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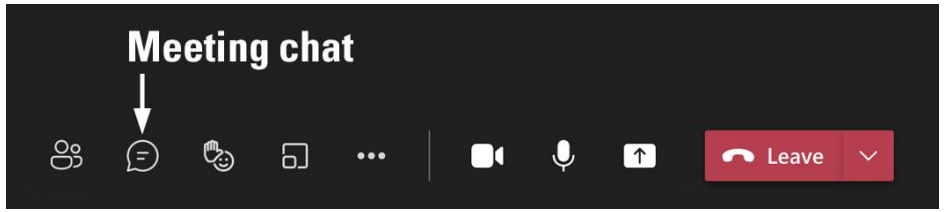
Thank you for joining us



Sami Piittisjärvi

Product Portfolio Manager,

Konecranes Port Services

Hybrid Power Workshop 60’

1. Introductions: Sami Piittisjärvi 3’
2. The Technology: Ingo Schmuland 15’
3. Performance. Uncompromised.: Carl Walters 15’
4. South Carolina Port Proof of Concept Partnership: Scott Lane 10’
5. EPA Grant Process 101: Scott Lane 7’
6. Q&A 10’

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Ingo Schmuland

Product Manager, Konecranes Port Services

Carl Walters

Sales Director, Konecranes Port Services (USA)

Scott Lane

Vice President, Konecranes Port Services (USA)

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The Technology

Ingo Schmuland

Converts a diesel RTG into a hybrid power RTG **producing the same power as a diesel gen-set.**

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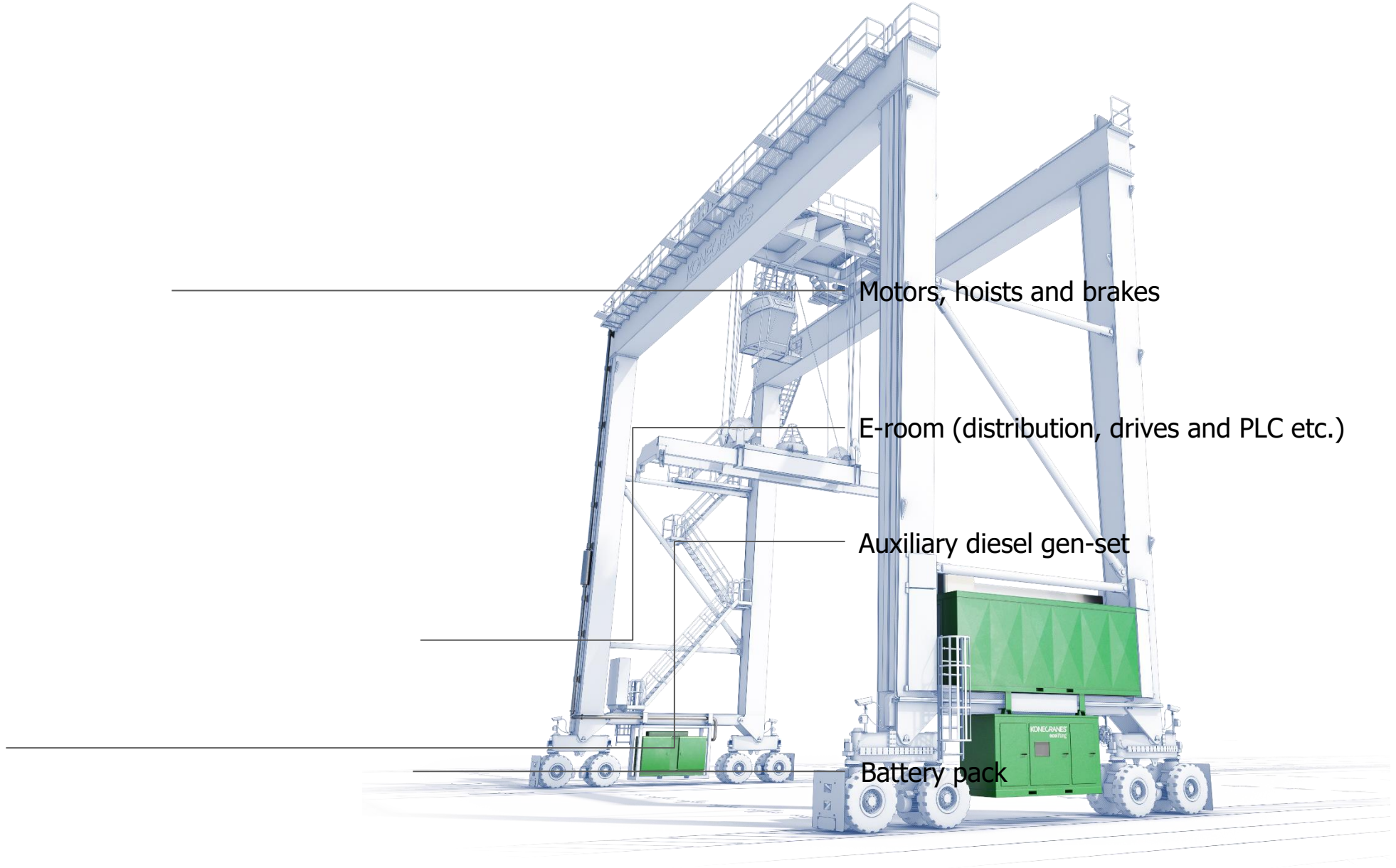

MODE 1

Normal operation: All RTG functions use 100% battery power.

Motors, hoists and brakes

E-room (distribution, drives and PLC etc.)

Auxiliary diesel gen-set

Battery pack

Charge kept between 35 – 65% for optimal battery life.

