RESPONSE TO ROYAL SOCIETY OF EDINBURGH INQUIRY

"ISSUES FOR SCOTLAND'S ENERGY SUPPLY"

EXECUTIVE SUMMARY

Scotland is arguably a special case in energy terms for a number of reasons associated with the geography (and geology) of the UK and the limited capacity of the interconnector.

Given Scotland's resources of hydro, wind, wave, tide, opencast coal, biomass, oil and gas, the country should be a net exporter of electricity. It would be irresponsible to be a net importer. Scotland should have a balanced portfolio of electricity generation – nuclear (baseload), renewables (mostly intermittent), coal and gas (load following).

Renewal of much of Scotland's electricity generating plant (coal and nuclear) is overdue. Investment now in replacement coal-fired plant would reduce emissions and reduce security-of-supply risks. Since Cockenzie (coal, 4 x 300MW) and Longannet (coal, 4 x 600MW) are scheduled to close by, at the latest, 2015, Hunterston (Nuclear, 2000MW) by 2011 and Torness by 2023, at least 6000MW of new generation capacity will be needed by 2015 to maintain the status quo and Scotland's ability to export power. It will take around four years to build a new Unit; two years for a major retrofit. To allow a steady programme, renewal should start now.

As a consumer, Mitsui Babcock is concerned about the 30% hike in gas and electricity prices last year and again this year. These increases directly impact on our profitability and are driving manufacture (and emissions!) abroad. The increase in electricity prices are due to the increasing price of gas (determined by international market), the cost of carbon allowances being built into the price of electricity and the new grid connection charges due to BETTA.

To minimise increases, investment should be made in the lowest cost options. Our analysis demonstrates that clean coal provides the lowest cost option for "low carbon electricity".

Large replacement plant, whether nuclear or clean coal (with or without CCS) require major capital investment that will be repaid over 20 or even 40 years. It is a major challenge to persuade generators to invest in these technologies given the uncertainties of energy policy but such investment is vital to security of supplies and reduction of emissions.

The Scottish Executive should seek opportunities to locate demonstrations of Carbon Abatement Technologies in Scotland. This policy would complement the Scottish Executive's action on Energy research through the Energy ITI.

A. MITSUI BABCOCK

Mitsui Babcock is a British company (HQ in Crawley; R&D, Manufacture and Services in Renfrew) established in 1891, and wholly owned by Mitsui Engineering and Shipbuilding Co. Japan, since 1995. We employ 4000 people worldwide (3800 in the UK, of whom 1000 are in Scotland). We serve all sectors of the Energy industry in UK and Europe. In Asia Pacific and the Americas our sole focus is coal-fired power plant. In the UK, whilst we have interests in nuclear, renewables, oil and gas, our largest business area is coal-fired power plant.

Approximately half of the coal-fired power plants in the UK have Mitsui Babcock boilers and more than half of the total have our Low NOx Burners. We have available a portfolio of NOx reduction technologies required for the implementation of the European Large Combustion Plant Directive.

In China, we have supplied 4 GW of coal-fired plant in the last decade and in 2003, when approaching 100 GW of pulverised coal fired power plant was ordered, we had around 15% of the boilers for this market, more than 10 GW being high efficiency supercritical boilers.

As a UK company, we support the government's objectives in energy, the environment and enterprise. We have successfully developed cleaner coal technology products with the assistance of the DTI's Cleaner Coal R&D programme and exported these. We have a portfolio of Carbon Abatement Technologies for fossil fired plant at various stages of development ready for full-scale demonstration and are pressing the government to recognise the major opportunities which such technologies bring for carbon dioxide emissions world-wide.

Our response focuses on measures to obtain significant cost effective reductions in CO_2 emissions from fossil power generation additional to those obtained by energy efficiency and renewable measures.

The key messages of our response to this consultation are:

1. Implementation of Carbon Abatement Technology for fossil fuels measures can start relatively quickly ahead of the full scale introduction of carbon dioxide capture and storage.
2. The DTI's CAT Strategy, recently published, deserves full support. It needs to be backed up by a substantial research, development and demonstration programme commensurate with ambitious objectives and investment in other countries.
3. New incentives similar to the Renewables Obligation will be necessary to stimulate investment in Carbon Abatement Technologies. Rules for award of allocations under the ETS should be framed to encourage investment in Best Available Technologies (in CO_2 terms) for coal and for gas.
4. Comment on opportunities for Scottish companies:

   Renewal of much of Scotland's electricity generating plant is overdue. Investment in replacement coal-fired plant would reduce emissions and reduce security-of-supply risks. The timescales to renew coal and nuclear plant are such that work needs to start as soon as possible.

   Mitsui Babcock has developed a design of coal-fired boiler – known as "Capture Ready Advanced Supercritical", which is suitable for retrofit in place of existing older boilers (such as Longannet). With a suitable turbine upgrade, the plant cycle efficiency can be improved to around 45%, giving an 18 - 20% reduction in CO_2. This type of boiler can be used for biomass cofiring (up to 20%) giving a

total of 40% reduction in CO_2 and is designed to be capture-ready (up to 95% total CO_2 reduction).

