

FORECASTS FOR MOTOR VEHICLE AND OIL DEMAND TO 2030 AND 2050

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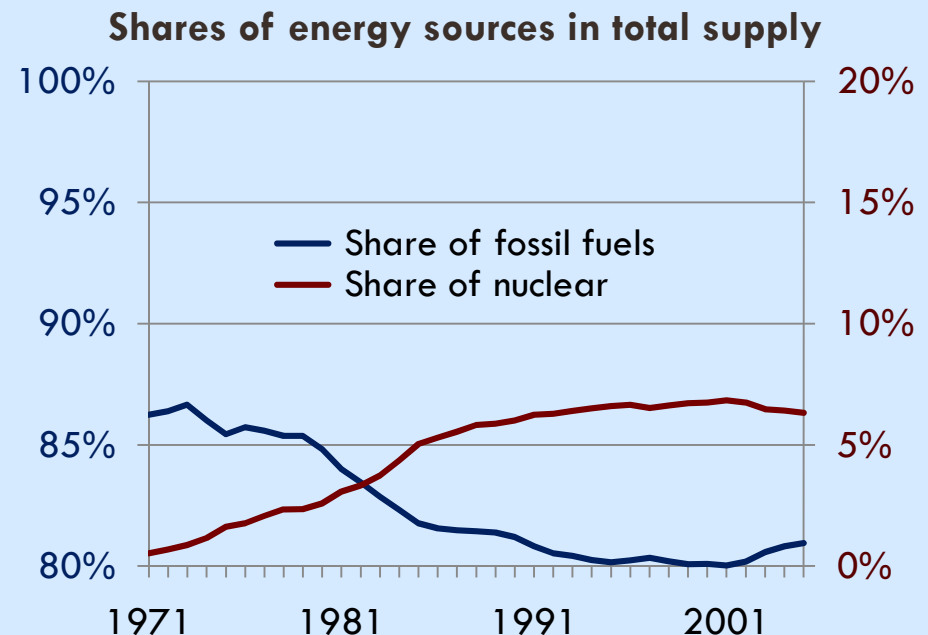
Where are we headed?

□ Rising energy demand

- If the development pattern of developing countries like China, India, Brazil, and countries in SE Asia will mimic (with adequate differences in terms of improved efficiency) the one followed by OECD economies, the world will experience an energy-intensive phase of economic growth

□ Rising emissions of GHG

- Looking at the past 30 years, a strong coupling between energy demand and CO₂ emissions is evident
- To date, only nuclear energy led to a significant reduction of the reliance on fossil fuels



Drivers

□ Rising population

- In the IEA Energy Technology Perspectives 2008 book (ETP 2008), global population is projected to increase from about 6.5 billion (2005) to roughly 8 billion by 2030 and more than 9 by 2050
- Similar values have been estimated by other sources (Shell in the figure, using UN)



□ Rising GDP per capita

- The average GDP per capita (using PPPs) is projected to increase more than twofold by 2030 (from 8.6 thousand USD in 2005 to 17 thousand USD) and more than threefold by 2050 in the ETP 2008
- Strong economic growth is being observed in all large developing economies

Constraints

□ Oil (and energy) supply

- Easily accessible oil and gas are increasingly difficult to produce
 - Large wells now mostly in decline, replacing lost production itself is a challenge
 - The World Energy Outlook 2007 warns about the risk of a “supply crunch” in the period to 2015
 - Oil prices are well above 100 USD/barrel, demand growth slowing but appears likely to remain strong over time
- Alternatives (oil in remote areas, non-conventional oil, nuclear energy, renewables) all suffer from shortcomings (efficiency, cost, investment needs, environmental impacts, public acceptance) and are subject to investment delays

□ Increasing environmental stresses

- De-coupling of CO₂ emissions from energy use (and other human activities, including the changes in land use) is a very tough challenge
- The choice of sources of energy supply and the reduction of energy demand (energy efficiency) are key elements for the success of humanity in taking up the challenge
- A lack of success is likely to result in increased concentrations of GHGs in the atmosphere and a subsequent strengthening of climate change (IPCC)

ETP 2008

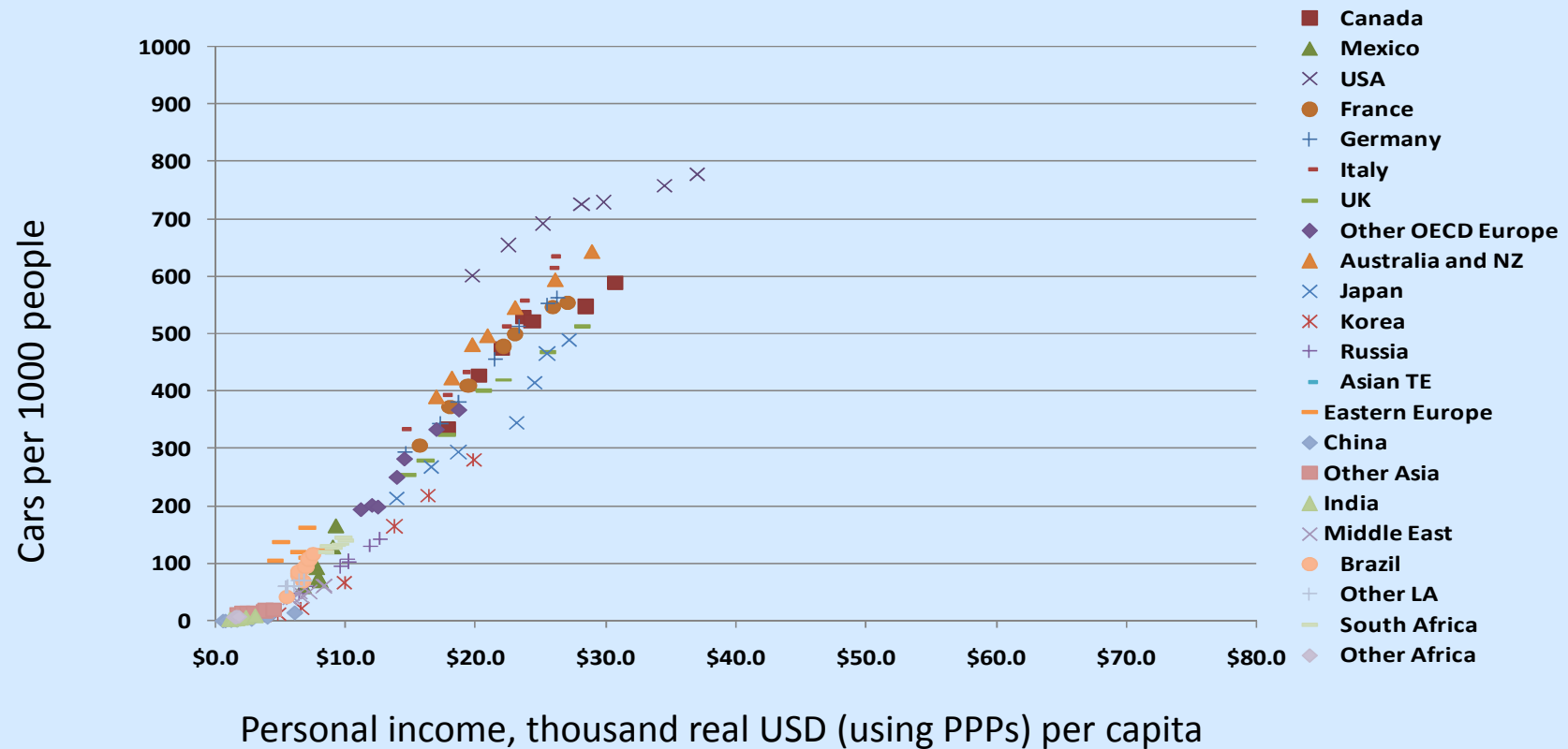
- Some questions leave room for important uncertainties...
 - Which types of feedback exist between the increasing difficulties in oil production, GHG emissions and other environmental stresses and economic growth?
- Scenarios in ETP do not take into consideration directly feedbacks on the economy
 - ETP scenarios are built using the population (largely based on UN forecasts) and GDP growth (largely based on the OECD Economic Outlook) as exogenous drivers
 - The BLUE scenario uses the same population and GDP growth assumptions of the baseline scenario
- The data presented here highlight some of the assumptions underlying the ETP 2008 scenarios for what concerns transport
 - The presentation will focus on the global Light Duty Vehicles (LDVs) stock and the energy demand related to them, since the fuel economy of LDVs is the object of the Symposium

