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Strategic questions of a horizontal policy nature:
Environment, climate change and transport –
Mitigation of environmentally harmful effects of inland transport

For Future Inland Transport Systems (ForFITS)

Implementation for UNECE member States

Analysis for Inland Transport Committee (ITC)

Contents

I. Project Background and Executive Summary

1. The goal of the For Future Inland Transport Systems (ForFITS) UNECE-wide implementation project was to produce estimations of future CO_2 emissions attributed to the transport sector of member States of the United Nations Economic Commission for Europe (UNECE) using the ForFITS tool[1]. ForFITS was tested successfully in pilot studies in seven countries around the world and this study builds on these results by assessing future policy impacts on overall transport CO_2 emissions at a region-wide level.

2. The results of this project are intended to provide a useful basis for analysis of region-wide trends in vehicle activity, energy use, and CO_2 emissions stemming from the transport sector for UNECE member States. They also demonstrate how member States can use ForFITS to assess trends at national or sub-regional levels. This analysis complements existing national tools for measuring and projecting emissions by providing results which are comparable and can be aggregated at a regional level. The use of ForFITS allows for analysis of countries where detailed data are not available. The output for each country reflects a reference scenario, or baseline, where no significant changes in the drivers of transport activity, energy use, and emissions were modelled beyond projected socio-economic trends and technology improvements related to energy use reduction (discussed in more detail in the Results section). Transport policy changes, including those that could mitigate CO_2 emissions, are not within the scope of this scenario. The reference scenario considers the foreseen evolution of macroeconomic parameters (GDP and population) over time. The expected technology improvements at the short- and long-term are also taken into account by reducing fuel consumption and increasing vehicle price over the projections.

3. Work began in April 2014 to collect relevant historical data with an ultimate goal of analysing and comparing both the CO_2 emissions stemming from the transport sector and overall transport activity in the 56 countries that comprise the UNECE using ForFITS. Data were collected for all countries though in some cases insufficient data were available to include the country in analyses.

4. Projections were generated separately for each member State with sufficient data and aggregated at a regional level for presentation in this report. Using ForFITS, ECE was able to analyse 41 UNECE member States. As a percentage of the UNECE region, these countries represented 78% of the population and 93% of the Gross Domestic Product (GDP) measured in US dollars in 2013. For several graphs the countries were divided into economic groups (*low*-, *middle*- and *high-income*) or regional groups (*North America*, *European Union (EU) + European Free Trade Agreement (EFTA)* member states, *rest of UNECE*) in order to highlight different characteristics of projections among member States (detail available in the Data Notes section). Since higher income countries tended to have more complete databases, the results reflect this bias.

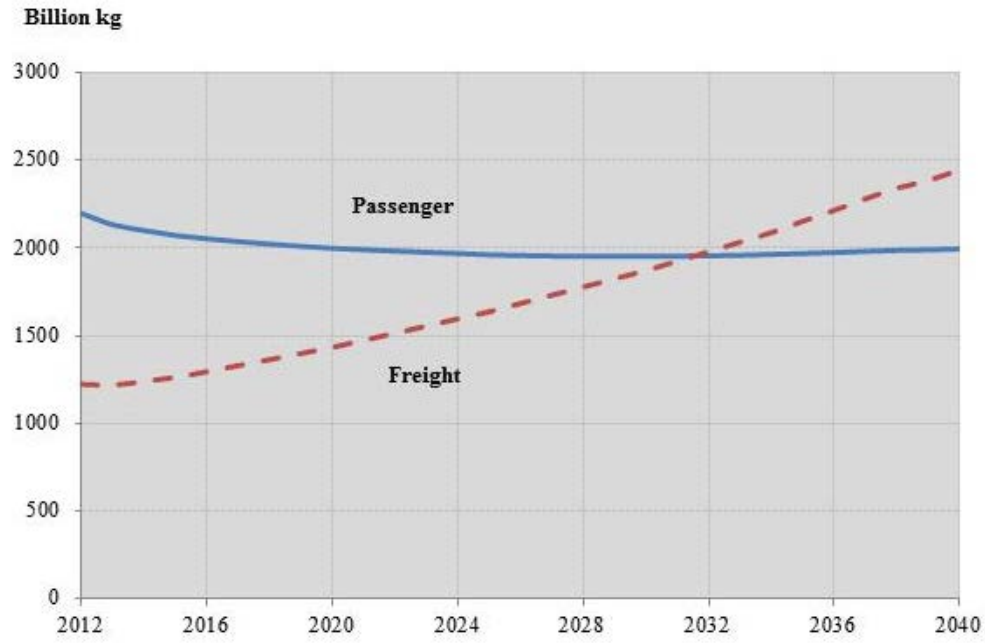
5. Figure 1 shows the projected trend in well-to-wheel (WTW)[2] CO_2 emissions between 2012 and 2040, with no policy intervention, but with the technology improvements set out in paragraph 2, for the member States analysed. The change over time primarily reflects projections of population growth and GDP growth. Differences in economic

[1] More information on ForFITS, including the tool and user manual, is available on the UNECE website - www.unece.org/trans/theme_forfits.html

[2] Well to wheel (WTW) emissions refers to CO_2 emissions from both a vehicle itself through its operation as well as emissions from the production and distribution of the fuel used for the vehicle's operation.

maturity also play a factor since countries with a lower GDP per capita in 2012 are projected to have increased freight and passenger activity in the future as their economies close the gap to countries with higher GDP per capita. Overall, CO_2 emissions from passenger transport are projected to decrease by more than 9 per cent by 2040 while emissions from freight transport are projected to more than double in the same time period.

