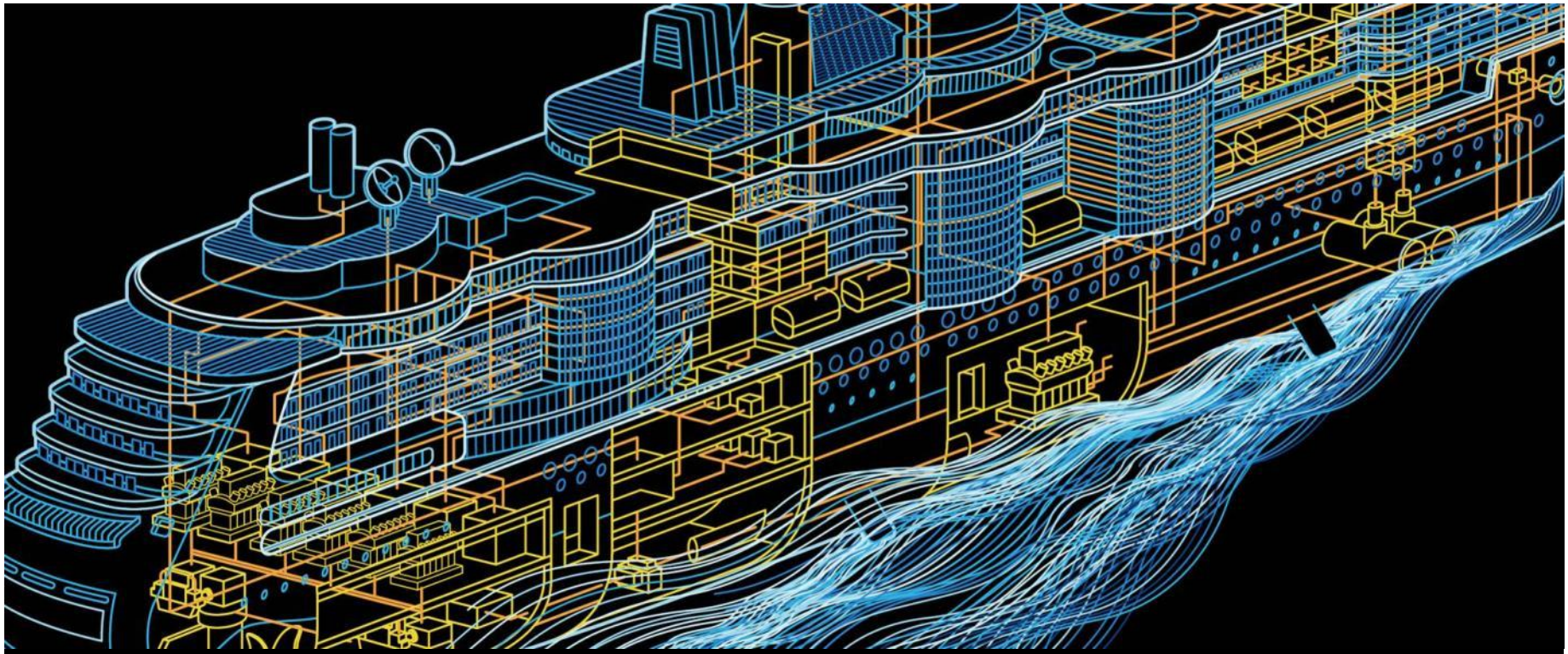

Christian B. Petersen, ABB , 04.06.2014

Clean air in ports and port cities

Danish Parliament

Agenda

IP POWI

1. The situation today
2. Shore to ship power – a solution to cut ship emissions dramatically
3. Why is shore to ship power not implemented already?
4. Case study – Marine Station Korsør
5. The future
6. Summary

Increasing air pollution hospitalize Copenhagen citizens

New legislation to cut ship emissions

- Law of reducing tax on shore power (L171) just approved by the Parliament (May 2014)
- New EU legislation:

"Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and sea-going ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the ***TEN-T Core Network****, and in other ports,* ***by 31 December 2025****, unless there is no demand, and the costs are disproportionate to the benefits, including environmental benefits."*

The situation today

One vessel emets equivalent amount of NOX in 8h at the port as 10’000 cars each driving 1’000 km

1 x **=** **10.000 x**

10’000 cars x 0.1 g/km x 1000 km = 1.0 t NOx
11.8 kg/MWh x 8 h x 12 MW = 1.1 t NOx

The situation today

Emission from cruise ship in Copenhagen 2009

Calls in

2009: 345

2012: 381

Increase:

10%

Particle emissions:

- Total cruise ships in 2009: 9,6 ton/year
- Total from all cars in Copenhagen Municipality: 10,1 ton/year

Air polution (NO_x):

- Total cruise ships in 2009 : 378 ton/year
- Total from all cars in Copenhagen Municipality:121 ton/year

CO_2- emissions

- Total cruise ships in 2009 : ~ 23.500 ton/year
- Total from all cars in Copenhagen Municipality: ~ 470.000 ton/year

