

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.

ESRC Center for Genomics in Society

QUESTIONS ANSWERED:

Question 1

ANSWER:

Biofuels offer the quickest 'technological fix' to the problem of energy for transport: at least in theory, they offer a solution to the scarcity of fossil fuels, as well as their high costs in financial and environmental terms, without necessarily involving massive changes in / challenges to transport infrastructure, the car industry and the ways in which citizens conceive of transport. The use of biofuels is to be welcomed as an improvement over the use of fossil fuels, and yet it should not be seen as the only possible solution, nor should all investment go into finding biofuels that can supplant fossil fuels in the very short term. It would, for instance, be possible to involve society as a whole in the development, rather than only the consumption, of biofuels – such as for instance the cultivation of grasses from which biofuels can be extracted. Involving citizens in the development of biofuels would heighten people's awareness of how fuels are produced, at what cost and with which consequences, hopefully shifting current perceptions about transport (for instance by increasing appreciation and use of public transport). There is no convincing evidence yet that a general switch to biofuels will reduce the consumption of fossil fuels except in the types of economics and social microclimates envisaged above.

Question 2

ANSWER:

- Compatibility with, and development together with, other forms of alternative energy.
- Land use and management: the preference should be for biofuels that can be either extracted from waste deriving from the food industry, or for biofuels that can be cultivated and harvested (or otherwise extracted) without affecting land currently dedicated to growing food crops.
- Environmental and social impact at the local level. Especially in the case of plant-derived biofuels, the best way to foster sustainability seems to be to encourage the cultivation and extraction of biofuels as a side-activity for farmers and gardeners across the country. Setting up centralised facilities for the production of plant-derived biofuels appears to be both potentially unsustainable and inefficient.

Question 3

ANSWER:

My expertise on biofuel development comes principally from surveying the scientific research currently under way to develop second and third generation biofuel technologies; particularly, the genetic manipulation of plants to produce green biofuels.

Question 4

ANSWER:

The greatest challenge confronting biofuel development is to preserve the commitment to sustainability without undermining the efficiency of biofuels as sources of energy. While being regarded by the government as an easy, non-challenging alternative to fossil fuels, which does not require substantial alterations in transport infrastructure, emerging biofuel technologies could be promoted as a source of energy that consumers can appropriate and fabricate at home, in much the same way as solar panels are now acquiring increasing popularity as means to make electricity. This way of planning biofuel production would challenge the current commitment to centralising the development of biofuels into industrial complexes, resulting in a more participatory, flexible chain of production for biofuels. Consumers could be directly involved in all phases of biofuel development, and would be able to adapt biofuel production to their own ways of life, environmental context and energy needs. For this to happen, both the government and industry should favour research on biofuel technologies that enable consumers to grow the required

organisms at home, and extract fuel directly from them. Putting this forward as a policy goal would greatly encourage the development of such technologies, and would also shift the emphasis of biofuel research from centralised, industrial production of the fuels themselves to the industrial production of the technologies required to enable consumers to produce fuel. The Gallagher report has argued that biofuels have had a negative impact in this regard (see The Gallagher Review of the indirect effects of biofuels production, July 2008, http://www.renewablefuelsagency.gov.uk/_db/_documents/Report_of_the_Gallagher_review.pdf).

Question 9

ANSWER:

All of these three technologies are promising to enhance capacities for the development of biofuels that are as sustainable, safe and efficient as possible. In fact, the existing synergies between these three technologies need to be improved. A combination of genetic studies and genetic manipulation with large-scale breeding experiments in the field will certainly prove important to the development of sustainable and efficient biofuels, while the extraction of fuel from plants could be greatly enhanced through the use of genetically engineered microbes (such as *E. coli* modified to make biodiesel directly from sugars or plant fibre – see Nature 2010, vol 463, issue 28, p.409). Currently, these three fields of research operate at a distance from each other: in particular, researchers working in plant breeding are not often cooperating with researchers working on the genetic modification of plants and bacteria in the lab. Further, there are issues of coordination between researchers working on different organisms. As exemplified by the heated debates on the use of the drought-resistant perennial *Jatropha curcus* as a source of bioenergy (Sanderson, K, 2009, Wonder weed plans fail to flourish, Nature 461: 328-329), there is as yet no consensus on which traits (and thus species) should be favoured, nor are there efficient communication channels established between researchers working on *Jatropha* and others working on trees or other grasses. The choice of desirable traits depends partly on scientists' interpretations of the notions of efficiency and sustainability, as well as on the technology used to extract energy from the chosen plant and on its ecological and socio-economic impact. However, the choice of desirable traits is also shaped by the type of knowledge available on candidate species, which in turn depends on the specific methods, materials, communication strategies and collaborative practices used by plant scientists. It is therefore imperative to research and improve current strategies of interdisciplinary (and lab-to-field) communication and collaboration. Again, the problem is that of adaptation to microclimates both social, economic and agro-ecological which suggests scepticism about generalised breeding practices.

Question 11

ANSWER:

There is not enough understanding of the complex research trajectory leading from plant to fuel, by shedding light on scientific and social factors affecting (1) the choice of organisms used as sources of bioenergy; (2) the dynamics of interdisciplinary collaboration underpinning translational research and (3) the challenges of cost-effective distribution and production.

Question 12

ANSWER:

The main issue I would like to draw attention to is the current tendency, by both national governments and industry, to conceive of biofuel R&D as mass-production funded by and supporting the transport industry. A useful alternative to that, which might prove more sustainable as well as more energy-efficient, is to devote more investments and policy support to the development of decentralised, home-based methods for the production of biofuels (such as required to transform garden waste and composts into fuel). The development of such methods is feasible from the scientific viewpoint and would bring economic advantages in the form of a new market for home-based technologies for the extraction of biofuels and an increase in national self-sufficiency with respect to imported forms of energy (e.g. gas and

fossil fuels).

Question 21

ANSWER: