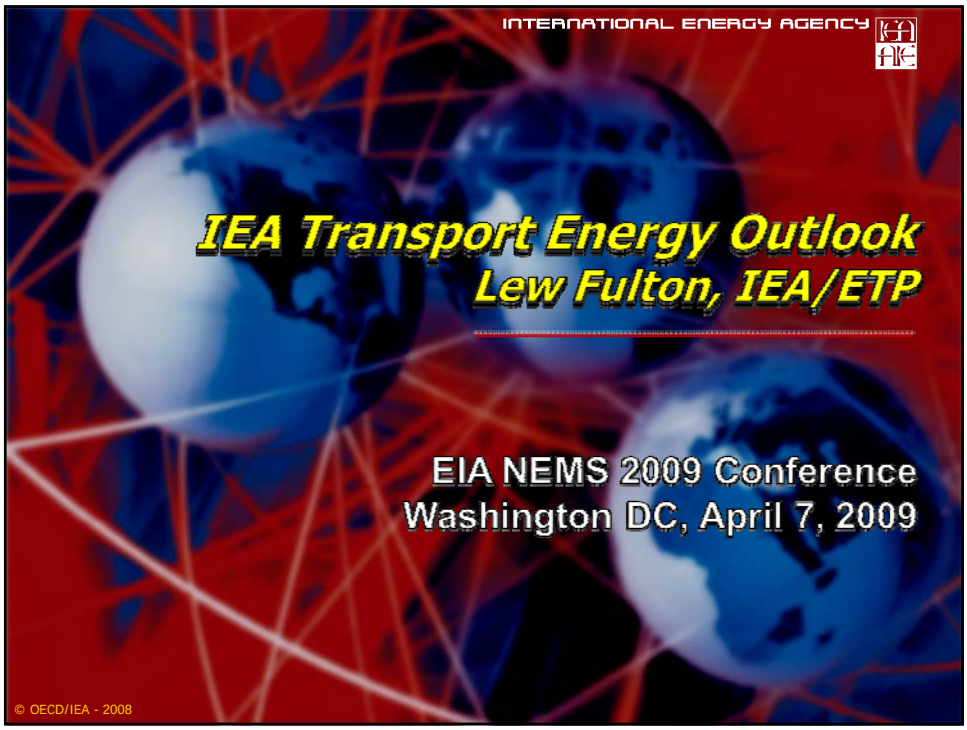


To Cover…

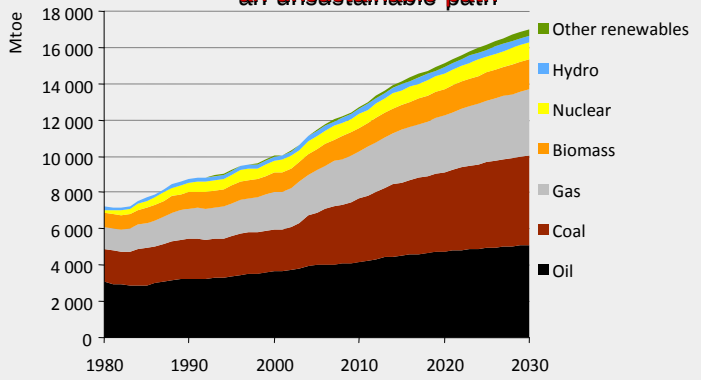
World Energy Outlook 2008

- Transport Energy and CO_2
  - Where are we going?
  - What are the dangers?
  - How do we change direction?
- Primarily reporting on:
  - IEA WEO 2008
  - IEA ETP 2008
  - On-going work with IEA's Mobility Model
- One or two detours to talk about modelling

