Energy Efficient Ship Design & Operation

by Embracing Simulation & Digitalization

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Deltamarin Ltd.

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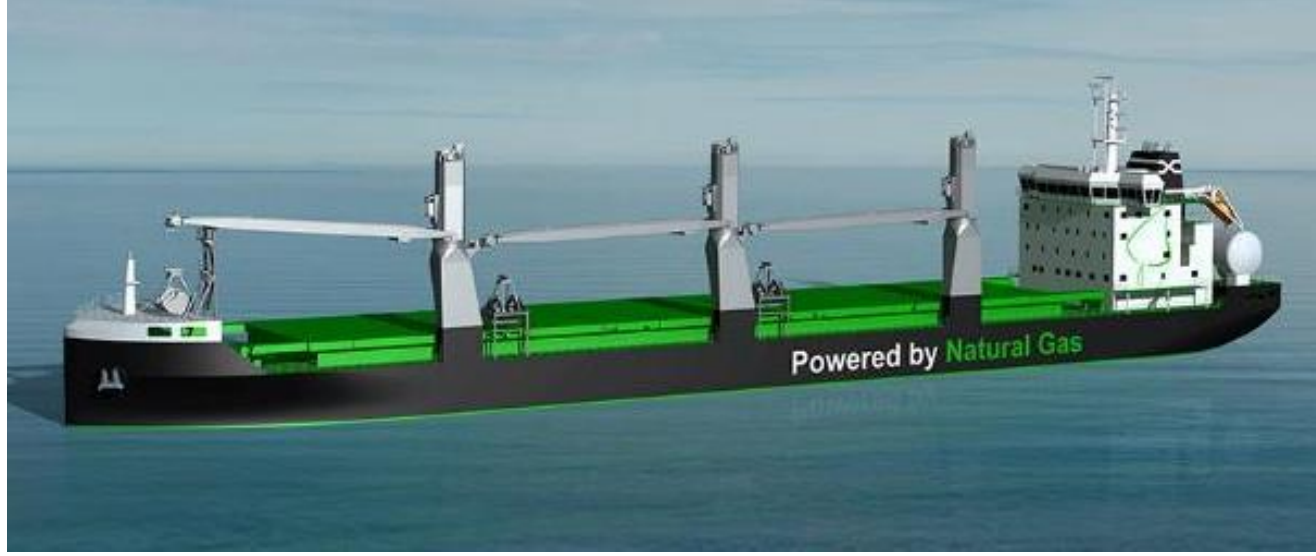

Thousands
of concepts

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Hundreds
of vessels sailing

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More than 25 years of experience

Established 1990 in Finland

1998 Office in Croatia

2006 Office in China

First FPSO project

2008 Office in Poland

First B.Delta design

2013 AVIC buys 79,7 % of Deltamarin shares

2014 Business expands to EPCM

2015 Turnover exceeds € 36 M

Efficient Delta designs

2016 400 employees

Continuously setting NEW TRENDS

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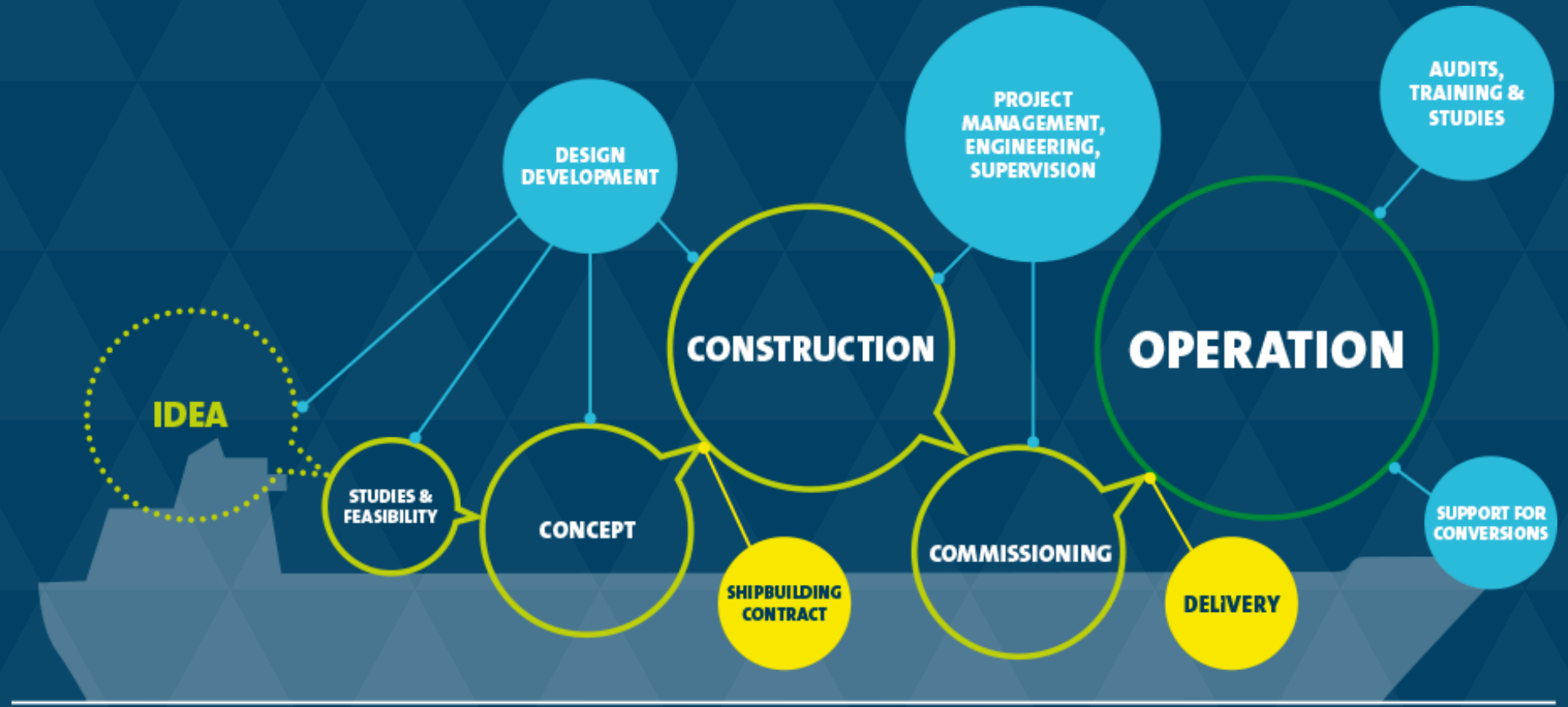
Solutions for the entire lifecycle.



