The Swiss Chemical and Pharmaceutical Industry
Table of contents

Introduction 1
  Preface: Ability to innovate as the key to success 1
  Chemistry and the chemical industry 3
  The Swiss chemical and pharmaceutical industry 4

The Swiss chemical-pharmaceutical industry on the world markets 5
  Worldwide sales 5
  Leading export nation 6
  Focus on life science products and chemical specialties 7
  Increasing trend towards specialties 8
  Increased focus of the companies 10
  Internationally leading companies 11
    Lead positions in individual market segments 11
  Worldwide presence 14
    World map of direct investments 14
    Employees abroad 15
    Growing importance of direct investments abroad 16

Innovation as the lifeblood 17
  Innovation as the basis for economic success 17
  High research intensity 22
  Internationally integrated research 23
  Rapidly rising costs of research and development 24
  Stringent regulatory environment 25

The chemical-pharmaceutical industry in Switzerland 27
  Switzerland: an important research location 27
    R&D expenditures in Switzerland 27
    Employees in R&D in Switzerland 28
    Exports are financing R&D expenditures in Switzerland 29
  Strong dependency on export 30
    Imports and exports are vital 30
    Important export industry 31
    Growing importance of exports 32
    Significant trade surplus 33
  Production and employment 35
    Contribution to Gross Domestic Product 35
    Dynamic industry 36
    Major employer in industry 37
    Size of companies in Switzerland 38

RESPONSIBLE CARE 39
  The Programme 39
  Principles for health, safety and protection of the environment 40
  Parameters as Indicators of Performance 41
    Workplace Safety 42
    Energy Consumption 43
    CO2 Emissions 44
    VOC Emissions 45
    Water Consumption 46
Preface: Ability to innovate as the key to success

• for the chemical and pharmaceutical industry

The chemical industry is present in Switzerland for over 150 years. From the beginning, a small domestic market and the lack of chemical raw materials induced a focus on the production and world-wide marketing of specialised chemicals with high added value. Despite all changes which took place during the course of the years, this basic orientation has continued to be the key to success for the Swiss chemical and pharmaceutical industry, which today emphasises heavily life-science products as well as high-value specialty chemicals.

Economic success is never secured for ever; the industry has always had to face the challenges of the day. Currently, we are experiencing enormous changes in the world economy. The unexpectedly rapid opening up of many Eastern European and South East Asian markets, as well as the unstoppable technological revolution in biotechnology, in genetic engineering, in information technology and telecommunications are creating a new international economic environment.

The companies operating in our industry face a continuous need to adapt to this changing environment. Existing manufacturing locations world-wide are being re-evaluated to assess competitive advantages; new corporate objectives and restructuring are inevitable to successfully operate under intensified international competition. For a long time, the strength of the Swiss chemical and pharmaceutical industry has been innovation and the ability to quickly respond to changes in the domestic as well as in the foreign environment.

A merely defensive corporate strategy geared exclusively towards greater efficiency - rationalisation and cost reduction - would not go far enough. In our sector, each cost-cutting strategy must be supplemented and extended by a strong element of innovation. The capability for innovation is and remains our most important key for future economic success. Innovation today, however, is not limited to products and production methods, it also includes administrative processes and organisational structures. Translation of ideas into fully developed products and services has to be better, faster and more cost-effective. This means that innovation no longer depends solely on the scientific skills of a few top scientists, but is increasingly determined by the professionalism of the entire workforce.

An important aspect of modern management in the chemical and pharmaceutical industry is the trend towards highly competitive companies focusing on their core competencies. Such companies control all elements of the total value chain - from the raw material to the final product - without however, owning all the elements of the chain. By co-ordinating the collaboration of many autonomous firms, large virtual enterprises arise. Each contributing node in the value chain concentrates on developing its specific strength in this network of firms. The division of labour intensifies in line with the comparative advantages of the individual companies. While the core companies restrict their activities to innovation and co-ordination and shrink their workforce size accordingly, their periphery of business partners, suppliers, traders, laboratories, etc. grows through outsourcing. The emerging niches enable a considerable number of smaller, medium-sized enterprises to operate as specialised sub-contractors and service providers, both at home and abroad.

