



Transport, Energy and CO₂: Moving Toward Sustainability

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**Expert Group Meeting on Transport for Sustainable
Development, 27 August 2009**

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 - Energy use and GHG emissions in 2050
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 - Urbanisation key to transport dual evolution
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 - Issues with low-GHG individual transport
 - ◆ Manufacturing emissions might become predominant
 - ◆ The current hype in dedicated line for surface mass transit might reverse => Mode shifts appears less useful
- **Freight land transport : rail vs trucks on long distances**

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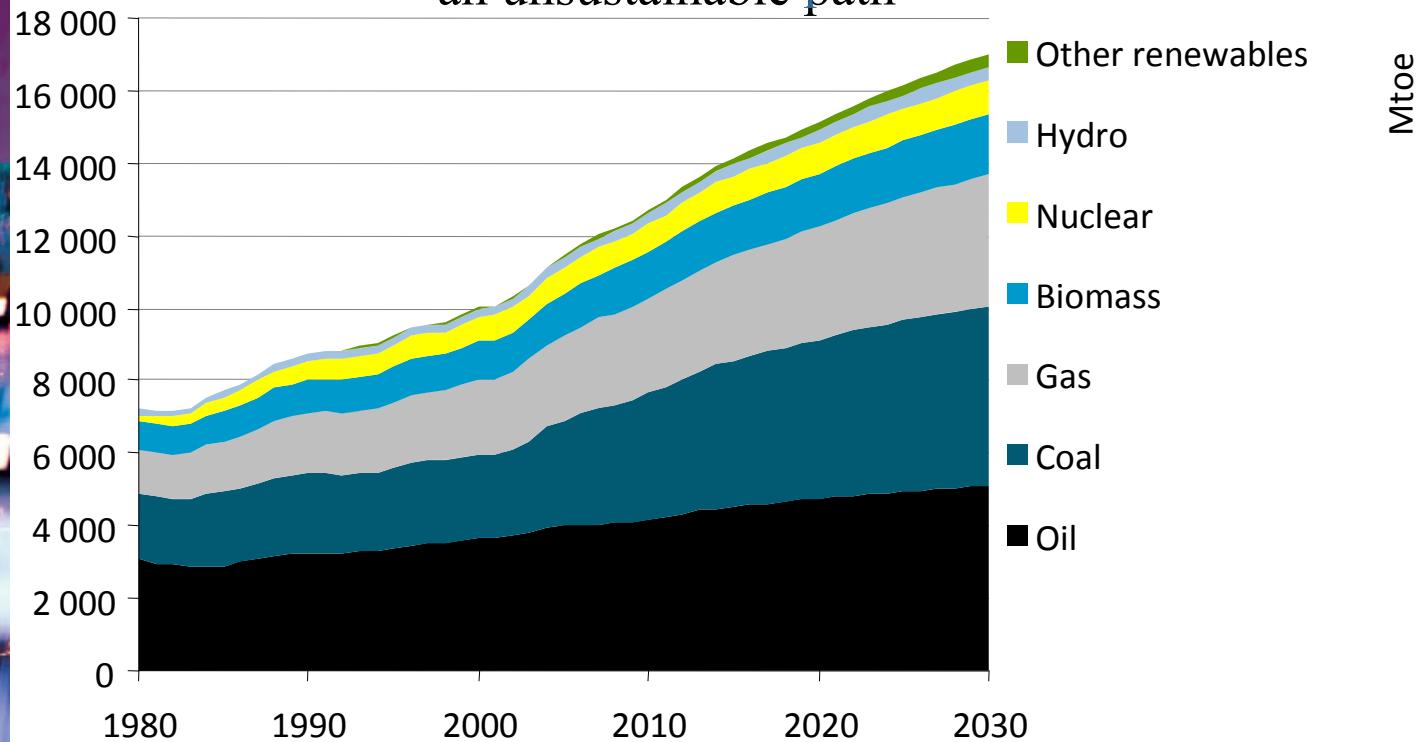
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Where are we headed? World Energy Outlook 2008

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World primary energy demand in the Reference Scenario:
an unsustainable path

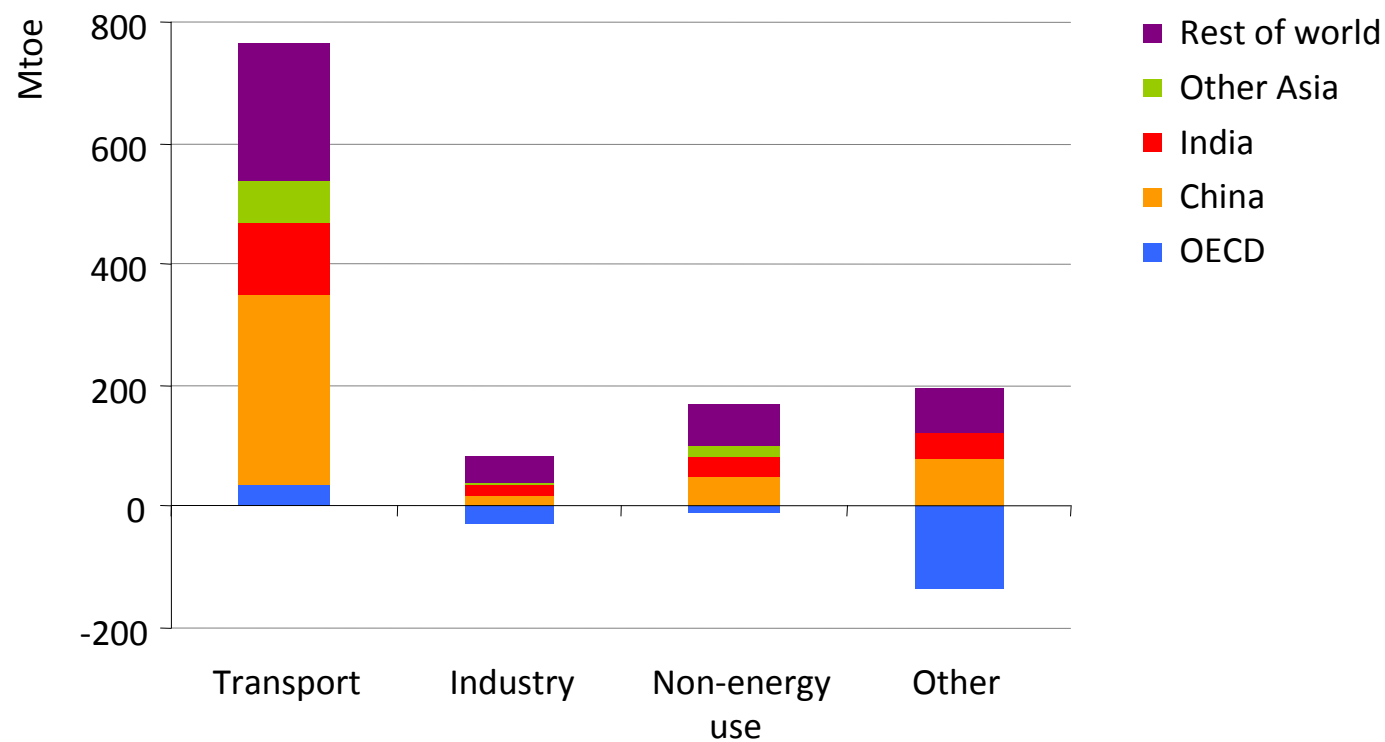


World energy demand expands by 45% between now and 2030 – an average rate of increase of 1.6% per year – with coal accounting for more than a third of the overall rise

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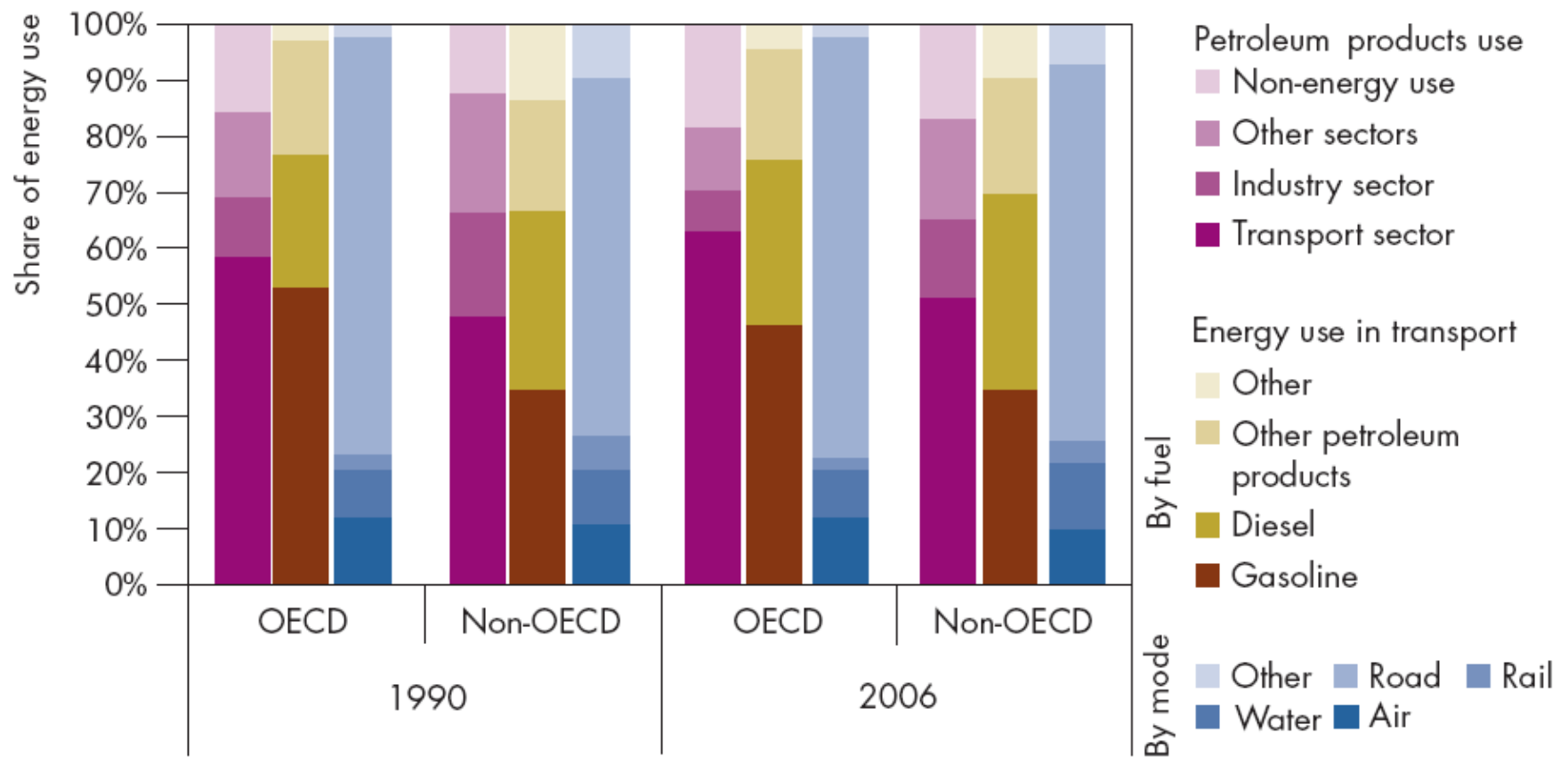
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WEO 2008 Reference Scenario: Incremental oil demand, 2006-2030



*Around three-quarters of the projected increase in
oil demand comes from transportation*

