Towards the decarbonisation of the transport sector by 2050

Backcasting policies for climate friendly transport

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European Commission
Presentation overview

- Context
- Overview of project
- Some findings & scenarios
- Conclusions
Context

- **EU objective of maximum 2 degree increase**
- **Low Carbon Economy Roadmap**
  - Adopted March 8th
  - Foresees 50-70% GHG reduction from transport
- **Transport White Paper**
  - Adopted March 28th
  - Strategy aiming at 60% reduction in transport GHG by 2050
“EU Transport GHG: Routes to 2050?”

Goals of project

- Carried out in 2009-10
- Begin to consider long-term GHG policy framework for transport in context of need to reduce overall emissions
- Medium to longer-term (2020 to 2050) i.e. moving beyond short-term policy measures
- Identify what we know about reducing transport’s GHG emissions and what we do not
- Identify by when we need to take action and what that should be
- Qualitative and quantitative approach (necessarily given timeframe)
- Engage transport and other stakeholders in discussing what transport might have to deliver in terms of GHG emissions reductions to 2050
- Covered all modes but main focus on road
Projected BAU-a GHG emissions by mode

**Total Combined (life cycle) GHG emissions**

- **FreightRail**
- **MaritimeShipping**
- **InlandShipping**
- **HeavyTruck**
- **MedTruck**
- **Van**
- **WalkCycle**
- **Motorcycle**
- **PassengerRail**
- **IntlAviation**
- **EUAviation**
- **Bus**
- **Car**
- **BAU-a total**

**Source: SULTAN BAU Scenario, April 2010**
“EU Transport GHG: Routes to 2050?”
Options to reduce transport GHG emissions...

GHG emissions reductions in transport

- Decarbonise transport energy
- Make vehicles more energy/GHG efficient
- Efficient use of vehicles, e.g. co-modality
- Efficiency of system

17 Technical project papers and reports covering a range of topic areas
**EU Transport GHG: Routes to 2050?**

**Part 1 - Assess current knowledge**

- **Options:**
  - Inventory and assessment by mode of the technical and non-technical actions that can be taken to reduce GHG emissions.
  - Identification of likely scale of emission reduction

- **Policies:**
  - Assessment of potential policy instruments for stimulating uptake of these options
  - Issues, risks and limitations associated with these options and instruments

- **Other influences:**
  - Energy security: understand impact of options
  - Other sectors impact on transport demand
  - Factors limiting uptake of options
  - Other studies: identify assumptions re options and policy instruments
  - Potential technological game-changers
"EU Transport GHG: Routes to 2050?"
High level findings – technical options

- Potential technical improvements to existing technologies for all modes
- Up to 50% lower energy consumption per unit transport (compared to current new vehicles) by 2050 from e.g.:
  - Electrification of drivetrains, recovery of energy
  - Improved aerodynamics, lighter vehicles
- Reduction potential from changes to fuels/energy:
  - Electrification of powertrains
    - Fully electric vehicles for (short-distance) road vehicles and trains
    - Hybridisation of vehicles on other road applications
  - Biofuels (in longer-term) for long distance road freight, aviation, inland waterways?
  - Fuel cells/hydrogen: Specialised road (fleets, urban buses) and rail applications
  - Wind and Liquefied Natural Gas for maritime ships
**Table 7: GHG emissions reduction potential of the technical inland shipping options**

<table>
<thead>
<tr>
<th>Technical option</th>
<th>Current reduction potential on ship level where applicable</th>
<th>Current payback time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Powertrain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More efficient engines</td>
<td>15 – 20%</td>
<td>&gt; 10 years</td>
</tr>
<tr>
<td>Diesel-electric propulsion</td>
<td>10%</td>
<td>&gt; 10 years</td>
</tr>
<tr>
<td><strong>Reduction of required propulsion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Larger units (economy of scale)</td>
<td>Up to 75% depending on difference in scale</td>
<td>No general conclusion possible</td>
</tr>
<tr>
<td>Improved propeller systems</td>
<td>20 – 30%</td>
<td>Short payback time</td>
</tr>
<tr>
<td>Improved hull design</td>
<td>10 – 20%</td>
<td>Short payback time</td>
</tr>
<tr>
<td>Computer assisted trip planning and speed management</td>
<td>5 – 10%</td>
<td>&lt; 1 year</td>
</tr>
<tr>
<td>Lightweight hulls</td>
<td>5-15%</td>
<td>&gt; 10 years (experimental)</td>
</tr>
<tr>
<td>Air lubrication</td>
<td>10%</td>
<td>Unknown (experimental)</td>
</tr>
<tr>
<td>Whale tail/experimental propulsion systems</td>
<td>25%</td>
<td>Unknown (experimental)</td>
</tr>
</tbody>
</table>
“EU Transport GHG: Routes to 2050?”
High level findings – non technical options