• for Switzerland
The changing international economic environment also presents a great challenge to individual countries. In a world where all production factors, with the exception of labour, have become mobile, Switzerland must create internationally outstanding conditions for the economy in order to protect the welfare of its citizens. Countries too, have to follow the dual strategy of 'cutting costs - promoting innovative capability'. scienceindustries therefore expressly welcomes the program of economic renewal launched in Switzerland a few years ago. It hopes that this revitalisation will boost competition and exert a favourable influence on price and cost levels in Switzerland, which are excessively high compared to international standards.

At the same time, capabilities of Swiss companies for innovation must be strengthened through setting appropriate basic conditions. To achieve this, the legislation should not delay or prevent advances into new areas of knowledge and technology and their industrial development in Switzerland. Rather, the government has to contribute towards a climate of openness to innovation. Genetic engineering will play a vital role for the future of our industry. It is a modern key technology that is essential in all scientific fields of the chemical industry, from research to manufacturing. The industry is in need of reliable legal guidelines to allow the application of this technology in Switzerland. Academia and industry have to increase their efforts to convince the population of the benefits of genetic engineering in daily life. Distrust can only be allayed through open information; acceptance only gained through honesty.

Finally, an up-to-date Swiss government must also ensure that its institutional relations to the world economy, that is to its major trade partners, are on a basis that meets the new economic challenges. This includes, first of all, a commitment to actively contribute to the deepening and strengthening of the multilateral trade system of the World Trade Organisation (WTO). It also includes the establishment of our relationship with the European Union on the basis of the current realities and developments.
Chemistry and the chemical industry

Chemistry is the science of molecules, their properties, their composition, their synthesis and transformation. The discipline of chemistry is grouped into different areas, such as inorganic chemistry, organic chemistry, biochemistry, pharmaceutical chemistry, agrochemistry and food chemistry.

Scientific findings form the basis for the activities of the chemical industry. The activities are mainly centred around the chemical transformation of diverse base materials into substances with new chemical, physical and biological properties. The chemical industry can roughly be seen as two general categories: base and specialty chemistry, the latter including the pharmaceutical industry. Base chemistry uses primarily petroleum, but also minerals and metals as starting materials to produce fairly basic chemicals in large quantities. The specialty chemistry manufactures a wide variety of high-grade, high-value products for application in different areas.

The chemical and pharmaceutical industry significantly contributes to the standard of living.

The chemical industry provides a decisive contribution to the life of modern mankind through its products and activities: it meets the demands for health (health care drugs and diagnostics), food (fertilisers, crop protection, additives), clothing (dyes, fibres) and many others.

Many products of daily life have a surprisingly high content of substances provided by the chemical industry, as might be seen in the following graph:
The Swiss chemical and pharmaceutical industry

The Swiss chemical and pharmaceutical industry operates nearly exclusively in the field of specialties. Today 90% of the Swiss chemical industry's overall product portfolio are specialties; a remarkable portion compared to international average. Producing more than 30'000 products, it is exceptionally differentiated. The global annual demand for some of these specialties often is below a few metric tons and even lower.

The following major product groups can be distinguished in terms of areas of application:

- Pharmaceuticals and diagnostics
- Fine chemicals
- Vitamins
- Flavours and fragrances
- Crop protection agents
- Specialty chemicals for industrial-technical purposes
- Pigments, paints and lacquers.

This strategy of concentration on specialties is the Swiss chemical and pharmaceutical industry's key to success. With their high-grade specialised products Swiss companies have established a world-wide presence, and often a market leadership.

Research and development for new products and processes are the lifeblood of the Swiss chemical and pharmaceutical industry. Using scientific findings and methodologies, our companies continuously develop new products and processes which satisfy existing and future requirements of customers. The necessary, significant investment into research can only be made if the companies can rely on future returns. Research expenditures are funded by the profits made from the sale of today's products.

The most important ingredients for this innovation process are the scientific and technological know-how and the skills of the workforce. Their work is decisive for the success of a research or development project. Additionally, the company has to provide the necessary research infrastructure and to create an open, creative atmosphere with a management style inkeeping with the times. However given all these factors, scientific success can be neither planned nor guaranteed. While the risk of failure can be reduced by adequate research management, investments in research nevertheless carry a high risk compared to capital expenditures in physical assets.
Worldwide sales

World-wide sales of the "top ten" Swiss chemical and pharmaceutical companies

Total 2011: 149.2 bn CHF

The Swiss chemical and pharmaceutical companies are present on all world markets as suppliers of speciality products.

