



The State-of-the-Art for Green Terminals

An Automated Terminal is a Green Terminal

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Mark Sisson, PE

What's not “Green” about Traditional Container Terminals

- Vessel emissions
- Yard tractor and yard crane emissions
- Queues of street trucks waiting for service
- Light and noise pollution

What are Features of a State-of-the-Art Green Terminal

- Cold ironing for vessels, with rapid automated berthing
- Automated transport vehicles w low emission technology
- Electric end-loaded yard cranes
- Electric cranes serving the on-terminal railyard
- Appointment systems to reduce idle time for street trucks

Vessels Generate a Large Fraction of Total Port Pollution



Techniques to Reduce Vessel Emissions

- Electric shore power for hoteling of vessels (AMP)
- Use of alternate fuels on vessel when in port
- Voluntary or mandatory speed reduction near the port
- Reduce the amount of time vessels spend in port via automated mooring devices

Alternative Marine Power (AMP) or “Cold Ironing” Reduces Vessel Emissions



Automatic Mooring Systems Reduce Ship Idle Time During Manual Line Handling



Automated Transport Vehicles (AGVs) Emit Less than Manned Vehicles

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



**Diesel-electric Busses are in Service Today,
Similar Technology Could be Used for Terminal Tractors or AGVs
Alternate Fuels Could Also be Used in Hybrids**



