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Theme

Fuel Cell and Hydrogen Technologies: The National Government's Perspective

UK Energy Policy Context

- To put ourselves on a path to cut the UK's carbon dioxide emissions by some 60% by about 2050, with real progress by 2020;
- To maintain the reliability of energy supplies (making sure the lights stay on);
- To promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve our productivity; and
- To ensure that every home is adequately and affordably heated.

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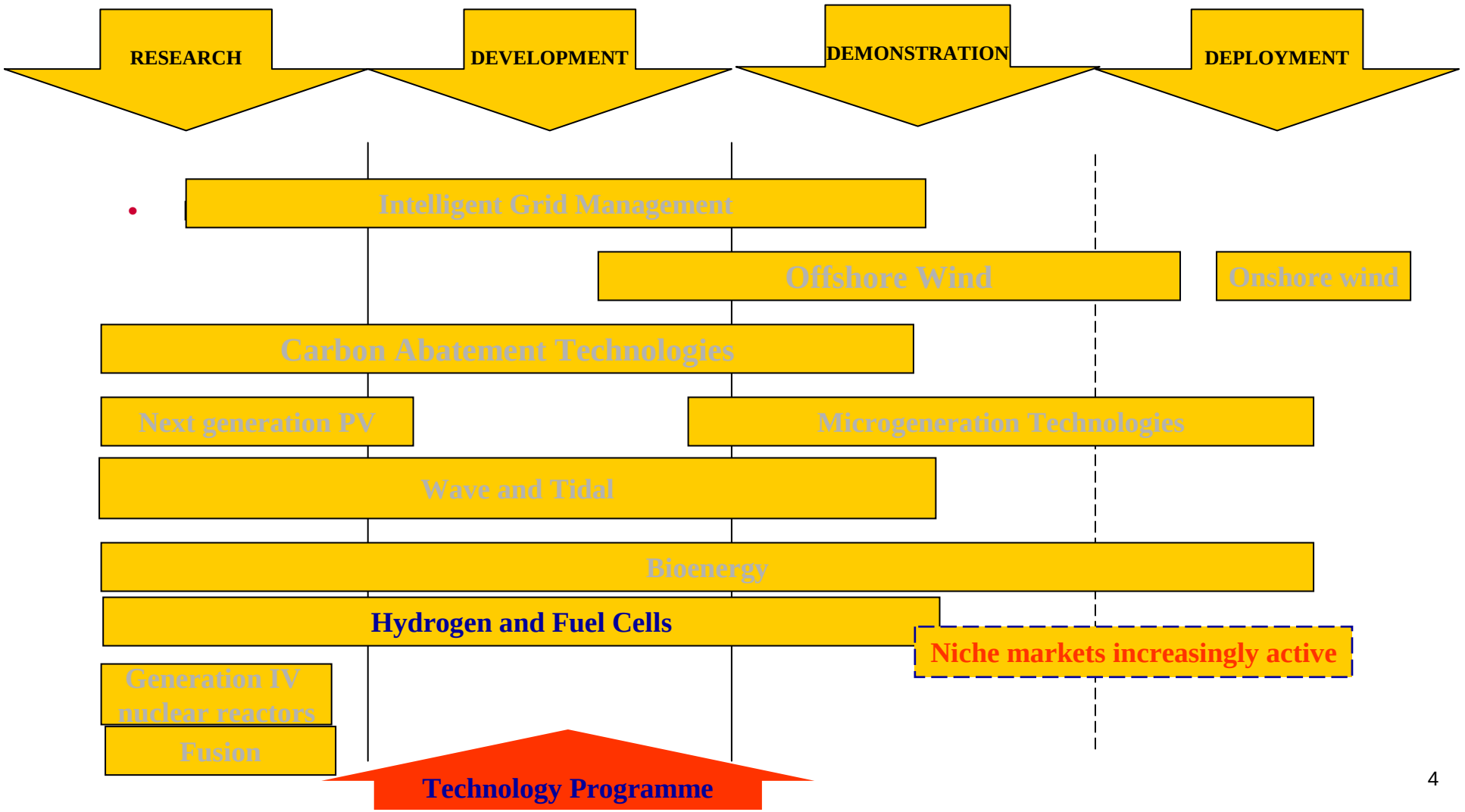
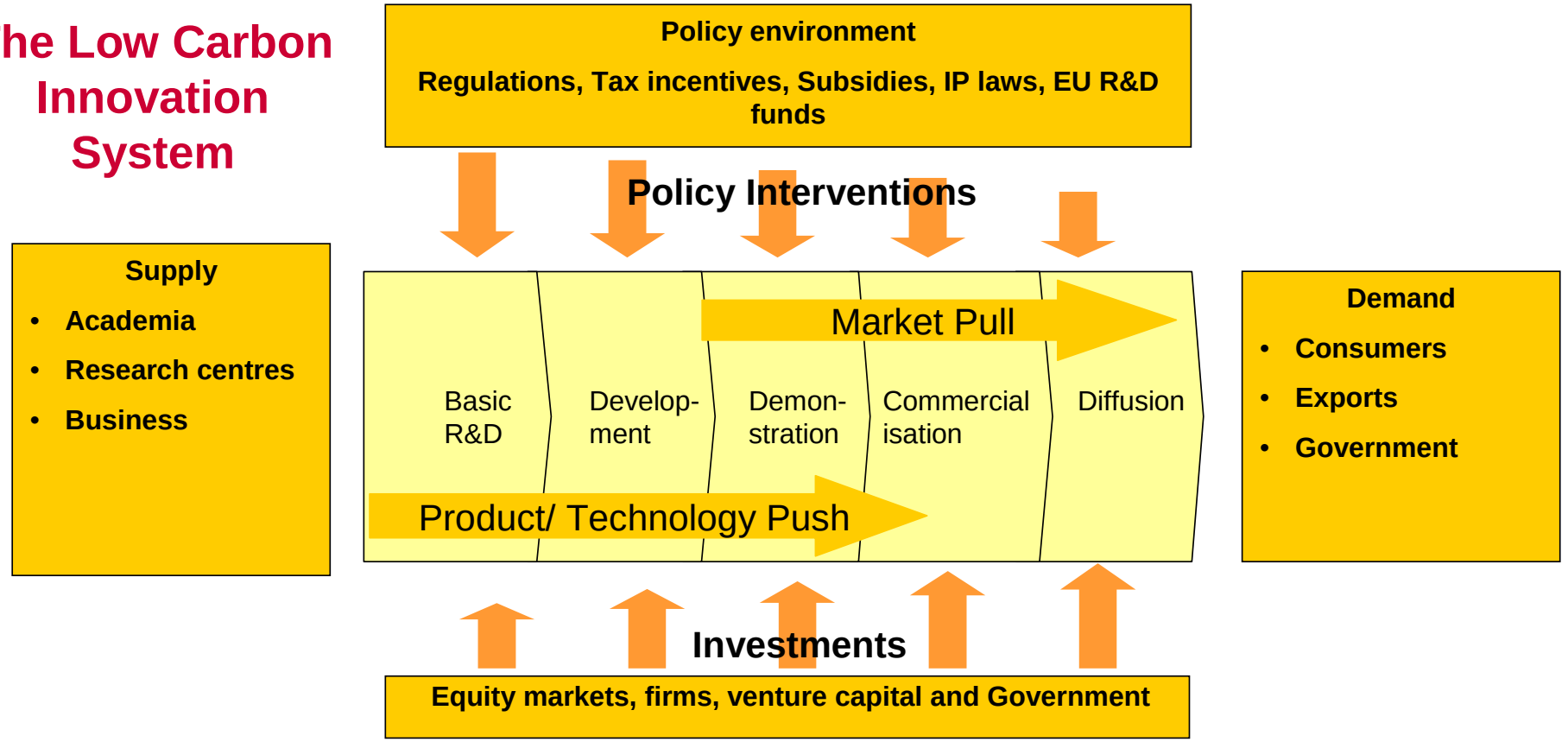
Multiple Drivers

