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ROBERTO BERNACCHI, GLOBAL PRODUCT MANAGER, APRIL 2018

## **Shore-to-ship power and smart ports**

Paving the Way to Smarter, Stronger, Greener Port Electrical Grids





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Stronger, smarter and greener port grids

2

Optimized solutions for specific port needs

3

Shore-to-ship power and port electrification

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Selected references

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Conclusion





# Smart ports

## Towards decarbonisation

### Mission

- Become market leaders
- Maximize return on investment
- Add more capacity
- Ensure smooth operations
- Minimize energy consumption
- Reduce pollution to the absolute minimum

## Ports want to be...

1

Competitive

2

Efficient

3

Green





# Smart ports towards decarbonisation

## Turning a green vision into reality



### Climate change is (unfortunately) not for free

- Look for measures that minimize costs and maximize benefits is key
- New business models: “thinking out of the box”



### The technical way

- Enhance the penetration of renewable energy in ports
- Promote shore-to-ship power (S2SP) solutions
- Electrify handling equipment and vehicles



### The strategic way

- Partnerships: collaboration and sharing best practices for optimized costs and benefits
- Incentives planning: reducing carbon demand/intensity

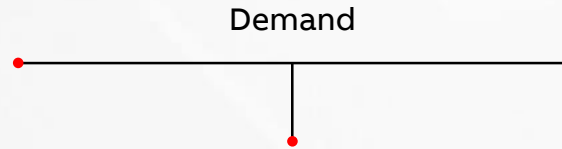


# Why should ports become smart?

## New consumers with new demands



E-mobility market (E-vehicles and E-buses) is growing extremely fast



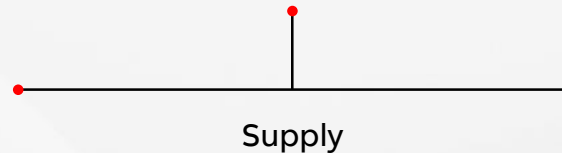
**State-of-the-art  
Port Electrification solutions**



Shore-to-ship power, hybrid and fully electrical ferries are now a reality



Integration of renewables is launching ports into a new green era



Producing electricity on-shore is more efficient than on-board generation



# Smart Ports

High efficiency and sustainable port

Shore-to-ship power

Electric cranes

Renewables integration

Distribution substations, grid reliability, power quality

Power transformers, HV equipment, T&D Substations

Terminal automation, eBop

Electric vehicles

Smart grids and cities



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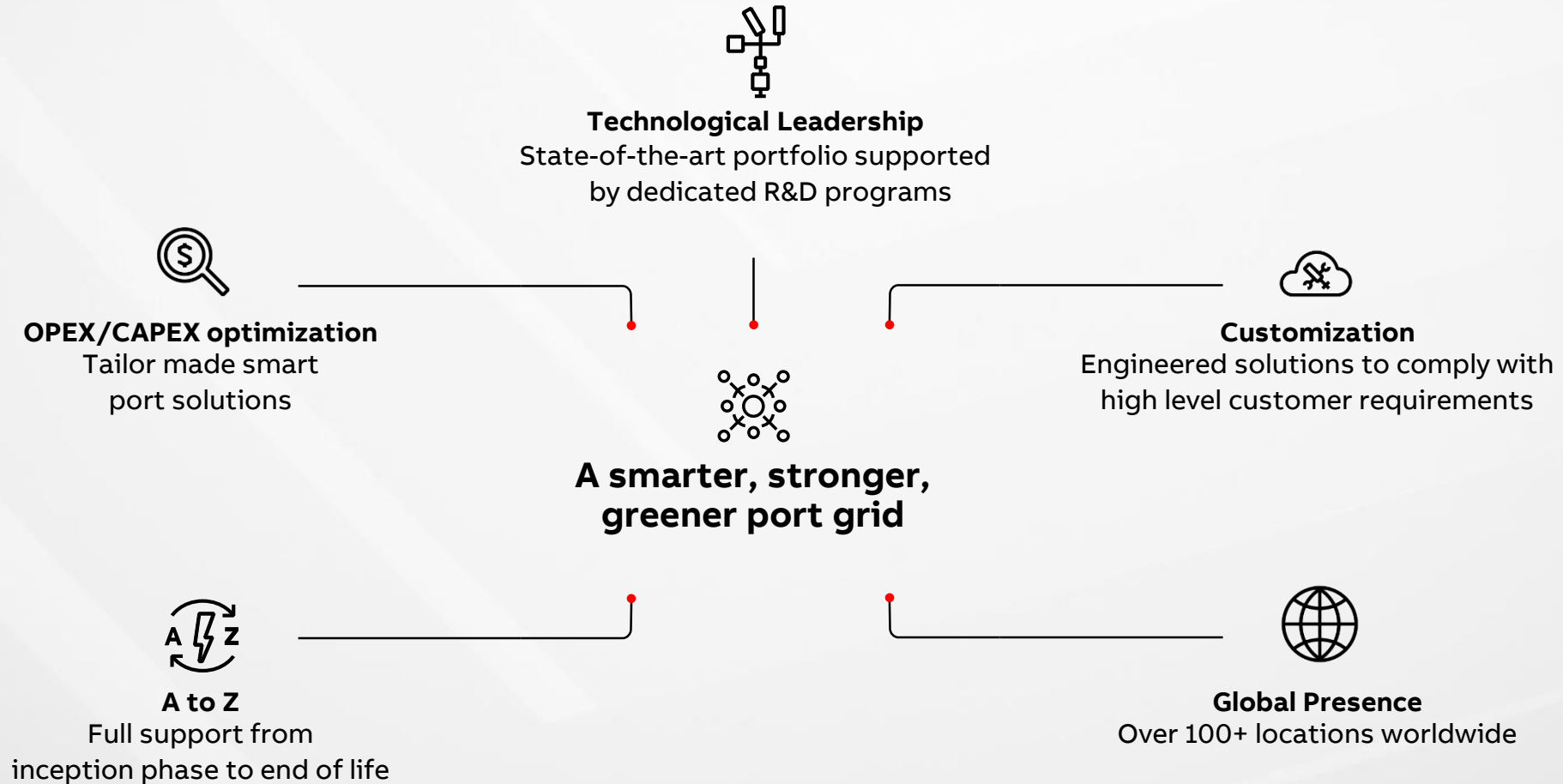
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# Shore-to-ship power and smart ports

