

This response was submitted to the consultation held by the Nuffield Council on Bioethics on *New approaches to biofuels* between December 2009 and March 2010. The views expressed are solely those of the respondent(s) and not those of the Council.

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QUESTIONS ANSWERED:

Question 1

ANSWER:

The technology to produce vast quantities of low cost carbon negative biofuels, without the use of fossil fuels, is now available. The hitherto missing prerequisite can be summed up as an unlimited supply of fresh water, produced with no energy cost and no GHG emissions, in solar energy rich barren lands. Biofuels can be transported, stockpiled and used on demand for transport systems and power generation. When they are produced without using fossil fuels, unrestricted industrial expansion can proceed with no harm to the environment. With appropriate international management the conversion of barren lands, into plant growing regions, provides the means to control atmospheric CO₂ levels to the optimum value. The most efficient converter of solar energy into chemical energy is micro algae. An algal colloidal suspension in water is perfect for mass production in photo bioreactors comprising: a transparent cylinder, UV filtration and a means to bubble CO₂ laden air through the liquid. The bubbles agitate the liquid and periodically expose each alga to sunlight. The UK government has a £9.5 billion plan to capture CO₂, liquefy the gas and pump it into spent oil and gas fields, in the North Sea. CO₂ is an essential feed stock for algal biomass production. Instead of burying this valuable feedstock it should be transported to the Saharan and Arabian deserts to be bubbled through a photo bioreactor where algae will capture the carbon and release the oxygen. The delivery ships could return to the UK with the recycled carbon bonded onto hydrogen from water. This hydrocarbon fuel should replace the fossil fuels used by power stations and transport systems thereby making both carbon neutral. Plans to build 11 new nuclear power stations in the UK should be scrapped. Instead 11 new biomass fuelled power stations should be built. The technology to convert solar energy into chemical energy is now in place. Uranium is not a renewable energy and the UK no longer has the expertise to build the reactors. It is not even capable of safely disposing the 600 tons of nuclear waste imported from the EU, to Dounreay, in the nineties. Ed Miliband's unproven and dubious plan to bury CO₂ under the North Sea will increase the cost of electricity and create a CO₂ time bomb. Dumping CO₂ makes no sense. CO₂ can penetrate a hole having a diameter of 4 Angstroms. This size is so small that Ed would not be able to see it, even with the world's most powerful optical microscope. Furthermore CO₂ dissolves in water to form carbonic acid.

Question 2

ANSWER:

Future algal fuels must be produced in solar energy rich barren lands which currently serve no useful role in the atmospheric carbon cycle or food production. Essential requirements to replace fossil fuels, with future generation algal fuels, are inexhaustible supplies of the following: solar energy, carbon dioxide, fresh water containing plant nutrients and fast growing plant life. Because plants convert water molecules into molecules that are not water, any water impurities, not absorbed by the plant, will become more and more concentrated in the residual water and slow down the process until it stops. This issue has been the main stumbling block during the last 30 years. Countries that are rich in solar energy are fresh water stressed. Large scale algal production in an open solar lagoon containing either waste or seawater cannot be sustained without a continuous water purge to prevent a build up of contaminants harmful to the algae. It is difficult and costly to separate micro algae and plant nutrients from the runoff water. Serious environmental damage will occur if algae are grown, on a scale to satisfy global energy requirements, in sea water or waste water. The most important ethical challenge is to provide the third world with all the fresh water needed for personal use and land irrigation, without burning fossil fuels. Furthermore the fresh water and the biofuels must be produced at a low cost, affordable to the poor, without harming lakes, rivers, sea, land and the environment.

Question 3

ANSWER:

I am not well informed about biofuels. Successful creation of new green energies cannot be achieved by a traditional single scientific discipline. The scale and diversity of work to gain control of the earth's CO₂ cycle requires international collaboration between political leaders, industrialists, horticultural research stations, universities, ministries of energy, environment and agriculture. My specialist knowledge and expertise relates to the behaviour of water molecules and in particular to: continuous, low temperature, isothermal, flash distillation of sea water by the power of solar energy. Such a process is now up and running and available for inspection in Scotland. It can deliver all the fresh water needed for biofuel and food production, in barren solar energy rich lands, without emitting any CO₂.

