STOA project: Backcasting, Targets, Baseline, Images for 2047

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The Future of European Long Distance Transport

STOA project: Backcasting, Targets, Baseline, Images for 2047

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STOA project description:

- For: STOA – The **European Parliament's** panel on Science and Technology Options Assessment
- By: European Technology Assessment Group ETAG (DBT + ITAS)
- With: a Scenario Working Group:
  - David Banister, Jonas Åkerman, Kaj Jørgensen, Maria Giaoutzi, Otto Anker Nielsen, Peder Jensen, Henrik Gudmundsson

Further information: http://www.tekno.dk/subpage.php3?article=1386&survey=15&language=uk

Purpose of the project

- To contribute to policy clarification and improved governance by working out **scenarios for 2047** for a sustainable, efficient and less oil dependent European transportation along with related policy options.

Why is a long time perspective?

- **Substantial inertia** in transport infrastructure, etc; (**aircraft** fleet renewal **exceeds 45 years**!)
- **Present decisions** will have a substantial impact still in 2050

Why long distance?

- **Growing EU** with new Member States emphasize importance of long-distance
- Significant **increase** in Long Distance segment
- Significant **potentials** to shift/improve

Long Distance Transport - Delimitation

Long distance transport: Transport exceeding 150 km

Compared with all EU 27 Transport:

- 15% of passenger car and passenger rail
- 80% of truck transport
- Intra EU + 50% of cross EU-border air travel
- 100% of ”inland” navigation and freight rail
- Excluding: Air freight
- Excluding: Intercontinental sea freight is not included.
- Excluding Non-CO2 emissions from aviation (H2O and NOx) due to uncertainty (probably substantial!)

Targets from Workshop in EU-Parl.

- Oil consumption reduced by 80% between 2005 and 2047
- CO2-emissions reduced by 60% between 2005 and 2047
- High level of accessibility; offering an efficient, effective transportation system at affordable prices

Approach: Backcasting-type

Suitable when:

- Solutions to **major societal problems** (e.g. Climate change) are searched for
- *and* **more than marginal** changes to trends might be needed

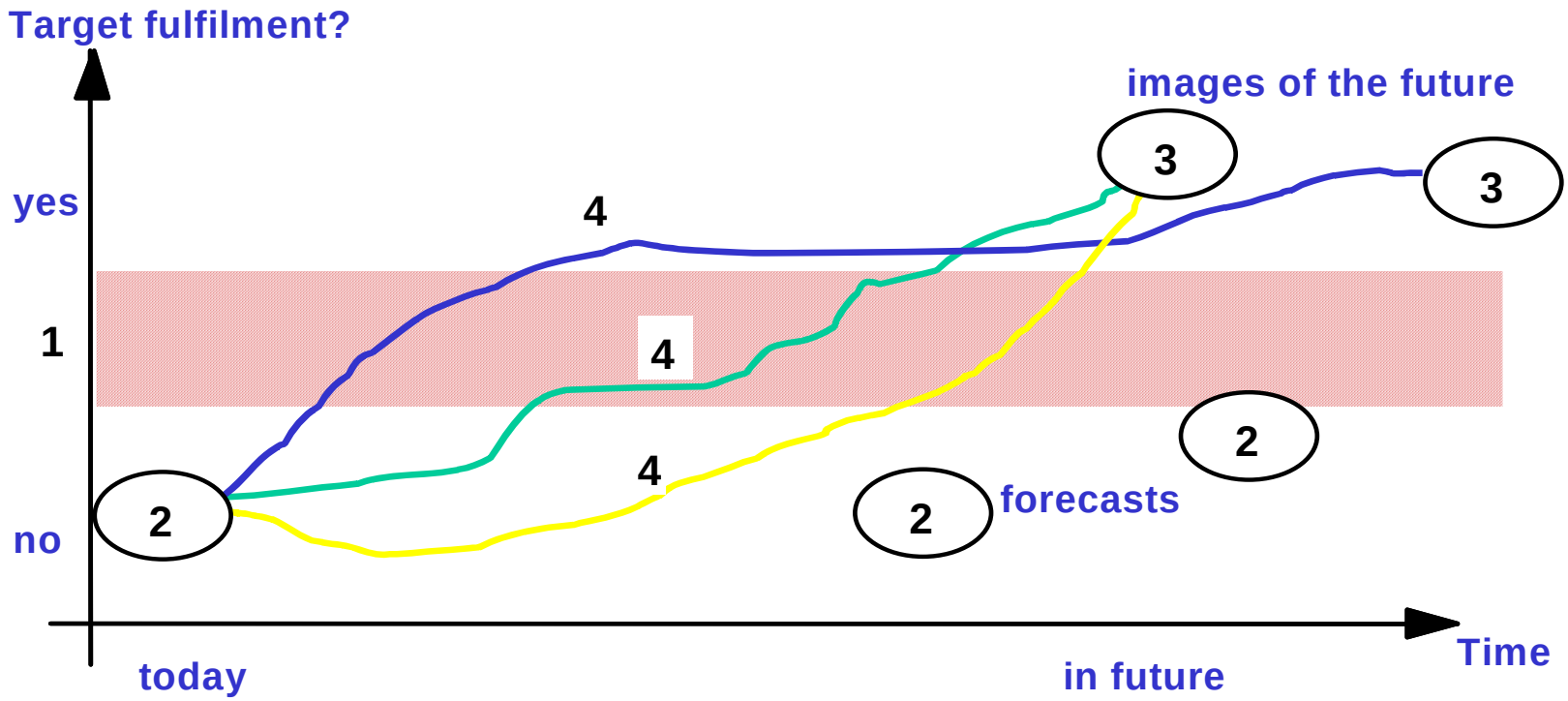
Aim:

- Illustrate **magnitude of changes** necessary to reach targets, e.g which transport volumes, modal shares etc are consistent with targets.
- Provide **support for present strategic decisions** concerning long-lived structures, e.g. transport infrastructure, fuel chains,

Application in the STOA project:

- Combination of **quantitative** assessment and **qualitative** dialogue
- **Internal** and **external** expert workshops
- Not ’complete’ backcasting methodology

Backcasting – Main steps



1. Definition of target
2. Trend analysis (baseline/forecasts)
3. Outlining images of the future
4. Analysis of paths to images of the future including policy measures

’Baseline’ assumptions

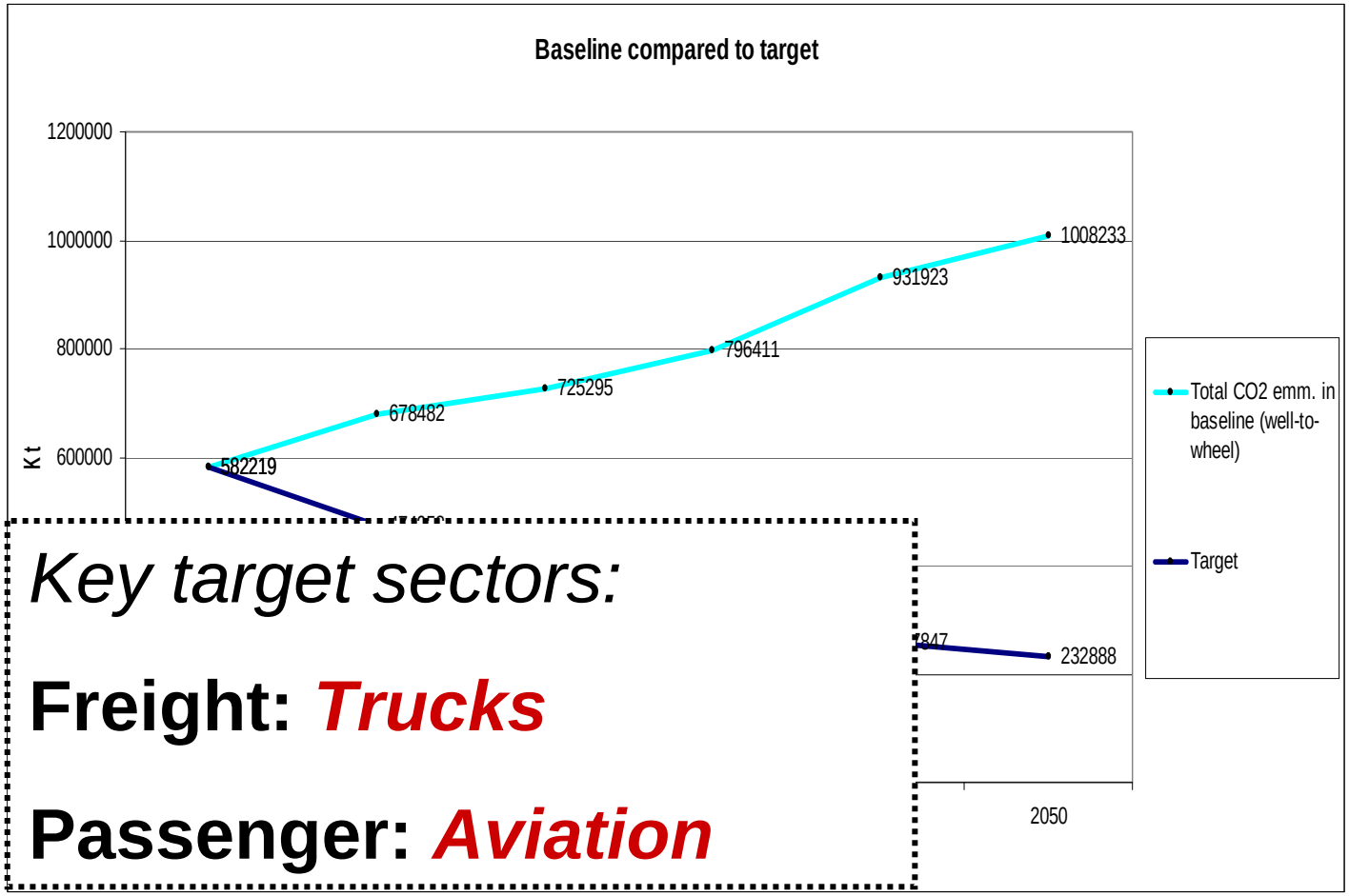
Data source to 2030: **DG-TREN ”European Energy and Transport – Trends to 2030, Upd. 2005” (PRIMES)**

- + Annual transport volume increase between 2030 and 2047 is assumed equal that between 2020 and 2030
- DG-TREN Forecast assumes some decoupling of transport growth from economic growth (’White Paper’) .
- Moderate specific energy efficiency improvement (e.g. 40% for air, 15% for trucks, 30% for cars)
- 10 % share for biofuels in 2047

Some data, delimitation issues 2005

- **Trucks:** Difficult to get separat reliable data on long distance trucks
- **Aviation:** If other GHG than CO2 had been included, climate impact might almost be twice as high (high uncertainty).
- **Intercontinental sea transport:** Little data available but emissions seems to be substantial and rapidly increasing.

The gap to bridge -> 2047



Key target sectors:

Freight: *Trucks*

Passenger: *Aviation*

How much effort to bridge the gap?

- Change of transport demand alone
- Change of Modal Split alone
- Change of technology alone

Example: Modal split alone

MODAL SPLIT	Transport volume & carbon intensity as in baseline
Change in modal split needed to reach target (+/- 1%) (change needed in relation to the baseline in 2050)	75% reduction of private cars and motorcycles (= - 908 Gpm) 96% reduction of intra EU aviation (= - 1113 Gpm) 1850% increase in passenger rail (= + 1654 Gpm) 600% increase in passenger inland navigation (= + 357 Gpm) 97% decrease in trucks (= - 2972 Gtkm)) 96% decrease in freight inland navigation (= - 395 Gtkm) 660% increase in freight rail (= 3356 Gtkm)