The Swiss chemical and pharmaceutical industry has an outspoken international orientation, clearly demonstrated by the geographical breakdown of its sales. Europe and America each share about 40 % of the sales, while Asia takes in 23 %, leaving Switzerland with a very small domestic market.

World-wide marketing is an essential part of the strategy of specialties, which is based on the manufacturing and sale of innovative high-value products. Swiss companies have been present on the international markets for decades, not only the big multinational corporations, but also many small and medium-sized enterprises which pursue their successful niche strategies.
Leading export nation

Switzerland is a leading exporter of chemicals.

With a share of about 5% of the world export of chemical and pharmaceutical products, Switzerland is number 8 among the biggest export nations.

This leading position is astonishing, as Switzerland is number 95 in terms of inhabitants and number 147 in terms of its area extension. Measured on its gross domestic product index however, Switzerland takes the position of number 33.
Focus on life science products and chemical specialties

World-wide turnover of the "top ten" Swiss chemical and pharmaceutical companies

Total 2011: 149.2 bn CHF

The Swiss chemical and pharmaceutical industry is a producer of specialties, emphasising 'life science' products.

The breakdown of the turnover along product groups, clearly demonstrates the orientation of the industry towards specialties. About three quarters of the products are life-science products, defined as products impacting on the metabolic processes of living organisms. This group includes in particular pharmaceuticals, vitamins and fine chemicals, as well as crop protection agents and animal health preparations.

- Pharmaceuticals: prescription and over-the-counter drugs (patented or generic) as well as their ingredients to be used in formulations.
- Diagnostics: health care products which support the physician to get additional information for curing a disease.
- Vitamins, flavours and fragrances: products not ready for consumption, but rather ingredients in the form of 'bulk products' to be used in the manufacturing of pharmaceuticals, foodstuffs, animal feed as well as cosmetics and perfumes.
- Crop protection agents: herbicides, fungicides and insecticides including their active ingredients. Primarily used in agriculture.
- Specialty and fine chemicals: numerous highly specialised products providing specific effects, often manufactured in relatively small quantities and in response to specific needs of individual customers. Professional advice to customers is usually of considerable importance with these products.
Increasing trend towards specialties

Share of specialties in the total exported volume

The pharmaceuticals have increased their share and importance during the last two decades.

The Swiss chemical and pharmaceutical industry shows a rapid and significant development into high-value specialties. In particular the pharmaceuticals have gained importance: their share of the total export of the industry has increased since 1980 from 40 % to 81 %.

Export Growth 1980 - 2011 (1980 = 100 %)

From 1980 to 2011 exports of pharmaceuticals, vitamines and diagnostics have risen from 100 % to over 1600 %. In the other specialties areas the growth has been more moderate with
increases from 130 % to 400 %. (Beginning with 1988 pharmaceutical and crop protection intermediates are also included in the export figures, reducing the share of organic products).
Increased focus of the companies

Industry restructuring illustrated by the Basle based chemical companies (1970 - 2010)

The companies of the chemical and pharmaceutical industry are continuously focusing on their core competencies.

The continuing focus of the companies towards their core competencies has changed the chemical and pharmaceutical industry in Switzerland with a lasting effect. The continuation of the strategy towards specialties not only geared the companies towards high-value products; it also induced an ongoing regrouping and restructuring of the companies and the industry as a whole. Out of diversified companies with a broad product offering arose a set of focused companies, active in very different markets with different products. This development is illustrated by showing as an example the restructuring which occurred in the chemical and pharmaceutical companies in Basle.

