



**Establishing the carbon footprint and the specific CO<sub>2</sub> emissions  
(CO<sub>2</sub> intensity) of inland navigation  
- Overview of studies establishing figures for the CO<sub>2</sub>-intensity (CO<sub>2</sub> emission factors)  
of inland navigation -**

For cargo transport, the CO<sub>2</sub> intensity of a given mode of transport can be presented via its CO<sub>2</sub> emissions based on its transport performance. This is largely done in g/tkm, but g/TEUkm can also be used. This ratio is often also known as the CO<sub>2</sub> emission factor. As with other modes of transport, CO<sub>2</sub> intensity is a key element in establishing the carbon footprint of inland navigation.

Various institutions are currently presenting and offering procedures to enable a comparison of the emissions from various modes of transport during actual transport operations. These procedures are based on figures representing the CO<sub>2</sub> intensity of the mode in question (emission factors) which draw on often complex calculation methods to determine the overall emissions from the given transport operation.

There is, however, no standardised procedure to establish the CO<sub>2</sub> intensity of a given mode of transport (emission factors) and the process is highly complex. This could go a long way towards explaining the gaping discrepancies in the figures published.

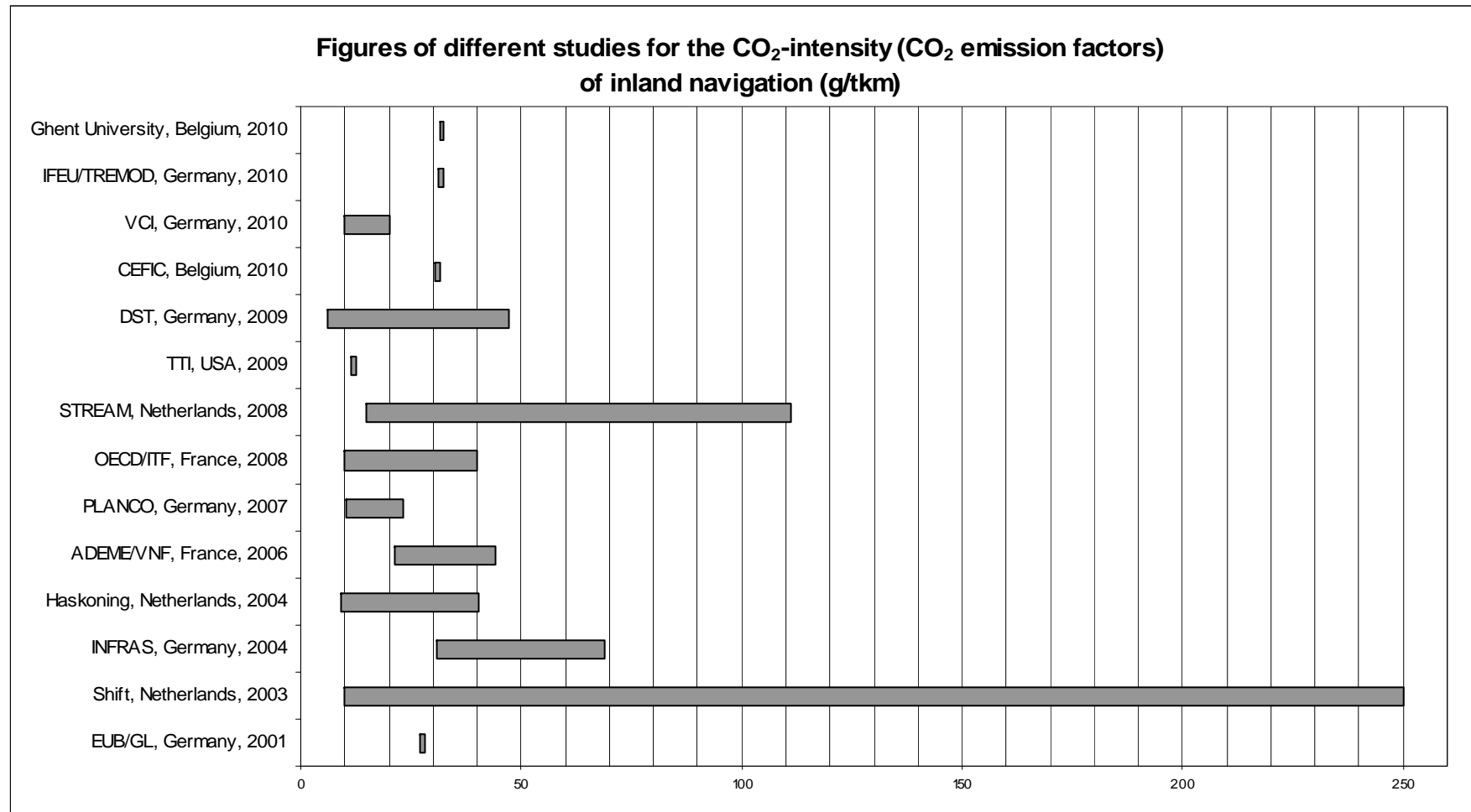
Since there is no standardised procedure for gauging CO<sub>2</sub> intensity and as the Secretariat notes that some of the procedures use figures for the CO<sub>2</sub> intensity of inland navigation that could seem questionable, it has compiled a number of relevant studies, which are shown below.