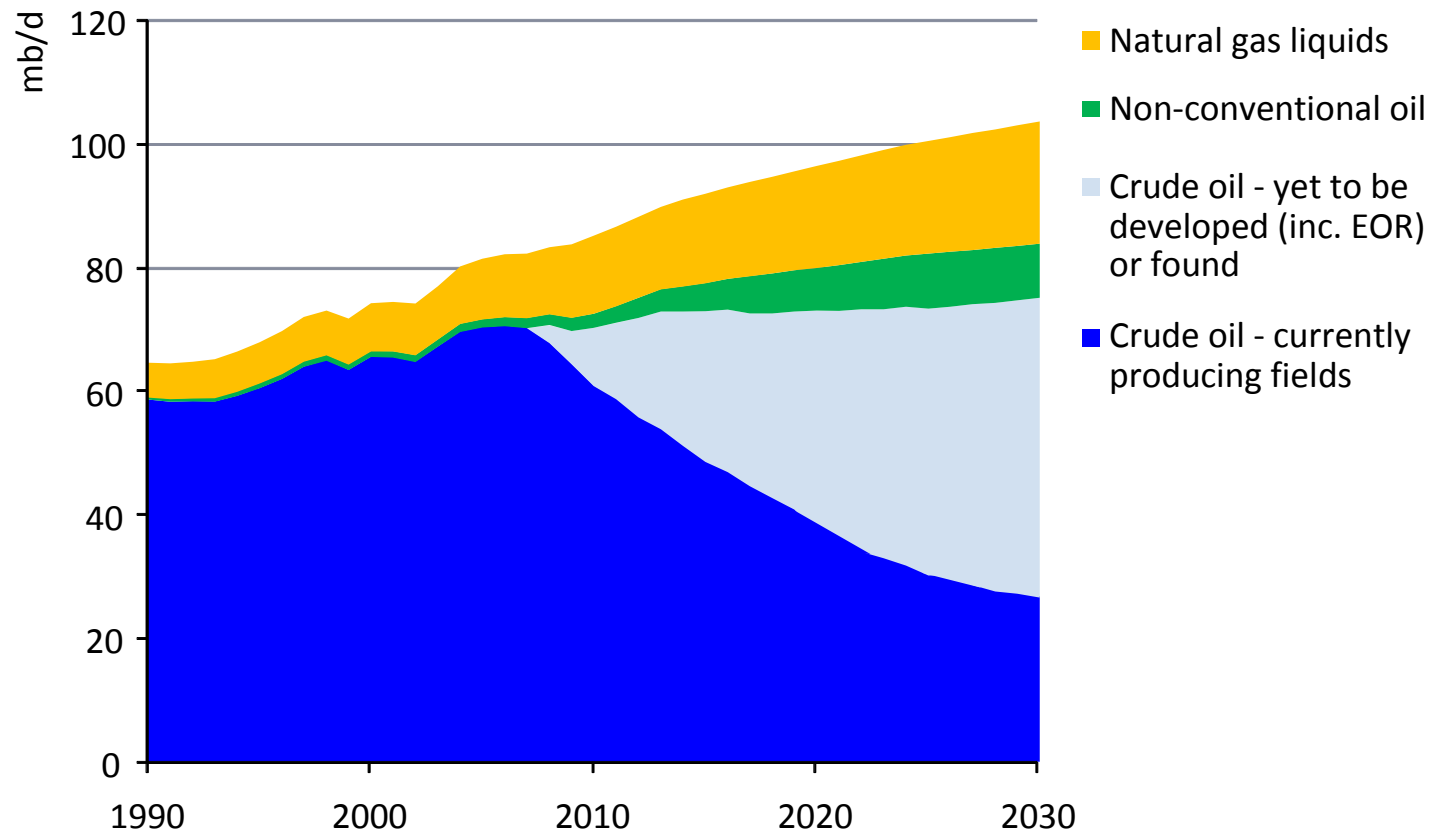
World transport sector relies (almost) entirely on oil



Source: IEA Statistics.

The proportion of petroleum products use in the transport sector has increased in the last decade; energy diversification is failing

World oil production by source in the Reference Scenario



***64 mb/d of gross capacity needs to be installed between 2007 & 2030
– six times the current capacity of Saudi Arabia – to meet demand
growth & offset decline***

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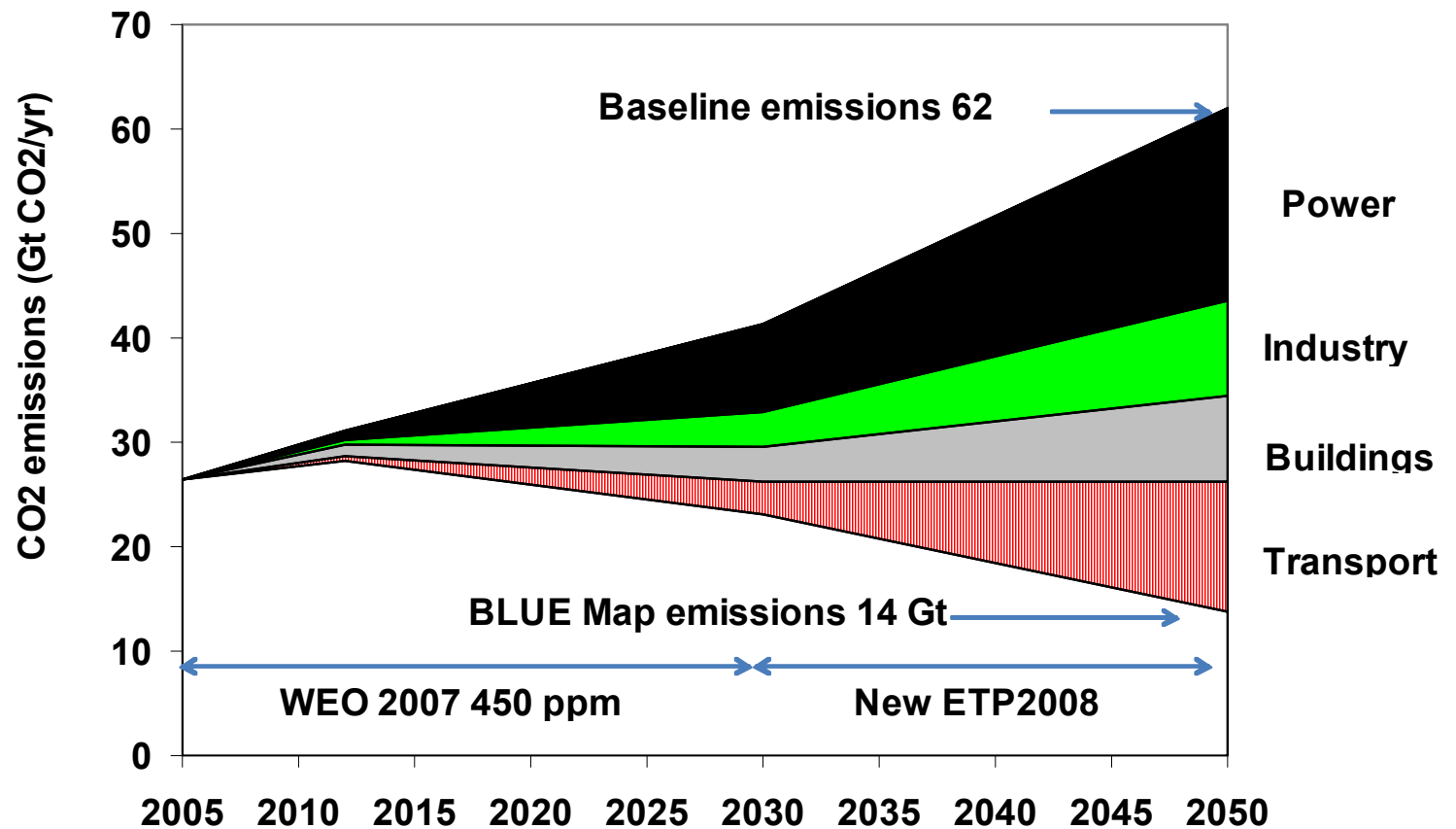
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We need a global 50% CO2 cut by 2050

IEA ETP 2008: Where reductions come from

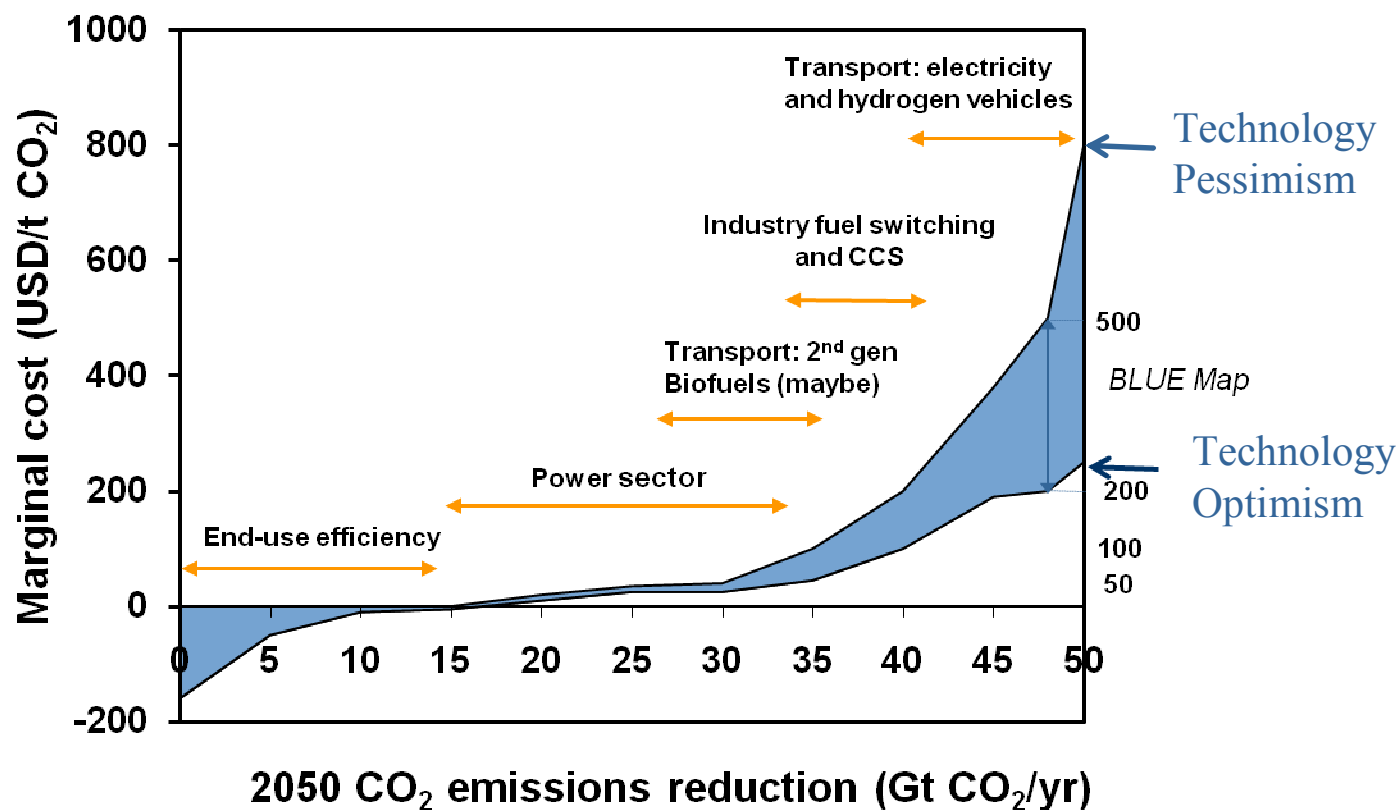
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A New Energy Revolution?

