

# DAMEN

OCEANS OF POSSIBILITIES

Damen Digital Solutions – Digital Ship Conference 2022

22 September 2022

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# Fleetwide remote monitoring

How to reduce Emissions and deal with Energy Management in your daily operation?

Marcel Cleijssen – Manager Development

Marco Wedemeyer – Data Scientist



MOST SUSTAINABLE SHIPBUILDER IN THE WORLD

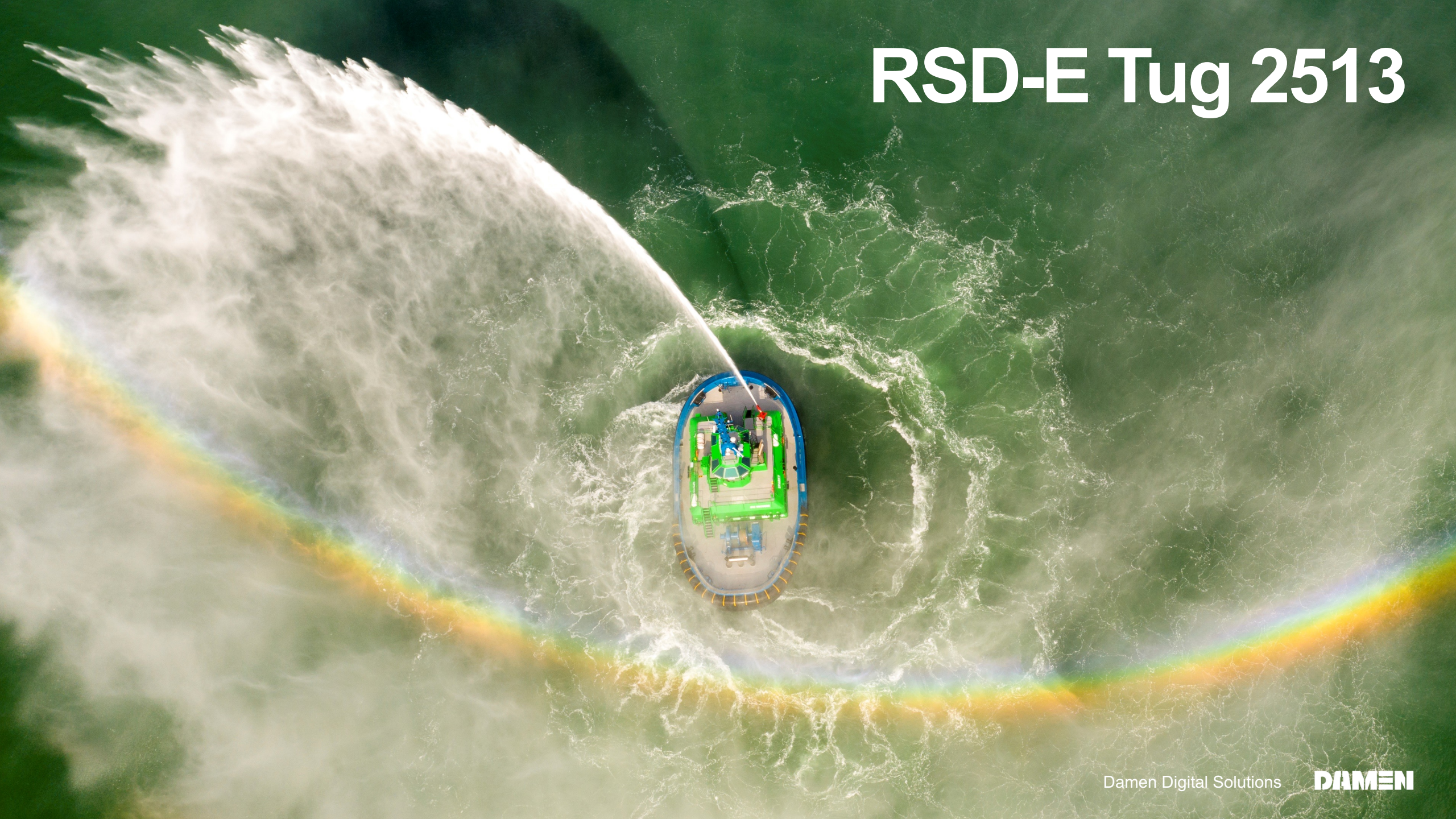
# Emission reduction

- Damen Goals
- Paris agreement
- IMO targets
- European targets
- Local targets





# RSD-E Tug 2513





ELECTRIC MARITIME SOLUTION

# RSD-E Tug 2513

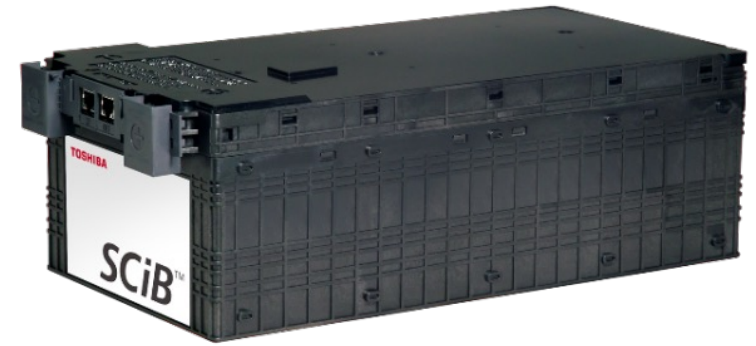


- System integrator
- High efficiency
- Modular and scalable design
- Worldwide deployable
- Design for the lowest TCO
  
- 70ton BP and 12 knots on batteries
- 40ton BP on generator sets
- Shore charger

## ELECTRIC SYSTEM

# Battery system

- Toshiba LTO batteries
- Expected lifetime 30.000 cycles ( $\pm$  30 years)
- Classified by DNV-GL and BV
- 2.8 MWh
- Fully charged in under 2 hours
- Back-up generator



## ELECTRIC SYSTEM

# Charging

- Passive tidal difference compensation
- Robust and simple design
- 1 man operation
- 1500 kW charging power
- 4 x 375 kW HPC cables
  - Safe
  - Efficient





