Foresight

Making the future work for you

Energy Futures Task Force

Fuelling the Future

A consultation document

Everybody, sooner or later, sits down
to a banquet of consequences.

Robert Louis Stevenson (1850-1894)

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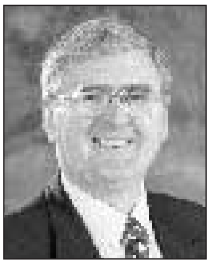
Message from the Chairman



The primary objectives of the Foresight programme are to provide society with the tools to secure a strong international position for the United Kingdom in the future, while fulfilling the other demands of society. The Foresight Energy and Natural Environment Panel is concerned with the energy and environmental aspects implicit in such considerations, and has taken as its primary objective the identification and highlighting of key opportunities and challenges posed by future changes in the supply and demand of energy and natural resources, and those posed by pressures on the environment.

In order to assist with this task, the Foresight Energy and Natural Environment Panel has established a number of Task Forces to inform the discussion and to develop a consensus on the key issues to be faced and on the consequent requirements for the energy and environment sectors. The particular responsibility of the Energy Futures Task Force is to try to develop a robust view of the research and development, and associated activities which will provide the best prospect for achieving the Foresight objectives. In so doing, the Task Force will attempt to draw on the widest possible base of expertise and experience.

Forty years is an extremely long time to try to look forward in an uncertain world, and there are any number of examples of the mistakes that are made in even more modest attempts at crystal ball gazing. Nonetheless, both the provision of energy supplies, and the environmental consequences of energy use involve large-scale and long-term investment over this sort of timescale. It is imperative that we identify those opportunities which maximise the potential long-term benefit while minimising the risks if our predictions of the future go badly astray. It is also important to recognise that technology is only one aspect of building for the future and that it will be equally important to consider the balance of social, economic and educational implications of the changes in lifestyle and working patterns that may come with technological evolution.

The Task Force has approached the problem by considering the implications of the four environmental scenarios already developed within the Foresight programme. This consultation document is the outcome of the first part of this process. It summarises the early deliberations of the Task Force itself and the outcomes of discussions held with a number of individuals and organisations. It is intended to serve as the starting point for consultation on the widest possible basis. The Task Force is keen to attract as many contributions as possible, and will welcome comments and suggestions, both on the scenarios themselves and on their R&D implications.

I would like to thank my colleagues on the Task Force, the Secretariat, those who have contributed to the debate so far, and all of you who will add to this through the consultation process.

Professor John McMullan
Director, Northern Ireland Centre for Energy Research & Technology
University of Ulster

1 Aims and objectives

Energy makes a vital contribution to the lives of everyone. Without access to sufficient energy, the whole fabric of current society would be undermined. Life as we know it would become impossible: transport, heated homes, communications, food, retailing, manufacturing and our national security all depend on a diverse, sustained and adaptable supply of energy. As a consequence, the energy production and supply system is well developed and by and large unobtrusive. Indeed, it is only when a sudden disturbance occurs in its price or availability that energy concerns tend to become prominent in the public arena.

Energy is also a key driver for the environment. The combustion of fossil fuels releases large quantities of carbon dioxide, particulates, and oxides of sulphur and nitrogen. The International Energy Agency (IEA)[1] and the World Energy Council[2] predict an increase in global energy demand of 2-3% per annum for the next 25 years. Thus, measures to limit emissions and necessary reactions to environmental concerns will have profound implications for the energy sector.

The energy sector may appear mature. Yet there have been considerable changes in technology, direction and experience over the last hundred years, and there is no reason to believe that this will not continue in order to meet the needs of the future. What is much more difficult is to see what the course of these developments may be. This sector, perhaps more than any other, has always felt the need to look well ahead in order to meet predicted future needs and the requirements for its products and services. Equally it knows through experience that simply acting upon an extrapolation from a particular prevalent position at any given time is likely to become misleading very quickly. Past attempts to formulate long term policy on that basis have had limited success, particularly in attempting to pick technology 'winners'.

According to the views of the Foresight Energy & Natural Environment Panel, the present almost total emphasis within the energy sector on addressing short-term, albeit business-critical issues needs to change. To fulfil the demands of society and secure a strong international position over the next forty years requires a long-term strategic framework including consideration of sustainable development and the environment in particular. Focusing energy related Research & Development efforts on those areas of most significance to the UK is a first step to achieving success in the future. Throughout this document, the term R&D will be used as shorthand to include not just the basic research, but also the necessary technical development, pilot and demonstration plant, and associated dissemination activities needed to realise a usable product or service.

1 World Energy Outlook (International Energy Agency, 1998)

2 Joint Study by the World Energy Council and the International Institute for Applied Systems Analysis (World Energy Council, 1998)

The aim of the Foresight Energy Futures Task Force is to identify these energy related technologies, systems and practices that over the next forty years could present both opportunities and obstacles to UK business and society. This is a longer time frame than has been generally followed in the current round of the Foresight Programme and twice as far ahead as in the corresponding considerations of the previous Foresight Energy Panel in 1994-5[3]. However, it reflects the need for a longer-term vision and matches approximately a time when the overwhelming majority of the current energy-related infrastructure will have reached the end of its life and would have been superseded.

The Foresight Energy Futures Task Force aims to develop a consensus upon the key issues facing the UK, and the consequential R&D requirements this will place on the energy sector. By facilitating widespread and forward thinking and discussion within the sector on the factors that will influence its future, it hopes to define some common actions that can then be taken forward together.

Three Associate Programmes are already underway examining requirements for particular generation technologies, and their findings will be incorporated into the Task Force's forthcoming action plan.

ENERGY-RELATED FORESIGHT ASSOCIATE PROGRAMMES

- Advanced Power Generation Task Force - generation from fossil and associated fuels (waste & biomass)
- Solar Photovoltaics in the UK
- Nuclear Technology Requirements out to 2020

We are putting forward our views in outline in this document, but wish to hear the views of as many people and organisations as possible before we finalise our vision and the actions we recommend should be followed. Hence we are seeking answers to the following broad questions:

QUESTIONS:

- Have we identified the right technological and social issues?
- What have we missed?
- How can our conclusions be improved?

3 Progress Through Partnership: Energy (HMSO, April 1995)

2 Methodology

The Task Force recognises that there have been recent studies relating to the technological needs in this area focusing in particular on climate change concerns. The most notable example is the report by the Royal Commission on Environmental Pollution (RCEP)[4]. The Task Force therefore wished to address the subject from a different angle, and hence has adopted a complementary approach with the objective of widening the debate. This is being achieved by using a prospective scenario-based process developed and deployed elsewhere in the Foresight Programme. The aim of this approach is to identify common strands that are of importance across a wide range of potential future situations to provide a set of underpinning actions which may be robust against differing outcomes, whatever they may prove to be.