Three Images for 2047

Image I: Strong and rich High-Tech Europe

Image II: Slow and reflexive lifestyles

Image III (contrast image): Economic pressure and expensive energy

Policies considered (examples)

	Freight (trucks)	Passenger (aviation)
Pricing	Carbon based taxation Cap and trade	Carbon based taxation Cap and trade Individual carbon allowances
Technology	Emissions standards Hybrid technologies and alt fuels Load matching, speed control, routing	Emissions standards Alternative fuels
Land use	Efficient warehouse location Local production and sourcing	Airport investment policy Intermodality – rail air integration

2047	Image I Strong and rich High-Tech Europe	Image II Slow and reflexive lifestyles	Image III economic pressure + very expensive energy
Governance	EU is cohesive and has a leading role in the world; efficient EU-regulations to combat climate change	Strong UN has established successful climate instruments;	Weak EU, weak UN, few international co-operation; poor regulations to combat climate change; strong local identity
Economy/GDP-growth	Roughly 2,4%	Roughly 1,7%	Roughly 0,7%
Lifestyles	Consumption oriented, fast; cheap mass products are popular; also luxury products; Status symbols are important	Focus on health and quality of life; high quality regional products are popular; dematerialisation	Consumption oriented, fast
Means for accessibility	Air & High speed rail	Virtual mobility, comfor-table rail; slow air	Air & virtual mobility
R&D	Intensive research activities; EU as global high-tech centre;	Strong global research community with very active UN-institutions	Technical progress triggered by competition between nations; poor international research networks
Energy	CO2-lean energy technologies highly advanced; some surprising breakthroughs (battery tech; supergrid; CCS)	Relatively low energy demand; CCS	Energy as a geopolitical instrument; efficiency is high because of high energy prices

2047	Image I: Strong and rich High-Tech Europe	Image II: Slow and reflexive lifestyles	Image III: economic pressure + very expensive energy
Main LDT fuels	Electricity, hydrogen, biofules, CNG, diesel, kerosene	Electricity, biofuels, CNG, diesel, kerosene	Biofuels, CNG, diesel, kerosene
Transport Infrastructure	High quality, intelligent, completely harmonised in EU	Advanced	No harmonised development of infrastructure in EU
Telematics	Widespread	Widespread	Moderate
Transport volume 2047 compared to baseline	- 30%	-45%	-60%
Biofuels share 2047	30%	25%	15%
Increase in passenger rail	190%	75%	0
Increase in freight rail	70%	100%	0
Improvement in carbon intensity for aviation	64%	58%	58%
Improvement for carbon intensity for trucking	57%	44%	40%

Some inputs to the discussions…

- Freight: Trucking; Passenger: aviation
- Growth rates of car, air and truck transport need to be reduced to reach targets - still an increase compared to 2005 is possible.
- Improved vehicle technology is important but is not sufficient to reach the targets
- Infrastructure investments could need to be stronger focused at rail and ICT (including virtual mobility); Organisational integration of European railways is a key-issue.
- Different research paths must be promoted -impossible to predict which technologies will emerge as the front-runners.

Thank you!

***Further information**:*
http://www.tekno.dk/subpage.php3?article=1386&survey=15&language=uk

EXTRA SLIDES

Image I **Change in total transport activity, %, compared to the baseline**	**2050: compared to baseline**
Passenger transport total (LDT) as compared to baseline	-30%
Freight transport total (LDT) as compared to baseline	-30%
Image I **Change in transportation activity in each mode, related to the global 20% volume reduction compared to the baseline**	
Total passenger transport	**0%**
Private cars and motorcycles	-5%
Rail	190%
Aviation intra EU	-10%
Inland navigation	0%
Total freight transport	**0%**
Trucks	-15%
Rail	70%
Inland navigation	25%

Image I - modal share %	2005	Baseline 2050	Image I 2050
Passenger transport total Gpm	**100%**	**100%**	**100%**
Private cars and motorcycles	60%	48%	46%
Rail	6%	4%	10%
Aviation intra EU	32%	46%	42%
Inland navigation	3%	2%	2%
Freight transport total (Gtkm)	**100%**	**100**	**100%**
Trucks	66%	72%	65%
Rail	20%	16%	22%
Inland navigation	14%	12%	13%

