

## **iGEM as laboratory in responsible research and innovation**

Dirk Stermerding, dr., Rathenau Instituut, The Hague

In this paper we focus on the collaboration that has been established in the field of synthetic biology between the European project SYNENERGENE ([www.synenergene.eu](http://www.synenergene.eu)) and student teams participating in the annual undergraduate international Genetically Engineered Machines Competition iGEM ([www.igem.org](http://www.igem.org)).

SYNENERGENE is a Mobilisation and Mutual Learning Action Plan on challenges in Responsible Research and Innovation (RRI) in synthetic biology within the European Commission's FP7 Science in Society Work Program. As a new emerging field synthetic biology offers huge potential for novel drugs and vaccines, as well as for 'greener' chemicals and biofuels. Nonetheless, this field, about which there is as yet fairly scant public knowledge, also brings with it various challenges, ranging from regulatory issues of biosafety, biosecurity and intellectual property rights to potential environmental and socio-economic risks in developing countries. Thus, in the context of RRI, synthetic biology raises questions relevant to many different stakeholders, policy makers and the general public. SYNENERGENE aims at mobilizing a wide variety of stakeholders and members of the public, bringing them together and facilitating a sustainable and fruitful dialogue in order to promote responsible research and innovation in synthetic biology.

iGEM represents a growing community of dedicated young science students who already work in the spirit of RRI, contributing to the development of synthetic biology as a new field of engineering. At the beginning of the summer, student teams are given a kit of biological parts from the Registry of Standard Biological Parts. Working at their own schools over the summer, they use these parts and new parts of their own design to build biological systems and operate them in living cells. This project design and competition format is an exceptionally motivating and effective teaching method which also strongly fosters the spirit of RRI. So-called 'policy and practices' work is an inherent part of each iGEM project. One of the aims of the established collaboration is to extend these practices of RRI by stimulating interaction between the iGEM community and partners in the SYNENERGENE network and to get inspired by the work and creative ideas of the iGEM teams in its own activities.

The collaboration provides for an iGEM Fund offering small grants to iGEM teams for contributions to the program of activities undertaken by SYNENERGENE partners. One example is a series of 'real-time technology assessments' to explore possible futures for synthetic biology, which will be carried out by SYNENERGENE partners in collaboration with iGEM teams working on particular creative and significant ideas for innovation. Other examples include contributions from iGEM teams to: anticipatory and adaptive forms of biosafety assessment in the field of synthetic biology, the development of a web-based educational platform introducing synthetic biology and its potential applications and implications in a playful way, and the development of design ideas for exhibitions aiming to expose the public in imaginative and artistic ways to different dimensions of synthetic biology.

In this paper we discuss our experiences with a recent call for proposals from iGEM teams with an interest to collaborate in a process of real-time technology assessment supported by partners from SYNENERGENE. iGEM teams will have to contribute in their policy and practices work to a process of real-time technology assessment by elaborating two different kinds of future scenarios relating to SynBio applications envisaged by the teams:

#### *Application scenarios*

Application scenarios offer detailed and realistic descriptions of how SynBio ideas can lead to actual applications in society, including: design criteria for the products proposed, target producers and users of the products, the needs and costs involved, legal issues of patenting, regulatory requirements, potential safety, social and ethical implications, and available or conceivable alternatives.

#### *Techno-moral scenarios*

A techno-moral scenario is a tool to stimulate imagination, reflection and debate about ways in which SynBio applications may transform our society through wider impacts, including ethical, legal and social issues.

SYNENERGENE partners will take up the scenarios as a starting point for an interactive process of technology assessment, involving a variety of stakeholders and iGEM team members in workshop settings with the aim to develop socially robust agendas for SynBio innovation. Scenarios will also be used by SYNENERGENE partners as a tool in organizing public debates on SynBio futures.

An important step in the development of application scenarios is to identify and specify the practices and conditions in which particular SynBio applications envisaged by iGEM teams might be produced and used. How does these practices look like, who is involved in what role, and how will these practices be changed and affected by the new applications? Knowledge about the experiences and visions of actors involved in these practices is vital for the elaboration of future application scenarios.

While application scenarios focus on the prospects and challenges for innovation and related regulatory concerns in regard to risks and ownership, ‘techno-moral scenarios’ highlight the wider transformative potential of future applications of synthetic biology in society. Techno-moral scenarios explore the ways in which new technologies may challenge and shape what we want, how we relate to each other, and how we relate to the world. Thus they invite audiences to imagine and appraise ways in which particular SynBio applications might change our world, our ideas, values and ideals.