PLATINA3
IWT policy platform
- FLEET -

Report on implementation of European IWT emission label / energy index / GLEC for vessels D2.6

Grant Agreement No.	101006364
Start date of Project	01-01-2021
Duration of the Project	30 months
Deliverable Leader	SPB
Dissemination level	Public
Status	Final
Submission Date	28-02-2022
Author	Martin Quispel, SPB, m.quispel@eicb.nl
Co-author(s)	Khalid Tachi, SPB, k.tachi@eicb.nl Laure Roux, CCNR, L.Roux@ccr-zkr.org

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006364. The opinions expressed in this document reflect only the author's view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Version

Version #	Date	Authors	Organisation
0.1	8 July 2021	Martin Quispel	SPB
0.2	15 July 2021	Martin Quispel	SPB
0.3	1 September 2021	CCNR (incl delegations)	CCNR
0.4	21 September 2021	Martin Quispel comments processed IWT Platform and CCNR	SPB
0.5	27 December 2021	Martin Quispel, Khalid Tachi, Niels Kreukniet	SPB
0.6	13 January 2022	Martin Quispel, Khalid Tachi, Laure Roux	SPB, CCNR
0.7	20 January 2022	Martin Quispel, Khalid Tachi, Laure Roux, Manfred Seitz	SPB, CCNR, DC
0.8	24 January 2022	Martin Quispel, Khalid Tachi, Laure Roux, Andreas Kortenhaus	SPB, CCNR, ESC
0.99	14 February 2022	Martin Quispel, Khalid Tachi, Laure Roux	SPB, CCNR
1.0	28 February 2022	Martin Quispel	SPB
Final	7-12-2022		CINEA

Release Approval

Name	Role	Date
Khalid Tachi	Task 2.6 leader	14-02-2022
Martin Quispel	Project Coordinator, WP 2 leader	28-02-2022

Table of Contents

List of Figures

List of Tables

Executive Summary

The Horizon 2020 PLATINA3 (https://platina3.eu) provides a platform for the implementation of a future inland navigation action programme. PLATINA3 is structured around four fields (Market, Fleet, Jobs & Skills, Infrastructure) of which work package 2 (WP 2) deals with various aspects of the fleet such as 1) zero-emission fleet; 2) climate resilient fleet; 3) digital and automated vessels; 4) technical regulations and standards for the fleet and fuels; and 5) accurate fleet data.

Task 2.6 deals with one of the aspects of WP 2 which is the coordination and standardisation for emission label / energy index for vessels on EU level as instrument for the zero-emission pathway for the fleet and facilitating stakeholder engagement. This report summarises and presents the conclusions from Task 2.6.

The specific objectives of the Task 2.6 of WP2 Fleet of PLATINA3 are:

- *To assess and where appropriate coordinate the scheme of a vessel index/label system and support the implementation.*
- *To elaborate the technological/methodological basis as the function of a label.*
- *To thus realise an instrument to enable a differentiated incentive scheme to get shipowners to invest in powertrain solutions for the zero-emission pathway.*
- *To assess the link with GHG calculations in logistics (grams per tkm).*

Therefore, the scope of the task includes freight vessels, passenger vessels, and also floating equipment (e.g. dredging, construction vessels). In addition, specifically for goods transport, also the link to GHG calculations in logistics chain is included. Moreover, as requested by the European Commission DG MOVE, specific attention is paid to the technical screening criteria of Taxonomy. The task report can also serve as basis for the EU energy index methodology needed for monitoring and reporting carbon intensity of inland waterway vessels as announced in NAIADES III.

A label or index instrument addresses the issues such as the lack of an **unambiguous methodology and criteria,** the lack of sufficient **data on the emission performance of inland vessels**, the lack of **visibility of green inland vessels** meeting the latest emission standards or better in view of their marketing to clients, and the lack of **recognition** of retrofit solutions meeting the same or better emission performance compared to new engines.

Several types of possible end-users for the proposed label or index instrument can be distinguished. These are policy makers on EU, Member State, regional and municipality level, ports and waterway managers, shippers / clients using inland vessels, vessel owners, financial institutions, technology/energy suppliers and shipbuilding industry, and the inland navigation sector as a whole. These end-users have been identified, together with their specific interests.

Task 2.6 and this report aims amongst other objectives at designing a label/index instrument to provide support and positive incentives to vessel owners in the steps to make towards achieving lower energy consumption and emissions. This is further discussed in Chapter 4.2 of this report.

As a starting point, a variety of existing schemes, concepts and initiatives in the field were systematically described. The analyses and mapping of these schemes and initiatives inspired the development of possible methodologies for a label or index system for different objectives in the field of reducing climate and air pollutant emissions and to increase energy efficiency.

Five different 'levels' were identified and further described in Chapter 3 in order to define a methodology for expressing the energy and environmental performance of vessels and services:

A. Powertrain only (propulsion of the vessel)

B. All primary energy convertors on board (for propulsion power, heating, cooling, auxiliary propulsion, pumping, on board facilities, etc.)

C. Vessel performance including hydrodynamics for certain operating conditions

D. Service performance including speed, utilisation, empty sailing

E. Multimodal door-to-door service including also pre-/end haulage and transhipment

A Multi Criteria Analysis (MCA) was performed (Chapter 4) for a detailed assessment of these levels which concluded that levels A and E are not relevant at this stage. Therefore, a more detailed assessment and further elaborations focussed on Level B, Level C, and Level D.

It is also important to note at this stage that this report presents the conclusions of research work presenting options and considerations for policy makers. The recommendations presented in this report need to be discussed with and between relevant actors who will play a role in the design and implementation of a label/energy index.

Since the primary focus of Task 2.6 is the development of a European instrument to incentivise and support investments by vessel owners in clean powertrain solutions and use of renewable/clean fuels with low or zero carbon intensity, the following key conclusions were derived:

- **the concept of a label or index for several types of targets, users and applications can be seen as an interlinked, layered and modular development;**
- In order to evaluate the **WTW performance of GHG emissions** for fuel / energy types, several approaches exist. It can be **a choice in the methodology for the user to select which type of WTW approach is to be taken into account using different WTT datasets in the calculation scheme**.
- **Level B can be implemented on short term in the whole of Europe** and presents the air pollutant and climate emission performance for the energy used by the vessel, a weighted average. This concerns the powertrain of the vessel as well as other energy converters. **It is important for the level playing field and acceptance to cover all of Europe and all vessel types and type of services**. Level B methodology can be used for the emission and energy performance energy convertors and to differentiate between comparable vessel classes and operating profiles.
- **Level B can be seen as a first important basic module of the instrument**, as much data is already available or can be made available with limited effort and costs. Subsequently, additional data modules can be added, for example to express the environmental performance against the service performance of the vessel (level D) and to add the EEDI profile of the vessel (level C).
- **Level C** provides **specific information on the energy efficiency of the hydrodynamic characteristics** and the energy efficiency of the propulsion power. Level C therefore enables to achieve objectives which cannot be achieved with level B. However, before this module can be applied in practice, it needs further research work which is planned to be completed in the course of the year 2023.
- **Level D presents the overall performance of a service** carried out by a freight vessel. It thus **includes a wide range of factors** related to the vessel, for example the operational and logistic requirements as well as the human skills of the crew. It is therefore **not focussed or limited to the static characteristics of the vessel itself.** It reflects in particular the operational elements

affecting into large extent the energy demand for the transport performance. This level enables achievement of objectives which cannot be achieved with levels B or C, such as enabling a comparison with other modes and carbon footprint calculations for transport services.

Levels B, C, and D are complementary and create synergies and can service different objectives. It is therefore a matter of selecting the most appropriate level for the objective, which is to be achieved. A goal could be for instance that level B and C are combined when it comes to the design of the vessel, and that levels B and D are combined when it comes to the operation of the vessel and monitoring of the fleet performance. It would be good to have level B for every vessel, level C to be applied for each newly build vessel and level D at a more aggregated level for a differentiated monitoring of vessel types, cargo types and type of waterways.

Further conclusions, opportunities for the expansion of the methodologies, potential barriers, and mergers of the levels are discussed in Chapters 4 and 5 of this report. These conclusions and further discussions have led to the following key recommendations:

- **The objective of the instrument and the first main users and applications** need to be discussed. This will allow the appropriate methodology to be selected and the indicators to be used, followed by setting reference values or threshold values for labelling/indexing.

- Discussions with all stakeholders should take place to see whether there is an **interest for a European label/index instrument** based on methodology for Level B as basis for stakeholders to provide incentives. The indicators provided by Level B can drive the discussion with possible users on the more specific objectives, applications and incentives which can be provided based on the indicators.

- **If stakeholders support this approach, Level B can be implemented on short term in Europe and can be applied for all vessels.** This may also be a politically driven decision to require through legislation a label/energy index according to the different levels.

- **Level B can also be used as a first step for an instrument as announced by NAIADES III for the EU energy index methodology** which is mentioned in NAIADES III for the purpose of monitoring and reporting carbon intensity of inland waterway vessels. This can be done by means of the methodology as Level B takes into account the type of energy/fuel used and the share of renewable energy on the basis of an individual vessel, expressing it in **grams CO_2 equivalent per kWh (WTW)**. In a second step, Level B can be combined with **Level C to express emissions in grams per tkm / pkm**, wherever possible and useful as soon as the work on $EEDI_{inland}$ is completed. If the goal is to monitor the fleet at a more aggregated level, the operational performance of the vessel ($EEOI_{inland}$) can be used as well, for example for the monitoring and reporting about the yearly average for the fleet, with differentiation to segments.

- **Different options for the WTW GHG emissions can be offered in a European labelling/indexing instrument** based on the same set of core data. Offering different well-to-tank datasets, allows **flexibility** for the short term towards the different preferences from users /incentive providers. It thus also enables a possible link and may serve as **reference applications on EU level** such as use of the methodology for Taxonomy technical screening criteria in view of state-aid-support, EU grants and loan instruments and the setting of targets to be achieved. On long term it is desired to develop **one unambiguous dataset** for well-to- wake GHG values.

Further recommendations are also provided considering the Taxonomy aspect (Chapter 5). It became also clear from the analysis of barriers that further work towards a **more sophisticated label/index** is recommended. A **more specific and detailed methodology**, using **continuously measured emissions**, both for cargo (for instance expressed in g/tkm for specific market segments and origin-destinations) and passenger vessels (for instance expressed in g/pkm) are main elements in the specific recommendations.

In view of **$EEDI_{inland}$ and $EEOI_{inland}$,** more research is required for validation and the evaluation of a possible need of extension of conditions, type of waterways as well as vessel types in view of EU representativeness. In particular for Level D, setting-up a neutral and trusted **intermediary organisation** should be considered, possibly together with Smart Freight Centre, for **data collection and developing KPIs and their values for a matrix of different sub-segments** (type of vessel, type of cargo, type of waterway / operating area) to take into account the specific conditions and circumstances in which the vessels operate. Specific attention is recommended to creating **synergies with ongoing and growing digitalisation** and **data collection and exchange** in the field of inland waterway transport operations and communications.

Summary

Introduction

This report made in the framework of the Horizon 2020 PLATINA3 project presents the conclusions from Task 2.6. This task focusses on defining methodological approaches for a labelling and/or indexing the energy and emission performance of inland vessels.

The specific objectives of the Task 2.6 of WP2 Fleet of PLATINA3 are:

- *To assess and where appropriate coordinate the scheme of a vessel index/label system and support the implementation.*
- *To elaborate the technological/methodological basis as the function of a label.*
- *To thus realise an instrument to enable a differentiated incentive scheme to get shipowners to invest in powertrain solutions for the zero-emission pathway.*
- *To assess the link with GHG calculations in logistics (grams per tkm).*

In addition, to achieve the emission reduction objectives set at international, European, regional and national levels, the emissions generated by the entire inland waterway fleet should be tackled. The methodological approaches developed therefore include as part of their scope freight vessels, passenger vessels and floating equipment (e.g. dredging, construction vessels). Some methodological approaches are not applicable to floating equipment. In addition, specifically for goods transport which means freight vessels, the link to GHG calculations in logistics chain in terms of grams per tkm is also addressed. Moreover, as requested by the European Commission (DG MOVE), specific attention is paid to the technical screening criteria of Taxonomy. The task report can also serve as basis for the EU energy index methodology needed for monitoring and reporting carbon intensity of inland waterway vessels as announced in NAIADES III.

Rationale – which bottlenecks and problems to address?

The bottlenecks and problems which can be addressed by a label or index instrument are the following:

- Lack of an **unambiguous methodology and criteria**
  - which can be used by IWT **clients for contracting**
  - which can be used by governments, banks and ports for **providing incentives to vessel owners** such as grants, (soft) loans and guarantees, tax reductions, reduction of port dues, etc.
  - which can be used by policy makers to implement policies **encouraging the use of low/zero emission vessels**
- Lack of sufficient **data on the emission performance of inland vessels**[1], resulting in lack of convincing evidence of energy consumption and emissions by inland waterway vessels compared to other modes, reducing the economic potential and the **political support of modal shift**
- Lack of **visibility of "green" inland vessels** meeting the latest emission standards or better in view of their marketing to clients
- Lack of **recognition** of retrofit solutions meeting the same or better emission performance compared to new engines

[1] Data regarding the emission performance of the total fleet is indeed generally available (macro level), but not necessarily at the level of individual vessel (micro level).

What are possible users and applications of a label/index instrument?

The methodology for a label and/or index is the basis for applications and incentives. A wide range of different users can apply the methodology in order to reach different objectives. Identifying the key indicators and the instrument which are the most suitable and relevant therefore depends on the users and their own objectives. Several types of possible users can be distinguished The following list gives an indicative overview of such users and how they could use such a label/index instrument:

- Policy makers on EU, Member State, regional and municipality level:
  - Facilitate the elaboration and implementation of public financial support systems
  - Monitor and assess the progress on energy transition and zero-emission pathway
  - To implement policy encouraging the use of low/zero emission vessels
  - Statistical and modelling purposes
  - Assist in the creation of a possible European funding and financing scheme: contribution European financial instrument (reference to Task 2.5 PLATINA3)

- Ports and waterway managers:
  - Benefit from harmonised criteria in order to differentiate port dues
  - To define priority or access rules based on the label/index system for vessels.

- Shippers / clients using inland vessels:
  - To allow a conscious choice of an ecological means of transport
  - To encourage shippers/clients to prioritise contracting environmentally friendly vessels

- Vessel owners:
  - Accepted proof of environmental performance, notably recognition for retrofit solutions
  - Marketing of the favourable energy and emission footprint to clients
  - Having a sound basis for: requesting grants and attractive loan conditions, reduction of port dues and getting higher priority, support in investment decisions,
  - Reference tool to use for corporate social responsibility/CSR balance sheet

- Financial institutions:
  - To provide guidance as to the financing, e.g. link with the Taxonomy screening criteria.

- Technology/energy suppliers and shipbuilding industry:
  - Having common targets for vessels for energy and emission performance for R&D work
  - Promote/market more easily products which are environmentally friendly and energy efficient

- For the inland navigation sector as a whole:
  - Compare IWT favourable environmental performance with other transport modes, in view of promoting modal share of IWT

As regards the question if a label/index system shall be mandatory or can be voluntary, the answer to this question depends on the type of user, the objective and the incentives which are linked to the system. It can be stated that if the benefits, associated with the use of a label/index bring, are sufficiently convincing for vessel owner/operators, the level of participation will be high and mandatory use of index/label system may not be needed anymore.

What are most relevant available schemes and initiatives?

As a starting point, the task took stock of the variety of schemes, concepts and initiatives in this field and described them in a systematic manner. Most relevant ones are:

- Emission Performance Label for inland vessels
- Energy Efficiency Design Index for inland navigation ($EEDI_{inland}$)
- Energy Efficiency Operational Index for inland navigation ($EEOI_{inland}$)
- GLEC Framework / ISO standard for carbon footprint calculations in Business to Business applications
- EU Taxonomy Delegated Act concerning climate mitigation
- Green Award label

The analyses and mapping of existing schemes and initiatives, inspired the development of possible methodologies for a label or index system. Such methodologies aim at achieving different specific objectives in the field of reducing climate and air pollutant emissions and to increase energy efficiency. The methodologies developed in this deliverable can be seen as complementary and enable a modular approach.

Which approach was used to develop the different methodologies underlying a label/index instrument?

As a next step, different levels were identified in order to define a methodology for expressing the energy and environmental performance of vessels and services:

A. Powertrain only (propulsion of the vessel)

B. All primary energy convertors on board (for propulsion power, heating, cooling, auxiliary propulsion, pumping, on board facilities, etc.)

C. Vessel performance including hydrodynamics for certain operating conditions

D. Service performance including speed, utilisation, empty sailing

E. Multimodal door-to-door service including also pre-/end haulage and transhipment

These levels were described in a systematic way and subsequently assessed on the basis of multiple criteria. In the Multi Criteria Analysis (MCA) a first conclusion was that level A and E were not that relevant at this stage. Level A does not present a complete picture of the emission profile of a vessel and Level E is directly using the result of Level D, while other elements (transhipment, pre/end haulage) are out-of-scope for IWT. Level E requires a lot of input data (similar to Level D) and would also benefit from further steps to be made to increase the data quality in Level D. Therefore, the more detailed assessments and elaborations focussed on Level B, Level C and Level D and it was decided to exclude levels A and E from this more detailed assessment.

	Level B: All energy convertors on board	Level C. Vessel performance including hydrodynamics	Level D. Service performance including speed, utilisation, degree of load.
Definition	Identify the environmental performance of all energy convertors on board of the vessel	Identify the efficiency of the vessel design. Expresses the CO_2 performance of the power train (only) and the hydrodynamics from a Tank to Wake viewpoint at different draughts and sailing speeds for different types of waterways.	Identify the operational efficiency of a freight transport service. It measures and presents the value of the CO_2 equivalent emission in grams per tkm for a service. The value is used to calculate the carbon footprint of provided services.
Objective which can be achieved with this level	- To make a differentiation in the fleet by means of identifying the energy and emission performance of all power convertors on board as well as the GHG emissions of the fuel (WTW) - Providing a basis to incentivise vessels based on the emission performance and the efficiency of all energy convertors on board, in combination with the type energy/fuel.	- To evaluate the energy efficiency and CO_2 emission of inland waterway vessels with regards to how they are designed/built, and are expected to performance under different circumstances. - to presents the energy efficiency and CO_2 emission performance based on "modelled" sailing conditions (taking into account the specific waterway and vessel type), to optimise in particular the hull and propellor design for the expected operating profile and area.	- To identify the operational Green House Gas emissions of inland waterway vessels in view of carbon footprint calculations in logistics and to benchmark the value with other modes. This is relevant for Corporate Social Responsibility Reporting, where companies with a public interest are in scope of the Non-Financial Reporting Directive. - Monitoring of the operational GHG emission performance of the fleet, differentiated to specific market segments
Is this level already applied	Yes, vessel label can be requested at SAB in The Netherlands[2]	Yes, mainly for new built vessels in the Rhine area, including also model tests at different water levels	Yes, in Business to Business applications for carbon footprint calculations according to the GLEC framework[3].
Information required	- Emission profile of each energy convertor according to ISO 8178: for air pollutant emissions (NOx, PM, …) and for Greenhouse gas emissions (CO_2, CH_4, N_2O,..) - Specific energy/fuel quantity and specification, including the WTW GHG profile of the energy/fuel - Number of running hours for each energy convertor - Maximum power output of each energy convertor	- Vessel design data - Outcomes (power demand versus speed) of e.g. CFD computations, model tests or generic power estimation methods, depending on the requested accuracy and complexity of the design, for different water depths, floating conditions and sailing speeds. - Operating conditions, operational profile - Waterway conditions (depth, flow velocity)	GLEC: preferably primary data from the operators is used, reflecting the average performance for a representative period. If not available, modelled data can be used or default data from literature, but needs to be typical for the vessel and its operational characteristics, including cargo type, type of waterway etc. $EEOI_{(inland)}$ uses only primary data from operator: - Fuel consumption for each specific journey - Tons transported and kilometres travelled on specific journey - Fuel consumption to be divided by tkm (or pkm)

[2] https://binnenvaartemissielabel.nl/nl/
[3] https://www.smartfreightcentre.org/en/how-to-implement-items/what-is-glec-framework/58/

			performance for each specific journey.
Indicator used	- Efficiency of the energy convertors: weighted average of the energy efficiency (e.g. MJ energy input per kWh output) - Emission levels per power input or power output for both the air pollutant and the greenhouse gas emissions (gram per kWh)	Grams CO_2 emission per tkm (TTW) including the performance at different speeds, type of waterways and draught conditions.	Gram CO_2 per tkm or pkm is currently used, either based on WTW (GLEC) or the TTW ($EEOI_{inland}$). This is currently limited to transportation of goods and passengers. Different types of goods are distinguished (e.g. light weight, medium and heavy cargo)
Reliability / accuracy	Real world performance of energy convertors as regards to air pollutant emissions may differ as result of load rates of the energy convertor (engine) which can deviate from the official weight average calculation according to the ISO 8178 measurement protocol.	The real world performance could be quite different compared to those intended/modelized during the design phase as operating areas and waterway conditions as well as payloads can differ from the assumptions made for the EEDI calculation.	The indicator can vary strongly depending of the service condition requested to perform (load type, load rate, share of empty trips, speeds and requested estimated time of arrival, waterway type, water levels (free flowing rivers), etc. …)
Pro's and cons	- The indicator "grams emissions per kWh" is clear and commonly used and agreed as main indicator for the air pollutant emissions and also for CO_2. - The specific fuel consumption data is available from the engine providers. Also, on board measurement is possible of fuel consumption and emissions to air. - Applicable for all type of inland vessels and for all geographic operating areas and type of waterways. - For the greenhouse gas emissions / carbon intensity it is needed to include also the upstream emission (well-to-tank). - Does not include in scope the hull, powertrain and operational / logistic efficiency elements - It does not allow to address the effect of	- Models for EEDI not available for all EU waterways and neither for all vessels (yet), mainly suitable for new to built vessels which still have options to optimise hull shape and propellor. - Optimised design (EEDI) for predefined operational profile. - Calculated result may differ from real life dynamic conditions. - Limited to the powertrain, no other energy consumers on board are considered in the calculation. - Assuming a theoretic average deadweight in tons for freight transport while for passenger vessels, displacement mass instead of deadweight is used. - Not included: upstream CO2 emissions (well to tank) and other Greenhouse gas emissions such as methane slip (CH_4) and N_2O. also air pollutant emissions such as NOx and PM - Not applicable to Floating equipment	- Allows comparison with other modes and multimodal chains, demonstrating the energy and GHG efficiency of IWT - Allows clients to include carbon footprint emissions from IWT in overall CSR reporting. - GLEC methodology can be further improved, in particular the use of reliable and verifiable empirical data as well as further development of the quality and level of detail for the default values for IWT vessels and types of waterways and cargo. - The currently used and applied indicator is focussed on transportation of goods and greenhouse gas emissions only. - Indicator pkm could be used for passenger vessels, but is probably less suitable for cruise vessels. - Floating equipment seems not to fit in level D. - $EEOI_{inland}$: For the specific purpose of detailed benchmarking between vessels CO_2 per tkm

	right sizing (installed power on board) to reduce energy consumption and emissions.		requires a huge amount of data to be continuously monitored. - Specific data on the vessel operation is often seen as confidential and commercially sensitive which may be a barrier for sharing data. - Detailed $EEOI_{inland}$ data analyses and benchmarking the $EEOI_{inland}$ values of vessels by waterway sections can reveal infrastructure bottlenecks on the inland waterways.

Conclusions

The first thing to note for the conclusions of the work is that the methodology to be selected by stakeholders depends on the objective, the type of user and envisaged applications and incentives.

Considering the specific main objectives of the Task 2.6, which is oriented on vessel characteristics and targets the change of behaviour of vessel owners, this first focus of the conclusions is the development of a European instrument to incentivise and support investments by vessel owners in clean powertrain solutions and use of renewable/clean fuels with low or zero carbon intensity. However, methodologies to identify the energy efficiency and the carbon footprint of the vessel design and the operation are relevant, depending on the objective to be achieved, and can be developed in parallel.

An important conclusion is that **the concept of a label or index for several types of targets, users and applications can be seen as an interlinked, layered and modular development**.

Based on the overview of the available schemes and initiatives and the assessed levels, already some potential is identified for enriching them:

Opportunities applicable for ALL LEVELS (B, C and D) for expansion of the methodologies:

- Provide WTW calculation for greenhouse gas emissions (CO_2 eq. emissions). Preferably one harmonised and consistent dataset to be used when available. For short term, different options can be facilitated in parallel
    - IPCC calculation method applied for instance by the CCNR
    - GLEC / ISO 14083 default values
    - EU Values from RED II / EU Fuel maritime
- Also take energy efficiency into account: MJ input/ kWh output of the energy convertors (TTW scope) which can be expressed in % efficiency of the energy convertors (Level B) and in MJ per tkm (Level C and D).

More specifically for the Levels B, C and D, the following specific expansions are seen as valuable:

Level B All primary energy convertors on board

This option is based on the Emission Performance Label and can have the following extensions in addition to the general ones:

- Include data from continuous monitoring on board to come closer to the real world emissions
- Add data on transport performance (e.g. tkm) to increase the scope to include other energy efficiency factors (Level D)

Level C Powertrain and hydrodynamics ($EEDI_{inland}$)

This option is based on $EEDI_{inland}$ and can have the following specific extensions, in addition to the general ones:

- Add the air pollutant emissions based on Level B emission profile

Level D Transport service operation ($EEOI_{inland}$ / GLEC-ISO)

Based on $EEOI_{inland}$ and GLEC and can have the following specific extensions, in addition to the general ones:

- Add the score from Level C to capture the specific hydrodynamic performance
- Consider adding the air pollutant emissions based on Level B emission profile module, especially if air pollutant emissions are continuously monitored. Possibly in combination with geographic information in view of impacts to sensitive nature areas (N2000) and densely populated areas.

In addition, the following main conclusions are:

- **Level B can be implemented on short term in the whole of Europe** and presents the air pollutant and climate emission performance for the vessel, by means of the type of energy/fuel used for the powertrain of a vessel and additional energy converters installed on the vessel. **It is important for the level playing field and acceptance to cover all of Europe and all vessel types and type of services**. Level B methodology can be used to the emission and energy performance of the vessel and to differentiate between comparable vessel classes and operating profiles. It can be a fair and useful instrument if it takes into account the distance to be travelled and type of waterways in relation to power demand and required energy storage on board. **Level B provides into large extent the basis for a differentiated incentive scheme to get shipowners to invest in powertrain solutions for the zero-emission pathway.** Lacking elements maybe right/down sizing efforts of installed power and specific hydrodynamic measures which can be taken to improve the overall energy efficiency and thus the power demand of the vessel. For these elements, specific additional methods can be added in a modular way.

- **Level B can be seen as a first important basic module of the instrument**, as most data is already available or can be made available with limited effort and costs. Data on energy consumption, type of energy and WTW GHG emissions, energy efficiency of the power convertors and the air pollutant emission profile of power convertors in grams per kWh are core elements for making a first step. Subsequently, additional data modules can be added, for example to express the environmental performance against the service performance of the vessel in level D and to add the EEDI profile in level C for specific assessments on required power on board and to evaluate the hydrodynamic characteristics.

- In order to evaluate the **WTW performance of GHG emissions** for fuel / energy types, several approaches exist. The IPCC approach, applied for instance in the context of the CCNR roadmap and RED II. Default values are also provided under RED II (EU Fuel Maritime proposal under Fit for 55) and the GLEC framework. It can be **a choice in the methodology for the user to select which type of WTW approach is to be taken into account using different WTT datasets in the calculation scheme**. It thus depends on the type of user and application.

- The different options and different datasets are not ideal and maybe confusion. For that reason, it is recommended to work towards a **single and harmonised approach and reference dataset** for the **WTW GHG emissions** for fuel / energy types to be applied in Europe.

- **Level C** provides **specific information on the energy efficiency of the hydrodynamic characteristics** and also uses figures on the energy efficiency of the propulsion power (e.g. grams fuel diesel needed per kWh output). This level C therefore enables to achieve objectives which cannot be achieved with level B. Level C is particularly relevant to support investment decisions in newbuilt vessels to optimise hull shape, propellor and cargo hold for the expected sailing area and conditions. However, before this module can be applied in practice on European level for all vessel types and waterways, it needs further research work which is planned to be completed in the course of 2023.

- **Level D presents the overall performance of a service** carried out by a freight vessel. It thus includes a wide range of factors related to the vessel, the actual dimension of the waterway, operational and logistic requirements as well as the human skills of the crew. This level allows to achieve objectives which cannot be achieved with level B or C. In particular, it allows the estimation of the **carbon footprint** of inland navigation services for **monitoring and reporting** and also for **comparing the score with other modes** for specific journeys. It is therefore **not focussed or limited to the static characteristics of the vessel itself.** It reflects also the dynamic operational elements affecting the energy demand for the transport performance.

- For Level D it is important to take good care of the **specific conditions** and to **differentiate** between them. Examples are the gravimetric density of the cargo (weight) as well as the type of waterway and the type of vessel. And to take into account market dynamics and dynamics in water/weather conditions (e.g. at free-flowing rivers), the use of average values derived during longer periods is most applicable at a differentiated level.

- For a Level D label or index based on $EEOI_{inland}$ or GLEC with a public purpose, the **sharing of data by operators is however quite sensitive in view of competition between operators and consists in a barrier**. As a result, **data is currently lacking, and this level is not mature enough to be applied for a label or index for <u>individual</u> vessels for public purposes**. Nevertheless, especially for the purpose of carbon footprint calculations by clients and comparison between modes it is important to **improve the default values** and to increase the level of **detail for differentiation** and the accuracy.

- For **Level D there is a high barrier for using the $EEOI_{inland}$ for making a sound benchmark between vessels**. It would require the continuous monitoring and collection of a large amount of data from a large group of vessels for a longer period (e.g. a couple of years). Only with such details it will be possible to distinguish in detail between the type of vessel, type of service and the type of waterway and to evaluate the performance of the individual vessel. However, **for Business to Business applications to calculate carbon footprint of services it can and does already work** (e.g. based on annual averages) and is already being applied (GLEC Framework) and shall be supported and strengthened (e.g. the default values).

- Furthermore, the **Level D can be enriched if the Level B information from the particular vessel is used**, which allows to add the air pollutant emission scores and alternative WTW values for the GHG emissions. With Level B, also the energy efficiency of the energy convertors can be derived and presented separately. However, for the air pollutant emissions, it would be good to take into account the load rates of the energy convertor and the related specific emissions as well as the geographic characteristics in view of impact of air pollutant emissions to sensitive nature areas and populated areas. Furthermore, **Level C information ($EEDI_{inland}$) would add specific information** on the efficiency of the hull and propeller at specific conditions (speed, water depth) and waterway types which can complete the dashboard of indicators relevant for the vessel operation.

- Thus, the **Levels B, C and D are clearly complementary and create synergies** and can service different objectives. It is a matter of selecting the most appropriate level depending on the objective to be achieved

- In general, the demands on the quality of the labelling system increase with the geographic scope, the range of uses and, in particular, the associated legal consequences. At the same time, the complexity is likely to increase. It is obvious that **the expectations for the quality of a labelling system but also its design depend very much on its intended use**.

Next steps / policy recommendations

First of all, **the value of an instrument is in its actual use, application and the incentives** provided based on the methodology for the instrument. The instrument and the underlying methodology have no added value if there are no users and it does not lead to changes.

Therefore, a next step will be to **discuss the objectives to be achieved with this instrument and the first main users and applications**. Next the appropriate methodology can be selected and the indicators to be used, followed by setting references values or threshold values for labelling/indexing. This may (eventually) also be a combination of methodologies and indicators as explained and concluded seen the possible synergies and the different objectives and areas to highlight in the performance label/index (e.g. energy convertors, hull and propeller, integrated operational performance in real world).

In particular, discussion need to take place with the European Commission services, river commissions, national governments (EU and non-EU member states), regional authorities, port authorities, shippers and forwarders associations/representatives, banks and other incentive providers. This to see whether there is **interest for a European label instrument** based on methodology for Level B as basis for stakeholders to provide incentives. If there indeed is interest and a common viewpoint, the methodology can be further detailed and elaborated, based on the specific objectives and the requested applications by stakeholders. The indicators provided by Level B can drive the discussion with possible users on the more specific objectives, applications and incentives which can be provided based on the indicators.

If stakeholders support this approach, a label system based on **Level B can be implemented on short term in Europe and can be applied for all vessels.**

Moreover, the **Level B is most applicable to link incentives to promote clean and efficient energy convertors on board and use of clean and low/zero-carbon fuels/energy**.

In this respect it is also concluded and recommended that for the short term **different options for the WTW GHG emissions can be offered in a European labelling/indexing instrument** based on the same set of core data. Offering different well-to-tank datasets, allows **flexibility** towards the different preferences from users /incentive providers. It thus also enables a possible link and may serve as **reference applications on EU level** such as use of the methodology for Taxonomy technical screening criteria in view of state-aid-support, EU grants and loan instruments and the setting of targets to be achieved. It is however recommended to work in parallel towards a single and harmonised dataset of WTW GHG emission factors for different fuels/energy types.

The **Level B can also be used as a first step for an instrument as announced by NAIADES III for the EU energy index methodology** which is mentioned in NAIADES III for the purpose of monitoring and reporting carbon intensity of inland waterway vessels. This can be done by means of the methodology as Level B takes into account the type of energy/fuel used and the share of renewable energy in total on the basis of an individual vessel. This score can be expressing in a **gram CO_2 equivalent per kWh (WTW)** which gives a basis for setting a reference and targets to be reached. This can be done both on fleet level, for different fleet segments as well as for individual vessels. However, if the monitoring purpose implies following all individual vessels, it probably requires a mandatory system. Whether a voluntary or a mandatory system is needed depends on the answer to the following question: will there be sufficient positive incentives for vessel owners to convince all vessel owners to apply the instrument voluntarily?

In a second step, Level B can be combined with **Level C to express emissions in grams CO_2 equivalent per per tkm / pkm**, wherever possible and useful.

If the goal is to monitor the fleet at a more aggregated level, the operational performance of the vessel (Level D, $EEOI_{inland}$) can be used as well, for example for the monitoring and reporting about the yearly average for the fleet, with differentiation to market segments and vessel types.

With respect to **Taxonomy** and the link to methodologies as presented and analysed in this report:

- This research work showed that the most suitable methodologies underlying a label/energy index greatly depends on the foreseen application. The specific recommendations for Taxonomy provided below transcribe the outcome of a first research work regarding what could be an alternative methodology to the one currently provided in the taxonomy. **There is however a clear need for additional follow-up discussion with the EC and stakeholders.**

- **Level B provides a reliable picture on the emission profile for the** vessel and thus Taxonomy can take this into account to set certain thresholds to be reached as regards the greenhouse gas emissions per kWh expressed in CO_2 equivalent as well as air pollutant emissions in gram per kWh.
- **Level C** can add to Level B separate **static information on the hydrodynamic performance of the vessel** which can be taken into account in Taxonomy for promoting energy efficient new vessel designs optimised for the conditions in which they will operate. Differentiation is needed for the type of waterways, vessels and market segments. It shall be made clear that these conditions need to be indeed representative for a longer period in which the vessel is in operation (e.g. by a long term contract).
- **Level D**, the EEOI score (Level D) is one of the current technical screening criteria in Taxonomy for IWT freight vessels in comparison with a reference road vehicle. However, the particular figure for the EEOI of an inland vessel (gram CO_2 per tkm) can be quite dynamic and difficult to predict. The figure highly depends on external factors, not related to the vessel itself. It may be unknown when there is a financing demand for the vessel, where the vessel will actually operate and what specific cargo it may transport and what the real world EEOI would be. This currently **limits the purpose of using the EEOI to compare between vessels and to indicate which vessel is more environmentally friendly than others**.
- Taxonomy requires technical screening criteria for "*Purchase, financing, leasing, rental and operation*" of vessels. Therefore, the main goal of Taxonomy is to give guidance on the climate and environmental performance of the vessel, ex ante. Thus, ex post assessments based on the measured transport service performance are less suitable, as the value is strongly influenced by other factors than the characteristics of the vessel itself. Consequently, it is recommended to **combine Level B with Level C for the Taxonomy purpose in view of comparing between vessels** ex ante **and to identify and support sustainable vessels**. The values for the criteria shall be provided ex ante and shall have relatively high reliability in Level B and Level C. A combination of Level B and C provides rather straightforward results, while ex ante assessments made for Level D (EEOI) can change a lot under real world conditions and thus are much less reliable and suitable for benchmarking between vessels.