- Similar non-technical options applicable across modes
- Optimisation of speeds and routes:
  - Speeds: Limits and enforcement
  - Eco-driving/improved driving behaviour - 10% (short-term)?
  - Routes: Voyage optimisation, air traffic management
- Improved maintenance and vehicle optimisation
- Optimised utilisation of freight and passenger transport
- Co-modality/modal shift – GHG benefits depend on:
  - Difference in carbon intensity of the modes concerned; and
  - Potential volumes/passenger that can be shifted
- Improved structure and planning of transport system
- Mobility management and system efficiency measures
- Potential role of Intelligent Transport Systems
- Reduction potential highly dependent on specific circumstances, e.g. products being transported
"EU Transport GHG: Routes to 2050?"
IWW – non technical options

- **Speed optimisation**
  - Strongly dependent on fuel pricing or possible CO₂ instrument
- **Improved maintenance**
  - Limited information – possibly 3-5% per component
- **Just –in time routing**
  - Likely to be limited in practice
“EU Transport GHG: Routes to 2050?”

High level findings – policy instruments

- **Similar policy instruments applicable across modes**
- **Regulation to set standards, e.g.**
  - Vehicle fuel efficiency/CO₂ emissions;
  - Fuel carbon intensity.
- **Economic instruments to, e.g.:**
  - Increase the cost of use
  - Incentivise different patterns of purchase or use
  - Removal of subsidies and perverse incentives
- **Spatial planning/infrastructure provision to:**
  - Minimise need for travel
  - Enable use of least carbon intensive modes
- **Information policies to increase awareness of, e.g.:**
  - Climate change reduction options
  - Travel options available
  - New transport technologies
- **Ultimate GHG reduction potential depends on scale, scope and level of ambition of policy instruments**
“EU Transport GHG: Routes to 2050?”
Illustrative scenarios

- Options and policy instruments papers provided overview of:
  - Reduction potential of various options by mode
  - Potential policy instruments for stimulating uptake of these options
  - Issues, risks and limitations associated with these options and instruments

- Other influences inform development of illustrative scenarios:
  - Assumptions in other studies re options and policy instruments
  - Timing issues for policies
  - Energy security implications
  - Possible breakthrough technologies

- SULTAN “illustrative scenarios tool”:
  - Range of possible scenarios to reduce transport GHG
  - What do these mean for GHG emission reduction potential in transport
  - Assumptions made are transparent way
  - Assumptions can be altered to illustrate what change this might deliver
**“EU Transport GHG: Routes to 2050?”**

**Combination scenarios assessed**

<table>
<thead>
<tr>
<th>C1</th>
<th>Technical: Increased biofuels penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>Technical: Mandatory CO₂ standards and biofuels</td>
</tr>
<tr>
<td>C3</td>
<td>Technical + Planning + Modal Shift</td>
</tr>
<tr>
<td>C4</td>
<td>Technical + Planning + Modal Shift + Speed + FED Training</td>
</tr>
<tr>
<td>C5</td>
<td>Technical + Planning + Modal Shift + Speed + FED Training + Tax (inc CO₂ Price)</td>
</tr>
<tr>
<td>C6</td>
<td>Non-Technical: Planning + Modal Shift + Speed + FED Training + Tax (inc CO₂ Price)</td>
</tr>
</tbody>
</table>

- **Combination impacts are NOT additive** – based on multiplicative combinations of % changes, e.g. for change of X% and Y% for two different scenarios, total impact is: \(((1+X\%) \times (1+Y\%) - 1)\)
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Comparison of scenarios assessed

**Total Combined (life cycle) GHG emissions (Sum All)**

- BAU-a
- C1-a
- C2-a
- C3-a
- C4-a
- C5-a
- C6-a

**Reductions:**
- 60% Reduction
- 80% Reduction
- 95% Reduction

**Graph Details:**
- X-axis: Years (2010 to 2050)
- Y-axis: Combined (life cycle) emissions, MtCO2e
- Emissions trends for different scenarios are shown with distinct colors, each representing a specific scenario and emission reduction target.
"EU Transport GHG: Routes to 2050?"
Scenario 2a – only technical measures

Achieves 36% lower GHG compared to 1990 level
“EU Transport GHG: Routes to 2050?”
Scenario 6a – all non-technical measures

Achieves 3% lower GHG compared to 1990 level
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Cumulative GHG comparison

Total cumulative GHG emissions, 2010-2050 (Sum All)

Combined (life cycle) emissions, MtCO2e

- BAU-a
- C1-a
- C2-a
- C3-a
- C4-a
- C5-a
- C6-a
Impact of CO₂ price

Total Combined (life cycle) GHG emissions (Sum All)

BAU-a
C5-a
C5-b
C5-c
C6-a
C6-b
C6-c

60% Reduction
80% Reduction
95% Reduction

Combined (life cycle) emissions, MtCO₂e

2010 2015 2020 2025 2030 2035 2040 2045 2050
Average GHG emissions factor by energy carrier (Sum All)

