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) •

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- **Introduction**
  Technology
  Best practice of today
  Environmental benefits
- **Commercial viability**
  Internal costs
  External costs
  The Stora Enso case
- **Further development**
  Standardization
  OPS project
- **Conclusion**

PORT OF GÖTEBORG

Port of Göteborg

will be an environmentally strong link in the logistics chain

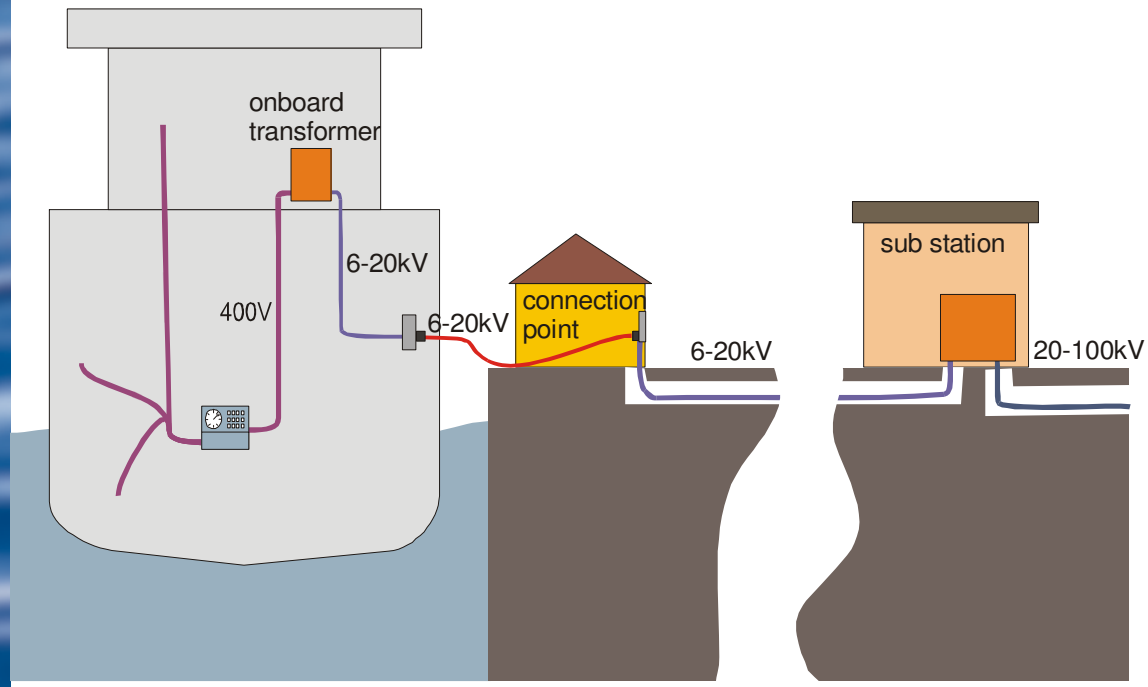
1,220 employees
Turnover SEK 1.6 billion
Profit SEK 75 million after financial items
Member of West Sweden Seaports
100% owned by City of Göteborg

2008

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



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

- 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

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.

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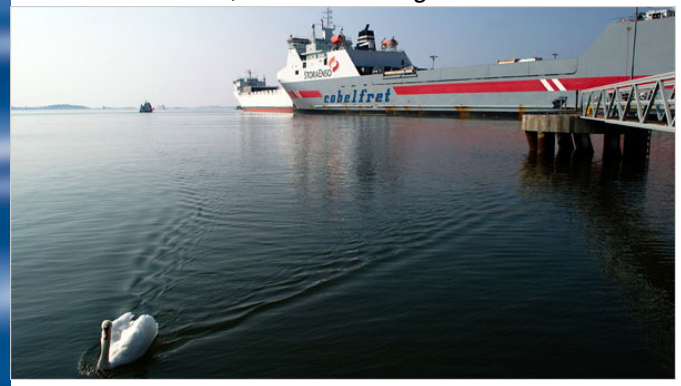
Current cases using OPS (high voltage)

Container terminal, Port of Los Angeles



Port of Göteborg,
photo The New York Times/Dean C.K. Cox

这就保证能满足船舶各种电气设备的用电需求。

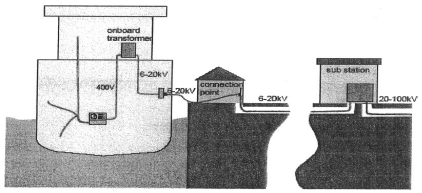


图 1 船舶接用岸电的示意图

码头（提供岸电）和靠港船舶（接受岸电）各自都专门带有一套岸电系统。

船舶的岸电系统包括三部分：①插座屏：一般在船尾，用来连接来自码头的电缆；

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!

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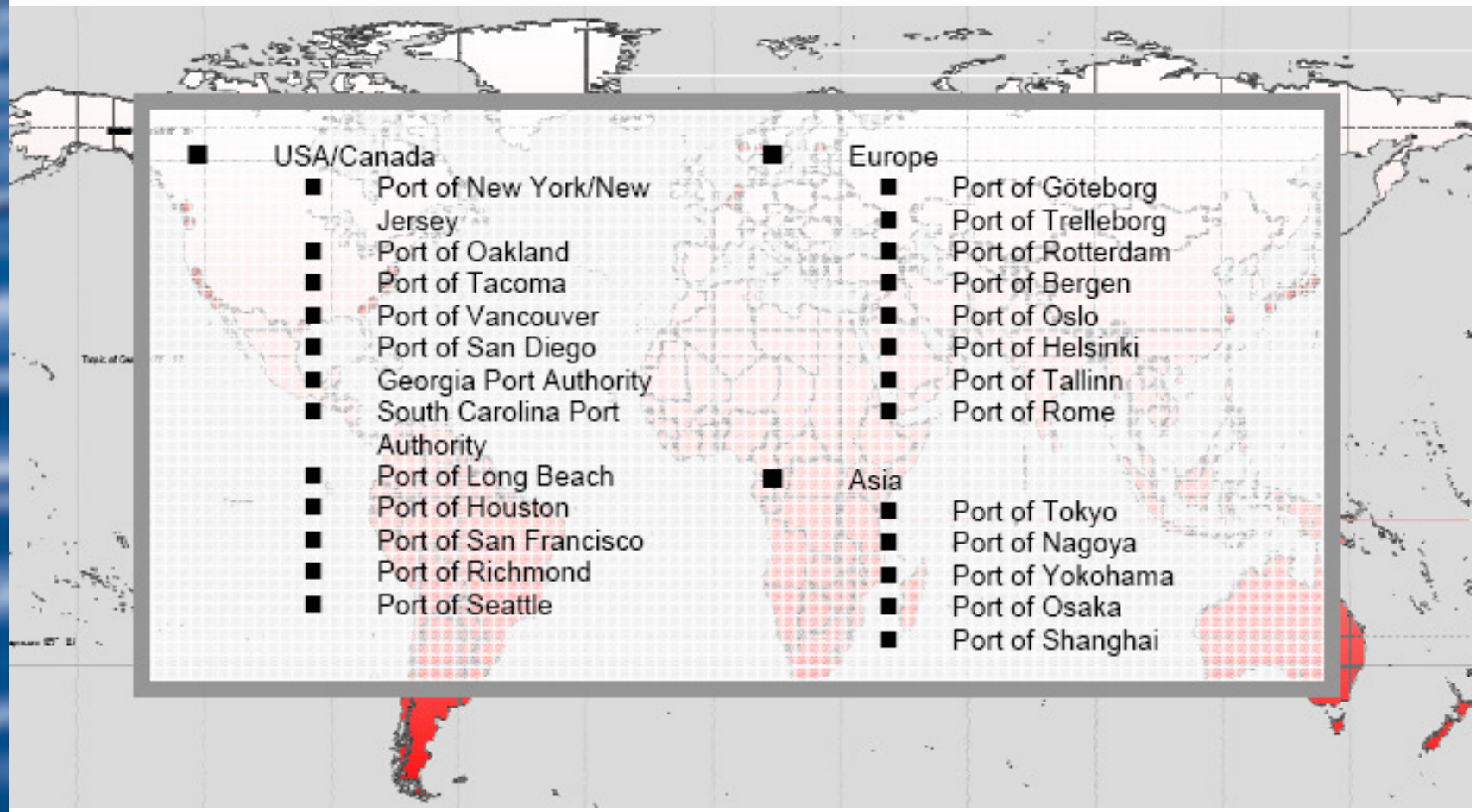
Ongoing investigations OPS in ports



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

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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!

