Chapter 10
Synthetic Biology and the Role of Civil Society Organizations

Shaping the Agenda and Arena of the Public Debate

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Abstract In this chapter we discuss the role of Civil Society Organizations (CSOs) in current and future public debates about synthetic biology as a new and emerging science and technology. We see CSOs as potentially important intermediaries between scientific and governance institutions on the one hand and wider publics on the other hand. In this role CSOs have already contributed to the agenda of the emerging debate about synthetic biology. However, the way in which CSOs and wider publics may be involved in future debates about synthetic biology will also depend on the framing of the issues at stake by governmental and scientific actors in these debates. To make this clear we refer in this chapter to the lessons learnt from earlier debates about genetic engineering and nanotechnology which show a notable difference between governmental and scientific approaches to the implications of new science and technology, focusing on issues of risk and regulation, and the activities of CSOs, emphasizing broader societal issues. This tension is also apparent from our analysis of the agenda of the emerging synbio

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debate and from the results presented in this chapter of a survey in which we have interviewed a variety of CSOs about their visions on synthetic biology. In the light of this tension we also discuss in this chapter the conditions that should be met for a constructive role of CSOs in future public debates about synthetic biology.

10.1 Introduction

As a new and emerging science and technology synthetic biology has recently gained prominence on the agenda of national governments and a variety of scientific and advisory organizations. In this context synthetic biology is discussed as a field raising shining promises and expectations about new pharmaceutical products, "living" therapeutics, biosensors, and sustainable production of biofuels and biobased materials. At the same time, however, the rise of synthetic biology may also refuel the well-known and protracted controversy about genetic engineering. Thus, for a socially acceptable and responsible development, it is vitally important to engage scientists and wider society in public debate about the aims and potential risks and impacts of synthetic biology as a new and promising field (Balmer and Martin 2008, Garfinkel et al. 2008, de Vriend 2006). As we know from earlier debates about genetic engineering and, more recently, nanotechnology, civil society organizations often take the lead in these debates and as such may play an important intermediary role between scientific and governmental institutions and wider publics. Civil society organizations (CSOs) are organizations whose membership represents a variety of public interests and responsibilities and which may include trade unions and employers' organizations ("social partners"); non-governmental organizations; professional associations; charities; grass-roots organizations; organizations that involve citizens in local and municipal life; churches and religious communities (European Commission 2006).

The mediating role of CSOs is especially important in a globalizing world in which scientific and technological innovation is more and more taking place in a transnational context and is often strongly driven by the commercial interests of large multinational corporations. Because the activities of CSOs are not limited to the national level of public policy-making, CSOs may play an important role in mobilizing and representing public interests in debates about the societal implications of scientific and technological innovation, both internationally and nationally (de Wilde and Vermeulen 2003, Murphy and Levidow 2006). In this role, CSOs may also be more accessible and trusted by the wider public as legitimate sources of information than governmental and scientific institutions. Thus we can expect that CSOs will be important, as actors and intermediaries, in engaging wider publics in societal debates about synthetic biology. Indeed, some of these organizations, as the Canadian based but globally operating ETC group, have already been highly active and visible in shaping the debate (de Vriend 2006).

Another reason why it is interesting to discuss the role of CSOs in public debates about synthetic biology is the elusiveness of the notion of public debate in the context of new and emerging science and technology. The "public" that might be interested to be engaged in a debate about synthetic biology is not just out there, waiting to be involved, but has to be actively created. Depending on the issues at hand, different arena's will have to be organized of potentially interested parties and individuals constituting relevant publics for a wider debate (Dijstelbloem 2008, Jasanoff 2005). In this respect, the role of CSOs is obviously important in raising public awareness, and in articulating and organizing public feelings, opinions and interests.

In this chapter we will discuss the potential role of CSOs in future societal debates from three different perspectives. First, we describe the recent and early involvement of CSOs in debates about synthetic biology. Then we discuss some of the main social and ethical issues that have been raised in these debates. We will argue that for a better understanding of the potential role of CSOs it is important to distinguish between different kind of issues, implying different roles and responsibilities for the various parties involved in debates about synthetic biology. In this context we will also refer to lessons that may be learnt from earlier debates about genetic engineering and nanotechnology. Finally we discuss, in addition to our more general observations, the main findings from a survey in which we have inquired a number of CSOs about their (intended) involvement with synthetic biology. On the basis of this survey we wanted to know more about the way in which these organizations define their own interests and role in relation to this field. In conclusion we will consider the findings from this survey in the light of the more general argument and lessons we have presented in this chapter and also suggest how the agenda of a future public debate about synthetic biology might be framed in ways that may productively involve CSOs in this debate.

