



Shell Global Solutions

The Drive for Energy Independence and Fuels of the Future

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What is the Global Energy Challenge?



Providing access to modern energy for all.



Meeting growing demand while reducing environmental and social impacts.



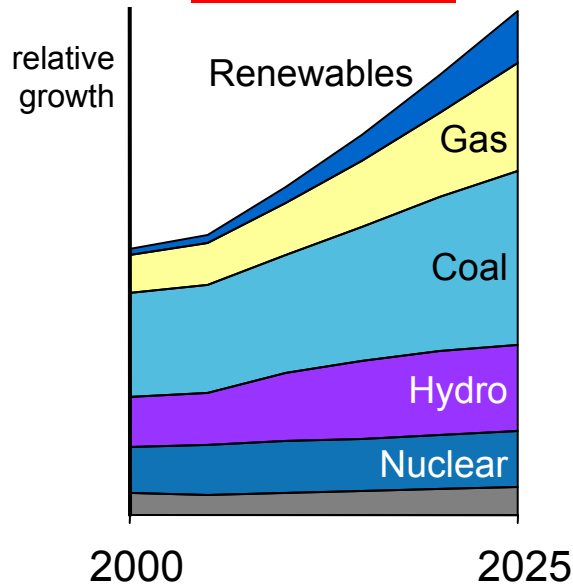
Shifting towards a low-carbon energy system.



Shell Scenarios

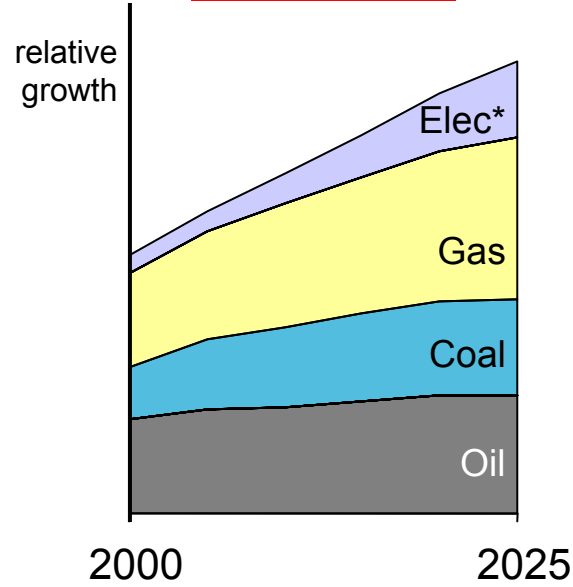
Power growth primarily from coal, gas and renewables

Global Power Demand



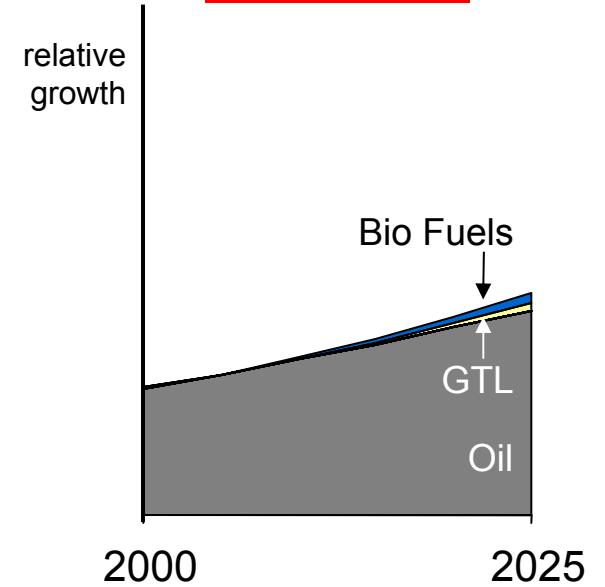
Heat growth draws primarily from gas....

Global Heat Demand



...while transport continues to be the preserve of oil

Global Transport Demand

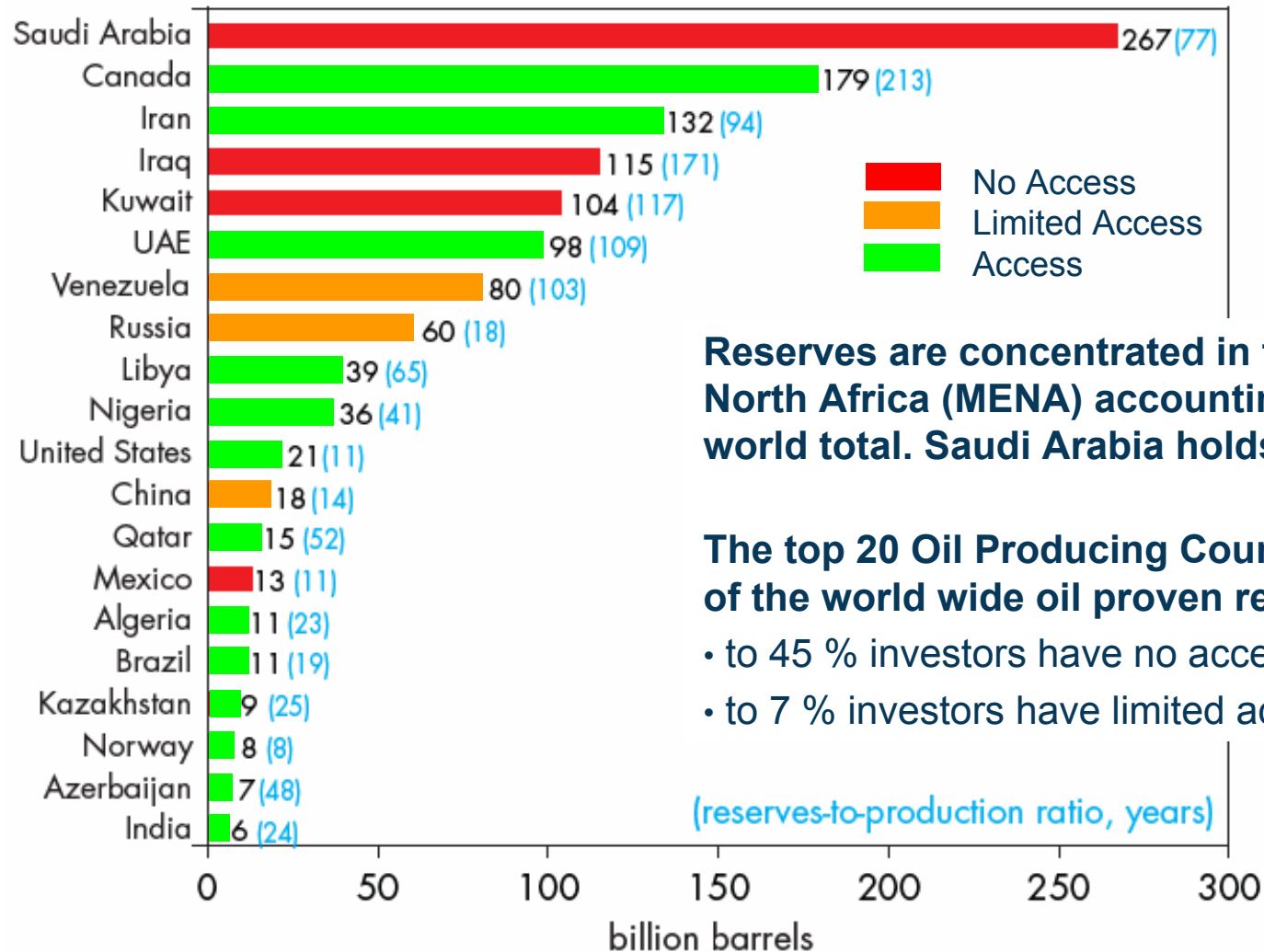


* Sourced by power

➔ The transport sector will be the natural home for the growing oil demand.



