2nd Carbon Footprint Workshop

20 May 2014, Kunming

Measurement of Transport CO2 Emissions: ForFITS Model

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Outline

- Introduction to ESCAP and UN mandates
- State of transport and emissions in Asia
- ForFITS Model
- Mitigation policy options


The Economic and Social Commission for Asia and the Pacific (UN ESCAP)
RUSSIAN FEDERATION
KAZAKHSTAN
MONGOLIA
CHINA
JAPAN
DEM. PEOPLE'S REP. OF KOREA
REP. OF KOREA
INDIA
BANGLADESH
MYANMAR
THAILAND
VIET NAM
LAO P.D.R.
CAMBODIA
MALAYSIA
SINGAPORE
BRUNEI DARUSSALAM
PHILIPPINES
I N D O N E S I A
AUSTRALIA
NEW ZEALAND
PAPUA NEW GUINEA
SOLOMON ISLANDS
VANUATU
FIJI
TONGA
SAMOA
NAURU
KIRIBATI
TUVALU
MARSHALL ISLANDS
FEDERATED STATES OF MICRONESIA
PALAU
NORTH PACIFIC OCEAN
SOUTH PACIFIC OCEAN
INDIAN OCEAN
Bering Sea
Sea of Okhotsk
Philippine Sea
South China Sea
East China Sea
Coral Sea
Tasman Sea
Arafura Sea
Celebes Sea
Arabian Sea
Bay of Bengal
Aleutian Islands
Hawaiian Islands
Northern Mariana Islands
Northern Line Islands
Southern Line Islands
Phoenix Is.
Tokelau Is.
Tuamotu Archipelago
Society Is.
Tubual Is.
Cook Islands
Marquesas Is.
French Polynesia
Pitcairn
Capital city
0 1000 2000 3000 km
0 1000 2000 mi

UN Mandates

- Global
  - Rio+20, focus on three pillars of sustainability
    - Economic
    - Social
    - Environmental
  - Millennium Development Goals, 8
  - Sustainable Development Goals (beyond 2015)
  - Kyoto Protocol – new protocol
- Regional
  - Regional Action Programme for Transport Development, 2012-2016
    (Ministerial Conference on Transport, 2012)
    - Sustainable transport development
    - Interisland shipping

    (10 Thematic Areas)

Rio+20 Outcome (Transport)

- Transport and mobility are key to Sustainable Development
- Efficient movement of goods and people
- Energy efficient multimodal transport system
- Clean fuels and vehicles
- Integrated approach to planning
- Affordable and sustainable transport
- Sustainable transit transport- need of landlocked and transit countries
- Capacity development

Post 2015 Development Agenda

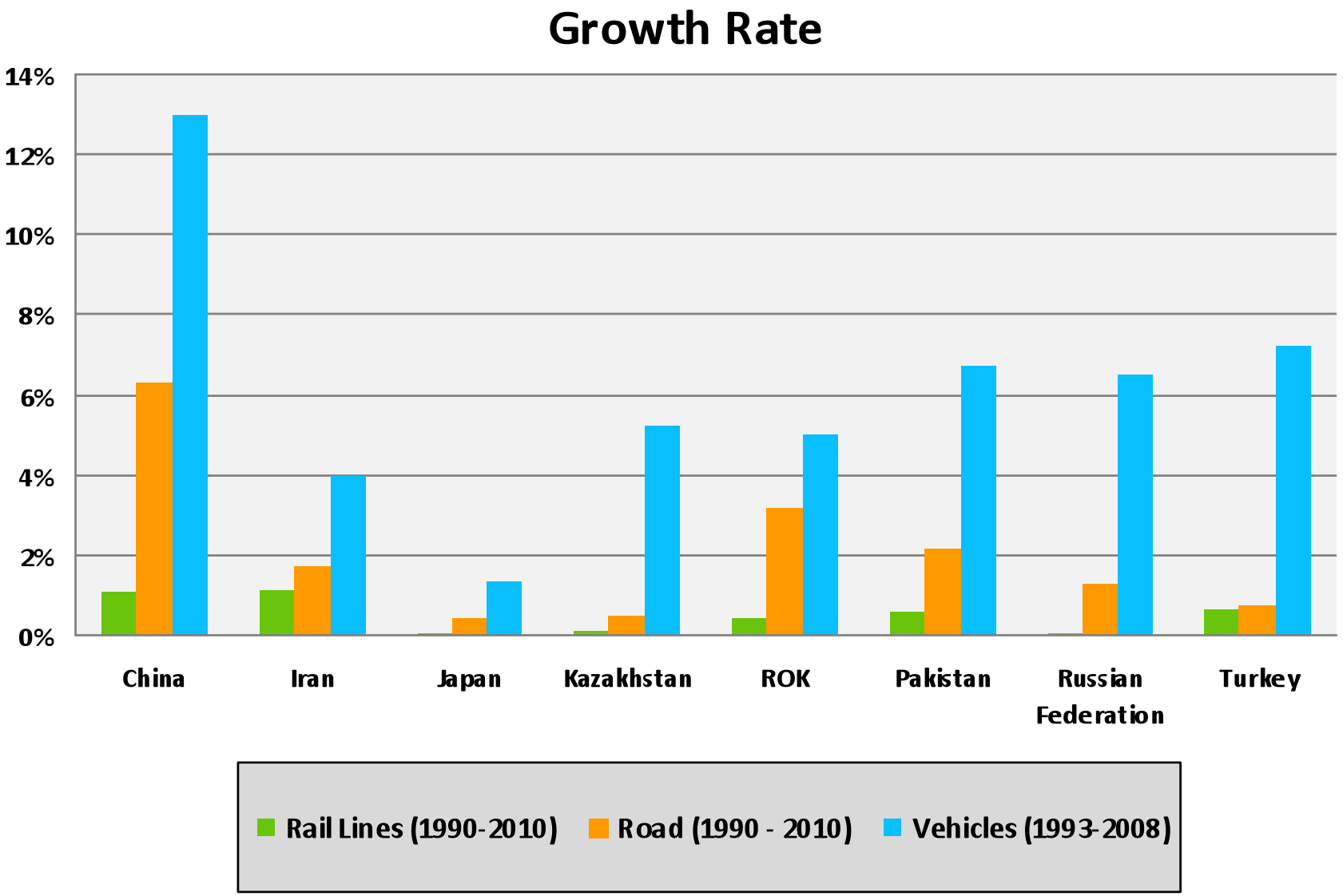
- Sustainable Development Goals
- Open Working Group
- Inclusion of Transport in SDG:

