Route Optimization for Offshore Maintenance Tasks & Case Study

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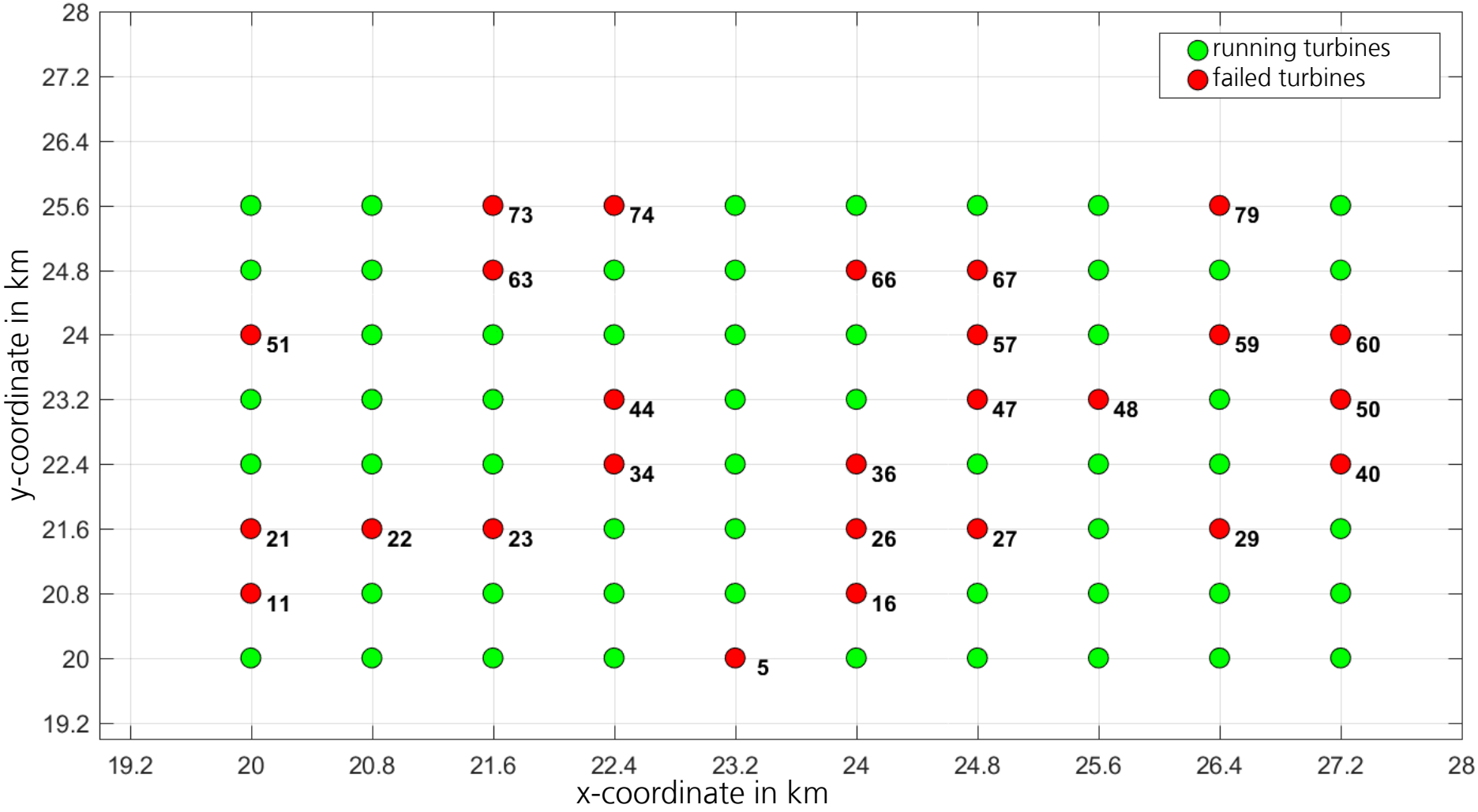
Problem Definition – Daily Route Optimization



