Possibilities for reducing fuel consumption and greenhouse gas emissions from inland navigation

Summary of the report by the Inspection Regulations Committee for the 2012 Autumn Meeting

(Annex 2 to protocol 2012-II-4
of the Central Commission for the Navigation of the Rhine,
29 November 2012)

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Summary

At its 2009 Autumn Meeting, the CCNR, taking up its responsibility for sustainable navigation on the Rhine and inland navigation elsewhere, set itself the target of cutting the greenhouse gas emissions generated by navigation of the Rhine in line with the emission reduction targets of its member states. To reach this goal, the CCNR has asked its Inspection Regulations Committee to provide a report containing and assessing measures and possibilities of reducing greenhouse gas emissions from inland navigation and to present a proposal for how they can be made accessible to the inland navigation operators as well as other potential users in an appropriate manner.

The report refers to the greenhouse gas emissions from inland navigation in the strict sense of the word, i.e. CO_2 emissions generated by the operation of inland vessels. With the exception of CH_4, the emissions of other pollutants apart from CO_2 are not taken into consideration, nor are emissions not resulting from the operation of the vessels. This limitation is not detrimental to the objective of the report, since on the one hand CO_2 is the most significant greenhouse gas emitted by inland navigation by a long way, and on the other hand, other emissions apart from those resulting from operation of the vessel are negligible due to the low levels – at least initially. Emissions from the cargo, such as in tankers, should be attributed to the production chain of the cargo, rather than to the inland navigation. However, in view of the large share of liquid goods in the total cargo volume of inland navigation, it seems useful to determine the quantity of greenhouse gas emissions from the cargo on tank vessels in a separate study, and to develop and implement measures for reducing them.

Targets for reducing greenhouse gas emissions from inland navigation

In absolute terms, the greenhouse gas emissions due to inland navigation are very insignificant in comparison to the total amount of greenhouse gas emissions caused by transportation and even more insignificant in comparison to all anthropogenic greenhouse gas emissions. This is a result of the high energy efficiency of inland navigation and of its generally minor role in the traffic mix. However, the other carriers that compete with inland navigation are making advances in reducing their greenhouse gas emissions. If inland navigation wants to retain its competitive advantage as being “environmentally friendly”, it also needs to further reduce its greenhouse gas emissions.

A continuous increase in greenhouse gas emissions from the transport sector would undermine the global emission reduction targets set by the EU. It is therefore necessary to take action to bring greenhouse gas emissions from transportation into line with the global climate protection goals. While some States and the European Commission have quantified their targets for reducing emissions from transportation as a whole, this is not the case for the CCNR member States. Such quantification is objectively a complex undertaking, due to the incomplete data on current emissions, the options for lowering emissions as well as overall the economic development.

Such quantification of the targets would, however, be helpful for all those involved, as it would minimise uncertainty and allow them to bring the political, economic, technological and all other processes into line with this target. Since the member states of the CCNR are responsible for about three quarters of the transport-related activities and thus the greenhouse gas emissions from inland navigation in the EU, it is obvious for these states to take a leading role, together with the CCNR, in drawing up concrete climate protection goals for inland navigation.

Carbon footprint of inland navigation

For cargo transport, the CO_2 intensity of a given mode of transport can be presented via its CO_2 emissions in relation to its transport performance. This is largely done in g/tkm, but g/TEUkm can also be used. This ratio is often also referred to as the CO_2 emission factor[1]. As is also the case for other modes of transport, the CO_2 intensity is the key element for determining the carbon footprint of inland navigation. Many studies have attempted to quantify the CO_2 intensity of inland navigation. However, the range of values resulting from these studies is so broad that they neither allow the carbon footprint of inland navigation to be determined reliably for the purposes of transport or climate protection policy, nor is it possible to accurately derive the CO_2 emissions of logistics chains. One possible solution is the combination of data from inland navigation companies on fuel consumption and the total transport performance of various vessel types in conjunction with the transport statistics. On this basis it should be possible to draw up reliable and generally acceptable figures on CO_2 emissions from inland navigation. Relevant studies carried out in this field should also be taken into account.

Determining the specific emissions of a mode of transport is a complex matter involving a great deal of uncertainty. It is, therefore, even more difficult to compare with one another the emissions from different modes of transport. Yet, studies into the issue would appear to agree that the CO_2 intensity of inland navigation is of approximately the same magnitude as that of rail transport but far smaller than the one of road transport.

Fundamental strategies for reducing greenhouse gas emissions from transport

Basically, there are the following strategies for reducing greenhouse gas emissions from the transport sector:

1. Reducing traffic volume,
2. Shifting traffic to more environmentally friendly modes of transport,
3. Reducing specific emissions.

In practice, transport policy will attempt to implement a combination of these three fundamental strategies.

This present report only deals with the third strategic option, which is looked at in greater depth in the report. Option 1 may result in a restriction in demand for transportation by inland navigation. Option 2 would only be beneficial for the inland navigation industry if it could continue to achieve significant success in reducing its greenhouse gas emissions.

[1] English texts refer "CO_2 intensity", while the corresponding German term used is "CO_2 emission factor"; the French version of this document uses this latter term.

