

Battery Integration & Energy Management on Cranes For More Sustainable Operation

with SIMOCRANE ESSM

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Key Initiatives

De-carbonization

UN SDGs & Paris Agreement 2015

The race to combat climate change. To keep global temperature increase well below 2C, and if possible, below 1.5C.

The **2030 Agenda** applies to all countries of the world. It was approved by the UN member states after a transparent and inclusive process. Its centerpiece comprises 17 sustainable development goals (SDGs), to be implemented by 2030.

Equally seminal for the future of our planet is the **UN climate agreement signed in Paris**. This saw the world community agree on key issues such as pursuing efforts to limit the global temperature increase to 1.5 degrees above the pre-industrial level, where possible.

New York, September 2015 | Paris, December 2015



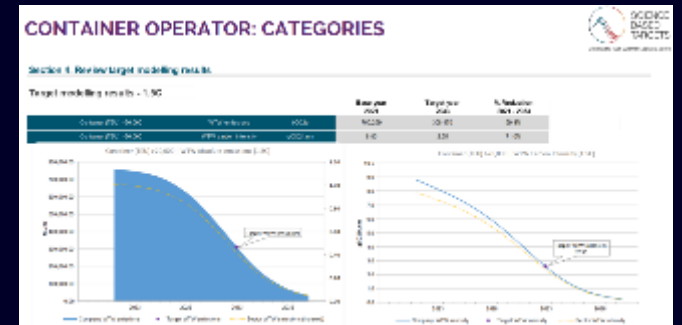
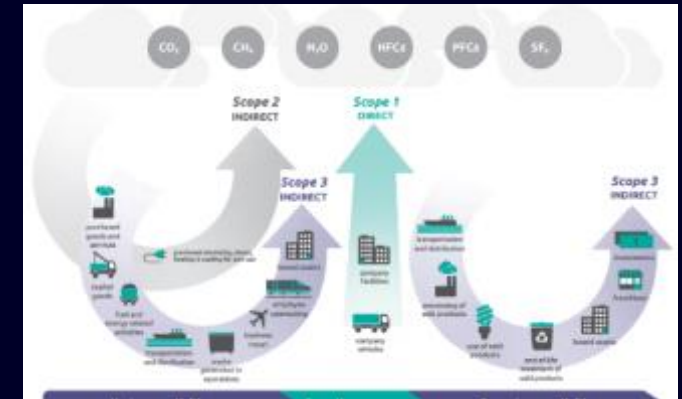
EU Emission Reduction strategy

Mandated by the EU Directive on Energy Efficiency (2023/1791), industries must reduce GHG emissions with at least 55% by 2030 and achieve a climate-neutral in 2050.



SBTi

Provide a clearly-defined path to reduce emissions in line with the Paris Agreement. More than 5,000 businesses around the world are already working with the Science Based Targets initiative.



How do we approach decarbonization and contribute to the energy transition?

Differentiation of crane types

Mobile Cranes

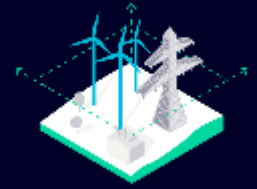


- ✓ Hybridization (short term)
- ✓ Smooth transition of HY-RTG to E-RTG
- ✓ Full electrification with Battery used for Yard change operation & infeed peak shaving E-RTG(+) (mid- long term)

Facts

- RTGs, HMCs & Straddle Carriers represent a major part of the total fuel consumption for a port (~ 50- 60%)
- Each conventional RTG produces ~240 tons of CO2 per year
- Each mobile crane needs grid independent power supply for being flexible

Shore Powered Cranes



- ✓ Peak – Shaving (short term)
- ✓ Holistic planning & power utilization optimization (mid-long term)

Facts – Shore Powered Cranes

- Cranes are peak power consumers, harming the power grid in regards of stability and power reserves
- Grid fees for peak power demands
- Expandability connected to high investments
- Ratio between cost for motoric power and refund for energy fed back to the grid is unbalanced
- Regenerating energy back to the grid is less efficient then storing and reusing it locally
- High connected power compared to RMS power demand