At the same time a new branch of companies has emerged in the past years: the biotechnology companies, existing beneath the branches of chemical and pharmaceutical companies. Biotechnology and genetic engineering is used as a basic technology in different areas of the industry. Besides the use of the technology in research and manufacturing a number of companies established themselves as pure biotech enterprises. Following a report of Ernst & Young (2003), the number of such companies active in Switzerland has tripled from 70 to 210 in the period from 1998 to 2003. These young companies - founded as start-ups by researchers out of the industry or universities - in the meantime employ approximately 11’000 people and create a turnover of 4.3 bn CHF. These companies constitute an economic factor of growing importance.
**Internationally leading companies**

**Lead positions in individual market segments**

The strategy of specialised products of Swiss companies has proved extremely successful over recent decades. Thanks to their outstanding performance in research, development and marketing, some companies have taken the international lead in their field, or at least joined the top group of companies. Our companies are frequently the world-wide leaders in their specific business segments, whether it is in the fields of 'life science' products or of specialty chemicals.

The success of the Swiss chemical and pharmaceutical industry can best be illustrated by listing some market segments in which well-known Swiss companies have achieved a leading global position. This table, structured by product group, cannot of course claim to be complete, since it restricts itself to the Swiss companies with the highest international profile.

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<th><strong>The Swiss companies in the chemical and pharmaceutical industry occupy leading positions in many market segments.</strong></th>
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**Agrochemicals:**

- Crop protection agents (Syngenta)
- Seeds for crops, vegetables and flowers (Syngenta)

**Flavours and fragrances:**

- Flavours (Firmenich, Givaudan)
- Fragrances (Firmenich, Givaudan)

**Diagnostics:**

- Blood screening, woman's health, genomics, microbiology, virology (Roche)
- Clinical chemistry (Roche)
- Diabetes (Roche)
- E-health solutions (Roche)
- Immune system chemistry (Roche)
- Molecular diagnostics (Roche)
- Patient care (Roche)

**Fine chemicals, vitamins:**

- Animal feed additives (DSM)
- Diketene, hydrocyanic acid and their derivatives (Lonza)
- Exclusive manufacturing of active ingredients and intermediates for the life science industry (Lonza, Siegfried)
- Indol derivatives and tetrazoles (Dottikon Exclusive Synthesis)
- Ingredients and formulations as well as development of their manufacturing processes for generics companies (Siegfried)
- Ingredients and substances under government control (Siegfried)
- Nitrate esters (Dottikon Exclusive Synthesis)
• Safety critical synthesis under ISO and GMP requirements (Dottikon Exclusive Synthesis).

**Pharmaceuticals:**

• Anaemia (Roche)
• Antibiotics (Roche)
• Anti-malaria drugs (Roche)
• Antiviral drugs: HIV, hepatitis, influenza (Roche)
• Cancer drugs (Novartis, Roche)
• Cardiovascular diseases (Novartis and Roche)
• Cephalosporin based antibiotics, antiinfectants (Roche)
• Dermatology, retinoides (Novartis, Roche)
• Diseases of the bones (Novartis)
• Diseases of the respiratory system (Novartis)
• Disorders of the central nervous system (Novartis)
• Drugs against AIDS (Roche and Merck Serono)
• Endocrine disorders (Novartis)
• Growth disorders (Merck Serono)
• Haematology (Novartis)
• Hormone replacement therapy (Novartis)
• Metabolic disease (Roche)
• Multiple sclerosis (Merck Serono)
• Ophthalmology (Novartis)
• Osteoporosis (Roche)
• Parkinson disease (Roche)
• Reproductive Health (Merck Serono)
• Rheumatism (Novartis)
• Transplantation (Novartis)
• Urology (Novartis and Roche)

**Specialty chemicals:**

• Aluminium dyes (Clariant)
• Antimicrobials (Ciba)
• Biocides (Lonza)
• Cellulose methyl ether (Clariant)
• Construction chemicals (Sika)
• Imaging and lacquer additives (Ciba)
• Lubricant additives (Ciba)
• Masterbatches (Clariant)
• Optical brighteners (Ciba)
• Optical information storage (Ciba)
• Paper dyes (Clariant)
• Pigments (Ciba, Clariant)
• Plastic additives (Ciba)
• Reactive dyes (Ciba)
• Textile chemicals (Ciba, Clariant)
• Textile dyes (Ciba, Clariant)
• UV absorbers (Ciba)
Vitamins:

- Carotinoids (Roche)
- L-Carnitin (Lonza)
- Niacin, Niacinamid (Lonza)
- Several vitamins (DSM)
Worldwide presence

World map of direct investments

Swiss chemical and pharmaceutical companies have direct investments in more than 80 countries.