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Ship energy efficiency

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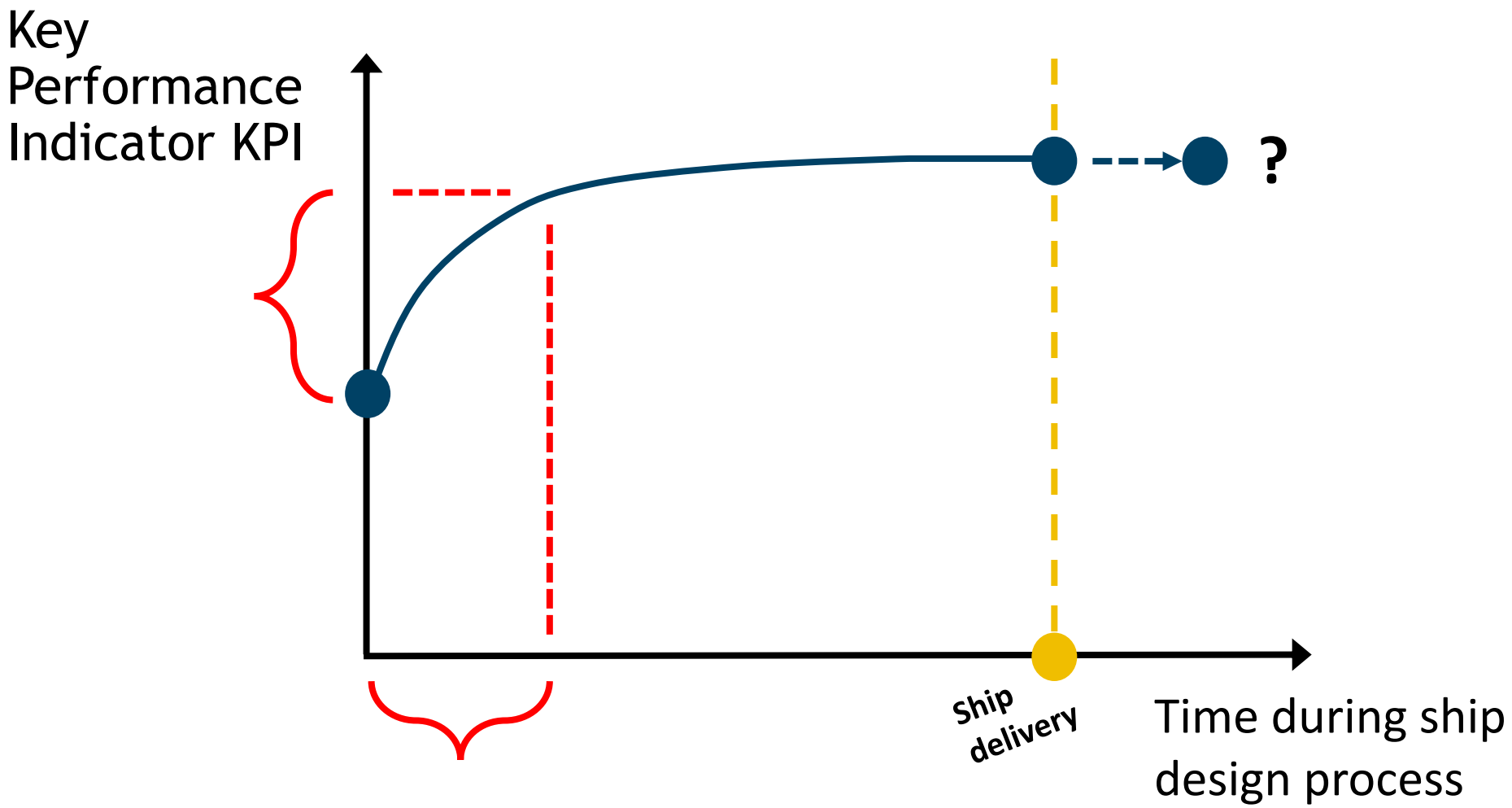
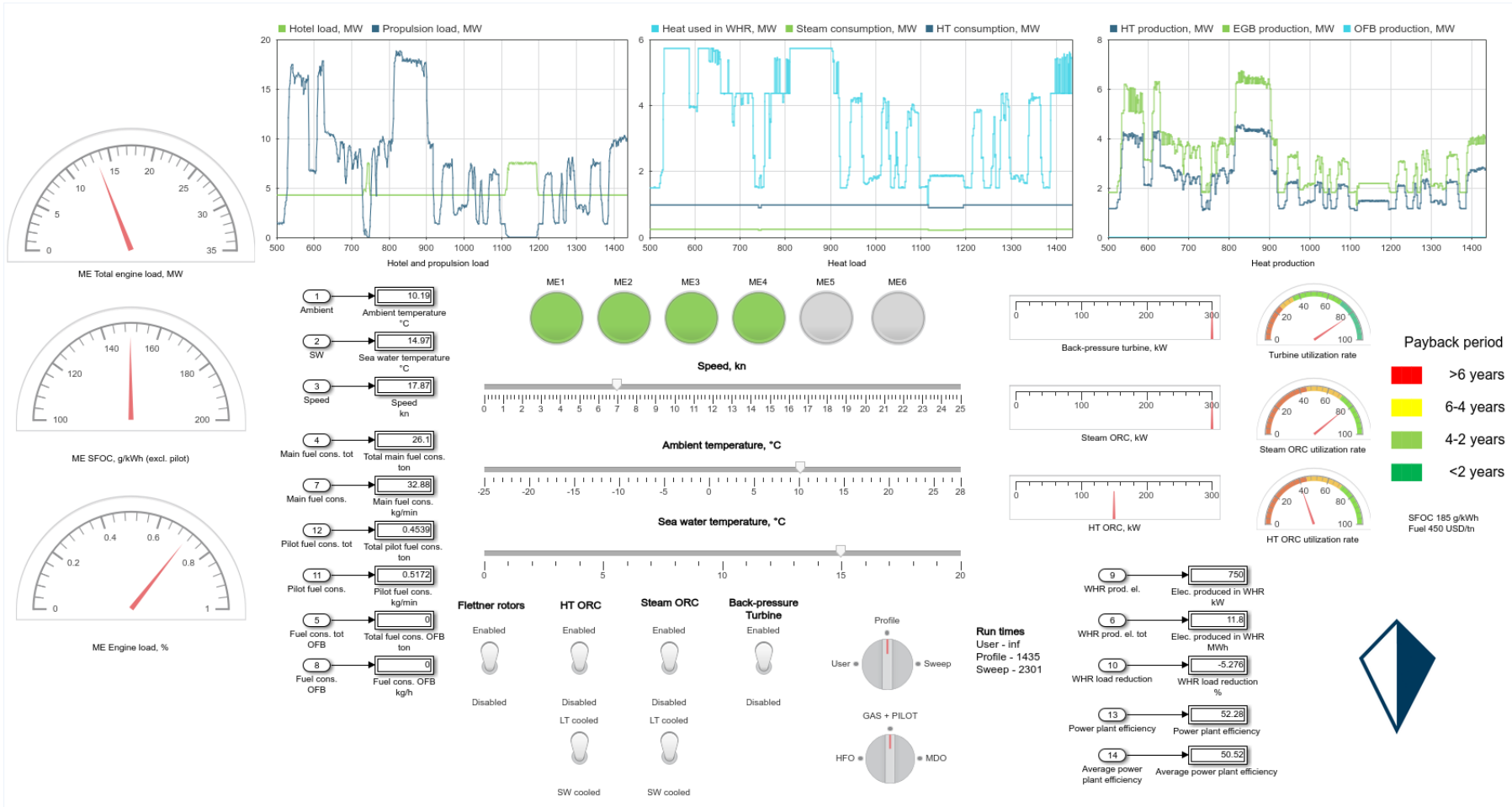
Ship design energy efficiency challenge

