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Life Sciences in the Netherlands

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1. Introduction

Life Sciences and biotechnology are, according to the European Commission, widely recognized to be, after information technology, the next wave of the knowledge-based economy, creating new opportunities for our societies and economies.
This sector document gives a picture of the Dutch Life Sciences sector. Following on from this introductory chapter, Chapter 2 continues with a brief analysis of the past 30 years of the modern biotechnology sector. Chapter 3 contains an overview of the current Dutch Life Sciences sector. Chapter 4 discusses the policy concept of the dynamic innovation system in the Netherlands. Chapter 5 deals with the economic and technological trends in Life Sciences in the Netherlands. Chapter 6 gives an overview of a selection of the players in the Dutch Life Sciences sector. Finally in chapter 7 the references are presented.

2. Broader context of the Life Sciences sector

Modern biotechnology was born in the early 1970s, when a series of remarkable scientific breakthroughs in molecular biology allowed scientists to accomplish what had never before been achieved: reaching into the DNA molecule to cut, paste and engineer genes at will. In the evolution of modern biotechnolgy the past 30 years the following phases are recognized by Ernst & Young in their Global Biotechnology Report 2006, Beyond Borders:

1. Early Phase (1970s-mid 1980s);
2. Critical Mass (mid-late 1980s);
3. Commercialization & Windows (1990-1997);
4. Genomics Bubble (1998-2002);
5. Coming of Age (2003-present and future).

In 1976, Genentech became the first company formed to commercialize the advances in the lab, giving birth to the modern biotechnology industry. An important breakthrough moment for the industry was the june 1980 decision of the U.S. Supreme Court that allowed for the patenting of genetically engineered life forms. This event helped jump-start the biotech industry. By the second half of 1980s, the biotechnology industry had grown from a collection of startups to a sector that was acquiring critical mass. Then the industry had grown to about 150 publicly traded companies and 700 privately held ones, with rapidly emerging biotech sectors in Europe and Japan. As companies became more established they began to focus on management and strategic alliances. The Genentech-Roche deal in 1990 (by turning to a big pharma partner), the company gained flexibility to pursue its research-driven strategy, while Roche gained acces to a strong research engine to stock its marketing machine. This deal, along with successes on the product front drew investors to the sector again, creating an IPO (initial public offering) window in the early 1990s. In the 1990s saw the U.S. industry shift from an entrepreneurial sector driven by science, to one where commercialization became increasingly important.

The European biotechnology industry started to come into its own, initially within Europe's large pharmaceutical and chemical companies, universities, and research institutions. As the '90s progressed, increasing numbers of European companies emerged that specialised primarily in using biotechnology processes or in supplying technology to biotech firms. In the latter half of the '90s, European governments increased their focus on the sector with ambitious programmes to stimulate technology transfer and company formation. In the late 90s', investors around the world became increalingy drawn to e-commerce companies, and the dot-com bubble was born. Initially, the bubble exacerbated biotech fundings challenges, as private and public equity funds were drawn away from the sector. That trend changed dramatically in the decade's final years when the Human Genome Project drew investors to biotech companies, giving rise to the genomics bubble. But when investors realized that these scientific advances were unlikely to translate into near-term financial return, they pulled out of the sector.

What emerged from the ashes of the genomics bubble was an entirely new capital market environment. This time around, in a pattern seen across the world, only companies with late-stage pipelines and well-articulated paths to products received strong valuations. This new paradigm – in which there are no more IPO windows, and no good or bad times to go public – brings several benefits, including more stable and reliable capital flows. As biotechnolgy enters its fourth decade, the industry is strong and growing across the globe. The picture that emerges from this history is of an industry that has dealt with change at every stage of its growth. For a long time biotech lived under big pharma's shadow. At this moment biotech firms trade at much higher price-earnings ratios then their big pharma counterparts, reflecting the sector's higher growth potential. And, far from showing down as it comes of age, the industry, is growing rapidly, expanding around the globe, and bringing innovative new products to the market.

As the bioindustry turns 30 and we celebrate its many accomplishments, it is timely to acknowledge the emergence of biotechnology's so-called third wave. The first wave consisted of health biotechnology (red biotechnology) and the second wave of agrobiotechnology (green biotechnology), the third wave consists of industrial biotechnolgy, also called white biotechnology. Many industrial biotechnology contributions has been towards intermediate inputs for consumer products. Broadly defined, industrial biotechnolgy incorporates any use of plants, microorganisms, or biomolecules for industrial, manufactoring, or environmental purposes. It encompasses products and processes across dozens of markets, all sharing a common theme in moving us towards a sustainable global economy.

3. The Dutch Life Sciences sector

Introduction

The Netherlands has a long tradition in biotechnology. Dutch-based Life Sciences companies have an overall yearly turnover of more than 49 billion euros, invest 950 million euros in research and development every year and employ 255.000 people (TNO STB, 2002). In general there is a distinction between 'Red' biotechnolgy which is confined to the healthcare sector, whereas'green' biotechnology is applied to the agro-food sector. The third sector is the so called 'white' biotechnology also known as industrial biotechnology.
The Life Sciences sector consists of four subsectors:

1. Agro-food (Animal; Plant & Seeds; Food/Nutraceuticals);
2. Human Health (Diagostics; Therapeutics; Prevention);
3. General Biotechnology (Bio-chemicals; Equipment, instrument & reagents, and others);
4. Environment.

Structure of the Life Sciences sector

A distinction is made between three categories of companies in the Life Sciences sector:

1. *'Dedicated' Life Sciences companies.*
   Knowledge-intensive companies, such as Crucell, Galapagos, Pharming Group, IsoTis SA, Fornix BioSciences, Keygene, specialised in biotechnology that are active in R&D and its application on processes, products and/or services.
2. *'Diversified' Life Sciences companies*
   Companies that, following the emergence of modern Life Sciences, integrate these in their existing R&D and production activities. Companies, such as Unilever, DSM, Akzo Nobel, Numico, Nutreco, Friesland Coberco Dairy Foods, CSM, Avebe, Cosun, Purac.
3. *'Following' Life Sciences companies.*
   Companies, such as beer breweries (Heineken and others) and most seed developers, that do not carry out R&D in the field of Life Sciences themselves, but do make use of Life Sciences knowledge (developed elsewhere) in their business activities.

More than four hundred companies are active in the Netherlands, of which about 124 are dedicated Life Science companies, about 30 diversified Life Sciences companies and about 300 follower Life

Sciences companies. In 2001 the group of dedicated Life Sciences companies realised a joint turnover of almost € 120 million with about 2.400 employees. Pharmaceuticals and fine chemicals companies account for more then 70% in this group, of which about 60% are employed in R&D.