Sustainable transport that enables universal access to safe, clean, and affordable mobility

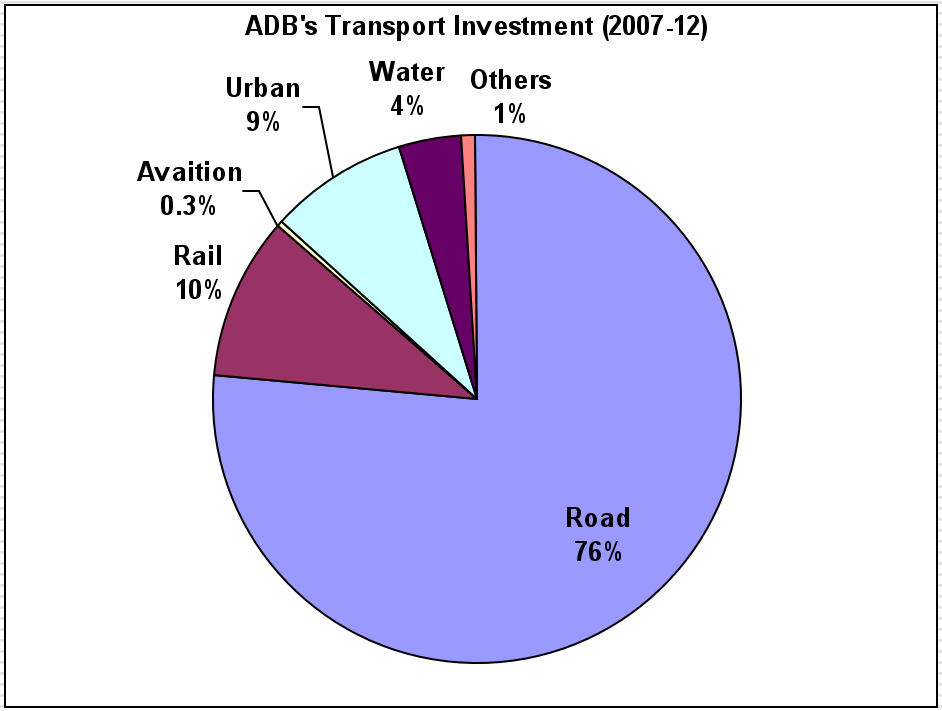
  - Increase access to mass transportation
  - Reduce urban air pollution
  - Increase efficiency of vehicle fleet
  - Reduce road fatalities

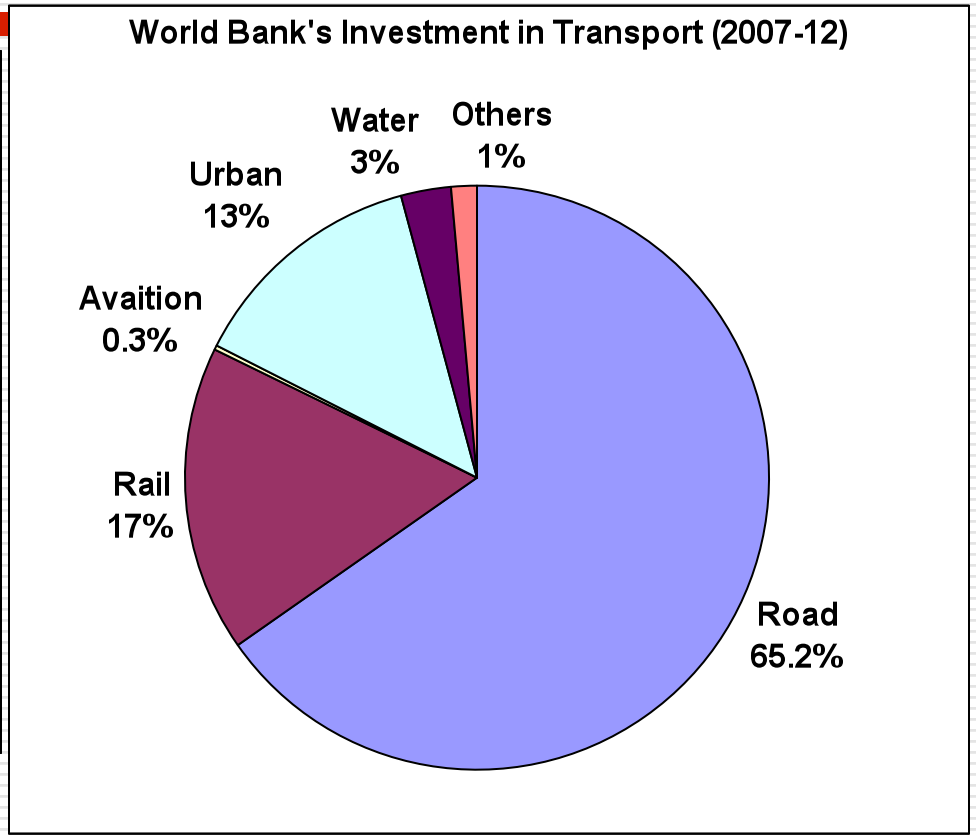
- Work in progress to define SDGs, targets and indicators in 16 Focus Areas
- SDG agreed by September. 2015