# Triton

Maritime monitoring and analytics platform







**On-Board**



**On-Shore**



**Sensors**

Data collection from various systems on board



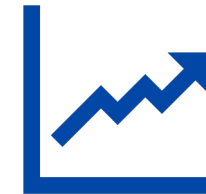
**Onboard System**

(Pre) process data, transfer to cloud and offline buffering



**Cloud Platform**

Store data, process and tag with meta-data



**Data driven Applications**

Present online, in (custom) reports or via API request

OUR AMBITION

# From Data to value



## Safety

reducing human exposure  
and chance of mistakes



## Sustainability

mapping and reducing  
environmental footprint



## Efficiency

using operational insight to  
optimize operations





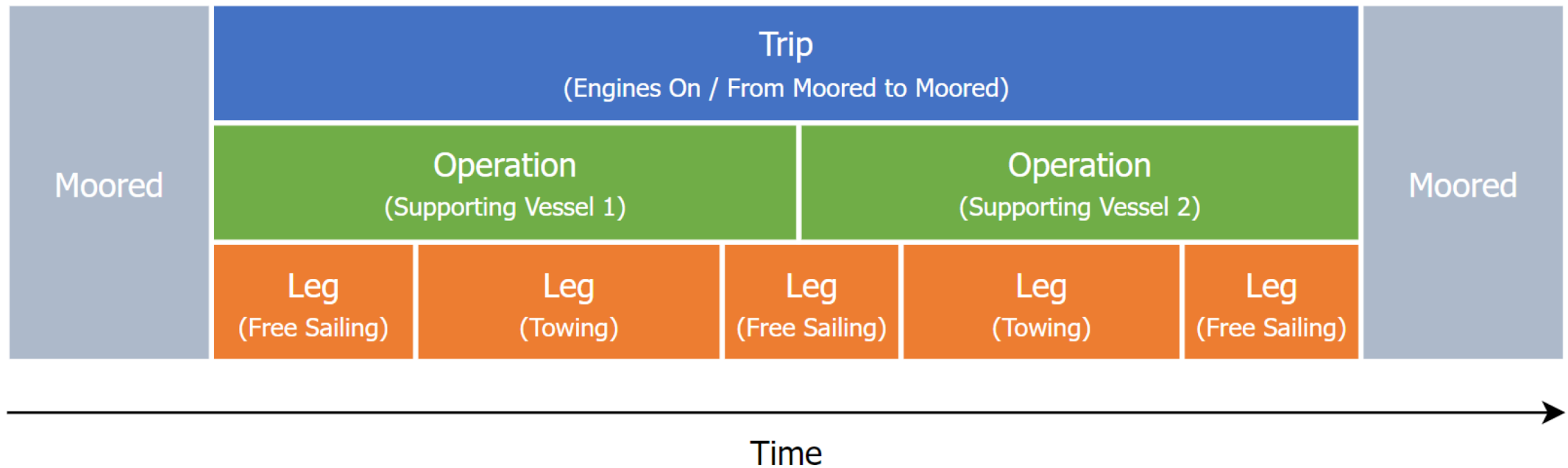
# Analysis

How would the RSD-E Tug 2513 perform in your daily operation



## DISCRETIZING DATA

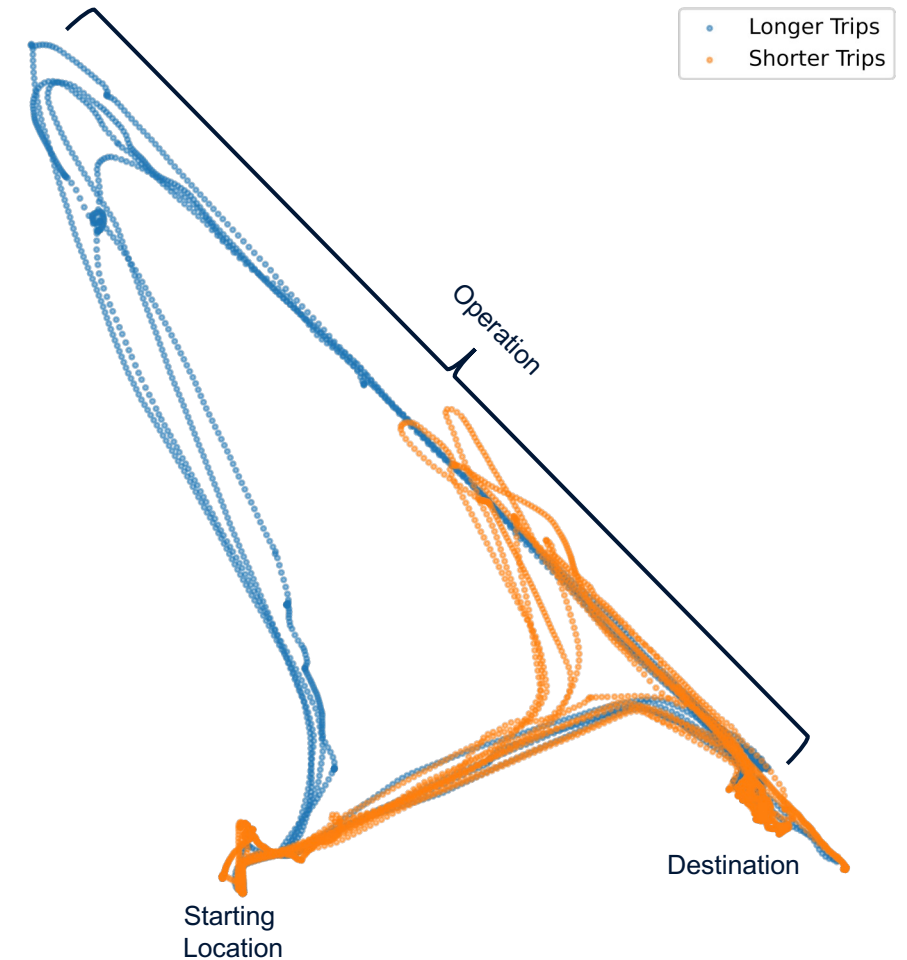
# Definitions



## BEST TIME TO LEAVE

# Route Optimizations

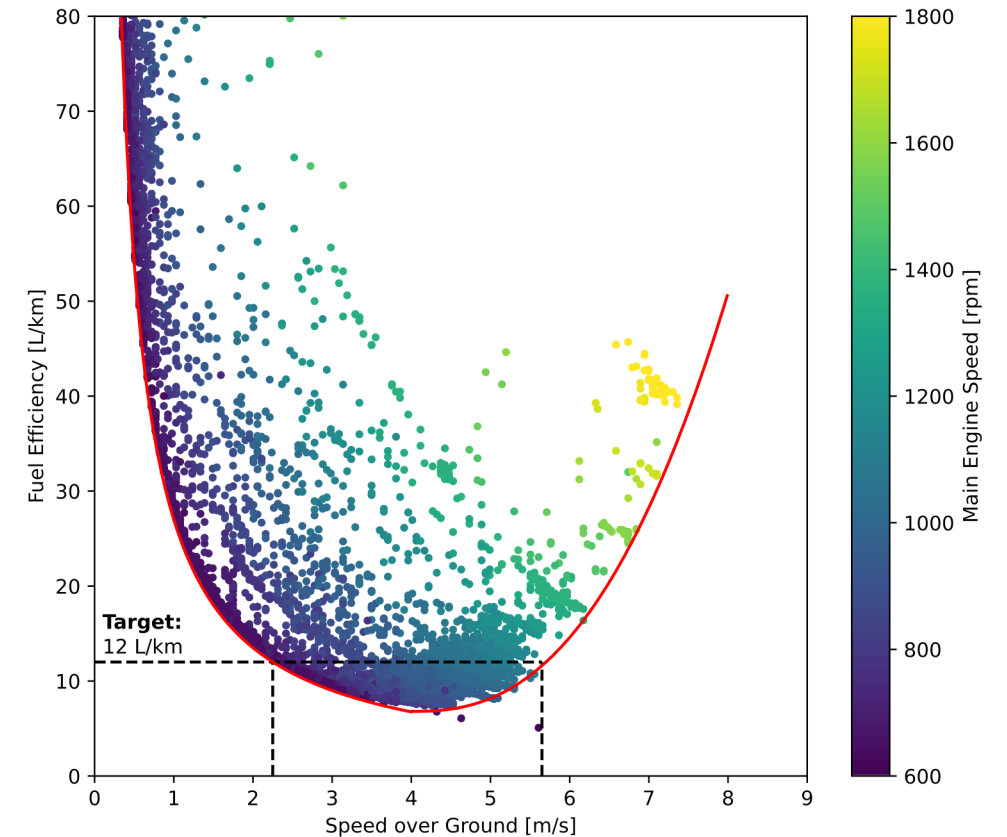
- Many variations of the same operation / route
- Leaving earlier or later might impact meeting point
- Leaving later → shorter shortest path to vessel
- Considerations
  - Safety
  - Regulations
  - Agreements