The group if diversified Life Sciences companies toghether account for an annual turnover of almost € 50 billion. The big three, Unilever, DSM and AKZO Pharma are responsible for € 28 billion in this group. No specific data is available on approximately 300 follower Life Sciences companies. About 4.800 persons work in R&D in the Netherlands.
The share of the knowledge intensive pharmaceutical sector, inculding fine chemicals, amounts € 773 million and 3.300 R&D employees. For the Agrifood these figures are € 170 million and almost 1.500 persons in R&D. Akzo Pharma, DSM and Unilever accounted for more than 75% of the total R&D investment and more than 50% of the total number of people working in R&D. Viewed from an international perspective, The Netherlands occupies the 8th position in Europe based on the number of dedicated and diversified companies. An important element of the knowledge intensive Life Sciences sector is formed by the techno-starters. As the backbone for innovation, these starters provide a major impetus for enhancing innovative ability. They convert knowledge, usually derived from public knowledge institutions, into commercial an market-oriented innovations. Another way of analysing the Netherlands' performance in the area of Life Sciences is to look at its position on patents. At an international level the Netherlands is among the top 7 countries with a strong rise in number of patents registered in the USA.

Segment	Share (%)
Genomics, proteomics and enabling technologies	**28**
Therapeutics	**25**
Diagnostics	**12**
Drug discovery technologies and services	**10**
Drug delivery	**9**
AgBIO	**6**
Tissue engineering	**5**
Industrial	**5**

Netherlands: 2005 distribution of biotech companies by segment. Source: Ernst & Young

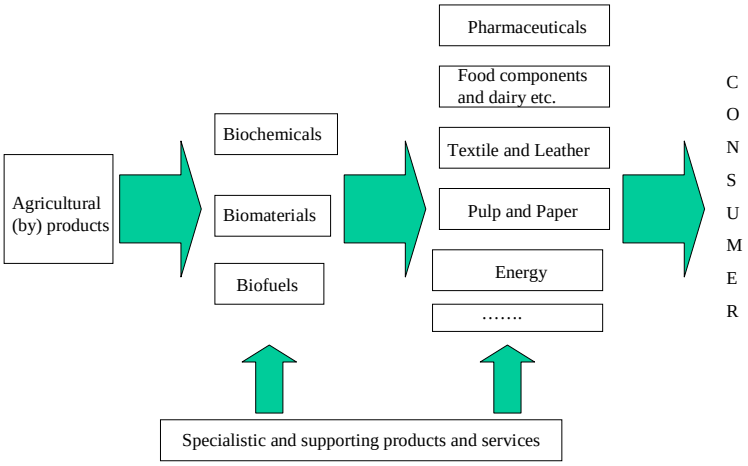
Industrial Biotechnology

Industrial biotechnology, also known as 'white' biotechnology, is the modern use and application of biotechnology for the sustainable production of biochemicals, biomaterials and biofuels from renewable resources, using living cells and/or their enzymes. A substantial part of the Dutch Life Sciences activities are devoted directly or indirectly to industrial biotechnology. The Netherlands has the infrastructure and potential to become a leading player in industrial biotechnology.

Industrial Biotechnology Value Chain

The figure below shows the industrial value chain. Raw materials, including crops and organic byproduct from agricultural resources and households, are converted into sugars. Starch, such as Avebe and Cargill, and sugar producers, such as CSM and Cosun are involved. In the second link the intermediates are produced, by conversion by tailor-made (micro-)organism. Important companies are DSM, Genencor, Diosynth (Akzo Nobel), Nedalco, Rodenburg Biopolymers and Purac. These companies supply amongst others to the pharmaceutical industry, the food and stimulant industry, textile- and paper industry. Important companies in this third link are amongst others Organon (Akzo Nobel), Solvay and Unilever.

Industrial Biotechnology Value Chain
Source: TNO, 2004



Traditionally, the Netherlands has a strong foothold in this value chain, given the presence of many important and international players in the agribusiness, food and chemical industry. Today the prime focus of the Dutch industry lies in the second part of the value chain, namely the fermentative and/or enzymatic production of biochemicals.

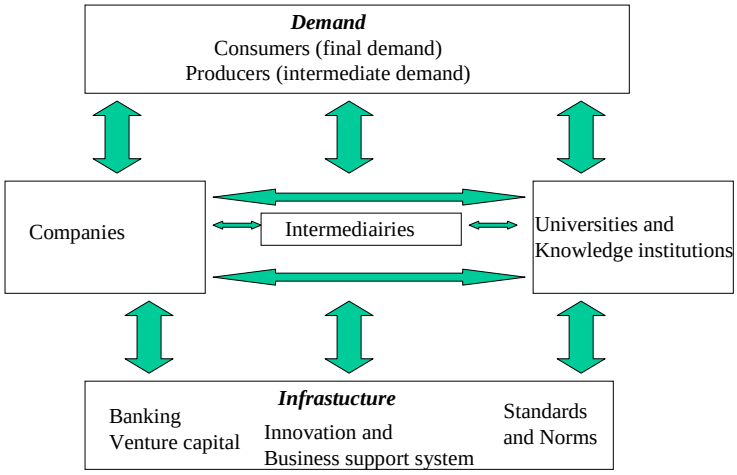
The most important universities and knowledge institutions in the industrial biotechnology domain are:

- Technical University Delft (Centre of Biotechnolgy, Kuyver Centre);
- University Groningen (Biomolecular Sciences and Biotechnolgy Institute);
- Wageningen University (Wageningen Centre for Food Sciences –WCFS, Agrotechnology and Food Innovations –A&F;
- University of Leiden (molecular genetics and cell biology);
- University of Utrecht;
- Radbout University Nijmegen;
- NIZO food research in Ede;
- TNO;
- Dutch Polymer Institute (DPI).

4. Dynamic innovation system in the Netherlands

Innovation is regarded as the essential factor in the motor driving sustainable growth, and that is why innovation policy has been given significant political and substantive impetus over the last few years. Life Sciences is considered as a key-technology in the road towards a knowledge economy. In the analysis and policy framework for innovation policy, the emphasis is shifting increasingly towards the interaction between the players (market, government, intermediairies) in the dynamic innovation system and an integral system approach, particular in the field of work of Life Sciences. After all, innovation, and certainly the long-term development processes in Life Sciences, do not occur in isolation, but in mutual interaction between many players and environmental conditions. The innovation chain is characterised less and less as a linear development model (from knowledge to market) but increasingly that of a cyclic model with feed-back mechanisms from application to fundamental research and the other development phases. These developments result in the creation of succesful concentrations of companies and knowledge institutions such as the BioScience Park in Leiden.