An important aspect of this technique is that it allows possible futures to be considered in which the major concerns may be very different from those that are regarded as critical today.

This should not be seen as wanting to ignore or discount any present day concerns but to see beyond them. For example, it is conceivable that by 2040, conditions might have arisen under which the provision of an energy supply of any type might be seen as being more important than the associated environmental consequences. Also the scenarios take very different views about how adaptation to climate change concerns may proceed.

The Foresight Environmental Futures scenario set[5] is an attempt to consider the main aspects of our society and hence the changes we might anticipate occurring over the next forty years. It examines four possible futures:

- **World Markets:** a world defined by an emphasis on private consumption and highly developed and integrated world trading systems;
- **Provincial Enterprise:** a world of consumerist and short-termist values coupled with policy-making systems that assert national and regional concerns and priorities;
- **Global Sustainability:** a world in which social and ecological values are considered in economic decisions, and in which strong collective action through global institutions tackles environmental problems;
- **Local Stewardship:** a world where stronger national and regional governance allows social and ecological values to play a strong role in the development of markets and behaviour.

4 Energy - The Changing Climate (Royal Commission on Environmental Pollution 22nd Report, June 2000)
5 Environmental Futures (Office of Science and Technology, March 1999)

Each scenario has been evaluated to determine its impact upon key factors affecting different sectors of the energy market within the United Kingdom. None of these scenarios is expected to happen as stated and none forms a single vision of the future the Task Force wants to promote. The Task Force will produce its specific recommendations after considering responses to this document and other analyses, such as that by the RCEP.

In developing its analysis, the Task Force met with an invited group selected to represent the highest levels of expertise and experience in energy matters, and the widest range of views from within the energy community. The viability, stability and desirability of each scenario were evaluated and some of the possible challenges each presented were identified. Subsequent discussion focussed on the R&D requirements facing the energy sector within these possible futures. Areas of common cause were highlighted, as were the knowledge gaps. Discussion was not restricted to technological matters, and in particular, social and educational needs were also considered.

3 The analyses

3.1 WORLD MARKETS SCENARIO

Description

This is a world defined by an emphasis on private consumption and a highly developed and integrated world trading system. Social values are materialist, with resulting high levels of consumption and mobility. Working towards long-term sustainable development is marginalised as an international political goal.

There is a declining role for governments in economic management and in the provision of public services. Pressure grows to reduce taxes. Regulation of utility and other markets is very light. There is minimal concern over inequality or social exclusion, and social tensions rise.

Large firms dominate global markets. High concentration into a few global players occurs in key industries (including integrated utilities) while there is a high specialisation for smaller niche producers in other industries. Growth in services dominates and traditional manufacturing migrates towards the developing world. International best practice in technology and management is adopted quickly and global standards emerge for many products and services.

Energy markets are dominated by fossil fuels, particularly natural gas. By 2020, exploitation of alternatives to conventional oil, including tar sands begins. Demand for electricity and transport fuels continues to grow. Electricity supply investments are generally in modular, more distributed power systems. Energy prices remain low, and there is little concern for energy efficiency except in pure economic terms, although by 2010 most of the easy energy efficiency opportunities have been realised. High discount rates and the low priority attached to global environmental problems preclude the widespread adoption of renewable energy but promote investment in modular, more distributed power systems. Neither is there a revival of nuclear power because of the high discount rates and prevailing fossil fuel prices.

Individual consumerist values lead to smaller households as more people live alone. A more mobile labour force accelerates migration towards South-East England. Segregation between the wealthy and the disadvantaged becomes more marked and gated communities develop. High incomes mean more households can afford to occupy larger dwellings with more extensive ranges of domestic appliances, such as air conditioning units, which may be high energy consumers.

Discussion

The Task Force considered this to be a realistic scenario for evolution from the present, with broad agreement with both the overall theme and the elements within it. They agreed that neither nuclear power nor renewable generation would receive attention in an international society driven purely by economic factors. However, with time and noticeable environmental consequences, methods of carbon dioxide sequestration and emissions trading would be demanded. In fact, there were questions as to whether this scenario could be sustained long term, particularly as there would at some stage be pressures arising from either the long-term availability or price of fossil fuels even taking into account use of unconventional sources. It was thought that environmental or regulatory pressures would eventually restrain this society.

The domination by natural gas in itself would promote modular, distributed generation. Use of inexpensive micro-turbines, and eventually other discrete technologies such as fuel cells using gas as fuel, was considered to develop increasing momentum within this scenario as investment in large scale capacity becomes rare in a very competitive environment. The Task Force believed that there were significant shortfalls in current knowledge and technology with regard to distributed energy systems and what would be a secure and stable network. Opportunities to develop CHP were thought particularly good in this scenario within the growing service sector.

Clean coal technologies such as gasification and liquefaction could be favoured in some areas, and combustion re-emerges through the use of supercritical coal fired plants. As prices rise over time, the efficient generation and supply of power as well as its efficient end-use also become significant. There would be significant overseas opportunities for the UK coal-powered sector to provide not only the technology but also the expertise to build and operate the generating capacity of developing countries.

Transition to hydrogen was considered to be possible but only in the very long term. One way it might enter the market within this scenario was though fuel transition in the transport sector. Urban travel using hybrid and electric vehicles is part of this scenario, although their presence would become obvious only in the latter half of this time frame.

The Task Force felt it important to communicate to the public the effects of such a future on the natural environment. They identified a need for social science research into issues such as how the public perceives risk and how to influence attitudes regarding sustainability. It was believed that education would also play an important role in society accepting and adapting to a culture of more sustainable development.

Implied R&D Issues

Improved fossil fuel extraction (conventional and unconventional)

