

THE POLITICAL AND ETHICAL CASE FOR RENEWABLE ENERGY

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The Kyoto Protocol, the Bali Roadmap and countless other pronouncements demonstrate that economies must reduce carbon emissions from fossil fuels. Churches of all denominations recognise their responsibility to join in such transformation. But how and with what alternatives? Yes, the efficient use of energy is essential, so decreasing energy consumption. Yet this alone is not sufficient, so, as fossil fuels reduce, one or both of renewable energy and nuclear power must increase. Are there ethical issues involved? This article argues for comprehensive and rapid increase in renewable energy.

Renewable energy is obtained from the energy already passing in the natural environment as sunshine (solar), plant-photosynthesis (biofuels), wind, flowing water, waves, tides and geothermal heat (collectively called 'renewables'). The word 'renewable' indicates that this energy-flow is not a 'once-only' resource, as with fossil fuel and nuclear. Renewables do not add to the long-term average heat leaving the Earth, nor introduce extra material to the environment as pollutant emissions. Commerce in renewables is increasing rapidly with proven technology, and now all governments state their commitment to increased renewable energy supply. For instance, new installations for wind power, solar power and biofuels are increasing exponentially at about 30% to 40% of capacity per year, with about 500,000 new jobs in Europe alone.

A major difficulty with fossil fuels is the release of additional carbon dioxide (CO₂) into the Earth's atmosphere. Human existence depends on a climate with 0.03% atmospheric CO₂, the concentration present before the Industrial Revolution when fossil-carbon remained sequestered naturally below ground. Now, the release of fossil-carbon has been the main cause of atmospheric CO₂ concentration approaching 0.04%, so causing climate change. In contrast, biofuels contain carbon extracted from the atmosphere by photosynthesis: bio-carbon. Despite bio-carbon and fossil-carbon being chemically identical, their routes into the atmosphere as fuels are distinct. Bio-carbon progresses in natural cycles between plants and the atmosphere, and will return to the atmosphere naturally, whether or not we first use the plant material as biofuel. In contrast, the emission of fossil-carbon is upsetting this balance and causing climate change. It follows that energy policies must now reduce fossil-carbon emissions by abating fossil-fuel use. We readily acknowledge that an attraction of nuclear power is that the intrinsic energy release does not release carbon, but other pollutants are produced, some with no proven permanent and universal disposal method, and there are weapons proliferation issues. Moreover, significant amounts of fossil fuel are needed for nuclear mining, fuel processing, subsidiary services and waste treatment.

Energy supply is needed predominantly for heat, electricity and transport. It comes from fossil fuels, nuclear power and renewables. The challenge is to link supplies to needs, so that the energy is:

- Sufficient where we are;
- Appropriate to local needs and situations, e.g. supporting local economies, linking with other infrastructure;
- Affordable to the general population, including the poor;

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- Safe, minimising environmental and harmful impact for health, safety, peace, ecology and climate;
- Sustainable, maintaining these characteristics indefinitely, without detriment to present and future generations worldwide;
- Complementary to religious, political and aspirational views.

How does renewable energy fit these criteria?

Sufficiency

Worldwide energy demand, for all purposes, now averages a continuous two kW per person; different forms of renewable energy add up to a total flow 10,000 times larger than this. If only part of this energy can be utilised, it is clearly sufficient. The challenge is to develop and install suitable equipment to harness this energy.