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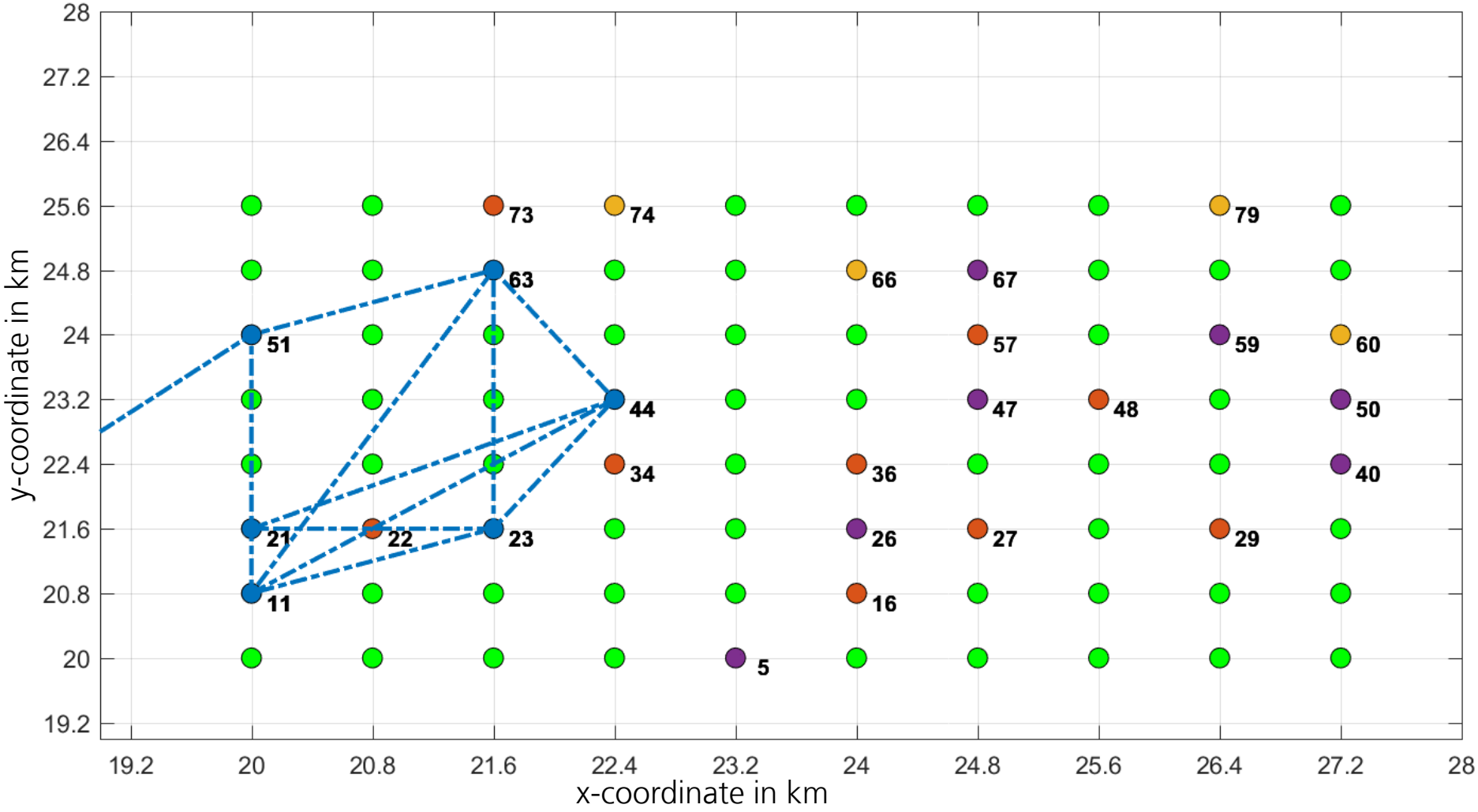
Problem Definition – Daily Route Optimization