Increased efficiency of generating technology

Increased efficiency of end-use, both stationary and transport

Clean coal technology

Carbon dioxide sequestration

Mechanisms to facilitate emissions trading

Transportation technology, e.g., fuel cells and their associated infrastructure

Network issues for distributed energy systems

Provision of a service rather than a commodity for the consumer

Social science investigation of societal behaviour and attitudes

Education to engender ownership of sustainable development

“World Markets” Scenario

Factor	Industry	Commercial, Public & Service	Transport
Economic Growth	High growth in UK & world trade. Shift from heavy to light industry but increased trade internationally as industrial skill and technology required overseas. Clean coal technology, chemicals, metals, consultancy.	Substantial growth in service sector. Growth of financial and other personal services.	High economic growth increases demand within all transportation sectors. Globalisation increases freight transport distances travelled.
Industrial Structure	High value added industry thrives. Regional specialisation. Pharmaceuticals, commodities, biotechnology, ICT. Large transnationals and SME’s serving niche markets.	Multinational companies catering to global mass markets. Smaller companies specialising in niche markets.	Car use continues to increase, as does rail and air travel and shipping. Large investment in infrastructure with some restrictions to future access.
Fiscal and Regulatory Policies	Liberalised open markets with light regulation. Competition promotes efficiency in use of resources. High rates of return are sought, reducing high capital cost investments.	Liberalised global markets increase opportunities but also competition. Limited role for public policies and institutions.	Market forces apply leading to cheaper travel. Some service integration. Use of road tolls.
Environmental Awareness	Minimal unless impinging on the life style of the affluent influential.	Environment viewed as a recreational resource to be purchased from leisure and tourism sector.	Low priority given to increased noise and pollution.
Local Environmental Policies	Industrial run-offs affecting water supply may provide opportunity for environmental technology and biotechnology. Waste is a commodity & incineration plants are located in poorer or industrial areas.	Few policies with negligible impact, especially upon global companies.	Any local concerns hindered by a weak planning system.
Global Environmental Policies	Weak. International emissions credit trading and technology transfer.	Ineffective.	Little impetus to control environmental impact.
Energy Consumption	Increases despite the decline of the more energy intensive industries. Natural gas is major fuel.	Increases.	Continues to grow.
Energy Security	Increased resource extraction - opportunities for exploration and extraction industry.	Impact on sector limited to opportunities for energy and particularly dispersed electricity and gas distributors.	A concern, especially as oil and gas supply influenced by world market demand.
Energy Costs	Low. Competitiveness more important than efficiency - no imposed costs (taxes).	Low.	Low.
Embedded/distributed power	New build of natural gas-fired, distributed power. More opportunity for smaller UK companies to become involved, e.g. in GTCC. Later possibilities as nuclear decommissioning peaks. Power from waste expands.	Opportunities for medium capital investment CHP systems for the growing service sector. Gas -fired microturbines or small scale GTCC.	Congestion increases demand for road and air infrastructure.
Technological change	Rapid and innovative but based on short -term goals and market driven.	Transition to service and knowledge based economy coincides with rapid innovations in ICT which will revolutionise the sector.	New lighter materials of construction. Use of hybrid and electric technology in cities.

Domestic	Agriculture	Power Generation	Facilitation
High growth world of materialistic demand with high levels of consumption. Expansion of the construction industry.	Globalisation of industrialised agriculture.	Increased electricity demand despite loss of heavy industry. Decline of nuclear power generation.	Sustainable development marginalised as a political goal. Market values dominate to maximise economic growth.
The scale of the built environment increases. Existing buildings are scrapped. New modular buildings are assembled from units pre-fabricated off-site.	Farm size increases but considerable conversion of agricultural land to housing and recreational purposes. Market dominated by large retailers.	Mixture of some large multi-utilities and many small scale generators.	Large transnational interests create global standards and adoption of international best practice.
Light regulation. High rates of return are sought, reducing capital investments.	Liberalised agriculture removes subsidisation from farming.	Light regulation of utility markets. High rates of return reduce investment for large-scale plants. Decommissioned nuclear capacity replaced by cheaper options.	Internationalist policies. Pressure to reduce taxes. Light regulation of utilities. No incentives or subsidies, which would interfere with, market forces.
Pleasant environment a commodity for the rich.	Pleasant environment a commodity for the rich.	Has no impact on generation.	Minimal, not to influence market.
Relaxed planning controls enable widespread building. Loss of green field sites. Increase in household waste.	Agricultural run off causes problems which are only addressed if affecting the rich, or public health.	Not significant to power sector. Waste incineration plants are developed.	Little policy at local level beyond assertion of lifestyle requirements by those who can influence the market. Local environment becomes another commodity.
Little effect upon sector.	Little effect upon sector.	Used to increase trade by selling generation technology and knowledge to developing countries in lieu of meeting any emissions targets.	International climate regime ineffective. Large-scale emissions trading and exploitation of the system occurs in response to market demands.
Increases with demand, despite new housing being more energy saving and having integrated services.	Greater use of technology & greater transport distances will lead to a gradual increase in energy use.	Increases, initially through use of natural gas, then clean coal technology becomes competitive.	Increases without control.
No impact upon sector.	No impact upon sector.	Exploitation of fossil fuel based generation. No uptake of uneconomic renewable based generation.	Increased resource extraction as and when needed.
Low.	Low.	Low. Competitiveness is the driving factor.	Competitiveness key issue - no imposed costs or taxes.
Distributed communities.	Fewer, large scale farms.	Growth of modular distributed power systems. New builds dominated by natural gas-fired generation, e.g. GTCC. Eventual re-emergence of larger scale efficient ultra-supercritical coal-fired plants	Price dictates use of natural gas as main energy source, which in turn leads to distributed generation.
New technologies, materials and construction processes are adopted.	New technologies are adopted as agriculture becomes industrialised.	Rapid, innovative, modular; based on economics and resource availability.	Rapid and innovative but based on short -term goals and market driven.

3.2 PROVINCIAL ENTERPRISE SCENARIO

Description

The Provincial Enterprise scenario envisages a world of private consumption values, coupled with a capacity for lower level policy-making systems to assert local, regional and national concerns and priorities. Market values are dominant, but the scope of markets is limited by national and provincial boundaries. Sustainability more or less disappears as a political objective.

The pursuit of narrow national interests makes this a relatively low growth world. The world economy grows at 4 per cent per year while UK GDP grows sluggishly at 1.5 per cent per year. Economic growth is constrained due to capital and periodic resource shortages. Economic policy is concerned with protecting and supporting ‘national champions’ against foreign competition through various non-tariff and tariff barriers. There is little commitment to social or environmental goals, and an ‘enterprise’ ideology informs most policy decisions.

Fossil fuels are in plentiful supply in this scenario. There is a strong tendency to preserve existing sources of energy including indigenous coal and nuclear power by extending the lives of existing stations. Prices for final consumers of energy are higher than in the World Markets scenario because some higher cost forms of generation are maintained. The pursuit of energy efficiency is limited in this scenario despite higher prices, due to a lack of available capital and the low priority attached to environmental investments in the light of low levels of public concern. Renewables do not develop under this scenario, though there is some further development of combined heat and power plant.

The trend towards people living in smaller households is constrained by the high cost of housing and limited social provision. There is continued growth in the number of household appliances but, compared with the ‘world markets’ scenario, this is limited by higher prices and non-tariff barriers.

The energy efficiency of lighting, appliances and domestic heating systems improves but national standards are not tightened, reflecting fears that this will put producers at a competitive disadvantage in export markets. Energy use per household is stable, with growth in household appliances and heating demand offset by modest gains in energy efficiency. With the number of households steady, overall domestic energy consumption is broadly flat.