Question 4**ANSWER:**

The most important factor in driving the development of biofuels is the need for global agricultural and economic development of third world countries. Population explosion, destruction of tropical rain forests and loss of agricultural land because of drought are the root causes of global warming and political instability. Priority should be given to resolving the fresh water issues and reversing desertification. The scientific evidence to confirm anthropogenic global warming is not sufficiently robust to withstand attacks from deniers and sceptics. The majority of the electorate will not support politicians who wish to raise taxes and place burdens on industrial expansion to control global warming unless it has been proven, beyond doubt, that the requested sacrifices are essential and beneficial. In consequence, any proposals to reduce atmospheric CO₂ levels by biofuels should be driven by strong sustainable market forces not the fickle forces of good intentions. The strength of market forces are dependent on government policies which are influenced by the quality of scientific advice delivered to politicians and the ability of politicians to comprehend the issues and the information presented. Resolving the global fresh water issues will create many new job opportunities and generate wealth in poor countries, from the conversion of solar energy into food and chemical energy. The developed world will benefit from a choice of energy suppliers and gain fresh markets, for their manufactured goods, in the new, self sufficient, third world. Increasing the earth's ability to soak up atmospheric carbon by greening up barren lands will benefit the environment. Scale, low cost economics and a 12 month continuous growing season in hot poor countries, provides the potential to undercut the cost of fossil fuel. The poorest people will gain access to low cost energy, abundant supplies of fresh water and the ability to produce all the food they require. Based on atomic mass and the photosynthesis equation, every ton of water converted into food or fuel by plants would result in the removal of 2.44 tons of CO₂ from the atmospheric. The oxygen released to the atmosphere is not a greenhouse gas. Atmospheric CO₂ levels can be reduced by simply growing algae to dump in spent oil or gas wells where it will eventually transform back into fossil fuels. If the government proceeds with its £9.5 billion plan to dump CO₂ under the North Sea, then every 3 tonnes of atmospheric carbon will be accompanied by 4 tonnes of oxygen. Attempts to fight nature generally result in widespread destruction and devastation. It would be much safer and more cost effective to dump algae in old wells and thereby restore the earth to its state prior to industrialisation. Politicians in the UK take a short term view of major scientific issues. They have no qualms when transferring outstanding problems to future generations.

Question 5**ANSWER:**

Contrary to the view taken by political leaders, greenhouse gas emissions do not need to be lowered when the emitted gas is recycled GHG. Biofuels produced and delivered to the point of use, without burning fossil fuels, are carbon negative. After lipid extraction to produce biofuel, the remaining biomass contains sequestered atmospheric carbon. It therefore follows that when carbon negative fuels are burnt, the GHG emitted to the atmosphere will be less than the GHG removed from the atmosphere during fuel production. It also follows that a gas guzzling vehicle, propelled by carbon negative fuel, benefits the environment and should be encouraged. An electric vehicle propelled by energy that is mainly produced from fossil fuels, harms the environment. Furthermore, mass production of batteries will create mountains

of toxic waste when the batteries need to be replaced. The government needs to consider the above paragraph and introduce new meaningful environmental policies based on sound scientific logic. It should confirm that carbon neutral fuels will not be taxed and they will receive carbon credits. Growing biomass on arable land instead of food makes no difference to the earth's carbon cycle. It simply increases the cost of food and the number of people who die from starvation. The EU's Renewable Transport Fuel Obligation (RTFO) encourages such actions as exemplified by Vireol's intention to raise £220m to build a refinery to process 530,000 tonnes of British wheat into ethanol. A distinction needs to be made between the emissions from a carbon negative biofuels, carbon positive biofuels and fossil fuels. Failure to rectify this omission will set back the biofuel development programs.