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State of the Art

- **Routing Algorithms:** [1] [2]
  - high computation times
- **Simulation Models:** [3] [4]
  - no optimisation
- **Reality:**
  - experience based decisions

Target Definition

- **Routing optimization** in reasonable computation time
- **Implementation in simulation model**
- **Compare logistic strategies** in case study
- **Evaluate possible improvements** (short-term/long-term)

Method - Decomposition

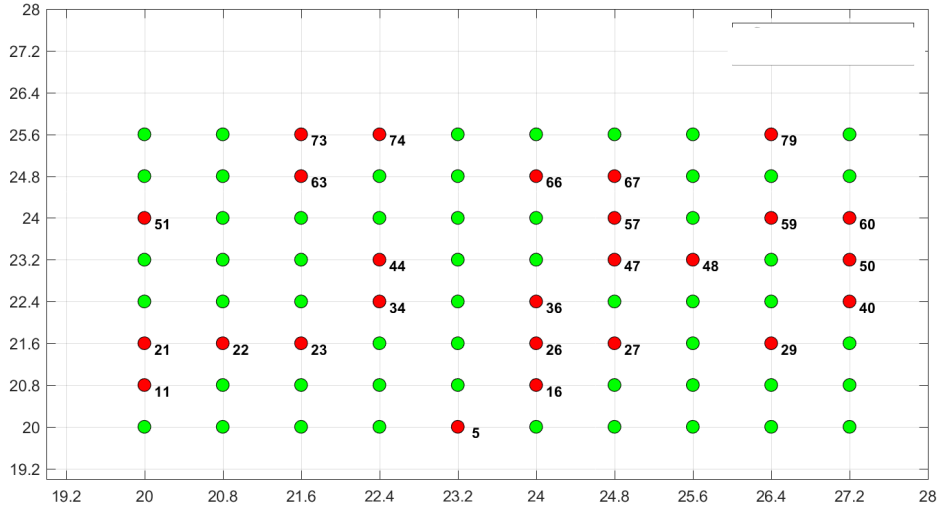
Downtime losses are higher than CTV fuel costs

1. Optimize Schedule →
- **Time-based availability**
- **Energy losses**

2. Optimize Routes →
- **Travelled distance CTVs**
- **Fuel costs**

Case Study – 8 Logistic Strategies

- **Simulation period:** 20 years
- **Windfarm:** 80 turbines
- **CTVs:** 1-3 CTVs
- **Teams per CTV:** 1-4 Teams



