



Standardizing Electrification

Jim Andriotis – Group Innovation Market Development Manager
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1. Define Electrification
2. What Drove Electrification?
3. How Is It Implemented Now?
4. How Do We Simplify It?
5. What Is Missing?
6. Summary



Definition:

The conversion of a machine or system to the use of electrical power

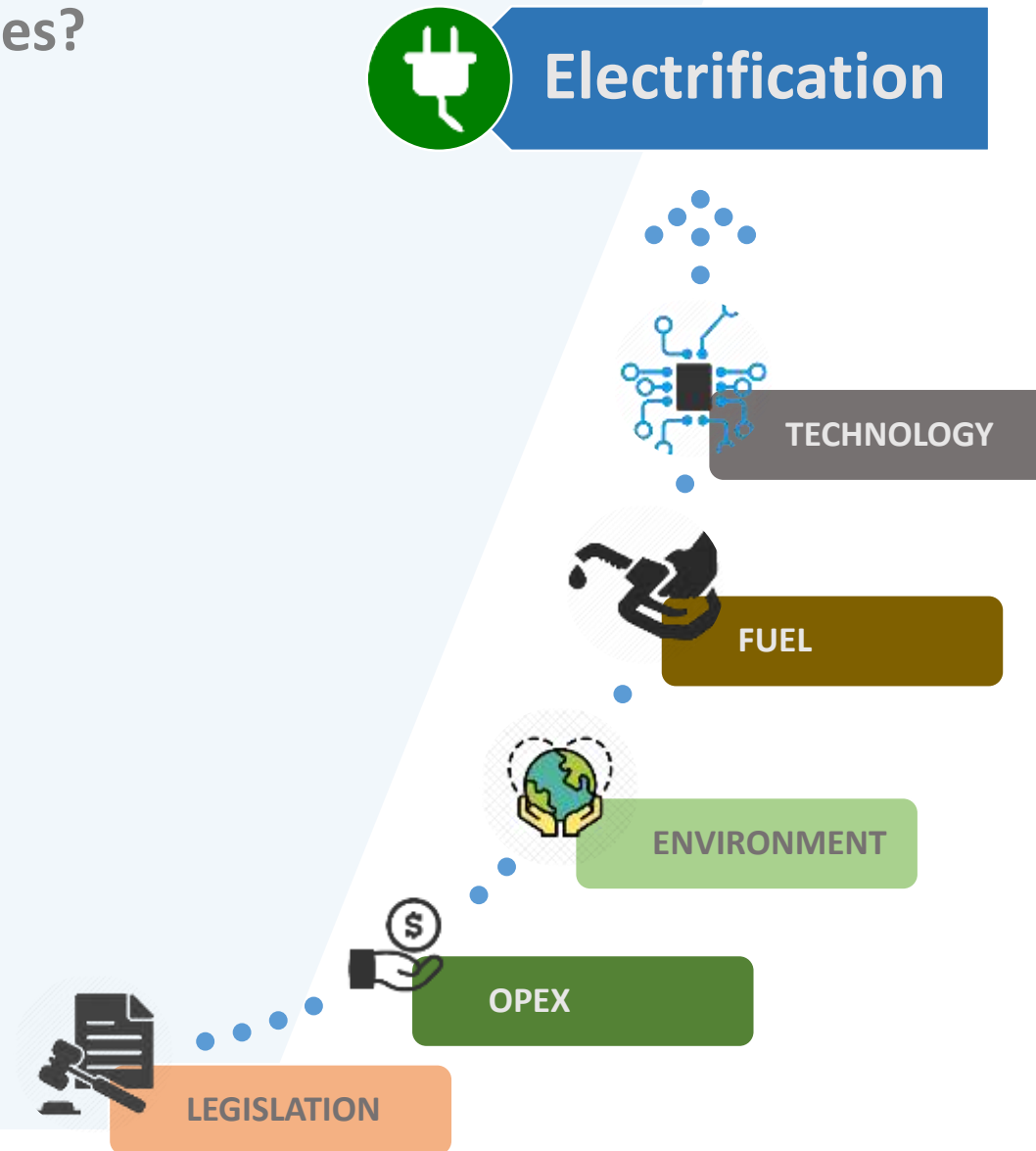
Focus:

STS
E-RTG
RMG / ASC



What drove electrification?

What drove these changes?



What drove electrification?