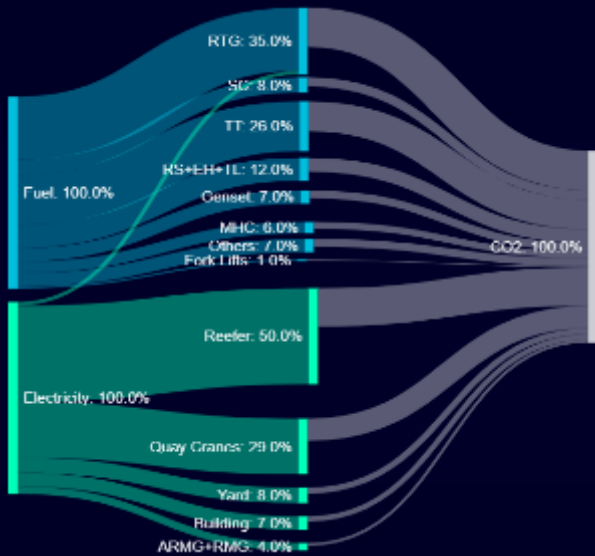
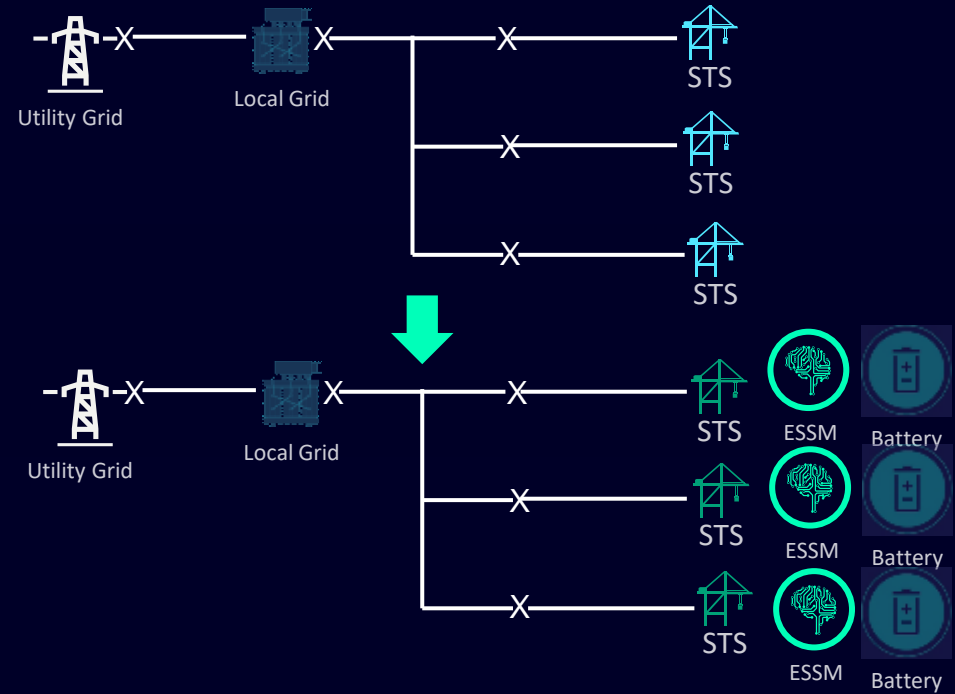
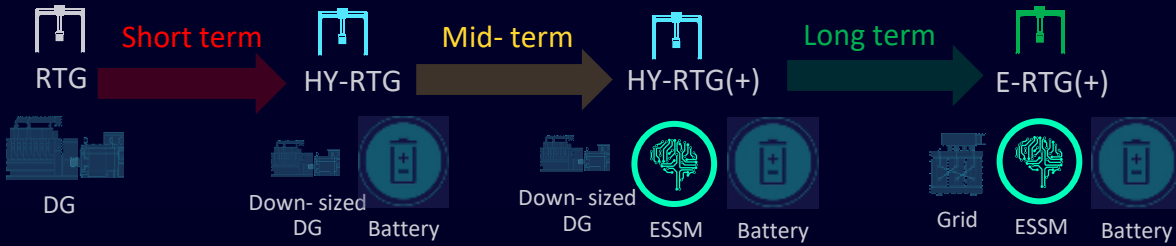
Smooth Transition from Hybridization to Electrification