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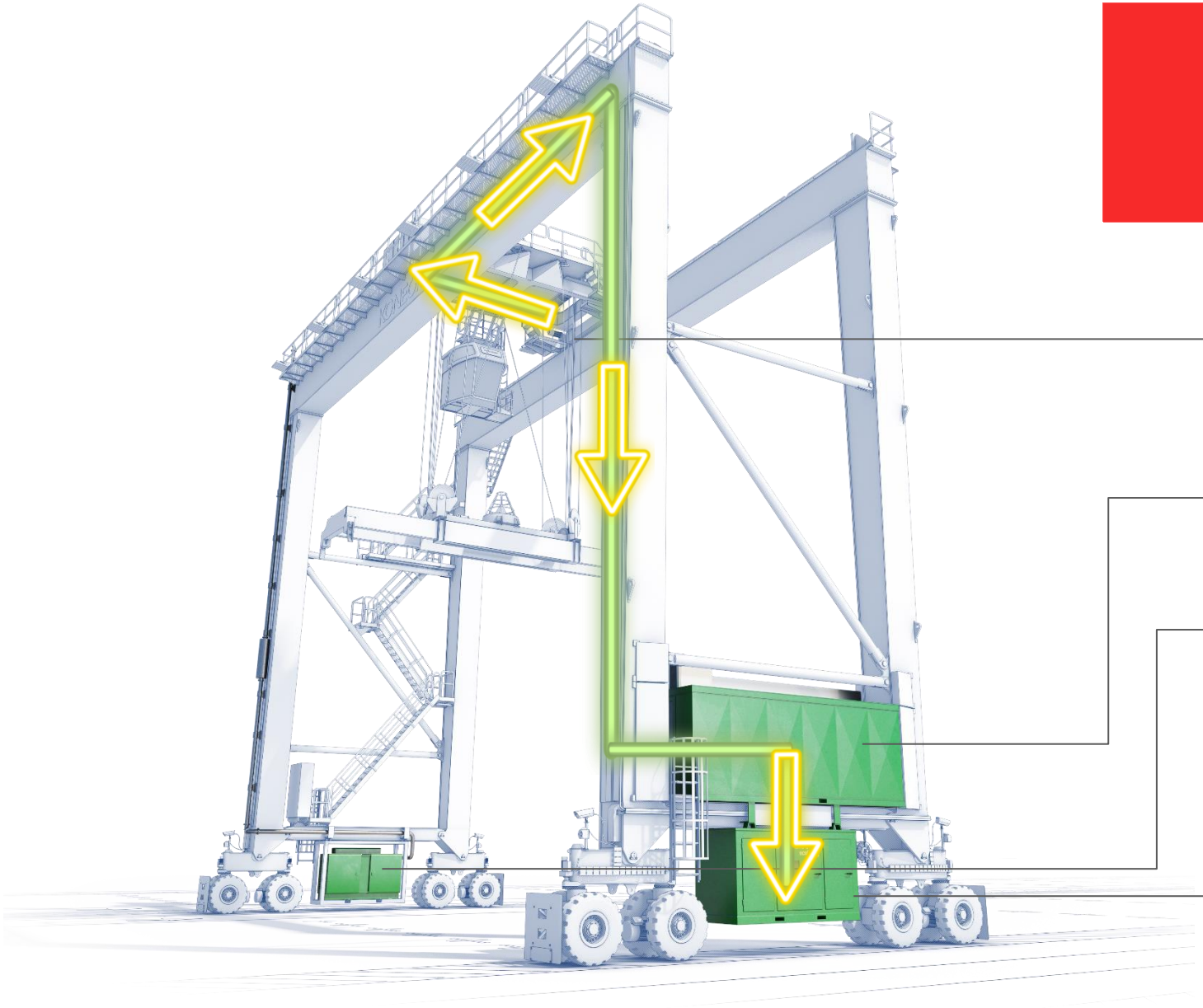
MODE 2
Braking



Motors, hoists and brakes

Regenerative braking energy while lowering containers used to recharge the battery.

E-room (distribution, drives and PLC etc.)

Auxiliary diesel gen-set

Battery pack

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MODE 3
Recharge

Motors, hoists and brakes

E-room (distribution, drives and PLC etc.)

Auxiliary diesel gen-set

At <35% SOC battery level, or peak power is demanded (Twinllift selection), control requests diesel gen-set until battery is charged to 65%.

Battery pack

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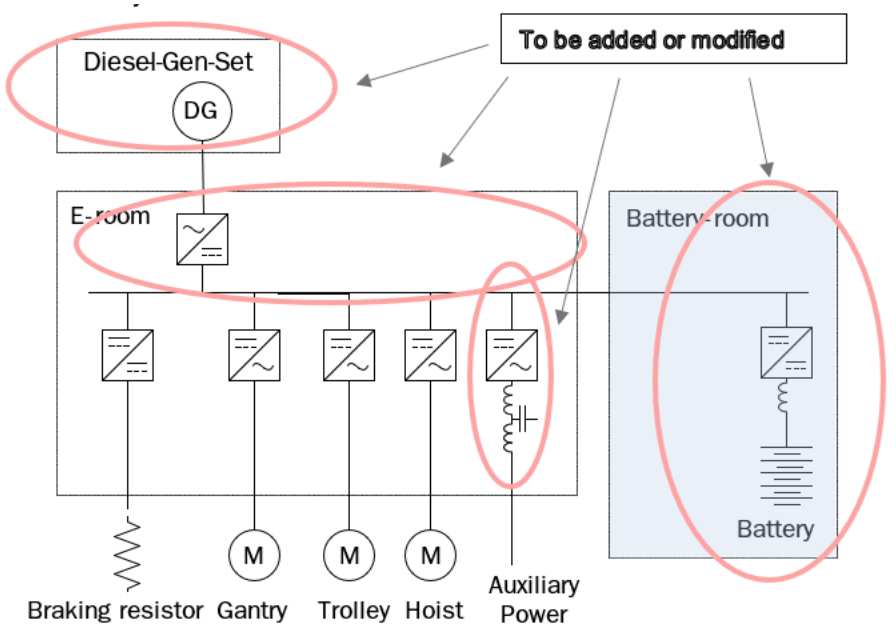
Drive configuration overview
MAIN COMPONENTS

- Battery system by Conductix Wampfler replaces the existent main diesel gen-set
- New down-sized diesel gen-set with own canopy placed on RTG's access side under sill beam
- Active rectifier to control and stabilize the charging power from the genset
- Aux. inverter to supply lighting, heating and control circuits from DC-bus supply
- Control system adoption



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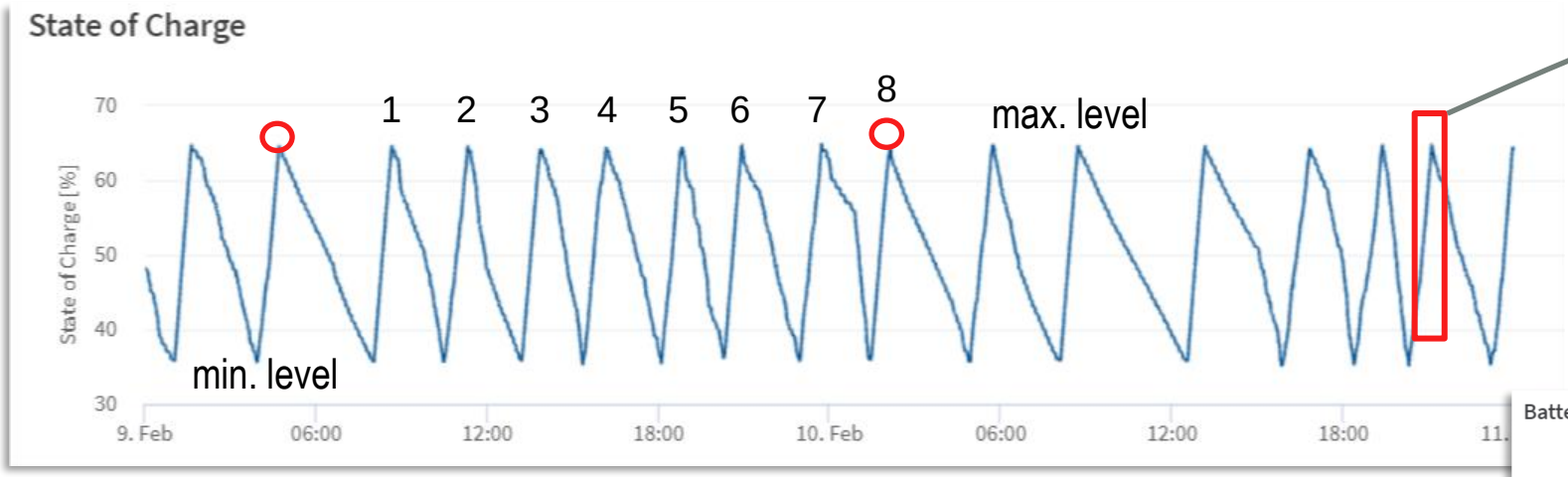
Energy Storage
BATTERY PERFORMANCE



