



## Low Carbon Transport: What Can Industry Deliver?

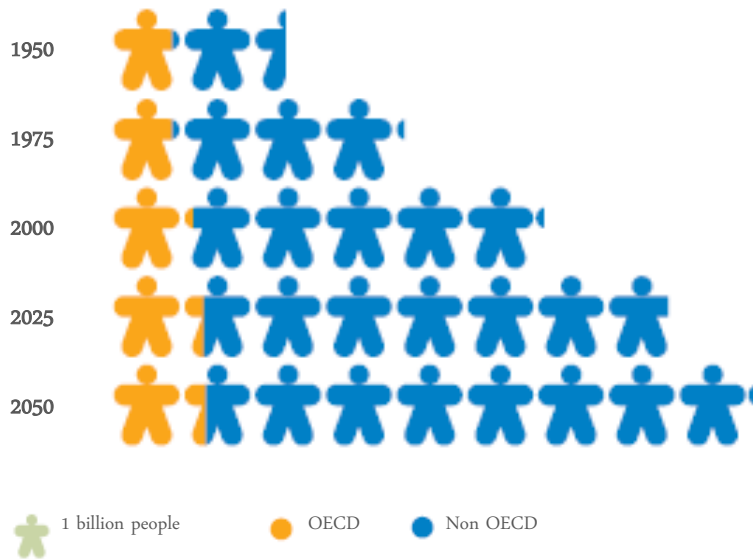
Dr. Graeme Sweeney

Shell International Petroleum

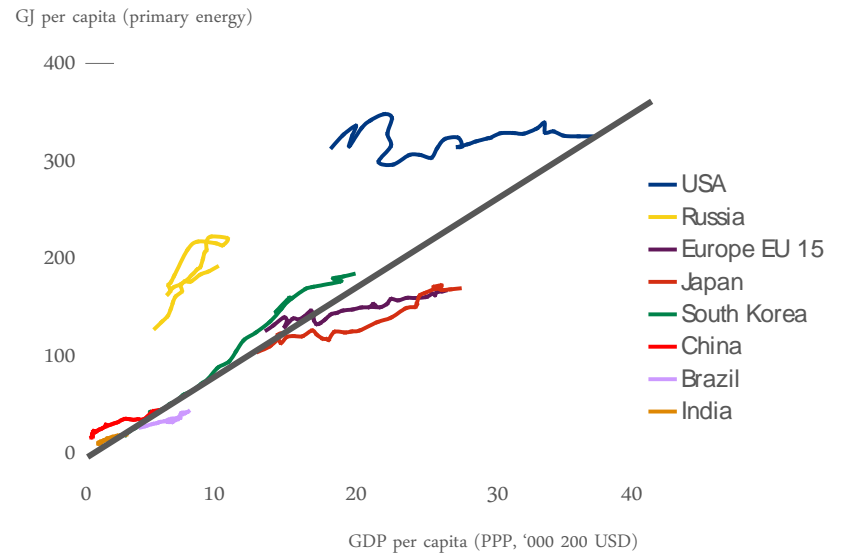
# THE “THREE HARD TRUTHS” GLOBALLY WILL IMPACT FUTURE ENERGY SUPPLY AND DEMAND

- 1 Step-change in energy use
- 2 Supply will struggle to keep pace
- 3 Environmental stresses are increasing

