

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.

Avantium

## **QUESTIONS ANSWERED:**

### **Question 1**

#### **ANSWER:**

Liquid fuels will remain the leading source of energy for transportation in the near future for almost all modes of transportation. Cars may gradually move to electricity, for example, but for aviation, liquid fuels with high energy density are there to stay a lot longer. When trying to move away from oil, which is a good thing for many reasons, including security of supply and price, biofuels are the way to go. Nevertheless, we should use biomass intelligently. If we target biomass that doesn't compete with food, and doesn't lead to deforestation, the more biofuel, the better. Naturally, these fuels need to be produced efficiently (high carbon efficiency from plant to fuel).

### **Question 2**

#### **ANSWER:**

To use as much of the biomass available in a certain region, the composition of the biomass feed should be as stable as possible. That would lead to more monocultures and more GMOs. The success of future biofuels may result in ever increasing cultivation of land for farming; we should try and work increasingly with non-arable land.

### **Question 3**

#### **ANSWER:**

Yes. Conferences, publications, meeting with the actors across the value chain.

### **Question 4**

#### **ANSWER:**

Most important drivers will be price, quality, overall environmental impact and, most importantly, clear and long term government regulations. Future biofuel technology needs time to mature. On the time scale of new technology development, 4 year policy alterations may kill many potential winners prematurely. Moreover, financial triggers are needed to let future biofuels enter the fuel commodity market. We need to make green cheaper than oil.

### **Question 5**

#### **ANSWER:**

More efficient biomass conversion processes (chemical vs fermentative) Higher energy fuel (butanol and others vs ethanol) Limited biomass transport. Encouraged through financial stimuli for efficient value chains from seed to exhaust gas. Sanction the waste of energy. Moving bulky biomass from long distances to the processing unit should be avoided.

### **Question 6**

#### **ANSWER:**

Any technology that uses locally grown biomass will do. It won't help Europe, for example, to develop solar to hydrogen technology for the Middle East or crops that only grow well in Southern Africa (in light of energy security, of course).

### **Question 7**

#### **ANSWER:**

More value from existing processes. Sugar beets, for example, are now produced for food and feed. If we upgrade the value of waste, margins for the farmers will increase. Additional processes leading to higher value end products will require plants and operators. If there's no biomass production taking place at all, the step-up will even be more significant. We should not encourage to make fuel (commodity) out of feedstock with higher potential (e.g. starch from corn).

### **Question 8**

#### **ANSWER:**

Too early to tell. The fully linked value chain from seed to fuel is important. In general, making a fuel is concentrating biomass. Crude oil is concentrated biomass. The more efficient one can concentrate, the better. Gasification, therefore, is unlikely to become a winner when bulky biomass needs to be imported from vast areas to match the required size of a gasification unit. Various single technology developments are taking place. Better traits, better enzymes / better pulping, better fermentation/better chemical transformation, better fuel quality, better combustion. The winning solution will be the optimal combination of all these factors, some of which may well be suboptimal in itself. Single developments, leading to a new optimum are emerging now and over the next 5 years. Optimized value chains will be more challenging and will require more time to mature.

### **Question 9**

#### **ANSWER:**

Whether or not these technologies are appropriate is not too relevant. If we want to move to a green economy, we will need all the tools we can master.

### **Question 10**

#### **ANSWER:**

There's a mismatch between the high tech innovations taking place and the market for which they are developed; fuels are a commodity, which leaves little room in the value chain to make money on IP. Incentives to use new technologies (through tax or credits) would be helpful.

### **Question 11**

#### **ANSWER:**

Something new in a highly regulated market will not get easily accepted. Innovative R&D and conservative markets are a poor match. Moreover, the urgency to find alternatives to oil has decreased with a decreasing oil price.

### **Question 12**

#### **ANSWER:**

Innovation is needed across the full value chain from seed (or cell, when algae are used) to exhaust gas. The industry as a whole will need to define where the major gains can be expected and act on it, supported by governments.

### **Question 13**

#### **ANSWER:**

A growing population with increased mobility, shifting towards biobased fuels will certainly have an impact on agriculture and therefore on land use. However, innovations that increase the efficiency of agriculture,

the efficiency of biomass conversion and the efficiency of engines may be able to re-balance the situation.

**Question 14**

**ANSWER:**

**Question 15**

**ANSWER:**

No, the system should become more advanced. It is unfair to add CO<sub>2</sub> to the balance of a sugar cane grower in Brazil who expands into land now used for soy growth, which leads to the soy grower burning forest to have new land. Smart LUC, rather than just indirect LUC.

**Question 16**

**ANSWER:**

Efficient biofuel production requires stable, consistent feedstock. Most efficient would be a well-engineered monoculture, which would imply ever more distance from original eco-systems based on variation. The major advantage is in stabilization of CO<sub>2</sub> levels in the atmosphere.

**Question 17**

**ANSWER:**

non-food feedstock says it all. With a growing population and a shift towards biofuels, problems related to food security are more likely to occur occasionally.

**Question 18**

**ANSWER:**

**Question 19**

**ANSWER:**

To increase the overall efficiency in the fuel value chain, new traits are being developed. IP protection on these traits has an impact on the way farmers use those seeds. The normal way is to save part of the crop for next year's seeding, but that is no longer allowed by the companies that develop the special traits, as they see the seeds as IP-containing products which belong to them. Farmers may get squeezed between the seed producers (demanding high prices for seeds) and biomass traders (demanding low prices for biomass).

**Question 20**

**ANSWER:**

**Question 21**

**ANSWER:**

Attention should in principle go to all links across the biofuel value chain. No single technology will win. The industry will need to agree on those areas where the most efficiency gains (risk-adjusted!) can be

achieved and direct the majority of funding and governmental support to those specific areas. Public-private partnerships can be very beneficial, as long as the number of contributing partners remains limited.

#### **Question 22**

##### **ANSWER:**

1) stability of regulations; change in the fuel market needs to be supported and stimulated by regulations. Companies need to build business plans based upon these regulations and will attract capital to support their businesses. Large strategic companies (the oil majors) will base their (investment) strategy on regulations. 5% vs 10% bio has a dramatic impact on the total industry. 2) fuel standards. Conservative, rigid standards for fuels leave little room for innovative approaches to emerge. If only the same components are allowed, nothing new will be developed. Allowing or supporting test programs with off-spec fuels will facilitate innovation. 3) laws limiting innovation. Soot filters in trucks are there to reduce soot in the air around us. Rather than imposing soot filters for every truck, one could think of giving truck manufacturers the freedom to deliver solutions with at least the same benefit, which incentivizes them to find a breakthrough, rather than a minor innovation on cost for example.

#### **Question 23**

##### **ANSWER:**

Promoting innovation in biofuels is best done by financially demotivating the use of fossil fuels or the net emittance of CO<sub>2</sub>. Oil majors will drive the oil train till it stops, because they run out of oil or the oil and the products derived from it get too expensive. Price is also the tool to regulate which fuel should be used.

#### **Question 24**

##### **ANSWER:**

Forcing our developed world to switch to biofuels (and, more broadly, bioenergy) while the factories of the world (asia) run and grow on oil and coal without penalties won't be sustainable. Reducing our impact on the local environment by outsourcing our energy consumption to foreign countries does not make sense on a global scale. We would need a level playing field globally.