Even when battery is being charged, RTG operation would never be disturbed.

Average 8 battery (discharging-charging) cycles within 24h.

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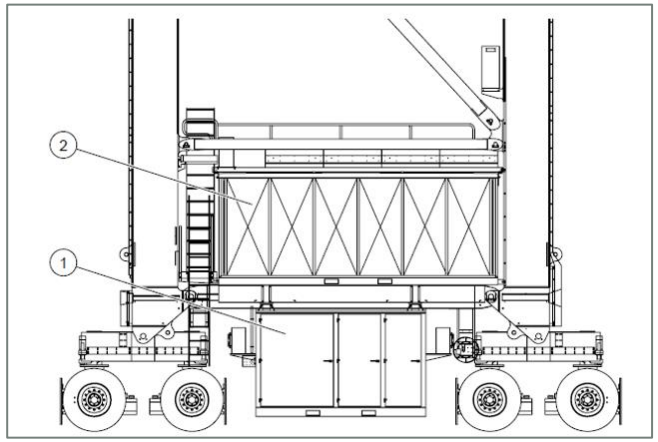
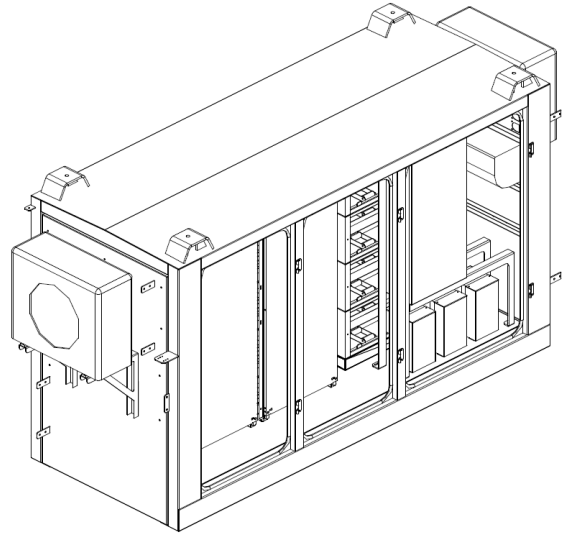
The battery at the heart of our hybrid



- Designed for high utilization up to 91.000 m/y
- Battery lifetime over 8 years (70% remaining battery capacity)
- Designed for 345kW nominal hoist load and 435kW peak load (3 sec.)

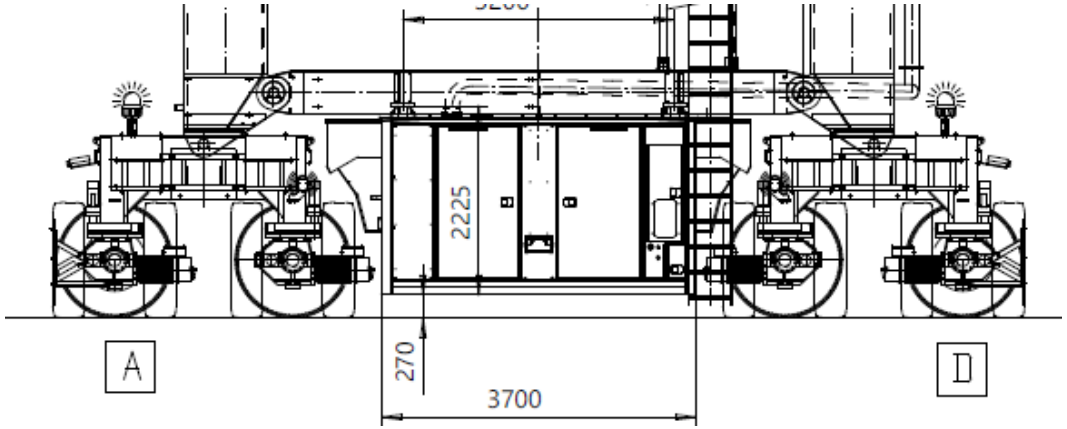
- 148kWh, 8 battery cell modules, 592VDC voltage level, SOC range 35-65%
- Inbuilt DC/DC converter for stabilization of DC voltage
- Liquid cooling system for the battery cells



- Battery house cooled by 2 AC units, incl. heating function
- Battery Monitoring System with own PLC and interface
- Local BMS panel screen as HMI, installed in door

Diesel Gen-Set, basic charging tool

- T4-F emission level, installed on RTG’s access side
- QSB5-G11 CUMMINS engine, 4,5l displacement
  Prime Power : 114kW (150hp) @ 1800rpm
- UCI274E STAMFORD standard synchronous generator, 179kVA-500V-60Hz
- Used as emergency power source, if needed
- Easily maintained: ground level with wide opened doors
- Well sized, 550l fuel tank in bottom of canopy.