10.2 Early Involvement of CSOs in the Synbio Debate

> Genetic engineering is passé. Today, scientists aren't just mapping genomes and manipulating genes, they're building life from scratch – and they're doing it in the absence of societal debate and regulatory oversight. (ETC Group, Extreme Genetic Engineering 2007)

In November 2003, a little more than a year after the publication of the chemical synthesis of Poliovirus cDNA in Science Magazine (Cello et al. 2002), a small international network of scientists, organized in the so-called Sunshine project, warned about the possibility of lowering barriers to access to potential biowarfare agents like smallpox and Ebola through genetic and genomic techniques and artificial synthesis (Sunshine Project 2003). This was probably the first time that attention was paid to the increasing possibilities of DNA synthesis as one of the key technologies in the emerging field of synthetic biology from a societal perspective. Two and a half years later, in May 2006, an open letter that was sent to the organizers of the Synthetic Biology 2.0 Conference in Berkeley showed that synthetic biology was also becoming an issue in the broader CSO community (ETC Group 2006). The letter was a reaction to intentions in the scientific community to vote on a scheme

of voluntary self-regulation and was signed by a group of thirty-nine CSOs. The list included environmental organizations such as Friends of the Earth and Greenpeace, organizations focusing on trade and agricultural biodiversity such as GRAIN and the Foundation on Future Farming, social justice organizations such as the Third World Network, the Research Foundation for Science, Technology and Ecology in India and the Indigenous People's Biodiversity Network, organizations focusing on the social and economic impact of genetic engineering such as Econexus, Genewatch UK and the GeneEthicsNetwork in Australia, and farmers organizations such as the National Farmers Union of Canada (see appendix).

The letter defined synthetic biology as an attempt to create novel life forms and artificial living systems, urged the organizers of the conference to withdraw the self-governance proposals, and called for inclusive public debate, regulation and oversight of the field of synthetic biology. The letter emphasized that:

- Society – especially social movements and marginalized peoples – must be fully engaged in designing and directing societal dialogue on every aspect of synthetic biology research and products. Because of the extraordinary power and scope of synthetic biology technologies, this discussion must take place globally, nationally and locally;
- Scientific self-governance doesn't work and is anti-democratic. It is not for scientists to have the determinant voice in regulating their research or their products;
- The development of synthetic biology technologies must be evaluated for their broader socio-economic, cultural, health and environmental implications not simply for their misuse in the hands of "evildoers".

It was the Canada-based ETC group that initiated the letter. This CSO had already been tracking biotechnology and nanotechnology for several years and had published, a few years earlier, a report about the social implications of the increasing convergence of bio-, nano- and information technologies (ETC Group 2003). It was also the first to spot developments in the field of synthetic biology as an outstanding example of converging technologies that could have a significant impact on society. A little more than 6 months later, the open letter was followed by the publication of a more comprehensive report by the ETC group, titled Extreme Genetic Engineering: An Introduction to Synthetic Biology (ETC Group 2007a). This report describes the principles of synthetic biology and its major players and presents a more extensive analysis of the potential and adverse societal implications of synthetic biology, focusing in particular on global problems of socio-economic justice. In subsequent publications, the ETC group has targeted more specific issues, again relating to its general concern with notions of global justice. In June 2007, the organization challenged the patent on the first micro-organism with a complete synthetic genome, applied for at that time by the Venter Institute. Always creative in using evocative language, ETC nicknamed, in the tradition of "Dolly", this synthetic organism "Synthia" (ETC Group 2007b). One year later, the ETC group highlighted the role of synthetic biology in the bio-based production of fuels and materials and the impact on the sugar economy (ETC Group 2008).

Meanwhile, members of the scientific community came to realize that CSOs and the issues they raise should not be ignored, and the ETC group was invited by scientists to comment on a working paper on the risk assessment of synthetic genomics (Fleming 2007). The ETC group was also invited to participate in a panel on the social impact of synthetic biology at the Synthetic Biology 3.0 Conference in Zurich, and a year and a half later the CSO community had its own panel on the Global Social Impacts of Synthetic Biology at the Synthetic Biology 4.0 Conference in Hong Kong. At the same time, a number of CSOs have started to organize teach-ins in London, Washington DC, and San Francisco, where people from the scientific community have been invited to give tutorials. In November 2008, an international CSO response to structural and technological convergence was discussed in Montpellier, France (BANGseminar 2008).

Thus we see how a loose, international network has evolved of a variety of CSOs which have critically responded to the emergence of synthetic biology. So far, a few organizations have taken the lead. They actively inform other CSOs about developments in synthetic biology, raising questions about its impacts, and involve them in the activities they organize, directed both at the scientific community and the wider public. The situation is pretty much the same as in 1986, when several European CSOs started activities on issues related to genetic engineering, such as risk assessment of introductions of genetically modified organisms in the environment, transgenic animals, and patents on genes (see box below).

The evolvement of a genetic engineering CSO-network

After the Asilomar Conference on Recombinant DNA in 1975 it took several years for CSOs to become aware of what was going on in the field of genetic engineering, and it was not before the second half of the 1980's that the first protest activities against experiments with genetically modified organisms were launched. In Europe, Friends of the Earth Europe, the farmers organization Conféderation Paysanne Européenne and several small groups from the UK, Germany, Denmark, Belgium and The Netherlands dedicated to genetic engineering took the lead. They organized around specific topics, such as the risk of GMO releases to the environment, patents on life and the bovine growth hormone BST. As application of the technology proceeded, other issues were discussed, roles shifted and other organizations became involved, e.g. labeling & consumer organizations. For Greenpeace, which is typically a campaign oriented organization, it took until the first shiploads of GM soya arrived in the European ports in 1996 to enter the stage. This heralded a new phase in public awareness. First loosely organized and supported by the Greens in the European Parliament, the CSO network became more structured with the start of a Biotechnology Clearing House in the early 1990's and the foundation of the Genetic Engineering Network in 1995, which has grown to a network of 51 organizations in 27 European countries (GENET 2008, Schenkelaars and de Vriend 2008).