On a longer term, **work on further development** towards a **more sophisticated label** is highly recommended. A **more specific and detailed methodology**, using **continuously measured emissions**, both for cargo (for instance expressed in g/tkm for specific market segments and origin-destinations) and passenger vessels (for instance expressed in g/pkm) would be essential.

In view of **$EEDI_{inland}$ and $EEOI_{inland}$** more research is required for validation and the evaluation of a possible need of extension of conditions, type of waterways as well as, vessel types for EU representativeness. In particular for Level D one may consider setting-up an **intermediary organisation**, possibly together with Smart Freight Centre, for **data collection and developing KPIs and their values for a matrix of different sub-segments** (type of vessel, type of cargo, type of waterway / operating area) to fairly take into account the specific conditions and circumstances in which the vessels operate. Specific attention is recommended to creating **synergies with ongoing and growing digitalisation** and **data collection and exchange** in the field of inland waterway transport operations and communications.

List of abbreviations

AIS	Automatic Identification System
BMDV	Bundesministerium für Digitales und Verkehr (Federal Ministry for Digital and Transport), Germany
CCNR	Central Commission for Navigation on the Rhine, PLATINA3 partner
CDNI	The Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways
CESNI	EUROPEAN COMMITTEE FOR DRAWING UP STANDARDS IN THE FIELD OF INLAND NAVIGATION
CO_2	Carbon dioxide
CSR	Corporate Social Responsibility
DC	Danube Commission, PLATINA3 partner
DST	Development Centre for Ship Technology and Transport Systems, Duisburg, Germany
EEDI	Energy Efficiency Design Index
EEOI	Energy Efficiency Operational Index
EICB	Expertise- en InnovatieCentrum Binnenvaart, The Netherlands, PLATINA3 coordinator
ESC	European Shippers' Council, PLATINA3 partner
FAME	Fatty Acid Methyl Ester, traditional bio-diesel
GHG	GreenHouseGas
GLEC	Global Logistics Emissions Council
HC	Hydrocarbon
HVO	Hydrotreated Vegetable Oil
I&W	Dutch Ministry for Infrastructure and Water
ISO	International Organization for Standardization
IWA	Inland Waterway Auxiliary engine (Stage V NRMM)
IWP	Inland Waterway direct Propulsion engine (Stage V NRMM)
IWT	Inland Waterway Transport
IWT Platform	Inland Waterway Transport Platform, PLATINA3 partner
kWh	kiloWatthour
MCA	Multi Criteria Analysis
MJ	MegaJoule
N_2O	Nitrous oxide
NFRD	Non-Financial Reporting Directive

NH_4	Methane
NOx	Nitrous oxide
NRE	Non-Road Equipment (Stage V NRMM)
NRMM	Non-Road Mobile Machinery, regulation reference EU2016/1628 for Stage V
pkm	passenger-kilometre
PM	Particulate matter - microscopic particles of solid or liquid matter suspended in the air
RED II	Renewable Energy Directive II (Directive 2018/2001/EU)
RIS	River Information Services
SAB	Stichting Afvalstoffen en Vaardocumenten Binnenvaart
tkm	ton-kilometre
TCO	Total Cost of Ownership
TTW	Tank-to-Wake, scope of emissions occurring after charging/bunkering
WTT	Well-to-Tank, scope for production and logistics of the fuel/energy
WTW	Well-to-Wake, the sum of TTW and WTT

1 Introduction

The Horizon 2020 PLATINA3 project[4] provides a platform for the implementation of a future inland navigation action programme. PLATINA3 is structured around four fields (Market, Fleet, Jobs & Skills, Infrastructure) of which work package 2 (WP 2) deals with various aspects of the fleet such as 1) zero-emission fleet; 2) climate resilient fleet; 3) digital and automated vessels; 4) technical regulations and standards for the fleet and fuels; and 5) accurate fleet data.

This report presents the conclusions from Task 2.6 of PLATINA3 which focusses on the methodological approach for the labelling and/or indexing the energy and emission performance of inland vessels. The task builds on the variety of available schemes, concepts, and initiatives in this field and seeks to develop an instrument which can be a reference to be linked with incentives for ship owners. Such incentives have to be based on the emission as well as energy performance of a vessel, with a view to supporting the return on investment that are made on the zero-emission pathway.

For example, better market contracts, discounts on port dues and grants for investments can be provided for innovative vessels with low emission/energy profile. This with a view to reduce the Total Costs of Ownership (TCO) of the vessel in comparison with vessels with older engines and using fossil fuel and to provide an economic drive for modernisation and decarbonisation of the fleet and the energy usage. Based on Task 2.5 work in PLATINA3 and the CCNR studies[5], it is clear that there is a significant additional cost for owning and operating a green vessel using renewable energy compared owning/operating a conventional vessel using fossil. This is a significant barrier for the transition towards a zero-emission inland vessel fleet.

Moreover, attention is also paid to possible synergies and the link to greenhouse gas calculations in logistics with more operational data such as the emissions per ton-kilometre (tkm) to increase awareness about the relatively low carbon intensity of transport by inland waterways as well as to support the carbon footprint reporting by clients of IWT as well as larger operators in IWT.

The process of developing any incentives by different stakeholders and users is not addressed in this task and report. This can be seen as a next step, possibly also linked to the conclusions and recommendations of other parallel work and initiatives such as the PLATINA3 Task 2.5 which addresses the financial challenge to achieve a zero-emission fleet.

[4] https://platina3.eu

[5] See for more information: https://ccr-zkr.org/12080000-en.html

1.1 Policy background

Within Task 2.6, the following key European references for the policy background have been identified:

- The European Green Deal, COM (2019) 640
- Fit for 55: delivering the EU´s 2030 Climate Target on the way to climate neutrality, COM (2021) 550
- A Clean Planet for all – A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy, COM(2018) 773
- The European Sustainable and Smart Mobility Strategy, COM (2020) 789
- NAIADES III: Boosting future proof European inland waterway transport, COM(2021) 324

Furthermore, the Mannheim Declaration and the work carried out by CCNR on the zero-emission roadmap and the related studies[6] are also relevant for the policy background of Task 2.6 of PLATINA3.

Various aspects of the policy background which have been considered for the work of Task 2.6 are discussed in more detail in the following.

Sustainable and Smart Mobility Strategy

The Sustainable and Smart Mobility Strategy (COM(2020) 789) points out that the European Green Deal calls for a **90% reduction in greenhouse gas emissions from transport**, in order for the EU to become a climate-neutral economy by 2050, while also working towards a zero-pollution ambition. To achieve this systemic change, it is needed to (para. 10):

(1) make all transport modes more sustainable,

(2) make sustainable alternatives widely available in a multimodal transport system, and

(3) **put in place the right incentives to drive the transition**.

This implies that all policy levers must be pulled:

(1) measures to significantly reduce the current dependence on fossil fuels (by replacing existing fleets with low- and zero-emission vehicles and boosting the use of renewable and low-carbon fuels);

(2) decisive action to shift more activity towards more sustainable transport modes (notably increasing the number of passengers travelling by rail and commuting by public transport and active modes, as well as shifting a substantial amount of freight onto rail, inland waterways, and short sea shipping); and

(3) internalisation of external costs (by implementing the 'polluter pays' and 'user pays' principles, in particular through carbon pricing and infrastructure charging mechanisms).

The Sustainable and Smart Mobility Strategy points out that incentives for transport users to make more sustainable choices must be reinforced. These incentives are mainly economic, namely carbon pricing, taxation, and infrastructure charging, but should be complemented by improved information to users.

Furthermore, the Sustainable and Smart Mobility Strategy indicates that currently, neither individuals planning a trip, nor shippers/logistics operators organising a delivery, give sufficient consideration to environmental footprint. This is partly because **they are not given the right information**, including on

---

[6] See for more information: https://ccr-zkr.org/12080000-en.html

available alternatives. The **most sustainable choice should be clearly indicated**. With adequate **information on the environmental footprint** and a more systematic opportunity for consumers to voluntarily offset their travel, consumers and businesses will be empowered to make more sustainable delivery and transport choices. This is why the Commission plans to establish a European framework for the harmonised measurement of transport and logistics greenhouse gas emissions, based on global standards, which could then be used to provide businesses and end-users with an estimate of the carbon footprint of their choices, and increase the demand from end-users and consumers for opting for more sustainable transport and mobility solutions, while avoiding greenwashing. Information on the carbon footprint of a specific journey could become a new passenger right as well as a right for logisticians, and in this case should apply to all transport modes.

An important action in the Sustainable and Smart Mobility Strategy is the initiative of 'CountEmissionsEU'. This initiative sets out a common framework to calculate and report transport-related greenhouse gas emissions. It can be applied by both the passenger and freight sector, including IWT. Transparent information will allow service providers to monitor and reduce their emissions and improve the efficiency of their transport services, and will enable users to choose the most sustainable option. This is quite relevant for the work in ISO/DIS 14083 on "Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations to the ISO14083".

Position of Inland Waterway Transport

Inland waterway transport has the potential to play an important role in reducing its own emissions as well as by shifting demand towards inland waterway transport to reduce greenhouse gas emissions on European level. Furthermore, there is a clear intention to develop policy measures on internalisation of external costs, which implies that the external costs can be quantified in a reliable manner.

However, there is a clear lack of reliable information and transparency on the emission performance of individual vessels. This was amongst others made clear in the PLATINA2 project when reviewing databases and methods for calculations of external costs of inland waterway transport.

Moreover, also for global methodologies for carbon footprint calculations (e.g. the methodology Framework developed by the Global Logistics Emission Council) the greenhouse gas emissions of inland waterway transport need to be reliable and accurate. This is becoming increasingly relevant in view of the CountEmissionsEU' initative and the ISO standard. Some default values exist that are useful to help transport buyers and policy makers on macro level. However, the GLEC Framework is not yet widely used and applied by IWT operators to capture the true greenhouse gas emissions from individual operations. Moreover, GLEC does not address the air pollutant emissions which are causing the vast majority of external costs of emissions by IWT[7].

The lack of information and transparency has different consequences, in particular:

- difficulties for public authorities, banks, ports, and other stakeholders to place the right incentives to drive the transition towards zero-emission inland navigation;

Source: PROMINENT D6.3/6.5 https://www.prominent-iwt.eu/wp-content/uploads/2018/07/2018_04_30_PROMINENT_D6.3_D6.5_Combined_Deliverable.pdf

- difficulties to contract low/zero emission vessels of IWT services' clients (i.e. shippers, brokers, passengers), resulting in less demand for clean vessels and less rewarding of the environmental performance and engineering, also in comparison with other modes (modal shift opportunity[8]); and
- difficulties to monitor the fleet performance also in comparison with other modes and assess the progress made in relation to targets for emission reduction, set for example by the CCNR (Mannheim declaration signed in October 2018[9]), by the European Commission (Green Deal presented in December 2019[10]) and by companies purchasing transport services that have set corporate emission reduction targets.

The development of a standardised methodology to measure vessel energy efficiency and emission performance would help to overcome these difficulties. It would support the development of inland navigation transport as an even more sustainable and efficient mode. Given the deployment of clean technologies in other modes, such a methodology increases comparability of the actual performance of IWT. A sound methodology is also a key step towards the development and subsequent implementation of a European labelling system in inland navigation, supporting environmental and climate protection initiatives.

Energy efficiency enhancement of inland navigation

Achieving climate neutrality of the waterborne transport sector not only requires a greater use of renewable and low carbon energy but also improving energy efficiency. In other words, using less and cleaner fuels while transporting the same amount of goods (tkm). Increasing energy efficiency includes, for example, a better use and navigation of vessels (higher load rates, less empty trips), increased efficiency by means of modern propulsion systems, improvement of the vessels' hydrodynamics, application of smart navigation methods with optimised sailing speeds and less waiting time at locks, and an efficient integration of inland navigation with seaport logistics. Rising awareness for smart navigation amongst the boat masters and scheduling staff can also have a positive effect on energy savings.

National and international climate targets can only be achievable by combining both the use of renewable energy as well as by increased energy efficiency. This is highlighted in many studies, at national or European levels (see a few examples below).

- According to the 'Fit for 55' proposal for a revision of the Directive on energy efficiency (recast)[11], the energy savings potential is large in the transport sector, as it is responsible for 30% of final energy consumption. While not fixing specific obligations for the transport sector or inland navigation, the proposed Directive foresees annual energy savings obligations of -1.5% for all Member States. The overall energy saving objectives encourages member States to make the best possible use of public funding investments into energy efficiency improvement measures and to promote and support alternatives which are more energy efficient[12].

---

[8] The European Green Deal calls for a substantial part of the 75% of inland freight carried today by road to shift to rail and inland waterways.

[9] Mannheimer_Erklaerung_en.pdf (ccr-zkr.org)

[10] The European Green Deal (europa.eu)

[11] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0558

See also the European Commission's 2018 strategy "A Clean Planet for all" which underlines for transport, the importance of switching to low-carbon modes and zero-emission vehicles, the central role of electrification and renewable energy sources, and pushes for operational efficiency improvements. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773

- The important role played by energy efficiency to reduce greenhouse gas emissions from inland navigation is also highlighted in the report by the Inspection Regulation Committee of the CCNR[13].
- The different transition pathways developed in the relevant CCNR study reports[14,15] assume an increase of 30% in energy efficiency of the entire inland navigation fleet by 2050 compared to an increase of 15% in a 'business-as-usual' scenario[16]. Seen the objective to reach in total at least 90% emission reduction, the remaining share, around 60% of the GHG emission savings, are to be achieved by means of changing to alternative/renewable energy in IWT.
    - The CCNR study indicates that the role played by energy efficiency in reaching an emission reduction of at least 90% (both greenhouse gases and air pollutants) by 2050 compared to 2015 is significant. The assumption that energy efficiency will increase by 30% in the transition pathways compared to 15% in a 'business-as-usual' scenario can be explained by the increased awareness and the larger economic incentive to reduce energy consumption and installed power on board as a result of high energy costs and high investment costs for the zero-emission technologies and energy carriers.
    - It also consists in an extrapolation of the developments observed in recent years with regards to energy efficiency and take into account the currently known technical measures to increase efficiency. Indeed, within the past decades the hydrodynamic efficiency of ships has been improved significantly. Ships built in the 1960s and 1970s have about 20 to 25 % higher power demands at the same speed compared to a new ship. Ships from the 1980s and later still leave about 10 % room for improvements.
- The International Renewable Energy Agency (IRENA) points to improving energy efficiency and using less carbon intensive and polluting fuels as essential pillars to achieve climate neutrality re-location of industrial to continents in some sectors.
- Another valuable source demonstrating the importance or energy efficiency measures alongside using cleaner fuels and investing in new powertrain technologies is the DENA's lead study "Aufbruch Klimaneutralität"[17]. This study shows that the transport sector in Germany will have to reduce its energy consumption by almost 60% by 2045 to achieve climate neutrality. Whether all modes of transport will have to reduce their energy consumption equally or whether the already particularly energy-efficient modes, including inland navigation, will be less challenged will be decided politically.

Therefore, in the development of both national and international inland navigation policy, energy efficiency should be given attention alongside the use of climate-neutral energy sources. In view of the modal shift potential and the need to reduce greenhouse gas emissions, the strength of low intrinsic energy consumption by inland waterway transport and related low CO_2 equivalent emissions for transport services shall be made more visible and should be more exploited. Of course, this also requires reliable information based on a sound methodology. This should be reflected in the context of a development of a labelling system for inland navigation covering both emissions and energy performance, as well as in future research projects and funding programmes.

---

13 https://www.ccr-zkr.org/files/documents/rapports/Thg_ber_en.pdf

14 Two transition pathways are identified, one conservative and one innovative, to reach an emission reduction of at least 90% by 2050 compared to 2015.

15 Deliverable C (Edition 1) on the technical and economical assessment of greening techniques which fit into zero-emission development of IWT and Deliverable C (Edition 2) complementing the findings from Edition 1 in order to come up, in particular, with more refined transition pathways towards zero emission.

16 In this study, the BAU shows how the European fleet will develop towards 2050 based on the status quo and announced developments

17 https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2021/Abschlussbericht_dena-Leitstudie_Aufbruch_Klimaneutralitaet.pdf

Beyond energy efficiency improvements and the use of climate-neutral energy sources, two other elements are worth mentioning, even if they are not at the heart of the report, when considering the ways to achieve zero emissions:

- Modal shift from road transport to inland waterway transport can play a major role to reduce overall transport emissions, seen the low energy demand for transporting goods by IWT compared to road haulage. However, it also requires that inland waterway transport is at least competitive with respect to the air pollutant emissions such as NO_x and PM in order to ensure overall lower external costs and policy support. An energy index/label system can play a role in supporting the shift to more sustainable transport modes, such as inland navigation.
- Reduction of transport demand[18] and the distance to be travelled to carry goods or passenger from a point A to B is also expected to contribute to reducing the GHG emissions. This could for instance be achieved through the promotion of local production in Europe as alternative for production in other continents like Asia, a trend which is already observable. This may lead to a growth of intra European transport, providing new market opportunities for IWT. Here, the an energy index/label system can play a role to support that additional IWT transport will have low emissions.

Link with Task 2.5 of PLATINA3

In addition, the development of a labelling system based on a standardised methodology for measuring emissions is strongly related to Task 2.5 of PLATINA3 which addresses the financial challenge to achieve a zero-emission fleet. Also, as concluded in amongst others the CCNR Study[19], there is currently in general no business case for technologies which facilitate the transition pathway to reach near zero-emission in 2050. This is the major bottleneck for driving the transition towards zero-emission. There are currently only few and insufficient incentives in place for greening inland waterway transport. Without intervention and extensive additional financial support to ship-owners in IWT, the transition will not take place and goals for emission reduction goals for 2050 will not be reached. In order to address this barrier, Task 2.5 of PLATINA3 develops recommendations for a new European instrument to financially support the vessel owners willing to invest in low/zero-emission technologies, based on mixed sources (public and private), including a sector contribution.

Such a dedicated instrument promoting the transition of the fleet also **requires a system to indicate the emission and energy performance of vessels** and to enable a **differentiated incentive scheme which gets ship-owners to invest in powertrain solutions for the zero-emission pathway**. Such a system would allow all stakeholders to determine, for instance, the amount of public grants, the co-financing rate to be applied, as well as to enable differentiated contributions from vessel owners.

NAIADES III

In addition, the NAIADES III Communication[20] published in June 2021 mentions a number of actions relevant in the context of this report, which are quoted below:

---

[18] IRENA report "Eliminating CO2 emissions from industry and transport in line with the 1.5°C climate goal" September 2020: "https://www.irena.org/publications/2020/Sep/Reaching-Zero-with-Renewables

[19] https://www.ccr-zkr.org/12080000-en.html

[20] https://transport.ec.europa.eu/transport-modes/inland-waterways/promotion-inland-waterway-transport/naiades-iii-action-plan_en

- *"The Commission will further encourage the take-up of renewable low-carbon fuels through tax incentives in the revision of the Energy Taxation Directive. The revised Energy Taxation Directive will promote the shift to less polluting fuels in inland waterway transport by introducing a harmonised EU minimum rate for the fuels used in inland waterway transport according to their environmental performance. This tax will also incentivise energy efficiencies."*
- *"In addition to ensuring the full implementation of Regulation (EU) 2016/1628 on pollutant emissions from non-road mobile machinery,* ***the Commission will assess the need for further legislative measures to promote the uptake of zero-emissions vessels. As a first step, an agreed EU energy index methodology (in collaboration with the Horizon Europe zero-emission waterborne transport partnership and the H2020 Platina III project) is needed for monitoring and reporting carbon intensity of inland waterway vessels****. This will serve to define carbon intensity reduction targets and draw up a technology roadmap for the deployment of zero-emissions shipping by 2050".*
- Annex Action Plan, Action number 11:" *Facilitate through the H2020 Platina III project the elaboration of an EU energy index methodology for assessing carbon intensity levels of inland waterways vessels (2022)"*
- *"Finally, the EU Taxonomy Climate Delegated Act recognises the potential of low-carbon modes such as inland waterways to contribute to modal shift. The Commission will therefore establish relevant* ***technical screening criteria*** *for determining the conditions under which overall inland waterway infrastructure contributes to climate change mitigation, with a view to* ***guiding market participants in their investment decisions****."*
- *(footnote 38) "H2020 CSA Platina III will make a technology roadmap, built on the CCNR technology roadmap currently in preparation. Platina III will also propose a CO_2 methodology or Horizon Europe for the sector."*

The European Commission mentions the need for an EU energy Index methodology and specifies in footnote 37 that this could be similar to the maritime Energy Efficiency Design Index (EEDI). Furthermore, the link to Taxonomy and technical screening criteria will be taken into account, in particular for the time period after 2025.

1.2 Objectives

In view of the policy context and the background of the challenges and opportunities for the inland waterway transport, according to the Grant Agreement for PLATINA3, the objectives[21] of Task 2.6 of WP2 Fleet of PLATINA3 are the following:

- *To assess and where appropriate coordinate the scheme of a vessel index/label system and support the implementation.*
- *To elaborate the technological/methodological basis as the function of a label.*
- *To thus realise an instrument to enable a differentiated incentive scheme to get shipowners to invest in powertrain solutions for the zero-emission pathway.*
- *To assess the link with GHG calculations in logistics (grams per tonne km).*

Therefore, the overall scope of Task 2.6 includes freight vessels, passenger vessels and also floating equipment (e.g. dredging, construction vessels). In addition, specifically for freight vessels, the link to GHG calculations in logistics chain in terms of grams per tkm is to be addressed. Moreover, as requested by the

[21] The text box provides a direct quote of task objectives as laid down in the Grant Agreement of PLATINA3

European Commission DG MOVE, specific attention will be paid to the technical screening criteria of Taxonomy. The task report can also serve as basis for the EU energy index methodology needed for monitoring and reporting carbon intensity of inland waterway vessels as announced in NAIADES III.

1.3 Rationale

Potential bottlenecks and problems have been discussed within Task 2.6. They are listed below and can principally be addressed by implementing a label or index instrument.

- Lack of an unambiguous methodology and criteria which can be used by IWT clients for contracting services;
- Lack of an unambiguous methodology and criteria which can be used by governments, banks and ports for providing incentives to vessel owners such as grants, (soft) loans and guarantees, tax reductions, reduction of port dues, etc.;
- Lack of an unambiguous methodology and criteria which can be used by policy makers to implement policies encouraging the use of low/zero emission vessels;
- Lack of data on the emission performance of inland vessels[22], resulting in
  - lack of convincing evidence of energy consumption and emissions by inland waterway vessels compared to other modes, reducing the economic potential and the political support of modal shift from road to inland waterway transport,
  - insufficient monitoring, statistics and emission calculation models for the fleet in view of development of the inland vessel fleet (including type of energy convertors and type of energy/fuel used) towards zero-emission and related financial incentives;
- Lack of visibility of green inland vessels meeting the latest emission standards or better in view of their marketing to clients; and
- Lack of recognition of retrofit solutions meeting the same or better emission performance compared to new engines.

Therefore, four categories of reasons explaining why such a label or index instrument is needed have been identified as follows:

- **Acknowledgement** for ship owners investing in emissions reduction, greening and using clean / renewable fuels
  - .1 After market retrofit solutions able to meet new standards
  - .2 Technologies going beyond standards (e.g. zero-emission, Stage V, Euro VI)
- **Distinguishing** between vessels based on their potential emission and energy performance
- **Monitoring** tool for performance of the fleet as a whole, e.g. for setting targets and developing technology roadmap (reference NAIADES III).
- Basis for **intervention** and policy measures to incentivise ship-owners/operators to improve the environmental performance, meaning air pollutant emissions (NOx, PM, CO, HC)[23] and greenhouse gases (such as CO_2, CH_4, N_2O), as well as energy consumption towards zero-emission in 2050. Thereby, stimulating use of clean and renewable fuels but also of less fuel.

It is worth noting that each category might overlap (i.e. in order to justify a policy intervention, distinguishing between the vessels and acknowledging ship owners who have already invested to improve their emission performance is necessary.

[22] Data regarding the emission performance of the total fleet is indeed generally available (macro level), but not necessarily at the level of individual vessel (micro level).

[23] As referred to in Regulation (EU) 2016/1628

There is a wish, at least from governments, to have a **reliable**, **replicable**, **exact**, **easy to implement** and **practicable** label or index instrument. With reliable it shall give true and realistic information of efficiency and emission performance. With replicable this concern that criteria ought to be scientific and objective. Hence, the criteria used do not only give the relevant/necessary information, but are also verifiable, whenever needed. Moreover, it needs to be relatively easy to implement at relatively short term, seen the urgency to address the GHG and air pollutant emission problems. Finally, the effort to measure and calculate may not be too costly and too time-consuming.

Those traits may cancel out each other, but there is a need to find a “pareto”- optimum. Governments are bound by the rule of law, so any policy based on a label needs to be sound and it must be possible to grant equal treatment.

1.4 Possible users and functions

The methodology for a label and/or index is the basis for applications and incentives. A wide range of different users can apply the methodology for providing incentives and prioritising sustainable green transport solutions. Identifying the key indicators are most suitable and relevant depends on the users and their own objectives. In this respect, a major challenge is to identify and anticipate the possible uses of such a vessel index/label system. Indeed, the suitability and the design of a vessel index/label system very much depends on the intended use. Several types of possible users can be distinguished with examples on the function and added value of the methodology for a label/index. The following gives an indicative overview:

- Policy makers on EU, Member State, regional and municipality level:
    - Facilitate the elaboration and implementation of public financial support systems (grants, including state aid schemes, and other economic and fiscal incentives), for instance by making it possible to appraise activities in accordance with their environmental performance based on the label/index system for vessels and EU Taxonomy.
    - Monitor and assess the progress on energy transition and zero-emission pathway. To facilitate this assessment, data resulting from the label/index system for vessels could be included the inland vessel certificate.[24]
    - Monitor the development of the European inland fleet in view of the emission reduction objectives and energy use.
    - To implement policy encouraging the use of low/zero emission vessels, such as low emission zones or restrictions.
    - Statistical and modelling purposes: to serve as a data source for internationally harmonized data on energy consumption and greenhouse gases and air pollutants emissions and models to assess the impact of air pollutant emissions (e.g. NOx and PM).
    - Assist in the creation of a possible European funding and financing scheme: contribution European financial instrument (reference to Task 2.5 PLATINA3)

[24] The CESNI/PT working group is currently working on a new model of inland shipping certificate in which these data can be included as an obligation. In this way, it is ensured that we get an overview of the entire fleet and not just of a portion of the vessels. Further coordination with RV Committee as well as CESNI/CESNI/PT would be necessary.

- Ports and waterway managers:
  - Benefit from harmonised criteria in order to differentiate port dues to give discounts to clean vessels based on the label/index system for vessels.
  - To define priority or access rules based on the label/index system for vessels.

- Shippers / clients using inland vessels:
  - To allow a conscious choice of an ecological means of transport (transparency) based on the label/index system for vessels.
  - To encourage shippers/clients to enter into contractual arrangements with environmentally friendly vessels (i.e. selecting contractors) based on the best/better scoring vessels according to the label/index system.

- Vessel owners:
  - Accepted proof of better energy and emission performance, notably recognition for retrofit solutions and solutions going beyond the state-of-the-art. This, to be able to claim any benefits and discounts in this regard and to promote the environmental performance to clients and other stakeholders based on their score in the label/index system.
  - Marketing of the favourable energy and emission footprint to clients (shippers/ forwarders) based on a reliable and common methodology of the label/index system.
  - Having a sound basis for:
    - Requesting grants and attractive loan conditions for making investments and using renewable fuels based on the label/index score to be achieved after making these investments to demonstrate and quantify the emissions and energy savings.
    - Reduction of port dues and getting higher priority for green vessels.
    - Support in investment decisions by providing insight on the impact of investments on the label/index score. It is a reference instrument for making investments to achieve a better score in the label/index system (for example, by encouraging them to retrofit existing engines), also in view of corporate social responsibility/CSR balance sheet for larger companies.

- Financial institutions:
  - To provide guidance as to the financing (i.e. (soft) loans) of environmentally friendly vessels and development of financial products. There is a strong link with the Taxonomy initiative in this case. Also a comparison can be made with the Poseidon principles[25] as applied for seagoing vessels under IMO which uses EEDI and EEOI as main methodology.

- Technology/energy suppliers and shipbuilding industry:
  - The label/index system can help to define common targets for vessels for energy and emission performance to be reached by means of use of clean fuels and technologies. It helps to guide research and development actions as well as deployment.
  - To promote/market more easily their activities of building new, more environmentally friendly and energy efficient vessels and/or retrofits. Together with related incentives such as subsidies, it can provide a demand for technical solutions in hardware and clean energy and can provide economies of scale and provide a growing market for technology and energy suppliers.

[25] See also: https://www.poseidonprinciples.org/finance/wp-content/uploads/2019/07/Poseidon_Principles.pdf

- For the inland navigation sector as a whole:
  - To have a measurement system in place regarding greenhouse gases and air pollutants that would allow to compare its environmental performance with that of other transport modes and in order to promote to modal share of IWT (societal benefits).
  - Would support active marketing for an environmentally friendly mode of transport with large transport capacities.

1.5 Methodology and activities of Task 2.6

Task 2.6 of WP2 provided coordination and support for the discussion on a European wide approach and implementation of a labelling system for inland navigation and, also related to Task 2.5, the creation of an instrument to differentiate and provide financial incentives for ship owners to invest in zero-emission technologies and the use of clean fuels. The work of Task 2.6 is technical and neutral focussing on possible methodologies as input to policy makers and politicians as well as private sector for a decision making process to select the suited methodology depending on the objectives to achieve.

Using secondary research and interviews, an overview of the various initiatives to raise awareness of the performance of inland vessels in terms of their emissions and energy performance is provided and an assessment is made.

Initiatives appearing as most relevant in the context of preparing this deliverable are:

- Emission performance label for inland vessels developed and implemented in The Netherlands (see chapter 2.1)
- The German initiative of the energy efficiency indicators EEDI and EEOI for inland vessels (CESNI/PT, Task-PT-26) (see chapter 2.2 and 2.3)
- The worldwide framework for GHG calculations of the Global Logistics Emissions Council (GLEC) developed by Smart Freight Centre as well as the forthcoming ISO 14083 (in development) (see chapter 2.4)
- the recent development on “Taxonomy” is addressed as well (see chapter 2.5).
- Green Award for inland shipping (The Netherlands) (see chapter 2.6)
- Count your transport emissions – ‘CountEmissions EU’; towards an EU framework for harmonised measurement of transport and logistics emissions (see Annex III)
- The PIANC working group PIANC InCom Working Group 229 on “Guidelines for Sustainable Performance Indicators for Inland Waterways (see Annex IV)”
- Handbook external costs (CE DELFT, INFRAS)(see Annex V)

The CCNR has also expressed its desire to set up an international labelling system for environmental and climate protection in inland navigation to support the reduction/elimination of pollutant and greenhouse gas emissions and accelerate the energy transition of inland navigation towards zero emission[26]. CCNR appreciates the broadest possible cooperation to leverage synergies and to avoid, for example, the introduction of “competing” labelling systems at different levels and according to different criteria. In light of the strong synergies with PLATINA3 Task 2.6, the CCNR, through the involvement of its Secretariat, does actively take part in providing input to PLATINA3.

[26] See Annex VI for more information about the position of the CCNR in relation to label development for energy and emissions of inland vessels

A first step in Task 2.6 was therefore to review all the above-mentioned initiatives, to systematically describe them, and to analyse their complementarity in order to reach synergies and coherence. Essential in the activities is to:

- take note of the different viewpoints and requirements
- create an overview of the different initiatives
- facilitate the dialogue between all involved actors like policy makers (European, national, regional), port authorities, financial institutions, grant providers, GLEC, IWT sector, shippers, brokers, forwarders, shipbuilding industry
- prepare possible future research work and policy developments

A first presentation and discussion on this reviewing exercise took place at the 1st Stage event on 7 April 2021. The presentations given during this event are shown in Figure 1.

Session 4 – Towards a European toolbox for emission and energy labelling and carbon footprint calculation in inland navigation
Opening, background and introduction, *Presentation by Martin Quispel, SPB/EICB*
Dutch Emission Label Scheme for inland vessels addressing greenhouse gas and air pollutant emissions, *Presentation by Rens Vermeulen, Dutch Ministry of Water and Infrastructure*
Energy Efficiency Indices as an instrument for the reduction of CO_2 emissions of inland vessels, *Presentation by Gernot Pauli, German Ministry of Transport and Digital Infrastructure, and by Jens Ley, DST*
Carbon footprinting of IWT: Standardisation of methodology and approach for IWT, *Presentation by Alan Lewis, Smart Freight Centre / Global Logistics Emissions Council on the GLEC framework and views on IWT*
Carbon footprinting of IWT: How does this work in practice? What are the lessons learned so far? *Presentation by Leon Simons, Connekt*
Chair of session*: Khalid Tachi, SPB/EICB*

Figure 1: Overview of presentations and discussions on a European labelling system for inland waterway transport during the First PLATINA3 Stage Event

The most relevant schemes and initiatives are presented in Chapter 2. Further exchange was organised by means of separate interviews and feedback requests by the involved PLATINA3 partners in their own networks and among their members (CCNR, DC, IWT Platform, ESC).

By means of a technical expert workshop organised on 4 November 2021, more details and views were collected. This resulted in a description of the possible scope levels and the objectives as well as the most suitable indicators. The results are presented in Chapter 3 of this document. Subsequently a multi criteria analysis was performed for the options, see Chapter 4 of this document. As a final step, the recommendations for follow-up work were developed and presented in Chapter 5 of the document. At the 3rd Stage event on 11 February 2022 the findings, conclusions and recommendations were presented and discussed with a broad group of stakeholders. The presentation is online at https://platina3.eu/.

2 Systematic overview of schemes and initiatives

2.1 Emission Performance Label for inland vessels

2.1.1 Background

The development of the Emission Performance Label is based on agreements laid down in the Green Deal on Maritime and Inland Shipping and Ports in the Netherlands[27] which was signed on 25th of June 2019. The Parties have the following ambitions (as mentioned in Article 1 in the Dutch Green Deal):

- By 2030 to have a reduction of carbon emissions from the Dutch inland fleet by 40% to 50% relative to 2015 and to have fitted at least 150 inland vessels with a zero-emission powertrain.
- By 2035 to have a reduction of emissions of environmental pollutants from inland shipping by 35% to 50% relative to 2015.
- By 2050 to have a near zero-emission and climate-neutral inland fleet.

Efforts and actions to reach these ambitions include to set up a Sustainability Fund (Article 3) and also a Labelling System (Article 4). In 2019, 2020, and first half of 2021 the actions for Articles 3 and 4 have been executed and accomplished. Article 3 concludes the following on behalf of the parties which signed the Dutch Green Deal (1:1 quote below):

> *Article 3 Sustainability fund*
>
> *The Dutch Ministry (I&W) will investigate the feasibility of a European sustainability fund for inland waterway vessels. This study will be conducted in collaboration with other CCNR member states and will examine the extent to which the sustainability fund would be able to satisfy the following criteria:*
>
> *a. Entrepreneurs can apply to the fund to finance investments in improving a vessel's emissions performance, as referred to in article 4, paragraph 3.*
>
> *b. The fund is broadly accessible to entrepreneurs from all segments of the inland navigation sector.*
>
> *c. It is a low-threshold fund, in both financial and administrative terms.*
>
> *d. Award of grants from the fund are contingent on improvements to the vessel's emissions performance.*
>
> *e. The fund gives entrepreneurs an incentive for investing in emissions performance.*
>
> *The study will also consider how the fund will be financed, for example through annual contributions from inland navigation entrepreneurs, contributions from the EU/national governments or resources from financial institutions.*
>
> *BLN and CBRB will support the action mentioned in paragraph 1 through the European Barge Union (EBU), the European Skippers' Organisation (ESO) and the Inland Waterway Transport (IWT) platform*

Therefore, the fund as described in Article 3 needs an instrument to identify and monitor the emission performance of individual vessel. For this the Labelling System is envisaged as described in Article 4.