Since the beginning of the last century the Swiss chemical and pharmaceutical industry has consolidated the international presence of its innovative products by direct investment in more than 80 countries. The value of the industry's foreign direct investments amounted to more than 62 billion CHF in 2002, a share of 45.8% of all direct investments by the Swiss industry.

The Swiss chemical and pharmaceutical companies have sales organisations in nearly all countries of the world. Manufacturing is concentrated in only a few sites for cost optimisation. Research centres are located mainly in Europe, the US and Japan.
Employees abroad

Employees of the "top ten" companies by region

Total 2011: 354'500 employees

World-wide presence with a strong base in Switzerland.

Switzerland as a location for research and manufacturing is important. The breakdown of the workforce of the ten largest companies in this sector shows that almost 13 % of their employees world-wide have their workplace in Switzerland. All companies in this sector employ about 308'000 persons in their branch offices and subsidiaries outside Switzerland.

Currently the total number of employees in the entire chemical and pharmaceutical industry in Switzerland is 65'000 (2011); about half of these positions are in small and medium sized enterprises.
Growing importance of direct investments abroad

Headcount of the Swiss chemical and pharmaceutical companies increases abroad, stays constant in Switzerland.

The number of employees abroad of the "top-ten" companies increased in the past 14 years by over 80 %, whereas it grew only moderately in Switzerland. The total world-wide headcount increased by about 140'000 employees, corresponding to an annual growth rate of over 4 %. The highest growth rates are in the Asian countries.
Innovation as the basis for economic success

Scientific innovation is the basis for the Swiss chemical and pharmaceutical industry's economic success. According to an investigation of the Federal Office of Statistics, the industry invested in the year 2000 about 8.1 bn CHF, or more than 35 million CHF per working day towards innovation.

New results from scientific research have to be transformed by the companies into marketable products. This requires a wide range of entrepreneurial skills. For example, project oriented and interdisciplinary collaboration has to be ensured across existing structures, both inside and outside the company. Furthermore, work processes have to be aligned, manufacturing capacities created or new sales channels have to be found. An early and quick impact on the market is of growing importance. The success of a chemical or pharmaceutical company depends not only on the scientific level of individual top scientists; increasingly it is dependent on the professionalism of the entire workforce.

Innovation is the basis of the chemical and pharmaceutical industry’s economic success.

Nevertheless, scientific and technological progress remains the most important basis for the economic success of our industry, as the following examples illustrate:

Example 1: Diagnosis and treatment of AIDS

As early as the mid 1980's, the basic idea for a completely new AIDS drug was born in the Basle research centre of Roche. The objective was to block the HIV proteinase, a specific enzyme of the virus, as this enzyme cuts individual proteins from a filament to build new viruses. Roche researchers succeeded in producing the (not directly infectious) HIV proteinase by means of genetic engineering, in quantities that enabled the start of the search for suitable proteinase inhibitors in extensive laboratory tests.

In 1989, Roche chemists identified an extremely selective active substance in Ro 31-8959 or Saquinavir. At the end of 1995 INVIRASE was registered by Roche as the world's first drug in the new class of HIV proteinase inhibitors, and it was subsequently introduced in various markets.

Almost simultaneously, the PCR technology - a type of fast-copying process for genes or gene sequences on the basis of molecular biology - has been acquired and developed to full maturity by Roche. This technology has revolutionised the diagnostics of AIDS. With the highly sensitive HIV Amplicor test, the AIDS virus can be detected shortly after infection directly via the genes, at a time when an indirect immunological proof is not yet possible or does not provide sufficient evidence. Above all it is now possible to also measure the quantity of viruses in the blood using the PCR test in the HIV Amplicor monitor kit. As a result, each patient can now be offered an optimal individual therapy with a specificity that was considered impossible, even a few years ago.

Resistance against existing drugs arises as a consequence of virus mutations, calling for new drugs with new mechanisms.
As a first representant of such a new generation of drugs since 7 years Fuzeon has been approved by FDA in the US in March 2003. Fuzeon has been developed by Roche in collaboration with the US company Trimeris. Contrary to all currently known drugs Fuzeon is hindering the virus from entry into the human immune cells: this stops the reproduction of the virus which affects the immune system reaction of HIV infected persons.