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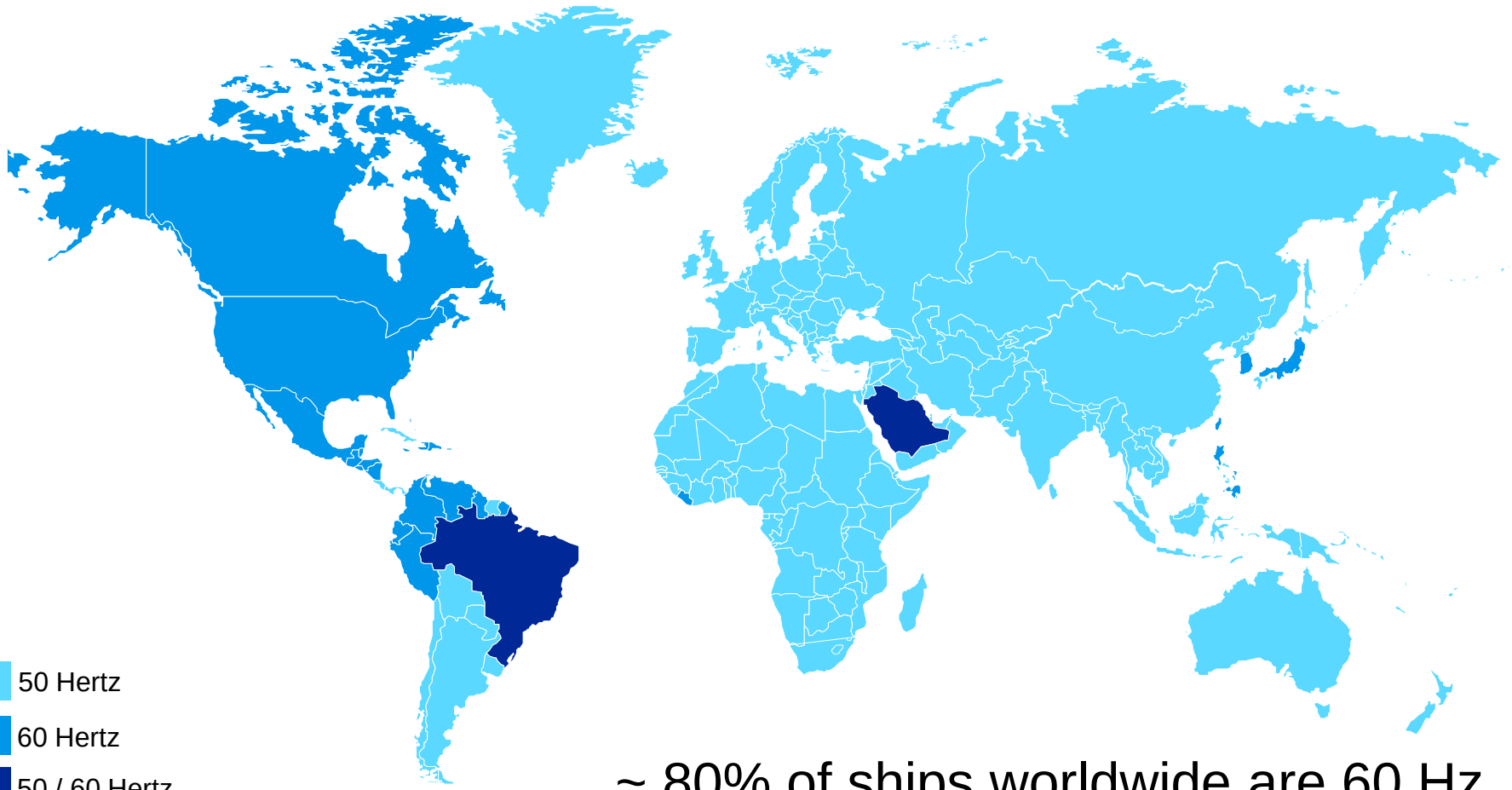
Shore to ship power – many names, same technology

- Shore-to-Ship Power
- Alternative Maritime Power
- Shore Connection
- Cold Ironing
- HV Electrical shore to ship connection
- On Shore Power supply

Different wording describe the same technology

Def.:Ship switch off Auxiliary Engines during the port-stays receiving power from the electrical power grid of the port itself

Converting the frequency
Not all the world's power is at the same frequency!



