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What Do Energy and GHG Scenarios Tell Us?

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Outline of talk:

- Global energy/CO projections overview
- Transport in global projections
- Fuel use and implications
- Oil supply and demand
- Costs and policies

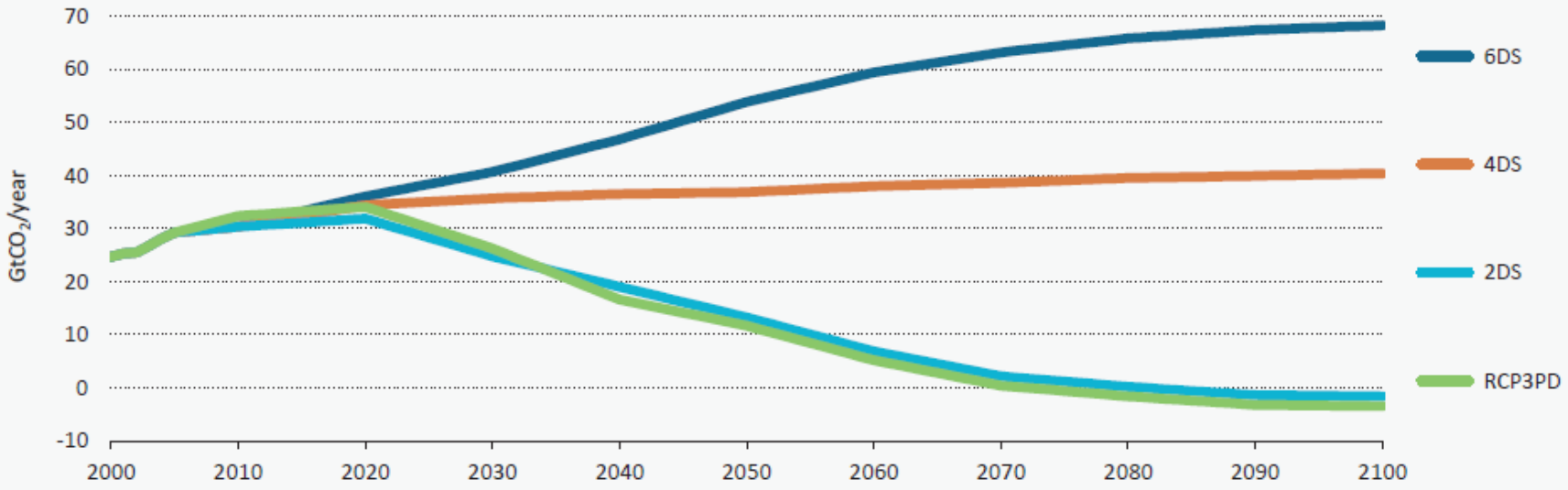
Reports covered in this presentation:

Study	Projection year	Geographic coverage
IEA, Energy Technology Perspectives 2012	2050	World
IEA World Energy Outlook 2012	2035	World
Global Energy Assessment (IIASA et al) 2012	2100	World
Shell New Lens Scenarios (2013)	2050	World
BP World Energy Outlook (2013)	2030	World
NRC 2013: Transitions to Alternative Vehicles and Fuels	2050	United States
UC Davis …various work…		

IEA Energy Technology Perspectives (ETP) 2012

Three different CO2 trajectories to 2100

Figure 16.1 Long-term energy-related CO_2 emissions derived from ETP scenarios and compared with RCPs.



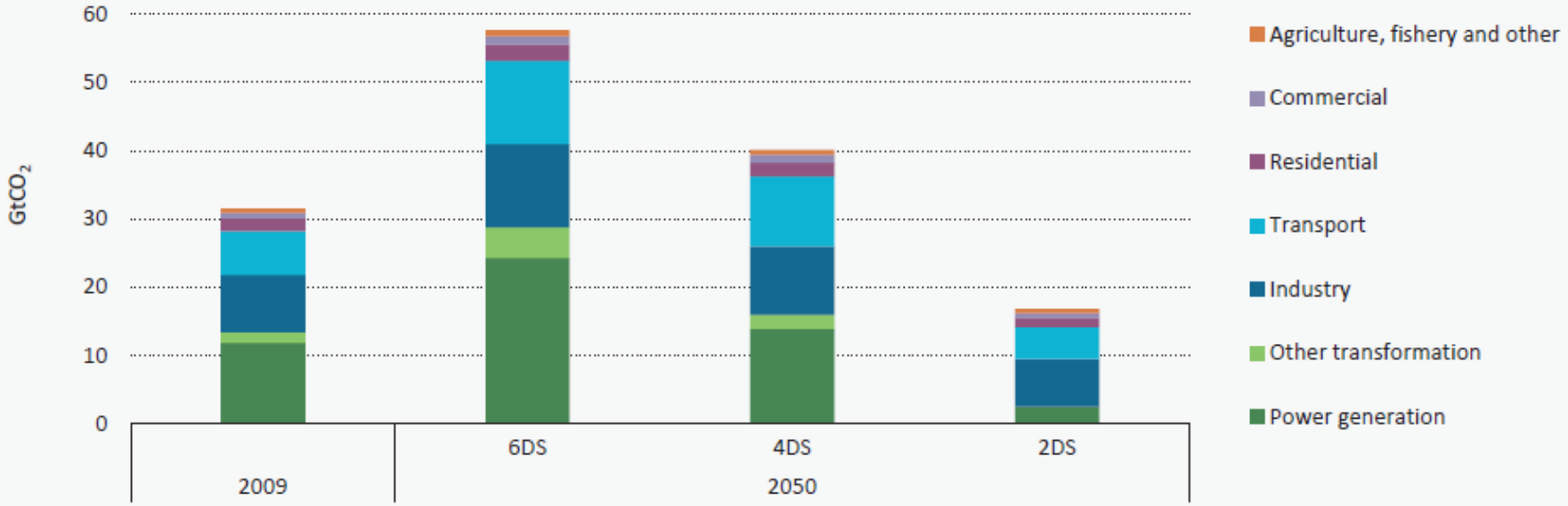
Source: Unless otherwise noted, all tables and figures in this chapter derive from IEA data and analysis.

Key point *Energy-related CO_2 emissions need to be completely eliminated by 2075 in order to limit global temperature rise to 2°C.*

IEA ETP 2012 – 3 different CO2 trajectories

Transport and industry have the most emissions in 2050 2DS, but transport is significantly lower than today

Figure 1.5 Global CO_2 emissions by sector and scenario



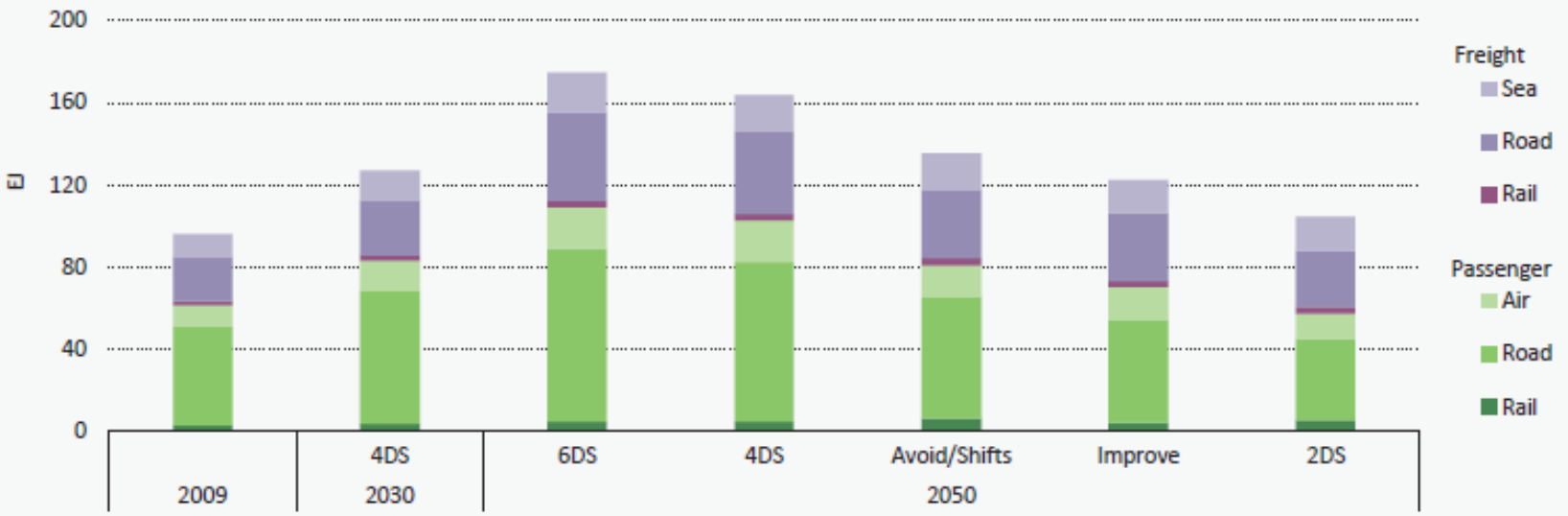
Note: CO_2 emissions in this graph are accounted for in the sector, where the CO_2 is physically emitted.