Scenarios

- A set of scenarios are presented, relying on the work done on the [Mobility Model of the IEA \(MoMo\)](#) for the [ETP 2008](#). The scenarios take into account:
 - The population and GDP growths used in ETP 2008
 - Two possible ownership patterns
 - Two possible evolutions of fuel economies ([one more oriented towards improvements and one more conservative](#))
 - Constant travel per vehicle
 - A slightly shortening vehicle scrappage age, [linked to the growth of personal income](#)
 - Four estimations of the total energy demand, [linked to the evolution of ownership patterns and fuel economies](#)

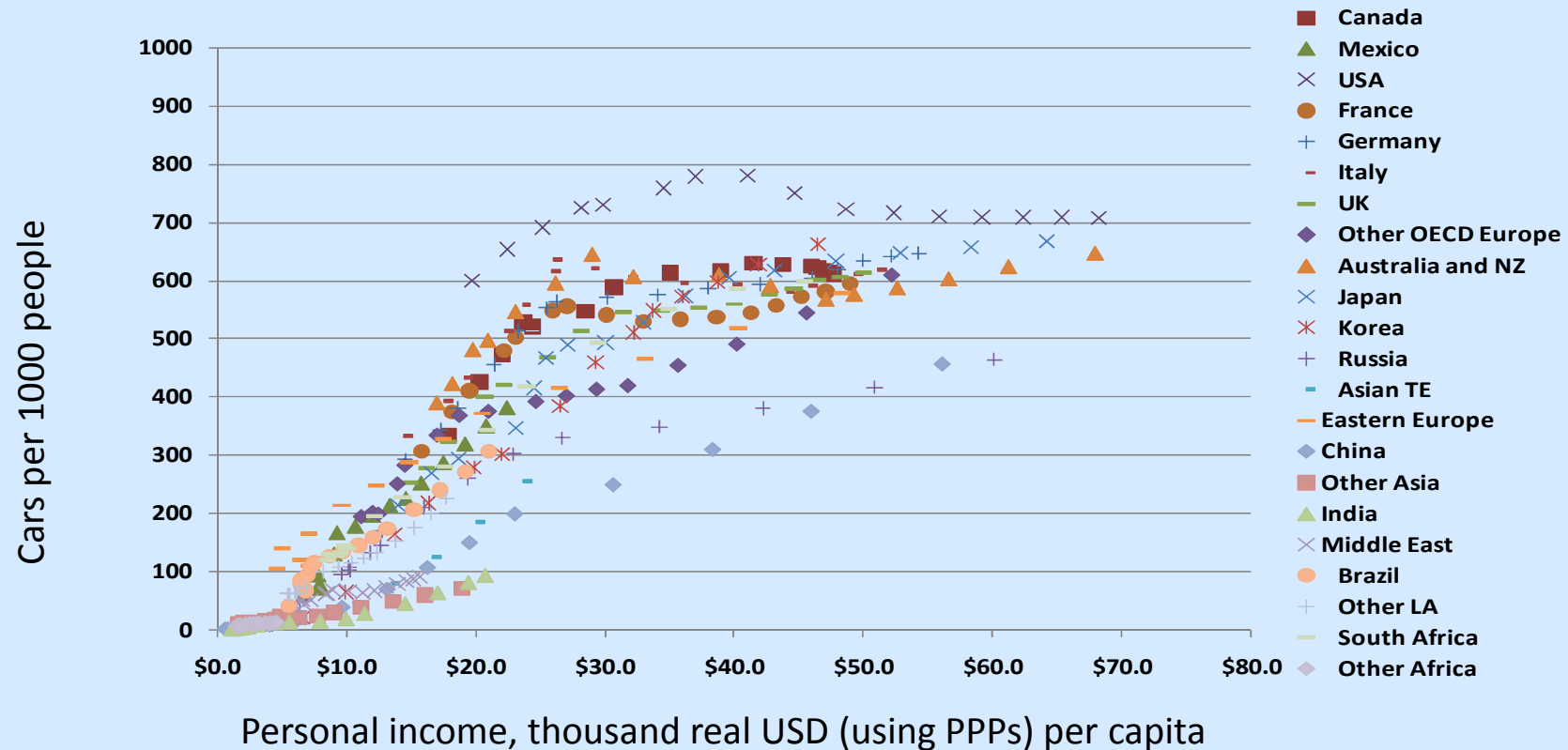
LDV stock and personal income

Historical data



LDV stock and personal income

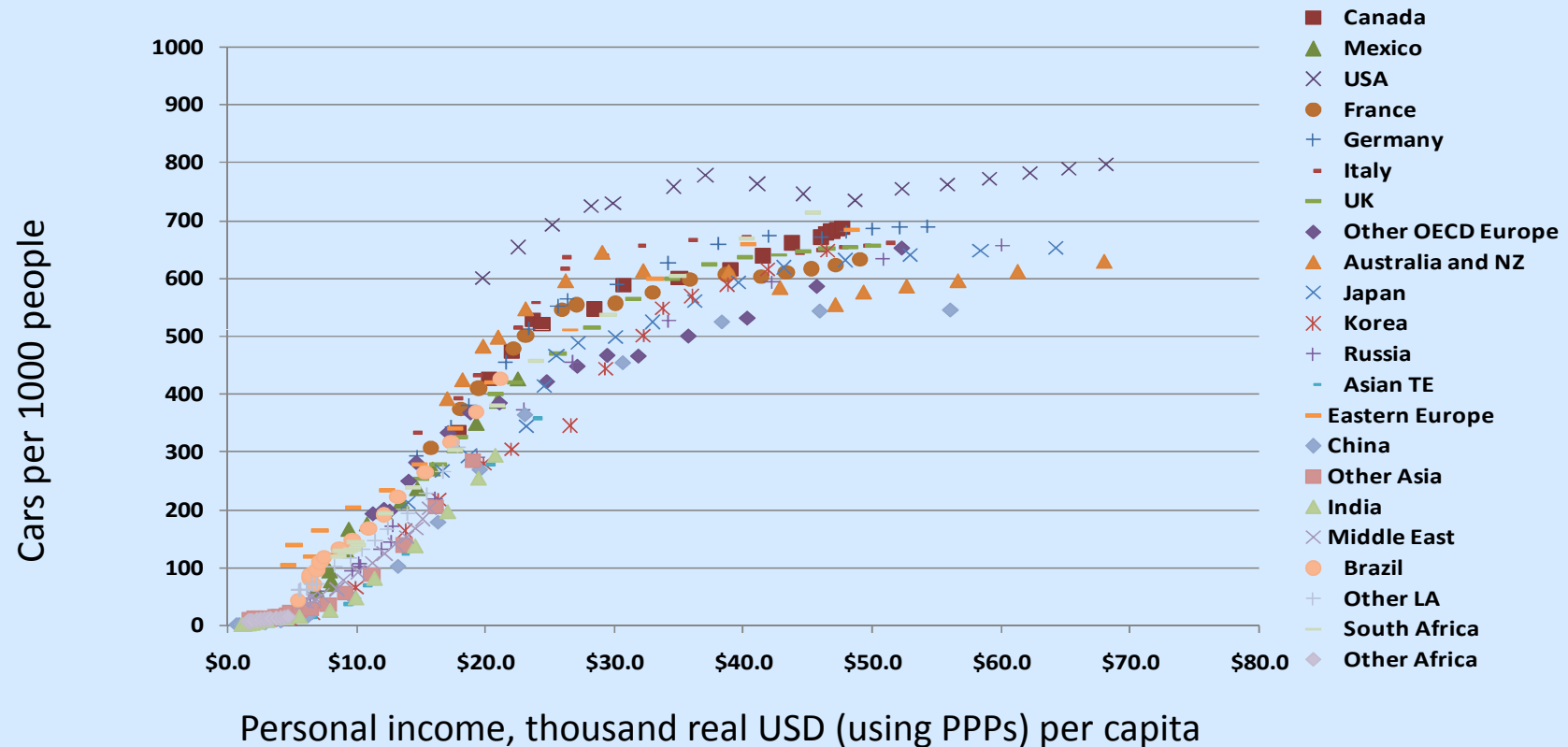
ETP projections (all scenarios)



- Trends similar to the past, with Asia (India, China, SE Asia) on the low-end because of...
 - High degree of urbanization
 - Extremely fast growth rates in income, probably skewed towards some population subsets

Vehicle fuel economies

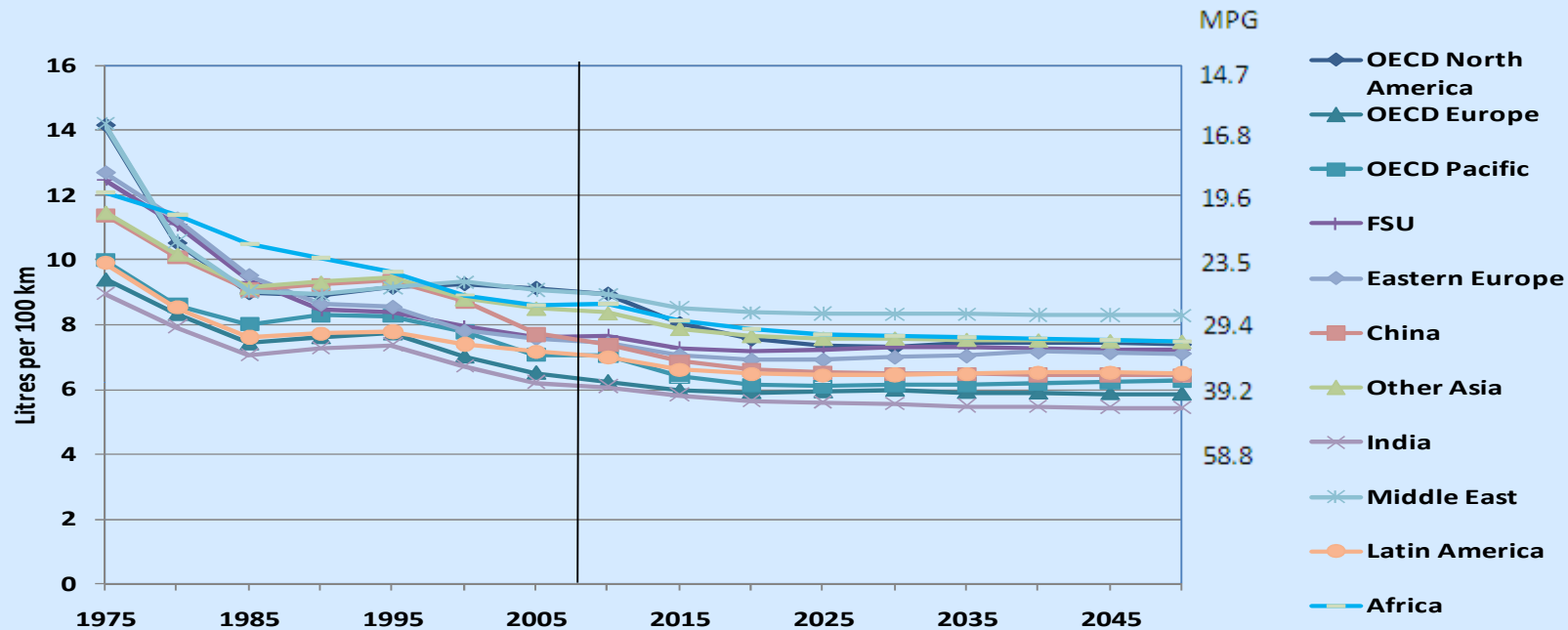
A possible alternative (higher ownership)