Today, with the emergence of synthetic biology, we see a similar pattern of a few relatively small organizations taking the lead. However, due to a number of facts the speed in which the pattern develops is nowadays much higher. First of all, CSOs have created a sophisticated, well-organized network of organizations that are capable of fitting new developments such as synthetic biology into the issues they are already working on. Moreover, CSOs have internet access to an enormous amount of information, which allows rapid detection of new developments that may require their attention. And finally, extensive use of electronic communication opportunities enables them to "spread the word" very effectively.

10.3 Shaping the Agenda of the Synbio Debate

Through their early involvement CSOs have not only created a wider arena for public debate, but have also contributed to the agenda of the synbio debate. What is the significance of their contribution to the debate and how does it relate to other contributions coming from the scientific and broader Technology Assessment (TA) community? What we will discuss here is first of all the way in which the agenda of the synbio debate has been shaped by a variety of actors, including both academic, TA and CSOs. However, in this chapter, we are not only interested in the way the agenda is shaped by a diversity of organizations and interests. More importantly, we also want to argue that the way in which the issues are framed, has consequences for the way in which various actors, including CSOs, may be involved in wider and future debates about synthetic biology.

Three reports, published in the last 3 years, we see as most prominent and helpful in giving us a picture of the issues that have been raised about synthetic biology from different actor perspectives. The first report was published by a Dutch TA organization with the aim to identify issues that need societal and political attention and debate (de Vriend 2006). The second report is a more recent independent review commissioned by a working group of the British Biotechnology and Biological Sciences Research Council BBSRC (Balmer and Martin 2008). The third report represents the views and concerns of an international civil society organization (ETC Group 2007a). The first two reports represent more distant, analytical positions in the synbio debate and it is interesting to contrast these reports with the more politically motivated concerns raised in the ETC report.

In *Constructing Life*, the Dutch TA report, synthetic biology as a new multidisciplinary field is characterized by two different approaches, aiming at top-down deconstruction and bottom–up construction of life. The newness of synthetic biology is defined by its level of artificialness suggesting, according to the report, a paradigm shift which might fundamentally change current views on biology and life. The report presents an overview of current developments in terms of applications, products and expectations, and identifies key players in the field. The last chapter focuses on "social, ethical and legal aspects" and identifies biosafety, biosecurity and intellectual property rights as issues that have already been widely recognized in the scientific community. In addition the report points out that ethical issues do not

yet seem to have an important place on the agenda of the synthetic biology community. Issues that are mentioned as raising potential ethical concern include questions about the way in which developments in synthetic biology might affect culturally established and cherished distinctions between "living" and "non-living" entities, about the limitations and implications of the reductionist approaches which seem to characterize synthetic biology, and about the ways in which synthetic biology might lead to new hybrid forms of life, combining human DNA with the cellular components of other species, and thus raising questions about the moral status of these entities.

In its presentation of the issues, the review published on behalf of the UK Biotechnology and Biological Sciences Research Council is highly identical to the Dutch TA report. Synthetic biology is defined as deliberate design of biological systems, whereby the falling cost of gene sequencing and synthesis is seen as a crucial factor in the resurgence of a long-standing interest in the idea of using engineering principles to create artificial life. Like the Dutch TA report, the review observes that the scientific community is acknowledging the potential dangers of synthetic life forms, with many reviewers of the field indicating a need for ethical debate, internal regulation and safe practice. Five issues are described in the review as main social and ethical challenges: uncontrolled release, bioterrorism, patenting and the creation of monopolies, trade and global justice, and the cultural and philosophical implications of creating artificial life. The possibility that synthetic biology will create new, or exacerbate existing, inequalities in international trade and development is the only issue in this list that was not discussed in the Dutch TA report, and it is significant that, in mentioning this issue, the review explicitly and exclusively refers to the ETC report published 1 year before.

In many ways indeed, the ETC report is different from the two other reports, both in tone, in wording, and in its definition of the issues. Designating synthetic biology as "extreme genetic engineering", the report emphasizes that instead of manipulating genes, scientists today are building life from scratch. And they are doing it, according to the report, in the absence of societal debate and regulatory oversight. Thus, the report calls for wide spread debate. Moreover, given the aim to commercialize new biological parts, devices and systems, the debate should not be limited to issues of biosecurity and biosafety. Because, like biotech, the power to make synthetic life could be concentrated in the hands of only few major multinational firms. In other words, socio-economic issues are seen as most important, as also becomes clear from the major topics discussed in the report. Apart from bio-weapons and biosafety, the list of issues includes biofuels as a green "techno-fix", the creation of new intellectual monopolies, and the implications of commodification in synthetic biology for the conservation of genetic resources, the politics of biodiversity, and international trade. It is not only the framing of the issues which is different in the ETC report. It is also the use of particular phrases, quotes and stories, like BANG for the convergence of biotechnology, nanotechnology and genetics at the level of atoms, and the now (in)famous story of the microbial production of Artemisinin to treat malaria, presented as "synthetic biology's poster child". Concerns about synthetic commodification are also made vividly clear in the report by a map, showing

the world-wide distribution of DNA synthesis companies, and tables listing a sample of recent patents and companies active in synthetic biology.