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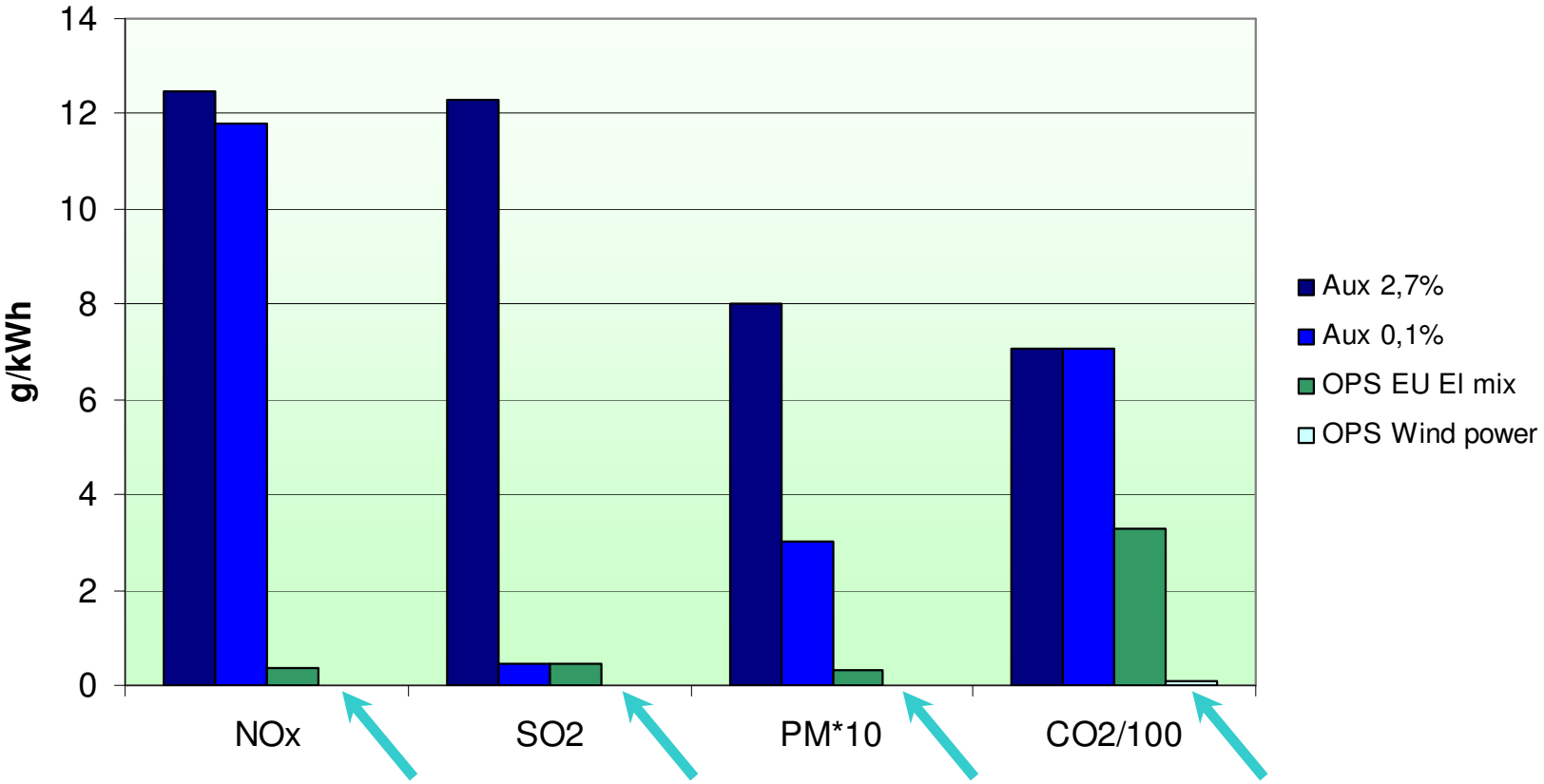
Environmental benefits



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

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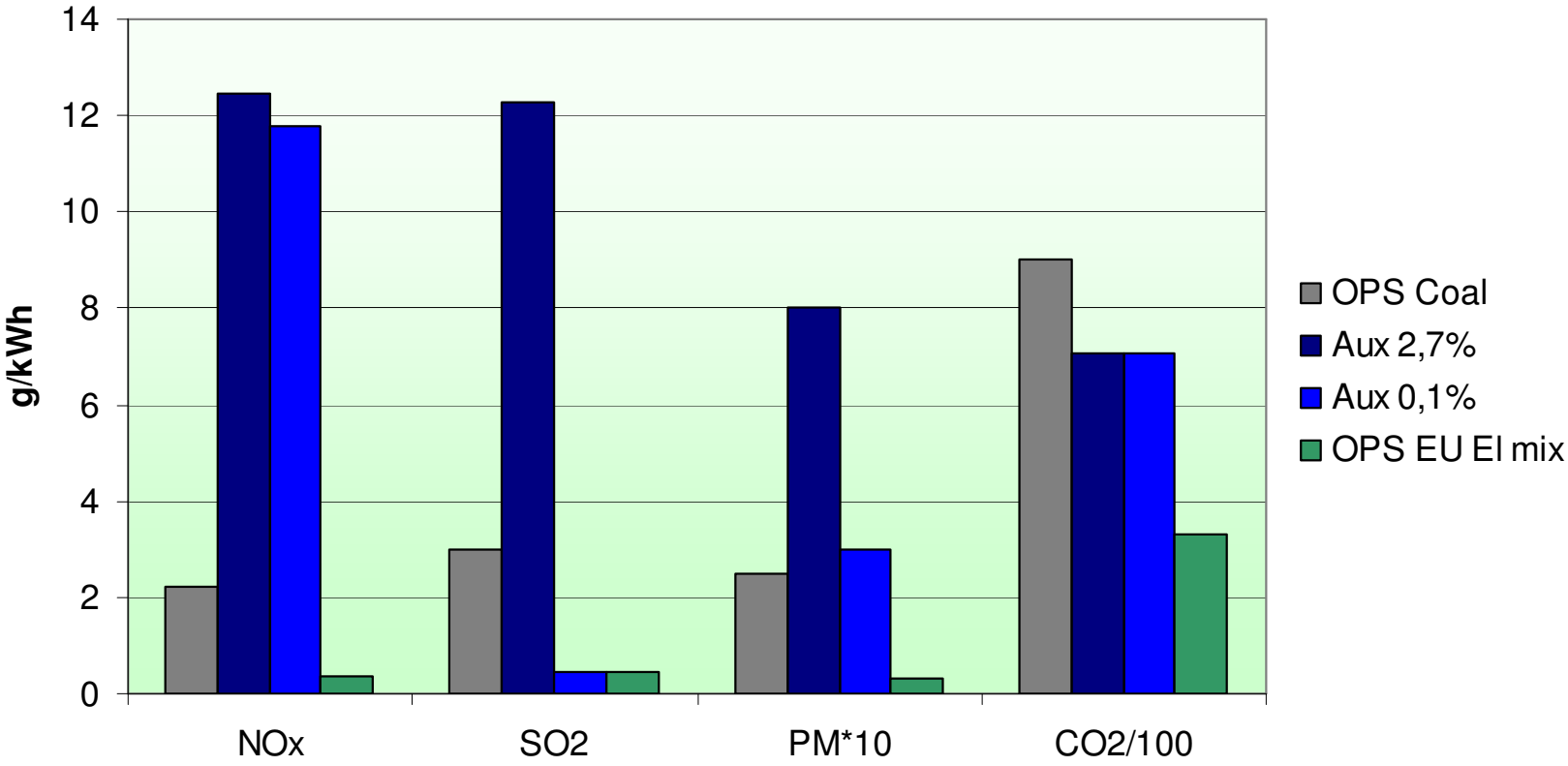
Environmental benefits