Where are we headed? World Energy Outlook 2008

World Energy Outlook 2008

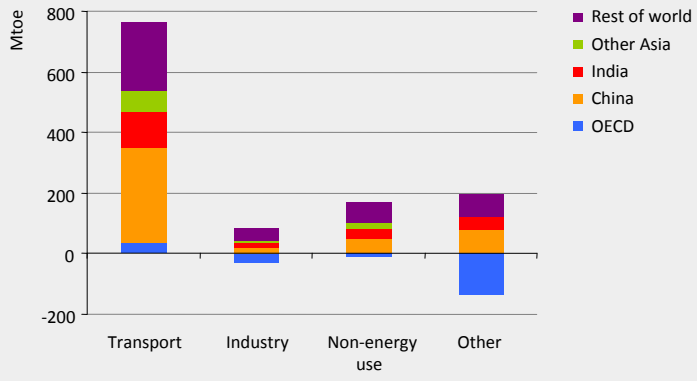
World primary energy demand in the Reference Scenario: an unsustainable path



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

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

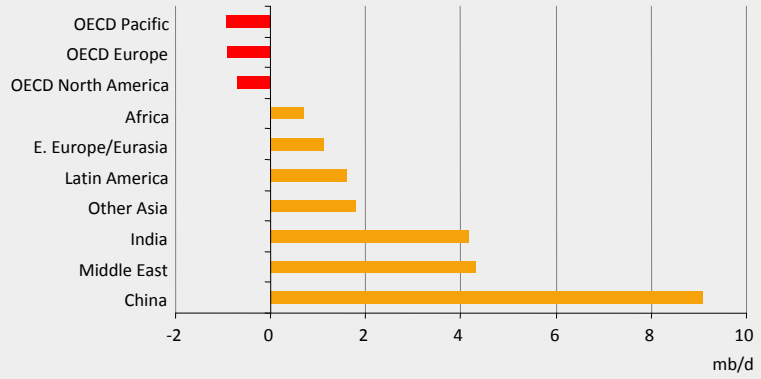
World Energy Outlook 2008



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

Change in oil demand by region in the Reference Scenario, 2007-2030

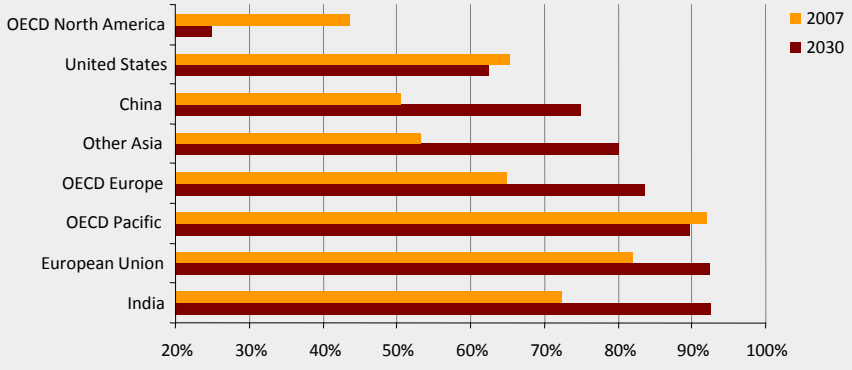
World Energy Outlook 2008



All of the growth in oil demand comes from non-OECD, with China contributing 43%, the Middle East & India each about 20% & other emerging Asian economies most of the rest

