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Dutch Biotech Scenarios 2030

Foresight Brief No. 068

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Sponsors: Netherlands Commission on Genetic Modification (COGEM)
Type: Scenario Study
Organizer: TNO
Duration: Oct. 2004 – Dec. 2005
Budget: €60,000
Time Horizon: 2030

Purpose

The purpose of the project was to gain insight in the future of biotechnology to support the work of COGEM, including technical and scientific risk analysis as well as the facilitation of public debate on biotechnology.

What Will Biotechnology Look Like in the Year 2030?

The Dutch Commission on Genetic Modification (COGEM) advises the government on the potential risks of genetic modification to human health and the environment. To perform its advisory tasks COGEM needs to obtain a broad understanding of the key factors in science and society that shape the future of biotechnology. To review possible future developments in a systematic manner COGEM asked TNO to carry out a project "Scenarios Biotechnology". The project was supported by a steering committee appointed by COGEM.

The key question in the scenario project was: "What will biotechnology look like in the year 2030?" Biotechnology was defined as modern with special attention to genetic modification. To answer this question the study explored a number of possible, alternative futures. The analysis included both a discussion on possible developments in society at large as well as more specifically in biotechnology.

Qualitative Assessment of Future Trends

The scenario process followed a number of steps:

- **Literature review.** The project started with a review of key documents on the future of biotechnology - medical, agro and industrial biotechnology - from a variety of sources, including research and foresight institutes, government studies, international organisations, private sector and NGOs.
- **Identification of trends and issues.** A distinction was made between generic trends and issues - societal, technological, economic, ecologic and political - and those specifically related to biotechnology. Key issues were summarised with an emphasis on – highly - uncertain issues, rather than on more certain trends.
- **Scoring of issues and trends.** Next, all trends and issues were scored using two criteria: (un)certainty and impact. The purpose of this exercise was to identify those trends and issues with a high degree of uncertainty and expected high impact as the basis for the scenarios. The scoring was done by a number of COGEM members.
- **Identification of drivers.** Uncertain trends and issues were used to identify possible extremes to serve as a basis for scenarios. Several possible drivers/driving forces were considered including economic growth vs. stagnation; continued globalisation vs. regional/national development; government vs. governance; technology vs. user; and controversy vs. consensus in biotechnology. In con-

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sultation with the steering committee a decision was made to select one dichotomy expressing societal issues and dynamics and a second focusing on different developments in science and technology.

- **Building scenarios.** On the basis of the two key uncertainties four draft scenarios were formulated. These are discussed in the following section. The draft scenarios focused mainly on the generic aspects.
- **Stakeholder workshop.** COGEM stakeholders from science, industry, government and NGO's were invited to participate in a workshop that had two main objectives: to review and provide feedback on the draft scenarios; and to further elaborate the four scenarios, especially with regard to the meaning of these scenarios for biotechnology development, the opportunities and threats in the scenarios for the biotech sector and possible institutional changes. Participants worked in four scenario rooms and provided additional information and comments on medical, agricultural and industrial biotechnology, thereby enriching the scenarios. A cartoonist visualised the workshops outcomes and discussions.
- **Preparation of scenario document.** A final scenario document was written on the basis of the different sources of information obtained in the course of the project.

The Four Scenarios

The scenarios were developed on the basis of two fundamental drivers/axis:

The first axis is based on the uncertainty about the **future role of science and technology**. Here two extremes can be seen: on the one hand a situation where technology is a dominant and a strong driving force in society. At the other extreme a situation may develop where technology is mainly applied to serve societal needs. Technology dominance results from rapidly increasing investments in science and technology, which result in powerful scientific breakthroughs. These are accompanied by a high priority given to applied research, technology transfer, and other supporting policy measures. At the other end of the scale a situation is found where technology is mainly used in the service of individuals and society. This situation results from lower investments in R&D and is typical of a society with limited confidence in science and the scientific establishment. Individuals, organisations and networks play a role in setting the R&D agenda and in shaping technology for the benefit of consumers and society.

The second driver/axis describes **uncertainties about future developments in society**. The extremes of the society axis are two quite different images of the future: one is a situation that is strongly individualistic whereas in the other collective and public interests dominate. In the situation of individualism companies and individual consumers are key actors as producers and consumers of products and services. Markets are the key governance mechanism in this situation. The role of governments is limited to facilitating the proper functioning of markets. At the other end we find a situation, which is much more strongly steered by governments, public organizations and civil society. Societal goals often take precedence over economic goals and questions about environment, poverty, safety and exclusion feature prominently on the agenda.

