Maintenance dredging: Towards smart, sustainable, and circular strategies

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Marine ingenuity

Presentation Outline

1. Introduction

2. Smartness, Sustainability, and Circularity in Port Maintenance

3. Research Methodology

4. Results

5. Conclusion

7. The Way Forward

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1. Introduction

What is maintenance dredging?

Why do we maintain water depth?

What strategies are there for maintenance?

How do we select these strategies?

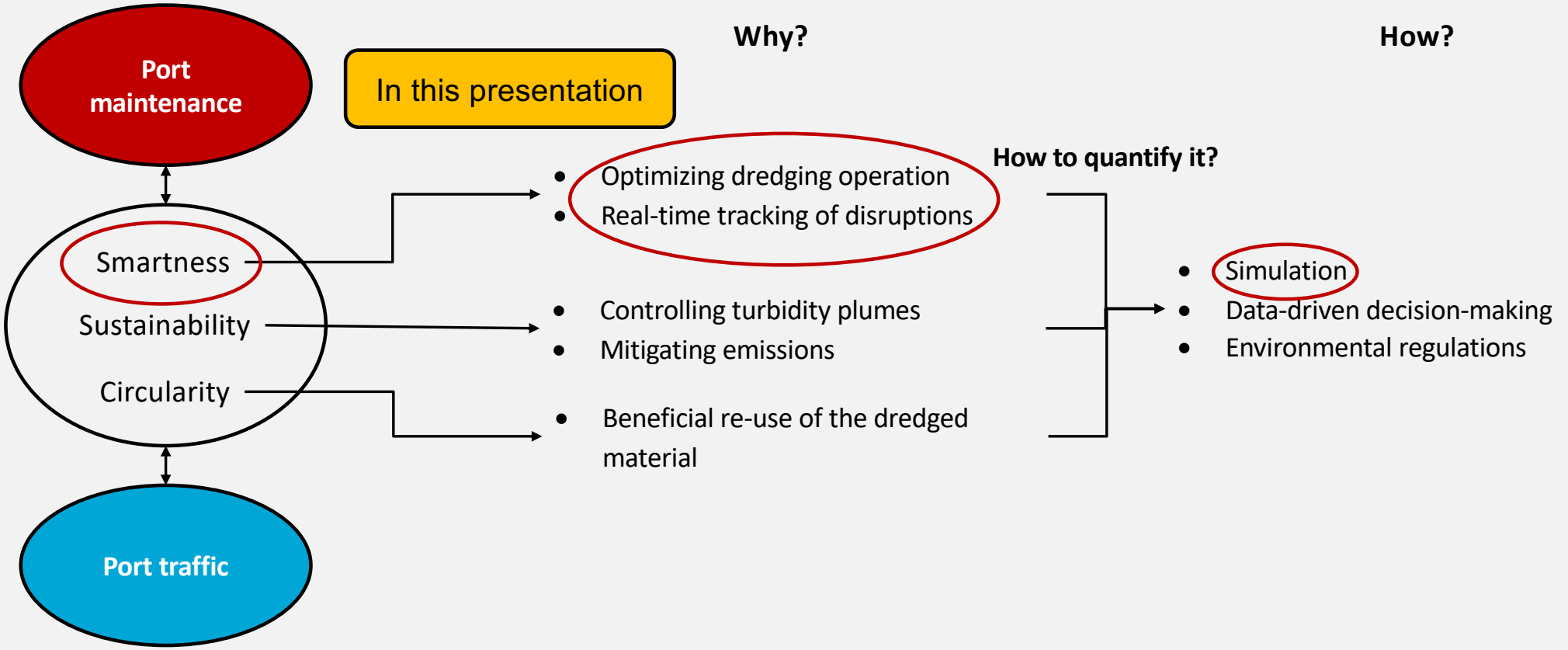
What are the trade-offs?

How the trade-offs can be quantified?

What are the applications?

How to implement?

