Energy efficiency policies for transport

John Dulac and Francois Cuenot
International Energy Agency
Paris, 9 April 2013
Content

1. Scene setting

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3. Transport data collection
Transport scene-setting

- Why transport policies?
- Role of transport in energy consumption
- Understanding drivers of demand
Why are transport policies needed?

- To reduce increasing energy demand
- To attenuate negative impacts
  - Damage to the environment
  - Health related issues (local pollutants / noise)
  - Injuries / fatalities
  - Economic loss (congestion / fuel / time / accidents)
- To (try to) provide equal access to mobility
  - Basic principle individuals should be able to move freely
  - Social equity
  - Access to employment and services
The 450 Scenario illustrates what the 2°C goal will require.

Holding GHG concentration to 450 ppm would limit temperature increase to 2°C, compared with 3.5°C in the New Policies Scenario & 6°C in the Current Policies Scenario.
Efficiency gains can contribute most to emissions reductions

World energy-related CO₂ emissions abatement in the 450 Scenario relative to the New Policies Scenario

Energy efficiency measures – driven by strong policy action across all sectors – account for 50% of the cumulative CO₂ abatement over the Outlook period

<table>
<thead>
<tr>
<th></th>
<th>Abatement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2020</td>
<td>2035</td>
</tr>
<tr>
<td>Efficiency</td>
<td>72%</td>
<td>44%</td>
</tr>
<tr>
<td>Renewables</td>
<td>17%</td>
<td>21%</td>
</tr>
<tr>
<td>Biofuels</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>CCS</td>
<td>3%</td>
<td>22%</td>
</tr>
<tr>
<td>Total (Gt CO₂)</td>
<td>2.5</td>
<td>14.8</td>
</tr>
</tbody>
</table>
Transport is currently the second largest source of energy-related emissions. In the 450 Scenario, transport becomes the largest source of energy-related emissions, as the power sector is largely decarbonised.
CO$_2$ emissions below 2000 levels

- Combining Avoid/Shift/Improve helps reaching 2DS objective
- Vehicle efficiency improvement key to success
L’addition s’il vous plaît

- Efficiency gains and alternative technologies bring huge fuel savings
- Avoid/Shift reduces vehicle and infrastructure bill
- Combined Improve/Avoid/Shift greatest savings
Why are transport policies needed?
Role of transport in energy consumption

World transport energy use by mode, 1971-2006
Global car sales: a new geography

Data: first semester, in volume (OICA – CCFA)
Oil demand is driven higher by soaring car ownership

Vehicles per 1,000 people in selected markets

The passenger vehicle fleet doubles to 1.7 billion in 2035; most cars are sold outside the OECD by 2020, making non-OECD policies key to global oil demand.
Transport scene-setting

Flash survey

• What is the major transport issue presently facing your country?

• How does it relate to transport energy use?

• Is transport a big consumer of energy (> 20%) in your country?
Understanding drivers of demand

• Two key parameters driving transport demand
  ▪ Travel Time Budget (TTB)
  ▪ Travel Money Budget (TMB)

• Rebound effects
  ▪ Demand increases as budget grows (or is substituted)
Policies for energy efficient transport

25
Energy Efficiency Recommendations across 7 Sectors

Worldwide Implementation Now
Transport policies

Transport

16 Mandatory vehicle fuel-efficiency standards
17 Measures to improve vehicle fuel efficiency
18 Fuel-efficient non-engine components
19 Eco-driving
20 Transport system efficiency
Transport policies

3 policy levers

**AVOID/REDUCE**

- Reduce or avoid travel or the need to travel
  - Integration of transport and land-use planning
  - Smart logistics concepts
  - …

**SHIFT**

- Shift to more environmentally friendly modes
  - Transport Demand Management
  - Mode shift to Non-Motorized Transport
  - Mode shift to Public Transport
  - …

**IMPROVE**

- Improve the energy efficiency of transport modes and vehicle technology
  - Low-friction lubricants
  - Optimal tire pressure
  - Low Rolling Resistance Tires
  - Speed limits Eco-Driving (Raising Awareness)
  - Shift to alternative fuels
  - …