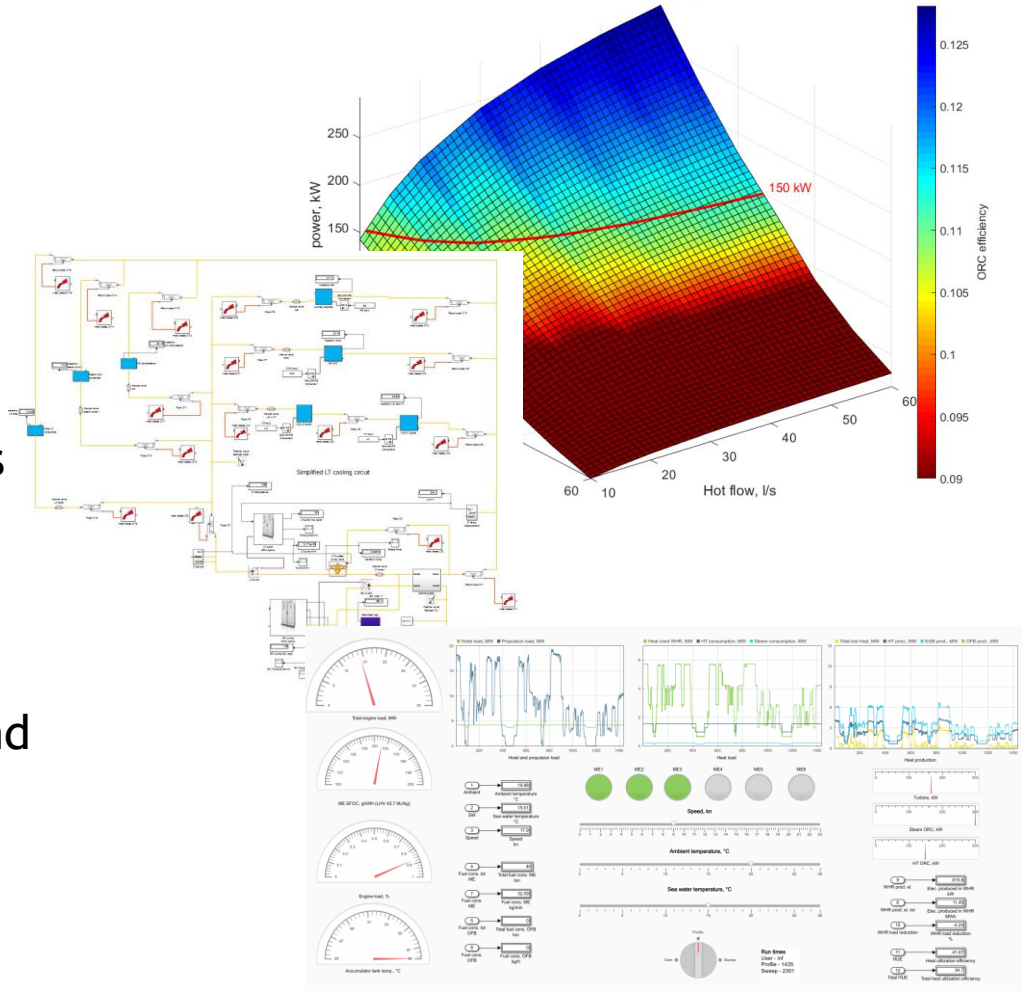


Holistic ship system simulation



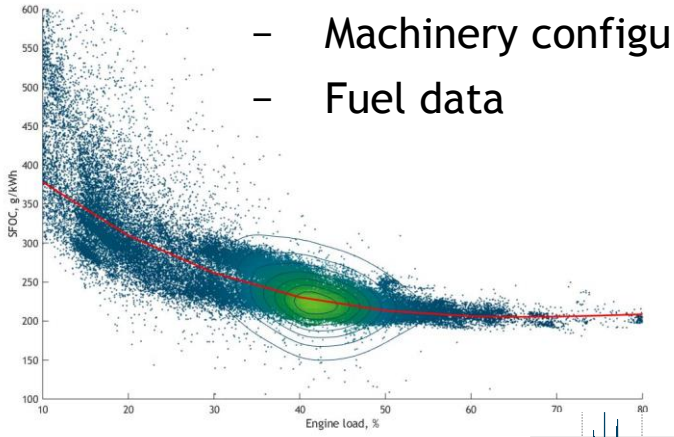
Deltamarin's energy flow simulation tool

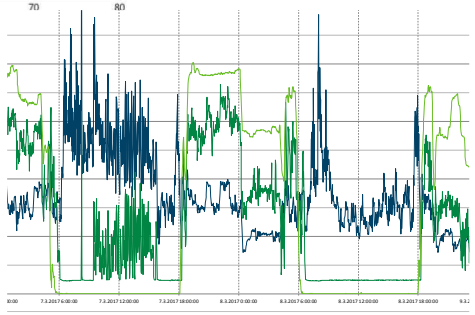
- Dynamic, efficient and accurate view of the ship processes
  - Development started in 2009
  - Modelling environment is Matlab, Simulink and Simscape
- Case specific energy flow modelling
  - Combining design data and measured data
- Shows the improvement potential in existing vessels already during ship concept design stage
  - Rapid testing for operational changes and system updates
  - Where the energy is produced and consumed?
  - How much can be saved?
- Helps to explain conflicts between system design and real-life operation
- The most feasible fuel saving solutions are obtained based on accurate and reliable simulations for the selected ship



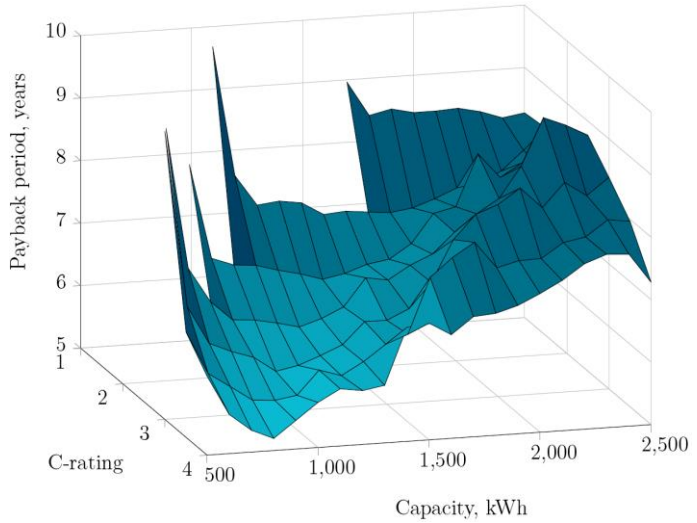
Model inputs and results

- **Key input parameters**
  - Operation profile
  - Power requirements of various systems
  - Machinery configuration
  - Fuel data