Growth of railways, road and vehicles



Pattern of Investment in Transport

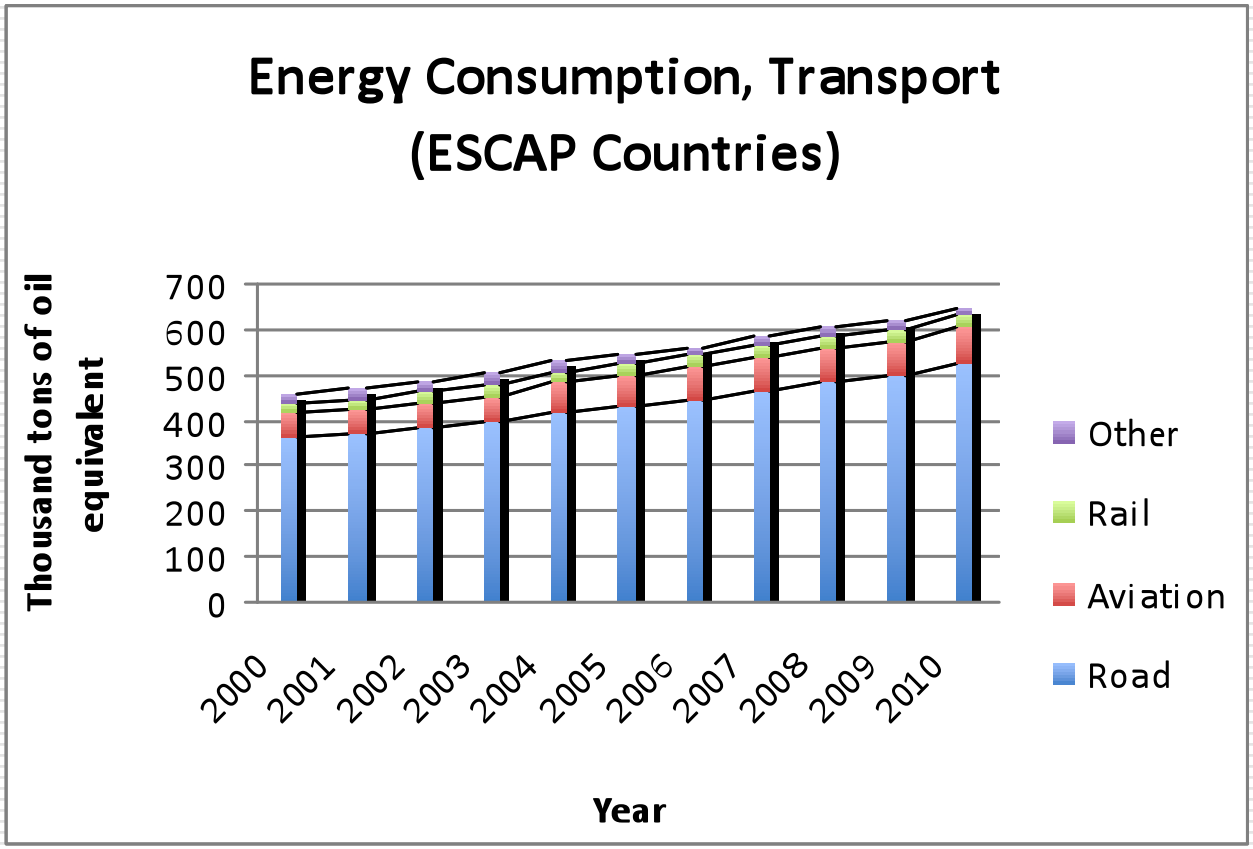




(ESCAP, 2013)

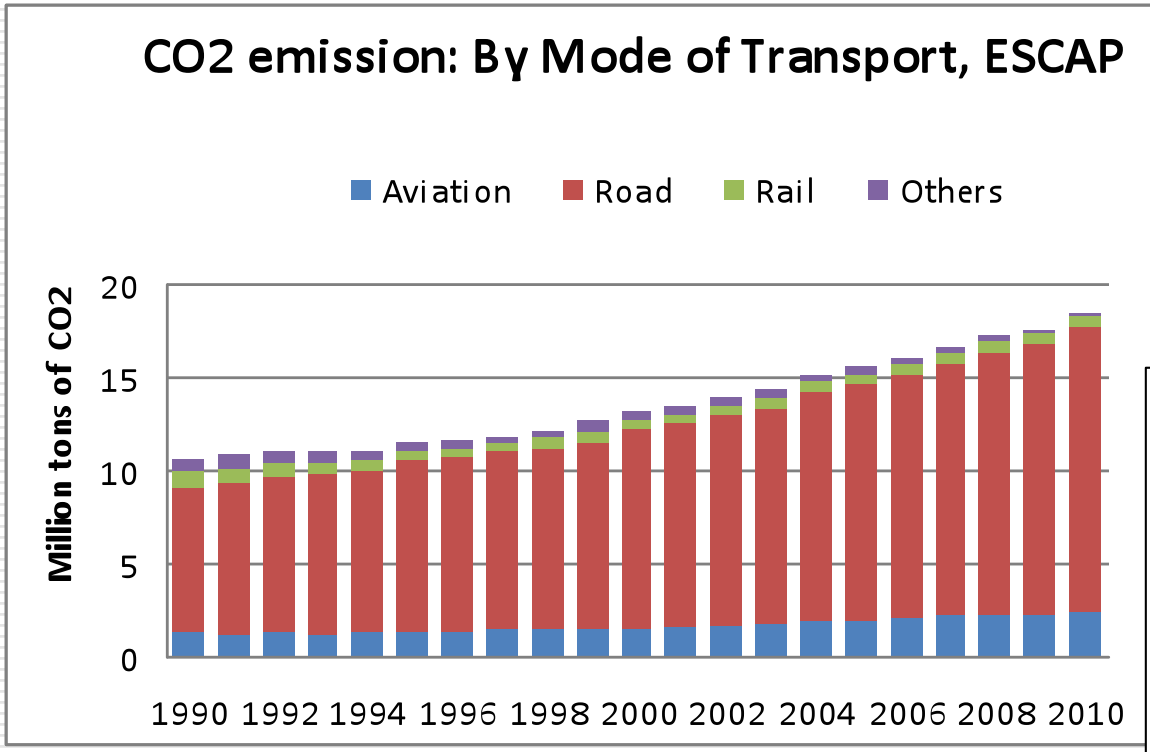
- Railway and water transport are more environmental friendly than roads
- Majority of investment is in roads
- Rail and Urban transport investment increasing
- Limited investment aviation, inland water transport and coastal shipping

