ICCT Global Transportation Roadmap
Response to External Review Comments

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ICCT Roadmap Model Version 1-0
December 2012

THE INTERNATIONAL COUNCIL
ON CLEAN TRANSPORTATION

Introduction

The Roadmap model has been extensively reviewed by a diverse group of external experts prior to its official public release; as a result of this review, numerous changes have been made to the Roadmap model to ensure its accuracy, transparency, and usability. This document gives a summary of our responses to the main comments and questions offered by reviewers; however, it does not provide an exhaustive list. Comments are paraphrased and organized by topic in order to make this document useful to a broader audience.

Outline

- Data and validation
- Socio-economic projections
- On-road vehicle efficiency
- Emission factors
- Vehicle fleet turnover
- Fuels
- Rail
- Aviation
- Marine
- Travel demand management
- General

Data and validation

Comment	Response
D1. How does Roadmap compare to other emissions inventory models and energy consumption statistics?	The Roadmap team conducts an annual review to compare the emissions estimates of the Roadmap with other leading global and national emission inventory models and data sources. Roadmap is calibrated to match historical energy consumption for each region and mode for which data is available. The results of the 2012 validation are available in presentation format along with the model itself on ICCT's website.
D2. How up-to-date is the Roadmap data?	We did a comprehensive review of input data to ensure that the Roadmap uses the most up-to-date available data. We collaborated with in-country partners to ensure that Roadmap uses the most reliable publicly-available data on transportation activity by mode, vehicle stock and sales, vehicle efficiencies, total energy consumption, etc. For aggregate regions, the Roadmap previously used IEA's SMP model, published in 2004. These parameters have since been updated with data from IEA's MoMo (2011).
D3. What about countries within aggregate regions? For example, if you are interested in investigating the options for Thailand, you should be able to enter the Socio data for Thailand and use the Asia-Pacific-40 input data to estimate the impact of policies in your country.	The Roadmap team is considering development of a tool to estimate transportation emissions in smaller countries that are at present included in aggregate regions (e.g. Thailand or Indonesia). Such a tool would allow users to input as much country-specific data as available and pull remaining data inputs from a selected similar Roadmap region.

Socio-economic projections

Comment	Response
S1. How might socio-economic projections of future transportation activity change?	In addition to comparing socio-economic projections for each region and mode with leading national and global models, the Roadmap team plans to use the Global Change Assessment Model (GCAM) to generate a new set of globally consistent projections of future passenger and freight transportation activity. These projections will be compared with Roadmap and other models and may be selected to replace the current methodology.
S2. Projections of passenger travel per capita and vehicle ownership need to be coordinated. More importance should be given to macroscopic trends rather than to specific inputs (such as average load factors), unless their precision is not questionable.	See comment **S1**.
S3. It is probably better to rely more on TKM vs. GDP for the projection of freight transport activity, rather than on TKM per capita and GDP per capita.	We wanted to be consistent in how we predicted passenger and freight activity. Regression analyses of historical activity and socio-economic indicators indicated good correlation between those variables. See comment **S1**.
S4. It is difficult to understand the implications of changing some inputs. The issues related to light-duty vehicle ownership, for example, depend on inputs of load factors and vehicle travel. I would suggest creating some warnings, at least, if inputs result in very strange parameters somewhere else in the model.	Future versions of the model will include warnings if different (calculated) parameters reach values outside of a specified range.
S5. Data for HHDTs differ significantly from the other HDT modes depending on economic development, in particular since they have much higher renewal rates than LDTs and MDTs. Thus, the function for HHDT has to be treated separately, as well as the growth rates.	Because of challenges in predicting future activity data by sub-mode because of lack of historical data, a more aggregate approach was taken. In the revised version of the model, the user is now able to add alternate activity projections for each mode. See comment **S1** for more details.

