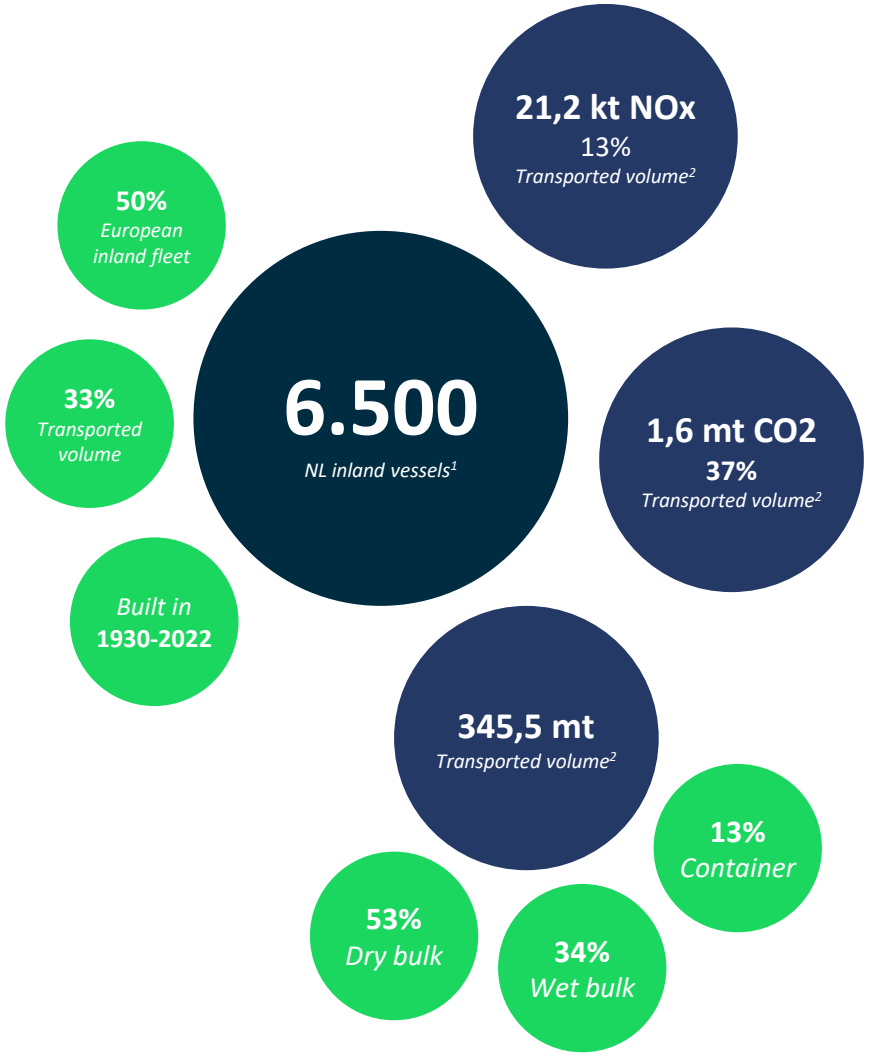
Swappable battery containers: only for shuttles or also for more challenging sailing profiles?

Danube Ports Days, Synergetics Technology Transfer Forum
24 November 2023
Koen van Eig – representing shareholder Port of Rotterdam

ZERO EMISSION SERVICES

A call to action
Important ‘22 Dutch inland shipping facts



2019 DUTCH GREEN DEAL for Maritime shipping, Inland Waterway Transport & Ports[3]

2024	2030	2035	2050
20% CO2 reduction c.f. ‘15	40% - 50% CO2 reduction c.f. ‘15	35% - 50% pollution reduction c.f. ‘15	Climate neutral inland shipping

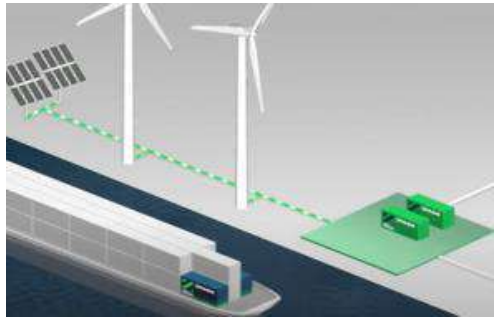
1. CBS.nl; 2. Factsheet Verduurzaming Binnenvaart (EICB – Marin – TNO – KBN); 3. Dutch government signed Green Deal in 2019.