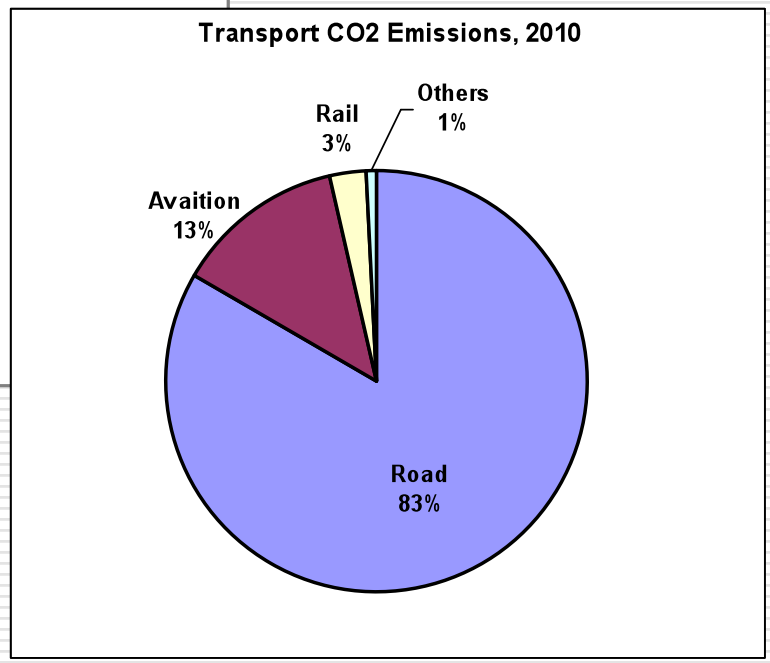
Energy consumption



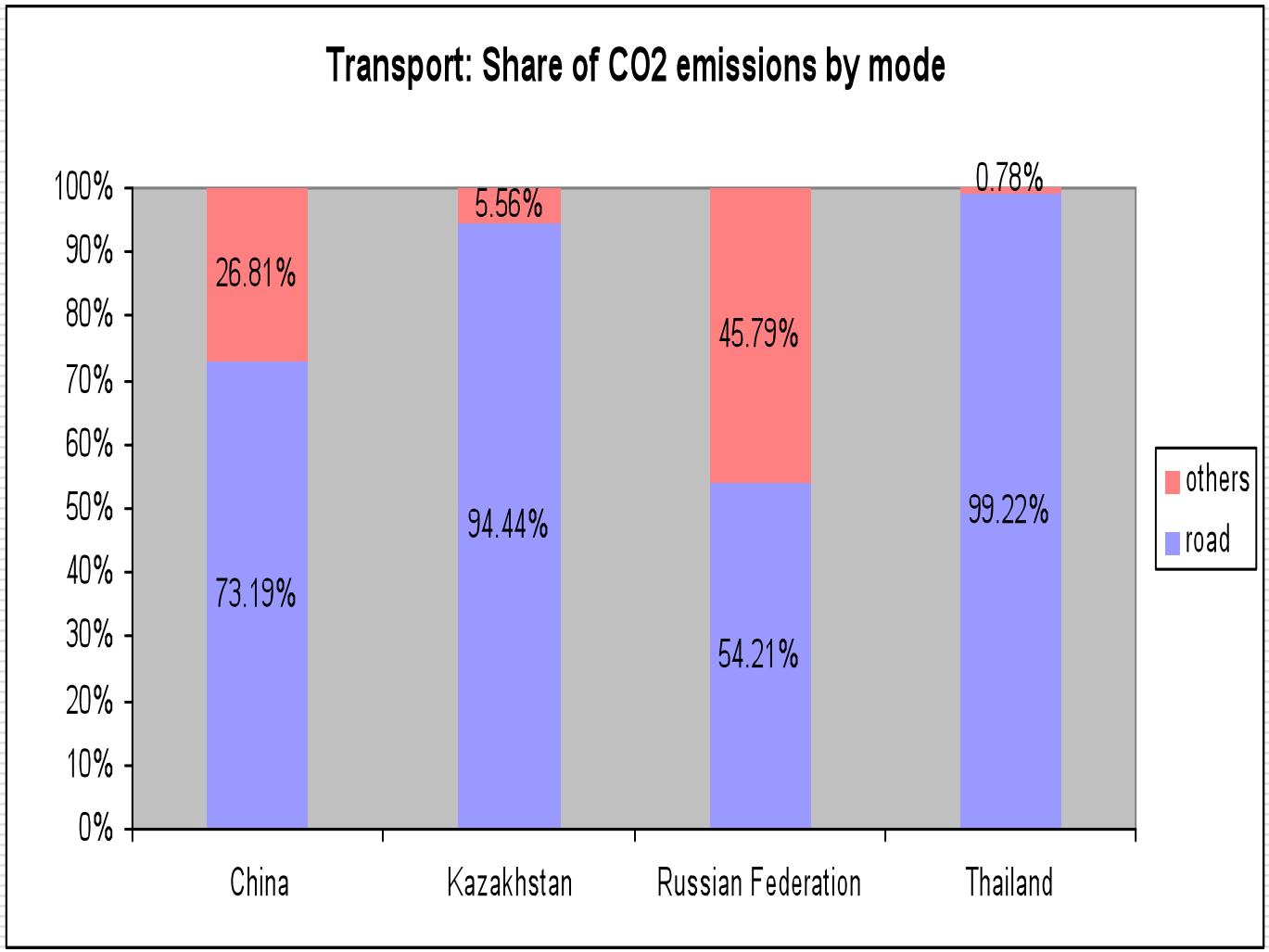
- World-236.2 mil TOE
- ESCAP-64.8 mil TOE (27.4% of world)
- Road- 81%
- Avaition-13%
- Rail- 4%
- Others- 2%

Transport emissions by modes, ESCAP





Share of emissions in selected countries



Road transport- major share of CO2 emissions in Asia-54-99%

Major industrialized Asian countries- China, India, Japan, South Korea- 31% of CO2 emissions

Emission Assessment Model

- Global Review of emissions models, data, mitigation policies
- Develop a freely available emission assessment model capable to evaluate various policy options to reduce transport CO2 emissions
- Assist countries and policy makers:
  - in making informed decision for planning for sustainable transport development
  - in the selection of the most appropriate and effective mitigation measures
- Enhance cooperation among countries
- Raise awareness about the need to measure transport emissions