Systematic diagram of the dynamic innovation system
Source: adaptation of technolpolis



Innovation is only possible if the necessary environmental conditions are present, such as an efficiently functioning capital market, optimum protection of intelectual property rights, regulations on standardisation and normalisation, an attractive fiscal climate, propensity to innovation and entrepreneurship, a physical infrastructure that facilitates mobility, public perception and a level playing field. The functioning of the dynamic innovation system is determined by the quality of its components and their mutual relations and interaction. This quality is affected by the presence (or lack) of market, system and government imperfections in and between the variuos components of the innovation system.

Regional distribution

Mapping the location and intensity of Life Sciences activity in the Netherlands, it provides a view on where the dedicated Life (highly innovative) Sciences companies, incubators and science parks, genomics centers of excellence and other important Life Sciences industry participants are located. In the Netherlands 9 biotechnology clusters can be indentified in the following regions:

- Amsterdam region;
- Delft/Rotterdam region;
- Groningen region;
- Leiden/The Hague region;
- Lelystad region;
- Maastricht region;
- Nijmegen region;
- Utrecht region;
- Wageningen/Ede region.

If we look at the current numer of highly innovative Life Sciences companies, the region of Leiden takes the lead with 49 companies, followed by the regions of Utrecht (44), Amsterdam (40), Groningen (25), Arnhem/Nijmegen (22) and Wageningen (21). By splitting the regional distribution into subsectors, it can be determined in which areas the concentration of the various subsectors lies. There is a high-concentration of agro-food companies in the regios of Wageningen and North East of North-Brabant. The majority of general biotechnology companies are located around Leiden, Utrecht, Groningen and Amsterdam. Human health is concentrated around Utrecht, Leiden and Amsterdam. The development of new companies appears to be closely related to the presence of knowledge

institutions. Wageningen University and Research Centre (WUR) and the University of Groningen have generated the highest number of Life Sciences spin-offs to date.

5. Economic and technological trends in Life Sciences in the Netherlands

Economic trends

Life Sciences is generally acknowledged as the next step after ICT towards a knowledge-intensive economy, with which new opportunities are created for the economy and society. At this moment the European Life Sciences market is estimated to amount to more than € 100 billion.

Expectations for the *pharmaceuticals* and *fine chemicals* area of application are very positive. The figures show a clear trend: substantial growth. The global market for pharmaceuticals will grow continuously: more than a doubling in 2010 compared to the market in 2000. The share of biotechnology-related products will rise relatively sharply. The ambition of a number of Dutch companies is high. The estimates for the impact (use of biological processes) of Life Sciences in the chemical industry for 2010 are between 10 and 20%. In 2010 the estimated share in the turnover of the Dutch pharmaceutical industry of biotech nature is 34%. In the chemical industry an estimated share of 27% of the turnover will be of biotech nature in 2010.

Market expectations for *agrifood* – Life Sciences related food (including genetic modification) vary widely. Market acceptance is the determining factor here. The production volume of the food market in the OECD countries is expected to remain more or less the same, but the share of products with a high added value such as new foods (functional foods) will rise by about 10% a year. In 2010 the estimated share in the turnover of the Dutch agrifood sector of biotech nature is 30%.

Biotechnology already forms an important part of the *environmental market.* The Dutch position in this international market has always been strong and, in view of the expectations of the companies in the sector itself, will be able to reinforce itself further. In 2010 the estimated share in the turnover of the Dutch environmental market of biotech nature is 18%.

There is little market information on the *tools and equipment sector* in relation to Life Sciences. Interviews with Dutch companies in this sector indicate that these companies may be able to benefit from a 10 to 15% growth in turnover.

Technological trends and areas of innovation

The trends in Life Sciences affect the above-mentioned sectors in different ways. After a brief explanation of the generic and cross-technological features of Life Sciences, this chapter will deal with the economic applications per sector in terms of new products and processes.

The most important technological trend in Life Sciences is *genomics*, in particular transcriptonomics (the functioning of genes), proteomics (the functioning of proteins), metabolomics (metabolism in the cell) and systems biology. Systems biology is the combination of these functional genomics techniques. New knowledge based on genomics research, combined with advances in areas of technology that were already being used in the last century such as *high throughput* analysis techniques and other biotechnology techniques (cloning, cell and tissue culturing, genetic modification) will have a far-reaching effect on various economic and social sectors in the coming decades.

In addition, future technological development in Life Sciences is characterised above all by the *integration of developments in biosciences* with developments in three other generic technologies: ICT, nanotechnology (microsystems, nanosystems and molecular systems) and materials technology.

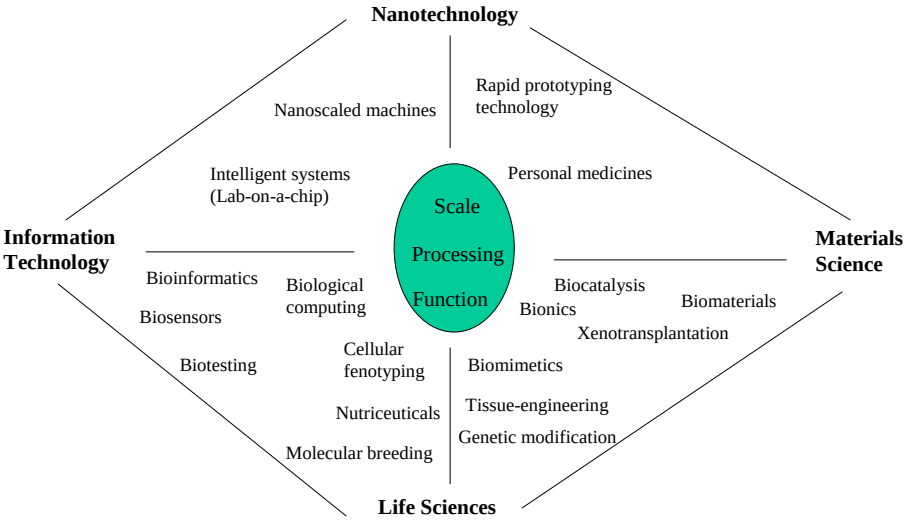
The figure below shows how these four generic technologies combine and integrate with each other, thus producing new technological systems and applications.
This integration can lead to results in three different areas: scale, processing and function. Smart systems such as a *lab-on-a-chip*, for example, are the result of the integration between nanotechnology and information technology, whereby complex processes can be organised on a nano scale. Smart materials are the result, for example, of the integration between biosciences and materials technology, with new materials that possess new, special functions.