Figure 1
Well-to-wheel CO_2 emissions from freight and passenger inland transport in selected UNECE member States: 2012–2040



Note: Vessels and aircraft are not included. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used for operation.

6. As mentioned in paragraph 4, these data were based on a subset of member States and significant further work would need to be done to increase the amount of source data available in order to use the ForFITS tool for the full UNECE region.

7. The remainder of this document will set out the work completed and the challenges faced as well as providing results and conclusions.

II. Methodology

A. Historical data collection

8. In April 2014, ECE began the ForFITS data input collection process. Data were collected from all known international organizations with transport and socio-economic statistics and from websites of national statistics offices for each UNECE member State. In addition, ECE sent questionnaires to member states to provide an opportunity to confirm data collected from public data sources and add missing data where possible. The data sought through the questionnaires included all primary inputs required for the use of the model including vehicle stock, historical new registrations of vehicles, annual travel, average fuel consumption and powertrain distribution by mode of transportation as well as more general inputs such of fuel taxation and projections of population and economic

parameters. ECE disseminated final questionnaires in early November 2014 and in the subsequent weeks twelve countries[3] completed and submitted their completed questionnaires. This information provided welcome insight into the transport systems of these countries. The result of these activities was a simple database which included sources for all member States.

B. Input data estimation where data gaps exist

9. As substantial data gaps persist in transportation data, data were estimated in many cases. The member States focused on for analysis report a high level of available data yet still required estimation for a number of missing inputs. While data on vehicle stock and new registrations were often available for countries in the region, average fuel consumption and annual travel for vehicles as well as the breakdown of vehicles between powertrain types were more difficult to collect. Member States with less developed statistical systems had low levels of available data and required estimation for the majority of their ForFITS input.

10. Techniques such as interpolation, analogies, as well as more advanced statistical methods as necessary were utilized in order to estimate missing data. As an aide for estimation, ECE calculated database averages based on countries where data were available. However, database averages were biased toward higher income countries since these countries have more data available. Analysis would be needed to better reflect possible differences between countries when filling these gaps. Default data could also become more sophisticated if relationships between input variables are modelled. This could be investigated in the future both through statistical comparisons and also through research on current and historical conditions in specific countries.

C. Development of input projections

11. The ForFITS tool requires inputs of the projected changes in a country's economy and population. Projections were analysed to ensure they were in line with both the range of international historical norms and with the projections performed by other international organizations. Economic projections took into account International Monetary Fund (IMF) projections to estimate long-term growth through 2040. GDP projections provided by countries in their completed questionnaire were used in place of IMF projections when available. Population projections used the "medium-fertility" scenario generated by the 2012 UN Population Division projections except in cases where countries provided projections in completed questionnaires. Population and economic growth are major drivers of vehicle stock and these projections were reviewed in detail. ECE did not project technology improvements directly by country as these improvements were modeled directly in the ForFITS tool.

D. Generation of projections of CO_2 emissions and analysis of results

12. After the assembly of input data, ECE used ForFITS to generate projections of CO_2 emissions. The separate analysis of each country ensured that results reflected realistic scenarios and comparisons helped to identify outliers. In some cases, data were revisited where results were not in line with realistic expectations. In addition, ECE compared

[3] Austria, Belgium, Bulgaria, Canada, Czech Republic, Denmark, Finland, Ireland, Lithuania, Netherlands, Slovakia and Switzerland.

outputs against other international sources as a final verification of overall results. The Organization for Economic Cooperation and Development provides passenger kilometre (pkm)[4] and tonne kilometre (tkm)[5] data for most types of inland transport for nearly all UNECE member States while the International Energy Agency provides overall energy use statistics for the inland transport sector. When checking against these sources, the intent was not to match exactly the output, but rather to note large differences (greater than 30 per cent) and re-investigate inputs in these cases as necessary.

III. Challenges

13. The large number of minimum data requirements and the gaps in international transport statistics presented a difficult issue for developing projections of activity and CO_2 emissions. It shows that transport statistics are in need of much better coordination at the international level, data availability at individual country level may vary greatly and breakdowns of statistics are not standardized as much as it is the case in some other sectors.

14. Possible misalignments of transport boundary of the data collected by ECE also posed a challenge. Where possible, ECE verified that data included only vehicles registered in the country and included the international travel of those vehicles. However, in many cases verification of these boundaries was not possible and the risk remains that emissions and activity from certain vehicles may have been either double-counted or omitted.

15. With this in mind, the reliability and comparability of the data were assessed throughout the process. Where data were estimated, numerous checks on the data were performed to ensure that such inputs were reasonable and justifiable. In addition, ECE analysed differences in terminology between country databases and made adjustments to data where necessary to ensure that regional totals were cohesive. Despite data quality checks, some uncertainty remained around not only the estimations, but also around the official data in the database. For these reasons, countries were analysed at a deliberate pace.

16. In general, data on vehicle stock were available, but many other important input data were more difficult to find. Common data gaps included the following:

- Average fuel consumption for vehicles other than passenger cars
- Average annual distance travelled for vehicles other than passenger cars
- Average vehicle load
- Breakdown of vehicles by powertrain
- Vessel related data
- Aircraft data

17. Based on these data gaps, the results given in this report do not include inland water, maritime and air transport. Difficulties in estimating data in these modes due to differences in vehicle size, fuel consumption and average travel within each sector and between countries contributed to their exclusion in analysis. However, it is noteworthy that preliminary indications suggested that a large portion of freight vehicle activity and freight CO_2 emissions may result from inland water and maritime vessels in some countries.

[4] A passenger kilometre is defined as a unit of passenger carriage equal to the transportation of one passenger one kilometre.