Zero Emission Services

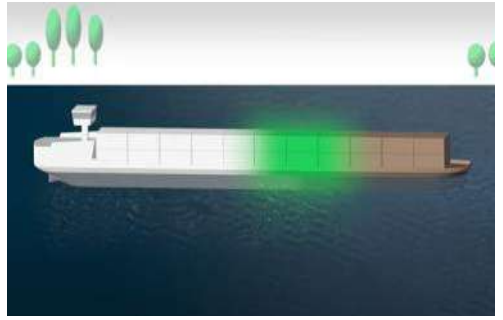
New energy concept for inland shipping

Exchangeable **energy containers**

Charging infrastructure & **grid balancing**



Pay per use business model



Alphenaar – Generation 1.0

- LOA 90 m
- Breadth 10.5 m
- Capacity 104 TEU

- Main engine Oswald 2x544hp
- Bow thruster Veth-Jet 1x650hp

- Built in 2019
- Owner/operator CCT Moerdijk

- Sails daily on electricity as per September 4th ’21
- Alphen a/d Rijn and Moerdijk

- Uses 2 ZESpacks generation 1.0 for a roundtrip

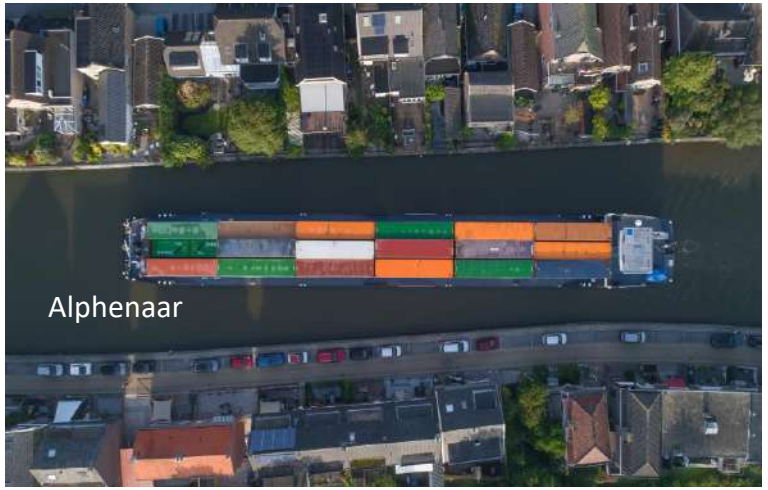
Reduced fuel & emissions ’22

- 154 m³ MGO
- 384 t CO2
- 7 t NOx

ZES modular energy technology in operation since September ‘21

Alphenaar is the first inland vessel sailing with ZESpacks


Generation 1.0 docking
CCT Alpherium


Alphenaar

Important lessons are implemented in the next generation development

Generation 2.0 docking station

- Double docking connection
- 2 MVA grid connection
- 2 x 2,9 MWh ZESpacks
- Max. 3 hrs charging
- 15 x 20 m footprint
- Megawatt Charging System connector
- Handling with crane of reach stacker

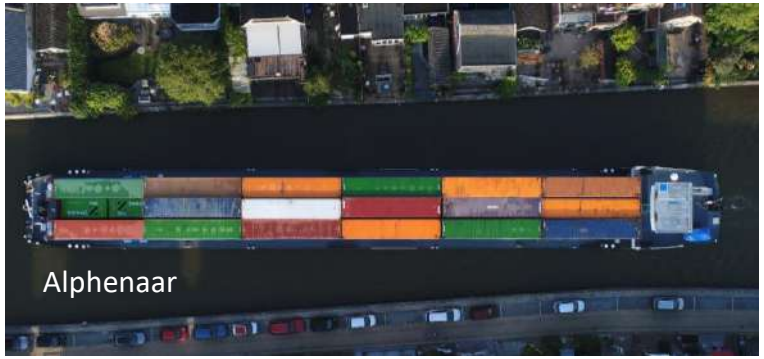
ZESpack generation 2.0 - Swappable Modular Energy Containers
Focus on simplicity and standardization

- **Zero emission energy**
  Charged with Dutch certified renewable energy
- **Future proof**
  LFP Lithium-ion batteries, ready for other future energy carries (i.e. hydrogen fuel cells)
- **Open access**
  Standardized open access interface to allow for rapid market adoption
- **Performance**
  1 MW power / 2,9 MWh / 2,6 MWh nominal[1] energy storage for a range of 60 - 90 km
- **Safety**
  Lloyds Register - Approval in Principal
- **Mobile / modular**
  Designed for maritime applications (including shocks / vibrations)
- **Asset standardization**
  MCS connector for vessel and docking station


