Can the Energy Market Protect the Environment?

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Liberalisation of the energy market is extending across the world like a pandemic, embracing the former centrally planned economies as well as the European Union. Enthusiasm for the market as a guiding force goes back to Adam Smith in the 18th Century but more recently the omniscience of the energy market in controlling supply and demand was extolled by Nigel Lawson, later Chancellor of the Exchequer, in a speech at Cambridge in 1982; "Energy is a traded good …… our task is to set a framework which will ensure that the market operates in the energy sector with a minimum of distortion." This led, in the United Kingdom, to a programme of privatisation of the monolithic, nationalised energy industries, starting with gas in 1986, electricity in 1990, coal in 1994 and finally, nuclear electricity, which had been left out of the initial electricity privatisation because it was thought unsaleable, was privatised, very successfully in 1996. This determination by the UK to liberalise its energy market has been used as an example, by many countries. Prices to the customer of coal, gas and electricity have been driven down to below 1970 figures but, paradoxically, this has been achieved by draconian regulation of industries often referred to as "de-regulated". This has been necessary because distribution of gas and electricity is a natural monopoly and excessive charges to third parties wishing to use the networks had to be curbed. Also the privatisation process was thought not to have produced sufficient competition for the market to operate well and surrogate competition was provided by the regulators. Marketing, particularly of electricity, via a pool mechanism was also bedevilled by "gaming" on the part of the major generators such that the pool price occasionally rose to absurdly high figures and the average

wholesale prices of electricity from the pool has not altered over a decade whilst fuel, generation and distribution costs have halved, despite repeated intervention by regulators! It is hardly surprising that arrangements for marketing electricity are being changed. The major failures of the market mechanism are:

a) Environmental costs are not included (with the exception of nuclear power)

b) Long term investment has been squeezed out by short term gain

c) Support for Research and Development has been a noticeable casualty with programmes in electricity and gas reduced by 90 per cent or more since privatisation.

d) Heavy regulation has been needed to provide surrogate competition

e) Transport, a huge energy user and environmental polluter, has been allowed to expand unchecked.

These problems are being addressed in the UK and elsewhere with varying degrees of success.

Drivers of the Energy Market

A major driver of the energy market is the ever-increasing demand for energy, particularly from developing countries where some economies are growing at 10 percent or more and is bolstered by the enhanced expectations of the rising populations. With American and Canadian per capita consumption at least an order of magnitude greater than in South East Asia and with 20 percent of the world population consuming 80 percent of the available energy, emphasising the disadvantage of the developing world, demand for energy will continue to rise through he next century. An analysis

by the Royal Society of London and the Royal Academy of Engineering suggests that future energy requirements will be 1.4 times present demand by 2020 and between two and three times by 2050 (and five times by 2100). Left to the market this demand will be largely met by fossil fuels, with gas and then coal taking over the major share as oil supply peaks. There is some optimism that gas hydrates might provide a huge additional resource of natural gas. Currently hydrocarbons provide about 80 percent of world energy with large scale hydro and nuclear providing around 10 percent between them and biomass (fuel wood) the rest although, ironically, this renewable resource is the first fuel to start running into short supply particularly in SE Asia and Sub-Saharan Africa. New renewables, solar, wind etc. hardly figure in the statistics; wind, for example, provides only 0.15 percent of world electricity.

Threats to the Environment

The consequences of this massive and increasing combustion of fossil fuels is raising the concentration of carbon dioxide levels in the atmosphere from the 270 ppm of the mid 19th century to over 370 ppm today. The dire consequences of the resultant global warming are already being perceived with a temperature rise of 0.6^{o}C and a sea level rise of 18 cm through the 20th century. By 2020 the temperature will have risen by another 0.4^{o}C and the sea level rise will be an additional 10cm. Climatic patterns are changing and there seems to be an increasing incidence of extreme climatic events; hurricanes, storm surges and the like. This long-term threat to the world's climate, essentially a destabilising of the weather machine, has penetrated political thinking and stimulated a series of international conferences to decide what should be done. The latest COP5 (5th Conference of the Parties) advised by the Intergovernmental Panel on Climate Change (IPCC) met in