Top 20 Countries Proven Oil Reserves, End 2005



Reserves are concentrated in the Middle East and North Africa (MENA) accounting for 62% of world total. Saudi Arabia holds a fifth.

The top 20 Oil Producing Countries represent 94 % of the world wide oil proven reserves.

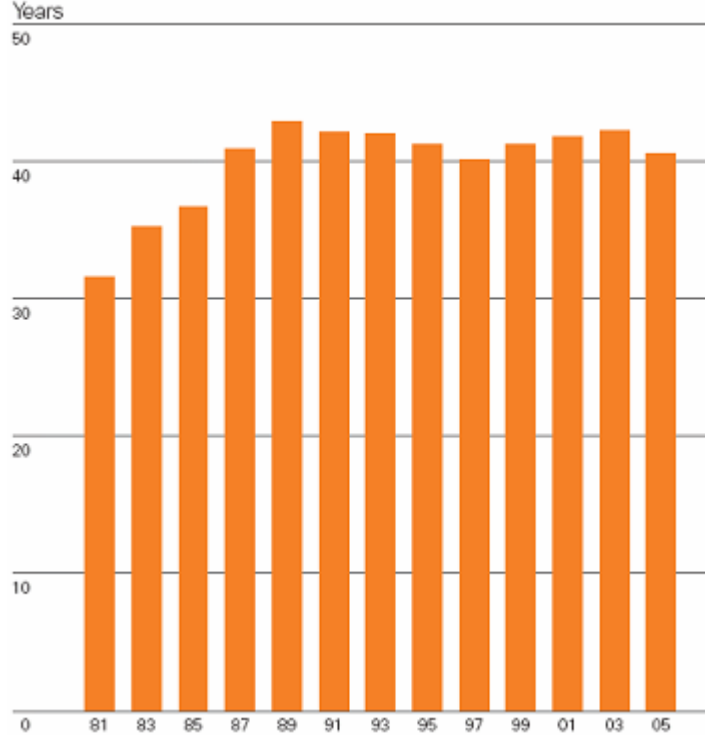
- to 45 % investors have no access.
- to 7 % investors have limited access.

(reserves-to-production ratio, years)

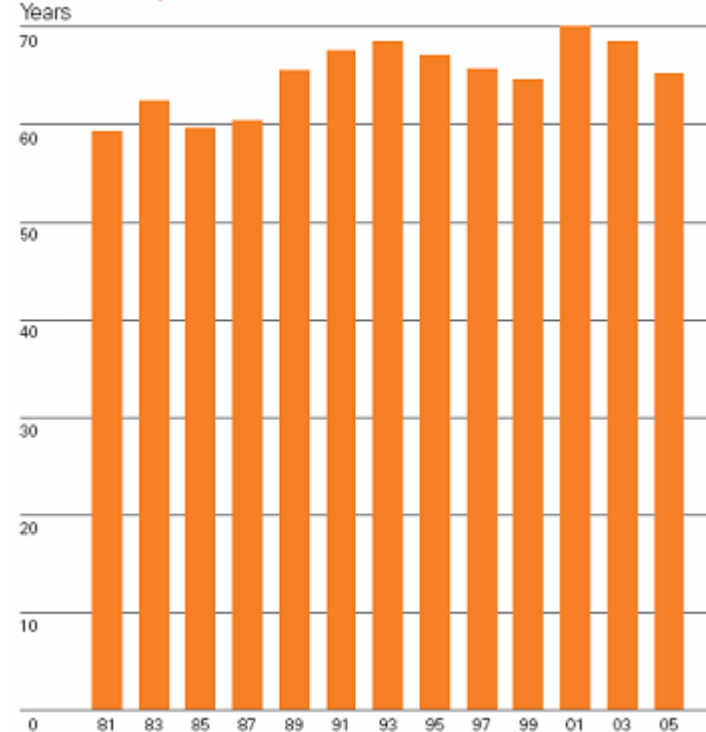


Oil and Gas Reserves-to-Production Ratios

Reserves-to-production (R/P) ratios



Reserves-to-production (R/P) ratios



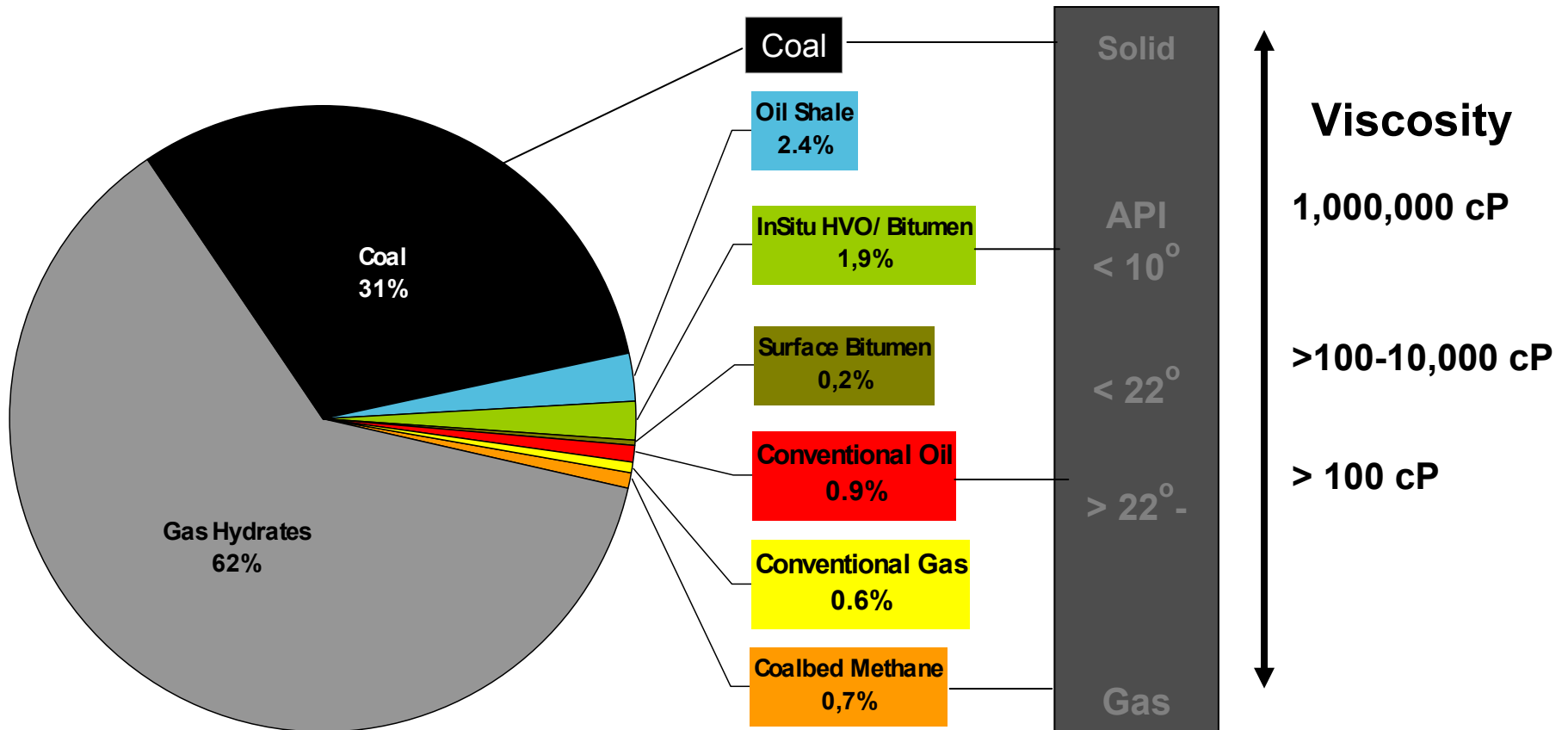
- Oil reserves are expected to last some 40 years