Source: GTZ
Transport policies

Transport energy use

A. Avoid
   • Land use, urban design, telework

B. Shift
   • Low carbon transport modes

C. Improve
   • Efficient vehicles, technology
Avoid transport energy use

• The most energy efficient trip is the one that is not performed
  ▪ Land use planning
  ▪ Parking policy
  ▪ Urban design
Avoid - land use planning

- Land use shapes transport, which in turn shapes land use.
- Transport policy is, in part, land use policy

Photo source: www.uli.org
Avoid - land use planning

• A 10% increase in urban density reduces per capita travel vehicle kilometer by 1% - 3%

• Compact development policy:
  ▪ Population near employment
  ▪ Access and proximity to transit
  ▪ Mixed-use development
  ▪ Pedestrian, bicycle and transit-friendly design

Dongton Eco City: Town of three villages
Avoid - land use planning

Parking Policies – breaking the circle

- Cars are parked more than 90% of the time
- 3 parking spots for 1 car in the US
- From 15 m² to 40 m² per space

Source: Adapted from Litman (2008b).
Transport policies

GHG reduction through land use

Example: Carbon footprints (residential emissions only) in different neighborhoods in Toronto, Canada

- East York - 1.31 tCO2e/cap (residential only)
- Etobicoke - 6.62 tCO2e/cap (residential only)
- Whitby 13.02 tCO2e/cap (residential only)

High-density apartment complexes within walking distance to a shopping center and public transit:
1,31 tCO2e/capita

High-density single family homes close to the city center and accessible by public transit:
6,62 tCO2e/capita

Suburbs with large, low-density single family homes that are distant from commercial activity and public transit:
13,02 tCO2e/capita

Source: GTZ
## Transport policies

### Avoid - urban design

<table>
<thead>
<tr>
<th>Urban Design Factors Affecting Traffic Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (people and/or jobs)</td>
</tr>
<tr>
<td>Parking supply &amp; management</td>
</tr>
<tr>
<td>Land-use mix</td>
</tr>
<tr>
<td>Walking &amp; cycling conditions</td>
</tr>
<tr>
<td>Regional accessibility</td>
</tr>
<tr>
<td>Transit quality &amp; accessibility</td>
</tr>
<tr>
<td>Centeredness</td>
</tr>
<tr>
<td>Site design</td>
</tr>
<tr>
<td>Connectivity</td>
</tr>
<tr>
<td>Mobility management</td>
</tr>
<tr>
<td>Roadway design &amp; management</td>
</tr>
</tbody>
</table>
Transport policies

Avoid - telework (remote commuting)

• One-day telework per week can reduce commuting related vehicle travel by roughly 20%.

• Local regulations should not inhibit teleworking.

• Marginal cost of vehicle travel is high to justify telework.

• Enabling telecommunication infrastructure.
Transport policies

Avoid - review

• Building cities from scratch is not often possible

• Timeframe to alter urban design is usually very long
  ▪ Bigger effects to be seen in the long term

• Dense environments with good transit use less energy

• Energy and GHG savings potential enormous as lifestyle are altered for generations
Transport policies

Transport energy use

A. Avoid
   • Land use, urban design, telework

B. Shift
   • Low carbon transport modes

C. Improve
   • Efficient vehicles, technology
Shift transport energy use

- Aim is to use the most energy efficient mode
- Optimal mode depends on trip distance / location
Transport policies

Shift transport energy use

Figure 1.6  ▶ GHG efficiency of different modes, freight and passenger, 2005

Note: The clear line indicates world average, the bar representing MoMo regions’ discrepancy.
Sources: IEA Mobility Model database; Buhaug (2008).
Transport policies

Shift - emissions reduction

Baseline

BLUE Shifts

Mode share

Trip distance (km)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Plane

High speed rail

Train/bus

Personal cars

2-wheelers

Urban public transport

Bike

Walk
Shift - bus rapid transit (BRT)

- Bogota’s BRT a reference: 100+ systems in world today (cities in Columbia, Ecuador, China, India, Brazil....)

- Significant CO$_2$ reduction - 25% - 39% (IEA estimate).

