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Dynamic Techno - Economical Scenario Simulation Model for Sustainable Waterborne Activities and Transport

D 4.3 Methodology and guidelines for transferability

Document information	
Short description	The Deliverable addresses critical components, including key drivers for the green transition and a detailed methodology for the transfer process including the identification of target groups for transfer.
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Task	Task 4.3: Methodology and guidelines for transferability
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Executive summary

The report provides valuable insights into the process for transferring the NEEDS generic simulation model. The introduction sets the stage for understanding the context and purpose of the document, emphasizing its relevance to impact analysis for different development scenarios in the realm of sustainable waterborne transport. The subsequent sections delve into critical components, including key drivers for the green transition and a detailed methodology for the transfer process including the identification of target groups for transfer.

In essence, this document serves as a guide and reference for stakeholders involved in or impacted by the green transition within the waterborne transport sector, offering strategic insights for the adoption and adaptation of the NEEDS simulation model.

List of abbreviations

BAU	Business As Usual
CAPEX	Capital Expenditures
CO2	Carbon Dioxide
CO2e	CO2 equivalent emissions (also known as CO2eq)
ECA	Emission Control Area
GHG	Greenhouse gases
H2	Hydrogen
HFO	Heavy Fuel Oil
HVO	Hydrotreated Vegetable Oil
ICE	Internal Combustion Engine
LNG	Liquified Natural Gas
LPP	Length between perpendiculars
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MWh	Megawatt hours
NOx	Nitrogen Oxides
OPEX	Operational Expenditures
OPS	Onshore Power Supply
PM	Particulate Matter
RES	Renewable Energy Sources
SO_2	Sulfur Dioxide
SRIA	Strategic Research and Innovation Agenda
TRL	Technology Readiness Level
WTW	Well-to-Wake

1. Introduction

This document pertains to Work Package 4, specifically addressing Task 4.3 under the title "Methodology and guidelines for transferability." The deliverable, D4.3, is a comprehensive exploration of the transferability of the NEEDS simulation model, intended for public dissemination.

The report provides valuable insights into the process for transferring the NEEDS generic simulation model. The introduction sets the stage for understanding the context and purpose of the document, emphasizing its relevance to impact analysis for different development scenarios in the realm of sustainable waterborne transport. The subsequent sections delve into critical components, including key drivers for the green transition and a detailed methodology for the transfer process including the identification of target groups for transfer.

2. Most impactful drivers for the green transition

Based on the identification of barriers, challenges and enablers in task 4.2, the most impactful drivers for the green transition are derived. Table 1 addressed the drivers and describes their potential impact.

Driver	**Description**
Economic Incentives	Fuel Costs and Efficiency: Rising fuel costs in combination with carbon pricing (like ETS or direct carbon pricing) and the potential for fuel efficiency gains drive the adoption of technologies that reduce fuel consumption and emissions. Thereby, the Total Cost of Ownership (TCO) needs to be considered, which refers to the comprehensive evaluation of all costs associated with owning, operating, and maintaining a particular asset or investment throughout its entire lifecycle. TCO goes beyond the initial purchase price and includes various direct and indirect costs incurred over the asset's useful life. Key components of Total Cost of Ownership may include: 1. Purchase Cost: The initial cost of acquiring the asset or investment. 2. Operating Costs: These encompass the ongoing expenses related to the regular use and operation of the asset, such as fuel, energy consumption, maintenance, repairs, and consumables. 3. Maintenance Costs: The expenses associated with routine upkeep, repairs, and necessary replacements to ensure the asset's continued functionality and longevity. 4. Depreciation: The reduction in the asset's value over time, accounting for wear and tear, and impacting its resale or salvage value. 5. Insurance: The cost of insuring the asset against potential risks or damages. 6. Financing Costs: If the acquisition involves borrowing money, interest payments and financing charges are included in the TCO. 7. Downtime Costs: Expenses incurred during periods when the asset is not operational, including potential losses in productivity or revenue. 8. Training and Implementation Costs: Expenses related to training personnel or implementing new technologies associated with the asset. 9. End-of-Life Disposal Costs: Costs related to the removal, disposal, or recycling of the asset at the end of its useful life. 10. Resale or Salvage Value: The expected value of the asset when it is sold or salvaged at the end of its lifecycle. By considering all these elements, TCO provides a more accurate and comprehensive understanding of the economic impact of an investment or asset, helping businesses and individuals make

	informed decisions based on the total cost implications rather than just the initial purchase price.
Proven matureness of technology	New technologies have the challenge to prove their reliability in day-to day operation. Especially in the early adopter phase, oftentimes there are lesson learned to further improve and make the product/service more attractive to other potential users. In this context, operational experience is especially important in the maritime industry, where assets are used in rough environments and a high safety needs.
Availability of alternative energy	The reliable availability of alternative energy carriers at expected price levels is a key factor in the greening transition. In addition, there should be a number of suppliers available to decrease the dependency on one business -relationship and therewith achieve reliable and cost-effective access to energy.
Political measures	Political measures can act in both ways: The fit for 55-package by the EU is an impactful driver for the green transition. On the other hand, an outdated tax system, which is putting an extra-tax on a fuel as soon as it is used as a fuel for shipping is hindering the transition. In both ways: Political measures can have a remarkable impact on the transition.
Public and Stakeholder Pressure:	Corporate Social Responsibility (CSR) increased awareness and concern for environmental issues, including climate change, have led to pressure on companies to adopt sustainable and environmentally friendly practices. Market demand: The market demand for transport services is affecting the green transition as well. More and more companies demanding transport services are pushed by end-consumers, who are requesting a low environmental impact and are willing to pay a premium. Investor Demands: Investors increasingly consider environmental, social, and governance (ESG) factors in their investment decisions, influencing companies to adopt greener practices (see also the driver financing).
Regulatory Pressures	Rules and regulations can affect the green transition in both ways. A non-existing regulation for a certain fuel type is a barrier, while a clear and easy to implement regulation might boost the decision for a certain energy type. Regulations set by the EU and the IMO, such as the fit for 55 package or the International Maritime Organization's Initial IMO Strategy on the reduction of GHG emissions from ships or the Emission Trading