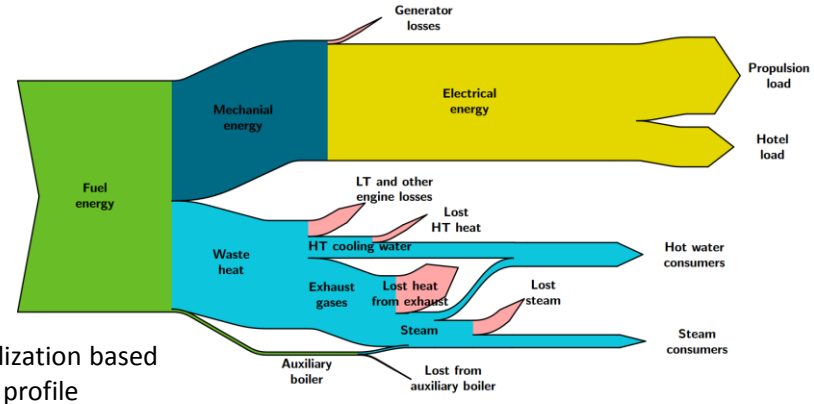




- **Result examples**
  - Fuel consumption
  - **Dynamic** and **cumulative** energy distribution inside the ship
  - Optimal heat recovery setup/ hybrid machinery…
  - Evaluations of ship autonomy
  - Emission calculation



Battery sizing for a Ro-Pax vessel



Fuel energy utilization based on a simulated profile

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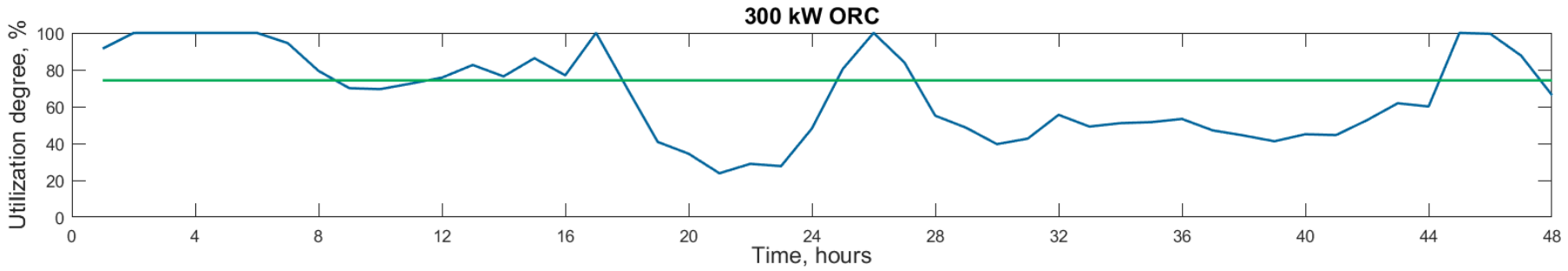
Assessing profitability

Turbine utilization degree

Steam ORC utilization degree

HT ORC utilization degree

- $Utilization\ degree = \frac{Average\ power}{Maximum\ power}$
- Correlates directly with payback time
- Requires dynamic simulation
- → preliminary pay back time indicators added in simulation tool
- WHR equipment example:



Payback period

- >6 years
- 6-4 years
- 4-2 years
- <2 years

SFOC 195 g/kWh
Fuel 600 USD/tn

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Energy modelling during ship project phases

