Views of Scotland
www.viewsofscotland.org

Proceedings of the
Fourth National Conference

In Thrall to Wind?

Perth, 15 January 2005

The Fourth National Conference of Views of Scotland took the theme *In Thrall to Wind* following Deputy First Minister Jim Wallace's reply to an open letter from the group. In it he said, 'Your representation of the Executive's renewables policy as being in thrall to wind development is an extremely inaccurate reflection of our position'.

Two speakers at the conference examined, in substantive contributions, the role of wind power in its wider context.

Since both are relevant to examining whether Executive policy is indeed uncritically supportive of what many feel is a flawed technology, the conference asked that they be made available to a wider audience.

They are on www.viewsofscotland.org

Renewable energy – an engineer's view

When confronted with a difficult problem, engineers study available data and make a decision on the basis of their experience and interpretation of the evidence and its credibility. This I have tried to do with the issues of climate change, wind power and other electricity generation systems.

Climate Change

The threat of climate change and its possible effects appear to be the main driving force for renewable energy schemes. The notion that man-made greenhouse gases are the principle cause of climate change, and therefore of global warming, has been turned into a semi-religious belief by many in our media.

Climate change is, I believe, a natural occurrence. Studies of the past history of our planet show this. The exact cause of these periods of global warming and cooling cycles has yet to be proven. Many theories abound but the activities in our sun and its effect upon our planet appears to be the most likely cause. Whether we like it or not we must learn to live with climate change. With our advanced science and technology we should be able to understand and try to mitigate against its worst effects.

Carbon dioxide is one of the largest constituents of greenhouse gas emissions, the other being methane. It is necessary to understand that most CO_2 is naturally present in our atmosphere. It plays an essential part in the life and growth of all living things on our planet. Calculations of the quantity and concentration of CO_2 in our atmosphere have been carried out over many decades and have been estimated from geological and scientific records and observations. These tend to show that fluctuations over the many thousands of years have varied from around 200 parts per million (ppm) to 300 ppm. Modern methods of measurement have shown that the amount of CO_2 in our atmosphere during the last century appear to have risen from a figure of 280ppm to around 380ppm. Forecasts have been made that continued industrialisation and the subsequent release of CO_2 could push this figure up to an estimated value of between 400 and 500 ppm.

Methane, the second most important greenhouse gas, appears to have risen to an all-time high of 1,750 parts per billion (ppb) – more than twice that recorded over the past 400,000 years.

Who knows how nature will react if this increase materialises?

The Antarctica and Greenland ice drillings have shown that nature has dealt with many great changes in the composition of the earth's atmosphere. International energy agencies estimate that man's total contribution to global emissions is

Ron Quartermaine is a Chartered Mechanical and Electrical Engineer. After early experience with hydro-electricity, he worked for some years in SE Asia, mainly on power generation and supply, before becoming Chief Engineer for a UK firm of Consulting Engineers. He later became an advisor to the Scottish Office and, finally, its Chief Mechanical and Electrical Engineer. He lives in Perthshire. His paper looked at power generation from renewable sources with an engineer's eye.

approximately 7.4 Gigatonnes of CO_2 per annum. When this is compared with an estimated nearly 200 Gigatonnes of CO_2 released into the earth's atmosphere from the land, oceans and biological sources, the man-made element is small. Calculations also show that the 200 Gigatonnes of CO_2 released by nature are balanced by equivalent movements, through time, of CO_2 from the atmosphere to the land through growth of trees and plants and absorbed by micro-organisms in the oceans.

It is therefore considered by some that the man-made contribution is too small to have any real long term effect on nature's balancing mechanism and thus be the cause of our present climate change. But many others take an opposite view.

But, I argue, all man-made pollutants, whether on land, sea or air, should be reduced wherever possible

The ice age cometh? Last weeks big chill was a reminder that the Earth's climate can change at any time… The last one [ice age] ended 10,000 years ago; the next one – for there will be a next one – could start tens of thousands of years from now. Or tens of years. Or it may have already started.

Time Magazine, January 1994

in order that the safety of our planet and the health of our populations are not unduly affected.