Step by step in line with operation and energy supply capacity

Mobile Cranes



Shore Powered Cranes



CO2 Emissions Baseline 2020



LI-ION ESS – One standardized solution

Covering all use cases with modular approach

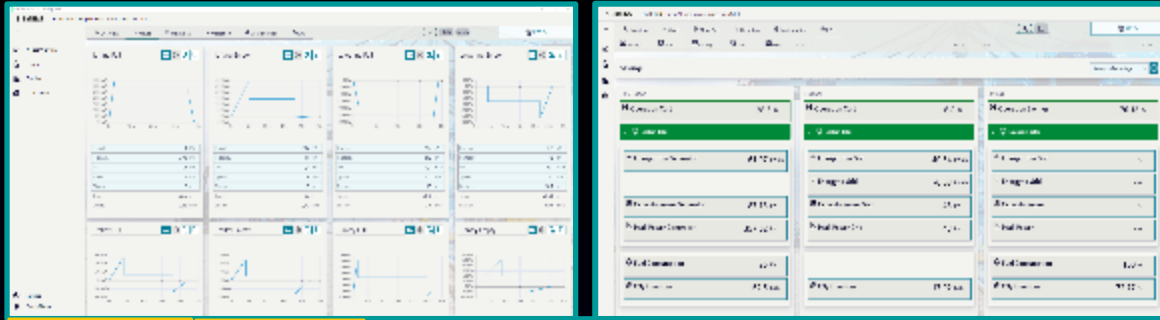
	Mobile Cranes (E-RTG, Hybrid RTG)			Shore Powered Cranes (STS, RMG)
Drive Scheme	<p>ESS, Aux. Sup., Crane axis</p>	<p>Grid, ESS, Aux. Sup., Crane axis</p>	<p>Diesel genset, ESS, Aux. Sup., Crane axis</p>	<p>Grid, Aux. Sup., ESS, Crane axis</p>
Operation mode				
Power Supply	Battery	Grid & Battery	Battery & Diesel Genset	Grid & Battery
ESS use case	load handling & long travelling	long travelling & Emergency load handling	load handling & travelling	power peak shaving Emergency load handling
Battery charging	via Grid & Regen.	via Grid & Regen.	via DG & Regen	via Grid & Regen.
Effect				