In combination the two drivers present a matrix with four scenarios, each possible images of the future with a unique and different character:

- Tech-World
- Technoconsumer
- National champions
- Network society

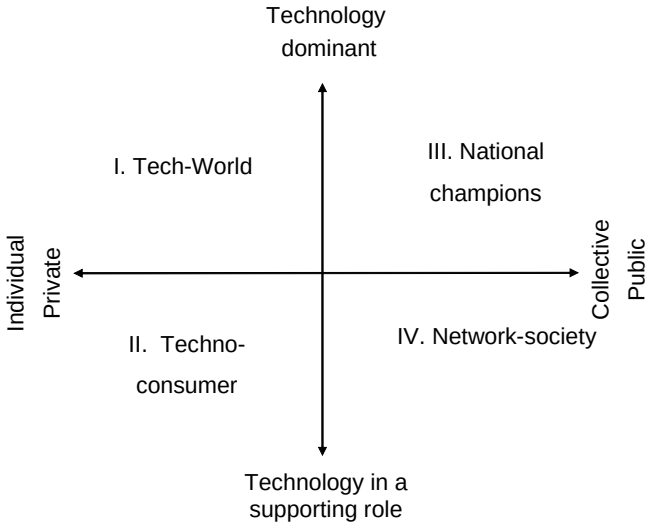

Figure 1: Biotechnology Scenarios

I. TechWorld

The TechWorld scenario combines technology dominance and individualism in a scenario of rapid technological development and market governance. Technology is everywhere: it is pervasive and embedded, and individuals are technology dependent. Globalisation has created worldwide-integrated markets for goods, services and technology. The role of governments is limited to market facilitation and creating a level playing field for actors to compete. National governments have transferred tasks to supranational governments and global institutions such as WTO. Openness and new technology have led to rapid economic growth, especially in Asia. China and India have become the engine of this Brave New World. For consumers high levels of economic growth mean that high tech companies produce a constant stream of new products that make life more productive and more comfortable. At the same time however many people feel that there is

no escaping new and increasingly complex technology which is forced upon them and from which there is no escaping. Rapid economic growth in TechWorld leads to increases in emissions and environmental problems, which are mainly seen as technological issues.

In TechWorld biotechnology has made rapid advances. Technology-push by companies and small government have reduced regulatory restrictions on biotechnology research and development and has led to a situation with widespread acceptance of Genetically Modified Organisms (GMOs). Public acceptance of GMOs appears to be strong, but is in fact quite fragile, and may be shattered by a single crisis. GMOs also play an important role in industrial and environmental biotechnologies. Biomedical technologies play a key role in medicine and pharmaceutical companies and insurers play a key role in the adoption of personalized and preventive medicine in an effort to provide cost efficient health care to an aging population.

II. Technoconsumer

Free markets are also important in this scenario, but consumers play a key role in shaping and adapting new technologies. Companies have learned from the 1990s GMO debacle that they ignore consumer demands and societal concerns at their peril. “Lead users” and “early adopters” are increasingly involved in the development of new technology. Consumers and patients are very well informed and highly demanding with respect to new products and services. Companies have adopted small scale, flexible production systems that have turned the idea of mass customization into reality. Technology is ever more adjusted and fine-tuned to the demands and needs of specific groups of users. Many consumers however are overwhelmed by the endless possibilities and have to deal with the ‘burden of choice’. Consumers often become producers especially in information technology related applications, where open source innovations have become the norm. Environmental problems are addressed through a combination of technological and institutional innovations such as individual tradable pollution rights.

In response to consumer demands life sciences companies have shifted their attention from improving producer characteristics to improving consumer benefits in GMO’s. This has led to a range of new healthy and convenient products, which are readily consumed. GMO acceptance is no longer an issue as consumers widely consider the benefits to outweigh the risks. The genomics revolution has produced a large number of new ‘personalised medicines’, based on individual genetic characteristics. Life science and life style innovations have become increasingly integrated.