- Trends per unit income are more similar to IEA countries in the past
- However, assumes that ownership growth rates per unit time are far higher, and must be associated with very rapid development of infrastructures

Vehicle fuel economy, new sales

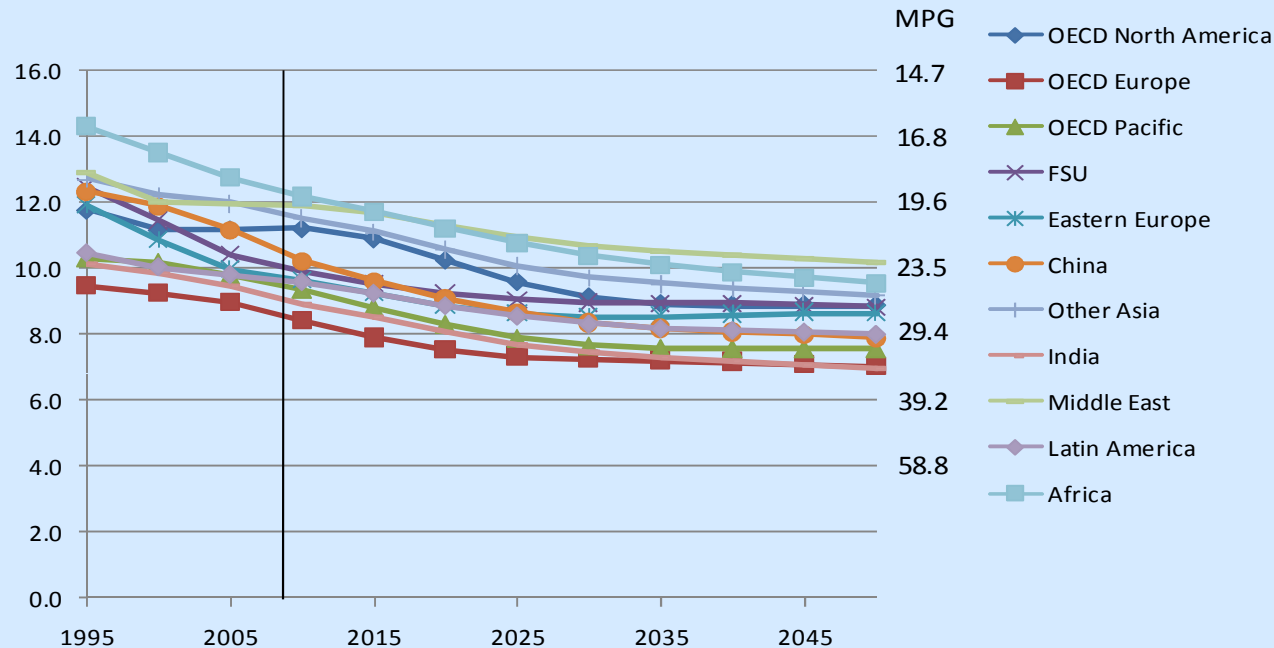
Baseline ETP



- Fuel economy improves in the baseline scenario
- The new CAFE in US and the Top runner in Japan are included. NOT the 130 g CO₂ per km in Europe (fuel economies remain close to 140 g)
- Technology for conventional gasoline and diesels is progressively introduced all over the world (in combination with vehicle technology – e.g. improved tyres), 50% of the efficiency potential is used to improve fuel economy and 50% for performance