Key point *Decarbonising electricity is critical, but all sectors must contribute to emissions reduction.*

ETP-2012 transport scenarios

Combinations of shifts in travel and uptake of new vehicles/fuels can get us to 2DS

Figure 13.20 Energy demand in the transport sector by mode

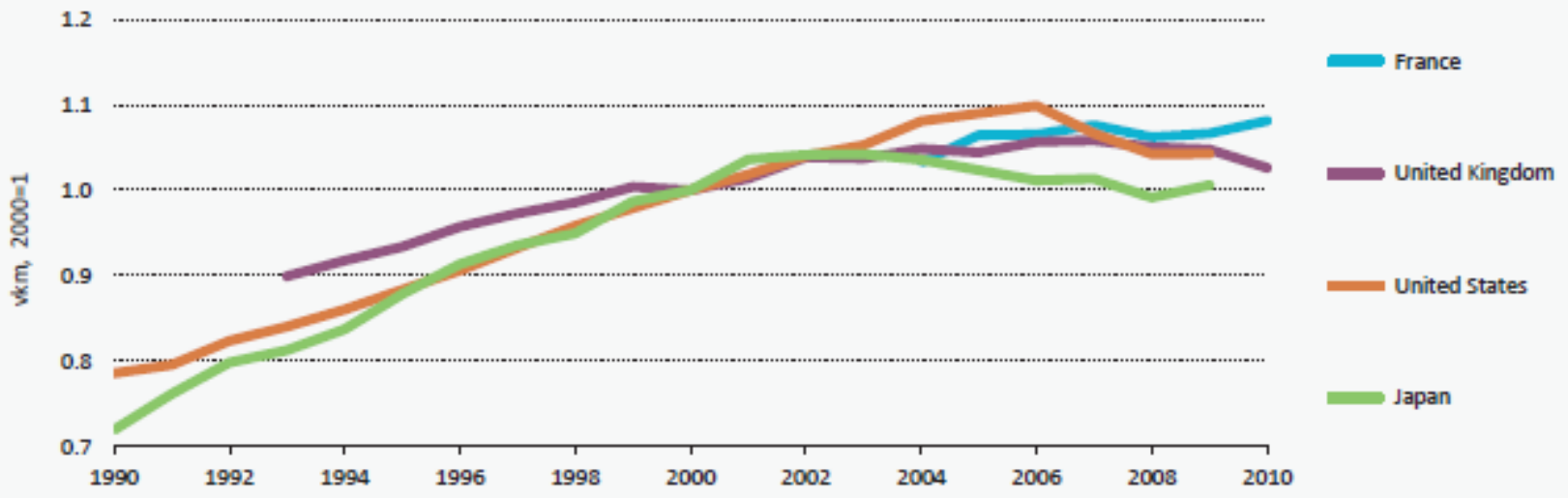


Key point *The 2DS reflects both travel* Avoid/Shift *changes and vehicle* Improve *changes, which combine for maximum fuel savings.*

IEA ETP 2012 – travel trends

LDV travel has flat-lined around OECD, but at a high level per capita, and will it last?

Figure 13.11 Passenger LDV travel for selected OECD countries, indexed to 2000

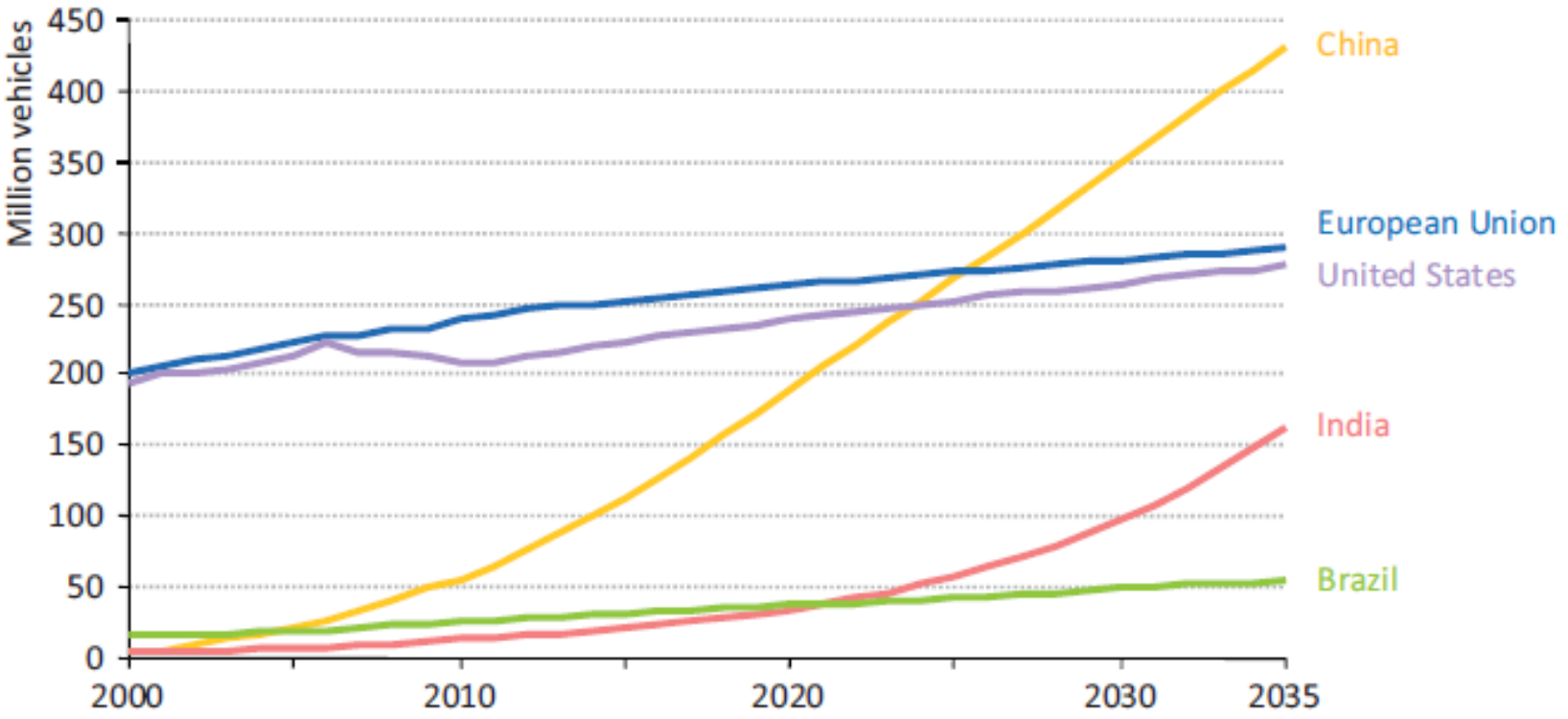


Key point *Key point: Vehicle travel began to flatten or even decline after 2000, suggesting "peak" travel may be occurring in the OECD.*

IEA WEO 2012: heading toward 2 billion cars

OECD is fairly saturated, but rest of the world is not.:

Figure 3.6 ▷ PLDV fleet in selected regions in the New Policies Scenario



Global Energy Assessment 2012

Passenger travel could quadruple over the century

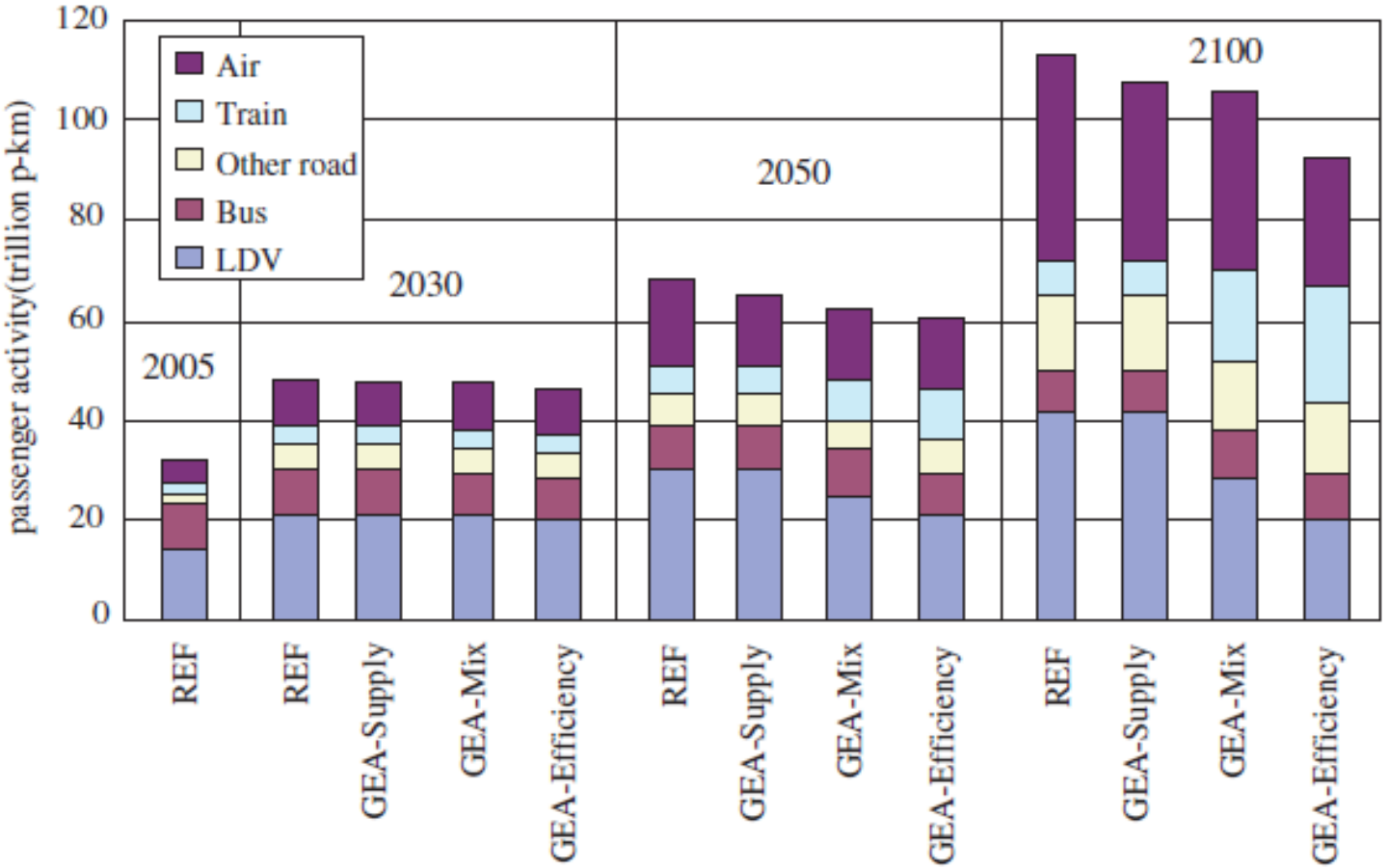


Figure 9.39 | Growth of passenger transport activity.