Bonn this October to try to world out technical details of the commitments made at the Kyoto meeting of 1997. These were reductions in greenhouse gas emissions levels, of which CO_2 is the major player, of 5.2 percent below 1990 figures by the developing nations between 2008 and 2012. The US share of this saving is seven percent; as it is already seven percent over its 2000 commitment to reduce green house gases to 1990 figures, the prospects for meeting its 2010 Kyoto commitment seem remote. Germany and the UK seem better placed to meet at least their 2000 commitment (the result of the Rio de Janeiro meeting of 1992). In the case of Germany, closure of the inefficient coal-based industries in East Germany on unification and, in the UK case halving of coal-fired electricity generation and replacement with gas, together with a more confident and successful nuclear industry (30 percent of UK electricity) have conspired to ensure compliance. This can been seen as a market success which has only coincidentally improved environmental performance of the two countries. But this success will not be repeated and in the UK government policy is to let the nuclear industry gradually fade away as stations come to the end of their useful life. Carbon dioxide emissions will therefore rise by five percent between 2008 and 2012 if the decommissioned Magnox stations are replaced by gas-fired stations which are currently cheaper to install and run.

The Market and the Environment

In assessing the costs of different energy supply technologies the cost to the environment of implementing a particular technology is not applied evenly across the board. In the case of nuclear power, decommissioning and waste storage costs are included and reflected in the cost of a unit of nuclear electricity. Not so for coal, oil or gas-fired electricity where decommissioning costs of, for example, North Sea gas rigs are not currently reflected in the gas and therefore electricity price but, more importantly, the costs of mitigating

the effects of global warming such as improved sea defences to reduce risk of flooding, costs to farmers of irrigation in drought hit areas, migration of starving populations from countries rendered unsustainable by climate changes or even submerged in the South Pacific are not included. These figures are very difficult to ascertain so they are ignored, but they should be properly included in the cost of electricity generation from fossil fuel stations or added as a credit to clean technologies such as nuclear or renewables. It should be said that there are environmental costs not associated with global warming which are attracted by renewable energy. Wind farms cause visual pollution, large scale hydro alters the landscape irrevocably, causing changes in farming and fishing and, worse, occasionally dams burst; 300,000 people have died in Hunan Province in China alone since 1944 as a result of bursting dams. All electricity generation technologies have risks as well as benefits. Sequestration of carbon dioxide in geological formations from which oil and gas have been extracted or as a liquid or solid in the deep sea is an expensive business and will only be used as a last resort.

The use of fixed instruments to protect the environment from the vagaries of the energy market.

Costing the environment turns out to be insuperably difficult. The market, of course, values it at zero and will throw anything into it that it can get away with unless stopped by legislation. The reduction of sulphur emissions to the atmosphere by European legislation, the large combustion plant directive, has been strikingly successful and illustrates the point. Another technique is taxation and the taxation of transport fuels by governments could be seen as an attempt to reduce the continuing explosive growth of cars in particular but, in truth, up to now it has merely been a revenue generating process. The money obtained has rarely been fed back into public transport or even

improved road networks. There are 600 million cars on the world's roads today; estimates of up to 3 billion cars have been suggested for 2020. In industrialised countries such as France and in the UK a 40 percent increase is probable. Transport is responsible for 25 percent of current carbon dioxide emissions, just less than the electricity supply industry which stands at 30 percent. Unfortunately, control of the number of cars on the road is extremely difficult; the freedom and provision of private space which car ownership confers is much prized and people are very reluctant to give it up. Indeed, in developing countries the desire to own a car is very strong; China expects a six-fold increase to 60 million cars by 2020. Where change in social habits and expectations is likely to prove extremely difficult resort to a "technical" fix offers the best prospect for reducing transport emissions. The modern diesel engine is 30 percent more efficient than a gasoline engine and less polluting with modern clean-up systems. A move to diesel vehicles giving 100km for 3 litres of fuel is encouraged by a number of European countries where diesel fuel costs a third less than gasoline. This is an example of taxation being used to achieve a desirable environmental end. The market alone would not deliver such a result where the status symbol of a large and powerful car drives the market, as in the US, where gasoline is less than one US dollar per gallon and the four litre 4 x 4 sports vehicle is the norm. Unfortunately, in the UK the policy is to tax the motorist, whether diesel or gasoline powered, off the road without providing alternative means of transport. This disadvantages the poor and those living in rural areas where deregulation of the bus service has almost destroyed rural public transport.

