Low Carbon Vehicles -

The role of hydrogen

24th February 2005
H-Valley Launch

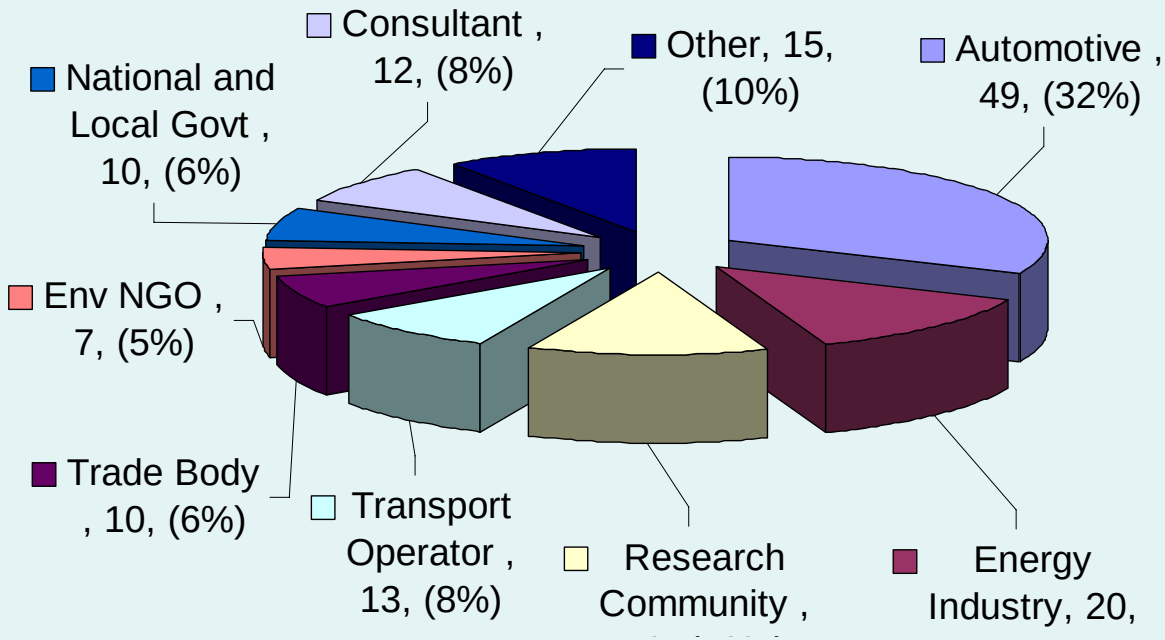
Greg Archer
LowCVP Director

LowCVP
low carbon vehicle partnership

Low Carbon Vehicle Partnership

Accelerating a sustainable shift to low carbon vehicles and fuels in the UK

Stimulating opportunities for UK businesses



LowC VP
low carbon vehicle partnership

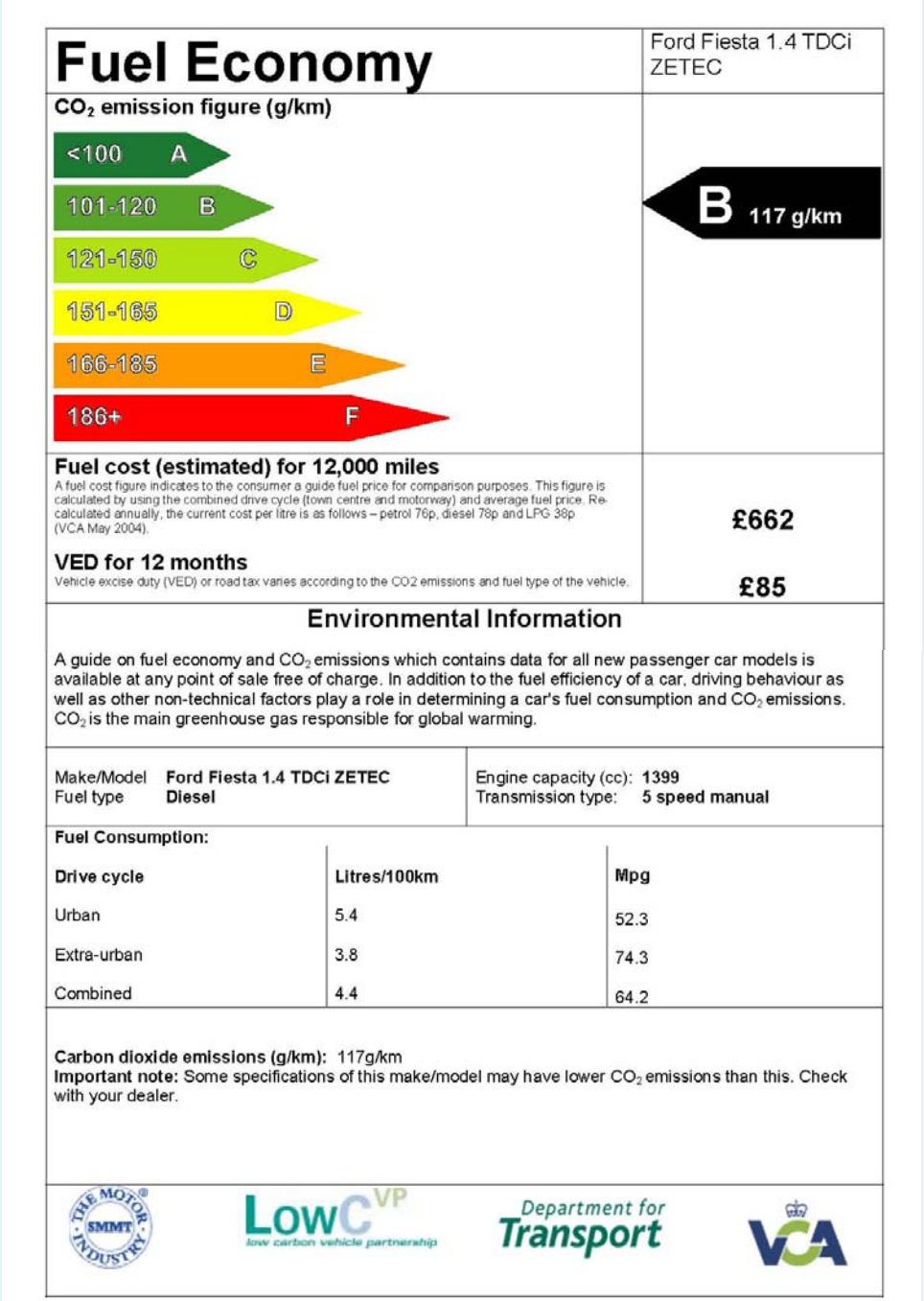
LowCVP Activities

- Action by members
  - Biofuels accreditation
  - Car label
- Advice to Government
  - Bus programme
  - Centre of Excellence
- Research
  - Car buying behaviour
  - R&D agenda for CoE
  - Testing of commercial vehicles
- Policy development
  - Future of voluntary agreements
  - RTFO feasibility study
- Programme advice
  - TransportEnergy programme

LowCVP
low carbon vehicle partnership

Voluntary car labelling scheme

- Voluntary Scheme to be launched in summer 2005 – ahead of EU scheme
- Collaboration between LowCVP, UK Government and SMMT
- Bands linked to UK Vehicle Exercise Duty CO2 categories
- Consistent with European Energy Efficiency labels



Fuel Economy

Ford Fiesta 1.4 TDCi ZETEC

CO_2 emission figure (g/km)

<100	A
101-120	B
121-150	C
151-165	D
166-185	E
186+	F

B 117 g/km

Fuel cost (estimated) for 12,000 miles £662

A fuel cost figure indicates to the consumer a guide fuel price for comparison purposes. This figure is calculated by using the combined drive cycle (town centre and motorway) and average fuel price. Re-calculated annually, the current cost per litre is as follows – petrol 76p, diesel 78p and LPG 38p (VCA May 2004).

VED for 12 months £85

Vehicle excise duty (VED) or road tax varies according to the CO2 emissions and fuel type of the vehicle.

Environmental Information

A guide on fuel economy and CO_2 emissions which contains data for all new passenger car models is available at any point of sale free of charge. In addition to the fuel efficiency of a car, driving behaviour as well as other non-technical factors play a role in determining a car's fuel consumption and CO_2 emissions. CO_2 is the main greenhouse gas responsible for global warming.

Make/Model **Ford Fiesta 1.4 TDCi ZETEC**
Fuel type **Diesel**
Engine capacity (cc): **1399**
Transmission type: **5 speed manual**

Fuel Consumption:

Drive cycle	Litres/100km	Mpg
Urban	5.4	52.3
Extra-urban	3.8	74.3
Combined	4.4	64.2

Carbon dioxide emissions (g/km): 117g/km
Important note: Some specifications of this make/model may have lower CO_2 emissions than this. Check with your dealer.