## World population



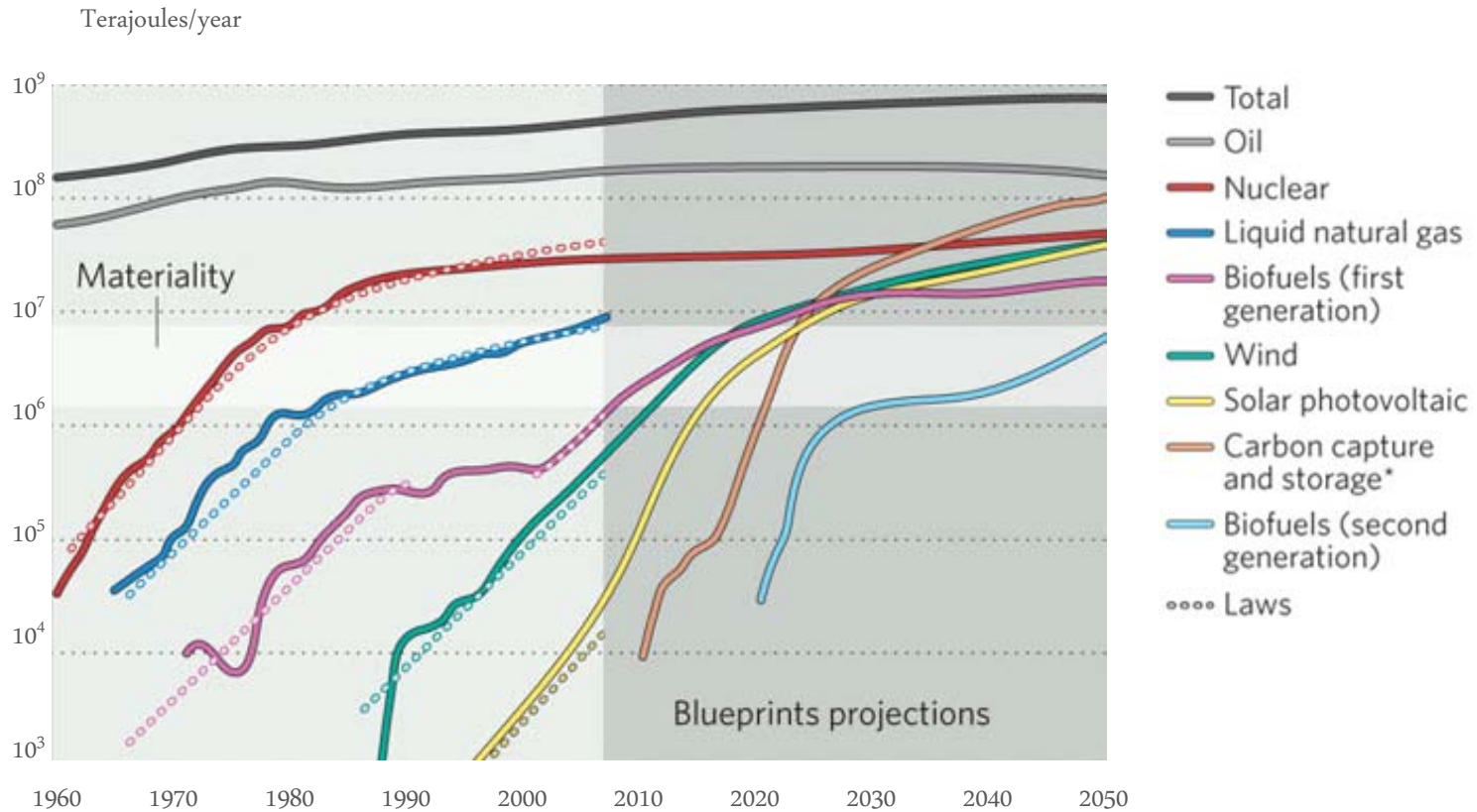
## Climbing the energy ladder



Data shown 1970-2005

# ENERGY TECHNOLOGY CHANGE TAKES TIME

Global production of primary energy sources.



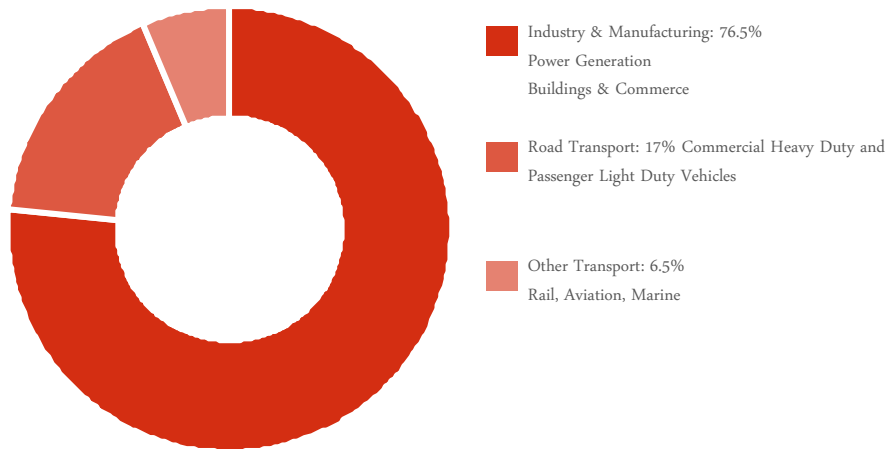
Source: Historic Data: Energy Balances of OECD Countries (IEA, 2009), Energy Balances of Non-OECD Countries (IEA, 2009). Projections: Shell International, from the article: *No quick switch to low-carbon energy* by Gert Jan Kramer & Martin Haigh *Nature* 462, 568-569(3 December 2009)

\*Coal and natural gas used in power generation with carbon capture and storage

# TRANSPORT ENERGY DEMAND WILL INCREASE RAPIDLY

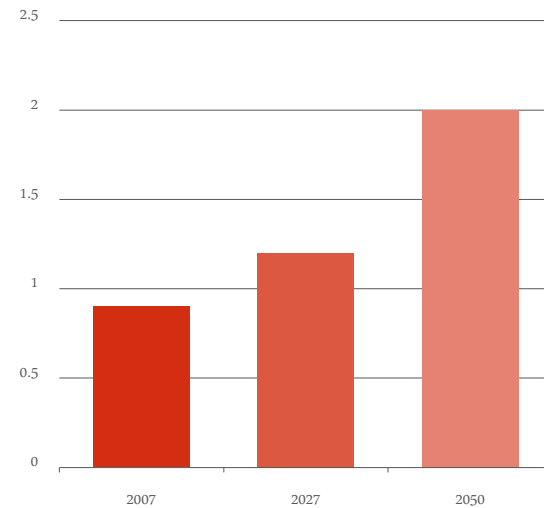
- *Energy-related* CO<sub>2</sub> emissions account for 62% of the global total
- Transport accounts for about 23% of *energy-related* CO<sub>2</sub> emissions. Road transport accounts for 17%
- Global population is growing and demand for mobility is increasing
- The number of vehicles on the road is likely to double to more than two billion by 2050