Some numbers



Carbon Taxes

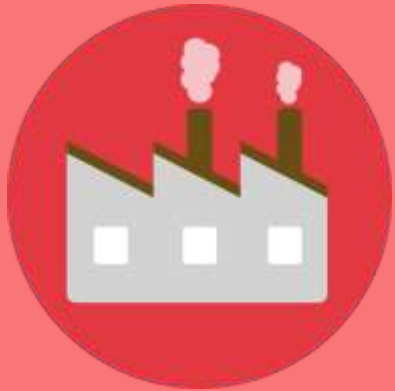
*30 – 85€ per tonne
of CO₂ (Proposed)*

MAREX – Port of Rotterdam

Diesel Price

*Dec. 2008: \$1.59/gallon
Dec. 2017: \$2.58/gallon*

EIA.gov, Conventional Off-Highway Diesel



Pollution Reduction

*NO_x: 32.3%
CO: 22.1%*

2008/2016 Air Emissions Inventory, POLB, RTG Cranes

OPEX Reduction

*Fuel costs: 92%
Maintenance: 43%*

Estimated Reduction; Full Diesel RTG to E-RTG with Gen. for Block Change



What drove electrification?

Technologies adapted



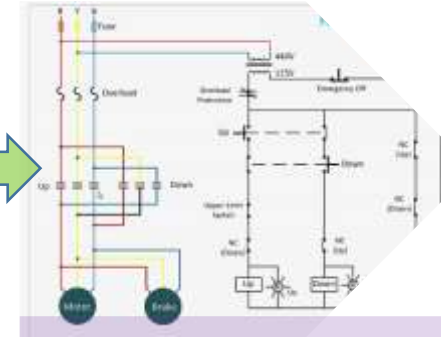
Diesel



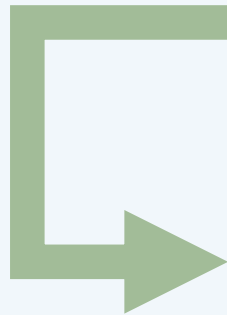
Cable Management



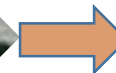
