Powering the nation

Dr Derek Allen, Co-Chairman of the Materials UK Energy Materials Working Group, outlines a long-term strategy and implementation plan for energy materials in the UK.

One of the key recommendations of the Materials Innovation and Growth Team (IGT) report published in 2006 was to establish Materials UK (MatUK) as a unique, independent organisation owned by the UK materials community. Its vision is for the UK to be one of the foremost advanced technological societies where world-class expertise underpins sustainable growth. Much of this will be achieved by implementating the recommendations of the IGT report and through further development of a national materials strategy.

MatUK has established a number of working groups to deal with priority areas identified by the IGT. The Energy Materials Working Group recognises the significant role materials will play in tackling global environmental issues.

The 2006 Energy Review and the recent Energy White Paper highlight the importance of energy in many aspects of our lives and for the success of the UK economy. The White Paper identifies two long-term challenges – tackling climate change by reducing carbon dioxide emissions globally and ensuring secure, clean and affordable energy as dependence on imported fuel increases.

In support of this, the Stern Review revealed the global economic impact of climate change if it is not adressed immediately. From a market perspective, the UK will need around 30-35GW of new electricity generation capacity over the next two decades and around two thirds of this by 2020, providing massive opportunities for the sector and its supply chain.

Energy Materials Working Group

Reporting to MatUK, the Energy Materials Working Group is developing a strategic research agenda (SRA) and deployment plan for the UK Energy Materials supply chain. This seeks to improve profitability and effectiveness while meeting the challenges of sustainability, climate change and security of supply, it encompasses –

- Power generation – conventional, nuclear and renewable energy sources.
- Transmission – distribution and energy storage.
- Energy efficiency – conservation and usage.
- Regulatory and socio-economic aspects.

The SRA and deployment plan are being brought together though broad consultation with the materials community, UK Government, NGOs, research councils and funding agencies, looking both into the future and at the R&D requirements to maximise opportunities for the UK.

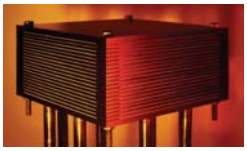
The Working Group comprises an advisory committee of members of the UK Energy materials supply chain, including industry, academia, government departments, research and technology organisations and regional development agencies. The secretariat is supplied by the DTI.

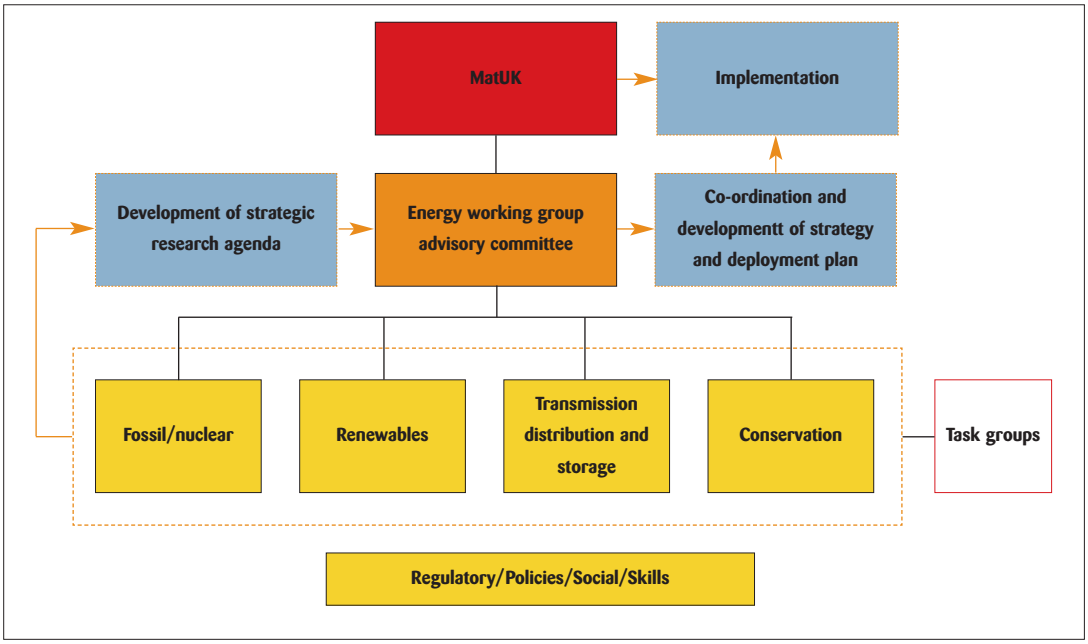
Task groups have been set up to tackle specific issues or technology areas. Currently four groups exist, covering fossil and nuclear power generation, renewables, transmission, distribution and storage, and energy conservation.