In comparing these three reports we see an interesting contrast between the Dutch TA report and UK scientific review on the one hand, and the ETC report on the other. Although the reports by and large agree in their definition of safety, security and intellectual property rights as important points for concern, they are clearly different in the way in which they define broader societal issues that have to be considered in debates about synthetic biology. While both the Dutch TA report and the British scientific review pay special attention to the potential and longer-term cultural and moral impacts of creating artificial life, the ETC report puts all emphasis on the potentially adverse socio-economic implications of synthetic biology in an international context. The contribution of the ETC group offers an interesting example of the role that CSOs may play in wider societal debates about new and emerging science and technology, especially in relation to other governing institutions. In a discussion of the role of CSOs in environmental policy-making and debate, Sheila Jasanoff has described these organizations as crucial in supplementing and extending the activities of scientific and governance institutions (Jasanoff 1997, see also Fisher 1997 for more critical reflections). However, as other authors have noted, we also often see a tension between governmental and scientific approaches to the implications of new science and technology, focusing on issues of risk and regulation, and the activities and style of CSOs, directed at broader issues and mobilization of the public in societal debate (de Wilde and Vermeulen 2003, Murphy and Levidow 2006). In this respect, we may also learn indeed from experiences with the earlier biotechnology and more recent nanotechnology debates.

10.4 Lessons from the Bio- and Nanotechnology Debates

In a discussion of lessons to be learnt from the UK agricultural biotechnology controversy, Kearnes et al. have distinguished two different and competing understandings of the questions at issue in this controversy (Kearnes et al. 2006, see also Stemerding and Jelsma 2003). In the context of governmental regulatory policies the implications of GMO have been predominantly framed in technical conceptions of risk, whereas in the wider societal debate issues were mainly framed by social and political concerns about GM as “unnatural”, diminution in consumer choice, and corporate control of food systems. While governance actors failed to take responsibility for addressing in an accountable public manner social questions about the purposes and interests of biotechnology innovation, it became the role of CSOs to express these wider concerns. However, the only way for CSOs to address these issues in a political context was in terms of the existing legal framework for risk governance, which resulted in disputes of a highly technical and legal character that were hard to follow for the public.

To the foregoing observations we may add a number of lessons that we have recently published in the context of the nanotechnology debate (Hanssen et al. 2008). A most important lesson we learned from the nanodebate is that it is important for the framing of this debate to make a distinction between issues that

call for a clear role of the government in considering and managing these issues, and questions that should be made subject of a wider societal debate. In the case of nanotechnology, the issue of risks is seen as a clear example of a problem that demands for action of the government (including consultations of CSOs), while more general societal questions and impacts will first of all have to be considered in a broader public debate. For this societal debate it is important to develop an agenda which can rely on wide support and which remains open to the way issues are framed by CSOs involved in the debate. In framing the issues, it is also important to build wherever possible upon already existing discussions, as for example present debates about sustainability or human enhancement. This strategy may help to structure the debate and will promote participation on the part of organizations already active in these debates. To facilitate the involvement of CSOs, the government must offer these organizations means for capacity building. In addition it is important to "keep a finger on the pulse" of the public opinion, by organizing for example focus groups and panel discussions in which the public can be given a voice at the grass roots level.

What can we conclude from these lessons for (1) the way in which societal debate might be stimulated and organized about synthetic biology, and (2) the way CSOs might be involved in this debate? First of all, we seriously need to consider the question how to frame the agenda of this debate. Which questions do primarily demand for action of the government, and what are the issues that should get priority in a broader public debate about synthetic biology? And to what extent can we relate these issues to already existing debates? On the basis of the three reports mentioned above, offering early reflections on the emerging field of synthetic biology, we may distinguish two different kind of questions. The *first kind* of questions clearly relate to existing practices, responsibilities and debates in our society in the field of biosafety, biosecurity and intellectual property rights. In all these fields, earlier developments in biotechnology, genetic engineering and genomics have led to practices of governance and regulation constituting relevant, although contested, frameworks for the past and current developments in these fields. As such these frameworks will also form an important focus for debate and policy-making in the field of synthetic biology. The *second kind* of questions relate to broader and more ill-defined social, cultural and ethical issues which might become a source of future societal concern. These issues include the way in which synthetic biology may affect established cultural and moral notions of life, and also the broader socio-economic and global prospects and implications of a future and emerging bio-based economy.

What is the significance of the distinction between these two kinds of questions for the framing of public debates about synthetic biology? The first kind of questions refers to established regulatory practices and public responsibilities which imply more immediate *governmental action*, informed by scientific, public and political consultations. Such action will have to include the monitoring and governance of scientific and technological developments, and the identification of regulatory issues in relation to biosafety, biosecurity and intellectual property rights. The second kind of questions will have to be considered in wider forms of *societal debate*, aiming at a more critical understanding of the issues at stake. Such debates should involve

CSOs and also expertise from the social sciences, ethics, and the TA community, and it should include initiatives directed at public communication and engagement. How do these observations and conclusions relate to the way in which CSOs position themselves towards the emerging synbio debate? As one of the lessons learnt from earlier debates we have emphasized in the foregoing the importance of involving CSOs in the development of an agenda. Thus, we should obviously take into account the visions of CSOs themselves about the issues to be addressed and about their own role in engaging civil society in a wider synbio debate.