[5] A tonne kilometre is defined as a unit of freight carriage equal to the transportation of one metric ton of freight one kilometre.

IV. Results

A. Data notes

18. For the purpose of analysis, UNECE member States were divided into three groups by 2013 GDP per capita (in US dollars). This breakdown (shown in table 1) was defined in order to highlight different characteristics of projections among member States with differing current economic situations. These income-level group definitions are for comparison purposes only and do not correspond to World Bank classifications. *High-* and *middle-income* countries were the subject of the majority of analyses as these countries in general provide more complete input data through international sources or their own national websites.

Table 1
Categorization of UNECE Member States by 2013 Gross Domestic Product per capita (US dollars)

Category	Count[1]	Member States		
Low income	17 (**7**)	• Albania • **Belarus** • FYR Macedonia • **Montenegro** • Serbia • Ukraine	• Armenia • **Bosnia and Herzegovina** • **Georgia** • Republic of Moldova • Tajikistan • Uzbekistan	• **Azerbaijan** • **Bulgaria*** • Kyrgyzstan • **Romania** • Turkmenistan
Middle income	15 (**13**)	• **Croatia** • **Greece** • **Latvia** • **Poland** • **Slovakia ***	• **Czech Republic** • **Hungary** • **Lithuania*** • **Portugal** • **Slovenia**	• **Estonia** • Kazakhstan • **Malta** • Russian Feder. • **Turkey**
High income	24 (**21**)	• Andorra • **Canada*** • **Finland*** • **Iceland** • **Italy** • Monaco • San Marino • **Switzerland***	• **Austria*** • **Cyprus** • **France** • **Ireland*** • **Liechtenstein** • **Netherlands*** • **Spain** • **United Kingdom**	• **Belgium*** • **Denmark** • **Germany** • **Israel** • **Luxembourg** • **Norway** • **Sweden** • **United States**

[1] Figure in parenthesis shows count of countries in group for which initial ForFITS analysis has been performed

* Completed questionnaire submitted

Note: **Bold** = ForFITS analysis performed. GDP = Gross Domestic Product. USD = US dollars. Low income = 2013 GDP per capita < 10 000 USD. Middle income = 2013 GDP per capita 10 000 – 25 000 USD. High income = 2013 GDP per capita > 25 000 USD. FYR Macedonia = Former Yugoslav Republic of Macedonia.

19. An alternative breakdown by regions is shown in table 2. Similar to the breakdown by income level, more data were available for member States in North America or those that are members of the European Union and European Free Trade Agreement than for other UNECE member States. Consequently, all countries in the aforementioned regions were analysed while only a third of those in other regions of the UNECE were analysed.

Table 2
Categorization of UNECE Member States by region

Category	Count[1]	Member States		
North America	2 (**2**)	• **Canada***	• **United States**	
EU+EFTA	32 (**32**)	• **Austria***	• **Belgium***	• **Bulgaria***
		• **Croatia**	• **Cyprus**	• **Czech Republic**
		• **Denmark**	• **Estonia**	• **Finland***
		• **France**	• **Germany**	• **Greece**
		• **Hungary**	• **Iceland**	• **Ireland***
		• **Italy**	• **Latvia**	• **Liechtenstein**
		• **Lithuania***	• **Luxembourg**	• **Malta**
		• **Netherlands***	• **Norway**	• **Poland**
		• **Portugal**	• **Romania**	• **Slovakia ***
		• **Slovenia**	• **Spain**	• **Sweden**
		• **Switzerland***	• **United Kingdom**	
Rest of UNECE	22 (**7**)	• Albania	• Andorra	• Armenia
		• **Azerbaijan**	• **Belarus**	• **Bosnia and Herzegovina**
		• FYR Macedonia	• **Georgia**	• **Israel**
		• Kazakhstan	• Kyrgyzstan	• Monaco
		• **Montenegro**	• Republic of Moldova	• Russian Feder.
		• San Marino	• Serbia	• Tajikistan
		• **Turkey**	• Turkmenistan	• Ukraine
		• Uzbekistan		

[1] Figure in parenthesis shows count of countries in group for which initial ForFITS analysis has been performed