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The Performance
Carl Walters

Benefits

- Increased eco-efficiency: CO_2 emissions reduce by 60-63% over the in-use period, and by 75-85% over the extended idle operation
- Significantly lower fuel consumption: **A minimum of 50%** depending on the operating conditions
- Maximize crane uptime

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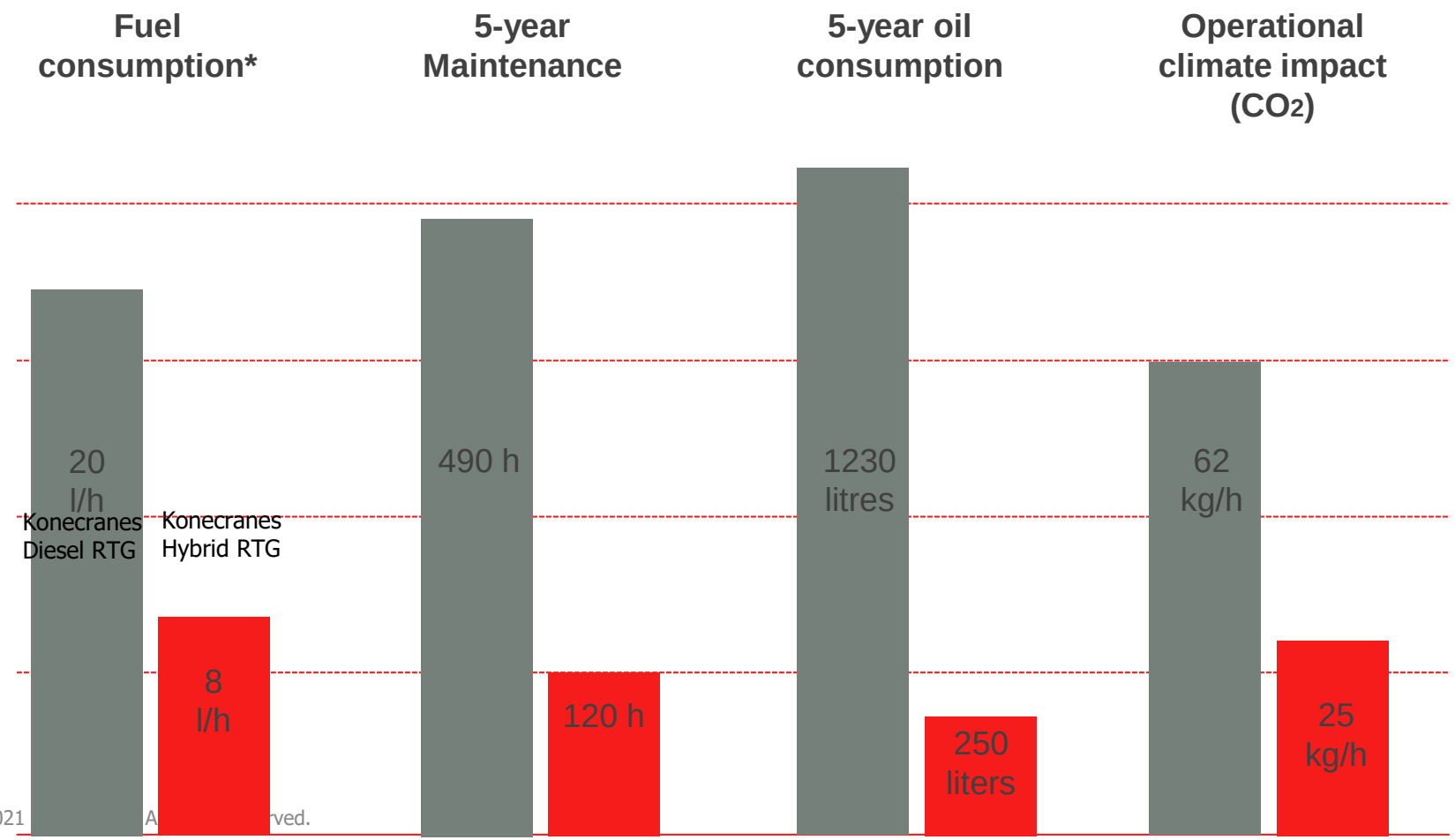
Proven Fuel Economy

Port of Houston Annual Consumption by RTG type: 6/1/2020 – 6/1/2021

TYPE	FUEL Liters /HR	FUEL Liters	AVG HRS.
Diesel	20,20	64,534.71	3,195.19
Fuel Saver Unit	15,86	39,297.33	2,477.55
Hybrid	7,98	21,971.42	2,752.00
Maersk Converted Hybrid	9,63	15,111.71	1,568.60

Extrapolated Savings



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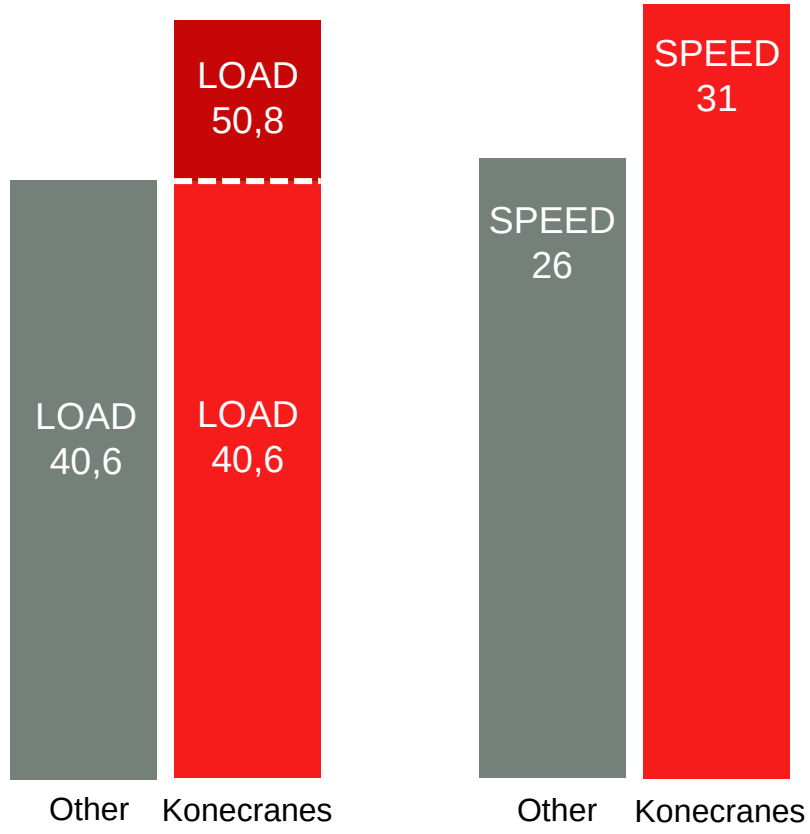
Uncompromised Power

Konecranes Hybrid Retrofit provides:

- Full load spectrum in use
- Full speed range in use
- Battery only mode up to 40LT
- Parallel and emergency modes

