Reader's guide

International Transport Forum (ITF) modelling framework

ITF Transport Outlook presents long run scenarios, up to 2050, on the development of global passenger mobility and freight volumes. The scenario outcomes are based on several models, which look at freight transport demand, differentiating between surface freight (road and rail) and passenger transport, both urban and inter-urban. In each case, the outputs are vehicle-kilometres or tonne-kilometres, and are translated into CO_2 emissions by applying transport technology paths built by the International Energy Agency (IEA). In the urban case, local pollutants and health impacts are also computed, using the methodology developed by the International Council on Clean Transportation (ICCT).

Surface freight volumes correlate strongly with GDP and the modelling proceeds by analysing the link between freight volumes and GDP for countries with varying income levels. Projections for international freight by mode of transport are derived from trade flow projections, up to 2050, developed by the OECD Economics Directorate. The ITF international freight model converts flows in value to flows in volume and assigns them to existing itineraries in a multi-modal context.

The urban model acknowledges the primary role played by motorisation rates in the evolution of mobility and modal share, especially in developing countries and investigates the link between income and vehicle fleet numbers under different urban development scenarios. Urban mobility results are then extrapolated at national levels to obtain figures for global passenger transport.

International Energy Agency's Mobility Model (MoMo)

The IEA has been developing its Mobility Model for over 10 years. It is a global transport model for making projections to 2050, with considerable regional and technology detail. It includes all transport modes and most vehicle and technology types. MoMo is used to produce the periodic IEA Energy Technology Perspectives report. MoMo covers 29 countries and regions. It contains assumptions on technology availability and cost at different points in the future and how costs could drop if technologies are deployed at a commercial scale. It allows fairly detailed bottom-up "what-if" modelling. Energy use is estimated using a bottom-up approach. MoMo is used to produce projections of vehicle sales, stocks and travel, energy use, GHG emissions (on a vehicle and well-to-wheel basis). It allows a comparison of marginal costs of technologies and aggregates to total cost across all modes and regions for a given scenario.

International Council on Clean Transportation Global Transportation Roadmap model

The ICCT analysis estimates premature mortality from primary fine particulate matter ($PM_{2.5}$) emitted by on-road vehicles in urban areas. The ICCT Global Transportation

Roadmap model captures well-to-wheel (WTW) transportation sector emissions from 2000 through 2050. The model calculates tank-to-wheel (TTW) emissions of local air pollutants – fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), non-methane hydrocarbons (HC), etc. – as the product of vehicle activity and fleet-average emission factors. Average emission factors for each region and on-road mode (light-duty vehicles, 2-wheelers, and buses) are calculated based on the share of the fleet meeting various vehicle emission standards using a fleet turnover algorithm and a policy implementation timeline. More information on the model is provided in Box 4.5.

Definitions of terms frequently used in this report

Mode: Contrasting types of transport service relevant to the comparison being made: e.g. road, rail, waterway, air or private car, powered two-wheelers, bus, metro, urban rail.

Modal split/modal share: Percentage of total passenger-kilometres accounted for by a single mode of transport; percentage of total freight tonne-kilometres or tonnes lifted accounted for by a single mode.

Four-wheelers: Passenger cars and light trucks.

Two-wheelers: Powered two-wheeled vehicles, motorcycles and scooters.

Three-wheeler: Powered three-wheeled vehicles, such as auto-rickshaws in India.

Land-use: Urban density evolution.

Bus Rapid Transit (BRT): Buses running in lanes separated from the general traffic, with high standards of quality of service, in particular regarding frequency and reliability.

Mass transit: BRT or urban rail (metro included).

Public transport service: Per capita vehicle-kilometres of total public transport.

Quality of public transport: Share of rapid vehicle-kilometres offered as a percentage of total public transport service. Rapid vehicle kilometres are those provided by rail systems, metro or bus rapid transit in segregated corridors.

Road intensity: Kilometres of roads per capita in urban areas.

Oil price scenarios

High oil price: Strong upwards divergence of real oil prices relative to the baseline oil price scenario.

Baseline oil price: The reference oil price scenario used by the International Energy Agency 2012 New Policy Scenario.

Low oil price: Strong downwards divergence of real oil prices relative to the baseline oil price scenario.

Urban land-use scenarios

Baseline: From 2010 through 2050, all urban agglomerations grow in surface area in proportion to population expansion, following their observed population growth-surface expansion path. Urban density of the average city only slightly increases.

High sprawl: From 2010 through 2050, all urban agglomerations grow in surface area following the highest observed population growth-surface expansion path for each region. Urban density of the average city decreases.

Low sprawl: From 2010 through 2050, all urban agglomerations grow in surface area following the lowest observed population growth-surface expansion path for each region. Urban density of the average city increases.

Urban public transport service scenarios

Baseline: Public transport expands according to the *Baseline* evolution of urban density of each country. It follows the observed positive relation between urban density and public transport service. Public transport services grow in pace with urban population growth. Public transport quality follows past observed trends.