There is a huge potential market for Carbon Abatement Technologies such as described above, world-wide, particularly in those countries (including China, India and the USA) which are expected to continue to use increasingly large quantities of coal for power generation. The IEA (International Energy Agency) forecasts that energy demand will increase by about 60% to 2030 with fossil fuels continuing to meet more than 80% of demand (22% coal, 35% oil and 25% natural gas). The increase in CO_2 emissions from China alone will completely overwhelm any reductions anticipated in the UK. It is essential to develop, demonstrate and implement technologies in the UK that can be used in the rest of the world.

The DTI (UKTI) has been promoting the opportunities for these technologies and has issued a Strategy to promote their use – cognisant of the global environmental benefits to be gained through exports and technology transfer. Scottish industry is well placed for a significant share of this business.

Although Carbon Abatement Technologies are available now, their widespread adoption will be facilitated by Research, Development and Demonstration aimed to drive down costs, improve reliability and improve operational flexibility. The UK Government should support a substantial Research, Development and Demonstration programme to run alongside national programmes in the USA, Canada, Australia, Norway, Germany, Japan, etc., and European programmes. The first stages of such support have been announced in the DTI CAT Strategy.

It is essential to support demonstration of new technologies (and not just R + D) and to commit a long-term budget commensurate with the size of the opportunities for CO_2 savings indicated above.

The Scottish Executive should seek opportunities to locate demonstrations of Carbon Abatement Technologies in Scotland. This policy would complement the Scottish Executive's action on Energy research through the Energy ITI.

B. PARTICIPATION IN RSE INQUIRY

We welcome the RSE Inquiry into Energy Issues in Scotland and confirm our willingness to provide further supporting information. Our contact is Dr Mike Farley, who is our representative on a number of relevant bodies:

- DTI Advisory Committee on Carbon Abatement Technologies;
- Chief Scientist's Private Sector Energy R, D&D Group;
- UK Advanced Power Generation Technology Forum;
- IPA – Scottish Industrial and Power Group (Chairman);
- UK Trade and Investment Power Sector Advisory Group.

C. CONSULTATION QUESTIONS

General

Q1: How should Scotland provide for its energy needs over the next 5, 15, 30, 45 years, in the context of the likely UK, European and global energy environment?

Answer:

Scotland is arguably a special case in energy terms for a number of reasons associated with the geography (and geology) of the UK:

- largest hydro resource in the UK;
- largest onshore wind, tide and wave resources in the UK, albeit located away from most major users;
- largest UK resources of mineable (open cast) coal;
- deep water facility for coal imports;
- relatively close to UKCS oil and gas reserves and potential sites for carbon dioxide storage (in oil and gas fields and saline aquifers);
- less gas generation than the average for the UK;
- older power station fleet than the average for the UK;
- Scotland's electricity grid is independent of the UK's to the extent that it is connected by an "interconnector" of limited capacity (equivalent to about one-third of peak demand) to the England/Wales/Northern Ireland networks

Other special features of the Scottish situation are:

- 33% of Scotland's generation is from two nuclear power stations, whose generation is CO_2-free;
- Scotland has a history of engineering relevant to current power generation technologies (nuclear, oil, gas, coal) but a very limited home market for the companies in these fields due to the lack of investment in replacement plant.

Since Cockenzie (coal, 4 x 300MW) and Longannet (coal, 4 x 600MW) are scheduled to close by, at the latest, 2015, Hunterston (Nuclear, 2000MW) by 2011 and Torness by 2023, at least 6000MW of new generation capacity will be needed by 2015 to maintain the status quo and Scotland's ability to export power. To allow a steady programme, the building of replacement stations should start now.

It will take around four years to build a new Unit; two years for a major retrofit.

Q2: Should Scotland aim to be self-sufficient in energy in general, and in electricity in particular, despite trends towards interdependence within Europe?

Answer:

Yes. Given Scotland's resources of hydro, wind, wave, tide, opencast coal, biomass, oil and gas, the country should be a net exporter of electricity. It would be irresponsible to be a net importer. Scotland should also take responsibility for its own waste.

Q3: What are the possible implications and consequences for Scotland, and the UK, of becoming increasingly reliant on imported oil and gas for their energy needs?

Answer:

There are serious implications in terms of security of supplies, gas and oil coming from relatively unstable countries and risks of major price rises as these fuels

become scarcer as supply peaks and demand from other countries (including India, China and USA) grows.

Energy Supply

Q4: What is the feasibility, availability, reliability, sustainability, efficiency, capacity and risks of the different energy generation technologies?

Q5: What are the likely trends, and uncertainties, in the availability and cost of energy sources over the next 20/45 years?