This makes the difference



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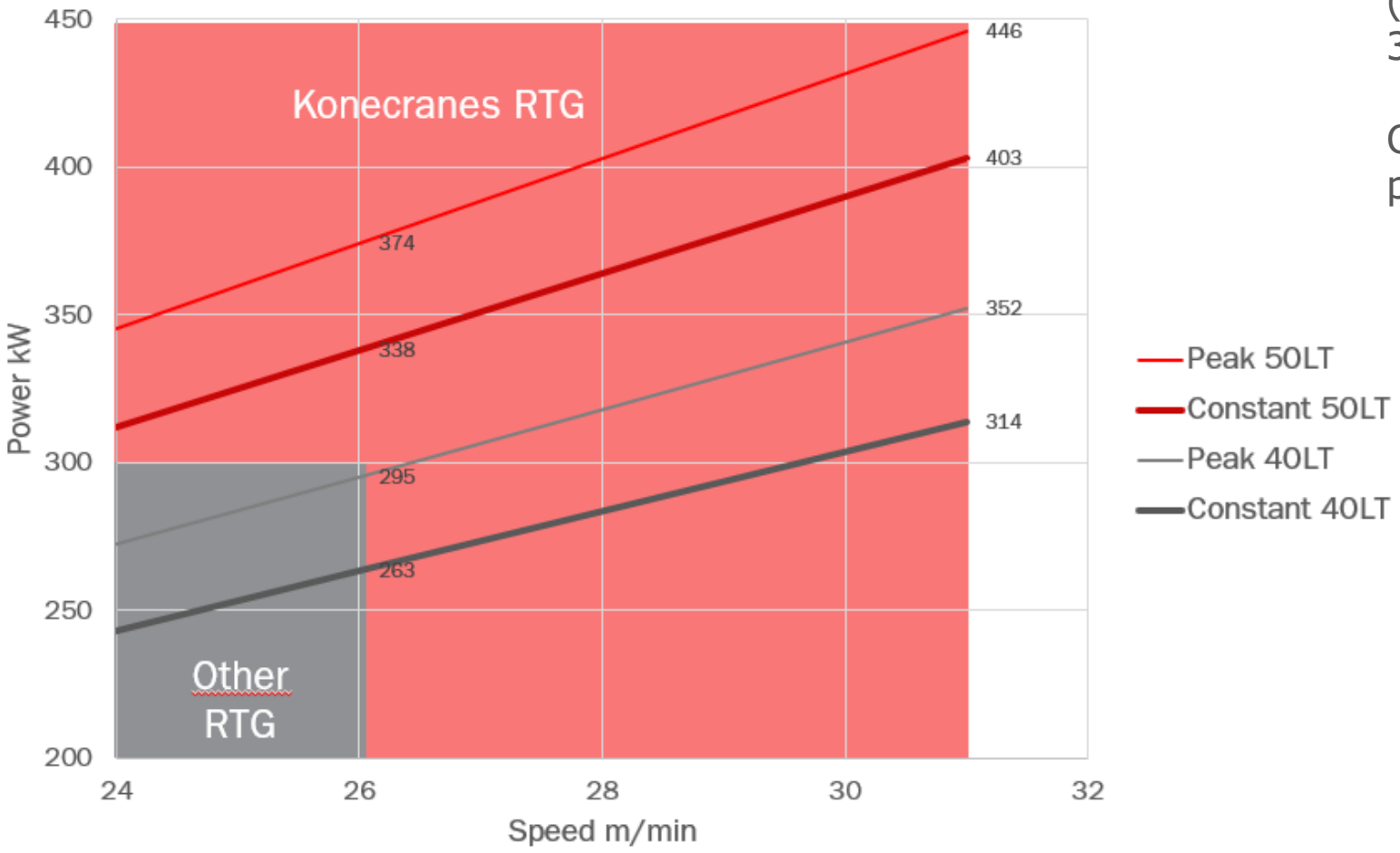

The Konecranes Hybrid retrofit allows for normal operational lift of a 50LT container (Twinlift Operation), with a speed of 31m/min and full acceleration.

Competitors have to change their drive parameters due to limited power capacity.

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Proof of Concept

Scott Lane

Proof of Concept

- Partner: South Carolina State Port Authority
- Testing Vendor: West Virginia University: Centre for Alternate Fuels, Engines and Emissions.
- February 2021

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WHY

- Low emissions technology and equipment is a key component of ports decreasing emissions.
- Konecranes launched a hybrid RTG in December 2019 and immediately began working to have the technology as a retrofit pack for existing diesel–electric machines.
- Retrofit powerpack launched October 2020.
- The Konecranes Ecolifting™ retrofit range already includes retrofit cable reels, busbars and fuel saver.

HOW

- Three RTGs emissions and fuel consumption compared and scientifically measured
  - Two RTG Hybrids (5135.7hrs and 5795.9hrs)
  - One conventional Tier 3 diesel-electric RTG crane
- Two real-world cycles tested:
  - Konecranes standard use cycle
  - Extended idling

HOW

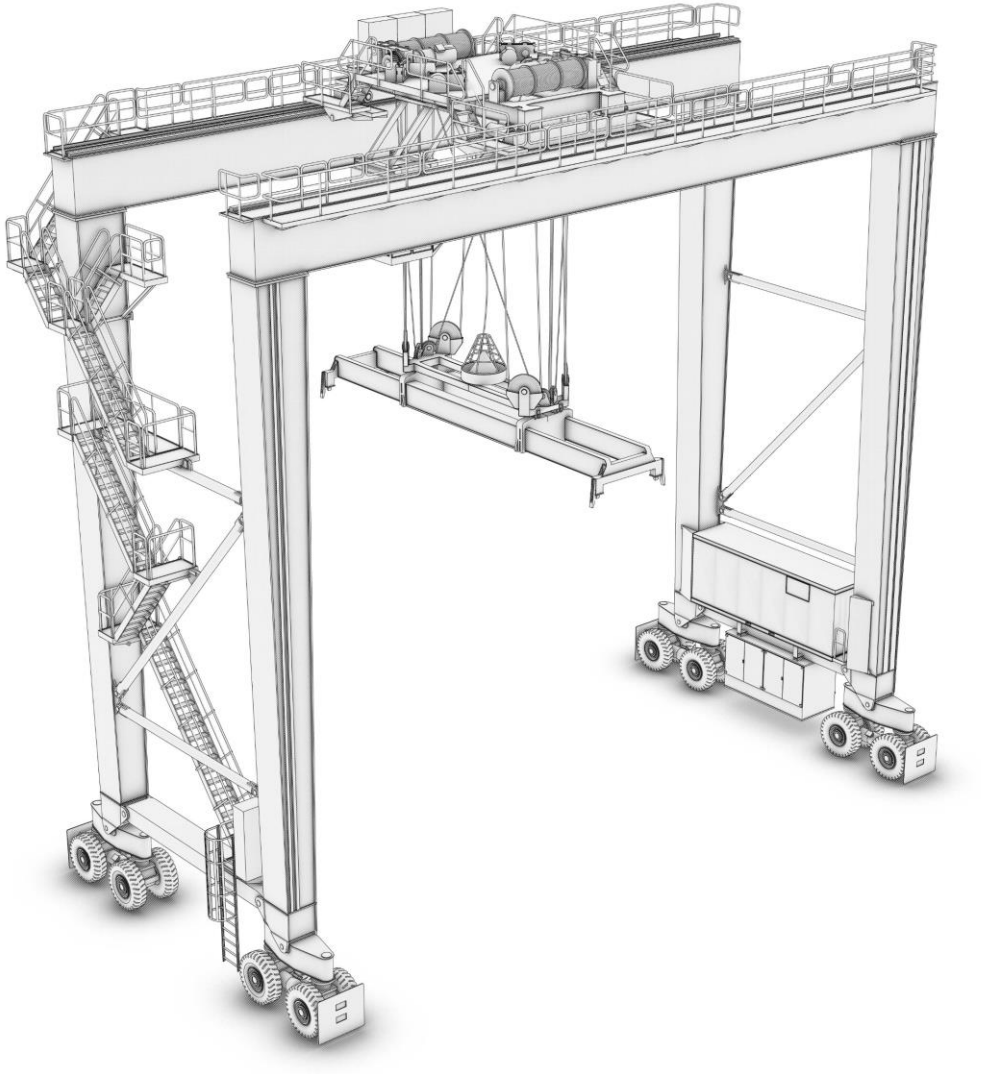
Same spreader, same container, same starting conditions:

Standard use

- Warm Start
- 18T Load
- 20 moves/hour

Extended idling

- Diesel – 5-8 Hour
- Hybrids – From ~65% - ~35% battery SOC



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Standard-Cycle Emissions Test Results by WVU

Test Equipment [-]		CO [g/hr]	CO2 [g/hr]	THC [g/hr]	NO [g/hr]	NOx [g/hr]	NOx_Kh [g/hr]	TPM [g/hr]	Fuel Eco [kg/hr]
RTG Crane Unit-ID I (*hybrid degreened*)	Average	6.93	22716.5	0.05	1.75	2.88	2.73	0.09	7.12
	Stdev	2.85	801.1	0.02	0.18	0.22	0.21	0.03	0.25
RTG Crane Unit-ID II (*hybrid aged*)	Average	7.60	21465.4	0.01	1.49	2.50	2.39	0.07	6.73
	Stdev	2.34	479.4	0.01	0.03	0.14	0.11	0.01	0.15
RTG Crane Unit-ID III (*conventional*)	Average	187.92	58069.1	31.85	178.26	313.15	296.61	7.15	18.32
	Stdev	29.32	344.8	0.85	1.83	2.59	2.35	0.85	0.12
Δ *degreened vs. aged* [%]		**-9.60**	**5.51**	**85.55**	**14.38**	**13.35**	**12.42**	**27.43**	**5.50**
Δ *conventional vs. degreened* [%]		**96.31**	**60.88**	**99.83**	**99.02**	**99.08**	**99.08**	**98.74**	**61.14**
Δ *conventional vs. aged* [%]		**95.96**	**63.03**	**99.98**	**99.16**	**99.20**	**99.19**	**99.09**	**63.27**

Extended Idling Cycle Emissions Test Results by WVU

Test Equipment [-]	CO [g/hr]	CO2 [g/hr]	THC [g/hr]	NO [g/hr]	NOx [g/hr]	NOx_Kh [g/hr]	TPM [g/hr]	Fuel Eco [kg/hr]
RTG Crane Unit-ID I (*hybrid degreened*)	2.29	7379.3	0.02	1.63	2.79	2.64	BLD	2.31
RTG Crane Unit-ID II (*hybrid aged*)	2.09	4837.3	BLD	0.92	1.49	1.41	0.02	1.52
RTG Crane Unit-ID III (*conventional*)	169.15	33372.3	49.61	128.83	245.07	231.91	1.68	10.59
Δ *degreened vs. aged* [%]	**8.56**	**34.45**	**-**	**43.85**	**46.46**	**46.46**	**-**	**34.43**
Δ *conventional vs. degreened* [%]	**98.65**	**77.89**	**99.96**	**98.73**	**98.86**	**98.86**	**-**	**78.16**
Δ *conventional vs. aged* [%]	**98.76**	**85.51**	**-**	**99.29**	**99.39**	**99.39**	**98.69**	**85.68**

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EPA Certified – April 2021

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OFFICE OF
AIR AND RADIATION

Mr. Tomas Haapala
Energy and Drives, Engineer
Konecranes PLC
Koneenkatu 8
Hyvinkaa Finland, 05830

Dear Mr. Haapala:

The U.S. Environmental Protection Agency (EPA) has reviewed your request for verification of the Konecranes PLC's (Konecranes) EcoLifting Hybrid System (or EcoLifting). The EcoLifting Hybrid System replaces the conventional diesel generator set(s) on a rubber-tired gantry crane (RTG). The EcoLifting Hybrid System includes a new diesel engine generator set, battery package with cooling system, active rectifier, control system, auxiliary converter and energy recovery capabilities. Based on our evaluation of your application, test data, and analysis provided by Konecranes, EPA hereby verifies that this technology reduces emissions of certain pollutants and improves fuel consumption by the percentages described below provided all of the operating criteria are met.

This approval is to replace an original Tier 0, Tier 1, Tier 2 or Tier 3 diesel engine-equipped RTG generator with an EcoLifting Hybrid System equipped with an engine meeting final Tier 4 (Tier 4F) emissions standard. The emission reductions below are based on an RTG originally equipped with a Tier 3 engine generator which was replaced with an EcoLifting Hybrid System utilizing a Tier 4F engine. This testing also demonstrated a 30% or greater fuel economy improvement depending on the operating conditions.

Technology	Particulate Matter (PM) %	Carbon Monoxide (CO) %	Hydrocarbons (HC) %	Oxide of Nitrogen (NOx) %	Carbon Dioxide (CO_2) %
Tier 4F EcoLifting Hybrid System	90	90	90	90	30

Note that these values are based on Tier 4F EcoLifting Hybrid System equipped with an engine that does not use emission credits. If a Tier 4F engine certified using credits is incorporated in this system, the reductions may be lower. These reduction levels are based on an RTG equipped with a conventional Tier 3 engine generator being retrofit with a Tier 4F EcoLifing. Emission reductions may be greater when the original RTG generator is equipped with a Tier 0, Tier 1 or Tier 2 engine.

The following operating criteria must be met to achieve the aforementioned emissions reduction.