2. Smartness, Circularity, and Sustainability in Port Maintenance



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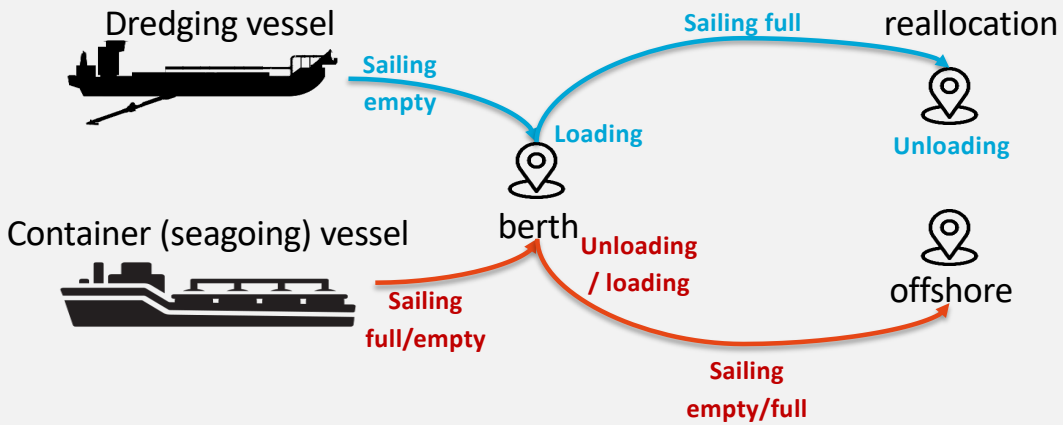
3. Research Methodology



OpenCLSim

- Simulating dredging and seagoing activities
- Monitoring the interactions between these activities and disruptions

Input parameters

Vessel-related	Port-related
• Position (geographical location) • Capacity • Loading/unloading rate • Velocity	• Berth capacity • Terminals traffic • Terminal capacity • Cubic meter of sediment to be dredged • Tonnage of handled container

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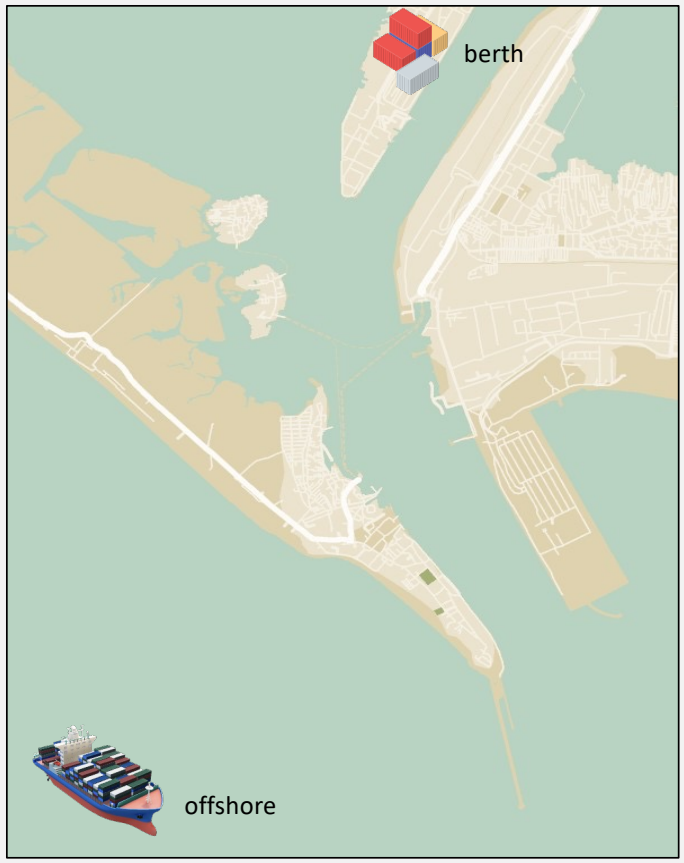
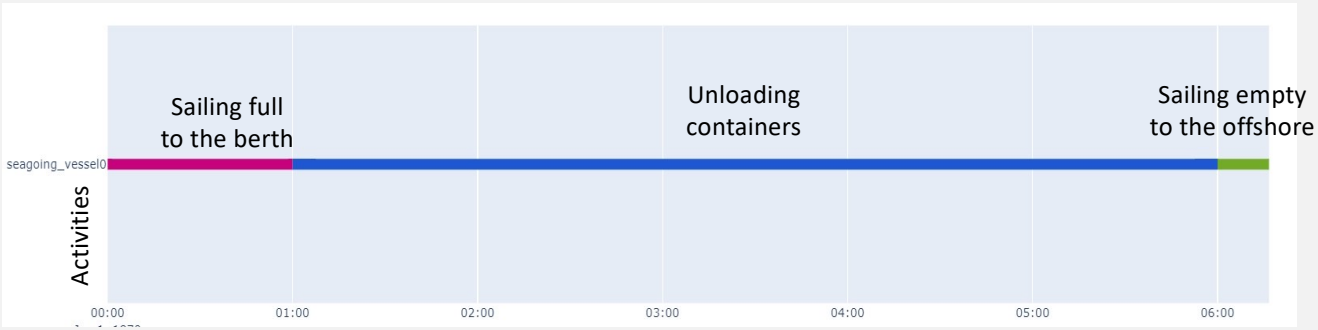
4. Results