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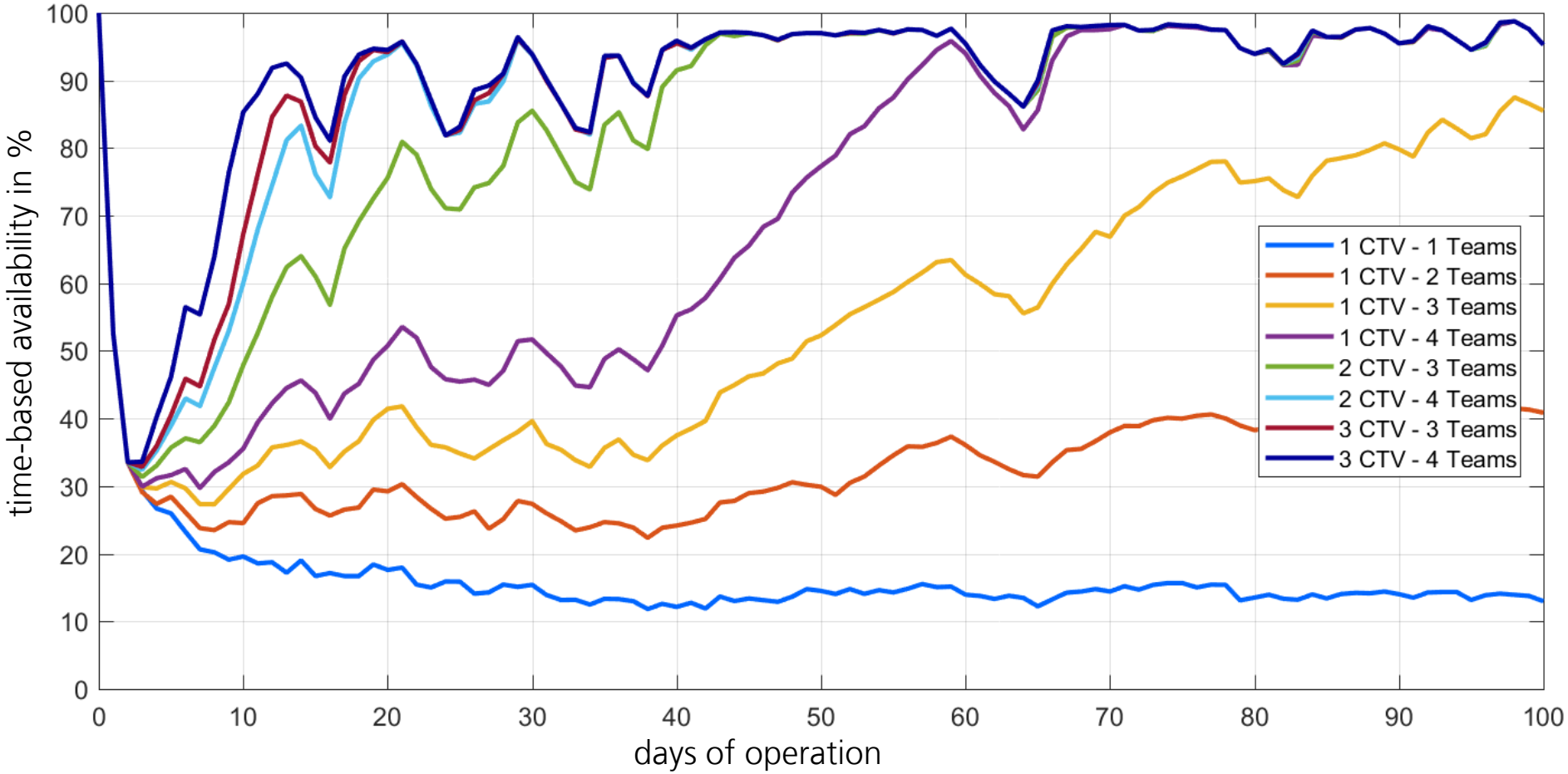
Results – Time-Based Availability