Fuzeon is a significant step forward in the fight against HIV infection and AIDS. Besides the medicinal progress, Fuzeon is an important progress in the synthesis of peptides. The modern manufacturing process has been successfully implemented at the Roche site of Boulder, Colorado.

With these innovations in diagnosis and therapy the currently used combination treatment has changed the disease symptoms fundamentally: the deadly AIDS syndrome has been converted to a chronic infectious disease with a long survival period, providing satisfying quality of life for the patients.

**Example 2: L-Carnitin - the "energy vitamin"**

When the Americans began to investigate the nutrients essential to the diet of astronauts it turned out that, in addition to the 13 known vitamins, L-Carnitine is one of these vital nutrients. L-Carnitine, which is related to the vitamins of the B group, is essential for burning fatty acids and supports optimum performance under conditions of physical and mental stress. In addition, L-Carnitine has been used as a supplement to children's food and nutrient additives for sportsmen for more than 2 decades. Recently a number of "functional food" preparations containing L-Carnitine have become available. Pharmaceutical applications have also been developed: drink ampoules for the heart and the immune system, infusions for intravenous treatment of heart and circulation problems, tablets for the oral treatment of hereditary or induced L-Carnitine deficiency.

Since Lonza 's market entry in 1983, the company has had a decisive influence in building up and shaping the L-Carnitine market. Lonza's success is based on innovations in product forms, production processes as well as in the development and patenting of new applications.

The hygroscopic (water-absorbing) properties of pure L-Carnitine complicated its handling and formulation (tablets, capsules, solid dosage forms). This problem, as well as that of the fishy smell associated with pure L-Carnitine, were solved to the full satisfaction of customers by the development of the two patented products L-Carnitine L-tartrate and L-Carnitine magnesium citrate.

The biotransformation from a natural precursor, a novel, patented technology which guarantees extremely high purity (0.0% D-Carnitine), is an additional success factor. The process causes lower environmental pollution since it produces less waste and does not require solvents for the separation of L-Carnitine from D-Carnitine.

With L-Carnitine Lonza has opened up a number of new markets and has patented various applications including several in the area of animal nutrition (feeding of sows to increase the litter rate, improving health of the hearts of domestic animals and feeding of hens to reduce levels of stress induced death).

**Example 3: Femara® - fewer relapses in breast cancer cases**
Through the aromatase blocker Femara (Letrozol) Novartis is demonstrating its commitment to helping women suffering from breast cancer. This commitment is necessary, for although great advances in the treatment of breast cancer have been made over the last few decades, a third of women affected still suffer a relapse in the first 15 years after diagnosis. Over half of these relapses occurs 5 years after initial diagnosis, whereby distant metastases in particular are to be feared. One of the goals of breast cancer treatment therefore is to continuously reduce the risk of relapse.

Sex hormones such as oestrogen stimulate cell growth in certain organs and tumours. In the case of hormone sensitive breast cancer, tumour growth and metastasis formation can be stopped or at least retarded by suppressing the hormone effect (anti-hormone treatment). In post-menopausal women oestrogen is no longer formed in the ovaries but rather in other tissues and organs. It is here that the enzyme aromatase is required. By blocking aromatase Letrozol prevents hormone production right from the start.

The enzyme aromatase was discovered in the mid-70’s, the aromatase blocker Letrozol at the end of the 80’s. In the laboratory Letrozol was about ten times more potent and a hundred times more selective than the previously used substance. After all the clinical development stages had been successfully passed Letrozol was initially introduced to the market in Great Britain in 1996 under the trade name Femara (advanced breast cancer). Since then Femara has demonstrated its superiority in all stages of breast cancer over the respective established standard drugs (megestrol acetate, aminogluthethimide, tamoxifen). In July 2004 Switzerland became the first country in Europe to approve Femara as the only drug for the extended adjuvant treatment (after 5 years tamoxifen therapy) in early stage breast cancer. In the meantime Femara has been approved in more than 75 countries, to some extent even for post-operative treatment of early stage breast cancer. In Switzerland this indication is, at present, still in the process of registration.