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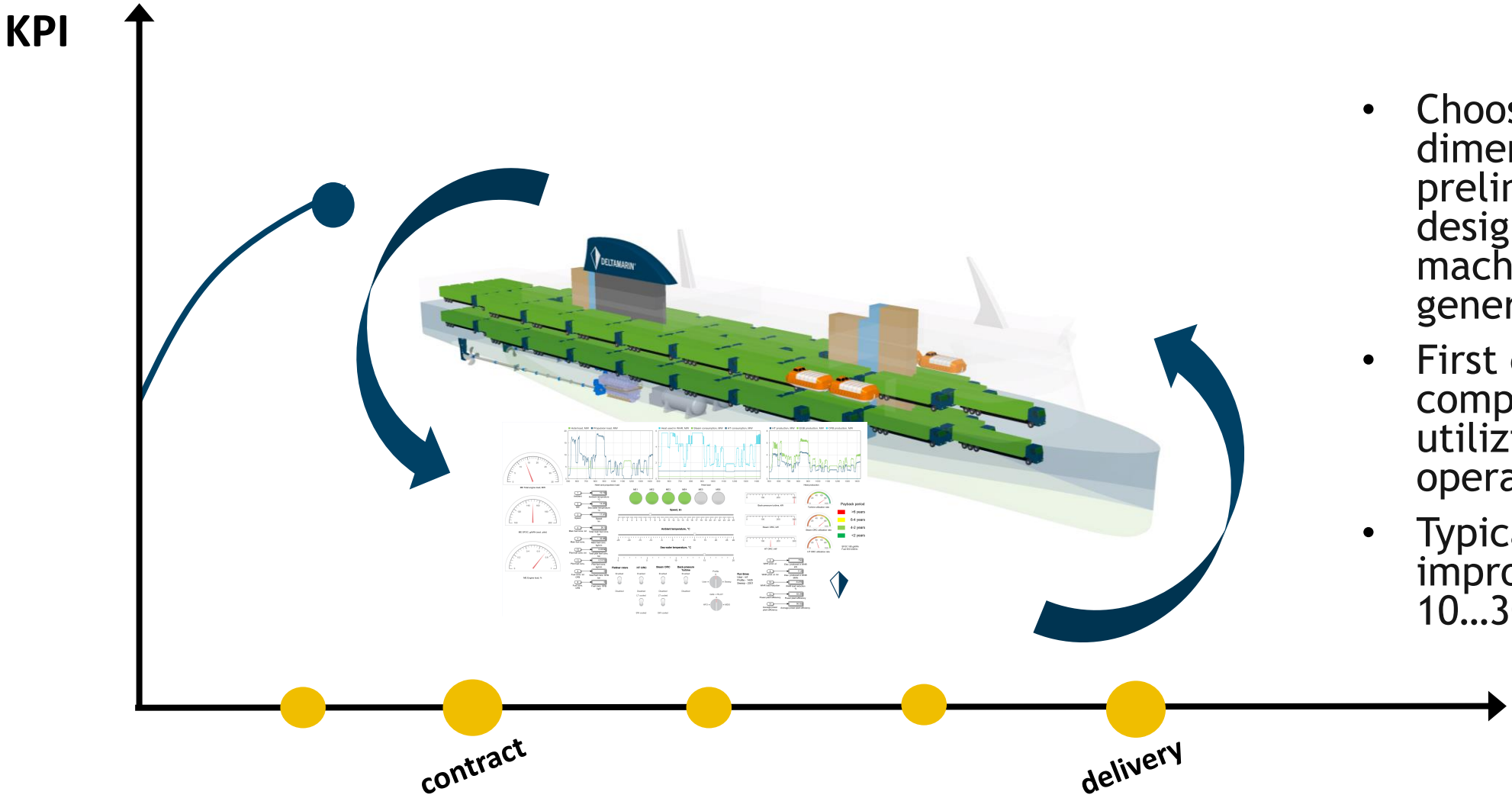
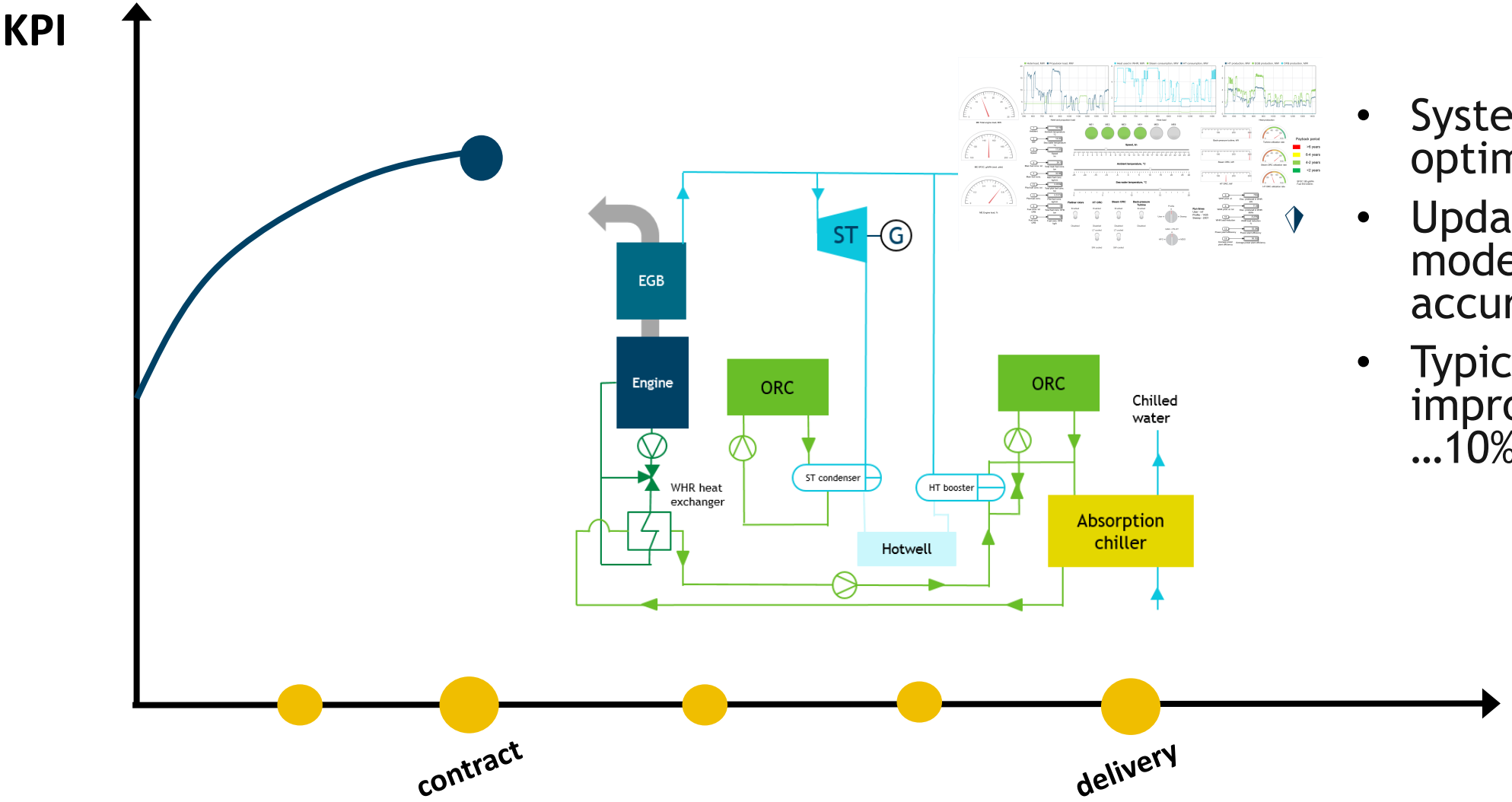
Early conceptualizing



- Choosing the main dimensions, preliminary hull design and machinery concept generation
- First energy model compiled by utilizing suitable operational data
- Typical efficiency improvement 10…30%