- Advantages: improved fuel efficiency, higher speeds and less stop-and-go traffic on dedicated routes
Transport policies

Shift - rail

- HSR is ~15% more efficient than previous generation
- New high speed rail are built/planned in many countries
- Worldwide ~ 37 000 km of HSR tracks are under construction or planned (IEA, 2009)
Shift - car share (commuting)

- Requires users to be within convenient distance
- Participation in car sharing on average reduces car travel by 3,000 km/year
- By 2050 ~1% population in urban areas could use car-sharing
- Avoid 75 billion km vehicle travel and 12 million tCO$_2$
Shift - non-motorised transport (NMT)

Cycling:

- Infrastructure provisions: lanes, parking, traffic signals

- Funding / cycling mode relationship:
  - Amsterdam: US$ 39/resident, Cycling 35%,
  - USA: US$ 1.5/resident, Cycling 1%.

- Bicycle “sharing” (rental) services
- Viable alternative for short trips
- Best promoted for densely populated city centers
Transport policies

Shift - NMT

Walking:

- Pedestrian infrastructure, amenities and services are often neglected.

- Pedestrian friendly policies:
  - Safe sidewalks
  - Well marked, respected crossings
  - Car-free zones
  - Traffic calming measures

- Walkability Index: modal conflict, security from crime, crossing safety, motorist behavior, benches and street lighting, etc.
Transport policies

Shift - potential rebound effects

• Targeted users not necessarily the ones reached
  ▪ Shifts away from low-emission modes

• More traffic activity generated
  ▪ Distances rising due to reliable / faster alternative modes
Discussion

• Does your country have any experience with mode shifting?

• What barriers do you think exist to achieving significant mode share?

• What policies can you implement to achieve shifts to energy efficient modes?
Transport Energy Use

A. Avoid
   • Land use, urban design, tele-work

B. Shift
   • Low carbon transport modes

C. Improve
   • Efficient vehicles, technology
Improve transport energy use

- Technology efficiency policy
  - Standards
  - Alternative technology
  - Components

- Behavioural policy
  - Promotion & awareness
  - Incentives for cleaner vehicles

Photo source: Schipper et al. 2010
Transport policies

Improve - IEA recommendations

5.1 Fuel-efficient tyres
- Labelling on tyre rolling resistance
- Tyre pressure monitoring systems (TPMS)

5.2 Fuel efficiency standards for light-duty vehicles

5.3 Fuel efficiency standards for heavy-duty vehicles

5.4 Eco-driving
- Driver training
- In-car feedback instruments
Transport policies

Improve - other policy measures

• Fuel switching
• Electric vehicles
• Pricing, subsidies and incentives
Transport policies

Improve - fuel switching

Energy density of batteries and liquid fuels

- Lithium batteries
- Top performing batteries
- Methanol
- Hydrogen (70 Mpa)
- Butanol
- Ethanol
- Hydrogen (35 Mpa)
- Diesel fuel
- Gasoline
- LPG
- CNG (20 Mpa)
Transport policies

Improve - electric vehicles

- EVs more efficient, but be careful of electricity mix
- Will not solve traffic and other transport issues

![Graph showing average new vehicle GHG emissions (g CO₂-eq/km) for different vehicle types and years.](Image)

- **Gasoline**
- **Gasoline hybrid**
- **Plug-in hybrid gasoline**
- **Diesel**
- **Diesel hybrid**
- **Plug-in hybrid diesel**
- **Electric vehicle**
Transport policies

Improve – emissions savings from biofuels

• GHG life-cycle impact of fuels to consider:
  ▪ Production, transport, storage, use

• For bio-fuels consider GHG associated with production of fertilizer, use of machines, need for irrigation
Transport policies

Improve - potential rebound effects

• As cars become more efficient, mileage is rising
  ▪ Cost of use should rise accordingly

• High up-front costs may lead to willingness to use vehicles, no matter the cost of use

• Technological answers have to be implemented with accompanying measures to counter balance negative effects
Transport policies

Improve - fuel pricing

• Fuel prices strongly influence “driving culture”
  ▪ Countries with higher fuel prices drive smaller cars and less

• Fuel subsidies skew market and are inequitable

Source: Gallagher, 2010
Transport policies

Improve – road pricing

• Stockholm congestion charge
  ▪ Trial 1\textsuperscript{st} Jan – 31\textsuperscript{st} July 2006
  ▪ Charge differed by time-of-day (€1.10, €1.60, €2.20) and levied on inward and outward journeys
  ▪ Many exemptions (ecovehicles, taxis, public transport)
  ▪ Increase in public transport services (7\%) 4 months before start
  ▪ Attitudes changed during trial