[27] GD230 Green Deal on Maritime and Inland shipping and Ports.pdf (greendeals.nl)

Article 4 of the Dutch Green Deal has a strong relation with Task 2.6 in PLATINA3. Article 4 is the following:

Article 4 Labelling system

1. *In anticipation of and with a view to the establishment of a labelling system, a system of recognition for modified engines that comply with the CCNR II and Stage V emissions standards will be introduced in the short term, based on the principle of equivalence.*
2. *I&W and the EICB will work out the details of a labelling system for inland vessels' emissions performance. The labelling system will be ready by spring 2020.*
3. *Emissions performance refers to a vessel's emissions of carbon dioxide and atmospheric pollutants. In developing the labelling system, the parameters for air pollutants will probably be worked out sooner than those for carbon dioxide. If necessary, therefore, the labelling system will be introduced in phases for these two components. This is important in terms of establishing equivalence in connection with local low-emission zones.*
4. *The emissions measured in a practical test will determine a vessel's emissions performance and label, not the type approval of the engine.*
5. *The labelling system can be used to establish a vessel's emissions performance for the purposes of, for instance:*
   a. payments from and contributions to the sustainability fund, as referred to in article 3;
   b. local allocation of benefits to vessels with a better emissions performance;
   c. agreeing transport contracts;
   d. financing by banks and other financial institutions;
   e. ongoing monitoring of emissions from inland navigation.
6. *I&W, the Provincial Authorities and EICB will investigate how the emissions of inland waterway vessels can best be measured in practice. To this end, the CLINSH (Clean Inland Shipping) partners involved in this Green Deal will share the results of that project.*
7. *I&W will seek to ensure the labelling system is enshrined in law.*

A draft for the labelling system was developed in 2020, based on expert input and consultation of stakeholders. It was presented by the Dutch Ministry at the 1st Stage Event of PLATINA3.

2.1.2 Scope

Table 1 presents the scope characteristics of the Dutch Emission Performance Label for inland vessels.

Table 1: Characteristics of the Dutch Emission Performance Label for inland vessels

Scope characteristic	
Geographic coverage	Issued by the Stichting Afvalstoffen en Vaardocumenten Binnenvaart[28] in The Netherlands, open for any vessel owner (regardless of nationality).
Type of vessels considered	All commercial crafts including floating equipment, on individual level. It is based on the scope of EU directive 2016/1629. Historical vessels do however not belong to the target group and are excluded because of very small impact and costs which would be disproportional. The label system is aligned with the "ES-TRIN". The scope therefore starts with vessels with engines with at least 19 kW and a length of the vessel of at least 20 meters or over 100m^3 in LBT
Type of engines	All engines on board above 19 kW power
Type of emissions	Air pollutant emissions: corresponding with CCNR II, Stage V, etc. Greenhouse gas emissions: CO_2, CH_4
Scope of emission chain	Tank to Wake, while taking into account IPCC method to correct for the climate change emissions for renewable fuels (e.g. biofuels) as applied by CCNR for the Studies on financing the energy transition of the inland fleet and described in the CCNR roadmap

2.1.3 Objectives

The objectives of the Dutch label scheme are the following:

- Providing an instrument to be used to implement incentives by different stakeholders in IWT (ports, shippers/forwarders, banks, grant providers...)
- Boost innovation and uptake of green technologies contributing to the emission targets towards 2050
- Monitoring the emission performance of the fleet

2.1.4 Methodology

Table 2 summarises the methodology of the Emission Performance Label for inland vessels in The Netherlands.

[28] https://sabni.nl/

Table 2: Methodology of the Emission Performance Label for inland vessels

<table>
<tr><th>Method characteristic</th><th></th></tr>
<tr><td>Data sources</td><td>

Type of vessel and dimensions, load capacity (static)
Type approval certificate of engines to identify power and emission class (initial status and when changes occur)
Number of running hours of energy convertors (usually an engine) (initial value)
Annual energy/fuel consumption and type of fuels/energy (yearly)
Annual consumption of urea (yearly)
Emission performance of each energy convertor and the specific energy/fuel consumption per kWh. This is based on the type approval and/or on board measured for the specific the emission factors based on ISO 8178 (initial) procedure, expressed in grams per kWh or number per kWh (PN) for the emissions
Rated power of the energy convertor (engine)
Running hours per year for each energy convertor (yearly)
Optional: tonnes transported, kilometres travelled, tkm performance (annual).

</td></tr>
<tr><td>Calculation method</td><td>

Weighted average emission performance is determined for the vessel based on the following data:

the individual energy convertor emission factors (either by type approval values for young type approved engines (<20,000 engine hrs) or measured on board (each 10,000 hrs)
fuel consumption data for the vessel as a whole
the installed power of energy convertors on board
the running hours for each installed energy convertor

The system is voluntary, vessels not taking part will be classified on worst class “E5” by default.

</td></tr>
<tr><td>Presentation method</td><td>

Classification for air pollutant emission performance expressed in average gram per kWh for the vessel: (NOx, PM) ranging between 0 and 5, linked to emission limits from CCNR II and different Stage V options.
Classification for greenhouse gas emission performance expressed in average gram per kWh for the vessel (CO_2, CH_4) with a linear range between A and E

The classification is therefore a 2 dimensional table, the schematic overview is the following:
<table>
<tr><td></td><td></td><td colspan="6">Air quality emissions (0,…5)</td></tr>
<tr><td rowspan="6">Climate emissions (A,…E)</td><td></td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>A</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>B</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>C</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>D</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>E</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

The limit values for the categories are:

Climate emission category:

Label category Climate emission	Limit value in gram CO2e per kWh (maximum) Well to Wake according to IPCC/CCNR method
A	0.00 (=net zero-emission)
B	0.01 – 265
C	266 - 530
D	531 - 795
E	> 795

Air pollutant emission category:

Label category air quality emissions	Limit value in grams or number (#) per kWh (the weighted average for all energy convertors on board. Scope: energy convertors with a power output above 19kW Tank to Wake emissions
0	0 (=zero-emission tailpipe)
1	NOx: <0.46 PM: <0.015 PN (#): < $1*10^{12}$ Or certified Stage V equivalents (Euro VI, NRE >56 kW)
2	NOx: <1.8 PM: <0.015 PN (#): < $1*10^{12}$ Or certified Stage V equivalents (IWA, IWP ≥ 300 kW)
3	NOx: <2.1 PM: <0.10 Or certified Stage V equivalents (IWA, IWP 130 kW - 300 kW)
4	NOx: <6.0 PM: <0.20 Or certified CCR2 / STAGE 3A engines
5	NOx: >6.0 PM: >0.20 (or not certified CCR2 / STAGE 3A engine)

Reliability, checks and enforcement

- Data to be checked and validated on annual fuel consumption (linked to CDNI waste collection contribution) and urea consumption (providing invoices if necessary)
- Emission factors per engine (emission per kWh), either from certificate or from measurement on board by certified independent body
- Renewal of emission factor measurement each interval of 10,000 hours for engines with after treatment[29] and each 20,000 hours for engines without after treatment. First 10,000 or 20,000 hrs can be based on type approval of

[29] Taking into account that in NRMM Stage V, the first 10,000 hours of engine use, the emission performance is guaranteed by supplier. Therefore, the first moment for measurement on board will be at 20,000 hours and subsequently repeated each 10,000 hours.

	the engine. After this interval, on board measurements are needed, executed by certified/accredited measurement companies. • Random checks on board on the spot

The information used for the Emission Performance Label consists of a set of **core data** which are needed. The design also allows for **optional data** to be added. Presented schematically, it concerns the input data and calculation steps in Figure 2 to arrive at the core indicator values which determine the label class of the vessel.

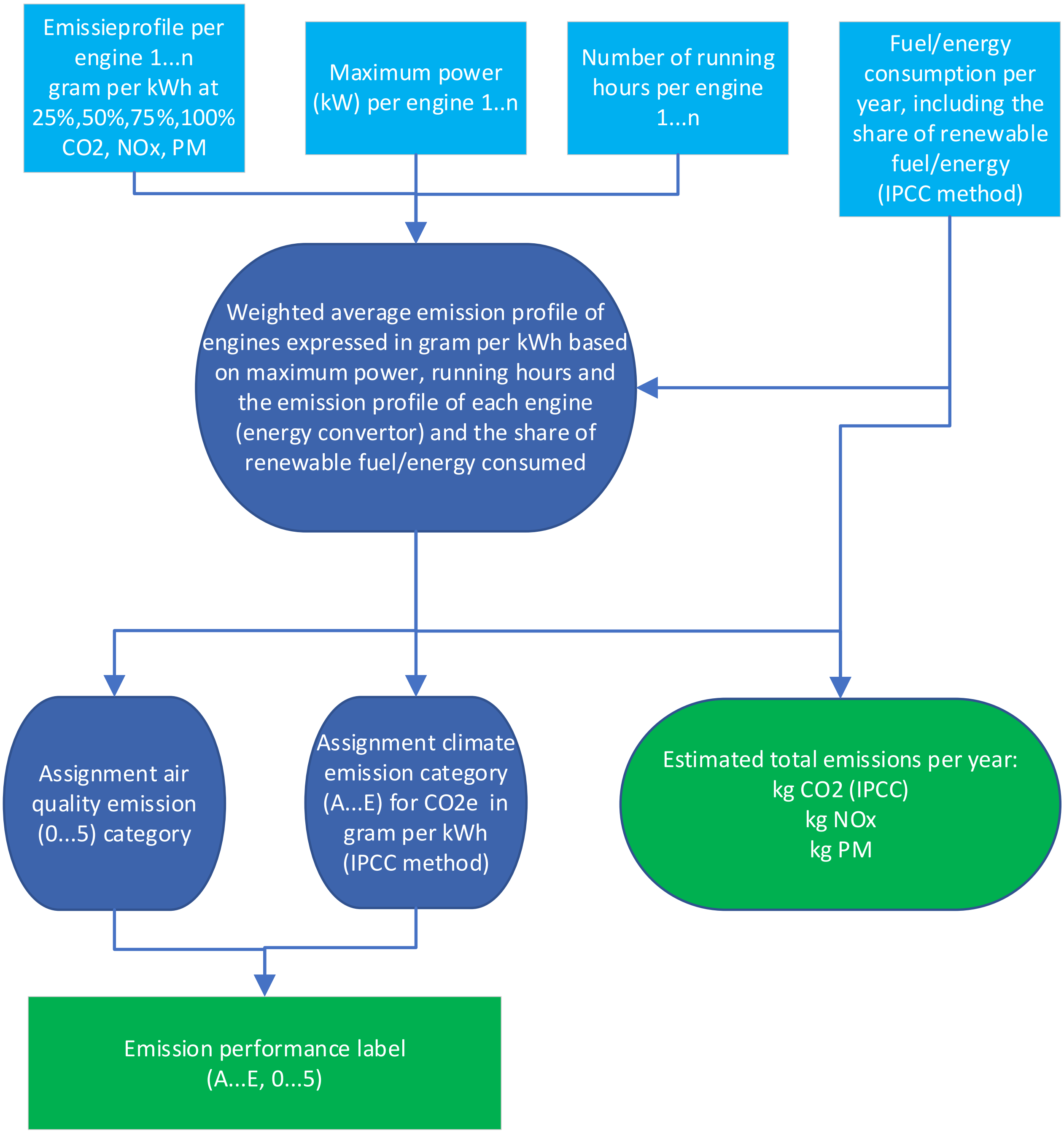


Figure 2: Input data and calculation steps for the Dutch Emission Performance Label for inland vessels

In light blue the input data is specified. It concerns the specification of engines (or energy convertors) on board of the vessel. For each engine/ energy convertor on board (above 19kW maximum output power) the following information is provided:

- Maximum power value (kW)
- Number of running hours per year
- Emission profile (grams per kWh and # PN (if relevant))

The maximum power output is known and available based on the engine data. The number of running hours is recorded and reported each calendar year. At application, the number of hours can be estimated, especially for new vessels. For existing vessels, the vessel owner may report the recorded running hours of the previous year.

The emission profile can be based on the information provided by the engine supplier in case of young engines (until 10,000 running hours). In case or older engines, or alternatively, the emission profiles will be measured by an independent certified and recognised company. This usually concerns an on board measurement with mobile measurement devices according to the ISO 8187 test cycle using the E3 or E2 test cycle. This method is well-known and applied already and formally approved (also by CCNR) and is used also in the granting process of Green Award certificates for vessels. Also the fuel / energy consumption is measured during this process, which gives information on the energy efficiency of each engine / power convertor.

On an annual basis, the fuel/energy consumption is reported by type of fuel/energy. This is done to correct for the share of renewable energy and to determine the CO_2 equivalent emissions according to the IPCC method which is also applied by CCNR. Based on the information it will become clear which share consists of fossil fuel (e.g. diesel) and which share concerns sustainable/renewable fuel such as FAME/HVO, electricity or alternative fuels such as (Bio)Methane. In case of a B30 (70% fossil diesel and 30% HVO), a reduction is applied of 30% in the CO2 emission compared to B0 (100% fossil fuel).

Consequently, based on this data it is possible to determine the weighted average of all engines / energy convertors on board for CO_2e, NO_x and PM. Next, the assignment of the label category is done.

Of course it is relevant to add further vessel characteristic as well such as:

- Type of vessel
- Dimensions of the vessel
- Load capacity or water displacement

By means of these characteristics one can search and select the applicable type and size of vessels. This is for example relevant for shippers which would like to contract a vessel with low air pollutant emissions and low carbon intensity (low carbon footprint) based on the efficiency of the energy convertors on board and the type energy use.

In addition, based on the total volume of fuel/energy consumed calculation can be made of the total emissions the vessel emits per year. Such annual data can be valuable for new optional/modular applications, for example to determine average indicators like the CO_2 equivalent emission per tkm or the average emission or energy used per kilometre travelled.

All the data (including optional data) can lead to a dashboard with values for relevant indicators for the energy and emission performance of the vessel. The following table (Table 3) gives an example.

Table 3: Example dashboard of relevant indicators for the Dutch Emission Performance level

Type vessel	**Motor vessel dry cargo**
Length (m)	**110**
Width (m)	**11,40**
Load capacity (t)	**2500**
Climate emission label	**Air quality emission label**
C	**4**
Indicators per kWh	
avg. fuel consumption (gram fuel per kWh)	**208,5**
avg. CO2 eq emission IPCC (gram per kWh)	**464,1**
average NOx emission (gram per kWh)	**5,732**
average PM emission (gram per kWh)	**0,148**
Indicators per tkm	
CO2 eq emission IPCC (gram per tkm)	**17,5**
NOx emission (gram per tkm)	**0,217**
PM emission (miligram per tkm)	**5,603**
Indicators per kilometer travelled	
Mechanical power (kWh per km)	**42,5**
Fuel consumption (liter per km)	**10,6**
CO2 eq emission IPCC (kilogram per km)	**19,7**
NOx emission (gram per km)	**243,8**
PM emission (gram per km)	**6,3**
Indicators per transported ton	
Mechanical power (kWh per ton)	**8,39**
Fuel consumption (liter per ton)	**2,08**
CO2 eq emission IPCC (kilogram per ton)	**3,90**
NOx emission (gram per ton)	**48,11**
PM emission (gram per ton)	**1,24**
Annual totals	
Mechanical power (kWh per year)	**1.813.021**
Fuel consumption (m3 per year)	**450**
Transport performance (tkm per year)	**47.952.000**
Travelled distance (km per year)	**42.624**
Transported weight of cargo (tons per year)	**216.000**
CO2 eq emission IPCC (kg per year)	**841.428**
NOx emission (kg per year)	**10.391**
PM emission (kg per year)	**269**

In addition, also the energy efficiency could be added: comparison between calorific value of fuel used compared to the kWh mechanical energy as output. Annex I provides a more detailed explanation and example of the calculation method for the Emission Performance Label system.

2.1.5 Status / next steps

A call for tender was published and the Stichting Afvalstoffen en Vaardocumenten Binnenvaart (SAB) was selected as winner of the tender to manage and execute the label. The Emission Performance Label was implemented on 15 November 2021. SAB is the executive agency to manage the label system and to issue the labels to vessel owners[30].

Experiences will be shared within the CCNR in view of the work it is currently undertaking regarding a labelling system for environmental and climate protection in inland navigation. This will allow the CCNR Secretariat to report on recommendations and lessons learnt regarding the implementation of the Emission performance label for inland vessels in the context of PLATINA3 Task 2.6.

As regards this label, further developments are foreseen in the framework of improvement of the methodology and making the link to carbon footprint emission data, expressed in grams per tkm for the freight transport sector as an add on for the current system. Where possible this will be done in cooperation with other member states.

Furthermore, improvements are expected in the emission factors by means of more advanced on board measurements, possibly continuous measurements of the fuel consumption per energy convertor, the actual load rate of engines and continuous measurement of emissions like NO_x. Such technology is becoming available at relatively low price. This may replace periodical measurements and makes it possible to apply more tailor made weight factors for engine load rates and the respective emissions profile. This will more accurately reflect the operational sailing profile of the vessel under real world conditions.

2.2 Energy efficiency indices for inland navigation - $EEDI_{inland}$

2.2.1 Background

Basis for the description about $EEDI_{inland}$ is the presentation given at the 1st Stage Event[31] as well as the summary of a report on research by DST, which was commissioned by the Federal Ministry for Digital and Transport (BMDV) and presented to CESNI/PT[32]. The report is publicly available on CESNI website[33] and provides more background information about the methodology and approach.

The research by DST is inspired by tools already available and applied in the maritime sector. Newly constructed vessels for maritime transport have had to comply with **Energy Efficiency Design Index (EEDI)** limits as of 1 January 2013 and are awarded an international energy efficiency (IEE) certificate. The

[30] See also: https://www.binnenvaartemissielabel.nl/nl/,

[31] See also: https://platina3.eu/download/gernot-paulii-and-jens-ley-on-energy-efficiency-indices-as-an-instrument-for-the-reduction-of-co2-emissions-of-inland-vessels/?wpdmdl=391&refresh=60e580dfac1da1625653471

[32] R&D project 40.0399/2017 Evaluating the energy requirement of inland vessels using energy efficiency indices Executive summary of final report no. 2252, direct link: to the report https://www.cesni.eu/wp-content/uploads/2021/03/cesnipt_energyindex_en.pdf

[33] See also: https://www.cesni.eu/en/studies/

development of EEDI began around the beginning of the 1990s and is currently updated to reflect the state-of-the-art. In principle, the approach is based on a comparison between the attained EEDI and the required EEDI. The attained EEDI must be lower or equal the required EEDI. The required EEDI is determined by given baselines which are functions of the ship's deadweight and depending on the ship type considered. The EEDI concept proposed stipulates the quantity of CO_2 greenhouse gas emissions (Tank to Wake) based on the volume of fossil diesel used[34] for propulsion power only, relative to the transport performance (tkm). The intention is to drive the development of innovative technical components in ship design, resulting in lower fuel consumption and consequently in CO_2 emissions.

A review of the maritime EEDI approach was conducted by DST. It was concluded that the existing approach needs modifications with respect to the baseline and for the determination procedure of the existing EEDI to be suitable for inland vessels. The models of DST are mostly based on the German network, such as the river Rhine and the canal network. Vessels that are subject to trade-related restrictions or local circumstances are not yet covered[35]. This means that not all vessel types are yet included and it is neither representative for all waterways in Europe. Further research work is planned to take place to expand the type of vessels and the geographic coverage of the models and is expected to be ready by 2nd half of 2023.

Of particular note here is the fact that inland waterway vessels use significantly lower engine power than the maximum available installed power, which is only needed for occasional extreme operating situations where high power is required. On the Rhine, for example, a loaded freight motor vessel with a length of 110 m, a breadth of 11.45 m and a draught of 2.8 m at average to high water levels heading upstream will use powers of between approximately 600 kW and 1000 kW and downstream of approximately 100 kW to 300 kW. But the installed propulsion power can be 2500 kW or more. An operating point with a propulsion power of 75% of the total installed propulsion power, as in the case of seagoing vessels, is therefore not a representative operating point for an inland navigation vessel. More common is an average operating point of 30-40% of the installed power, as seen during monitoring work in the PROMINENT project[36].

Other important factors influencing the energy efficiency of inland navigation vessels are navigation area and water conditions because they largely dictate the minimum draught at which the operator is still prepared to operate the vessel. In turn, this minimum draught determines the propeller diameter and/or propulsion concept. The propeller diameter plays an important role in the energy-efficient operation of the vessel at all draughts. Vessels that have been designed for small draughts would be significantly disadvantaged were a large reference draught to be selected, such as the maximum draught to be found in the inland navigation vessel certificate.

Therefore, it is needed to mention the significant differences between vessel types as concerns own weight and thus deadweight, as well as the very different pushed convoy configurations. The use of deadweight in determining transport performance as a component of the EEDI is therefore not appropriate for all vessel types, especially not on free-flowing rivers which are dynamic in the possible draught for the vessel to pass certain sensitive sections of the waterway. The draught available at

[34] CF [g CO_2 g Diesel] CO2 diesel equivalent (3,206 g CO_2 per g Diesel) and SFC [g$Diesel\ kWh$] specific fuel consumption (220 g $Diesel$ kWh).

[35] Area dependent EEDI-Baselines were proposed in the DST report and apply for h/T > 1.4, water depths between 3.5 and 7.5 m and current velocities between 2 and 8 km/h. The determination of the EEDI could be done on the Danube, where these conditions are fulfilled. There is also a proposal for convoys.

[36] https://www.prominent-iwt.eu/

waterway segments during the journey is decisive for the payload which can be carried by the vessel on the full journey.

An approach for inland navigation vessels was developed considering these and other parameters, based on the derivation of the EEDI for seagoing vessels. This entailed power (75% of the installed power) being replaced by use of a shaft power dependent on type of vessel and the reference speed being replaced by speed over the ground. Deadweight is used except for vessel class 4, passenger vessels. The displacement mass Δ is used for passenger vessels to minimise the number of passenger vessel types (day excursion vessel, cabin vessel or passenger vessel sizes that depend on passenger numbers).

Furthermore, a specific fuel consumption of 220 g /kWh should be used for inland navigation vessels instead of 215 g/kWh for seagoing vessels. This figure is derived by DST from the test-bed reports for inland vessel engines.

The EEDI does not include the power use for additional consumers. Neither are renewable energy sources considered in the current approach. The power consumption of additional energy generators[37] could not be taken into consideration as this data is not available. This information is typically unknown when model tests are being carried out and were therefore not available to the DST for the modelling. However, it is in future possible to expand the approach and to take alternative energy sources into consideration as well. Therefore the specific CO_2 -factor for the energy source needs to be known and can subsequently be used. As a result, the EEDI baselines would shift and could be used.

EEDI values for the vessel variants were calculated using this approach and displayed in the form of scatter diagrams. The required input data (power, speed, and deadweights) was derived from power forecasts previously calculated at the DST based on model test results for different types of vessel, water depths and speeds etc. A total of 500 operating profiles from DST model tests were examined and analysed. It was assumed that this data is a representative reflection of the hydrodynamically determined energy requirement to achieve a target speed.

In determining the $EEDI_{inland}$ for inland vessels, it was proposed to consider forward propulsion shaft power only. This could also eliminate the relatively high investment costs for equipping all main and auxiliary generator sets with power consumption measuring equipment.

Upper limits or envelopes were calculated for the data determined for each vessel type using the preferred evaluation approach, which consequently depend on the vessels' primary parameters (draught, displacement mass or deadweight, vessel breadth, vessel length and shaft powers) and on the waterway conditions (water depth, channel width and current).

A comparison between the findings from the model testing and full-scale measurements resulted in some adjustments, i.e. shifts or changes in the trajectory of the envelope graph lines. A total of 65 operating profiles from full-scale DST measurements were analysed.

The envelope graph curves (lines) are the trend lines of an $EEDI_{inland}$. All calculated $EEDI_{inland}$ values from the model and full-scale investigations of the vessels included in the study fall below these trend lines.

[37] This concerns generators to power: 1) the nautical and technical operation of the vessel both underway and stationary, 2) the cargo, 3) the emergency power supply, 4) the bow thruster system, 5) the ballast system, 6) crew quarters and facilities

This yields the hypothesis, if the vessels considered in the regression analysis are representative of the existing fleet, that the actual $EEDI_{inland}$ values for the vessels in the existing fleet will not exceed the calculated $EEDI_{inland}$ trend lines.

Four classes of vessels were ultimately required to properly represent the inland vessel fleet:

- Vessel class 1: dry cargo and container vessels
- Vessel class 2: tankers
- Vessel class 3: pushed convoys
- Vessel class 4: passenger vessels

For vessel classes 1-3 the shaft power to be used depends on deadweight, and for class 4 on the displacement mass Δ. For all vessel classes, the shaft power also depends on water depth and vessel breadth. The validity ranges of the calculated relationships, e.g. relative to water depth h, vessel draught T, current V_{str} (flow velocity), vessel breadth B, and the h/T relationship was stated in all cases.

The following formulas are applicable:

$$EEDI_{\text{Binnen}} = \frac{CF \cdot SFC \cdot P_{\text{D (vessel type) (upstream or downstream or mean value)}}}{V_{\text{ü}G} \cdot dw} \qquad (3)$$

or

$$EEDI_{\text{Binnen}} = \frac{CF \cdot SFC \cdot P_{\text{D (vessel type) (upstream or downstream or mean value)}}}{V_{\text{ü}G} \cdot \Delta} \qquad (4)$$

CF	$[\frac{\text{g CO}_2}{\text{g Diesel}}]$	CO_2 diesel equivalent (3,206 $\frac{\text{g CO}_2}{\text{g Diesel}}$)
SFC	$[\frac{\text{gDiesel}}{\text{kWh}}]$	specific fuel consumption (220g/kWh)
$P_{\text{D (vessel type) (upstream or downstream or mean value)}}$	[kW]	Shaft power used, depends on vessel type and/or journey of travel upstream or downstream or an average shaft power
$V_{\text{ü}G}$	[km/h]	Speed over the ground
dw	[t]	Deadweight
Δ	[t]	Displacement mass

The regression analyses performed by DST culminated in two proposed approaches for evaluating inland vessel energy efficiency. The first simplified proposal (Basic $EEDI_{Inland}$) applies to all 4 vessel types. The test voyage to determine what EEDI has been attained can be undertaken in deep water provided that such depths are available. In the case of the second proposal, a distinction is made between different navigation areas, like zone 3 (Rhine) and zone 4, including canals. Consequently, provided that the consumption for forward propulsion is captured by means of the consumption indicator, or the shaft power is measured, the inland navigation vessels' $EEDI_{inland}$ can be performed in deep and, sideways, virtually unlimited water, as well as when underway on rivers with a current and channel widths consistent with those of the Rhine using the established parameters. Likewise, the $EEDI_{inland}$ can be determined when operating on a standard canal. Representative test areas should be used in all cases and the corresponding trend lines of an $EEDI_{inland}$ need to be applied. In principle, a certain propulsion power needs to be applied during the test voyage (based on associated formulas). The attained maximum speed over ground is then measured and used to calculate the attained $EEDI_{inland}$ which should be lower or equal to the required $EEDI_{inland}$ (given by the trend line).

The practical approach to determining the energy efficiency during the test voyage was subjected to critical scrutiny. Admittedly, for new ships, an EEDI voyage might not incur high, or indeed any, additional investment costs because the engines typically are fitted with a consumption indicator. The accuracy of these indicators would need to be checked. Vessels in the existing fleet, however, need to be equipped with a gauge to determine the shaft power.

As the $EEDI_{inland}$ only considers one vessel operating point, relative to the many possible operating points, one could well imagine other concepts and approaches to proposing an Energy Efficiency Index. However, since the publication of the DST report in April 2019, discussions have been taken place and the proposal has found support. Furthermore, as indeed, the proposal considers only one vessel operating point, this does not prevent policy makers from demanding more than one. The question to be answered is whether more than one operating is indeed needed for the intended objective. The proposal put forward here is intended to stimulate discussion on this topic within the navigation industry.

For new ships, an $EEDI_{inland}$ can be performed in deep water or on a representative section using calibrated fuel consumption indicators. It was proposed to start with an envelope curve covering the existing fleet. A gradation of 15% and of 25% relative to the established relations could for example be considered for new ships to reduce inland navigation vessels' CO_2 emissions. State-of-the-art technical measures could be used to achieve this reduction. Vessels in the existing fleet can emit between 15% and 25% less CO_2. However, to achieve an absolute reduction in CO_2 emissions of 15% - 25% requires extensive conversion measures, such as changing the shape of the vessel's stern and/or fore-section, optimising the propulsion and steering system and/or increasing the vessel's length. It is questionable into what extent such investments are economically feasible for existing vessels and how certain they are seen possible changes in operating conditions.

2.2.2 Scope

Table 4 presents the scope characteristics for the concept EEDI for inland vessels.

Table 4: Characteristics for the Energy Efficiency Design Index (EEDI) for inland vessels **$EEDI_{inland}$**

Scope characteristic	
Geographic coverage	Depending on data availability and segmentation. Basically, the $EEDI_{inland}$ approach can be varied out on rivers with water depths between 3.5m and 7.5m (or deep water) with current velocities between 2 and 8 km/h. On channels with trapezoidal profiles it can be applied as well.
Type of vessels considered	4 classes of vessel were ultimately required to properly represent the inland vessel fleet: • Vessel class 1: dry cargo and container vessels • Vessel class 2: tankers • Vessel class 3: pushed convoys • Vessel class 4: passenger vessels
Type of engines	Engines providing forward propulsion shaft power
Type of emissions	CO_2 emissions
Scope of emission chain	Tank to Wake

2.2.3 Objectives

The objectives for the EEDI can be summarised as follows:

- Energy efficiency of vessels to increase dramatically
- Energy and emission data to go beyond engines and refer to vessels
- Inland navigation related impact factors to be considered
- CO_2 emissions to be given in g/tkm (Environmental impact/Economic benefit)
- Giving supporting to shipowners for their investment decisions, increasing the resale value of the vessel
- Enhanced sales by shipyards of climate-efficiency new vessels with lower costs for loans due to better rating
- Ensuring the transparency of economic incentive systems such as discounts on port or waterway dues and embedding in environmental certification systems (e.g. Green Award)
- Development of a sound reference for public subsidy systems that is independent of the measures taken, geared to reach specific targets.

2.2.4 Methodology

The $EEDI_{inland}$ dependent on the navigation area is proposed having regard to water depth, current direction and current speed. This entails two different navigation areas, described in accordance with the definition in the Inland Vessel Inspection Ordinance (BinSchUO)[38]: Zone 3 (Rhine) and Zone 4.
The various vessel types are divided in 4 classes (Vessel class 1: dry cargo and container vessels, Vessel class 2: tankers, Vessel class 3: pushed convoys, Vessel class 4: passenger vessels) depending on navigation area Zone 3 (Rhine) or 4. A test voyage is to be conducted favourably in upstream direction. The corresponding shaft power to be used is to be calculated and the maximum reachable speed must be measured.

Specific details about the $EEDI_{inland}$ calculations, general conditions and the formulas for these two distinguished zones (3 and 4) for the four vessel classes are available in the report made for CESNI[39].

Furthermore, the publication "Design of Contemporary Inland Waterway Vessels The Case of the Danube River" also provides background information[40] on the methodology, mainly chapter 67 of this publication concerning "Transport Efficiencies and Performance Indicators".

The following screenshots from the CESNI/DST report (chapter 5) provides an example of the general conditions and the used formula's and type of presentation in the case of the $EEDI_{inland}$ for dry cargo vessels and container ships on Zone 3 waterways (Rhine)[41]:

[38] The BinSchUO is implementing Directive (EU) 2016/1629
[39] Report available at: https://www.cesni.eu/wp-content/uploads/2021/03/cesnipt_energyindex_en.pdf
[40] Book can be ordered via Springer, website: https://link.springer.com/book/10.1007/978-3-030-77325-0
[41] It should be noted that the greek symbols (alpha, beta, gamma etc.) in the following equations represent (known) constants/numbers.

5.1 Zone 3 waterways (Rhine)

5.1.1 Vessel class 1 (dry cargo vessels and container ships)

The following general conditions apply for dry cargo vessels and container ships during the test voyage to determine the $EEDI_{Binnen}$ in an upstream direction:

a) Draught: T = 1.5 · propeller diameter in the range 2.0 m ≤ T ≤ 2.8 m

b) Length: 40.0 m ≤ L ≤ 135.0 m

c) Width: 5.0 m < B < 17.0 m

d) Deadweight: 250 t ≤ dw ≤ 6000 t

e) Current speed: 2.0 km/h ≤ V_{str} ≤ 8.0 km/h

f) Water depth: 3.5 m ≤ h ≤ 7.5 m

g) Water depths/draught ratio: h/T ≥ 1.40

The shaft power to be employed is to be determined using equation (12)

$$P_{D\,Berg\,MS} = \left(\alpha_6 + \beta_4 \cdot EXP(-\gamma_4 \cdot B) - \delta_2 \cdot EXP\left(\frac{h}{-\varepsilon_1}\right)\right) \cdot dw \quad [kW] \qquad (12)$$

During the test voyage the current speed must be known. The speed $V_{üG}$ is measured with the shaft power setting $_{D\,Berg\,MS}$ The $EEDI_{Binnen}$ is calculated as per equation (3).

$$EEDI_{Binnen} = \frac{CF \cdot SFC \cdot P_{D\,(vessel\ type)\,(upstream\ or\ downstream\ or\ mean\ value)}}{V_{üG} \cdot dw} \qquad (3)$$

The $EEDI_{Binnen}$ calculated using equation (3) should be smaller than the index calculated using equation (13) and accordingly fall below the current-dependent $EEDI_{Binnen\ trendline}$ in Fig. 2 .

$$EEDI_{MS\ Binnen\ trendline} =$$

$$(\alpha_7 + \beta_5 \cdot V_{str} + \gamma_5 \cdot V_{str}^2) + (\delta_3 + \varepsilon_2 \cdot V_{str} - \zeta_1 \cdot V_{str}^2 + \eta_1 \cdot V_{str}^3) \cdot EXP\left(\frac{dw}{-\theta_1}\right) \qquad (13)$$

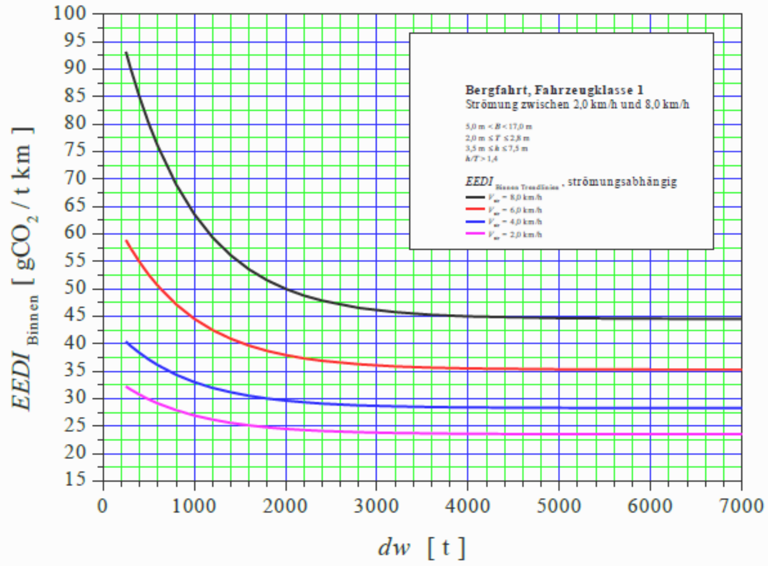


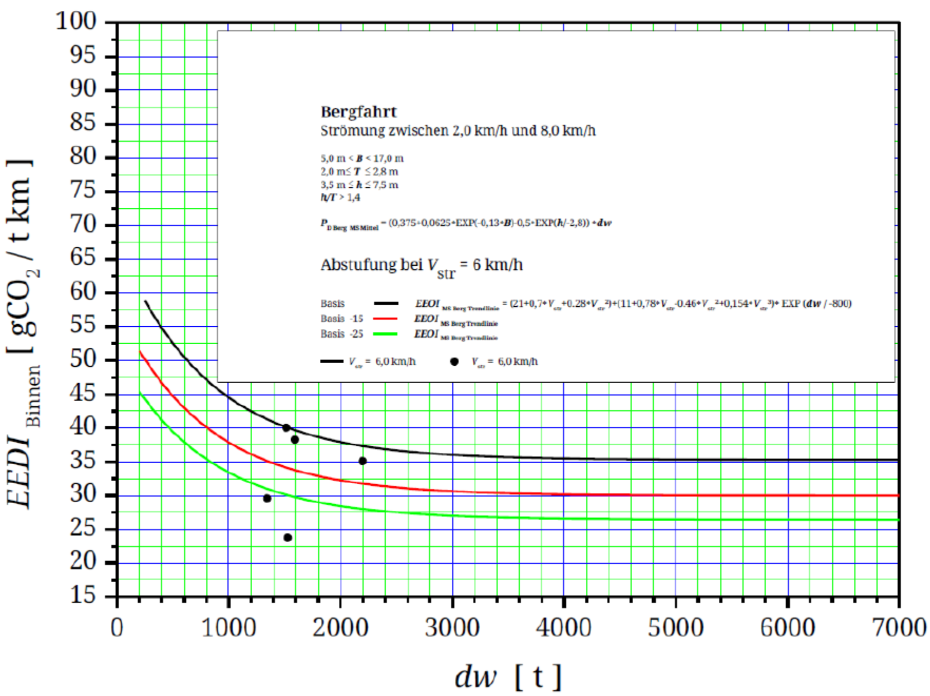
Fig. 2: $EEDI_{Binnen}$ trend lines for vessel class 1 (current-dependent)

Table 5 summarises the methodology for the EEDI for inland vessels.