Energy Related CO<sub>2</sub> Emissions\*



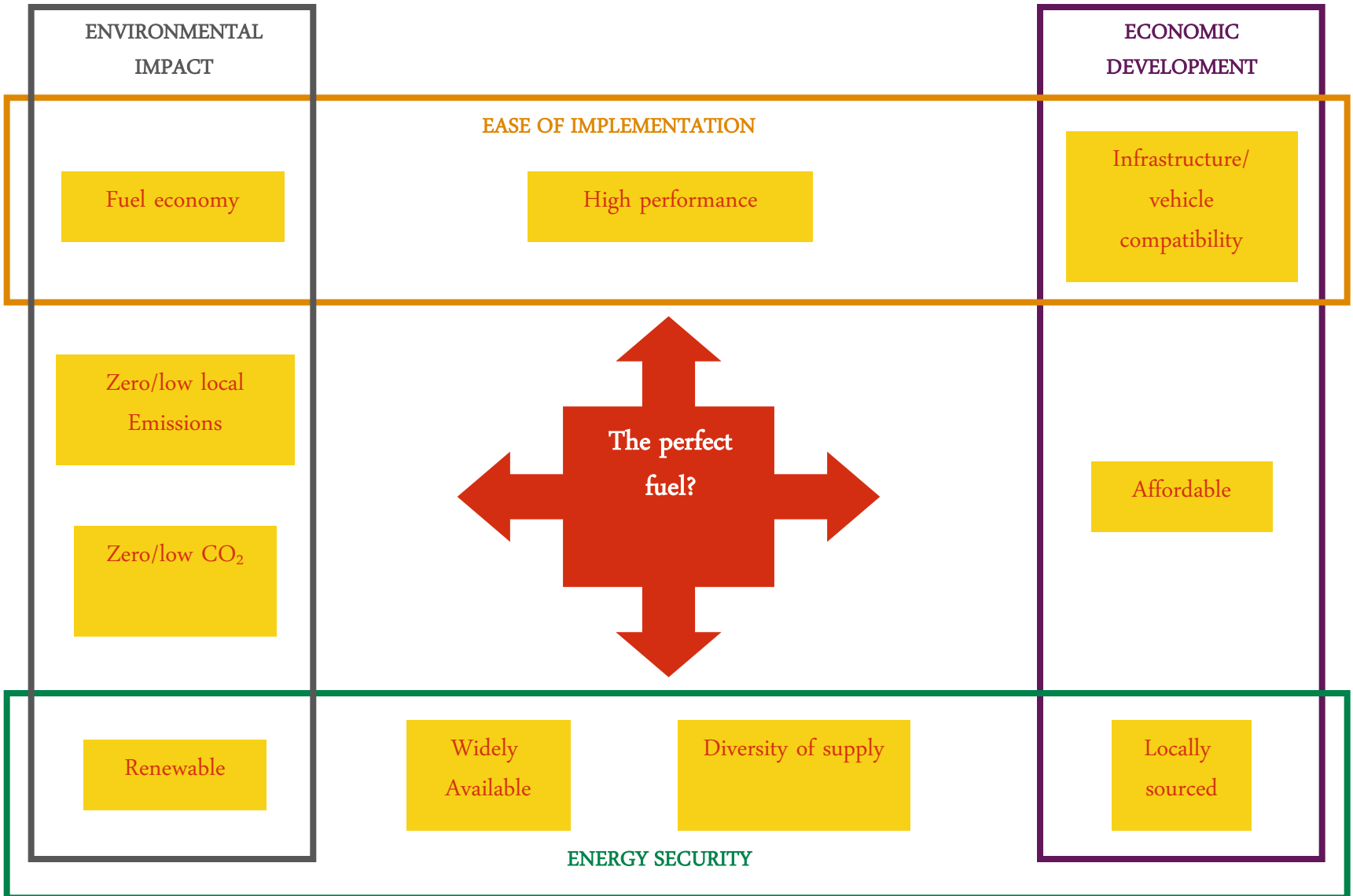
Source: International Energy Agency  
\* 62% of global CO<sub>2</sub> emissions

Estimate of worldwide vehicle demand



Source: World Business Council for Sustainable Development 2007

# DEMANDS OF FUELS



## NO SINGLE ALTERNATIVE TO OIL BASED ROAD TRANSPORT FUELS

- All fuel options will be needed
- Not just fuels: Improvements in CO<sub>2</sub> emissions through vehicle efficiency, fuel technology , infrastructure and consumer (driver) behaviour
- Countries and regions will choose a mosaic of fuel solutions based on cost, security of supply, existing infrastructure and CO<sub>2</sub> emissions
- The internal combustion engine and liquid fuels will continue to play an important role
- Electric and hydrogen will play an important role if technical and infrastructure challenges can be overcome
- Natural gas will continue to find a niche in local markets

