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To :
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Dear Sir or Madam

CABINET OFFICE PERFORMANCE AND INNOVATION UNIT [PIU] : REVIEW OF ENERGY POLICY

Executive Summary

Immediate concerns about energy stem from two main facts :

- Human-induced climate change is believed to be primarily caused by increasing concentrations of carbon dioxide in the atmosphere as a result of mankind's increasing use of fossil fuels.
- Reserves of fossil fuels are finite.

Consequently there is a pressing need to reduce energy use and to develop alternative energy sources which have less impact on our environment, particularly the atmosphere.

The Royal Society of Chemistry believes there is a need for :

- absolute reductions in energy demand.
- a large deployment of alternative energy sources.
- the UK government to set out a program for energy demand reductions and the development of alternative energy sources that will prevent an increase in UK emissions of carbon dioxide.
- an international body to fund research, development and design in the energy field.

The Society believes that chemistry has a vital positive role to play, for example by contributing to :

- more efficient extraction of fossil fuels.
- improved methods to use coal as a source of petrochemicals.
- developing more secure storage for nuclear wastes.
- improved use of biomass as a fuel.

- new approaches to combining carbon monoxide and hydrogen to produce basic petrochemicals feedstock and clean fuels.
- improved fuel cell technology.
- better solar energy generation (photovoltaics).
- better methods of energy collection and storage.
- more efficient use of energy, for example by developing better lubricants to reduce energy losses, and lighter materials which require less energy to move them.
- developing methods to sequestrate carbon dioxide.
- our understanding of environmental processes and impacts.
- better environmental monitoring procedures and techniques.

Introduction

The following submission has been prepared under the aegis of the Scientific Affairs Board of the Royal Society of Chemistry [RSC].

The Society's Royal Charter obliges it to serve the public interest by acting in an independent advisory capacity and we are happy for this submission to be put into the public domain.

We welcome this timely review of energy policy and note that it will also be used to inform the government's response to the 22nd Report of the Royal Commission on Environmental Pollution 'Energy – the changing climate'. The Royal Society of Chemistry was among the bodies which submitted evidence to the Commission's study.

Why is energy a concern ?

In its 22nd Report the Royal Commission on Environmental Pollution states that :

"Access to abundant and instantly available energy underlies our entire way of life, yet its impact on the environment is growing. This poses a radical challenge for the UK ... All energy supplies have substantial effects on the environment ... Damaging air pollutants from fossil fuels, large, intrusive wind farms in upland scenery, radioactive emissions from the reprocessing of spent nuclear fuel and the destruction of woodlands to supply cooking fuel and warmth in poor countries are all well known examples .."

We agree with this. However the immediate concerns about energy stem from two principal facts :

- Human-induced climate change is believed to be primarily caused by the rising concentrations of carbon dioxide in the atmosphere as a result of mankind's increasing use of fossil fuels.
- Reserves of fossil fuels are finite. The reserves constraint is likely to be a very real one by the middle of this century or earlier.

There is a pressing need to reduce energy use and to develop alternative energy sources which emit significantly less greenhouse gas than fossil fuels. At the same time we need to make more efficient use of the fossil fuels and other greenhouse gas emitting fuels that we do use. In reality solving the energy problem will require both changes to public policy and technological development.

Policy solutions

We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 6] that there need to be absolute reductions in energy demand and a large deployment of alternative energy sources if the UK is to make deep and sustained cuts in carbon dioxide emissions while protecting its environment and quality of life.

We also support the Commission’s recommendation [22nd Report, Recommendation 4] that the UK government should set out within the next five years, a programme for energy demand reductions and development of alternative energy sources that will prevent an increase in UK emissions of carbon dioxide.

However concern about energy must be seen as part of the broader debate on sustainable development. It is essential that the PIU study addresses the long-term issue of what the sustainable solution to energy needs might be. In this respect energy cannot be treated in isolation. An integrated move towards greater sustainability, whatever that might ultimately mean, will have as some of its facets the move away from dependence on fossil fuel, the move towards the use of renewable energy resources, and the move towards the use of less energy per capita. We believe that the key to sustainability is being able to change people's lifestyles.