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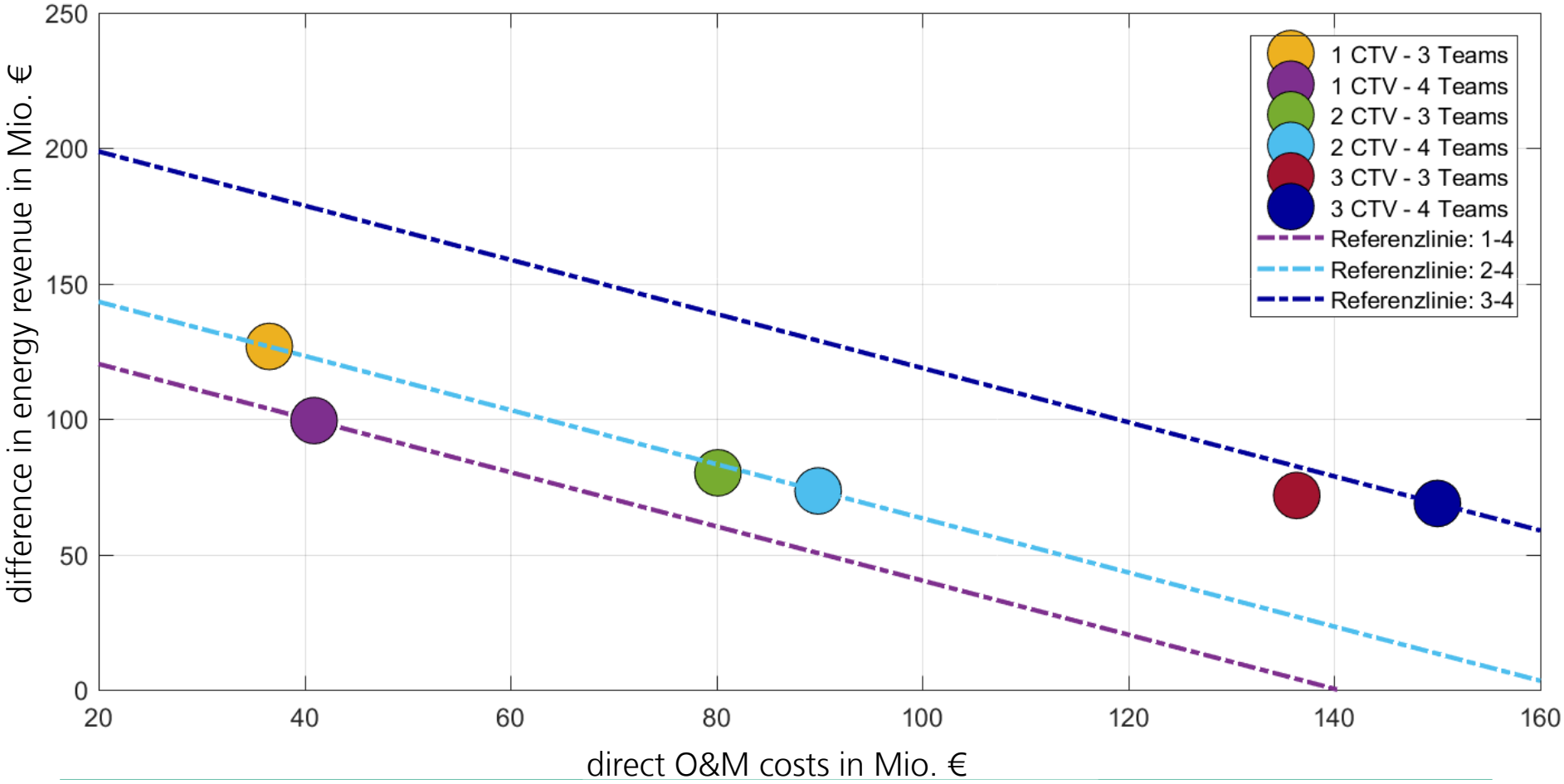
Results – Cost Comparison