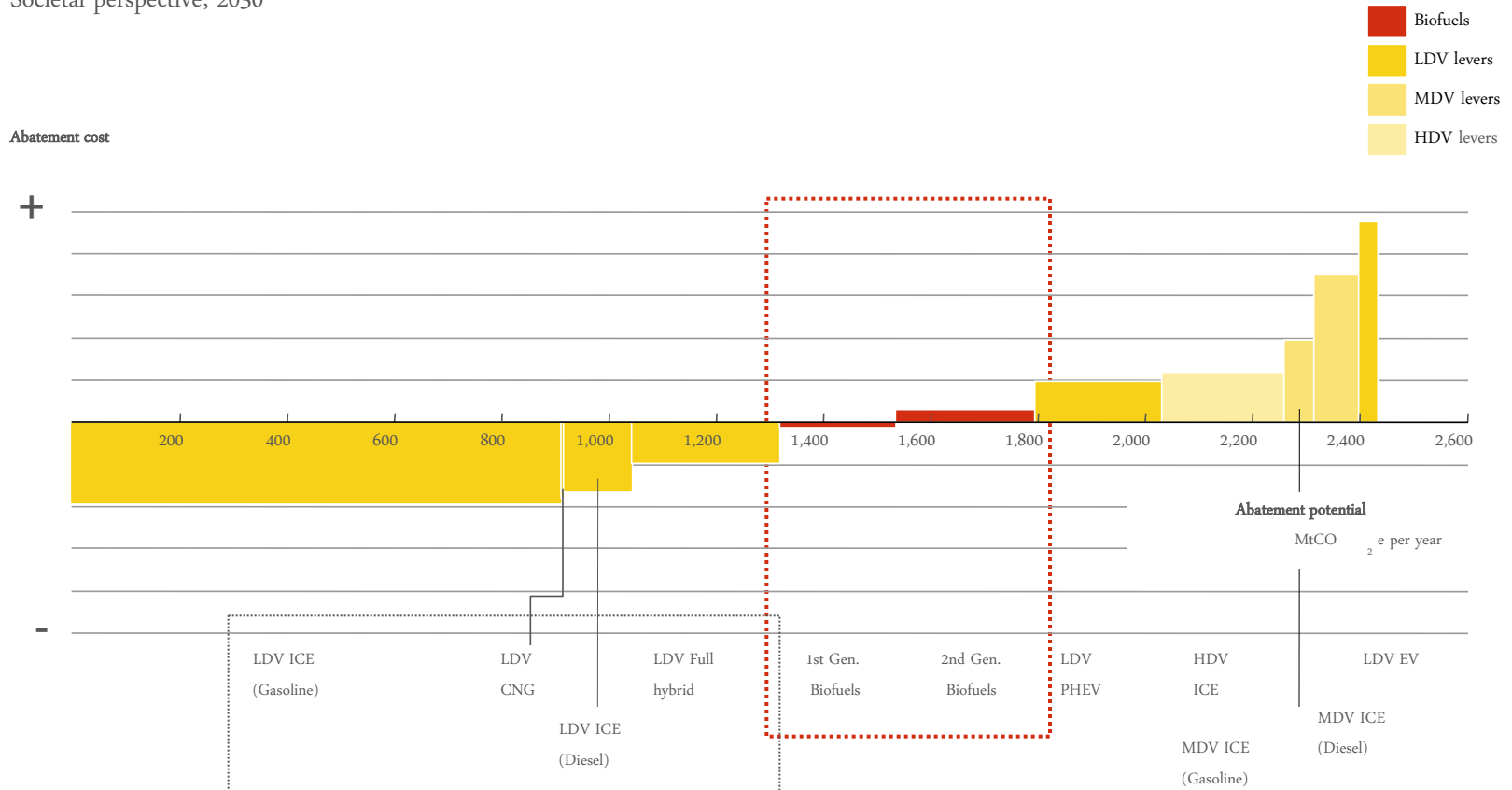


# BIOFUELS AND EFFICIENCY: REDUCING CO<sub>2</sub> EMISSIONS TODAY

- Efficiency and today's biofuels are the most realistic commercial solution to take CO<sub>2</sub> out of the transport fuels sector over the next twenty years

