

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.

Robert Henry

Question 1

ANSWER:

This is an essential part of our response to climate change. We have no other carbon neutral alternative options for transport fuels for planes and heavy vehicles.

Question 2

ANSWER:

The challenge is to balance land and water use for essential energy production against use of these resources for food production and biodiversity conservation.

Question 3

ANSWER:

I do regard myself as well informed. I read the scientific literature and have recently completed a book reviewing the topic (Plant resources for food, fuel and conservation , Earthscan London, 2010)

Question 4

ANSWER:

Policies that set a price for carbon pollution and taxes on biofuels will be important issues. Biofuel production has the potential to diversify agricultural landscapes and make positive contributions to biodiversity.

Question 5

ANSWER:

Second generation biofuel production has the greatest potential to reduce GHG emissions. Biochemical conversion approaches using biomass with altered composition and producing enzymes in planta should allow low cost and energy efficient conversion of lignocellulosic biomass to sugars. Synthetic biology will then allow the production of optimal biofuel molecules. I have edited a special issue of the Plant Biotechnology Journal (Wiley Blackwell) on these technologies. It should be published in early 2010 as volume 8(3).

Question 6

ANSWER:

Reduced energy consumption should be given very high priority. However this needs to be combined with a range of alternative carbon neutral approaches to stationary energy production and second generation biofuel for transportation.

Question 7

ANSWER:

Second generation biofuel production should be encouraged. First generation biofuel production especially that from oil producing plants should be discouraged. The fuel yields from these crops are dramatically lower than those from second generation technologies. The land and water requirements cannot be justified for the small amount of energy generated. We need urgent work on species selection for specific environments. We do not just have one food crop in the world and it should be the same for energy crops. These need to be selected and developed so that they are targeted to sustainable

production in local environments

Question 8

ANSWER:

The most likely technology for short to medium term biofuel production is second generation biofuels produced by biochemical conversion. Ethanol is the short term target. Other fuels from this route should be possible on the commercial scale but not for say 5 years. Ionic liquids work well and recovery of the liquids to reduce costs is the main constraint. Very recently, enzyme production in planta has been demonstrated to be technically effective. This should largely remove the cost of this step making biochemical conversion very attractive.

Question 9

ANSWER:

All of these technologies are appropriate and offer great environmental and social benefits.

Question 10

ANSWER:

We need more public investment to ensure that IP is accessed by all, these technologies are widely adopted and that key technical developments are accelerated.

Question 11

ANSWER:

Poor public understanding of these issues and lack of clarity about first and second generation biofuels is constraining the targeting of public investment and R & D expenditure on the more desirable technologies. Too much is being invested in first generation R&D and production.

Question 12

ANSWER:

Second and third generation conversion technologies using genetically selected and enhanced feedstocks should be the priority.

Question 13

ANSWER:

Problems will arise. The objective should be to achieve the best possible outcome balancing the need for sustainable energy production, food security and biodiversity conservation. Reducing GHG emissions by producing biofuels may improve food security by avoiding dangerous climate change and reducing food production costs for both food transport and food production energy. Biodiversity may also benefit directly by the planting of a wider range of species with better habitat potential and by the reduced risks of climate change. Careful analysis will be required to manage these competing factors.

Question 14

ANSWER:

Many of the same issues. Access to IP may restrict the more sustainable options to developed countries.

Question 15

ANSWER:

Yes by careful analysis of the whole system

Question 16**ANSWER:**

LCA should allow analysis of net benefits or cost and direct management of environmental outcomes.

Question 17**ANSWER:**

Yes as discussed above. Net improvement in food security by the use of biofuels should be the target for new technologies.

Question 18**ANSWER:**

As above for the environment

Question 19**ANSWER:**

Same as for agriculture generally

Question 20**ANSWER:**

As above

Question 21**ANSWER:**

All sources should contribute funds. Involvement of public sector funding is vital to ensure wide access to key technologies. Must focus on the most sustainable technologies

Question 22**ANSWER:**

Importance of considering the positive impacts on climate change and costs of transport especially food transport in overall assessment of biofuel technologies.

Question 23**ANSWER:**

We need a price on carbon and tax advantages for biofuels. These need to advantage the most sustainable technologies.

Question 24**ANSWER:**