Medium Voltage



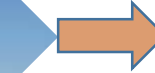
Advanced Controls



Automated Plug-In



Battery/Hybrid

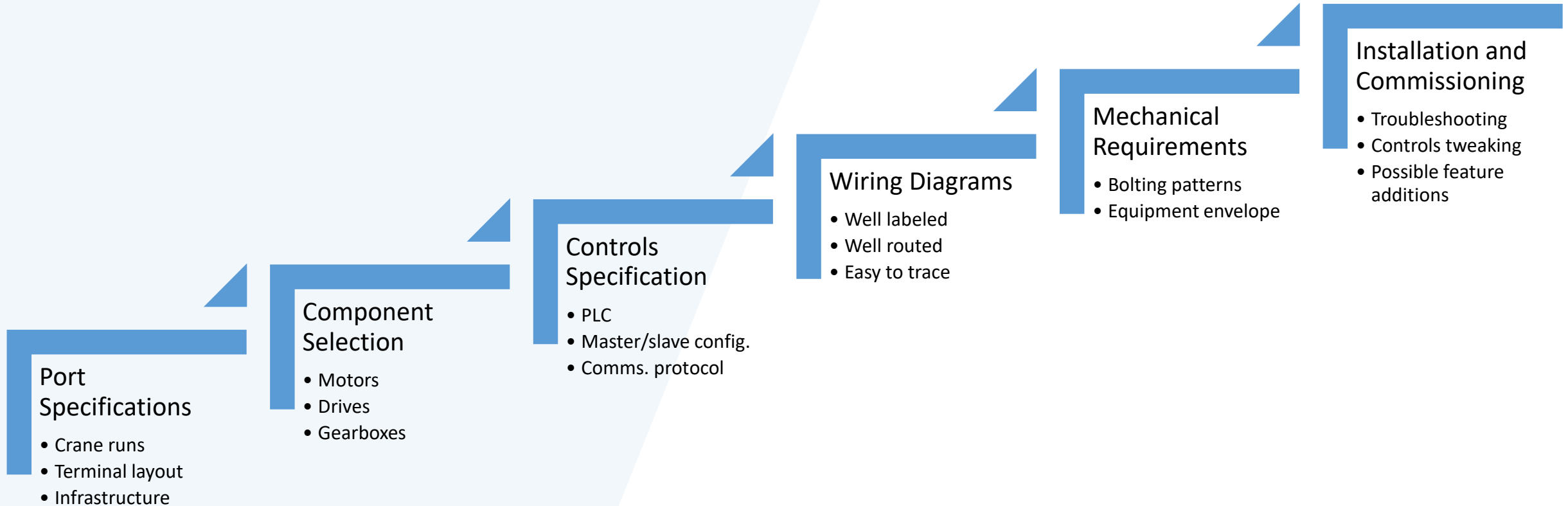


Peak Shaving

Terminal Flexibility + Zero Emission + Reduced OPEX

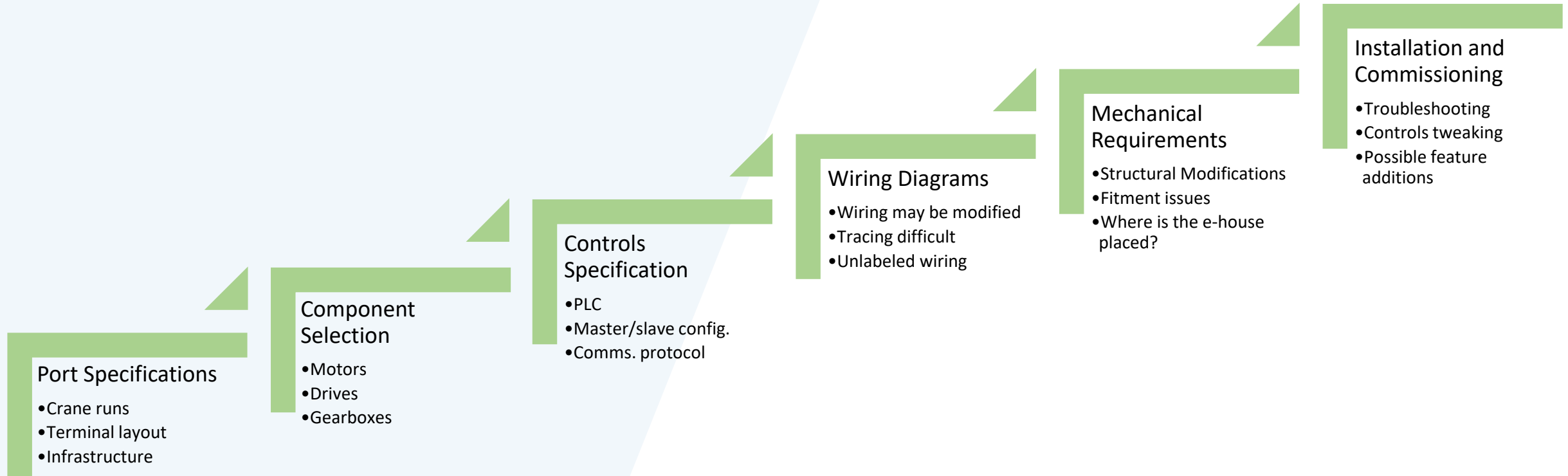
How is it implemented now?

New crane process



How is it implemented now?

Electrification retrofit/upgrade process



How is it implemented now?

Other port equipment examples



E-Trucks



AGVs

Straddle Carriers



How do we simplify it?

Examples from other industry

Tesla

Apple Car Play

Android
Auto



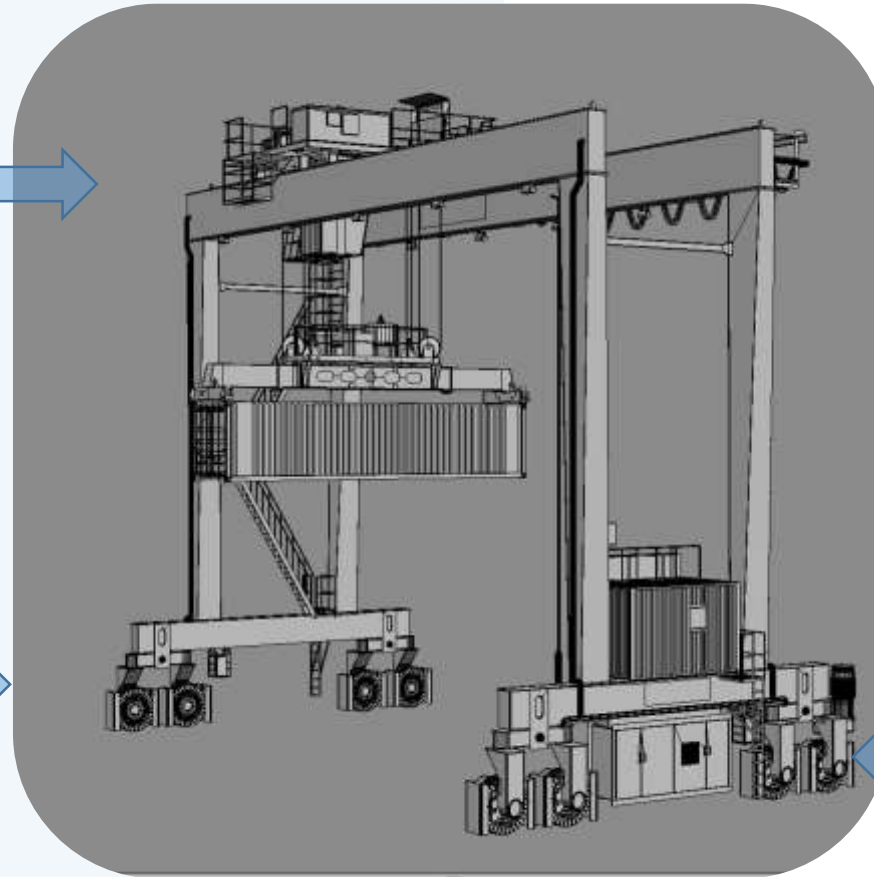
How do we simplify it?