GEA, 2012: *Global Energy Assessment - Toward a Sustainable Future*, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.

GEA: CO2 reduction scenarios for LDVs

Many ways to get there…

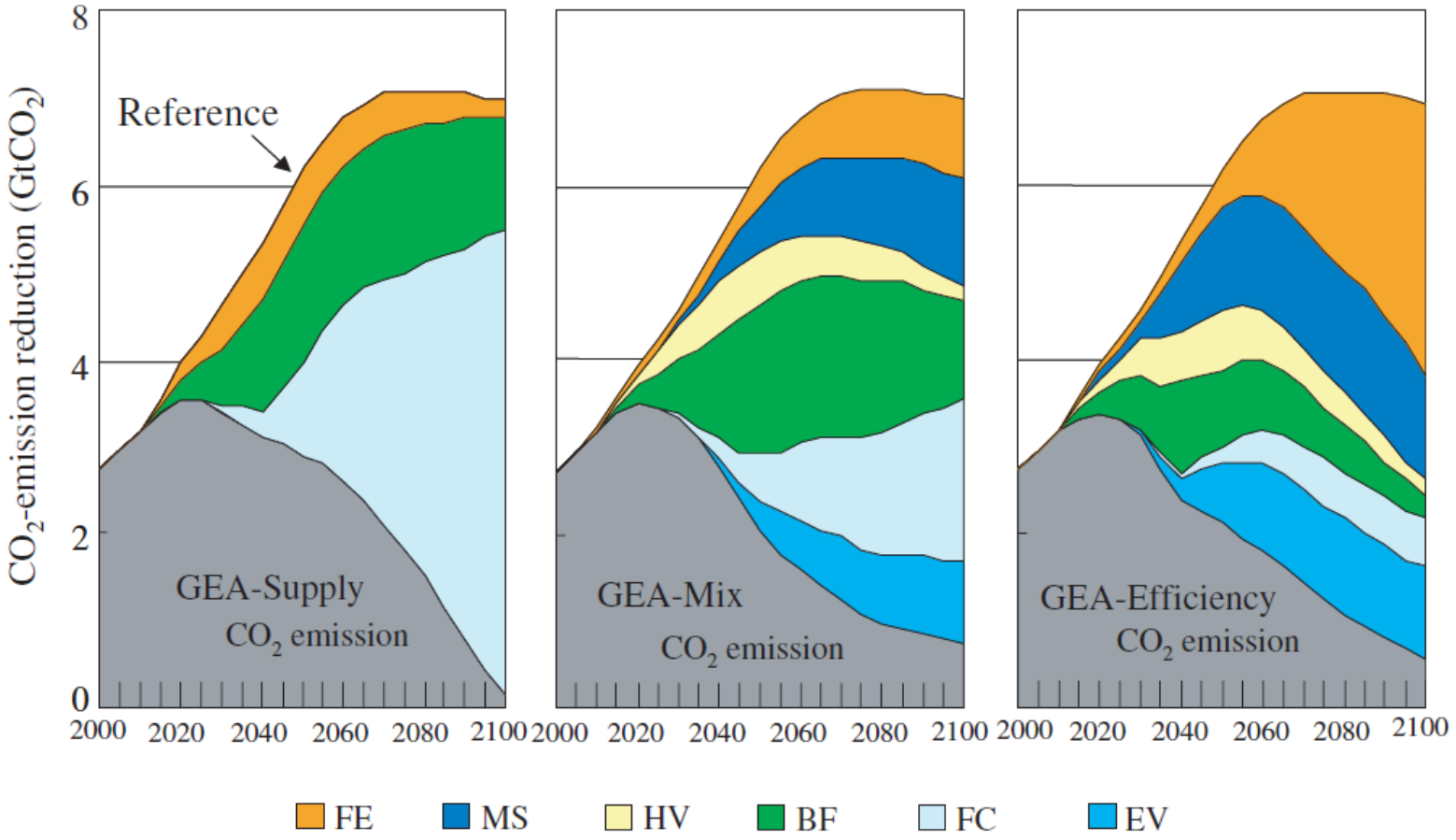
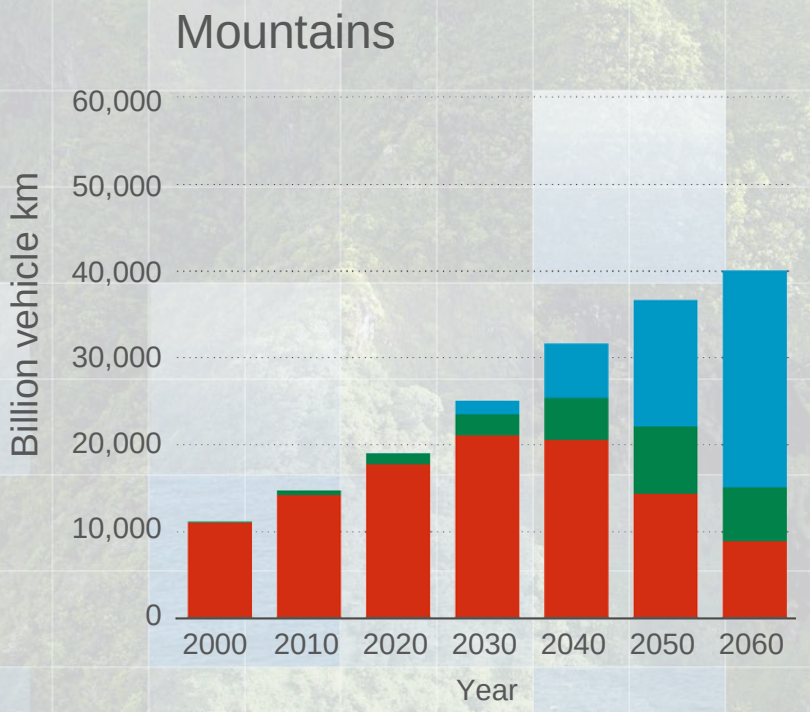
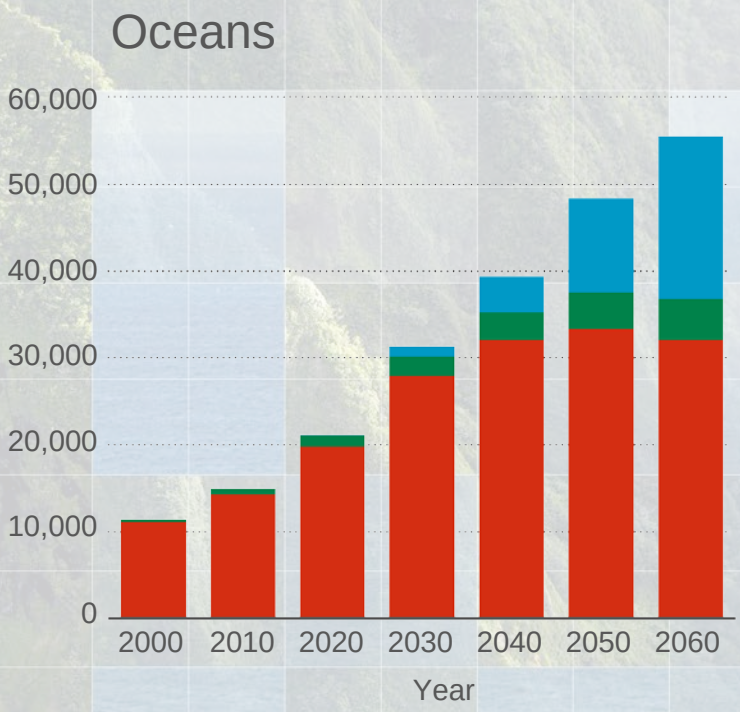


Figure 9.46 | Reduction of well-to-wheel CO_2 emissions for LDVs from reference scenario in GEA (FE: Fuel efficiency, MS: Modal shift, HV: Hybridization, BF: Biofuel, FC: Fuel cell, EV: Electric vehicle).

GEA, 2012: *Global Energy Assessment - Toward a Sustainable Future*, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.