High public transport: Increase of public transport service expands beyond levels that correspond to the observed relation between density and expansion. In this way public transport vehicle-kilometres grow significantly more than urban population. Public transport quality grows at the highest speed observed in the country or region.

Low public transport: Supply of public transport service develops in this case according to the *High sprawl* evolution of density in cities. Total vehicle kilometre growth lags behind population growth and public transport quality grows at the lowest speed observed in the country or region.

Urban road infrastructure scenarios

Baseline: Per capita road infrastructure expands at a rate that corresponds to the evolution of urban density under the *Baseline sprawl* scenario. It follows the negative relation between urban density and road intensity observed in historical data.

High roads: Urban roads expand at higher rates than urban population, following the highest trend observed in the country or region.

Low roads: Urban road infrastructure per capita grows following the *Low sprawl* evolution of urban density, following the lowest trend observed in the country or region.

Urban policy pathway scenarios

Baseline: Land use and public transport service and quality develop according to their *Baseline* scenarios; fuel prices follow their reference scenario.

Private transport-oriented: Land use is modelled according to the *High sprawl* scenario; public transport service expands following the *Low public transport* scenario; public transport quality increases at the rate of the *Baseline* scenario; fuel price evolution corresponds to the *Low oil price* scenario.

Public transport-oriented: Land use is modelled according to the *Low sprawl* scenario; public transport service expands following the *High public transport* scenario; public transport quality increases at the rate of the *High quality* scenario; fuel price evolution corresponds to the *High oil price* scenario.

Transport scenarios

Passenger transport

Highest: Corresponds to the *private transport-oriented* urbanisation path, combined with the *High roads* case.

Central: Combines *Baseline* urbanisation path, with the *Baseline* road infrastructure case.

Lowest: Simulates *public transport-oriented* urbanisation under the *Low roads* infrastructure case.

Surface freight transport

Highest: Freight intensity remains unchanged throughout the 2010-50. This constitutes an upper bound for freight volumes by 2050. Linked with *Low rail scenario* which takes the lowest rail share observed in each region, except for the European Union, where rail share is assumed to remain constant after 2015 (low post-crisis levels). These together form the highest scenario for CO_2 emissions.

Baseline: Freight intensity evolves following the growth in income of countries. As countries move to higher GDP per capita levels, their freight intensity declines. This is the most probable outcome if no specific policies are introduced for a stronger decoupling. Combined with *Central scenario for rail share*, according to which rail share will decline for the major emerging economies. We consider this to be the most likely scenario for CO_2 emissions.

Upwards transition: Freight intensity for all countries decreases to 0.7 by 2030 (*decoupling*). This sets a lower bound for freight volumes by 2050. This combined with *Central scenario for rail share* captures the twofold effect of income growth for low and middle income economies; a shift to lower freight intensity but also to higher share of road transport as the goods transported become of higher value.

Lowest: Freight intensity for all countries decreases to 0.7 by 2030 (decoupling) combined with *High scenario for rail share* which takes the highest rail share observed for each region, except for areas where rail infrastructure is notably low and not expected to increase over the projection period (especially in Asia and Africa). We consider this to be the lowest scenario for CO_2 emissions.

Vehicle technology scenarios

IEA New Policy Scenario (NPS): corresponds to a context in which the broad policy commitments and plans that have been announced by governments to date are implemented. Under this scenario fuel economy standards are tightened and there is progressive yet moderate uptake of advanced vehicle technologies.

Regional aggregates

Africa: Sub-Saharan Africa and North Africa.

Asia: South and East non-OECD Asia excluding China and India.

EEA + Turkey: EU28 + Switzerland, Norway and Turkey, non-EU Nordic (Iceland).

Emerging economies: Brazil, China, India, Indonesia, Russian Federation, South Africa, Saudi Arabia.

EU27: European Union countries as per 1 August 2013 excluding the non-ITF member country Cyprus.[1, 2]

Latin America: South America and Mexico.

Middle East: Middle East including Israel.

North America: United States and Canada.

ODA: Afghanistan, Bangladesh, Mongolia, Nepal, Pakistan, Papua New Guinea, Chinese Taipei, Sri Lanka, Samoa.

OECD: All OECD countries.

OECD Pacific: Australia, Japan, New Zealand and South Korea.

Transition economies: Former Soviet Union countries + Non-EU South-Eastern Europe.

Abbreviations and acronyms

ACI: Airport Council International

BRT: Bus Rapid Transit

IATA: International Air Transport Association

ICCT: International Council on Clean Transportation

IEA: International Energy Agency

IMO: International Maritime Organisation

ITF: International Transport Forum

MoMo: International Energy Agency's Mobility Model

PPP: Purchasing Power Parity

RPK: Revenue passenger-kilometres

UNCTAD: United Nations Committee for Trade and Development

UNEP: United Nation's Environment Program

Notes

1. Footnote by Turkey. The information in this document with reference to " Cyprus " relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
2. Footnote by all the European Union Member States of the OECD and the European Commission. The Republic of Cyprus is recognized by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.