## Optimized solutions for specific port needs

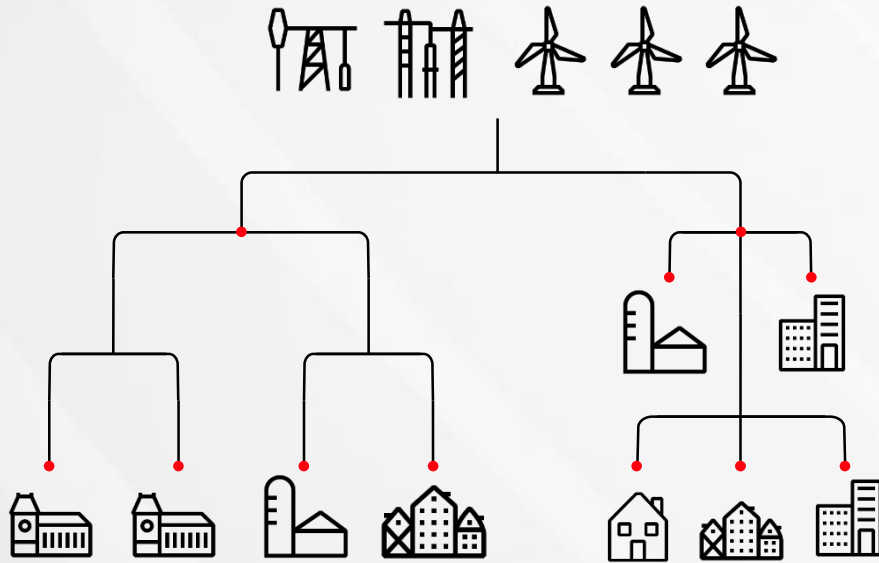




# A smart port requires a smart grid

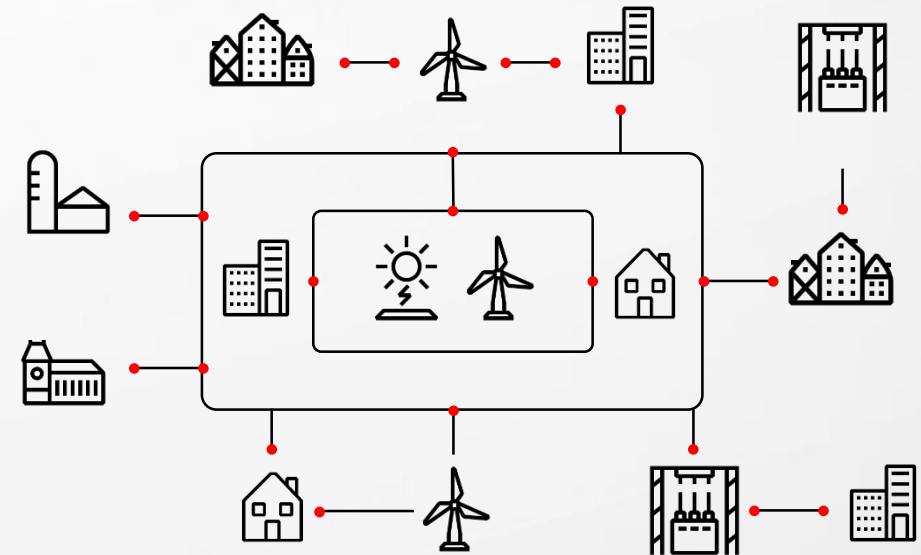
## Transitioning from a traditional to smart grid

### From a traditional grid



- Centralized power generation
- One-directional power flow
- Generation follows load
- Top-down operations planning
- Operation based on historical experience

### To a smart grid



- Centralized and distributed generation
- Multi-directional power flow
- Intermittent renewable generation
- Consumption integrated in system operation
- Operation based on real-time data