The next stage in personal transport is the hybrid vehicle with electric traction and a battery kept charged by an optimised diesel or gasoline engine. This reduces carbon dioxide emissions by 40 percent and provides an extended range over the simple battery car although a straightforward battery-driven car with a range of 60 miles is ideal for commuting and has a daily running cost of one pence per kilometre. It is preferable if the electricity used to

charge the car at night is nuclear or renewable based but a modern gas-fired power station with a generation efficiency of 55 percent is also a striking improvement over a gasoline powered car which only gets 17 percent of the energy in the fuel to the wheels. This falls to four percent in slow moving traffic! The next stage is the fuel cell car powered by hydrogen, again preferably produced by nuclear or renewable energy. Such cars already exist, encouraged by states such as California which specify a percentage of cars sold in the state must be zero emission vehicles. The only way that carbon dioxide emissions from transport, and cars in particular, can be reduced is by the use of "carrot and stick" fiscal instruments.

The move to hydrogen-based fuel cells presages the advent of a hydrogen economy. In the Netherlands up to 15 percent hydrogen is already being added to the natural gas supply so that carbon dioxide emissions are reduced when the gas mixture is burned.

Air transport is also set to increase rapidly over the next 20 years with the number of aircraft doubling. This means that air transport will be responsible for six percent of world carbon dioxide emissions, not a negligible contribution. A move to hydrogen-rich hydrocarbon fuels or even hydrogen itself is contemplated.

The future for nuclear and renewable electricity in a market-led economy

The success of the market, encouraged by regulation, in driving down fuel costs particularly coal and gas makes the future for nuclear and renewable energy bleak. Although between them large-scale hydro and nuclear provide 35 percent of world electricity without emitting carbon dioxide, investment in

new generation will be in gas or coal-fired stations where generation and investment costs are less and construction times much shorter. Both nuclear and hydro systems have high initial capital costs and long construction times which means returns on capital is delayed; planting trees for biomass-based generation suffers from a similar problem. But such stations last a long time, typically 40 years for a nuclear station and 100 years or more for hydro stations and can provide long-term fixed price contracts as fuels costs are low or zero. In the case of gas or coal a modest increase in price leading to a one pence per kWh increase in the wholesale electricity price begins to make nuclear competitive but such is the short term investment thinking used by electricity generators with, as they always say, shareholders in mind, that they go for gas or coal and assume the market will keep prices low forever, or at least 30 years or so.

The situation could be transformed by the imposition of a carbon tax, not an energy tax which taxes "clean" energy just the same as "dirty" energy. New renewables, that is, wind, solar, tidal, small-scale hydro, wave, geothermal, ocean and so on together with large scale hydro are planned to provide up to 12 percent of European energy by 2010, currently 6 percent. There is little prospect of further large-scale hydro so relatively mature technologies such as wind power, but with biomass as the biggest provider, will have to achieve an enormous expansion. Figures of up to 25 percent renewable energy supply are given in World Energy Council scenarios for 2050. A Shell scenario gives 50 percent renewable energy by 2050 but it does not stand up to perceptive scrutiny and is seen as a maverick prediction although politicians find it attractive in that it apparently reduces the need for a nuclear input. Other scenarios suggest a nuclear input of 14 percent total energy will be required by 2050. Looking further ahead to 2100 and beyond it is difficult to see how demand for energy, five times today's demand, can be met without a large scale nuclear input and that will mean moving to the fast breeder reactor. The technology is proven but requires continuous further development to ensure

safe and reliable operation. The Russians have run the NS600 fast reactor for 17 years with an availability of over 70 percent; it is a pity that short-termism caused the close down of the Dounreay Prototype Fast Reactor in Scotland and Super Phenix in France, the argument being that they would not be required for 30 years. It has taken 40 years to develop thermal reactors to their current level of sophistication. Using uranium fuel in the fast reactor with its 60 percent improvement in efficiency would essentially multiply total energy reserves of the world by 10. But it is a matter of pubic perception of the risks and benefits of nuclear power; are the risks of a nuclear accident more acceptable than the near certainty of global warming with its attendant destabilising effect on climate and weather? This comparison is rarely put and the nuclear industry persists in its siege-like mentality of never making public announcements unless forced to; it might be helpful to be more pro-active.