ETP 2008 Cost Curve



Reducing emissions by 50% would require options with a cost up to USD 200/t, possibly even up to USD 500/t CO₂

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IEA's New Transport Publication

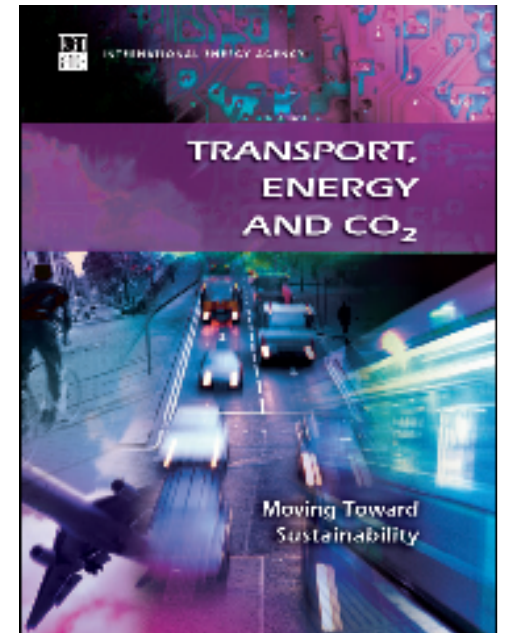
- For release Mid November 2009
- Builds on ETP 2008, will feed into ETP 2010
- Transport analysis based on on-going development of IEA Mobility Model, supporting research
- Book features:
 - Indicator update and extension to more countries
 - Technology potential and cost updates
 - Fuel and Modal assessments (LDV, truck, aviation, shipping)
 - Detailed scenario analysis with regional detail – Baseline, High Baseline, Modal Shift, BLUE technology scenarios
 - Role of future technologies, modal shift
 - More regional detail than in ETP
 - Continuing development of CO2 mitigation cost analysis
 - Policy considerations

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Scenarios adopted in the book

- **Baseline:** follows the IEA World Energy Outlook 2008 Reference Case to 2030 and then extends it to 2050. It reflects current and expected future trends in the absence of new policies.
- **High Baseline:** Non-OECD countries follow more closely OECD passenger LDV ownership trends.
- **BLUE CO₂ reduction scenarios:** developed based on achieving the maximum CO₂ reduction measures costing up to USD 200/tonne. These scenarios will require strong policies to achieve.
 - **BLUE Map:** achieves CO₂ emissions by 2050 that are 30% below 2005 levels. Greater use of biofuels, deployment of EVs, FCVs.
 - **BLUE EV Success:** Dominant EVs for LDVs and light trucks
 - **BLUE Shifts:** No advanced technology deployment, gain through modal shifting only. Compared to the Baseline in 2050, BLUE Shifts results in a 20% reduction in energy use and CO₂.
 - **BLUE Map/Shifts:** BLUE Map + BLUE Shifts. It results in a 40% reduction in CO₂ below 2005 levels by 2050.

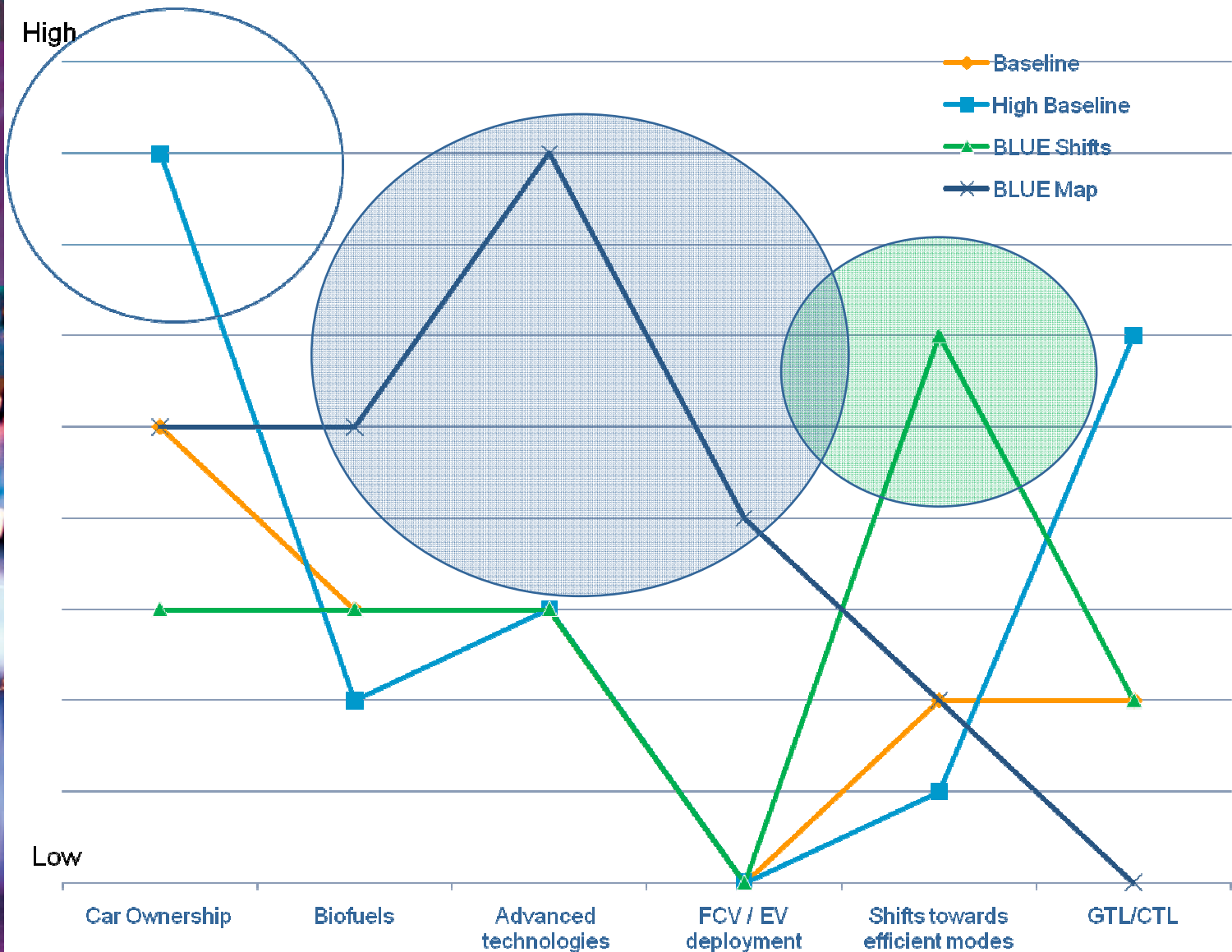
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Scenarios – Key variables



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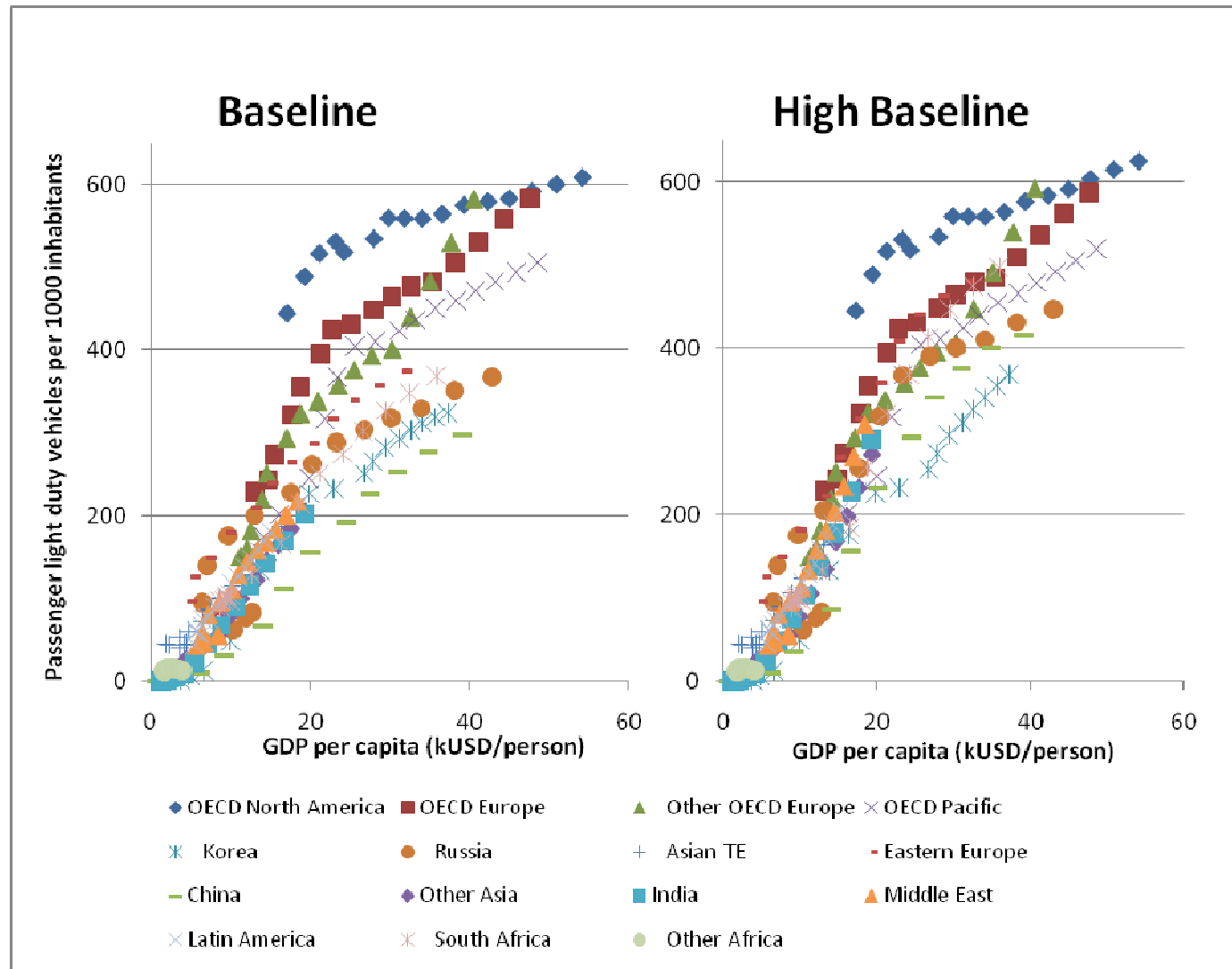
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High Baseline – Car ownership projections

The difference between 2 and 3 billion cars in 2050...