The integration of information technology in Life Sciences is extremely important. In bio-information technology, methods are being developed to manage and analyse large volumes of genomics data quickly and efficiently. Combined with the increasing use of user groups and virtual networks of patients, doctors, hospitals, and other parties, this produces above all major breakthroughs in diagnostics and research into medicines. Identifying new *drug targets*, undertaking clinical trials, but also developing *mass-customised* medicines will be realised much more efficiently and effectively as a result.

Bionanotechnology uses biological components and principles at nanometre scale. It is being used, among other things, for surface treatment and making *scaffolds* (frameworks to which tissue structures can attach themselves), medical implants and biomedical systems at nanometre scale. Bionanotechnology, in combination with the rapidly growing knowledge of the human body, will lead to major breakthroughs in the diagnosis, treatment and prevention of illnesses and disorders.

Materials technology offers many opportunities in combination with the three other generic technologies. By using biological principles and concepts, smart, 'intelligent' materials can be developed with multifunctional properties.

Cross technological developments at the interfaces of four technologies
Source: TNO STB, adaptation of a figure from Anton, P et al 2001



The combination of knowledge in Life Sciences and other technologies such as ICT will ensure new development opportunities and innovations in a wide variety of sectors. The four most important areas of application are pharmaceuticals and fine chemicals, agrifood, the environment and tools. Below follows a discussion about the expected sector-specific developments.

Innovations in the pharmaceutical and fine chemical sector

The detailed mapping of the sequence of the human genome has recently been completed. This will lead to far-reaching developments in the biomedical and biopharmaceutical sciences in the coming two

decades. Life Sciences knowledge in this sector is also known as ‘red’ biotechnology. Innovations are numerous and comprise the following areas of application:

- Diagnostics;
- Medicines;
- Gene therapy;
- Tissue and organ engineering;
- Biomedical materials;
- Fine chemicals;
- Personal care.

Innovations in the agrifood sector

The developments in functional genomics and *systems biology* may well have a significant impact on agriculture and the food and luxury goods sector. We already know that various foods such as vegetables contain certain chemicals that have a beneficial effect on health. If gene passports become available in the future, nutritional advice can be given to suit the person (*personalised nutrition),* and there may even be a role for *personalised food.* This development is in fact already underway with the development of food for specific groups of patients.
Diagnostic systems (biosensors and biotests), partly developed on the basis of functional genomics, will contribute to increasing the safety and quality of foods. Biosensors can be used throughout the entire production process to register contamination, pathogens and signs of decomposition.
Another important development is that of crops with a high added value. This involves, for instance, the plant as a means of production for such products as vaccines, new types of proteins, raw materials for medicines, biopolymers and bioplastics.
Finally, genomics research is used for agronomic plant and animal breeding. The new genetic properties discovered through functional genomics research can be incorporated in the breeding process both with classic methods and with genetic modification techniques.

Innovations in the environmental sector

Life Sciences knowledge is used increasingly for developing clean production processes and designing new products that are more environmentally friendly. Examples of the latter are bioplastics, potatoes without amylase and trees with less lignin. Environmental biotechnology also focuses on the development of new sources of energy to replace fossil fuels. Research is concentrated above all on the reduction of environmentally harmful raw materials and on shortening the production process by using bacteria and enzymes. In addition, the raw materials themselves are modified in such a way that processing time and environmental impact is reduced.

Innovations in the equipment and tools sector

Manual processes in technical and scientific research are becoming more and more automated and are being taken over by machines. Proteomics is a hot item in the development of tools; tool producers are entering into all kinds of joint ventures aimed at developing integrated systems. During the last few years we have therefore seen a growing and ever more specialised sector producing laboratory tools and equipment specifically for Life Sciences.

An important spin-off from genomics research is the development of analytical methods that can be used in scientific research, the industrial production of medicines, food and during the storage and transport of biomaterials. An example is the DNA microchip, an important analytical tool in genomics research, for which other applications have been found too such as in food quality control, food safety and water quality.

Another development in this area is *biological computing,* such as nano-electrical circuits built from programmed DNA molecules. These are long-term developments and it will be some time before biological computers will supersede our present computers. *Biological computing* is based on the action of DNA and the brain (neural networks).

6. Selection of Players in the Dutch Life Sciences sector

Name and contact information	Field of activity
'Dedicated' Life Sciences companies	
AMGEN BV (Breda) www.amgen.nl	Amgen is a leading human therapeutics company in the biotechnology industry. For 25 years, the company has tapped the power of scientific discovery and innovation to dramatically improve people's lives.
Avantium (Amsterdam) www.avantium.nl	Avantium provides innovative, high value-added R&D services and tools to the pharmaceutical and chemical industries.
Crucell (Leiden) www.crucell.nl	It is Crucell's goal to improve healthcare throughout the world by fighting infectious diseases. Crucell does this by discovering, researching and developing technologies, vaccines and antibodies, using its own fully integrated infrastructure for in-house development, production and marketing and, where useful or necessary, by forging partnerships with other companies and organizations.
Pharming Group N.V (Leiden) www.pharming.com	Pharming strives to develop outstanding therapies for a range of medical needs based on our unique science and technology. Pharming specializes in the production of human proteins with healthcare potential, highly pure and in large quantities. Healthcare applications vary from treatment of genetic disorders, to repair of tissue damage during surgery and beyond.
Galapagos NV (Mechelen, Belgium)/Leiden www.glpg.com	Galapagos is a genomics based drug discovery company, that has drug discovery programs based on proprietary disease modifying drug targets. Their vision is to bring novel drugs to the market in selected diseases areas for which there is a need for effective and safe medicines.
Keygene NV (Wageningen) www.keygene.com	Keygene is a private cooperation that provides genetic and genomic research. Keygene works for leading vegetable and animal breeders, universities, hospitals and the fermentation and food industry. Keygene is a service provider in the genetic analysis of plants, animals and micro-organisms.
IsoTis SA (Lausanne Switzerland; Bilthoven) www.isotis.com	IsoTis OrthoBiologics has a product portfolio with several innovative and proprietary natural and synthetic bone graft substitutes on the market and others in development, an established North American independent distribution network, and an expanding international presence.
Fornix BioSciences (Lelystad) www.fornix.nl	Fornix BioSciences is a profitable Biotechnology company involved in the development, manufacturing and marketing of Biopharmaceuticals and related products. Fornix BioSciences was established in October 1999 as a result 'reversed takeover' of Dr Fisher Farma B.V. by Artu Biologicals N.V.
Applikon Biotechnology BV (Schiedam) www.applikon.com	Applikon Biotechnology is a privately owned Dutch company whose purpose is to develop, manufacture and supply on-line process analyzers and bioreactor systems for both research and production use.
Genencor International B.V. (Leiden) www.genencor.com	A different kind of biotechnology company, Genencor traces its roots to 1982 when a joint venture was established between Genentech and Corning to exploit the industrial applications of protein engineering. Genencor delivers over 250 diverse products to customers around the world. To serve those markets, we operate eight manufacturing centers in United States, Argentina, Belgium, China, and Finland. Our