THE MOTOR INDUSTRY SMMT · LowCVP low carbon vehicle partnership · Department for Transport · VCA

LowCVP low carbon vehicle partnership

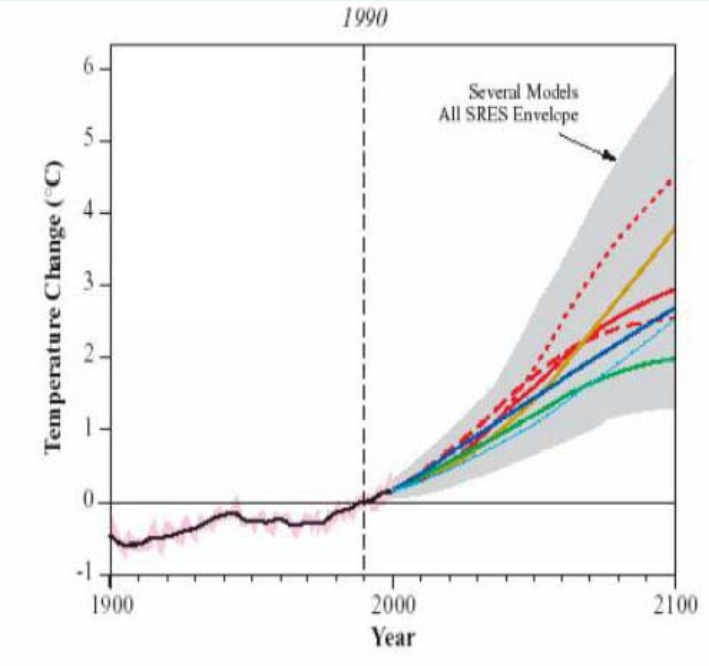
Centre of Excellence for Low Carbon and Fuel Cell Technologies

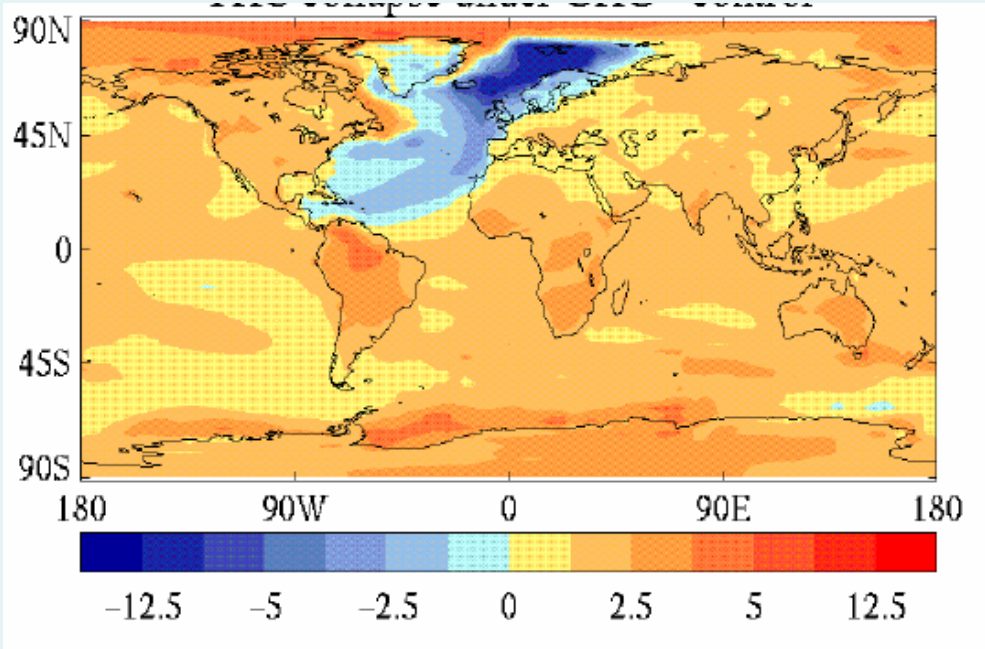
Holywell Campus,
University of Loughborough

- To be launched in Spring 2005 at Loughborough University
- Create stronger linkages between academia, supply chain and OEMs
- Partnership developed Supply Chain database will form a key element of Knowledge Transfer Activities
- Research priorities identified through Partnership R&D Working Group