.... and 65 years for natural gas at current production levels.



World Hydrocarbon Resources

Conventional Oil and Gas are less than 2%





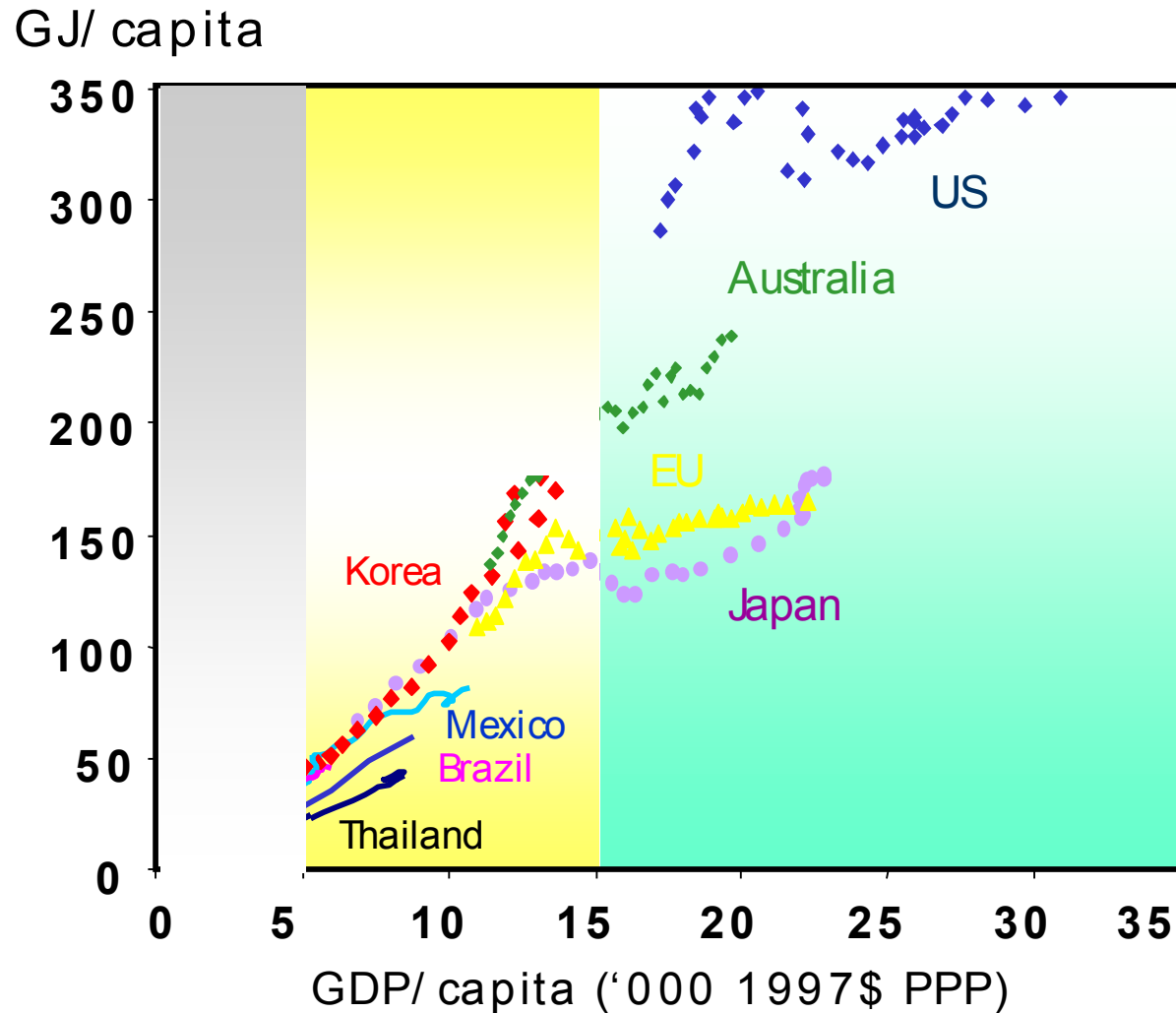
... and Additional Unconventional Sources