- Gasoline
- Diesel
- Electricity
- Hydrogen
- LPG
- CNG
- Kerosene
- Marine Fuels
- LNG

Combined (life cycle) emissions, KgCO2e/GJ

Year: 2010, 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050

European Commission: 20
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Efficiency assumptions – scenario C5

Average new vehicle energy consumption per vehicle-km

- Car
- Bus
- EUAviation
- IntlAviation
- PassengerRail
- Motorcycle
- WalkCycle
- Van
- MedTruck
- HeavyTruck
- InlandShipping
- MaritimeShipping
- FreightRail

Index, 2010 base

2010 2015 2020 2025 2030 2035 2040 2045 2050

0% 20% 40% 60% 80% 100% 120%
Passenger demand – scenario C5

Total demand by passenger mode

- WalkCycle
- Motorcycle
- PassengerRail
- IntlAviation
- EUAviation
- Bus
- Car
- BAU-a total

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Freight demand – scenario C5

Total demand by freight mode

- FreightRail
- MaritimeShipping
- InlandShipping
- HeavyTruck
- MedTruck
- Van
- BAU-a total

Billio tonne-km

2010 2015 2020 2025 2030 2035 2040 2045 2050
“EU Transport GHG: Routes to 2050?”
Indications from scenario C5

Average new vehicle emissions per vehicle-km

- Car
- Bus
- EUAviation
- IntlAviation
- PassengerRail
- Motorcycle
- WalkCycle
- Van
- MedTruck
- HeavyTruck
- InlandShipping
- MaritimeShipping
- FreightRail

Index, 2010 base
“EU Transport GHG: Routes to 2050?”
Indications from scenario C5

Total energy use by energy carrier (Sum All)

- LNG
- Marine Fuels
- Kerosene
- CNG
- LPG
- Hydrogen
- Electricity
- Diesel
- Gasoline
- BAU-a total

European Commission: 25
"EU Transport GHG: Routes to 2050?" Decomposition of impacts C5

Total Combined (life cycle) GHG emissions (Sum All)

- Energy GHG intensity
- Vehicle efficiency (technical and operational)
- System efficiency
- Total for C5-a
- 95% Reduction
- 80% Reduction
- 60% Reduction
- Total for BAU-a

Combined (life cycle) emissions, MTCO2e

0 500 1.000 1.500 2.000 2.500
**EU Transport GHG: Routes to 2050?**

Possible long term policy actions (1)

- **Regulation of energy or GHG efficiency of vehicles**
  - For all modes
  - Stepwise tightening
  - Test cycles reflecting real life emissions

- **Regulation of energy carriers:**
  - Shift to low-carbon alternatives for current fuels
  - Strong interaction with other sectors (energy, food)
  - Broad facilitation and standardization needed for major shift

- **Spatial, infrastructure, speed and traffic management**
  - Policy at all levels and abolishment of subsidies to:
    - Encourage slow modes
    - Influence demand/system efficiency
    - Put higher weight to GHG reduction in EIA, SEA and CBA

- **Non-transport policy for transition to transport**
  - Extensive economic growth (e.g. development of Green GDP)
Possible long term policy actions (2)

- Set of pricing policies at all levels to:
  - Support uptake of low-carbon technology
  - Influence demand
  - Improve efficiency of the transport system

- Generic pricing instrument:
  - Carbon tax on fuel
  - Transport in ETS or separate emission trading scheme for transport

- Other key pricing instruments:
  - Kilometre-charging
  - Vehicle taxation (differentiated to fuel efficiency)
  - Company car taxation (50% of new cars is bought by companies!)
  - Remove tax exemption for travel expense declaration
  - Same VAT regime for all transport modes
  - Land use taxation
  - Parking fees and permits
Follow up:

- “Transport GHG: Routes to 2050” follow-on project to provide further insights:
  - Co-benefits
  - Embedded emissions (vehicles and infrastructure)
  - Knock-on consequences
  - Less transport intensive structures
  - Major risks and uncertainties
  - SULTAN further development
  - Interaction between pre and post 2020 policies
  - Cost effectiveness of packages
Key Conclusions (1)

- Transport demand and GHG emissions expected to keep on growing without policy intervention
- To meet long term goals requires transport GHG emission reductions of the order of 60% compared to 1990
- Broad range of ambitious options required: technical, structural and improved system efficiency
- Under-achievement in one area implies more effort in others
- No policy silver bullet exists - mix of policy instruments needed
Over half potential reduction is due to technical measures (mainly decarbonisation of fuels and vehicle efficiency), with the remainder due to non-technical measures.

All government levels need to take action:

- Energy efficient vehicles and low carbon energy: particularly national and international level
- More efficient transport system and transport system efficiency: action at all levels required

Urgent need for action because of long lead times and risks of policies achieving less than expected.
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www.eutransportghg2050.eu
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