## Global CO<sub>2</sub> abatement cost curve for the Road Transport sector - Mix Technology World scenario

Societal perspective; 2030



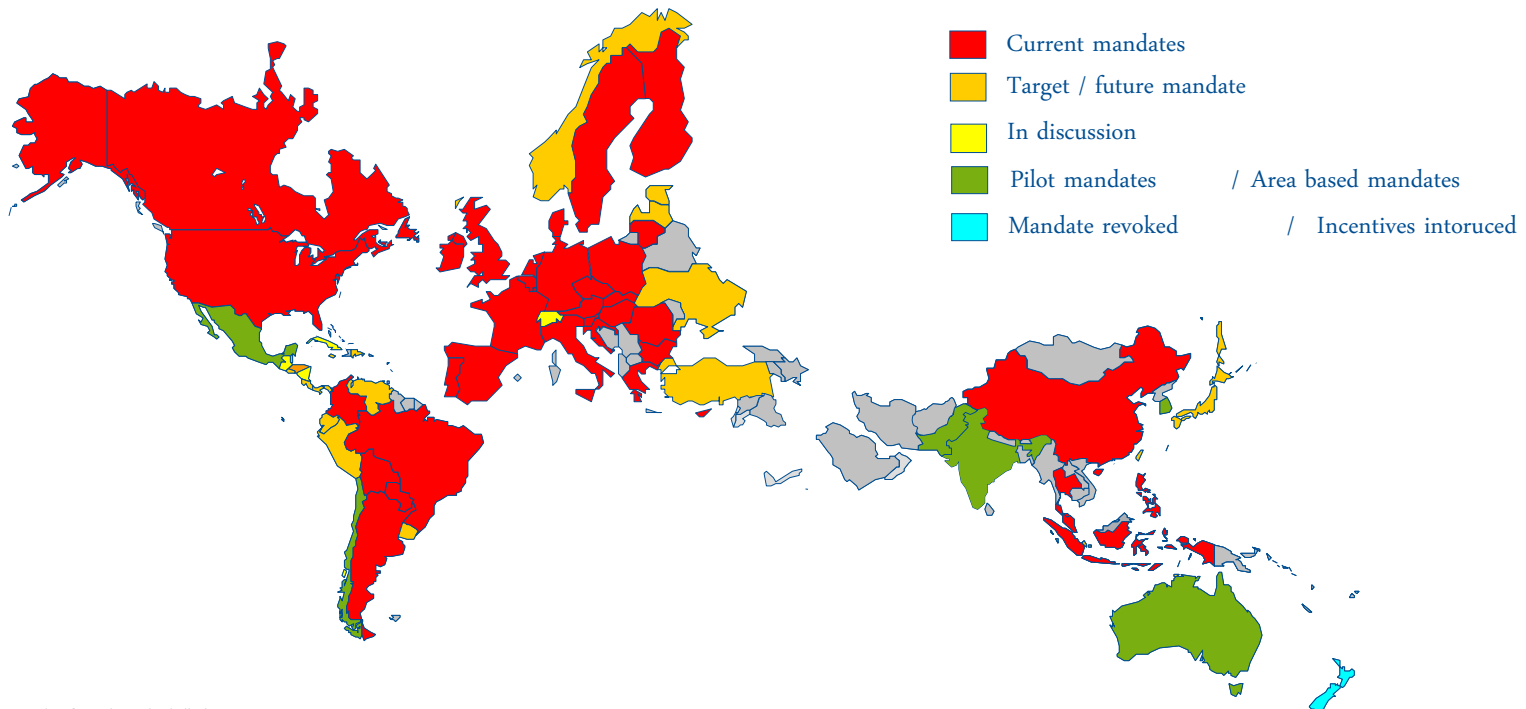
Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €100 per t CO<sub>2</sub>e in a penetration scenario if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.0

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## GOVERNMENT POLICIES CREATE A MARKET FOR BIOFUELS

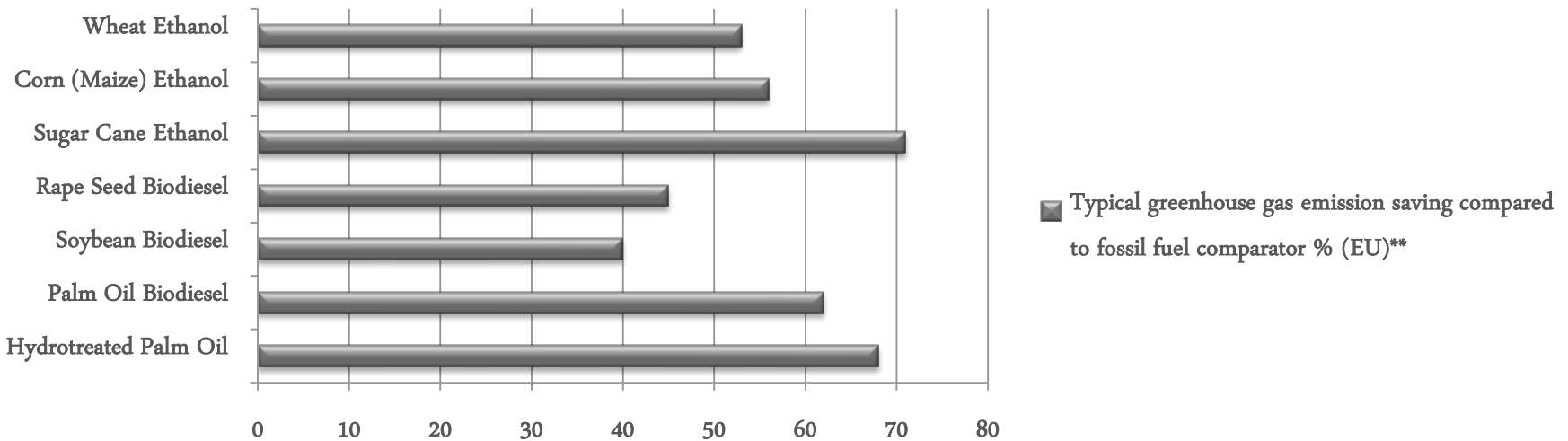
- More than 65 countries have or are developing renewable fuels mandates
- Legislative priorities differ – energy security, support for domestic agriculture, environment
- Policies have created an international market for biofuels.
- The International Energy Agency has estimated that biofuels could represent 30% of the world's road transport fuel mix by 2050





