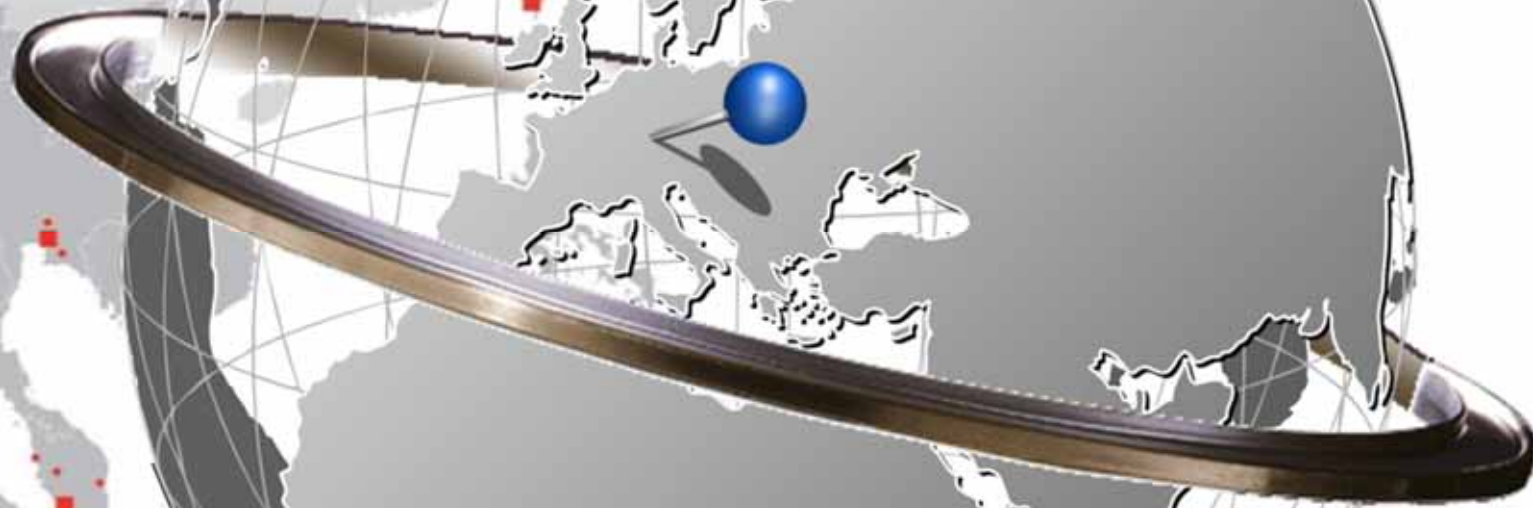




VAHLE



Electrification of RTGs

Ports of the future run on electric power

Port Electrification

Port electrification is a holistic approach integrating shorepower and advanced energy management, communication and transportation systems with port operations.