Table 5: Methodology for the EEDI for inland vessels

EEDI

Method characteristic	
Data sources	• Design data and scaled model test results at different speeds (DST data)
Calculation method	• Calculation of the shaft power to be used during the test trial depending on the ship type and navigation area with equation (12) of the figure (see previous page). • Performing a test trial at the chosen navigation area with the previously calculated power applied. • Measurement of the reached maximum ship speed • Calculation of the attained $EEDI_{Inland}$ by the corresponding equation (3) of the figure (see previous page). • Comparison with the required $EEDI_{Inland}$ from the trendline as shown in the figure or given by equation (13) in the figure (see previous page) • The attained $EEDI_{Inland}$ must be lower or equal the required $EEDI_{Inland}$.
Presentation method	• Graph showing the performance at different speeds, type of waterways and draught conditions. See for example the picture below. The attained EEDI should be lower or equal than the applicable baselines.



Reliability, checks and enforcement	• Need for further measurement of real world data to develop reliable / representative baseline values matching reality. Full scale prognoses of power demand based on model test results for inland vessels is done at DST and other model testing facilities by many decades and follows international standards given by ITTC. For the maritime EEDI, model test results are even used to determine an acknowledged provisional EEDI during the design stage

	for the newly built ship. It is then validated and fixed during the sea trial. Although the situation in IWT is more complex and dynamic compared to sea operation, with more detailed data to be collected from IWT vessels, such a situation could possibly also be achieved for $EEDI_{inland}$ as well.

2.2.5 Status / next steps

Given the critical importance of Energy Efficiency Indices in evaluating CO_2 emissions, the baseline conditions for the indices in this report tend to be excessively skewed towards model tests relative to full-scale conditions such that a more pronounced demarcation may be required.

The Energy Efficiency Indices for inland vessels that have been developed help in capturing the CO2 emissions from freight transport on inland waterways. The socio-political requirement for a significant reduction in CO2 emissions compared to 1990 presupposes that current inland navigation vessel emissions can be quantified, and any changes can be measured. It has not been possible to quantify earlier developments in inland navigation vessel construction and improvements in operating processes resulting in lower emissions from water-borne transport. By using Energy Efficiency Indices within a given framework, it is possible to capture the current status and evaluate optimisations. Given the critical importance of Energy Efficiency Indices in evaluating CO2 emissions, the baseline conditions for the indices in this report tend to be excessively skewed towards model tests as compared to full-scale conditions such that a more pronounced demarcation may be required.

DST therefore recommends that the project be continued with the emphasis on “large-scale measurements for checking and validating the baseline conditions for the Energy Efficiency Index in real life operation”. The BMVD recently commissioned follow-up research regarding the EEDI (and also EEOI) taking into account these observations. The results from this follow-up research work is expected towards the end of 2023.

2.3 Energy efficiency index for inland navigation - $EEOI_{inland}$

2.3.1 Background

Basis for the description about the Energy Efficiency Operational Indicator (EEOI) for application on inland vessels is the presentation made at the 1st Stage Event[42] as well as the summary of a report on research by DST, which was commissioned by the Federal Ministry for Digital and Transport (BMDV) and presented to CESNI/PT[43]. The report is publicly available on CESNI website[44].

The research is inspired by tools already available and applied to the maritime sector. In the maritime sector the **Energy Efficiency Operational Indicator (EEOI)** has established itself alongside the EEDI and enables the maritime ship operator to evaluate the energy efficiency of his vessel in operation, based on actual fuel consumption and the transport performance expressed in tkm.

42 See also: https://platina3.eu/download/gernot-paulii-and-jens-ley-on-energy-efficiency-indices-as-an-instrument-for-the-reduction-of-co2-emissions-of-inland-vessels/?wpdmdl=391&refresh=60e580dfac1da1625653471

43 R&D project 40.0399/2017 Evaluating the energy requirement of inland vessels using energy efficiency indices Executive summary of final report no. 2252, direct link: to the report https://www.cesni.eu/wp-content/uploads/2021/03/cesnipt_energyindex_en.pdf

44 https://www.cesni.eu/en/studies/

The EEOI is basically calculated in a similar way than the EEDI (see section 2.2), but the EEOI captures actual fuel consumption and calculated CO_2 emissions (TTW) during the vessel's operation relative to the product of quantity of cargo carried (tons) and the transportation distance (km). The EEOI concept includes the fuel used for all consumers. As this is different compared to the methodology for EEDI (only propulsion power), the EEOI value cannot be compared with EEDI.

In principle the methodology can be applied on any operating area and is suitable for freight transport vessels. All technical measures implemented on the vessel and improvements, in route planning for example, or as a result of nautical assistance systems are reflected in the calculated EEOI value. Also, the training and skill level of crew plays a role with respect to efficient/smart navigation and the related fuel consumption. Furthermore, logistic requirements such as the Expected Time of Arrival (ETA) of the vessel to fulfil the contract can also determine into large extent the sailing speed and thus the required power and fuel consumption. Relevant is also the share of empty sailing as result of structural and dynamic imbalances in trade flows. Another factor is the type of waterway and the dynamic conditions such as water level which can change dramatically on free flowing sections of the inland waterway network (e.g. on Rhine and Danube) leading to less cargo which can be carried and big differences in the resistance in the water and the fuel consumption. Moreover, there can be empty trips in between and cargo carried by the same freight vessel can have a low density (kg/m^3) or high density causing a varying performance in tkm. All these elements are taken into account in the final result of the EEOI calculation.

EEOI allows to assess the CO_2 emission under operational conditions and includes the human factor. Regularly documenting energy consumption data in a database as well as the carried volume of goods, the sailed route, actual waterway conditions and speeds, can in the medium term allow appropriate calculations and comparisons to be made to reflect the average CO_2 emission per tkm for certain trade lanes and type of commodities.

The EEOI must **primarily be seen as a monitoring tool based on aggregated level** and is not directly suitable for benchmarking between individual vessels. If the objective would be to prepare benchmarks or reference values, it is required to collect data on a large scale for a specific operating area. There is no reference curve, which needs to be fulfilled (as it is the concept for $EEDI_{inland}$).As currently there is a lack of data collection, this means that not all vessel types are yet included and neither are EEOI figures representative for all waterways in Europe. Further research work is planned to take place to expand the type of vessels and the geographic coverage of the models and is expected to be ready by 2nd half of 2023.

In addition to the concrete proposals for the $EEDI_{inland}$ (see section 2.2) an approach how the Energy Efficiency Operating Indicator (EEOI) should be handled was also developed by DST. A significant perceived challenge was that capturing energy consumption on the same sections of water on different days results in different results of limited comparability owing to different water conditions, such as water levels and current speeds.

A proposal for determining an EEOI has been devised which enables an energy assessment of individual inland navigation vessels to be conducted for their respective vessel classes and in their navigation area, or on specific stretches of water. This concept entails subdividing the voyage segment as soon as there is any material change to the waterway parameters. As before, not only is the fuel consumption for forward propulsion factored in, but also the vessel's entire consumption for a section of waterway or the entire section. The fuel consumption can be read off from the fuel tanks' filling level indicators and documented or alternatively fuel flow meters can be used (if installed on board).

The sections of waterway should however be sufficiently long to permit the filling level indicators to give an accurate reading of fuel consumption. Depending on the tanks' size and geometry and the accuracy with which the filling level indicators can be read, an appropriate quantity of fuel should be consumed. For example, to determine an operating point for a period of approximately 1 to 2 hours (the time required for an EEDI journey) the indicated differences in filling level are too small to establish the exact fuel consumption. This can be an argument to install and use fuel flow meters, but this will lead to costs for the vessel owner.

The method in the proposal for determining the EEOI can be performed by the ship operators themselves. To this end, representative sections within the waterway network should be used suitable for determining an EEOI. The EEOI should be continually calculated for the waterway sections being operated on and the total transport route, both for the existing fleet and for new ships.

In sum and to conclude, as regards the comparison to the EEDI (see section 2.2) and EEOI in maritime transport, for Inland Waterway Transport, the following conclusions with respect to energy efficiency of inland vessels can be derived:

- Significant impact of permanently changing environmental conditions such as water depth, fairway width etc.) on energy demand (high impact of chosen sailing area);
- Large range of installed and applied power (upstream / downstream);
- Large range of draughts (partial loadings);
- Design restrictions, e.g. caused by the demand to sail on low water levels, prevent the free choice of propellers diameter; the diameter has a significant impact on the energy efficiency;
- The method in the proposal for determining the EEOI can be performed by the ship operators themselves. To this end, representative sections within the waterway network should be used suitable for determining an EEOI value, while differentiating between the type of cargoes, load rate (payload vs capacity), sailing speed and the actual water conditions (depth and current). Compared with an $EEDI_{Inland}$, which can be performed in deep water or on a representative section using calibrated fuel consumption indicators, the EEOI should be continually calculated for the waterway sections being operated on and the total transport route, both for the existing fleet and for new ships with differentiation to type of cargo and taking into account the actual conditions of the waterway.
- The core purpose of EEOI is monitoring the performance and enabling carbon footprint calculations for clients of IWT, including the comparison with other transport modes. To use the EEOI as fair and reliable benchmark between inland vessels is much more demanding in terms of the required data collection efforts and procedures.
- Data from real world performance is currently lacking. Baseline conditions for the indices are excessively skewed towards model tests relative to full-scale conditions. The proposed EEDI baselines based on scaled model test results should be validated by additional full scale measurements for EEOI, while taking into account that EEOI does include all primary energy convertors on board where EEDI does not. Large scale measurements would be needed to develop a baseline for an energy efficiency Index in real life operations. Data stemming from CDNI, GPS data or automatic identification system (AIS), Fairway Information Systems and electronic reporting could possibly be used for this purpose.

2.3.2 Scope

Table 6 presents the scope characteristics for the concept EEOI for inland vessels:

Table 6: Characteristics of concept EEOI for inland vessels

EEOI

Scope characteristic	
Geographic coverage	Can be done everywhere for the purpose of monitoring performance, carbon footprint calculations and comparison with other modes. However setting reference values in case of a purpose of benchmarking between inland vessels the EEOI performance, differentiated to comparable conditions and services requires vast amount of data to be collected first, which is not available yet.
Type of vessels considered	Principally it can be done on each vessel. However, setting reference values for the purpose of benchmarking between freight and passenger vessels, the performance requires vast amount of data to be collected first, which is not available yet.
Type of engines	All engines and consumers on board
Type of emissions	CO_2 emissions
Scope of emission chain	Tank to Wake

2.3.3 Objectives

In sum, the objectives for EEOI can be summarised as follows:

- Energy efficiency of vessels to increase dramatically (in operation);
- Making possible the robust monitoring of CO_2 emissions;
- Inland navigation related impact factors to be considered;
- CO_2 emissions to be given in g/tkm or g/pkm (Environmental impact/Economic benefit);
- Ensuring the transparency of economic incentive systems such as discounts on port or waterway dues and embedding in environmental certification systems (e.g. Green Award).

2.3.4 Methodology

Table 7 summarises the methodological approach for an EEOI for inland vessels, Figure 3 shows an example calculation of an EEOI for inland navigation.

Table 7: Methodology for an EEOI for inland vessels

EEOI

Method characteristic	
Data sources	• Fuel consumption from fuel tank indicators for each specific journey • Tons transported and kilometres travelled on specific journey
Calculation method	• Fuel consumption to be divided by tkm performance for each specific journey and designated different waterway sections
Presentation method	• Average grams CO_2 per tkm. See example next page
Reliability, checks and enforcement	Manual readings from fuel tank are mentioned in the DST report and are assessed as not reliable for short trips (e.g. 2 or 3 hours), fuel flow meters can be considered as well. As alternative, the data can be displayed, stored and evaluated with the navigation data via an NMEA interface (fuel consumption meters have an NMEA interface as standard). When entering the necessary AIS properties of the vessel, the skipper can not only enter its navigation status, but also its current draught. Thus, the amount of cargo based on the draught can possibly also be stored in the AIS log. The navigation data provide the distance travelled, the amount of cargo and the consumption data of the propulsion system. In principle, "all " consumers on board could be recorded in this way, but it is a relatively cost-intensive solution. With a comparison of the consumption of the propulsion systems and the tank gauges, the total consumption could be determined. With the respective bunker quantity, the total consumption is checked. There is however no legal framework for a mandatory reporting and for checks and enforcement in contrast to the Maritime EEOI which refers to the ISM code[45] and MRV[46] applies as well for vessels above 5000 GT. Moreover, at IMO there is a guide for EEOI[47]. The legal basis and such schemes and codes are not available for IWT. This gap would also need to be addressed.

[45] More information on ISM code: https://www.imo.org/en/OurWork/HumanElement/Pages/ISMCode.aspx

[46] More information on MRV: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015R0757

[47] More information on Guide for EEOI: https://gmn.imo.org/wp-content/uploads/2017/05/Circ-684-EEOI-Guidelines.pdf

	Example:	***EEOI*** in inland navigation															
	Section	III	IV	V	VI	VII	VIII	IIIa	IVa	IVb	Va	VIa	A	B	C	D	
	Sections	Spyck-Koblenz	Koblenz-Mainz	Mainz-Mannheim	Mannheim-Iffezheim	Iffezheim-Kembs	Kembs-Rheinfelden	Mosell e	Main	MDK	Danube	Neckar	WDK, RHK, DEK, MLK, ESK, EHK,	Ems	Weser	Elbe	**Total**
	Section length	266 km	93 km	74 km	91 km	160 km	30 km										
	Gauge station	Cologne	Kaub	Mannheim	Maxau		Rheinhalle										
1	***Journey***	Duisburg to Bamberg						***Amount of cargo***		2000	t						
	Water level [cm]	**314**	**209**														
	Distance [km]	189	93						387								669
	Consumption [l]	3732	2542						5290								11564
	EEOI $_i$ [gCO₂/tkm]	26.7	37.0						18.5								23.4
	Travel without cargo	Bamberg to Regensburg															
	Consumption [l]																1400
2	***Journey***	Regensburg to Berlin						***Amount of cargo***		1500	t						
	Water level	**305**	**199**														
	Distance [km]	282							378	204			587				1451
	Consumption [l]	1300							3360	1896			5933				12489
	EEOI $_i$ [gCO₂/tkm]	8.3							16.1	16.8			18.3				15.5
	Travel without cargo	none															
	Consumption [l]																
3	***Journey***	Berlin to Duisburg						***Amount of cargo***		1800	t						
	Water level																
	Distance [km]												587				587
	Consumption [l]												6215				6215
	EEOI $_i$ [gCO₂/tkm]												15.9				15.9
	Travel without cargo	none															
	Consumption [l]																
4	***Journey***	Duisburg to Wörth						***Amount of cargo***		2200	t						
	Water level	**325**	**220**	**255**	**449**												
	Distance [km]	189	93	74	59												415
	Consumption [l]	4050	2750	1800	1550												10150
	EEOI $_i$ [gCO₂/tkm]	26.4	36.4	30.0	32.4												30.1
	Travel without cargo	none															
	Consumption [l]																
										Amount of cargo t			7500				
										Distance [km]			3121				
										Consumption [l]			41817				
										EEOI $_i$ [gCO₂/tkm]			19.25				

Figure 3: Example calculation of EEOI for inland navigations

2.3.5 Status / next steps

As previously mentioned, the baseline conditions for the indices in the DST report tend to be excessively skewed towards model tests relative to full-scale conditions such that a more pronounced demarcation may be required.

It is therefore recommended to put more emphasis on “large-scale measurements for checking and validating the baseline conditions for the Energy Efficiency Index in real life operation”.

The BMDV recently commissioned follow-up research regarding both the EEDI and the EEOI taking into account these observations. The results from this follow-up research work is expected towards the end of 2023.

2.4 GLEC Framework / ISO standard for carbon footprint reporting

2.4.1 Background

The GLEC Framework was initially developed between 2014 and 2016, and published in June 2016, in response to an industry request for an approach to **logistics GHG calculation and reporting** that would allow compilation or comparison of GHG emissions from different elements of a global supply chain on a like-for-like basis. The development was led by Smart Freight Centre in conjunction with a network of multinational companies, industry associations and green freight programs - the Global Logistics Emissions Council. The GLEC Framework was subsequently updated in 2019 to reflect an updated reporting scope (the GLEC Declaration), incorporation of updated GHG emission factors and default emission intensity values (including the result of industry collaboration for inland waterway emission intensities). The main purpose is therefore carbon footprint reporting for clients and comparison between modes for. The purpose is not to compare the score of individual vessels.

The GLEC Framework is currently the only globally-recognized approach for the calculation and reporting of GHG emissions from freight and logistics operations across all modes. It incorporates aspects of the approaches most widely used and respected by companies and industry association that operate or buy freight transport services, whilst bringing them up to date through a harmonized approach that aligns with the latest GHG accounting and reporting standards. Designed to inform business decisions and steer efforts to reduce emissions. It is in alignment with:

- Greenhouse Gas Protocol
- UN-led Global Green Freight Action Plan
- CDP Guidance for Company GHG reporting.

It is used as a basis for transport sector calculations within Science-Based Targets Initiative.

The collaborative approach taken in developing the GLEC Framework was based around avoiding ‘reinventing the wheel’; as such, it is not intended to replace other methodologies, but rather to ensure consistency between their calculation scopes, reporting formats and data requirements, as well as guiding them towards a harmonized approach across modes, geographic locations etc. that is in line with GHG accounting best practice.

To date, interest in and application of the GLEC Framework has largely been based on assessment and collation of the GHG impacts of individual transport operations, whether operated by the company’s own equipment or via a subcontract agreement, to support corporate GHG accounting. Currently more than 170 multinationals have committed to the use of the GLEC Framework for their logistics GHG emission calculation and reporting. More recently interest has grown in assessing the GHG impact of individual consignments, which requires greater disaggregation in terms of input data. Opinions among industry stakeholders are mixed as to whether this level of information is truly valuable.

Implementation can vary from company to company, and mode to mode within an individual company's inventory, depending on the nature of the available data. However, there is general acceptance that a move to basing calculations on primary data (GHG emission report directly coming from the contract transport operator) would be beneficial in order to understand and quantify the impact that result from operational improvements, vessel upgrades and use of low emission fuels. However, implementation for inland waterway transport is currently largely via use of default values (data from literature) due to the lack of primary operational inland waterway data being monitored and available. This means that a shift to primary data should be a priority. At the same time, there is a need to strengthen the quality and level of differentiation for the default values as back-up option. The GLEC methodology has strong similarities with the EEOI approach as presented in section 2.3, focusing on aggregated performance at service level.

2.4.2 Scope

Given that the purpose of the GLEC Framework is to provide a harmonized, comprehensive approach to the calculation and reporting of GHG emissions from all transport modes on a global level, the scope for inland navigation (Table 8) is the same as for other modes.

Table 8: Characteristics of the GLEC framework for calculating GHG emissions

Scope characteristic	
Geographic coverage	Global
Type of vessels considered	All mechanically powered vessels
Type of engines	All engines and consumers on board
Type of emissions	GHG emissions (all GHGs specified by the IPCC, not just CO_2)
Scope of emission chain	Well to wheel / wake

2.4.3 Objectives

The purpose of the GLEC Framework is to provide a harmonized, comprehensive approach to the calculation and reporting of GHG emissions from all transport modes on a global level. The information is intended for sharing between transport operators, their customers (the purchasers of freight transport services) and broader stakeholders to inform:

- Improved transparency, completeness and accuracy of GHG emissions from transport operations / purchased services;
- Support for tracking of progress against targets set by different stakeholder types (operators, transport buyers, researchers, policy makers etc.);
- Support for decision makers at corporate and policy level through the provision of better information throughout the multimodal supply chain, so that all possible emission reduction levers (e.g. modal shift to lower emission modes, operational improvements, vehicle / vessel efficiency, use of low emission energy sources) are accessible and will lead to beneficial outcomes;

- Ensure alignment with higher-level, global frameworks for GHG accounting and reporting of freight transport and logistics (e.g. GHG Protocol, CDP, SBTI, ISO 140XX family) in order to maximize consistency and impact.

2.4.4 Methodology

The methodological approach for the GLEC Framework is summarised in Table 9.

Table 9: Methodological approach for the GLEC Framework

Method characteristic	
Data sources	• 3 types of data are specified within the GLEC Framework for the calculation of GHG emissions, namely: - Primary data, preferred, whereby the vehicle / vessel operator collects the data based on the actual operation of the vehicle / vessel (EEOI). - Modelled data, where the operational performance is approximated by a suitable operational model that takes into account fuel consumption, fuel type, loading and other influencing factors (e.g. direction and rate of flow, draft clearance etc.), for example using EEDI data as one of the inputs. - Default data, where data considered to be typical of the vessel and its operational characteristics, including loading, waterway etc., are used as a substitute for more specific (i.e. primary or modelled) data. Usually data from at least a roundtrip is used.
Calculation method	• The energy used for all operational activity is converted to GHG emissions using the appropriate GHG emission factor for the fuels / energy sources used and divided by the total transport activity, expressed in tkm (similar to the maritime EEOI). • The approach offers flexibility in that it could be applied to cover CO_2 only or GHG and at either TTW or WTW scope for the fuel supply chain, depending on the emission factors that are used; however, full WTW, GHG scope is necessary to meet the requirements of the GLEC Framework. • Standard aggregation is to support annual GHG accounting and reporting. Shorter periods can be covered as long as the periods used for fuel and transport activity data are consistent • The emissions associated with fuel use for any empty or repositioning journeys must be included and distributed proportionally across loaded journeys according to transport activity (tkm) • Smart Freight Centre has accredited several calculation tools such as EcoTransIT, LogEC, Greenrouter and TK'Blue as calculating emissions in conformance with the GLEC Framework.
Presentation method	• Default data for inland waterways presented within the GLEC Framework is the result of collation of various data sources conducted in 2018 resulting in operational values expressed as gCO_2e/ tkm for the following vessel classes: - Motor vessels ≤ 80m (<1000t) - Motor vessels 80 - 110m (1000 – 2000t) - Motor vessels 135m (2000 – 3000t) - Coupled convoys (163 - 185m)

	- Pushed convoy - push boat + 2 barges - Pushed convoy - push boat + 4/5 barges - Pushed convoy - push boat + 6 barges - Tanker vessels - Container vessels 110m - Container vessels 135m - Container vessels - Coupled convoys • Information collected for all modes is consolidated into a standardized data template (B2B GLEC Declaration) for transmission between transport operator and customer. A standard template for presentation of consolidated corporate logistics GHG emissions across all modes (public GLEC Declaration) is also available
Reliability, checks and enforcement	• Voluntary validation available either by Smart Freight Centre in comparison with the GLEC Framework or as part of broader corporate GHG calculation and reporting such as CDP submission or ISO 14064. • Default data considered to be based on best sample available in 2018.

2.4.5 Status / next steps

An international process is underway to develop ISO 14083 “Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from operations of transport chains”. The GLEC Framework is being used as the primary basis for the freight transport element of ISO 14083. ISO 14083 is approaching its final stages of development and is expected to be published in Q4, 2022 if the current ambitious timescale can be adhered to.

The European Commission is anticipating following the ISO as part of its future requirement, within the implementation of the European Green Deal in the transport sector and on transport service providers to provide GHG information to their service users. This refers to the initiative “EU framework for harmonised measurement of transport and logistics emissions – ‘CountEmissions EU’ (see Annex III of this report) one of the actions listed in the EU Sustainable and Smart Mobility Strategy[48].

Various initiatives are underway to enhance the role that digital data collection and transfer in the calculation and reporting of GHG emissions from transport operations, including in the inland waterway sector (e.g. Horizon 2020 project IW-Net). The digital space is a relatively fast evolving space that offers opportunities to significantly improve uptake if GHG data can be incorporated into other digital developments, but also risks GHG calculation and reporting falling behind if space is not found in the digital specifications and dashboards that are being developed.

Specific to the inland waterway sector, discussions are ongoing with the IWT Platform and with the Corporation Inland Tanker Barge Owners (CITBO) regarding access to existing data and future operational data collection activities that would help to:

1. improve the basis of the GLEC default values by further enhancing and updating the data used
2. improve the current low awareness and implementation of emission calculation and reporting actions in the inland waterway sector.

[48] See e.g. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789

The benefit of applying the GLEC Framework in this sector is that it does not have to be at the expense of the other possible approaches, but rather in cooperation with them so that their scope is aligned with best GHG accounting practice.

2.5 Taxonomy Delegated Act concerning climate mitigation

2.5.1 Background

In order to meet the EU's climate and energy targets for 2030 and reach the objectives of the European Green Deal, it is vital that the European Commission directs investments towards sustainable projects and activities. To achieve this, a common language and a clear definition of what is 'sustainable' is needed. This is why the action plan on financing sustainable growth called for the creation of a common classification system for sustainable economic activities, or an "EU taxonomy".

The EU taxonomy is a classification system, establishing a list of environmentally sustainable economic activities. It could play an important role helping the EU scale up sustainable investment and implement the European green deal. The EU taxonomy would provide companies, investors and policymakers with appropriate definitions for which economic activities can be considered environmentally sustainable. In this way, it should create security for investors, protect private investors from greenwashing, help companies to become more climate-friendly, mitigate market fragmentation and help shift investments where they are most needed.

The Taxonomy Regulation was published in the Official Journal of the European Union on 22 June 2020 and entered into force on 12 July 2020. It establishes the basis for the EU taxonomy by setting out four overarching conditions that an economic activity has to meet in order to qualify as environmentally sustainable.

The Taxonomy Regulation establishes six environmental objectives:

1. Climate change mitigation
2. Climate change adaptation
3. The sustainable use and protection of water and marine resources
4. The transition to a circular economy
5. Pollution prevention and control
6. The protection and restoration of biodiversity and ecosystems

Different means can be required for an activity to make a substantial contribution to each objective.

With respect to vessels, we refer to Annex II of the document C(2021) 2800 final published 4 June 2021 (Brussels) supplementing the Regulation EU 2020/852 published 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088. This addresses the climate mitigation part, the greenhouse gas emissions by vessels.

In addition, a delegated act will also be developed on the topic of pollution[49], which will need to be taken into account as soon as it is adopted, notably for the requirements on the air pollutants emissions.

[49] More information on the draft delegation act for pollution elements in Taxonomy: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210803-sustainable-finance-platform-report-technical-screening-criteria-taxonomy-annex_en.pdf

However, the climate mitigation delegated act already requires at least Stage V performance as regards the air pollutant emissions such as NO_x and particulate matter.

2.5.2 Scope

The characteristics of the Taxonomy Delegated Act for inland vessels are summarised in Table 10 below.

Table 10: Characteristics of the EU Taxonomy Delegated Act on inland vessels

Scope characteristic	
Geographic coverage	European Union
Type of vessels considered	Taxonomy applies to the following activities relevant for inland vessels: • Purchase, financing, leasing, rental and operation of **passenger vessels on inland waters**, involving vessels that are not suitable for sea transport. • Purchase, financing, leasing, rental and operation of **freight vessels on inland waters**, involving vessels that are not suitable for sea transport. • **Retrofit and upgrade of vessels for transport of freight or passengers on inland waters**, involving vessels that are not suitable for sea transport. Vessels dedicated to transport of fossil fuels are out of scope.
Type of engines	All engines
Type of emissions	CO2 Other type of emissions and environmental criteria: emissions to water and air and also including waste, hazardous materials on board of ships and ensuring their safe recycling, reuse and recycling of batteries and electronics, including critical raw materials therein. Vessels comply with the emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).
Scope of emission chain	Tank to Wake (in view of application of the EEOI until 2025 with reference to IMO guideline) Zero direct (tailpipe) emissions from 2025 onwards Note: The greenhouse gas reductions by means of usage of sustainable biofuels or climate neutral synthetic carbon fuels (e.g. made from H_2 and captured CO_2) in combustion engines are not into account.

2.5.3 Objectives

The EU taxonomy aims at:

- creating a common classification system for sustainable economic activities, by establishing a list of environmentally sustainable economic activities;
- providing companies, investors and policymakers with appropriate definitions and criteria to identify which economic activities can be considered environmentally sustainable.

In order to be considered as sustainable, the economic activity must contribute to one of the following six environmental objectives set out in the Taxonomy Regulation and must not significantly harm any of the other environmental objectives.

2.5.4 Methodology

Annex II of this report presents the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives.

As mentioned in the scope, for inland vessels there are three types of activities distinguished:

- Inland Passenger Waterway Transport
- Inland Freight Waterway Transport
- Retrofitting of inland water passenger and freight transport

Distinction is made between the period until 31 December 2025 and the period thereafter.

Most relevant are the climate change mitigation elements. In addition, the Annex also makes clear that vessels need to reach emission limits according to the NRMM Stage V: “Engines in vessels comply with emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).”

With respect to the methodology, it is yet unclear how the scheme would work in practice in relation to the required quality reliability and level of detail of the data. Therefore, there are still open questions on the operability of the current technical screening criteria. However, with the view of the announced revision process, these questions may become irrelevant if better / more appropriate technical screening criteria are being selected and applied in the near future.

For climate mitigation, the requirements differ between the three categories (quotes from the original text in *italic*):

Inland passenger transport vessels:

(a) the vessels have zero direct (tailpipe) CO_2 emissions;

(b) until 31 December 2025, hybrid and dual fuel vessels derive at least 50% of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation.

Inland freight transport vessels:

(a) the vessels have zero direct (tailpipe) CO_2 emission;

(b) where technologically and economically not feasible to comply with the criterion in point (a), until 31 December 2025, the vessels have direct (tailpipe) emissions of CO_2 per tonne kilometre (gCO_2/tkm), calculated (or estimated in case of new vessels) using the Energy Efficiency Operational Indicator, 50% lower than the average reference value for emissions of CO_2 defined for heavy duty vehicles (vehicle subgroup 5- LH) in accordance with Article 11 of Regulation 2019/1242.

Retrofitting:

1. Until 31 December 2025, the retrofitting activity reduces fuel consumption of the vessel by at least 10 % expressed in litre of fuel per tonne kilometre, as demonstrated by a comparative calculation for the representative navigation areas (including representative load profiles) in which the vessel is to operate or by means of the results of model tests or simulations.

2. Vessels retrofitted or upgraded are not dedicated to transport of fossil fuels.

Inland passenger vessels

Method characteristic	
Data sources	• Engine configuration and use of type of energy/fuel • Engine emission specifications in relation to compliance with reaching NRMM Stage V maximum emission levels • List of measures in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling. • For battery-operated vessels, list of measures includes reuse and recycling of batteries and electronics, including critical raw materials therein.
Calculation method	• Fuel consumption and share of zero direct (tailpipe) CO2 emission fuels or plug-in power • Emission characteristics in gram per kWh Note: it is not defined how this shall be measured, possibly by means of the ISO 8178 standard[50], similar to the Emission Label for inland vessels and Green Award)
Presentation method	• Share of renewable energy in operation? • Gram per kWh performance for NOx, PM, CO, HC CH_4 (A value)?

[50] For more information on the ISO 8178 standard, see https://dieselnet.com/standards/cycles/iso8178.php

	• Particle Number (PN) per kWh"?
Reliability, checks and enforcement	• Not (yet) defined by EC

Inland freight vessels

Method characteristic	
Data sources	• Engine configuration and use of type of energy/fuel (note: not (yet) defined by EC how this will be determined) • Engine emission specifications in relation to compliance with reaching NRMM Stage V maximum emission levels • List of measures in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling. • For battery-operated vessels, list of measures includes reuse and recycling of batteries and electronics, including critical raw materials therein. • As regards (b): reference value[51]: *50% lower than the average reference value for emissions of CO2 defined for heavy duty vehicles (vehicle subgroup 5- LH) in accordance with Article 11 of Regulation 2019/1242.* • As regards (b) the collection of data from ships should include the distance travelled, the quantity and type of fuel used, and all fuel information that may affect the amount of carbon dioxide emitted. • It is important that sufficient information is collected on the ship with regard to fuel type and quantity, distance travelled and cargo type so that a realistic assessment can be generated.
Calculation method	• Emission characteristics in gram per kWh to check compliance with NRMM Stage V emission levels (Note: it is not defined how this shall be measured, possibly by means of the ISO 8178 standard, similar to the Emission Label for inland vessels and Green Award) • According to the IMO Guideline (MEPC.1/Circ. 684) for the EEOI*:* *The Energy Efficiency Operational Indicator is defined as the ratio of mass of CO_2 emitted per unit of transport work. It is a representative value of the energy efficiency of the ship operation over a consistent period which represents the overall trading pattern of the vessel. Guidance on how to calculate this indicator is provided in the document MEPC.1/Circ. 684 from IMO[52] requiring input on fuel consumption, CO_2 emission factor for fuel and the tonne kilometre performance, including taking into account empty trips and different load rates.* *In order to establish the EEOI, the following main steps will generally be needed:* *1 define the period for which the EEOI is calculated**

51 Currently the threshold value is estimated at 28 grams of CO2 per tkm

52 See for the document: https://gmn.imo.org/wp-content/uploads/2017/05/Circ-684-EEOI-Guidelines.pdf

	2 define data sources for data collection; *3 collect data;* *4 convert data to appropriate format; and* *5 calculate EEOI.* ** Note: Ballast voyages, as well as voyages which are not used for transport of cargo, such as voyage for docking service, should also be included. Voyages for the purpose of securing the safety of a ship or saving life at sea should be excluded.* *The distance travelled should be calculated by actual distance travelled, as contained in the ship's log-book. Amount and type of fuel used (bunker delivery notes) and distance travelled (according to the ship's log-book) could be documented.* *As a ship energy efficiency management tool, the rolling average indicator, when used, should be calculated by use of a methodology whereby the minimum period of time or a number of voyages that is statistically relevant is used as appropriate. "Statistically relevant" means that the period set as standard for each individual ship should remain constant and be wide enough so the accumulated data mass reflects a reasonable mean value for operation of the ship in question over the selected period.*
Presentation method	• Gram CO_2 per tkm • Gram per kWh performance for NOx, PM, CO, HC CH_4 (A value)? • Particle Number (PN) per kWh"?
Reliability, checks and enforcement	• In general, it is (yet) unclear what requirements are for reliability, checks and enforcement. • According to the IMO Guideline (MEPC.1/Circ. 684): *For the EEOI: documented procedures to monitor and measure, on a regular basis, should be developed and maintained. Elements to be considered when establishing procedures for monitoring could include:* *• identification of operations/activities with impact on the performance;* *• identification of data sources and measurements that are necessary, and specification of the format;* *• identification of frequency and personnel performing measurements and* *• maintenance of quality control procedures for verification procedures.* *The results of this type of self-assessment could be reviewed and used as indicators of the system's success and reliability, as well as identifying those areas in need of corrective action or improvement. It is important that the source of figures established are properly recorded, the basis on which figures have been calculated and any decisions on difficult or grey areas of data. This will provide assistance on areas for improvement and be helpful for any later analysis. In order to avoid unnecessary administrative burdens on ships' staff, it is recommended that monitoring of an EEOI should be carried out by shore staff, utilizing data obtained from existing required records such as the official and engineering log-books and oil record books, etc. The necessary data could be obtained during internal audits under the ISM Code, routine*

	visits by superintendents, etc. It shall be noted that there is no legal base in IWT for such auditing as common under the ISM Code for seagoing vessels. Therefore, it is (yet) unclear how the EEOI will be checked and audited in the case of application of the methodology for IWT.