LowC VP
low carbon vehicle partnership

Climate projections indicate a global temperature rise of 1.5 - 6°C by 2100[1] - with potentially profound implications





http://www.stabilisation2005.com/day1/Schneider.pdf

http://www.stabilisation2005.com/33_Richard_Wood.pdf

LowC VP
low carbon vehicle partnership

Wales in 2050

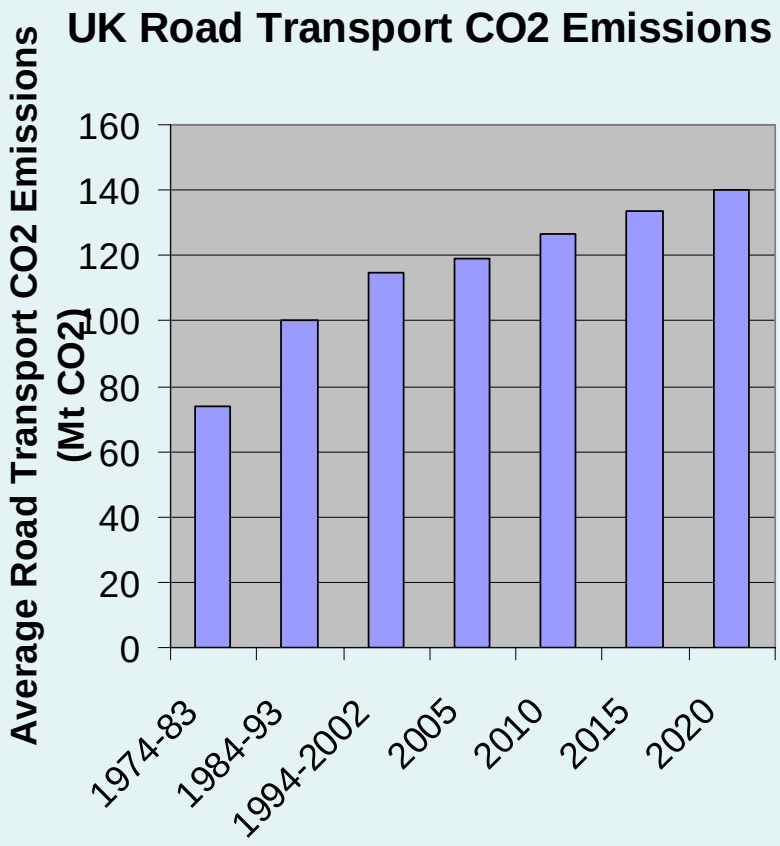
- ❑ Heavier winter rainfall – increased flooding in low-lying areas
- ❑ Summer droughts and water shortages (possibly by 2025)
- ❑ Coastal areas prone to increased flooding during storm surges – with impacts for tourism
- ❑Alpine plants in decline in upland areas – including the Snowdon lily
- ❑ Forests could be affected by increased storm damage and new pests such as the spruce aphid

LowC VP
low carbon vehicle partnership

Forecasting the future, changing climate, changing behaviour, EST, 2004

Reducing road transport emissions will require a combination of measures

- Reduced vehicle emissions
- Low carbon / alternative fuels
- Improved driver behaviour
- Reduced vehicle use
- Better freight distribution
- *Hydrogen represents a possible solution post 2030*



LowCVP
low carbon vehicle partnership

The possible transition to hydrogen requires addressing several challenges

- Higher costs per unit of energy
  - Oil prices rises may eliminate this
- Development of refuelling infrastructure
- Supply of a range of affordable vehicles
- Renewable production volumes - particularly if used for internal combustion
- Practical storage
- High cost of fuel cells

- *Step wise transition is most likely*

Honda FCX – Hydrogen fuel cell

Hydrogen Mini - IC

LowCVP
low carbon vehicle partnership

There is a chicken & egg dilemma regarding provision of vehicles and refuelling infrastructure

http://www.chevrontexaco.com/about/energy_opportunities/docs/img_hydrogen_energy_ad.pdf