Example 4: Omalizumab—A breakthrough in the treatment of allergic asthma

A broad-based Novartis programme to research the therapeutic potential of monoclonal antibodies led to cooperation with Genentech Inc. and Tanox in the field of anti-IgE. The goal was to develop a drug which directly influenced one of the basic causes of asthma, namely the allergic cascade facilitated by IgE.

IgE, a naturally occurring antibody, is produced in large quantities in people suffering from asthma, when they have been sensitised by an allergen, e.g. faeces of house dust mites or scurf of domestic animals and subsequently re-exposed thereto. These antibodies then bind to mast cell receptors, leading to the release of inflammatory mediators like histamine which in turn cause, among others, well-known asthma symptoms —wheezing, tightness of the chest and shortness of breath—by contracting the smooth muscle system in the respiratory tract.

Several asthma drugs, such as the Beta-2 agonists, treat the asthma symptoms directly by relaxing the constricted smooth muscle system of the respiratory tract. Others, such as the inhaled corticosteroids (ICS), attack the basis of the complaint, namely the inflammation in the respiratory tract. ICS are, however, only effective when taken regularly. Poor discipline in patients receiving ICS is a big problem and can lead to a recurrence of asthma attacks.

Omalizumab removes any free IgE from the serum and thus prevents it binding to the mast cells; consequently the release of inflammatory substances is stopped and the appearance
of asthma symptoms prevented. Clinical studies have shown that Omalizumab can prevent asthma attacks and reduce the number of Beta-2 spray applications necessary to control the asthma symptoms. A further important advantage: the reduction in the dose of ICS is highly significant because ICS can cause, especially in children, undesirable side effects such as growth disorders.

In Switzerland Omalizumab is at present in the process of being registered and, once approved, is to be marketed under the trade name Xolair®.

**Example 5: High performance dyes for optical information storage - our contribution to the Digital Revolution**

The digitalisation of the world is proceeding at a breakneck pace. Today, Switzerland counts 75 mobile phone sets per 100 of its inhabitants and 50% of the Swiss enjoy regular surfing on the Internet. Besides a gamut of products ranging from photoinitiators for printed wiring boards, special pigments for LCD flat screens and inks for digital ink jet printing, Ciba Speciality Chemicals is also contributing to the digital revolution with its innovative dyes for optical information storage.

Ciba recognised the huge market potential of optical data storage when the concept of recordable CD-ROMs first cropped up in 1990. Since then Ciba has brought several generations of high-performance dyes for use in this area to market under the trade name Ciba® IRGAPHOR®, with great success. Ciba's functional dye, which the manufacturer applies to the polycarbonate disc in a thickness of 100 nanometres, is the CD's actual storage medium. During the recording process, a strong laser beam burns the information as a binary code into this thin dye layer. The process is very demanding in chemical and physical terms. The highest recording speed, which is available today, is the equivalent of 200 kilometres per hour! One of the latest products, IRGAPHOR® Ultragreen MX launched in 1999, matches customers' ever higher expectations regarding photostability, the absorption spectrum and thermal properties. In 2002, more than six billion CD-R's were sold world-wide. Of these, 60 % used Ciba dyes. And the market for CD-R's continues to grow!

Ciba's innovative approach to optical information storage materials is based on the core competencies in dyestuff synthesis, spectroscopy and solid state physics, combined with application tests at a very early stage. This allows Ciba to offer integral solutions to customers. Information technology is in a constant change. Its major trends points towards higher storage capacity. And Ciba's scientists are forging ahead with the next and even the next-but-one generation technologies.

**Innovative activities of SMEs**

Given the expenditures necessary for research and development of a new drug or plant protection ingredient, the innovative activity of small and medium-sized enterprises in the chemical and pharmaceutical industry has to be concentrated on areas within well defined borderlines. The concentration of several companies involved in leading-edge research in Switzerland (called a cluster in innovation theory) creates favourable conditions for the success of SMEs too. The increasing orientation of the large companies towards highly innovative fields is accompanied by a corresponding outsourcing of research and manufacturing activities. The niches that open up allow a fair number of smaller and medium-sized enterprises to operate
as specialised sub-contractors and service providers. Their innovative activity relates to this limited role within the entire industrial network around a research cluster.
High research intensity

The Swiss chemical and pharmaceutical industry is committed to research and development to an unique extent. It is leading in modern technologies.