# An environmental issue

## Emissions from vessels during port stay

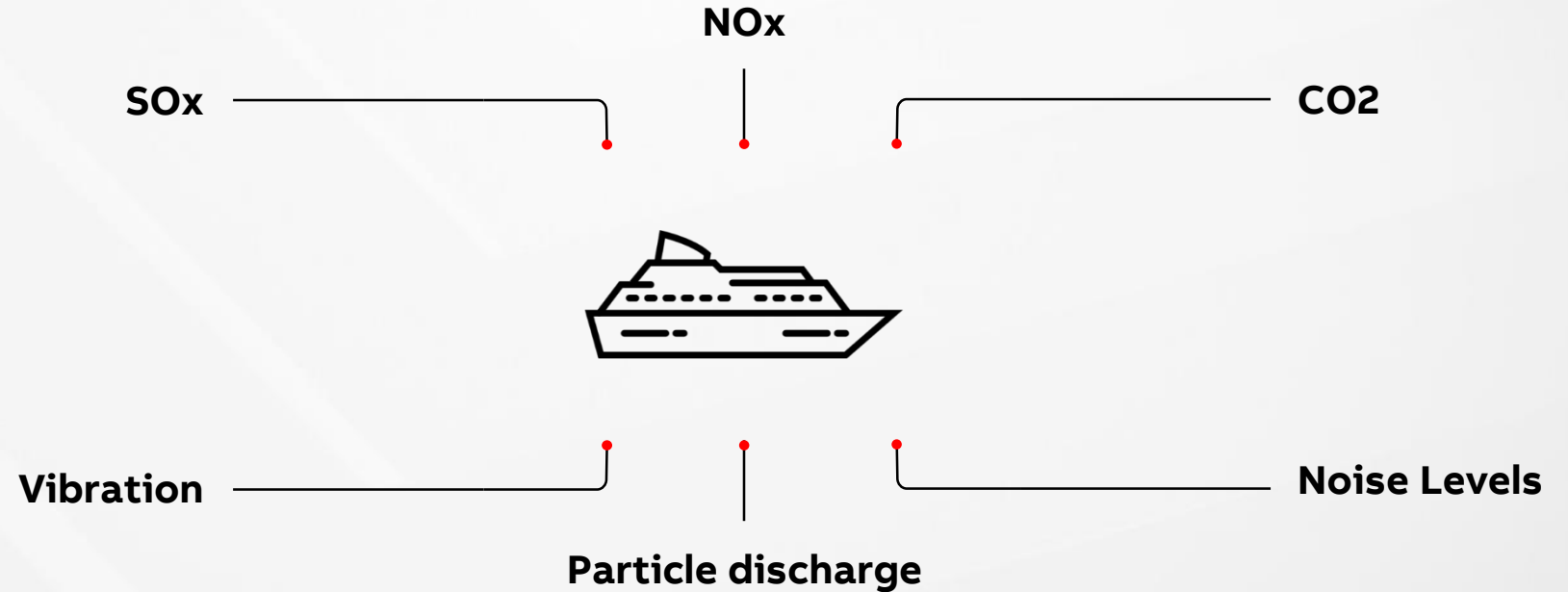
### Facts

Auxiliary engines run by ships in port produce a large quantity of pollutants:

- SOx – Sulphur Oxide Emissions
- NOx – Nitrogen Oxide Emissions
- CO2 – Carbon Dioxide Emissions
- Particle discharge

Auxiliary engines run by ships in port significantly increase:

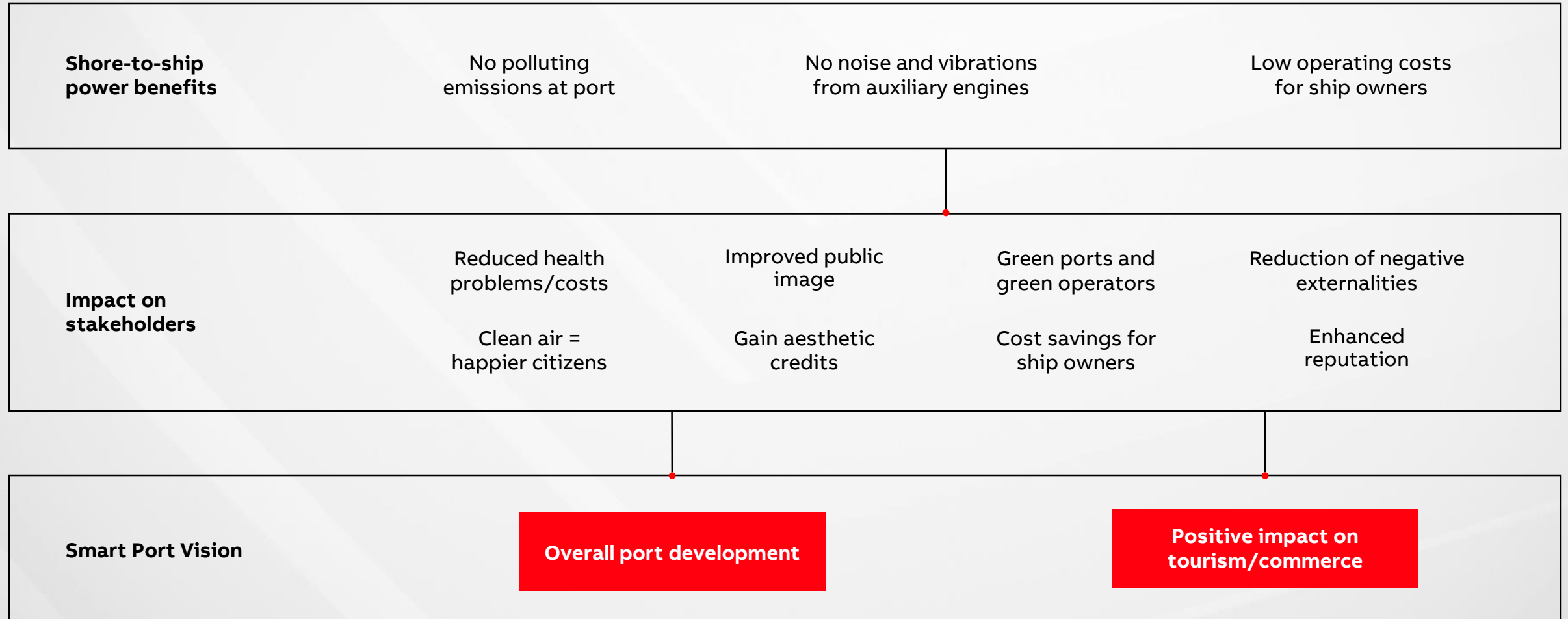
- Noise levels
- Vibration





# Shore-to-ship power and smart ports

## Economical and environmental benefits



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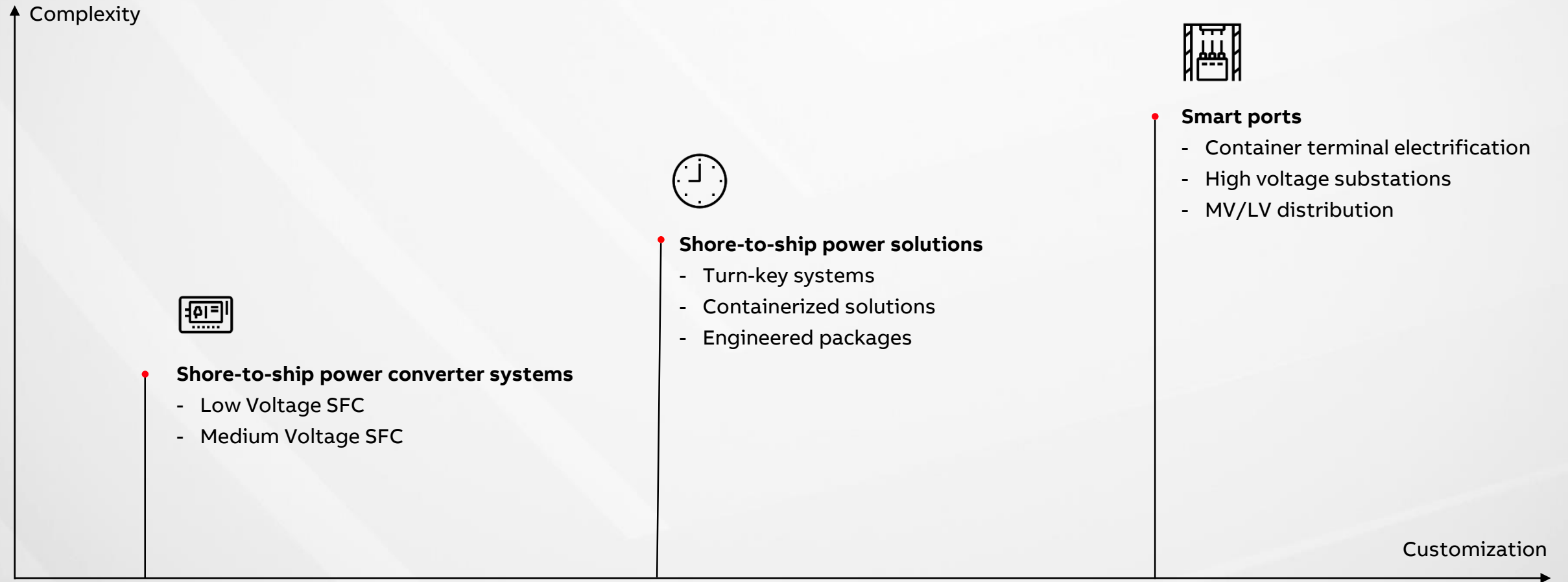
**Conclusion**  
Enabling more together