	large and efficient organization enables us to deliver protein products at any scale to customers around the world.
KREATECH Biotechnology B.V. (Amsterdam) www.kreatech.com	KREATECH Biotechnology has committed itself to developing a unique range of tools for labeling and detection of DNA, RNA and proteins. In other words: we target labeling. This targeted research effort has resulted in a wide range of labeling and detection tools, based on a truly revolutionary patented technology platform: ULS™, Universal Linkage System. Using ULS, biomolecules can be labeled in a fast, robust and non-enzymatic way.
'Diversified' Life Sciences companies	
DSM N.V. (Heerlen) www.dsm.com See also www.niaba.nl (aangesloten leden)	DSM is one of the largest biotechnology companies in Europe. Biotechnology has, in one form or another, been a core activity for DSM for more than hundred years.
Unilever (Rotterdam) www.unilever.com See also www.niaba.nl (aangesloten leden)	Unilever's mission is to add vitality to life. Unilever meets everyday needs for nutrition, hygiene, and personal care.
Organon (Akzo Nobel Pharma) www.organon.com See also www.niaba.nl (aangesloten leden)	Organon is a renowned biopharmaceutical company with a strong commitment to health care. It is a truly global company, with products sold in more than 100 countries worldwide. More than half of these countries have an Organon subsidiary company.
Diosynth B.V. (Oss) www.diosynth.nl See also: www.diosynthbiotechnology.com	Diosynth, a business unit of Akzo Nobel, is a market-driven and technology based manufacturer of active pharmaceutical ingredients. The company's expertise is complex organic chemistry, extractions, cell culture, fermentation and chromatographic purification, including HPLC. These technologies are used on an industrial scale to manufacture steroids, synthetic peptides, opiate analogues, carbohydrates, insulin, heparin, human gonadotrophin and recombinant proteins as well as proprietary innovator products.
Numico (WTC Schiphol Airport) www.numico.com	Numico is a high growth, high margin, specialist baby food and clinical nutrition company. Acknowledged as the European and Asia Pacific market leader in infant nutrition and medical nutrition, our products range from infant milk formula to specialised nutrition for babies with specific needs and for breastfeeding mothers. For people with specific nutritional requirements, Numico offers a complete range of enteral clinical nutrition, diet products and disease-specific nutrition.
Royal Friesland Foods (Friesland Coberco Dairy Foods) www.fcdf.com	Friesland Coberco Dairy Foods is a multinational company that profitably develops, produces and sells a wide range of branded dairy products and fruit-based drinks for the consumer market, professional users and food producers. The company has a strong presence on dairy markets, especially in Western Europe, Central Europe, West Africa and Southeast Asia.
Avebe Group (Veendam) www.avebe.com	AVEBE is a global starch company. We create and market starch based solutions for food, feed, paper, building, textiles and adhesives industries. We have operations in 20 countries and employ around 2.000 people.
Royal Cosun (Breda) www.cosun.nl	Cosun produces and sells natural ingredients and foodstuffs for the international food industry, foodservice channel (restaurants, caterers and wholesalers) and retail outlets.
Purac (Gorinchem) www.purac.nl See also www.csm.nl	CSM, is a company operating and engaged in the development, production, sale and distribution of bakery supplies and food ingredients. CSM has a leading market position in bakery ingredients, sugar,

	lactic acid/lactates and gluconic acid/gluconates. CSM Biochemicals is a division of CSM and operates in the marketplace under the name PURAC. The principal product groups are lactic acid and lactic acid derivatives, gluconic acid and gluconic acid derivatives, lactic acid-based biomaterials and lactitol.
Nutreco (Boxmeer) www.nutreco.com	Nutreco is a global food and animal nutrition company inspired by consumer demands, creating value through sustainable modern aquaculture and agriculture.
Nedalco (Bergen op Zoom) www.nedalco.nl	Royal Nedalco, a subsidiary company of the Dutch sugar producer Cosun, is a leading producer of ethanol (ethyl alcohol) of agricultural origin in Europe.Together with our production location in Sas van Gent, our sales unit Belgalco our joint venture with Brüggemann Alcohol in Germany we have reached a strong position in the European alcohol market.
Rodenburg Biopolymers (Oosterhout) www.biopolymers.nl	Rodenburg Biopolymers is a member of the Rodenburg Group which offers a unique infrastructure. Rodenburg Biopolymers upgrade by-products of the food-processing industries towards bioplastics using state of the art technologies and environmentally friendly processes.
Solvay Pharmaceuticals B.V. www.solvay.com	Solvay is an international chemical and pharmaceutical Group. It employs more than 30 000 people in 50 countries.
Government	
Ministry of Economic Affairs Directorate-General for Innovation Market and Innovation Cluster Life Sciences PO Box 20101 2500 EC The Hague The Hague www.lifesciences.ez.nl	Improved treatment of disease, food that is safer and healthier and a cleaner environment are just a few of the applications for Life Sciences. Put simply, Life Sciences consists of a collection of techniques in which living organisms, or parts thereof, are used to make improved products or new processes.Life Sciences is an important supplier of innovative products and innovation is the engine that drives the sustainable growth of the Dutch economy. Economic Affairs has decided to work together with other ministries in order to promote Life Sciences. But this can only be achieved if we are able to put in place certain guarantees with regard to safety, transparency within the decision-making process, ethical acceptability and the freedom of choice for all of our fellow citizens.
Ministry of Health, Welfare and Sport Postbox 20350 2500 EJ Den Haag +31 (0)70) 340 79 11 www.minvws.nl	Medical biotechnology is set to play an increasingly important role in preventing, diagnosing and treating disease. The Ministry of Health, Welfare and Sport is highly enthusiastic about medical biotechnology and its applications, and supports research in the field of Life Sciences. To develop policy on the issue, the Ministry set up the Dutch Forum for Biotechnology and Genetics, together with other Dutch ministries, scientists and practitioners.
Netherlands Ministry of Housing, Spatial Planning and the Environment PO Box 20951 2500 EZ The Hague The Netherlands Telephone: +31 (0)70 339 39 39 www.vrom.nl	The Netherlands is a densely populated country where issues concerning space have to be considered carefully. The aim of VROM is to make living, working, recreation and moving inside the Netherlands pleasant. The Ministry wants to stimulate inhabitants and companies in the Netherlands to approach issues on nature, environment and raw materials in a responsible way. VROM establishes conditions for the above in agreement with citizens, interest groups and social organisations. It creates regulations and distributes subsidies for improving the country's living environment.