Oil-import dependence in the Reference Scenario

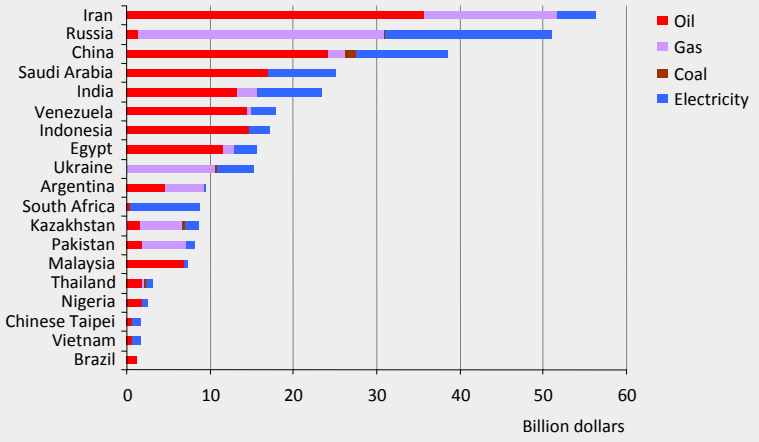
World Energy Outlook 2008



OECD Europe & Asia become even more dependent on oil imports, but import dependence drops in North America & OECD Pacific

Energy subsidies in non-OECD countries, 2007

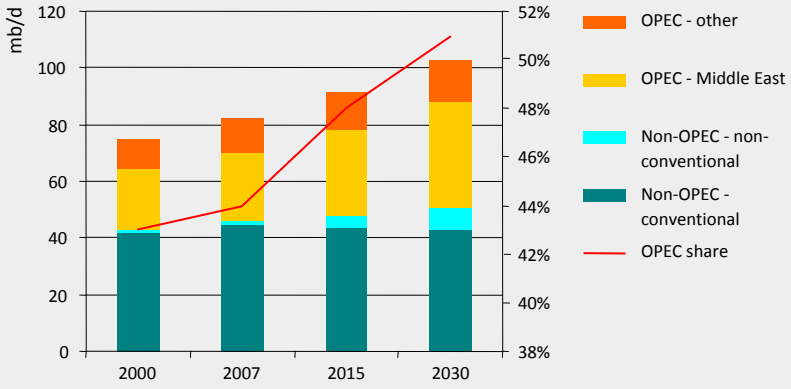
World Energy Outlook 2008



Energy subsidies in the 20 largest non-OECD countries hit $310 billion in 2007 – creating, in many cases, an unsustainable economic burden & exacerbating environmental effects

World oil production by OPEC/non-OPEC in the Reference Scenario

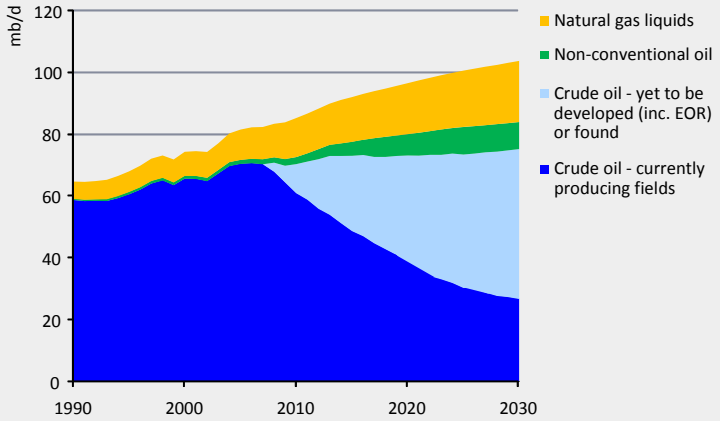
World Energy Outlook 2008



Production rises to 104 mb/d in 2030, with Middle East OPEC taking the lion's share of oil market growth as conventional non-OPEC production declines