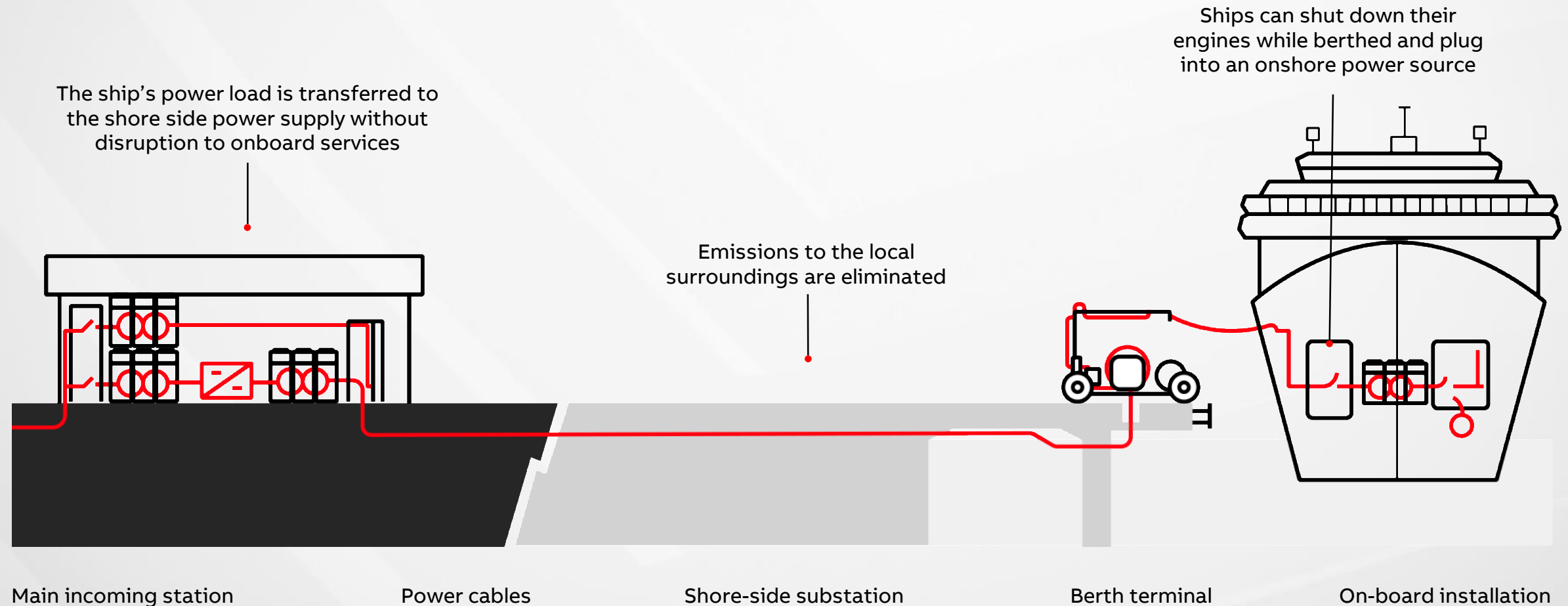
# Shore-to-ship power & Smart Ports

From converter systems to turn-key port electrification



# Shore-to-ship power

What does a shore-to-ship power supply do?