# Optimal Speeds

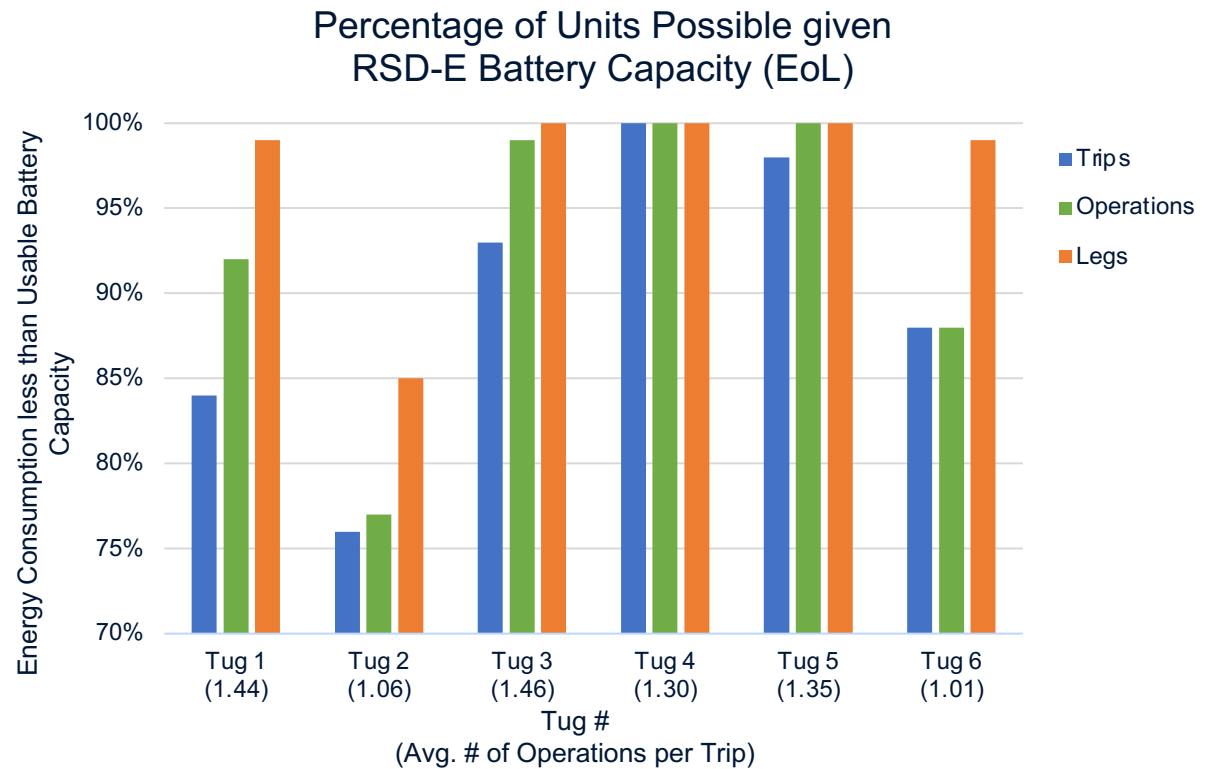
- Reducing diesel tug emissions
- Triton Analytics Feature: Determining the optimal speed range
- Considering Free sailing with constant speed only
- During operations safety is first
- During free sailing fuel efficiency can be optimized