- The business opportunity
- Emission reduction
- Renewables targets – 10% by 2010, 20% by 2020
- Security of supply
- Playing our part in the global challenge: G8/Kyoto post 2012

The portfolio of technologies and their current state of development:



The Low Carbon Innovation System



Framework conditions: macro economic stability, education and skills development, business climate, provision of public goods, etc.

Source: Adapted from Carbon Trust

The Government provides support to fuel cell and hydrogen technologies at each stage of their development

Fundamental Research

- Research councils programmes
- SUPERGEN: UKSHEC
- SUPERGEN: Fuel Cells
- Response Mode

£3-4 Million pa
FP7 Projects

Applied Research & Development

- **Technology Programme**
- OGD programmes, DfT funds studies
- Carbon Trust R&D Programme
- International R&D – IEA, EU -FP7 Projects
- Energy Technologies Institute

Demonstration

- Real world testing of systems and applications

- Low Carbon Buildings Programme: Fuel Cells eligible?
- Hydrogen and Carbon Abatement Technology Demonstration Fund
- £15 million over 3 years
- CENEX
- Environmental Transformation Fund
- EC Joint Technology Initiative

Pre-commercial

- Moving towards large scale production

- Renewables Obligation
- Non Fossil Fuel Obligation
- Exemption from the Climate Change Levy
- EU ETS
- RTFO apply to renewable H2?
- Forward commitment to buy
- Tax/Fiscal Regime

Tech Prog R&D is also critical to <u>support</u> (not directly fund) demonstration activity

The Government also support low carbon technologies through non-financial support:

- Reform of planning regulations for renewables (PPS 22)
- Committee on Radioactive Waste Management
- Leading international effort to establish regulations for CCS

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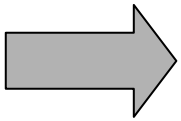
Programme Performance Measures