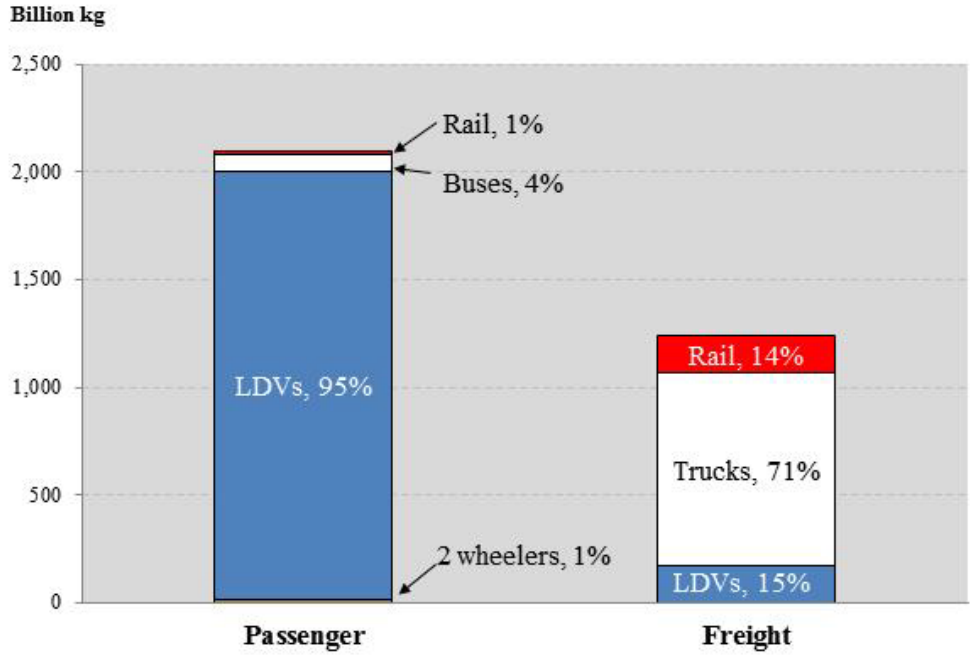
* Completed questionnaire submitted

Note: **Bold** = ForFITS analysis performed. EU+EFTA = European Union and European Free Trade Agreement member states. FYR Macedonia = Former Yugoslav Republic of Macedonia.

B. UNECE region in 2012

20. The breakdown of estimated WTW CO_2 emissions in 2012 from the transport sector for the UNECE member States analysed is shown in figure 2. Emissions from passenger transport in 2012 were estimated to be nearly twice as much as those from freight transport. For freight transport, trucks were estimated to be responsible for the majority of CO_2 emissions (71 percent) while for passenger transport and mobility, passenger light duty vehicles (LDVs) were estimated to be by far the largest emitter of CO_2 (95 percent).

Figure 2
Inland transport sector well-to-wheel CO_2 emissions by mode of transport, selected UNECE member States: 2012



Note: LDV = Light duty vehicle (classified as passenger or freight depending on usage). Passenger two-wheelers (not shown) <0.1 per cent of passenger CO_2 emissions. Vessels and aircraft not included. Percentages may not sum to 100 per cent due to rounding. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used for operation.

21. These emissions figures compare with the fact that passenger buses and rail are estimated to account for 15 per cent of pkm vs 4 percent of passenger transport CO_2 emissions. Correspondingly, the share of passenger LDVs in total pkm is 85 per cent compared to 95 per cent of passenger transport CO_2 emissions. For freight vehicles, trucks remain responsible for the majority of freight transport activity[6] (67 per cent), though the share of rail is much greater than for freight transport CO_2 emissions (30 per cent vs 14 per cent). This shows the higher energy efficiency of public vs personal transport and of freight rail vs freight trucks.

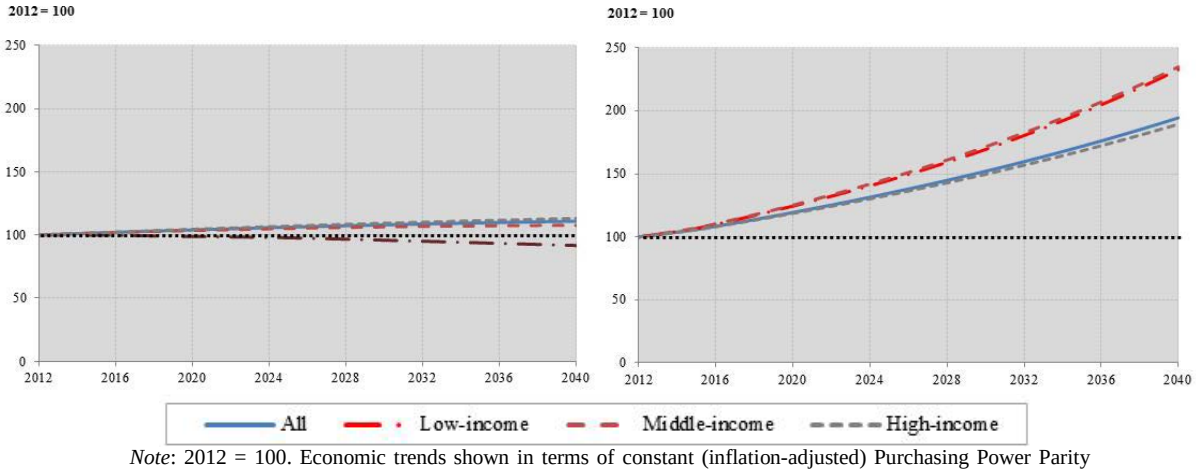
C. Forecasts to 2040

22. Projected population and GDP trends for the countries analysed are shown below in figure 3. Differences are evident as GDP growth in *low-* and *middle-income* countries is projected to be stronger than *high-income* countries for those in the study (average annual growth of 3.4, 3.1, and 2.3 per cent for *low-*, *middle-*, and *high-income* groups, respectively). In addition, a population decrease is expected in the *low-income* countries analysed while a mild population increase is expected for the *middle-* and *high- income* countries studied. Each of these factors as well as the substantially higher growth of GDP as compared to population for all regions has a direct impact on the projections for CO_2 emissions.

[6] Freight activity is measured in tonne kilometres.