1st ZESpack delivered on June 17th '21

1. 2,6 MWh is comparable with 43 Tesla's with a 60kWh nominal battery

Electricity hub development
Opportunities for terminals and other locations



Energy locally produced and stored

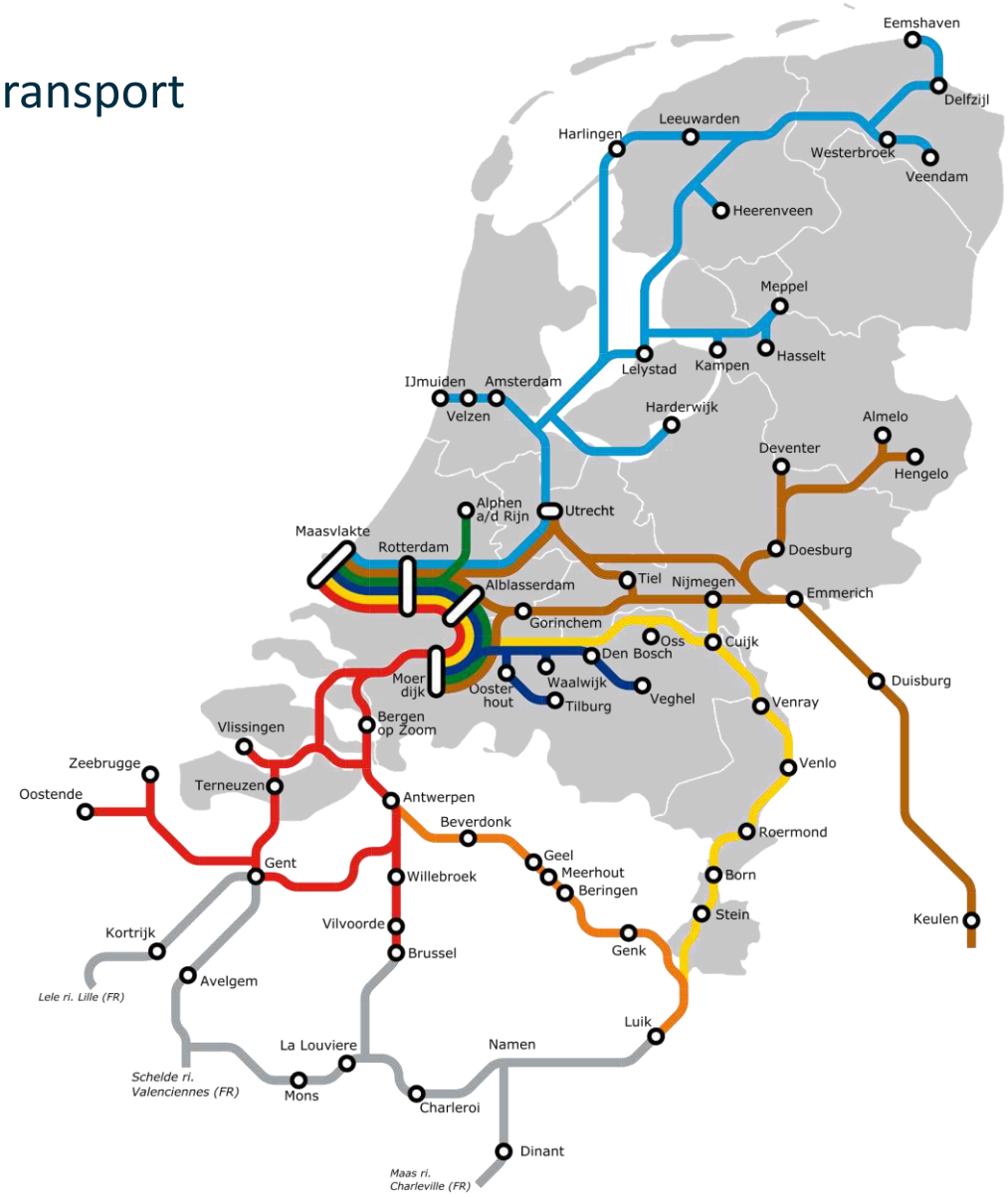
Energy locally used

Customer cases
With a focus on shuttles inland waterway transport

- **> 50 container terminals in the Netherlands & Belgium**
  Many times per week back & forth to the Ports of Rotterdam and Antwerp

- **Total Cost of Ownership (TCO) in comparison to fossil fuels is leading**
  Optimal usage (cycles) of battery containers