Reference: De Boer et al., (2023), Simulating for sustainability: Alternative operating strategies for energy efficiency

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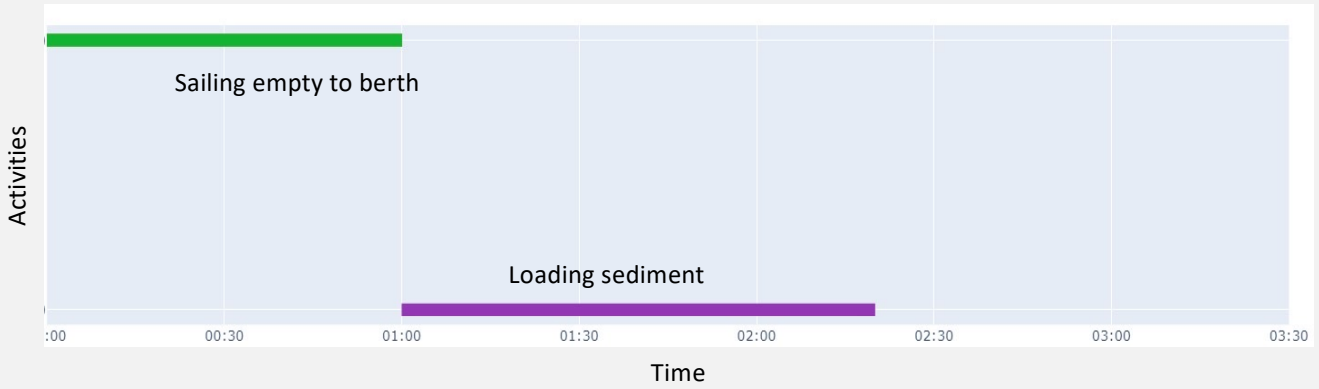
4. Results



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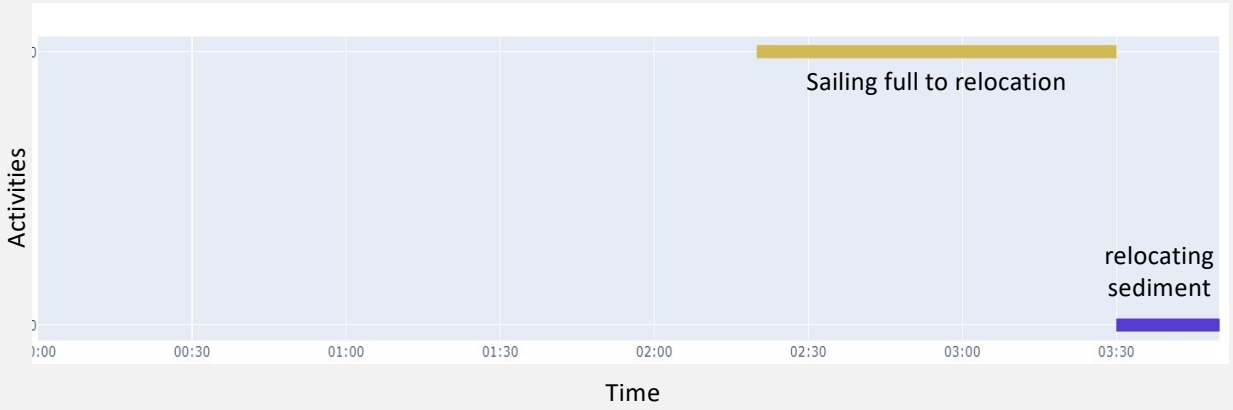
4. Results