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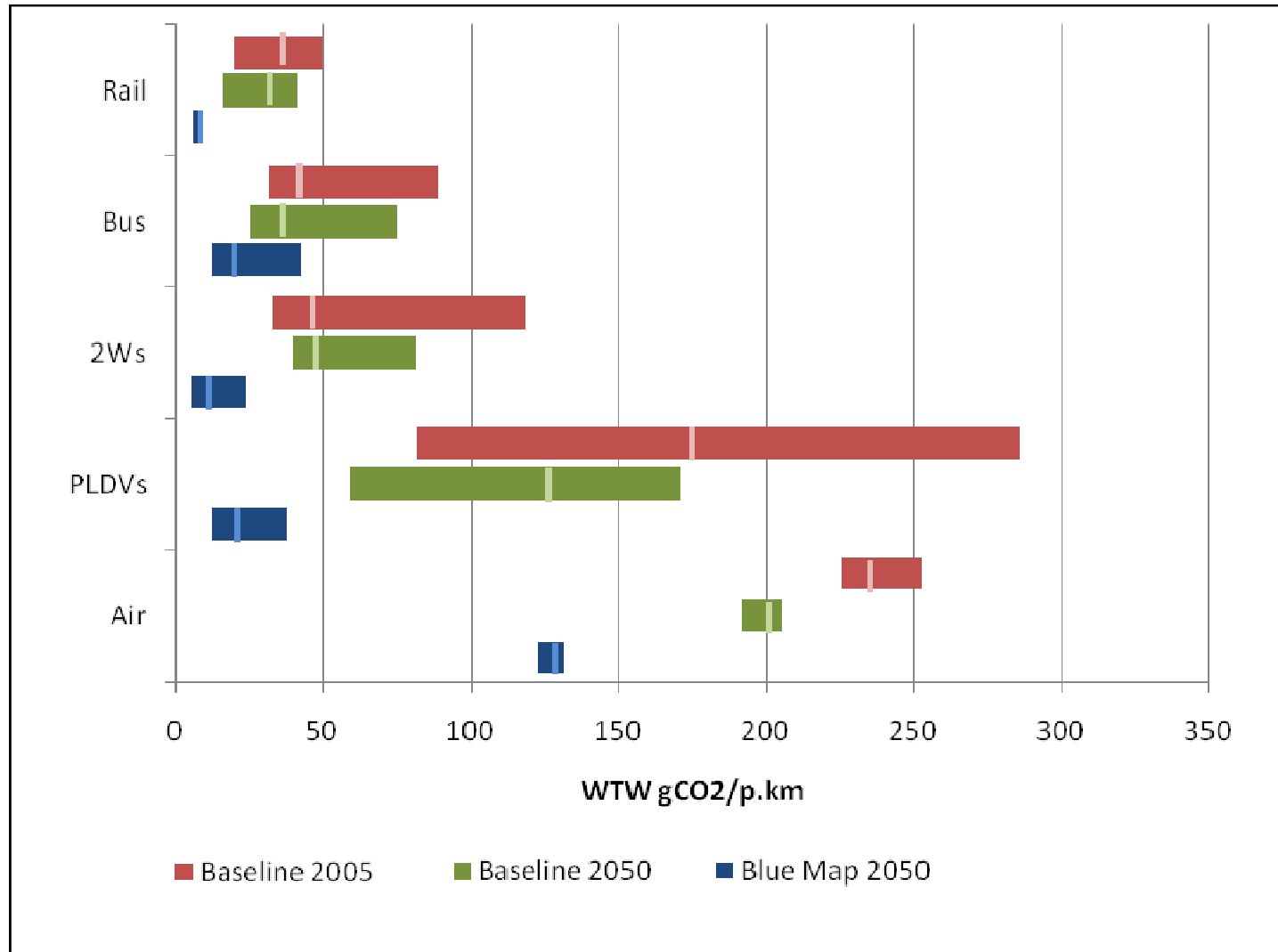


BLUE Map – Strong Technology Penetration GHG intensity by mode and scenario

Through a combination of efficiency and fuel switching, surface modes become extremely low CO₂ by 2050 in BLUE

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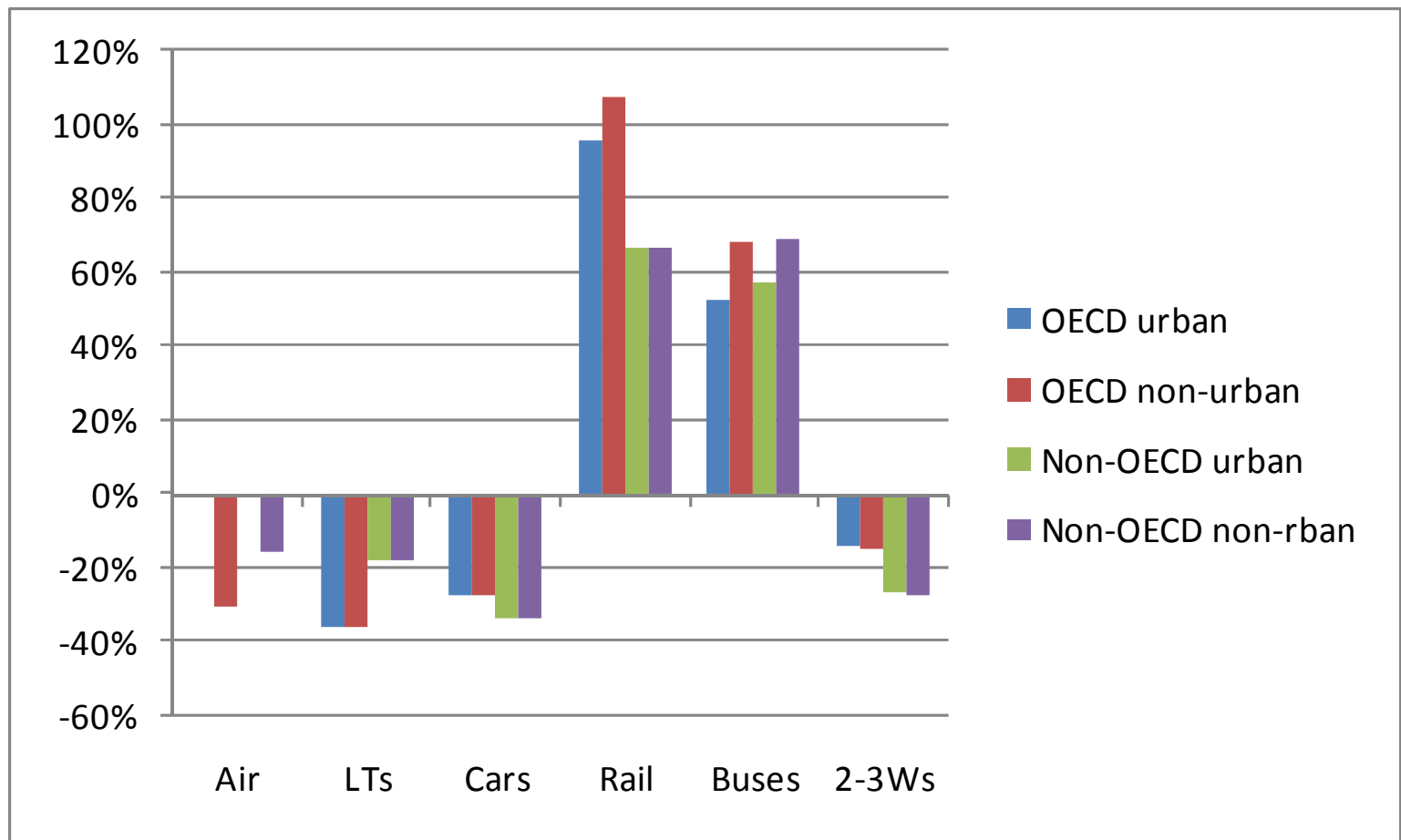


Changes from Baseline to BLUE Shifts case in 2050

Shifting 25% of LDV and air travel can cut total energy use by 20% in 2050

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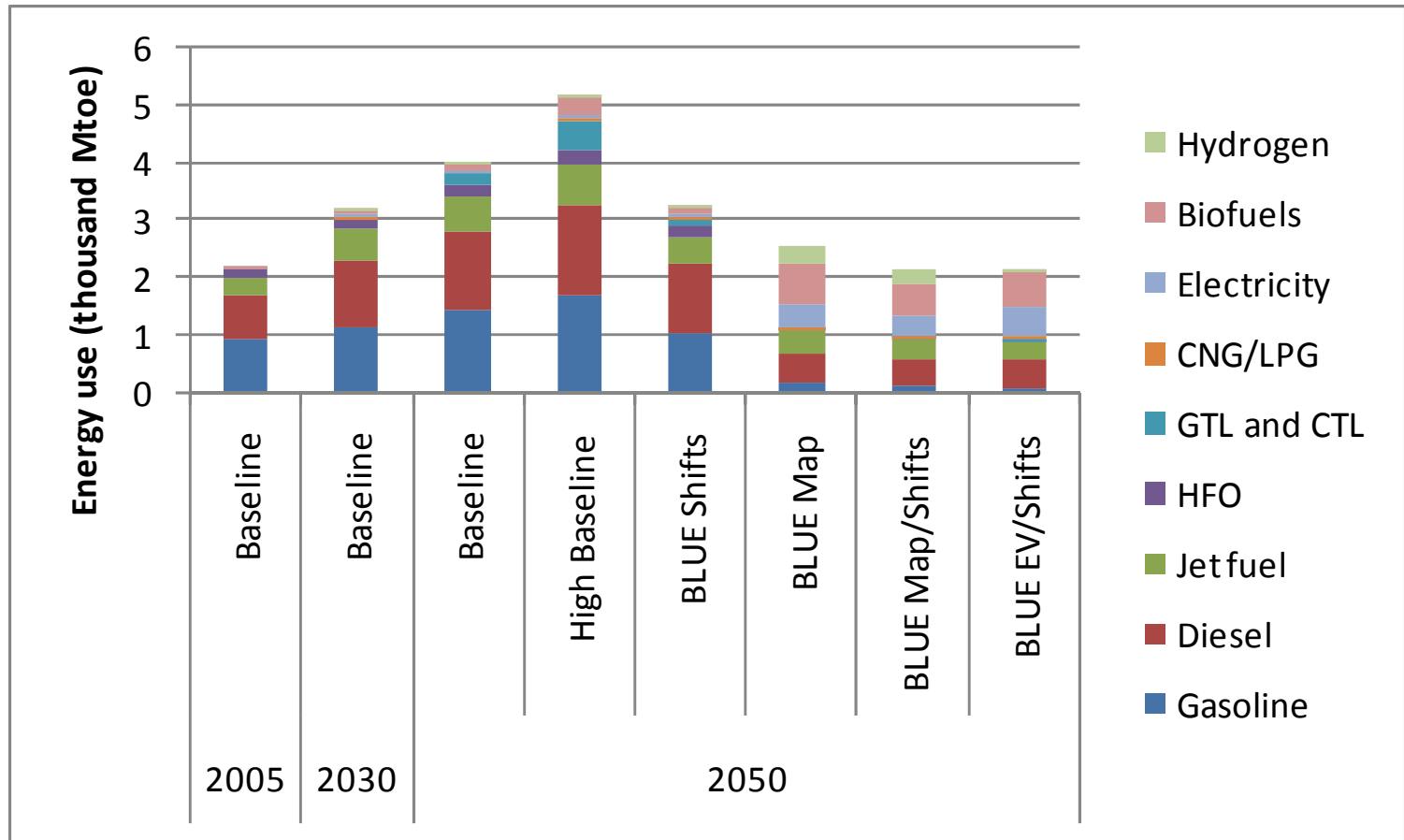


Energy use by scenario

In BLUE Map/Shifts, energy use returns to 2005 level, and with more than 50% very low CO₂ fuels