## Overview of studies establishing figures for the CO<sub>2</sub>-intensity (CO<sub>2</sub> emission factors) of inland navigation

CO <sub>2</sub> intensity	Study/Procedure	Date of publication	Additional information
27,7 g/tkm	<b>EUB/GL</b> ; <i>Erarbeitung von Verfahren zur Ermittlung der Luftschadstoffemissionen von in Betrieb befindlichen Binnenschiffsmotoren</i> ; Energie - Umwelt - Beratung e.V., Germanischer Lloyd; FE Vorhaben der Bundesanstalt für Gewässerkunde; Hohen Luckow	2001	Average figure for inland navigation in Germany, taking into account empty runs; many simplifications
10 ... 250 g/tkm	<b>Shift</b> ; van Essen, H., Bello O., Dings, J., van den Brink, R., <i>To shift or not to shift, that's the question – The environmental performance of freight and passenger transport modes in the light of policy making</i> ; CE; Delft <a href="http://www.thepep.org/ClearingHouse/docfiles/toshiftornottoshift.pdf">http://www.thepep.org/ClearingHouse/docfiles/toshiftornottoshift.pdf</a>	2003	Various emission factors for different vessel types (vessel dimensions) and transport operations; Considers energy consumption for fuel production
31 g/tkm	<b>INFRAS</b> ; <i>External Costs of Transport, Update Study</i> ; Final Report <a href="http://www.infras.ch/downloadpdf.php?filename=UpdateExternalCosts_FinalReport.pdf">http://www.infras.ch/downloadpdf.php?filename=UpdateExternalCosts_FinalReport.pdf</a>	2004	Underlying data tenuous; many simplifications
9,2 ... 40,5 g/tkm	<b>Haskoning</b> ; Schilperoord, H.A., <i>Binnenvaart voortdurend duurzaam – Environmental Performance of Inland Shipping</i> ; Royal Haskoning for Centraal Bureau Rijn- en Binnenvaart Koninklijke Schuttevaer <a href="http://www.ebu-uenf.org/fileupload/rapport_milieupformance.pdf">http://www.ebu-uenf.org/fileupload/rapport_milieupformance.pdf</a>	2004	Various emission factors for different vessel types (vessel dimensions) and transport operations
21,5 ... 44,3 g/tkm	<b>ADEME/VNF</b> ; <i>Etude sur le niveau de consommation de carburant des unités fluviales françaises – Rapport final</i> <a href="http://www2.ademe.fr/servlet/KBaseShow?sort=-1&amp;cid=96&amp;m=3&amp;catid=16309">http://www2.ademe.fr/servlet/KBaseShow?sort=-1&amp;cid=96&amp;m=3&amp;catid=16309</a>	2006	Average figure for inland navigation in France, taking into account empty runs
10,4 ... 23,2 g/tkm	<b>PLANCO</b> ; <i>Verkehrswirtschaftlicher und ökologischer Vergleich der Verkehrsträger Straße, Bahn und Wasserstraße</i> . PLANCO Consulting GmbH, Essen, in cooperation with Bundesanstalt für Gewässerkunde, Koblenz <a href="http://www.wsv.de/wsd-o/service/Downloads/Verkehrstraegervergleich_Gutachten_komplett.pdf">http://www.wsv.de/wsd-o/service/Downloads/Verkehrstraegervergleich_Gutachten_komplett.pdf</a>	2007	Various emission factors for different vessel types (vessel dimensions) and transport operations, considers energy consumption for fuel production
10 ... 40 g/tkm	<b>OECD/ITF</b> ; <i>Greenhouse Gas Reduction Strategies in the Transport Sector, Preliminary Report</i> ; OECD/ITF <a href="http://www.internationaltransportforum.org/Pub/pdf/08GHG.pdf">http://www.internationaltransportforum.org/Pub/pdf/08GHG.pdf</a>	2008	Broad, unrefined assessment