Production of Shale in the US and Oil Sands in Canada





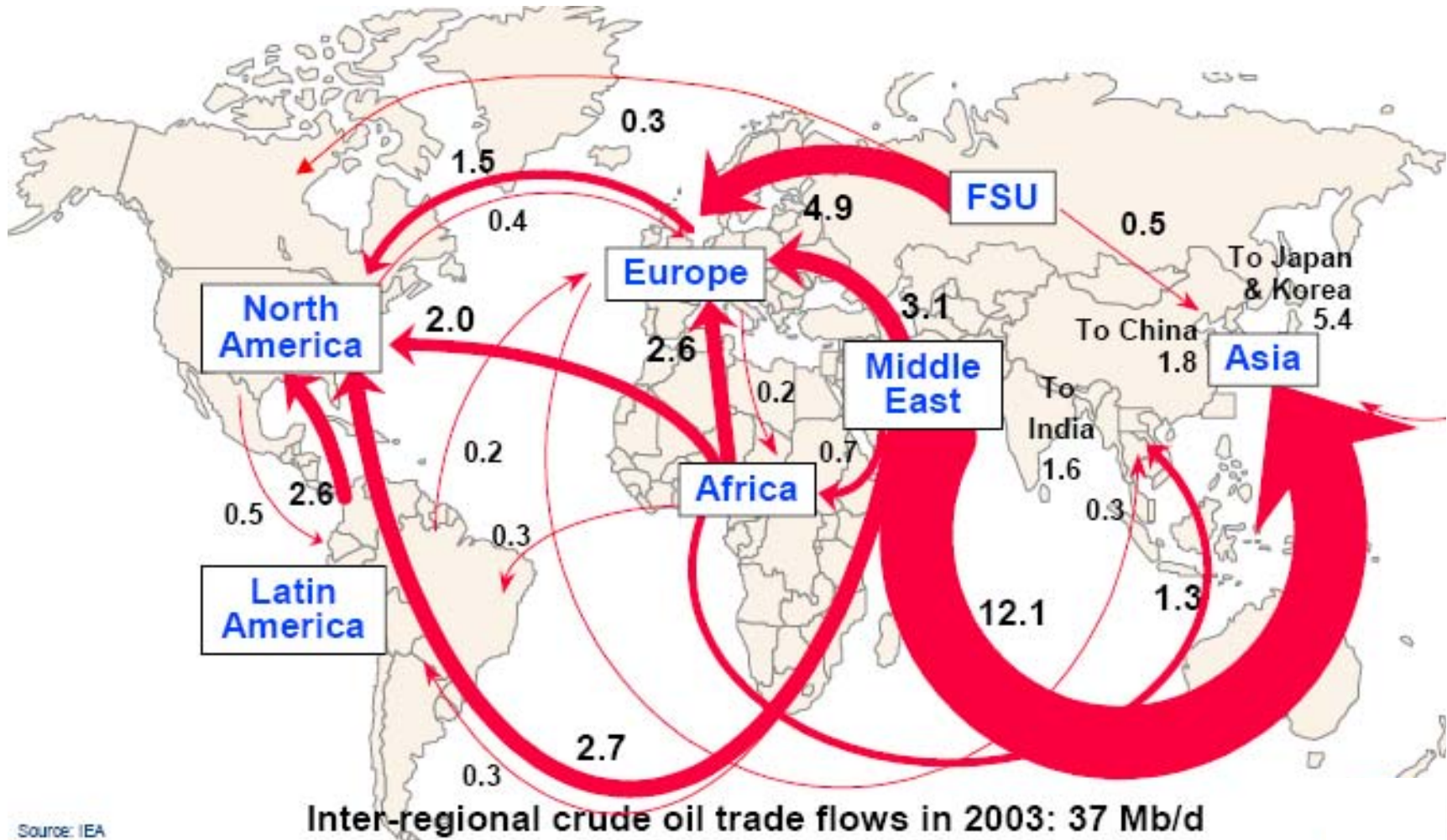
Climbing the Energy Ladder



- **+\$25k/capita:** little extra energy needed.
- **+\$15k/capita:** services start to dominate growth.
- **+\$10k/capita:** industrialisation near complete.
- **+\$5k/capita:** industrialisation and mobility take off.