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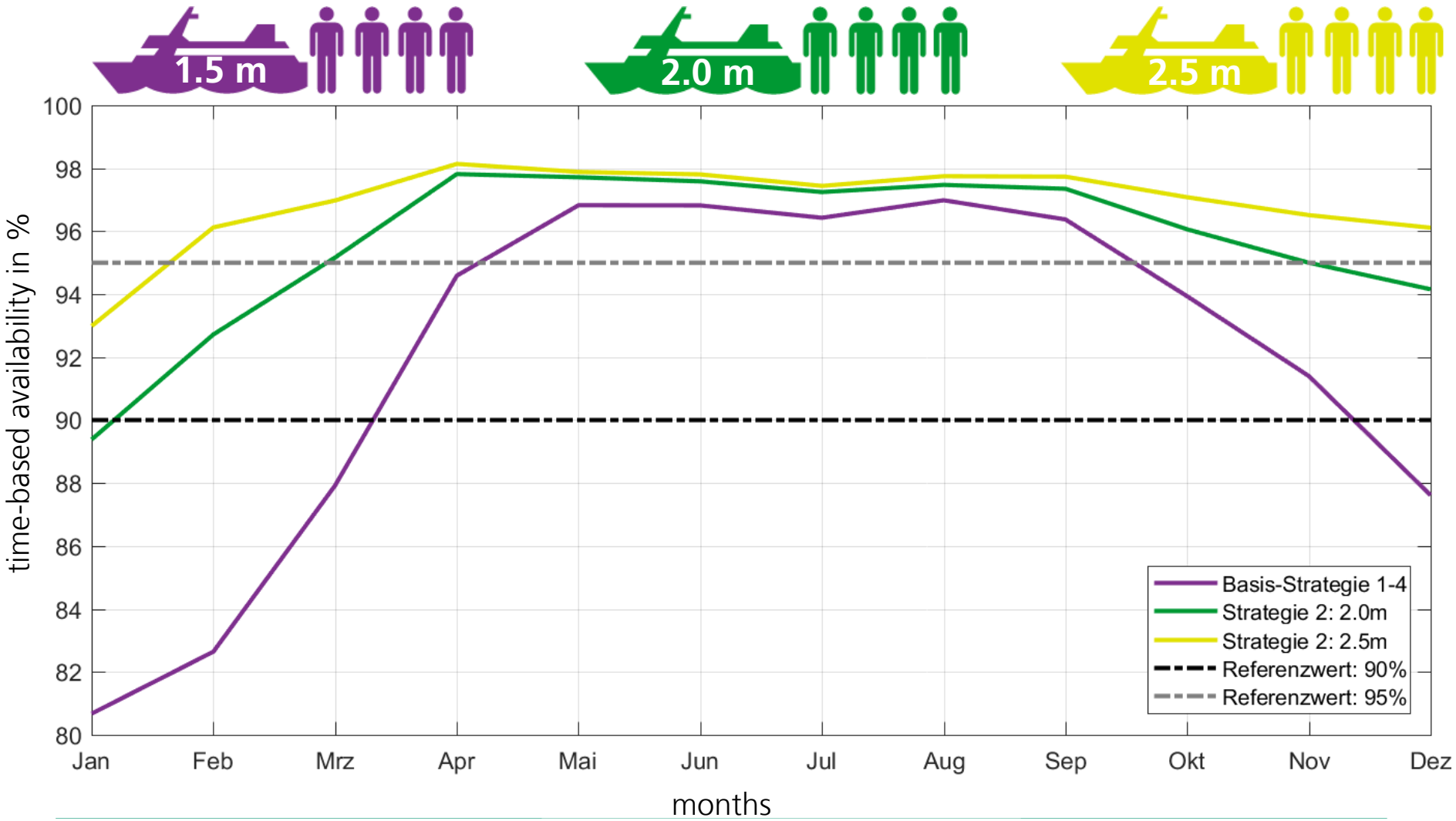
Improved Strategy – Seasonal Behavior



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Improved Strategy – 20 Years Behavior