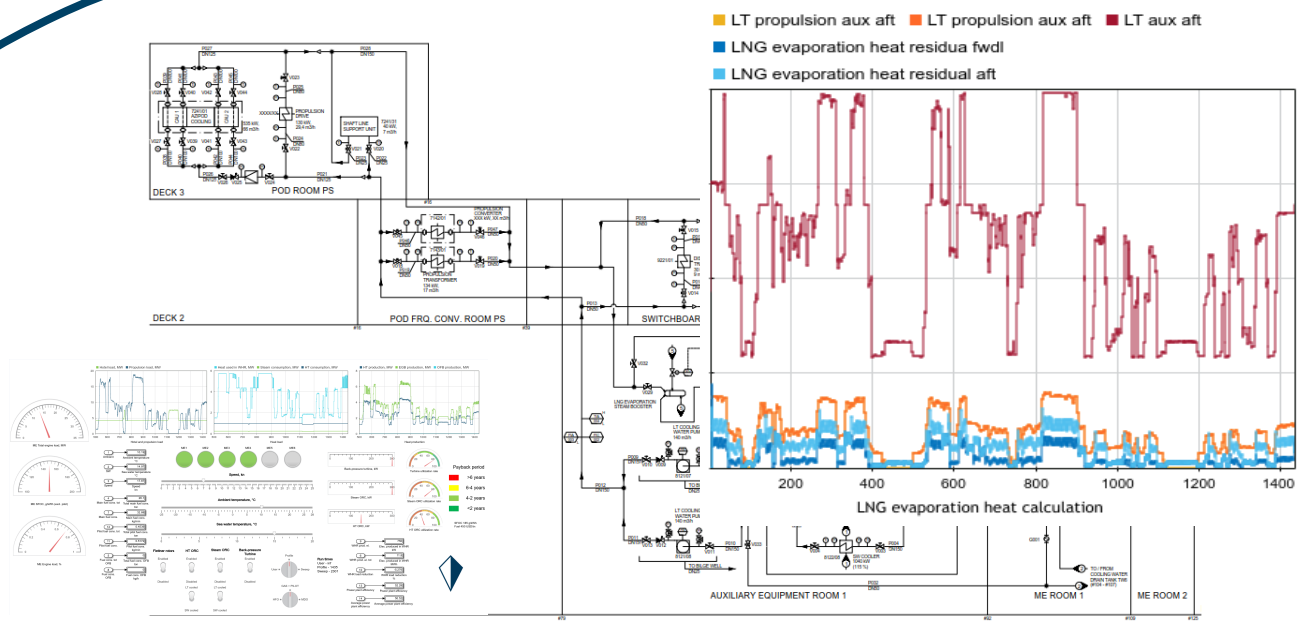
Contract design



- System optimization
- Updated energy model with more accurate data
- Typical efficiency improvements …10%

Basic and detail design

KPI



contract

delivery

- System development and equipment choices
- Smart dimensioning of equipment for operational efficiency and optimized costs
- Updated energy model with more accurate data
- Typical efficiency improvements …5%

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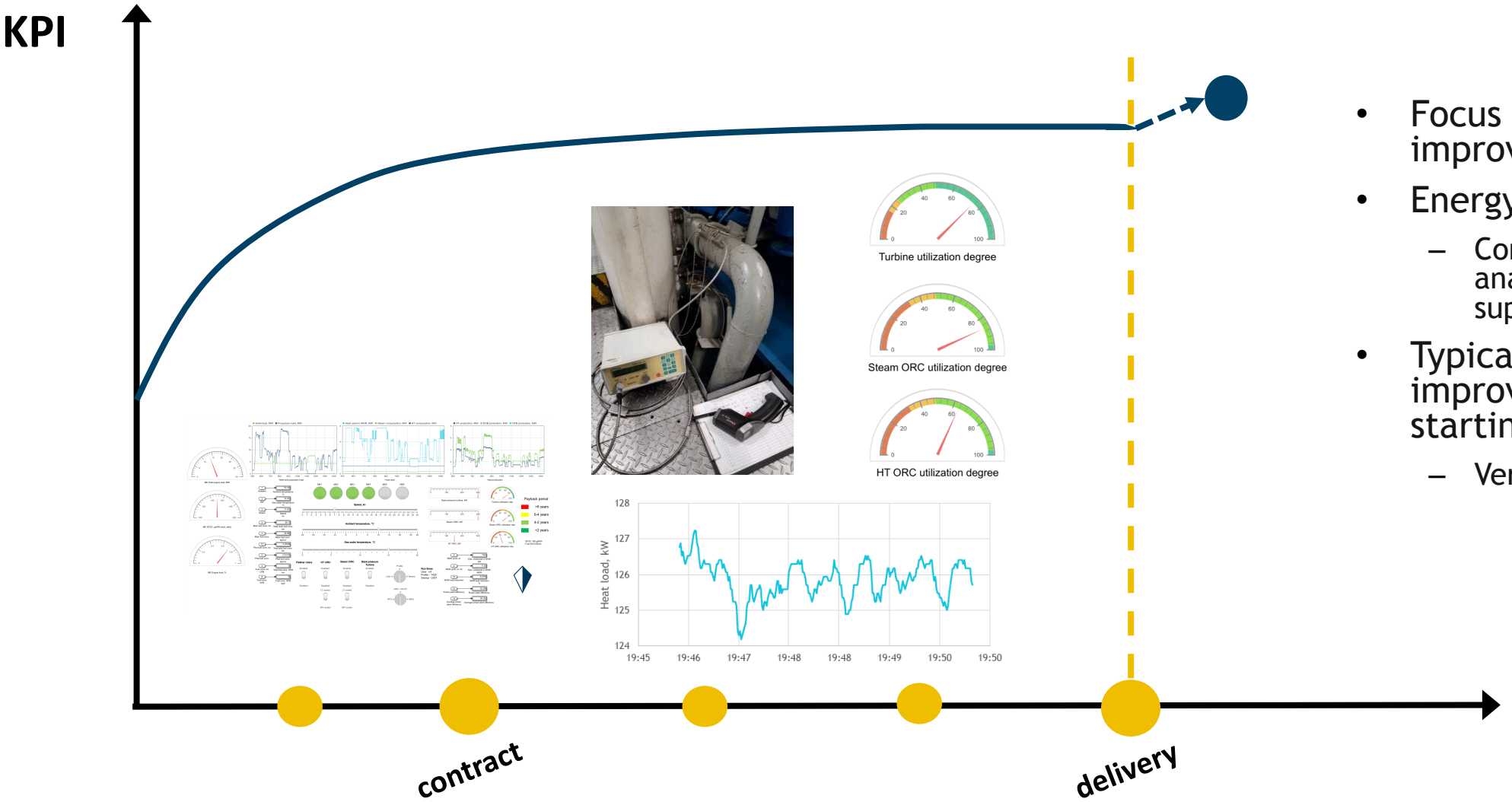
Operations



