MRV Transport Sector

matching transport with carbon finance

Dr. Jürg M. Grütter
jgruetter@gmail.com
www.transport-ghg.com
Outline

- Why monitor
- General principles
- Approaches to monitoring transport
- Activity based indicator set
- Project based versus sector-based monitoring
- Links to NAMAs
- Organisational structure
- Steps forward
Why Monitor

- Transport activity related data is needed to:
  - Evaluate, assess and improve policies and strategies in the transport sector
  - Improve planning of transportation measures
  - Realize more realistic and accurate projections of the transportation sector
  - Improve usage of resources as these can be targeted to measures with a high impact and cost-effectiveness
  - Gain better access to carbon finance

- What we measure we can assess and improve...
- With data we will know if the transport sector is on track towards a more sustainable system
Measure move towards sustainable transport....

Inter-urban India 2013

Urban, Wuhan/China 2013
Propose and monitor targets...

Baseline 2013 motorized mode split in % of pkm for airport Wuhan/China 2012

- Car: 59%
- Taxi: 27%
- Bus: 14%
- Metro: 37%
- HSR: 8%

Target 2040

- Car: 20%
- Taxi: 18%
- Bus: 17%
- Metro: 37%
- HSR: 8%
Compare and improve....

Mode share Swiss cities 2012 in % of PKM

white: car; red: PUT; grey: NMT

GHG WTW emissions of buses in gCO2/km in Zhengzhou, China, 2013

Hybrid CNG 12m 769
Hybrid Diesel 12m 794
CNG 12m 946
Diesel 12m 1,075
Hybrid Diesel 18m 1,180
Diesel 18m 1,788
Principles

- Objective, transparent, replicable
- Consistent
- Relevant
- Reliable, robust, accurate, measurable
- Available, accessible
- Cost-effective
Approaches

- Top-down: fuel/energy consumption
- Bottom-up: activity based approach
Top-Down Approach

- Based on fuel consumption
- IPCC guidelines; used for GHG inventory
- Usefulness limited as not linked to sub sectors (e.g. freight, urban) nor actions or strategies; influenced by many external factors (e.g. GDP growth, population growth, fuel prices etc)
- Reliability limited as fuels used in transport sector are also used in other areas:
  - Gasoline: OK; basically passenger transport
  - Diesel: usage also industry, agriculture, energy production; used both in freight as well as pax transport
  - Gaseous fuels: usage also in households, industry (especially LPG difficult to separate); freight as well as pax transport
  - Electricity: not related to transport in general in statistics but to the energy sector; however rail, metro and increasingly road vehicles (incl. hybrids) use electricity
- However top down data is useful for plausibility check of some bottom-up data
Bottom-Up

- Activity related
- The ASIF framework can be used (Activity; Structure/mode share; Intensity; Fuel mix)
- Can quantify transport impacts and relate them to policies and strategies
What to Monitor

Passenger                           Freight

Urban                                 Inter-

Why separations:

- Different actors and stakeholders
- Different actions, strategies, policies
- Different indicators and measurement approaches
- However some overlap e.g. fuel policies, vehicle certification
General Indicators

- Vehicle registration; core aspects
  - Vehicle classes (e.g. small, medium large bus; truck categories)
  - Fuel types (take care of conversions e.g. CNG)
  - Age
  - Emission standard
  - Discard vehicles not used anymore
  - Best annual based on e.g. tax

- Fuels
  - Fuel quantities (gasoline, diesel, gaseous, electricity)
  - Biofuels (types and blending %)

- Emission factors of fuels:
  - for CO₂ based on NCV and EF₉₀₂
  - for CH₄ based on vehicle technology (only for gaseous vehicles relevant)
  - N₂O not relevant
  - Can be based on IPCC defaults
Freight Core Indicators General

- Overall indicator: emissions per tkm
- Ton kilometer: 1 tkm = 1 ton moved 1 km
- Levels
  - Activity: tkm
  - Emissions: gCO₂/tkm
Freight Core Indicators Elements