Discussion

This scenario as a whole was thought to be incapable of persisting for a significant period of time and would take significant changes to establish. However, there were elements present which were considered plausible and worth discussion. It was suggested that this was the most “negative” of the four scenarios. The potential for unrest within society, as well as the inevitable disintegration of such strong trade barriers was highlighted as causes of instability for this scenario.

Within this scenario, developing a method of large-scale energy storage was considered more important than any technological development for power generation. However, development of any nature was expected to be minimal. Priority would be given to maintenance and preservation of existing capacity, including nuclear generation. It was thought that research would be required into the social acceptability of maintaining the UK's nuclear capacity. Planning issues were, in general, thought to pose difficulties for any new power generation site in this scenario, such that extensive links would be essential with consumer groups and local interested parties.

There would be some development of CHP as a consequence of the stabilisation of national industries and their auto-production of heat and power. Again, it was felt important to investigate network issues and system dynamics to prepare for this and for the possibility of individual cities seeking to generate their own capacity.

Although generation is expected to be largely utility-based, where the need arises, potentially from areas with poor energy resources, biomass and waste could be used to generate power. It was recognised that attention would need to be paid to the development of biomass markets and waste to energy schemes.

Implied R&D Issues

Large-scale energy storage

Network issues for distributed energy systems

Social science investigation into the resolution of planning difficulties

Biomass and waste utilisation

Education to engender ownership of sustainable development

“Provincial Enterprise” Scenario

Factor	Industry	Commercial, Public & Service	Transport
Economic Growth	Slow economic growth nationally and limited international growth in an isolated sovereignty. Manufacturing stabilises with local substitution (where possible) for previously imported goods or materials.	International services and products decline, e.g., finance, but national monopolies created and growth in personal services for the wealthy.	Growth in transportation sector falls with decreased economic growth
Industrial Structure	Existing industrial capacity is protected, creating “national champions” such as producers of steel, paper, chemicals, pesticides and fertilisers. Global specialised industry declines.	SMEs producing goods and services for the national market.	Slower growth of car use and ownership. Increase in air travel lessens. UK freight transport mainly by road.
Fiscal and Regulatory Policies	Protectionist policies defending UK monopolies: pharmaceuticals, defence, electronics and media. Mixed energy intensity. Economic independence preserved which hinders access to global capital investment.	Investment is low and focuses on small-scale opportunities. Few public finance initiatives. Protectionist policies for national security.	Protection of existing industry but low investment leads to a stagnant vehicle market of older and polluting vehicles.
Environmental Awareness	People want clean air and better built environment but inconsistent practices between regions. Little consideration of wider environmental issues.	Low environmental awareness.	Little value attached to the environment.
Local Environmental Policies	Any action is a reaction to a perceived local problem and is enterprise led to address poor industrial performance. Opportunities for remediation and clean-up technologies. Landfill usual with some waste incineration. Illegal dumping is a significant problem.	Industry is not eco-efficient. Some environmental services offer remediation for local environmental concerns.	NIMBY protests ineffective.
Global Environmental Policies	Climate regime falters through lack of commitment and ineffective co-ordination. Sustainability not considered.	No commitment to sustainable practise.	No impact upon transportation sector.
Energy Consumption	Increases, all indigenous sources used.	Increases.	Increases slowly.
Energy Security	Fossil fuel plentiful but of increasing low quality. Sensitivity to local scarcity leads to interest in alternative, biofuels.	Fossil fuels plentiful.	Stronger reliance on indigenous fuel sources.
Energy Costs	High generation costs from older plants. No priority given to efficiency improvements or cheaper long-term production from new-builds.	High energy costs.	High.
Embedded/distributed power.	Utility dominance. Extension of existing plant lives of fossil fuel and nuclear power plants. Some CHP, some energy from waste.	Some CHP developed.	No growth in infrastructure. High congestion.
Technological change	Slow innovation, low R&D investment. Small scale technology uptake in commodities sector. Growth of biotechnology industry ensured primarily through scientific knowledge rather than investment.	Biotechnology biggest driver, IT to a lesser extent.	Lack of investment precludes most developments in technology or efficiency.

Domestic	Agriculture	Power Generation	Facilitation
Slow growth in housing.	Intensification of agriculture without significant international input.	Slow economic growth due to capital shortages. No significant new plant builds. Some growth in CHP, partly supplied by large industrial autoproducers.	Slow economic growth with no co-ordination beyond national level.
Construction and upgrading of existing urban areas.	Intense exploitation of agriculture with greater diversification to meet local demands.	Large utility based generation.	Economic protection measures created to support existing national structure.
Lack of investment in housing and infrastructure.	Protection of agricultural market against outside forces.	Low levels of investment. Policy protects existing utilities.	Market values coexist with a supported local economy. Use of tariffs and tariff barriers. Restrictions on availability of global capital. Widespread lack of investment.
Low value placed on environment.	Low value placed on environment.	Has no impact on generation.	Environmental appreciation minimal due to lack of access and experience.
Little conformance to building or other regulations. Illegal disposal of waste.	Farming influenced mostly by retailers and at cost to wildlife.	Environmental problems caused by ageing plants are not addressed due to lack of political will.	Planning and regulation come second to local requirements for employment and economic growth.
Little effect upon sector.	Little effect upon sector.	Slow economic growth is much more significant than any international agreement.	National interests weaken already ineffective climate regime. No international co-operation and no response to climate change.
Increases. Lack of energy saving materials or operation.	Increases.	Increases. Energy efficiency is not considered. Biofuels may be considered for areas with poor energy resources.	Increases, using strategy of extending plant lifetimes.
No impact upon sector.	No impact upon sector.	Plentiful supply of fossil fuel. Rather, priority given to preservation of power stations.	Met by indigenous local sources without consideration to emissions.
High.	High.	High as high cost generation maintained. Coal-fired and nuclear power generation dominate.	High energy costs. Lack of exploitation of lower energy costs, arising from new technology, due to absence of high capital investment.
Small scale new build on brown field sites.	Medium to large scale farms. Some increase in use of greenhouses to substitute for produce currently obtained from international markets.	Preservation of existing structure.	Economic and political power consolidated in strong interest groups such as the defence and manufacturing industries.
Emphasis on refurbishment, reuse and low cost approaches.	Little technological change in this sector.	Limited to increasing the lifetime of existing generation capacity.	Slow technological change without capital or demand.

3.3 GLOBAL SUSTAINABILITY SCENARIO

Description

This is a world in which social and ecological values are more pronounced and in which the greater effectiveness of global institutions is manifested through stronger collective action in dealing with environmental problems. Stress is placed on balancing economic, social and ecological values resulting in the adoption of more sustainable technologies and patterns of behaviour. Governance structures become more global but also more distributed.