Ultimately we cannot stabilise energy demand if usage and the world population continue to increase. The latter is a key factor in any debate on global sustainability. However significant reductions in energy demand should be possible in the UK even in the short to medium term. The difficulty is that without incentives to review their energy use it is unlikely that most people will do so. If energy remains as cheap as it currently is the demand to use it is likely to increase. Finite resources such as fossil fuels will be unable to provide for ever increasing energy demands. Advances in chemistry will be necessary in order to bring about step changes in for example, the way energy is generated, distributed, stored and used, and also in developing more energy efficient ways of delivering goods, effects and services. However the current ‘cheapness’ of energy means there is limited incentive to develop these new technologies.

We believe there is considerable scope for cost-effective energy saving in the business sector, particularly in SMEs. However real incentives are needed if only to overcome inertia in the first instance. A "user friendly" audit facility could help. In addition techniques could be developed to help "bring out" energy costs which are often subsumed in other costs. The relatively cheap current cost of energy will however not help stimulate interest in this in SMEs or anywhere else.

Industry as a whole tends to favour lowest cost options. It is true that larger companies are realising that 'greener' options can be beneficial financially and/or otherwise. However in general implementing more environmentally friendly options is likely to involve higher initial costs with any savings coming from better use of raw materials, cheaper running costs or waste recycling. SMEs are driven by shorter-term profitability and are less likely to embrace such options.

A key issue is the visibility of energy costs, particularly in SMEs. If each organisation makes a relatively small improvement it could add up to a large national improvement. SMEs could also benefit from free energy advice.

There is ample scope for larger companies to influence their suppliers in particular, but the real issue is not what scope exists but what incentives exist to encourage this. Incentives that might encourage large companies to influence suppliers might include a requirement to label goods and services with energy usage and to report key environmental criteria, such as emissions of carbon dioxide, in company annual reports.

We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 85] that the UK should take a lead within the EU in pressing for a broader range of household and office appliances to have mandatory labels and minimum energy efficiency standards.

Finally as the PIU recognises, the UK is responsible for a relatively small percentage [2%] of the world's total global climate change emissions. However looked at in terms of emissions per head of population the UK is among the world's highest emitters. Thus in order to lead by example the UK must act to improve its own performance. However the UK is also in a position to profit financially from exporting technologies for cleaner energy supply. The scope is probably very large but timing and a home base for products are important factors. Too early and there is no market. Too late and others will have cornered it. There are obvious opportunities providing it can be demonstrated that the UK has a clear lead in specific technologies. Chemistry has a vital part to play in developing these technologies.

Scientific and technological solutions

The sections below give an overview of the needs and possible scientific and technological contributions to meeting those needs. However they are far from exhaustive. Some further information is given in Annex 1 which contains extracts from the Society's submission to the Energy and Natural Environment Foresight Panel in October 2000.

Overall the UK must encourage new ideas for provision and better use of energy. The starting point for each option should be an environmental assessment coupled with an objective economic appraisal that evaluates all the costs including disbenefits to health and to the environment. Without such an appraisal we are likely to arrive at measures that are far from optimal and which may be based on political expediency. The final decisions should of course be taken by government but they should be informed by as rigorous an analysis of all the relevant information as possible.

We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 70] that there should be an international body to fund research, development and design in the energy field.

Sources of energy

- Fossil fuels

Chemists have made major contributions to improving the extraction and use of fossil fuels. For example extraction technology for petroleum oils has been improved by the use of smart fluids injected at the drill point, emulsifiers, etc. and new ways have been found to use coal as a source of petrochemicals.

Nonetheless the reserves constraint on fossil fuels is likely to be a very real one by the middle of this century or earlier. Exploitation cost constraint is essentially the same as the reserves constraint in that exploitation costs will rise as remaining reserves fall due to higher finding costs, more difficult conditions and poorer reserve productivity. Nonetheless globally there are considerable reserves of heavier oils, tar sands, oil shale as well as low grade coals and lignite. The technology already exists to upgrade and utilise these if it were economic to do so.