- Activity level (tkm) per mode: road, rail, ship, air, pipeline:
  - Rail, ship, air, pipeline: Stats on tons and average trip length: relatively easy available as centralized
  - Road:
    - Many actors (logistics companies, «truckers», industrial and commercial companies with property fleets)
    - Basically required:
      1. Average load factor
      2. Distance travelled by vehicles
      3. Number of trucks per category with average carrying capacity
    - Sources are surveys, on-road measurements, on-board instrumentation

- Emission factor per mode: requires SFC per mode; sources are company reports, official stats, sample measurements, default values
Passenger Transport Indicators General

- Overall indicator: emissions per person and per pkm
- Levels
  - Inhabitants
  - Activity: pkm
  - Emissions: gCO₂/pkm
- Avoidance is monitored (at least for urban)
- Separation in urban and inter-urban (different EF, actors, policies, measurement approaches)
Passenger Core Indicators Inter-Urban

- Activity level (pkm) per mode: road, rail, air, (ship):
  - Rail, air, (ship): Stats on passengers and average trip length: relatively easy available as centralized
  - Road various modes: bus, car (main)
    - Basically required: Average occupation rates, distance travelled and number of units per mode OR average trip distance of passenger (not vehicle) and nu. of passengers per mode
    - Sources are company data (bus companies), surveys, on-road sample measurements

- Emission factor per mode: requires SFC per mode for inter-urban traffic; sources are company reports, official stats, sample measurements, default values
Passenger Transport Urban Indicators I

- **3 levels**
  - Emissions per vehicle per mode (CO$_2$ per km)
  - Emissions per trip (CO$_2$ per pkm)
  - Emissions per person (CO$_2$ per inhabitant)

- **Emissions per vehicle (CO$_2$ per km)**
  - Measures vehicle efficiency (specific per mode) and total vehicle emissions (absolute)
  - Typical modes: buses (potentially sub-categories), taxis, motorcycles, 3-wheelers, private cars, rail-based transport (metro, LRT, (sub)urban rail, tram)
  - Requires information on SFC per mode per fuel type
  - For absolute numbers you require also:
    - Number of vehicles per mode
    - Annual average distance driven per mode
    - or absolute fuel usage per mode (e.g. rail, eventually Public Transit)
  - Sources are sample measurements, on-board equipment, company information (e.g. taxis, buses, rail), defaults
Passenger Transport Urban Indicators II

- **Emissions per trip (CO\(_2\) per pkm)**
  - Measures trip efficiency and mode share
  - Include also NMT
  - Requires information on average occupation rate per mode, distance travelled per vehicle per mode and number of vehicles OR average trip distance of passenger per mode and number of passengers
  - Total pkm required to monitor mode share: beware mode share is reported based on number of trips and based on pkm
  - Sources are company data (bus companies), household and other surveys, on-road sample measurements

- **Emissions per person (CO\(_2\) per inhabitant)**
  - Measures system efficiency
  - Includes trips avoided or shorter trips
  - Requires benchmark / baseline
  - Is based on total pkm per motorized mode and emission factor per mode plus number of inhabitants
  - Source basically household surveys
Passenger Transport

- Performance Standard
  - Improve (vehicle efficiency)
    - gCO₂/km (high precision, low complexity)
- Public Transport
  - Shift (mode shift)
    - gCO₂/pkm (low precision, high complexity)
- NMT & TDM
  - Avoid (trips & trip length)
    - gCO₂ for transport per inhabitant (low precision, high complexity)
Activity Indicators

- Monitor Input and are important explanatory elements (cause-effect)
- Include financial inputs and physical inputs
- Real (ex-post) and not planned values
- Include for finance:
  - Investment in transport
  - Investment in rail and shipping
  - Investment in public urban transport
  - Investment in MRTS
  - Investment in NMT
- Include for physical:
  - Km built in MRTS (separate metro, LRT/tram and BRT)
  - Km built in inter urban rail separating HSR
  - Km built of separate bike lanes
  - These indicators are also listed in ISO 37120:2014 for sustainable development of communities
Sustainable Development Indicators