Shell Scenarios 2013
Scenario Contrast: World passenger transport

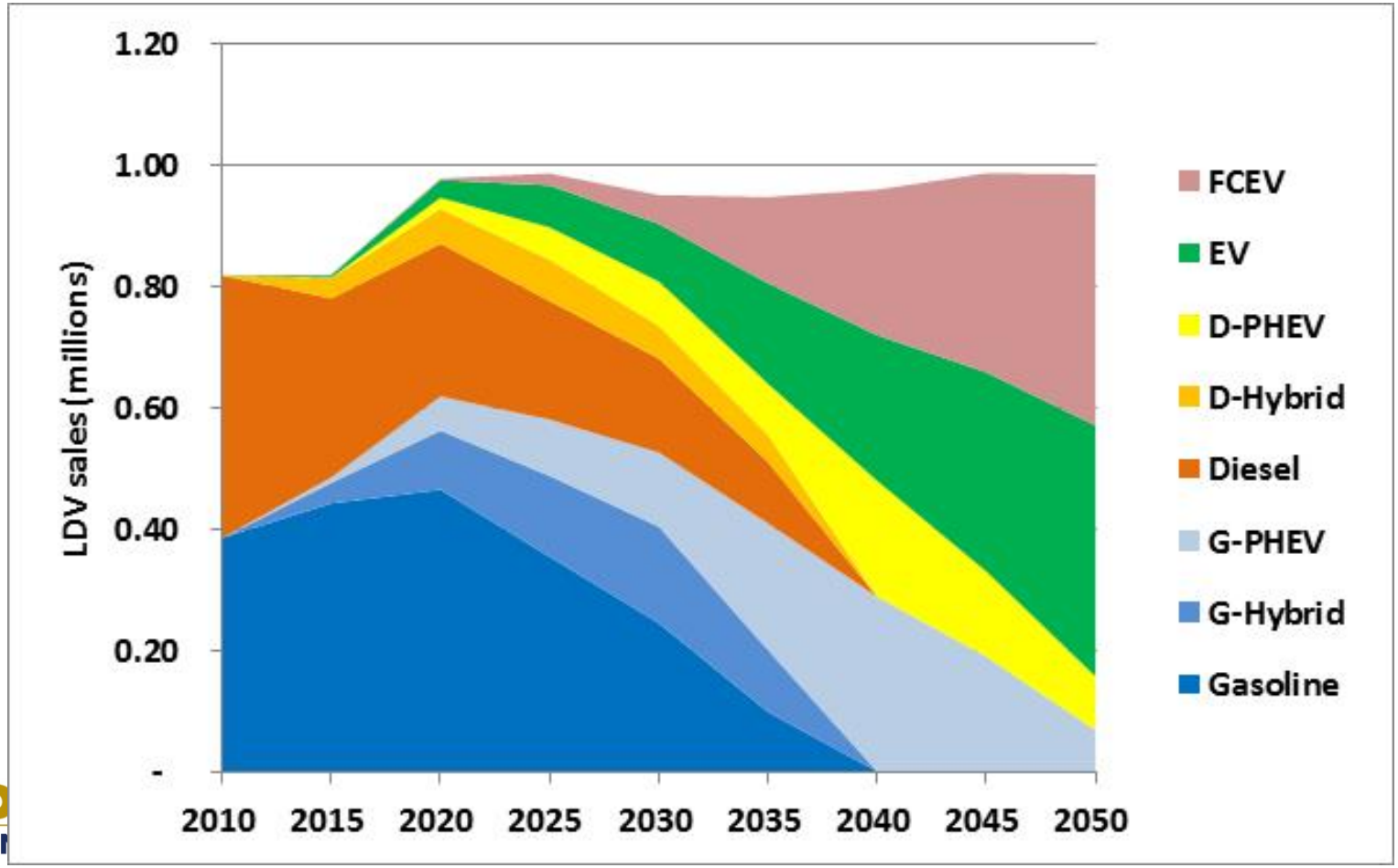




Combined with the impact of higher economic development, *Oceans* sprawling suburbs lead to higher travel needs than *Mountains* compact cities

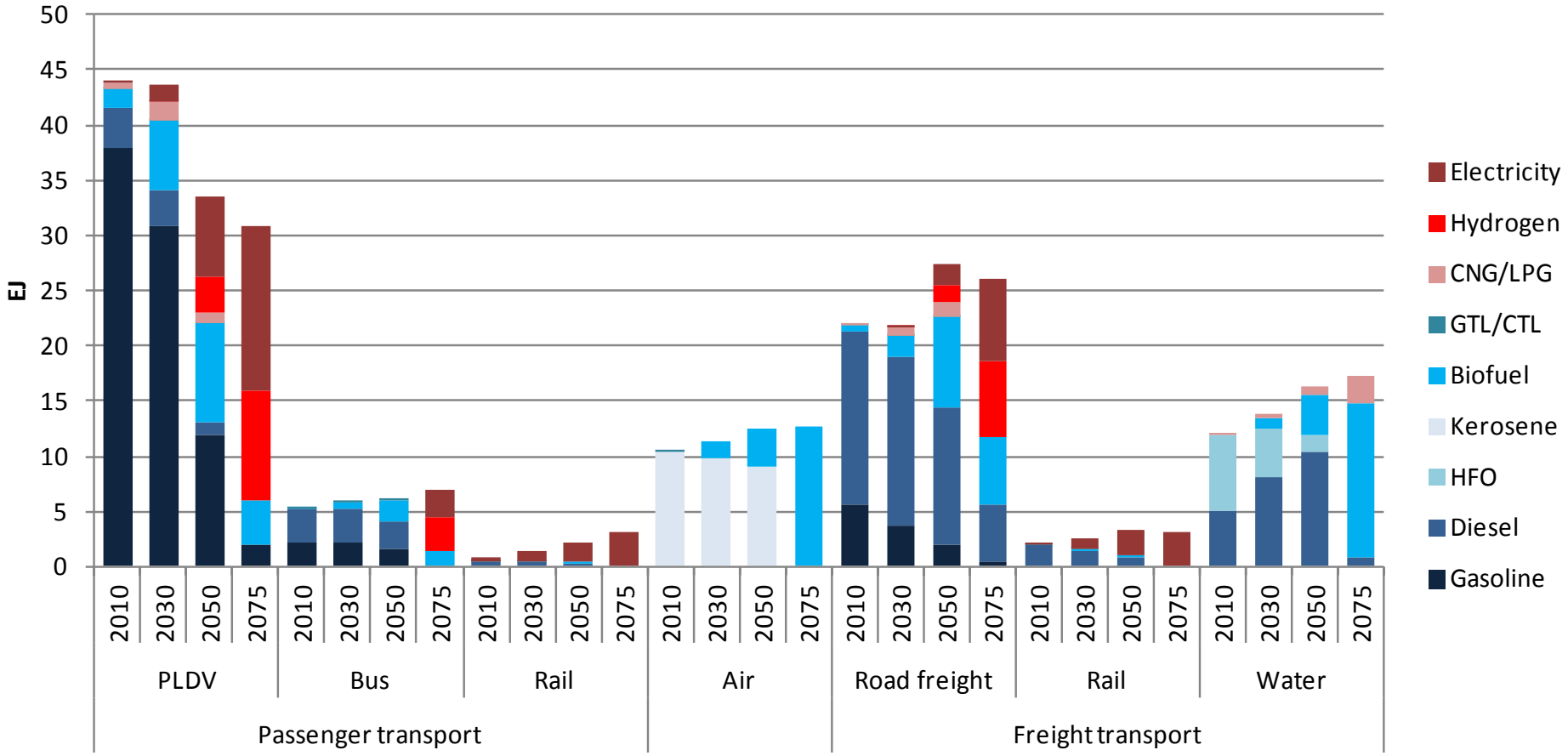
NextSTEPS Nordic Rapid Transition Scenario: LDV sales reaches 100% plug-in-capable by 2040

In RTS, plug-in electric vehicle sales shares grow rapidly after 2020; fuel cell vehicle shares after 2025; only plug-in and FCVs are sold after 2040.



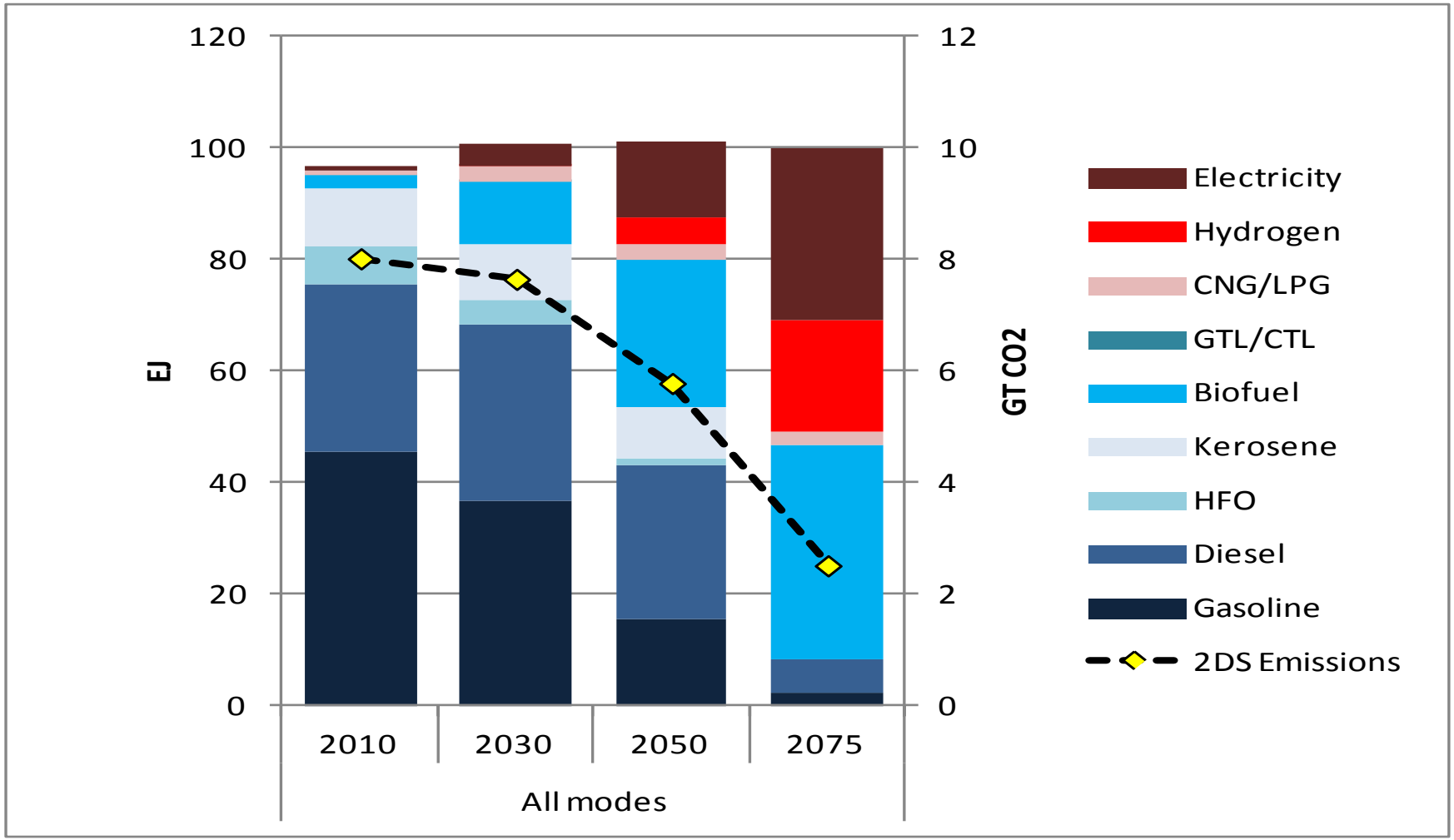
IEA ETP-2012 Extensions (Fulton et al, draft paper)