10.5 Responses from CSOs to the Emerging Synbio Debate: A Survey

> Never doubt that a small group of committed citizens can change the world. Indeed, it is the only thing that ever has. (Margaret Mead, anthropologist)

To get a more detailed picture of the interest and activities of CSOs in regard to synthetic biology, we have interviewed a variety of CSOs active in different fields and based in different countries (see Table 10.1 below). We have asked them questions about (1) their awareness of recent developments in synthetic biology, (2) the way they perceive and evaluate these developments, and (3) the role they see for themselves and others in responding to these developments. In the following we will describe the main results of this enquiry and then we come back to the questions posed above about the most appropriate framing of the issues to be addressed in initiatives to stimulate and organize societal debate.

10.5.1 Awareness

The level of awareness can be defined in terms of the synthetic biology's position on the agenda of the organizations and in terms of knowledge and perceptions of the technology. Therefore we asked the organizations for how long they have been following what is happening in the field of synthetic biology, how they would define synthetic biology, and whether they already have a position in the debate.

10.5.1.1 Leaders and Followers

The CSOs we interviewed are all aware of recent developments in synthetic biology but we noticed clear differences in the level of awareness. Most organizations have been following what's happening in the field of synthetic biology since 2006. Extensive studies have only been done by the ETC Group and by Gregor Wolbring from the University of Calgary, a scholar working in the field of science and technology governance who founded the International Centre for Bioethics, Culture and Disability. While Greenpeace UK told us they just "keep an eye on it", Friends of the Earth US started participating actively in the organization of teach-ins

Table 10.1 List of organizations interviewed and major issues mentioned

Organization	Based in	Response	Level of awareness	Major issues	Opinion
ETC group	Canada	Yes	Leader	Corporate control, social justice, biodiversity	Yes, several papers
Swedish society for nature conservation	Sweden	Yes	Passive follower	Environment, nature conservation	No
Wolbring, international center for bioethics, culture and disability	Canada	Yes	Inspirator	Ability & governance of new, emerging and converging sciences and technologies	Just analysis in several papers, no opinion
Friends of the earth US	US	Yes	Early active follower	Environment	Planned to
Friends of the earth Australia	Australia	Yes	Early active follower	Environment	Not yet
Greenpeace UK	UK	Yes	Distant follower	Environment	No
Werkplaats biopolitiek	NL	Yes	Incidental follower	Biotechnologies & social justice	No
Institut für Kirche und Gesellschaft	Germany	Yes, but limited time right now and still exploring the field	Late active follower	Religion, ethics	No
Terra de Direitos	Brazil	Only initial response	Late active follower	Human rights, social justice	Produced a review in Portugese for members
Sciences citoyennes	France	Yes, but unable to answer the questions	Passive follower	Democracy in science	No
Econexus	UK	Yes, but no time right now	Passive follower?	Research science & technology, corporate control	No
Genewatch UK	UK	Yes, but too swamped with work	Passive follower	Genetic engineering	No
Sunshine project	US	No longer existing	Leader & inspirator	Bioweapons (proliferation)	Yes, in a 2003 paper
Third world network	Singapore	No	Late active follower?	Developing countries and trade	No information available

Table 10.1 (continued)

Organization	Based in	Response	Level of awareness	Major issues	Opinion
ICTA	US	No	??	Research of technological impact on society, nano-technology, human biotechnology, intellectual property	No information available
Global justice ecology project	US	No	??	Social justice, environment	No information available

in Washington DC and San Francisco. This organization also submitted a testimony for a Congress hearing on new biotechnologies and planned to draft a small report, based on the ETC-reports, explaining the issues and laying the ground for biofuel activities in the near future (see also ETC group 2009). Friends of the Earth Australia started to alert journalists about synthetic biology and mentioned it in a report on nanotechnology that was published in March 2008 (Miller and Senjen 2008). The Dutch Biopolitics Workshop got interested in synthetic biology and Craig Venter's activities in this field in 2007 (van Wietmarschen 2007). The German Institute for Church and Society became aware of developments in synthetic biology only recently and decided to discuss some of the ethical issues during a conference in December 2008 (Evangelische Akademie Villigst 2008). Other organizations, such as the Swedish Society for Nature Conservation, say they are interested but as yet had no opportunity to give it more detailed attention.

On the basis of our interviews, we can distinguish a few organizations that have been internationally active as *inspirators* systematically tracking and analyzing developments (Wolbring, Sunshine Project) and *leaders* raising awareness in civil society at large (ETC Group). Other organizations may be considered as *active followers* translating issues to the grassroots on the national level (Friends of the Earth) and offering more in-depth analysis of specific issues (Institute for Church & Society). In addition we find more *incidental, passive or distant followers* publishing issues on a website or in more targeted papers (Biopolitics Workshop), participating in activities organized by others (e.g. signing the open letter by several organizations), or just keeping an eye on it (Greenpeace).