Vehicle fuel economy, stock

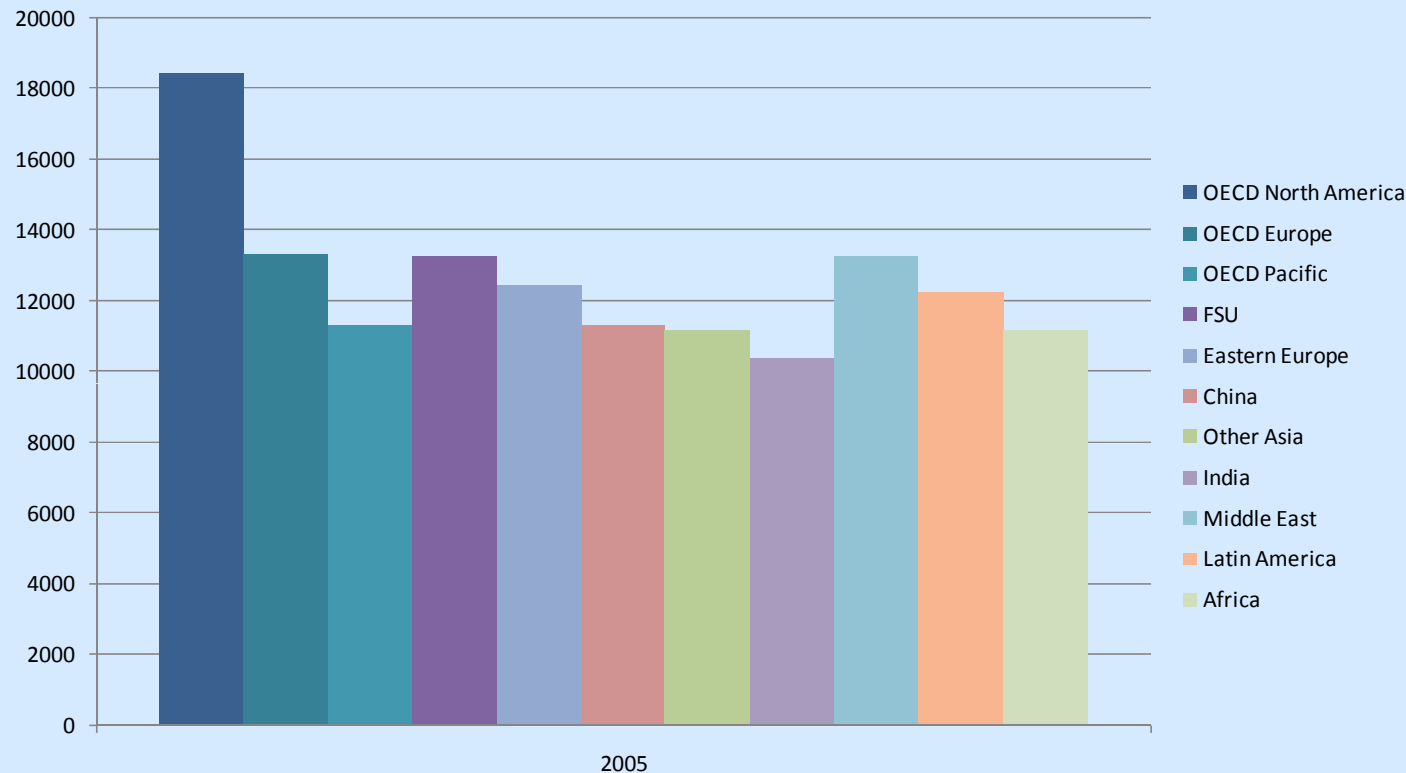
Baseline ETP



- ❑ Technologies are passed on to the stock, but the improvement takes time
- ❑ North America: important delay due to the flat trend of fuel economies since 1985...
- ❑ Some developing countries are affected by delays associated to the trade of second hand vehicles (characterized – generally speaking – by lower efficiencies)
 - ❑ A proper evaluation of this effect is very difficult because of the lack of reliable and complete data

Vehicle travel

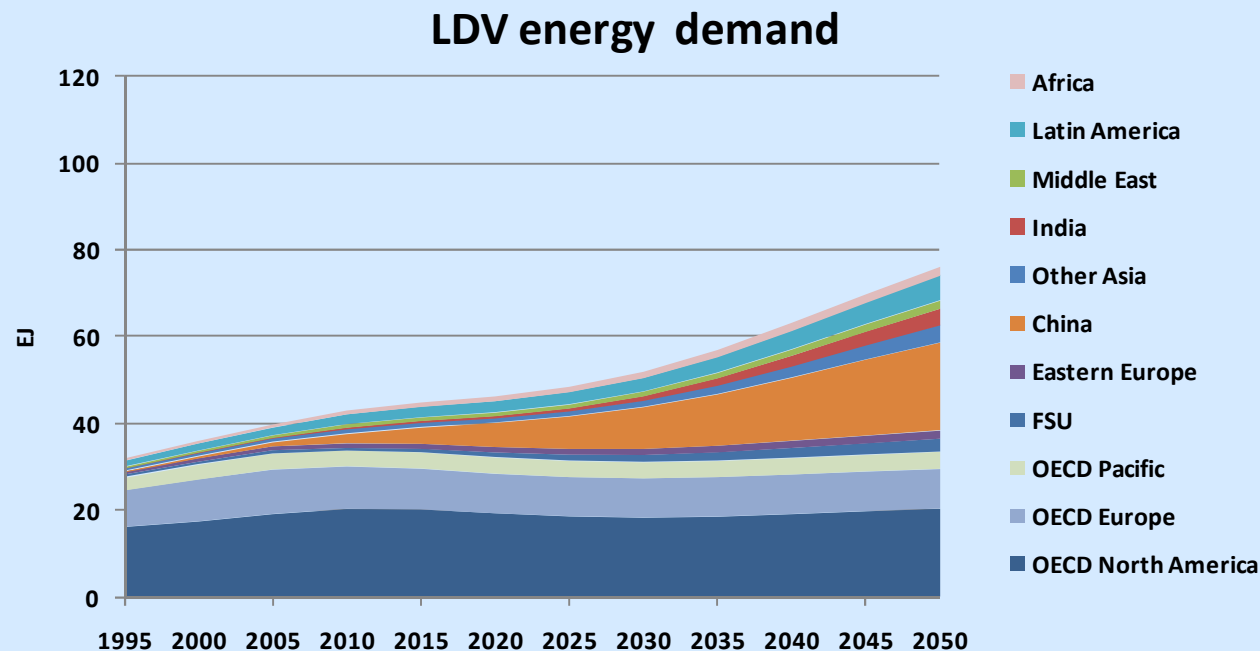
All scenarios



- Travel assumed constant at the values above (we are mainly looking for indications)
- Vehicle age assumed to be slightly declining with wealth (faster turnover, limited at 11-13 years minimum, depending on the region)