Retrofitting/upgrading vessels

Until 31 December 2025, the retrofitting activity reduces fuel consumption of the vessel by at least 10 % expressed in litre of fuel per tkm, as demonstrated by a comparative calculation for the representative navigation areas (including representative load profiles) in which the vessel is to operate or by means of the results of model tests or simulations.

Method characteristic	
Data sources	• Engine emission specifications in relation to compliance with reaching NRMM Stage V maximum emission levels • Fuel consumption of vessel, in litre of fuel per tkm as demonstrated by a comparative calculation for the representative navigation areas (including representative load profiles) in which the vessel is to operate or by means of the results of model tests or simulations • List of measures in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling. • For battery-operated vessels, list of measures includes reuse and recycling of batteries and electronics, including critical raw materials therein.
Calculation method	• Emission characteristics in gram per kWh to check compliance with NRMM Stage V emission levels (Note: it is not defined how this shall be measured, possibly by means of the ISO 8178 standard, similar to the Emission Label for inland vessels and Green Award) • Fuel consumption of vessel, in litre of fuel per tkm as demonstrated by a comparative calculation for the representative navigation areas (including representative load profiles) in which the vessel is to operate or by means of the results of model tests or simulations
Presentation method	• Litre of fuel per tkm • Gram per kWh performance for NOx, PM, CO, HC CH_4 (A value) • Particle Number (PN) per kWh"?
Reliability, checks and enforcement	• In general it is (yet) unclear what requirements are for reliability, checks and enforcement.

2.5.5 Status / next steps

The results of PLATINA3 Task 2.6 are seen as valuable input for the revision process of the delegated act.

A revision is foreseen in 2022/2023 by DG CLIMA on the Delegated Act for the climate mitigation screening criteria. A major concern in the current version is the zero emission tailpipe requirement from 2025 onwards, as it is not expected that technologies will be available, affordable, and feasible from a competitive viewpoint of the ship-owner/operator.

Furthermore, there is large uncertainty, doubt and concern about the practical applicability of the technical screening criteria and how to make the criteria operable. Detailed guidance and further explanations and discussions are required here.

Moreover, in addition to the climate mitigation Delegated Act, a delegated act will also be developed on the topic of pollution[53], which will need to be taken into account as soon as it is adopted, notably for the requirements on the air pollutants emissions. However, the climate mitigation delegated act already requires at least Stage V performance as regards the air pollutant emissions such as NO_x and particulate matter. Finally, there is a link between State-Aid guidelines and Taxonomy as well.

2.6 Green Award label

2.6.1 Background

Green Award for the inland navigation comes from the Green Award scheme established in 1994 in order to promote quality shipping amongst sea-going vessels. The benefits for extra clean and extra safe ships include image improvement, charterers' preference, reduction on port dues, discounts on pilotage services and various trainings, reimbursement by a bank for a part of the certification costs etc. Green Award is presented as an operational quality mark for ships that demonstrate high safety and environmental standards. Green Award certificate entitles a vessel to various incentives including discounts on ports dues, products and services[54].

In 2011, Green Award launched a certification program for inland waterway transport vessels. The certification program for inland navigation barges has resulted in a total of 955 inland vessels with a Green Award certificate and incentive providers adopting the Green Award in their rules and regulations. In particular, port authorities in The Netherlands use Green Award to differentiate port tariffs and give discounts to Green Award labelled vessels[55]. The program was developed further and a 3-tier certification was introduced; namely, Bronze, Silver, and Gold certification levels. Later on, the Platinum label was added as well to stimulate innovations.

Ports and other maritime service providers and suppliers provide incentives to Green Award certified inland vessels. These incentives are meant to motivate ship owners to invest in cleaner technologies and safer operations; Green Award believes that its certification program contributes to the sustainable environment.

---

[53] More information on the draft delegation act for pollution elements in Taxonomy: https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/210803-sustainable-finance-platform-report-technical-screening-criteria-taxonomy-annex_en.pdf

[54] More information about Green Award: https://www.greenaward.org/inland-shipping/

[55] The full list of incentive providers is available online:" Incentive providers - Inland Shipping (greenaward.org)

The Green Award certification and requirements apply to

- engines
- the technical equipment on board
- the crew

To be eligible for a Green Award certificate the main engines must meet the emission requirements pertaining to CCNR phase 2. This requirement was submitted by incentive providing port authorities involved. So vessels with CCNR-2 engines can be eligible for a Green Award certificate in any case, of course provided they score on other items as well. Vessels with other engines (i.e. without CCNR-2 certification) can also be eligible, provided they arrive at or score better than the emission requirements pertaining to CCNR phase 2 as a result of aftertreatment or other measures. This is to be proved by the applicant by means of emission test reports. The measurements must be executed by an independent and accredited measurements company in accordance with the CCNR protocols.

In consultation with the port authorities, it was decided that only the vessels whose main engines are compliant with the emission standard EU Stage V can be eligible for 'Gold'. However, they must score on other items as well. Dependent on their score they will receive 'Gold' or 'Silver'. Vessels whose main engines comply with emission ceiling CCNR-2 can be eligible for 'Bronze' and 'Silver'. A platinum label for inland ships is granted when ships "operate underway with zero emissions as ship generated exhausts including CO_2, SOx, NOx, PM for a minimum of 50% of time or 3 hours per day. Recorded onboard and reported to GA annually." A platinum label is granted on top of the Green Award certification levels Bronze/Silver/Gold, showing that they sail zero emission. The definition of the platinum label is reviewed annually.

In general: the certification costs for both freight ships and river cruises will be charged once every three years. Green Award certification costs for freight ships (situation 2021) are € 875,00 (excl. VAT) for an inland navigation ship and € 698,00 (excl. VAT) for a push barge. The certification cost for river cruise: € 1.425 (excl. VAT).

A vessel needs to score a minimum number of points on both sheets A & B in order to be certified. The certificate is subsequently valid for three years from the inspection date. Therefore, there are two sheets with data to be filled in, a data sheet on Engines (sheet A), see Figure 4, and a data sheet for additional requirements (Sheet B), see Figure 5.

DOC 5a (A. Engines)

Green Award Inland Waterway Transport - Schedule of Requirements 2017 (rev.3)

Motor vessel:
Date and location of inspection:
Inspector:

List A: engines

Engine	Application	Fuel	AfterTreatme	Emission-level NO_x	Points	Emission-level PM	Points	Fuel-saving in % (fs)*	Weighting-factor fs	Engine-power in kW	Operating hours annually	kWh	Contribution per engine	Points per engine
	propulsion									1.800	8.500	15.300.000	90%	0
	bow thruster									750	270	202.500	1%	0
	generator									225	3.700	832.500	5%	0
	generator									225	500	112.500	1%	0
	generator									175	3.500	612.500	4%	0
												0	0%	0
											Total:	17.060.000	100%	0

Both main and auxiliary engines should be completed.
Select the emission level here, the number of points will appear automatically. Take care not to delete the formula.
Enter the power and the operating hours here. The spreadsheet will calculate the contribution per engine automatically and award the points.
Emission level is the same for all the engines, entering the emission level will suffice. In that case there is no point in calculating the contribution per engine
For example: if all the engines are CCNR-2, the result will always be 200 points.

Main engines — ***Points***

Emission requirements in conformity with CCNR phase 2 for NO_x and PM — 200 (score 100 for CCNR2-NO_x and 100 for CCNR2-PM)

> NO_x or PM (EU StageV) — 300 (score 100 for CCNR2-NO_x or PM and 200 for EU StageV-NOx or PM)

*NO_x: engines 130 ≤ P ≤ 300, **2,1** g/KWh   PM: engines 130≤ P ≤ 300, **0,1** g/KWh*
*NO_x: engines P ≥ 300, **1,8** g/KWh   PM: engines P ≥ 300, **0,1** g/KWh*

> NO_x and PM (EU StageV) — 400 (score 200 for EU StageV-NO_x and 200 for EU StageV-PM)

*NO_x: engines 130 ≤ P ≤ 300, **2,1** g/KWh   PM: engines 130≤ P ≤ 300, **0,1** g/KWh*
*NO_x: engines P ≥ 300, **1,8** g/KWh   PM: engines P ≥ 300, **0,1** g/KWh*

Auxilary engines

Unknown/non-certified — -200 **
Emission-requirements in conformity with CCNR phase 2 for Nox and PM — 200 see above
> NO_x or PM (EU StageV) *(values: see main engines)* — 300 ditto
> NO_x and PM (EU StageV) (*values: see main engines)* — 400 ditto

* Possibility to reward demonstrated fuel savings in case of adaption of engine configuration (no additives), if applicable.
To be assessed by Green Award. When a vessel is arranged with a diesel-electric main propulsion? In list A: calculate 4% fuel savings and apply weighting factor 1.
** This applies for auxiliary engines. This score cannot occur with main engines, because unknown/non-certified is not eligible for a Green Award certificate anyway.
Unknown/non-certified engines which demonstrably achieve an emission level of CCNR-2 or better are eligible, however.

Figure 4: Data sheet A for engines for the Green Award certificate

DOC 5.3.7b (B. Additional requirements)

Green Award Inland Waterway Transport - Schedule of Requirements 2017 (rev.3)

Motor vessel:

Date and location of inspection:

Inspector:

List B: additional requirements

		Points	
10	**Fuels**	**Max.**	**Obtained**
a	LNG as fuel for propulsion	40	
b	LNG as dual fuel for propulsion	20	
c	GTL as fuel for propulsion	20	
d	HVO (called BIO fuel)	20	
20	**Propulsion/hull measures**		
a	Does the vessel have a diesel-electric main propulsion and or bow-thruster(s) drive?	20	
b	Does the vessel have an alternative energy-saving propulsion?	30	
c	Does the vessel have an energy-saving rudder system?	10	
d	Does the vessel have an operating shaft generator?	10	
e	Does the vessel have a counter-rotating rudder propeller?	10	
f	Does the vessel have a thruster pipe covering the propellor?	8	
g	Have resistance-diminishing measures to the vessel's hull been taken?	10	

30	**Fuel saving**		
a	Is a certificate pertaining to a course on fuel saving present on board? Alternative: E-learning course.	10	
b	Does the vessel participate in the Lean and Green Programme? Alternative: CO2 calculator.	15	
c	Is a fuel-consumption meter present on the main engines?	4	
d	Is an intelligent consumption meter present? (cruise control, A-tempomat in combination with a fuel-consumption meter)	15	
e	Is a the vessel arranged with a heat exchanger? (engine warmth utilized for heating purposes, e.g. warmwater)	15	
f	Is the vessel arranged with anchor pile(s)	5	

Green Award Inland Waterway Transport - Schedule of Requirements 2017

Motor vessel:

Date and location of inspection:

Inspector:

List B: additional requirements

		Points	
40	**Waste & maintenance** (either a or b is a compulsory score for any certification level)	**Max.**	**Obtained**
a	Has Is the vesselping Environmental Plan (SEP) or an alternative in conformity with ISO 14001 been implemented and maintained on board for at least 6 months?	20	
b	If SEP/ISO is lacking: is a registration of waste submission (divided into plastic, household refuse, vessel's waste, HHW) present?	12	
c	Are proper and fitting drip trays present under the engines?	12	
d	Is the bilge clean?	8	
e	Is a microfiltration system in use for lubricating oil?	5	
f	Does the vessel have a valid 'IVR (International Association the Rhine vessels Register) Certificate of Damage-Prevention Survey'?	15	
g	Does the vessel has a by Green Award approved alternative for the "Certificate of Damage-Prevention Survey"?	15	

50	**Preventing Pollution**	**Max.**	**Obtained**
a	Does the vessel have certified propeller-shaft stopvalve(s) (inside and outside)?	15	
b	Does the vessel have demonstrable rudder stopvalve(s) (rudder-trunk stopvalve)?	20	
c	Are the bunkertanks been provided with a permanent high-level alarm?	15	
d	Has a bunker-safety checklist for bunkering the vessel's fuel been implemented?	10	
e	Is a closed-circuit greywater system present on board, including release point?	20	
f	Is a closed-circuit greywater system present on board, excluding release point?	10	
g	Is a water-purification plant present on board?	10	

60	**Safety**	**Max.**	**Obtained**
a	Are SOS stopvalves present outside on deck?	10	
b	Is a fire-prevention drill held every six months?	5	
c	Is a drill involving a simulation of a man-overboard situation held every six months?	5	
d	Is a demonstrable use of personal protective equipment (such as helmet, life jacket, hearnig protection) apparent?	5	
e	Are fill-level indicators present on the side ballast tanks? Alternative:stability software program applied?	10	
f	Are battery packs placed in acid proof trays?	5	
g	Is the vessel main cargo deck arranged with a railing to protect the crew from falling overboard	10	

Figure 5: Data sheet B for additional requirements for the Green Award certificate

2.6.2 Scope

The characteristics for the Green Award label is summarised in Table 11.

Table 11: Characteristic for the Green Award label

Scope characteristic	
Geographic coverage	Basically open to any inland vessel but practically the Green Award is applied in The Netherlands, Germany, Belgium. The use mainly depends on the incentive providers which are mainly the ports providing discounts on the port dues.
Type of vessels considered	All inland vessels
Type of engines	All engines, CCNR2 performance or better
Type of emissions	Air pollutant emissions (NOx and PM) Greenhouse gas emissions only in relation to Platinum label (zero-tailpipe emission for at least 3 hrs of sailing)
Scope of emission chain	Tank to propeller (sheet A), Additional points (sheet B) for alternative fuels (LNG, GTL, HVO,.)

2.6.3 Objectives

The main objective is promoting clean and safe ships by means of incentives linked to the Green Award scheme.

2.6.4 Methodology

The methodology for the Green Award label is summarised in Table 12.

Table 12: Methodology for the Green Award label

Method characteristic	
Data sources	Sheet A (engines): • Gram per kWh performance of engines • Engine power • Aftertreatment specification • Operating hours per engine • Fuel used Sheet B (other) • Alternative fuels specification[56] • List of propulsion measures • List of fuel saving measures • List of waste and maintenance measures • List of preventing pollution measures • List of safety measures
Calculation method	• Points awarded for scope per engine (Sheet A) • Points awarded for other measures (Sheet B) • Summing up the points • Checking total score in relation to threshold scores for Green Award categories
Presentation method	• Label type: Bronze, Silver, Gold, Platinum
Reliability, checks and enforcement	• Inspection by Green Award • 3 year validity of certificate • Platinum performance to be supplied and monitored each year • ….

2.6.5 Status / next steps

It is foreseen to align the Emission Performance Label managed by SAB with the Green Award scheme. This specially concerns a revision of the part A form of the Green Award concerning the emission performance of the engines on board as well as the part B on the fuels (in view of the greenhouse gas emissions).

[56] Most reputable alternative fuels come from suppliers that can make ISCC or RSB certificates available

3 Levels and objectives for a new instrument

3.1 Introduction

In general, there can be multiple ways to reduce the greenhouse gas emissions and the air pollutant emissions, with different viewpoints, involved actors and intervention areas. Ways can be to reduce the energy demand (improvement of energy efficiency), use of energy or fuels which is less greenhouse gas intensive and less polluting and power converters which are more efficient and less emitting (Table 13).

Table 13: Potential reduction of GHG and Air Pollutant emissions for inland vessels

	Reduce Green House Gas emissions / carbon intensity	**Reduce Air Pollutant emissions (local) for health and nature, NO_x and PM, NH_3, …**
Use less greenhouse gas intensive and less polluting energy or fuel	• Increase use of renewable energy / energy with low WTW GHG footprint (gram CO_2 eq per MJ) • Apply technical measures to reduce other greenhouse gasses on board: CH_4 (methane slip) and N_2O	• Use of clean fuels with less air pollutant emissions • Use of clean energy convertor and /or pre- and after treatment (e.g. catalysts, filters)
Increase Energy Efficiency	**Improve hardware of vessel:** • Energy convertors efficiency (energy input vs energy output (decrease thermal losses, e.g. MJ caloric value vs kWh mechanical output). Note that the energy efficiency of the fuel (e.g. the amount of energy used to generate the fuel) is not taken into account or discussed in this report, only the energy efficiency of the vessel. TTW approach is used • Hydrodynamic improvement: hull shape, propeller **Improve operational use**: • Optimise trip planning, sailing speed and energy management • Optimise payload, reduce empty sailing and economies of scale	

With respect to increasing energy efficiency, it is worth noting that the energy efficiency of the fuel itself is also important to consider when appraising the emission reduction challenge. Indeed, if the energy efficiency of a vessel is increased by 50% but an energy carrier is used which is 100% more energy intensive in its production compared to another energy carrier based on the same feedstock or primary energy source, from an overall well-to-wake perspective there is no energy efficiency gained compared to the other energy carrier.

From a well-to-wake approach, the choice of fuel may have a significant effect on the overall energy consumption of vessel. While this is not considered in the different levels and related methodologies, this might be a factor worth considering in the future once more data about energy efficiency of fuels will become available. This may be relevant for instance in order to prioritise in case of scarce renewable sources. For example, in case of use of green electricity (e.g. from solar power, wind, water energy) the most energy efficient option is to use shore charged batteries rather than hydrogen (from electrolysis) or the use of produced synthetic e-fuels.

In addition, the waterway conditions also play a significant role. For example, fairway maintenance is key to safeguard the navigability and the payload which can be carried by barges. Especially low draught conditions at free flowing waterways can result in high energy demand and thus emissions, especially if expressed by the indicator of energy or grams per tkm.

Furthermore, economies of scale can be achieved by using larger vessels if this fits with the shipment sizes. However, this also requires of course that the infrastructure dimensions allow for use of larger vessels. Typical bottlenecks in this respect are for example limited dimensions of locks and bridge clearance (the latter in case of container transports) and low water levels resulting from poor waterway maintenance (lack of dredging).

However, the focus here is on a label /index for the performance of the vessel rather than the performance of the infrastructure. Therefore, the available infrastructure dimensions are seen as a given, and external factor for the vessel. The available infrastructure dimensions, including varying water levels and currents, are important explanatory variables for the performance of a vessel, especially for the application of the EEOI and EEDI.

The infrastructure dimensions are, within PLATINA3 Task 2.6, not a primary parameter to benchmark. It could however be a spin-off resulting from a data collection of the operational vessel performance (EEOI), taking into account the waterway conditions and dimensions of the infrastructure performance (Good Navigation Status). By means of a detailed continuous monitoring of the vessel performance on different sections of waterways, it becomes much clearer and more visible as well what the impact is of infrastructure characteristics on the emission and energy performance of inland waterway transport. Such insight may be supporting to identify bottlenecks and for the decision making on infrastructure investments. For example, such data can feed Social Cost Benefit Analyses for increased dimensions with more reliable information on the benefits and external cost savings resulting from emission costs.

The objective of the instrument to be defined under Task 2.6 were described in the PLATINA3 grant agreement (see section 1.2). Two objectives are rather general:

- To *assess* and where appropriate coordinate the scheme of a vessel index/label system and support the implementation.
- To *elaborate* the **technological/methodological basis** as the function of a label.

The two others are more specific:

- To thus *realise* an instrument to enable a differentiated incentive scheme to get **shipowners** to invest in **powertrain solutions** for the zero-emission pathway.
- To *assess* the link with GHG calculations in logistics (grams per tkm)

In addition, the NAIADES III Action Plan specifically mentions the need for an EU energy index methodology for monitoring and reporting carbon footprint intensity of inland vessels[57] and a specific action is presented for this: Action 11 "*Facilitate through the H2020 PLATINA III project the elaboration of an EU energy index methodology for assessing* ***carbon intensity levels of inland waterways vessels***". This means that special attention should be given to the vessels' performance as regards the greenhouse gas emissions.

Next to carbon emissions, reducing air pollutant emissions (NO_x and PM) is also a highly important objective stemming from European and regional policy, as highlighted in particular in NAIADES III and the Mannheim Declaration[58]. For ensuring the EU wide policy support modal shift, it is needed that inland waterway transport is at least competitive as regards the air pollutant emissions compared to road transport for the transport service.

Both the PLATINA3 objectives for Task 2.6 and the NAIADES III Action Plan speak about "vessels" and 'ship-owners' which can be seen as leading for the methodology to conclude and recommend.

Consequently, it is clear that the **primary goal** of the foreseen **instrument** should be to **incentivise the reduction of both air pollutant and greenhouse gas emissions and that a new instrument should aim at identifying the emission performance of the vessel and the carbon intensity of the energy used.** In order to take into account the carbon intensity of the energy used, the well-to-wake perspective is to be applied to identify the carbon intensity of the vessel. The characteristics of the vessels in general, as well as its engines and fuels used must be considered in the methodology, notably the specific energy consumption and the emission profile, in order to achieve this overall goal.

In addition, to achieve the emission reduction objectives set in the Smart and Sustainable mobility strategy, as well as in the Mannheim Declaration, the emissions generated by both inland waterway passenger and freight transport should be tackled. Without efforts being made in both market segments, the emission reductions objectives cannot be made.

In light of the above, it is clear that, to achieve at least the objectives stated in the grant agreement, the scope of the instrument should at least:

- **include both freight and commercial passenger transport** vessels and their owners in the scope of such an instrument. Furthermore, since also floating equipment such as dredger vessels are subject to technical requirements for inland vessels, floating equipment is seen as part of the scope. Other types of crafts such as pleasure craft could also be considered on a longer term.
- **be wider than only the powertrain**. Focusing only on the powertrain would provide an incomplete picture about the air pollutant emission performance of the vessel and the carbon intensity (see more detailed information below).

[57] NAIADES III: […] "As a first step, an agreed EU energy index methodology (in collaboration with the Horizon Europe zero-emission waterborne transport partnership and the H2020 Platina III project) is needed for monitoring and reporting carbon intensity of inland waterway vessels."…

[58] https://www.ccr-zkr.org/files/documents/dmannheim/Mannheimer_Erklaerung_en.pdf

- **be enlarged so as to include all primary energy convertors on board**. Another argument for choosing all energy convertors is the expected increase of vessels propelled by electric engines. The energy convertors producing electric energy on board can have multiple energy users, not necessarily only the powertrain but also for other purposes. For example, on passenger cruise vessels a lot of electric power is also needed for the comfort of the passengers. Another example is the pumping of liquid cargo in/out of motor tankers.

Having said that, it should be made clear that the objectives described in the grant agreement for Task 2.6 are not exhaustive and that the suitability of the methodology on which basis the instrument should be designed greatly depends on the specific purpose, the foreseen uses and applications or this instrument (and which might not specifically be described in the objectives of Task 2.6). For instance, other objectives than those described in the grant agreement might be to:

- encourage vessel owner to improve the energy efficiency of their vessels by means of adaptation of hull shape and propeller and optimising load capacity.
- have an instrument in place that could be used by public authorities to define access to certain areas (urban areas or sea and river ports) or adjust certain fees (port dues, fees for occupying the public river domain)
- have an instrument enabling inland waterway companies to define their greening policy.

In fact, the discussions on the different uses, within the CCNR as well as PLATINA3 (Chapter 1) indicate that there could be different purposes and objectives which may ask for several modules integrated in an instrument, suitable for new built and certified as well as for existing vessels and retrofit solutions of energy convertors and possibly hull and propellor. One instrument consisting of different modules could be envisaged, whereby the combination of different modules allows different users to derive the information fitting best to their needs and objectives. As mentioned, also relevant information for waterway managers could be generated, to support the investments in maintenance and upgrading of the waterway network.

The following are some examples of how this tool could be modulated depending on the objective to be achieved

- To achieve one of the objectives of Task 2.6 developing "**a label as basis for a differentiation between vessels and thus to provide incentives which stimulate investments in powertrain solutions**" fitting in the pathway to zero-emission, it would seem appropriate that the instrument focuses primarily on the **ship-owner and the powertrain** in view of the steps to be made in the zero-emission pathways. In this respect, focus of a new instrument could therefore primarily be put on the **environmental performance of the power convertors on board and the fuels to be used in view of the air pollutant emissions and carbon intensity of the used energy by the vessel**. As is made clear in the Task 2.5 of PLATINA3 and the CCNR study, this is also the particular field where a lack of business case is seen in the market, for example for vessels with low air pollutant emissions and with a low carbon footprint. As indicators for a label, the gram per kWh performance for air pollutants and greenhouse gas emissions (WTW) and the energy efficiency of the power convertors (MJ energy per kWh output) could be used in this example in view of the no-regret investments needed in zero-emission powertrain technologies, while taking into account the 'right sizing' of the installed power.

- To achieve another objective described the grant agreement for Task 2.6, which specifically refers to "***assessing the link to logistics and the unit grams per tkm***", the focus would need to be put on freight transport and should be then more elaborated than the previous example in view of a possible link between a label/index scheme with the data used for GHG calculations in logistics (grams per tkm).

  Moreover, in general the possible synergies shall be identified with other uses and functions which may go beyond the primary objective of stimulating the ship-owner in making investments in energy convertor solutions which fit in the pathway towards zero-emission.

  In view of the link to logistics, a possible step is to link the powertrain performance to the waterway conditions and the service provided or the waterway on which the vessel is operational. In this step the total energy consumption and emissions can then be divided by the transport performance (e.g. moved tonnes, distance travelled, transport activity). In this way the average emissions, such as greenhouse gas emissions per tkm can be identified.

  For example, based on fuel consumption and the emission profile of the powertrain, the service performance can be taken into account by dividing the total energy consumption and emissions by the transport activity. This gives the link to greenhouse gas calculations in grams per tkm. Thus, it can be an instrument to assess carbon intensity levels of inland waterway transport services, both on the level of the energy convertors on board as well as on the level of the transport performance.

  In particular, the carbon intensity level for a particular service is relevant for the comparison with other modes of transport. Here it is beneficial to ensure operational compatibility with the Global Standards from GLEC and ISO. Moreover, in view of modal shift, the full door-to-door chain needs to be taken into account. This therefore includes the additional energy and emissions for transhipment processes and pre- end haulage operations.

- To achieve other objectives than those described in the grant agreement, such as improving the energy efficiency of the vessels, other intervention areas such as the hydrodynamic performance of the vessel (hull shape, propeller) and the operational performance elements such as sailing speed, logistic optimisation must be considered. It is worth noting that when it comes to reducing fuel consumption, there is already a market mechanism to apply these innovations as they can be profitable. A return on investment of energy saving measures could be provided by reduced energy costs, especially if higher energy prices are expected in future.

- Similarly, if emission reduction objectives target specifically the passenger transport market and aim at addressing inland passenger transport as a service, it would be necessary to look into a specific methodology based on specific indicators, possible gram emissions per passenger km, or gram emission per km, differentiated by type and size of passenger vessel.

Overall, the following levels were identified in order to define a methodology for expressing the energy and environmental performance of vessels and services:

A. Powertrain only (propulsion of the vessel)

B. All energy convertors on board (incl. heating, cooling, auxiliary engines, on board facilities, etc.)

C. Vessel performance including hydrodynamics for specific operating conditions

D. Service performance including speed, utilisation, empty sailing

E. Multimodal door-to-door service including also pre-/end haulage and transhipment

Technical assessments and expert discussions took place to assess the characteristics for these levels. Depending on the objectives to be achieved and the foreseen use of the instrument, some levels might be more appropriate than others. If the idea of a modular instrument is retained, such levels could be considered as different modules. The levels are explained and discussed in more detail below.

3.2 A. Powertrain only (propulsion of the vessel)

A first objective is to make a differentiation in the fleet, to identify the energy and emission performance of the powertrain, and thus to provide a basis for promotion and providing incentives to vessels which have efficient powertrains with low impact on emissions in combination with use of energy with reduced or zero carbon intensity.

Therefore, the first level which was identified in order for the foreseen instrument to achieve this objective is the environmental performance of the powertrain. The performance of the powertrain can be expressed by means of:

- Powertrain efficiency: energy efficiency (e.g. MJ energy input per kWh output)
- Emission levels per power input or power output. This can be expressed grams emission per MJ of caloric value of the fuel or per litre of fuel[59] or grams per kWh mechanical output for both the air pollutant emissions and the greenhouse gas emissions.
  In order to be consistent and comparable with standards for type approval of engines, the indicator grams per kWh is most often used.

In case of multiple engines on board of the vessel, the running hours of each engine are important to calculate the weighted average performance. For example, in case of an older engine (e.g. CCNR I) combined with a new engine (e.g. Euro VI), the methodology will take into account what the share of the engine is in the total kWh (maximum power (kW) * running hours (h)). As the emissions are expressed in grams per kWh, the weighted average can be calculated on this basis.

It however cannot distinguish the real sailing conditions in relation to the load rate of the engine. Therefore, if emissions or energy consumption deviate from the weighted average measured according to the ISO 8178 protocol, this is not taken into account. Table 14 presents the weight factors applied for the most commonly used E3 cycle in ISO 8178.

[59] The energy efficiency of the fuel (i.e. the amount of energy used to generate the fuel) is not taken into account or discussed in this report, only the energy efficiency of the vessel. TTW approach is used.

Table 14: ISO 8178 weight factors for the E3 cycle

ISO 8178 Weight factor E3 test cycle	Load factor engine
0.15	25%
0.15	50%
0.50	75%
0.20	100%
Weighted average for E3 cycle	68.75%

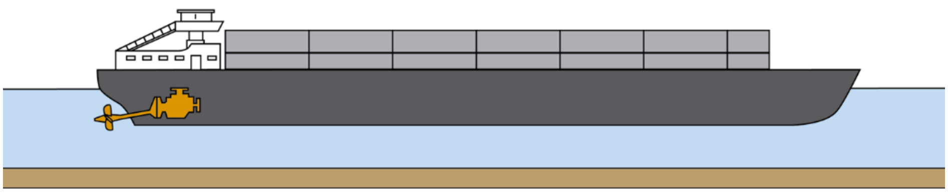
This may lead to some inaccuracy between the theoretic value and the real world value for the energy consumption and emissions. In the PROMINENT project[60], detailed measurements illustrated examples of average engine load rates between 30% and 40%.

In particular, if the engine has a low load rate, for example when sailing empty at low speeds or downstream, the specific fuel consumption (litres per kWh) and thus CO_2 emissions can be higher. Also emissions of air pollutant emissions may deviate. This can be especially the case for NO_x emissions in case of SCR, which are sensitive for the exhaust gas temperature. At low loads of the engine (e.g. below 20%), temperatures may drop resulting in less effective functioning of the SCR, resulting in higher NO_x emissions per kWh at low loads.

Therefore, having an overpowered engine on board which is inefficient as a result of low load rates of the engine will not become visible in the output values. In practice, such cases of (too) low load rate of the engine can be solved either by means of right sizing (installing an engine with less power) or by means of a multi-engine configuration, where for example bigger engines are only used when there is sufficient power demand and at lower power demand a smaller engine is used.

Table 15 summarises the key features of level A.

Table 15: Key characteristics of level A (powertrain only)

Definition	This level takes into account the environmental performance of the powertrain only.  *Figure 6: LEVEL A Powertrain only*

60 https://www.prominent-iwt.eu/

Objective which can be achieved with this level	To make a differentiation in the fleet, to identify the energy and emission performance of the powertrain and thus to provide a basis for promotion and providing incentives to vessels which have efficient powertrains with low impact on emissions in combination with use of energy with reduced or zero carbon intensity.
Is this level already applied	Partly, on test beds for type approved engines (e.g. CCNR 1, CCNR 2, Stage 3a and Stage V NRMM) and also by means of on board measurement
Information required	• Emission profile of engine according to ISO 8178 for air pollutant emissions (NO_x, PM, …) and greenhouse gas emissions (CO_2, CH_4, N_2O), based on the fuel consumption at specified engine load rates (e.g. 25%, 50%, 75%, 100%) • Specific energy/fuel consumption for engine (e.g. gram fuel or MJ per kWh) • Maximum power output of engine • Number of running hours of engine • Specification of the fuel and energy types used and share in total (in order to determine carbon intensity)
Indicator used	The performance of the powertrain can be expressed by means of: • Powertrain efficiency: energy efficiency (e.g. MJ energy input per kWh output) • Emission levels per power input or power output (e.g. grams per MJ energy input or kWh output) for both the air pollutant emissions and the greenhouse gas emissions
Reliability / accuracy	Real world performance as regards to air pollutant emissions may differ as result of load rates of the engine which can deviate from the weight average according to the ISO 8178 measurement protocol. Usually the average load of the engine is lower than the 68.75% which is applied in the E3 cycle for emission measurements of direct propulsion engines.
Pro's and cons	• The indicator "grams emissions per kWh" is clear and commonly used and agreed as main indicator for the air pollutants, with the Tank-to-Wake scope. This also aligns and corresponds to the indicators used for type approval of engines (e.g. CCNR 1, CCNR 2, NRMM Stage 3A and NRMM Stage V). On board measurements can be done, also for retrofit solutions according to the commonly applied ISO 8178. • There is no current standard or legislation for IWT to express the carbon intensity or fuel efficiency of power convertors for inland vessels. However, the specific fuel consumption data is available at the engine providers and the values are reported in the type approval certificates. Furthermore, in case of older engines (e.g. pre- CCNR I) or adapted engines (e.g. refit solutions) also on board measurement is possible of fuel consumption and CO_2 emission according to same ISO 8178 standard used for type approved engines. • For the greenhouse gas emissions / carbon intensity it is needed to include also the upstream emission aspect, in order to properly take into account the sustainable fuels such as biofuels (e.g. HVO) and renewable fuels of non-biological origin (e.g. e-fuels made with green electricity or hydrogen from renewable source). To be considered low or zero emission, these

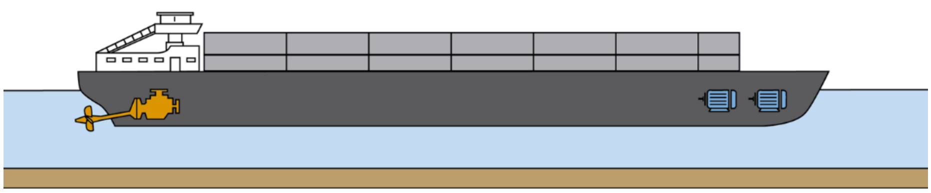
	alternative fuels or energy sources must indeed be derived from renewable sources. • A complexity is that auxiliary engines such as generator sets on board are often multi-purpose and is very difficult and complex to determine which part of the power is used for propulsion of vessel and which part is used for other purposes. Especially in near future with more electric engines expected and hybrid power configurations on board, this is a significant barrier. • This methodology does not allow to address the benefits of right sizing or a multi-engine strategy to reduce energy consumption and emissions

3.3 B. All energy convertors on board

Based on level A (only powertrain) and the findings, a logical step is to define a level which include all energy convertors on board of the vessel. In this way, the vessels can be compared with each other based on their weighted average emissions per energy convertor. This has the advantage that it includes also energy convertors like generator sets which can be used both for hotel electricity on board and for propulsion power in case of electric engines. This level would also aim at ensuring that the instrument could be used to make differentiation in the fleet to promote vessels which have powertrains with low impact on air pollutant emissions in combination with promotion of use of energy with reduced or zero carbon intensity as well as energy efficient energy convertors.