For those who believe that man-made CO_2 emissions are directly linked to climate change and who believe that these can be reduced by utilising renewable energy sources, it is important that they are aware of what contribution the UK could actually make to the reduction of global CO_2 emissions. If ten per cent of our electricity supply were to be produced by generators such as wind turbines the answer is less than 0.1 per cent.

The UK is responsible for approximately three per cent of total global emissions of which one third can be attributed to electricity generation.

It has been estimated that less than two thousandths of the total global annual emissions attributed to human development would be saved even if all UK's electricity generation produced no CO_2 . This figure could diminish as the economies of China, India and others expand. Even Denmark, with her vast wind turbine development, is still increasing her output of CO_2. The major source of man-made CO_2 emissions is transport and industry.

Non-renewable Sources of Power Generation

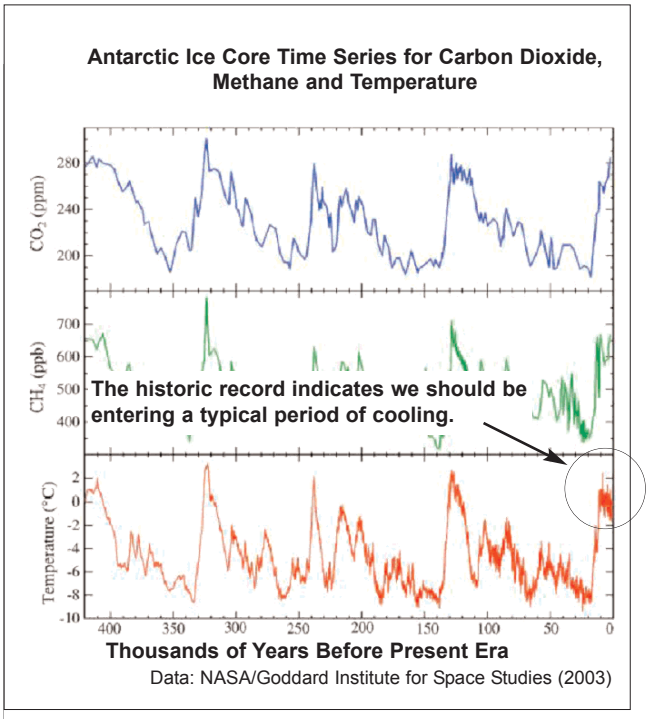
I would like to take a look at various sources of non-renewable power generation available to us at present.

Coal-fired power stations

Coal-fired power stations in the past have been dubbed the 'dirty man' of the power industry. This may have been the case in the past but, with the new Clean Burn designs of coal-fired power stations, the production of greenhouse gases is estimated to be capable of a reduction of at least 10 to 20 per cent.

With the introduction of the combined burning of coal and biomass products, it is estimated that the reduction in emissions could be a further 20 per cent. If research and development into removal of CO_2, sulphur etc from flue gases is adequately funded, there is every reason to believe that the reduction in their greenhouse gases could be further reduced by 20 per cent thus bringing the total reduction of emissions to between 50 and 60 per cent.

As China has indicated that it proposes to build some 60 coal-fired power stations in the near future and as America is substantially funding research into Clean Burn technology, there appears to be a good argument for the UK to design and develop such power stations not only in order to reduce man-made emissions but also so that our industries could benefit through the expansion of low-emission coal-fired power stations worldwide.



Gas-fired Power Stations

Our politicians appear to be pinning their hopes of maintaining a secure electricity supply by building more gas-fired power stations. These are greenhouse gas emitters. Serious doubts are now being expressed as to the security of the supply routes of gas from such countries as Russia, the Middle East, Algeria and other remote sources. But gas-fired power stations do have a part to play in the overall generation mix for this country.

Renewable energy sources

Renewable energy has come to be understood by many to be those sources of power generation that do not emit, during operation, greenhouse gases and do not draw on non-renewables such as coal, oil or gas for support.

There are many types of what are seen to be renewable energy systems other than wind, such as wave, tidal, biomass, solar, geothermal and others. These require much further research and development before they are able to take their place in the electricity supply industry. The timescales involved (10 to 20 years plus) in the research, development and production of such types of generators in the quantities required will not unfortunately allow them to help meet the targets set by our present politicians and their advisors.