Energy demand

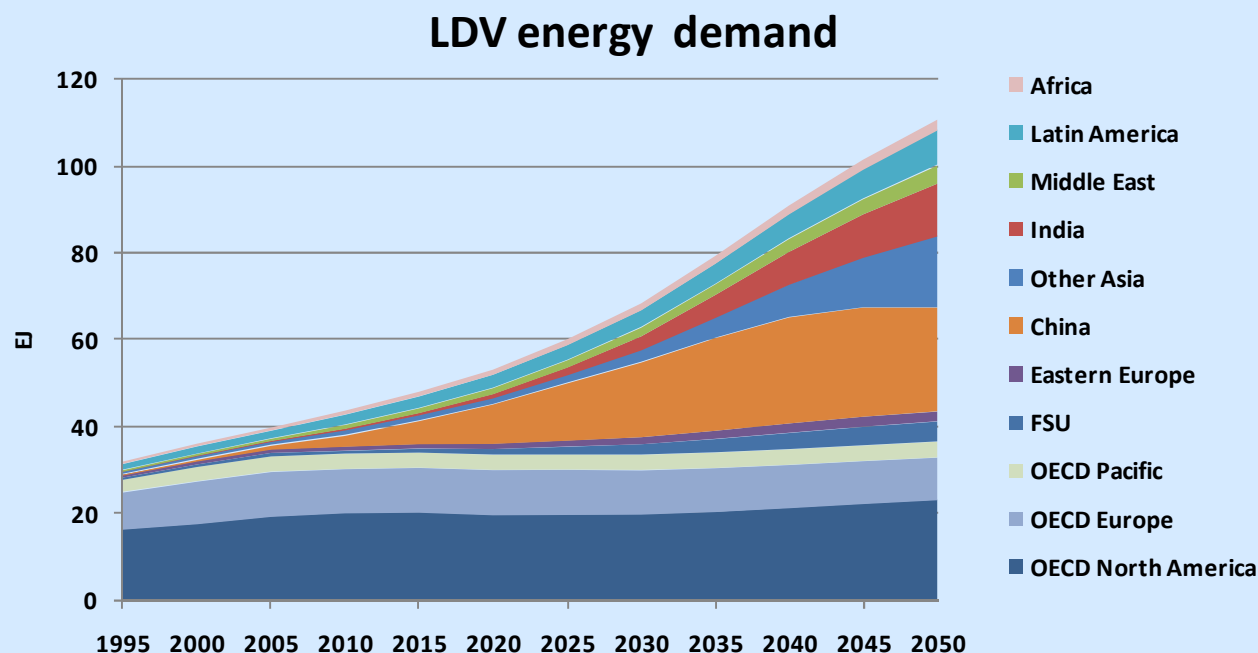
Baseline ETP



- LDV energy demand stabilizes in the OECD: gains due to some increases in ownership are balanced by fuel efficiency improvement (the effect fades with time, since the potential gains stop)
- Non-OECD energy demand grows significantly, and China plays the main role
- Latin America weight more than OECD Pacific by the end of the projections

Energy demand

Baseline fuel economy, high ownership

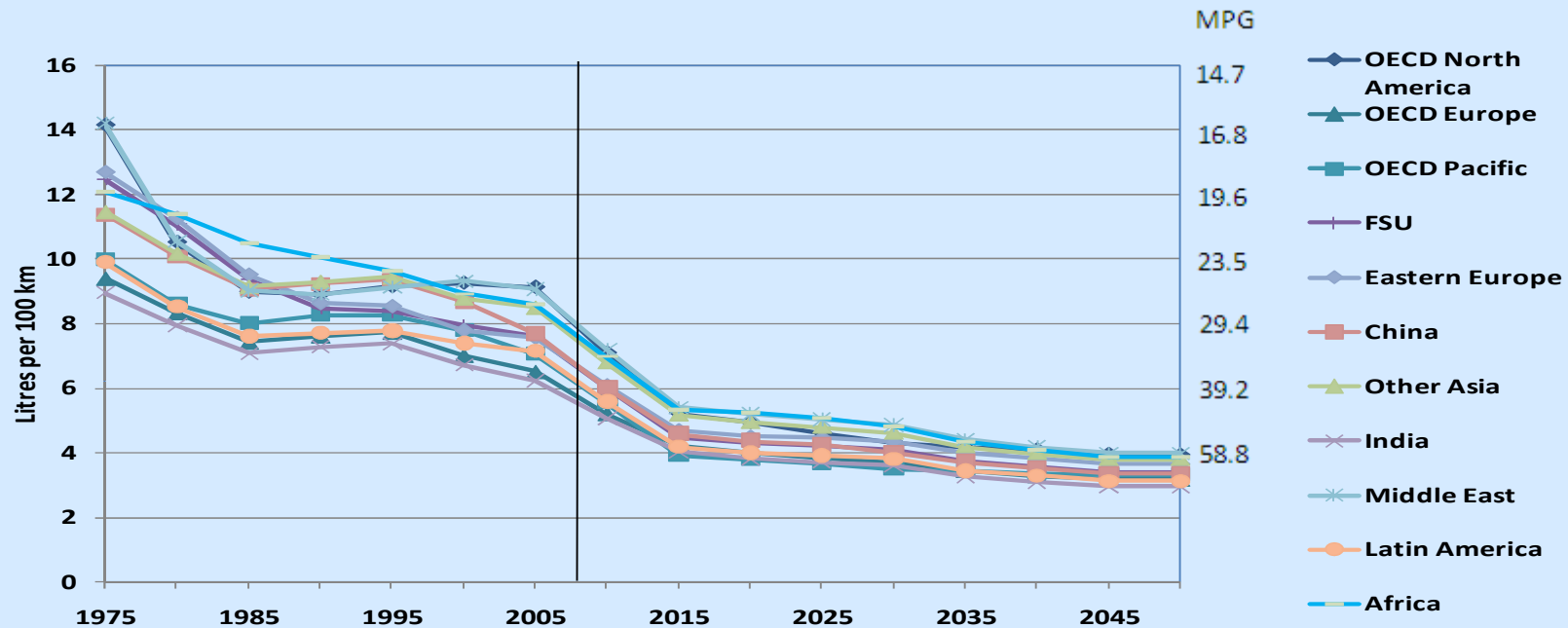


- LDV energy demand does not vary much in the OECD (most OECD countries already have large ownership rates)
- With higher growth rates, non-OECD energy demand is nearly double by 2050 compared to the baseline scenario
 - Key “drivers” are China, India and SE Asia (Latin America also remains more relevant than OECD Pacific after 2030)

The rate and manner that Asia develops is key to determine the final energy demand from LDVs