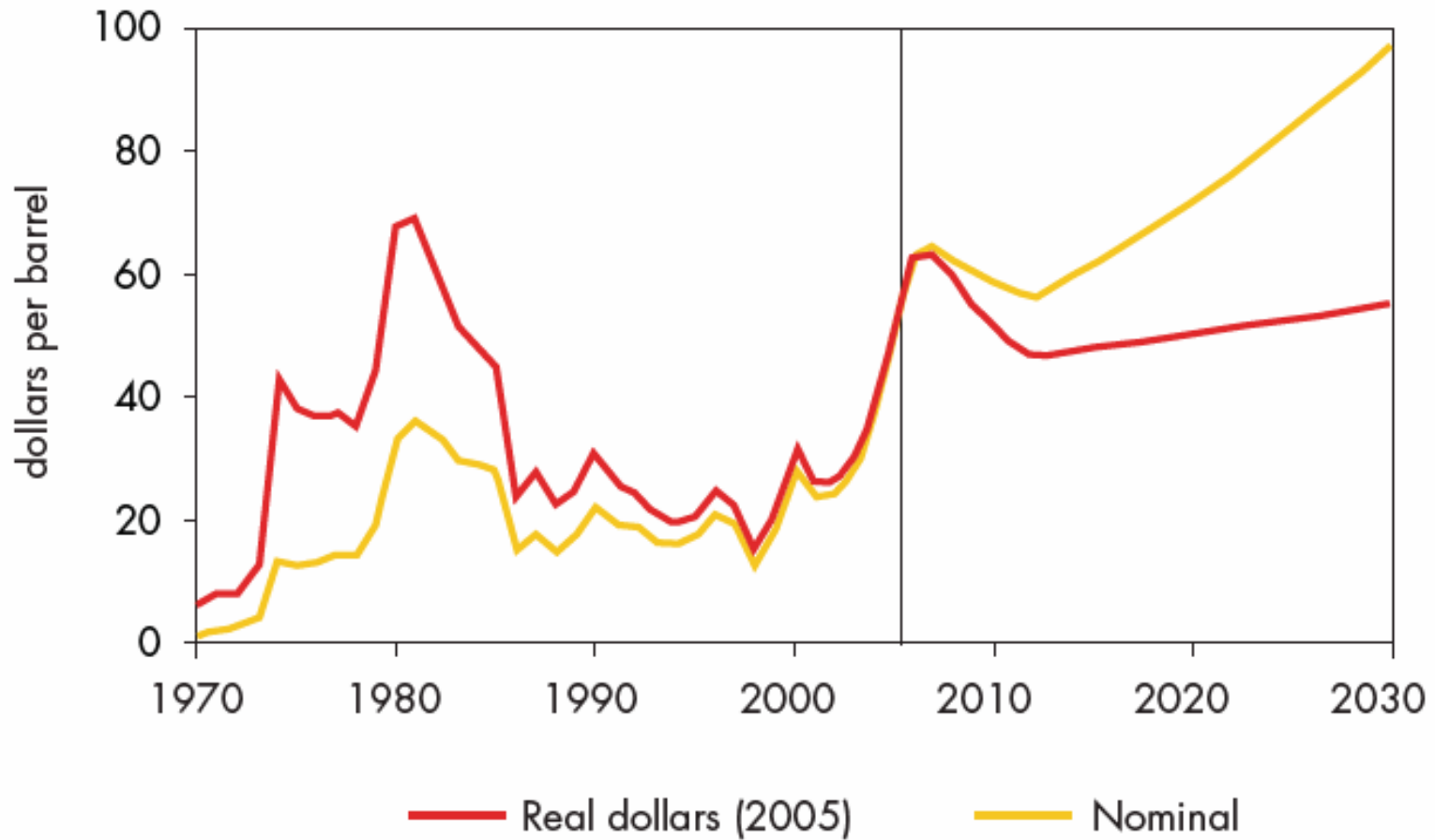
World Crude Oil Trade Patterns



Source: IEA

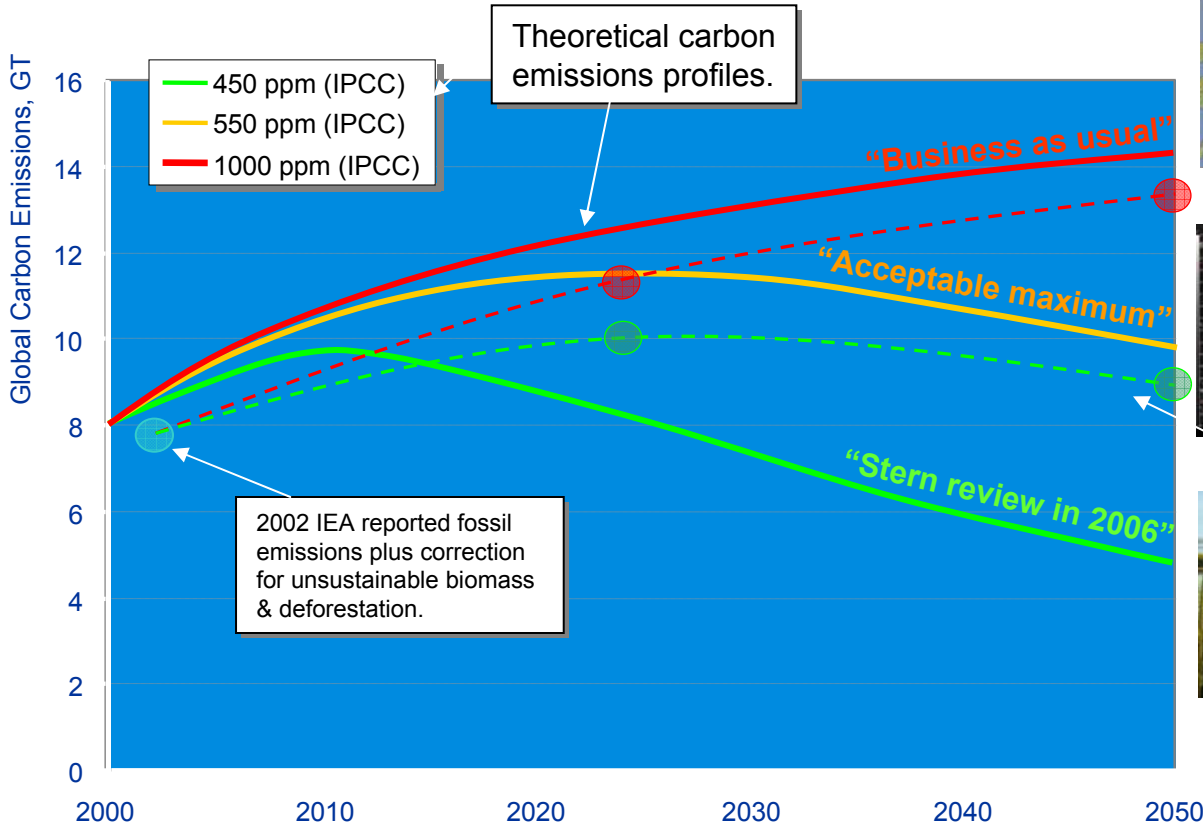


IEA Crude Oil Import Price Forecast





High and Low Carbon Pathways



High CO₂ Trajectory Energy by 2050:

- Coal double compared to 2000
- Oil up 50% compared to 2000
- Gas double compared to 2000
- Biofuels at 10% in vehicles
- Vehicle efficiency up 50%.
- Renewables growing
- Modest increase in nuclear.

Low CO₂ Trajectory Energy by 2050:

- Coal up 50%, but half of power stations use gasification and carbon capture and storage.
- Oil flat to down.
- Gas nearly triple compared to 2000
- Biofuels at 20% in vehicles.
- Hydrogen has arrived.
- Vehicle efficiency up 100%
- Renewables provide half of electricity generation.
- Significant increase in nuclear.
- Sustainable biomass practices.
- Energy efficiency is essential

Q: Can energy demand grow and carbon emissions begin to fall?

A: Yes – but it will be tough!

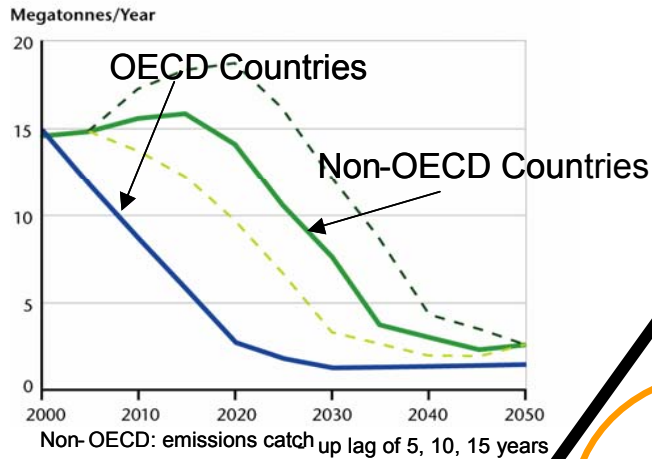
1. Intergovernmental Panel on Climate Change, Third Assessment Report, 2001.

2. World Business Council for Sustainable Development, Energy and Climate Focus Area; Pathways to 2050 (published December 2005); Policy Directions to 2050 (to be published March/April 2007)