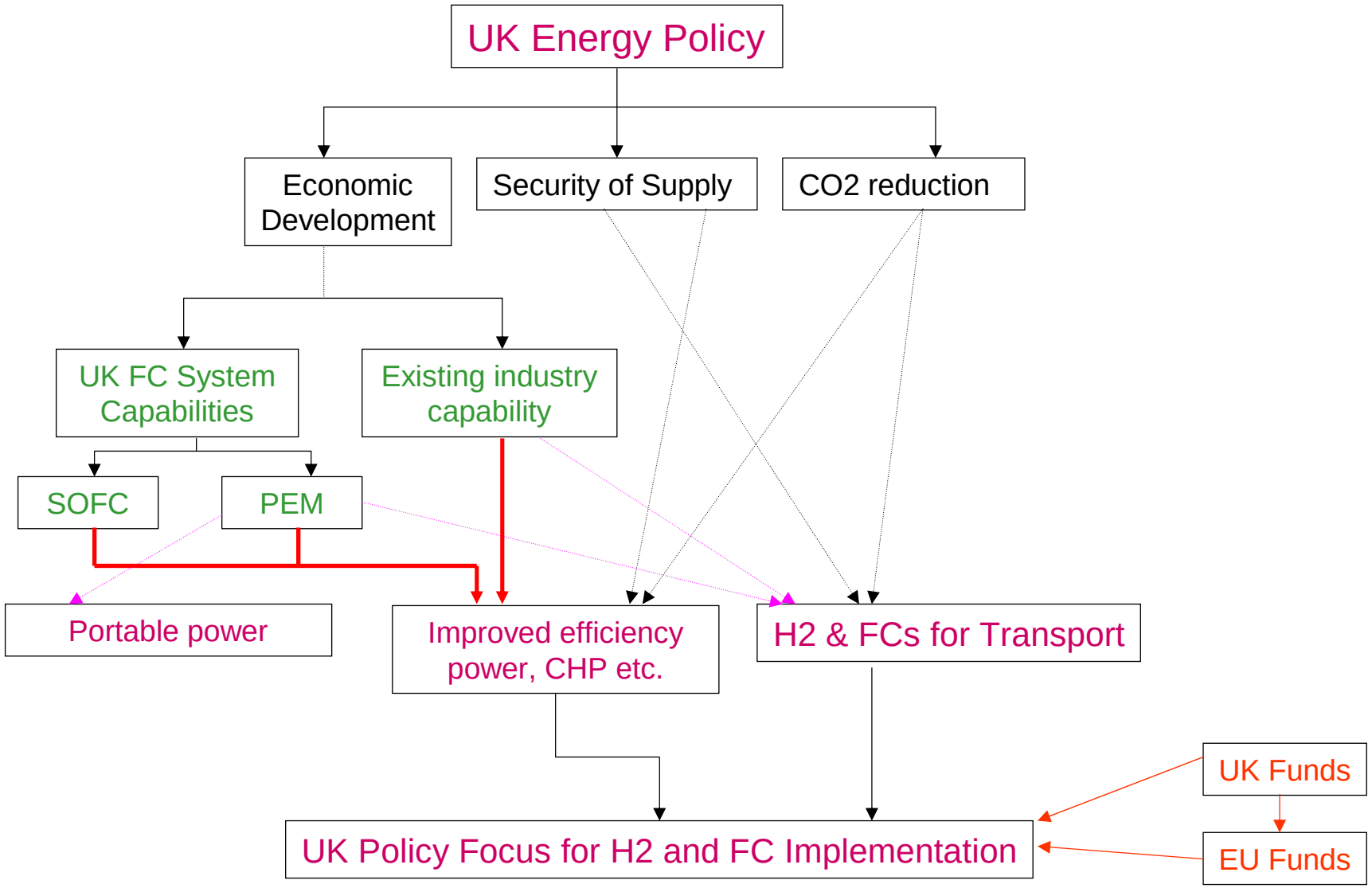


- **Technology route maps including milestones and timescales**
- **Progress against critical development issues for technologies**
- **Progress against technology cost & performance measures**