Source: Entec, Shore-side electricity report (2005) blue and green bars

NEA, Nuclear Energy Outlook (2008), Methodex Emissions calculator, grey bars

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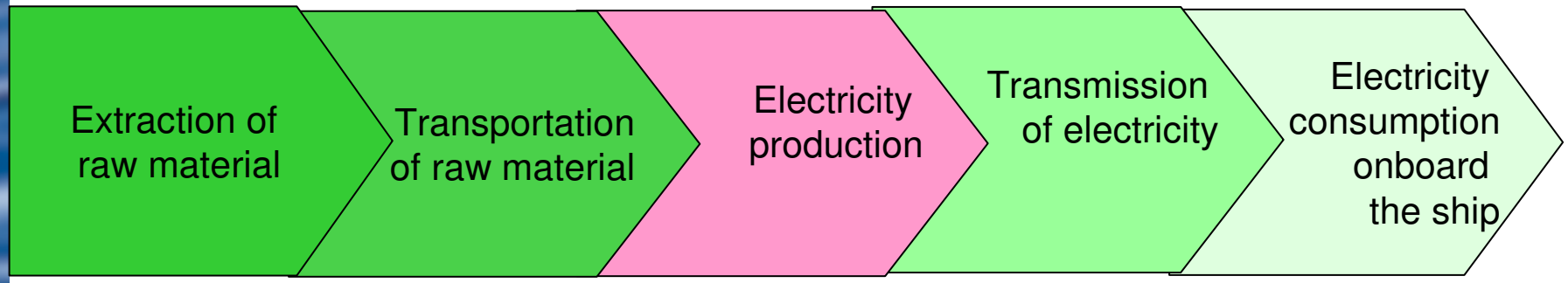
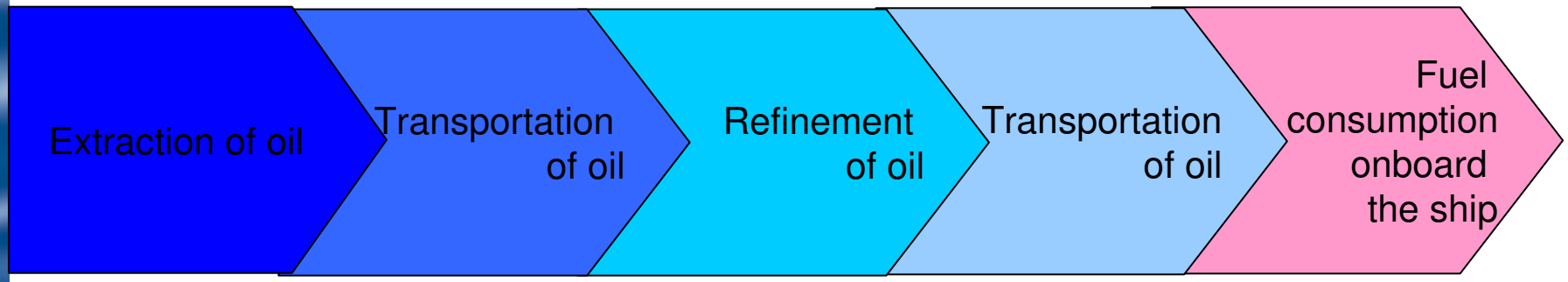
Not a life cycle analysis

Electricity for onshore power supply



Oil for using auxiliary engine



Pink parts are included in the emission calculated

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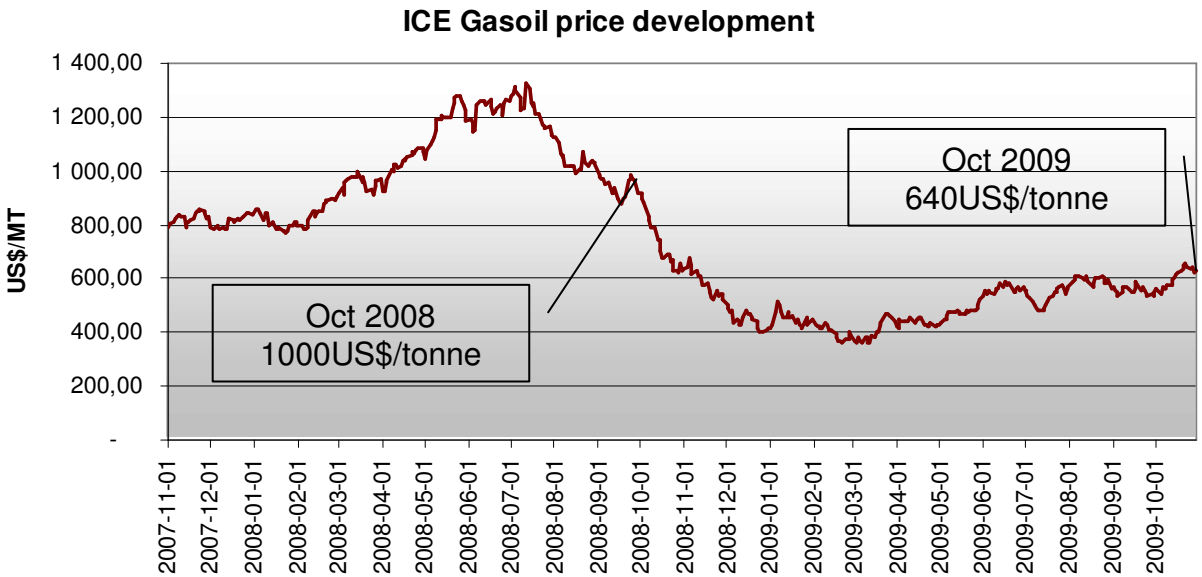
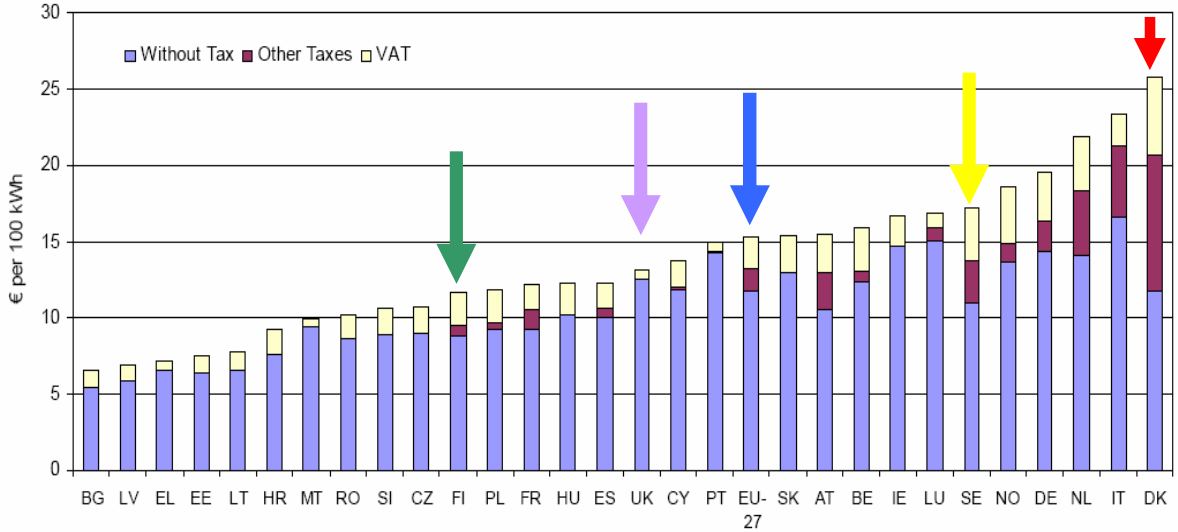
Commercial analysis - variables