Answer:

	Nuclear	Clean Coal	Coal + CCS	Gas	Gas + CCS	Biomass Cofiring	Biomass Stand-Alone	OnShore Wiind	Offshore Wind	Hydro	Wave	Tide	Nuclear Fusion
Feasibility	√√√	√√√	√√	√√√	√√	√√√	√√	√√	√√	√√√	√	√	?
Availability	√√√	√√√	√√	√√√	√√	√√	√	√	√	√√√	√	√	?
Reliability	√√√	√√√	√√	√√√	√√	√√	√	√√	√	√√√	√	√	?
Sustainability	√√	√√	√√	√	√	√√√	√√√	√√√	√√√	√√√	√√	√√	√√
Efficiency	-	√√√	√√	√√√	√√	√√√	√	-	-	√√√	√√	√√	?
Capacity	2x2000MW	3600MW		2000 - 2500MW		400 - 500MW				Limited Additional capacity	Large but remote		?
Risks	Minimal	Minimal	Acceptance of CCS	Gas Supplies / price	Acceptance of CCS	Low	High Cost	Public Acceptance	Technical Risks	Public acceptance of devices and associated transmission lines			Huge Technical Risks; 40 years away
Cost p/kWh	3.0	2.6	3.6	3.0 - 5.0	3.9 – 5.9	~5	?>6	3.68	5.52	?	?	?	
Cost Trends	Capex Dominates	Capex Dominates	Value of EOR rising	Price will rise		Price should stabilise	High Capital Cost. Stand alone plant	Costs should reduce slowly	Costs should reduce slowly	Stable	Costs should reduce		?

Q6: What are the economic issues of capital investment in the supply and distribution of energy that need to be considered?

Answer:

Large replacement plant, whether nuclear or clean coal (with or without CCS) require major capital investment that will be repaid over 20 or even 40 years. It is a major challenge to persuade generators to invest in these technologies given the uncertainties of energy policy but such investment is vital to security of supplies and reduction of emissions.

Q7: What are the key issues surrounding the development of Scotland's bulk electricity transmission and local distribution systems?

Answer:

Whilst not Mitsui Babcock's area of expertise, the key issue is public acceptance of new transmission lines. The public will not accept these unless they are convinced of their necessity. People may prefer replacement of the existing (carbon-free) nuclear generation to more and large transmission lines/towers.

ENERGY DEMAND

Q8: What will the impact of energy availability and price be on the demand for energy by commerce and industry in Scotland?

Answer:

As a consumer, Mitsui Babcock is concerned about the 30% hike in gas and electricity prices last year and again this year. These increases directly impact on our profitability and are driving manufacture (and emissions!) abroad. The increase in electricity prices has three elements:

i) price of gas (determined by international market);

ii) cost of carbon allowances being built into the price of electricity;

iii) grid connection charges due to BETTA.

Q9: What are the likely trends in the domestic demand for energy for space heating and other purposes? What would need to be done to achieve major savings? What are the investment costs?

Answer:

Whilst not our area of expertise, we would venture the view, based on our own experience, that whilst space heating demand may be better controlled through energy efficiency measures, the demand for air conditioning/climate control in offices and shops will grow significantly.

Q10: What are the likely trends in the demand for energy for transportation in Scotland? What is the likely time-scale and scope for substituting other power sources for fossil fuels? What are the likely investment costs?

Answer:

Currently, excluding electric trains, all transportation uses carbon dioxide generating fossil fuels. Reductions in emissions of carbon dioxide are possible by:

1) improving efficiency (mpg)
2) replacing hydrocarbon fuels with biofuel (limited capacity)
3) replacing hydrocarbon fuels with electrification (railways, trams, battery cars)
4) replacing hydrocarbon fuels with hydrogen.

3) and 4) only reduce CO_2 emissions significantly if the electricity or hydrogen is generated without emission of CO_2. This is possible in three ways:

1) electricity and hydrogen from coal or natural gas with CO_2 capture and geological storage
2) electricity and/or hydrogen (by electrolysis) from additional nuclear generation

or

3) electricity and/or hydrogen (by electrolysis) from renewable sources. Hydrogen storage will be essential to smooth out the intermittency of the renewable electricity.

We understand that 1) (coal and CCS) is the most economic.

Environmental and Social Issues

Q11: What are the environmental concerns that need to be taken into account, in terms of the impact on ecological and other natural resources, as well as waste management and impacts on the landscape?

Answer:

Reduction of emissions is often considered a major challenge for coal-fired generation. However, there has been massive progress in this area as shown by the comparisons in the table below. The table compares the levels of emissions from an "average" coal in the past "uncontrolled levels" by 2008 and 2016 in Europe and "best available" technology levels currently being tendered in the USA.

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Q12: Can the objectives of environment improvement and economic growth both be met without a major increase in energy costs? What steps should be taken to enable an informed debate on the issue?

Answer:

It is clear that low carbon electricity, heat and transport will be more expensive. It is therefore essential to pursue all options and allow the least cost to emerge. Our own calculations show "Carbon Abated" coal to be economically attractive, even without the credits for enhanced oil recovery (EOR) – see below:

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NB: The prices in this table were for gas between 17.5p and 30p/therm.
The current price is much greater.

Q13: What are the social values and consequences of energy generation and distribution on employment opportunities, health, and energy affordability?

Answer:

	Employment Opportunities	Health	Energy Affordability
Clean Coal / Carbon Abatement / CCS	Excellent	Positive	Moderate cost
Nuclear	Good	Positive	Moderate cost
Wave / Tide	Very modest	Positive	Very high cost
Wind	Modest	Positive	High cost, especially offshore

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