This level B is consistent with the approach for the emission performance label developed in the Netherlands and has also similarities with the engine and fuel elements of the Green Award certificate (see chapter 2).

Table 16: Key characteristics of level B (All energy convertors on board)

Definition	This level takes into account the environmental performance of the energy convertors on board of the vessel  *Figure 7: LEVEL B All energy convertors on board*
Objective which can be achieved with this level	To make a differentiation in the fleet, to identify the energy and emission performance of all energy convertors on board and thus to provide a basis for promotion and providing incentives to vessels which have efficient energy

	convertors with low impact on emissions in combination with use of energy with reduced or zero carbon intensity.
Is this level already applied	Yes (see section 2.1: Emission Performance Label inland vessels as developed in The Netherlands)

Information required	• Emission profile of each energy convertor according to ISO 8178:
	  ○ Weighted average for air pollutant emissions (NOx, PM, …)
	  ○ Weighted average for Greenhouse gas emissions (CO_2, CH_4, N_2O)
	• Specific energy/fuel consumption for each energy convertor (e.g. gram fuel or MJ per kWh)
	• Maximum power output of each energy convertor
	• Number of running hours for each energy convertors
	• Specification of the fuel and energy types used and share in total for the vessel as a whole (in order to determine carbon intensity)

Indicator used	The performance of the powertrain can be expressed by means of: • Efficiency of the power convertors: weighted average of the energy efficiency (e.g. MJ energy input per kWh output) • Emission levels per power input or power output (e.g. grams per MJ energy input or kWh output) for both the air pollutant emissions (TTW) and the greenhouse gas emissions (WTW)
Reliability / accuracy	In general the reliability is high as the method is straightforward, replicable and verifiable. Real world performance as regards to air pollutant emissions may however slightly differ as result of load rates of the engine which can deviate from the weight average according to the official and legally based ISO 8178 measurement protocol. Usually the average load of the engine is lower than the 68,75% which is applied in the E3 cycle for emission measurements of direct propulsion engines. This is a possible area for further development and is foreseen to be addressed.
Pro's and cons	• The indicator "grams emissions per kWh" is clear and commonly used and agreed as main indicator for the air pollutants, with the Tank-to-Wake scope. This also aligns and corresponds to the indicators used for type approval of engines (e.g. CCNR 1, CCNR 2, NRMM Stage 3A and NRMM Stage V). On board measurements can be done, also for retrofit solutions according to ISO 8178. • There is no current standard or legislation for IWT to express the carbon intensity or fuel efficiency of power convertors for inland vessels. However, the specific fuel consumption data is available at the engine providers and the values are reported in the type approval certificates. Furthermore, in case of older engines (e.g. pre- CCNR I) or adapted engines (e.g. refit solutions) also on board measurement is possible of fuel consumption and CO_2 emission according to same ISO 8178 standard used for type approved engines. • This level works for all type of inland vessels (freight (self-propelled and push convoys), passenger crafts and floating equipment) and for all geographic operating areas and type of waterways

	• For the Greenhouse gas emissions / carbon intensity it is needed to include also the upstream emission aspect, in order to properly take into account the sustainable fuels such as biofuels (e.g. HVO) and renewable fuels of non-biological origin (e.g. e-fuels made with green electricity). • Level B does not include the hull and operational / logistic efficiency elements • The current methodology does not allow to address the benefits of right sizing or a multi engine strategy to reduce energy consumption and emissions. It can be improved in case of applying continuous measurement on board of the load rate of the engine, fuel consumption and the NOx emissions. Field lab tests of such continuous measurements are taking place in 2022 funded Connekt which may provide a solid basis for expansion and improvement of the methodology to further increase accuracy in relation with real world emissions. • Data on fuel consumption and type is already included. Transport performance information can be added relatively easily, e.g. on yearly basis, which makes the step towards level D and allows monitoring of the fleet performance based on realised fuel consumption and transport performance.

3.4 C. Vessel performance including hydrodynamics

Level C refers to the $EEDI_{inland}$ as presented in chapter 2.2 of this report. This concerns a limited level A (only GHG emissions, TTW of powertrain) but adds the hydrodynamic performance (hull shape, propeller) and the efficiency of the hull shape for specific theoretic operating conditions.

Test trials are used to identify the maximum reachable speed for a pre-calculated and applied shaft power. The related Energy-Efficiency Index (in g CO_2/tkm) is then calculated and compared with a required $EEDI_{inland}$. The required $EEDI_{inland}$ can be obtained from given trendline curves or by the associated functional equation. The attained $EEDI_{inland}$ needs to be lower or equal the required $EEDI_{inland}$. Trendline curves were derived for different ship types and different waterway conditions (deep water and restricted water depths with and without current).

This level is particularly relevant to evaluate the energy efficiency of inland waterway vessels with regards to how it is designed and built. If the idea of a modular instrument is retained, Level C and B could be considered as complementary modules.

Table 17 summarises the key characteristics of level C (vessel performance including hydrodynamics).

Table 17: Key characteristics of level C (vessel performance including hydrodynamics)

Definition	This level does identify the efficiency of the design of the vessel, it expresses the CO_2 performance of the power train and the hydrodynamics from a Tank to Wheel viewpoint at different draughts and sailing speeds for different type of waterways.

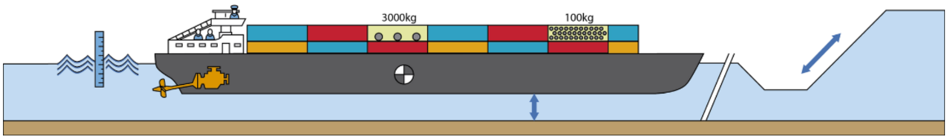
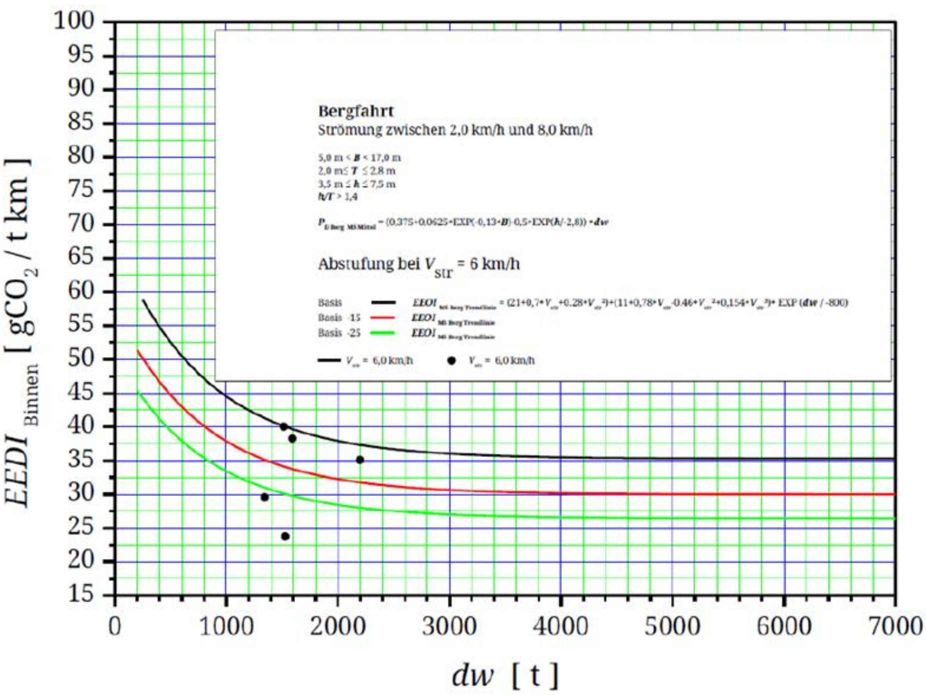
<table>
<tr><td></td><td>


Figure 8: LEVEL C Vessel performance including hydrodynamics
</td></tr>
<tr><td>Objective which can be achieved with this level</td><td>To evaluate the energy efficiency and CO_2 emission of inland waterway vessels with regards to how it is built/designed and how it performs under different circumstances. It presents the energy efficiency and CO_2 emission performance for specific waterways at different waterway depths and sailing speeds of the vessel.</td></tr>
<tr><td>Is this level already applied</td><td>Yes, mainly for new built vessels in the Rhine area, including also model tests at different water levels</td></tr>
<tr><td>Information required</td><td>

- Design data (main particulars of the ship, deadweight, propeller diameter, draught etc.)
- The maximum reachable speed for a given applied shaft power.
- Waterway conditions (water depth, flow velocity)

</td></tr>
<tr><td>Indicator used</td><td>

- Grams CO_2 emission per tkm. Graphs are used showing the performance at different speeds, type of waterways and draught conditions. Graphs present the target values to be reached, for example the proposed base line or at later stage a 15% lower emission per tkm or 25% lower emission per tkm (see Figure 9 as an example).



</td></tr>
</table>

	Figure 9: Example for permissible indicators EEDI in gCO_2/tkm
Reliability / accuracy	• Since the real world application of vessels can deviate substantially from the estimated use and conditions at the design phase, the real world performance could be quite different compared to the intended design. For example, if vessels designed to operate at low draught conditions are not used for such conditions (e.g. only used in deep open water), the particular advantages in the EEDI would not show in practice and the design may even show to be less efficient than the benchmark. Furthermore, the design speed can also be different compared to the speed in real world, which can also lead to strong differences. It is therefore mainly applicable for vessels for which the specific operational area and conditions are already quite clear and certain during the design phase of the vessel.

Pro's and cons	• Basically, the $EEDI_{inland}$ approach can be varied on rivers with water depths between 3.5m and 7.5m (or on deep water) with current velocities between 2 and 8 km/h. On channels with a trapezoidal profile the approach can be applied as well.
	• Models for EEDI are not available for all EU waterways and neither for all vessels.
	• This methodology allows to determine the EEDI of a vessel with sufficient accuracy already in the design phase by model testing or numerical simulations if it is already known where the vessel will be used for the lifetime of the vessel. The EEDI can then also take into account the relevant waterway conditions.
	• EEDI calculations represent the results for specific conditions for a typical vessel model type, which can be quite different and very dynamic in real world situation. The vessel can deviate (e.g. other dimensions) and can carry different types of cargo with varying payloads, share of empty trips, currents, depth of the fairway, speeds, type of waterways, etc.. A real test run must be done to confirm or correct the attained $EEDI_{inland}$ compared to the previously identified value in the early design phase. It is questionable how representative the $EEDI_{inland}$ values are in real world conditions. This can be further validated through detailed data collection and analyses.
	• Limitation to the power train only (no auxiliary power is considered)
	• The used indicator for EEDI is grams CO_2 per tkm (tank to wake scope) assuming a theoretic average payload in tonnes for freight transport while for passenger vessels, displacement mass instead of deadweight is used. But this excludes:
	  o Upstream CO_2 emissions (well to tank)
	  o Other Greenhouse gas emissions such as methane slip (CH_4) and N_2O
	  o Air pollutant emissions such as NO_x and PM
	  o Floating equipment

3.5 D. Service performance including speed, utilisation, empty sailing

Level D refers to the performance of a transport service operation for a certain period of time. The main reference is the $EEOI_{inland}$ description from chapter 2.3 and the GLEC framework as presented in chapter 2.4. Therefore, it is limited to transport purposes and would exclude floating equipment such as dredgers. In addition, the main indicator available to assess the performance of a transport service is currently expressed only in grams CO_2 per tkm with Tank-to-Wake scope (TTW) for the $EEOI_{inland}$ while GLEC does take into account the Well-to-Wake emissions (WTW).

This methodology mainly aims at freight transport. Therefore, it is not yet possible to apply this methodology to passenger vessels and floating equipment. Further research is needed to identify the proper methodology which would enable to include passenger vessels and floating equipment as part of this scope level (operational energy efficiency). This level is particularly relevant to identify and evaluate the energy efficiency of inland waterway transport services, including the operational performance of the vessel in dynamic real-world operating conditions.

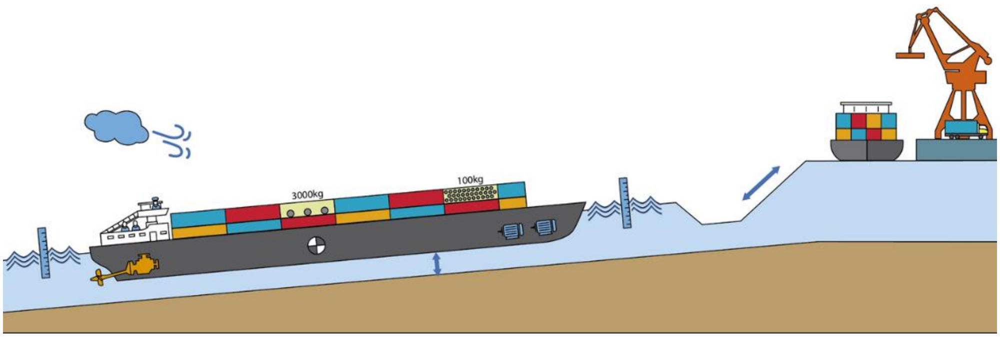
An example of benchmarking between services can also be found in the EU Taxonomy in relation to the gram per tkm performance of the vessel according to the EEOI guideline by IMO. Services with inland waterway freight vessels having Stage V engines which remain below the threshold of around 28 grams CO_2 per tkm (Tank to Wake) are considered to be in scope of EU Taxonomy until year 2025.

The GLEC approach is used for Business-to-Business applications. This is also based on the CO_2 emission per tkm, but applies a Well to Wake scope. Data for the CO_2 emission per tkm will be used to calculate the overall CO_2 emission for a transport operation.

Table 18 summarises the key characteristics of level D (service performance of a vessel, including speed, utilistation, and empty sailing.

Table 18: Key characteristics of level D (service performance of a vessel)

Definition	This level does identify the operational efficiency of a freight transport service. It measures and presents the value of the CO_2 emission in grams per tkm for a certain time period. The value is used to calculate the carbon footprint of provided services and for comparison with other modes.

	 *Figure 10: LEVEL D Service performance of a vessel*
Objective which can be achieved with this level	The main objective is to identify the operational CO_2 emissions of inland waterway vessels in view of carbon footprint calculations in logistics and to benchmark the value against other modes. The main objective is not to benchmark between individual vessels. Information on the estimated or empirical measured CO_2 performance of the vessel executing a transport service can be a basis for selection between service providers. An inland waterway transport operator with a lower carbon footprint for the service to be executed may therefore be prioritised, in order to reduce the overall carbon footprint. Shippers and forwarders have an in interest in reducing their footprint in view of their Corporate Social Responsibility Reporting and possibly further measures and incentives to reduce the greenhouse gas emissions. Larger companies with a public interest are in scope of the Non-Financial Reporting Directive (NFRD) to report on their sustainability and it is proposed to expand the scope in relation to the companies which would need to report this in future. Only in case of large scale data collection (large sample size), it could also allow for benchmarking between the vessels if operating at the same conditions (payload and type of cargo, waterway depth, currents and sailing speeds).
Is this level already applied	Yes, in Business to Business applications for carbon footprint calculations according to the GLEC framework. Currently mainly the default values are used from literature rather than the direct primary data from the IWT operators. The current Taxonomy technical screening criteria for IWT freight vessels valid until year 2025 refer to the EEOI approach and the IMO guideline. This with the purpose to benchmark the transport service provided by the inland vessels with the performance of a modern truck and setting an approvement of having a CO_2 emission level of at least 50% lower than the reference truck. There are however not yet examples of these Taxonomy technical screening criteria being applied in practice by banks or other stakeholders for individual vessels. For Taxonomy addressing investments or purchases at a certain point in time it raises the question on how to make sure that also in practice these estimated values according to EEOI calculations are achieved after making the investment or purchase, since the real-world operational circumstances may be rather dynamic

	and can be quite different compared to the assumptions made while the financing for the investment decision or purchase occurred. Furthermore, in studies this level is applied, for example for the calculation of external costs and environmental impacts. There is however a limited level of detail and limited differentiation.

Information required	GLEC:
	• 3 types of data are specified within the GLEC Framework for the calculation of GHG emissions, namely:
	  ○ Primary data, preferred, whereby the vehicle / vessel operator collects the data based on the actual operation of the vehicle / vessel.
	  ○ Modelled data, where the operational performance is approximated by a suitable operational model that takes into account fuel consumption, fuel type, loading and other influencing factors (e.g. direction and rate of flow, draft clearance etc.)
	• For GLEC: default data, where data considered to be typical of the vessel and its operational characteristics, including loading, waterway etc., are used as a substitute for more specific (i.e. primary or modelled)
	$EEOI_{inland}$
	• Fuel consumption from fuel tank indicators for each specific journey
	• Tons transported and kilometres travelled on specific journey
	• Fuel consumption to be divided by tkm performance for each specific journey and designated different waterway sections
	
	Depending on the use of EEOI, the kind of data needed for its application varies greatly. For benchmarking of the operation of the vessel, no further data than the one mentioned above a required. If applied for benchmarking of vessels (being a main objective of developing a methodology in Task 2.6) specific reference values for the EEOI will be needed per type of vessel, operating area, type of waterways and type of cargo. For such a purpose, much more detailed data will be needed to properly take into account the specific circumstances such as actual water levels and currents, density of cargo, sailing speed and required lead-time as requested by the cargo owner. The analyses of EEOI values for a specific journey or waterway segment could for example allow reflection whether the sailing speed chosen by the crew was optimal in operation.

Indicator used	• TTW gram CO_2 ($EEOI_{inland}$) or WTW CO_2e per tkm (GLEC) is currently (only) used, based on the energy used . This is currently limited to transportation of goods.
Reliability / accuracy	• There can be issues with the reliability and representativeness of the value since the actual conditions and logistic requirements can change a lot over time. For example, payloads may vary in time as result of changing market demand and also sailing speeds as well as fluctuating water levels which have a big impact on the number of grams CO_2 per tkm. This calls for use of aggregation of collected data over a longer period, differentiated to trade lanes, vessel types and cargo type for carbon footprint reporting and comparison with other modes. • There can be issues with an ex-ante estimation of the EEOI (e.g. applied in the framework of Taxonomy), since the actual conditions, the operating area and

	logistic requirements can differ a lot from the assumptions made during ex ante estimations. • Moreover, if the purpose is to benchmark between vessels, the method shall take into account explanatory variables and correct for them or differentiate into sub-groups to enable or a fair comparison between vessels. Only then it can be seen as a reliable and accurate way of benchmarking the vessel as such.

Pro's and cons	• The method for Business to Business application with data which are kept is already well developed (GLEC) and is being settled by ISO as well. However, the actual use of the methodology in IWT would be further improved. In particular by means of increased use of reliable and verifiable empirical data and by improving the quality and details of the default values for IWT vessels and types of waterways.
	• The current actual use is in particular for the comparison with and / or in combination with other modes for the carbon footprint calculations IWT clients and focussed on transportation of goods and greenhouse gas emissions. For passenger vessels the indicator gram CO_2 per pkm can be considered for public transport services by water but might be less suitable for river cruise vessels. Floating equipment seems not to fit in level D. Therefore, in the future, specific indicators for operational monitoring could be discussed to expand the scope.
	• Voluminous cargo with a relatively low density (e.g. empty containers) will have a quite different scores than heavy bulk cargo. The same for tankers and their cargo. Also the possible size of vessels matters (higher CEMT class -> economies of scale). This needs to be acknowledged and requires differentiation and thus broad and large samples of data to have sufficient representativeness.
	• Should the EEOI be used to benchmark between vessels (and not between operation of vessels) , then the operational value of CO_2 per tkm is not a very suitable indicator, because of the following elements that play a role:
	  o Power demand (and therefore CO_2 emission) is very much depending on the type of waterway, the currents, sailing speed, the available draught, also during the year (low/high water and varying currents). This is why the EEOI is determined section wise for relatively constant waterway conditions.
	  o The possible draught of the vessel and thus the amount of payload depends on the actual water levels for the free flowing sections of rivers (e.g. middle and lower Rhine). Therefore, data is needed for long term is needed to be able to compare the emission performance of journeys at similar waterway conditions and payloads carried. Only then, conclusions can be made on improvements, e.g. emission reduction before and after technical improvements of a ship.
	  o The level of fuel efficient navigation is also related to the skills and training of the crew. '
	=> in case the EEOI is used for benchmarking between vessels, consequently, it will require very detailed data to be collected for a long time and for a broad group of vessels and services and cargoes, to taking into account all the

	decisive factors and to be able to correct for them to allow for a fair and effective benchmarking purpose. • Specific data on the vessel operation is often seen as confidential and commercially sensitive which may be a barrier for sharing data and transparency on the performance in case of a wider community that would like to access and use the data. • Detailed EEOI data analyses and benchmarking the EEOI values of vessels by waterway sections can reveal infrastructure bottlenecks on the inland waterways. Examples can be detection of lack of maintenance (too shallow draught as result of lack of dredging) or low bridge clearances. Such information can lead to action by infrastructure managers and responsible authorities and thus supporting Good Navigation Status on the inland waterways.

3.6 E. Multimodal door-to-door service

The performance of the overall transport chain is most relevant from the viewpoint of the client for the transport service, both for passenger and freight transport. Most important in this respect is the carbon footprint of the provided service: the absolute amount of greenhouse gas emissions as result of the service, e.g. expressed in the kilograms of CO_2 equivalent emission, taking also into account the CO_2 equivalent emissions not only during the operation (tank-to-wake) but also to produce the energy and to bring the fuel to the transport unit (well-to-tank part).

As clients are expected to more and more select providers on the carbon footprint, there is an interest to reduce the carbon footprint emissions. Inland Waterway Transport has in general a strong advantage compared to road haulage with respect to the energy consumption and the CO_2 emissions when benchmarking on service level. This advantage supports the argument to promote modal shift from road to waterborne transport / IWT since a modal shift is expected to contribute to achieving a smaller carbon footprint.

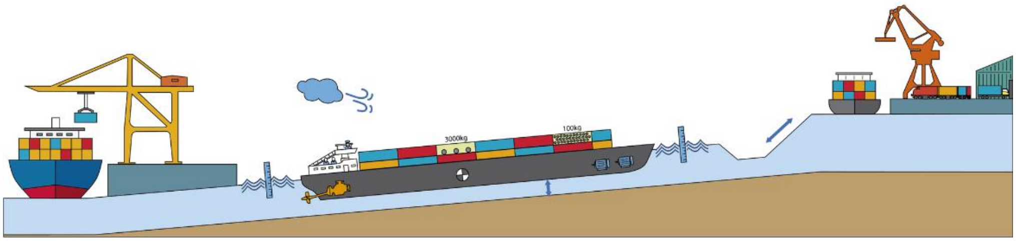
This stresses the importance to develop transparency and reliable data on the actual performance of IWT (level D), as it gives strong arguments for modal shift and thus a growing market for IWT to reduce overall GHG emissions in transport. The CountEmissionEU initiative may also further support this development.

However, viewing from the door-to-door perspective of the shipper/forwarder, in many cases the origin-destination cannot be reached directly by vessels. Transhipment of cargo in ports and pre-/end haulage by truck will be needed. Furthermore, there will be a difference in the distance for direct transport by truck and the transport to be travelled by inland vessels waterways. This can either be positive (e.g. shortcuts to be made by vessels in case of trucks having to cross bridges) but may also be negative (e.g. in case of destinations lacking a waterway access or waterways with a lot of curves while there is a straight line motorway for trucks). Moreover, the possibility of the return load shall also be taken into account, which can be easier to arrange for trucks compared to barges due to higher density of the road network and smaller size of shipments /volumes which are needed for an efficient operation. As a result, the situation is very much case specific and can be dynamic as well, depending on the type of vessel, the type of waterway, speed and the operational conditions such as the load rate, water levels, currents and the specific transport demand (return cargo) and the share of empty sailing.

Therefore, the main conclusions for level E (Table 19) are:

- Reliable data is first needed on the waterway transport service leg (level D)
- Align with ISO and GLEC for short term and promote the actual use of these methodologies among the IWT operators

Table 19: Key characteristics for level E (multi-modal door to door service)

Definition	This level does identify the operational efficiency of a freight transport service for the full door-to-door chain. It measures and presents the value of the CO_2 emission in grams per tkm for a certain transport from A to B. The value is used to calculate the carbon footprint of provided services.  *Figure 11: LEVEL E Multimodal door-to-door service*
Objective which can be achieved with this level	To identify the operational CO_2 emissions of a door-to-door transport service using inland waterway vessels in view of carbon footprint calculations in logistics. Different intermodal / multimodal options can be compared against each other or can be compared with direct road haulage. Information on the estimated or empirical measured CO_2 performance of an intermodal operator or freight forwarding company can be a basis for selection between service providers. As inland waterway transport often has a lower carbon footprint compared to other modes, an intermodal service using inland vessels may therefore be prioritised in order to reduce the overall carbon footprint. Shippers and forwarders have an in interest in reducing their footprint in view of their Corporate Social Responsibility Reporting and possibly further measures and incentives to reduce the greenhouse gas emissions. Larger companies with a public interest are in scope of the Non-Financial Reporting Directive (NFRD) to report on their sustainability and it is proposed to expand the scope in relation to the companies which would need to report this in future.

Is this level already applied	Yes, in Business to Business applications for carbon footprint calculations according to the GLEC framework. Furthermore, in studies this level is applied, for example for the calculation of door-to-door CO_2 calculations, external costs and environmental impacts. There is however a limited level of detail and limited differentiation because of lack of data.

Informatio n required	GLEC:
	• 3 types of data are specified within the GLEC Framework for the calculation of GHG emissions, for all modes of transport, namely:
	    ○ Primary data (EEOI), preferred, whereby the vehicle / vessel operator collects the data based on the actual operation of the vehicle / vessel.
	    ○ Modelled data, where the operational performance is approximated by a suitable operational model that takes into account fuel consumption, fuel type, loading and other influencing factors
	• For GLEC: default data, where data considered to be typical of the vessel/vehicle and its operational characteristics are used as a substitute for more specific (i.e. primary or modelled)
	
	Moreover, if applied for a fair benchmarking and reliable data more detailed empirical data will be needed to properly take into account the specific circumstances and to correct for dynamic elements. Therefore, most common is to use values derived from measurements done over a longer period for multiple journeys.

Indicator used	• Gram CO_2 per tkm is currently (only) used, either based on WTW emissions of the energy used (GLEC) or the TTW emissions of the energy used ($EEOI_{inland}$). This is currently limited to transportation of goods.
Reliability / accuracy	• There can be issues the reliability and representativeness of the value since the actual conditions and logistic requirements can differ a lot over time. For example payloads may vary over time as result of market demand and also sailing speeds as well as fluctuating water levels. As a result, aggregated data for a certain time period or for a group of similar vessels are used to derive values for trade lanes to be provided to clients.
Pro's and cons	• For benchmarking between modes, the bottom-up assessment will be needed for a fair and effective comparison. This will also require the information for the type vessel to be used and their emission profile, combined with the fuel consumption and the EEOI or TEU or tkm performance (including empty trips) for that particular roundtrip. Moreover, also the emissions for transhipment and pre/end haulage need to be added. The GLEC framework supports such calculations as it covers all modes of transport with a common calculation method. The method for Business to Business application with data which are kept is already well developed (GLEC). However, the actual use of the methodology can be further improved, in particular the use of reliable and verifiable empirical data and better default values for a broader range of IWT vessels and types of waterways. • The currently used and applied indicator is focussed on transportation of goods and greenhouse gas emissions. The current actual use is in particular for the

	comparison with other modes and for the carbon footprint calculations by clients in Business to Business relations. Air pollutant emissions are not covered. • Specific data on the vessel operation and other legs in the door-to-door transport chain is often seen as confidential and commercially sensitive which may be a barrier for sharing data and transparency on the real door-to-door performance in case of a wider community that would like to access and use the data. Data can lead to insights in opportunities for modal shift as it makes clear how door-to-door- chains using inland waterway transport can perform compared with chains using other modes (e.g. road). Furthermore, it can result in information to guide investments in waterways but also in ports. For example, it may demonstrate the advantage of a dense network of transhipment locations or production/distribution areas along waterways to avoid pre/end haulage operations by trucks in order to support modal share of IWT.

3.7 Additional function - benchmarking between waterways

If data will become available on the energy and emission performance of services it will be required to implement a differentiation between the types of waterways. This will also enable the benchmarking of the inland waterways and the relative amount of emissions and energy use by vessels. This can be input for policy measures to reduce the external costs.

As mentioned, the emissions per kilometre of waterway or tkm performance will vary significantly. The resistance of the vessel and the energy needed to travel are influenced by:

- The **dimensions of the waterway**, both width and depth. The larger the dimensions, the less resistance. Therefore, a narrow channel with shallow draft, will cause much more power and emissions compared to navigating in open and deep water. Shallow draft may also be the result of lack of maintenance (e.g. dredging). By means of benchmarking using the EEOI (level D) this may become visible.
- Waterflow **currents** will play a strong role, in relation to the effective speed over ground to move the vessel from A to B. Upstream sailing (e.g. Rotterdam -> Basel) will be much more energy demanding compared to downstream sailing (e.g. Basel -> Rotterdam).
- **Speed restrictions** which may limit the power demand, resulting in lower energy consumption and emissions, especially since relation between speed and power is exponential in IWT.

As regards air quality, there will also be a relation. NO_x abatement technology SCR does require an operating temperature of 180 degrees Celsius or more. Low power demand for an engine may result in lower operating temperatures and may affect the effectiveness of the SCR. This may occur for example when sailing downstream with an empty vessel at low speeds. This may also become visible with real-time monitoring.

4 Multi Criteria assessment of options

To perform this assessment a Multi Criteria Assessment (MCA) Matrix was developed (see Annex VIII).

Three main criteria are distinguished to assess the different levels:

- Suitability with regard to objectives to be achieved
- Availability of data and possible time of implementation and involved costs
- Applicability to inland fleet and emissions in Europe illustrating fairness and level playing field

Based on a first assessment with experts (November 2021) it was concluded that out of the longlist of 5 levels (A…E) as presented in chapter 3 a shortlist can be derived. It was concluded that levels A and E are not actually fit for a detailed MCA assessment due to the following reasons:

- **Level A**: it is concluded and agreed by the involved policy makers and experts during the work carried out for this task, that the scope "powertrain only" is not sufficient. It is not suitable for the main objective as level A gives an incomplete picture about the air pollutant emission performance of the vessel and the carbon intensity. In addition, there is a problem with the availability of the data and the involved costs. Level A would require knowing the specific fuel consumption of the powertrain only, excluding fuel consumption for other energy convertors such as auxiliary engines for hotel and transhipment functions. The complexity is that energy convertors can be used for both propulsion and for hotel and transhipment functions which blurs the reliability and applicability. Furthermore, today fuel consumption data is only available for the whole vessel[61], for the total of all power convertors. Only a small share of vessels has reliable fuel consumption measurement and reporting devices for each power convertor (engine) on board.
  As a result of these arguments, it was recommended to expand level A with the other energy convertors on board. Thus, it was decided to discard level A and to use level B (all energy convertors on board) as the starting point for the MCA.
- **Level E**: On the other side of the spectrum, level E is relying on further steps to be made on top of level D (the EEOI / GLEC). There is a strong direct link between the maturity of Level D and subsequently the maturity of Level E. It is therefore too early to lay focus on level E as long as the gaps of level D are not addressed.

Therefore, the further assessment of options can be focussed and limited to level B, C and D:

- **B. All energy convertors on board** (gram per kWh and efficiency of energy convertors)
- **C. Vessel performance including hydrodynamics** ($EEDI_{inland,}$ installed power and hulls shape, CO_2 per tkm based on model results)
- **D. Service performance** including speed, utilisation, empty sailing ($EEOI_{inland}$. GLEC, grams CO_2 per tkm based on operational data)

For each of the three aforementioned criteria an overview is provided in the following on how the Levels B, C and D relate to these criteria.

61 In a large number of countries such data is already collected and recorded for each vessel (based on CDNI contribution to the waste collection system).

4.1 Suitability with regard to objectives to be achieved

Table 20 presents the assessment considering the contribution to objectives to reduce emissions and energy consumptions. Here the primary objectives as based on the Task 2.6 description are highlighted in yellow (powertrain / energy converters on board, carbon intensity of the vessel).

Table 20: Assessment of Levels B, C, and D in reducing emissions and energy consumption

		Level B	Level C	Level D
a. Increase Energy Efficiency (as a way to reduce greenhouse gases and air pollutant emissions)[62]				
a1	Improvements of the hardware of the vessel (powertrain, energy convertors, hull, propeller)	Partially (only propulsion and auxiliary engines)	Partially (mainly hull and fuel efficiency of propulsion engines)	Yes, implicitly, combined with other factors
a1.1	Power convertor efficiency	Yes, taken into account according to ISO 8178 and the share of power convertor in total energy consumption	Partially, as input for EEDI estimation is needed on the fuel/energy use per kWh. Knowledge about required power in EEDI calculations at different circumstances can be used for efficient configuration of powertrains (e.g. right sizing, multiple engines).	Yes, implicitly, combined with other factors
a1.2	Hydrodynamic improvement	No	Yes, combined with the propulsion engine	Yes, implicitly, combined with other factors
a2	Improve operational use:	No	Partially through better awareness (EEDI gives insight how vessel operates under specific conditions and speeds)	Yes, implicitly, combined with other factors
a2.1	Optimise trip planning, sailing speed and energy management	No	Yes, $EEDI_{inland}$ data could be used as input parameter to define the most economic speed depending on type of waterway and the fairway dimensions	Yes, implicitly, combined with other factors

[62] The energy efficiency of the fuel (i.e. the amount of energy used to generate the fuel) is not taken into account or discussed in this report, only the energy efficiency of the vessel. TTW approach is used.

		Level B	Level C	Level D
a2.2	Optimise payload, reduce empty sailing and economies of scale (where possible)?	No	Yes, $EEDI_{inland}$ could be an indicator for selecting the most efficient type and size of vessel depending on the available dimensions	Yes, implicitly, combined with other factors
b **Reduce Greenhouse Gas emissions**				
B1	Increase Energy Efficiency	Yes (partially) *See line a. for more details*	Yes (partially) *See line a. for more details*	Yes, implicitly, combined with other factors) *See line a. for more details*
B2	Increase use of renewable energy / energy with low WTT GHG footprint (gram CO_2 eq per MJ)	Yes, since WTW scope is applied for the GHG emissions of energy used	No, the current EEDI concept does not include the Well-to-Tank emissions, only the Tank-to-Wake emissions. It does not take into account where the fuel comes from (if it is renewable or not)	Yes, implicitly, in case of GLEC / ISO which differentiates between fuel types and uses WTW scope for energy in relation to the CO_2 footprint.
B3	Technical measures to reduce other green house gasses on board: CH_4 (methane slip) and N_2O	Yes	No	Yes, implicitly, in case of GLEC / ISO when WTW scope is applied.
C **Reduce Air Pollutant emissions (local) for health and nature, NOx and PM, NH3, …**				
c1	Increase Energy Efficiency	Yes (partially) *See line a for more details*	Yes (partially) See line a for more details	Yes, implicitly, combined with other factors *See line a for more details*
c2	Clean energy convertors / pre- and after treatment (e.g. catalysts, filters)	Yes	No, only CO_2 emissions per tkm, but indicators for air pollutant performance can be added if level B is used as well (air pollutant emission profiles)	No, focus on GHG emissions, but can be added if level B is used as well (air pollutant emission profiles)
c3	Clean fuels / energy with reduced or zero air pollutant emissions	Yes	No, only CO_2 emissions per tkm, but indicators for air pollutant performance can be added if level B is used	No, focus on GHG emissions, but can be added if level B is used as well (air

		Level B	Level C	Level D
			as well (air pollutant emission profiles)	pollutant emission profiles)

4.2 Availability of data and time and costs needed for implementation

The assumption for the MCA is to have a voluntary instrument, not a mandatory instrument. If sufficient promoting incentives are based on the instrument, the instrument will be popular as it provides gains and would not require a legal basis. However, of course this depends on the users of the instruments and whether it will be sufficiently providing positive incentives.