Wind Turbines

Wind turbines appear to be our politicians' main solution in order to meet their targets for renewable energy and as a means to lower CO_2 emissions. Let me state my position. I believe, from my investigations into wind power, that *wind farms are uneconomic, unpredictable and environmentally unfriendly*.

I consider wind farms to be uneconomic because, without the indirect subsidies such as the Renewable Obligation Certificates, Climate Change Levy and government grants, few if any would be built. The cost of power generation by this means is estimated to be 5.35p per kwhr onshore and 7.19p per kwhr offshore as compared to 3.45p per kwhr for coal-fired, 2.57p per kwhr for gas-fired and 2.26p per kwhr for nuclear. So the cost of electricity by wind power is more expensive than by conventional means.

Wind turbines are not, in reality, renewable sources of energy as they need substantial backup from conventional power stations. The backup required for other renewable energy systems is small compared with wind. One is led to believe by promoters that wind-power generators are capable of standing alone. This is not so.

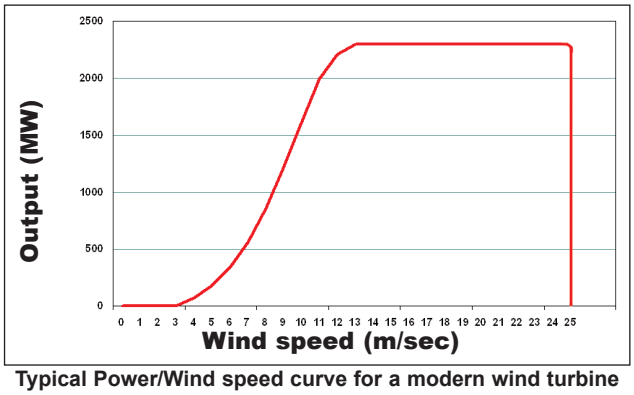
Clean renewable energy through the use of wind turbines sounds appealing but in practice the saving of CO_2 by this method is small. It is also an extremely expensive way to save these small amounts of emissions.

The cost of extending and reinforcing our present grid systems, together with building new conventional type power plant as backup for wind power will be enormous. The cost of this reinforcement is presently estimated to be some £4,000 million for the UK as a whole.

If our politicians' targets for renewable energy by wind power are realised, the cost of bulk electricity generated in Scotland could be increased by more than 25 per cent. Despite these huge costs the whole of the UK programme for renewable energy schemes is estimated to reduce total man-made emissions worldwide by less than two parts in a thousand or 0.002 per cent. You and I will have to pay for this through our electricity bills.

As one financial guru put it, 'With a commercially-viable project, government subsidies are not required. With a project which is not commercially viable, no amount of government subsidies will make it so.'

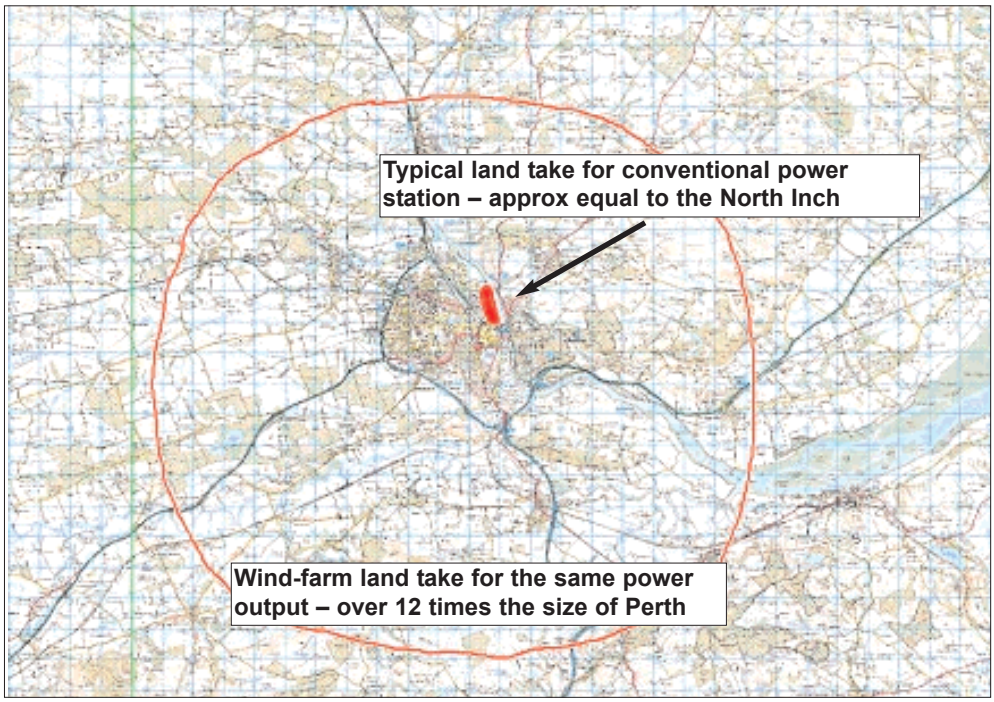
I consider wind farms to be unpredictable because they are not capable of generation when there is little wind or when there is too much. Even with the excellent weather forecasts available today it is difficult to predict wind speeds in local areas where wind farms may be situated. The electricity supply industry requires reasonable notice of the power available in order to maintain an adequate and continuous supply and avoid instability in their system. It is known that the British Isles as a whole can be affected by a total loss of wind for long periods. How then can developers of wind power predict within a reasonable period, one to two hours, when they will have power available and in what quantity as required by the grid system if this is to managed efficiently?