Appropriate We now use energy in different forms for heat, transport and electricity. Nuclear power can only supply base load electricity, although there are a few nuclear submarines and ships. Both fossil fuels and renewables can supply all three sectors. The most widespread options supplied directly or indirectly by renewables include:

For heat

- 'passive' solar design (sun-facing windows, conservatories, shading, correct thermal-mass, extensive insulation).
- 'active' solar thermal using collectors
- biomass solid fuel (chip or pellet boilers, cookers and stoves)
- heat pumps (ground-source, water-source, attic-source)
- geothermal heat

For transport

- biodiesel, e.g. from rape-seed
- bioethanol, e.g. from sugar-cane
- electric vehicles (trains, road vehicles), with supply from renewable electricity
- marine wind (for leisure and fuel-saving)
- hydrogen, although this is currently commercially available only from fossil sources
- electricity for electric vehicles and trains

For electricity

- Utility generation is now fully conventional from hydropower, geothermal, onshore wind, biomass, solar thermal, solar photovoltaic.
- In commercial operation, albeit not widespread: offshore wind, wave power, tidal-barrier, concentrated-solar heat engine.
- In development: tidal-stream

For both electricity and heat

- Combined heat and power (including micro-scale for houses), from biofuels, e.g. oils, biogas,

Renewable supplies are intrinsically variable, as indeed are uses of energy, with distinctive and predictable characteristics by type of renewable source. Modern control technology, careful design and various forms of storage can cater for such variability. Also, renewable sources of energy are widespread and dispersed. For electricity supply, this characteristic is called 'embedded generation' if different forms of production are integrated into a large-scale grid; it is a characteristic which contrasts with central, large-scale generation from nuclear power or traditional fossil-

fuel stations. Stored energy is essential to moderate supply, and this can be achieved from hydro dams, pumped storage, tidal barriers, building mass and biomass fuels. Likewise, control of loads is necessary to match supply to demand, using variable tariffs and automatic load-management. It is possible for the proportion of renewables on a grid to increase, while still providing consumers with a reliable and cost-effective service and, in practice, back-up.

Affordable

The public seeks adequate products and services, usually choosing the cheapest. In some circumstances extra price is tolerated for ethical reasons, e.g. for organic food and Fairtrade. To be generally accepted, the market price of renewable energy must be competitive with that from fossil fuels or nuclear power. Governments may influence prices by taxation and by legal obligations, often related to pollution abatement policies. Renewables benefit from 'clean energy' policy instruments, which should not be considered as subsidies. As with nuclear power, renewables' costs are capital intensive, although in most cases the incoming energy resource is free, e.g. wind and sunshine. Allowing for capital payment and for carbon-abatement credits, relative costs per unit supply in the UK may be summarised as:

- hydroelectricity – electricity cost from historic plant is very cheap (~2p/kWh);
- landfill gas – cost effective for electricity and local heat; dependent on waste disposal;
- wind power – onshore costs (~3 to 4 p/kWh) are less than from nuclear-power and clean-coal, and competitive with latest gas costs; off-shore costs are greater, but so is production, with insufficient experience for conclusions.
- solar, low-energy, building design – adds 5% to 10% to capital cost but contributes at least 50% reduction in running costs, with 'zero energy' buildings possible;
- biomass – use of local wastes is especially cost competitive for heating (~2p/kWh heat); however, the definition of 'waste' as a renewable source is contentious;
- biofuels for transport – competitive (~0.95p/litre) with fossil-petroleum if taxation is appropriate and vehicle fuel-systems are compatible;
- geothermal heat – (hot-aquifers and geysers) are generally competitive with fossil fuels;
- heat pumps, e.g. ground sourced – good design competitive with gas; electricity input (ideally from renewables) is the only operating cost (~3p/kWh heat output)
- solar water heating – payback in about 8 years against present electricity prices
- hydroelectricity – new plant, usually medium to small scale, commercially attractive as longer term investment (~5p/kWh, after loan repayment ~2p/kWh)
- solar photovoltaic electricity – expensive, but capital costs are decreasing as the market increases and incentives become available; payback now ~10 y in Germany, ~30 y in UK.
- energy-payback – all manufactured equipment consumes energy in manufacture and use; the time to 'repay' this 'embodied energy' is usually between six months and two years for all forms of supply (fossil, nuclear or renewables). For instance, a wind turbine in the UK repays embodied energy in about 6 months and solar thermal and solar photovoltaics in about 2 to 3 years. Note moreover, that electricity generated has more economic value than the predominant heat used in manufacture.