Joint UNDA project among –Five UN Regional Commissions, UNECE leading

ForFITS: Model requirements

Key model requirements

- Freely available software
- Allow the estimation/assessment of emissions in transport
- Allow the evaluation of transport policies for CO_2 emission mitigation

Model converts information on transport activity into fuel consumption and CO_2 emissions considering the influence of the socio-economic parameters and policy levers

- Sectoral transport model, not including feedback on economic growth
- Local, national, international applications are possible
- The model is flexible with respect to data needs

ForFITS model Coverage

- Passenger and freight transport services
- Two different areas (e.g. to define the transport systems: urban, non-urban, non-spec.)
- Nine transport modes:
  - non-motorized transport,
  - two wheelers,
  - three wheelers,
  - light road vehicles,
  - medium and heavy road vehicles,
  - rail,
  - Navigation
    - inland,
    - short-sea
    - deep-sea/maritime,
  - Air
  - pipelines

Maritime sector

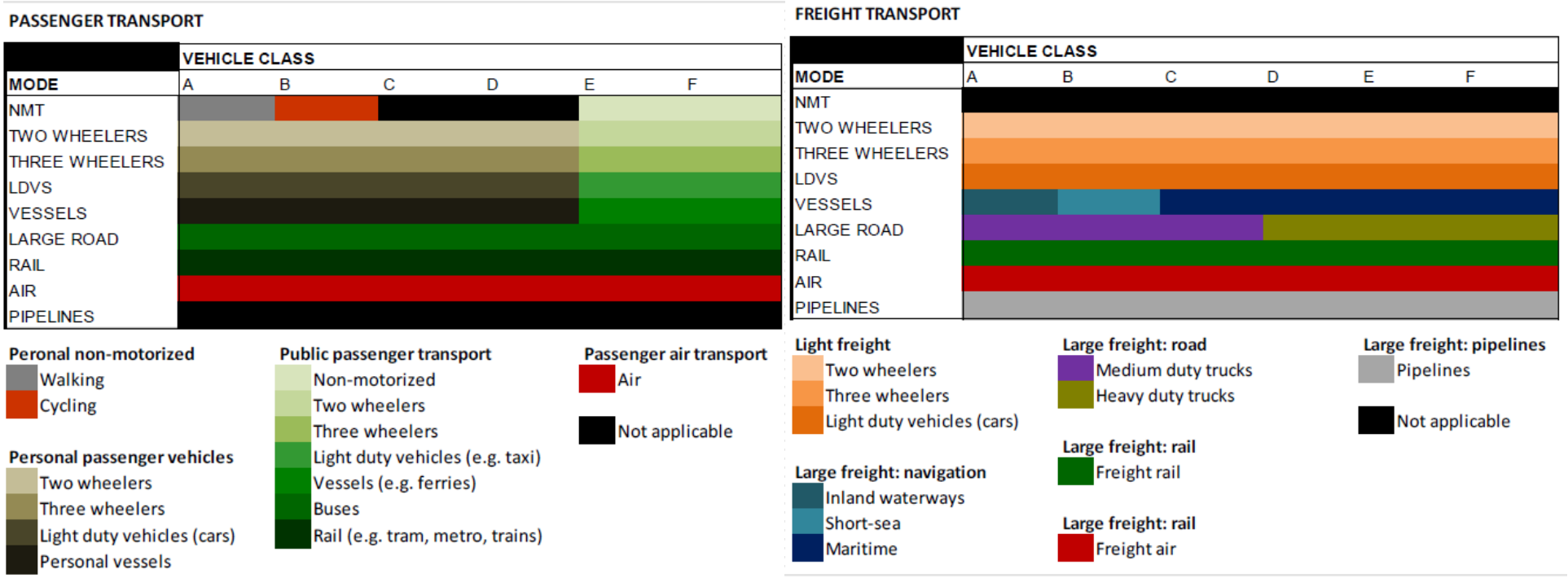
Vessel types (Passenger)

- A-Personal boats (non-specified)
- B- Outboard motorboats
- C- Inboard motorboats (cabin cruisers)
- D- Inboard motorboats (yachts)
- E-Ferries
- F- Vessels for public transport (other / non-specified)

Vessel types (Freight)

- A-Inland navigation (carrying capacity ≤ 3000 t)
- B-Short sea shipping (3000 t < carrying capacity ≤ 7500 t)
- C-Maritime (7500 t < carrying capacity ≤ 33750 t)
- D-Maritime (33750 t < carrying capacity ≤ 60000 t)
- E-Maritime (carrying capacity > 60000 t)
- F-Maritime (non-specified)

Different vehicle subsets within each mode (organized in six vehicle classes – A to F



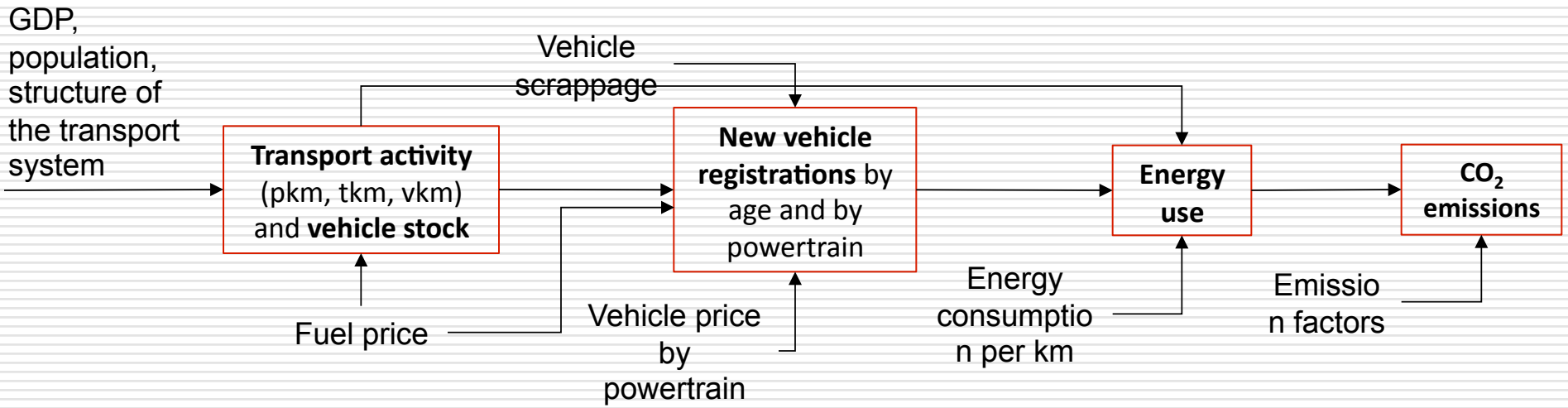
- 31 powertrain technologies (e.g. internal combustion engines, hydraulic hybrids, electric hybrids, plug-ins, fuel cell, electric)
- 10 fuel blends, some of which are associated with specific modes and/or powertrains