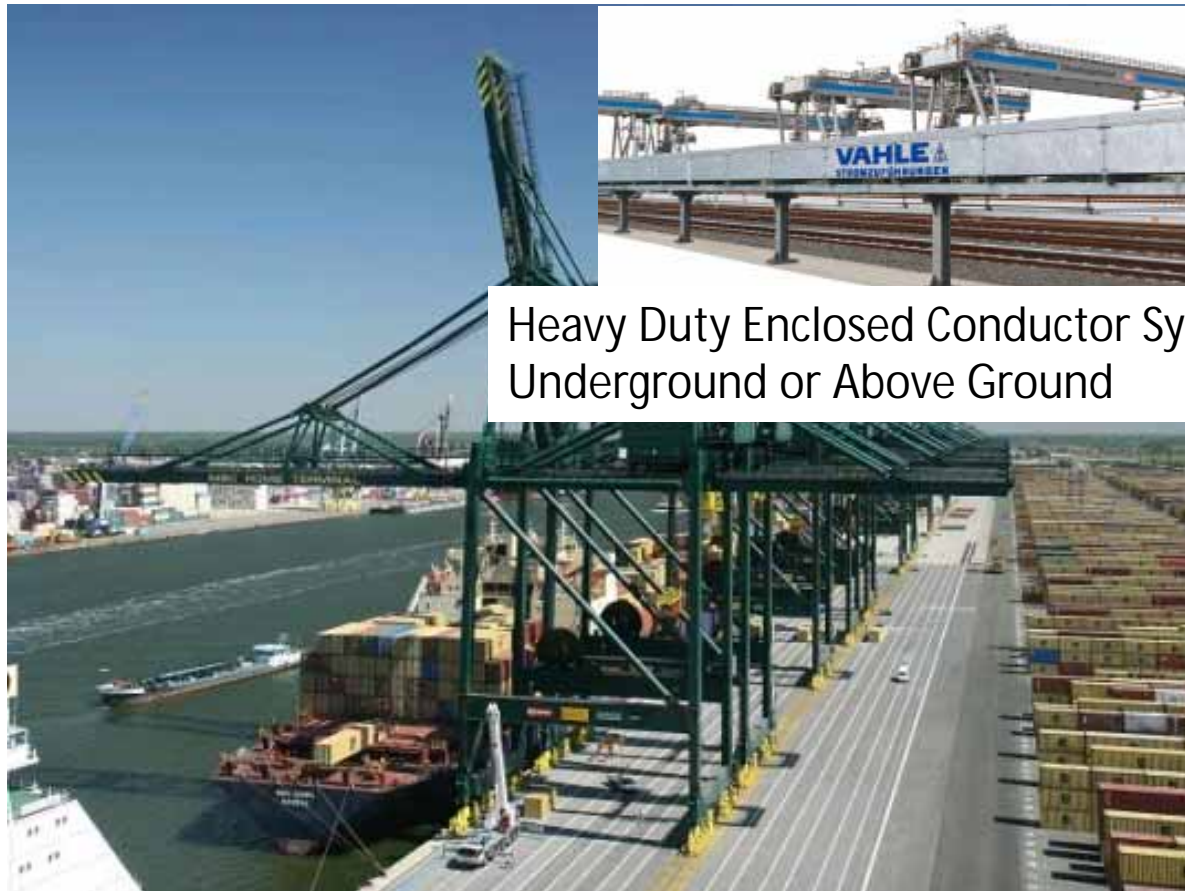
- Reducing Emissions
- Saving Energy
- Reducing Maintenance



Major Equipment Groups

- Ship-To-Shore Container Cranes
(including Mobile Harbour Cranes)
- Yard Container Cranes
- Mobile Port Handling Equipment