III. National Champions

Free markets and minimal government have not been able to address a range of problems such as climate change, persistent poverty, and safety and security. Governments and public organizations play a key governance role in society. Social and policy objectives are achieved through the provision of public services. European cooperation remains important but national interests play a more dominant role and national governments need to balance national and international objectives. Governments have placed innovation high on the policy agenda and play a key role in funding new technology and supporting national technology initiatives. Markets are regulated to promote competition between national players. Technology policy is based on national priorities and is used to support strong sector in the economy.

Governments have strongly supported the introduction of GMOs through the establishment of clear and transparent rules and by providing credible information to the general public. Biotechnology benefits from a coherent and transparent regulatory framework and the government’s technology initiatives. Environmental regulation and fiscal incentives have provided strong support for the transition to a bio-based economy in which industrial biotechnology plays a key role. Medical biotechnology focuses on urgent societal issues such as obesity, which is becoming an ever-bigger strain on public health budgets. A genetic passport is prepared for every citizen and used to prevent disease, which is a key policy concern. For citizens it becomes increasingly difficult to escape genetic screening.

IV. Network Society

Governments play a smaller role in this scenario and public interests are mainly the concern of civil society organisations. Markets are regulated and stability and sustainability are key public concerns. Quality of life, wellbeing and individual freedom are important, but within acceptable and sustainable boundaries. Governance takes place through networks, where all stakeholders participate in decision-making. Decisions are broadly communicated and widely shared, although consensus building through participatory processes can be very time consuming. Technology development is steered by civil society. Learning by doing in “communities of practice” is important and social and environmental issues are high on the agenda. Users play an important role in innovation processes, either directly or through intermediary organizations, and transparency and communication reduce the uncertainty about new technologies. Confidence between science and society is restored in this scenario.

Bio-ethics questions play a key role in the Network Society. NGOs that remain strongly opposed to genetic modification receive broad support in public opinion. GMOs are not well accepted in this scenario and bio-safety remains high on the policy agenda. In plant biotechnology the emphasis is on technologies such as *molecular breeding* and *marker assisted selection*. Medical biotechnologies on the other hand are much more accepted: patients and their organisations play a key role in decision-making about preventive screening and testing and the use of pharmacogenetic technology. Public support for research on orphan diseases is strong in this scenario. Cloning

continues to be a highly contentious issue. Industrial biotechnology receives strong support in this scenario. Sustainability is a key driver and it is realised that biotechnology can play a key role in the transition process to environmentally friendly bio-based systems. The use of GMOs remains limited to contained use.

A Bigger Role for Consumers and Patients

- The role of biotechnology differs in the scenarios. In most scenarios (with the possible exception of Network Society) it will increase considerably in importance.
- The nature of the biotechnology R&D process differs between the scenarios, especially with regard to the role of open source research, and the protection of intellectual property.
- Most scenarios indicate the possibility of improved confidence in biotechnology, which can however be fragile, especially when based on public ignorance as opposed to informed consent. Risk perception and assessment are key issues.
- Ethics will play an increasingly important role, especially in medical biotechnology.
- Governments will continue to play an oversight role in biotechnology, and will focus on achieving consensus on new technology.
- Freedom of choice and participation in decision-making will be important. The 'burden of choice' will shift increasingly to consumers and patients.
- International developments will remain quite uncertain: the controversy on globalisation and liberalisation will have important implications for the development, adoption and dissemination of new biotechnology.
- Industrial biotechnology and to a lesser extent agricultural biotechnology will play an increasingly important role in sustainable production.

As a result the future nature, role and place of biotechnology will differ considerably between the scenarios.

COGEM will use the scenarios as one of the bases for the new Biotechnology Trend Analysis report, presently under preparation and to be published in 2007. In addition COGEM is using the scenarios to support its longer-term foresight work on the future of biotechnology.

Sources and References

Gijsbers, G.W., Enzing, C.E.,and Vullings, W. 2006. Biotechnologie in 2030: Vier scenario's voor de Commissie Genetische Modificatie (COGEM). Delft: TNO

Biotechnology Scenario's 2000-2050: Using the Future to Explore the Present. 2000. World Business Council for Sustainable Development Scenario Unit

Ministry of Research Science and Technology, New Zealand. 2005. Biotechnologies to 2025 Futurewatch.

Institute for Alternative Futures. The 2029 Project source. http://www.altfutures.com/2029.asp

Plant Research International Wageningen UR. 2000. Crops of uncertain nature.

Brian Sager, Scenarios on the Future of Biotechnology, Technological Forecasting & Social Change, 68 (2001), 109-129.

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