## BIOFUELS REDUCE CO<sub>2</sub> TODAY AND DIVERSIFY FUEL SUPPLY

- Biofuels are a low 'well-to-wheel'\* CO<sub>2</sub> sustainable alternative to gasoline and diesel available today
- But CO<sub>2</sub> emission reductions depend on whole journey to combustion – feedstock production, process used, distribution and use in vehicles
- Biofuels diversify transport fuel pool and offer prospect of improved energy security
- Biofuels can be used in existing liquid transport fuel infrastructure
- For some countries biofuels can offer economic and rural development opportunities

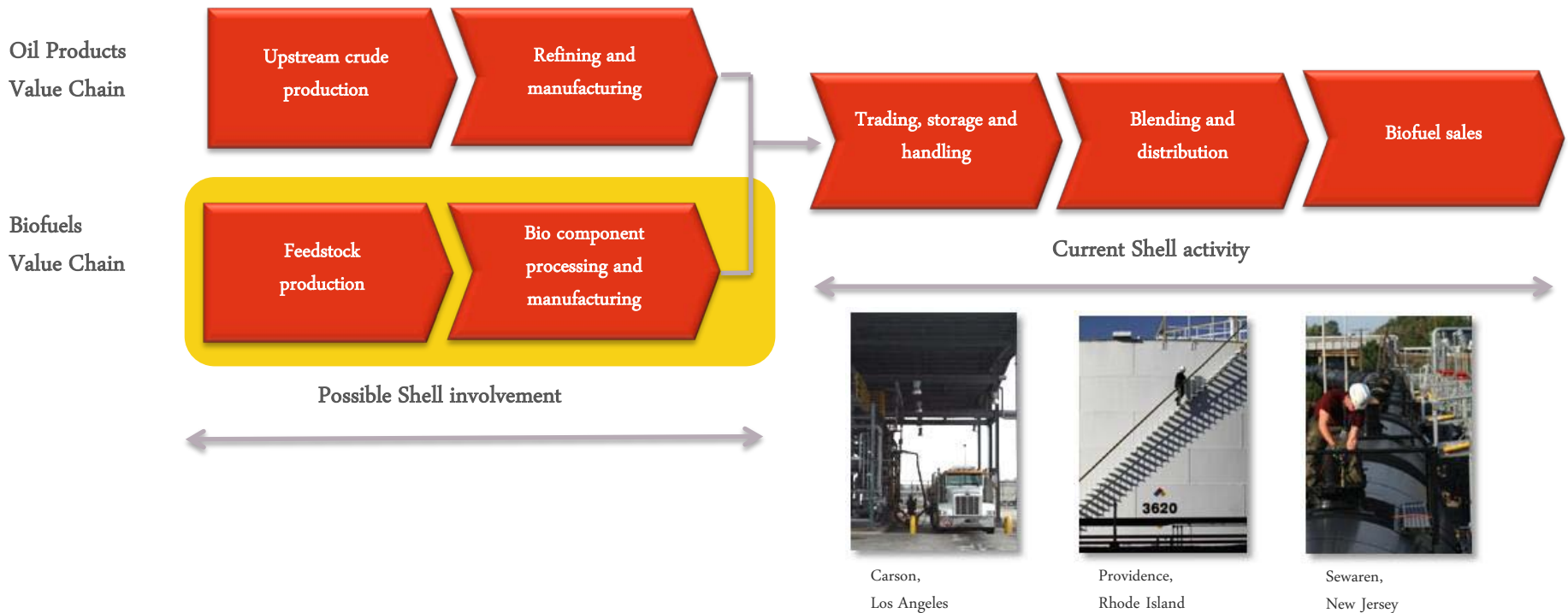


\*Well-to-Wheel CO<sub>2</sub> analysis calculates the CO<sub>2</sub> emissions relating to a particular fuel pathway. The calculation divides the pathway into two parts: (i) 'Well-to-Tank' (WtT) CO<sub>2</sub> emissions – from the production and distribution of the fuel feedstock and the actual fuel (ii) 'Tank-to-Wheel' CO<sub>2</sub> emissions – from the use of the fuel in the vehicle