# Why should ports become smart?

Smart ports need lean grid integration



RORO/ Ferry



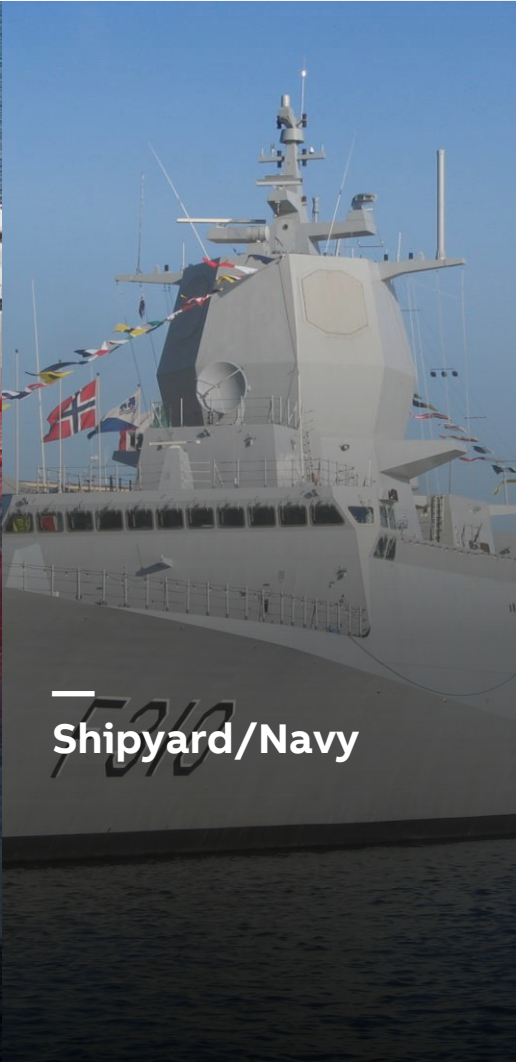
Container vessel



Cruise vessel



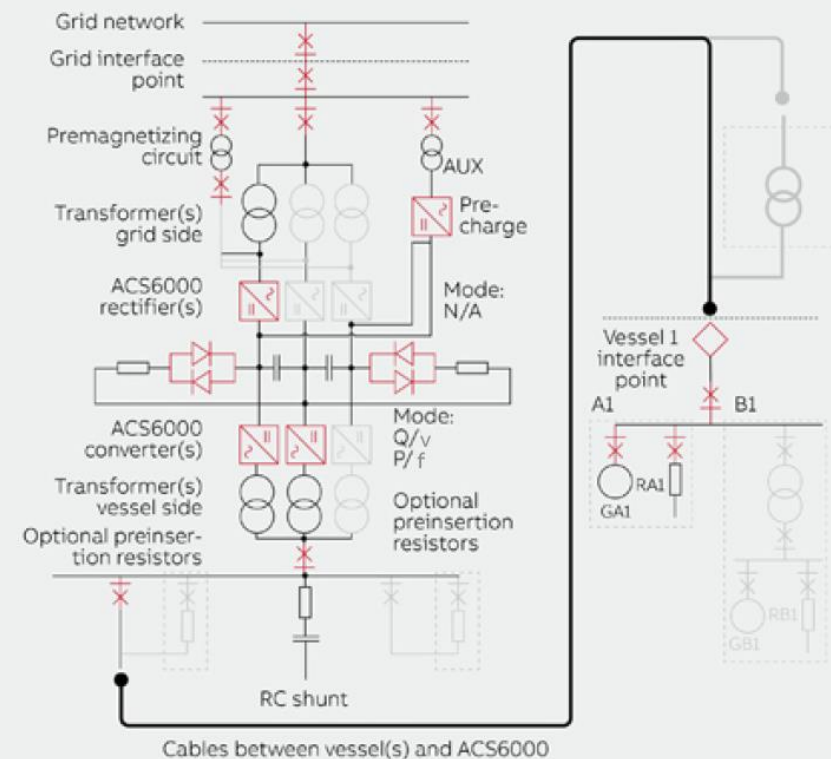
LNG/Tanker/FSU  
/FPSO



Shipyard/Navy

# Shore-to-ship power

## Connecting any vessel



Full range of converter solutions – from 1 to 24 MVA



# Shore-to-ship power

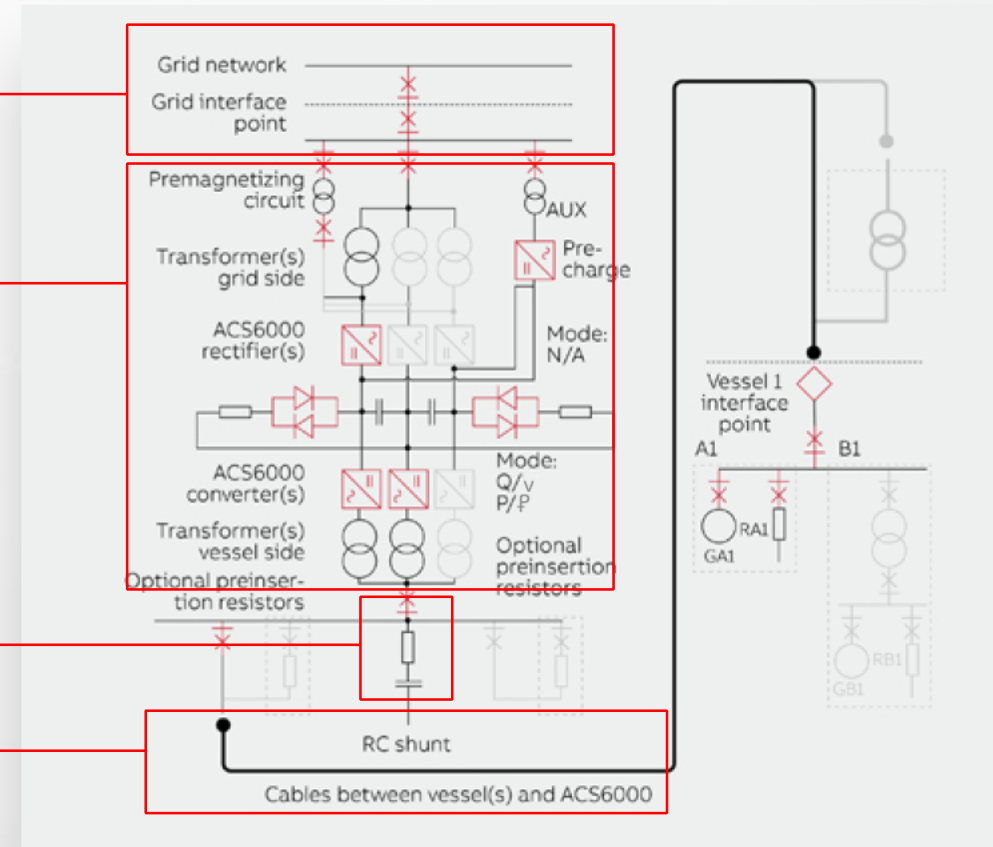
## Traditional S2SP solutions – single vessel connection

Incoming MV supply

1 to 20MVA Static Frequency Conversion System to supply No.1 vessel

Harmonic filters

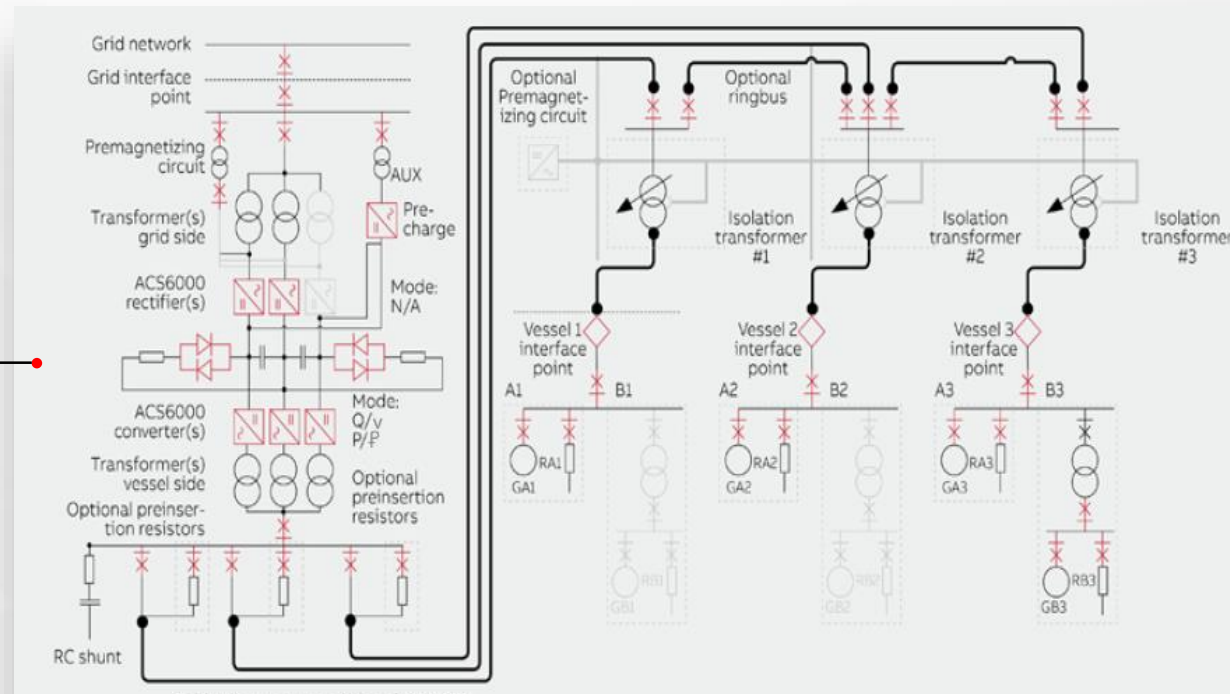
Cable Management System



One single converter can supply a cruise vessel ensuring full compliance with IEC/ESO/IEE 80005-1