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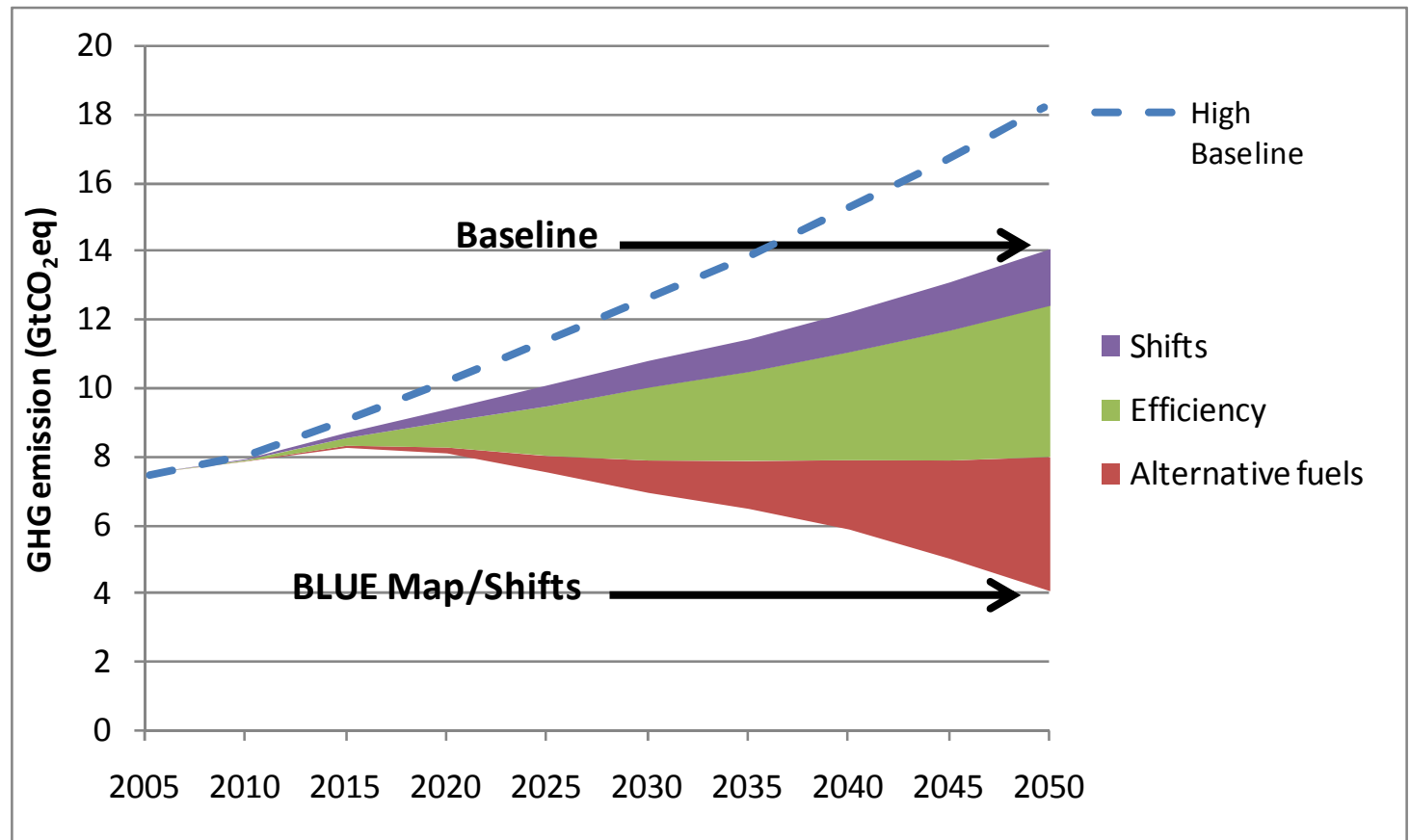


Transport CO2 reductions in BLUE Map/Shifts

A 3-part evolution...

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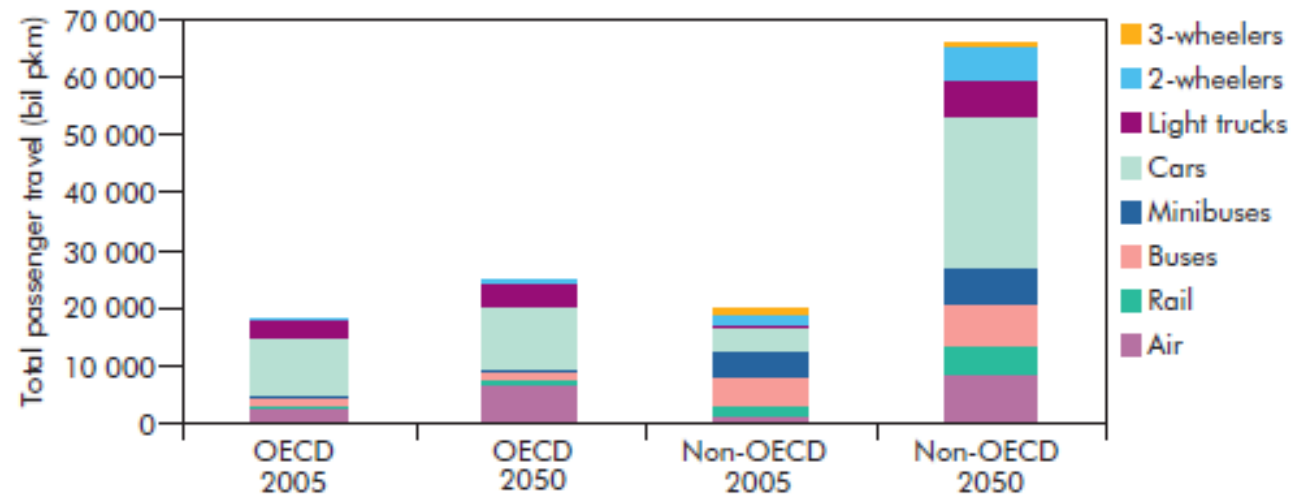
Land Passenger travel by mode and region, Baseline scenario

Non-OECD is where the growth happens, though from a far lower base per capita than OECD

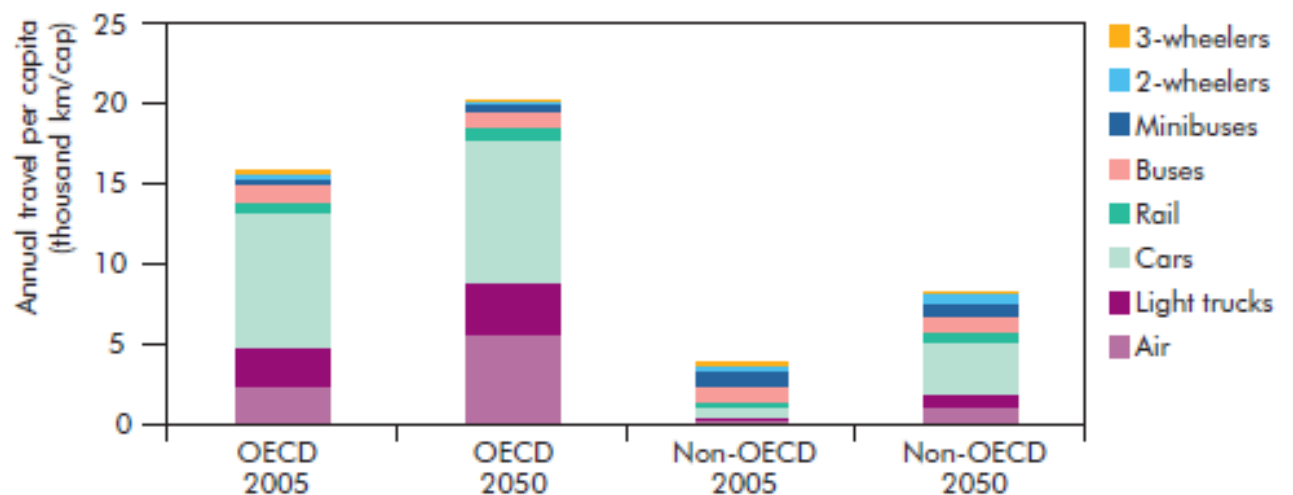
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Total



Per capita



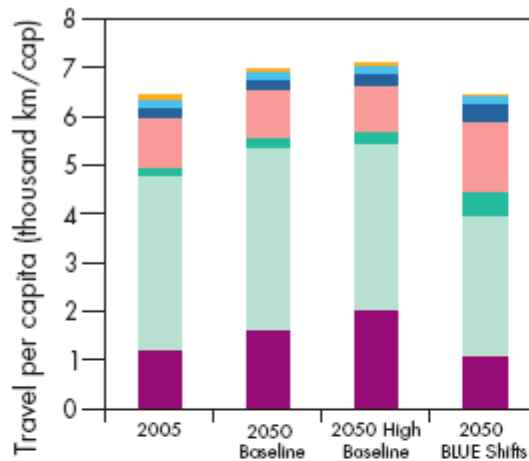
Land transportation - Passenger

- Air to grow in OECD countries
- Cars to grow in non-OECD countries

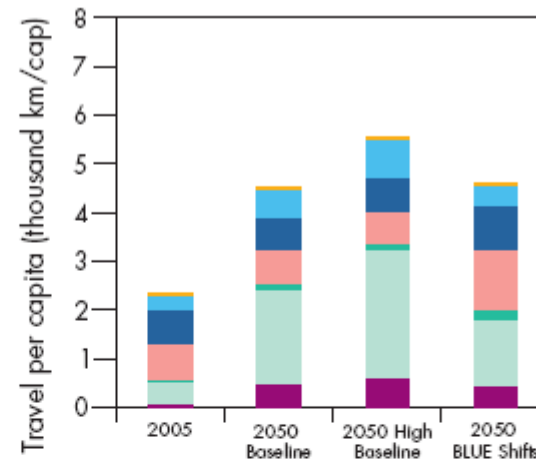
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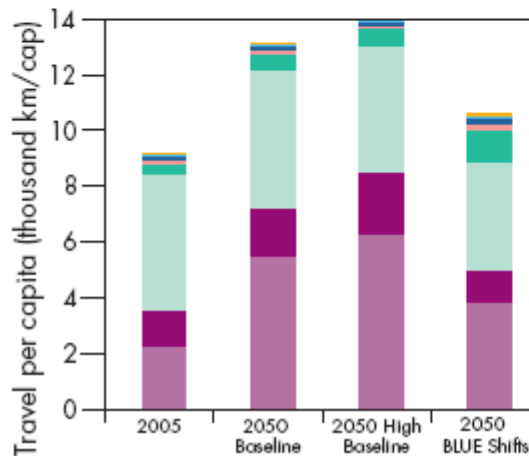
OECD, urban