- Important for entire picture
- Core parameters:
  - Economic: time usage in transport (especially urban)
  - Social: transport fatality rate per mode per 1Mkm
  - Environment: air quality (impact on health i.e. social and economic and urban on buildings)
Project Vs Sectoral Monitoring

- Project monitoring is activity related and mainly singular
- CDM project based approach

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Project</th>
<th>Sectoral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Impact of singular activity is known</td>
<td>• Captures impact of strategy or policy</td>
</tr>
<tr>
<td></td>
<td>• Can be simpler to measure</td>
<td>• Includes synergy and leakage impacts</td>
</tr>
<tr>
<td></td>
<td>• Project budget available for monitoring</td>
<td>• Boundary establishment clear</td>
</tr>
<tr>
<td>Disadvantage</td>
<td>• Synergy / leakage effects difficult to capture</td>
<td>• Needs continuous and consistent monitoring</td>
</tr>
<tr>
<td></td>
<td>• Many external factors influence project</td>
<td>• Difficult to get financial resources</td>
</tr>
<tr>
<td></td>
<td>• ad-hoc monitoring</td>
<td></td>
</tr>
</tbody>
</table>
Links to NAMAs

- NAMAs can be individual projects: the core idea is however transformational changes towards a green growth society which implies sectoral and structural changes.
- MR for NAMAs thus more apt on a sectoral level to capture the impact of a policy or strategy.
- NAMAs can be used to build up and finance a monitoring structure if NAMAs are not too narrow and too activity/project focused.
Organisational Structure

- Various institutions involved:
  - Ministry of transport
  - Ministry of energy / fuels
  - Ministry of environment
  - Statistical department
  - Urban development
  - Rail/shipping/air authorities
  - Universities, research institutions, private enterprise
- Main however or coordination: Transport Ministry
- At City level transport authority
Steps Forward

- Assess status quo: Make a complete list of all transport data collected in a regular and official form (data parameter, frequency, organisation in charge, consistency, data quality)
- Agree upon core indicators to be monitored
- Make a step-by-step approach e.g. focus first on urban passenger transport
- Use NAMAs as vehicles to kick-start financing of MRV
## Summary Indicators

<table>
<thead>
<tr>
<th>ID</th>
<th>Area</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overall</td>
<td>Vehicle registration data</td>
</tr>
<tr>
<td>2</td>
<td>Overall</td>
<td>Total fuel consumption per fuel type</td>
</tr>
<tr>
<td>3</td>
<td>Overall</td>
<td>Biofuel content</td>
</tr>
<tr>
<td>4</td>
<td>Overall</td>
<td>Specific fuel consumption per mode</td>
</tr>
<tr>
<td>5</td>
<td>Overall</td>
<td>Carbon emission factor per fuel</td>
</tr>
<tr>
<td>6</td>
<td>Overall</td>
<td>GDP, population data</td>
</tr>
<tr>
<td>7</td>
<td>Overall</td>
<td>Transport fatality rate per mode</td>
</tr>
<tr>
<td>8</td>
<td>Freight</td>
<td>Tkm per mode → is sum of various other indicators incl. average load, tons of freight, average load factor, distance driven of trucks</td>
</tr>
<tr>
<td>9</td>
<td>Passenger inter-urban</td>
<td>Pkm per mode inter-urban → is sum of various other indicators incl. average trip length, number of passengers, average occupation rate, distance driven of cars and buses</td>
</tr>
<tr>
<td>10</td>
<td>Passenger urban</td>
<td>Pkm per mode urban → is sum of various other indicators incl. average trip length, number of passengers, average occupation rate, distance driven of various modes</td>
</tr>
<tr>
<td>11</td>
<td>Passenger urban</td>
<td>Emissions per inhabitant → is sum of various other indicators incl. average trip length per mode and emission per mode per km</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Air quality</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Time used in transport</td>
</tr>
</tbody>
</table>