Figure 3

Projected population (left) and Gross Domestic Product (GDP) trends (right) in selected UNECE member States, by region: 2012–2040

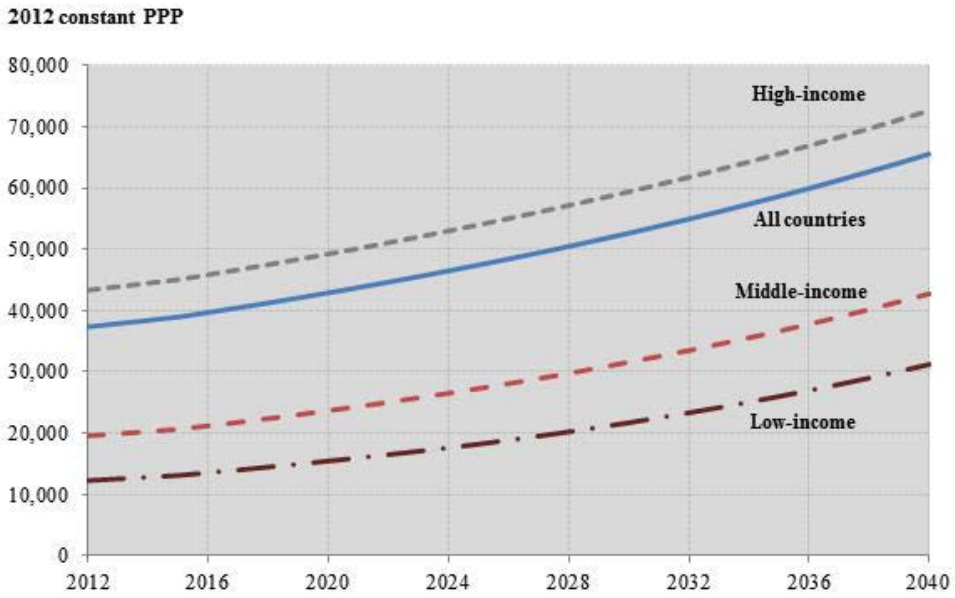


Note: 2012 = 100. Economic trends shown in terms of constant (inflation-adjusted) Purchasing Power Parity (PPP) growth. See report for definitions of regions.

23. As a result, the gap in per capita GDP between *low-* and *middle-income* countries and the region as a whole is projected to narrow. While in 2012, the per capita GDP of countries analysed in the *low-* and *middle-income* groups were respectively 73 per cent and 55 per cent less that of *high-income* countries analysed, these gaps are projected to decrease to 56 per cent and 41 per cent by 2040. Projected per capita GDP trends for the countries analysed are shown in figure 4.

Figure 4

Projected per capita Gross Domestic Product (GDP) in selected UNECE member States, by region: 2012–2040



Note: Data shown in 2012 constant (inflation-adjusted) Purchasing Power Parity (PPP) units. See report for definitions of regions.

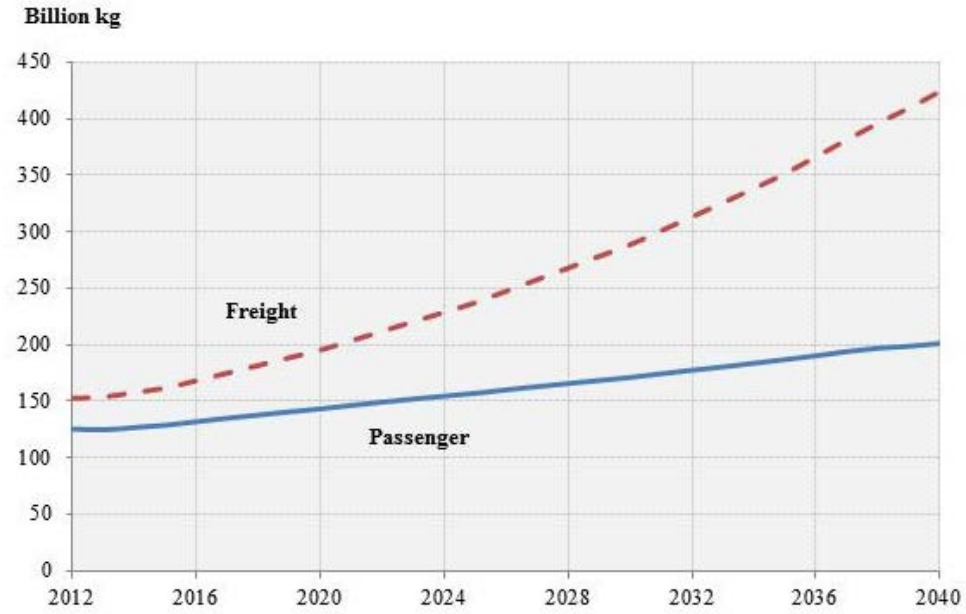
24. Figure 1 (see summary section) shows projections of CO_2 emissions stemming from inland transport for all countries analysed in this study. These projections are based on an

assumption of improvements in vehicle by powertrain and changes in the level of car ownership as a result of changes in living standards within countries. They exclude structural changes to the economy or changes to the level or quality of infrastructure. These projections are steady-state changes and reflect the following:

- changes in the share of transport on personal motorized passenger vehicles based on historical trends in economic development rather than policy changes
- no change in the market share of different powertrain technology (petrol, diesel, hybrid, etc.) for all vehicles and all modes
- vehicle technology improvements (engine and not-engine) associated with fuel consumption reduction potential and increase of purchase vehicle price based on specific studies and reports
- unchanged CO_2 well-to-tank and tank-to-wheel emission characteristics

25. Overall, CO_2 emissions from passenger transport and mobility are projected to decrease by 10 per cent by 2040 as a result of several factors including low population growth, improved fuel efficiency and vehicle ownership saturation levels. Emissions from freight transport are projected to double over the same time period due primarily to sustained economic growth.

Figure 5
Well-to-wheel CO_2 emissions from freight and passenger inland transport in selected middle-income countries of UNECE: 2012–2040



Note: Vessels and aircraft not included. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used for operation. See report for definitions of income levels.