Graph 3: Composition of electricity prices for household consumers on 1 January 2007 (in euro per 100 kWh)

Standard consumer Dc: annual consumption of 3 500 kWh

Source: EUROSTAT



- 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

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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/MT

Auxiliary engine

Bunker cost	277 316	€/year
Maintenance cost	0	€/year
CO2 cost	0	€/year
Sum	**277 316**	**€/year**

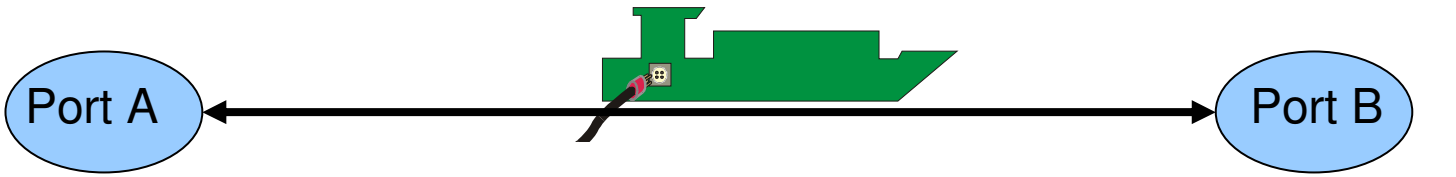
OPS on Ship

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	***-112 099***	

Variable data
Aux Engine Costs
OPS Costs



2 calls/week

2 calls/week

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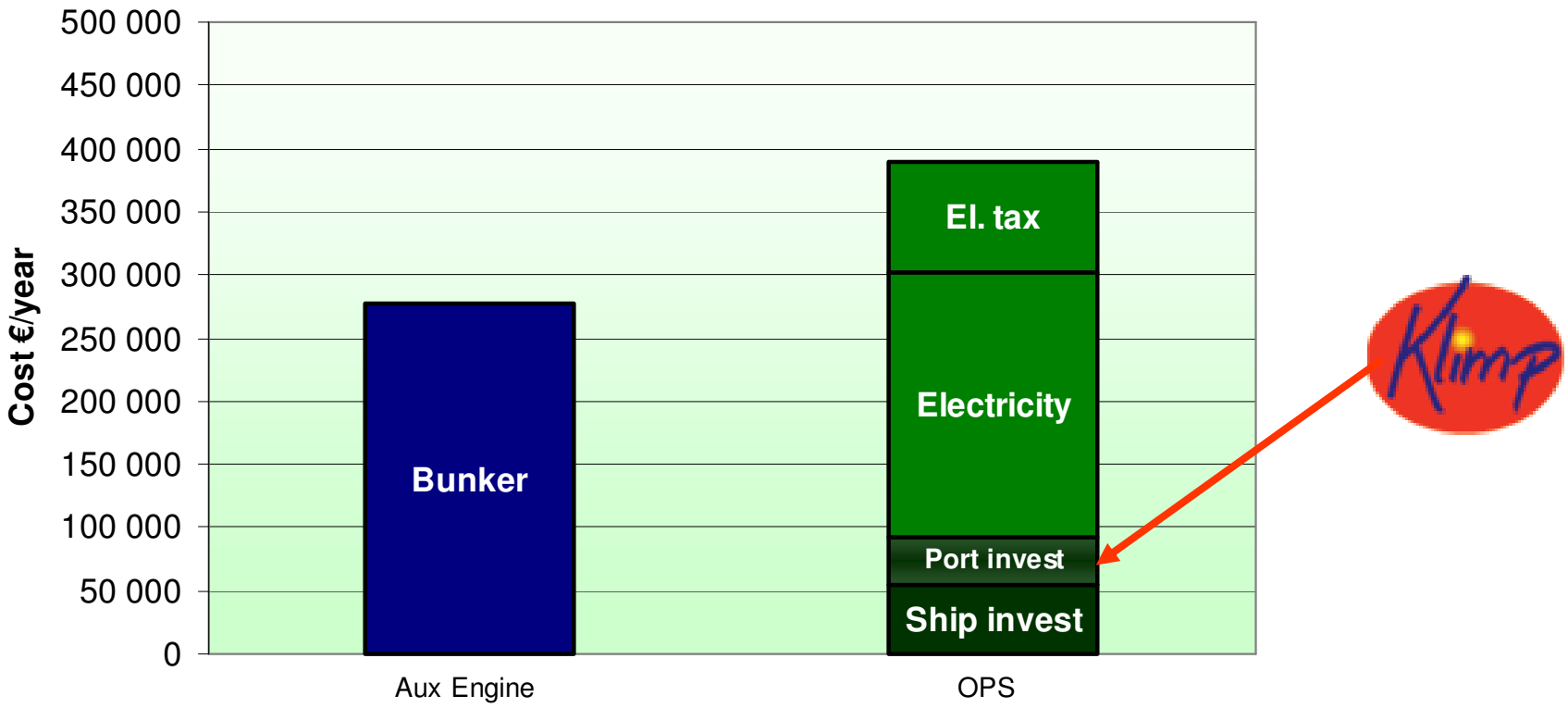
Case ro/ro Sweden-today Oct - 09