- Nuclear power

In many ways nuclear power would seem to be the obvious successor to fossil fuels. It is to all intents and purposes an unlimited resource and it is capable of producing very large amounts of energy without producing greenhouse gases. However in its 22nd Report the Royal Commission on Environmental Pollution observed that :

'Nuclear power is a significant source of carbon-free energy for the UK, having enjoyed four decades of extensive state support in research, development and operation. But unless new plant is built nuclear power will almost have ceased by 2020. New nuclear power stations should not be built until the problem of managing nuclear waste has been solved to the satisfaction of both the scientific community and the general public.'

Chemists have already made, and can continue to make, major contributions to nuclear power. For example together with plant and soil scientists, chemists are helping to develop more secure storage for nuclear wastes.

- Other energy sources

Chemists can and do make significant contributions to developing and improving fuel sources. The following examples are by no means exhaustive :

- Improving the use of biomass as a fuel. This might include the use of vegetable oils, algae and similar burnable products.
- New approaches such as combining carbon monoxide and hydrogen to produce methanol, ethanol and other relatively clean fuels for transportation.

- Fuel cells which already make a useful contribution and should be further developed to improve their efficiency. Smaller lighter fuel cells would also have wider applications eg in transport. Fuel cells using hydrocarbons or compounds derived from hydrocarbons, such as methanol, are very efficient converters of carbon into energy.
- Solar energy research (photovoltaics) has been active for many years. However the efficient conversion of sunlight to energy remains a major problem. Chemists help to develop new photoantennae and find more efficient ways of photo-electron transfer.

The most readily available source of ‘greener’ energy on a large scale in the immediate future is use of municipal waste for combined heat and power production and this should be further developed. Not all waste is strictly renewable and these processes do of course produce greenhouse gases. However the waste would do so anyway if left in landfill. We support the recommendation of the Royal Commission on Environmental Pollution [22nd Report, Recommendation 6] that there should be much wider use of combined heat and power schemes in the industrial, commercial and domestic markets.

Renewable energy sources have the potential to make a significant contribution to meeting the UK’s energy needs. However it is important to consider the overall ‘life cycle’ in detail. It is essential that renewable energy sources do not themselves cause significant pollution either directly or indirectly [eg in manufacture]. For example one of the limiting factors in terms of environmental impact from solar energy has been chemical waste from solar cell production [gallium arsenide, arsenic, selenium etc].

The applicability of renewable energy sources will depend upon the region in question. All forms could have some application. Technologies such as hydroelectric, solar, wind, fusion, geothermal, high temperature superconductivity, and (perhaps most promising in the near future) tidal energy, all have potential and should be developed. For example it is claimed that Scotland has access to 40% of Europe’s wind energy [‘Foresight Link’, Summer 2001, page 7]. Combination techniques such as hydroelectricity and electrolysis of water to produce hydrogen could eventually provide a major source of renewable energy.

The use of biomass directly as a fuel [eg straw & sawdust burning] and as a source of biogas [eg anaerobic digestion of sewage & farm waste] are already viable at small to medium scales. There is considerable scope to increase the use of biomass but as in many cases the real issue is whether or not incentives exist to encourage it. Our understanding is that UK research in this area has been very low key because biomass was not seen as an economic alternative to fossil fuels. Given appropriate incentives research could be encouraged into developing greater energy conversion efficiencies with the goal of approaching those achieved in living organisms. We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 18] that growing crops for energy should be regarded as a primary use for agricultural land and policies and support measures should reflect this.

Energy storage

It is vitally important to develop better ways of storing energy. For example most renewable sources – wind, tidal, solar, etc - are intermittent and energy supply is not matched with demand. Chemistry is involved in developing better methods of energy collection and storage.

We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 69] that the government should promote research and development into new technologies for large-scale energy storage, possibly on a collaborative basis in Europe.

<u>More efficient use of energy</u>

Many of the ways to improve energy use are not immediately obvious and/or are not generally associated with the energy debate. For example :

- better lubricants can reduce energy losses
- lighter materials can be used to make products that require less energy to move them [eg in cars]
- if more use was made of wood as a building material then carbon [& effectively carbon dioxide] would be safely 'stored' in the wood. This is in contrast to steel and concrete where carbon dioxide is released during their production.

