

# The Green Transition in Maritime logistics: A Systems Analysis of Alternative fuels

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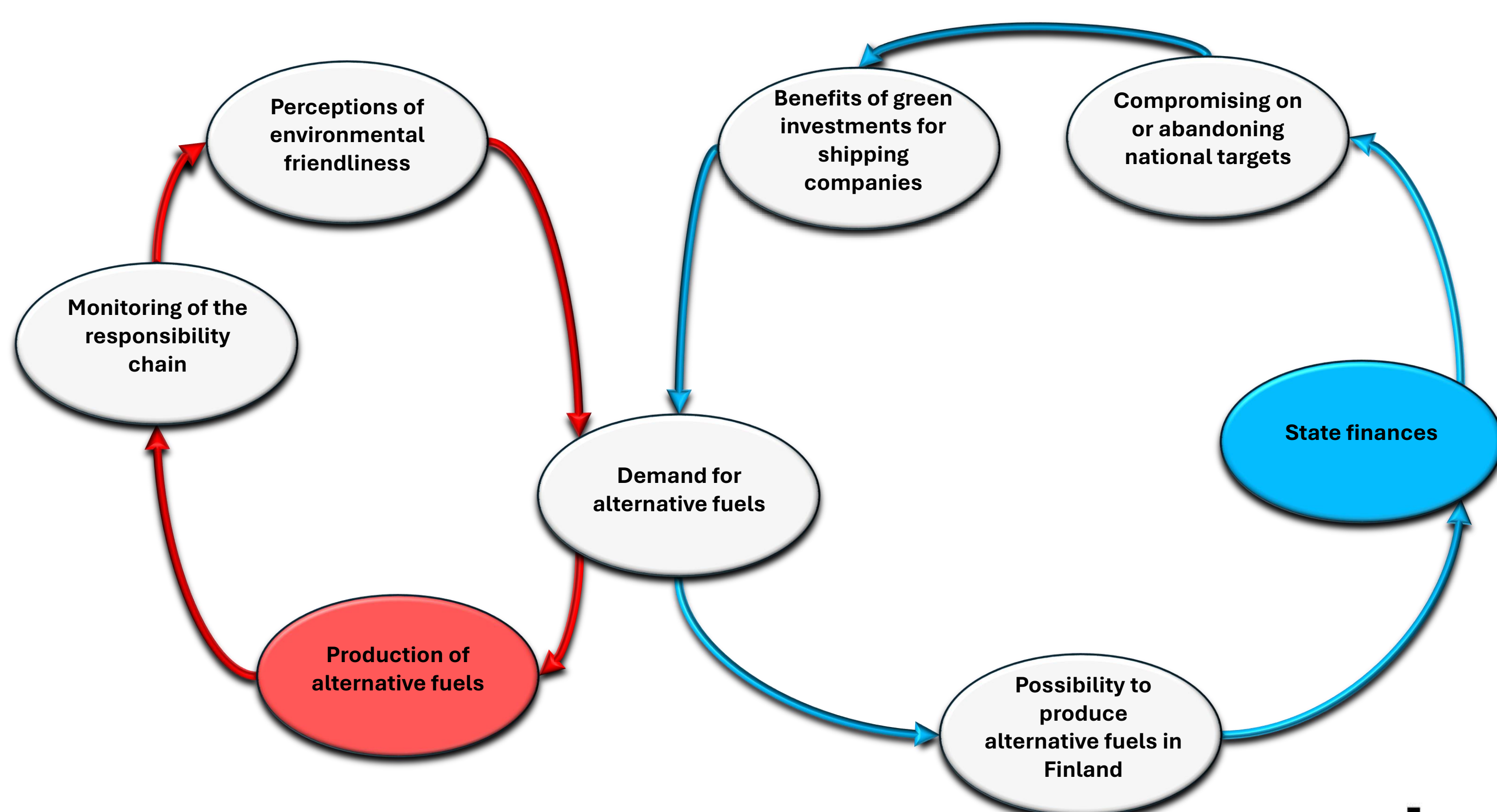
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## Introduction

- The maritime sector needs to decrease greenhouse gas emissions for mitigating climate change
- Technical and operational development can reduce emissions but to meet the goals, new carbon neutral fuels are needed
- The potential risks caused to other sustainability goals must be identified and proactively managed
- We address this by bringing together experts to co-create systems understanding on the production, distribution, and maritime use of two new fuels: methane and ammonia

## Results

- The causal networks drawn based on two workshop discussions show the question is highly complex (128 variables in the ammonia and 126 variables in the methanol network)
- The pre-selected sustainability indicators helped participants to consider different perspectives of sustainability
- The variables functioning as intermediaries in the both networks, have direct connections with each other, creating a sub-system that consists of two interconnected feedback loops
- They can accelerate change, whether positive or negative, or help to stabilize the system
- *Demand for alternative fuels* variable connects both feedback loops



## Research Goals

- To understand the development and systemic interconnections that enable a sustainable green fuel transition in the maritime sector
- To identify potential sustainability drivers or bottlenecks in hydrogen-derived fuel adoption

## Materials and Methods

- Expert workshops
- Causal conceptual mapping
- Network theoretic systems analysis using Gephi software

## Discussion

- Fuel sustainability accounts for the **full life cycle** (well-to-wake) including spatially and temporally extended impacts, risks, and opportunities
- The **same system** in its different states may both enable and inhibit sustainability: create a **virtuous cycle** or a **vicious cycle**
- Understanding and shaping the loops is essential for steering maritime fuel systems toward **long-term sustainability**
- We need to recognize and strengthen the **infrastructures and regulatory frameworks** that reinforce the positive feedback loops
- Creating **virtuous cycles** requires:
  - **Systemic thinking** in decision-making
  - **Collaborative foresight**
  - **Informed public participation**