World oil production by source in the Reference Scenario

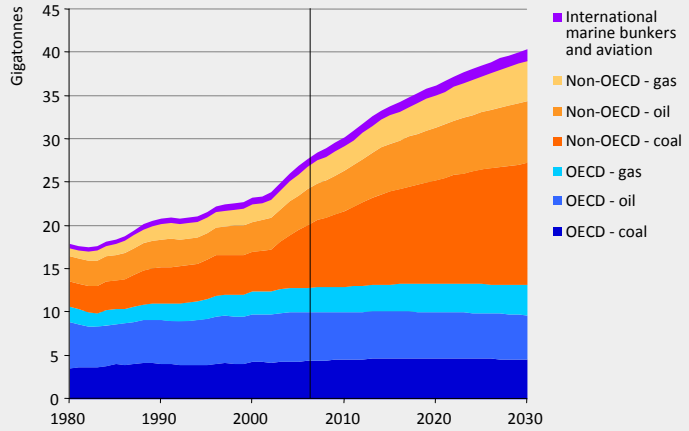
World Energy Outlook 2008



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

Energy-related CO_2 emissions in the Reference Scenario

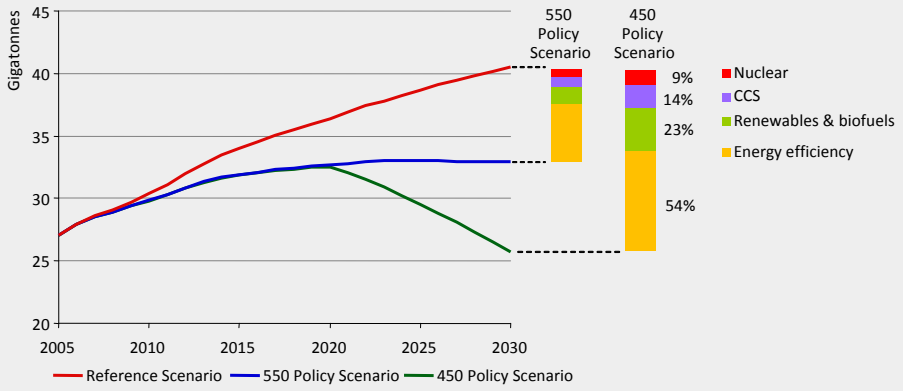
World Energy Outlook 2008



97% of the projected increase in emissions between now & 2030 comes from non-OECD countries – three-quarters from China, India & the Middle East alone

WEO 2008 scenarios for CO_2 emissions pathways to 2030

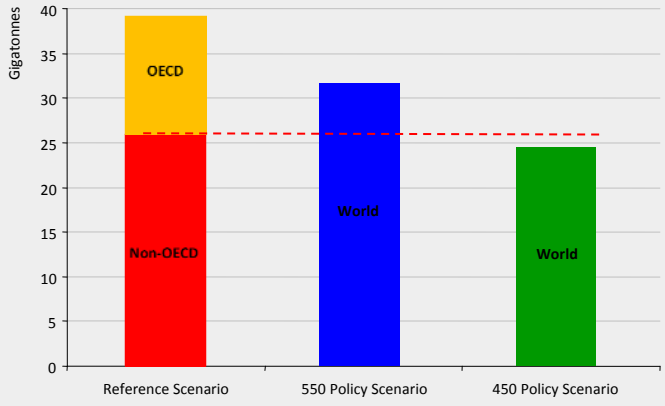
World Energy Outlook 2008



While technological progress is needed to achieve some emissions reductions, efficiency gains and deployment of existing low-carbon energy accounts for most of the savings

World energy-related CO_2 emissions in 2030 by scenario

World Energy Outlook 2008



OECD countries alone cannot put the world onto a 450-ppm trajectory, even if they were to reduce their emissions to zero

IEA's Long-term View: Energy Technology Perspectives 2008

- A Low CO_2 world to 2050: what it looks like and how to get there
  - A study primarily about the role of technology
  - Achieving IPCC CO_2 emission targets
    - Transport does not have to achieve zero emissions, but it would clearly help.
  - Identifying short and medium term technology and policy needs
- Scenario analysis – three main scenarios:
  - Baseline WEO2007 Reference Scenario, extended to 2050
  - Global stabilization by 2050 (ACT – up to USD50/tonne)
  - Global 50% reduction by 2050 (BLUE – up to USD200/tonne)