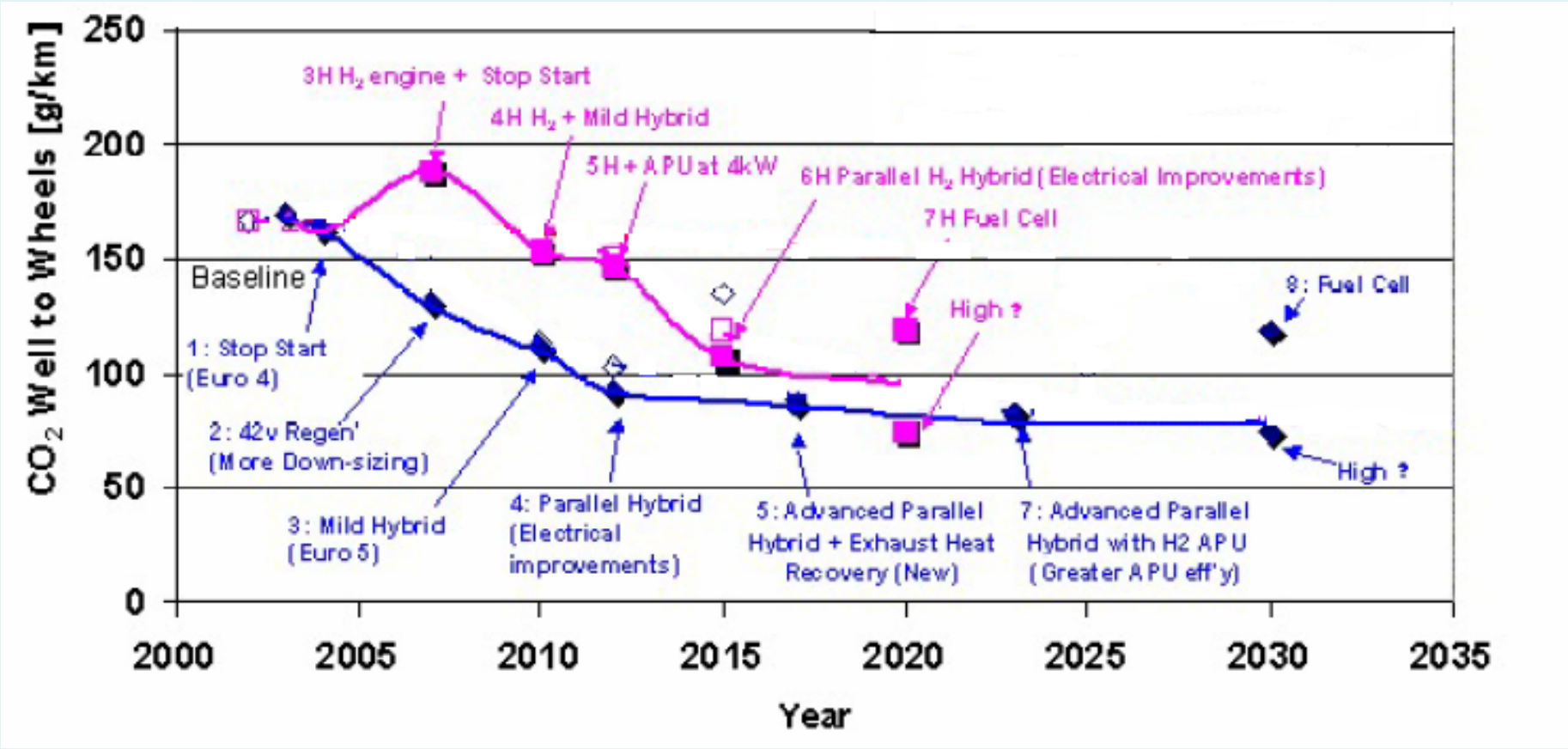
LowC VP
low carbon vehicle partnership

H Fuel Cell Buses are being trialled in London

- Daimler Chrysler Citaro buses
- 3 buses in London – 30 in 10 cities across Europe
- Demonstrating, testing and examining –
  - Technology
  - Infrastructure
  - Safety
  - Reliability
  - Operating experience in different conditions
  - Life-cycle costs
  - Environmental benefits / impacts
  - Public acceptability
- c£800k per bus compared to c£150k for conventional buses

LowCVP
low carbon vehicle partnership

Pathway to low carbon vehicles



Ricardo 2003, Carbon to Hydrogen Roadmaps for Passenger Cars
http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_026217.hcsp