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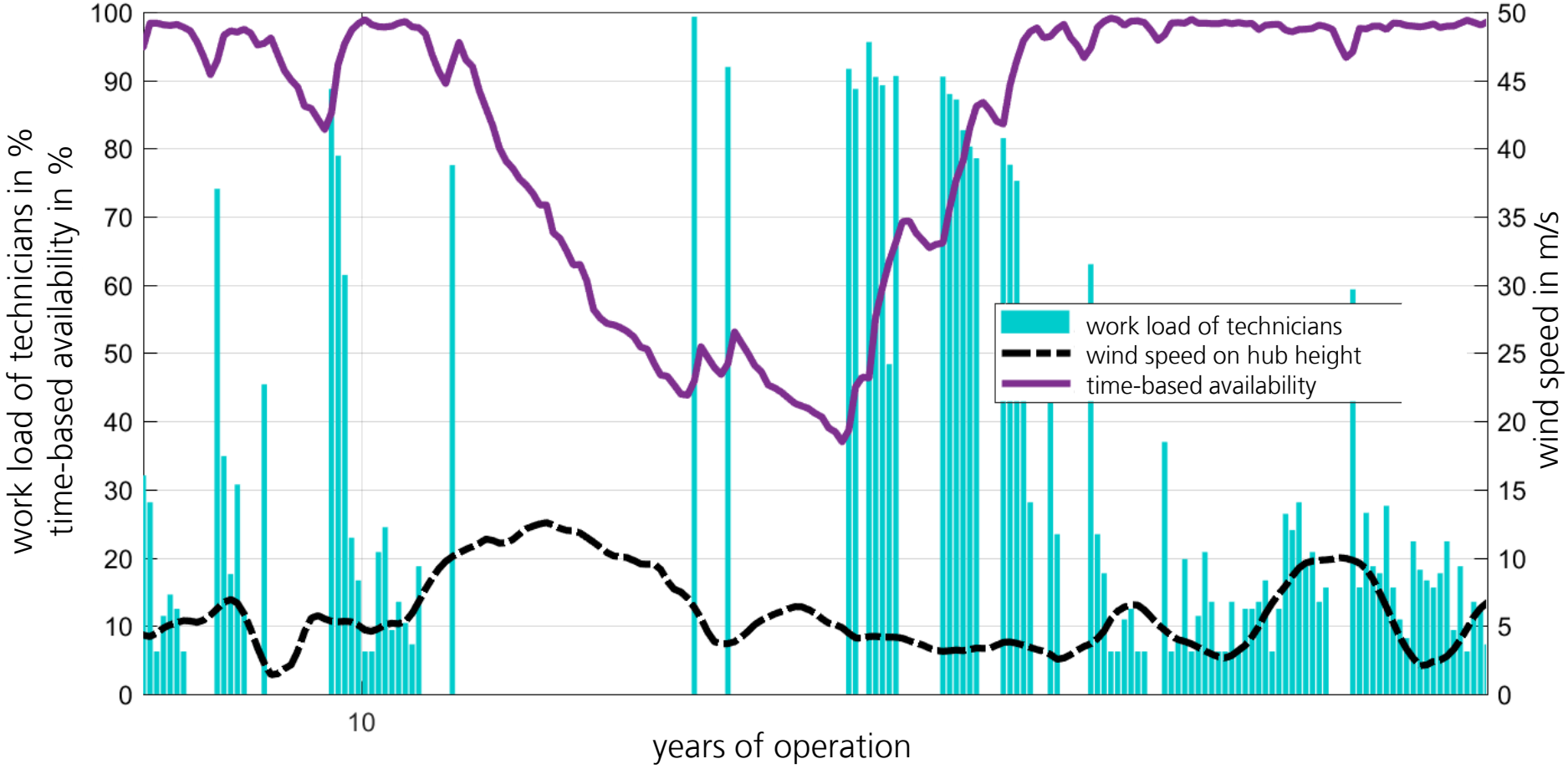
Detailed Evaluation – Winter Storm