In support of the G8 Plan of Action

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

Baseline Scenario

- We have a lot of decoupling in the BAU case…
- Growth 2005 - 2050
  - GDP x 4
  - Final & Primary energy use x 2
  - Coal demand x 3
  - Gas demand x 2.5
  - Oil demand x 1.5
  - Electricity demand x 2.5
  - Energy CO_2 emissions x 2.3
- If we don't get this decoupling, the baseline will be even higher…

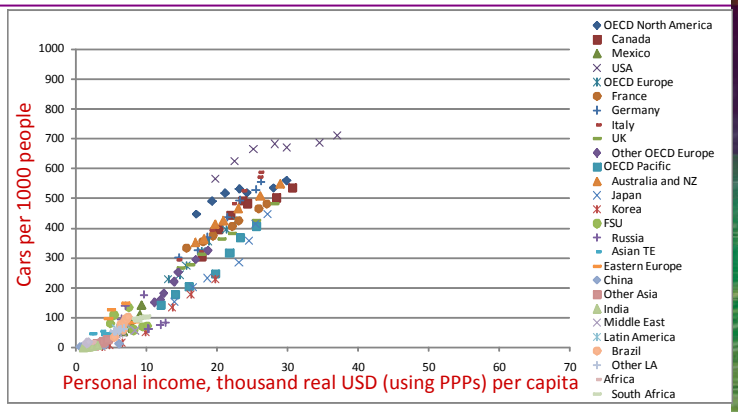
In support of the G8 Plan of Action

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

LDV stock and personal income
Historical data



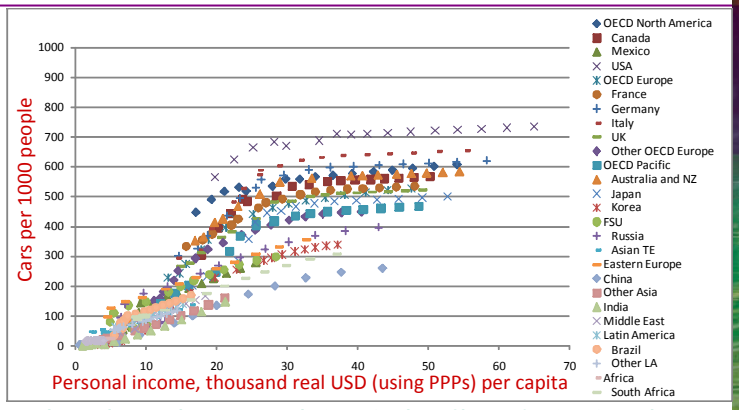
ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

LDV stock and personal income
ETP projections (consistent with WEO)



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

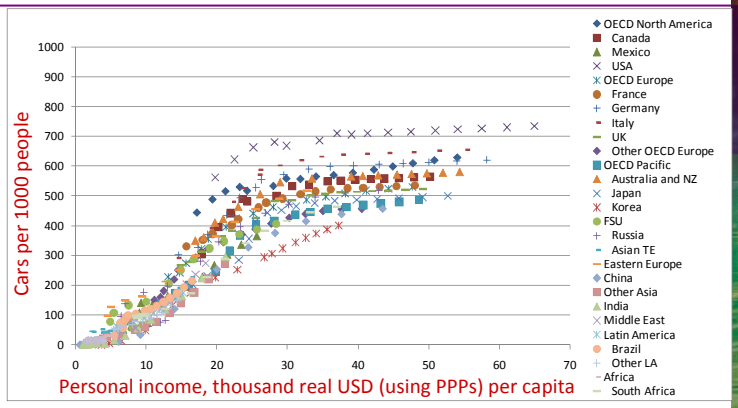
ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