~ 80% of ships worldwide are 60 Hz

General concept

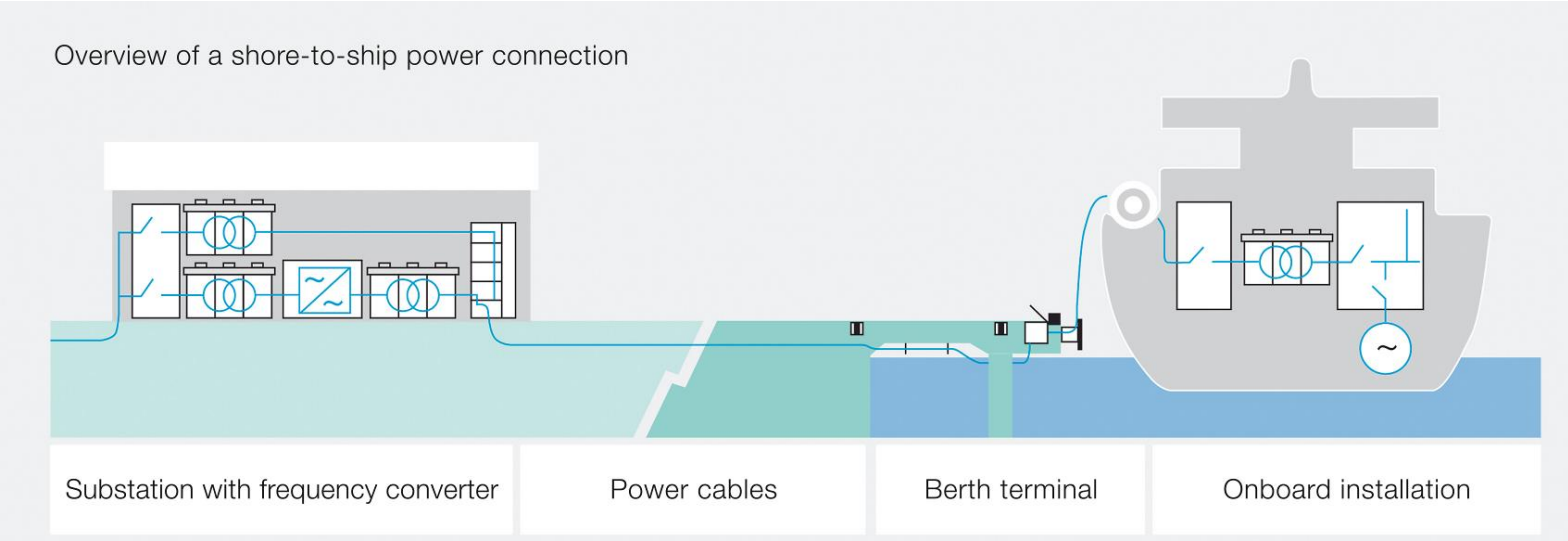
Shore-to-ship power is the solution for electric connection of vessels at a port or at a shipyard