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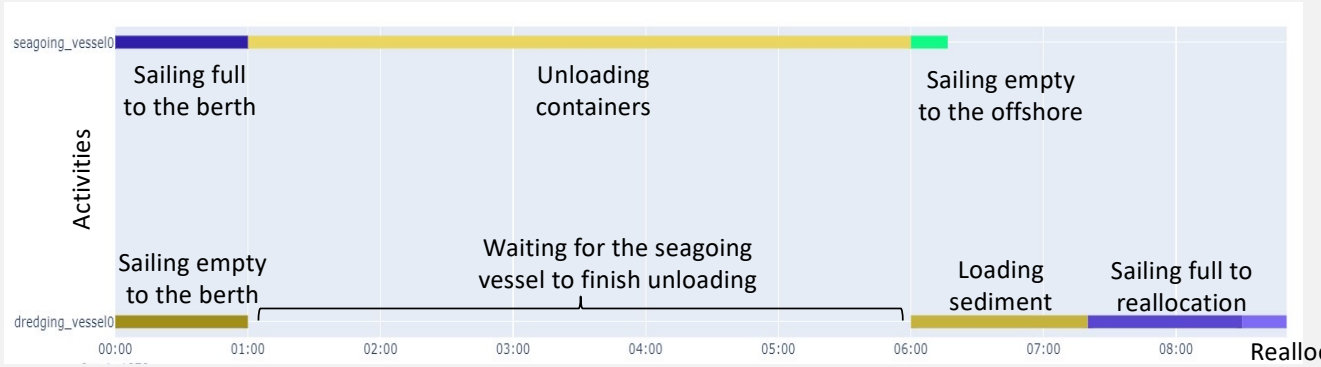

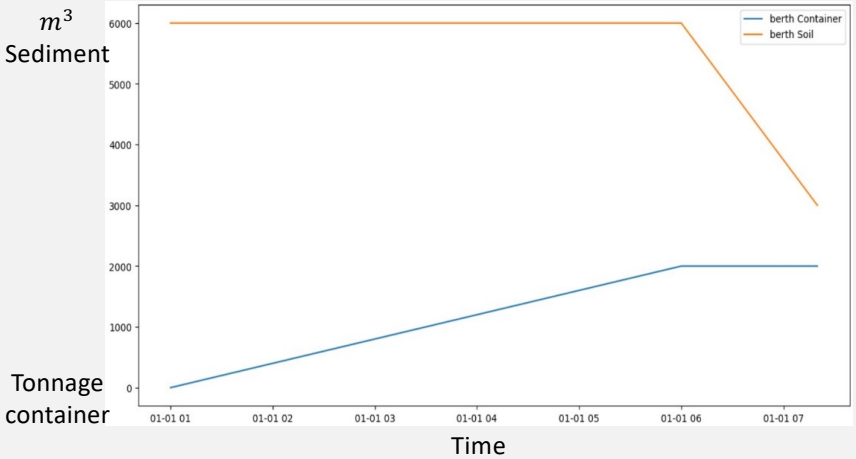

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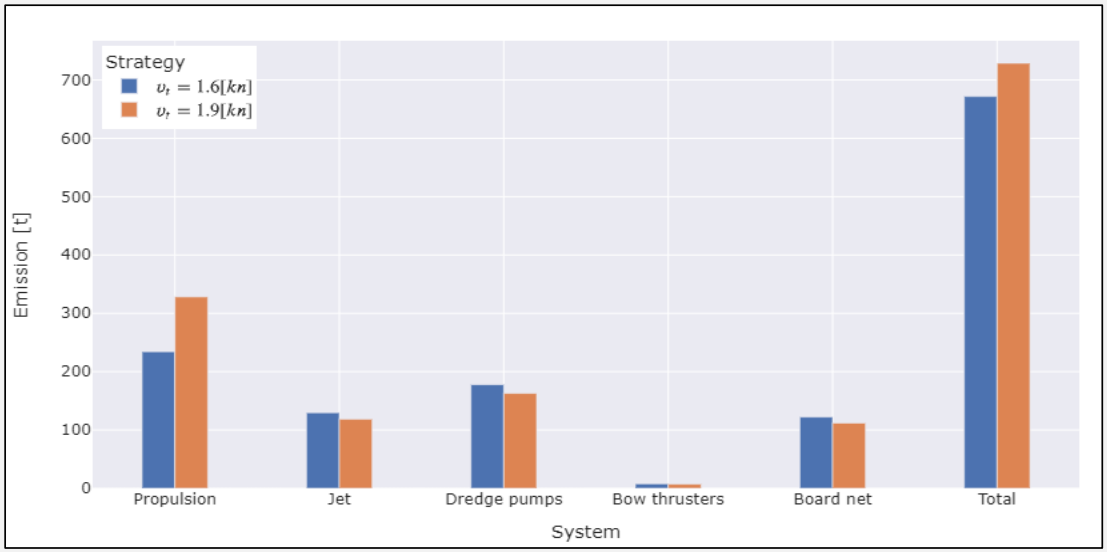
5. Sustainable Port Maintenance

Determining the energy consuming sectors of the vessel

Calculating the energy consumed for different setups (trailing velocity, etc.)