LowC VP
low carbon vehicle partnership

Vehicles employing Stop-Start and Mild Hybrid technologies are now available

Citroen C3 – stop start technology

Honda Civic – mild hybrid

LowCVP
low carbon vehicle partnership

Toyota and Ford market full hybrid vehicles

Toyota Prius

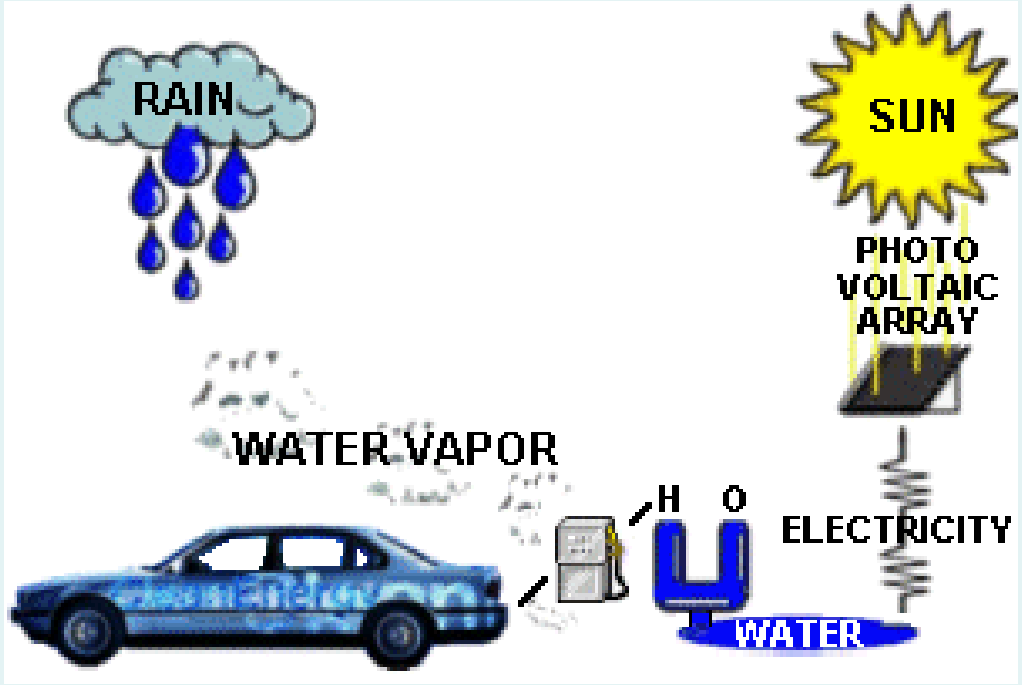
Ford Escape

LowCVP
low carbon vehicle partnership

BMW are unconvinced by hybrid development and advocate using solar energy to generate renewable hydrogen

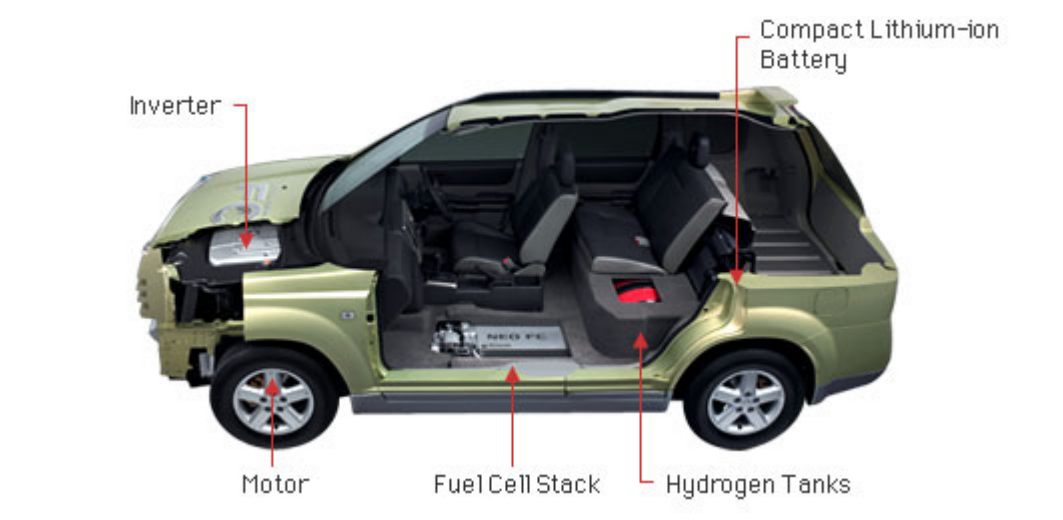
BMW's H2R concept car

H745 – Hydrogen IC



LowCVP
low carbon vehicle partnership

Supply of affordable fuel cell vehicles is someway off – although concept vehicles have been produced by a range of manufacturers