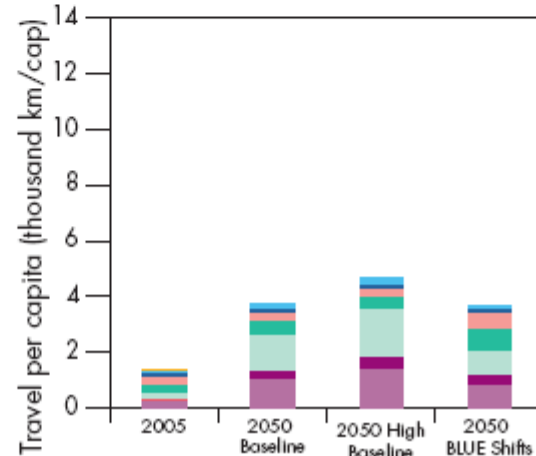
Non-OECD, urban



OECD, non-urban



Non-OECD, non-urban



- 3-wheelers
- 2-wheelers
- Minibuses
- Buses
- Rail
- Cars
- Light trucks
- Air

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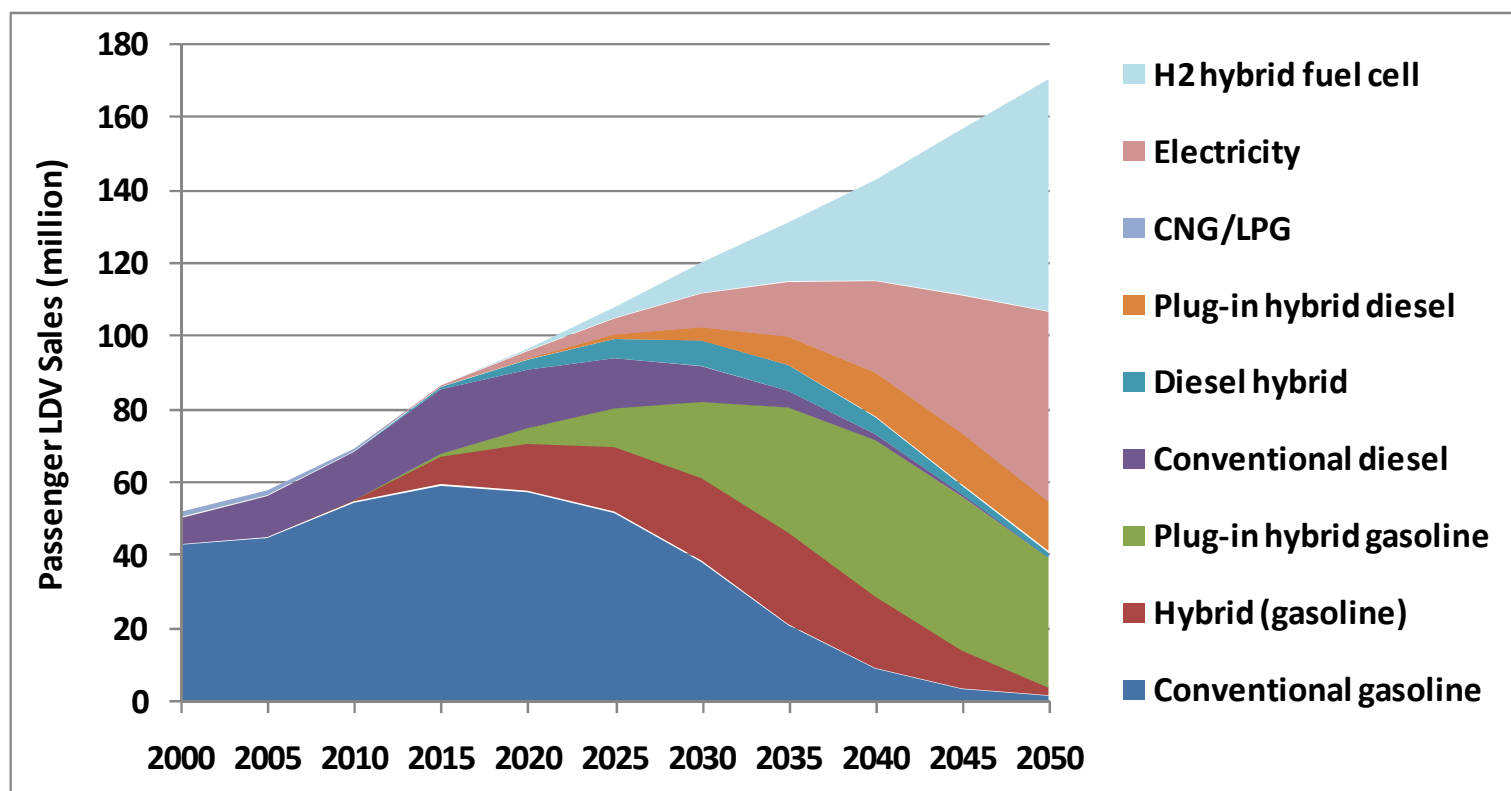
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LDV sales profile to 2050 in the BLUE Map scenario

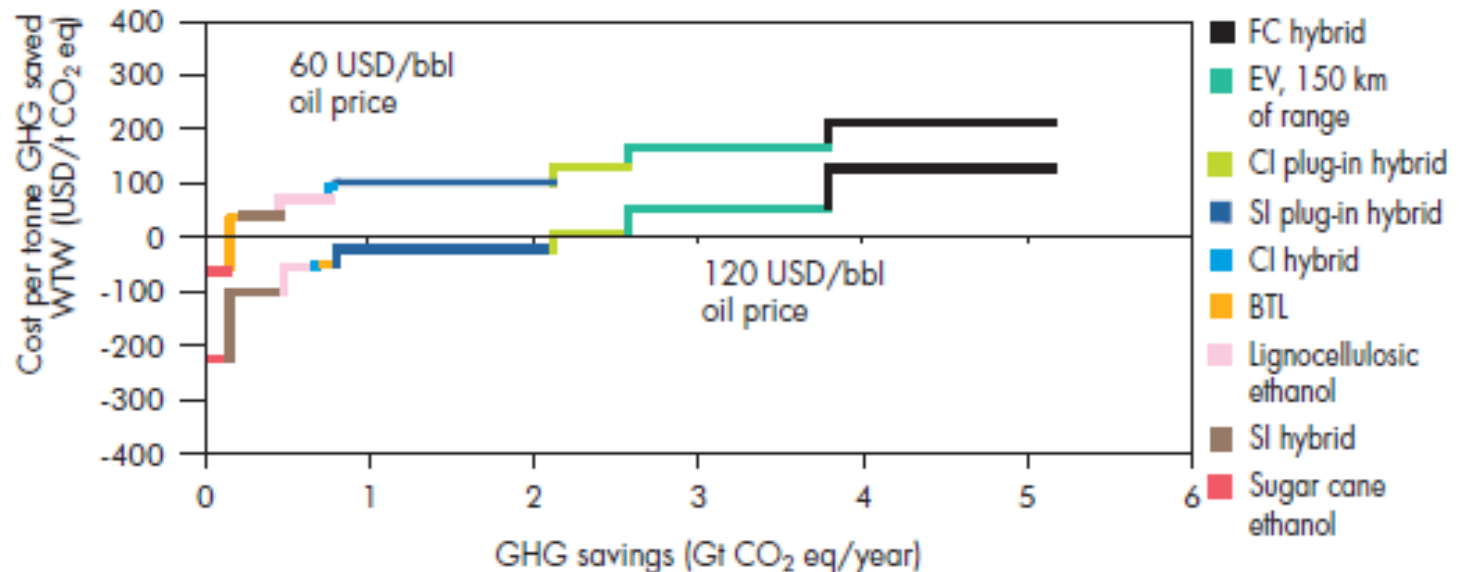
Unprecedented rates of change to advanced technologies



What will all this cost?

The price tag is very uncertain, but by 2050 it might be pretty affordable...

- Oil price impacts all the other alternative prices, at different rates, depending on “oil content”
- FCVs seems to be the most expensive option, likely to be too expensive without significant technological breakthroughs



Notes: SI = spark ignition (gasoline) vehicle; CI = compression ignition (diesel) vehicle; ICE = internal combustion engine vehicle; “hybrid” refers to hybrid-electric vehicle; BTL = biomass-to-liquids biodiesel.

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IEA EV/PHEV Roadmapping Effort

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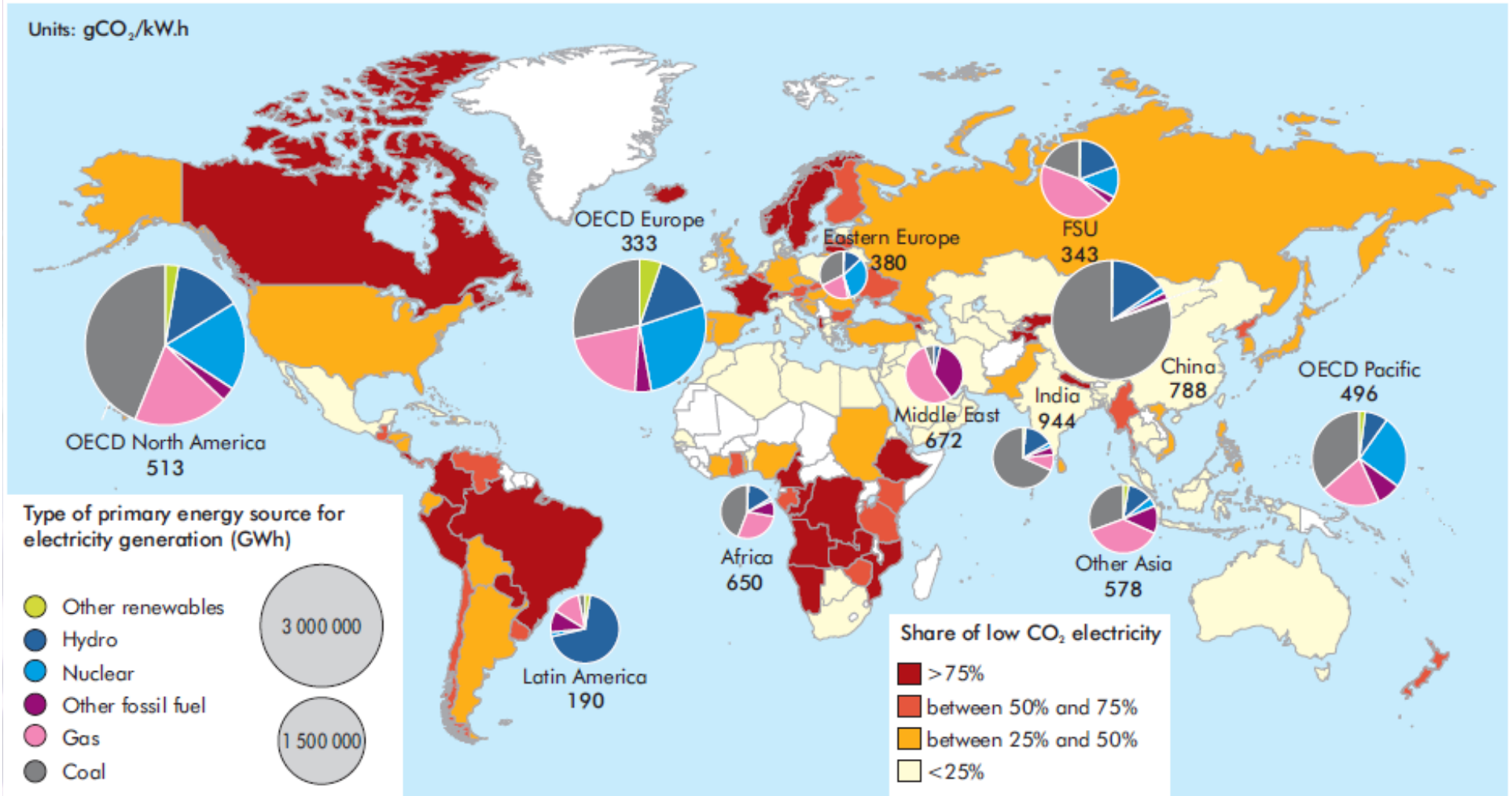
- **Develop a common view on how an EV/PHEV “roll-out” could occur over next 10-20 years**
- **Identify key actions for governments, stakeholders**
- **Understand where international collaboration/coordination is needed**
- **Cover R&D, vehicle deployment infrastructure, investment requirements**
- **Workshop held in January 2009; draft report by end of June; publication of report by October**