Onshore: Substation

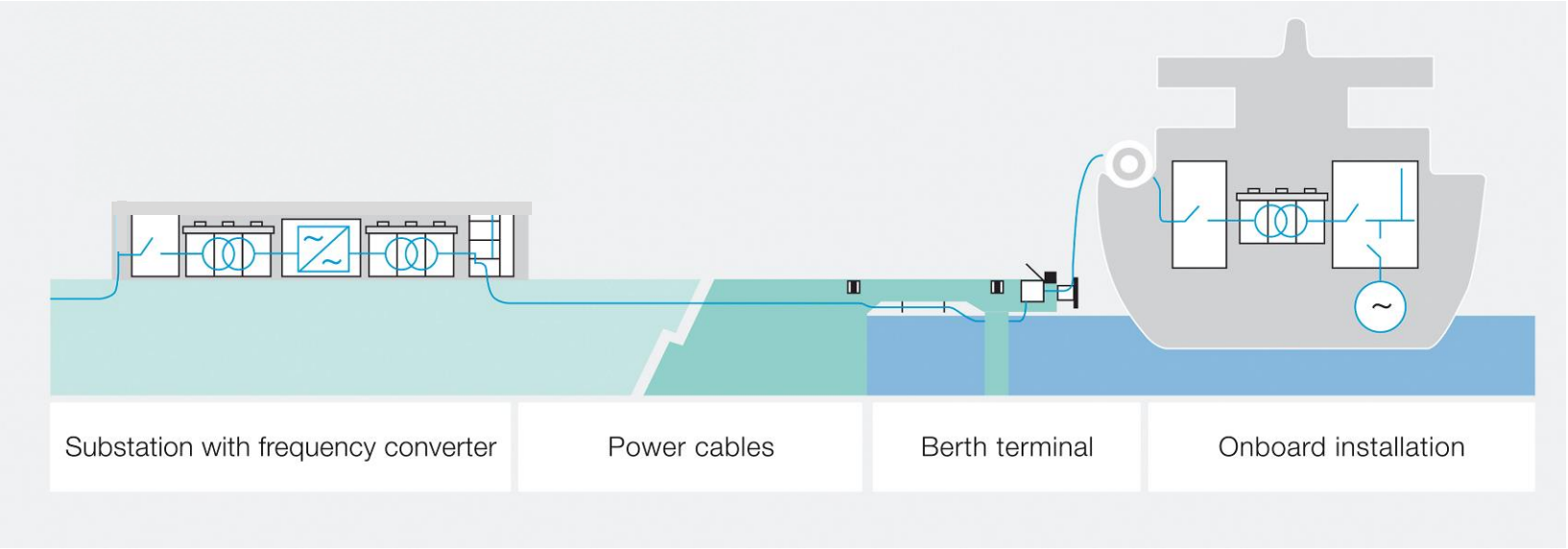
Frequency converter 50/60 Hz

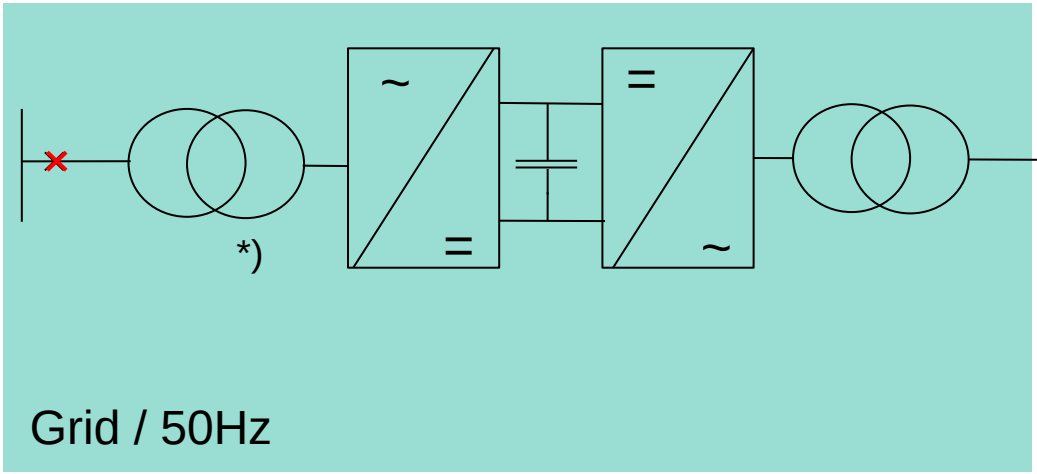
Cable system

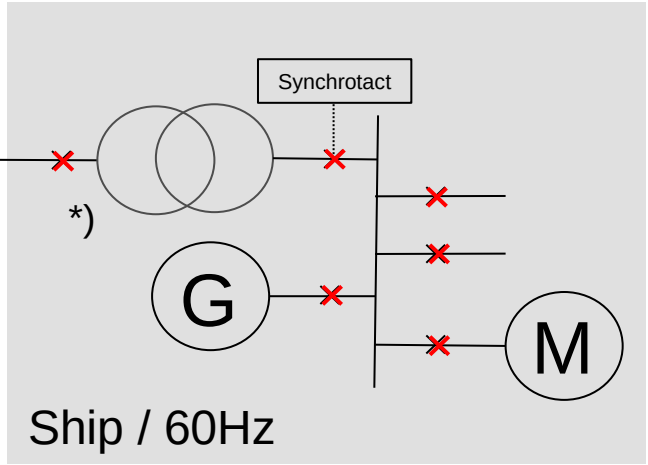
Onboard: Shore connection panel



Shore to ship power
Connecting a ship – Turn key project

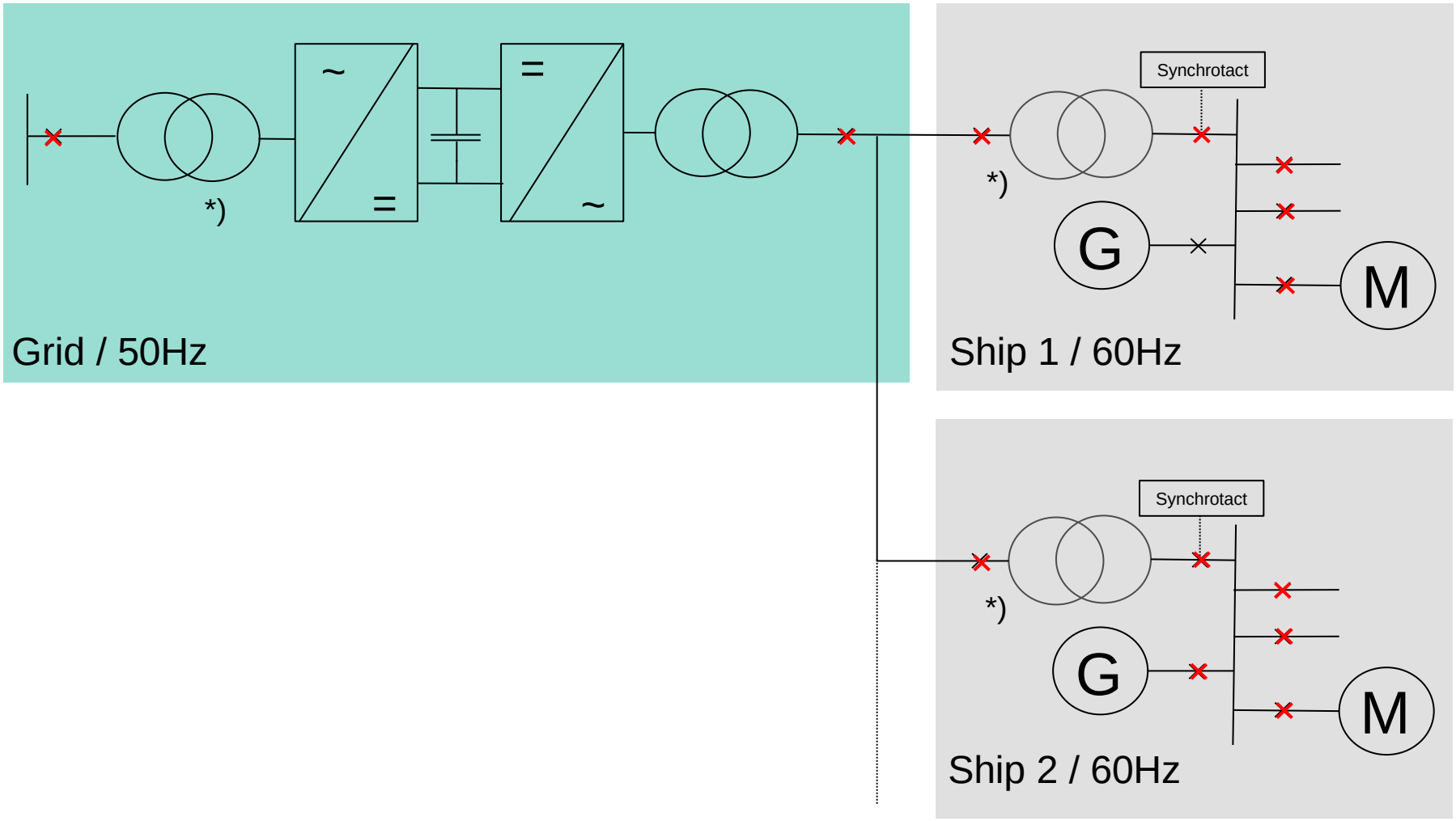