There is greater co-operation and management within the international system and the role of national governments is primarily in the negotiation and enforcement of global economic, social and environmental agreements. Global trade grows, but international trade and environment policies are co-ordinated, reducing the scope for national discretion, to support international equity and sustainable development.

Access to education is widespread and helps to underpin support for sustainable development strategies, including their social and equity dimensions. Working hours decline and there is more leisure. High mobility labour, global markets for training and education, and global tourism are all engines of convergence between cultural and political systems.

The ‘greening’ of business is pervasive, with adoption of ‘best available’ technologies. Some of the greatest commercial opportunities arise in fast-growing developing countries experiencing ‘catch-up’. Interest rates are low, producing high levels of investment, especially in projects with longer-term benefits to the economy and society.

Household formation falls due to more collectivist social values and controls on new housing development. These controls also restrain the extent to which increased incomes lead to demand for increased living space. New dwelling concentrated in existing urban centres and on brownfield sites are built to high environmental standards. There is strong growth in the number and range of domestic appliances in the home but these appliances are built to high standards. Consumers are attitudinally green and want to make eco-effective purchases.

Reductions in energy use are limited, however, by an increase in home working. Energy use per household declines by 0.50% per annum but increasing household size means that, overall, household consumption stays flat.

Natural gas is the dominant energy source up to 2010 in this scenario, but renewable energy sources gain a large market share thereafter. Emission-free fossil fuel options, including large-scale carbon sequestration, begin to play a major role in the UK energy mix in 2010-2020. A large global market for solar energy builds up by 2020-2025. Encouraged by regulatory incentives, energy suppliers move towards the provision of integrated services, greatly enhancing the take-up of energy efficiency measures. Investment in higher cost energy forms and environmental controls mean that the price of energy for the final consumer is high. The need to reduce carbon emissions coupled with a willingness to invest in technologies with low rates of return on capital, allow a partial revival of nuclear power from 2015. With the growing importance of non-fossil energy, hydrogen becomes a significant energy carrier by 2030 and there is major infrastructure investment associated with its production, storage and distribution.

Use of natural gas will encourage modularity and domestic generation from micro-turbines through to fuel cells, which will allow for a gradual shift to hydrogen in the long-term. In the interim solar power dominates, creating yet again the need for a new approach to management of the electricity network. Opportunities exist for the development of innovative techniques for control, transmission and storage of electrical energy. Clean coal, biomass and nuclear power could all re-emerge as competitive options in comparison to renewable conversion. It was recognised that R&D used to reduce the cost of either renewable energy or carbon sequestration would in the long run be advantageous to the introduction of hydrogen.

Discussion

The development of a strong partnership between government and industry was considered essential to this scenario to permit the co-operation necessary to produce such a consensus throughout the sector. There would need to be a full understanding of market dynamics to stimulate development and of mechanisms to facilitate long-term investment in efficiency and R&D.

To reach a point at which society has fully internalised the costs of energy conversion requires many years of communication, education and a full understanding of the public's needs and behaviour. In such an informed and environmentally aware society, the re-emergence of nuclear power could only be subsequent to safety and waste concerns being addressed. This would initially involve technological solutions, but also the development and acceptance of comparative risk by the public. As with previous scenarios, education has a pivotal role to play.

Implied R&D Issues

Development of technological capacity and storage capability

Wind, wave and tidal energy conversion

Increased efficiency of technology and end-use

Transportation technology, e.g., fuel cells, and fuel and their associated infrastructure

Clean coal technology and subsequent sequestration

Network issues for distributed energy systems

Provision of an integrated service for the consumer rather than a commodity

Regulatory facilitation of investment in energy efficiency and reduction measures

Familiarisation with future export markets

Investigation into social acceptability of renewable, nuclear power and large-scale generation

Research to study the effect of policy upon public behaviour

Education to promote an understanding of sustainable development

Development of hydrogen infrastructure

"Global Sustainability" Scenario

Factor	Industry	Commercial, Public & Service	Transport
Economic Growth	High growth but sustainable & co-ordinated at international level. Increase in eco-efficient goods & services. Opportunity to provide "catch-up" for fast-growing developing countries.	High level of sustainable growth at national and global level. Highest growth in sectors providing eco-efficient goods and services.	Sustainable and equitable growth have major impact on transportation. Integrated travel at both national and global level.
Industrial Structure	Strong partnership between government and industry. Large global market for solar energy by 2010. Increased emphasis on provision of services as opposed to goods.	Increased provision of services over goods. Rapid penetration of new eco-efficient services of high quality.	Heavy investment in public and mass transport. Freight transport shifts to rail and water.
Fiscal and Regulatory Policies	Low interest rates, high investment levels. Long term socio-economic benefits valued. Regulatory incentives to integrate energy services.	High levels of investment in long-term projects. Waste minimisation regulations. Domestic fiscal instruments used to meet global agreements.	Regulations & incentives used to change behaviour. International agreements with manufacturers prove effective. Major investment in new technology.
Environmental Awareness	Environmental concerns are ideological as well as practical and immediate.	Environmental conservation through resource efficiency and waste minimisation.	"Best" environmental solutions adopted.
Local Environmental Policies	Negotiation and enforcement of global agreements. Packaging minimisation and substantial waste recycling and recovery.	Major recycling and recovery programmes at local level.	Controlled by global agreements.
Global Environmental Policies	Taxes and regulations used to meet Protocol targets. Tight controls on trade and emission sinks.	Strong global agreements met through local government enforcement of eco-efficient practises.	Global emissions targets increase innovation.
Energy Consumption	Increased consumption. Natural gas dominant until 2010, when renewable energy systems matures. Nuclear power revival from 2015.	Increases.	Increases.
Energy Security	Global markets exist with a supply infrastructure to ensure equity.	Sharing of resources, use of renewables and implementation of hydrogen based services.	Greater sharing of resources within trading regimes.
Energy Costs	Final cost to user high. Environmental control, efficiency and sustainable energy usage take priority.	High energy costs to protect the environment leading to higher cost goods and services.	High.
Embedded/distributed power	Economies of scale realised from large solar energy production. Hydrogen based economy begins and infrastructure created.	Energy suppliers provide integrated services. Large scale solar power.	Significant investment in infrastructure but after consideration to the environment.
Technological change	Rapid adoption of environmental BAT throughout industry, e.g. lowT lowP chemical processes.	Strong technological growth. Best available technology adopted.	Rapid uptake of low emission technology and green technology such as hybrid and fuel cell vehicles.