The Ministry of Agriculture, Nature and Food Quality (LNV) Bezuidenhoutseweg 73 2594 AC Den Haag Postbus 20401 2500 EK Den Haag T (070)3786868 www.minlnv.nl	The Ministry of Agriculture, Nature and Food Quality (LNV) considers this to be of prime importance and therefore ensures that the necessary biotechnology facilities are available in the Netherlands. There are two reasons why LNV places such importance on biotechnology. The first is that the agriculture and food industries are vital to the Dutch economy. The second is that the government believes that biotechnology can make a huge contribution to solving a number of intractable societal and social problems, such as environmental problems and food shortages in developing countries. The advent of genetically modified crops (gm crops) is a hot topic in the Netherlands and the rest of Europe. The question is whether conventional and organic agriculture can co-exist with the cultivation of genetically modified organisms (GMOs). Through mixing and cross-fertilisation, the cultivation of gm crops can lead to the contamination of non-gm products with gm substances. Currently no gm crops are grown commercially in the Netherlands and there are only a limited number of small-scale field trials.
OCW (Dutch Ministry of Education, Culture and Science) Ministry of OCW PO Box 16375 2500 BJ Den Haag T: 003170 412 34 56 www.minocw.nl	The Ministry of Education, Culture and Science makes policies, drafts legislation and appropriates public funds on behalf of Dutch citizens. It serves 3.5 million pupils, students and their parents, as well as artists, curators and teachers. And it serves everyone else in the Netherlands affected by the activities in its remit.
Science Park Amsterdam Kruislaan 404; 1098 SM Amsterdam P.O. Box 94604 1090 GP Amsterdam Phone: +31 20 525 7990 Fax: +31 20 525 7675 www.scienceparkamsterdam.nl	Science Park Amsterdam is a significant terrain near the centre of Amsterdam. It will be developed into Europe's largest high-tech location over the next ten years. At this moment the science park houses the Faculty of Science of the Universiteit van Amsterdam, several large Dutch national research institutes and about 80 high-tech companies. Science Park Amsterdam is historically known as a centre of excellence for computer-science and life-sciences. It houses the world's largest internet hub (AMS-IX), the best network and is home to many research institutes and companies which are pushing the frontiers of grid-technology, artificial intelligence and super-computing. The large life-science community in the park, with its focus on medical biology, genomics and proteomics is uniquely positioned, particularly as many opportunities exist to exploit synergies with the science park's computing community.
Leiden Bio Science Park www.lifemeetsscience.nl	Leiden is a centre of innovative life sciences research, and is the front runner in biomedical life sciences activities at national level. The aim of the partners involved in the collaboration is to promote the continued development of Leiden as the centre for innovative biomedical life sciences where the wealth of knowledge acquired can be used to benefit the wellbeing and prosperity of society.
Universities and Knowledge Institutions	
RUL (University of Leiden) www.leidenuniv.nl See also: www.bodl.bt.tudelft.nl	The University consists of nine faculties, a School of Management and a School of Education. The University houses faculties of Archaeology, Arts, Creative and Performing Arts, Law, LUMC (Leiden University Medical Center), Mathematics and Natural Sciences, Philosophy, Social and Behavioural Sciences, and Theology. Biotechnology Studies Delft Leiden is a joint initiative of Delft University of Technology and

	Leiden University.
RUG (University of Groningen) Biomolecular Sciences and Biotechnology Institute www.chem.rug.nl	
Radbout University Nijmegen www.ru.nl	Radboud University Nijmegen is one of the leading academic communities in the Netherlands. Renowned for its green campus, modern buildings, and state-of-the-art equipment, it has eight faculties and enrols over 16.000 students in approximately 90 study programmes (about 40 Bachelor's and more than 50 Master's programmes).
University of Utrecht www.uu.nl	Utrecht University, which celebrates its 370th anniversary, has developed into one of Europe's largest and most prominent institutes of research and education. Utrecht University offers the broadest spectrum of disciplines available in the Netherlands, innovative research and liaises with universities and research centres all over the world.
Wageningen University P.O. box 9101 6700 HB Wageningen The Netherlands Tel. +31 (0)317477477 www.wageningenuniversiteit.nl	Wageningen University is the leading European university in the Life Sciences. Researchers and students at Wageningen University focus on the fields of nutrition, health, nature and the living environment. Wageningen UR works on knowledge that helps us to create safe, healthy and above all tasty food. Food that is healthy and safe for us, but also for our environment. Wageningen UR develops more efficient production and distribution methods in which wastage of natural raw materials is minimised.
WCFS (Wageningen Centre for Food Sciences) P.O. Box 557 6700 AN Wageningen The Netherlands Tel. +31 317 485 383 Website http://www.wcfs.nl	WCFS is one of four Leading Technology Institutes (LTIs) established in 1997 as partnerships for innovation by industry, research and government. The LTIs are instruments of the innovation policy of the Netherlands government. WCFS has the ambition to become a leading research institute for food and nutrition in Europe with an increased number of partners and a larger research portfolio.
NIZO food research 2 Kernhemseweg P.O. Box 20 6710 BA Ede The Netherlands Telephone: +31 (0) 318 659 51 www.nizo.nl	Consumers make greater and greater demands on food producers. Taste, convenience and nutritional value are key words for them, just like safety and the conditions of production. To meet the consumer's demand, food manufacturers have to be capable of rapid innovations without any concession to the quality and reliability of the products. NIZO food research can help companies to achieve this. We do research for clients and we develop technologies for further improvement of products and production processes. Moreover, companies can engage NIZO food research for independent scientific support of health claims connected with products.
Delft University of Technology Department of Biotechnology Kluyver Laboratory for Biotechnology Julianalaan 67 2628 BC Delft The Netherlands www.bt.tudelft.nl	The department of Biotechnology concentrates on the multidisciplinary fields of Biocatalysis, Metabolic Engineering & Fermentation Technology, Environmental Biotechnology and Bioprocess Technology as well as the exciting developments in the area of Life Science & Technology - in particular, genomics and metabolomics.
TNO Schoemakerstraat 97 NL-2628 VK Delft P.O. Box 6000 NL-2600 JA Delft T +31 15 269 69 69 www.tno.nl	TNO is a knowledge organisation for companies, government bodies and public organisations. The daily work of some 5,000 employees is to develop and apply knowledge. We provide contract research and specialist consultancy as well as grant licences for patents and specialist software. We test and certify products and services, and issue an independent evaluation of quality. And we set up new companies to

