STOA workshop in cooperation with the University of Copenhagen and the Technical University of Denmark (DTU)

Synthetic Biology
Enabling sustainable solutions for food, feed, bio-fuel and health
Event report from the STOA workshop 6 June 2012, European Parliament, Brussels

Speakers

Vittorio Prodi, MEP and member of the STOA panel
Professor Birger Lindberg Møller, University of Copenhagen Center for Synthetic Biology and the DTU Novo Nordisk Foundation Center for Biosustainability (NNF)
Professor Jim Haseloff, University of Cambridge
Dr. Andy Boyce, International Relations Manager, UK Biotechnology & Biological Sciences Research Council (BBSRC)
Peter de Pous, Policy Director at European Environmental Bureau (EEB)

Background

The economic growth in Europe is highly dependent on the innovative power of future knowledge technologies. This is one of the core points in the European Commission's proposal for Horizon 2020 and for the EU framework programme for research and innovation towards the year 2020. On June 6 2012 STOA invited a group of stakeholders to take part in a workshop focusing on **one of the most promising new technologies to be supported by this programme: Synthetic biology.**

The workshop, which was organized in collaboration with the **University of Copenhagen and the Technical University of Denmark (DTU)** aimed to include as many views as possible on the topic at hand, in order to discuss and clarify the economic and environmental potentials and challenges of this, for many people, yet new and unknown field of research.

Scientifically speaking, synthetic biology can be defined as **the study of biological systems with the aim of constructing similar systems, components, cells and organisms which address society's needs**. This new multidisciplinary field of research is quickly establishing itself as **a key enabling technology** with great potential for contributing to the realization of a prosperous bio-based European economy.

Synthetic biology - engineering biology to produce systems, components, cells and organisms that address society's needs.

Conducted in a safe manner in contained systems, synthetic biology involves collaboration between a range of scientific disciplines and holds sustainable solutions for many of society's challenges related to energy, food supply and health.

Synthetic biology entails the development of a variety of sustainable solutions based on bioengineering. This includes:

- Sustainable **cell-based production systems** for bio-fuels and chemical building blocks, biologically degradable plastics, food colorants, flavor compounds and washing powder enzymes, replacing the heavily polluting petrochemical industry as well as greatly minimizing the conflict of interest between the production of biofuels and agricultural food production.

- Cell-based production of **medicinal compounds**, e.g. drugs for treatment of malaria and cancer to avoid their isolation from rare non-cultivatable plants in which the compounds are only produced in low amounts in a complex mixture of other bioactive molecules.

- **Novel screening methods**, smart drug delivery systems and bio-sensors minimizing the use of test animals, undesired side effects from broad spectrum medication and greatly speeding up health improving initiatives.

Further, it can be seen as a cross-cutting field of science not only underpinning the European vision of industrial leadership but also as an instrumental technology in the solution of the current and future **societal challenges** related to health and demographic well-being, food security, energy efficiency and climate change.

However, as with all new technologies the potential of synthetic biology can only be fully unfolded with strong political support, and as with many other novel fields of research, there is also a need for establishing **solid guidelines** that will guarantee sustainable research in compliance with the **high ethical standards** of the European research community and taking into account the public interest.

Event summary

MEP and STOA Panel member **Vittorio Prodi** opened the session by welcoming the audience to the workshop, encouraging both audience and speakers to engage in an open dialogue on this frontier research topic. Each speaker had been carefully chosen to cover a specific angle of the issue.

Professor Birger Lindberg Møller from University of Copenhagen and the Technical University of Denmark addressed synthetic biology in scientific terms and gave a brief introduction to the topic at hand. Dr. Møller described the very tangible potential for synthetic biology in terms of developing better, more sustainable production systems; e.g. by channeling solar energy and CO_2 directly into the production of high-value compounds in plant cells, thereby **tapping into the ultimate renewable energy source – sunlight** – with the aim of replacing the oil-based petrochemical production. Dr. Møller furthermore described the beneficial prospects of the development of personalized, targeted drugs to reduce side-effects and feasible production of novel anti-cancer and anti-malaria medicinal compounds.

Dr. Møller also addressed the ethical aspects related to synthetic biology as this field of science is based upon the study of living cells. Dr. Møller stressed that sustainable synthetic biology production is developed for contained systems, which resemble the production methods of medicinal compounds like insulin. These systems will have no contact with the natural environment. Furthermore, this approach does in no way entail the creation of artificial life forms.

Assessments from ethical councils in both Europe and the US have stated that no new legislation is needed to govern synthetic biology at this point and that the research field adheres to all laws and regulations. However, Dr. Møller pointed out, it is important to draw on the knowledge from the very polarized debate on genetically modified organisms in Europe. Therefore synthetic biologists very keenly engage in continuous dialogue on the ethical aspects of the research to ensure that the **safe and sound** development of the technology is done **in a publically and politically accepted way**. Dr. Møller concluded his speech by pointing out how synthetic biology can play an important role in the formation of a bio-based economy due to its clear potentials for industry uptake within the fields of biochemicals, energy, and health.