Diesel Yard Cranes Are Also Significant Emitters




End loaded RMGs: ECT, Rotterdam

DMIM HARRIS | AECOM

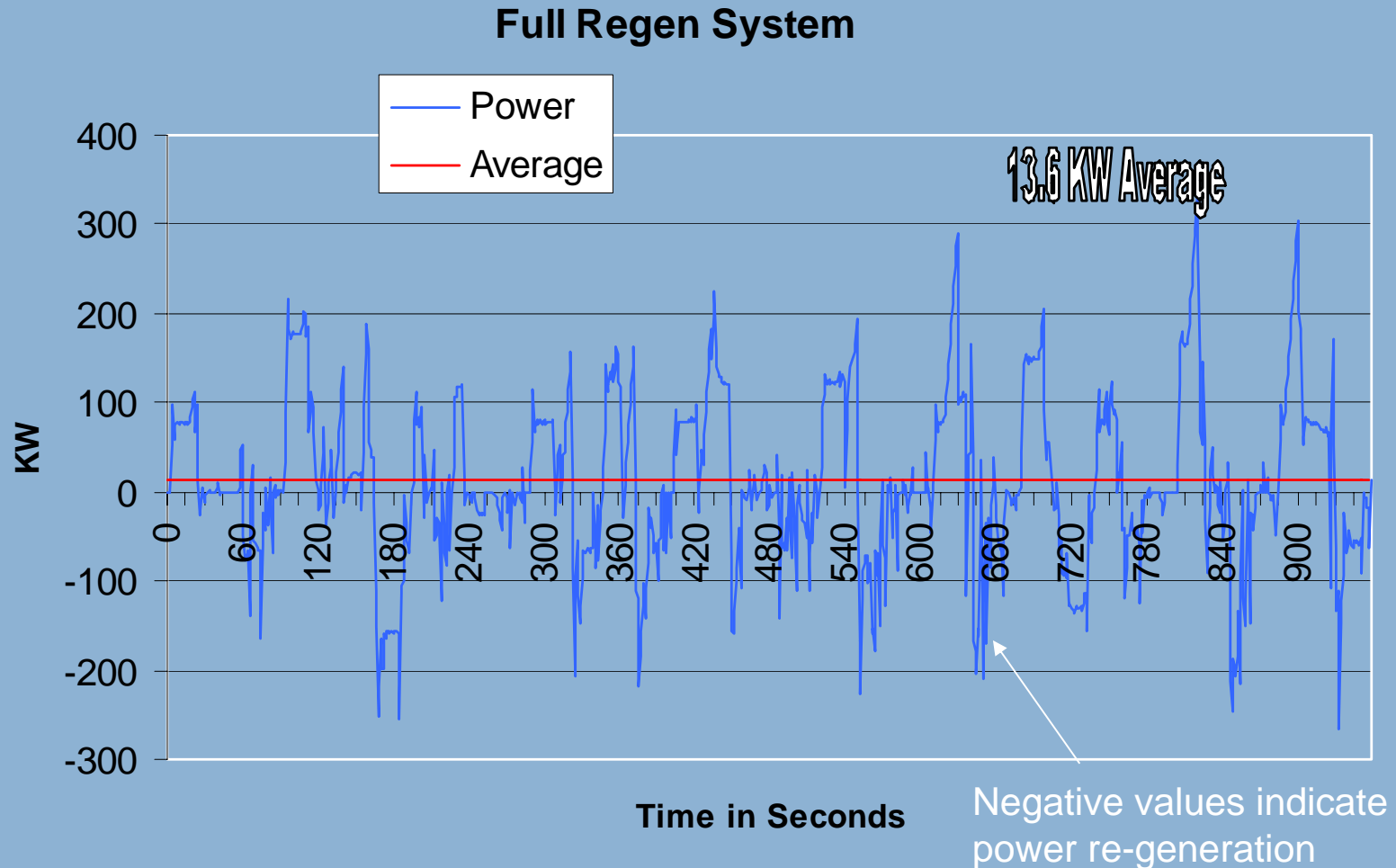


Electric RMGs perform part of the transport



Transport vehicles only need to travel a short distance to reach the CY cranes

RMG Power Consumption over Time



On-terminal Intermodal Yards are Greenest

- Trains emit less per ton-mile than trucks.
- If cargo is destined for rail, best practice is to minimize the travel distance to the railyard (on-terminal is better than off-terminal)
- On terminal transport via cleanest possible yard tractor technology
- Electric cranes to load and unload trains



Appointments and Gate Technology can Reduce Street Truck Time on Terminal

- Ports and operators have little control over emissions per hour from street trucks
- Terminals can be operated to minimize the time spent on terminal
- Appointments to smooth congestion and to re-handle in advance
- Automated data capture at entry and exit gate to reduce gate time



OCR Gate Portal at TraPac POLA



Vacis X-ray Inspection in Hong Kong for Automated Inspection of Empties

Radiation is beamed between these two panels



With end loaded CY systems, trucks back up to the landside end of the CY stacks and are served by remote operators

With no need to creep forward, trucks can shut off engines while waiting for service



Console for Remote Yard Crane Operations for Gate Service in Hamburg

A camera on each corner of the spreader shows an image here



This joystick controls the electric crane



Light and Noise Advantages of Automation

- Machines do not need light for navigation
- Electric operations are quieter than diesel
- Machines 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

Other Benefits of Automated Terminals

- Increased Safety
 - Fewer people = fewer people getting hurt
 - No need for trucks to drive underneath yard cranes
- Increased Security
 - Street truckers cannot access containers directly
 - Fewer terminal personnel
 - Computer control and recording of all container movement
 - Automated scanning of cargo while in the CY