As a result, the legal steps for mandatory implementation are discarded at this stage. It may depend on the further use case of a label or index. In case it is mandatory, there are legal questions and the time and costs needed for implementation will be longer. However, if authorities are to apply this label and grant advantages on the basis of a label, it needs to be sufficiently credible because of legal reasons. In general, the demand for reliability varies for different uses. If data can trigger certain government action, the data needs not only to be very reliable, it also must be transparent and verifiable. The same if there will be strict requirements in future on the reporting of the carbon footprint by companies. Also here the provided information between companies needs to be reliable and verifiable.

Also for many uses, in particular Business to Business applications, no legislation is needed. Most often public or private standards are sufficient as demonstrated by GLEC (see section 2.4) and also by the Emission Performance Label scheme (see section 2.1). The drivers here are the type of users and the applications and incentives which are to be linked to the scores on the indicators[63].

Another issue is the required level of detail. This will also be depending on the type of user and the application. If it is not used in public sphere, self-reporting and self-confirmation by data owner can be sufficient. Furthermore, AIS and ERI could be further developed so that it could be used for calculating emissions as well. There is already a system developed within the RIS COMEX project for allowing owners of RIS data (skippers) to share the RIS data with selected third parties which may save administrative costs.

Taking into account the availability of data and both time and costs needed for implementation, the following can be concluded with respect to the different levels:

- Level B: It can be concluded that level B is relatively easy to implement on a voluntary basis. Data is available in most of the cases or can be generated at limited. Furthermore, there is already an operational label scheme available in practice (managed by SAB in The Netherlands) for which the methodology can be used as a first basis.
- Level C: The initial proposal for an $EEDI_{inland}$ is based on data originating from North-western Europe and designed for waterways of zone 3 (Rhine) and zone 4 (canals) waterways as well

[63] These scores on indicators which can be categorised in labels (e.g. certain bandwidths) and indexes compared to a certain benchmark values to express for example the difference compared to the average performance.

as for deep water situations (lakes, estuaries). A study commissioned early 2022 will verify the initial proposal with real world trials, if deemed necessary add data from vessels and waterways typical for other parts of Europe and propose a practical way of implementing the $EEDI_{inland}$. Even the initial proposal could be used already, in particular for designs of new vessels providing additional valuable data next to level B information. Consequently, the results of the further research could allow more specific recommendations on adding $EEDI_{inland}$ for the purpose of a more integral label of the inland vessels.

- Level D: the general lack of publicly available detailed data on the transport service performances is a barrier for Level D. In addition, the privacy and business sensitivity (competitiveness) play a key role. For GLEC, the default values for carbon footprint calculations need to be upgraded and extended.
  Furthermore, in case of a wish for a fair benchmark between vessels based on operational data (level D), it is required to have detailed information as well about the actual operating conditions such as the requested lead-time/sailing speed, water levels and currents, the type of cargo and crew skills at that particular moment. With respect to time needed before implementation it is concluded that it will take a long time to develop such reliable and effective KPIs, because of the sensitivity and complexity in terms of the sheer amount of data to be collected and analysed first. A large sample size would be needed with data collection efforts for multiple years to be able to have sufficient representativeness.

4.3 Applicability to inland fleet and emissions in Europe illustrating fairness and level playing field

The EU Green Deal and NAIADES III objective and policy to reduce energy consumption and greenhouse gas and air pollutant emissions in IWT does address all countries of EU and all type of vessels. In particular if the objective to provide incentives for greening the inland fleet is put at the centre, it is relevant that all vessel types and areas are able use the methodology and data is or can be made available.

Furthermore, also non-EU member states need to be able to use the methodology in order to ensure effectiveness, fairness and level playing field. It is therefore important to assess the applicability to the inland fleet.

Based on the characteristics as described in the chapters 2 and 3 of this report, the following results were found for the different levels with respect to the applicability:

- Level B is applicable to all powered inland vessels in Europe and can be implemented on short term. It covers all types of emissions and takes into account the emission profile of energy convertors (both air pollutant emissions and greenhouse gas emissions) and also the type of fuel and the Well-to-Tank performance of the fuel as regards the GHG emissions. Data can be made available relatively easy.
  Although Level B does cover the main elements for emission reduction towards zero-emission, it does not address all the specific elements. Additional elements which may increase the efficiency are the right sizing of engines, hydrodynamics of vessels and optimised cargo space design for a specific route. Therefore, vessels with such optimised configurations and designs would not be scoring significantly better in the indicators for

Level B alone. Therefore, in order to cover these elements, further development and expansion is foreseen to complete the picture and to make it even more fair and useful:

- continuous monitoring of engine load rates and emission levels (mainly CO_2 and NO_x) to express the emission performance under real world conditions instead of the official ISO 8178 test cycle
- to include also the gram per tkm performance to allow Level D objectives such as fleet monitoring in relation to transport performance
- Specific attention to required power estimations and hull shape and propellor design ($EEDI_{inland}$)

- Level C is particularly relevant when it comes to newbuilt vessels as the $EEDI_{inland}$ of a freight or passenger vessel can be determined with sufficient accuracy already in the design phase. This level is particularly relevant to support vessel owners and involved stakeholders and in their investment decisions for the renewal of the inland navigation fleet. However, this accuracy is only valid if the operating area and conditions used for the determination of the $EEDI_{inland}$ remain the same during the operation. This uncertainty is a risk for the applicability. EEOI could to some extent be used to compare with $EEDI_{inland}$, if corrected for the energy consumption (all energy convertors in EEOI while only powertrain is in scope for EEDI)

  Level C is for the time being limited to transport activities by freight and passenger vessels. Floating equipment does not fit. Furthermore, a limited focus on Tank-to-Wake CO_2 emissions is insufficient on its own. There are still significant external costs from air pollutant emissions which are neglected in the current methodology but do result in significant damage to inhabitants and nature affected by NOx and PM emissions. For example, specific efforts done in the field of air pollutant reductions (for example applications of exhaust gas filters and catalysts) are not recognised in Level C. Furthermore, the Well-to-Tank greenhouse gas emissions of fuels are more and more relevant seen the climate goals and the need to apply renewable fuels to achieve the reduction targets to stay within the 1.5 degree of global warming. For example, usage of sustainable biofuels (e.g. HVO) or e-fuels (e.g. green methanol or green methane) are not recognised in the Level C. Level C does not address air pollutant emissions.
  Therefore in order to cover these elements, expansion would be needed
    - Add the air pollutant emissions
    - Add the Well-to-Tank emission for green house gasses
    - Add the other greenhouse gas emissions (e.g. methane slip in case of LNG)
    - Develop $EEDI_{inland}$ for a wide range of vessels and waterways in Europe

- Level D is focussed on freight transport barges and therefore does not cover the inland fleet as a whole. For passenger vessels the indicator gram CO_2 equivalent per pkm can be used, in particular for public transport over water. It is less suitable for river-cruise vessels. It is not aimed at all at floating equipment, e.g. dredger vessels or crane vessels. Furthermore, similar to Level C, there is currently a limitation only to CO_2 / greenhouse gas emissions. Such a limited scope may be seen as improper and insufficient as in IWT, in contrast to other modes, there are still significant external costs from air pollutant emissions which are neglected in the methodology but actually do result in significant damage to inhabitants and nature affected e.g. by NO_x and PM emissions. Furthermore, since level D is also much used to compare with other modes of transport, the limitation to compare and benchmark only on the greenhouse gas emissions, may be seen as unfair in the comparison with other modes

which have an advantage on the air pollutant emission performance, such as modern heavy duty vehicles (Euro VI standard).
Furthermore as the score on EEOI is highly depending on the operational conditions and logistic requirement, the value can be quite dynamic. Therefore this needs to be properly into account to produce representative and comparable default values for trade lanes, vessel types and cargo types.
Therefore in order to cover these elements, expansions could be considered:

- Ensure to take into account the Well-to-Tank emission for green house gasses
- Add the other greenhouse gas emissions (e.g. methane slip in case of LNG)
- Intensified monitoring and differentiation of the GLEC/EEOI default values according to vessel type, waterway sections, cargo types taking into account explanatory variables such as speed requirements, waterway conditions.
- Add the air pollutant emissions from continuous monitoring (e.g. NOx) as well as the registration of geographic area of impact (to assess impact on nature, populated areas)

5 Summary, conclusions, and recommendations

It is important to note at this stage that this report is the result of research work executed by the PLATINA3 consortium, aiming to provide input to policy makers for next steps and implementation. Therefore, the **recommendations provided in this report need to be discussed with and between relevant actors who will play a role in the design and implementation of a label/energy index**.

5.1 Summary

Task 2.6 deals with one of the aspects of WP 2 which is the coordination and standardisation for emission label / energy index for vessels on EU level as instrument for the zero-emission pathway for the fleet and facilitating stakeholder engagement.

The specific objectives of the Task 2.6 of WP2 Fleet of PLATINA3 are:

- To assess and where appropriate coordinate the scheme of a vessel index/label system and support the implementation.
- To elaborate the technological/methodological basis as the function of a label.
- To thus realise an instrument to enable a differentiated incentive scheme to get shipowners to invest in powertrain solutions for the zero-emission pathway.
- To assess the link with GHG calculations in logistics (grams per tkm).

Therefore, the scope of the task includes freight vessels, passenger vessels, and also floating equipment (e.g. dredging, construction vessels). In addition, specifically for goods transport, also the link to GHG calculations in logistics chain is included. Moreover, as requested by the European Commission DG MOVE, specific attention is paid to the technical screening criteria of Taxonomy. The task report can also serve as basis for the EU energy index methodology needed for monitoring and reporting carbon intensity of inland waterway vessels as announced in NAIADES III.

Existing schemes, concepts, and initiatives in the field were systematically described in Chapter 2. These schemes included the Emission Performance Label, the Energy Efficiency Indices EEDI and EEOI, the GLEC framework, the Taxonomy Delegated Act concerning climate mitigation, and the Green Award Label. The analyses and mapping of these schemes and initiatives inspired the development of possible methodologies for a label or index system for different objectives in the field of reducing climate and air pollutant emissions and to increase energy efficiency.

Five different 'levels' were identified and further described in Chapter 3 in order to define a methodology for expressing the energy and environmental performance of vessels and services:

A. Powertrain only (propulsion of the vessel)

B. All primary energy convertors on board (for propulsion power, heating, cooling, auxiliary propulsion, pumping, on board facilities, etc.)

C. Vessel performance including hydrodynamics for certain operating conditions

D. Service performance including speed, utilisation, empty sailing

E. Multimodal door-to-door service including also pre-/end haulage and transhipment

The characteristics of these levels were summarised using comparable categories to make them better comparable. These overviews can be found in Table 15 to Table 19, respectively.

A Multi Criteria Analysis (MCA) was performed (Chapter 4) for a detailed assessment of these levels which concluded that levels A and E are either insufficient (Level A) or not achievable at this stage (Level E) due to its need of data. Therefore, a more detailed assessment and further discussions focussed on Level B, Level C, and Level D which were listed against three main criteria:

- Suitability with regard to objectives to be achieved
- Availability of data and possible time of implementation and involved costs
- Applicability to inland fleet and emissions in Europe illustrating fairness and level playing field

The results of this criteria mapping can be found in Sections 4.1 to 4.3, respectively.

5.2 Conclusions

The analysis and MCA of the various levels has indicated that **the methodology to be selected is highly dependent on the nature of the objective, the user, and the type of application and incentives to be associated** with the energy and emission performance assessment of the individual vessel.

However, considering the objectives of Task 2.6, there may be a first focus for development of a European instrument to incentivise and support investments by vessel owners in clean powertrain solutions and use of renewable/clean fuels with low or zero carbon intensity. At the same time, methodologies to identify the energy efficiency and the carbon footprint of the vessel design and the operation are relevant as well for rewarding related investments and promotion of more rationalised operation.

An important conclusion is that **the concept of a label or index for several types of targets, users and applications can be seen as an interlinked, layered and modular development**.

Based on the overview of the available schemes and initiatives in chapter 2, already some potential is identified for enriching them:

Level B All primary energy convertors on board

This option is similar to Emission Performance Label (see chapter 2.1), but can have the following revisions and extensions to broaden the purpose and applicability to objectives:

- Also take energy efficiency into account: MJ input/ kWh output to capture the energy efficiency of the energy convertors (Tank to Wake basis)
- For the carbon intensity score: alternative WTW calculation options for greenhouse gasses could be provided:

    - CCNR approach / IPCC (as applied in CCNR roadmap and Studies as well as Emission Performance Label in The Netherlands)
    - GLEC / ISO 14083 default values
    - Values from RED II / EU Fuel maritime
- Include data from continuous emission monitoring (load rate of engines, NOx emissions, CO_2 emissions) to improve the representativeness compared with real world emissions
- Add also data on transport performance (e.g. tkm) to also include other energy efficiency factors related to the vessel like right sizing, optimised hydrodynamics, optimised cargo space. Therefore, make a direct link with Level C and D.

Level C Powertrain and hydrodynamics ($EEDI_{inland}$)

This option is based on $EEDI_{inland}$ (see chapter 2.2), but can have the following revisions and extensions:

- Also take energy efficiency into account: MJ input / kWh output to capture the energy efficiency of the energy convertors (TTW)
- Add the air pollutant emissions based on level B emission profile
- For the carbon intensity score: include the WTW calculation options for greenhouse gasses, with options to be provided:
    - CCNR approach / IPCC (as applied in CCNR roadmap and Studies as well as Emission Performance Label in The Netherlands)
    - GLEC / ISO default values
    - Values from RED II / EU Fuel maritime

Level D Transport service ($EEOI_{inland}$ / GLEC-ISO)

Similar to $EEOI_{inland}$ and GLEC (see chapter 2.3 and 2.4), but can have the following revisions and extensions:

- For the carbon intensity score: include the WTW calculation options for greenhouse gasses, with options to be provided:
    - CCNR approach / IPCC (as applied in CCNR roadmap and Studies as well as Emission Performance Label in The Netherlands)
    - GLEC / ISO default values
    - Values from RED II / EU Fuel maritime
- Add the score from level C to capture the specific hydrodynamic performance
- Consider to add the air pollutant emissions based on level B emission profile module (preferably with continuous emission monitoring) as well as the information on the area of air pollutant emission seen the relevance of local impacts to sensitive nature areas (N2000 areas) and densely populated areas such as cities
- Also take energy efficiency into account: MJ input / kWh output to capture the energy efficiency of the energy convertors (TTW)

Moreover, the following conclusions were derived:

- In theory, Level B can be implemented on short term in the whole of Europe and presents the air pollutant and climate emission performance for the weighted average of the energy convertors on board on the vessel. It is therefore fair when applied to comparable vessel classes and operating profiles (e.g. taking into account the distance to be travelled and type

of waterways in relation to power demand and required energy storage on board).
Based on collected data, it can also present the energy efficiency of the energy convertors (TTW) based on the ISO8178 E3 cycle. It is a scheme which can be made fit to measure the progress of the full inland fleet towards reaching zero-emission by 2050 and to provide the incentives to all vessel owners to make the investments and to use clean/renewable fuels.

- Level B can be seen as a first basic module of the instrument, as much data is already available or can be made available with limited effort and cost.

- Data on energy consumption, energy efficiency of the power convertors and the emission profile of power convertors in grams per kWh are core elements for making a first step. Subsequently, additional data modules can be added, for example to express the environmental performance against the service performance of the vessel in level D and to add the EEDI profile in level C.

- In order to evaluate the WTW performance of GHG emissions for fuel / energy types, several approaches exist, there is a lack of harmonisation in this field. The IPCC approach, applied for instance in the context of the CCNR[64] roadmap and RED II. Default values are also provided under RED II (EU Fuel Maritime proposal under Fit for 55) and the GLEC framework. It can be a choice in the methodology to select which type of WTW approach is to be taken into account using different WTT datasets in the calculation scheme. It depends on the type of user and application. For example, the WTT values in the GLEC /ISO standard are probably mostly used by companies while default values from European legislation (e.g. RED II) are developed and used by EU institutions (e.g. for Taxonomy) and CCNR would use the IPCC methodology according to their roadmap.

- Level C provides specific information on the energy efficiency of the hydrodynamic characteristics and the energy efficiency of the propulsion power. This level allows to achieve objectives which cannot be achieved with level B as it includes the specific hydrodynamic performance of hull and propeller based on measurements and calculation results. However, before this module can be applied in practice, it needs further research work (validation, additional vessels types and waterways). A study is currently ongoing and final results should be available in the course of 2023. This complementary study should allow to pursue the work on this topic.

- Level D presents the overall performance of a transport service carried out by a vessel. It thus includes a wide range of factors related to the vessel the operational and logistic requirements as well as the human skills of the crew. It is therefore not limited to the static characteristics of the vessel itself. It not only reflects the environmental and energy efficiency of the power convertors and the hydrodynamic design, but also the operational elements affecting the energy demand for the transport performance.
This level allows to achieve objectives which cannot be achieved with level B or C. In particular, when it comes to comparing the environmental footprint of inland navigation

64 CCNR roadmap for reducing inland navigation emissions, as envisaged by the Mannheim Declaration, chapter 3.2 Tank-to-wake approach (available through this page: https://www.ccr-zkr.org/13020400-fr.html)

services compared to other modes.
Furthermore, it needed to differentiate between cargo types. For example light weight, medium and heavy cargo shall be duly differentiated. Additional indicators may be developed for river cruise vessels. For a label or index based on $EEOI_{inland}$ with a public purpose a barrier is that sharing data by operators is quite sensitive in view of competition between operators. As a result data is lacking resulting in lack of maturity to apply it for a label or index for individual vessels for public purposes. Default data for carbon footprint reporting (GLEC) also would need to be upgraded and extended.

- For Level D the main purpose is enabling carbon footprint calculations for clients and comparison with other modes. It is not intended for benchmarking between vessels. However, if the step is to be made towards benchmarking between individual vessels based on operational performance, there can be a number of dynamic factors which are important to address for a fair and sound methodology:
  - Energy consumption for other purposes than propulsion (e.g. aux. engines, heating, cooling)
  - Operating speeds as result of waterway conditions and logistic requirement (expected ETA by client)
  - Resistance in water, caused by type/dimensions of waterway, currents and waterway depth.
  - Payload in tonnes depending on the type of goods (weight per m3) and depending on offer by client and available (dynamic) water depth
  - The length and share of empty trips influenced by market dynamics and seasonal patterns
  - Level of skills and training of crew to sail economically

  Consequently, for a sound methodology and KPIs to benchmark between vessels, it is needed to continuously collect a large amount of data from a large group of vessels. This is a major barrier for the Level D application for public purposes if the aim is to benchmark individual vessels. However, for Business to Business applications to calculate carbon footprint of services it can and does already work (e.g. based on annual averages) and is already being applied (GLEC).

- The Level D can be enriched if the Level B information from the particular vessel is used, which allows to add the air pollutant emission scores and alternative WTW values for the GHG emissions. With Level B also the energy efficiency of the energy convertors can be derived and presented separately. Furthermore Level C information ($EEDI_{inland}$) would add specific information on the efficiency of the hull and propeller at specific conditions (speed, water depth) and waterway types.

- Thus, the Levels B, C and D are clearly complementary and create synergies and can service different objectives. It is a matter of selecting the main purpose and next to select the most appropriate level.

- In general, the demands on the quality of the labelling system increase with the geographic scope, the range of uses and, in particular, the associated legal consequences; at the same time, the complexity is likely to increase. It is obvious that the expectations for the quality of a labelling system but also its design depend very much on its intended use. If the system is only intended to provide supplementary information for decisions by private entities, the quality may be relatively low. If, on the other hand, the scope of government funding or even driving bans (e.g., passing through cities or entering ports) is made dependent on it, or if it is a government test or quality seal, the quality of the labelling system must be very high. Therefore, before developing and implementing a labelling system, it is imperative to answer the question of which body will issue it and what it will be used for (i.e. a public or private body). In case when a private body would issue labels, sufficient oversight by a public body is probably needed. Even if a private body issues it, but it is used for public policy actions, it must be as accurate as if it would be issued by a public body. Thus, the use seems to be overriding. Furthermore, it is good to bear in mind that also private initiatives can unfold a normative effect.

5.3 Next steps / policy recommendations

First of all, the value of an instrument is in the actual use, application and the incentives provided based on the methodology for the instrument. The instrument and the underlying methodology has no added value if there are no users and it does not lead to change.

Therefore, as a **next step, it is required to discuss the objective of the instrument and the first main users and applications**. Next, the appropriate methodology can be defined and the indicators to be used, followed by setting reference or threshold values for labelling. This may (eventually) also be a combination of methodologies and indicators as described in section 5.1.

In this context, discussions need to take place with the European Commission services, river commissions, national governments (EU and non-EU member states), regional authorities, port authorities, shippers and forwarders associations/representatives, banks and other incentive providers.

A label system based on **Level B can be implemented on short term in Europe and can be applied for all vessels** and addresses the long-term policy objectives to work towards a zero-emission future for IWT. The indicators proposed for Level B can drive the discussion with possible users on more specific objectives, applications, and incentives which can be provided based on the indicators. This to see whether there is interest for a European label instrument based on methodology for Level B as basis for stakeholders to provide incentives. If there indeed is interest and a common viewpoint, the methodology can be further detailed and elaborated, based on the specific objectives and the requested applications by stakeholders. In this respect, it is also concluded and recommended that different options for the WTW GHG emissions can be offered in a European labelling/indexing instrument based on the same set of core data. Offering different well-to-tank datasets, allows flexibility towards the different preferences from users /incentive providers. It thus also enables a possible link and may serve as reference applications on EU level such as use of the methodology for Taxonomy technical screening criteria in view of state-aid-support, EU grants and loan instruments and the setting of targets to be achieved.

Level B can also be used as a first instrument as announced by NAIADES III for the EU energy index methodology which is mentioned in NAIADES III for the purpose of monitoring and reporting carbon intensity of inland waterway vessels. This can be done by means of the methodology as Level B takes into account the type of energy/fuel used and the share of renewable energy on the basis of an individual vessel, expressing it in a gram CO_2 equivalent per kWh (WTW), including the overall efficiency of the energy convertors. However, if the monitoring purpose implies following all individual vessels, it probably requires a mandatory system. The decision whether a voluntary system is sufficient or a mandatory is needed, depends on the answer to the question if there will be sufficient positive incentives for vessel owners to convince all vessel owners to apply the instrument voluntarily. **As a second step, the EEDI (Level C) can be added to the EU energy index methodology** as soon as it is available to complete the picture as regards the specific energy efficiency of hull and propellor.

If the goal is to monitor the fleet at a more aggregated level, **the operational performance of the vessel (Level D, $EEOI_{inland}$) can be used as well**, for example for the monitoring and reporting about the yearly average performance for the fleet, with differentiation to market segments and vessel types.

With respect to **Taxonomy** and the link to methodologies as presented and analysed in this report:

- **Further discussion needs to take place** with European Commission services (DG MOVE, DG CLIMA, DG FISMA) as well as other stakeholders to define the key priorities for Taxonomy as well as the timeline. This also shall be seen in comparison to revision developments in other modes, such as sea transport.
- **Level B provides a reliable and verifiable picture** on the emission profile for the vessel based on official test cycle ISO 8178 and thus Taxonomy can take this into account to set certain thresholds to be reached as regards the **greenhouse gas emissions per kWh expressed in CO_2 equivalent (WTW) as well as air pollutant emissions in gram per kWh**.
- Level C can add to Level B **separate static information on the hydrodynamic performance of the vessel which can be taken** into account in Taxonomy for promoting energy efficient new vessel designs optimised for the conditions in which they will operate. It shall be made clear that these conditions need to be indeed representative for a longer period in which the vessel is in operation (e.g. by a long term contract).
- Level D, the EEOI score (Level D) is one of the current technical screening criteria in Taxonomy for IWT freight vessels in comparison with a reference road vehicle. However, the particular value for the EEOI of an inland vessel can be quite dynamic and difficult to predict and highly depends on external factors, not related to the vessel itself. It may be unknown when there is a financing demand for the vessel, where the vessel will actually operate and what specific cargo it may transport and what the real world EEOI would be. This currently **limits the purpose of using the EEOI to compare between vessels and to indicate which vessel is more environmentally friendly than others**. EEOI is more applicable for monitoring the performance ex post and at a higher level of aggregation.
- Taxonomy requires technical screening criteria for "*Purchase, financing, leasing, rental and operation*" of vessels. Therefore, the main goal of Taxonomy is to give guidance on the climate and environmental performance of the vessel rather than the transport service which is strongly influenced by other factors than the characteristics of the vessel. Consequently, it is recommended to **combine Level B with Level C for the Taxonomy purpose in view of comparing between vessels and to identify and support sustainable vessels**. The values for the criteria shall be provided ex ante and shall have relatively high reliability in Level B and Level C. A combination of Level B and C provides rather static data, while calculations made for Level D (EEOI) can change a lot in real world conditions. The

latter especially may occur for example in spot market operations with changing logistic requirements, changing origins and destinations of cargo and different shipment sizes to be carried. For companies and vessels operating with short term contracts / spot-market with dynamic markets and conditions, the use of EEOI quite complicated. It shall be noted that PLATINA2 showed that 55% of the companies in IWT are active on the short term market / spot-market.

On a longer term, work on further development towards a more sophisticated label is highly recommended. A more specific and detailed methodology, using continuously measured emissions, both for cargo (e.g. expressed in g/tkm for specific market segments and origin-destinations) and passenger vessels (g/pkm) would be key elements in further development work.

A project recently started in The Netherlands to continuously monitor and report the NOx emissions, CO_2 emissions and fuel consumption data in relation to specific operational conditions for 20 vessels for at least one year. This project can provide further insights to be taken into account. For example it can possible illustrate the deviation between application of the formal SIO 8178 test cycle versus the use data from continuous on board monitoring. Furthermore, it will illustrate what external elements play a role in the g/tkm performance and with what level of magnitude.

In view of $EEDI_{inland}$ and $EEOI_{inland}$ more research is needed on data collection and model development for validation, extension of conditions, type of waterways, vessel types for EU representativeness. This work is also already planned to take place, funded by the German BMDV.

In particular for Level D, the set-up of neutral, trusted intermediary organisation may be considered, possibly together with Smart Freight Centre, for data collection and developing KPIs and their values for a matrix of different sub-segments (type of vessel, type of cargo, type of waterway / operating area). This can help to overcome the barrier with sharing business specific data which is commercially sensitive and usually confidential. The intermediary organisation could provide benchmarking services based on anonymised data as an added value to parties which are willing to share data. It is therefore recommended to set-up a framework allowing for the data to be made available in a reliable manner while addressing privacy and confidentiality of data. This could also include a discussion on the use of AIS data, ERI data, CDNI data which may be supportive to develop.

Overview of Annexes

Annex I: **Calculation example Emission Performance Label**

Annex II: **Taxonomy Annex Delegated Act**

Annex III: **EU framework for harmonised measurement of transport and logistics emissions**

Annex IV: **PIANC working group 229 "Guidelines for Sustainable Performance Indicators for Inland Waterways**

Annex V: **Handbook external costs of transport (CE Delft, INFRAS)**

Annex VI: **Contribution of the CCNR in view of task 2.6 of the PLATINA3 project**

Annex VII: **DENA study "dena-Leitstudie Aufbruch Klimaneutralität"**

Annex VIII: **Matrix for Multi Criteria Assessment**

Annex IX – Fact Sheet on EEDIinland and EEOIinland

Annex I Calculation example Emission Performance Label

This Annex provides more background information for the chapter 2.1 of this report. In this Annex concrete examples are illustrated for the calculation approach to determine the label category and the Key Performance Indicators for the Emission Performance Label as developed and implemented in The Netherlands. It concerns a calculation based on information provided by the applicant (usually the vessel owner), explained in a step by step manner. For reasons of simplicity only the ISO 8178 E3 test cycle is used here in the calculation example (the one for marine application propeller law).

However, other test cycles are also possible, especially for generator sets (e.g. cycle D2). Please see https://dieselnet.com/standards/cycles/iso8178.php for the full specification of test cycle options and their application.

Step 1:

For each vessel will be identified which type of energy convertors / engines are installed and which specific energy/fuel consumption each one has as well as the emission profile for each energy convertor/engine unit. For example, for an engine this concerns the following table to be filled in:

Engine X	Main Engine X
Max. power (kW)	…
Specific fuel consumption	gram diesel per kWh
25% engine load rate	…
50% engine load rate	…
75% engine load rate	…
100% engine load rate	…
Emission NOx (Nitrogen Oxides)	gram per kWh
25% engine load rate	…
50% engine load rate	…
75% engine load rate	…
100% engine load rate	…
Emission PM (particulate matter mass)	gram per kWh
25% engine load rate	…
50% engine load rate	…
75% engine load rate	…
100% engine load rate	…
Emission PN (particle number)	# per kWh
25% engine load rate	
50% engine load rate	
75% engine load rate	
100% engine load rate	

Emission CH4 (methane slip)[65]	gram per kWh
25% engine load rate	
50% engine load rate	
75% engine load rate	
100% engine load rate	

For new engines with less than 20,000 running hours this information can be derived from engine information provided by the engine manufacturer/supplier. For engines with higher running hours a measurement on board provides the required information. Based on this information the weighted average values are determined. This concerns the CO2 equivalent emission (gram per kWh), NOx en particulate matter emissions expressed in gram per kWh and particulate numbers (# per kWh). The particulate number information is only relevant in case the DPF is applied with the aim to achieve air quality label 1 or 2.

[65] Methane slip is only relevant for gas engines, for example single or dual fuel engines using Liquid Natural Gas or BioMethane. According to IPCC wordt the GWP100 value for methane (CH4) will be applied for the CO2 equivalency calculation.

Example datasheet energy convertors (engines) on board (step 1):

Energy convertor 1	Main engine 1	
Power	800	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	220	gram diesel per kWh
50%	210	gram diesel per kWh
75%	205	gram diesel per kWh
100%	205	gram diesel per kWh
E3 weight avg.	**206,4**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	699,6	139,92
50%	667,8	267,12
75%	651,9	391,14
100%	651,9	521,52
E3 weight avg.	**656,2**	360,9
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	6,2	4,96
E3 weight avg.	**5,7**	3,2
Emissie PM (particulate matter)	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Energy convertor 2	Main engine 2	
Power	800	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	220	gram diesel per kWh
50%	210	gram diesel per kWh
75%	205	gram diesel per kWh
100%	205	gram diesel per kWh
E3 weight avg.	**206,4**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	699,6	139,92
50%	667,8	267,12
75%	651,9	391,14
100%	651,9	521,52
E3 weight avg.	**656,2**	360,9
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	6,2	4,96
E3 weight avg.	**5,7**	3,2
Emissie PM (particula	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Energy convertor 3	Genset 1	
Power	50	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	250	gram diesel per kWh
50%	240	gram diesel per kWh
75%	230	gram diesel per kWh
100%	225	gram diesel per kWh
E3 weight avg.	**230,7**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	795	9,9
50%	763,2	19,1
75%	731,4	27,4
100%	715,5	35,8
E3 weight avg.	**733,7**	25,2
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	6,4	5,12
E3 weight avg.	**5,8**	3,2
Emissie PM (particula	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Energy convertor 4	Genset 2	
Power	50	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	250	gram diesel per kWh
50%	240	gram diesel per kWh
75%	230	gram diesel per kWh
100%	225	gram diesel per kWh
E3 weight avg.	**230,7**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	795	9,9
50%	763,2	19,1
75%	731,4	27,4
100%	715,5	35,8
E3 weight avg.	**733,7**	25,2
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	6,4	5,12
E3 weight avg.	**5,8**	3,2
Emissie PM (particula	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Energy convertor 5	Bowthruster 1	
Power	200	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	240	gram diesel per kWh
50%	230	gram diesel per kWh
75%	225	gram diesel per kWh
100%	225	gram diesel per kWh
E3 weight avg.	**226,4**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	763,2	9,5
50%	731,4	18,3
75%	715,5	26,8
100%	715,5	35,8
E3 weight avg.	**719,8**	24,7
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	5,9	4,72
E3 weight avg.	**5,6**	3,1
Emissie PM (particul	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Energy convertor 6	Bowthruster 2	
Power	200	kW
Type approved	CCNR 2	
Sp[ecific consumtion		
Load rate engine		
25%	240	gram diesel per kWh
50%	230	gram diesel per kWh
75%	225	gram diesel per kWh
100%	225	gram diesel per kWh
E3 weight avg.	**226,4**	gram diesel per kWh
Emission CO2	gram per kWh	kg per hour
Load rate engine		
25%	763,2	9,5
50%	731,4	18,3
75%	715,5	26,8
100%	715,5	35,8
E3 weight avg.	**719,8**	24,7
Emissie NOx	gram per kWh	kg per hour
Load rate engine		
25%	4,2	0,84
50%	4,9	1,96
75%	5,8	3,48
100%	5,9	4,72
E3 weight avg.	**5,6**	3,1
Emissie PM (particula	gram per kWh	kg per hour
Load rate engine		
25%	0,15	0,03
50%	0,15	0,06
75%	0,12	0,072
100%	0,20	0,16
E3 weight avg.	**0,15**	0,082

Step 2: vessel data and running hours of the energy convertors (engines)

The next step is to provide data about the vessel, the annual energy/fuel consumptions and the running hours of the energy convertors during a reference year (for example the past calendar year).

As regards the energy/fuel it can concern different types which are used during the reference period. One can think of fossil diesel duel (B0), a blend of fossil with biofuels (e.g. B7/B30), LNG, hydrogen, methanol as well as electricity for the recharging of batteries on board.

Based on the fuel/energy consumption the CO2 equivalent emission is calculated, taking into account the share of sustainable/renewable energy.

The following table can be illustrative for the required input

Vessel characteristics	
Type vessel	**[multiple choice]**
Length	…
Width	…
Load capacity -weight (ton)	…
Load capacity -volume (m3)	
Load capacity -containers (TEU)	
Capacity passengers	
Fuel/energy consumption	
1. Type fuel/energy	**[multiple choice]**
Volume	**[in liter/m3, kg/ton or kWh]**
2. Type fuel/energy	**[multiple choice]**
Volume	**[in liter/m3, kg/ton or kWh]**
N. Type fuel/energy	**[multiple choice]**
Volume	**[in liter/m3, kg/ton or kWh]**
Running hours per year of energy convertors (engines)	
Energy convertor 1	3200
Energy convertor 2	1600
Energy convertor N	5000

Based on the distribution of the running hours the weighted average is calculated for the fuel/energy consumption and the emissions of the vessel, expressed in values per kWh.

Optionally also information can provide input about the transported cargo, travelled distance and the transport performance (tkm).

Transported volume	…(ton, TEU, m3, # passangers)
Travelled distance	… (km)
Tkm performance	…

As an example, this may look like the following:

Type	**Motor vessel dry cargo**	
Length	110	meter
Width	11,40	meter
Load capacity	2500	ton
Carried cargo	216.000	ton
Travelled distance	42.624	km
Freight transport performance	47.952.000	tkm
Fuel consumption	315	m3 fossil diesel
Share sustainable	30%	B30
Type sustainable	135	m3 HVO
Total fuel onsumption	450	m3
Share fossil in energy consumption	70%	
Share reneable in energy consumption	30%	
Gross emission CO2	1.202.040	kg
net CO2 equivalent emission IPCC	**841.428**	kg
net CO2 equivalent emission IPCC per kWh	**464**	
	Running hours per y	Maximum power (kW)
Main engine 1	3200	800
Main engine 2	1600	800
Genset 1	5000	50
Genset 2	100	50
Bowthruster 1	500	200
Bowthruster 2	200	200

Based on the running hours and the maximum power, the share of each energy convertor is determined in the total fuel/energy consumption. This share combined with the average emission per kWh per energy convertor is taken into account for the calculation of the weighted average for vessel.

This calculation of the weighted average is further illustrated in the next table:

					Weighted average			
	Running hours per y	Maximum power (kW)	kWh max	Share in total maximum power on board	gram fuel per kWh	gram CO2 per kWh	gram NOx per kWh	gram PM per kWh
Main engine 1	3200	800	2.560.000	60,4%	124,7	396,7	3,46	0,090
Main engine 2	1600	800	1.280.000	30,2%	62,4	198,3	1,73	0,045
Genset 1	5000	50	250.000	5,9%	13,6	43,3	0,34	0,009
Genset 2	100	50	5.000	0,1%	0,3	0,9	0,01	0,000
Bowthruster 1	500	200	100.000	2,4%	5,3	17,0	0,13	0,003
Bowthruster 2	200	200	40.000	0,9%	2,1	6,8	0,05	0,001
			4.235.000	100%	**208,5**	**663,0**	**5,7**	**0,1482**

With these data combined with the annual fuel/energy consumption, the calculation can also be made on the estimated annual mechanical power output (kWh) and the emissions. In this step, the share of renewable fuel for the CO_2 calculation in accordance with IPCC is corrected.