1) The original RTG generator(s) must be equipped with a Tier 0, Tier 1, Tier 2 or Tier 3 engine(s).
2) The original RTG must be equipped with a DC bus or the EcoLifting Hybrid System package needs to be equipped with properly sized power frequency converters with common DC bus capability.
3) Prior to installation, Konecranes must appropriately size the EcoLifting Hybrid System for the original RTG. In sizing the EcoLifting Hybrid System, a smaller horsepower new Tier 4F diesel engine-equipped generator and battery-equipped energy system must be optimized to satisfy application-specific requirements.
4) The EcoLifting Hybrid System includes the components necessary to replace a conventional RTG diesel engine generator and other original power system components as necessary. The EcoLifting components include a new genset equipped with a new Tier 4F diesel engine, exhaust system, battery energy storage system, battery monitoring system, battery cooling and heating system, regenerative brake/energy recovery system, and typically other components as necessary including DC/DC converter, active rectifier, auxiliary converter system, and electrical & mechanical components needed to integrate the system to the crane.
5) EcoLifting and the RTG owner must evaluate battery technology options for the specific RTG. Different battery technologies may be preferred due to individual preference and performance requirements, so it is the responsibility of Konecranes and the RTG owner to select a battery technology and size based on these needs.
6) The EcoLifting Hybrid System must include a battery monitoring system to alarm operators for necessary actions to ensure the proper operation of the batteries.
7) The owner's manual must include maintenance procedures, safety precautions information and battery disposition information.
8) The engine must be operated on ultra-low sulfur diesel fuel (ULSD) of 15 ppm or less.
9) The engine used in the EcoLifting Hybrid System must be certified for use in generator sets and meet current model year standards.

If Konecranes's EcoLifting Hybrid System is modified from the application description provided to EPA, you must notify EPA immediately. This verification does not automatically confer to modified devices or devices that are similar to this original verification.

Information on Konecranes's EcoLifting Hybrid System, percent reduction, and applicable engines will be posted on the EPA's Verified Technology List website at: https://www.epa.gov/verified-diesel-tech/verified-technologies-list-clean-diesel. As you know, Konecranes will be responsible for completing the required in-use testing program and for submitting all in-use testing data to EPA as outlined in EPA's in-use test methods.

Thank you for participating in EPA's Technology Assessment Center Verification Program. If you have any questions or comments, please contact Kuang Wei, of my staff, at 202-343-9329.

Sincerely,

KARL SIMON

Digitally signed by KARL SIMON
Date: 2021.05.24 22:08:00 -04'00'

Karl Simon, Director
Transportation and Climate Division
Office of Transportation and Air Quality

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Hyvinkää Finland, 05850

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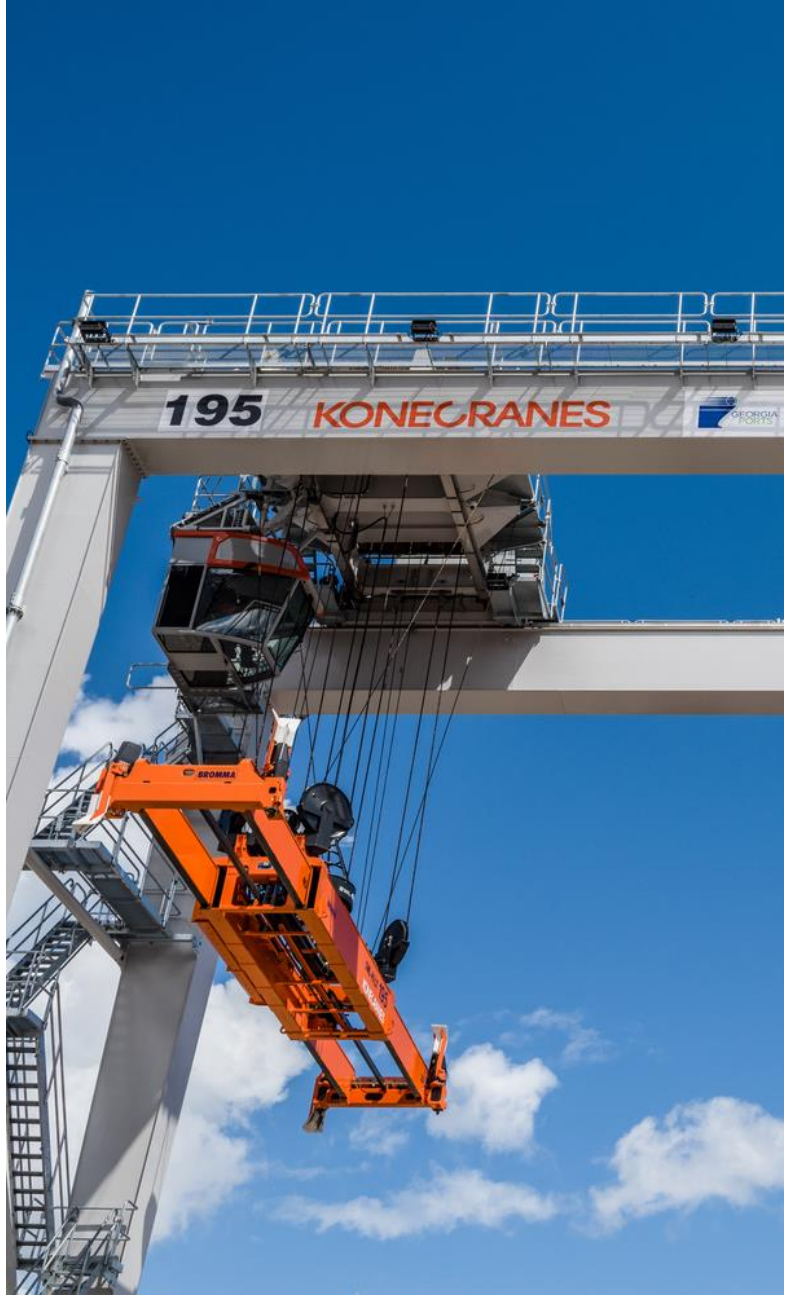
EPA Grants 101

DERA Application: FAQ

- What is DERA?
- Who can apply?
- What are the timelines for 2022?
- What do they pay for?
- How to apply.

DERA
What is it?