LDV Stock: 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 infrastructure

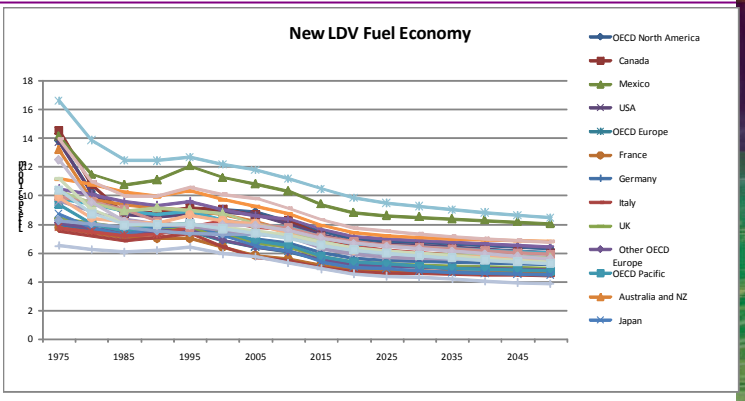
ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

LDV Fuel Economy Baseline



- Fuel economy improves by 25% 2005-2050 in the baseline scenario
- Assumes all pending fuel economy rules take effect
- Available technology for conventional gasoline and diesels is progressively introduced all over the world – 75% for fuel economy, 25% for other things

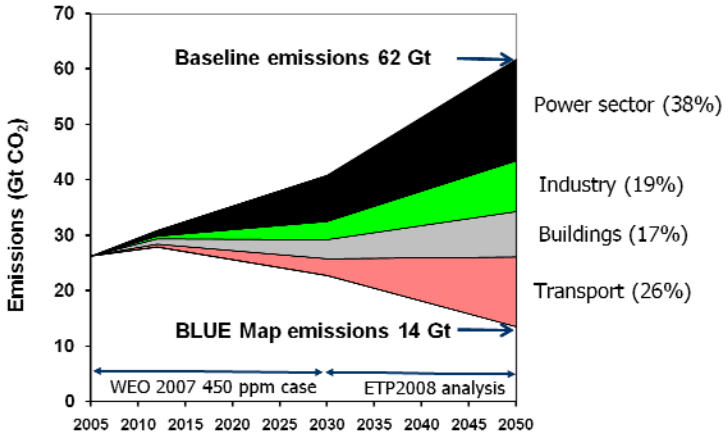
ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

Sector Contributions



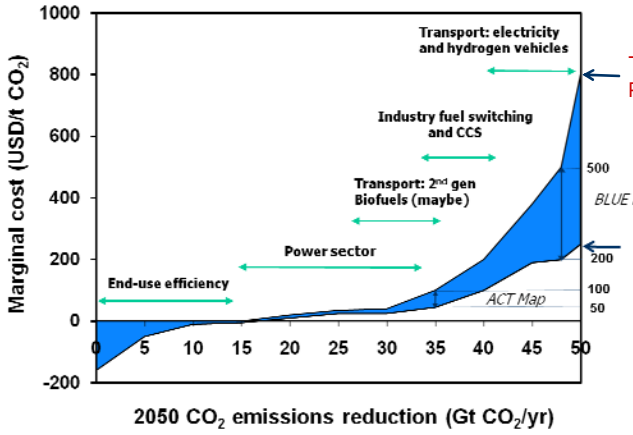
ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

A New Energy Revolution ?



To bring emissions back to current levels by 2050 options with a cost up to USD 50/t are needed. Reducing emissions by 50 % would require options with a cost up to USD 200/t, possibly even up to USD 500/t CO_2