Domestic	Agriculture	Power Generation	Facilitation
Sustainable development of housing. Fall in formation of new households. More use of underground sites.	Sustainable development of agriculture. Decrease in land use for agriculture. Livestock farming declines.	Emphasis on sustainable growth causes substantial developments in the generation sector. Fastest growing sectors include renewable and hydrogen based power systems.	Consideration given to factors other then GDP such as social and ecological values and indicators.
Rapid turnover of housing stock and reclamation of brown field sites. New energy efficient buildings with short lives. District heating developed alongside gas supply networks.	Agriculture supplies major brands and retail chains.	Growth of small scale power plants. Initially natural gas based, e.g. GTCC. Subsequent introduction of fuel cells.	World Environmental Organisation formed and strong trading regimes are created which operate within its rules. Global carbon trading.
High levels of investment for restructuring and energy efficiency measures. Controls on new housing development.	Common Agricultural Policy supports sustainable management of rural landscape.	Low interest rates favour long-term investments. Economic policy is used to support the introduction of renewable energy based power production.	International co-ordination to support sustainability and equity. Considerable investment to establish eco-efficiency. Renewable energy conversion technology supported.
Environmental concerns dictate housing policy.	Environmental concerns dictate agricultural policy.	Driving force for change.	Preservation and restoration of environment a key priority.
Strong planning controls protect greenbelt via eco-sensitive development. Installation of energy saving materials and equipment due to subsidies and tax incentives.	Subsidy payments to farmers to ensure sustainable management of rural landscapes.	Individual responsibility for carbon emissions fostered by linking reduction with access to countryside and environmental goods.	Strict environmental controls in place.
International environmental policies promote clean, energy efficient priorities within sector.	International environmental policies promote clean, energy efficient priorities within sector.	Requirement to reduce carbon emissions contributing to change in generation technology choice.	Strong agreement to reduce carbon emissions. Investment and direct production subsidies, tax credits and market based policies such as market constraints and third party financing.
Increases.	Increases.	Consumption increases but from efficient clean sources or technologies.	Regulatory incentives provide motivation towards meeting increased demand through energy efficiency.
No concerns over energy security.	No concerns over energy security.	Possible limitation to growth of renewables eventually reached due to availability.	Energy shared on an equitable basis through investment in infrastructure and technology transfer to developing countries.
High, due to higher cost energy forms and environmental controls. Creates a market for small-scale (household) energy conversion.	High.	High prices as a result of prioritising environmental issues over economic competitiveness.	High energy costs from eco-efficient production using cleaner or alternative sources, or due to carbon taxation on production from older plants.
Avoidance of building beyond existing developed sites.	Support for farmers to preserve land for nature conservation.	Initially natural gas favours smaller scale distributed power production. Renewable generation moves to large-scale supply as solar energy matures. Clean coal and biomass re-emerge in the combustion sector. Also nuclear power.	International institutions and federal political systems push towards emission-free generation, from all energy sources.
Best available environmental technologies and practices adopted.	Rapid change in farming practices. Significant reforestation.	Strong technological growth of clean, low input production and consumption, both in renewable and fossil fuel based systems.	Low interest rates encourage investment in all cleaner production techniques and efficiency improvements.

3.4 LOCAL STEWARDSHIP SCENARIO

Description

Local stewardship implies a world in which stronger local and regional governments allow social and ecological values to be demonstrated to a greater degree through the preservation of environments at the local level.

Political systems are transparent, participatory, inclusive and democratic at a more local level. There is a high level of public provision for health, education and social services. Regional and local cultural identities are revived, and the family is strengthened as the primary social unit in the context of the local community. The flow of culture, people, capital, goods and services across economic and political boundaries is constrained. International economic and political institutions are seen as ineffective in a culturally and politically diverse world, and exist primarily to mediate relations between countries.

The trend towards smaller households is reversed as a result of lower rates of family breakdown and an increasing number of extended family units. There is general migration away from the larger cities and a corresponding growth of small and medium-sized towns. Tight planning control over the countryside, and the need to preserve land for agricultural production, lead to urban development which is dense, with low dwelling sizes.

Consumers become aware of the "greenness" of their purchasing decisions and this changes the marketing of energy towards an emphasis on sustainability and service based provision. This service-based provision not only supports local employment but is also socially inclusive with poorer households benefiting as much as wealthier ones.

Despite many more people working at home, energy use per household declines by 0.75% per year and, with a decline in the number of households, total domestic energy consumption reduces by 1.5% per annum.

The exploitation of local energy resources, whether fossil fuel or non-fossil fuel, is a particular feature of this scenario. A wide range of renewable energy technologies, including wind, biomass, photovoltaics and small-scale hydro are exploited, facilitated by a willingness to invest in technologies with low rates of return. However, returns to scale are more limited than in the Global Sustainability scenario because a more diverse set of options is pursued. Some local coal resources are also exploited in this scenario, but with high standards of environmental control. Locally based combined heat and power schemes flourish. Green tariffs are taken up by environmentally conscious consumers and reinforce more formal regulatory controls. Small-scale nuclear power could develop in some contexts of very high energy prices, partly as a route to energy independence. High energy prices will also lead to the large-scale adoption of energy efficiency measures in other contexts. This is the only scenario in which energy demand is considered to fall, as well as becoming less carbon intensive.

Discussion

As with the Provincial Enterprise scenario, this localised situation was difficult to envisage, especially how it would persist over a long period of time. The utilisation of such a wide range of generation technologies at such a small scale would require a greater investment overall to develop and it implies the currently available transmission systems would be at least partially abandoned.

This is the only scenario in which energy consumption declines. With such a strong dependence on small-scale local energy resources, system optimisation and energy efficiency are prioritised. Widespread adoption of reuse & recycling and a voluntary reduction in travel are major changes in public behaviour that can only have arisen through an effective, long-term campaign to alter society's attitudes.

Implied R&D Issues

Development of a full range of small-scale conversion technology

Development of energy storage capability

Increased efficiency of generating technology

Transportation technology, e.g., fuel cells and their associated infrastructure

Increased efficiency of end-use, both stationary and transport

Clean coal technology & environmental control

Mechanisms to facilitate emissions trading

Network stability concerns

Research into social behaviour, market dynamics and life cycle costs.

