



## Advanced Technologies for Lower Emissions and Efficiency in Overseas Ports

Faster Freight Cleaner Air  
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### Some Green Features of Overseas Terminals

- Reduced emissions from berthed vessels
- Automated transport vehicles with low emission technology
- Electric yard cranes
- Electric cranes serving on-terminal rail yards
- Advanced street truck processing systems

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## Vessel Emissions Reduction

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### Techniques to Reduce Vessel Emissions

- Electric shore power for hoteling of vessels (AMP)
  - In limited use in overseas ports – but expanding
- Use of cleaner fuels on vessel while near land or in port
- Reduce the amount of time vessels spend in port
  - Automated mooring systems
  - Faster loading and discharging of vessels

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## Automated Mooring Systems

- Reduce ship idle time during line handling
- Typical time to attach and secure vessel ~ 12 seconds



Ferry Terminal  
Auckland, NZ



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## Faster Discharging and Loading

Indented berth with up to nine cranes working simultaneously



Ceres Paragon Terminal  
Amsterdam, Netherlands

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## Increased Crane Lifts per Hour

Dual hoist cranes;  
up to 20% increase  
in number of lifts per  
hour



Container Terminal  
Altenwerder, Hamburg,  
Germany

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## Increased Crane Lifts per Hour

Tandem 40/quad 20;  
up to 50% increase  
in number of containers  
handled per hour



Jebel Ali Container Terminal,  
Dubai, UAE

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AP Moeller Terminal, Algeciras, Spain

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## Electric Yard Cranes

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## Electric Rail-mounted Gantry Cranes (RMGs)

Zero emissions



Gottwald Design for Antwerp, Belgium



Container Terminal Altenwerder,  
Hamburg, Germany



European Combined Terminal,  
Rotterdam, Netherlands

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## Rubber-tired Gantry Cranes (RTGs)



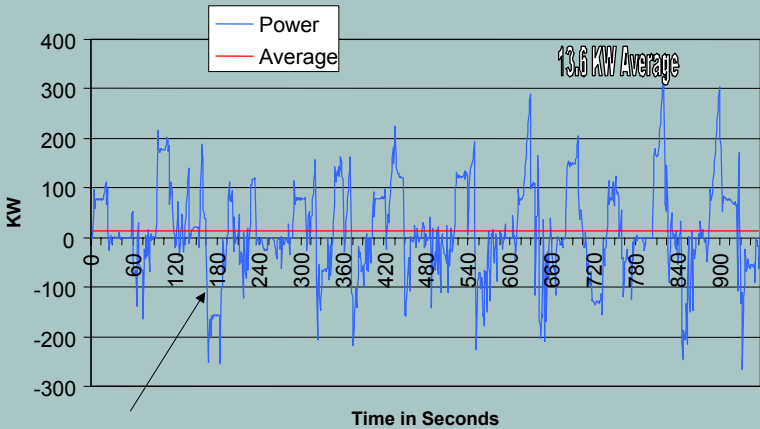
Kalmar Electric RTG  
Oslo, Norway  
Zero emissions



ZPMC Capacitor RTG  
Seattle, Washington  
10% - 13% fuel reduction  
Significant emissions reduction

## Power Consumption over Time

### Full Regeneration System



Negative values indicate power re-generation

## On-terminal Intermodal Yards are Greenest

- Trains emit less per ton-mile than trucks.
- If cargo is destined for rail, on-terminal is better than off-terminal
- On terminal transport via cleanest possible yard tractor technology
- Electric cranes to load and unload trains; common practice in Europe



APL Pier 300 Terminal, Los Angeles



Transport Equipment

## Automated Guided Vehicles

- Automated vehicles are typically linked with end-loaded yard stacks
- This minimizes travel distance
- Robots drive more smoothly than humans
- Robot vehicles can be hybrid-electric with diesel or natural gas
  - Regenerative braking
  - Engine off during idle



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## AGVs Do Require A Little Wiring



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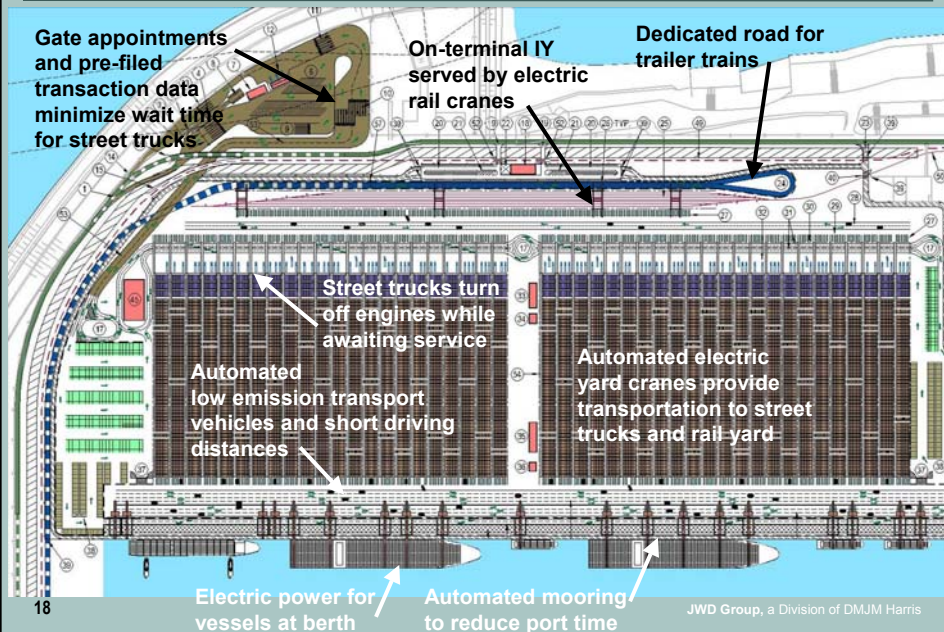
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## Appointments and Gate Technology can Reduce Street Truck Time on Terminal

- Terminals have little control over emissions from street trucks
- Terminals can minimize truck turn-time by:
  - Appointments to eliminate congestion at gate and in yard
  - Pre-filing transaction data reduces exception handling and allows terminal to pre-position the container
- Automated data capture at entry and exit gate can fully automate the gate process



## Review of Green Terminal Features Euromax Terminal, Rotterdam – Conceptual Design



## Rough Comparison

Euromax		West Coast	
– Quay cranes	20	– Quay cranes	23
– Vessel Strads (diesel)	80	– Vessel UTRs (diesel)	140
– Yard cranes (electric)	88	– Yard cranes (diesel)	66
– Intermodal cranes (electric)	4	– Intermodal cranes (diesel)	4
– Intermodal strads (diesel)	12	– Intermodal UTRs	24
– Chassis flipping	0	– Chassis flipping (diesel)	3
Total diesel engines	92	Total diesel engines	234

**Diesel engine reduction of approximately 60%**

## Light and Noise Advantages of Automation

- Machines do not need light for navigation
- Electric operations are quieter than diesel
- Automated cranes place containers more precisely and quietly than humans:
- *“Another notable impression was the almost silent operation. There was no audible noise from the spreader hitting a container or the containers contacting with each other.”*
  - From World Cargo News, July 2005 describing automated RMGs in Korea

## Conclusion

- An automated terminal is safer
  - Fewer people = fewer injuries
  - No need for trucks to drive underneath yard cranes
- An automated terminal is more secure
  - Street truckers cannot access containers directly
  - Fewer terminal personnel
  - Computer control and recording of all container movement
- ***An automated terminal is a green terminal***



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Thank You

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