A case study on the potential to use magnesium as a lighter material of construction is given in Annex 2.

<u>Other issues</u>

- Carbon dioxide sequestration

There has been much interest recently in the possibility that fossil fuels could be made more environmentally acceptable by preventing the carbon dioxide they produce from entering the atmosphere and so contributing to the greenhouse gas.

Even with sequestration fossil fuels remain a finite energy source. Therefore although sequestering carbon dioxide might be environmentally helpful it would not alter the fundamental need to find alternatives energy sources. In any case the Society's view is that its unlikely carbon dioxide sequestration could make a significant difference quickly enough to make continued use of fossil fuels acceptable in the foreseeable future. The volumes of carbon dioxide involved would simply be too large.

Nonetheless in the longer term it might be possible to develop methods that could 'lock up' carbon dioxide in sufficient quantities and with sufficient security to make a real difference. For example it might be possible to recover and use or store carbon dioxide for accelerated photosynthesis so producing useful plant products.

- Understanding and monitoring

We support the recommendation by the Royal Commission on Environmental Pollution [22nd Report, Recommendation 66] that adequate long-term programmes of research and monitoring are vital to improve scientific understanding of the carbon cycle and the greenhouse effect, the consequences for the climate, and the repercussions these in turn will have, as of other environmental impacts of obtaining and using energy.

Understanding the chemical processes occurring in the environment [such as the greenhouse effect] is clearly a vital factor in helping to solve associated problems [such as increased global warming].

Chemical monitoring of various environmental parameters also provides information on changes. For example chemical monitoring can provide baseline data so that the environmental impact of policy changes can be assessed.

Conclusions

There is good cause to be concerned about energy. Fossil fuel supplies are finite and the effect of this is likely to be felt by the middle of this century or before. The other pressure on fossil fuels is the need to reduce emissions of the greenhouse gases they produce.

As the Royal Commission on Environmental Pollution observed in its 22nd Report :

'A sustainable energy policy for the UK should protect the interests of generations to come, but it must also seek to achieve social justice, a higher quality of life and industrial competitiveness today. Achieving the right balance is formidably difficult; current policies do not strike it'

Both public policy and scientific and technological development will be required if such a policy is to work. In the past there has been a tendency to address energy and other environmental issues on a short-term basis. Attempts to improve the way we produce and use energy should be regarded as long term and part of the broader 'sustainability' agenda, and given appropriate government support.

In our view it is essential to adopt policies that reduce energy use and use of fossil fuels in particular. However it is also essential to put in place policies that encourage the development of technological solutions.

Chemistry is central to developing new energy sources and ensuring that energy is used with maximum efficiency. More generally it is vital to understanding the environment and ensuring that man's impact upon it is sustainable.

I hope that the above comments are helpful.

Yours sincerely

Professor Jon McCleverty

Chairman, Scientific Affairs Board of the RSC

The Royal Society of Chemistry is the UK Professional Body for chemical scientists and an international Learned Society for the chemical sciences with 46,000 members world-wide. It is a major international publisher of chemical information, supports the teaching of the chemical sciences at all levels and is a leader in bringing science to the public.

ANNEX 1 – EXTRACTS FROM RSC RESPONSE TO ENERGY AND NATURAL ENVIRONMENT FORESIGHT PANEL OCTOBER 2000

1. THE DRIVERS OF CHANGE

This section looks at the trends and forces operating today and how these will affect the future.

Resource depletion could be a major driver of change eg availability of crude oil. Alongside "Growth in global energy/resource demand", "Capacity of the world to supply energy demand" could be a major driver and should be included.

Without a favourable economic framework, industry (and Governments) will not invest in the technology needed to develop more sustainable systems of production and energy.

An important trend is the decreasing rate of discovery of crude oil. According to some reports the rate of consumption is 4x the rate of discovery. Along with increasing demand from developing countries, this could lead to sharp price rises and shortages with major economic and societal impacts.