Ship-To-Shore Container Cranes



Heavy Duty Enclosed Conductor Systems
Underground or Above Ground



Mobile Port Handling Equipment

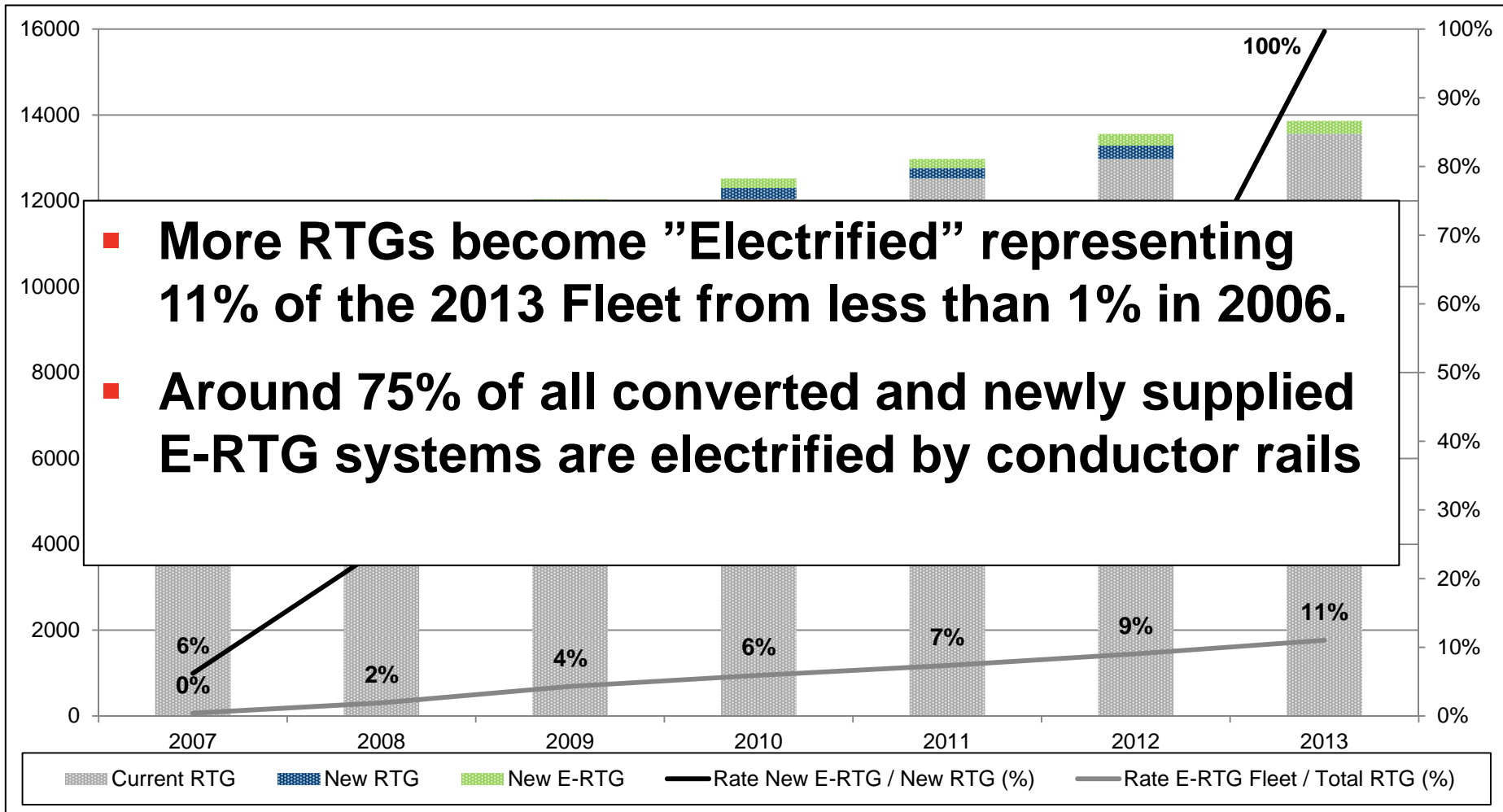


Yard Container Cranes

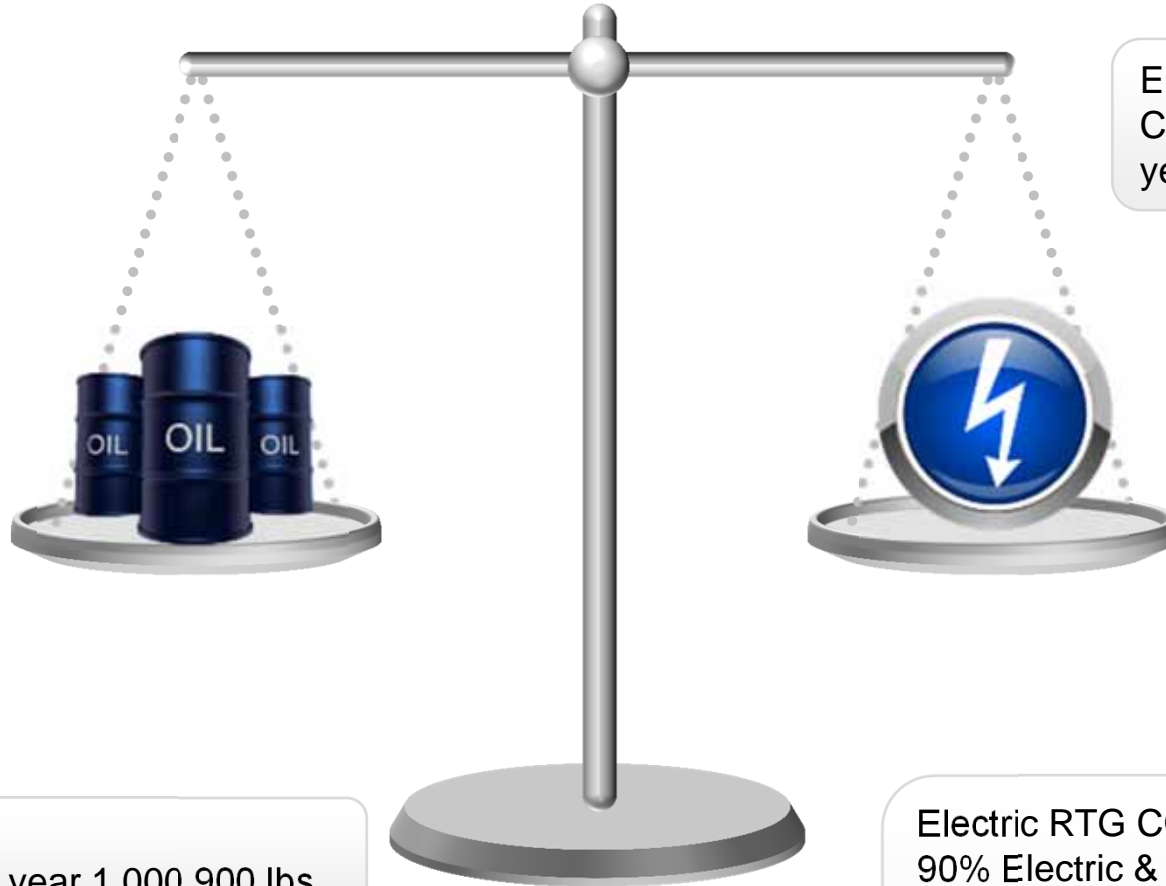


E-RTGs

- The 1996 Kyoto Accords brings world attention to the environment
- In 2006 first developments have started to convert diesel powered RTGs to electrical RTGs.
- The first electrification of RTG Cranes has been done by using Cable Reels.
- In 2007 first developments in China have seen the use of conductor rail systems with plug connections.
- More recently fully flexible Drive-In solutions, such as those first developed by Vahle have been successfully been implemented in major terminal operations.
- In 2013 marketing of automated RTGs by crane OEMs



**Eco'Logical'
facts from
an eRTG
solution
from a
container
terminal
operator**



Diesel RTG
CO₂ emission per year 1,000,900 lbs.


Electric RTG
CO₂ emission per
year 414,470 lbs.


Electric RTG CO₂
90% Electric & 10% Diesel (due
to Maintance & Block Changing)
emission per year 447,000 lbs.

CO₂ reduction of ~ 52%

RTG Type	Conventional RTG	EcoRTG	EcoRTG w/supercapacitors	eRTGs