CO <sub>2</sub> intensity	Study/Procedure	Date of publication	Additional information
15 ... 111 g/tkm	<b>STREAM</b> ; den Boer, L. C., Brouwer, F. P. E. & van Essen, H. P. <i>STREAM – Studie naar TRansport Emissies van Alle Modaliteiten</i> , Versie 2.0. CE Delft <a href="http://www.cedelft.eu/publicatie/stream%3A_study_on_transport_emissions_of_all_modes/832">http://www.cedelft.eu/publicatie/stream%3A_study_on_transport_emissions_of_all_modes/832</a>	2008	Update and improvement of the <b>Shift</b> study
12 g/tkm	<b>TTI</b> ; Kruse, C., Protopapas, A., Olson, L. E. & Bierling, D. H. 2009. <i>A Modal Comparison of Domestic Freight Transportation – Effects on the General Public: Final Report</i> . prepared for the U.S. Maritime Administration and the National Waterways Foundation; Texas Transportation Institute, Center for Ports & Waterways, The Texas A&M University System, College Station, Texas <a href="http://www.americanwaterways.com/press_room/news_releases/NWFStudy.pdf">http://www.americanwaterways.com/press_room/news_releases/NWFStudy.pdf</a>	2009	Average figure for inland navigation in the USA; Calculation model was checked against actual transport performance and fuel consumption
6,1 ... 47,1 g/tkm	<b>DST</b> ; Zöllner, J; <i>Strömungstechnische Möglichkeiten zur Reduzierung des Kraftstoffverbrauchs und der CO<sub>2</sub>-Emissionen von Binnenschiffen</i> ; Paper from the CCNR Congress on Rhine Navigation and Climate Change held June 24-25, 2009 in Bonn; DST <a href="http://www.zkr-kongress2009.org/de/programme-documentation.php">http://www.zkr-kongress2009.org/de/programme-documentation.php</a>	2009	Various emission factors for different vessel types (vessel dimensions) under standard operating conditions
31 g/tkm	<b>CEFIC</b> ; Measuring and Managing CO <sub>2</sub> Emissions of European Chemical Transport; Professor Alan McKinnon, Dr Maja Piecyk <a href="http://www.cefic.be/files/publications/McKinnon-Report-Final-230610.pdf">http://www.cefic.be/files/publications/McKinnon-Report-Final-230610.pdf</a>	2010	Based on emission factors published by INFRAS, TRENDS, Tremove and IFEU; an average value only
10 ... 20 g/tkm	<b>VCI</b> ; <i>VCI-Leitfaden zur Ermittlung der CO<sub>2</sub>-Emissionen in der Logistik der chemischen Industrie</i> ; Verband der Chemischen Industrie e.V., Frankfurt <a href="http://www.vci.de/template_downloads/tmp_VCIInternet/127664LFErmittlCO2EmissionenLog06072010.pdf?DokNr=127664&amp;p=101">http://www.vci.de/template_downloads/tmp_VCIInternet/127664LFErmittlCO2EmissionenLog06072010.pdf?DokNr=127664&amp;p=101</a>	2010	Average figures for different vessel types and transport routes, based on works by PLANCO
31,8 g/tkm	<b>IFEU/TREMOD</b> ; <i>Fortschreibung und Erweiterung "Daten- und Rechenmodell: Energieverbrauch und Schadstoffemissionen des motorisierten Verkehrs in Deutschland 1960-2030</i> (TREMOM, Version 5) Endbericht; IFEU <a href="http://www.ifeu.de/verkehrundumwelt/pdf/IFEU(2010)_TREMOM_%20Endbericht_FKZ%203707%20100326.pdf">http://www.ifeu.de/verkehrundumwelt/pdf/IFEU(2010)_TREMOM_%20Endbericht_FKZ%203707%20100326.pdf</a>	2010	Broad, unrefined assessment

CO <sub>2</sub> intensity	Study/Procedure	Date of publication	Additional information
32 g/tkm	<b>Ghent University</b> ; Stefan Geerts, Bart Verwerft, Marc Vantorre, Frans Van Rompuy. <i>Improving the efficiency of small inland vessels</i> . Maritime Technology Division, Ghent University; Belgian Federal Public Service Mobility and Transport, Brussels <a href="http://www.vliz.be/imisdocs/publications/217434.pdf">www.vliz.be/imisdocs/publications/217434.pdf</a>	2010	Average figure for inland navigation in Belgium, taking into account empty runs; fleet consisting of vessels with a carrying capacity ranging from 250 to 1350 t; share of transport determined on statistical research



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