Socio-economic projections (continued)

Comment	Response
S6. The global socio-economic growth function for GDP and vehicles per capita should be differentiated for a least 5 regions: 1-North America; 2-EU; 3-Japan+South Korea; 4-BRIC+South East Asia; 5-Rest of Europe, Rest of Asia, Middle East, Latin America+Africa. Doing so would reduce variability, even when applied in relative terms. The global functions may overestimate growth rates as they use an upper-bound limit.	We decided to aggregate all regions in one function to increase sample size and statistical significance. In future versions of the model, we will likely revise the methodology for activity projections. See comment **S1** for more details.
S7. Gompertz activity and mode share functions must be estimated separately for key global regions. Countries whose GDP depends on low-value-added production (minerals and metals) have increasing freight intensity with increasing GDP (e.g. eastern Europe), while others with high-value-added production have decreasing freight intensity with increasing GDP (e.g. western Europe).	We decided to aggregate all regions in one function to increase sample size and statistical significance. In future versions of the model, we will likely revise the methodology for activity projections. See comment **S1** for more details.
S8. Descriptions of demand forecasts should be more tentative, recognizing that past trends will not always predict future impacts.	In the revised version of the model, the user is now able to add alternate activity projections for each mode. In future versions of the model, we will likely revise the underlying algorithms for activity projections. See comment **S1** for more details.
S9. For countries in the South-East Asian region like Indonesia, Thailand, Taiwan, and Malaysia, an additional grouping could be provided due to their high growth rates; also, New Zealand should be added to Australia in order to do the calculations with similar parameters for a common region. Since regional socio-economic trend data vary significantly, a regional approach with corresponding regional fitting functions may produce less variation and thus provide a better basis for projections.	Because of the global focus on the model, we had to aggregate some countries in Aggregate regions. In general, we disaggregated some regions where the ICCT is more active in supporting local policymakers (South Korea, Australia). Future versions of the model will provide further regional disaggregation based on which countries are seeking to engage in policy discussions. We are also working on a separate model that will enable the calculation of emissions for a specific region that is currently not disaggregated in the model. See comment **D3** for more details.

On-road vehicle efficiency

Comment	Response
O1. How is new vehicle fuel consumption translated to fleet average fuel consumption?	Average fleet fuel consumption in the year 2000 is typically assumed to be a fixed percentage higher (e.g. 10%) than new vehicle fuel consumption in that year; in subsequent years, average fleet fuel consumption is calculated using new fleet efficiency and turnover algorithms. These algorithms are explained in the model documentation.
O2. How does Roadmap address the gap between test cycle and in-use fuel efficiency?	Based on feedback from the external review process, mode-specific tabs now include adjustment factors to convert test cycle efficiency to in-use efficiency for new vehicles. These can be used to calibrate estimates of TTW energy consumption with historical data sources.
O3. Which units can be used to input vehicle efficiency/fuel consumption?	Fuel consumption for new vehicles can be entered in multiple units (L/100km, km/L, CO_2/km, CO_2/mi, mpg, MJ/km), provided the input unit is specified to the left of the assumptions.
O4. What is the technical potential for ICE vehicle efficiency?	The model is not meant to prescribe specific assumptions for vehicle technical potential. Instead, these are meant to be identified by the user. The “Global Transportation Energy and Climate Roadmap” report, also available on ICCT's website, includes assumptions for near-term potential improvements in vehicle efficiency.
O5. The determination of fuel consumption and emissions currently used assumes implicitly that travel per vehicle is the same for all powertrain options. This is a major problem, since it results in misleading weighting of different fuel and vehicle technologies with respect to emissions.	We have made modifications based on the external review process. The LDV input tab now allows differentiation of distance per vehicle by fuel/engine technology: for example, battery electric vehicles could be assumed to be driven less on average than ICE vehicles.
O6. Fuel consumption differentials for each vehicle class should include effects due to technological differences as well as size-related effects. For example, compare the diesel to gasoline differential in India (1.18), which is likely to be affected by a larger average weight and size of diesel LDVs, vs. the technical estimate (0.82).	The reviewer is correct that fuel consumption differentials are meant to account for both technological differences and size differences.

Emission factors

Comment	Response
E1. Are wear & tear PM emissions from roads, tires, overhead wires included?	No. Only WTT and tailpipe PM emissions are considered. Tire and brake PM emissions, as well as infrastructure-related emissions, are outside the scope of the model.
E2. How does the Roadmap address the high share of used vehicle imports in developing countries?	The current version of the model does not address the issue of used vehicle imports. ICCT is actively seeking out consistent, reliable data sources on used vehicle imports in developing countries; in order to adequately represent these effects, much more must be known about the functioning of emission control devices in old vehicles. We may add more model functionality to address used vehicles in future versions of the model depending on data availability.
E3. Emission factors seem to be underestimates due to neglecting differences between test cycle and real life emission factors.	ICCT has undertaken a comprehensive study of vehicle emission factors for local air pollutants. Roadmap currently assumes that compliance and enforcement of emission standards result in zero-mile in-use emissions that are in compliance with test cycle emission standard values. These emission factors do, however, account for deterioration of control technologies over the lifetime of the vehicle. ICCT will significantly improve the emission factors in future versions of the model to incorporate new data regarding the differences between test cycle and in-use emissions.