Consumers ultimately have the impact on the environment. Producers only sell what people will buy and have little incentive to invest in environmentally better products unless their customers demand them. Governments appear unable to collectively agree and carry through programmes that will reduce consumer demand. First priority is to educate consumers as to the impact of their decisions and create the framework whereby the market will provide better alternatives.

2. THE FUTURE: CHALLENGES AND OPPORTUNITIES

This section looks at what the consequences of future changes lead to in terms of problems and prospects.

Some areas are not receiving the attention they deserve. Industry still spend more on end of pipe treatment than radically new production processes that eliminate waste at source. Governments around the world have decreased publically funded R&D in new energy technologies dramatically since the 1980 (UK by 90%). One major challenge therefore is to significantly increase R&D on short, medium and long term projects to give a breathing space, prepare for major change and make the step changes needed.

The UK has a SET base that is capable of tackling all of the topics below to create new business opportunities that could be exploited globally. All require multidisciplinary inputs from chemists, materials scientists and engineers.

Energy
Nuclear Energy
Stretching hydrocarbon resources
Increasing efficiency of current vehicles
Fuels cells
Hydrogen fuel
Photovoltaics
Raw materials
Eliminating Waste via Greener Chemistry
Water
Toxicology & eco-toxicology
Environmental monitoring and modelling

All of the above offer potential for widespread global applications. Time scales vary from short to long.

UK is well placed in terms of the basic SET base to compete with rest of the world. Industry sector is not well developed in UK or anywhere else particularly. Successful R&D could lead to new companies starting up and grow the industry sector in the UK.

3. RESEARCH, DEVELOPMENT AND DEMONSTRATION THEMES

This section explores the panel's view on long-, medium- and short-term research and development needs and requirements.

The UK has a SET base that is capable of tackling all of the topics below to create new business opportunities that could be exploited globally. All require multidisciplinary inputs from chemists, materials scientists and engineers.

Energy

One of the greatest challenges we face is to develop more environmentally benign energy sources. New and improved ways of generating and storing energy including clean coal technology, more efficient combustion processes, biomass, fuel cells, electrocatalysis, battery technology and the production and safe storage of hydrogen.

Nuclear Energy

This surely must be the best solution to CO_2 reduction. UK is in danger of losing out to US when the world wakes up.

Stretching hydrocarbon resources

To get the most out of current oil, coal and gas reserves we need new and improved refining technologies capable of upgrading difficult hydrocarbons such as heavy oil while we pursue new energy sources. This requires new chemistry and process technology. Understanding combustion processes is central to increasing efficiency and reducing emissions but is still relatively primitive and in need of development.

Increasing efficiency of current vehicles

We need to better understand how fuels burn, how exhaust gases can be cleaned more efficiently, how fuels and lube additives can increase fuel efficiency and decrease emissions to improve the energy efficiency of ‘conventional’ and hybrid vehicles. In battery technology despite over 100 years of development, the problems for electric

vehicles remain the same - power/weight. Batteries research does not appear to be a priority in the UK.
Whatever the motive power, R&D will also be required on cheaper lighter, stronger, more durable materials to improve the energy efficiency of vehicles. Much of this research will be in the chemistry and processing required to manufacture advanced ceramics, polymers and composite materials.
In stationary power generation improved high temperature superconductors would mean less energy lost in transmission and better insulators could reduce the energy used to heat buildings. Here again, new chemistry will be needed for the design and manufacture of next generation materials, cables and components.

Fuel cells have great potential but cannot compete yet on cost and performance measures against current engines. Their biggest technical limitation is fundamental chemistry - the ion transfer rates across fragile membranes. The challenge is to make membranes cost effectively that are impermeable to hydrogen and oxygen while conducting protons efficiently.

Hydrogen fuel - once the fuel cell problems are solved hydrogen is the simplest and cleanest fuel. However this requires major advances in the technology for producing, transporting and storing hydrogen. Ultimately hydrogen could be produced by electrolysis of water, but in the short term it's likely that hydrogen will be produced from fossil fuels, with biomass a longer term option for sustainable fuels production. New chemical processes will be required for conversion of biomass into hydrogen.