Modularization

Peak Shaving



Auto Steering



Cable Reel



Battery System

How do we simplify it?

Standardization

Peak Shaving



Auto Steering

Communication Protocol



Wiring Harness



Cable Reel

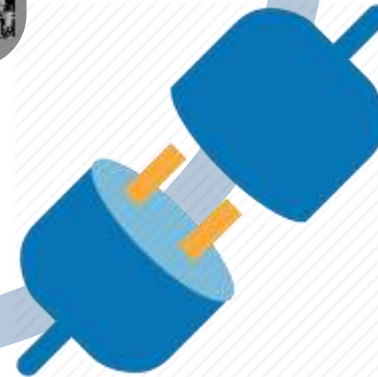


Battery System

Software

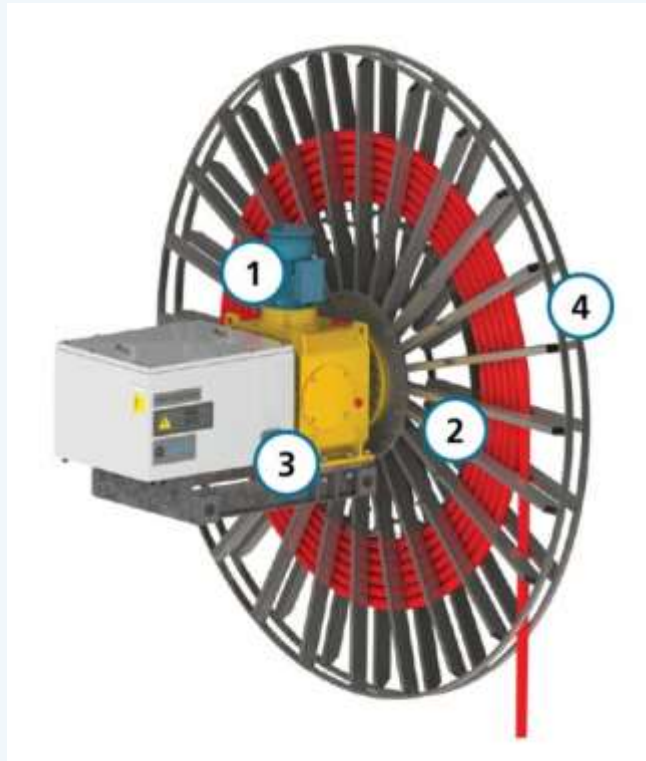


Plugs

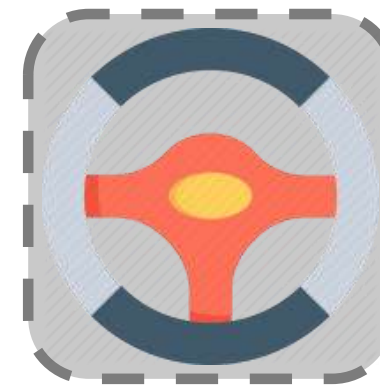
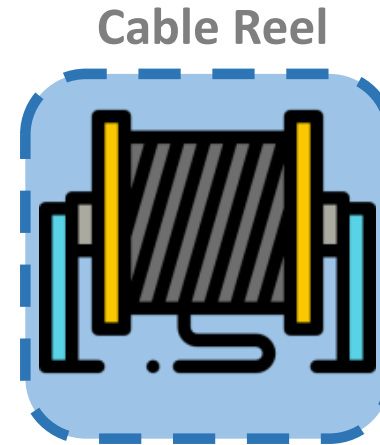


How do we simplify it?

Our example: Cavotec Eco-system



Cavotec
Control Unit



Auto Steering



Battery System

What is missing?

Standards

- › Industry wide
 - Needed to drive design and implementation
- › Improve all aspects of port expansion/electrification
 - Crane electrification and commissioning becomes plug and play
 - Easier maintenance
- › Opens simplified path to automation
 - Port infrastructure plug and play next step
- › Drive through industry recognized bodies
 - ISO
 - PEMA
 - IEEE



What is missing?

Education

- › Proper research
 - Show full ROI benefits of a standardized environment
- › Impact of electrification
 - What is the true ROI of going electric



Summary

- › Electrification is here to stay
 - The benefits are clear
- › Modularization is possible now
 - The technology exists
- › Standards need to be created
 - A common path for all equipment to work together seamlessly





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