Vehicle fleet turnover

Comment	Response
V1. Base year (2000) fuel consumption values do not seem to adequately take into account the impact of the existing fleets' age (and technologies) on average fuel consumption (other than via an across-the-board simple multiplier of 1.1). Survival curves do not take into account differing average vehicle fleet ages across countries.	Because the model starts in 2000, a user-specified factor needs to be used to convert new fleet parameters to in-use fleet parameters. In years beyond 2000, survival curves in the model do take into account regional differences if region-specific survival curves are provided by the user (see "Survival" tab).
V2. In computing the average fuel economy, the calculation does not appear to correctly weigh the impact of the reduction in per-vehicle VKT with age and intrinsic fuel efficiency by year of sale in each year of calculation.	The turnover algorithm that converts new fleet parameters to average fleet parameters (e.g., fuel economy) take into account the fact that vehicles are used less often as they age. Please refer to the "Survival" tab and the supporting model documentation for more information.

Fuels

Comment	Response
F1. How does Roadmap handle WTT and TTW emission factors for biofuels, and to what extent can these be modified by the user?	By default, Roadmap does not assume emission reductions from biofuels; however, users may choose to assess emissions using one of several regulatory treatments: CARB, US EPA, and EU with or without iLUC effects.
F2. How does Roadmap handle WTT emissions for electricity, hydrogen, and unconventional fossil fuels?	• Electricity WTT emission factors are estimated in ICCT's Power Sector Roadmap; grid decarbonization can be entered by region. • Hydrogen WTT emission factors are entered for a base year and adjusted by region with user factors. By default, hydrogen factors assumed to decline 1.75% per year from 2010 to 2050. • Global average WTT emission factors for fossil fuels (gasoline and diesel) are based on the weighted average of conventional and unconventional oil sources. Users can adjust forecasts of the share of each source.

Fuels (continued)

Comment	Response
F3. How should one interpret the "user factors" for fuels?	The user factors for fuels are meant to adjust the default WTT EFs for different regions. For example, a factor of 1.05 increases the default emission levels for the specified fuel type, region, and year by 5%. Annualized rates of reduction for 2010-2050 can be entered in the "Fuels" tab.
F4. How are emissions modeled for PHEVs?	The model lets the user specify the share of VKT driven by PHEVs using electricity and conventional fuels. The default assumption is 50%. The model then calculates emissions separately for the electric drive portion and the conventional fuel portion.
F5. Why do you exclude synfuels for fossil energy (GTL and CTL)?	We had to constrain the number of fuel pathways to limit the model size. The model provides an option to increase WTT EFs for gasoline/diesel due to increasing shares of unconventional fuels.

Rail

Comment	Response
R1. Only the EU-27 and the US have emission standards for rail; “no standard” levels should applied elsewhere.	Rail data were revised based on the comment. Future versions of the model will provide updates to the rail modules as more data becomes available.
R2. Add a load factor for passenger rail (passengers per VKT).	Because rail represents a relatively low share of transportation emissions, a more simplified approach was taken for rail emissions. Rail efficiency is specified in terms of MJ per passenger-km, and emissions are the product of passenger-km, efficiency, and emissions per MJ. In the current model version, an increase in the load factor for passenger rail can be approximated by an increase in passenger rail efficiency (reduction in MJ/passenger-km). The passenger and freight rail modules will be revised in v2.0, and we will likely include a load factor for rail.