Image I
Improvement of well-to-wheel carbon intensity in addition to baseline

Mode	**2050 in addition to baseline**	Baseline improvement of carbon intensity 2050 over 2005	Total improvement of carbon intensity 2050 over 2005
Passenger transport	60%	31.7%	72.7%
Private cars and motorcycles	55%	53.4%	79.0%
Rail	40%	40.4%	64.3%
Total aviation	40%	4.8%	42.9%
Inland navigation			
Freight transport	50%	14.5%	57.2%
Trucks	50%	50.8%	75.4%
Rail	30%	61.4%	73.0%
Inland navigation			
Assumptions for biofuels	**2050**		
Biofuel share, %	30%		
Biofuel, tons CO2 per TJ fuel - well-to-wheel	0		

Image II **Change in total transport activity, %, compared to baseline**	**2050: compared to baseline**
Passenger transport total (LDT) as compared to baseline	-45%
Freight transport total (LDT) as compared to baseline	-45%
Image II **Change in transportation activity in each mode, related to the global 35% volume reduction compared to baseline**	
Total passenger transport	**0%**
Private cars and motorcycles	5%
Rail	75%
Aviation intra EU	-12%
Inland navigation	0%
Total freight transport	**0%**
Trucks	-20%
Rail	100%
Inland navigation	30%

Image II - Modal share %	2005	Baseline 2050	Image II 2050
Passenger transport total Gpm	**100%**	**100%**	**100%**
Private cars and motorcycles	60%	48%	51%
Rail	6%	4%	6%
Aviation intra EU	32%	46%	41%
Inland navigation	3%	2%	2%
Freight transport total (Gtkm)	**100%**	**100**	**100%**
Trucks	66%	72%	61%
Rail	20%	16%	25%
Inland navigation	14%	12%	13%

Image II - improvement of well-to-wheel carbon intensity in addition to baseline			
Mode	**2050 in addition to baseline**	Baseline improvement of carbon intensity 2050 over 2005	Total improvement of carbon intensity 2050 over 2005
Passenger transport	40%	31.7%	59.0%
Private cars and motorcycles	40%	53.4%	72.0%
Rail	30%	40.4%	58.3%
Total Aviation	40%	4.8%	42.9%
Inland navigation			
Freight transport	35%	14.5%	44.4%
Trucks	35%	50.8%	68.0%
Rail	40%	61.4%	76.8%
Inland navigation			
Assumptions for biofuels	**2050**		
Biofuel share, %	25%		
Biofuel, tons CO2 per TJ fuel - well-to-wheel	2		

TRANSPORT MANAGEMENT: VOLUME	Carbon intensity & modal shares as in baseline
Change in transport volume needed to reach target (change needed according to 2050 baseline with the resulting changes compared to 2005 level in parenthesis)	77 % reduction of overall passenger transport for 2050 (51 % reduction compared to 2005 level) 78 % reduction of overall freight transport for 2050 (57 % reduction compared to 2005 level)

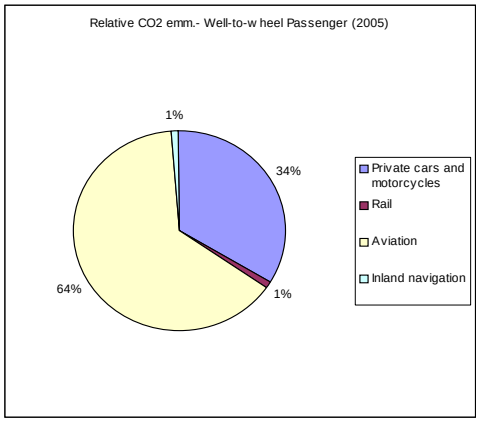
TECHNOLOGY INNOVATIONS	Transport volume & modal shares as in baseline
Change in specific carbon intensity needed to reach target (+/- 1%) (Total improvement of carbon intensity compared to 2005)	74.1% in private cars and motorcycles 79.0% in passenger rail 72.0% in intra EU passenger aviation 57.1% in inland passenger navigation 76.1% in trucks 77.9% in freight rail 82.6% in inland freight navigation 40.0% share of biofuels 0.5 TJ fossil primary energy per TJ fuel (well-to-wheel)[1] 20 tons CO2 per TJ fuel[2]