Vehicle fuel economies, new sales

Greater fuel economy (FE) improvement

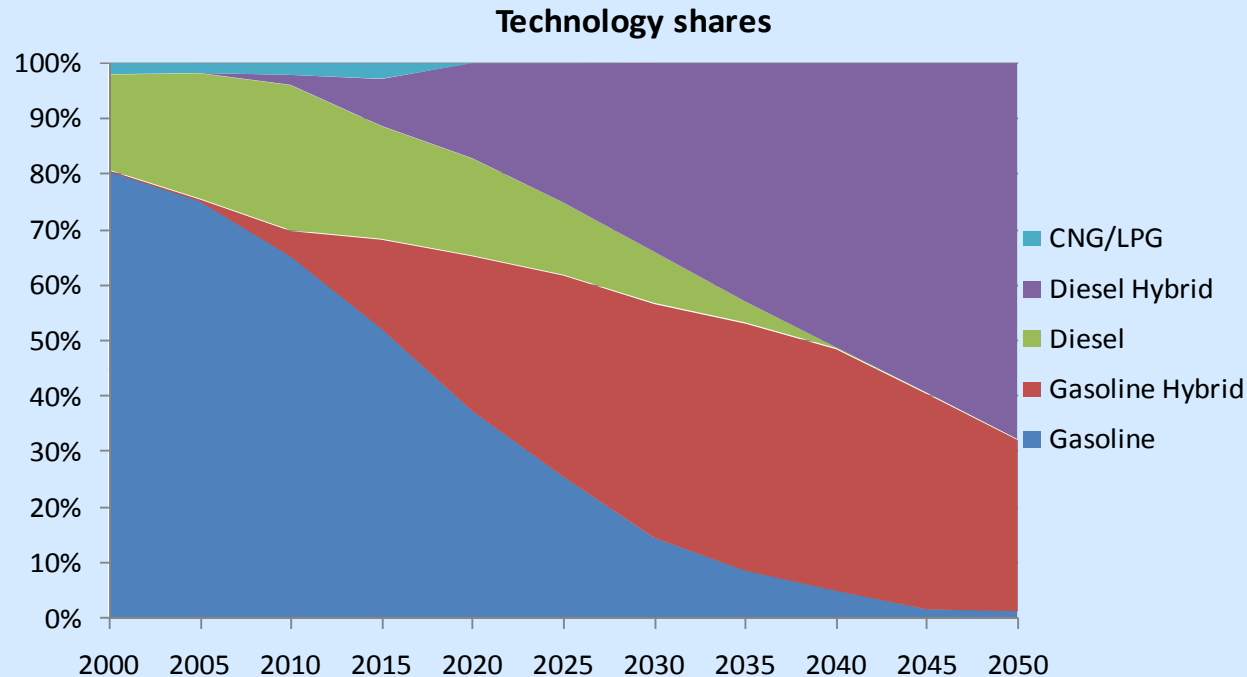


What happens with a much more aggressive fuel economy policy?

- Full potential used for fuel economy on new vehicles (i.e. not accounting for those that are already in the pipeline...)
 - ~ 40% improvement for gasoline and diesel, including engine (downsizing, CAI, etc.) and vehicle technologies (energy efficient tyres, lightweighting, etc.)
 - Roughly 50% for full hybrids, including all vehicle improvements
- Scenario exceeding current fuel economy policies (EU at 100 g CO₂ / km by 2015)

Vehicle fuel economies, new sales

Greater FE improvement



The technologies required for such an evolution...

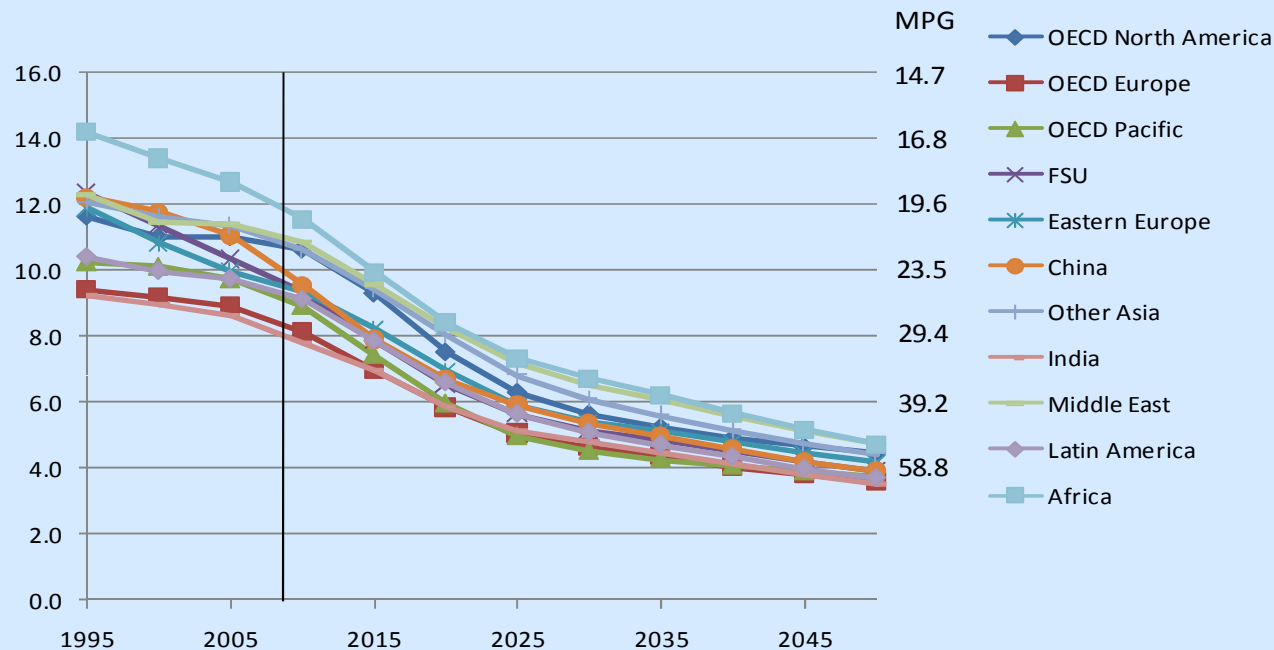
- Exist today but they are associated to relatively high costs
- OR Are very likely to be developed and used

Hybridisation is key

Other solutions (including smaller vehicles) can lead to similar results and could make more sense in some developing countries (safety standards should be assured – see paper)