Review of Greenest Terminal Features

On-terminal IY
served by electric
rail cranes

Street trucks turn
off engines while
awaiting service

End-loaded electric
yard cranes

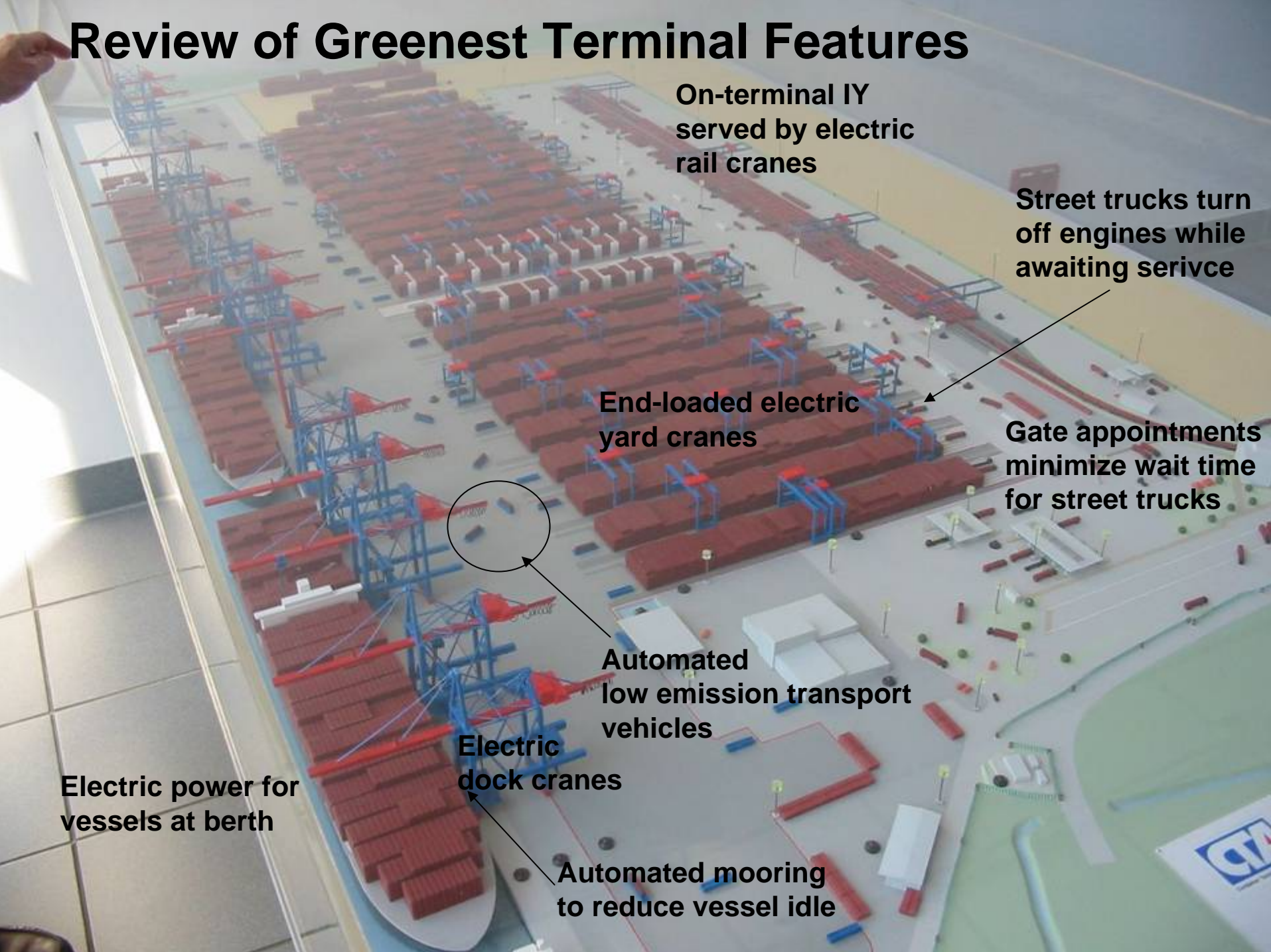
Gate appointments
minimize wait time
for street trucks

Automated
low emission transport
vehicles

Electric power for
vessels at berth

Electric
dock cranes

Automated mooring
to reduce vessel idle



Why Haven't Automated Environmentally Friendly Terminals been Built in the US?

- Ports and operators historically have not factored emissions into decisions on operations
- In the past, land has been plentiful and cheap so wheeled operations have been possible
- Restrictive labor rules have made RMGs unappealing, especially on the US West Coast
- All of these are changing rapidly

Planning and Analysis can Quantify Emissions Benefits

- Planning of alternatives combined with detailed simulation can quantify the engine hours required to move a given number of containers
- Simulation analysis can be used a basis for holistic cost comparison between systems
 - Construction cost
 - Equipment capital costs
 - Energy cost
 - Maintenance cost
 - Labor cost under various work rule scenarios



Thank You



Speaker Contact Information

- Mark Sisson, PE
JWD Group, a division of DMJM+Harris
300 Lakeside Dr.
Oakland CA, 94612
Phone: 510-844-0549
Fax: 510-835-3464
Email: mark.sisson@dmjmharris.com
Web www.dmjmharris.com