	market innovations. The development and application of innovative knowledge: that's what we're all about.
DPI (Dutch Polymer Institute) P.O. Box 902 5600 AX Eindhoven T +31 40 247 56 29 www.polymers.nl	DPI is a foundation funded by industry, universities and government set up to perform exploratory research in the area of polymer materials. DPI operates at the interface of universities and industry, linking the scientific skills of university research groups to industrial need for innovation. DPI performs pre-competitive research projects to add value to the scientific community through scientific publications and to the industrial community through the creation of intellectual property. DPI provides an unique platform for new technology awareness in which participating industrial companies, commercially competitors in the market place, communicate on a pre-competitive basis to trigger innovation.
RIVM (National Institute for Public Health and the Environment) PO Box 1 3720 BA Bilthoven The Netherlands Tel: +31 (0)30-2749111 www.rivm.nl	RIVM's activities focus mainly on carrying out research tasks commissioned by the Dutch government, with statutory responsibilities in public health, nutrition and the environment. We also cooperate with such international bodies as the European Union and United Nations organisations, including WHO, FAO and UNEP. Reports on these activities can be accessed from Internet, either from this website or via links to other websites.
NWO, Division for the Chemical Sciences Dr Yvonne van der Meer Tel. +31 (0)70 3440758 www.nwo.nl	Sixteen research organisations from twelve European countries have joined forces inthe area of industrial biotechnology. The network will be coordinated from the NWO (Netherlands Organisation for Scientific Research) office in The Hague.
Genomics Centres of Excellence	
Kluyver Centre for Genomics of Industrial Fermentation Management Office Julianalaan 67 2628 BC Delft The Netherlands Tel: +31 (0)15 278 6990 Fax: +31 (0)15 278 2355 info@kluyvercentre.nl www.kluyvercentre.nl	The Kluyver Centre for Genomics of Industrial Fermentation is a consortium of Delft University of Technology, Wageningen University and Research Centre, Leiden University, Nijmegen University, Utrecht University, TNO, Wageningen Centre for Food Sciences, Agrotechnology and Food Innovations and NIZO food research. It employs microbial genomics to improve microorganisms for use in industrial fermentation processes. Fermentation is used in the production, from renewable feedstocks, of food products and ingredients, beverages, pharmaceutical compounds, nutraceuticals, and fine and bulk chemicals. The research covers six programmes: yeast fermentation, fungal fermentation, lactic acid fermentation, biocatalysis, genomics tools including bioinformatics and society and genomics.
Centre for Medical Systems Biology (CMSB) Leiden www.csmb.nl	The Centre for Medical Systems Biology (CMSB) is a joint activity of Leiden University Medical Center, Leiden University, Free University Medical Center and Free University Amsterdam, Erasmus MC Rotterdam and TNO Leiden, aiming to apply innovative multidisciplinary genomics and bioinformatics approaches to improve diagnosis, therapy and prevention of common and rare diseases.
The Centre for BioSystems Genomics (CBSG) Wageningen www.biosystemsgenomics.nl	The Centre for BioSystems Genomics (CBSG) is being established as a Centre of Excellence under the auspices of the Netherlands Genomics Initiative. The network of scientists now spans four universities, two research institutes and fifteen industrial parties in the Netherlands.
The Cancer Genomics Centre (Amsterdam) www.cancergenomics.nl	The mission of the Cancer Genomics Centre is to improve diagnosis, therapy and cure rates for cancer patients. Genomics offers new promising opportunities for cancer research, with realistic expectations for

	therapy improvement in the coming decade. For instance, the genomics signature of the cancer and that of the patient may serve in the near future as a basis on which to choose the most effective therapy for the individual patient ('personalized medicine') to improve cancer patients chances of recovery and their quality of life.
Centre for Society and Genomics (Nijmegen) www.society-genomics.nl	CSG's mission is to be a leading centre for understanding and stimulating the interaction between society and genomics, both nationally and internationally.
Netherlands Toxicogenomics Centre (Maastricht) www.toxicogenomics-centre.nl	It is the mission of the Netherlands Toxicogenomics Centre that the toxicogenomics approach should be used to take the unique opportunity of developing highly predictive screens based on gene expression or protein/metabolite fingerprints, to be used for in depth evaluation of chemical safety for human health, thereby replacing/reducing/refining animal experiments, and improving the scientific basis of chemical risk assessment.
Netherlands Bioinformatics Centre (Nijmegen) www.nbic.nl	Foundation NBIC initiates and coordinates research, education and support activities to stimulate the development of the field of bioinformatics. Bioinformatics is a new discipline that combines informatics and mathematics with the life sciences. It is closely related to genomics, which analyses genome information. The genome governs the functioning and biological processes of the organism. These studies generate enormous amounts of data and information, and huge computer capacities are needed for further processing and analysis. Bioinformatics provides the knowledge, applications and analytical tools to handle genomics data, and is crucial to achieve results in the life sciences.
The Netherlands Proteomics Centre (NPC) (Utrecht) www.netherlandsproteomicscentre.nl	The Netherlands Proteomics Centre (NPC) is a strategic collaboration of research groups from six universities, three academic medical centres and several biotech companies.
BioPartner Centers	
BPC Amsterdam www.asp.nl	Initiated by the Municipality of Amsterdam, the Dutch organization for Scientific Research (NWO), the Rabobank and the University of Amsterdam (UvA), ASP was founded in 1989 to promote transfer of knowledge from educational institutions to small and medium-sized businesses.
BPC Groningen See: www.technopartner.nl	
BPC leiden www.biopartnerleiden.nl	In April 2001 BioPartner Center Leiden was the first BioPartner Center in The Netherlands to locate biotech start-ups. It resides in the BioScience Park in Leiden.
BPC Maastricht www.bpcm.nl	BioPartner Center Maastricht offers business accommodation to life sciences start-ups. Its main mission is to increase the chance of success for Life Sciences start-ups. Through its three tissue incubators and GMP cell therapy clean rooms, the Center offers a complete range of facilities from laboratory scale to GMP production for Life Sciences companies active in the fields of cell therapy and cell culturing.
BPC Utrecht E-mail: g.vanstrien@holdings.uu.nl	
BPC Wageningen www.biopartnerwageningen.nl	The business incubator BioPartner Center Wageningen offers a unique environment for life sciences start-ups, a place where facilities and knowledge can be shared.