“Local Stewardship” Scenario

Factor	Industry	Commercial, Public & Service	Transport
Economic Growth	Slow economic growth, determined by local conditions with little consideration given to international markets.	Fall in demand for retail services. Increased public provision of health education and social services.	Slow growth has major impact on transportation. Internationally, freight movements decline.
Industrial Structure	“National champions” in energy and communications. Growth in small scale sustainable production and local services. New processes tend to be modular and “process intensive” using IT and biotechnology.	Locally based financial and other, high quality, services increase market share. Staggered working hours to lessen peak energy demands.	Car-sharing, home deliveries and other measures used to reduce car ownership. Increased use of mass transit systems.
Fiscal and Regulatory Policies	International economic and political institutions are seen as ineffective. Publicly funded science and engineering to meet local needs. Low investment, overall, but a willingness to invest in low rate of return projects.	Participation and individual responsibility encouraged over, but as well as, regulation. Low investment favours SME’s.	Regulation replaced by governance by stakeholders. Relatively low investment.
Environmental Awareness	Environmental goals seen to improve quality of life.	Environmental awareness influences all consumer decisions.	Keen interest in environmental information.
Local Environmental Policies	Formal regulatory controls backed up by voluntary take up of green tariffs by some. Environmental quality ultimately dependent upon regional resources and capacity.	Uptake of energy efficiency in buildings in terms of their mode of use and materials of construction. Solar panelling and CHP from microturbines within larger buildings such as hospitals and schools.	A local community agenda develops that is supported by regional government. Decreased travel benefits local environment.
Global Environmental Policies	Piecemeal response to environmental problems. International agreements falter when in conflict with local sustainability issues.	Not significant to an inward looking culture.	Transport and its effects seen as a local issue. International interference not welcomed.
Energy Consumption	Demand falls. Exploitation of all local resources, renewable as well as fossil fuel.	Consumption falls due to less demand and widespread energy efficient practices.	Falls.
Energy Security	Energy independence ensured by utilisation of all energy sources available. Small-scale expensive nuclear power plants when necessary.	Energy security a main driver for falling consumer demand and desire for environmental practices and services.	Independence important so conservation of resources.
Energy Costs	High energy costs necessitate energy efficiency and discourage consumption.	High costs of energy have less impact on this lower intensity sector.	Very high as environmental costs are internalised.
Embedded/distributed power	Diverse options are pursued for power generation on small scale. Widespread CHP fulfils growing service sector needs from distributed power network.	Energy needs met by local or unit production. Electricity and heat dominant.	Publicly owned transport systems.
Technological change	Key technologies are renewable energy - wind, biomass, and photovoltaics. Transportation based on alternative technologies: fuel cells, electricity, and hybrids.	Substantial potential and public funding for provision of local needs such as energy, food, environmental services.	Fuel cells, hybrids and electrification of mass transport systems are all essential.

Domestic	Agriculture	Power Generation	Facilitation
Low growth scenario with small-scale local housing development.	Support for agricultural protection	Slow economic growth but increased use of renewables: wind, biomass, and photovoltaics. Alternative utility infrastructure developed to meet needs of small-scale development.	Low economic growth. Long-term equity and social inclusion regarded as highly significant.
Survival of traditional housing with investment in infrastructure to promote efficient use of local resources.	Traditional farming practices used. Retailers use local suppliers and lose customers to local markets and shops.	Diverse energy conversion technologies utilised in distributed networks. Fossil fuel, renewables and nuclear power exploited. Substantial CHP development.	Diffuse structure of governance.
Regulatory controls and green tariffs influence energy use.	Agriculture is heavily subsidised.	Investment levels low, but public funding for long term needs. High cost acceptable to preserve national independence.	Public funding of R&D. Green energy tariffs and regulatory renewable obligations such as purchase agreements. Small generators have access to grid via non-discriminatory tariffs.
The environmental impact of all housing developments is given full consideration.	Agriculture takes account of environmental, long-term view.	Conservation of the environment is a key issue.	Sustainability of environment for the community considered essential.
Regulation used to preserve local environment. Local authorities manage recycling programmes and withdraw approval for energy recovery systems.	Tight planning preserves land for agriculture. Preservation of the countryside.	High standards of local environmental control placed on generation technology.	Use of local resources supported by infrastructure investment and regulation. Demand side management highly effective due to eco-consumer ethic.
Some international targets met by default as local needs supersede any global considerations.	Food production for the nation takes priority over global agreements.	Global agreements are made but not enforced as local concerns take priority.	Lack of co-ordination results in non-achievement of global targets. Little concern, however as focus is on local measures.
Energy consumption falls with large-scale adoption of energy efficient measures.	Low energy methods of farming but many more small farms exist to meet demand for local supply.	Consumption falls.	Energy use discouraged through high prices but more so by public opinion and national interests.
Diverse and small scale options for energy conversion exploited to meet needs at local level.	Food security maintained by subsidisation.	Independence maintained by exploitation of all available local energy resources.	Exploitation of local energy resources through investment in smaller scale technologies. Protection of indigenous fuels through subsidisation.
High energy costs due to alternative energy use and small-scale production.	High costs.	High prices considered acceptable to preserve self-sufficiency.	High energy costs from capital intensive systems and high emission abatement technologies.
Growth of small and medium sized multifunctional towns. Supported by distributed power generation.	Small farms flourish, even in urban environments.	Power production sited to best exploit each particular resource and meet the needs of the local community.	National economic and political institutions. Little attention paid to international bodies.
Slow improvements in housing. Some small scale technology investment.	Considerable investment in agricultural technology to meet local needs.	Technology developments influenced by regional resources and capabilities.	Technology developments influenced by regional resources and capabilities. Management and control of emissions where clean generation not practical.

4 Analysis of arising R&D themes

The issues for Research and Development determined by the scenario exercise are summarised below, beginning with those which are seen as having the widest application, and ending with those which were considered relevant only within a more limited number of scenarios. Two particular topics, decommissioning and redeployment of existing technology, do not arise directly from the scenarios, but are intimately associated with their evolution.

All current plant will require to be decommissioned over the next forty years and the safety of this ageing plant will need to be maintained. This will place an immense burden on society in both environmental and cost terms, and the associated issues must be addressed if it is to be achieved smoothly and safely at an acceptable cost. There is a tendency to assume that decommissioning only applies to nuclear plant, but all large energy intensive equipment is affected.

R&D CHALLENGES ARISING FROM OVERALL SCENARIO ANALYSIS

- Network issues for distributed energy systems
- Development of more sustainable electricity generating technology whether conventional, renewable or nuclear
- Increased efficiency of generating technology including co-generation (CHP)
- Increased efficiency of end-use technologies
- Transportation technology, for example fuel cells and associated infrastructure
- Biomass and waste utilisation
- Large-scale energy storage
- Decommissioning
- Redeployment of existing technology
- Social science investigation of social behaviour and attitudes to energy use
- Education to engender understanding and ownership of sustainable development
- Mechanisms to facilitate emissions trading
- Carbon dioxide sequestration
- Regulatory mechanisms and facilitation of investment in energy efficiency and reduction measures
- Improved fossil fuel extraction (conventional and unconventional)

Most of these needs are already well known and many are currently being addressed to a greater or lesser extent. There is, however, a much stronger emphasis on general infrastructure and systems issues than appeared in the previous Foresight Energy Panel studies. We believe that this has arisen in part because of the longer time frame under consideration, but also because some shifts in thinking have occurred in the intervening years.