# Shore-to-ship power

## Multiple vessel connections

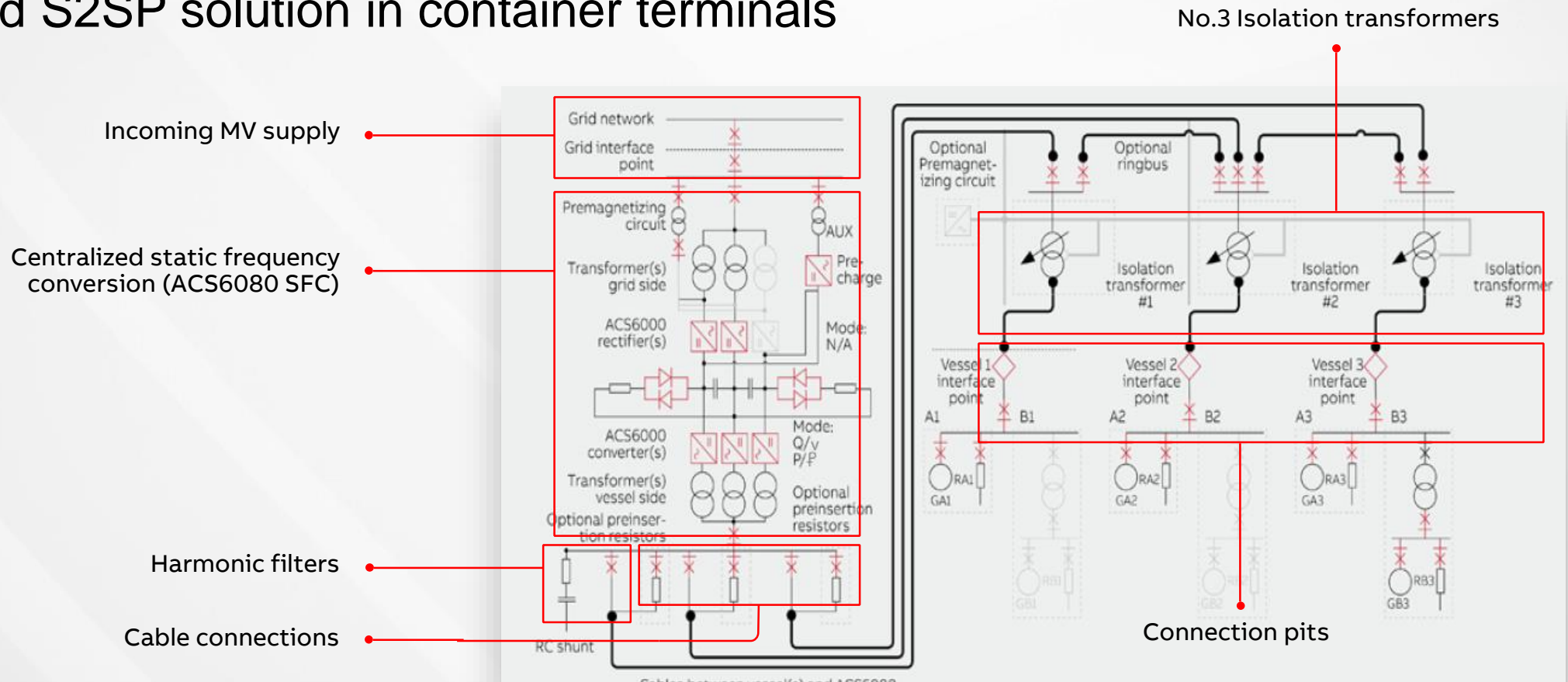


High power conversion platforms enter into the S2SP market – they enable the connection of multiple high consumption vessels



# Shore-to-ship power

## Centralized S2SP solution in container terminals



Enabling multiple high power vessel connections

# Smart ports – port electrification solutions

## Portfolio overview



### Air-insulated substations (AIS)

A versatile concept for all types of applications and environments, at a comparatively lower cost.

Several highly flexible switchgear layouts are possible. ABB has global expertise in all types of AIS applications.



### Hybrid substations

Hybrid substations reduce the installation footprint by integrating several functions in fewer components. Erection and commissioning are faster due to reduced civil works.

A flexible approach allows for various combinations of busbar and cable connections to suit the specific site needs.



### Gas-insulated substations (GIS)

A substation with all active switchgear components fully encapsulated offers a very compact footprint and fast execution due to pre-testing.

Further advantages are robustness against environmental conditions and low maintenance needs. ABB pioneered GIS technology in 1967.



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# Rotterdam, Netherlands

## Automated S2SP in a ferry terminal

### Customer needs

Complete electrical infrastructure to simultaneously power several vessels while berthed in the port of Hoek van Holland.