Electricity CO₂ content today share of low CO₂ electricity

A few countries are ready for Evs to spread without negative GHG impacts

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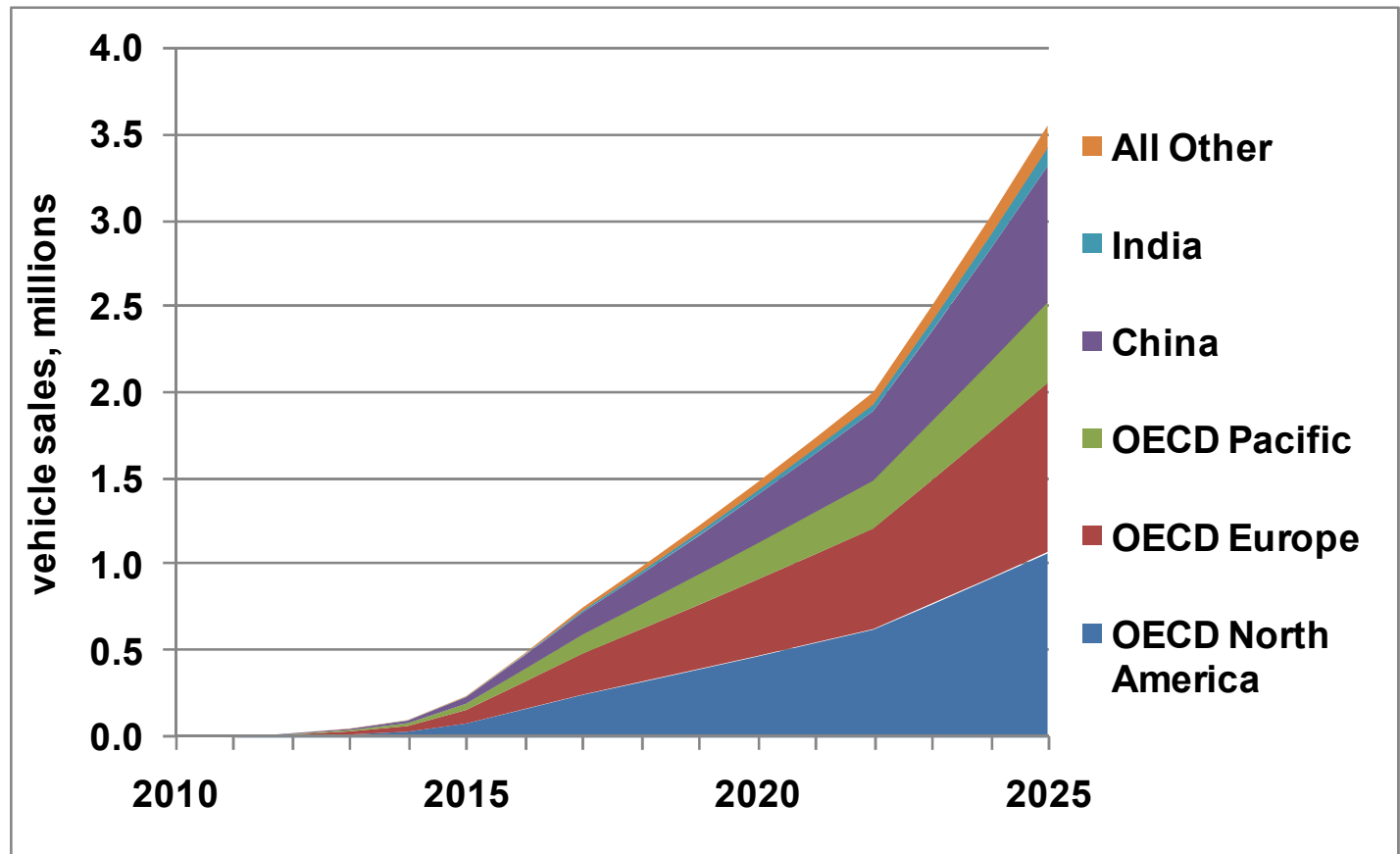
Units: gCO₂/kWh



Possible EV Sales trajectory to 2025 – can we do this?

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2015: 250,000: 10 models selling 25,000 each?

2020: 1.5 million: 20 models selling 75,000 each?

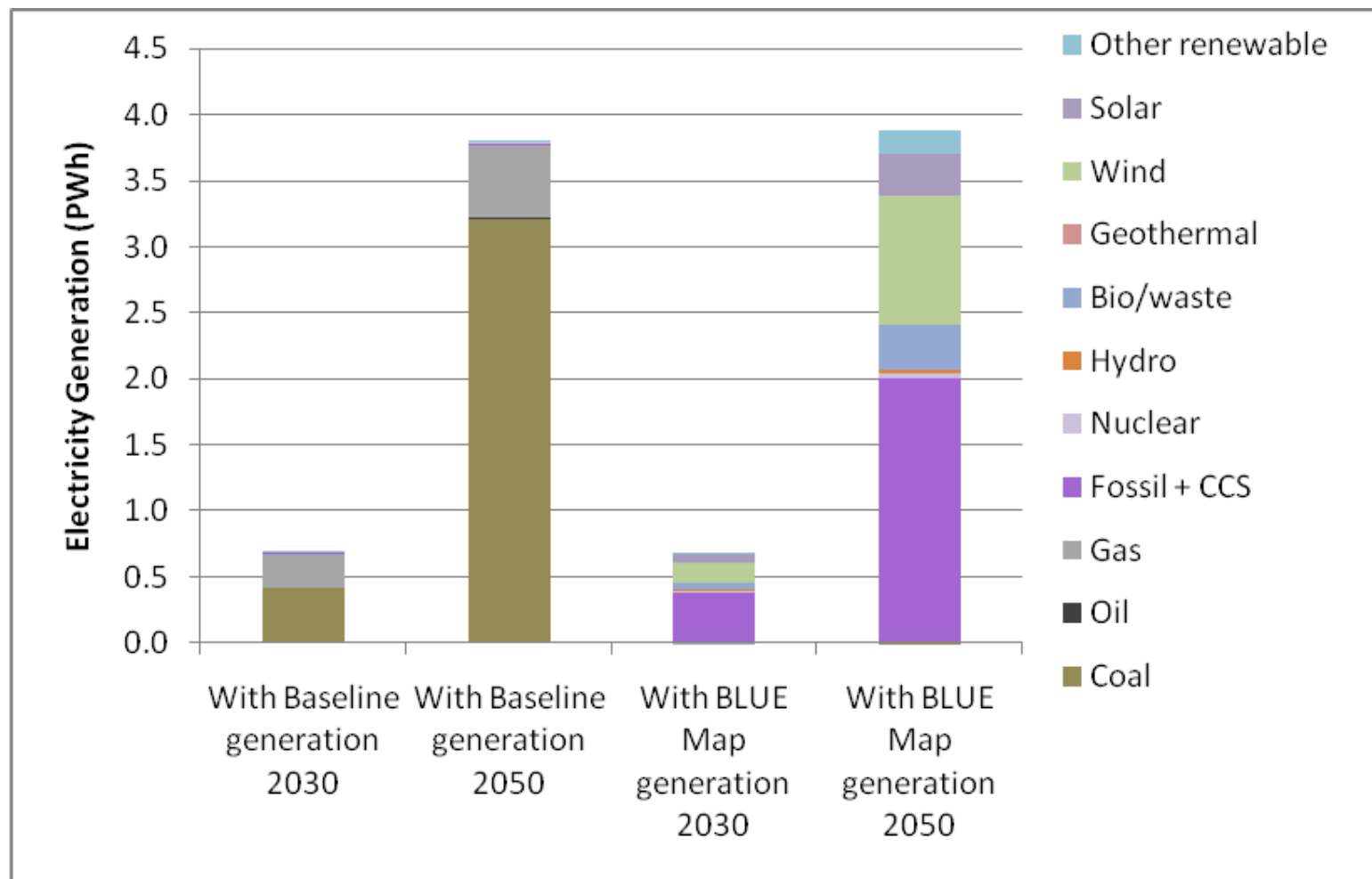
2025: 3.6 million: 30 models selling 120,000 each?

Incremental electricity generation for EVs and PHEVs in BLUE Map

Requires 7-10% more generation, but what kind will we get?

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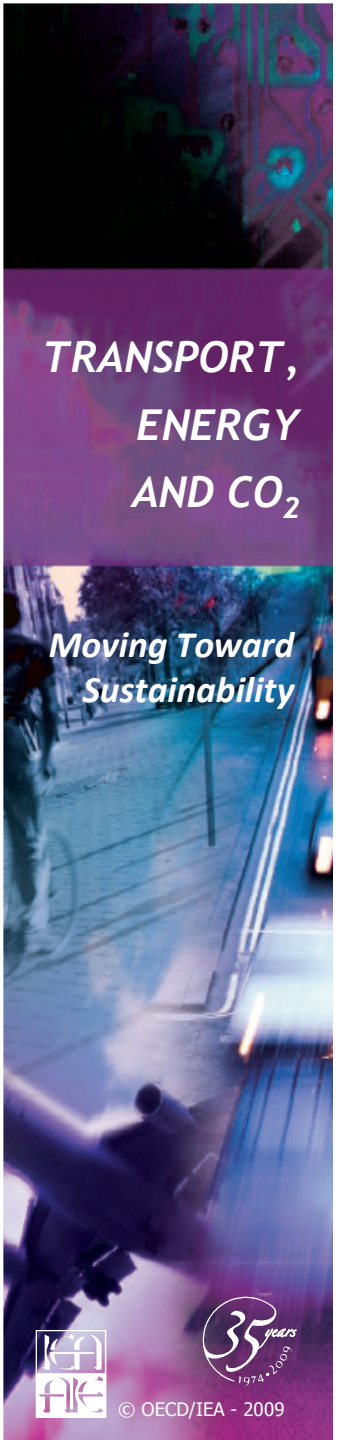
Issues with low-GHG / km LDVs

- **Manufacturing emissions then are not marginal any longer**

	CO ₂ emitted during vehicle lifetime (in tCO ₂)	2005	2030	2050
Baseline	GHG From Production	5	5	4
	GHG from Use	50	33	32
	Share from production	10%	15%	14%
BLUE Map	GHG From Production	5	3	2
	GHG from Use	50	14	2
	Share from production	10%	22%	100%

Note: GHG from production of vehicles in BLUE map represents a rough estimate. GHG from production for Baseline, vehicle lifetime, average fuel economy and annual travel from IEA Mobility Model.

- **WTT emissions are also getting more important as alternative fuels spread (especially with EVs and FCVs)**
- **Labelling and energy consumption information to consumer will need to take that into account**



Issues with low-GHG / km LDVs

■ Tramways / metro projects

Region	Rail system Type		Total
	Metro	LRT / Tram	
OECD Europe	25	62	87
OECD NA	5	12	17
OECD Pacific	1	3	4
Africa		3	3
Other Asia	3	4	7
China	5		5
Eastern Europe	2		2
India	4		4
Latin America	3	2	5
Middle East	1	3	4
Russia	1	1	2
Grand Total	50	90	140

Source: Railway-Technology.com.