Finding the optimal setup for equipment



Reference: Janssen, D. (2023), Physics-based energy estimation during the loading phase of a TSHD.

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6. Circular Port Maintenance

1. Problem identification	Need for material?
2. Port requirement	Port authorities' purpose?
3. Manage dredged material	Mud, clay, or sand?
4. Dredging company requirement	Equipment?
5. Characteristics of the project	Economic and environmental considerations?
6. Execution	Do the job!

Reference: De Boer et al., (2022), OpenCLSim: discrete event dredging fleet simulation to optimise project costs

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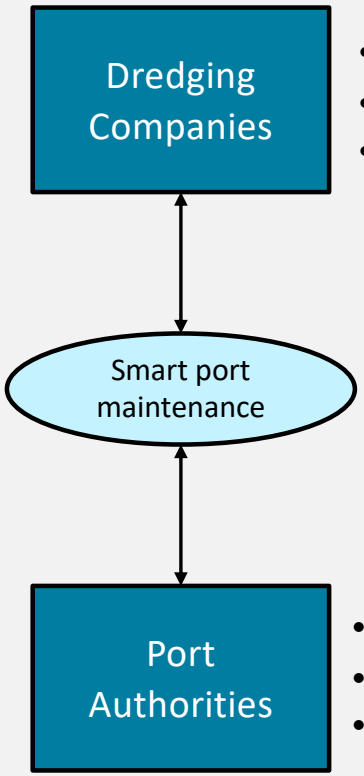
7. Conclusion



- Seagoing and dredging interaction can be formulated.
- Delays of both seagoing and dredging can be minimized.
- Port processes can be optimized during a port call.

OpenCLSim

Port accessibility

- Trade-offs can be identified (cost, emission, etc.).
- Trade-offs can be quantified and used to decide strategies and equipment settings.
- Data sharing with clients integrates the project processes.

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8. The Way Forward

Sustainable port maintenance

- Minimizing turbidity
- Mitigating greenhouse gas emission

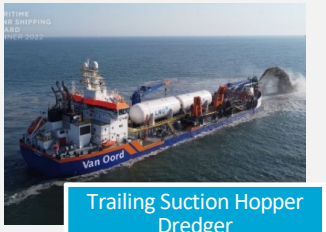
Smart port maintenance

Circular port maintenance

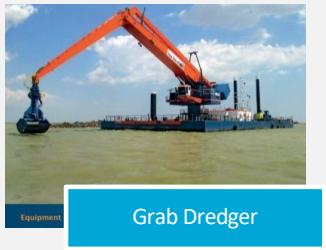
- Beneficial re-use of dredged material

Maintenance Strategies

Sediment Reallocation



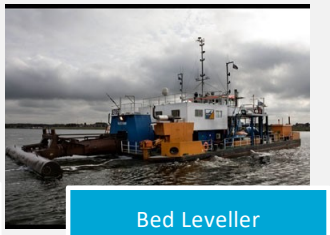
Trailing Suction Hopper Dredger



Grab Dredger

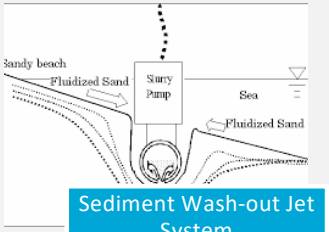
Sediment Remobilization

Water Injection Dredger

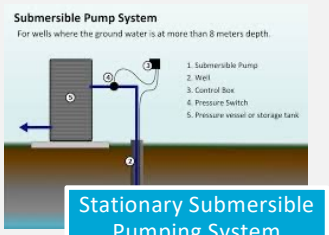


Bed Leveller

Sediment Bypassing

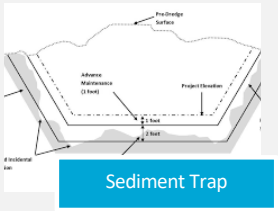


Sediment Wash-out Jet System

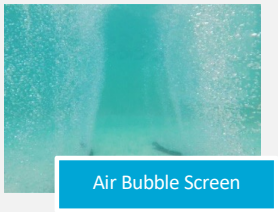


Stationary Submersible Pumping System

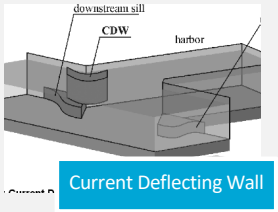
Anti-sedimentation measures



Sediment Trap



Air Bubble Screen



Current Deflecting Wall

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