- **Demonstrable progress down research & development chain**
- **Successful exploitation outcomes**

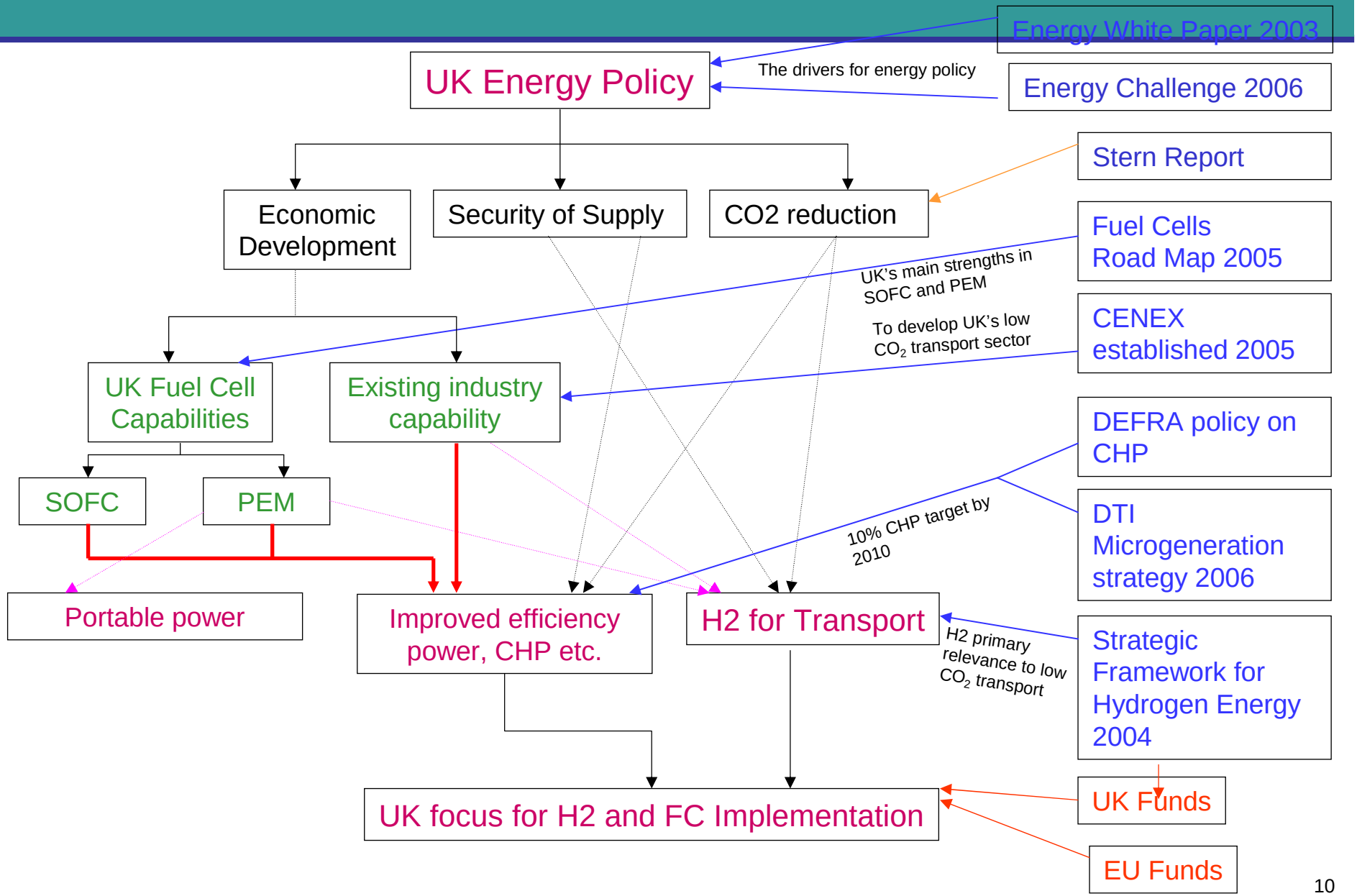
Relevant characteristics of the UK:

- De-regulated energy market
- High population density, driving the need for advanced systems in public transport and community heat and power
- The imminent (and politically accepted) requirement for extensive investment in new generating capacity
- Micro –generation Strategy
- Excellent opportunities for carbon capture and storage in the North Sea
- High potential capacity for renewable generation (eg Wind / Wave)
- Some strong emergent companies in Fuel Cell design and manufacture (mostly PEM and SOFC), allied to relevant supply chain capabilities
- 6 active Regional ‘Clusters’ driven by local carbon reduction and economic regeneration targets

Logic for the exploitation of H2 & FCs in the UK



The logic is backed by substantial strategic analysis



UK Support should be targeted at two areas:

- UK level support will focus on areas that address the issues identified in UK Energy Policy.
- Two priority issues are relevant at national level:-
  - H2 as a fuel for fuel cell-based transportation (from 6 distinct H2 energy chains)
  - Fuel Cells as a route to improved efficiency power generation (both micro and large scale CHP and primary power)
- Other areas may be addressed if they can be shown to have potential for national economic development.
- It is important to recognise that all technologies are developing and not yet commercially viable. Funding of deployment will not be prioritised until the commercial viability of the technology can be demonstrated (although it is recognised that appropriate action on regulations and fiscal measures should be pursued without delay).

The UK Regions most prominent for their support for H2 and Fuel Cells, and their common characteristics:

- London
- E. and W. Midlands
- Wales
- Yorkshire
- N.E. (Tees Valley)
- Scotland

- Numerous active stakeholder groups
- Established vision and strategic route map for establishing hydrogen and fuel cell futures
- Programmes for co-ordination of research, development and demonstration activities
- Incubator Units to assist new entrant H2 & FC companies
  - Technical and Commercial Advice
  - Financial Assistance
- Active H2 & FC Research Centres

The Regions are an important Implementation Route

- All have targets for economic development and carbon reduction
- Some have highly developed strategies for improved sustainability
- These are regarded as a potent source of
  - End-User opportunities
  - Finance
  - Encouragement and Coordination
- Their objectives are concerned with both Public Good and Economic Development.
- While they are largely autonomous entities, we are trying to exploit the special characteristics of each to maximise effectiveness of the whole.

H2 Transport in the UK can be justified by

- Public Good
  - The Hydrogen Strategy 2004 suggests that the use of Hydrogen as a transport fuel has high potential in pursuit of Reduced CO_2, and Security of Energy Supply, and identifies 6 possible supply routes.
  - UK support will therefore concentrate on any scheme designed to accelerate the commercial introduction of all aspects of the 6 low Carbon hydrogen chains, including:
    - H_2 generation from – Biomass, renewable electricity, nuclear electricity, coal and gas with carbon capture and from novel technologies (e.g. Nuclear thermochemical, photolysis)
    - Efficient H2 distribution
    - Hydrogen vehicles – specifically fuel cell hybrids
  - UK-specific actions are required to ensure that the transport-related technologies can be deployed in the UK.

- Need to encourage adaptation within the strong indigenous automotive components industry
  - The UK has significant strength in ICE's and other automotive components. H2 and FC's therefore pose a competitive threat which requires a rational and effective response.

The UK has a strong interest in efficient electricity generation through fuel cells

- Fuel Cells (initially hydrocarbon fuelled) have the potential to assist Security of Supply and CO_2 Reduction by improving the efficiency of generation and distribution.
- In addition the UK has a significant existing capability in fuel cell technology and the relevant support industries.
- There is therefore a strong case for supporting stationary applications which improve fuel efficiency – particularly those involving PEM and SOFC technologies.
- This implies support for large CHP/primary power fuel cells, stand-alone / back-up power, as well as smaller CHP for micro-generation applications.
- The public good argument requires schemes which allow commercial access to the technology as soon as practical.
- Here, support schemes can benefit UK competitiveness by encouraging UK industries – support schemes are more geographically specific.