Fuel / Energy consumption (15 moves / hour)	20,9 lit/hour	13,1 lit/hour	6,8 lit/hour	35kWh
Energy cost / h	\$17,2	\$10,80	\$5,63	\$3,15
Operating hours 3600, cost / year	<u>\$62 199,36</u>	<u>\$38 874,60</u>	<u>\$20 282,40</u>	<u>\$11 340,00</u>

Additional savings for reducing maintenance costs associated with diesel generators:

 Maintenance costs per operating hours (\$2.55 / hour) : \$9 180 per yr.

 Tier 4 Diesel replacement @ 25000 hours (\$6 / hour) : \$150 000

*Reference: Innovation for future generations conference, "GPA's eRTG demonstration project", Aug. 5-7, 2012.

Solutions: Electrification to reduce fuel and maintenance for achieving savings of up to 85%



E-RTG Solutions	Environment	Labor Saving	Safety	Space Savings
Hybrid				
Cable Reel				
Conductor Bar				

What to look for ?

- Space savings due to vertical arrangement (330mm single sided and 600mm double sided)
- Electrification of two aisles from one steel structure
- Lightweight and robust tubular steel structure
- Diabolo roller design for multi-dimensional guidance
- Minimized moving wear parts (3 rollers only)
- Fully Automated Connector System
- Automatic synchronization during switch-over
- One or two arms per RTG to maximize operational flexibility

What to look for ?