Hydrogen storage is another pressing problem. The low volumetric density of compressed hydrogen make transportation expensive. Currently compressed hydrogen is only suitable for stationary storage while liquefying the gas carries a heavy energy penalty. Research is needed to develop lightweight advanced composite materials suitable for compressed gas tanks and hydrogen absorbents that could improve storage of hydrogen for transport.

Photovoltaics - solar cell technology is also limited by the relatively expensive manufacturing processes. Current technology uses high temperature vapour deposition techniques that are slow and expensive. A new chemical process capable of putting down large area silicon films onto cheap substrates at low temperature and at very high throughput would dramatically reduce costs and revolutionise applications. New chemistry is required coupled with novel process engineering. The prize is very high.

Pressure to reduce CO2 and move to sustainable raw materials will require a massive investment in new chemistry and processes to use biomass as a feedstock. Growing plants are already being used as ‘chemical reactors’ to make natural products for pharmaceuticals, lubricating oils, etc. This trend seems set to continue and biomass could provide a sustainable feedstock for many specialised and even some bulk chemicals and materials derived from crude oil and gas today. For the past 200 years, chemists have been developing chemistry to convert hydrocarbons to a vast range of products that we use in our daily lives. We have only just started on exploiting biomass as feedstocks.

Eliminating waste at source is one of the key aims of ‘Green Chemistry’. A good example which is not immediately obvious is the new class of catalysts that make polyethylene with enhanced mechanical properties. These have permitted the use of much thinner plastic films in packaging, plastic bags etc with no loss of strength. In these applications it is now possible to use half the plastic while retaining the same performance and generating half the waste! Even the waste can now be chemically recycled back to virgin plastic. This is a good example of how new science can dramatically transform environmental impact while maintaining the quality of service and human benefits with minimal capital expenditure.

Water

At a global level the provision and storage of potable water is one of the great challenges facing mankind. Many of the challenges, at least in the UK, are to do with engineering. Elsewhere, recovery and purification of poor quality water for drinking requires new and much more efficient desalination technology and water treatment chemistry.

Chemistry and toxicology are central to diagnosing potentially harmful effects of chemicals in the environment. Improved test regimes for determining the toxicity and eco-toxicity of materials are required. Not only should they be more thorough and precise, but the use of molecular modelling and simulation should also lead towards the use of progressively fewer animals for testing.

Many of the major environmental threats to mankind, global warming, ozone depletion, pollution, are the results of chemical and physical processes occurring in the environment.

Ozone depletion for example, was first identified as a possibility by atmospheric chemists modelling stratospheric chemistry, quantified by physical chemists measuring the kinetics of key reactions between halogen atoms and ozone and confirmed as a problem by analytical chemists using sophisticated airborne detection techniques. Alternatives to CFCs were then quickly developed to allow continued use of household necessities such as refrigerators without damaging the environment. The ability to recognise environmental problems, understand them and devise solutions requires continuing investment in the basic physical sciences.

4. BARRIERS TO INNOVATION

This section considers social, economic and institutional factors that may act as inhibitors to application and deployment of energy and natural environment R&D.

Complacency about energy has led to low R&D expenditure in the UK. Since 1980 UK and many other western countries have reduced R&D in new energy technologies by 90%. We are working off a relatively low base with no mechanism to reduce costs of demonstrator projects that are essential for commercialising new technology.

R&D expenditure should be increased to levels comparable with biotech and infotech.

There should be (tax) incentives for large scale demonstrator projects that are the main barrier to technology scale up and commercialisation. Create entrepreneurial activity in UK around the energy sector, facilitate start-up and spin out companies by seed corn funding to universities etc.

ANNEX 2

MAGNESIUM - A CINDERELLA WHO MAY YET GO TO THE BALL

Summary

Magnesium castings could replace many current uses of aluminum and even iron and steel in motor vehicles with significant advantages in both energy consumption and in costs for both manufacture and use.