Professor Jim Haseloff from University of Cambridge reminded the audience that research has always played a vital role in the global history of growth and industrialization. Historically, it has always taken time before the underpinning innovations were in place to fully realize the potential of new technologies to form the basis for new industrial sectors. Bearing this in mind, Dr. Haseloff stressed that the European economy would move very slowly forward if the discovery of new technologies and scientific fields such as synthetic biology are not put to its full use by supporting further innovation within the technology. He noted that several new companies in the US and China has been founded based on novel synthetic biological technology, stressing the potential for European growth through innovative use of new technologies. In continuation, Dr. Haseloff noted that the **internationalization of standards** is a crucial facilitating factor that should be accounted for on a European political level to aid the process towards commercialization and market uptake of new products and systems stemming from synthetic biology research.

Dr. Andy Boyce from the UK Biotechnology & Biological Science Research Council (BBSRC) reported that after elaborate assessment **synthetic biology has been chosen as key priority area for innovation and industrial growth in the UK.** This focused effort will enable UK to benefit from the growth rate of the global market for products derived from synthetic biology, which is being estimated to increase by 45 % per year, exceeding 10bn $ in 2016. In the UK a national strategy for synthetic biology research and innovation has been outlined and will shortly be launched. In this context Dr. Boyce pointed out that the societal and ethical challenges of the use of synthetic biology have been mapped by the BBSRC through nationwide polls and interviews.
Dr. Boyce emphasized the importance of this investigation to ensure that further research will be done in an ethically sound way in coherence with public opinion. British funding agencies have already allocated large sums to research in synthetic biology and this will continue in the years to come following the UK strategy. However, Dr. Boyce acknowledged that **this cannot and should not solely be a project for a few European member states**. Mr. Boyce therefore invited the EU to share the ambitions of the British agenda on synthetic biology and to join the ongoing efforts in bridging the gap between the already existing excellent research and the constantly growing global industry and market potentials.

Professor Jim Haseloff (left) from University of Cambridge presented his ideas on how to turn knowledge of synthetic biology into business potentials.

There was a friendly atmosphere at the workshop with amicable exchanges.

Andy Boyce (right) from the UK Biotechnology & Biological Sciences Research Council emphasized UK's interest in European collaboration on synthetic biology.

Peter de Pous (right) from the European Environmental Bureau wanted to be sure that Synthetic Biology is a guaranteed safe and sustainable bio-technology.

After a short break, the workshop entered the more interactive part of the programme allowing the audience to ask questions to the speakers. In the panel, all of the previous speakers were joined by **Peter de Pous** from the European Environmental Bureau. De Pous introduced himself as a technology neutral representative and participated in the workshop to balance the debate with a more environment focused point of view. De Pous stated that the organization he is representing has a positive view on the idea of a bio-based economy. However he also foresaw a **great challenge in managing the shift to a bio-based economy without endangering the natural eco-systems**. Lindberg Møller acknowledged this point of view and emphasized the fact that synthetic biology can effectively be carried out in contained systems thus leaving the natural eco-systems unaffected. However, he also noted, if field trials with bio-engineered crops are introduced at some point in the future, this issue will most certainly be assessed elaborately and with due consideration to public concerns.

Another recurring point of the debate was the need for a holistic approach to the research activities. All the panel members agreed on the necessity of involving the public as openly and as much as possible. Fortunately due to the novelty of synthetic biology as a research field and the scientists' willingness to engage in dialogue, it will be possible to involve the public from the onset making it an **open research discipline based on bottom-up approaches**. However, as Dr. Møller emphasized, public involvement is not just a one-time exercise. Dialogue and openness should be a continuous process to secure the most coherent and sustainable evolution of synthetic biology. He also mentioned the positive effects of the **Open Access and Do-It-Yourself-science movements, as means to spark the general public's interest** in science, while he stressed the importance of established researchers guiding and mentoring the activity in these environments to avoid misuse.

At the end of the panel session, Mr. Prodi took the final word and concluded the session stating his awakened interest for the topic. Furthermore, Mr. Prodi declared that the purpose of the workshop was fulfilled, as most people seemed to be leaving with new insights on this fascinating new technology. It remains clear, that, as Mr. Prodi concluded **we should not consider biomass a second order material.** It is of high value and we should exploit it to its full potential. As he stated: We still have a lot to learn from plants and biomass.

Perspectives for the future

S**ynthetic biology is not confined to one single field of research**. On the contrary, synthetic biology holds potentials for the development of a wide range of new goods, services and processes that will be able to innovatively modernize European industry and enable the transition to a knowledge-based and resource-efficient economy.

Looking forward to Horizon 2020, synthetic biology as a research field has large potential in a number of research areas. With its **industrial growth potentials and SME-friendly features** synthetic biology has a natural role in the pillar closest to the market aiming at *industrial leadership*, either as a key enabling technology (KET) or as a substantial part of the already established KET on biotechnology.

Furthermore, due to its multidisciplinary character and wide scientific and technological applicability, synthetic biology could also play an important role in relation to several of the *societal challenges* identified in the part of Horizon 2020 dealing with applied research. As an example synthetic biology could contribute to solve the energy challenge by providing new sustainable production systems for bio-fuels, the food challenge by providing more effective production systems to the agricultural sector and the health challenge by providing new advanced cures and types of medicine. The applications of synthetic biology are globally being recognized as a commercially and environmentally feasible. The technology has already started creating jobs in the US where 70 products based on synthetic biology are nearing the market.

After the presentation all of the speakers engaged in an open dialogue with the audience. Here Birger Lindberg Møller (center) from University of Copenhagen and the Technical University of Denmark.

The audience was eager to learn more about the promising new technology.

MEP and member of the STOA-board Vittorio Prodi (left) closed the session with the words: "We still have a lot to learn from plants and biomass."