Bunker: 640 $/tonne
Cost: 110 000 €/year



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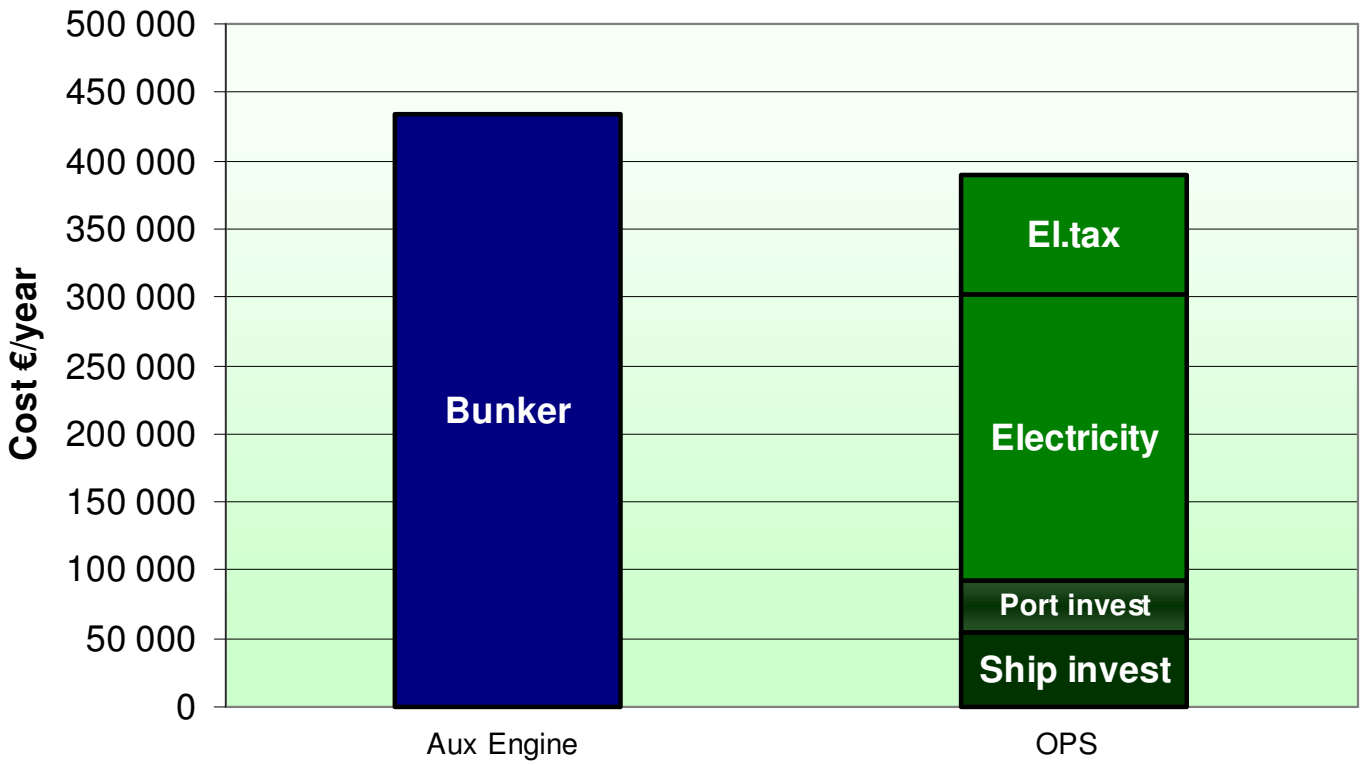
Case ro/ro Sweden-yesterday Oct - 08

Bunker: 1 000 $/tonne
Saving: 44 000 €/year



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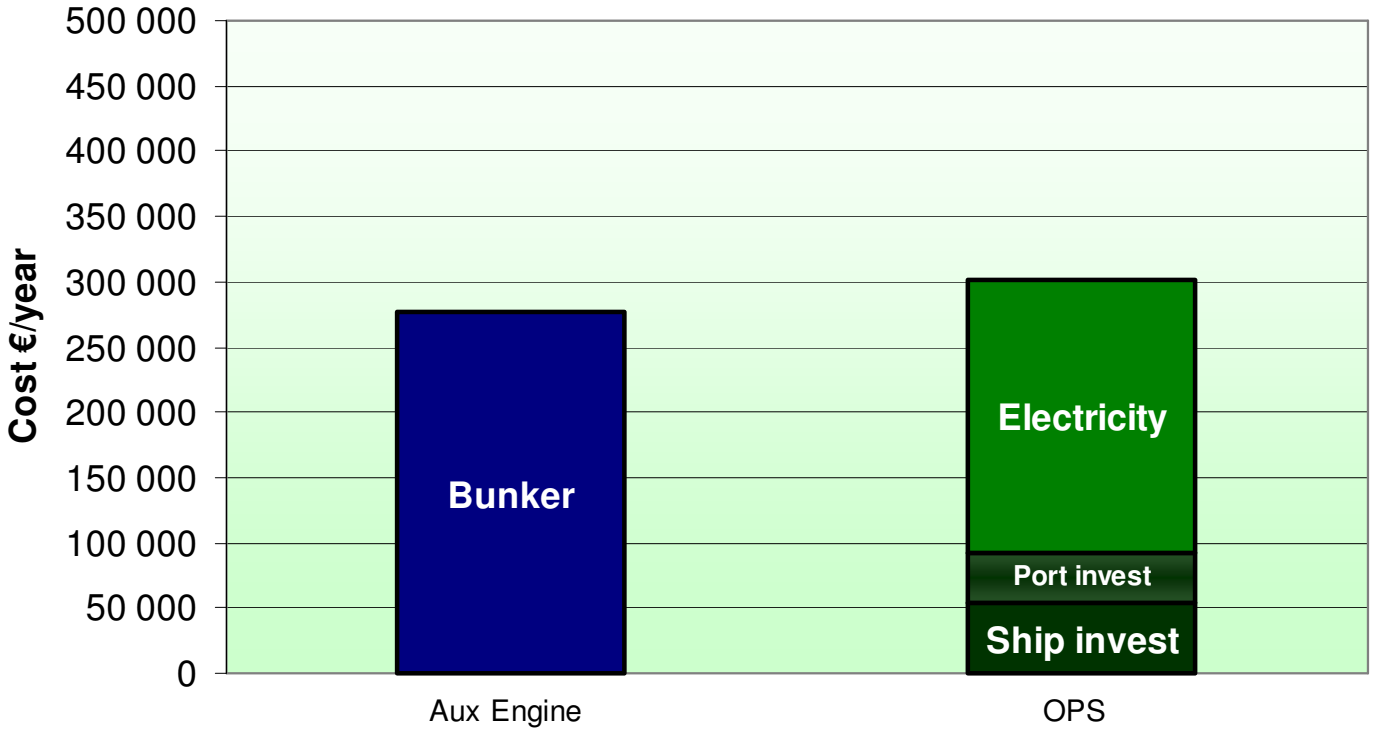
Case ro/ro Sweden- tomorrow? Oct -XX