Emission assessment

- ASIF Approach

Emission= **Σ** Activity (pkm or tkm) X Structure (mode share) X Fuel Intensity (fuel consumption per vkm by vehicle type) X Emission Factor (of fuel used in vehicle type)

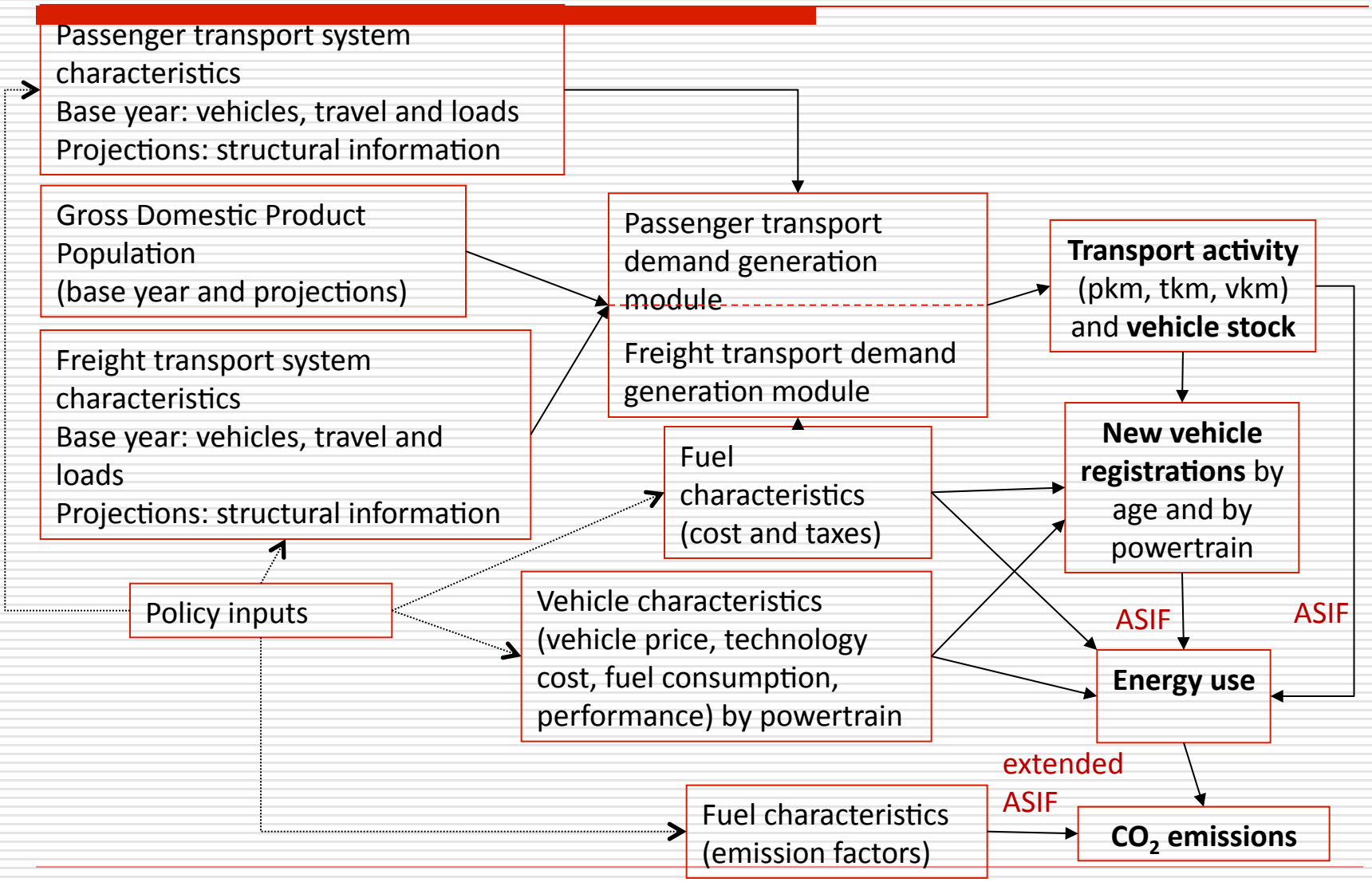
ForFITS model: Key modelling steps



Four key modelling steps

- Generation of **transport activity** (pkm, tkm, vkm) and **vehicle stock**
- Evaluation of **new vehicle registrations** by powertrain and characterization of the vehicles by age
- Calculation of the **energy use**
- Estimation of **CO_2 emissions**

ForFITS model: Simplified structure



ForFITS model: Data requirements

- the characterization of the transport system in the base year (historical inputs)
- the definition of the context in which the transport system should evolve (projections)
- Information on the initial and final times, the characterization of the areas, and the selection of the modelling approach for the powertrain choice (exogenous or endogenous),

Minimum data requirements:

Historical inputs

- GDP, population
- Vehicle stock: number of vehicles by powertrain, average travel and loads, average fuel consumption
- New vehicle registrations: same detail used for stocks needed for the base year, 5 and 10 years earlier (data in between are taken into account with linear interpolations)

Projections

- GDP and population
- Fuel prices (cost and taxation)
- Vehicle shares between two and three wheelers
- Pkm shares for different public transport modes (e.g. due to the construction of urban rail)
- Modal shares of light road freight vehicles
- Evolution of the network extension for pipelines
- With endogenous powertrain selection (optional), discount rate and powertrain shares