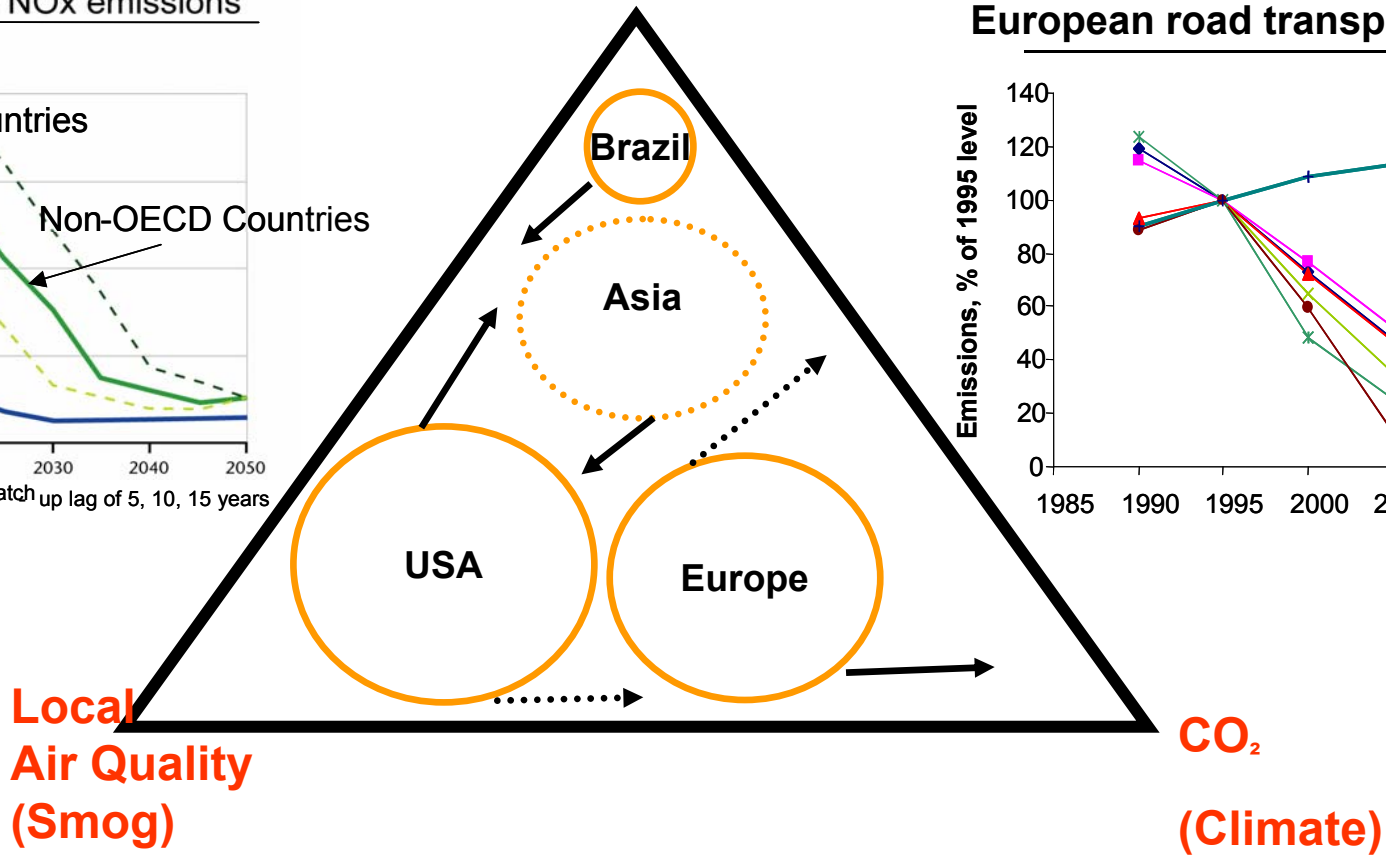


Societal Priorities Result in Different Local Regulations

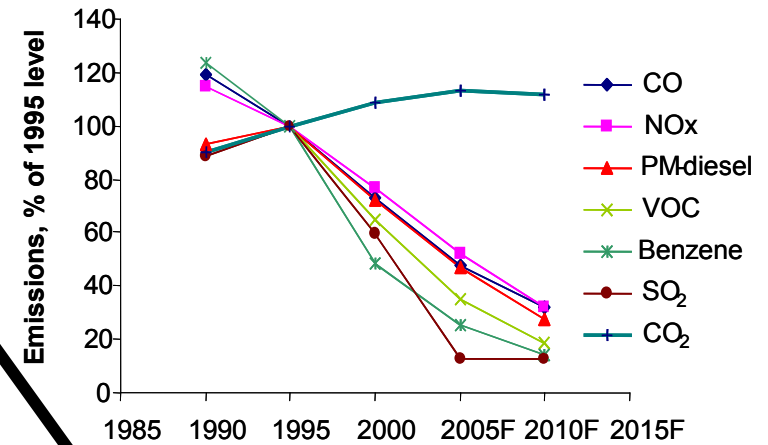
Transport-related NOx emissions



Energy Security



European road transport emissions

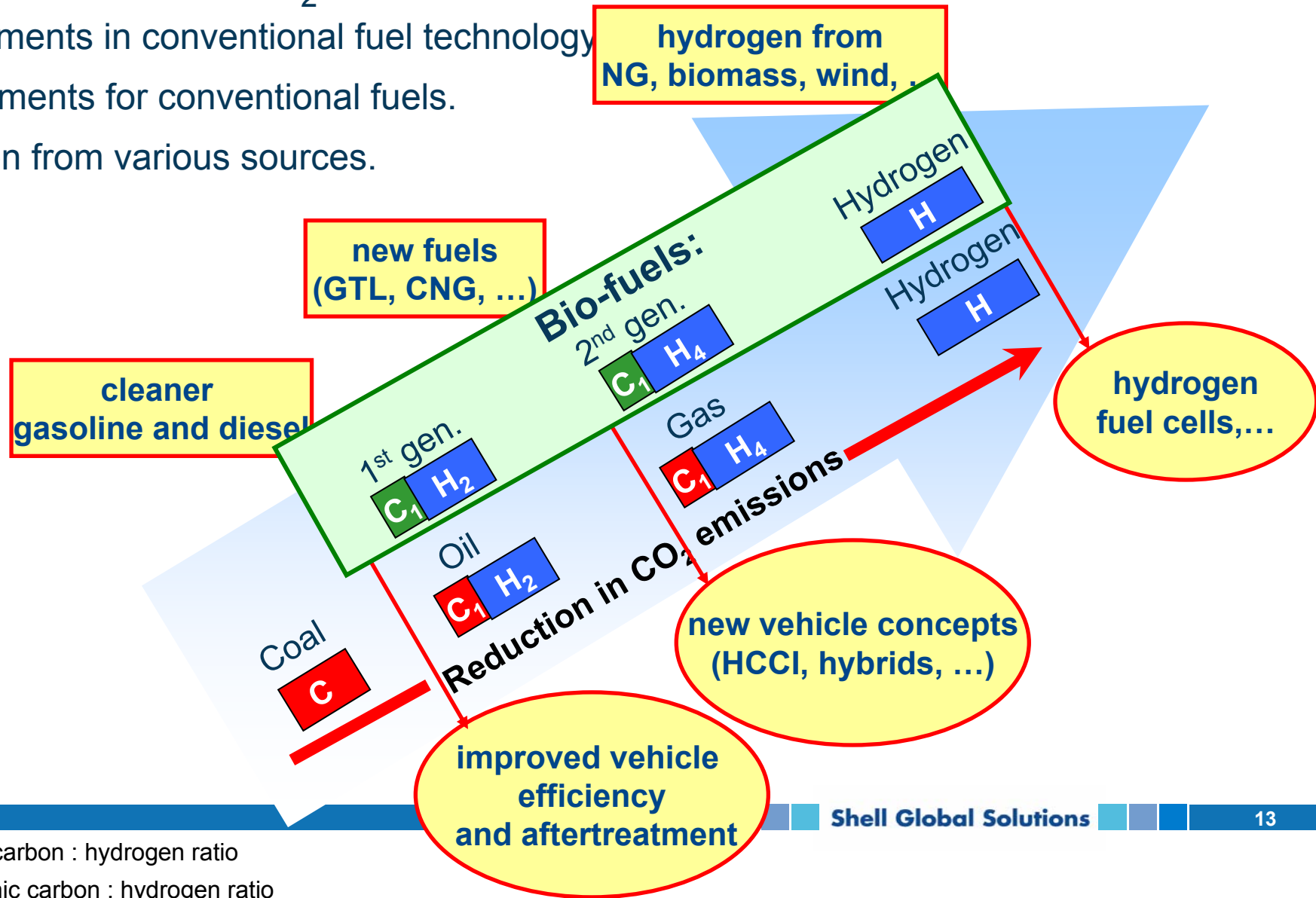




Changes to Automotive Fuels Are Inevitable

“De-Carbonization = CO₂ reduction to its best”

- 1) Improvements in conventional fuel technology
- 2) Replacements for conventional fuels.
- 3) Hydrogen from various sources.