### ABB's response

Turnkey 12kV substations including:

- Turnkey shore-to-ship power installation including design, engineering, project management, installation and commissioning
- Complete substation and automation package based on PCS 6000 static frequency converters rated at 6 MVA

### Customer benefits

- Mitigation of negative impact of ferry operations on the local community and the environment
- Reduction of fleet's fuel consumption
- Greenhouse gas emissions reduced by 98%
- Less noise and vibrations





# Moin, Costa Rica

## Container terminal electrification

### Customer needs

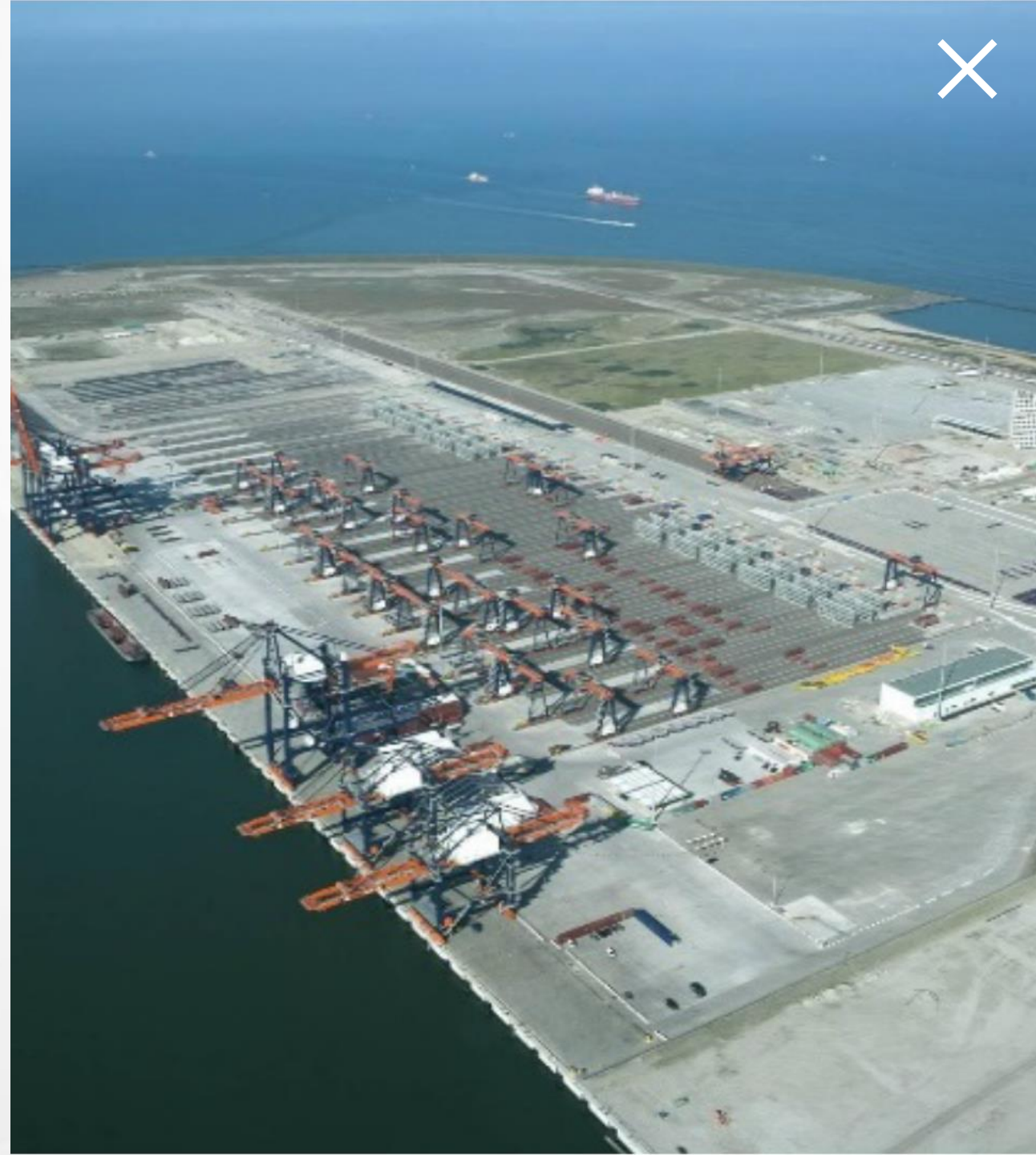
- Electric power solution for the largest infrastructure project in Costa Rica's history
- Capability to handle container ships with around eight times higher capacity compared to the country's other terminals

### ABB's response

- Main HV / MV substation
- Distribution substation and reefer substation including transformers, switchgear, grounding and panels in yard
- Reefer rack installation: plugs, panels and lighting
- Electrical conductors

### Customer benefits

- Optimized solution
- Single interface for all electrification supplies



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# Kodiak Island, Alaska

## Island Microgrid

### About the project

- Project name: Kodiak Island
- Location: Alaska, United States of America
- Customer: Kodiak Electric Association (KEA)
- Completion date: 2015

### ABB's response

- ABB Microgrid system integrating:
  - PowerStore Flywheel (2 MW/ 33 MWs)
  - Wind (6 x 1.5 MW)
  - Hydro (3 x 11 MW)
  - Diesel (1 x 17.6 MW, 1 x 9 MW, 1 x 3.6 MW, 1 x 0.76 MW)

### Customer benefits

- Stabilizing - frequency regulation
- Provide frequency support for a new crane
- Help to manage the intermittencies from a 9 MW wind farm
- Reduced reliance on diesel generators





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# Conclusion

## Partnership for success

### The tide is turning

Sustainable development in ports relies on achieving the optimum balance of costs and benefits.

One size does not fit all, so each project must be analyzed specifically to ensure CAPEX / OPEX optimization.

Technology providers like ABB are playing a key role in removing barriers towards the large-scale implementation of shore-to-ship power and port electrification solutions.

“

**ABB Grid Integration solutions help to balance the demand created by new electricity consumers entering ports with traditional and renewable power generation by enabling a stronger, smarter and greener port grid.**

**Patrick Fragman**

Managing Director,  
ABB, Power Grid, Grid Integration

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**ABB**