General conditions with an impact on the potential of inland navigation to reduce its fuel consumption and CO_2 emissions

In view of the options for reducing fuel consumption and CO_2 emissions, inland navigation is limited by special factors that play no or only a much more minor role in other modes of transport. These limiting factors need to be recognised and considered in determining or reducing levels of fuel consumption and CO_2 emissions in inland navigation. Inland vessels navigate relatively shallow waters and are consequently subject to the laws of shallow water hydrodynamics. This fact determines to a large extent the power requirements of inland vessels and thus also the amount of fuel consumed and CO_2 emitted.

Ways of reducing greenhouse gas emissions in inland navigation

There are many technical measures for the ship owners to reduce fuel consumption and CO_2 emissions of new vessels. They can choose the most economical and technically feasible of these options – for their ships and their applications. By implementing several measures simultaneously, one could realistically envisage a reduction in fuel consumption and emissions of greenhouse gases of between 10 and 50% compared with vessels currently in operation. The potential savings that can be achieved by conversion of existing ships are significantly lower. However, any quantification of the possible potential savings depends on a large number of factors, which can vary significantly from one type of ship to another and depending on the operating conditions. Increasing the size and capacity of vessels offers substantial potential for making savings. Given the importance of this issue, it ought to be studied in depth. In this respect, the limits are determined more particularly by the infrastructures. If vessels of a larger size require waterway development work to be carried out, the ecological aspects of developing the waterway must be taken into account.

When it comes to the operational measures for reducing fuel consumption and CO_2 emissions there are fundamental similarities to the technical measures. There is a wide variety of possible options available which ship owners can choose from, depending on which are most economically viable for their ships and applications. By implementing several measures simultaneously, one could realistically envisage a reduction in fuel consumption and CO_2 emissions of between 10% and 40% compared with those of vessels currently in operation. As opposed to technical measures that pertain to the vessels themselves, there are no major differences between new ships and existing ships when it comes to the operational measures. The greatest potential savings can be achieved by optimising the speed of the ships. This involves taking the specified time of arrival and the fairway conditions to be anticipated on the various sections of the route into consideration in order to choose the slowest possible speed. However, any quantification of the possible potential savings depends on a large number of factors, which can vary significantly from one type of ship to another and depend, in particular, on the operating conditions. Whereas ship owners and skippers generally determine the ship's fuel consumption and thus the emissions by their actions, several of the operational measures require the waterway authorities to create the right conditions, as for example the introduction of certain river information services (RIS).

Alternative fuels and sources of energy for inland navigation

At present, basically the only fuel used by inland navigation is gasoil (diesel fuel). The combustion of gasoil generates considerable CO_2 emissions. Given the current developments in the fuel market, switching to alternative fuels and types of propulsion is a long-term possibility not only for saving CO_2, but also for ensuring future fuel supply. These alternative energy sources have to be low-carbon or even carbon-free fuels and need to be available for a longer time or even indefinitely. Theoretically, liquid biofuels are a logical successor to today's mineral oils used as fuel, but it appears to be impossible to produce the required quantities sustainably. A mix of fuels is therefore more likely to become established in inland navigation, consisting of liquefied natural gas (LNG) as well as liquid and gaseous biofuels. Electricity, stored on board in batteries or obtained by the conversion of hydrogen or synthetic methane, is likely to be used to power inland vessels, at least for certain applications. The use of these fuels calls for extensive preparations, including with regard to the laws and regulations governing inland navigation. In particular, it is

necessary to ensure that the future energy mix makes it possible for the emission reduction targets for inland navigation to be achieved. A strategy for the switch by inland navigation to alternative fuels is therefore called for. This should be incorporated in a strategy covering all modes of transport and agreed at an international level, since inland navigation in Europe is operating internationally. The CCNR could be called on to develop this strategy if the fuel strategy expected at the EU and State level covering the entire transport sector does not pay enough attention to inland navigation.

Supporting measures for reducing fuel consumption and greenhouse gas emissions

The main supporting measures are making relevant information easily available for the navigation industry, the introduction of indicators and management plans for improving energy efficiency, as well as environmental labels and financial incentives. These measures could make a significant contribution towards encouraging those involved to actually implement the known measures for reducing fuel consumption and greenhouse gas emissions in practice. The measures are already very advanced, in some instances, or are already in use, in others. In order to make sure that the supporting measures are as effective as possible in inland navigation, it is necessary to:

- conclude the development of the supporting measures, where this has not yet been done, and to adapt measures in other fields – as necessary – to inland navigation in the process,
- help ensure that supporting measures that are already in use at a national level are implemented Europe-wide or at least for all navigation on the Rhine,
- set transparent and generally accepted standards, like the IMO, to which all those affected, including government agencies, for example, can refer in connection with direct or indirect subsidies.

Due to the extremely positive effects of the supporting measures and since they can also be voluntary, the tasks listed above should be given top priority and be addressed as soon as possible. The nature of these tasks calls for an overarching approach in several respects: the tasks need to be international, include all those affected and take both technical as well as operational aspects into consideration.