*) Transformer may not be required

Shore to Ship Power is modular
Connecting an additional Ship



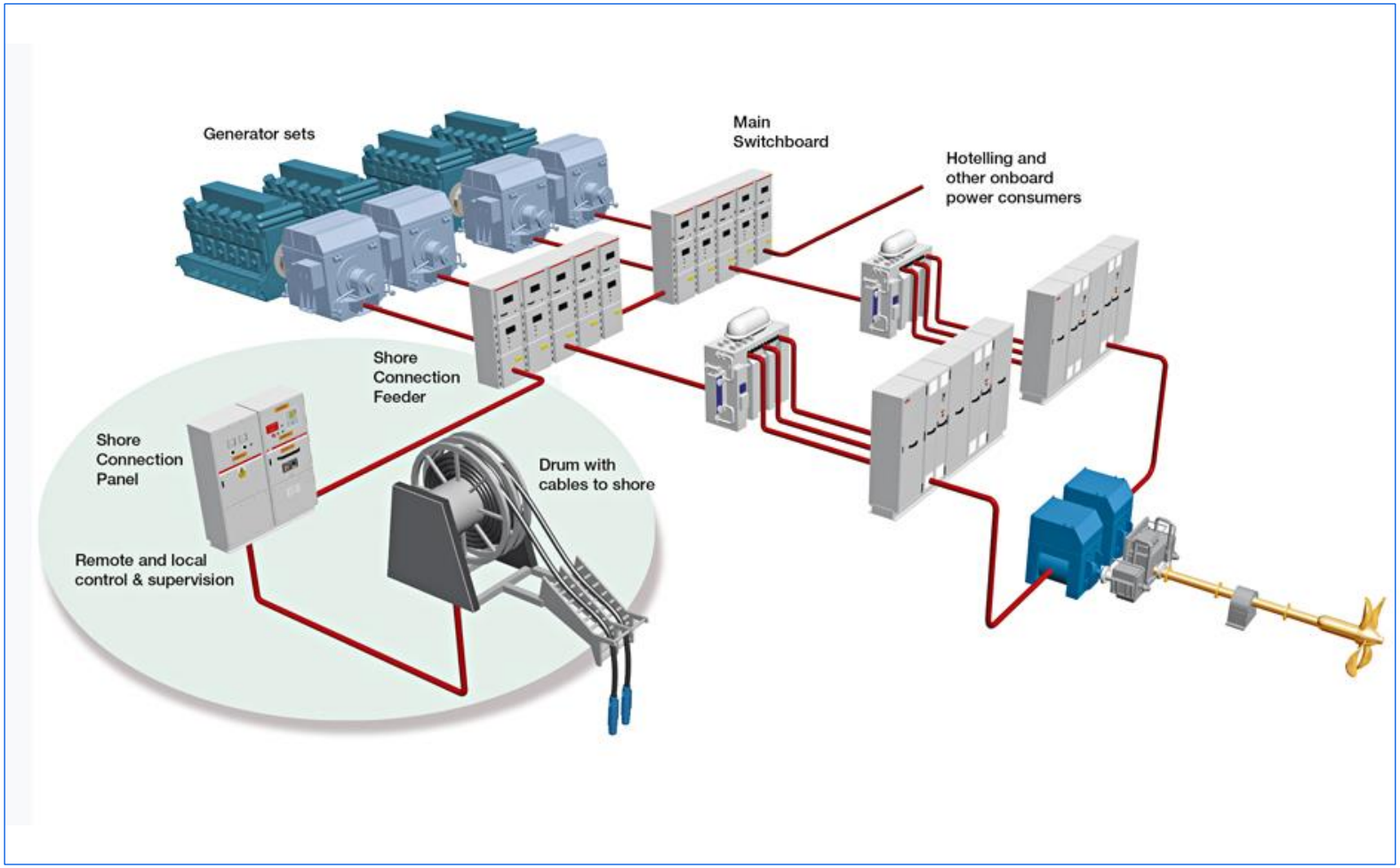
*) Xfo may not be required

Onboard overview

Ship with diesel-electric propulsion.

Shore Connection system configured with the Shore Connection Panel located outside the main switch-board room.