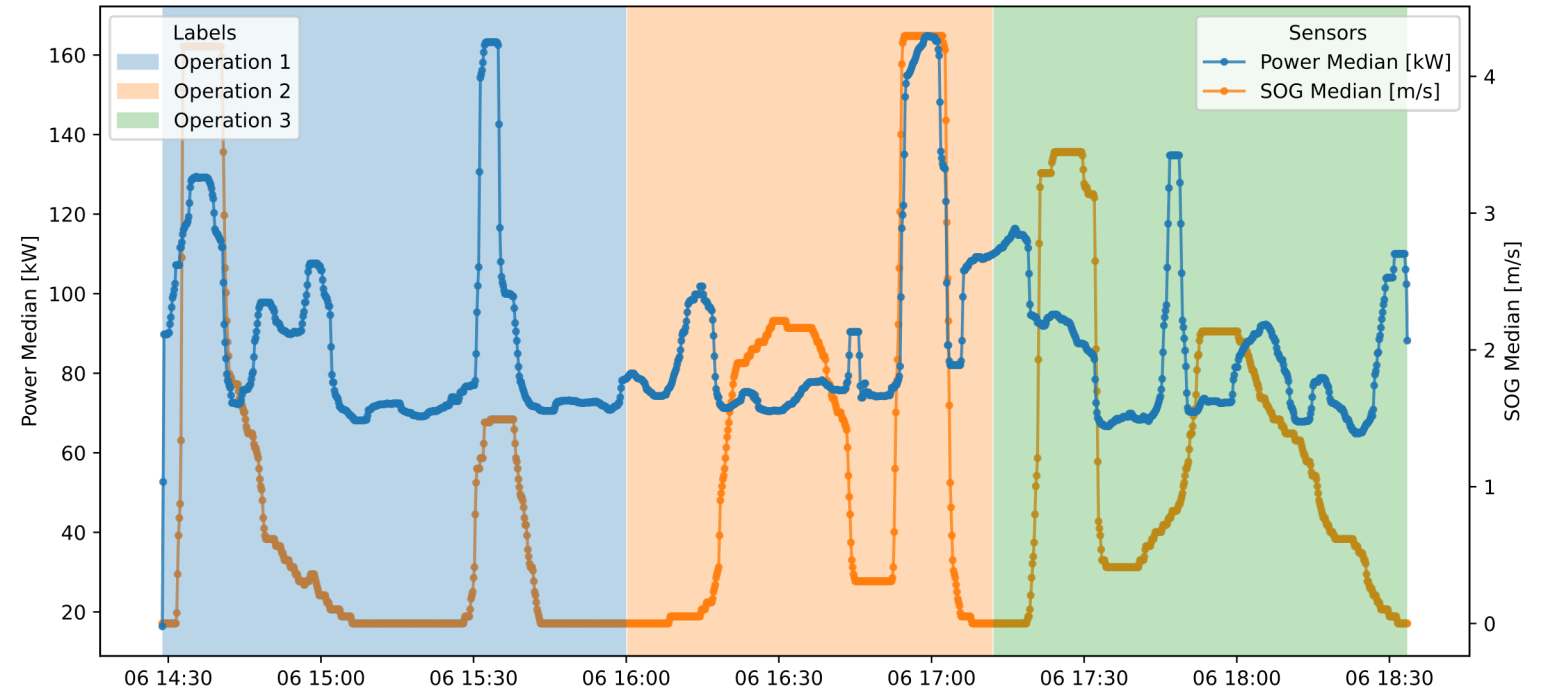
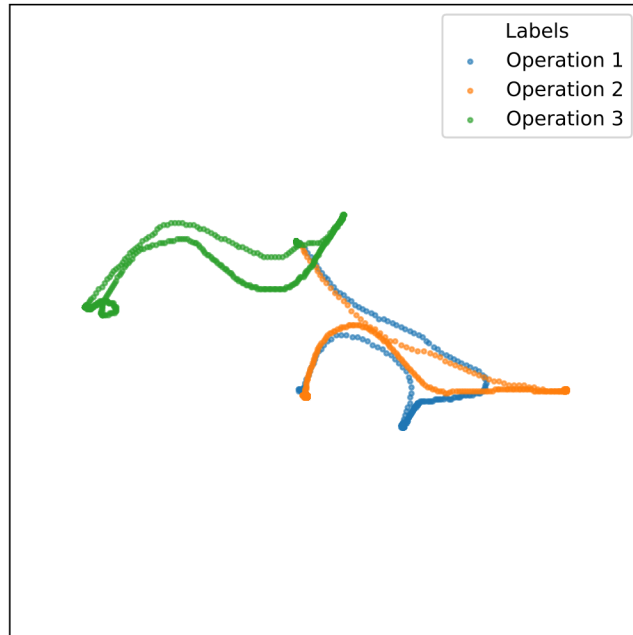
## PERCENTAGES POSSIBLE FULLY ELECTRIC

# Results

- Results differ per tug
- 100% can be reached with changes to how the tugs are used
- Tug 2 underperforms because it is a multipurpose tug
- EoL results are very similar to BoL