- Focus on operational improvements
- Energy management
  - Continuous data analysis and decision support
- Typical efficiency improvements starting from 5%
  - Very case dependent

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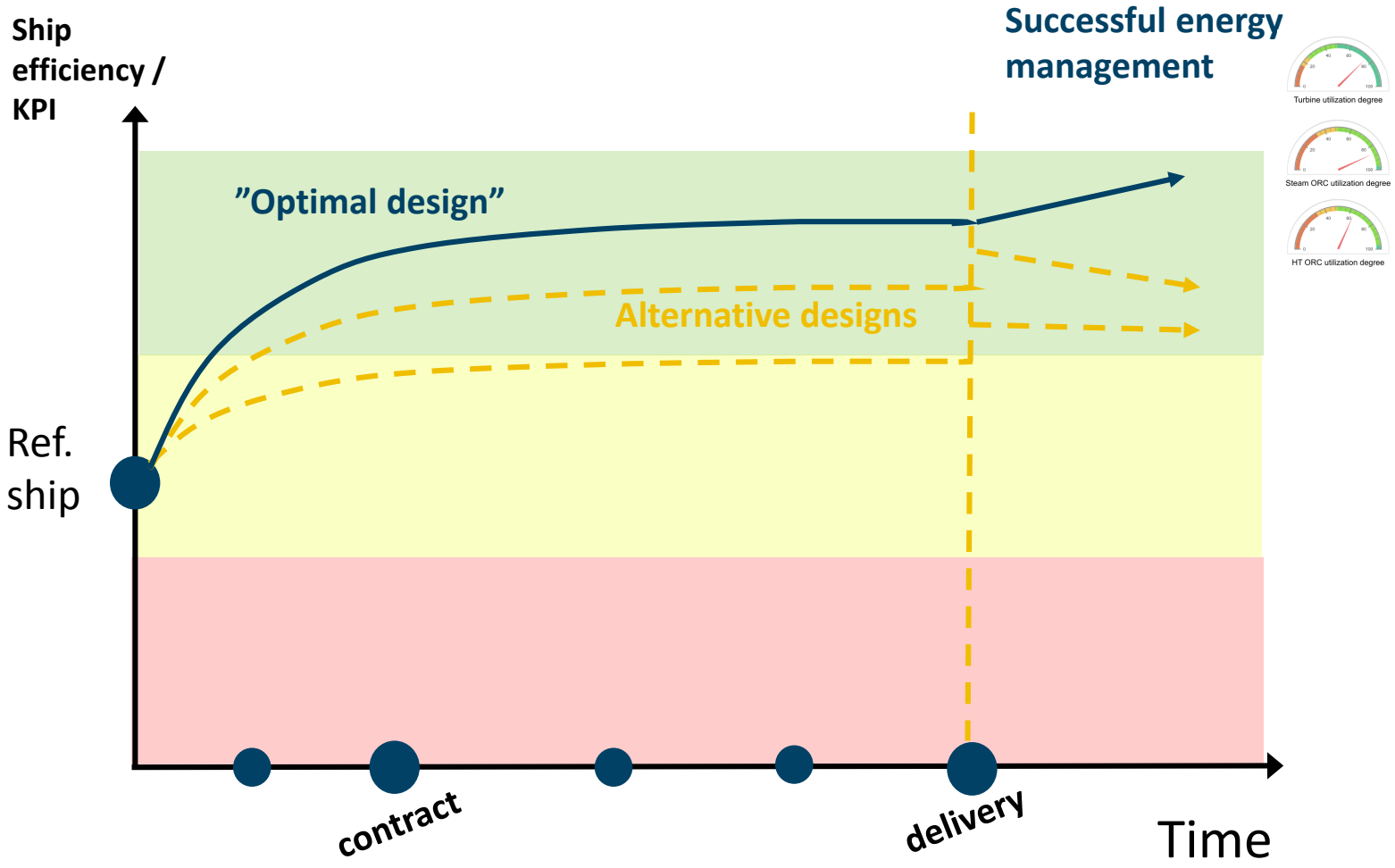
Summary

Optimization of ship efficiency

- Considering the actual operational conditions and profile as a starting point for optimization
- Monitoring the KPI(s)
- Analysing the energy flows and continuous improvements
- Special focus on the early concept stage



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