	Schemes (ETS), which provides motivation for the shipping industry to reduce emissions and therewith push for the adoption of cleaner technologies and the reduction of greenhouse gas (GHG) emissions.
Financing	Ships are long-term assets. Financing institutions need to assure, that the asset to be financed is keeping its value throughout the financing time. When it is unclear, if the vessel keeps the value and there si the risk of a stranded asset, the risk margin will rise and may hinder the attractiveness of a certain solution.

Table 1: Most impactful drivers for the green transition

3. Methodology to transfer the approach

3.1 Transfer methodology

The NEEDS simulation models offer a many benefits in order to assess different scenario for potential pathways towards zero-emission waterborne transport, as described ion D.1.2 and demonstrated in both regional models. The generic NEEDS model can be transferred and specified to other regions with the following approach:

The starting point is the creation of a configurations settings file. The information in this file contains the following specification for the new region:

- **Region**: Name the region for the simulation with a clear and distinct expression, What are the ports and shipping routes in the region? What vessel type is shipping on which route? These open questions need to be defined in a very first step.

- **Start time:** The time horizon of the simulation is determined by the start time.

- **Fleet composition:** What vessel types are navigating the in the to be simulated region? For each vessel type a number of basic characteristics needs to be determined, like total installed power, the energy source for the vessel, the operational profile and more.

- **Fuel types in simulation:** It is necessary to define the fuel types, the model shall consider. Thereby a wide selection of conventional and alternative fuels are available in the energy carrier database, which is part of the overall NEEDS simulation model framework.

- **Power system selection logic:** Shall the simulation consider the selection of the best power system, based on the total cost of ownership or not?

- **Early adopter increase**: Shall the simulation model consider early adopters in the market uptake of alternative fuels? It is a binary decision (Yes/No)

- **Selection size for power system selection logic:** How shall the simulation model consider the power system selection?

- **Retain transport capacity**: Shall the model add or delete ships to keep transport capacity constant? It is a binary decision (Yes/No)

- **Innovation level:** Do you want to apply different alternative price scenarios for the energy carrier?

- **Pathway file**: Shall there be a reference to a file that contains multiple scenarios?

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For the creation of the configurations settings file and access to the simulation model the support of MARIN is necessary. MARIN is offering the creation of a user-group, in which interested parties can join to tailor the simulation model to the region of their interest. At the same time, the user group members would have to pay an annual fee to enable the further development of the generic simulation model. More details on the user-group plans can be found in the plan for exploitation and dissemination of results (Deliverable 5.6).

So far, additional region has been added to the NEEDS simulation framework, so there si no best practice or guidelines for transferability established yet.

3.2 Target groups for a potential transfer

The NEEDS simulation model has been presented in several conferences and the NEEDS public workshop. Thereby, a number of interested stakeholders showed interest into the model. Based on the experience and taking into account the benefits the simulation results have to offer, the following target groups are identified:

- Shipping companies
- Port authorities
- Energy producer and supplier
- Associations (Shipbuilding, Shipping, Maritime equipment)
- Research institutes
- Authorities and political bodies

4. Conclusion

In wrapping up the findings of this report, the focus has been on developing a comprehensive methodology and guidelines for the transferability of the NEEDS simulation model. Highlighting the most impactful drivers for the green transition, the report identifies crucial factors such as the Total Cost of Ownership (TCO), proven matureness of technology, availability of alternative energy, political measures, market demand, rules and regulations, and financing. These drivers play pivotal roles in steering the transition toward environmentally sustainable waterborne transport.
The heart of the document lies in detailing the methodology for transferring the NEEDS simulation model to different regions. The creation of a configuration settings file serves as the starting point, encompassing key specifications like region name, ports, shipping routes, vessel types, start time, fleet composition, fuel types, power system selection logic, early adopter considerations, and more. Collaboration with MARIN is proposed for tailored adjustments and user-group participation.
Identified target groups for potential transfer encompass shipping companies, port authorities, energy producers and suppliers, associations related to shipbuilding, shipping, and maritime equipment, research institutes, and policymakers. The wide-ranging applicability of the simulation model positions it as a valuable tool for diverse stakeholders seeking insights into sustainable waterborne transport scenarios.

In conclusion, this deliverable lays the groundwork for transferring the NEEDS simulation model, providing a strategic approach and engaging stakeholders across the maritime industry. As the transition toward green and sustainable waterborne transport gains momentum, the outlined methodology and guidelines contribute to the broader goal of achieving climate-conscious and economically viable solutions.