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

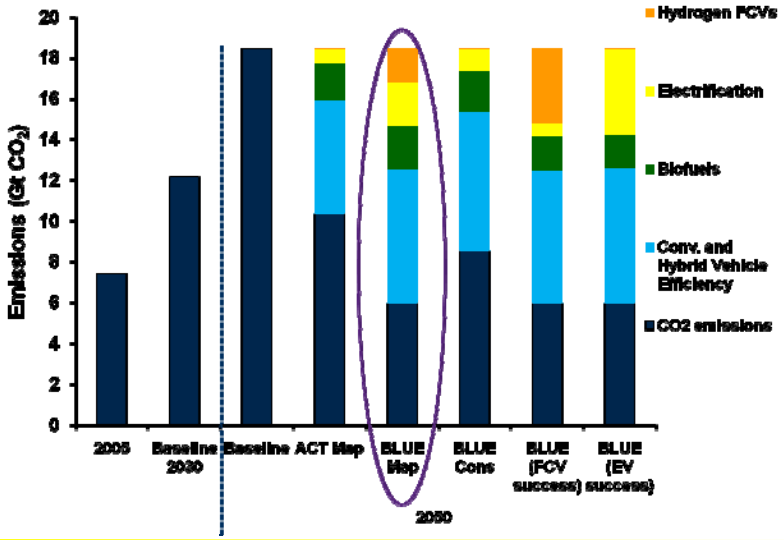
INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

© OECD/IEA - 2008

Transport GHG Emissions

(well-to-wheels CO_2-equivalent emissions)



ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

ETP BLUE
Light-duty Vehicles (cars, SUVs)

- LDVs 50% more efficient by 2030
  - Hybrids dominate by 2030, plug-in hybrids dominate by 2050
  - IEA has launched the Global Fuel Economy Initiative
- Electric and / or H2 Fuel Cell Vehicles play a major role after 2030
- Biofuels reach up to 12% of total liquid fuel share by 2030, mostly 2nd gen, mostly diesel
  - Rising to 26% by 2050 (20-fold increase compared to 2007)
  - LDVs may not be the best application

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

In support of the G8 Plan of Action

ETP BLUE: Other Transport Modes
Half of total demand

- **Air**
  - 15% efficiency improvement over baseline (30% in baseline) by 2050
  - Some logistic improvements
  - 30% biofuels (BTL fuel) by 2050
- **Shipping**
  - 30% efficiency improvement by 2050;
  - 30% biofuels (heavy fuel oil substitutes) by 2050
- **Trucks, buses**
  - 30-50% efficiency improvement by 2050
  - Same biofuels share as for LDVs
- **Lots of biofuels in these modes – and it probably won't be ethanol!**

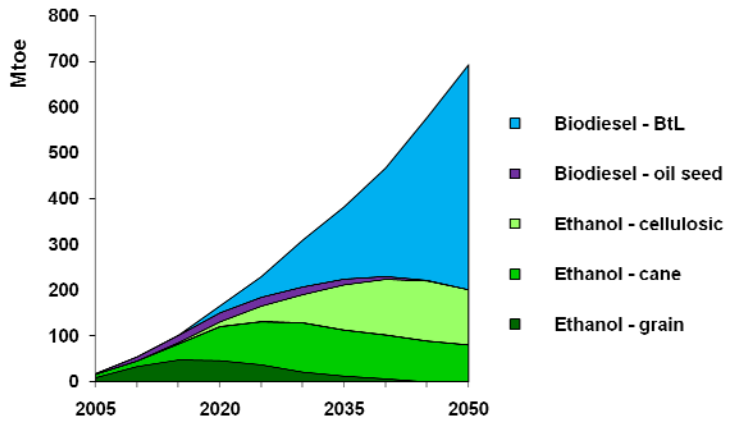
In support of the G8 Plan of Action

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

Biofuels Use in BLUE Map
26% of Transport Fuel Use in 2050



In support of the G8 Plan of Action

© OECD/IEA - 2008

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY

Um, Policies?

- Clearly we will need strong policies both internationally and at national levels (and local!)
  - International framework especially critical for air and maritime transport
  - Carbon price, yes – but $50/tonne is only $0.12/litre
- 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!
  - EVs/FCVs but relatively high cost and massive infrastructure investments will be needed
    - PHEVs as an incremental approach
- Local level - land use/ modal shift policies (but national gov's can encourage)

In support of the G8 Plan of Action

ENERGY TECHNOLOGY PERSPECTIVES 2008

Scenarios & Strategies to 2050

INTERNATIONAL ENERGY AGENCY