3 Steps to sustainability in terminal operation and cargo handling

Coverage from sizing to commissioning with digital solutions

Automated Power Profile Analysis

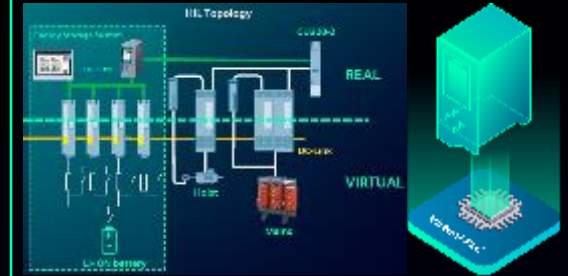
Automated KPI forecast



Software engineering

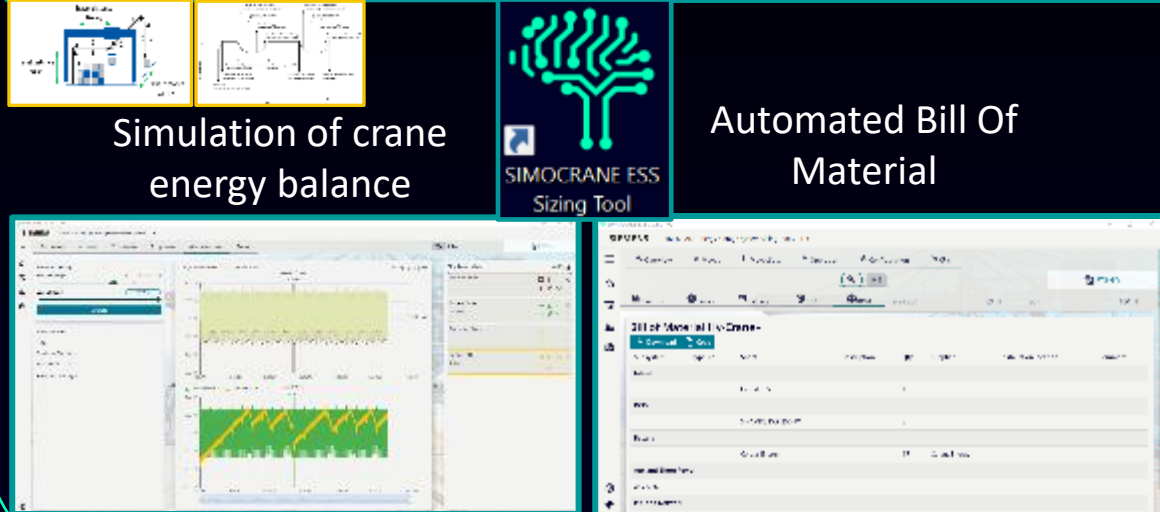


Virtual Pre-Commissioning



Simulation of crane energy balance

Automated Bill Of Material



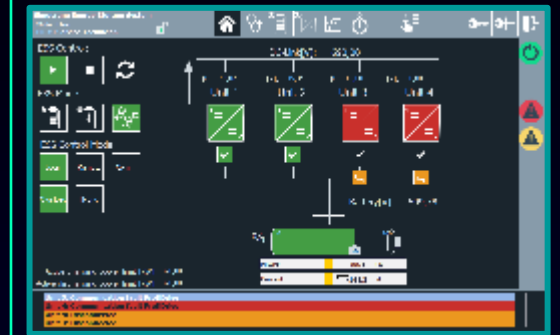
Standard Application

Modular design & construction



HiL Simulation

Final commissioning



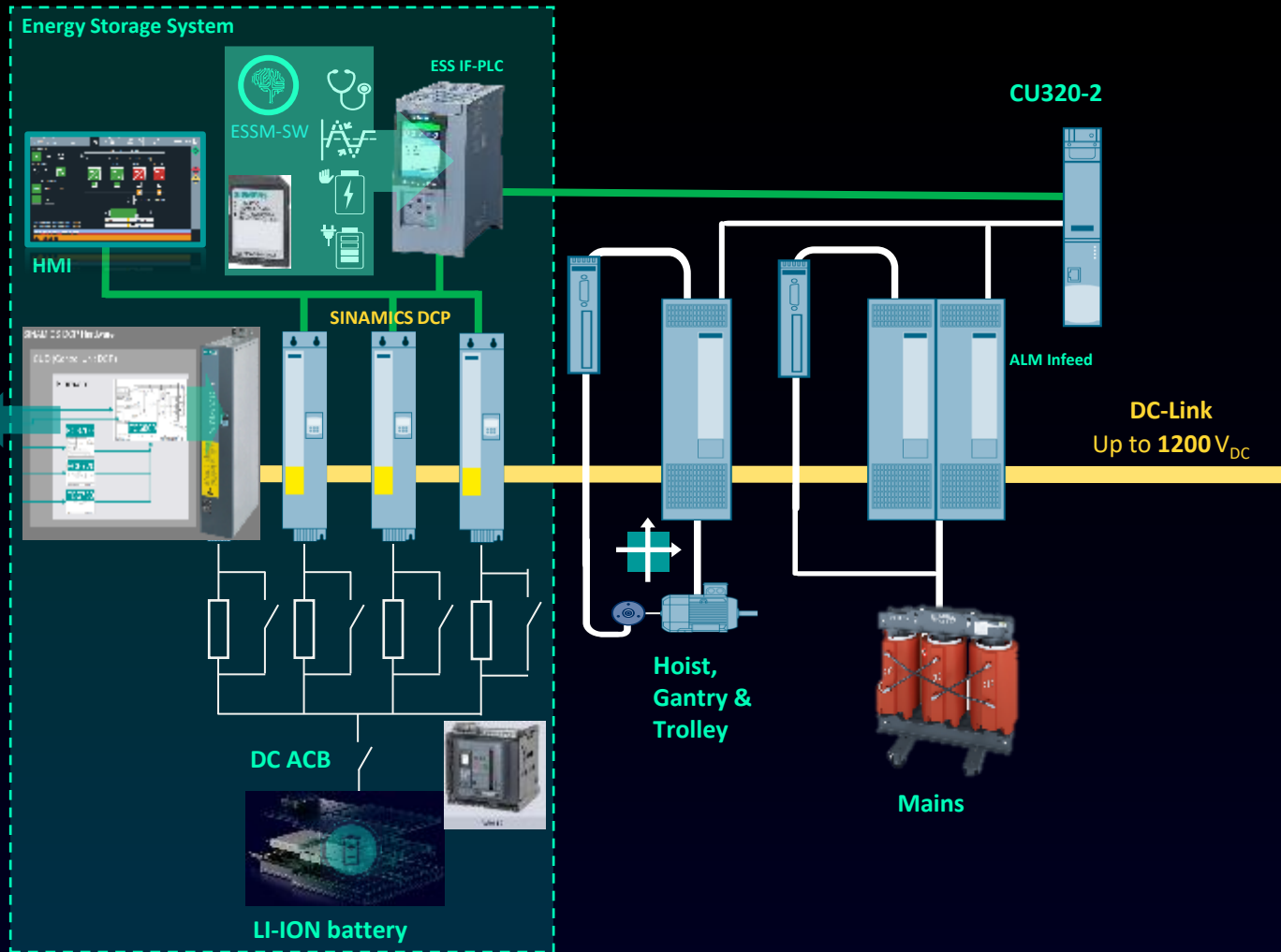
SIMOCRANE ESSM Web based sizing tool

System integrator/ OEM

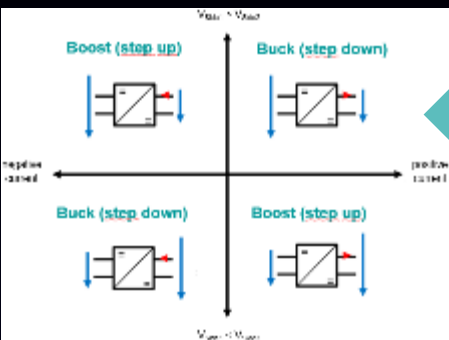
ESSM HMI

SIMOCRANE ESSM with SINAMICS DCP and Infeed

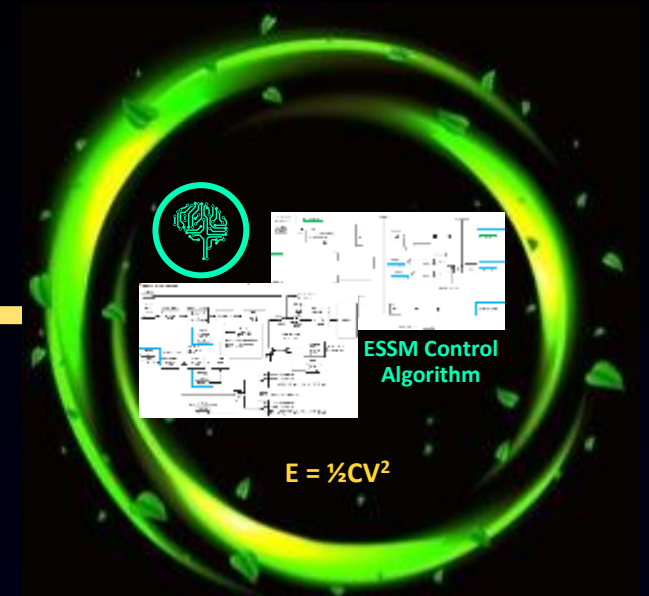
Cutting Edge Energy Management



Integrated buck-boost converter DCP allows 4 quadrant operation modes

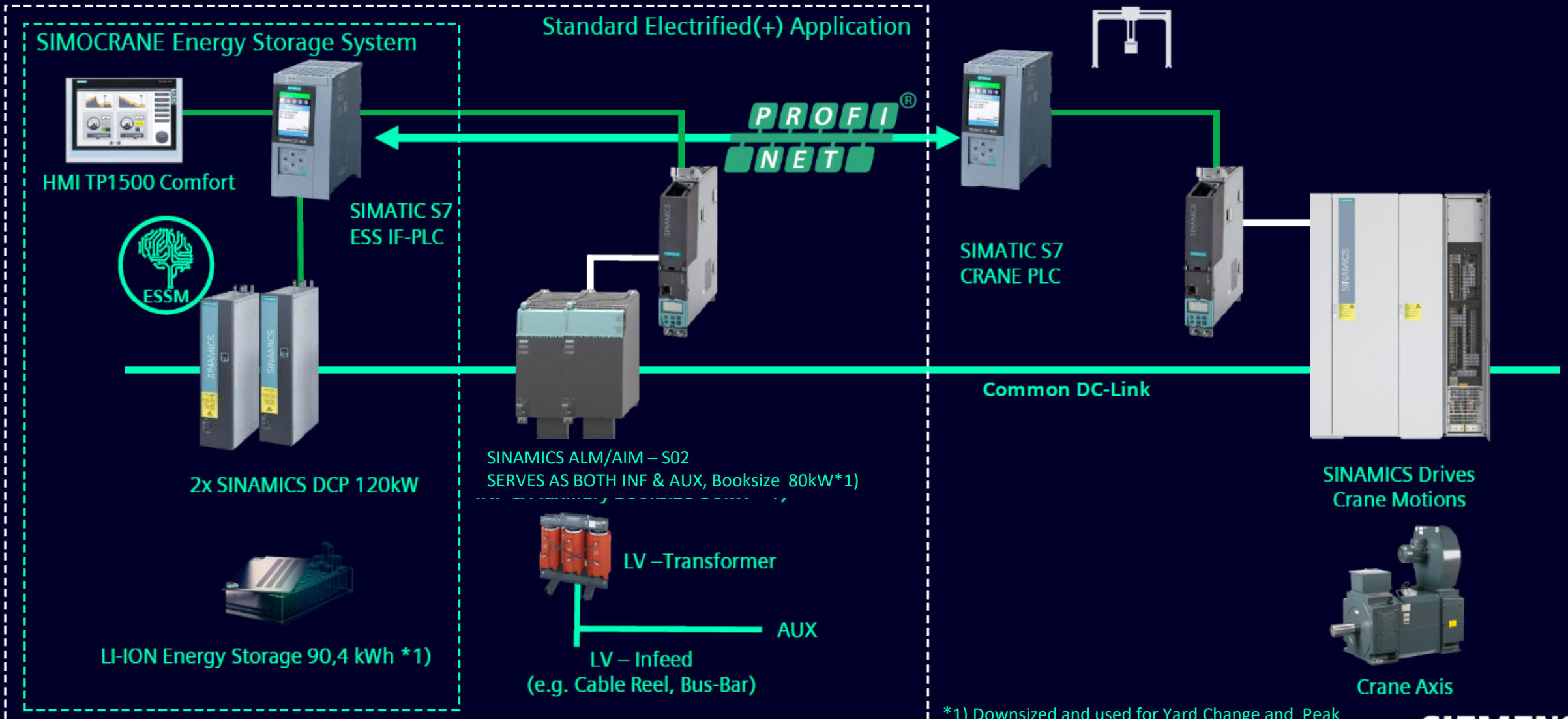