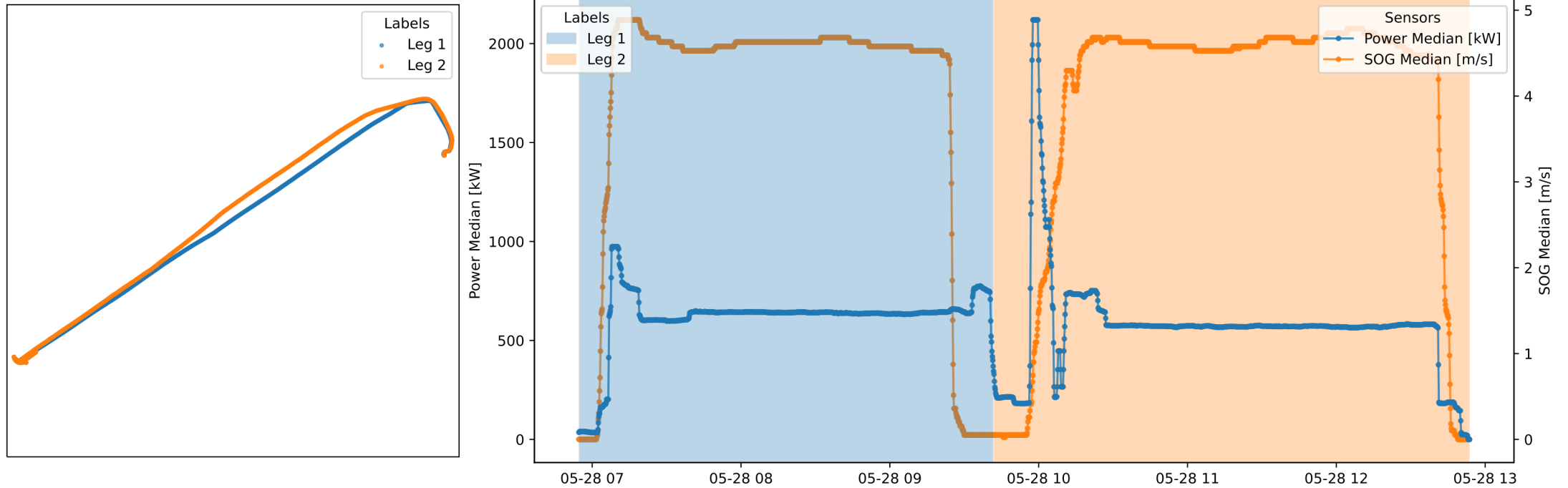


# Dividing Work



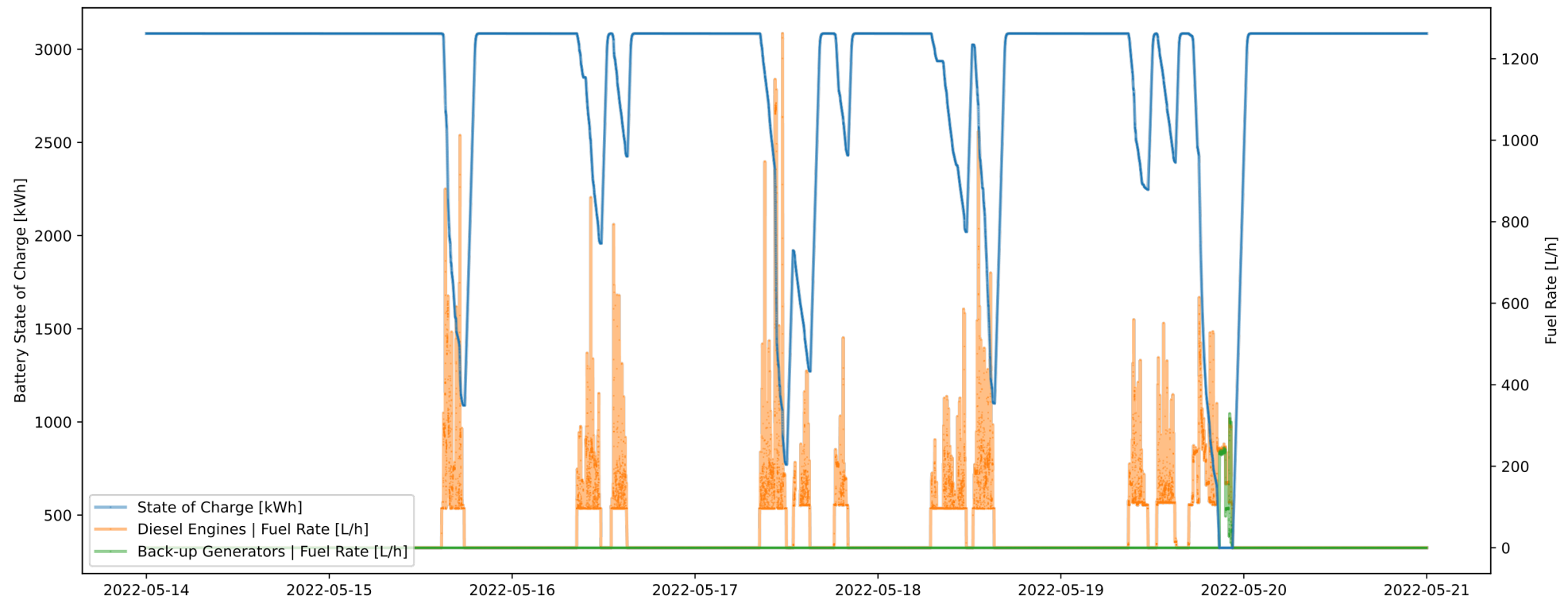
CHARGING BEFORE RETURNING BACK

# Dividing Operations



## SIMULATION

# Charging Strategy





## RESULTS

# Charging Strategy

*Table 5:* The proportion of time the vessel sailed electrically

<b>Vessel</b>	<b>Current Planning</b>		<b>With Recommendations</b>	
	<b>BoL</b>	<b>EoL</b>	<b>BoL</b>	<b>EoL</b>
Tug 1	92%	92%	96%	95%
Tug 2	75%	73%	76%	73%
Tug 3	95%	95%	99%	99%
Tug 4	>99%	>99%	>99%	>99%
Tug 5	99%	99%	>99%	>99%
Tug 6	98%	96%	98%	96%

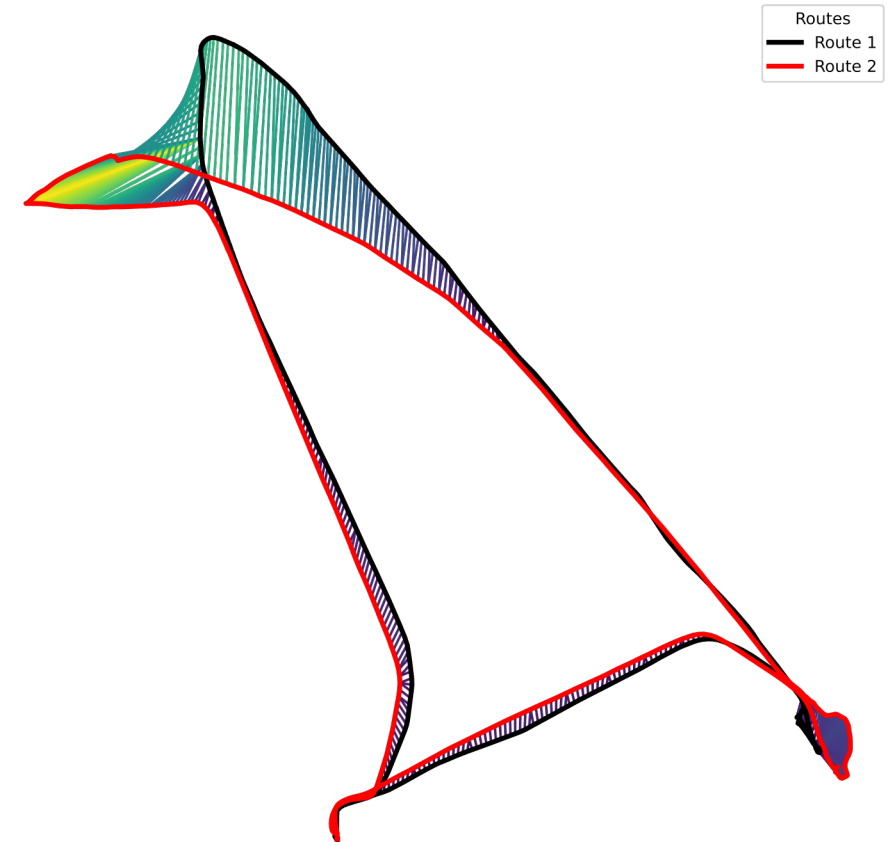
# Emission reduction results

*Table 6:* CO2 Emission reductions achievable given charging strategy and recommendations

<b>Vessel</b>	<b>Current Planning</b>		<b>With Recommendations</b>	
	<b>BoL</b>	<b>EoL</b>	<b>BoL</b>	<b>EoL</b>
Tug 1	92%	91%	96%	96%
Tug 2	50%	49%	52%	51%
Tug 3	94%	94%	99%	99%
Tug 4	>99%	>99%	>99%	>99%
Tug 5	99%	99%	>99%	>99%
Tug 6	96%	95%	96%	95%

# Future Analyses

- **Aim:** Learning from past operations
- **Application:** Onboard advice
- **Method:** Dynamic Time Warping & Hierarchical Clustering



# Conclusions

- Daily operations are achievable fully electrically
- The right tug for the job
- Changes to planning help reduce emissions
  - Dividing up operations between tug to allow for charging between jobs
  - Charging in between long legs of free sailing
- Emissions targets are achievable
  - Battery technology
  - Charging technology



# RSD-E Tug 2513