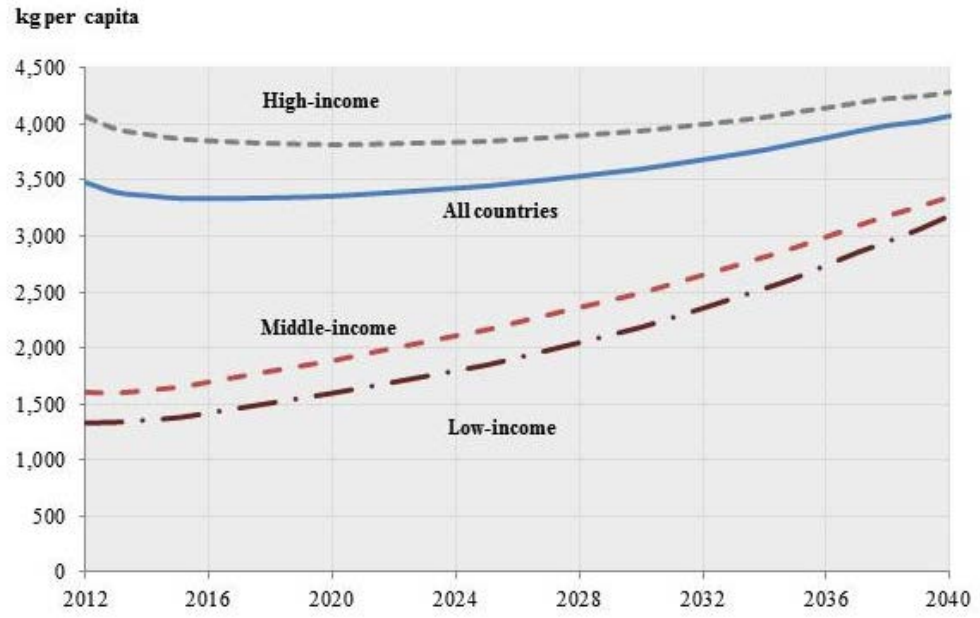
26. Focusing specifically on *middle-income* countries[7] as shown in figure 5, the relative growth of emissions from the freight sector compared to the passenger sector is similar to the overall trend in all the countries studied. While the trend is similar, the starting points

[7] As the contribution of middle- and low-income countries to total emissions of countries studied is relatively small, the projections for high-income countries are similar to those in Figure 1. Low-income countries are not shown as only 7 countries are included in this group.

differ. Notably, emissions from freight transport in 2012 in this region are already higher than emissions from passenger transport, partly as a result of the lower motorization rate of citizens in these countries compared to the rest of the countries studied. For the full set of countries included in this report freight transport accounted for approximately half the emissions of passenger transport in 2012.

Figure 6

Well-to-wheel CO_2 emissions per capita from inland transport, by income level, in selected UNECE member States: 2012–2040

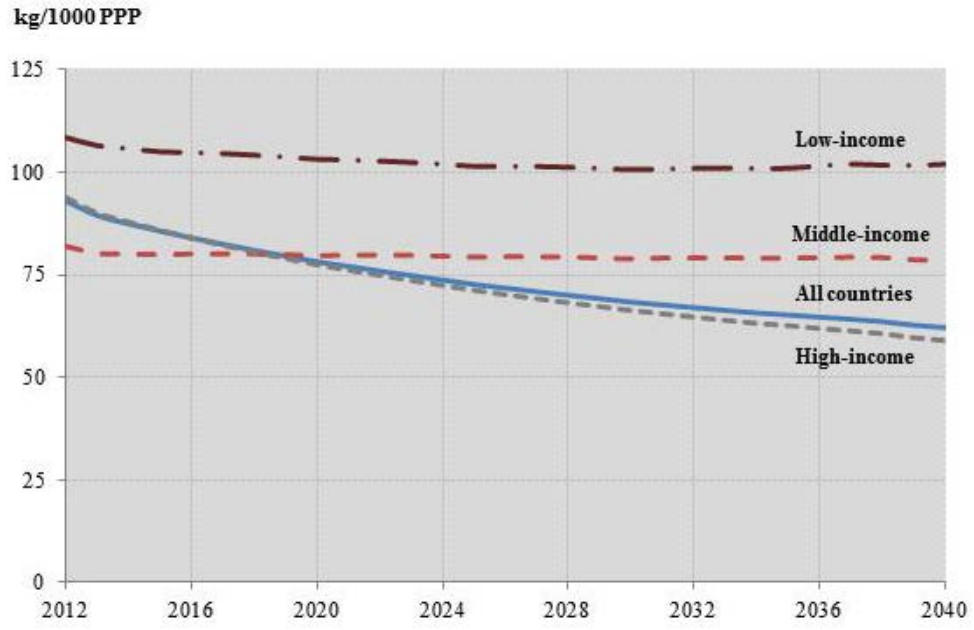


Note: Vessels and aircraft not included. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used operation. See report for definitions of regions.

27. Projected CO_2 emissions per capita and per unit of GDP are shown in figure 6 and figure 7. Differences are again evident when looking separately at the three groups of countries mentioned previously. *High-income* countries project to have higher per capita emissions throughout the period analysed while l*ow-* and *middle-income* countries show larger growth in per capita emissions over the same period. For emissions per unit of GDP, the *low-income* countries start at a much more inefficient level than *middle-* and *high-income* countries. This rate is projected to remain relatively steady over future years. It is estimated that the *middle-income* countries analysed have the lowest rates of the three groups in 2012, but the emissions per unit of GDP are projected to decrease slower than for *high-income* countries analysed.

