker price MGO 0.1%**: 640 $/MT
- **Retrofitting of quay**: 200 000 €/quay
- **External fundings**: 60 000 €/quay
- **Power demand**: 1 200 kW
- **Stop over time**: 14 tim
- **Energy demand**: 16 800 kWh/call
- **Call per week**: 4 number/week
- **Bunker consumption per produced energy**: 0.20 kg/KWh
- **Maintenance cost auxiliary engine**: 0 €/h
- **Maintenance cost OPS**: 0 €/quay, year
- **Electricity cost excl tax**: 0.060 €/kWh
- **Electricity tax**: 0.025 €/kWh
- **Electricity cost incl tax**: 0.085 €/kWh
- **CO2 cost**: 0.0 €/MT
- **CO2/MT bunker**: 2.6 €/MT

### Auxiliary engine
- **Bunker cost**: 277 316 €/year
- **Maintenance cost**: 0 €/year
- **CO2 cost**: 0 €/year
- **Sum**: 277 316 €/year

### OPS on Ship
- **Cost to retrofit the vessel**: 400 000 €
- **Number of ships**: 1
- **Total investment cost**: 400 000 €
- **Pay off time**: 10 Year
- **Interest**: 6.0%
- **Capital cost**: 54 347 €/year
- **Electricity cost**: 297 024 €/year
- **Sum**: 351 371 €/year

### OPS in Port
- **Number of quays**: 2
- **Investment for all quays**: 280 000 €
- **Pay off time**: 10 Year
- **Investment interest**: 6.0%
- **Capital cost**: 38 043 €/year
- **Maintenance cost**: 0 €/year
- **Sum**: 38 043 €/year

### Total Cost/Saving
- **Total Cost/Saving**: -112 099

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**Variable data**

**Aux Engine Costs**

**OPS Costs**

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**Port A**

2 calls/week

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**Port B**

2 calls/week
Case ro/ro Sweden-today Oct - 09

Bunker: 640 $/tonne
Cost: 110 000 €/year
Case ro/ro Sweden-yesterday  Oct - 08

Bunker: 1 000 $/tonne
Saving: 44 000 €/year
Case ro/ro Sweden- tomorrow? Oct -XX

Bunker: 640 $/tonne, no electricity tax
Cost: 25 000 €/year
Case ro/ro Sweden- tomorrow?  Oct -XX

Bunker: 640 $/tonne, no electricity tax, predicted CO2 price 15 €/tonne
Cost saving: 2 500 €/year
Case ro/ro Sweden - tomorrow?  Oct -XX

Bunker: 1 000 $/tonne, no electricity tax, predicted CO2 price 15 €/tonne
Cost saving: 160 000 €/year

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Aux Engine

OPS

Port invest
Ship invest
Break even points

Bunker price $/tonne

€/year

- AUX+CO2
- AUX
- OPS
- OPS excl tax
Comparison of external and internal costs for onboard and shore-side generation of electricity for a roro case using Gasoil 0,1% and EU el. mix


Using wind power will make it even more favourable!
Experiences so far

- Operative since 2000 without any major incidents or problems
- Maintenance costs for aux engines kept to a minimum
- Reduced CO2 emissions by ~2 500 tons per vessel and year
- Noise reduction positive for the environment and crew
- Cost effective
Running cost for a connected ship data from Stora Enso 2008

**Shore power**

**Investment**
- ~200 000€ per vessel
- ~500 000€ per port

**Running costs**
- ~70 000€ power supply per vessel

**Savings**
- ~60 000€ MGO in port
- Extra cost per year 90 000€
- Extra cost per day 246€
- Extra cost per lm: 0,18€ → 2.5€ per trailer
Further development

Co-operation between important stakeholders
potential shipping lines,
suppliers of the technology,
local power supplier,
port operator/port authority
potential funders/investors…

Ongoing work
WPCI – World Ports Climate Initiative
ISO - International Organization for Standardization
IEC - International Electrotechnical Commission
World Ports Climate Initiative OPS Project

Overall goal
Reduce local air pollutants and greenhouse gas emissions by stimulating as many ports, terminal operators and shipping lines worldwide to implement the technology of OPS where practical and useful.

The project will stimulate further use of Onshore Power Supply (OPS) by designing and building a web based application, which provides practical guidance on OPS.

Project leader: Ms Susann Dutt, Port of Göteborg, susann.dutt@portgot.se
Participating ports: Amsterdam, Antwerp, Göteborg, Hamburg

For more information about the project contact susann.dutt@portgot.se or look into www.portgot.se
OPS questionnaire

- 53 ports, 80% European, 20% Asia, USA, Africa ...
- 17 provide OPS today, 6 high voltage and/or 14 low voltage
- 85% answer yes or maybe on the question if they plan to introduce/expand the technology within 5-10 years
- A majority, 86%, will invest in OPS high voltage
- Main arguments for introducing/expanding the technology:
  - Environmental benefits (85%)
  - Reputation/goodwill (63%)
  - Benefit for the society (48%)
  - Customers (35%)
- 18 ports are planning to introduce/expand OPS for Container, 14 for cruise, 21 for ro/ro and 16 ports for other kind of ships.

For more information about the project see: www.portgot.se
Pros and cons

+ Significant reduction of local air emissions
+ Elimination of noise and vibration
+ Improved working conditions
+ When renewable energy or EU el mix is used greenhouse gases are reduced
+ Exemption from the requirement of using 0.1 % fuel
+ Economic advantages if the oil price raise

- No environmental benefits during the journey
- Ports and vessels have to be retrofitted
- Converting 60 Hz / 50 Hz raises the cost significantly
- No existing standard, but under progress within ISO and IEC

The energy for OPS in Port of Göteborg comes from two wind mills
Conclusion

- OPS is one among other measures to cut emissions from ships.
- If you predict a higher oil price or GHG emission price implementation of OPS means cost cutting.
- Implementation of OPS means:
  - supporting “green” logistic chains
  - better conditions for people living and working around the port
  - if starting now you will be a pioneer and benefit from good publicity
- Connecting shipping lines and ports will show that the maritime sector is not just the key to good economy but also the key to sustainability.

Photo from Port of Göteborg

Thank you for your attention.
Bonus pictures...
Cable connected to the vessel
Connection point at the quay
Outlet at the quay, connection point
Further information...

- www.portgot.se (fact sheet, program produce by French TV3, article by Bunker Spot…)


- Electrical Manager Mr Per Lindeberg per.lindeberg@portgot.se