An onboard cable drum lowers the cable down to the quay for onshore termination



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Market Drivers I
Benefits

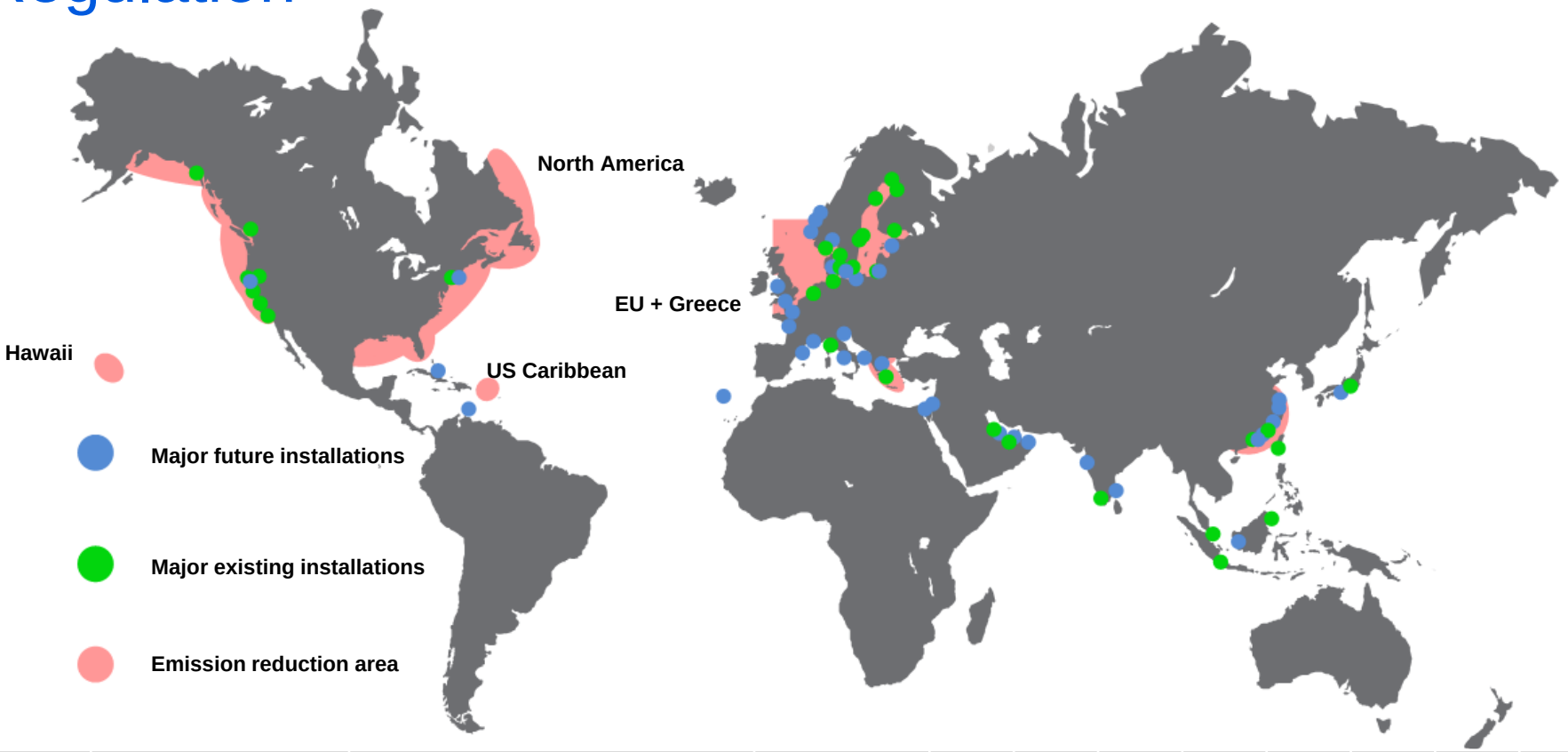
Port / Utility

1) Profit
   - Connection fee or extra service for ships to reduce their OPEX
2) Publicity: port can practice corporate social responsibility
3) No emissions, noise and vibration at port
4) No health influence
   - Asthma
   - Heart failure

Vessel owner

1) Cost reduction
   - Fuel vs electricity price
   - Maintenance cost
   - Discounts at ports (ESI) for mooring fees
2) Green vessel status
3) Higher comfort onboard (reduced noise and vibration)

Market Drivers II
Regulation



Level	Entity	Parameter	Parameter	2013	2014	2015	2016	2017	2018	2019	2020
Regional ECA legislation	EU	Ports outside ECA*	SO2, %	0.1							
	North America including Hawaii, Puerto Rico and US Caribbean	Ports inside ECA		1		0.1					
Local legislation	California	Reduced Onboard Power Generation or Shore power Option	Shore powered visits %	NA	50			70			80
		Equivalent emission reduction option	NOx, PM, %	25	50			70			80
	China	National and key regions (19 provinces) target emission reduction	NOx, %	7-13			New 5 year China national plan				
			SO2, %	10-12							
			PM, %	5-10							
		Ports with shore power demonstration projects		Tianjin, Shanghai, Nanjing, Ningbo, Guangzhou and Qingdao							

Why do we not have shore to ship power today? Challenges and myths

Challenges:

- Hen and Egg problem – ship owner or port
- Few ships are prepared for shore to ship power
  - 19 of 125 in the period of 2010-2013 alone in Copenhagen Malmø Port

Myths:

- ”There is no standard”
- ”It is too expensive”
- ”Unproven technology”
- ”Not installed in Europe”
- ”Ship produce electricity cleaner than power plants on shore”

Why do we not have shore to ship power today?
Myths about Shore to Ship Power

- ~~There is no standard!~~ Yes there is one standard (IEC_ISO_IEEE 80005-1 Ed1)
- ~~It is too expensive~~! There is a positive socio economic business for the port of Copenhagen (22 mio DKK)
- ~~Unproven technology~~ ABB has supplied shore to ship power solutions globally since 1999
- ~~Not installed in Europe~~. Hamburg, Livorno and Venice will have shore to ship power for cruise ships, starting from 2015
- ~~Ship produce electricity cleaner than Power plants on shore~~. Not true! Nordic power mix