• London congestion charge Feb 2003-present
  ▪ Congestion down 25\% from pre-charge
Transport policies

Improve - taxes and incentives

- CO₂-differentiated purchase, registration and ownership fees, annual circulation (mileage) tax
- Scrappage schemes, feebeates
- Special tax credits for hybrid or electric vehicles

<table>
<thead>
<tr>
<th>Country</th>
<th>Registration tax</th>
<th>Ownership tax</th>
<th>other tax incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>based on cc + age Based on CO₂ emissions in Wallonia</td>
<td>Based cylinder capacity</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>N.A</td>
<td>Based on fuel consumption and weight</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>N.A</td>
<td>Based CO₂ emissions (since 2009)</td>
<td>Scrappage programme</td>
</tr>
<tr>
<td>Spain</td>
<td>based on CO₂ emissions (changed in 2008)</td>
<td>N.A</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>based on CO₂ emissions</td>
<td>N.A</td>
<td>Bonus malus scheme introduced in 2008</td>
</tr>
<tr>
<td>Ireland</td>
<td>based on CO₂ emissions (changed in 2008)</td>
<td>Based CO₂ emissions</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>based on price and CO₂ emissions. Since 2006</td>
<td>Based on weight, province</td>
<td></td>
</tr>
<tr>
<td>Norway</td>
<td>N.A</td>
<td>purchase tax based on CO₂ emissions, Changed in 2006</td>
<td>CO₂ tax and fuel tax</td>
</tr>
<tr>
<td>Portugal</td>
<td>based on cc + CO₂ emissions</td>
<td>Based on cylinder capacity and CO₂ emissions</td>
<td></td>
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<tr>
<td>Sweden</td>
<td>N.A</td>
<td>Based on CO₂ emissions and weight</td>
<td>eco car subsidy</td>
</tr>
<tr>
<td>UK</td>
<td>N.A</td>
<td>Based on CO₂ emissions and cylinder capacity</td>
<td>Vehicle excise duty based on CO₂ emissions (since 2009)</td>
</tr>
<tr>
<td>Japan</td>
<td>reduced registration tax for fuel efficient cars (since 2001)</td>
<td>N.A</td>
<td>subsidies for efficient cars</td>
</tr>
</tbody>
</table>
Transport policies

Improve - CO₂ pricing effect

Change in sales by CO₂ classes (5 main EU markets) (Source AAA – Renault)
Transport policies

Avoid-Shift-Improve

Designing transport for livability and efficiency

Source: NYC DOT
Transport policies

Avoid-Shift-Improve

Designing transport for livability and efficiency

Source: NYC DOT
Transport policies

Avoid-Shift-Improve: Q&A

AVOID unnecessary trips
REDUCE km

SHIFT modes

IMPROVE vehicles
low carbon fuels

Source: GTZ
Transport policies

More information:

john.dulac@iea.org
francois.cuenot@iea.org
PART 2: Transport data and Indicators

Francois Cuenot

Energy Technology Perspectives
To cover today

1. **Data and indicators**
2. **How do we collect and analyse these?**
3. **Exercise and group discussion**
4. **Conclusions**
## Basic Indicators

<table>
<thead>
<tr>
<th>Energy Data</th>
<th>Activity Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Energy consumption (by fuel and vehicle type)</td>
<td></td>
</tr>
<tr>
<td>➢ LDV</td>
<td></td>
</tr>
<tr>
<td>➢ 2/3-wheelers</td>
<td></td>
</tr>
<tr>
<td>➢ Trucks</td>
<td></td>
</tr>
<tr>
<td>➢ SUVs</td>
<td></td>
</tr>
<tr>
<td>➢ Aviation</td>
<td></td>
</tr>
<tr>
<td>➢ Buses</td>
<td></td>
</tr>
<tr>
<td>➢ Trains</td>
<td></td>
</tr>
<tr>
<td>• Total number of vehicles by mode</td>
<td></td>
</tr>
<tr>
<td>• Total population</td>
<td></td>
</tr>
<tr>
<td>• Passenger-kilometers by mode</td>
<td></td>
</tr>
<tr>
<td>• Tonne-kilometers by mode</td>
<td></td>
</tr>
<tr>
<td>• Annual driving distance per vehicle</td>
<td></td>
</tr>
<tr>
<td>• Average passenger/freight load factor</td>
<td></td>
</tr>
</tbody>
</table>
## Supplementary Indicators