Fossil and nuclear

Together these technologies represent more than 90% of the UK energy supply. The Fossil and Nuclear group covers the materials implications and R&D necessary to produce the next generation of fossil energy plants (see chart above). This will include ultra-supercritical plant operating at temperatures of up to 700°C. Carbon capture technologies will be deployed, producing more

Renewable energy sources are being weighed up





Right: Structure of the Energy Materials Working Group. Above: Storage technologies face challenges of cost, upscaling, durability and performance. Top: Offshore power generation will continue to provide technology challenges in terms of maintainability and reliability

aggressive environments which materials must withstand, such as oxyfuel combustion and hydrogen-firing of gas turbines. The UK must decide which skills and technologies to develop if the option of new nuclear plants is taken up. We must, as a minimum, remain an 'informed buyer', retaining the facilities to understand plant degradation, structural integrity and the management of nuclear waste.

Renewables

This group will address the major materials, manufacturing and lifecycle challenges associated with the renewable energy sources – wind, wave, tidal, solar, biomass, fuel cells and hydrogen.This supports the UK Government's target of achieving 20% generation from renewables by 2020. A central issue is whether this target is realistic from a materials resource and manufacturing point of view. There is a definite need to ascertain any technology gaps. Many of the challenges arise from the need to lower production costs and improve quality and reliability. Areas such as the supply of composites and their recyclability, as well as the availability of suitable manufacturing facilities, have already been identified. Structural monitoring methods and maintenance of remote energy sources such as offshore wind and wave/tidal need reviewing. The development of materials for aggressive environments, such as biomass plants and offshore renewables, must also be considered.

Transmission, distribution and storage

When considering supplies and distributed energy generation, the infrastructure of the transmission and distribution network is paramount and could be one of the barriers to implementation, compromising security of supply.

The storage of oil, gas, CO_2, hydrogen and electricity, including upscaling battery storage technologies, will be reviewed. Specific issues with distributed power include power electronics and transmission with the potential for high temperature superconductors. These could offer improved efficiency, cheaper installation and lower system costs.

Conservation

Energy conservation is often the cheapest way of reducing carbon emissions and the UK is supporting EU proposals to save 20% of its energy consumption by 2020 through improved efficiency.

The Group's initial work focuses on the built environment – a major contributor to CO_2 emissions. Priority must be given to R&D into energy conservation materials, both in the production of the materials themselves – by optimising production and manufacturing, component lifetime and recycling processes – and in their use, developing highly insulating, low emission materials. Many such materials – photochromics, electrochromics, photovoltaics, Smart materials like embedded sensors, self-cleaning and healing coatings – have already been developed for use in other areas. The low-cost transfer of these technologies into the construction sector is required.

Mapping the supply chain

The energy industries in the UK play a central role by producing, transforming and supplying energy in its various forms. The sector contributes 3.2% of the GDP, 5.8% of total investment, 32.6% of industrial investment, and directly employs 135,000 people – four per cent of industrial employment.

There are no similar statistics for the supporting materials supply chain. As part of the SRA, its value will be calculated, and a better understanding of the market, R&D capabilities and the supply chain, in terms of its size, strengths, geography and market opportunities, will be gained.

NAMTEC has been commissioned to review and map the UK energy materials supply chain. Initially, this will focus on energy generation and include a top-level review of the UK energy generation sector to define size, turnover and R&D spend. The full supply chain – raw materials through to end use – and the innovation chain of universities and research and technology organisations will be mapped in terms of their size, value, R&D spend, activities and priorities.

Deliverables and timescales

The Energy materials Working Group plans to deliver and implement –

- Mapping of the UK energy materials supply chain.
- Reports addressing the key technology and R&D requirements in each task group area.
- A SRA for energy materials that defines the drivers, barriers and roadmap for R&D over the next 20 years.
- A deployment plan indicating how the SRA will be implemented and its impact on the UK materials industry.
- A concise strategic summary to support the case for continued energy materials R&D.

This will be formally presented through MatUK to stakeholders including Government officials, research councils, research development agencies and the technology strategy board to develop an agreed, long-term and sustainable research programme for the UK. Draft reports will be issued in late summer 2007 for comment, with the final reports available later in the year after consultation with the materials community.

It is important that findings are disseminated widely and an active dialogue continues during the formulation of the SRA and the mapping exercise. For this reason, comments are continually being sought on the activities of the working group. Dissemination and consultation with the wider community will continue.

Above: Turbine components will have to withstand more arduous operating conditions in the new generation of high efficiency and carbon capture power plant

Further information

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