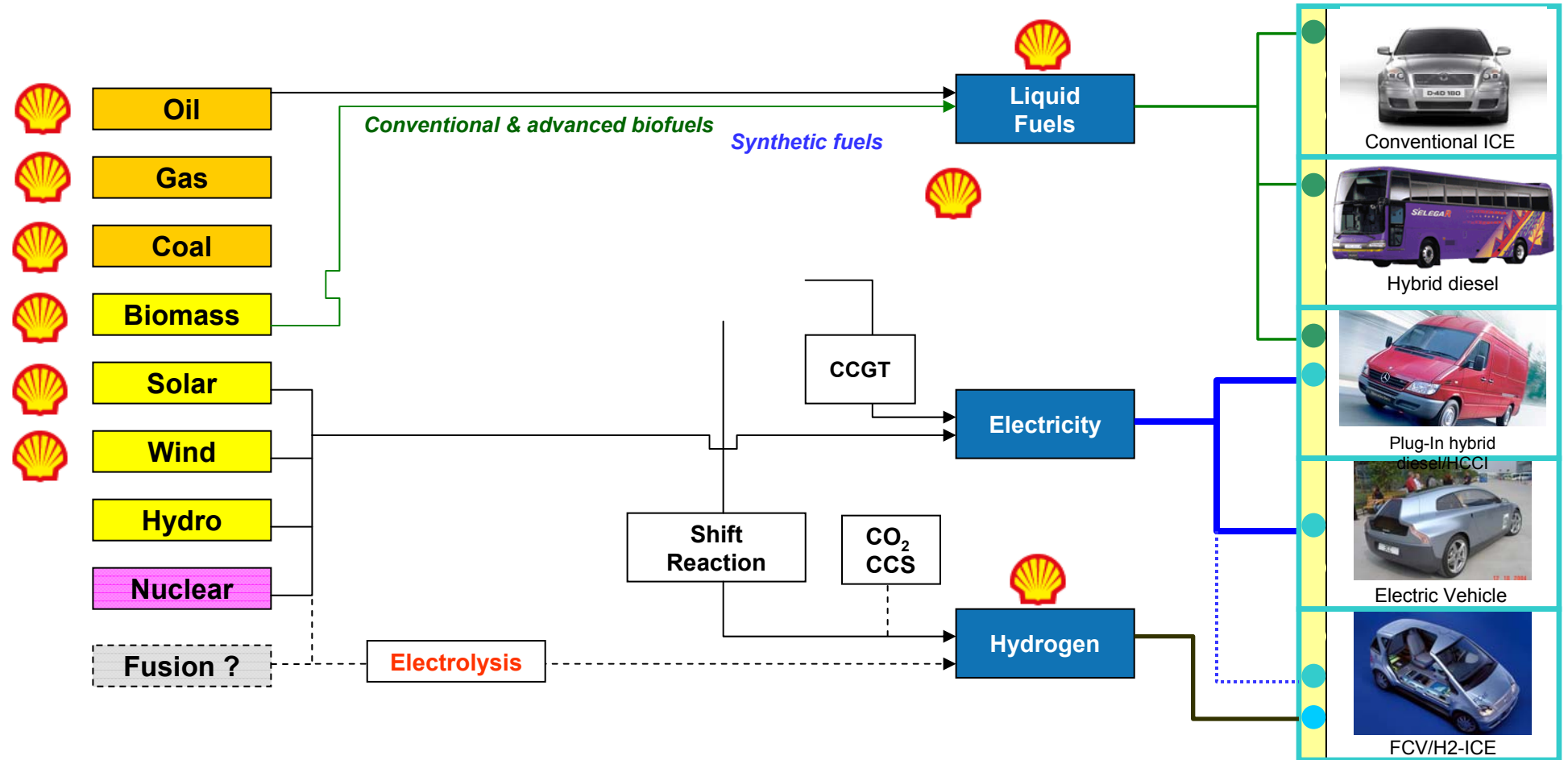


Options for Transport Fuels

Energy sources

energy carrier

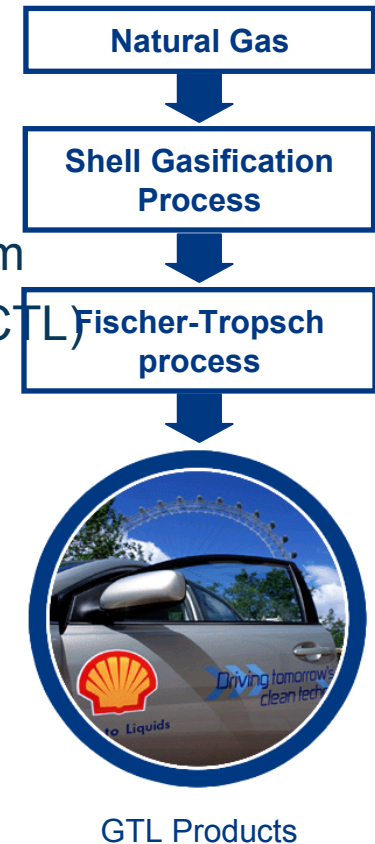
drive-train options



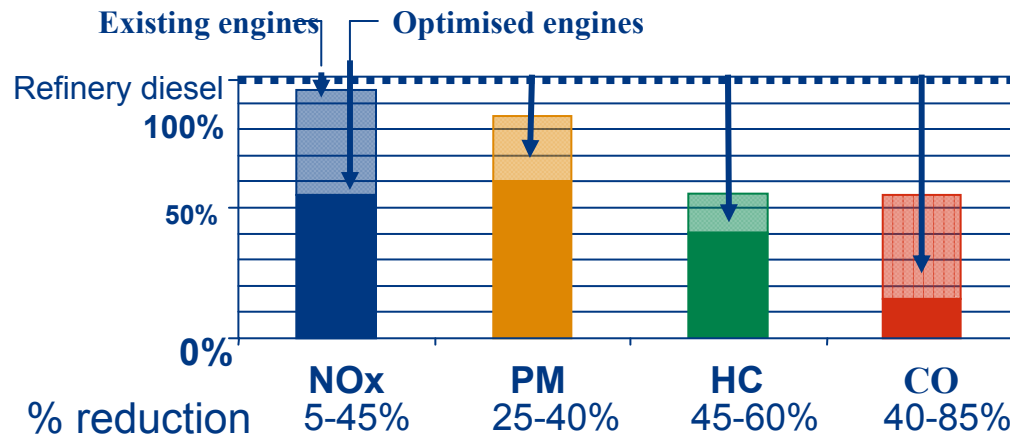


GTL as an Option for Enhanced Oil Independence

- Cleaner-burning synthetic fuel made from natural gas
- Can be used in today's infrastructure and diesel vehicles
- Lower local emissions can help tackle air pollution in cities
- Lifecycle CO₂ from GTL system comparable with refinery system
- Identical products can be made from biomass (BTL) and coal (CTL)



Local emissions from GTL Fuel compared with conventional diesel





Biofuels

First generation biofuel



Second generation biofuel

Benefits of second gen. biofuels:

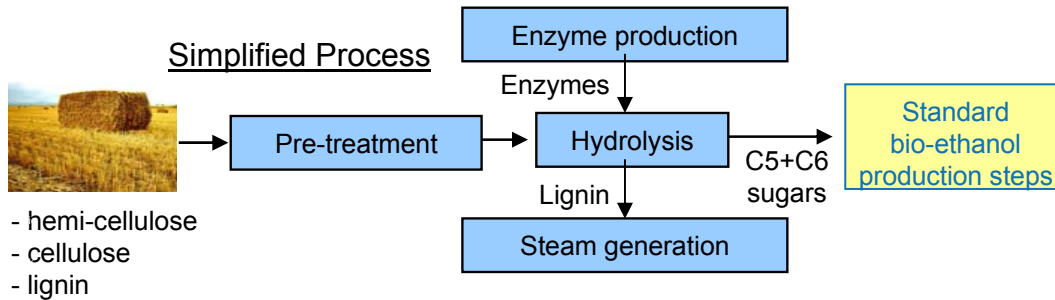
- Greater CO₂ reductions (~90%)
- Improved performance
- Lower costs
- More acceptable feedstocks (use waste)

...however not available in large scale commercial quantities for 5-10 years.

Bio Mass to Liquid (BTL) as 2nd Generation

Ethanol 2nd Generation

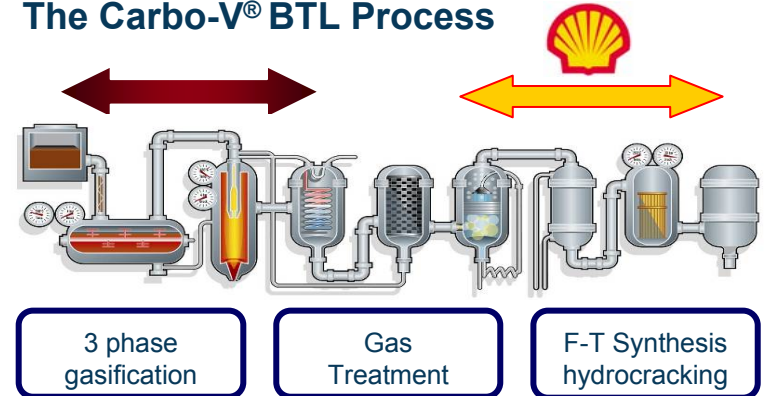
Iogen use non-food biomass to produce ethanol for blending into conventional gasoline to reduce CO₂ emissions.



Shell is working with CHOREN to develop commercially available biodiesel using a Biomass to Liquid process.



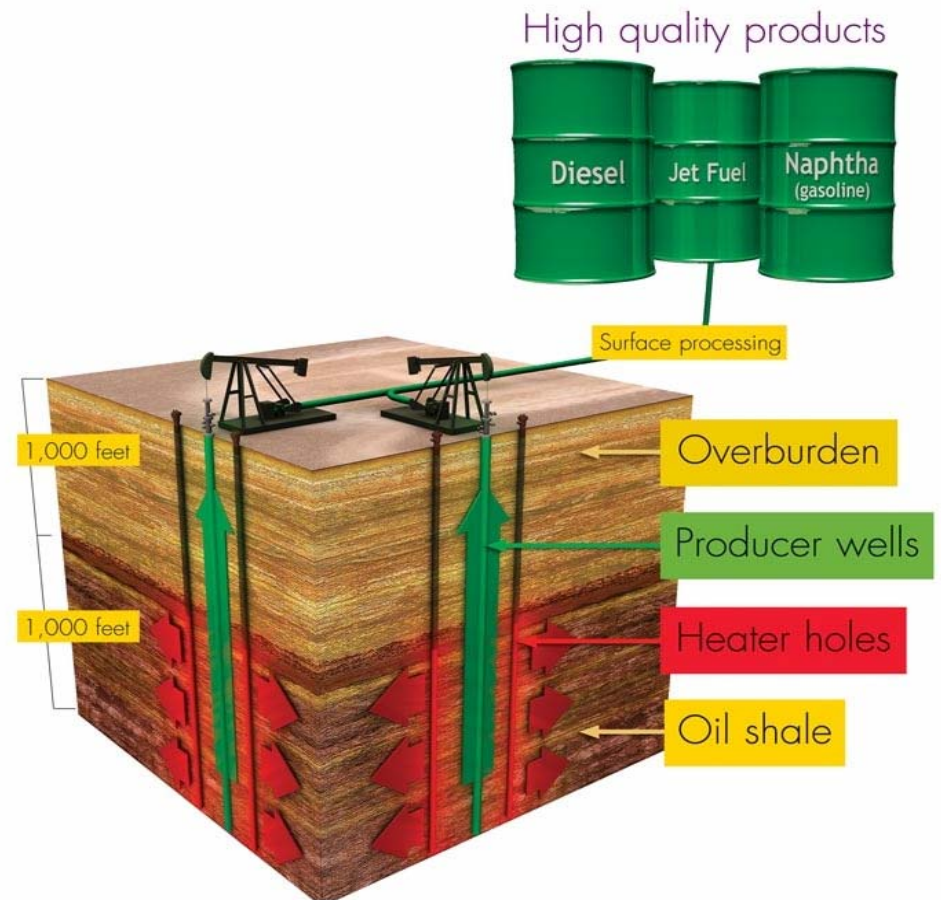
The Carbo-V[®] BTL Process





in-situ Conversion Process (ICP) for Shale

- Electric heaters gradually heat shale beneath surface
- Applicable to oil shale and heavy oil
- Heat converts kerogen in the oil shale into oil and gas
- Results in a high recovery of light hydrocarbon products yielding high quality transportation fuels





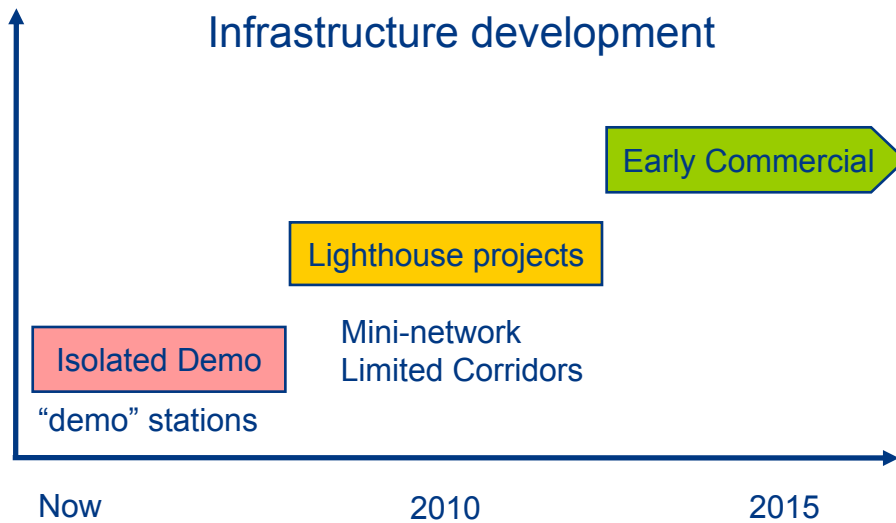
Hydrogen – We Have Started, but Some Way to Go

...

- Only energy company building hydrogen infrastructure in USA, Europe and Asia
- Four hydrogen demonstration projects
- Working to develop mini-networks
- **Challenges:** production/distribution costs, production process CO₂



Washington DC - combined petrol/hydrogen filling station



Iceland – initiative to transform Iceland into hydrogen economy



Thank you for your attention