Typical Power/Wind speed curve for a modern wind turbine – in this case a 2.3MW machine

I consider wind farms to be environmentally unfriendly because large industrial structures with nacelles the size of a single-decker bus at heights of up to 250 feet and an overall height of up to 400 feet must be considered as being a blot on our landscape. Looking at the distribution of the wind farms presently proposed, it will be difficult to stand on a clear day on any Munro in Scotland without being able to see wind turbines – if these are built. The peace and tranquillity of the countryside, which is the attraction for so many tourists coming to Scotland, will disappear.

The huge foundations required for these structures



The scale of the change that Scotland's environment faces is enormous.

A conventional power station takes up around 0.03 hectares/MW, wind power around nine hectares/MW. The land take of known proposals is already approaching that of the country's urban settlements.

and their access roads could sterilise large tracts of land and seriously affect the flora and fauna, peat bogs and underground water in the surrounding areas.

Given these points, one cannot help but wonder who is advising our politicians and their advisors. How accurate is the information given to them and what is the true overall objective?

A wind farm can earn around £65 per MWhr for the electricity it exports as compared with a power price under NETA of less than £15 per MWhr at present. This startling discrepancy indicates the real economic incentive for developing wind farms.

Lowells, 2003

Wind turbines and noise

It has long been known from studies in Japan and other countries which suffer from earthquakes that animals react to low frequency and infrasound to levels below 20 Hertz. These are inaudible to the human ear but can be felt as vibrations.

Low frequency and infrasound are believed to produce danger signals in animals; hence the reports of many animals leaving the scene of an earthquake before the event manifests itself on the surface. Low frequencies and infrasound vibrations can travel great distances at speed through the earth and water.

One hears of reports from medical practitioners that some of their patients living close to wind farms are experiencing problems of headaches, nausea and disorientation. Could this be caused by low frequencies and infrasound vibrations emanating from wind turbines? Many good articles on the subject of noise are now available. Are our politicians and their advisors concerned about this problem?

Biomass

Plant material burnt as a form of energy. The use of biomass materials could offer distinct advantages to Scotland provided our infrastructure is developed for harvesting and handling such materials to be burnt in suitably-built power stations. We could, with advantage, take note of the experience presently being gained by those Scandinavian countries which are developing such systems. The mixing of biomass in coal-fired power stations is presently being experimented within the UK. We should encourage the use of biomass. It could bring a much needed lift to employment in our rural communities.

Solar Energy

Solar energy for electricity production is being pursued actively on the European continent. The cost of electricity generation by solar power is still proving expensive and is not yet an economically viable proposition for large-scale power generation. The EC continues to support research in this field.

Wave Power

Our politicians have passed a small amount of our money to research in this field. With our long coastline coupled with the North Sea and Atlantic Ocean swells. we are well placed to experiment with this type of power generation.