Dynamic control of energy flow between battery, DCP, drive and ALM Infeed via DC-link



The E - RTG (+) configuration

For Peak Shaving Yard change, Full Flexibility, Full Availability, Zero-Emission. Reduced Infeed Power by 83%, Reduce Energy Cost by 55%



*1) Downsized and used for Yard Change and Peak Shaving, 45kW consumption limit in block

SIMOCRANE ESSM, Infeed and DCP

Cutting Edge Energy Management



Full control of the infeed power in 4 Quadrants

- Advanced Peak-shaving with energy categorization
- Prioritization of regenerative energy to charge the battery



Enhance energy management algorithms for 15 min Peak Power Value

- Downsized Infeed enabling readiness of HY-RTG(+) to E-RTG(+) transition



Unique Digital Solutions

- Crane Energy Balance Simulation
- Individual crane to terminal wide energy flow simulation, sizing & KPI forecast



Battery lifetime extension

- Cutting edge battery power management
- Dynamic close loop SOC control of battery



Integrated buck-boost converter

- Dynamic control of energy flow between battery and DC-link
- Compact, bi-directional DC-DC converter in parallel connection
- Redundancy set in Emergency mode

In summary

Environmental



- High energy & CO₂ savings
- Minimize reliance on Diesel
- Less noise & GHG emissions

OpEx



- Increase efficiency
- Increase availability
- Shorten commissioning time
- Less maintenance costs
- Significantly reduce electricity & demand charges

CapEx



- Downsizing crane infeed units and components
- Downsizing power supply infrastructure including busbar & cable
- Optimize consumption of available feeder capacity due to infrastructural downsizing
- Shift voltage level from MV → LV
- Proven modular system design
- Scalable expansion in future

Right setup for electrification is the **key to Sustainable Operation & Profitability**



Thank You!

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