10.5.2 Diverging Views on Synthetic Biology

At a general level, synthetic biology is marked by several CSOs as "a perfect example of converging technologies", especially of nanotechnology, informatics and

biotechnology. Very much like the scientific community, the CSOs we interviewed have different thoughts about the "newness" of synthetic biology. Several organizations describe synthetic biology as a more extreme form of genetic engineering, resulting from continuing advancements in molecular biology and bio-interventions. It is still tinkering with the building blocks of DNA, whereby synthetic biologists apply the same principles as in genetic and metabolic engineering and synthetic biology is based on genomics information. Others think synthetic biology is "somewhat new" because of the use of DNA synthesis, and the creation of de novo DNA sequences combined with the application of design principles using a more precise and modular, software-like approach. In this view, it seems that some basic breakthrough has been achieved, which allows for more ambitious engineering goals. As one of the interviewees observed:

> It is engineering at another level than "conventional" genetic engineering, which still depends on existing life forms.

Still others, however, see the use of DNA synthetically produced from scratch as very different from altering things that already exist in nature, and some even talk about "artificial life". The subtitle of the invitation for the December meeting of the Institute for Church and Society mentions "the construction of new life".

We also asked the CSOs how they value the promises of synthetic biology in applications such as pharmaceuticals, medical therapies, biofuels or biobased materials. Most interviewees were rather sceptical about these promises. According to one interviewee:

> It could become an important technology, but I find it difficult to assess. The technological possibilities are not clear and I have become rather cynical about all these promises of life sciences.

In addition, the claimed benefits may not come without new risks, so one has to make a cost-benefit analysis. Moreover, CSOs are usually not committed to a specific type of technology for problem solving. As the following comment makes clear, there may be other, more effective technological and non-technological solutions:

> The cost-benefit analysis is never straight forward because there may be better solutions. Sometimes it is not the technology that is the problem, but access.

10.5.3 Framing the Issues

By their nature, CSOs are committed to specific public interests, specific social issues, and specific world views. New developments, opportunities and threats will be perceived and evaluated in the framework of these interests, issues and world views or ideologies. This explains why assessment of new technologies by CSOs involves a wide range of values. Neglect of these values is what caused the debate on genetically modified foods ending up in a stalemate. In order to make CSO engagement in synthetic biology effective, we need to understand what these interests, issues and world views or ideologies are. When we asked CSOs why, from their

point of view, synthetic biology raises interest and concern, these specific interests and world views became apparent almost instantly. Three issues were mentioned repeatedly: growing commercial interest and social justice, new risks, and the technology fix. In most interviews, ethical issues were mentioned only after we explicitly asked about them.

10.5.3.1 Growing Commercial Interest and Social Justice

Initially, the ETC Group was concerned about the potential use of knowledge from synthetic biology in making bioweapons, but concerns about potential industrial applications have now become more important as it appeared from our interview:

> The fact that Craig Venter, who has got a strong track record in industrial development, got involved, made us realize that there was a strong commercial interest attached to this technology. Now we are more worried about corporate control over agriculture and natural resources. At the 4th International Synthetic Biology Conference in Hong Kong, in October 2008, we noticed the presence of several large industries, which indicates that this is rapidly going to be an area of industrial applications.

Most CSOs see increased power and control and its impact on socio-economic relations as a key issue in their assessment of synthetic biology. In the words of one of the interviewees:

> We fear that this technology will be too much influenced by commercial motives, by companies like British Petrol that have a vested interest in energy production. This is a fundamental issue of democracy and control in science and technology.

The issue of control also relates to various concerns mentioned by the interviewees about global justice, such as the use of patents as a tool to control access to the technology, bioprospecting or biopiracy (taking gene sequences from nature and recreating them somewhere else) and the rights of indigenous peoples. One of the interviewees linked these concerns to a general erosion of funding in public interests such as health, environment and social issues.

10.5.3.2 New Risks

Several of the interviewees believe that synthetic biology raises the same type of safety questions as genetic engineering, but some of them also observed that this technology is very experimental. Some of the applications will involve more or less radical transformations of living matter and such modified organisms may escape from the controlled situation they are kept in. Even if the modified organisms are initially incapable to cause any harm because they cannot survive or reproduce outside this controlled environment, there is always the possibility of mutations that may cause unexpected effects.

10.5.3.3 Technology Fix

According to several CSOs the "technology-fix" which underlies the promises of synthetic biology (earmarked as the next dot.com bubble by one of the interviewees) is problematic. Apart from the possibility of introducing new (yet unknown) risks, claims that the technology will contribute to solutions for major problems such as climate change are challenged. Instead of a reductionist technological approach, such problems require a comprehensive analysis of human behaviour and the existing socio-economic and political structures that underlie environmental and health problems, hunger and poverty. Rather than creating a "better world" by changing these structures, technologies tend to maintain or even reinforce the structures that are thought to be the cause of many problems. As one of the respondents stated:

> There is a danger of jumping to quick fix solutions, for instance to develop new forms of energy and biomaterials as a way of tackling the problem of climate change. It is important to understand the potentials of synthetic biology, but I am very worried that we may develop a high risk solution. We should seek a balance and make sure that we look at the full picture first. This includes fundamental issues of democracy and control in science and technology.