Lots of electricity and hydrogen by 2050 in some modes, but still a huge liquid fuels need



ETP-2012 extensions (Fulton et al draft paper)

Summary picture: 27 EJ of biofuels in 2050, 40 in 2075

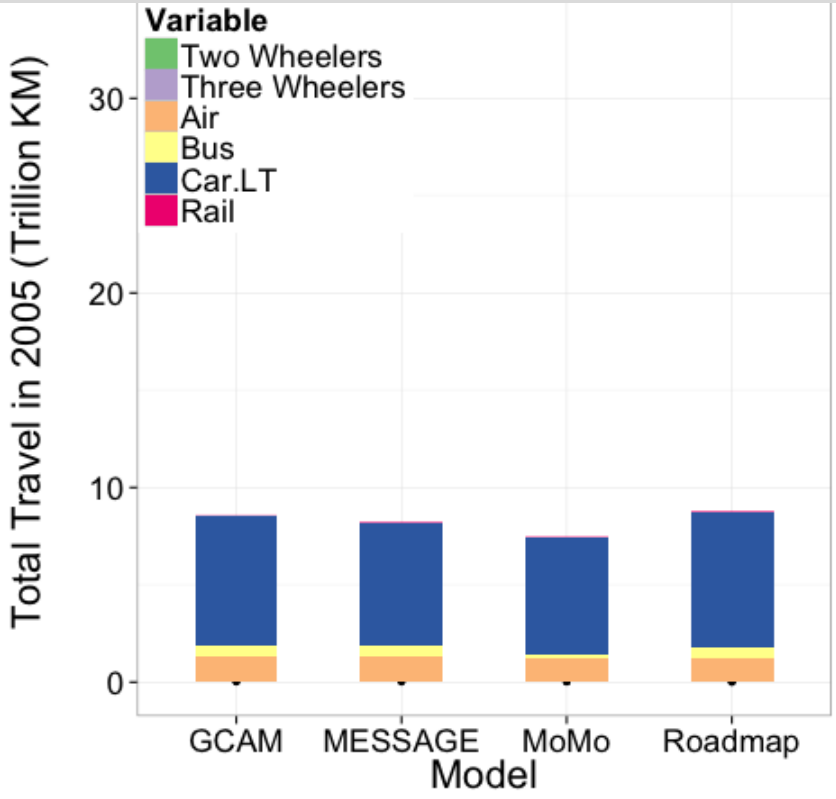


NEW!!! iTEM Project – VERY preliminary results

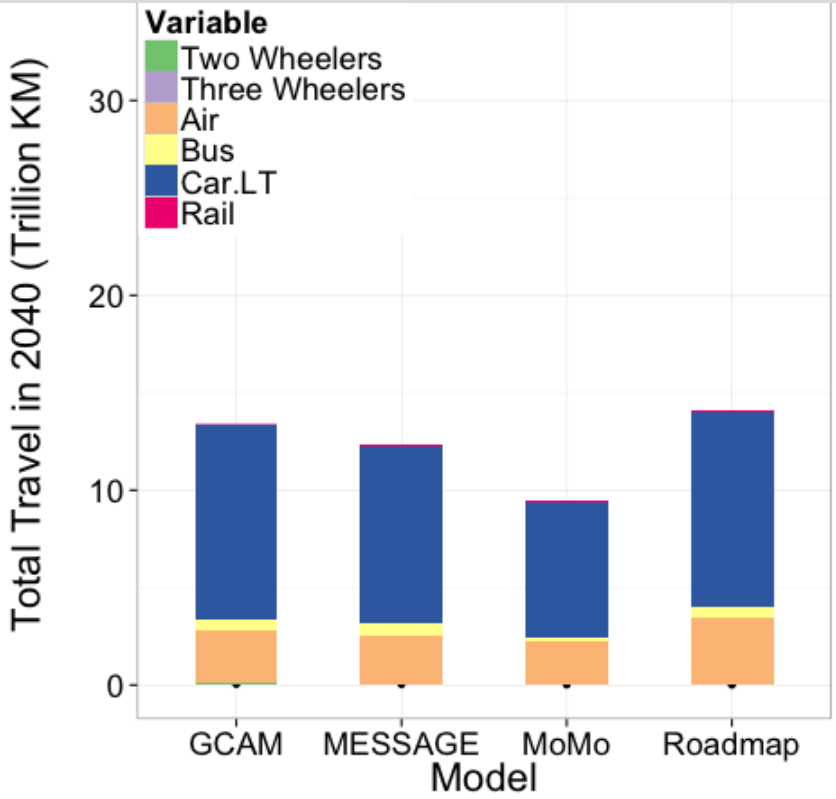
UC Davis, ICCT, PNNL, IIASA, IEA are comparing transport models and projections. Goals include comparison of historical data, basic drivers for projections, and transport activity/energy/CO2 projections under consistent assumptions. Some very early results here:

United States

2005

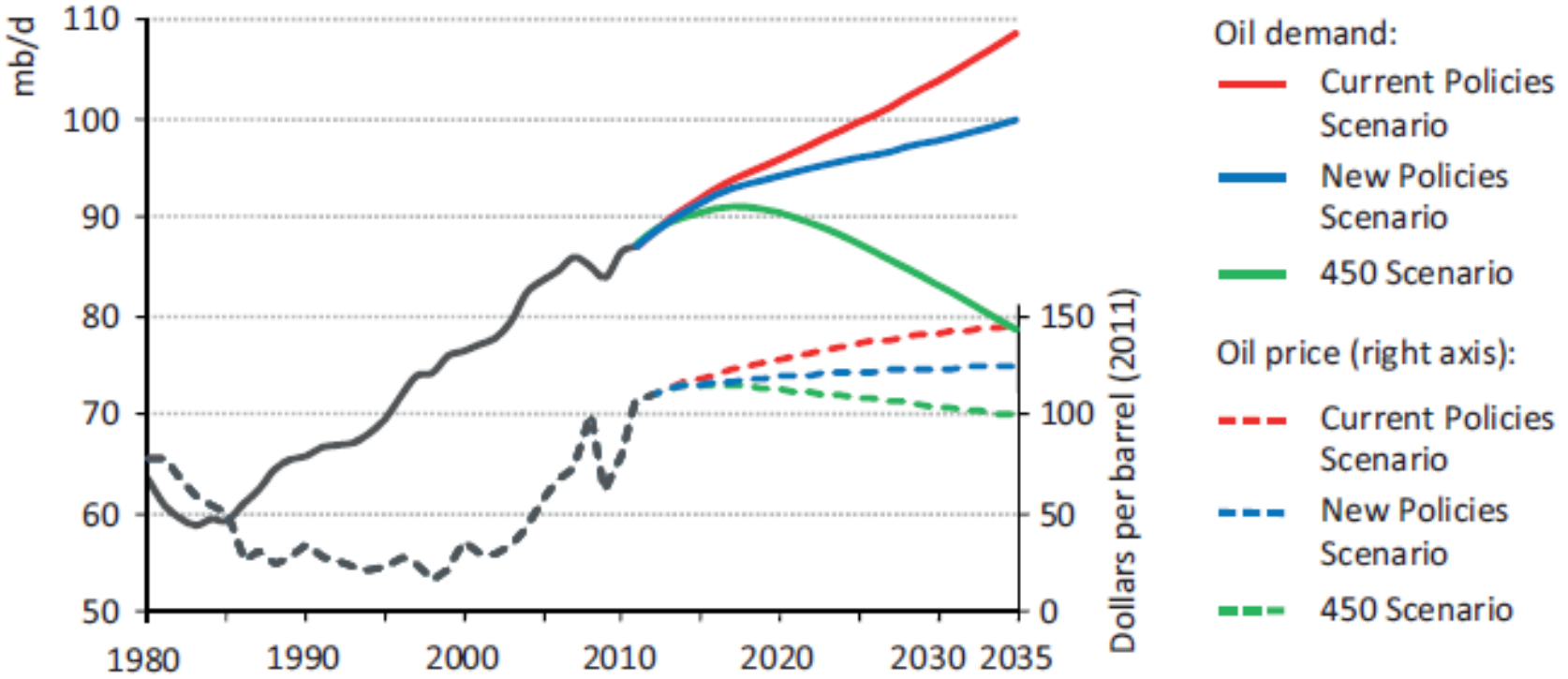


2040



Low CO2 Scenarios result in lower Oil Price

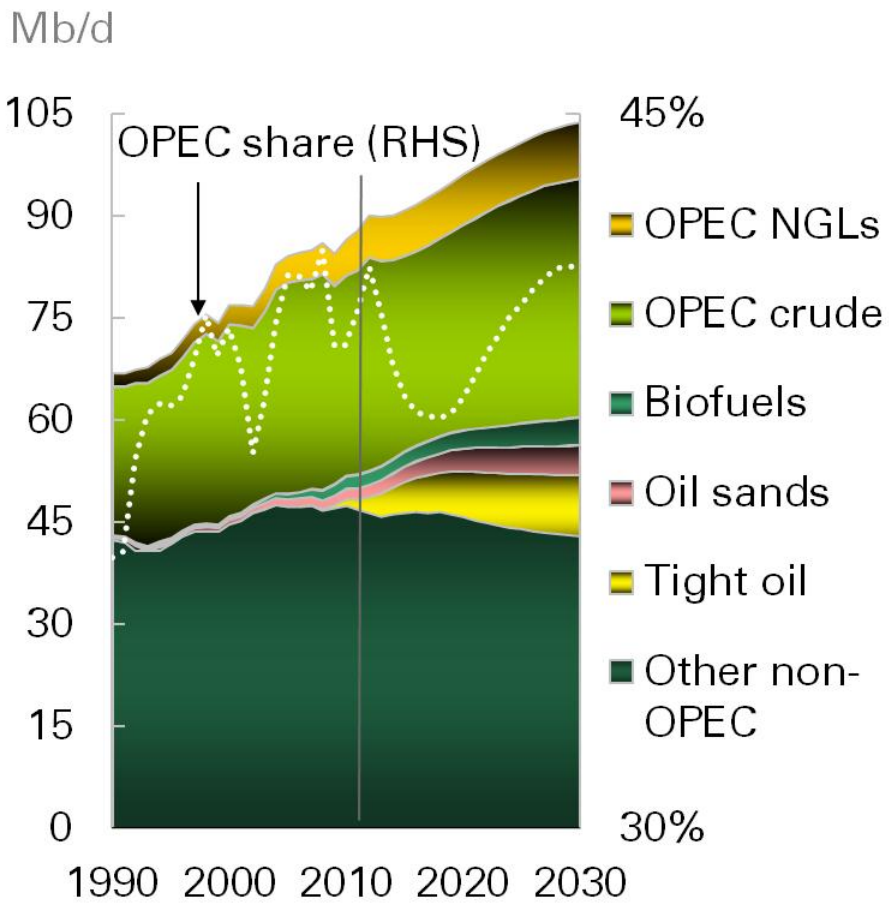
Figure 3.1 ▷ World oil demand and oil price* by scenario



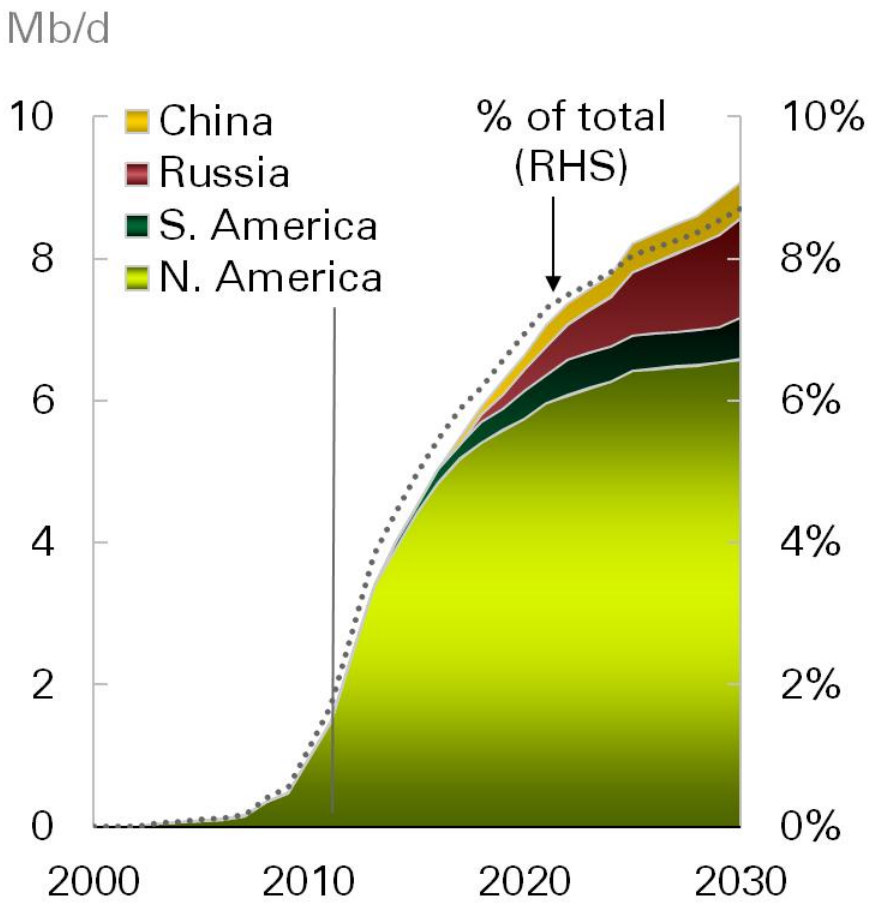
* Average IEA crude oil import price.