Vehicle fuel economies, stock

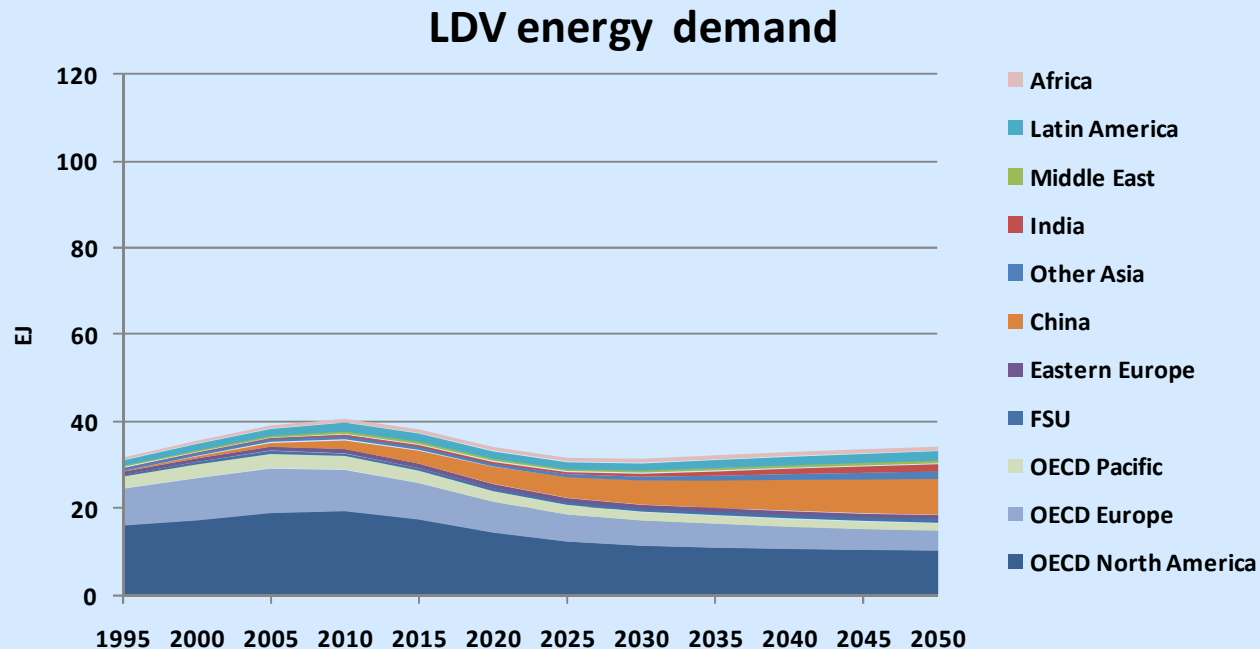
Greater FE improvement



- ❑ Technologies are passed on to the stock, the improvement takes time, but consistent policies end up delivering significant and rapid gains
- ❑ North America: delay due to the flat trend of fuel economies since 1985 still there, but quickly removed
- ❑ Also the areas relying on second hand vehicle trade benefit from improvements of the average fuel economy of the global fleet

Energy demand

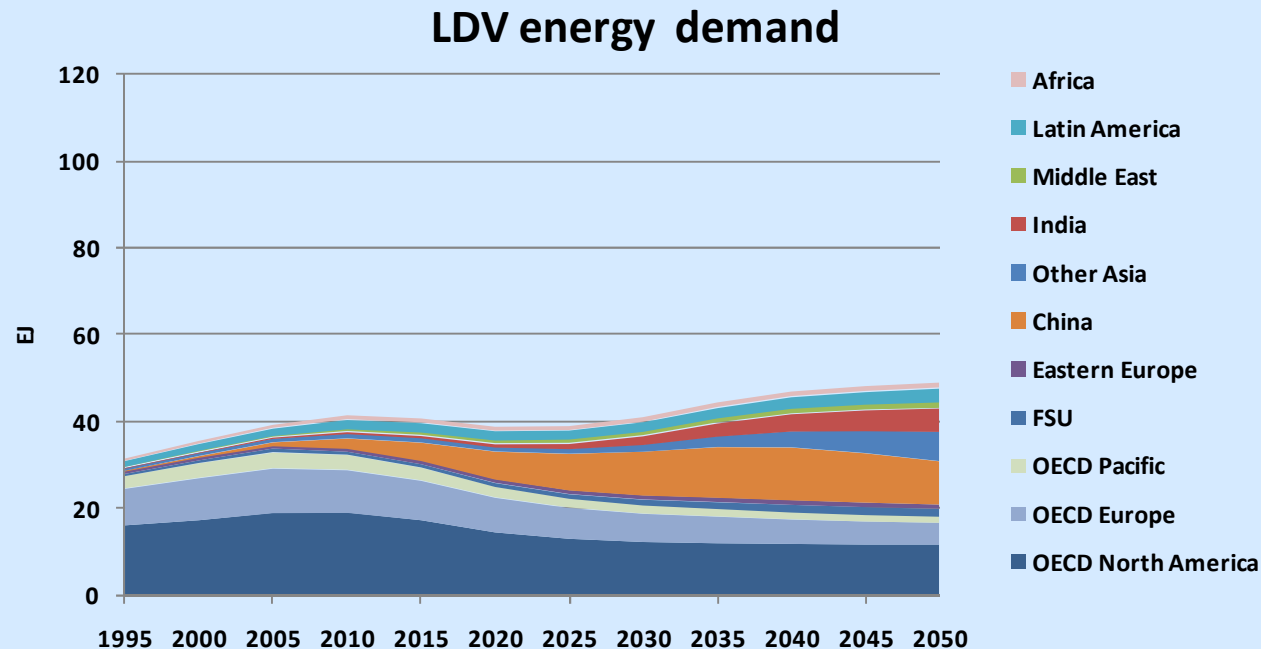
Greater FE improvement, baseline ownership



- LDV energy demand declines in the OECD: fuel economy gains exceed the increases in ownership
- Non-OECD energy demand grows, but the improved fuel economy limits the growth in such a way that global demand starts declining to stabilize around 30EJ (i.e. 2000 levels worldwide)

Energy demand

Greater FE improvement, high ownership



- Similar trends, but the growth in the developing world is so strong that total energy demand for LDVs does not decline. Though is still only half of baseline in 2050
- Will require very strong policies and changes in types of vehicles sold (e.g. complete switch from power and mass increase to fixed power and mass, with eventual reductions)

Conclusions

- Baseline LDV global energy demand likely to rise by 150% or more to 2050
- Significant demand reductions are possible, no matter what growth is expected in LDV ownership
- Supply constraints are worrying: a “supply crunch” before 2015 is increasingly likely (at the time of writing this presentation Goldman Sachs forecasted oil at 200 USD by the end of the year)

- Energy efficiency is a critical option, and a large set of technologies are available today
 - Some can be effectively combined (e.g. lightweighting, low rolling resistance tyres, direct injection and downsizing)
 - Costs remain a barrier in some cases, but many are available at negative costs over the vehicle lifetime
 - Many solutions are likely to become more effective with time (incremental gains)
 - Long-term options? Plug-ins and electrification look promising. Hybrids are a first step in this direction

- Over the past 20 years, technologies have been largely used to deliver size, weight and power increases, rather than better fuel economy: this trend needs to be reversed

- The earlier the action, the lower the demand is going to be (stock effects cause delays; halting the trend to larger, heavier vehicles needs to happen sooner rather than later)