\*\* Directive 2009/28/EC of the European Parliament and of the Council

# SHELL: A LEADER IN TODAY'S BIOFUELS

- 30-year history of biofuels development and investment
- Growing investment in infrastructure to store, blend and distribute biofuels
- One of the world's largest distributor of biofuels – 9 billion litres in 2010
- Building capacity in biofuels that provide best combinations of performance and low 'well-to-wheel' CO<sub>2</sub> performance from more sustainable feedstocks



## PROPOSED SHELL COSAN JOINT VENTURE

- Brazilian sugar cane – lowest CO<sub>2</sub> most sustainable and cost competitive of today's biofuels
- Non-binding Memorandum of Understanding with Cosan proposes \$12 billion joint venture
- 2 billion litres of ethanol production capacity per year – with room to grow
- Robust sustainability principles, standards and operating procedures



Ethanol fuel in Shell's retail network



Automated sugarcane harvesting



## PROMOTING CO<sub>2</sub> AND SUSTAINABILITY STANDARDS

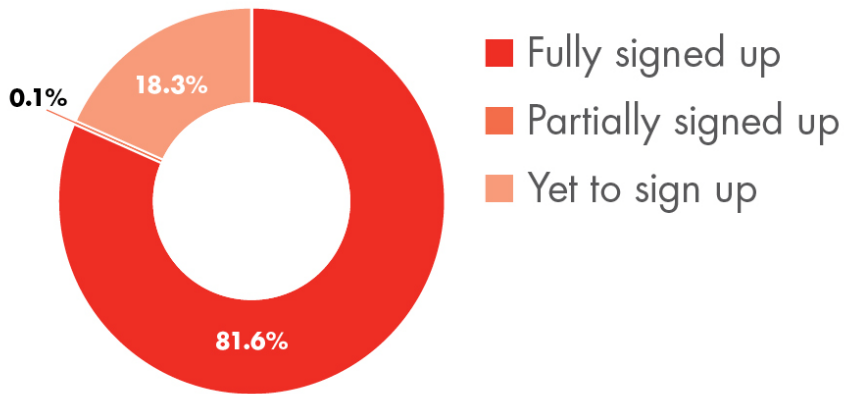
- Advocating for the adoption of ‘well-to-wheel’ CO<sub>2</sub> standards to reward low CO<sub>2</sub> biofuels
- Need for a consistent robust approach for calculating ‘well-to-wheel’ carbon intensity of fuels
- Engaging industry, governments, intergovernmental agencies and policy makers to encourage sustainability standards in the biofuels supply chain
- Participating in industry initiatives working on voluntary guidelines for particular feedstocks
- Working with the European Committee for Standardisation (CEN) to develop sustainability requirements in support of the European Energy Directive and Fuel Quality Directive
- UK has pioneered transparent carbon and sustainability reporting under RTFO



# SUSTAINABILITY OF SHELL'S BIOFUELS SUPPLY CHAIN

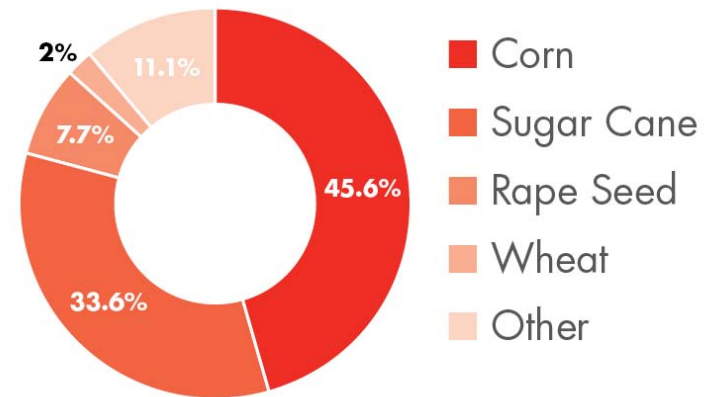
- Championing sustainability standards in our own biofuels supply chain
- Rules and practices to help assess risks, implement controls, monitor compliance and report our progress
- Sustainability clauses in new and renewed term contracts:
  - feedstocks not knowingly linked to violation of human rights or produced in areas of high biodiversity value
  - suppliers develop and implement supply chain traceability systems
  - suppliers join relevant international bodies developing sustainability criteria particular feedstocks

## Shell's Biocomponent Purchases Covered by Sustainability Clauses



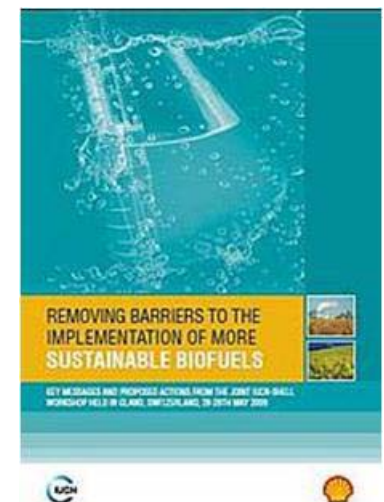
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## Shell Global Biocomponent Feedstock Purchase Q4 2009