Figure 7

Well-to-wheel CO_2 emissions per 1000 units of GDP from inland transport, by income, level in selected UNECE member States: 2012–2040

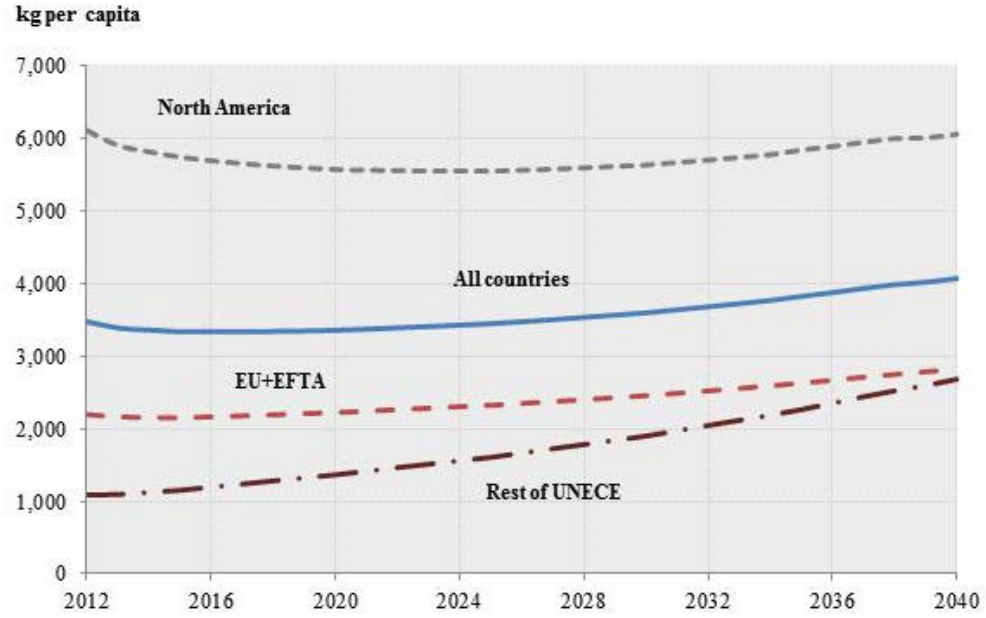


Note: GDP = Gross Domestic Product. GDP calculated in 2012 constant (inflation-adjusted) Purchasing Power Parity (PPP) units. Solid line represents all countries. Vessels and aircraft not included. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used for operation. See report for definitions of regions.

28. A further examination of the emissions per capita and emissions intensity levels by regions (figures 8 and 9) highlights additional differences within the UNECE. Projections of the levels of emissions per capita for European Union and European Free Trade Agreement (EU+EFTA) member States converge over time with those of other UNECE member States not including North America, while projections of CO_2 emissions from the transport sector in North America remain substantially higher than other UNECE regions. By contrast, while North America also projects to have higher intensity levels (as measured by emissions per unit of GDP) throughout the period analysed, the region also is projected to undergo the largest decrease in this ratio (decreasing by over 40 per cent). The EU+EFTA region is projected to have a decrease of 22 per cent while the rest of UNECE region is projected to have an increase of almost 14 per cent.

Figure 2

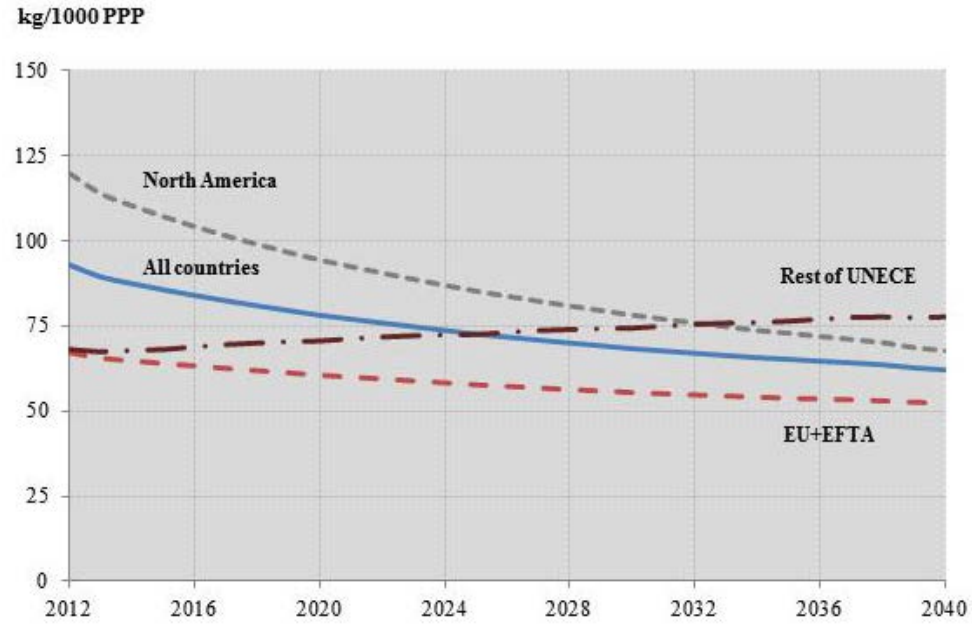
Well-to-wheel CO_2 emissions per capita from inland transport, by region, in selected UNECE member States: 2012–2040



Note: Vessels and aircraft not included due to lack of reliable data. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used operation. See report for breakdown of countries by group.

Figure 3

Well-to-wheel CO_2 emissions per 1000 units of GDP from inland transport, by region, in selected UNECE member States: 2012–2040



Note: GDP = Gross Domestic Product. GDP calculated in 2012 constant (inflation-adjusted) Purchasing Power Parity (PPP) units. Solid line represents all countries. Vessels and aircraft not included. Well-to-wheel = CO_2 emissions from both vehicle operation and emissions from production and distribution of fuel used for operation. See report for breakdown of countries by group.