10.5.3.4 Ethical Issues Not Well-defined Yet

Several issues that are highlighted by the CSOs have a moral dimension, such as biopiracy, social justice and the accessibility of the technology. Nevertheless, so far little thought has been given by these organizations to ethical issues that are specifically related to synthetic biology. One of the interviewees emphasized that there is a need for goal ethics, that is, an ethics focusing on the societal goals which technology should serve, rather than on the technology itself. On the other hand, the Institute for Church and Society raises some fundamental philosophical questions about the ethical implications by putting synthetic biology in the context of evolutionary principles, the evolving life, the role of genes therein, and its significance for humans as cultural entities.

10.5.4 The Role of CSOs and Other Parties

All interviewees agree that synthetic biology deserves attention from civil society and CSOs, but some of them think it may be difficult to engage CSOs in debates about new and emerging technologies. As one of the interviewees stated:

> Involving civil society means that you'll get input of different types of intelligence. It will enable the decision makers to understand what the public values are that they should align their policies (regulation) with. It is an interesting time to organize upfront engagement and discuss what regulation should be there now. There is none of these synthetic organisms functioning and there is still containment in the laboratories. We are thinking of ways of getting other CSOs involved in technology development at an early stage, but most of these organizations rather work on technologies that have already demonstrated to have negative effects.

Another interviewee noticed a difference in this respect between Europe and other parts of the world, because in Europe, the risks and social and ethical issues have been tabled by academics working in the field of TA and have been included in programmes such as the SYNBIOSAFE project.

As far as CSOs have become involved, their roles may by very different, depending on the issues they focus on and the resources they have. A number of CSOs have been active in raising awareness by analysing developments in synthetic biology and making this analysis available to civil society or by informing and educating the public. But, as one interviewee pointed out, apart from being informed, the public should also be listened to, even if they do not completely understand:

> Involving the public is really important because we need to understand what the public values are, what people think of the naturalness and need of synthetic biology. There is a lot of common sense out there.

Other organizations started lobbying activities and have engaged themselves in discussions of their main topics of interest with scientists and policy makers. Emphasising the need for regulatory oversight, most interviewees have clear ideas about the role that scientists should play. Scientists will have to contribute to the knowledge that is needed for assessing safety questions and potential environmental impacts, for setting up monitoring systems, and for developing more inclusive assessments of structural, socio-economic impacts. In addition, scientists should also develop a critical attitude towards the paradigms and assumptions they work with, in particular the notion of the gene as a functional unit, and the vision of DNA as a program. In this context, multidisciplinary collaboration with ecologists, bringing together different scientific approaches, is also seen as important. The present openness of the scientific community is considered by the interviewees as very encouraging in maintaining a dialogue with CSOs. However, despite their enthusiasm about the present openness of scientists, several CSOs expressed concerns that this openness will disappear as soon as commercial players become involved and scientists get tied to industries. As one of the interviewees stated:

> We need time to discuss things properly, not being pushed or hampered by commercial interests.

Indeed, observing "an unprecedented influx of commercial interest" at the Syn Bio 4.0 conference in Hong Kong, Jim Thomas of the ETC group has expressed concern about a lack of governance while the "Syn Bio express is steaming ahead with corporations firmly in the driving seat" (Thomas 2008). In this context, government authorities are not only seen by our interviewees as responsible for securing a regulatory framework and funding ongoing independent research, they also must encourage and enable a societal dialogue based on equal power. Therefore, governments should guarantee public access to knowledge and support capacity building in civil society.

10.6 Conclusions

In this chapter we have discussed the role of CSOs in the emerging synbio debate. We have argued that for our understanding of this role, it is important to consider the framing of the issues that appear on the agenda of the debate. Because, the way in which the issues are framed clearly relates to the way in which various actors, including CSOs, may be involved in wider and future debates about synthetic biology. As we concluded from the earlier bio- and nanotech debates, future societal debate about synthetic biology should not be limited to issues of risk and regulation, but should also include wider concerns. If we look at the issues which have been raised in the three reports that we have discussed, and in the responses of CSOs in our survey, we can distinguish three different kinds of debates. The first kind of debate concerns questions of regulation, relating to biosafety, biosecurity and intellectual property rights. The second kind of debate is a more academic and intellectual discussion focusing on potential and future cultural and moral implications of synthesizing new forms of life. The third kind of debate relates to more tangible socio-economic implications and questions of global justice.

Each of these debates is evolving in a different arena, in which governmental and scientific institutions, CSOs and wider publics may be differently involved. Debates about biosafety, biosecurity and intellectual property rights are already highly institutionalized in existing practices of regulation, which means that governmental authorities have an important responsibility in adressing the issues which arise in these debates and in creating public trust and legitimacy through a policy of transparancy and dialogue. However, attempts to limit the debate to issues of risk and regulation will inevitably give rise to the tensions and conflicts that we have seen earlier in the bio- and nanotech debates. As becomes clear from the early contributions to the synbio debate and from the results of our survey, questions of risk and regulation are considered by CSOs as highly important issues needing a robust governance framework. But, for most CSOs, the key question that has to be addressed in debates and policy-making about synthetic biology is how innovation in this field might be governed in a way that conforms to the aim of a just and sustainable global socio-economic development. In this light, it is important that public interest and support of synthetic biology does not suffer from too fast commercialization and that CSOs are engaged in upstream public discussions about the values and choices which should inform priorities in research and innovation.