Aviation

Comment	Response
A1. LTO aviation emissions could be attributed to countries using US FAA or ICAO Subcommittee data.	Currently the aviation module is based on data from ICAO and US FAA.
A2. Maturing markets are not factored into aviation growth.	Aviation historical and forecast activity was developed based on ICAO projections by country.
A3. Impacts from aviation NO_x and contrails (and other effects) have a GWP of approximately 2.	In the current version of the model, GWP is only considered for CO_2, CH_4, and N_2O. Future versions of the model may include GWP for other pollutants, including NO_x.
A4. Does the model not support modal substitution from air to rail because the mode share calculations do not include aviation? If so, this could be a possible limitation for national policy investigations especially in Europe.	Roadmap currently does not support mode shifts from aviation to rail, since aviation activity has not been disaggregated and allocated to regions. Doing so would require data on domestic vs. international flights and a methodology for allocating international fights to origin and destination regions. Future versions of the model may disaggregate aviation activity into international and domestic, which will allow the modeling of mode shifts from aviation to rail.
A5. How does the Roadmap handle operational improvements such as better air traffic management? This policy lever seems to be excluded from the aircraft efficiency calculations.	Operational improvements can be modeled using the "Market-based measures" (MBMs) lever for aviation. Values entered in these tables represent reductions in overall aviation activity as a result of operational improvements or market-based measures.

Marine

Comment	Response
M1. Does the Roadmap consider marine SO_2 emissions?	Yes. As with other pollutants, SO_2 emissions from vessels are based on IMO projections.
M2. Does the Roadmap consider inland navigation in waterborne emissions?	Yes. The current waterborne module considers emissions from all waterborne vessels (both inland and international shipping) as estimated in recent IMO projections. Future versions of the model may disaggregate waterborne emissions to regions.
M3. Coastal shipping is a significant share of the freight transport in the EU and US, much larger than road and rail freight in terms of TKM. This may also be relevant for other parts of the world, like Japan, China, India, Indonesia and the Caribbean, where the marine sector is economically important and causes serious impacts on the environment, in particular air pollution and water pollution in ports and coastal marine ecosystems.	ICCT's marine team is currently developing a more-detailed emissions inventory model for marine sources; this tool will likely be integrated with Roadmap upon its completion.

Travel demand management

Comment	Response
T1. Does the Roadmap support leverage factors for transit and NMT?	Leverage factors can be modeled by using the light-duty vehicle activity reduction lever in conjunction with mode shifts to public transit and NMT.
T2. Help users estimate the effects of TDM strategies using input elasticities from the research literature.	ICCT is coordinating with GCAM developers to develop a GCAM scenario using ICCT inputs. This scenario, designed to be consistent with Roadmap, could help users estimate the effects of TDM and other fiscal strategies on activity for input to the Roadmap. This functionality will be available in the next release of the Roadmap model.
T3. Improvements in in-use fuel efficiency for on-road sources (e.g., due to congestion relief strategies) seem to apply to non-urban VKT, when this measure should apply only to urban VKT.	This lever in the model applies only to urban VKT. The share of passenger vehicle activity in urban areas is approximated using UN data and projections of the share of population in urban areas.
T4. Why doesn't the Roadmap model consider baseline non-motorized transportation activity?	Due to a lack of credible and globally consistent data on non-motorized transportation activity, the model does not include NMT data with the exception of EU-27 (for which data were available). Since NMT activity does not generate emissions, it is less critical to generating accurate emission estimates than other potential model refinements. We might include NMT data in future versions of the model if credible data become available.

General

Comment	Response
G1. The documentation provides little guidance on potential emission reduction strategies. I suggest adding a section which describes various types of strategies, discusses factors to consider when evaluating and selecting strategies (including co-benefits), and provides additional supporting references.	The model was developed as a tool to let users choose their own assumptions regarding emission reduction strategies. ICCT's "Global Transportation Energy and Climate Roadmap" report, which relied on the Roadmap model and is also available on ICCT's website, provides a thorough evaluation of near-term policies and strategies to reduce transportation emissions.
G2. Which cells should be changed, and which should not be changed?	Generally, text in input cells are colored blue, while text in formulas and calculation cells are colored black.
G3. Where can the user find conversions between Imperial and SI units, or between fuel consumption and efficiency metrics?	Conversion metrics can be found in the configuration tab.
G4. Include a step-by-step example of what the user needs to do to analyze one scenario.	Webinars will be provided to users to give examples on how to use the model. Recordings of these webinars will be provided on ICCT's websites.

List of Acronyms

- EF – emission factor
- FAA – Federal Aviation Administration
- GCAM – Global Change Assessment Model
- GDP – gross domestic product
- GWP – global warming potential
- ICAO – International Civil Aviation Organization
- IMO – International Maritime Organization
- MJ - megajoule
- NMT – non-motorized transport
- PKM – passenger-kilometers
- TDM – travel demand management
- TKM – tonne-kilometers
- TTW – tank-to-wheel
- VKT – vehicle-kilometers traveled
- WTT – well-to-tank