For example, it is more commonly accepted today that a system built around large-scale electricity generating plants may not necessarily be more efficient or cost-effective overall than one based on a larger number of dispersed smaller-scale units using different technologies. However, the infrastructure now in place was not designed with this possibility in mind, as this was not the prevailing view at the time that the system was planned and developed.

A similar concern may arise over transport fuels in the near and mid-term. To a greater or lesser extent all the scenarios anticipate a need over the next 40 years to begin a process of substitution away from conventional oil-based products in transport, possibly with an emphasis on fuel cells, particularly in the transport sector and in small scale integrated energy supply applications. However, there are a number of different possibilities as to what these substitute fuels or energy carriers might be, and how they would be transported and made available at the point of sale in the manner that petrol and diesel are today. Three of these possibilities are methane, methanol or hydrogen. Each of these would require a different backing infrastructure, and it may be considered unlikely that more than one would be developed in addition to the current networks.

QUESTIONS:

- Do you agree that these are the major R&D challenges for the future? What have we missed? Which do you consider the most important?
- Which are the most significant for the application of current UK “know-how”?
- In which of these areas is the UK particularly well ahead?
- What actions need to be taken to ensure that this lead is maintained?
- In which areas is the UK behind the major competitors?
- What steps need to be taken to correct this situation?
- What do you see as the respective roles and responsibilities of government, business, academia, facilitating bodies and the general public in meeting these challenges?

5 The context of sustainable development

The R&D themes outlined above were identified by considering four world scenarios where a greater or lesser emphasis was placed on sustainable development aims or concerns over climate change. The Task Force considers this approach to have its main merit as producing recommendations that are robust against very different views about how social and political values may evolve.

The Foresight Energy and Natural Environment Panel has expressed a view of a long term need to facilitate 'a radical shift to an economy that uses much less energy and towards energy sources not based on carbon, or to novel ways of capturing and using carbon'[6]. Such a large shift is unlikely to be delivered by gradual incremental change, nor by considering only one side of the supply and demand equation.

There is a significant history in the UK of attempting to formulate energy policy to achieve a balance of environmental, social, and economic aims in the context of the time. For example over fifty years ago[7] the basic energy policy aims were considered to be:

- good standard of heating in the home
- electricity for all
- low cost and increased convenience
- national fuel economy
- smoke abatement

Although the expression of the economic and social aspirations in this policy statement may still be thought valid today and for the future, the environmental considerations were then thought of only in terms of local pollution rather than national or international impacts with long term implications.

Today these are reflected in the definition of sustainable development[8] as the achievement of a better quality of life for everyone, now and for generations to come by:

- social progress which recognises the needs of everyone;
- effective protection of the environment;
- prudent use of natural resources; and
- maintenance of high and stable levels of economic growth and employment.

Following these principles the overall aims of energy policy are now stated as:

- ensuring the security and diversity of UK energy sources within a competitive market framework
- contributing to the UK's environmental emissions targets via the development of sustainable energy technologies

6 A Way to Go (Foresight Energy and Natural Environment Panel Consultation Document, June 2000)

7 Simon Report, 1946

8 A better quality of life: A strategy for Sustainable Development for the United Kingdom (May, 1999)

6 The context for education and training

It is of concern that the understanding of energy and environment issues may not be generally addressed in today's education and training programmes, irrespective of discipline. Thus, high-level decisions are often being made without full understanding of issues such as sustainability, perception of risk, wider aspects of achieving security of supply, or the local environmental implications. In particular, training at all levels currently leaves little scope for addressing the interactions between these issues.

Of particular concern is the shortfall that is occurring in the number of newly qualified entrants to disciplines of importance to the energy and environment sector.

QUESTIONS:

- What steps can be taken to ensure that future leaders and decision-makers are aware of and understand the core issues involved in energy and environment decisions?
- What steps can be taken to reduce or eliminate the shortfall in the number of newly qualified entrants to energy and environment disciplines?
- How can the training of technical support, installation and maintenance personnel be improved?

7 On-going plans

The Task Force will develop its forward action plan in the light of responses received from this document and at further workshops and seminars to be held around the UK at the end of 2000 and into 2001. The Task Force intends to publish this plan by mid 2001.

QUESTIONS:

- Are you or your organisation engaged on work relevant to this Task Force?
- Would it or you be willing to contribute time and effort to develop networks or joint work?
- Have you got programmes that could contribute to and take forward the work of this Task Force?

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What is Foresight?

Foresight is about being ready for the future. No one can predict the future. What we can do is look ahead and think about what might happen so that we can begin to prepare for it.

The future is shaped by the decisions we make today. If we wait for the future to happen to us the UK will miss out on opportunities for wealth creation and a better quality of life. The UK's Foresight programme is about making sure that we are ready for what lies ahead.

Foresight brings together the voices of business, government, the science base and others to identify the threats and opportunities that we are likely to face over the next ten to twenty years or more. In doing so, Foresight aims to bring about a culture of change in the way business, academia and government relate to each other and to the future.

The programme was launched in 1993 following the white paper on science, engineering and technology, *Realising our Potential*. It has a panel-based structure and operates on a five-year cycle. The current round of Foresight began in April 1999.

Work is being taken forward through three thematic and ten sectoral panels, each looking at the future for a particular area. All panels have been asked to consider the implications of their findings for education, skills and training and sustainable development.

Foresight panels

Thematic panels: Ageing Population, Crime Prevention and Manufacturing 2020.

Sectoral panels: Built Environment & Transport, Chemicals, Defence, Aerospace & Systems, Energy & Natural Environment, Financial Services, Food Chain & Crops for Industry, Healthcare, Information, Communications & Media, Materials, Retail & Consumer Services.

A further industry-led panel is looking at Marine issues and there is a task force addressing the impact of E-commerce on business processes and supply chains.

For further information on the Foresight programme, panels' emerging findings and Foresight news and events, please visit the Foresight website on **www.foresight.gov.uk** or fax us on 020 7215 6760.

How to contact us

We welcome your comments on this report. You can contact us through the Foresight web site: http://www.foresight.gov.uk/ or write to us at:

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The closing date for comments is 1 March 2001.

Please note that your response to this consultation exercise may be made publicly available in whole or in part at the Department's discretion. If you do not wish all or part of your response (including your identity) to be made public, you must state in the response which parts you wish us to keep confidential. Where confidentiality is not requested, responses may be made available to any enquirer, including enquirers outside the UK, or published by any means, including on the Internet.

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