Shore connection
Standard

- General requirements
- HV-shore supply requirements
- Shore side installation
- Ship-to-shore connection and interface equipment, plugs and sockets
- Ship requirements
- HVSC system and control monitoring
- Verification and testing
- Periodic tests and Maintenance

Development in CO2-emission in the Danish grid

The CO2 emission per kWh is going downward – electricity increasingly becomes the green alternative to other fuels

Source: Danish Energy Association

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Case 1: Navy vessels in Korsør

Location

- Navy Vessels very close to city-center

Case 1: Navy vessels in Korsør

Project introduction

- Navy port Korsør
- Denmark has two navy ports where many vessels are docked during many hours
- Both ports are close to city-center and the local community requests shore to ship power

Case 1: Navy vessels in Korsør

Project introduction

- Order June-2011
- Delivery Dec-2011
- Installation Jan-2012
- Commissioning Feb-2012

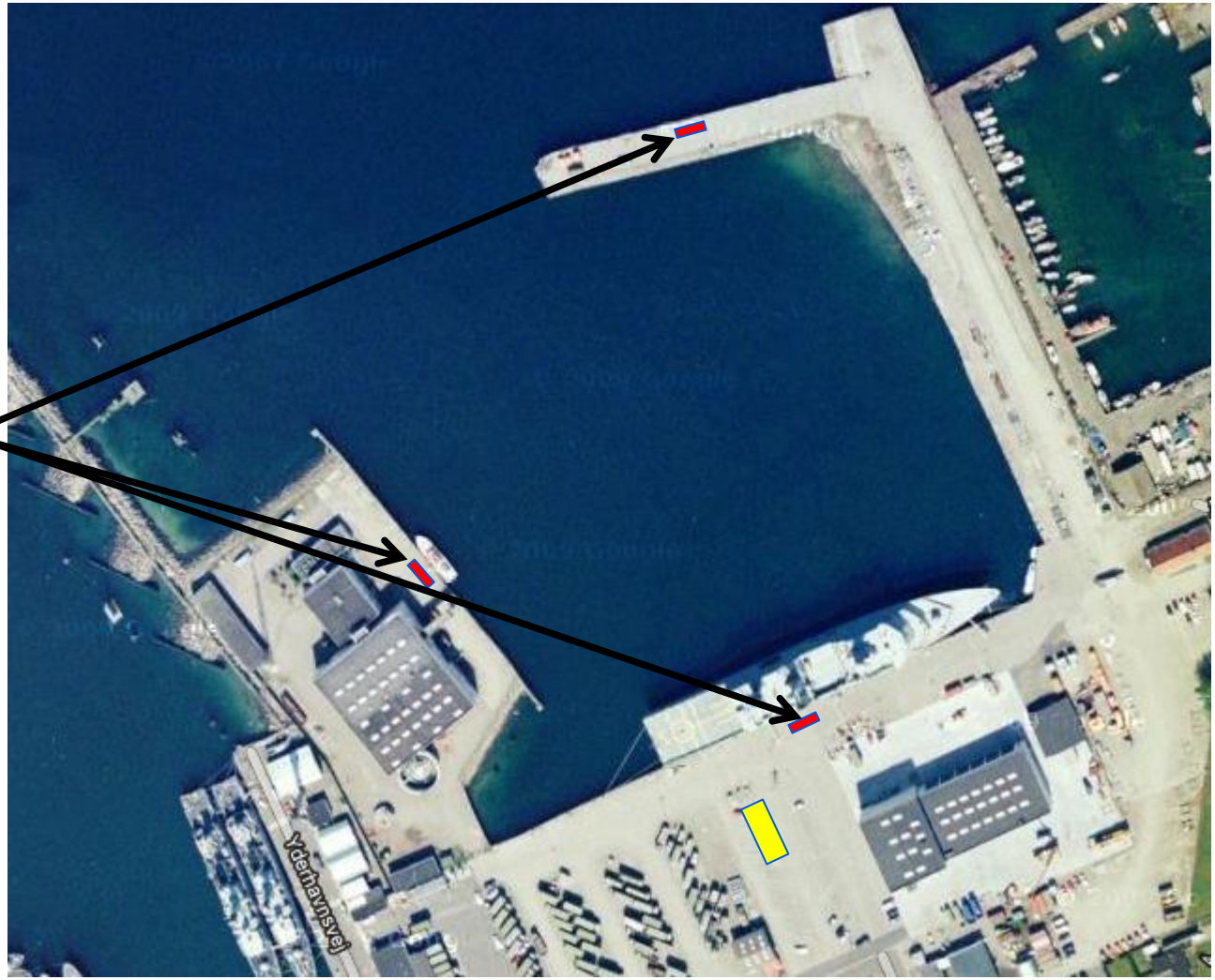
Case 1: Navy vessels in Korsør

- PORT
  - Converter building

    3 x 1000A

  - Connection panel

    1000A



Case 1: Navy vessels in Korsør

Connection panel
1000A

Case 2: Port of Gothenburg

- Port of Gothenburg has had shore to ship power for several years – primarily for Roll-on Roll-off
- The Swedish Government reduced tax on shore to ship power in 2011 to EU's minimum fee
- Shore to ship power is growing: In 2012 the port reduced its NOx-emission by 130 tons due to shore to ship power. An increase by 50 tons compared to 2011

Environment

Key figures – onshore power supply	2010	2011	2012
Percentage of vessels calling that can connect to onshore power*	23%	34%	34%
Percentage of laytime when onshore power can be used*	11%	19%	18%
Quantity consumed, MWh	6,000	6,230	10,340
Environmental benefits:			
Sulphur dioxide, tonnes	6	6	10
Nitric oxide, tonnes	77	80	130
Particulates tonnes	2	2	4
Carbon dioxide, tonnes	3,600	3,800	6,300

*) Excluding bunker vessels.