<table>
<thead>
<tr>
<th>Energy Data</th>
<th>Activity Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Specific fuel consumption of new cars (test value)</td>
<td>• Vehicle size, weight, power</td>
</tr>
<tr>
<td>• Fuel consumption by vehicle size (weight and power)</td>
<td>• Travel activity (km) by mode and time</td>
</tr>
<tr>
<td>• Energy consumption relative to driving pattern</td>
<td>• Travel vs. trip shares</td>
</tr>
<tr>
<td></td>
<td>• Travel activity and cost</td>
</tr>
</tbody>
</table>
Efficiency Indicators

- Energy efficiency of the transport sector is the amount of energy spent per unit of distance traveled
  - For passenger mobility: Joules per pass.km
  - For freight travel: Joules per ton.km
Link between Energy use and Traffic activity

- Vehicle’s fuel consumption allows to check that energy use and Traffic activity match each other
- Load factor links total passenger kilometres to vehicle kilometres (or freight tonne-kms to truck kms)
Energy Use

- Fuel importers
- Refineries
- Fuel station survey

Fuel volumes (litres)

Fuel consumption (l/100km)

Traffic Activity (veh.km)

Vehicle Numbers

Load Factor

Traffic Activity (p.km and t.km)

Survey Calculation

- Traffic counting
- Odometer reading (km per vehicle)
THE ASIF FRAMEWORK (by Lee Schipper)

Fuel Use and Emissions from Transport

\[ A \times S_i \times I_i \times F_{i,j} \]

- Load Factors – service levels, security, speed, etc
- Income, relative transport costs, speeds and service levels, etc
- Technological energy efficiency
- Vehicle characteristics – incomes, new vehicle taxation, fuel taxation, culture
- From surveys, not from new-vehicle tests
- Traffic controls, enforcement of speeding laws, CP and other means to reduce congestion
- Income, urban form, overall speed
- Energy Use per passenger km
- For Carbon – relative fuel prices, carbon taxes, low carbon fuel standards
To cover today

1. Data and indicators
2. How do we collect and analyse data?
3. Conclusions
How to Collect the Data?

There are four methods used to collect energy and activity data:

- Surveying
- Modeling
- Measuring/Metering
- Administrative Sources
Data collection via surveys

**Surveying**

- Data collection via direct observation or questionnaires regarding travel activities, energy use, etc.
- Can be labour intensive, require large sample sizes, etc.
- Tends to provide estimates, not hard data
- Can provide very rich data, useful to understand variations, correlations, and other aspects of the sample

**Examples:**

- National travel survey
- Survey of fleets, trucking companies
- Household surveys, focus groups
- Observational (e.g. roadside) surveys
GPS survey in Cincinnati

- Now some survey has performed entirely using GPS
- In the US
- In Australia

- Removes the barrier between stated behaviour and real behaviour
Survey Design- GPS Capabilities

- Personal GPS units so that all travel, not just vehicle trips, are recorded. Can be carried in a pocket or purse, or clipped on a belt or a wrist band.

- Goal of recording three days of travel.

- Every member of the household 13 years and older carries a GPS unit for three days.

- The GPS devices will be deployed over a one year time period beginning in July of 2009.
Prompted Recall Web Format

Household Travel Survey

Monday, November 05, 2007

12:00 AM - 8:37 AM At Home
9:57 AM - 9:00 AM Driver of Auto/Truck
9:30 AM - 9:03 AM Pick-Up / Drop Off Pe...
9:03 AM - 9:07 AM Driver of Auto/Truck...
9:07 AM - 9:19 AM Shop
9:10 AM - 9:43 AM Driver of Auto/Truck...

Start Time
9:10 AM
End Time
9:43 AM
Travel Time
3:33
Distance
11.2 miles
Speed
20.4 mph
Means of Travel
Driver of Auto/Truck
Companions
None
Travel Cost Including Parking
$ 0.00

Travel Event
Click here to show/hide this travel detail.

If there is any question mark in the detail list, please fill in the missing detail.