Bunker: 640 $/tonne, no electricity tax

Cost: 25 000 €/year



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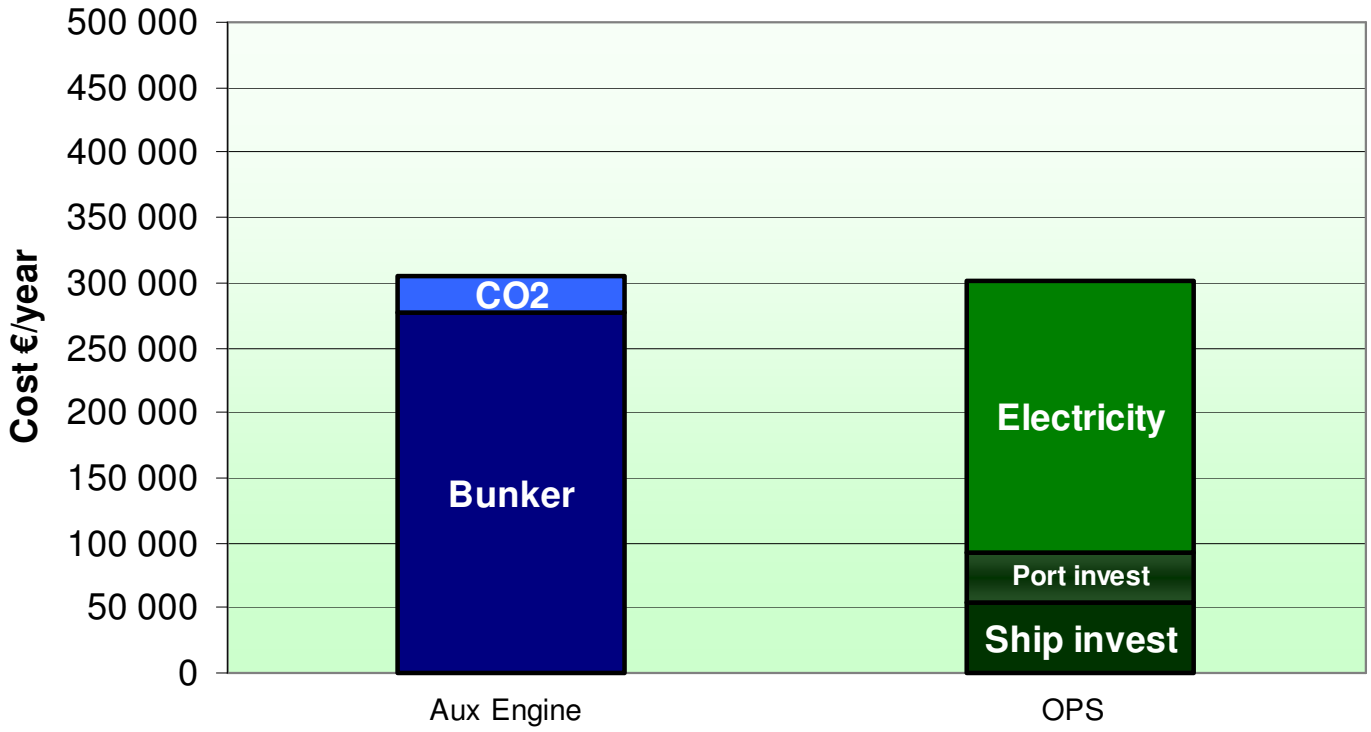
Case ro/ro Sweden- tomorrow? Oct -XX

Bunker: 640 $/tonne, no electricity tax, predicted CO2 price 15 €/tonne

Cost saving: 2 500 €/year



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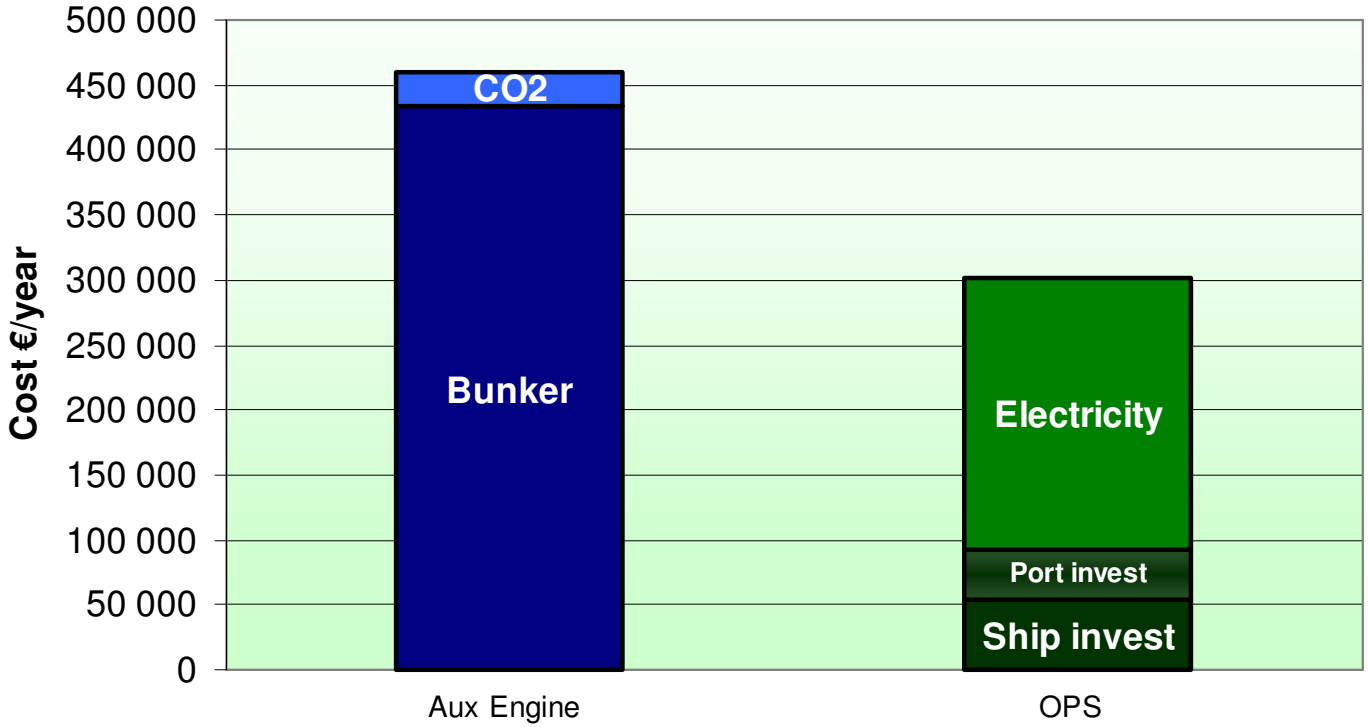
Case ro/ro Sweden- tomorrow? Oct -XX

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

Cost saving: 160 000 €/year



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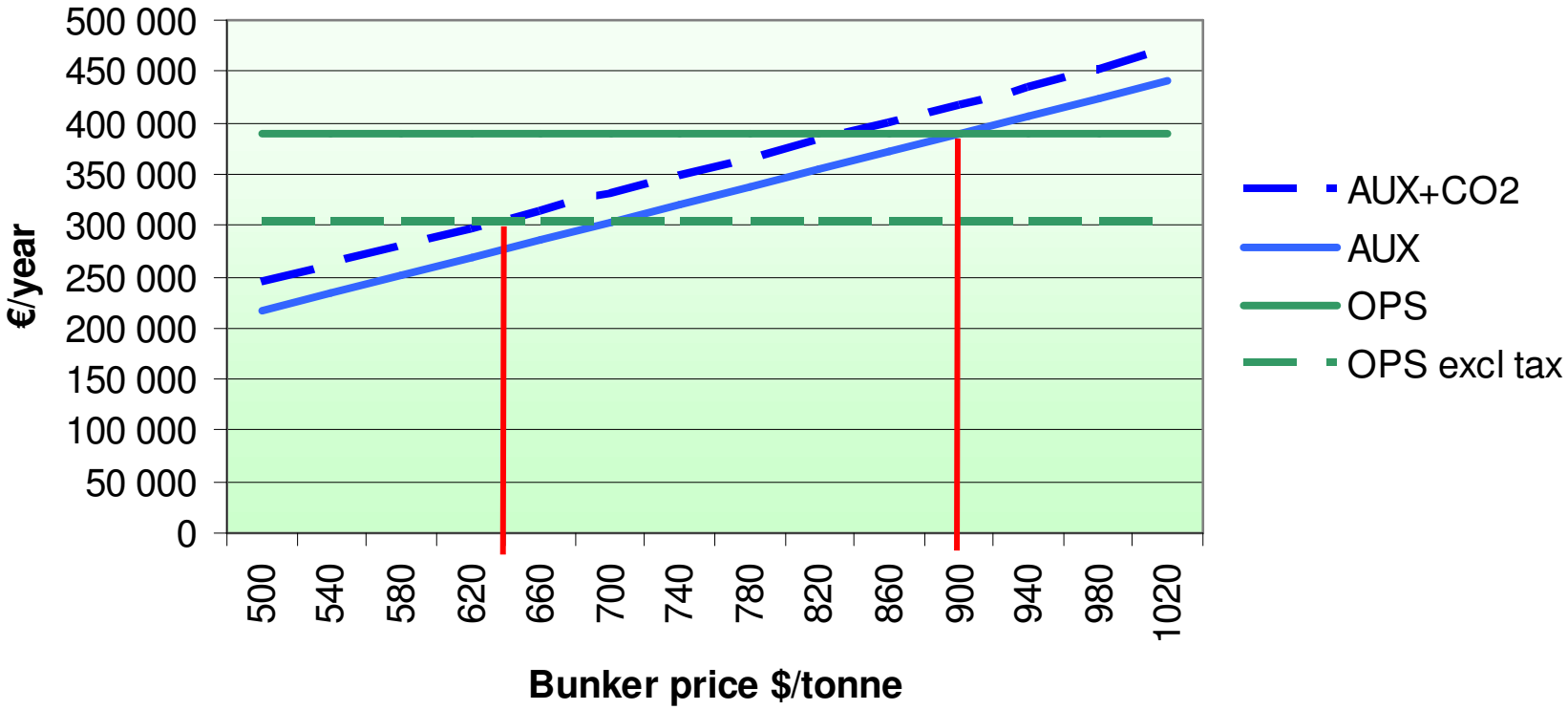
Break even points