Renewable energy, on the other hand, has a good press but claims made for it are often wildly optimistic and again the market does not deliver renewable energy into the mix unless it is subsidised one way or another via the Non Fossil Fuel Obligation (an unusual tax on fossil fuel electricity hypothecated for renewable and nuclear energy) in the UK or legislation in other European countries. There is a strong environmental lobby against some kinds of renewable energy. Wind farms are seen as visually obtrusive and tidal barrages disadvantage wading birds, again a question of risks and benefits, but rarely examined in this light. The Severn Barrage would provide seven percent of UK electricity at four pence per unit using an eight percent discount rate but the market will not deliver it as the £10bn price tag is too high for current investment criteria in that it will not deliver at a 16 percent discount rate which the city demands and it would take too long to build, 12 years or so. The facts are that it would last for over 100 years, delivering electricity at 0.5p / unit once the capital and interest had been paid back after 25 years. But it requires investors, which would have to include the

Government in some way, to take a statesmanlike long-term view. The main stumbling block however is undoubtedly the powerful bird lobby who do not want to see the estuary changed. Large-scale hydro suffers from environmental objections and particularly the fishing lobby; it is rejected as "unsustainable"!

If the renewable energy component of the energy supply mix is to grow, as it must if we are to meet our Kyoto obligations, and the UK has set itself an even more difficult figure of 20 percent carbon dioxide reduction by 2010, fiscal incentives, which would include a carbon tax, will have to be introduced and strengthened. The market will have to be manipulated in such a way as to do what it does best and , that is, deliver lower prices for energy, but without damaging the environment.

Why not use energy more efficiently and so reduce carbon dioxide emissions?

The energy producers, whether it be oil, gas, coal, renewable or nuclear want to sell more and so satisfy their shareholders and directors. That is the nature of private enterprise and for that matter, a legal obligation on a company. There is little incentive to improve the efficiency of energy use if it means selling less of it, perhaps 20 percent less as is often suggested. But improved energy use is an important plank in government strategy to meet Kyoto obligations. In the UK a levy on electricity is spent on improving the efficiency of energy use and the same may soon be the case for gas. Unfortunately the lower the cost of energy the less the incentive to use it efficiently and invest in new, more efficient systems. In the UK, having successfully driven the price down, the government now proposes a Climate Change Levy or Energy Tax to raise the price and so make people use energy

more efficiently. A paradoxical state of affairs, particularly as it is energy, not just carbon-based energy which is being taxed.

There is some enthusiasm for carbon trading as a cost-effective way of reducing carbon dioxide emissions. In the US it has been effective in reducing sulphur emissions and it is hinted that introducing carbon trading so that the US can buy permits from Russia cheaply is the only way to get the US to sign up to the Kyoto protocol.

In practice it is proving very difficult to organise carbon trading, though some international companies such as BP have succeeded internally.

Is an energy strategy necessary if we are to protect the environment?

Left to its own devices the market will encourage the growth of transport, and increase electricity supply generation using gas and coal-fired power stations. It will pay only lip service to improving energy efficiency as operators are intent on maximising profits. It will not deliver "secure, diverse and sustainable supplies of energy" as the White Paper "Prospects for Coal" (1993) promised. Countries intent on meeting their Kyoto obligations will have to use fiscal instruments of various kinds and, in the case of the electricity supply industry, set a strategic framework using fuel-specific licences. In the case of the UK and other developed countries a 30:30:30:10 fuel mix, that is 30 percent gas, 30 percent coal, 30 percent nuclear and 10 percent renewables, will begin to deliver reduced carbon dioxide emissions. For those countries politically opposed to using nuclear power 40 percent non-polluting, i.e. renewable will be required, a pretty tall order. Human

nature being what it is, is only likely to shift ground marginally towards, say, public transport and unlikely to make any firm move to use energy more efficiently, particularly if it is cheap; improved technology must be the way ahead; in other words, a “technical fix”. Some way of financing generic research and development in energy, a noticeable casualty of the privatisation process must be found. The enormous increase in the efficiency of electricity generation by using the gas-fired combined cycle shows just what can be done. Political rhetoric must be backed up with firm and cohesive actions. The market place is powerful within its confines but it will not deliver our environmental expectations without help, and that means countries will have to develop energy policies constraining the market within a strategic framework; an energy policy, in other words. This will reduce carbon dioxide and other emissions and slow down the rate of global warming.

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