Tight oil will drive global supply growth…

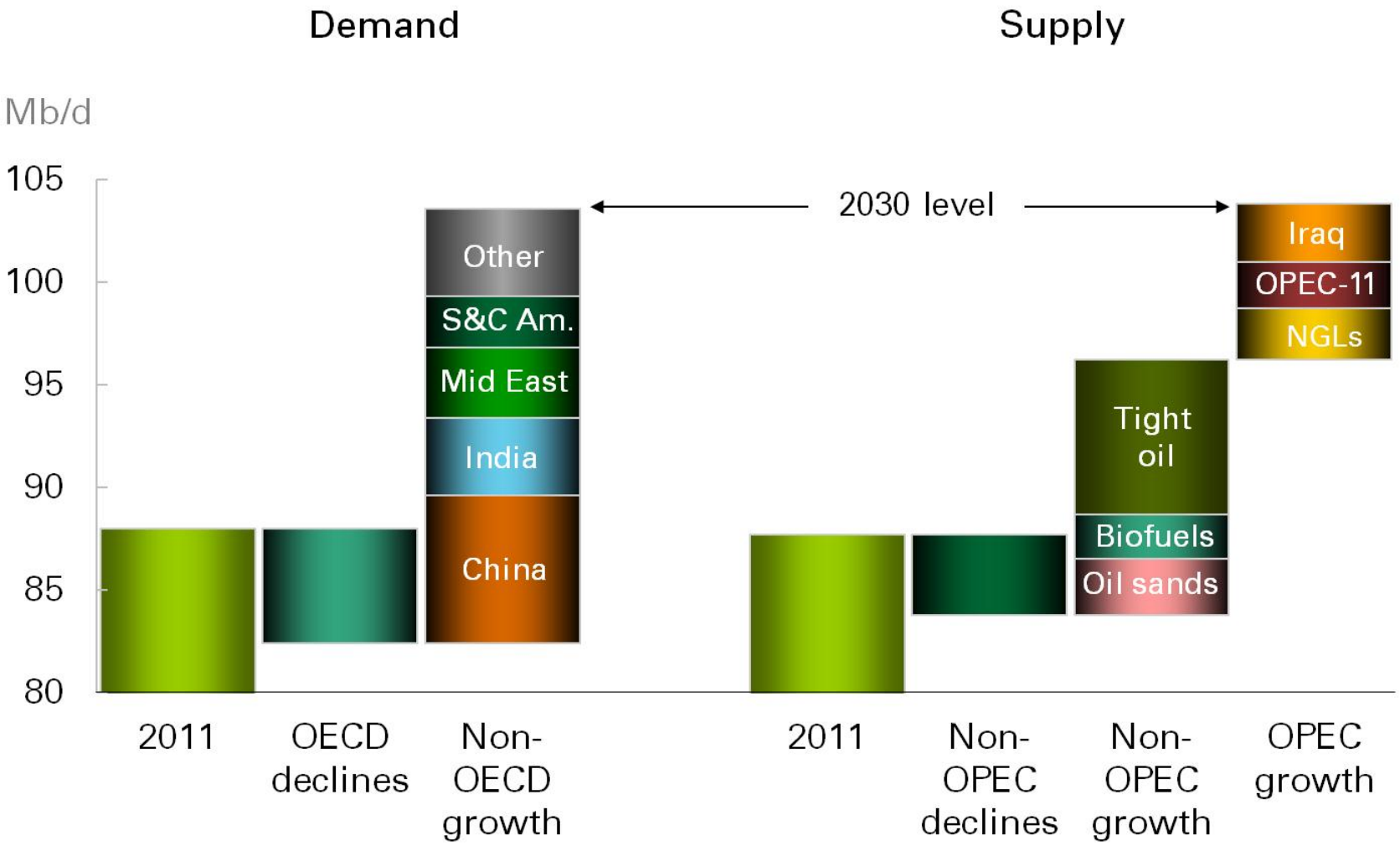
Liquids supply by type



Tight oil output



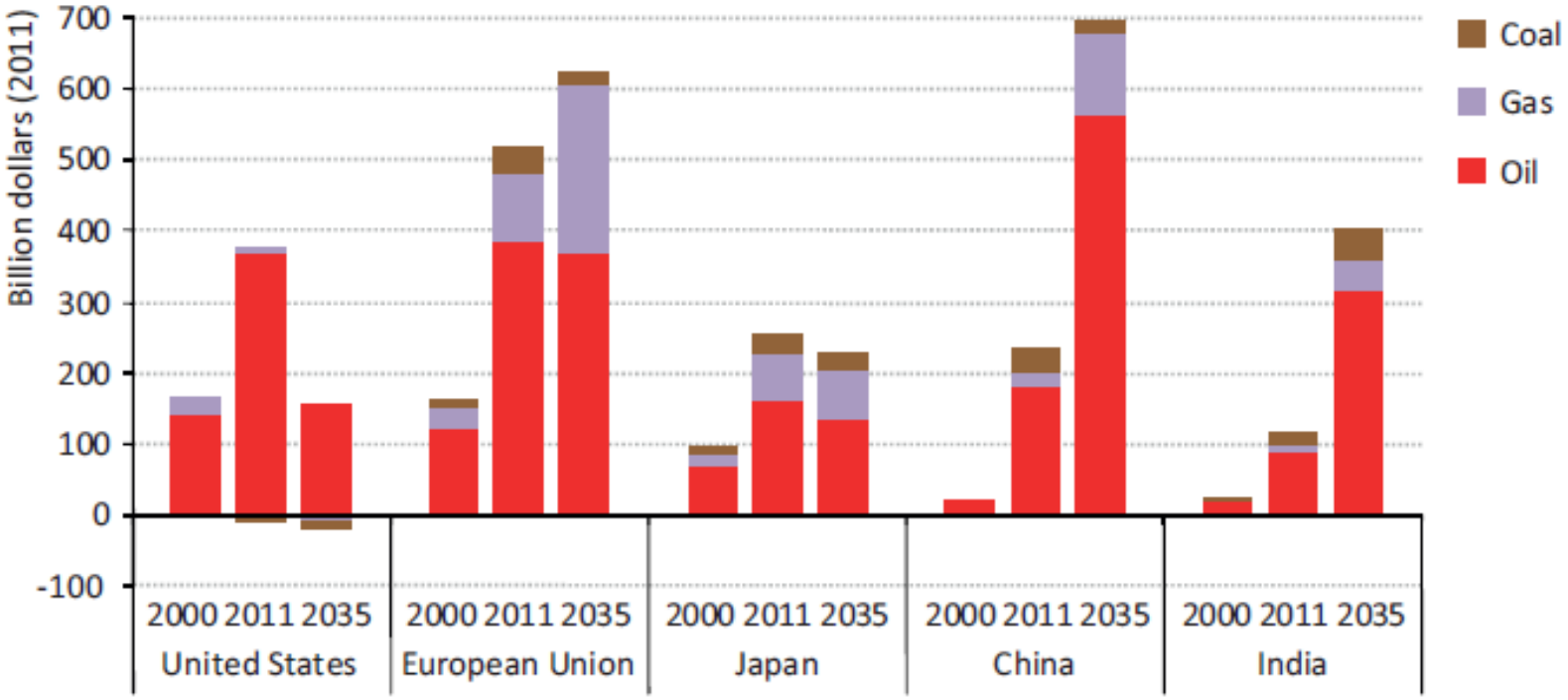
The global liquids balance reflects the shifts…



Lowering CO2 means lowering Oil Price

IEA WEO 2012:

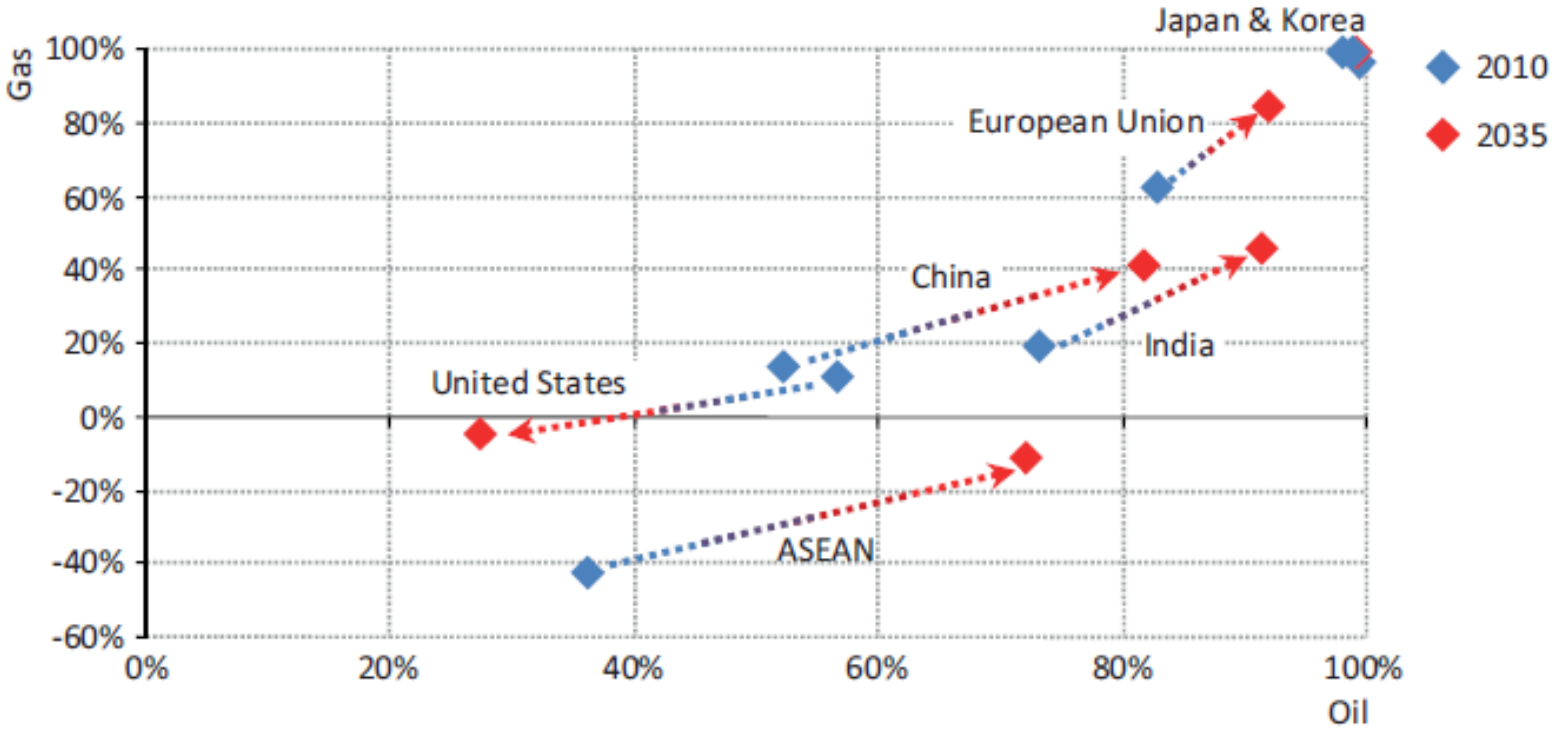
Figure 2.14 ▷ Spending on net imports of fossil fuels in the New Policies Scenario



Lowering CO2 means lowering Oil Price

IEA WEO 2012:

Figure 2.16 ▷ Net oil and gas import dependency in selected countries in the New Policies Scenario

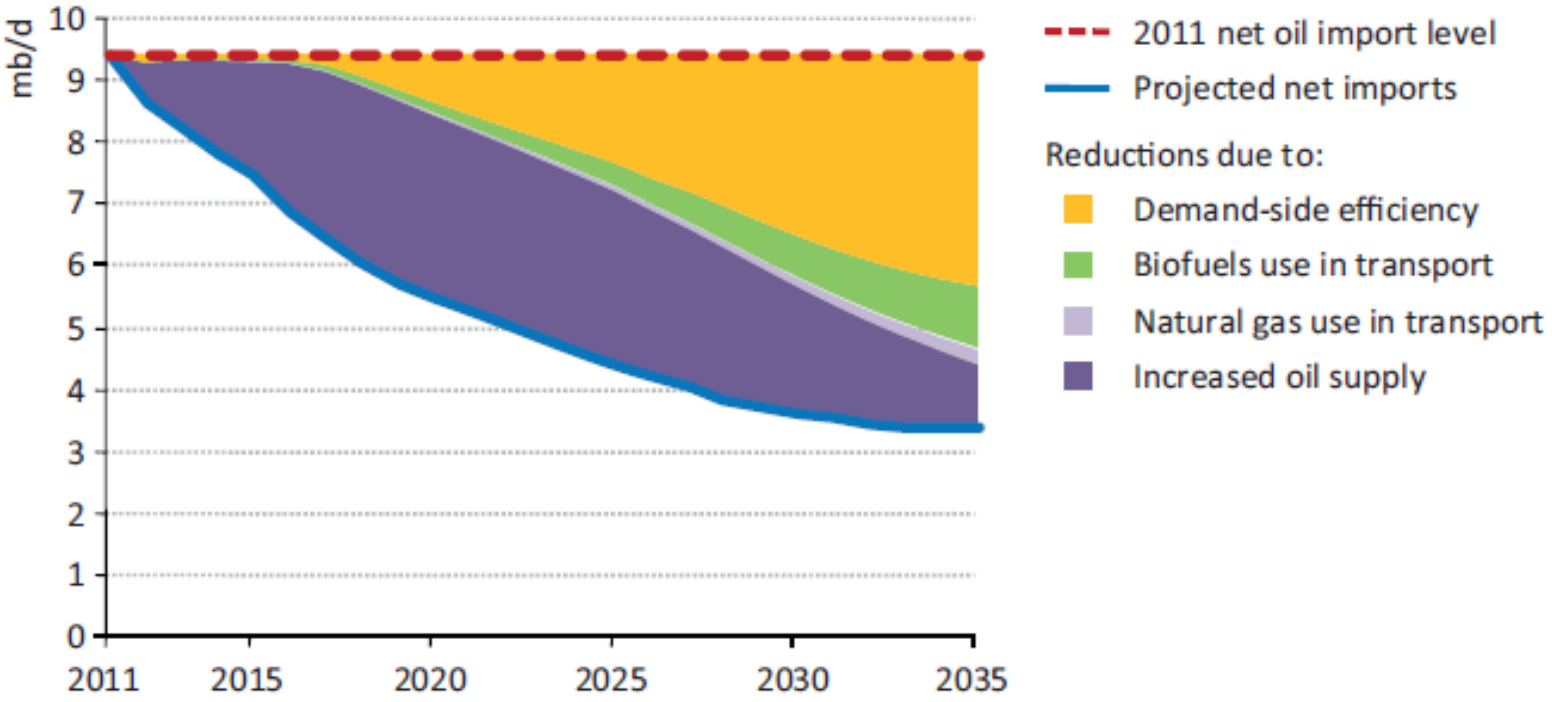


Note: Import dependency is calculated as net imports divided by primary demand for each fuel.