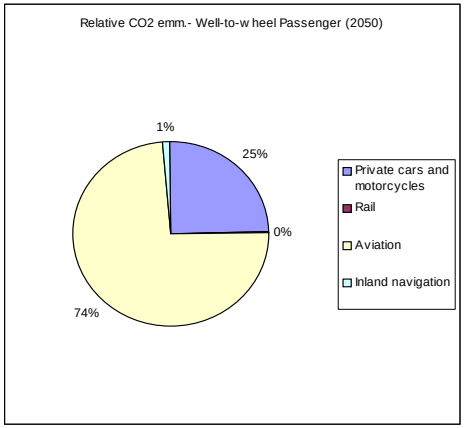
[1] Indicates the use of fossil energy (well-to-wheel) for production, distribution etc. of biofuels viewed as TJ energy input pr. TJ fuel output.

[2] Indicates the corresponding CO2 emissions viewed as tons CO2 pr. TJ biofuel output.

MODAL SPLIT	Transport volume & carbon intensity as in baseline
Change in modal split needed to reach target (+/- 1%) (change needed in relation to the baseline in 2050)	75% reduction of private cars and motorcycles (= - 908 Gpm) 96% reduction of intra EU aviation (= - 1113 Gpm) 1850% increase in passenger rail (= + 1654 Gpm) 600% increase in passenger inland navigation (= + 357 Gpm) 97% decrease in trucks (= - 2972 Gtkm)) 96% decrease in freight inland navigation (= - 395 Gtkm) 660% increase in freight rail (= 3356 Gtkm)

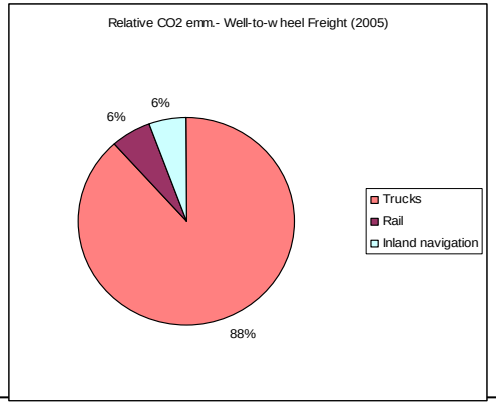
Aviation share of CO2

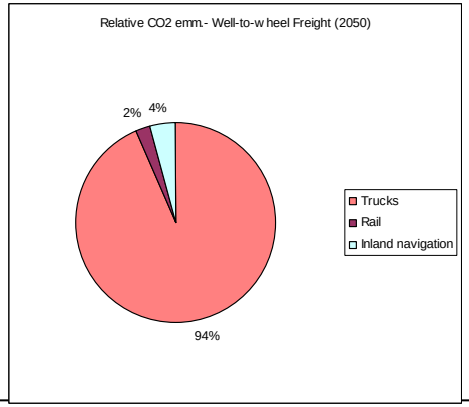




2005 **2050**

Trucking share of CO_2





Trucks	Travel volumes	Model shares	Capacity use	Oil cons-umption	Energy efficiency pr km	CO2 efficiency pr energy unit	Accessi bility
Carbon based taxation	++(+)		++		++	++	
Cab & Trade	++		++		+	+	
Emission standards					+	+	-
ITS Speed control Route guidance	+		+		+	+	+
Efficient Warehouse Distribution	+				(+)	(+)	+
Load matching	+		+(+)		+	+	(+)
Alt fuel promotion + Fuel Cells							
Road Trains			(+)		(+)	(+)	(+)
Hybrid	0				+	+	
Dedicated Freight Rail			+		+	+	+

example