However it requires process improvements in magnesium manufacturing : electrolysis of anhydrous magnesium chloride could produce both chlorine and magnesium metal whereas current production is either thermal or based on electrolysis of hydrated magnesium chloride.

Reasons for poor take up of magnesium alloys as structural materials (with the notable exception of the original VW Beetle) are complex but mainly derives from the control of magnesium manufacture by the aluminum industry giving little or no incentive to develop better process technology.

Magnesium is the eighth most abundant element in the earth's crust, the third most common in the seas and lakes and the second lightest of the metals available for structural applications. Lithium, the lightest is unlikely to achieve any significant uses outside of aerospace.

It is little wonder therefore that increased awareness of energy conservation led automotive manufacturers to look more seriously at replacing iron, steel and aluminium castings with magnesium die castings, a move first begun by Volkswagen in the 1950s. The original VW design resulted in a tail heavy vehicle, made practicable by the use of crankcase and transmission housings cast in magnesium alloy, some two-thirds the weight of equivalent aluminium components. The early commercial success of the Beetle prompted improvements in production technology, including the replacement of the sand foundry techniques by pressure diecasting. Here magnesium's higher thermal conductivity relative to aluminium offered significant productivity gains and these, coupled to its excellent machinability seemed to provide an assured future for the metal.

However this proved another false dawn as European production of the Beetle was phased out and its replacements no longer justified the use of high cost magnesium alloy components in their design. For many years, magnesium has found applications in transport. 1930s London buses had massive cast magnesium crankcases and the World War 2 Halifax bomber was supported on the ground by two huge magnesium undercarriage castings, probably the largest single light alloy castings ever made. However despite some enthusiastic protagonists both in Germany and the UK, magnesium alloys never achieved the usage that their technical merits justified.

The reasons for this lack of success are complex but stem mainly from a mixture of prejudice and misinformation, fuelled by the higher price of magnesium alloys relative to aluminium. Even now, about half the current consumption of magnesium metal is used as an alloying element in aluminium. Indeed much of the existing magnesium production capacity is controlled by the aluminium industry which has no reason to promote competition or to reduce the price of magnesium for its own structural applications.

There is indeed much prejudice against the use of magnesium as it is widely believed to be flammable. Many people will remember magnesium flash powder, school experiments with burning magnesium ribbon, and the ill-fated Mercedes racing car involved in the 1955 Le Mans tragedy. Magnesium is also widely believed to have poor corrosion resistance particularly when exposed to salt water. Both are true but have little relevance to a properly designed and controlled production process in which the hazards of finely divided metal are recognised and appropriately controlled. In automotive use the generally oily conditions inhibit corrosion even in components exposed to road salt for many years and a variety of corrosion resistant surface coatings was available even in the 1960s.

Chemistry is vital in promoting the wider application of magnesium alloys. At present most magnesium metal is produced by the electrolysis of magnesium chloride with a smaller quantity produced by a thermal reduction process. A new electrolysis plant was opened in 1997 on the Dead Sea in Israel and is expected to provide a major contribution to a revived demand from Volkswagen. Ford is considering automotive applications and may be involved in a new magnesium production plant for Australia.

Other than the thermal process, existing manufacture is based on the electrolysis of molten magnesium chloride to produce magnesium and hydrogen chloride (the salt used is the partially hydrated molecule). However if anhydrous magnesium chloride were to be used, chlorine would be produced at the anode instead of the lower value hydrogen chloride and the process economics improved considerably. There would appear to be considerable scope for development of the electrolytic process and possibly an improved thermal route (plans for a projected UK thermal plant in the Peak District were abandoned in the late 1960s).

Chemistry is vital to such developments. Lighter weight vehicles would consume less energy irrespective of how the energy is produced. There is no shortage of raw materials for primary production and increased availability at lower prices could stimulate demand for other structural applications. For example the original Samsonite attache cases used a diecast magnesium frame. Pressure diecast magnesium components could provide a serious challenge to not only heavier metals such as aluminium and steel but also to many existing applications of plastics materials, probably with less adverse environmental impact. Certainly there would seem to be a good case for further investigation into the potential of magnesium and chemistry is essential for this.