The engineering problems associated with this type of development are most challenging and I doubt whether the time scale given in our present CO_2 emissions-reduction targets will allow any great penetration of this form of energy into the Electricity supply industry in time to be effective. Research in this field is essential and should be supported. This, too, could have the potential to bring much needed industry to Scotland.

Tidal Power

Notwithstanding the huge engineering problems associated with the development of tidal power schemes using underwater propeller-driven turbines, research is going ahead, albeit slowly, due to a lack of funds combined with a shortage of academic and engineering personnel.

This is one of the most promising reliable sources of power generation Scotland has to offer. If we have the political will and the courage to engage in full scale research into tidal power systems and develop viable projects, we could lead the world in this field and produce the much-needed industrial growth and wealth for our nation.

Other systems of tidal power generation, such as envisaged by the Severn Barrage Scheme, should also be encouraged as this scheme alone is estimated to be able to provide a continuous power supply equivalent in capacity to the output of some 4,000 wind turbines. Tidal power from the Pentland Firth has been estimated to have the ability to provide sufficient power for the whole of Scotland with a surplus for export.

We should have no illusions that this type of development would be a long haul but with the knowledge gained from erecting structures for oil exploration and extraction in the North Sea we should be able, given the political will and the right leadership and backing, to become world leaders in this field. This could take many years to bring to fruition but we need to start now.

Hydro Power

Thanks to the far-sighted politician, Tom Johnson, Secretary of State for Scotland in the 1940's, we have hydro-power stations across Scotland which have served our electricity supply industry well for more than 50 years.

There is room for a limited expansion in the development of hydro-power in Scotland. This should be undertaken as soon as the economic climate will allow. Hydro-power plays a very important part in maintaining the stability of our electricity supply system and is used to great effect in this role.

The addition of pumped storage schemes allow for greater use of this facility and further developments of this feature should be encouraged.

Geothermal Power

This source of energy has not been researched to the extent it warrants largely due to the expensive drilling regimes necessary to study its performance. Nevertheless, it is a field that requires further attention.

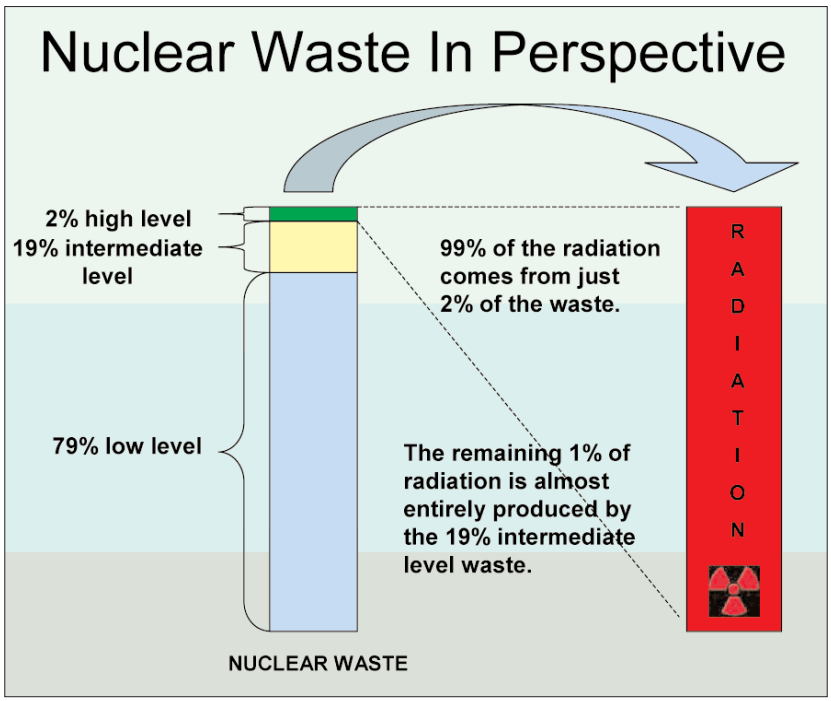
We in Scotland are close to a huge open source of geothermal energy from our neighbouring country, Iceland, which has geothermal energy in abundance. Suggestions have been made that Iceland could provide us with an ample supply of electricity by means of High Voltage Direct Current submarine cables.