D. Conclusions

29. For the 41 UNECE member States analysed in this study, the level of CO_2 emissions from the transport sector is projected to increase by 30 per cent between 2012 and 2040. Based on ECE projections, freight transport will be the main driver of increases in CO_2 emissions in the next decades for the countries analysed due to continued economic growth and moderate to low population growth in the region. Though freight transport activity is projected to be closely correlated to economic growth, the overall intensity of emissions (as measured by emissions per unit of GDP) is expected to decrease over this time, possibly due to improvements in the efficiency of various powertrains. The countries analysed also seem to have reached a plateau in per capita CO_2 emissions as very little growth or decrease is projected in future years. However, these overall trends mask differences within the region. *Low-* and *middle-income* countries are projected to have increasing per capita emissions through 2040 while projected rates in *high-income* change less over time (though remaining higher throughout the period analysed). These changes are expected as projected economic output in *low-* and *middle-income* countries climbs toward average levels in the UNECE region.

30. Regional projections for *North America* show the large comparative level of CO_2 emissions per capita compared to other regions. While emissions intensity (per unit of GDP) is expected to decrease more substantially than other regions analysed, this result shows the opportunity for further improvement in transport energy efficiency in this region. Though the *rest of UNECE* region results are based on only seven member States, due to lack of data, the projected increases in emissions intensity is also noteworthy and should be investigated further.

31. As noted earlier in the report, some modes of transport were omitted due to resource constraints (for example inland water, maritime and air transport due to lack of vessel and aircraft data) and therefore this study focused on road and rail in inland transport. In addition, lack of data on load, fuel consumption and distance travelled for passenger and freight limit the information that can be gleaned from analysis in some cases. Since estimates were often based on database averages, bias in the analysis is also possible if countries which have provided data for these areas exhibit characteristics that are not representative of countries which have not provided data. In lower-income member States, deviations from the projected trend of technology improvements may be possible as these trends were estimated based on data from high-income countries.

32. In addition to this analysis, specific policy interventions can be considered by ForFITS depending on availability and quality of the data. The simulation of some policy measures also require further information on transport characteristics and additional analytical work to quantify the magnitude of the policy intervention and to convert it in proper model inputs. This report excludes the evaluation of policy impact due to the amount and the quality of the data found available, as well as the lack of additional information to identify and quantify specific common policies that could be meaningful to simulate their implementation at the regional level. Table 3 lists a number of policy scenarios that could be evaluated within the ForFITS model assuming sufficient data and resources can be identified, which is expected to be the case over time and once a greater number of country level analyses and reviews have been carried out either through the involvement in the Environmental Performance Reviews (EPRs), the Transport-Health and Environment Pan-European Programme (THE PEP) or as individual Inland Transport Reviews upon demand.

Table 3
Possible scenarios/policies for future assessment

Scenarios/policies	Baseline	Degree of complexity		
		Low	Medium	High
Economic scenarios and avoid/shift policies normally implemented through economic instruments				
1. Changes to macroeconomic parameters (GDP and population)		✖		
2. Changes to fuel cost (excludes national fuel taxation schemes)		✖		
3. Changes to national fuel taxation schemes		✖		
4. Changes to purchase vehicle cost	✖			
5. Changes to road pricing			✖	
6. Changes to crew cost			✖	
7. Structural changes in freight transport due to changes in the country's economy orientation				✖
8. Environmental culture (participatory instruments)				✖
9. Changes to pipelines network extension		✖		
Shift policies/scenarios				
1. Shift from/to personal vehicles to/from public transport		✖		
2. Shift between large-freight modes		✖		
3. Changes to shares within transport modes which are grouped together in activity projections		✖		
Improve policies/scenarios				
1. Expected energy efficiency technology improvements	✖			
2. Penetration of new technologies (Endogenous technology choice)				✖
3. Penetration of new technologies (Exogenous technology choice)		✖		
4. Changes to fuel characteristics (Biofuels)			✖	
5. Vehicle fleet renewal			✖	

Note: The columns low, medium and high refer to the complexity to simulate a policy/scenario based on the following characteristics: (a) modelling issues (e.g. manipulation of ForFITS formulas is required by developers), (b) data requirements (e.g. the data that is required is often not available or difficult to obtain), and (c) the analysis of these data to convert it into appropriate model inputs (e.g. extensive analysis is required to ensure the scenario is properly modelled).

33. Overall, these results show the added value of the ForFITS tool in assessing future trends in CO_2 emissions related to the transport sector as well as transport activity. Most importantly, the analysis shows that important regional differences and sectors requiring particular attention in the future can be identified using the tool.

V. Possible Future Tasks

34. Any further analyses building on this study should consider the utility of projecting CO_2 emissions for countries with insufficient data. Fifteen member States were not analysed due to a lack of data. Where data remain unavailable, estimations could be used based on those data that are available. Including these estimations in analysis could help

counteract the bias in the current analysis toward higher income countries. There are, however, several reasons to avoid such estimations. First, as the level of required estimation increases, the robustness of projections decreases. This is largely due to the nature of estimations in a limited data environment. In addition, distinct characteristics of some countries could be masked by using such estimations of input data.

35. This study also serves as a step in continuing work to increase the functionality and reliability of the model based on increasing source data within the model. Vessels and aircraft likely represent a large proportion of global CO_2 emissions and could be included in future analyses (given better data availability) in order to provide a more complete view of the overall impact of transport. In addition, further research into typical average distances travelled and average fuel consumption (among other parameters) would help identify and avoid biases in future analyses.

36. Governments of member States which submitted data will be provided with results for their own country upon request. The secretariat will be prepared to discuss these results individually.