Additional benefits of a reduction in greenhouse gas emissions

Measures taken to reduce greenhouse gas emissions can be accompanied by additional benefits:

- If the reduction in greenhouse gases results from a reduction in fuel consumption, then pollutant emissions are almost always reduced as well.
- If the reduction in greenhouse gasses results from the use of LNG or the (indirect) use of electrical power from alternative sources, this leads to a significant or almost total reduction in pollutant emissions.

- Reducing fuel consumption also reduces the consumption of resources, specifically mineral oil. This enhances the sustainability of inland shipping and reduces its costs.
- If the reduction of greenhouse gas emissions is achieved by reducing the propulsion power used for transport, this generally leads to less wash and consequently less impact on the currents in the surrounding body of water. This in turn will result in less of a burden on the river bed and on the bottom. The negative impact of inland navigation on aquatic ecology is reduced to a minimum.

Scenarios for the development of greenhouse gas emissions from inland navigation

There are a wide range of measures open to inland navigation by which it can reduce greenhouse gas emissions from shipping operations. These measures include, on the one hand, the operation, construction and equipping of vessels. The widespread implementation of the former measures in future could be described as a conservative scenario, since these measures have already found their way into inland navigation and have basically been accepted.

On the other hand, there are also a large number of measures aimed at "decarbonisation" of the fuel, i.e. the use of fuels with lower CO_2 emissions. Measures in the latter group have, at best, only been applied in isolated cases to date, however. Implementation of these measures, over and above the former measures, could thus be seen as an optimistic scenario in terms of the reduction of greenhouse gas emissions.

What is of particular importance in both scenarios is increasing the average carrying capacity of the vessels as a result of the progressive modernisation of the inland navigation fleet. A model calculation of the greenhouse gas emissions for these scenarios reveals that, according to the conservative scenario, the total emissions would remain more or less constant, even with an increase in the total traffic & transport volume, and could be reduced by about two thirds according to the optimistic scenario. The following conclusions from this seem most relevant, particularly for transport and environmental policy:

- Widespread implementation of the various existing technical and operational energy-saving measures as well as a continued increase in the average size of vessels will enable the operational greenhouse gas emissions from inland navigation to be kept more or less constant, even with a steady increase in the total cargo volume.
- A significant reduction in the absolute amount of operational greenhouse gas emissions from inland navigation accompanied by a simultaneous increase in the total cargo volume will be possible, if biofuels and fuels produced using renewable energy are used on a large scale, alongside LNG. Tests should however be carried out on these fuels to ensure their compatibility with existing engines and exhaust gas aftertreatment systems.

Costs and barriers to reducing fuel consumption and greenhouse gas emissions

Well-founded decisions regarding measures to reduce fuel consumption and greenhouse gas emissions call for adequate knowledge of the associated costs. It seems remarkable that some of the measures presented in this report would contribute to cutting costs, but, in spite of this, have only found very limited use in inland navigation to date.

Further work

In addition to identifying and developing actual measures for reducing fuel consumption, inland navigation is only at the start of a long process aimed at reducing its greenhouse gas emissions. The report lists the tasks that are necessary to ensure the success of the process:

- Draw up supplementary reports on passenger shipping and Rhine shipping,
- Determine the carbon footprint of inland shipping,
- Determine fuel consumption by evaluating data from the Convention on the collection, deposit and reception of waste produced during navigation on the Rhine and inland waterways (CDNI),
- Adapt technical requirements for inland navigation vessels to allow approval of alternative energy sources (fuels),
- Generally examine the mandatory introduction of the Energy Efficiency Design Index (EEDI) for inland navigation,
- Generally examine a mandatory standard for the Energy Efficiency Operational Indicator (EEOI) for inland navigation,
- Generally examine any possible significant measures to be further taken by the CCNR to reduce fuel consumption and greenhouse gas emissions from inland vessels,
- Prepare scenarios for the development of greenhouse gas emissions from inland navigation,
- Provision of relevant information for the inland navigation sector,
- Develop quantitative objectives for reducing greenhouse gas emissions from inland shipping,
- Prepare a cross-transport-mode and cross-border strategy for future energy sources (fuels) used in inland navigation or alternatively a fuel strategy for inland navigation,
- Europe-wide introduction of a common environmental label for inland navigation,
- Support of the Europe-wide introduction of a programme to promote energy-saving operation of inland vessels (smart steaming),
- Develop quality standards for future energy sources (fuels) used in inland navigation,
- Develop measures for waterways and ports aimed at reducing greenhouse gas emissions from inland shipping,
- Examine CO_2 reduction potential through the use of LNG and other alternative energy sources (fuels) in inland navigation,
- Study in greater detail technical measures for the reduction of fuel consumption and greenhouse gas emissions from inland vessels involving the vessels themselves,
- Study in greater detail operational measures for the reduction of fuel consumption and greenhouse gas emissions from inland vessels,
- Determine reduction in fuel as a result of increasing average capacity of inland navigation vessels.

Particularly in view of its currently very limited resources, the CCNR is only able to actively support a small part of this work.

It will be essential to carry out further work in the European context and in conjunction with the European Commission, the navigation sector, and industry.