Please check on HELP to get more information about this survey. When you finish the modification on the daily travel list, please click on SUBMIT.

Questions or problems? Please call toll-free 1-877-284-7979 or email survey@okt.org

OKI

© OECD/IEA 2011
Wednesday, February 11, 2009

The map on the right displays one of your travel events corresponding to the details below. You need to:
- Click on each red question mark to update that detail.
- Click on each orange item to either confirm or update that detail.

You can also insert missing stops and/or delete stops that are not correct. After each red and orange item is updated, it will turn green. After all the red and orange items become green, you will see a continue link at the bottom of the page.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity/Stop Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:45 PM -&gt; 4:47 PM</td>
<td>Stay on &quot;D&quot;</td>
</tr>
<tr>
<td>Activity that describes what you were doing? ?</td>
<td></td>
</tr>
<tr>
<td>4:47 PM -&gt; 5:02 PM</td>
<td>&quot;D&quot; -&gt; &quot;E&quot;</td>
</tr>
<tr>
<td>What means of travel did you use? ?</td>
<td></td>
</tr>
<tr>
<td>Which of the following household members traveled with you to the next place? ?</td>
<td></td>
</tr>
<tr>
<td>Is there a stop missing during this travel? If yes, please insert a stop by clicking Insert. Insert A Stop</td>
<td></td>
</tr>
<tr>
<td>5:02 PM -&gt; 6:20 PM</td>
<td>Stay on &quot;E&quot;</td>
</tr>
<tr>
<td>If it was not a real stop, please delete this stop by clicking Delete. Delete This Stop</td>
<td></td>
</tr>
<tr>
<td>6:20 PM -&gt; 6:33 PM</td>
<td>&quot;E&quot; -&gt; Other Place</td>
</tr>
</tbody>
</table>

You may return to this travel at any time by clicking on the green numbered circle above.
Data collection via modeling

- Modelling
  - Not really collection – but estimation work
  - Can involve a number of techniques, and can sometimes be very reliable
    - Interpolation
    - Elimination of degrees of freedom
    - Statistical analysis
    - Optimization (for normative purposes)
    - Neural networks
  - Virtually all projections generate “data” that are really estimates via modelling
Implementation for learning phase

NODBOX BB3A+ hardware installed in the buses to record CAN data

Real time embedded measurement of all pollutants in parallel of CAN data
Neural network learning phase

- Exhaustive Dataset
  - CAN data = input
  - Pollutants = output

Correlation Analysis

Representative Dataset

Learning Phase

- Neural network architecture choice

Test & Validation

- High accuracy, even on cold-start phases
- Capable to generalize CO2 & pollutant prediction with reliability even on non-learned inputs
Restitution in Google Earth

Bus = EIV 770 EGF 78
Jour = 6/8/2009
Heure = 5h26m58s
Vitesse = 30.41 km/h
Conso inst = 53.17 L/100km (16.17 L/h)
CO = 5.93 g/km (0.0501 g/s)
CO2 = 1408.89 g/km (11.9005 g/s)
THC = 0.25 g/km (0.0021 g/s)
NOx = 25.32 g/km (0.2139 g/s)

Itinéraire: Vers ce lieu - À partir de ce lieu
Data collection via measuring / metering

Measuring / Metering

- Direct observation, usually of a physical phenomenon
- Can use existing metering systems or involve creating new ones
  - Roadside car counters
  - Vehicle fuel economy testing
  - Car fuel economy computers (in use performance)
  - Tailpipe emissions detection systems
  - Speed detection systems
  - Atmospheric concentration metering
- Typically reliable but often expensive
  - Sample size and data processing requirements will affect this
- Can deliver only certain types of information
Fuel economy measurement

- Vehicles are tested on similar test cycles within a given country.