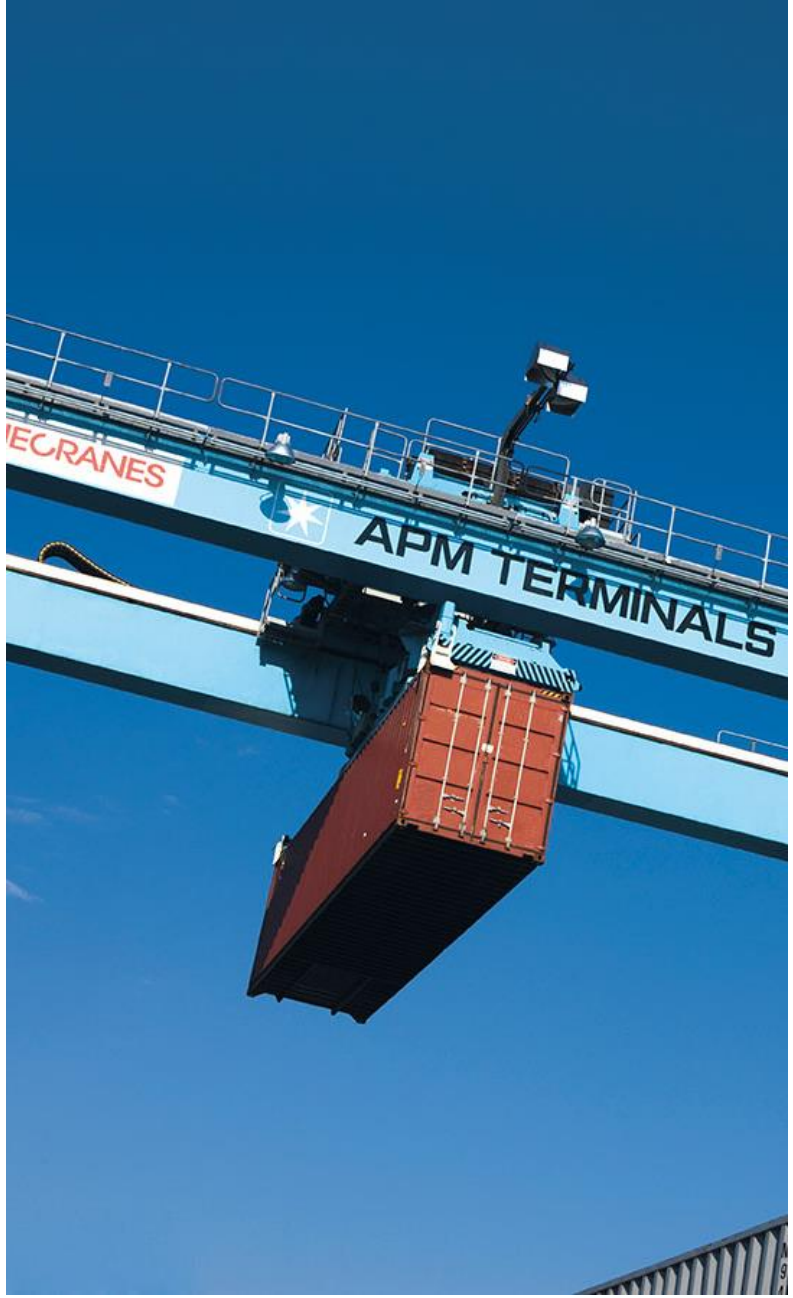
- Diesel Emissions Reduction Act – created under the Energy Policy Act of 2005.
- Amongst other things, it permits the EPA (Environmental Protection Agency) to offer funding to accelerate upgrade and turnover of legacy diesel fleets.



DERA
Who can apply?

- NATIONAL: Regional, state, local, tribal or **port agencies** with jurisdiction over transportation or air quality.
- STATE: Eligible U.S. states and territories to establish diesel emissions reduction programs and projects.
    - Liaise with state environmental regulators for State-specific DERA programs
- Agencies may apply for both National and State DERA grants.

** Manufacturers are not eligible to apply directly to EPA for funding. Manufacturers who would like to have their retrofit products eligible for purchase by recipients of this grant program must be listed on EPA or CARB's verified retrofit technology list.*



WHAT ARE THE 2022 TIMELINES?

NATIONAL GRANT	
December 2021	Request for Applications (RFA) opens
March 2022 (Exact Dates and Times TBA)	Deadline for applications close
April - May 2022	Notification of selected applicants
June to October 2022	Funding of awards

STATE GRANT	
March 2022	Release of Notice of Intent to Participate (NOIP) form
TBA	Submissions close for Notice of Intent to Participate form
	States, territories notified of final allocation amounts
April 2022	Deadline to submit Work Plan, Budget Narrative & Fleet Description to EPA Region
May 2022	Deadline for State Applications
October 2022	Regional offices finalize program awards

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DERA

What do they pay?

Eligible Upgrades	EPA Funding Limit	Mandatory Cost Share
Drayage Truck Replacement	50%	50%
Vehicle or Equipment Replacement with EPA Certified Engine	25%	75%
Vehicle or Equipment Replacement with CARB Certified Low NOx Engine	35%	65%
Vehicle or Equipment Replacement with Zero-tailpipe Emission Power Source	45%	55%
Engine Replacement with EPA Certified Engine	40%	60%
Engine Replacement with CARB Certified Low NOx Engine	50%	50%
Engine Replacement with Zero-tailpipe Emission Power Source	60%	40%
Certified Remanufacture Systems	100%	0%
Highway Idle Reduction Technologies when combined with new or previously installed exhaust after-treatment retrofit	100%	0%
Highway Idle Reduction Technologies without new exhaust after-treatment retrofit	25%	75%
Locomotive Idle Reduction Technologies	40%	60%
Marine Shore Connection Systems	25%	75%
Electrified Parking Space Technologies	30%	70%
Exhaust After-treatment Retrofits	100%	0%
Engine Upgrade Retrofits	100%	0%
Hybrid Retrofit Systems	**60%**	**30%**
Fuel and Additive Retrofits when combined with new retrofit, upgrade, or replacement	Cost differential	Cost of conventional
Aerodynamics and Low Rolling Resistance Tires when combined with new exhaust after-treatment retrofit	100%	0%
Alternative Fuel Conversion	40%	60%

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DERA
Grant Pack Download link will be shared.

1. **DERA application - where to start**
2. **EPA Glossary_19082021**
3. **EPA DERA Grant Q&As_19082021**
4. **Tips for a successful grant application_19082021**
5. EPA_VerificationLetter_KonecranesEcoliftingVerificationApproval_05242021
6. Sample_ApplicationFleetDescription_fy21-2021-01.xls
7. Sample_DERAScrappage_Statement_fy21-2021-01.doc
8. Sample_ProjectNarrative_fy21-2021-01.doc
9. SampleDERA_EligibilityStatement_fy21-2021-01.doc
10. 2021_BudgetInformation_SF424A-V1.0.pdf
11. 2021_DERA_TechnologyFleets_ProjectInformation_Tips.pdf
12. 2021_Instructions_ApplicationFederalAssistance_SF424_4_0-V4.0-.pdf
13. 2021_Instructions_BudgetInformation_forNon-ConstructionPrograms_SF424A-V1.0.pdf
14. 2021_Pre-Award_Compliance_Review_EPA4700_4_4_0-V4.0.pdf
15. 2021_PriorityCountyList.pdf
16. 2021EPA_KeyContacts_2_0-V2.0.pdf
17. Konecranes Testing Report [2021-05-03]_West Virginia University

Q&A

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Thank you for your time