- Numerous BRT projects expanding or being created
- Ensure long-term sustainability of mass transit vs. clean personal vehicles

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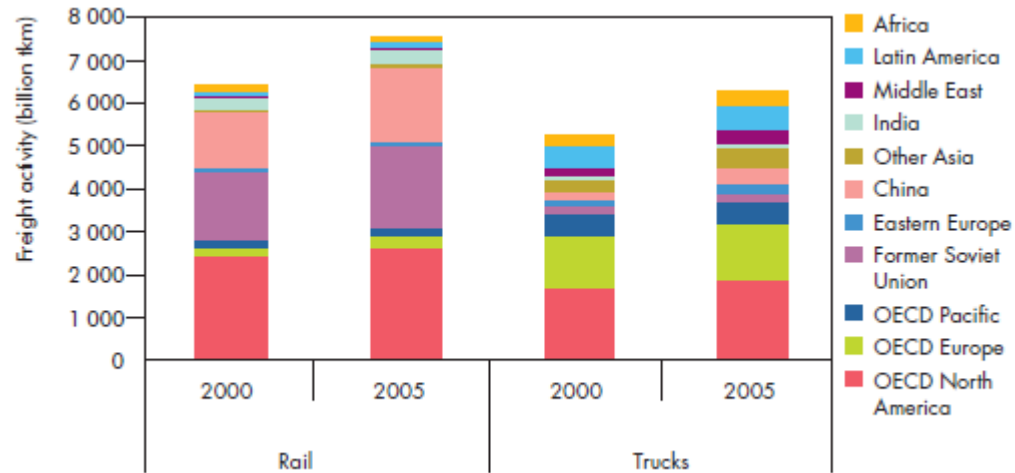
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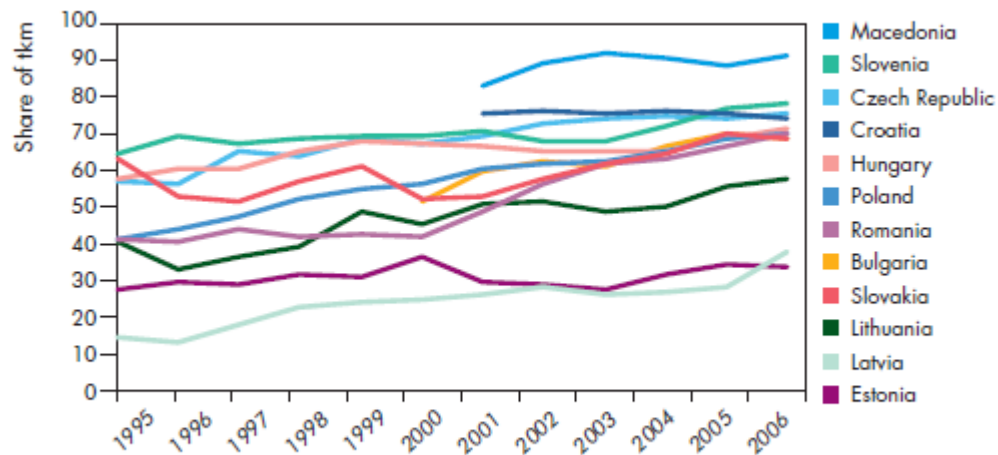
Freight Land Transport

- Rail dominates land freight transport (in tkm), but :
 - It is concentrated in a few countries



- It concerns a few raw materials, mainly coal
- It is losing ground over trucks

Figure 6.14 ► Road share of inland freight transport in Central/Eastern Europe



Note: includes road, rail and inland waterway.
Source: Eurostat.

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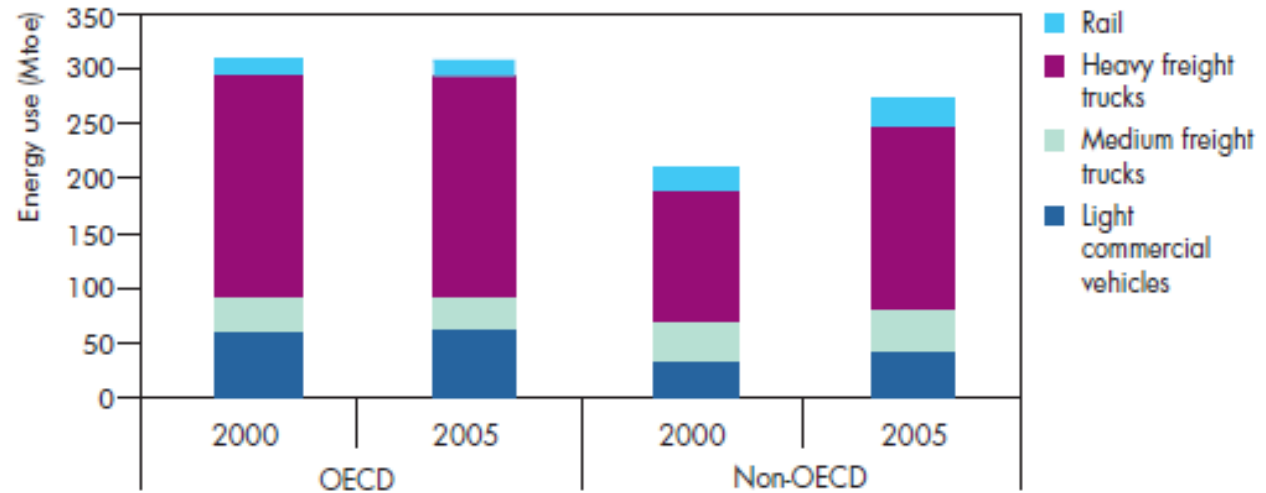


35 years
1974-2009

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Freight Land Transport

- Rail freight energy use is a fraction of Road freight energy use



			2005	2030		2050	
				Baseline	BLUE Map/Shifts	Baseline	BLUE Map/Shifts
Traffic evolution	absolute	% of tkm vs 2005		37%	35%	58%	54%
	per GDP	% of tkm vs 2005		-46%	-47%	-59%	-61%
Mode Shares	Road	%of tkm	46%	49%	44%	51%	43%
	Rail	%of tkm	54%	51%	56%	49%	57%
Efficiency improvement	Trucks	% of L/100km reduction vs 2005		-18%	-25%	-22%	-35%
	Freight Rail	% of MJ/tkm reduction vs 2005		-11%	-19%	-20%	-36%
Biofuels Share of liquid fuels	Trucks	% of Energy use	0.6%	2.8%	10%	2.9%	41%
	Rail	% of Energy use	0%	1%	10%	2%	40%

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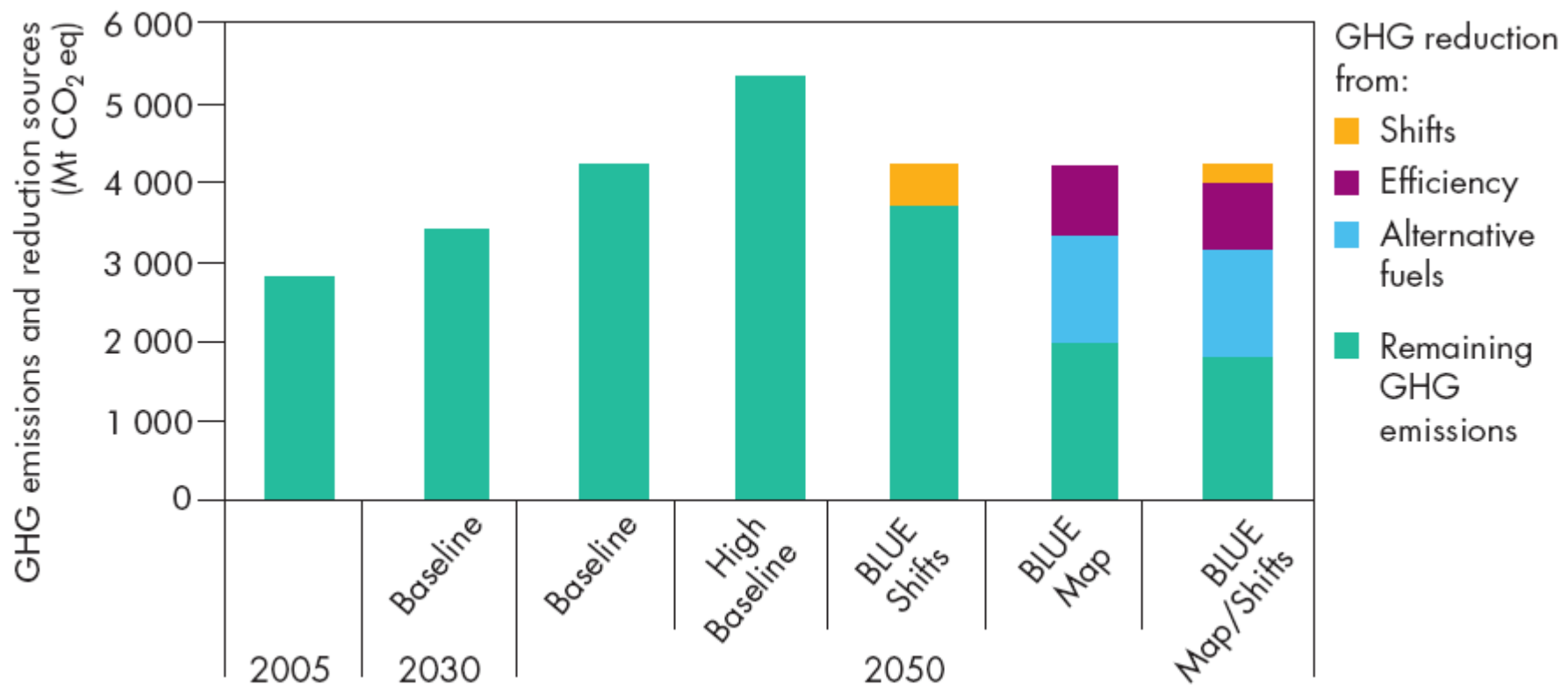


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Freight Land Transport Projections

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- Shifting potential expected to be limited
- Most GHG reduction comes from alternative fuels (2nd generation biofuels and rail electrification mainly)



Key Findings

- **Baseline (WEO Reference Case) transport fuel use 80% higher by 2050; a new High Baseline reaches 25% higher energy use in 2050**
 - **Mainly dependent on car sales projections and freight sensitivity to economic growth**
- **Fuel economy improvement remains among most cost-effective measures**
 - **Can reach 50% improvement for LDVs and 30-50% for other modes by 2050 or before**
- **Alt fuels still critical, though biofuels concerns growing; electrification may be key**
 - **Biofuels still important but concerns about sustainability are growing; a roadmap for achieving 2050 levels in BLUE is needed**
 - **Costs for batteries and fuel cells are dropping; EVs may reach commercial production very soon**
 - **PHEVs appear to be a promising transition strategy**

Key Findings (cont.)

- **Additional reductions can come from changes in the nature of travel**
 - **Modal shift analysis suggests that a 25% reduction from 2050 Baseline is feasible (almost 50% compared to High Baseline), though more work is needed on the costs and policies to get there**
 - **Technologies such as Bus Rapid Transit will be important, but ultimately its about land use planning and a comprehensive approach to travel policies.**
- **Together modal shift, efficiency improvements and alt fuels could cut transport CO2 by 70% compared to baseline in 2050 (30% below 2005)**
 - **More technology cost work is needed for aviation and shipping, but initial assessment suggests that many relatively low cost opportunities may be available.**
 - **For LDVs, 80% reduction in CO2 by 2050 at under 200 USD/tonne in that year**

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Um, Policies?

- **Clearly we will need strong policies both internationally and at national levels (and local!)**
 - (cross sectoral) cap and trade – yes, but time to implementation might be long
 - Carbon price, yes – but \$50/tonne is only \$0.12/litre for gasoline
- **National measures should include:**
 - Fuel economy standards on all types of vehicles – 30-50% reductions in energy intensity by 2050 seem possible for most
 - 2nd Gen Biofuels – yes – but we should not push this too fast! Low carbon fuel standards can help
 - EVs/FCVs but relatively high cost and massive infrastructure investments and coordination will be needed
 - ◆ PHEVs as an incremental approach
- **Local level - land use/ modal shift policies (but national gov's can encourage)**

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