Source: Port of Gothenburg annual report 2013

Extract of ABB's global reference list
Ports &Terminals & Shipyards

Connection type	In service	Power, MVA	Hz	SFC type	Location
Tanker terminal*	2014	6	60	PCS 6000	Stockholm
Ferry terminal**	2014	2.75	50	-	Kristiansand
Shipyard*	2014	2	60	PCS 100	Germany
Navy*	2014	3.775	60	PCS 100	Middle East
Shipyard	2013	2.5	60	PCS 100	Croatia
FPSO-to-platform*	2013	2.0	60	PCS 100	Mumbai
RO PAX / Ferry terminal II	2012	2.5	50	-	Trelleborg
Shipyard	2012	8	60	PCS 100	Singapore
Shipyard*	2012	1.25	60	PCS 100	Bahrain
RO RO & RO PAX Terminal	2012	6.25	50 & 60	PCS 6000	Ystad
LNG FSU	2012	6	60	PCS 6000	Malaysia
RO RO / RO PAX & Ferry Terminal	2012	6	60	PCS 6000	Hook of Holland
Ferry terminal	2011	5.625	50	-	Oslo

Extract of ABB's reference list
Vessels I

Vessel name	Vessel type	Owner
Norwegian Star	Cruise ship	NCL
Norwegian Jewel	Cruise ship	NCL
Sun Princess	Cruise ship	Princess Cruises
Dawn Princess	Cruise ship	Princess Cruises
Sea Princess	Cruise ship	Princess Cruises
Ocean Princess	Cruise ship	P&O
Golden Princess	Cruise ship	Princess Cruises
Star Princess	Cruise ship	Princess Cruises
Caribbean Princess	Cruise ship	Princess Cruises
Amsterdam	Cruise ship	HAL
Zuiderdam	Cruise ship	HAL
Oosterdam	Cruise ship	HAL
Westerdam	Cruise ship	HAL
Noordam	Cruise ship	HAL
Veendam	Cruise ship	HAL
Disney Wonder	Cruise ship	Disney
Queen Mary 2	Cruise ship	Cunard
Carnival Inspiration	Cruise ship	Carnival Cruise Lines
Carnival Imagination	Cruise ship	Carnival Cruise Lines
Carnival Miracle	Cruise ship	Carnival Cruise Lines
Carnival Legend	Cruise ship	Carnival Cruise Lines
Celebrity Century	Cruise ship	Celebrity Cruises

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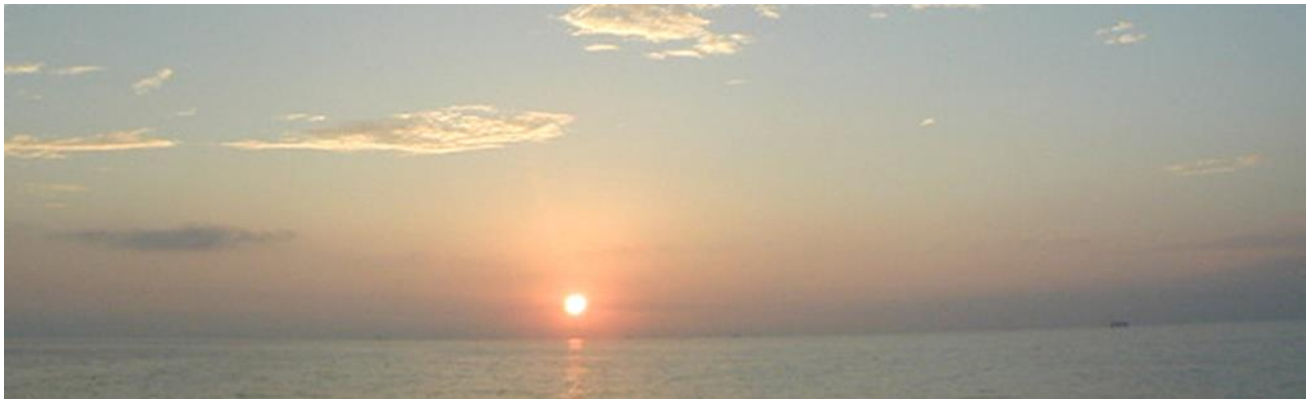
The future in cruise business
A business in growth

1. MSC will double its fleet over the next 10 years
2. The cruise ships will grow larger over the years
3. The cruise market is a growing market and has not seen the top yet
4. Major cities and ports in Denmark want to attract cruise ships



Summery

- Air pollution from ships at berth a major issue
- New EU and local legislation points to shore to ship power as a key solution cutting emission dramatically
- Shore to ship power is a solution that is growing in Europe, but primarily within ferries
- Many myths about shore to ship power need to be adressed
  - The technology for shore to ship is proven and can be installed in short time
  - We have one common standard for a complete shore to ship solution

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