	This accommodation package is also available to non-life sciences start-up companies.
Food Valley (Wageningen) www.foodvalley.nl	The Dutch ambition to create excellence in food is reflected in the name Food Valley. It is *the* science and innovation region of The Netherlands for agrofood, life sciences and health. Nationally, the annual turnover in agrofood exceeds 40 billion euro. Holland is proud to have a great history in food and agriculture - not only in R&D and production but also in marketing, trade and logistics.
BioMedCity (Groningen) www.biomedcity.nl	Groningen presents itself as BioMed City, and for good reason. The presence of several prominent businesses, the excellent research institutes, opportunities for knowledge transfer, and the availability of business incubators ensure that Groningen can offer a highly advantageous business climate for companies in this sector.
Biomedbooster (Maastricht) www.biomedbooster.com	BioMedbooster is a valorization company. The goal of Biomedbooster is to identify new ideas and technologies, analyse their market potential and assist with further commercial exploitation. For this, BioMedbooster has been granted the unique rights of the University of Maastricht (uM) and the Academic Hospital Maastricht (azM) to facilitate the exploitation of all new inventions in life sciences.
Competence Centre Life Sciences (CCLS) www.ccls.nl	CCLS is the Life Sciences network for the region South-Holland. With more than 90 Life Sciences companies, incubator facilities, research institutes, world leading Universities and Medical Centres South-Holland is the most dense area of Life Sciences activities in the Netherlands. CCLS guides you to excellent business and research opportunities present in the Life Sciences Cluster of South-Holland.
Intermediairies	
Niaba Rob T.A. Janssen (Managing Director) P.O. Box 443 2260 AK Leidschendam The Netherlands Tel.: (+31) 70 337 87 64 Fax: (+31) 70 337 87 65 E-mail: niaba@niaba.vnci.nl www.niaba.nl	Niaba is the Netherlands' Biotech Industry Association. With more than 60 members it represents the majority of the Dutch biotechnological companies and related organisations in human and animal healthcare, food, feed, agriculture and environment. Among its members are not only large multinationals companies such as Unilever and Akzo Nobel, but also small biotechnological companies, major research institutes and associations in related sectors. Niaba is active in the fields of lobbying and advising governments, but also on issues such as research and development. Furthermore Niaba focuses on communication with the general public on biotechnology. Niaba also works on improving other aspects of the business climate. One issue is the fact that Dutch universities do not patent their inventions as often as required. At the same time scientists still face too many problems when they want to start their own company.
NBV Netherlands Biotechnological Society p/a Dr. J.W. Chapman Unilever Research & Development Postbox 114 3130 AC VLAARDINGEN T.+-31-10-4605247 www.nbvsite.nl	The aim of the NBV is to promote the development of biotechnology in its broadest sense.
EFB Central Office (ECO) Christian Suojanen, Secretary General	The European Federation of Biotechnology (EFB) was established by European scientists in 1978. The objective of EFB is to promote safe and ethically

Anna Alsina, Communications Coordinator Alexandra Castells, Office Coordinator Pg. Lluis Companys 23, 08010 Barcelona - Spain Tel +34 93 268 77 03 Fax +34 93 268 45 00 E-mail: efb@efb-central.org, register@efb-central.org www.efb-central.org	acceptable biotechnology for the better use of Nature's resources. EFB also wishes to expand collaborations between academic and industrial researchers throughout Europe to increase competencies, strengthen education, promote innovation and increase the benefits of biotechnological research to society at large.
SBN Netherlands Biotechnology Foundation Dr. J. Sikkema Friesland Coberco Dairy Foods, Corporate Research Postbus 87, 7400 AB Deventer Fax: 0570-695986 E-mail: j.sikkema@fcdf.nl	Netherlands Biotechnology Foundation was founded in 1986 with the aim to stimulate biotechnology inthe Netherlands, with special focus on supporting young researchers, biotechnological events and facilitating the participation of Dutch biotechnologists in international activities.
B-Basic Julianalaan 67 2628 BC Delft The Netherlands T: +31 15 278 2342 F: +31 15 278 2355 E: info@b-basic.nl www.b-basic.nl	B-Basic is a consortium of universities, research institutions and industry. The programme focuses on the development of new bio-based production concepts for the chemical (and energy) industry which are rooted in the current explosive increase in fundamental insights in molecular biology through the genomics revolution, combined with advanced bioprocess technology and existing chemical knowledge. Research in the B-Basic optimally benefits from the latest breakthroughs in genomics research by using the new insights to develop processes that can convert biomass into chemicals using biocatalysts as microorganisms and enzymes. B-Basic is an independent NOW-ACTS programme. The scientific and business director are provided by the Delft University of Technology.
ACTS (Advanced Chemical Technologies for Sustainability) www.nwo.nl/nwohome.nsf/pages/NWOA_6P69LY	ACTS is the Dutch platform for pre-competitive research in chemistry and chemical technology in which catalysis plays a pivotal role. In ACTS government, industry, university and knowledge institutes cooperate in public-private partnerships. It is the mission of ACTS to initiate and support the development of new technological concepts for the sustainable production of materials and energy carriers, essential for the supply of food, comfort, health, shelter and mobility to the inhabitants of tomorrow's world. Through its activities ACTS will contribute to the sustainable economic growth and to the knowledge infrastructure in the Netherlands, and attract young talent to a career in science and technology.
Technopartner www.technopartner.nl	TechnoPartner concentrates on helping technostarters in Holland.
Holland Biotechnology www.hollandbiotechnology.nl	Portal site for Biotechnology in the Netherlands.
ABON www.bio-ned.nl	ASSOCIATION OF BIOTECHNOLOGY CENTRES IN THE NETHERLANDS.
Ernst & Young Health Sciences P.O. Box 7883 1008 AB Amsterdam The Netherlands Tel. +31 (0)20 5497245 www.ey.nl	University medical centres and other academic bodies are a source of many biotechnology start-ups. Their development of new drugs and equipment has had a significant influence on business processes in the health sector. At the same time, the industry is rapidly internationalizing and rolling back national and market boundaries. To be of even greater service to the organizations operating in this dynamic world, Ernst & Young recently combined its many years' know-how and experience in this area to create a Health Sciences Sector Group.

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