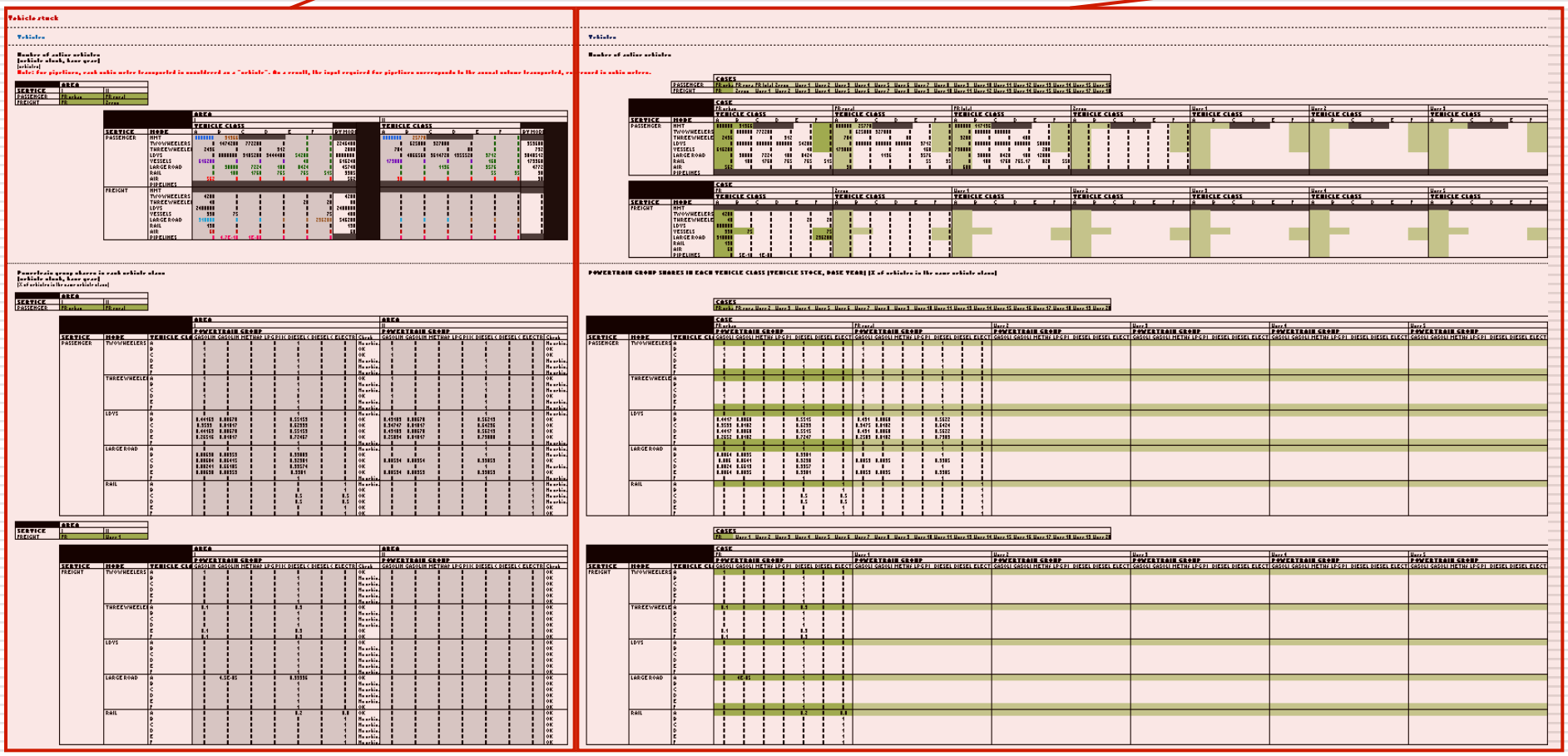
Need for coherence for inputs on each AREA, SERVICE, MODE, VEHICLE CLASS and POWERTRAIN

ForFITS model: XLS file

Example of input tables in the XLS file

Selection section
Inputs entered in the database section are activated here

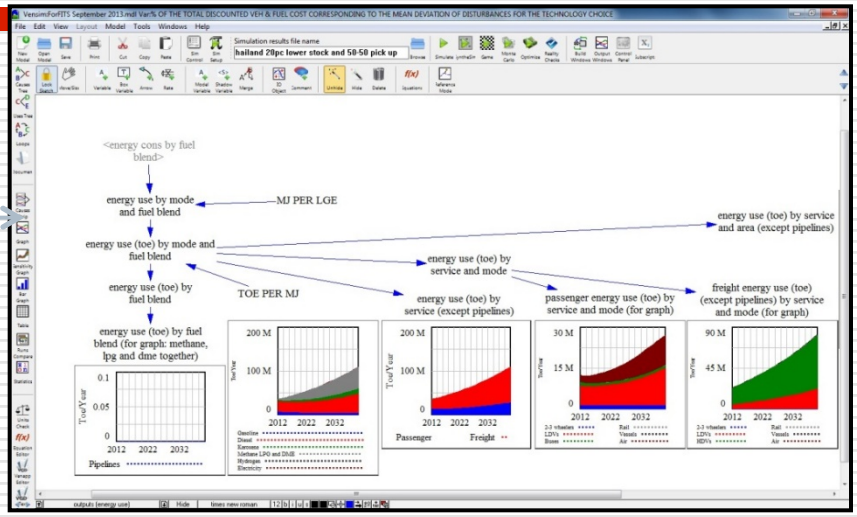
Database section
Data for new scenarios shall be entered here

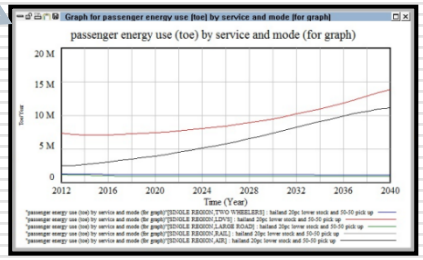


ForFITS model Results

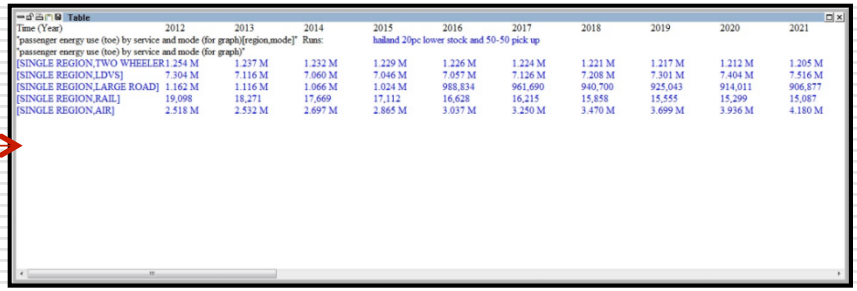
Results can be visualized in several ways:

- Using the "output" views of the VPM file
- With a graphical interface in the VPM file (up to 16 variables, including subscripts)





- As a table in the VPM file (any amount of subscripts and variables)



- Extracting tables in .txt files, readable and editable in Excel

  The visualisation as graphs and table is possible for each of the model variables

  Comparative results on multiple runs (e.g. to different scenarios, before and after one or more policy interventions) can also be visualized in graphs and tables

ForFITS Model:Dissemination and Advocacy

- International Review and Expert Meeting, April 2012, Geneva
- Global Review of emissions models, data, mitigation policies
- Model and User Manual available through project website:

  http://www.unece.org/trans/theme_forfits.html

- Capacity building workshop/Pilot national workshops:
  - ECLAC, Chile, 26-29 August 2013
  - ECE, Geneva, 13 September 2013
  - ESCAP, Thailand 23-24 September 2013
  - ESCAP, Regional, 26-27 September 2013
  - ECE, Geneva, 8-10 October 2013
  - ESCWA, Tunisia, 4-5 December 2013

ForFITS Links

Model, user manual, piloting workshops

Model download/UNDA project page
http://www.unece.org/trans/theme_forfits.html

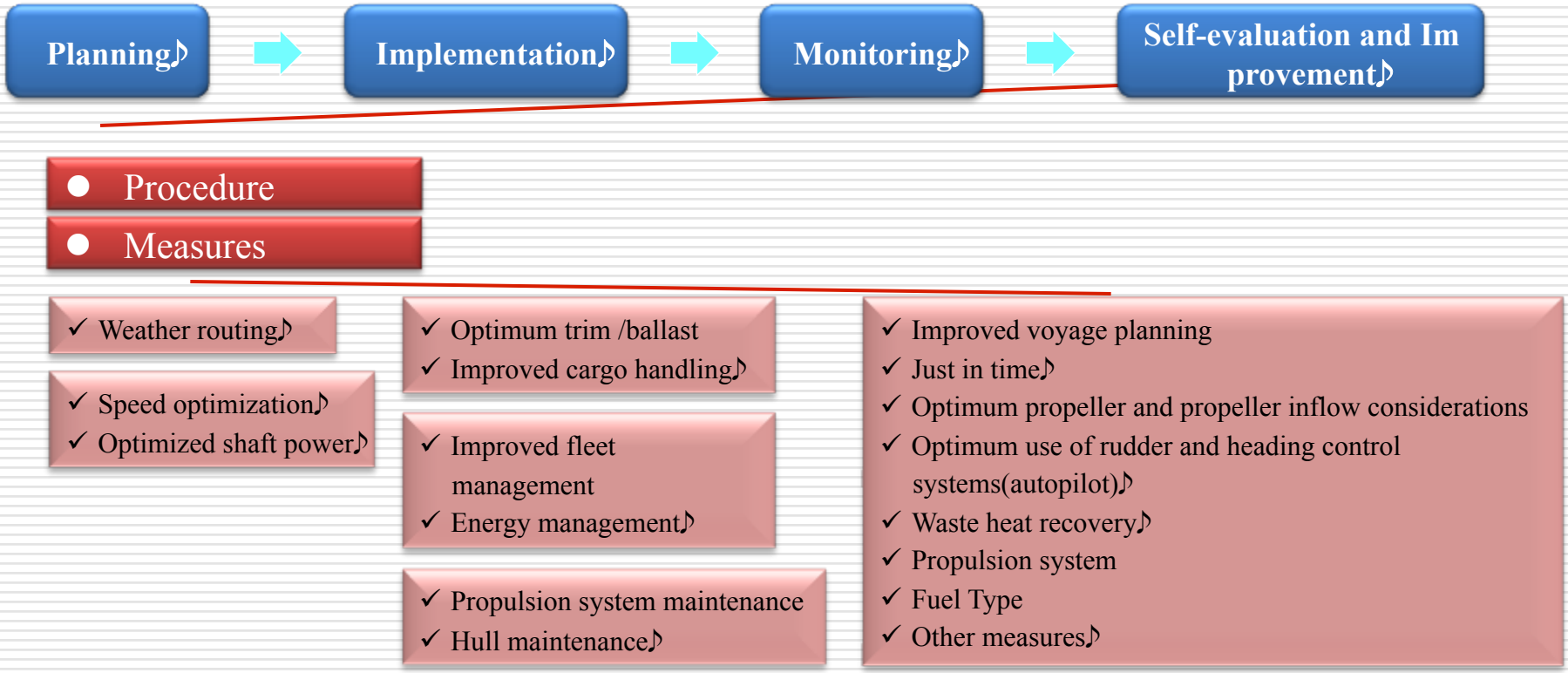
User manual, including methodological information
http://www.unece.org/trans/forfits_user_manual.html

ESCAP recent and planned activities on Sustainable Transport

- Expert Meeting on Policy options for Sustainable transport development, November 2013
  - Maritime sector- technology, efficiency
- Workshops on emissions measurement and mitigation policies, September 2013
- Regional/National Workshops on sustainable and inclusive transport development, 2014-15

Ship Energy Efficiency Management Plan (SEEMP)

- IMO SEEMP GUIDELINES (MEPC 213(63), 2012) entered into force on 1 January 2013.
- IMO leads CO2 emission reduction through voluntary effort of ship company.



Mitigation policy options

- Reduction of GHG emissions from ocean-going shipping
- Reduction of GHG emissions from port operations and development
- Reduction of GHG emissions from hinterland transport
- Enhancement of the use renewable energy
- Development and auditing of CO2 inventories

(Acknowledgment: Pierpaolo Cazzola & Miquel Gangonells, UNECE)

Thank you

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