- **Local grid connection crucial for docking stations**
  Congestion issues



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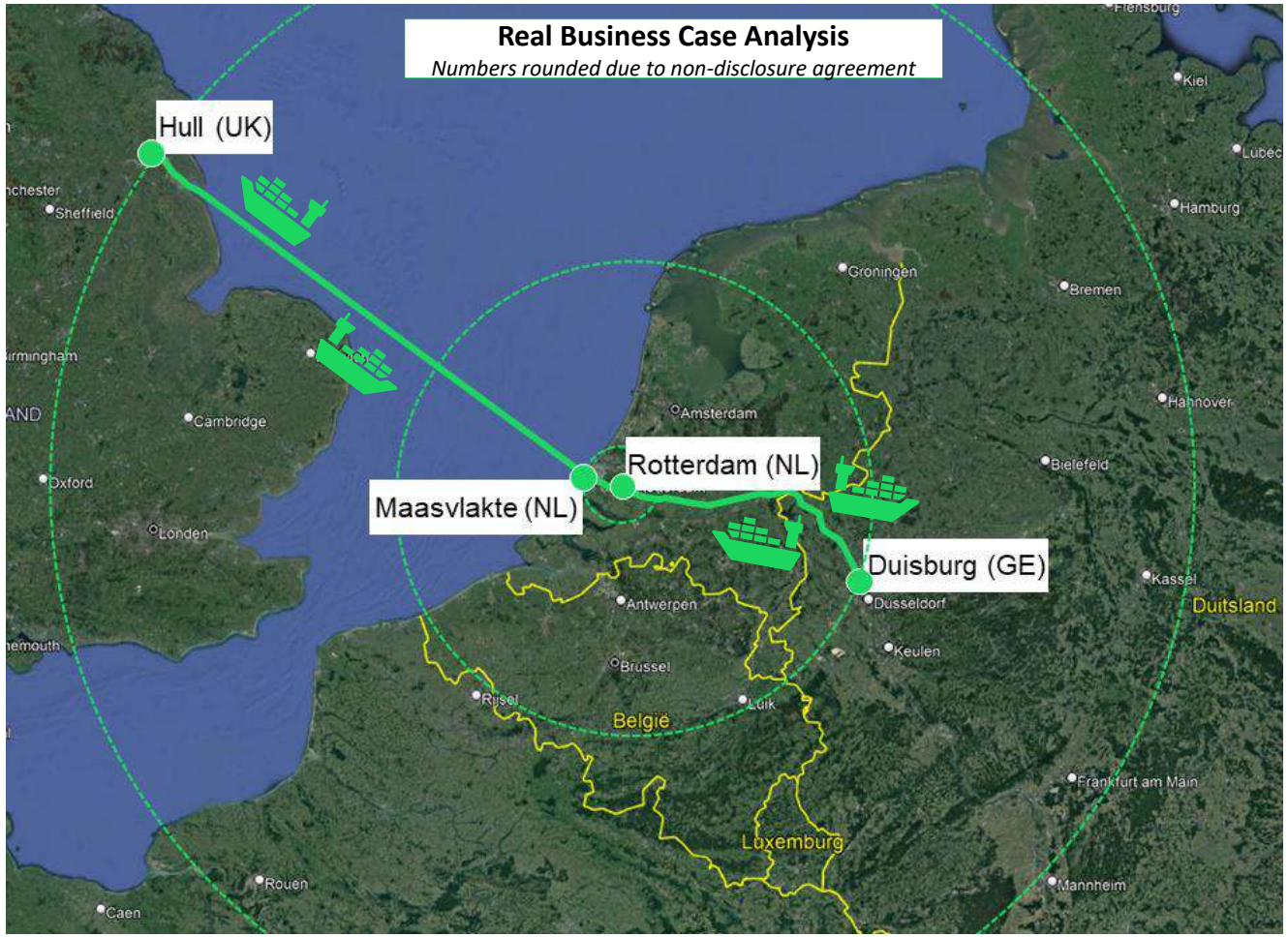
Powering clean corridors.

Extension customer cases
Including Long distance inland- and short sea shipping operation

- **Operational profile defined by customer**
  1x return/ week R'dam – Hull (UK)
  1x return/ week R'dam – Duisburg (GE)



Extension customer cases
Including Long distance inland- and short sea shipping operation