As we develop our future energy supply systems, we will, I believe, connect to surrounding countries by pipelines and submarine cables as we have already done with France and Ireland. It is believed that projects are being considered for pipeline connections for gas from Norway and other European countries. So why not a submarine cable from Iceland ? The power is available now and it could eliminate the need for wind farms in Scotland – and provide a continuous source of green energy.

Nuclear Power

Nuclear power stations do not produce greenhouse gases: one tonne of nuclear fuel can produce the same energy as 100,000 tonnes of coal.

While we in the UK appear to dither, the US government, by contrast, is funding substantial programmes in clean-coal technology and nuclear safety. France and Germany, I understand, are developing improved designs of Pressure Water Nuclear Reactors whilst South Africa is funding the building of new prototypes of Pebble Type Nuclear Reactors claimed to be of an inherently safe design. China, too, is showing signs of activity in this field



A tonne of fuel for a nuclear reactor is equivalent in energy terms to 100,000 tonnes of coal. Nuclear power clearly has the potential massively to reduce emissions. But what about waste?

The volume of high level waste (i.e. 99% of the radiation) produced in the UK since the start of the nuclear age over 30 years ago is roughly that of four double decker buses.

and we understand has built an experimental Pebble Type Nuclear Reactor.

We in the UK now need to display at government level the vision and foresight which would enable us to grasp the opportunities which the changes in the world's power production systems can offer us.

There has been much talk about radioactive nuclear waste. I would like to put this into perspective. The charts show the amount of waste, in the various categories, high-, medium- and low level, coming from operationing nuclear power stations.

As you will see, the amounts which are undoubtedly hazardous are relatively small in volume and the present methods of disposal, control and monitoring have been developed over 30 years or more in order to ensure greater safety. It is interesting to note that nuclear power stations in Scotland have operated successfully without major incident over the past 30 years and have produced some of the cheapest electricity – with no greenhouse gasses.

Fusion Power

Research into this type of nuclear reactor has been ongoing for many years and only in recent times have scientists and engineers overcome some of the basic problems inherent in this type of development.

Many countries are involved in the design and development of this type of reactor and projects are being considered to develop experimental power stations to test presently-envisaged designs. The USA and China are taking a great interest in these projects and have increased their funding to its development.

It is interesting to note that this type of reactor, which basically uses the power obtained by fusing atoms together, produces much less radioactive material than the present types of nuclear reactor.

Summary

There is a danger in mixing wind-farm arguments with the need for other power generating systems. Wind generators do not appear to be able to contribute to any significant reduction of CO_2 emissions and are hugely expensive. Wind farms, through indirect subsidies, can produce huge profits for the developers – but little useful power for the consumer.

Many scientists, engineers and those in authority appear to have turned a blind eye to the realities confronting our electricity supply industry.

What is needed now is a clear and hard-headed look at current policies which offer no real solutions either to achieving sensible long-term energy policy or even a significant reduction in emissions.

Many of our well meaning, but I believe ill-informed, politicians have, through the introduction of a system of indirect subsidies such as the Renewable Obligation System and the Climate Change Levy, opened a Pandora's Box to developers of wind power generation which will, if left unchecked, not only destroy huge tracts of our beautiful landscape but also endanger the security of our electricity supply systems and be hugely expensive. This, in turn, could have a devastating effect on our industries and our way of life.

This must be halted now and time taken to reassess our future needs for electrical energy supply in this country before it is too late and irrevocable damage has been done. Scotland has lost its ship-building industry, its steel industry, its mining industry. Its agriculture and fishing industries are under threat. Now it is our power infrastructure and, not least, our very beautiful landscape and the tourism it engenders which is under threat.

We must act now and stop this waste of our resources and yet one more insult to our country – one which does little to reduce the emission of greenhouse gases.

Information has been taken from publications of the Royal Academy of Engineering, the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Institution of Civil Engineers, the Institution of Chemical Engineers, the EU Energy Commission, ESB National Grid, NASA, OFGEM, DTI, Prospect, Casella Stanger, the Renewable Energy Foundation, BBC, Views of Scotland, Danish engineers in a private capacity. Thanks also to CB, GB, DB, GB, REQ, AG, HQ and members of PEG.