Lowering CO2 means lowering Oil Price

IEA WEO 2012:

Figure 2.17 ▷ Reductions in net oil imports in the United States by source in the New Policies Scenario

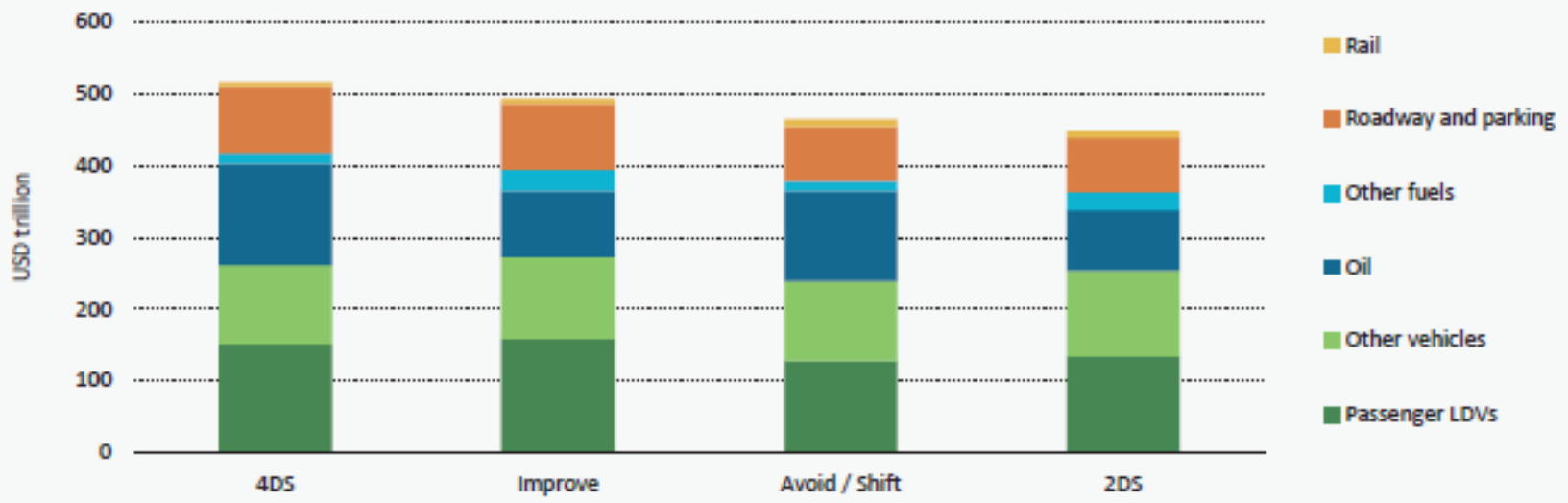


IEA ETP 2012 – Humans spend a lot on transport…

And sustainabilty could cost us less…

Total cost for vehicles, fuels and infrastructure 2010-2050 is now $500 Trillion…lower in 2DS because you need fewer vehicles and roads, and less fuel

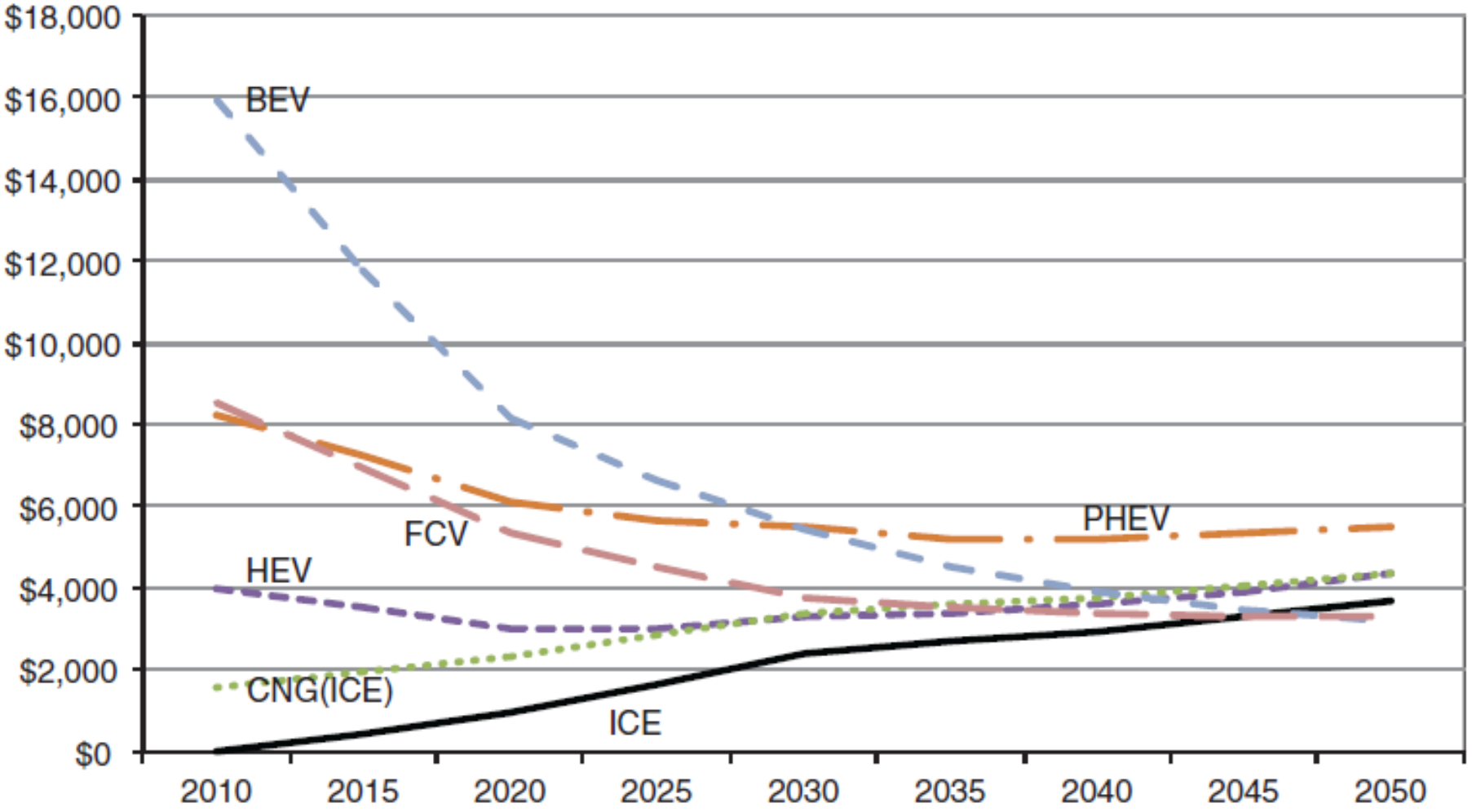
Figure 13.25 Cumulative transport costs, 2010 to 2050



Key point *The Improve case greatly reduces the expenditures on fuels, whereas the Avoid/Shift case cuts down infrastructure and vehicle costs.*

NRC 2013: Transitions to Alternative Fuels and Vehicles report

By 2040 technology costs converge…



NRC 2013 Figure 2.8 Car incremental cost versus 2010 baseline – midrange case

Transition costs in the US (Ogden/Fulton)

- *Assumes a very ambitious introduction of PHEV, BEV and FCEV LDVs in the United States (40M by 2030) along with large-scale introduction of advanced biofuels*
- *Using NRC-2013 cost projections, we estimate $100-300B to pay for all fuel infrastructure and vehicle buy-down costs through 2030*
- *Most or all returned in fuel cost savings*
- *The buy-down cost rises then falls, but averages around $10-20B/year*
- *In the US we pay close to $1 trillion per year for new cars plus fuel for all cars*
- *Can we afford 1-2% diverted for a transition to a low carbon fuel system?*

Final Thought – Policy Elements?

- *It seems we at least need:*
  - *To plan our cities/regions carefully and invest in alternative modes of transport*
  - *To have governments pay much of the buy-down costs for new technology vehicles and fuel infrastructure*
  - *Strong, long-term vehicle efficiency standards*
  - *Strong price signals – combination of fuel/carbon prices, vehicle prices (e.g. feebates), road/parking prices. This can also raise much needed revenue for investments*
- *Is this enough?*
- *How can we achieve "policy sustainability"?*