However, in the light of this conclusion, there is another important and final point to make. As our earlier distinction between different kinds of debates makes clear, socio-economic issues may not be the only source of wider societal concern about synthetic biology. Although CSOs are obviously important in articulating and representing broader public concerns in the emerging synbio debate, it is important to realize that CSOs also have their own agendas and need not be seen as representatives of the public opinion in every respect. This seems especially to be true for the more intangible cultural and moral implications of an increasing instrumentalization of life that may be achieved in the future development of synthetic biology. It remains then important to find other, more diverse and direct ways to give public concerns as well as hopes a voice in the synbio debate.

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Appendix: List of organizations signing the open letter of May 2006

Organization	Based in	Primary focus of the organization	More information
Accion ecologica	Ecuador	Environment and social justice	www.accionecologica.org
California for GE free agriculture	California (US)	Genetic engineering	www.calgefree.org
Centro ecologico	Brazil	Organic farming, social justice	www.centroecologico.org.br
Clean production action	Canada/US	Environment, green production	www.cleanproduction.org
Cornerhouse UK	UK	Environment and social justice	www.thecornerhouse.uk
Corporate Europe observatory	The Netherlands	Social justice, environment, democracy and corporate control	www.corporateeurope.org
Corporate watch	UK	Corporate control	www.corporatewatch.org
EcoNexus	UK	Science and (bio)technology, assessment on environment, biodiversity, human and animal health, food security, agriculture, human rights and society	www.econexus.info
Ecoropa	Europe	Environment and impact of science and technology	
Edmonds institute	US	Environment, health and sustainability	www.edmonds-institute.org
ETC group	Canada/US	Science and technology, socio-economic and environmental impact, social justice, corporate control	www.etcgroup.org
Farmers link	UK	Sustainable agriculture	www.farmerslink.org.uk

Organization	Based in	Primary focus of the organization	More information
Friends of the earth international	US/ International	Environment, health and social justice	www.foe.org
Foundation on future farming	Germany	Sustainable agriculture, organic farming	http://www.zs-l.de
Fondation sciences citoyennes	France	Democratization of science and technology	www.sciencescitoyennes.org
Gaia foundation	UK	Cultural and biological diversity in Africa, Asia and Latin America	www.gaiafoundation.org
Geneethics network	Australia	Genetic engineering, GM-free society	www.geneethics.org
Genewatch	UK	Genetics and genetic engineering, health, animal welfare, environment	www.genewatch.org
GRAIN	Spain	Agricultural biodiversity, social justice, control over genetic resources	www.grain.org
Greenpeace international	The Netherlands/ International	Environment and peace promotion	www.greenpeace.org
Henry Doubleday research association	UK	Organic growing	www.gardenorganic.org.uk
Indigenous people's biodiversity network	Unknown	Indigenous people, social justice, biodiversity	unknown
International center for technology assessment	US	Science and technology, impact on society	www.icta.org
International network of engineers and scientists for global responsibility	Germany	Science and technology, impact on society	www.inesglobal.com
Institute for social ecology	US	Nature and environment	www.social-ecology.org

Organization	Based in	Primary focus of the organization	More information
International center for bioethics, culture and disability	Canada	Emerging sciences and technologies, social, cultural, ethical, legal and economic impact and governance principles	www.bioethicsanddisability.org
International union of food and agricultural workers	Switzerland/ Interna-tional	Rights of workers in agriculture and plantations, food and beverages manufacturing, hotels, restaurants and catering services, and all stages of tobacco processing	www.iuf.org
Lok Sanjh foundation	Pakistan	Poverty reduction, sustainable development, food security and local democracy	www.loksanjh.org
National farmers union	Canada	Family farms, trade	www.nfu.ca
Oakland institute	US	Promotion of public participation and fair debate on critical social, economic and environmental issues in both national and international forums	www.oaklandinstitute.org
Polaris institute	Canada	Trade, corporate control and democracy	www.polarisinstitute.org
Pakistan Dehqan assembly	Pakistan	Farmers rights	
Practical action	UK/Several developing countries	Sustainable development for the poor, low-tech solutions	www.practicalaction.org

Organization	Based in	Primary focus of the organization	More information
Quechua Ayamara association for sustainable livelihoods	Peru	Indigenous people's rights, genetic resources, cultural and natural diversity	www.andes.org.pe
Research foundation for science, technology and ecology	India	Indigenous knowledge and culture, genetic engineering and biopiracy, organic farming	www.navdanya.org
Social equity in environmental decisions (SEEDS)	UK	Environment and social justice	
Soil association	UK	Organic production and consumption	www.soilassociation.org
Sunshine project	US/Germany	Bioweapons	www.sunshine-project.org
Third world network	Malaysia	Trade, environment, climate change, human rights, biodiversity, Intellectual Property Rights	www.twnside.org.sg

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