Current approach by HFC Team…

- H2 and Fuel Cells have the potential to make a significant contribution in the increasingly urgent search for alternatives to fossil fuels…
- …but the traditional technologies remain highly competitive, having the advantage of 100 years' sunk investment in skills and assets
- It is recognised that large scale private investment in manufacturing and distribution will remain difficult without appropriate changes in fiscal and/or regulatory policy
- Until then we should take the opportunity to encourage the development of the technologies, skills, and the infrastructure required to prepare them for commercial exploitation. It is expected that this will require substantial public support.
- Government (UK,EU and Regional) offers improved prospects to access funds at the required scale, and comparable with that in the U.S. and Japan

Status of the UK industry

- Over 100 UK companies are contributing to the creation of the global fuel cell industry.
- There is increasing recognition of the City as a key source of investment for hydrogen and fuel cell companies. 7 companies are now listed on the Alternative Investment Market, and these have a combined market cap of over £500m .
- The development of local supply chains is seen by many as important for the future development of the industry.

Status of the UK Research Community

- The UK has over 35 academic and contract research groups highly active in fuel cells and hydrogen research, as well as a number of contract research organisations with relevant experience.
- The UK academic base exhibits a high degree of collaboration, and there are strong links with Germany, the USA, Canada, Japan and China.
- The UK research community has particular strengths in hydrogen storage, materials and components and Solid Oxide Fuel Cells
- In 2003, UK academics published over 100 papers directly related to fuel cells and hydrogen.
- Academic institutions work closely with industry and several fuel cell companies have been spun out of academic research activity.

UK international engagement

- UK companies generally have extensive international links, whether with customers, development partners or investors. Many of the leading UK players derive a significant proportion (i.e. >50%) of their income from overseas.
- European examples include:
  - Ceramic Fuel Cells: German facilities
  - Baxi: acquisition of European Fuel Cell
  - Intelligent Energy: working with PSA Peugeot Citroen and ENFICA
- Both UK companies and universities are involved in the Hydrogen and Fuel Cell Platform, and plans for the JTI

Recent UK developments

- **Funding for Demonstration activity** - The Government has recently launched a new £15 million pound programme for fuel cell and hydrogen demonstration projects.
- **The UK Fuel Cell Development and Deployment Roadmap** – With input from the full range of UK stakeholders, this Roadmap identifies the actions and strategies needed for the UK to overcome the challenges it faces around the development and deployment of fuel cells.
- **Regional activity** - There is increasing interest and activity at the regional level:
  - *Fuel Cell Application Facility on Teesside*: various demonstration activities
  - *the Scottish Hydrogen and Fuel Cell Association and Scottish Demonstration fund*: providing a voice and actions for the community in Scotland
  - *London Hydrogen Partnership*: deployment of 70 vehicles
  - *Wales*: development of Hydrogen cluster

Scottish Hydrogen and Fuel Cells Association
Fuel Cells UK
UK Hydrogen Association

- Self sustaining trade associations up & running
- A sign of increasing confidence and seriousness to accelerate the commercial deployment of fuel cells and hydrogen technologies (and bring with that the associated public good benefits).
- These Associations are engaging effectively with Government and other stakeholders at all levels.

ACTIVE AND GROWING MEMBERSHIP OF THE THREE TRADE ASSOCIATIONS. Members incl.....

Air Products
AMEC
BAC2
Baxi
Bryte Energy
BOC
Calor Gas
Cass Business School
CCLRC Rutherford
Ceramic Fuel Cells
Ceres Power
CMR Fuel Cells
E.On
E4Tech
Fuel Cell Application Facility
Fuel Cell Control
Fuel Cell Control
Intelligent Energy
Johnson Matthey
Logan Energy
Renew Tees Valley
Rolls-Royce
Scottish Power
Scottish & Southern Energy
SiGEN Ltd
St Andrews Fuels Cells Ltd
TUV NEL Ltd
The Hydrogen Office
Unitec Ceramics
University of Birmingham
Voller Energy
Wind Hydrogen
University of Glamorgan

UK situation: Getting Down To Business

- Throughout the UK the fuel cells and hydrogen industry has come of age, with world leading companies and tremendous potential.
- This momentum has lead to self sustaining membership driven active associations: Scottish Hydrogen and Fuel Cells Association; Fuel Cells UK Industry; UK Hydrogen Association.
- The industry is underpinned by a strong innovation / IP / technology base.
- Private investors willing to back this industry FTSE 100 and AIM companies listed on London Stock Exchange.

Government, Industry, and Regions aligned to achieve commercial deployment!