Synthetic biology offers the promise of creating new biological materials for a host of purposes, including drugs and diagnostics, bioremediation and biosensors, food and biofuels. Jim Philp, OECD Policy Analyst, addresses the public perception concerns facing this emerging scientific discipline – particularly deeper-rooted ethical issues such as ‘playing God’ – and describes what stakeholders can do to advance the field.
Can you introduce synthetic biology and its potential applications for major global challenges?

A recent European definition states that: “Synthetic biology is the application of science, technology and engineering to facilitate and accelerate the design, manufacture and/or modification of genetic materials in living organisms.” I would add that synthetic biology is now attempting to bring some engineering rationale to biotechnology and also to fundamental biology research. It is in applications that this engineering approach is most obvious.

The applications span many fields and sectors, including: medicine, energy, chemicals, agriculture and the environment. Many of these applications directly relate to public policy goals pertaining to future societal threats, such as climate change, energy security, and food and water security.

The policy area I work in is bio-based production of fuels, chemicals and plastics, where the synthetic biology technique of metabolic engineering is used to create more efficient methods of production. But the ‘application’ that can easily be hidden is the application to fundamental discoveries relating to our understanding of life.

Largely, members of the public who are aware of the field attest to having mixed reactions to specific synthetic biology applications. Can you describe the major feelings and concerns about the emerging technology?

This is a hard question to answer because there are very few surveys out there, and they differ enormously in their quality. The opinions, of course, are polarised, but I would imagine that the majority of opinions are not at the poles.

One pole is that synthetic biology is immoral, dangerous, should be banned, and sometimes it is even evoked with religion – the ‘playing God’ opinion. Another pole is that it can be put to good use for people, and therefore it is a technology just like any other. In between, you can imagine that there is an opinion that it is a good thing but needs to be strongly regulated (by governments); another that it might be a good thing, but we need much more evidence; and others that it is a bad thing for different reasons.

How do these opinions vary across application types?

Opinions regarding applications are interesting, but again the evidence base is limited to a very small number of people. There has been a small survey in the UK to investigate public attitudes to synthetic biology in different applications. Questions that were asked concerned morality and risk, but also benefit to society around different applications. The results were most supportive of medical applications, but also quite supportive of other applications, especially energy. And of course, medical and energy touch on our daily lives. Overall, looking at the results of that survey, one could say there was ‘conditional support’ of synthetic biology, but from a very small number of individuals. However, there are definitely lessons for policy makers to learn from this investigation.

I should also point to an opinion that there is a danger of synthetic biology focusing too much on being applications-driven; this may limit the ability of the field to create new knowledge of the fundamental workings of biology and life. It even goes so far as to say that ultimately this could limit future applications.

How can synthetic biologists and other stakeholders address these concerns?

Scientists have to be engaged in the debates surrounding the field, but for many it is not easy. The science has its own language that allows the science community to communicate effectively, but is not always intuitive to the public. Therefore, scientists have to be careful with their language so they do not lose their audience. Even the relatively ‘tame’ language can be unfamiliar. For example, if one talks about the ‘upregulation’ or for that matter ‘downregulation’ of a gene or an operon, that might mean nothing to a member of the public. Is it similar to turning the volume up or down on your television? Would anyone ever say that they were upregulating the volume on their television?

The point is that it is very easy for scientists to lose their audience in the technicalities. This can lead to loss of public interest, or even distrust. It may be easier to address this through social media, where the language issue can be first considered, whereas in conversation it would be more difficult.

I also think that there is a big difference to be made through competitions like International Genetically Engineered Machine (iGEM) competition. The youthfulness of iGEM could go a long way to shaping the opinions of young people, as the participants spread their enthusiasm among their non-scientist friends. This may also influence their parents who are perhaps wary, worried, or who simply aren’t engaged or bothered.

Compared with the public, how do governments and policy and decision makers feel about synthetic biology?

I don’t think that government opinions vary so much from public opinions. It is natural for there to be enthusiasts and sceptics in any stakeholder group, so democratic governments would be no different. Governments have to tread a fine line – they have to see benefits of any technology
to society, but they must also respect their voters. For example, ask a senator or Member of Parliament whose constituency mainly consists of coal miners for his or her opinion on climate change.

In, say, an education or research ministry, synthetic biology would be a relatively ‘easy sell’. However, in an energy ministry of a country with a large stake in crude oil production and exporting, it might be vehemently resisted, or simply ignored. In general, I find synthetic biology relatively ignored even in bioeconomy debates. Governments have experienced strong resistance to genetic modification, and perhaps that makes them wary.

Over the past decade, pressure groups have challenged scientists studying genetically modified organisms (GMOs), particularly genetically modified (GM) crops. What could synthetic biologists learn from these challenges?

The GM crop debate has been multifaceted. Some people have been opposed to monopoly positions of large multinational corporations having too much power over food, but not necessarily opposed to the technology itself; some are anti-technology; some are environmental pressure groups; and some are religious.

I think Europe should look to the US’s experience with GM crops. Five major crops are approaching total market penetration in the country – GM canola, corn, cotton and soy are at about 90 per cent, and GM sugar beet at about 95 per cent. However, support for GM crops in the US is not monolithic. Comparatively, in Europe, we are seeing the lowest experimental releases in 20 years. Europe can surely learn from the ups and downs experienced in the US and Canada.

There can be few, if any, technologies with higher divergence in uptake across the Atlantic. Surely the greatest threat to agriculture from climate change is drought: biotechnology is trying to find solutions through genomics for many crops. I worry that this difference in the US and Europe will leave Europe in a shakier position to cope with the effects of climate change on agriculture. To me, that is a moral argument right at the very top of the agenda.

It has been suggested that the UK is a good base for synthetic biology research, especially in light of the fact that it held a series of public workshops and stakeholder interviews on the science and issues surrounding synthetic biology before creating a roadmap for the country. What lessons can be learned from this process so other countries can render themselves more inviting for synthetic biologists?

I think the country struck on the heart of the issue: public engagement. This is an essential step before a country creates a roadmap. Think about it this way – synthetic biology offers potential benefits across a wide variety of sectors, and therefore, across a wide cross-section of society. In the light of that knowledge, governments can take at least two approaches. The first is to create a roadmap without engaging at all, as the potential benefits are manifest. The second is to engage right from the start and find out (or at least try to find out) what the society wants from technology.

The country may end up with exactly the same policy goals for its roadmap, but there would be one all-important difference – in the second model, society could end up feeling consulted and engaged, that its opinion actually mattered. It is one thing to make a roadmap, but it is quite another to deploy it and make it succeed. I feel that a country is much more likely to succeed through public funding of a technology that the public wants.

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