## WORKING WITH OTHERS TO PROGRESS KNOWLEDGE

- Working with environmental and social experts to develop projects to help address the potential direct and indirect impacts of biofuels
- Sharing experience and expertise
- Long-term collaboration with the International Union for Conservation of Nature (IUCN):
  - Addressing conservation and livelihood risks and opportunities in the biofuels supply chain
  - Providing opportunities for IUCN to influence global markets towards more sustainable biofuels production processes
- Working with other oil companies and NGOs including WWF and IUCN to investigate ways to promote sustainable production of biofuels feedstocks on underutilised or marginal lands



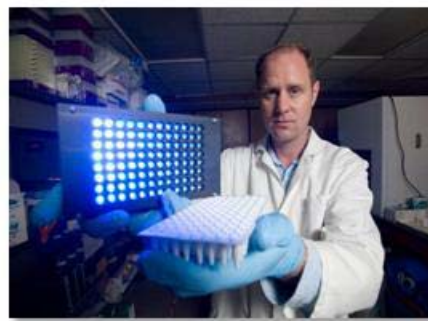
## LEADING DEVELOPMENT OF ADVANCED BIOFUELS

- Advanced biofuels, using feedstocks such as crop wastes or inedible crops and new conversion processes
- Offer the potential for improved CO<sub>2</sub> reductions and improved fuel characteristics.
- Accelerating research, development and demonstration of advanced biofuels
- Dedicated Shell biofuels teams across 4 research centres in the US, UK, Netherlands and India
- Research agreements with experts in leading academic institutions across the world



# TECHNICAL PARTNERSHIPS WITH LEADING BIOTECHNOLOGY COMPANIES

Shell also has technical partnerships with leading biotechnology companies





# HYDROGEN FOR TRANSPORT

- Hydrogen will play an important role as one of a number of options to diversify road transport fuel
- Its development is longer term. We estimate rapid expansion after 2025
- It will take considerable cooperation between car makers, fuel suppliers and governments for hydrogen to fulfill its potential
- Through partnerships Shell provides stand-alone, demonstration hydrogen filling stations
- These stations provide us with important experience in consumer behaviour, safety, cost and dispensing and storing hydrogen
- Numbers will change as new stations are developed and existing stations come to the end of their demonstration phase
- Shell also has a research programme into future low CO2 hydrogen options



## KEY PRINCIPLES FOR LOW CARBON FUEL POLICY

- Overall goal of low-carbon fuels policy/regulation should be to achieve a reduction in WtW CO<sub>2</sub>e production per unit of distance travelled
- Regulations should stimulate market-driven innovation to develop cost effective solutions, and should not close down options by prescribing the approach to meeting the policy goal

Shell advocates 8 key policy principles:

- Reward GHG performance of fuel
- Protect social and environmental needs – e.g. internationally agreed sustainability standards for biofuels
- Regulations that stimulate action by both energy companies and auto manufacturers
- Flexible, performance based standards
- Measures to influence driver behaviour and mobility choices
- Regulatory certainty, consistency and alignment across borders
- Challenging but achievable goals
- Delivering technology policy that addresses all required phases – Discover, Develop, Demonstrate, Deploy

## MOVING IN THE RIGHT DIRECTION

- Shell welcomes the latest report from the Committee on Climate Change: *'Meeting carbon budgets – ensuring a low carbon recovery'*.

Just to single out a few things, we welcome the CCC's focus on:

- Recognising the contribution biofuels have made so far and signals that they could play a greater role in future (e.g. 8% by energy towards EU 2020 targets)
- Improving policies in the agriculture sector
- Encouraging the move to more carbon-efficient cars
- Encouraging smarter eco-driving
- Encouraging smarter choices and alternatives to car travel
- Strengthening incentives for investment in low carbon power e.g. support for CCS technology demonstration

## SUMMARY

- There is no single alternative to oil based road transport fuels – all sustainable fuel options will be needed
- Efficiency and today's biofuels are the most realistic commercial solution to take CO<sub>2</sub> out of the transport fuels sector and diversify supply over the next twenty years
- Shell is building capacity in biofuels that provide best combinations of performance and low 'well-to-wheel' CO<sub>2</sub> performance from more sustainable feedstocks
- Shell and Cosan have recently announced a proposed JV for the production of Brazilian sugar cane ethanol
- Shell advocates for the adoption of 'well-to-wheel' CO<sub>2</sub> and sustainability standards to reward biofuels that perform well
- Shell continues to invest significantly in advanced biofuels research and development and to work aggressively on commercialization
- Hydrogen and electric will play an important role as one of the small number of options to diversify road transport fuel
- Overall goal of low-carbon fuels policy/regulation should be to achieve a reduction in WtW CO<sub>2</sub>e production per unit of distance travelled.