- Upgrade for automatic / remote operation to include data communication and positioning systems



The Busbar power connection converts the RTGs to fully electric operation. **Image: Konecranes**

Integrated Positioning and Data Communication System. **Image: Vahle**

Challenges

- Retrofit
 - Interface definition
 - Adaption to all RTG Types and port layouts

- Greenfield
 - Clear Interface
 - Off site test track with major RTG suppliers





UK

VAHLE

Turkey

Mexico

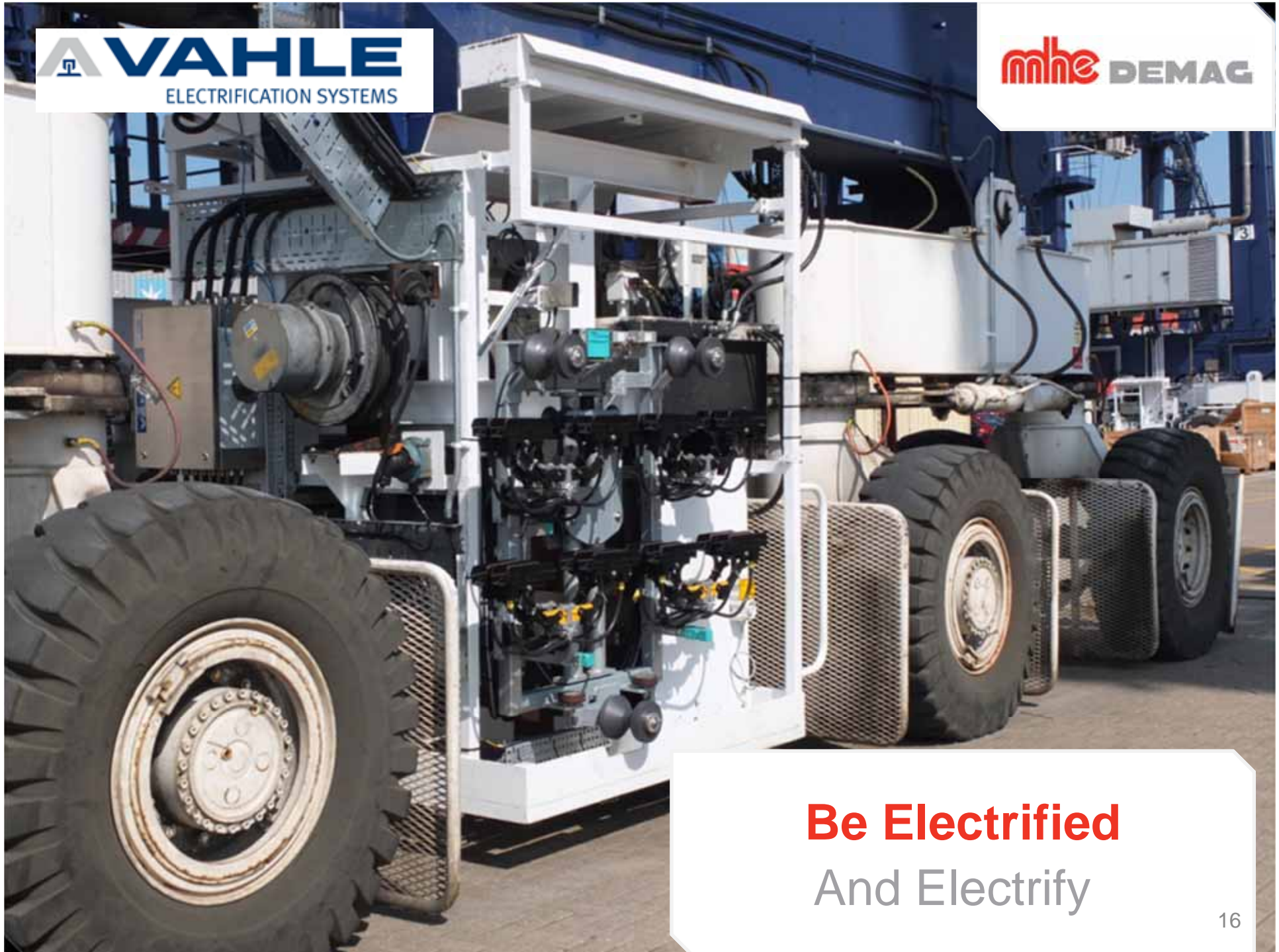
Panama

Hongkong

mlhe DEMAG

Singapore

Indonesia



Be Electrified
And Electrify