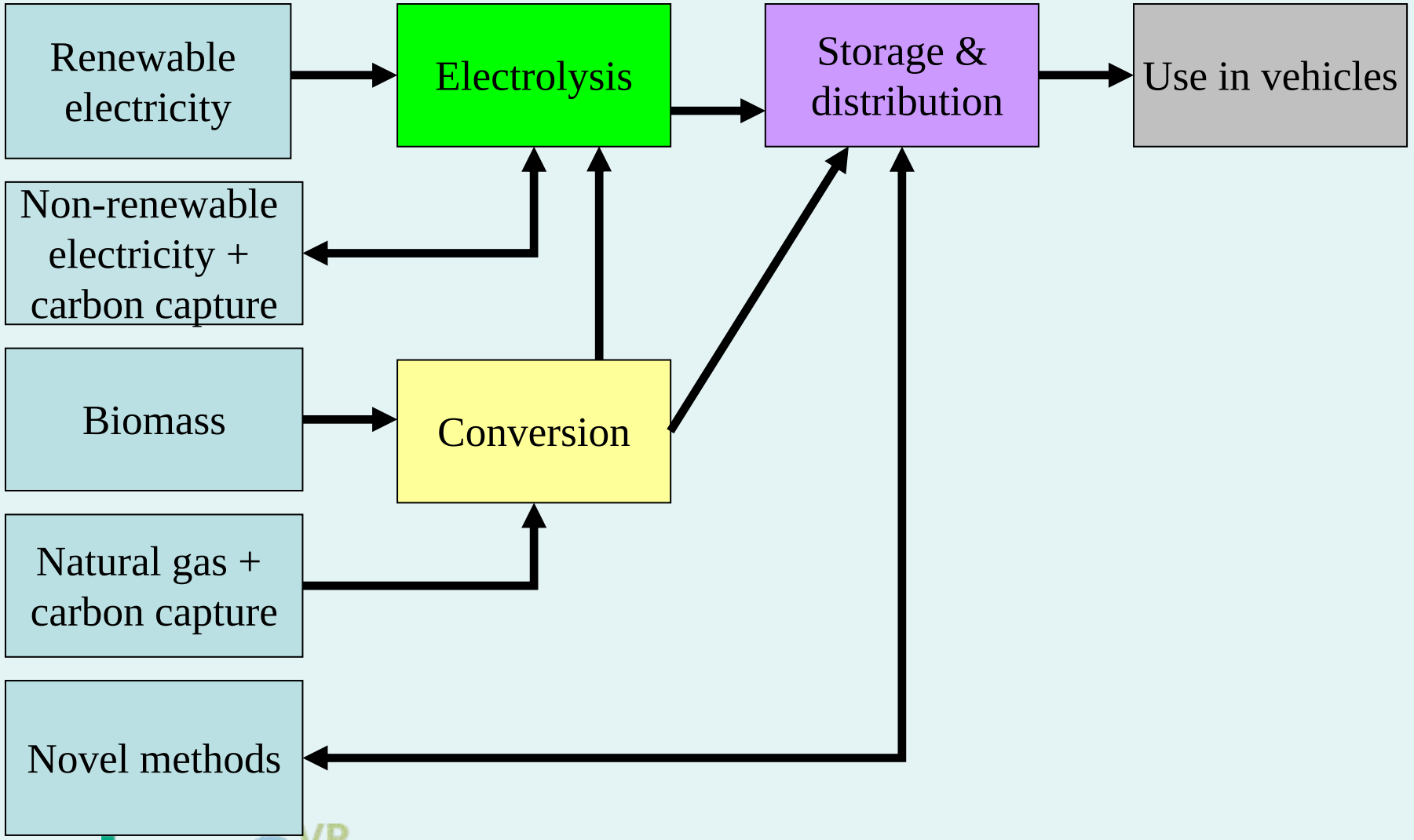


Nissan XTrail FCV

GM Sequel

LowC VP
low carbon vehicle partnership

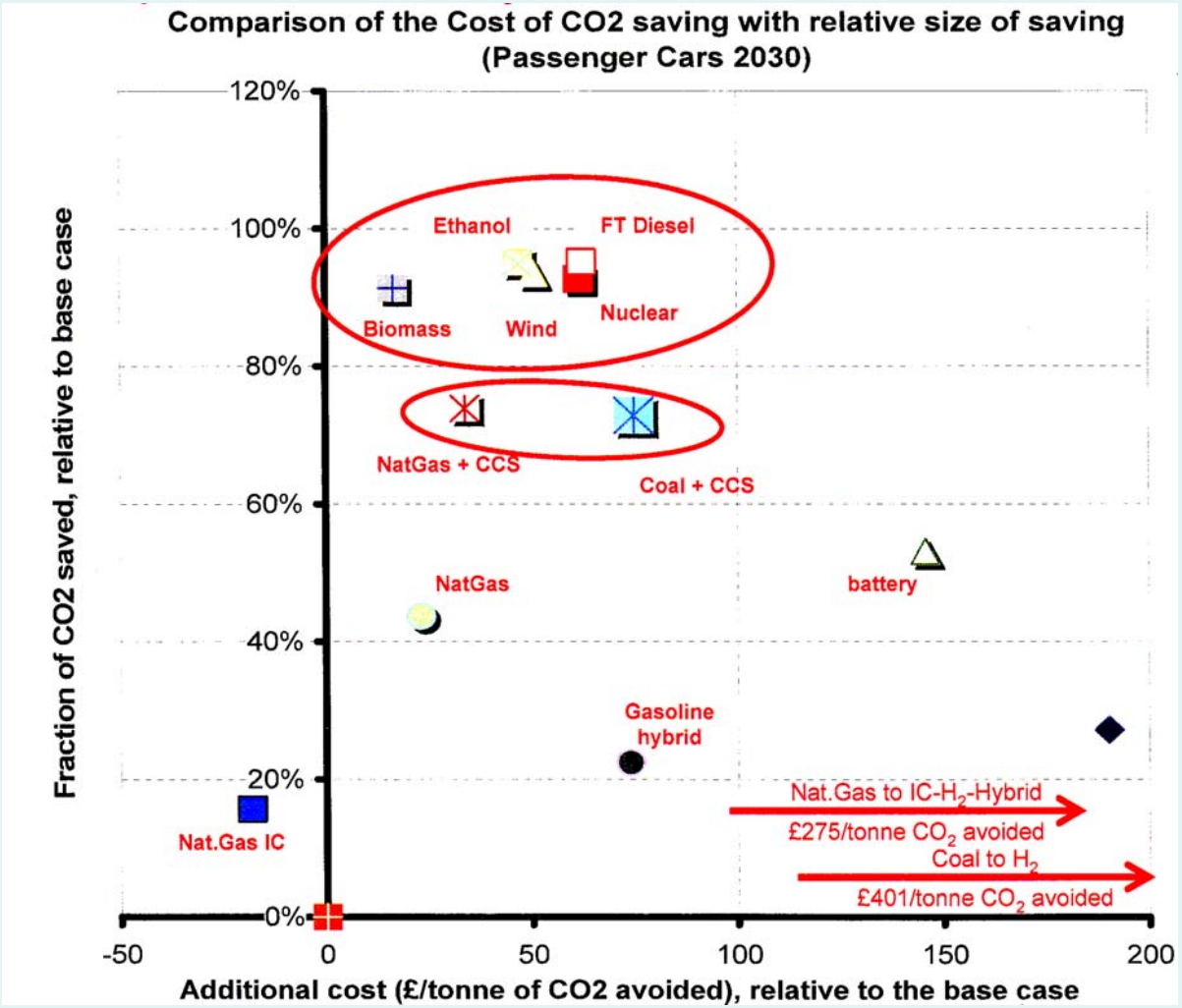
There are multiple options for renewable hydrogen fuel chains – all present challenges



LowCVP
low carbon vehicle partnership

6 H chains offer competitive and significant CO2 savings

- Biomass (possibly with carbon capture)
- Renewable electricity
- Nuclear electricity
- Natural gas conversion (ideally with carbon capture)
- Coal (with carbon capture)
- Novel technologies



LowCVP
low carbon vehicle partnership

www.dti.gov.uk/energy/sepn/hydrogen_framework_full.pdf

Conclusions

- Hydrogen represents a promising future fuel for road transport
- Supply of renewable hydrogen is essential to achieve significant CO2 savings compared to alternative fuels
- Promising energy chains for renewable hydrogen exist but further development is needed in all of these
- Improvements in vehicle efficiency (hybrids and fuel cells) are needed in parallel to reduce demand for renewable hydrogen
- The costs of fuel cell vehicles and installing hydrogen infrastructure are major constraints as are viable on vehicle storage systems
- Depot operations will be the principal market for hydrogen vehicles initially
- Widespread introduction of H powered vehicles is unlikely until at least 2030 – and is not guaranteed if developments are more rapid in other energy carriers, such as batteries

LowCVP
low carbon vehicle partnership

Finally ... hydrogen vehicles are not necessarily sustainable!

LowCVP
low carbon vehicle partnership

But even Hummer's can be green!

LowC VP
low carbon vehicle partnership