Safe

There are potential dangers with all forms of energy; nothing is perfectly safe:

- (i) Renewables generally provide dispersed and relatively small-scale energy supplies, and are therefore unlikely to cause major accidents, such as with Chernobyl or Piper Alpha. The failure of dams with large-scale hydropower is clearly an exception.
- (ii) National safety when threatened by warfare or terrorist action is of major importance; clearly, the misuse of nuclear facilities and the control of fossil fuel sources can both lead to international tensions. Renewables provide no such dangers.
- (iii) Since renewable energy is obtained from natural on-going energy currents in the environment, the technologies are intrinsically compatible with ecology, in contrast to fossil fuels and nuclear power. Notwithstanding, excessive concentration of renewables technology and processes, as with all industry, can certainly perturb local ecology.

Sustainable

Renewable energy supplies are obtained from continuous and permanent energy passing through the Earth's surface.

- (i) The predominant source is the Sun, with much smaller potential from tides and geothermal heat. All these sources are effectively infinite and therefore sustainable. Moreover, since they are 'normal' and 'natural', there are no polluting emissions.
- (ii) Fossil fuels and nuclear power are in marked contrast. They are sourced from finite quantities of ore which decrease as they are used. The 'economic lifetime' of these resources is of the order of decades to a few centuries.
- (iii) Renewables can supply heat, electricity and fuels from regional resources in the great majority of situations. Consequently, local sustainability is possible, with associated benefit for local employment and cash flow.
- (iv) Notwithstanding, all human activity can be harmful and renewables are no exception to this possibility, especially if the scale of development is large, such as large hydro and tidal barriers, or extensive crops for bio-fuels. The onus is on us to use energy efficiently and moderately, so reducing demand, and to choose the options most compatible with the environment.

Renewables are now established as biomass heating (fuelwood, forestry and sawmill wastes) and as electricity supply (hydropower, windpower, photovoltaic). Their use for transport fuels is globally small, but becoming significant (bioethanol, biodiesel). Hydrogen can be generated by electrolysis from renewables in the same way as from fossil fuels; the hydrogen then becomes a store of energy and may eventually be common as a fuel and energy supply. As for fossil fuels and nuclear power, efficient generation and use of energy is essential to reduce unwanted impacts and increase proportional supply. Amounts of renewable energy are currently increasing in all economic sectors for heat, fuels and electricity. Cost-effectiveness depends on internalising the external costs of all energy supplies (e.g. charging the harm of pollution to the polluters, charging waste disposal to the suppliers, charging resource depletion for the benefit of future generations) and on government and other institutional factors.

Complementary to religious, political and aspirational commitment.

Everyone hopes that their own activities cause no harm to others and, indeed, may help; however, energy supply has very considerable impacts. Negative impacts are the most worrying. For instance, fossil fuels use cause local pollution and damage health, but most importantly increase climate change. In addition, nuclear power adds to the legacy of radioactive waste and, by default, to the politics of nuclear warfare. Renewable energy has less environmental impact and may have beneficial impacts on employment, security and environment.

As individuals, we have a duty to consider the energy we use and its impacts. Thus we may: change electricity supplier to have 'green (renewables) electricity', insulate buildings, have solar water heating, install biomass heating (e.g. wood-pellet stoves), change to a low-energy car (perhaps hybrid or multi/biofuel), offset air-travel fuel, lobby officials and exercise our vote for environmental policies. There is hardly any action using energy that cannot be reduced, so decreasing the impact (e.g. changing thermostats, turning devices off, low-energy lighting, 'A class' white-goods, travel reduction).

My conclusions

For me, there are 'no regrets' in going for rapid and comprehensive increase in renewable energy. The scenario of 100% supply by renewables can be argued strongly, but only if we each use energy at least two or three times more efficiently and if we change our lifestyle to moderation. The consequences can mean healthier lives, secure economies, local adaptability and worldwide sustainability.