Question 6

ANSWER:

Energy security will be achieved by creating diverse global crop growing areas in arid lands having access to the sea. Each location should be capable of increasing outputs according to demand to prevent price escalation at times of political unrest.

Question 7

ANSWER:

A new approach to biofuel production, job creation and improvements to infrastructure which supports overall economic & agricultural development would be as follows. Contractors in the developed world would prepare plans for biofuel production in solar energy rich lands. Invitations to tender would be submitted, to produce the various components that constitute the overall plan. The project would ideally include the production and commissioning of the following. 1. Solar powered, sea water, flash distillation plants to provide all the fresh water needed, for personal use and land irrigation and the fresh water required for biomass production. The system would driven by the differential temperature of two thermal masses such as incoming seawater and water that has received some solar energy. Ambient temperature operation eliminates heat loses and gives a distillation efficiency of 100%. The solar energy received by 0.1% of the Saharan and Arabian desserts is considered, by some scientists, to equal the output of 780 nuclear reactors. 2. Photobioreactors for onshore micro algae cultivation in fresh water containing essential nutrients that have been precisely metered in terms of the quantity of water supplied so that when the water has been used up the nutrients will have been absorbed and the algae can then be quickly sun dried without creating any environmental issues. 3. A new power station having biomass fuelled boilers to produce steam, from distilled sea water, to drive the turbines. The low pressure exhaust steam would be fed to the low temperature flash distillation plant for recovery of both the sensible heat and the latent heat to distill additional incoming sea water. The water condensed during heat recovery would be recycled to the boiler water supply line. Given zero fuel costs to produce electricity, fresh water and biofuels it is possible to produce biofuel energy at a lower cost than energy from fossil fuels. Global sustainable economic development would be inevitable. The new infrastructure would create many new business opportunities involving biofuel production, agriculture, manufacturing and recreational facilities for the tourist industries

Question 8

ANSWER:

None of the new approaches to biofuel production, mentioned in the Nuffield document, can deliver energy on the scale required to render fossil fuels obsolete. It is obvious that fuels produced on valuable land having a 6 month growing season and high labour costs cannot compete, on price, with algal fuels produced on land having a negligible value, a 12 month growing season and low labour costs. Fossil fuels are processed into thousands of different products; the new approaches set out in question 8 are worth pursuing to establish the range of green products that can be manufactured to replace fossil fuel dependant goods. Research should be directed towards producing products such as fertilisers and polymers without the use of fossil fuels.

Question 9

ANSWER:

Some 200,000 strains of micro algae have been identified. Adequately funded R&D work, carried out during the last 30 years, has focused on identifying and modifying the best strains to grow in waste water or sea water. To date no one has mass produced biofuel energy at a price lower than fossil fuel energy. The issues do not relate to the plants but to the water.

Question 10

ANSWER:

The concerns expressed by Nuffield are valid, patent protection can sometimes place essential medication beyond the reach of people in poor countries. However IP does have some merits. Without patent protection large organizations will not invest major sums for R&D if the technology is freely available to other manufacturers who spend nothing on research and are therefore able to produce the same goods at a lower price. The IP relating to sea water flash distillation, by solar energy, has been filed for global patents for the following reasons. •Prevents fossil fuel companies from owning such IP and keeping the technology out of the market place until their fossil fuel investments have been fully exploited. •The technology is available to any manufacturing company, on a non-exclusive basis, subject to royalty payments. The funds generated will be invested in further development work to reduce costs and enable construction, from locally sourced materials, by the poorest people living in the poorest lands. These people would receive funding and technical support sourced from royalty payments. The USA has already agreed to 10 claims of novelty relating to the water technology and is considering a further 7 claims. By contrast, the EU patent examiner has not yet agreed to anything. Nevertheless four invoices, each to the value of £1153.59 have been issued to cover the maintenance of a patent that does not exist in the EU. This money will not be refunded if the claims are rejected. The relevant authorities in the EU should be notified that good ideas are not exclusive to wealthy people who can afford to pay the EU's curious claims to maintain something that does not exist.