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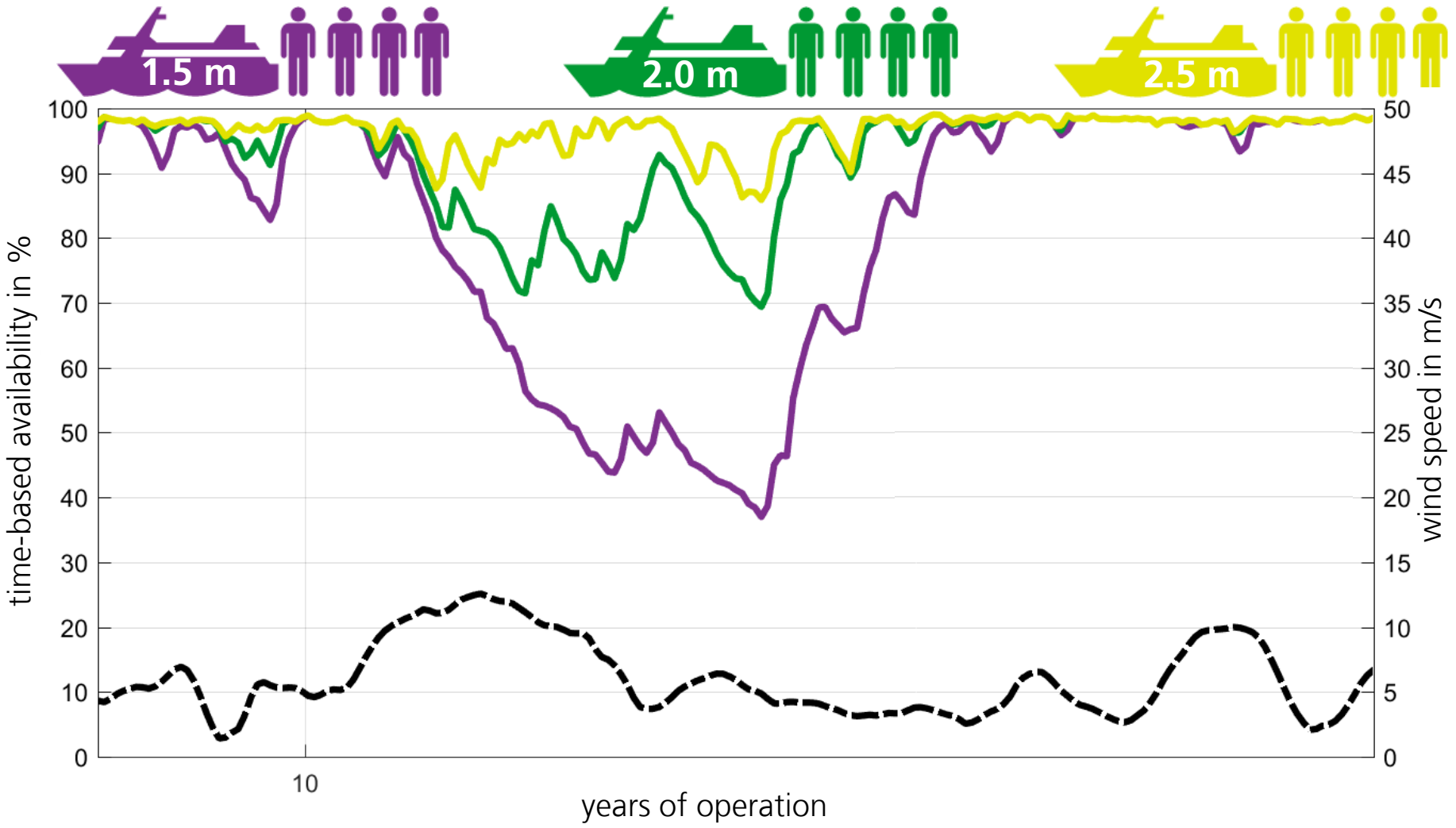
Detailed Evaluation – Winter Storm



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Conclusions

- **Route optimization + simulation model**
  - decomposition, optimization rules, iterative calculations
  - computation times: 1h – 1day for 20 years simulation
- **Comparison of logistic strategies**
  - in terms of costs, time-based availablity, energy output, work load…
- **Detailed analysis**
  - short-term strategy improvements

Thank You For Your Attention

Any questions?

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References

[1] L. Dai, M. Stålhane and I. Utne, "Routing and Scheduling of Maintenance Fleet for Offshore Win L. Dai, M. Stålhane and I. Utne, "Routing and Scheduling of Maintenance Fleet for Offshore Wind Farms," Wind Engineering 39, pp. 15-30, 2015.d Farms," Wind Engineering 39, pp. 15-30, 2015.

[2] M. Stålhane, L. M. Hvattum and V. Skaar, "Optimization of routing and scheduling of vessels to permorn maintenance at offshore wind farms," Energy Procedia 80, pp. 92-99, 2015.

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[4] T. Münsterberg and C. Jahn, "Offshore Windenergie: Kostensenkung durch Logistiksimulation," Simulation in Production and Logistics, 2015.

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