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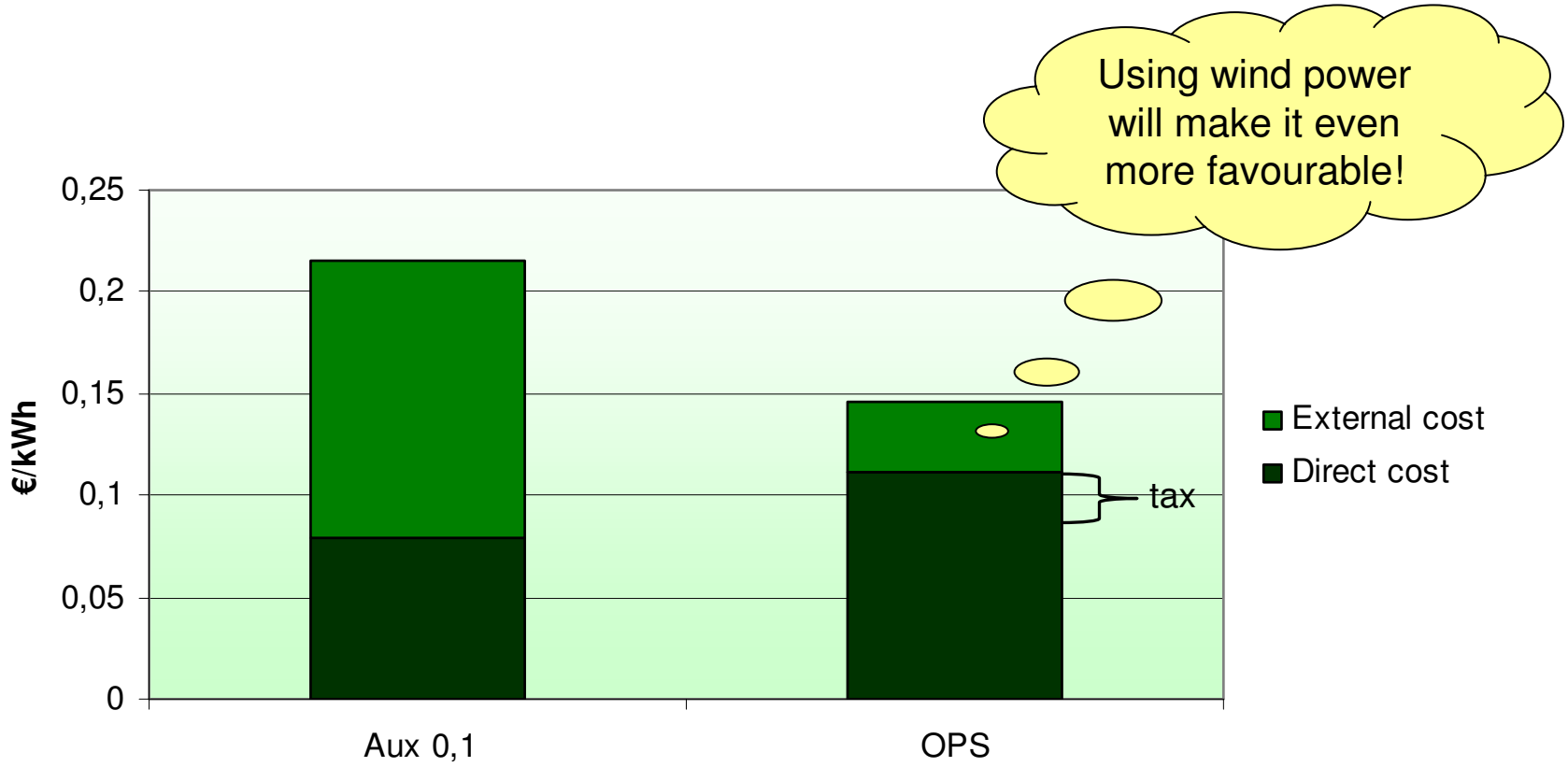
External and internal/direct costs



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

Source: Entec, Shore-side Electricity report for EU Comission DG Env (2005),
Holland Mike and Watkiss Paul, Estimates of the marginal external costs of air pollution in Europe BeTa version E 1.02a (2002)

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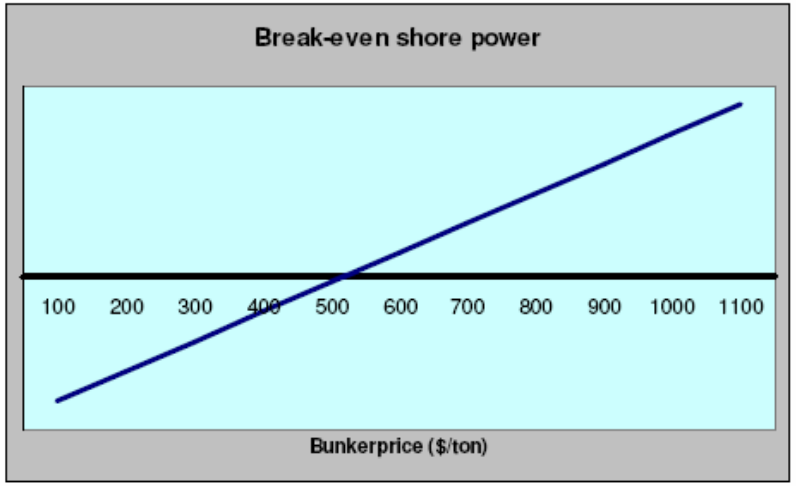
Experiences so far

- 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

Connecting a Ro/ro-vessel in Port of Göteborg

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

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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

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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

WORLD PORTS CLIMATE INITIATIVE

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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