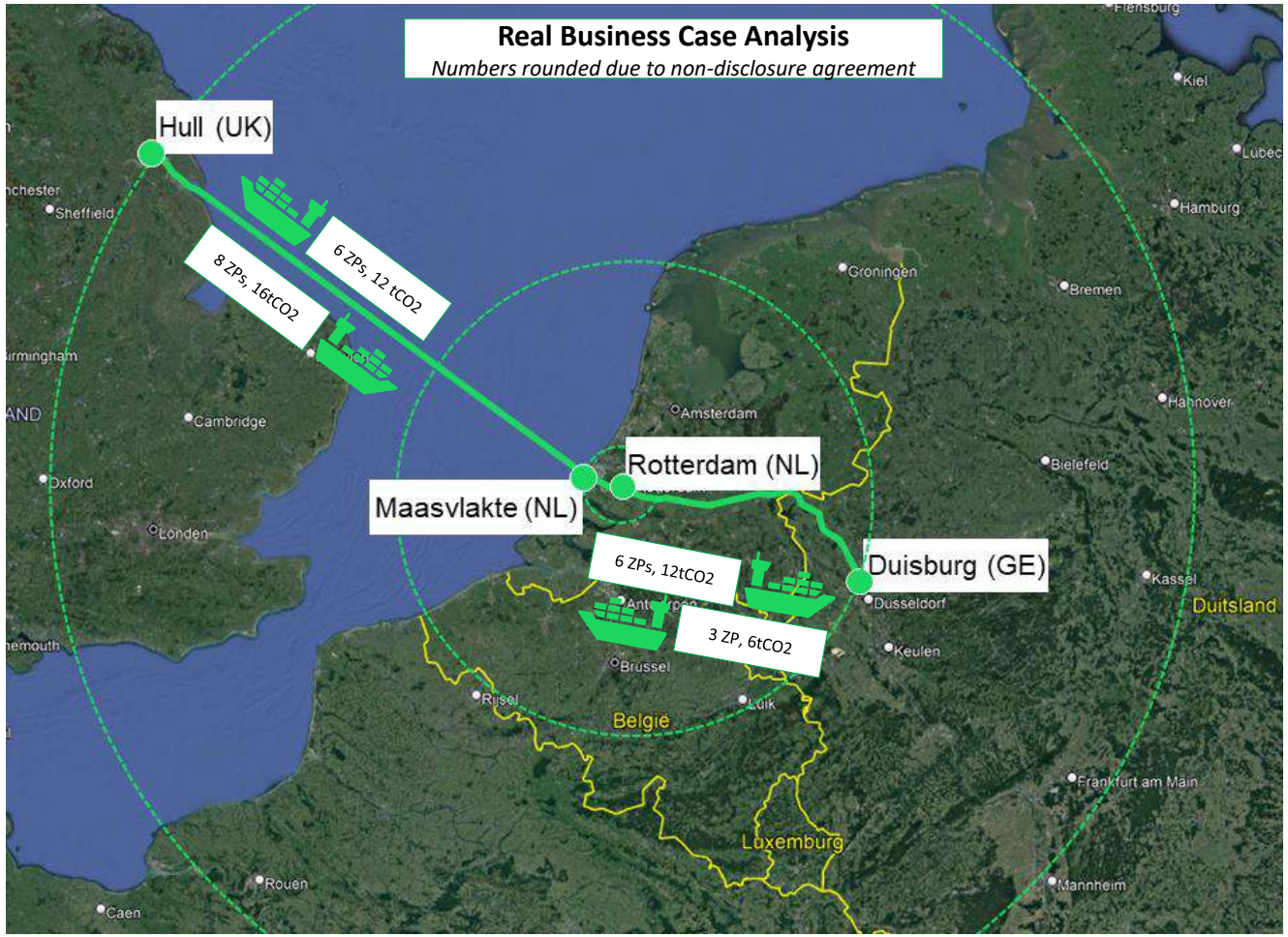
- **Operational profile defined by customer**
  1x return/ week R'dam – Hull (UK)
  1x return/ week R'dam – Duisburg (GE)

- **Operational trade-off between time - costs**
  More swaps decreases #ZESpacks on board
  More swaps increase operational inefficiency
  Less ZESpacks on board results in lower costs

- **Energy demand defined by customer**
  Speed-power curve is the calculation backbone

- **Power demand influenced by nature**
  Tidal and up-/ downstream affect energy demand

- **CO_2 emissions**
  Key calculation figures are Stage V benchmarked
  Energy density fuel > multiple eff. factors > result
  TNO key figures are used



ZES provides a proven modular energy solution for emission free sailing
For frontrunners in inland shipping ànd coastal shipping

Differentiate by leading..

- Creating a future proof supply chain using modular technology
- Charging infrastructure realised on key inland shipping corridors
- Lower asset investment for our customers
- Innovative pay-per-use model for rapid implementation
- Certified zero emission sailing using renewable energy
- Customers differentiate by leading the zero emission sailing transition

ZERO EMISSION SERVICES

Powering clean corridors.

Scan the QR code for information
or send an email to michiel.smit@zeroemissionservices.nl