![Graph showing fuel economy measurements over time with city cycle and highway cycle marked.]
**Figure 1** - Vehicle test diagram, displaying collection points for aldehyde and carbonic gas samples.
Administrative Sources

- Secondary approach: makes use of existing information and data, e.g.:
  - National annual energy consumption in the transport sector
  - National energy use and activity statistics
  - Vehicle characteristics (by size/fuel) activity
  - Activity patterns: mode share, travel, trip, fuel content, fuel consumption, travel patterns

- Great way to get comprehensive, often official data, however:
  - Collection methodology (and data quality) sometimes unclear
  - Comparisons between providers may be difficult
Administrative sources

Sources typically used for the administrative data

- Government statistical office
- Manufacturers
- National or international associations and organizations
- Energy companies
- Others
Best practices in Transport data gathering
Best Practices - Highlights

- Yearly update
- All data publically available
- Comprehensive time series available
- Detailed information on modes, by fuel type
- Scrappage functions
- Used import info (NZ)
- Vehicle technical information
- Regional details
## Ideal Data requirement vs Data availability: Russian Example

<table>
<thead>
<tr>
<th>Data need to develop indicators</th>
<th>IEA countries coverage</th>
<th>Data available from Russia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy consumption by:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Energy source</td>
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</tr>
<tr>
<td>- Transportation mode</td>
<td>21</td>
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</tr>
<tr>
<td>- Cars, SUV and personal light trucks</td>
<td>22</td>
<td>No</td>
</tr>
<tr>
<td>- Motorcycles and three-wheelers</td>
<td>10</td>
<td>No</td>
</tr>
<tr>
<td>- Buses</td>
<td>22</td>
<td>No</td>
</tr>
<tr>
<td>- Passenger train</td>
<td>24</td>
<td>No</td>
</tr>
<tr>
<td>- Domestic passenger airplane</td>
<td>23</td>
<td>No</td>
</tr>
<tr>
<td>- Domestic passenger ships</td>
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<td>No</td>
</tr>
<tr>
<td><strong>Passenger-kilometres by:</strong></td>
<td>20</td>
<td>?</td>
</tr>
<tr>
<td>- Cars, SUV and personal light trucks</td>
<td>26</td>
<td>No</td>
</tr>
<tr>
<td>- Motorcycles and three-wheelers</td>
<td>6</td>
<td>No</td>
</tr>
<tr>
<td>- Buses</td>
<td>23</td>
<td>YES</td>
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</tbody>
</table>
## Ideal Data requirement vs Data availability in Russia

### Data need to develop indicators

<table>
<thead>
<tr>
<th>Vehicle Kilometres by:</th>
<th>IEA countries coverage</th>
<th>Data available from Russia</th>
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<tbody>
<tr>
<td>o Cars, SUV and personal light trucks</td>
<td>23</td>
<td>No</td>
</tr>
<tr>
<td>o Motorcycles and three-wheelers</td>
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<td>No</td>
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<tr>
<td>o Buses</td>
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<tr>
<td>o Domestic passenger airplane</td>
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<td>No</td>
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<tr>
<td>o Domestic passenger ships</td>
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<td>No</td>
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### Vehicle stocks by:

<table>
<thead>
<tr>
<th></th>
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<th>Data available from Russia</th>
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<tbody>
<tr>
<td>o Cars, SUV and personal light trucks</td>
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<td>No</td>
</tr>
<tr>
<td>o Motorcycles and three-wheelers</td>
<td>24</td>
<td>Yes From MVD</td>
</tr>
<tr>
<td>o Buses</td>
<td>25</td>
<td>YES</td>
</tr>
</tbody>
</table>
Mexico Example - Methodology

- 5 min Questionnaire at fuel stations

**MILEAGE**
- Vehicle Type
- Vehicle Age
- Total Mileage
- Driving time per day
- Km/day estimated

**PASSENGERS**
- Vehicle Type
- Vehicle Model
- Passengers on board
- Stated average occupancy
- Estimated average occupancy

**TONS**
- Vehicle Type
- Vehicle Model
- Load on board
- Stated average load
- Estimated average load
MUESTRA DEL ESTUDIO DE TRANSPORTE 2010
Mexico

4 month from start to finish

Survey cost: aprox 60kEur
Improving Data collection

- More accurate mileage data
  - Odometer reading during vehicle inspection?

- Using diaries or follow-up to get:
  - Other modes trips information
  - Fuel consumption
  - distance by mode
  - Travel patterns

- GPS tracking
Conclusion

- A wide set of data is necessary to have accurate transport energy efficiency indicators
- Cross checking is possible with vehicle fuel efficiency: this is a key variable to get
- First estimates are possible with little investment
- No point in implementing Transport Policy without a good set of indicators to assess the efficiency