WORLD PORTS CLIMATE INITIATIVE

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Pros and cons

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

+ 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

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Conclusion

Photo from Port of Göteborg

- 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**

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GÖTEBORGS HAMN

Bonus pictures…

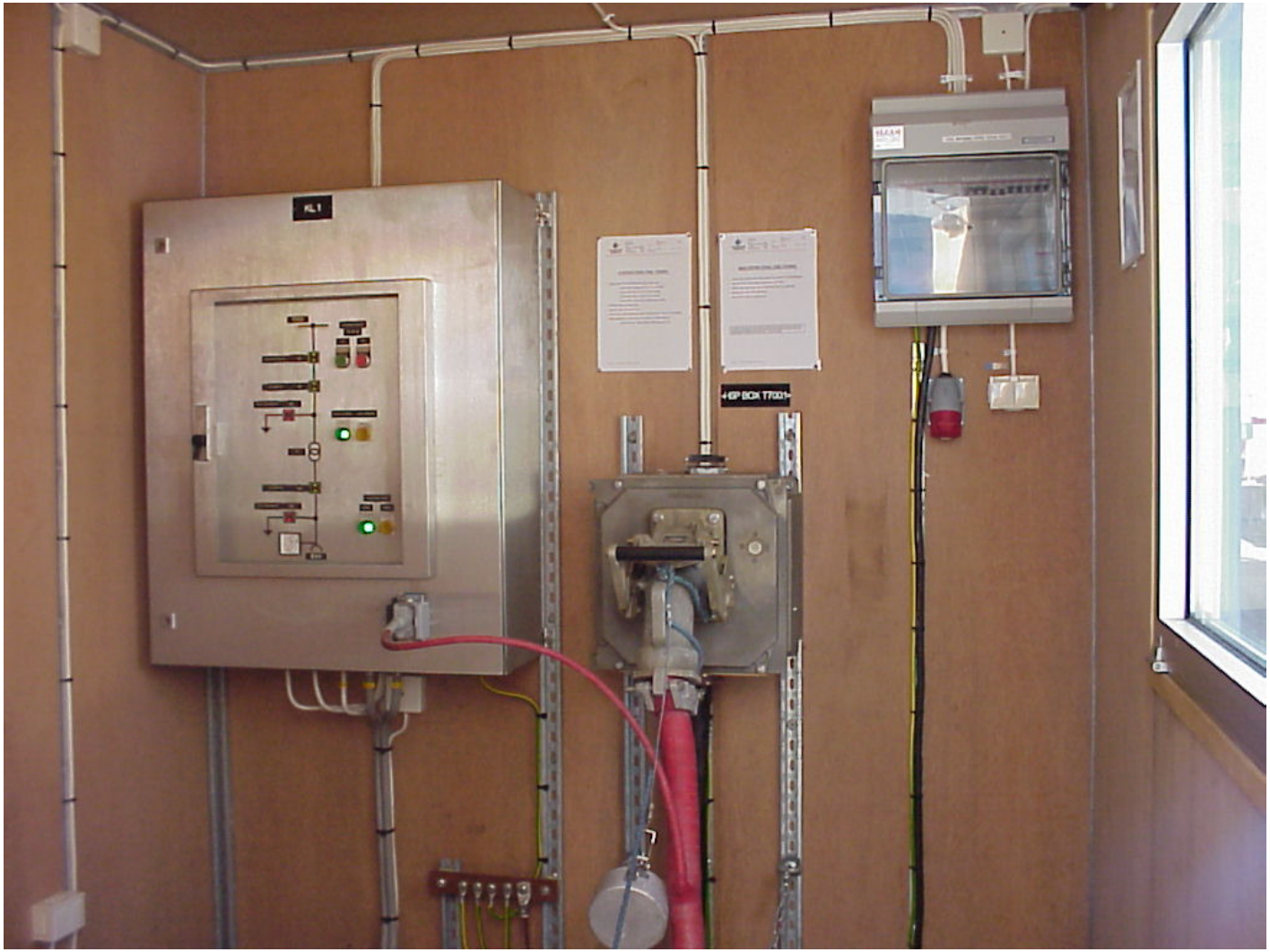
Cable connected to the vessel

GÖTEBORGS HAMN

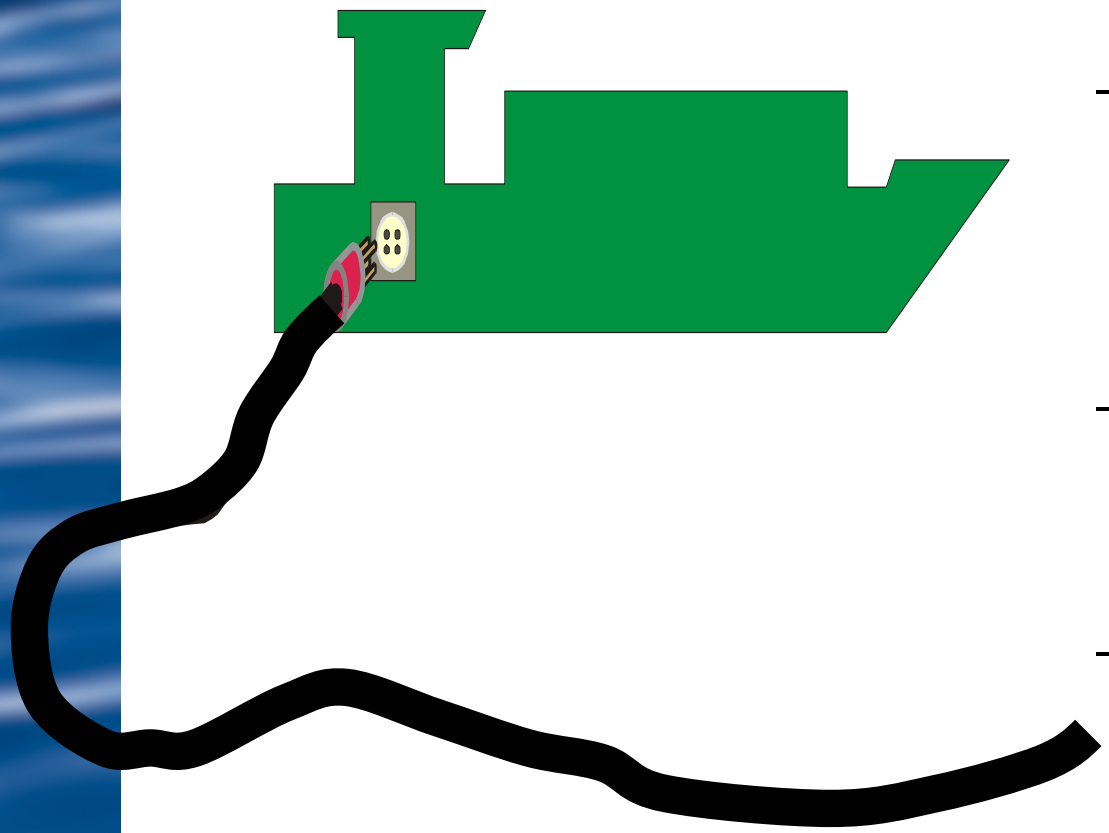
Connection point at the quay

GÖTEBORGS HAMN

Outlet at the quay, connection point



Further information…



- www.portgot.se (fact sheet, program produce by French TV3, article by Bunker Spot…)
- www.mariterm.se/nedladdningsbara_rapporter.html (shore-side electricity for ships report 2004)
- http://europa.eu.int/comm/environment/air/pdf/task2_shoreside.pdf
- International Herald Tribune http://www.iht.com/articles/2008/04/25/business/wbshipping.php
- Electrical Manager
  Mr Per Lindeberg
  per.lindeberg@portgot.se

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