Estimated mechanical energy (kWh) based on annual fuel consumption and weighing specific fuel consumption per energy convertor (engine) based on ISO 8178	**1.813.021**
Estimated NOx emission (kg) based on annual fuel consumption and weighing specific emission factor per energy convertor (engine) based on ISO 8178	**10391**
Estimated PM emission (kg) based on annual fuel consumption and weighing specific emission factor per energy convertor (engine) based on ISO 8178	**268,7**

Annex II: Taxonomy Annex Delegated Act

This Annex provides more background information for the chapter 2.5 of this report concerning the EU Taxonomy technical screening criteria for inland waterway transport for the climate mitigation objective.

The source is Annex 1 of the document C(2021) 2800 final published 4 June 2021 (Brussels) supplementing the Regulation EU 2020/852 published 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

Link: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2021)2800

6.7. Inland passenger water transport

Description of the activity

Purchase, financing, leasing, rental and operation of passenger vessels on inland waters, involving vessels that are not suitable for sea transport.

The economic activities in this category could be associated with NACE code H50.30 in accordance with the statistical classification of economic activities established by Regulation (EC) No 1893/2006.

Where an economic activity in this category does not fulfil the substantial contribution criterion specified in point (a) of this Section, the activity is a transitional activity as referred to in Article 10(2) of Regulation (EU) 2020/852, provided it complies with the remaining technical screening criteria set out in this Section.

Technical screening criteria

Substantial contribution to climate change mitigation	
The activity complies with one of the following criteria: (a) the vessels have zero direct (tailpipe) CO_2 emissions; (b) until 31 December 2025, hybrid and dual fuel vessels derive at least 50% of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation.	
Do no significant harm (‘DNSH’)	
(2) Climate change adaptation	The activity complies with the criteria set out in Appendix A to this Annex.
(3) Sustainable use and protection of water and marine resources	The activity complies with the criteria set out in Appendix B to this Annex.

(4) Transition to a circular economy	Measures are in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling. For battery-operated vessels, those measures include reuse and recycling of batteries and electronics, including critical raw materials therein.
(5) Pollution prevention and control	Engines in vessels comply with emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).
(6) Protection and restoration of biodiversity and ecosystems	N/A

6.8. Inland freight water transport

Description of the activity

Purchase, financing, leasing, rental and operation of freight vessels on inland waters, involving vessels that are not suitable for sea transport.

The economic activities in this category could be associated with several NACE code H50.4 in accordance with the statistical classification of economic activities established by Regulation (EC) No 1893/2006.

Where an economic activity in this category does not fulfil the substantial contribution criterion specified in point (a) of this Section, the activity is a transitional activity as referred to in Article 10(2) of Regulation (EU) 2020/852, provided it complies with the remaining technical screening criteria set out in this Section.

Technical screening criteria

Substantial contribution to climate change mitigation
1. The activity complies with one or both of the following criteria: (a) the vessels have zero direct (tailpipe) CO_2 emission; (b) where technologically and economically not feasible to comply with the criterion in point (a), until 31 December 2025, the vessels have direct (tailpipe) emissions of CO_2 per tonne kilometre (gCO_2/tkm), calculated (or estimated in case of new vessels) using

the Energy Efficiency Operational Indicator[66], 50% lower than the average reference value for emissions of CO_2 defined for heavy duty vehicles (vehicle subgroup 5-LH) in accordance with Article 11 of Regulation 2019/1242. 2. Vessels are not dedicated to the transport of fossil fuels.	
Do no significant harm ('DNSH')	
(2) Climate change adaptation	The activity complies with the criteria set out in Appendix A to this Annex.
(3) Sustainable use and protection of water and marine resources	The activity complies with the criteria set out in Appendix B to this Annex.
(4) Transition to a circular economy	Measures are in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling. For battery-operated vessels, those measures include reuse and recycling of batteries and electronics, including critical raw materials therein.
(5) Pollution prevention and control	Vessels comply with the emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).
(6) Protection and restoration of biodiversity and ecosystems	N/A

6.9. Retrofitting of inland water passenger and freight transport

Description of the activity

Retrofit and upgrade of vessels for transport of freight or passengers on inland waters, involving vessels that are not suitable for sea transport.

[66] The Energy Efficiency Operational Indicator is defined as the ratio of mass of CO_2 emitted per unit of transport work. It is a representative value of the energy efficiency of the ship operation over a consistent period which represents the overall trading pattern of the vessel. Guidance on how to calculate this indicator is provided in the document MEPC.1/Circ. 684 from IMO.

The economic activities in this category could be associated several NACE codes, in particular H50.4, H50.30 and C33.15 in accordance with the statistical classification of economic activities established by Regulation (EC) No 1893/2006.

An economic activity in this category is a transitional activity as referred to in Article 10(2) of Regulation (EU) 2020/852 where it complies with the technical screening criteria set out in this Section.

Technical screening criteria

Substantial contribution to climate change mitigation

1. Until 31 December 2025, the retrofitting activity reduces fuel consumption of the vessel by at least 10 % expressed in litre of fuel per tonne kilometre, as demonstrated by a comparative calculation for the representative navigation areas (including representative load profiles) in which the vessel is to operate or by means of the results of model tests or simulations.
2. Vessels retrofitted or upgraded are not dedicated to transport of fossil fuels.

Do no significant harm ('DNSH')

(2) Climate change adaptation	The activity complies with the criteria set out in Appendix A to this Annex.
(3) Sustainable use and protection of water and marine resources	The activity complies with the criteria set out in Appendix B to this Annex.
(4) Transition to a circular economy	Measures are in place to manage waste, both in the use phase and in the end-of-life of the vessel, in accordance with the waste hierarchy, including the control and management of hazardous materials on board of ships and ensuring their safe recycling.
(5) Pollution prevention and control	Vessels comply with emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).
(6) Protection and restoration of biodiversity and ecosystems	N/A

Annex III: EU framework for harmonised measurement of transport and logistics emissions

This Annex provides more background information for the chapter 2.1 of this report.

This concerns the EU framework for harmonised measurement of transport and logistics emissions – 'CountEmissions EU'. It concerns the elaboration of the Action 33 from the EU Sustainable and Smart Mobility Strategy[67]: ***Action 33. Establish EU framework for harmonised measurement of transport and logistics emissions***

An inception impact assessment document is published[68] on 19 November 2021 and provides the following information about this initiative:

Political context

Door-to-door transport and logistics operations are usually very complex due to the large number of actors and various transport modes involved. Further to growing demand, transport remains for the moment the only economic sector where total emissions are higher than they were in 1990. However, thanks to technological development, regulatory actions and improved environmental awareness, a broad range of instruments has helped to optimise the efficiency of operations and to lower associated emissions. One such instrument is the greenhouse gas (GHG) emissions accounting, as a method to generate, share and compare emissions data of both unimodal and multimodal transport activities and operations. This can incentivise companies, customers and passengers to take up more environmentally friendly and efficient transport solutions. This initiative aims to provide a common framework for calculating GHG emissions of transport operations in the freight and passenger transport sectors. It will contribute to implementing the European Green Deal, and to meeting the objectives and targets under the European Climate Law. It corresponds to Action 33 in the Action Plan of the Sustainable and Smart Mobility Strategy, published on 9 December 2020, and will form the basis for the implementation of Action 28 and Action 34 in the same Action Plan. The initiative will be coordinated with other regulatory and non-regulatory EU actions on the following: emission standards; requirements and monitoring of GHG emissions of vehicles, vessels and aircrafts; sustainable delivery of goods; green labels; the environmental performance of products and organisations; and corporate sustainability reporting and related EU standards development.

Problem the initiative aims to tackle

The main problem that the initiative aims to address is the information failure that prevents companies, customers and passengers from monitoring and comparing easily and accurately various transport service options with respect to their GHG emissions. This situation may lead to suboptimal choices by both businesses and individuals. Preliminary analysis indicates that this information failure arises from two main drivers:

a) **Fragmentation of methodological approaches for GHG emissions calculation and sharing in transport and logistics**

[67] Source: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789

[68] Source: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13217-Count-your-transport-emissions-%E2%80%98CountEmissions-EU%E2%80%99_en

Currently, there exists no common and universally accepted GHG emissions accounting framework for the transport and logistics sectors. On the one hand, this leads to substantial divergences in emissions data calculation results. On the other, the lack of comparability diminishes the usefulness of GHG accounting in informing decisions by organisations and users/passengers, hindering the overall effectiveness of GHG accounting as a policy tool to incentivise environmentally friendly business and consumer choices for transport/mobility. This problem driver is generally recognised and has materialised in several attempts by industry or national governments1 to produce a standard framework. The European CEN standard EN16258 was published in 2012, but is considered insufficiently precise. The fragmentation also creates an administrative burden for international operators who may need to comply simultaneously with different approaches.

b) Limited uptake of emissions accounting in everyday business practice

Despite the growing interest of transport stakeholders to use information about GHG emissions as a sales argument or as a decision-making support tool, the overall uptake of GHG accounting, especially in the SME sector, is still limited. Those who actually measure their carbon footprint at company or service level (mostly large market players) do it mainly for internal benchmarking purposes. Consequently, most of them do not publish their carbon footprint data, nor do they disclose such information in their business activities. A large proportion of small and medium-sized enterprises do not calculate emissions at all2 . This situation might be explained by the difficulty to pick a right methodology, insufficient awareness, low priority for environmental issues, lack of resources, reluctance to publish data, perceived administrative burden associated with the GHG calculation, or lack of interest from some customers to consider GHG emissions in their purchasing decisions. In addition, there exist no clear rules for the storage and handling of such data, which might raise concerns about exposing commercially sensitive information.

Objectives and policy options

The general objective of this initiative is to incentivise the reduction of emissions from transport and logistics, through:

- establishing a level playing field for GHG emissions accounting in the transport and logistics sectors; and
- facilitating behavioural change. In this context, the initiative aims to contribute to the improvement of the environmental performance of transport through the following set of specific objectives:
    - providing a single EU framework for calculating GHG emissions data of transport operations/services in freight and passenger sectors;
    - making available reliable and comparable information on the GHG intensity of individual transport services; and
    - facilitating the uptake of GHG emissions accounting in business practice. Due to the international outreach of transport and logistics, this initiative will give due consideration to the possibility to deliver a framework enabling further alignment on a global scale. Subject to further analysis, scoping and screening, the following horizontal dimensions will be combined in constructing the policy options.
- The methodological framework would consider the type of future methodology, including its scope, reliability, consistency, acceptability by stakeholders, applicability for transport services, level of detail as regards emissions data, calculation boundaries, and the geographical outreach (i.e. an EU-centred versus a globally recognised standard).
- The need for implementation specifications would provide detailed guidance, as necessary, on applying the harmonised methodology in specific sectors, based on the common framework.

- The verification regime would cover aspects related to independent data assessment and verification, and the organisation of data exchange between parties, with particular reference to the use of digital tools and frameworks.
- Technical support measures would facilitate the use of GHG emissions accounting by stakeholders. This would involve developing simplified solutions and tools, especially for micro companies and SMEs, and taking into account existing and future industry-led projects, specific software products and calculators.
- The type of policy instrument to be applied for effective implementation of the initiative. This dimension would look into a range of possible approaches, including soft law and legislative measures, and whether such measures should be mandatory or voluntary. The impacts of the options to be developed based on these horizontal dimensions will be assessed against the baseline scenario without EU action, where any future GHG accounting alignment is left to market forces, own initiatives by industry, and actions taken at national level.

Practical need for EU action
Actions of individual Member States, and own initiatives by industry, result in the development of a variety of national, local or industry schemes, which, while harmonising GHG emissions accounting on particular markets, hamper the comparability, consistency and reliability of results throughout the EU. The multiplication of approaches and methodologies can create barriers for the free movement of goods and services in the single market.

Status:
The Commission has planned a range of consultation activities to collect stakeholder views and data for fine-tuning the problem definition and objectives, developing policy options and assessing their feasibility and impacts. Stakeholders include transport operators, logistics service providers, shippers, e-commerce and ticketing platforms, passenger and consumer organisations, industry associations, environmental groups, standardisation organisations, national authorities and NGOs. The consultation process will consist of two main parts.

- A 12-week open public consultation to be launched in Q1 2022 in all official EU languages. It will be accessible via the Commission's central public consultations page (‘Have your say’). A factual summary report will be published on the consultation page after this public consultation is closed.
- Various targeted stakeholder consultations to be undertaken in the first half of 2022 (including surveys, individual interviews and workshops). The results of all consultation activities will be summarised in a synopsis report.

Annex IV: PIANC working group 229 "Guidelines for Sustainable Performance Indicators for Inland Waterways"

A PIANC working group is established on the topic of "Guidelines for Sustainable Performance Indicators for Inland Waterways" (PIANC InCom Working Group 229).

The objective of this working group is to develop guidelines that

- can assist waterways managers/operators/ governments/ ship designers /shipbuilders in classifying ports and vessels (environmental, operational)
- To develop sustainable design for both vessels and infrastructure
- It is understood that the first need of complementary design is to establish a common goal by having a feedback system from all concerned members of the trade.

PIANC is aware that performance indicators should also relate to technical performance, economical performance, maintenance performance, etc. But these are not in the scope of this WG. In addition, IW performance depends on:

- The characteristics the waterway (blockage coefficient of confined water, channel design, etc.)
- The shape of the ship hull for propulsion efficiency (hydrodynamics optimisation performed during early design stage of a vessel.

These are not in the scope of this WG. The WG targets alternate propulsion technology (e.g. LNG, electric, and others instead of typical fossil fuels) to get lower "environmental ship index" and drive to a more sustainable IW navigation.

The intended product is a set of guidelines to develop and define environmental performance indicators and to focus on hazardous emissions and greenhouse gas production aspects (induced by Inland Water navigation).

The scope of the WG will include the following:

- A review of current practice, codes and standards (possibly including gap analysis);
- Review of the methodology proposed in the paper "Maritime environmental performance indicators for urban waterways in Amsterdam", Journal of Engineering for the Maritime Environment, September 2016);
- A comparison of emission improvements in different mode of transport;
- Methods for collation of available data on emissions, fuel consumption, passenger kilometres and cargo kilometres;
- Collation of emissions produced by inland ship propulsion systems and the risks involved;
- Environmental classification of a series of ships;
- Selection of waterways to be investigated;
- Proposals for existing and possible future use fuels and related technologies ;
- A feasible roadmap on how waterways and ports could prepare themselves for changes (e.g. provision of facilities for alternative fuels);
- A study/inventory of ongoing projects both in maritime and inland waterways. Also pro-pose adoption of existing practices in maritime transport;
- Present inventory of environmental performance based incentives in transport sector and possibility of similar incentives in inland waterways (as for instance the Smart Freight Centre, a

PIANC partner, who have extensive experience of carbon foot-printing methodologies and have been working to coordinate and standardise approaches for the wider freight sector;

- Inventory of global initiatives from various government and administrative bodies to pro-mote rules and regulations to focus on environmental efficiency & performance of vessels (for instance the UN Sustainable Development Goals in helping to set the stage for developing appropriate metrics);
- Organise presentations and workshops in order to share knowledge and ideas, and to spread awareness.

There are meetings foreseen in 2022 to develop the guideline resulting in a report to be presented later in the year 2022s.

Annex V Handbook external costs of transport (CE Delft, INFRAS)

The Handbook on the external costs of transport (version 2019 1.1) was made for the European Commission. It concerns an updated handbook on external costs of transport which was developed in the study 'Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities' commissioned by the European Commission DG MOVE, by a consortium led by CE Delft. The objective of this study is to assess the extent to which the 'user pays' and the 'polluter pays' principles are implemented in EU Member States and in other developed countries. This will allow DG MOVE to take stock of the progress of Member States towards the goal of full internalisation of external (and infrastructure) costs of transport and to identify options for further internalisation.

This Annex provides more background about this handbook.

Source:

- CE_Delft_4K83_Handbook_on_the_external_costs_of_transport_Final.pdf (cedelft.eu) or https://cedelft.eu/wp-content/uploads/sites/2/2021/03/CE_Delft_4K83_Handbook_on_the_external_costs_of_transport_Final.pdf or https://op.europa.eu/en/publication-detail/-/publication/9781f65f-8448-11ea-bf12-01aa75ed71a1
- Annexes with Excel files: Internalisation of transport external costs | Mobility and Transport (europa.eu)

In 2008 the European Commission commissioned the first Handbook on External Costs of Transport, as part of the IMPACT study (Infras, CE Delft, ISI & University of Gdansk, 2008). This Handbook presented the best practice on the methodology to estimate different categories of external costs of transport. Additionally, it provided an overview of state of the art input values (e.g. the value of time or the value of a statistical life) that can be used to produce estimations of external costs by users of the Handbook themselves. Finally, the Handbook presented external cost figures (mostly presented in €/vehicle kilometre), which can be used directly by the users.

In 2014 the Handbook was updated with new developments in research and policy (RicardoAEA, TRT, DIW Econ & CAU, 2014). Furthermore, the scope was broadened: next to the external costs of transport, infrastructure wear and tear costs for road and rail transport were covered as well. In line with the 2008 Handbook, the focus of the 2014 Handbook was on marginal external costs of transport. Next to the Handbook, an accompanying Excel file was produced, containing country specific estimates of the main external costs of road and rail transport. This Handbook is an update of the 2008 and 2014 version, taking into account any new evidence that has become available on the methods and input values (e.g. emission factors) for estimating external costs of transport in research and policy since 2014.

The 2019 version of the Handbook does not only consider marginal external costs, as was the main focus of the previous Handbooks, but also total and average external costs of transport in all EU-countries, Switzerland and Norway. Furthermore, external cost figures for some non-European countries were produced to compare them with the European figures.

Scope

This Handbook covers all main externalities of transport:

— accidents;

— air pollution;

— climate change;

— noise;

— congestion;

— well-to-tank emissions;

— habitat damage;

— other external cost categories (e.g. soil and water pollution).

As regards modes, it considers road transport, rail transport, **inland waterway transport IWT**), maritime transport and aviation. Total and average cost figures are produced for the vehicle categories. Furthermore, cost-specific differentiations of the external cost estimates are produced when relevant (e.g. average/marginal air pollution costs of passenger cars are differentiated to Euro class).

For road transport, rail transport and **IWT**, input and output values are produced for all EU28 countries, Norway, Switzerland, Canada, US, and Japan.

Scope characteristic	
Geographic coverage	EU28
Type of vessels considered	CEMT II 350 tonnes, bulk and container CEMT IV (600t), bulk and container CEMT Va (1500t), bulk and container Pushed convoy (11,000t), bulk and container
Type of engines	CCNR 0, CCNR 1, CCNR 2, average
Type of emissions	NOx, PM, NMVC, SO_2, CO_2, CH_4
Scope of emission chain	WTW

Objectives

The objective of the handbook is to provide information on how to generate state-of-the art estimates for all main external costs of transport. This information is provided at three levels:

- Methodological level: what are the state of the art methodologies to estimate figures for the various external costs of transport?
- Input values: which input values (particularly at monetary terms, e.g. the value of time) are recommended to use to estimate external costs of transport?
- Output values: which default external cost values for different transport modes (and if meaningful, for different traffic situations) can be recommended?

State of the art methodologies, input values and output values for total, average and marginal external costs of transport are provided, both at the EU27 level as at the level of individual countries. This is done for all transport modes and all (main) external cost categories.

Methodology

Method characteristic	
Data sources	• All input and output values are presented for 2016 • All financial figures are expressed in Euro price levels of 2016 • For the purpose of this handbook a consistent set of transport performance data has been composed, mainly based on EU aggregated sources (like Eurostat and COPERT) • Emission factors • Transport performance per country, bulk and container • Shadow prices of emissions
Calculation method	• Multiplying the data
Presentation method	• Report, handbook
Reliability, checks and enforcement	• Rather aggregated data, difficult to check with reality

Annex VI - Contribution of the CCNR in view of task 2.6 of the PLATINA3 project

This Annex is related to the chapter 1 in view of the CCNR Roadmap. It presents the position and viewpoint of the CCNR at the beginning of the work for Task 2.6 in January 2021.

General remarks

- In order to swiftly implement a labelling system on short term, it should be, as a first step, simple (for instance, with regard to greenhouse gas and pollutant emissions, they could be expressed in g/kWh). In the meantime, the work on further development towards a more sophisticated label should continue.
- It should cover both cargo and commercial passenger vessels already in a first step. On a longer term, a more specific methodology, allowing to measure real emissions, both for cargo (for instance expressed in g/tkm) and passenger vessels (for instance expressed in g/ passenger km) would be essential. Other types of crafts (floating equipment, pleasure craft) could also be considered on a longer term.
- All delegations agree to strive for an international system for inland navigation (avoiding the introduction of competing labelling systems at different levels and according to different criteria).
- When developing a labelling system, possible links with the taxonomy initiative should be born in mind. Indeed, this labelling system and the underlying methodology for measuring vessel emissions could be used as a tool to identify whether inland freight and passenger transport "contribute substantially to climate change adaptation" in the context of the EU taxonomy regulation.
- Proper implementation of the label would require a guarantee of quality of the label delivered by independent and trustful authorities. Different measures could be considered such as involvement of the vessel inspections bodies, state administration oversight or accreditation.

A. Intended use and users of a labelling system for environmental and climate protection in inland navigation and

A labelling system

- provides incentives to improve the environmental performance, meaning air pollutant emissions (CO, HC, NO_x, PM)[69] and greenhouse gases (such asCO_2, CH_4), as well as energy consumption.
- allow to **assess and monitor the progress made by the fleet of inland vessels** with respect to the objectives set by the Mannheim Declaration.

In this respect, a major challenge is to identify and anticipate its possible uses.

The objective for delegations could be to discuss and anticipate all possible uses of this labelling system as well as to make proposals to complete the list below, in order to make the list as exhaustive as possible, bearing in mind that it may change over time.

A labelling system could be used in a variety of ways:

[69] As referred to in Regulation (EU) 2016/1628

1. For **vessel owners**[70],
   i. proof of environmental performance and claiming of any benefits and discounts in this regard.;
   ii. to support them in their investment decisions;
   iii. to support them in reducing their carbon/emission footprint (for example, by encouraging them to retrofit existing engines) as well as improving their corporate social responsibility/CSR balance sheet.
2. For **public authorities** at all levels including operators of waterways or ports, to implement and steer their energy transition policies in order, in particular, to:
   i. facilitate the elaboration and implementation of subsidy systems (e.g. by making it possible to classify activities in accordance to their environmental performance;);
   ii. provide harmonised criteria for prohibitions/restrictions of navigation or access to ports and harbours based on environmental grounds (for example, the access criteria to so-called green ports are evident with possible port fee reduction for greener ships or accompanying measures such as the obligation to use shore power);
   iii. support the economic and fiscal incentives as well as assessment systems of governmental and/or private institutions, such as ports;
   iv. help assess progress on energy transition. To facilitate this assessment, data resulting from the labelling system could be included the inland vessel certificate.[71]
3. For **banks, insurance companies and other financial market participants** to provide guidance as to the financing of environmentally friendly vessels and development of financial products.
4. For **shippers and brokers,** to allow a conscious choice of an ecological means of transport and to encourage them to enter into contractual arrangements with environmentally friendly vessels.
5. For the **shipbuilding industry,** to promote/market more easily their activities of building new, more environmentally friendly and energy efficient vessels and/or retrofits.
6. For the **inland navigation sector**, to have a measurement system in place regarding greenhouse gases and air pollutants that would allow to compare its environmental performance with that of other transport modes, such as the GLEC[72] methodology. It would support active marketing for an environmentally friendly mode of transport with large transport capacities.
7. **More generally**, to assist in the creation of a possible European funding and financing scheme.
8. For **statistical purposes** to serve as a data source for internationally harmonized data on energy consumption and greenhouse gases and air pollutants emissions

Remark: The demands on the quality of the labelling system increase with the geographic scope, the range of uses and, in particular, the associated legal consequences; at the same time, the complexity is likely to increase. It is obvious that the expectations for the quality of a labelling system depend very much on its intended use. If the system is only intended to provide supplementary information for decisions by private entities, the quality may be relatively low. If, on the other hand, the scope of government funding or even driving bans (e.g., passing through cities or entering ports) is made

[70] In the implementation phase it should be carefully checked whether the ship owner of the ship operator will be considered.

[71] The CESNI/PT working group is currently working on a new model of inland shipping certificate in which these data can be included as an obligation. In this way, it is ensured that we get an overview of the entire fleet and not just of a portion of the vessels. Further coordination with RV Committee as well as CESNI/CESNI/PT would be necessary.

[72] Global Logistics Emissions Council. A methodology designed to compare greenhouse gas emissions between different modes of transport.

dependent on it, or if it is a government test or quality seal, the quality of the labelling system must be very high. Therefore, before developing and implementing a labelling system, it is imperative to answer the question of which body will issue it and what it will be used for.

B. Identification of possible design criteria for a label

At the system design stage, all actors likely to be affected by the system or to use it should be part of the development process. This will substantially enlarge its potential and support.

The objective for CCNR delegations could be to discuss the possible design criteria of the label system and to make proposals to complete and/or amend the list below, bearing in mind that the criteria might evolve over time.

A labelling system for environmental and climate protection in inland navigation should:

1. apply in all CCNR Member states and be harmonized at European level;
2. cover cargo and passenger vessels as a first step (the inclusion of floating equipment and pleasure craft should be further investigated);
3. be accepted by all CCNR Member States, EU countries and relevant stakeholders;
4. be compatible and comparable with similar labelling and/or assessment systems for other modes of transport, so as always to demonstrate that inland navigation remains a particularly clean transport mode;
5. express ultimately greenhouse gas and pollutant emissions,
    - for cargo vessels in g/tkm (thereby taking into account the tonnages transported and the distances travelled). This should make it possible to show the competitiveness of freight vessels in relation to other modes of transport from an environmental point of view.
    - for passenger vessels in g/kWh or a more suitable criterion (perhaps grammes per passenger kilometres).

   A suitable criterion would also be needed if other types of craft are considered.
6. be open to all commercial vessel owners to avoid affecting the level-playing field;
7. allow re-evaluations: it should be possible for a vessel owner to ask for a revision/update of his/her label category in the event that, for instance, investments have been made to reduce the emissions of his/her vessel;
8. be open to further developments: the labelling system will be made more extensive and advanced over time;
9. be transparent and clear, while taking reasonable account of essential influencing factors but allowing documentation with reference to clients, transporters, institutions and investors
10. be cost efficient;
11. be as simple as possible to use and implement;
12. be technology-neutral and non-discriminatory against individual types of vessels and/or types of propulsions and/or type of energy, unless justified;
13. be compatible and evolving with future new policy objectives and technological developments, especially information and communication technology;
14. be fair: any required measurements should avoid unequal treatment and be easily replicable and reproducible (to the extent possible based on real sailing emissions);
15. be based, at least in a first step, on a tank-to-propeller approach[73];

[73] As decided by the CCNR in the context of the preparation of its roadmap for reducing inland navigation emissions as envisaged by the Mannheim Declaration (see PRE (21) 8 rev.2; “Part 3.1)

16. be based on the vessel operation, in addition to vessel design and equipment.

While the PLATINA3 proposal currently refers to an EU labelling system, the CCNR should try and ensure that the expected report refers to a European labelling system, so as to include at least EU and CCNR Member States (especially Switzerland) and, at best, all European IWT countries.

Annex VII – DENA study "dena-Leitstudie Aufbruch Klimaneutralität"

This Annex is related to the chapter 1 in view of the policy objective to promote energy efficiency measures on board of vessels.

The German DENA's lead study "Aufbruch Klimaneutralität"[74] provides an answer as to which fossil and renewable energies will be available for Germany in total in the future and which shares of the energy mix can be attributed to the individual energy using sectors. From these attributions, which were made for different years, it was possible to derive the amounts of energy that the different sectors must save in order for Germany to achieve its climate goals.

Energy using sector (TWh)	**2018**	**2030**	**2045**
Industry	722	638	578
Buildings	1005	789	571
Transport	762	536	328
Total	2489	1963	1477

Table 1: available energy quantities (energy mix) by sector. [75]

Savings compared to 2018 (%)	**2030**	**2045**
Transport	30%	57%
All energy using sectors	21%	41%

Table 2: Necessary savings (own calculations)

The calculations show that the transport sector will have to reduce its energy consumption by almost 60% by 2045 to achieve climate neutrality. Whether all modes of transport will have to reduce their energy consumption equally or whether the already particularly energy-efficient modes, including inland navigation, will be less challenged will probably be decided politically. The same is likely to apply to the question of whether the savings for the respective sectors apply in absolute terms or are related to the transport performance rendered.

Regardless of this, according to the DENA study, about half the current amount of energy available today for inland navigation will be available for inland navigation in 2045. If it is assumed for the sake of simplicity that this amount of energy will be generated entirely from renewable sources[76], it can be concluded that about half of the climate neutrality of inland navigation will be achieved through the use of climate-neutral energy sources.

[74] https://www.dena.de/fileadmin/dena/Publikationen/PDFs/2021/Abschlussbericht_dena-Leitstudie_Aufbruch_Klimaneutralitaet.pdf

[75] DENA, based on EWI-Gutachterbericht, 2021; ITG/FIW-Gutachterbericht, 2021; Öko-Institut-Kurzgutachten, 2021

[76] According to the DENA study, Germany will only be able to use diesel and methane from fossil sources to a very small extent in 2045. Therefore, this assumption seems appropriate for the present consideration.

Annex VIII – Matrix for Multi Criteria Assessment

Item Number	Criteria and sub-criteria	Level B All energy convertors on board	Level C Vessel performance including hydrodynamics for specific operating conditions (model)	Level D Service performance including speed, utilisation, empty sailing, crew,… (real life data)
		Energy and grams emission per kWh, based on weighted average. RED 2 Annex V values as reference for WTW GHG emissions.	Freight: Energy and emissions for moving the vessel per tkm, depending on predefined speed, load and waterway conditions	Freight: energy and gram per tkm or energy and gram per TEUkm
1	Level playing field - can it be broadly applied?			
a	**All (connected) countries with waterways? EU and non-EU counties?**			
b	**All type of waterways and the dynamic conditions?**			
c	**All type of vessels?**			
d	**All type of services?**			
	….			
2	Fairness			
a	**Is there level playing field?**			
b	**Sound benchmark by differentiation to subsegments of IWT?**			
b1	by type of waterways and the dynamic conditions?			
b2	by type of vessels?			
b3	by type of services?			
	…			
3	Effectiveness as regards objectives			
a	**Increase Energy Efficiency**			
a1	Improve hardware of vessel:			
a1.1	Powertrain efficiency			
a1.2	Hydrodynamic improvement			
a2	Improve operational use:			
a2.1	Optimise trip planning, sailing speed and energy management			
a2.2	Optimise payload, reduce empty sailing and economies of scale (where possible)?			
b	**Reduce Green House Gas emissions**			

b1	Increase use of renewable energy / energy with low WTW GHG footprint (gram CO2 eq per MJ)			
b2	Technical measures to reduce other green house gasses on board: CH4 (methane slip) and N2O			
c	**Reduce Air Pollutant emissions (local) for health and nature, NOx and PM, NH3, …**			
c1	Clean energy convertors / pre- and after treatment (e.g. catalysts, filters)			
c2	Clean fuels			
	…			
4	**Costs and administrative burden (public and private)**			
a	**Costs for ship-owner/operators**			
a1	FTE involved			
a2	Out-of-pocket costs (e.g. on board measurements, certification, accounts)			
b	**Costs for agency**			
c	**Costs for governance, organization, communication**			
	….			
5	**Legal feasibility / steps needed (mandatory or voluntary?)**			
a	**Is it currently available?**			
b	**Can existing legilsation be used as basis for extension / revision?**			
c	**Need for new legislation?**			
6	**Availability and reliability of data**			
a	**All waterways**			
b	**All vessel types**			
c	**All trips**			
d	**All goods**			
e	**All services**			
	…..			
7	**Time and organisational needs for implementation**			
a	**Time needed for legal framework**			
b	**Time needed to find financial resources**			
c	**Time needed to set-up organization, governance and executive agency**			
	…..			

Annex IX – Fact Sheet on $EEDI_{inland}$ and $EEOI_{inland}$

Indices as instruments for continuous improvement of energy efficiency:

$$EEDI_{inland} / EEOI_{inland} = \frac{CO2-\text{emission}}{\text{Transport work}} \triangleq \frac{\text{Environmental impact}}{\text{Economic benefit}}$$

$EEDI_{inland}$:

1. Applicable for newbuilt and existing ships
2. Unit: gCO_2 / tkm
3. Covers the vessel's performance including hydrodynamics (hull design and engine)
4. A proof must be provided (attained vs. required $EEDI_{inland}$):
    a. Calculation of the shaft power to be used during the test trial depending on the ship type and navigation area or calculation of the sailing speed and measurement of the used shaft power to reach the speed (depending on the ship type).
    b. Performing a test trial at the chosen navigation area with the previously calculated values for power or speed
    c. Measurement of the reached maximum ship speed or the required power
    d. Calculation of the attained $EEDI_{inland}$ by the corresponding equation (related to the ship considered)
    e. Comparison of the attained $EEDI_{inland}$ with the required $EEDI_{inland}$ from the trendline (given lines)
    f. The attained $EEDI_{inland}$ must be lower or equal the required $EEDI_{inland}$:

$$\text{Attained } EEDI_{inland} \leq \text{Required } EEDI_{inland}$$

5. Test trials can be conducted on rivers and channels with trapezoidal profiles
6. Trendlines (reference values) exist for 4 ship types
    a. Vessel class 1: dry cargo and container vessels
    b. Vessel class 2: tankers
    c. Vessel class 3: pushed convoys
    d. Vessel class 4: passenger vessels
7. Trendlines (reference values) exist for deep water
8. Trendlines (reference values) exist for restricted water depths (h) and different current velocities (v)
    a. 3.5 m < h < 7.5 m
    b. v_{Str} = 2 - 8 km/h
9. Auxiliary engines and regenerative power sources are not covered (yet).

$EEOI_{inland}$:

1. Applicable for any ship and at any waterway
2. Unit: gCO_2 / tkm
3. Covers the vessel's performance including hydrodynamics, operational conditions and human factor (navigation principles)
4. The impact of empty ship journeys is taken into account
5. Total fuel consumption is determined by means of fuel tank level indicators at the beginning and end of the stretch
6. The index is calculated per section with (almost) constant waterway conditions.
7. All fuel consumers connected to the tank are covered (main and auxiliary engines, etc.)
8. The representative water levels, sailing directions (up- / downstream), distance of the section, the amount of cargo and the fuel consumptions are recorded.
9. There is no reference line given; EEOI could be used by each ship operator to benchmark their ships and to detect improvement potential in terms of energy-efficiency.
10. Thus, EEOI could be part of regular management plans for ship owners aiming on the reduction of CO_2-emissions.

Sources:

1. Platina 3 presentation at 1st stage event: https://platina3.eu/download/gernot-paulii-and-jens-ley-on-energy-efficiency-indices-as-an-instrument-for-the-reduction-of-co2-emissions-of-inland-vessels/?wpdmdl=391&refresh=60e580dfac1da1625653471

2. R&D project 40.0399/2017 "Evaluating the energy requirement of inland vessels using energy efficiency indices", an executive summary of final report no. 2252, direct link to the report https://www.cesni.eu/wp-content/uploads/2021/03/cesnipt_energyindex_en.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006364. The opinions expressed in this document reflect only the author's view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Project coordination	Stichting Projecten Binnenvaart
Contact	info@platina3.eu

PLATINA3
IWT policy platform
- FLEET -

Funded by the Horizon H2020 Programme of the European Union under grant agreement No 101006364