Question 11

ANSWER:

The main constraint to biofuel R&D has been a scarcity of fresh water in solar energy rich countries. Now that this issue has been resolved the way forward must be reviewed.

Question 12

ANSWER:

Biofuel R&D should be targeted at fossil fuels such as coal and residual fuel oil that cause the greatest harm to the environment with their GHG emissions supplemented toxic and acidic emissions. In an ideal world the government should decide future biofuel strategies. Unfortunately politicians tend to be scientifically inept and are easily confused by industrialist from large international energy companies.

Question 13

ANSWER:

The new approach outlined above does not raise problems related to land use.

Question 14

ANSWER:

Farmers in the developed world wishing to produce bio fuels on valuable agricultural land will find their produce to be uncompetitive with fuel grown and low value lands having a 12 month continuous growing

season.

Question 15

ANSWER:

Implementation of the above will resolve the indirect land use change issues.

Question 16

ANSWER:

New approaches to biofuels, based on growing crops in hot deserts following irrigation from a solar energy powered sea water desalination system will also provide opportunities to grow crops such as sweet sorghum which can grow up to 4 metres in 4 months and is useful for ethanol production. Nutrient film techniques could be used to produce various food crops. Trees, irrigated by drip feeds, could provide construction materials which would store atmospheric carbon inside useful products. No environmental security issues would be raised.

Question 17

ANSWER:

The new fresh water approach to biofuel production will resolve the food security issues without introducing new ones.

Question 18

ANSWER:

This response shows how biofiels will, in future, only be grown in low value lands that currently produce nothing. The approach will resolve food security issues.

Question 19

ANSWER:

If the global cost of food is lowered then wages of farm workers could suffer. Historically this has not been the case.

Question 20

ANSWER:

Irrigating hot deserts with fresh water, produced with zero energy costs, will convert starving people into food producers. Global food prices will tumble; farmers in the developed world will revert to growing those crops that give the best performance in their region.

Question 21

ANSWER:

The prototype biofuel production units should initially be commissioned in the oil rich states in the Gulf. These countries are producing much of their food in Africa and other third world countries. In 2008 Qatar awarded the carbon trust £150m to fund experiments to grow Algae in seawater and waste water. 99% of Qatar's land surface is barren and could be developed to grow food and biofuels when sea water, distilled by solar energy, is available. A joint development project between Qatar and the UK to commission a desalination plant, a photobioreactor and a biomass fueled power station would mutually beneficial. The UK would manufacture the plant, transfer the technology and Qatar would fund the project. Following successful commissioning, private sector fund managers would enthusiastically invest in projects to

construct similar facilities, in the developing countries.

Question 22

ANSWER:

Hot barren lands must be transformed into fertile lands. The poorest and starving people must be provided with sustainable means to become self sufficient and prosperous in their own lands. This will end the recession make a major contribution to gaining control of climate change. Leaving the earth in a better shape for future generations must be sacrosanct to any policy.

Question 23

ANSWER:

Produce the biofuels at a lower cost than fossil fuels. Fuels produced, and delivered to the point of use without the use of fossil fuels should be tax free. Carbon negative biofuels should be subsidised in proportion to the carbon sequestered. Tax fossil fuels and apply a surcharge for the use of coal or residual fuel oil.

Question 24

ANSWER:

The quantity of GHG we emit is not important if the same quantity is recycled, this requires solar energy. We do not have enough solar energy, but the poorest people, living in the poorest lands do. They also have our carbon dioxide. We could ask them; "If we give you all the fresh water you need, would you give us back our atmospheric carbon, bonded onto hydrogen, so that we can use the hydrocarbon fuel?" They would be delighted, this trade will make the people wealthy, they will buy our goods and we will prosper.