The strategy of specialties requires big and continuous efforts in research and development. This strategy can be maintained only if the companies continuously succeed in introducing and marketing innovative products on the international markets. Without the profits of these new products, the necessary research and development expenses associated with innovation could not be financed by privately owned companies.

New technologies play an important role in ensuring the future economic success of the companies. While biotechnological methods are gaining importance as research and manufacturing tools in the life-science area (health care and agriculture), the development of research intensive, customer specific solutions is a cornerstone in specialty chemicals - not only products and formulations, but rather a comprehensive application system.

The leading position of the Swiss companies, compared to other countries, can be explained primarily by the high share of pharmaceutical research. This position demonstrates the decisiveness of the Swiss companies to remain in leading positions of scientific and technological innovation.
Internationally integrated research

Research expenditures of the Swiss chemical and pharmaceutical industry (Total "top ten" 2011: 20.7 bn CHF)

bn CHF

The Swiss chemical and pharmaceutical industry maintains a world-wide research network.

Science is international. It is based on well equipped regional centres, consisting of universities, private research institutes and companies. Europe hosts such research nodes in many scientific disciplines.

Nearly half of the world-wide research expenditures are in Switzerland. Since some years the research activities of Swiss chemical and pharmaceutical companies abroad show a particularly dynamic development. Increasingly, successful research is the result of an innovative process within a world-wide network.

Swiss companies have had an extensive international network of research centres for decades. For example, Novartis and Roche operate not less than seven large research centres outside Switzerland, namely in US, United Kingdom, Japan and Germany.

Moreover, co-operation with third companies and universities has become noticeably more important in recent years. The major investments in biotechnology and genetic engineering companies, as well as the tight network of research alliances and license agreements, illustrate the international nature of our research efforts. Biotech companies are particularly important in identifying and developing new ideas, new technologies and innovative products. Companies in Basle currently allocate around 20 % of their R&D budgets to co-operative projects with external research groups.
Rapidly rising costs of research and development

R&D cost for a new pharmaceutical molecule (NCBE)

Mio USD

Research and development of new products is a complex and lengthy process, associated with considerable business risks.

The costs of research and development of new chemical or biological entities (NCBE) are rising continuously. On one side scientific progress and the application of new technologies make research an increasingly complex process with inherent considerable risks of failure; on the other hand stricter international safety requirements call for increasingly longer evaluation and test periods for new products.

Today, 10 - 12 years elapse before a new drug reaches the medicine chest. Out of 10'000 substances going into pre-clinical tests, only 5 get so far as to be tested on humans. Only one of these 5 clinically tested substances is eventually marketed.

Rising research costs are not exclusively found in the pharmaceutical area; they rise in nearly all areas of the chemical industry. As an example, the development of a new active ingredient for crop protection costs on average 300 mio CHF (2002), which is 30% higher than in 1995. One third of these costs is used for testing the eco friendliness of the new product.
The market introduction of a pharmaceutical takes much time and vast financial resources. The companies of the Swiss chemical and pharmaceutical industry finance their research and development out of their own funds. The regulatory environment (patents, prices) is therefore very important.

The development of a pharmaceutical starts with the search for an adequate active ingredient. Often more than 100'000 substances have to be screened. Promising active ingredients will be submitted for patent application as soon as possible. On the average after the patent application has been granted 10 - 12 years are needed until a pharmaceutical is ready for market introduction.

During this time period research and development costs in excess of 1 billion USD will have arisen for one single product. The pharmaceutical companies pay for these expenses from the revenues that will come from sales during the remaining patent protection duration.

The commercially utilizable patent life time of a new pharmaceutical starts with its market introduction. In reality this period is hardly longer than 8 years. Often after the expiration of the patent protection, the producer is forced to lower the price of the product substantially due to the entry of generic alternatives into the market place.

As a result of additional safety requirements mandated by government authorities, the original aim of substantively promoting innovation has diminished. Therefore some countries have
introduced supplementary protection certificates (SPC). These certificates restore the originally intended patent protection duration of 20 years at least in part.
Switzerland is an important research location for the chemical and pharmaceutical industry. More than one third of the total of R&D expenditures of Switzerland are spent in our industry.

Switzerland is an important research location for the chemical and pharmaceutical industry. The number of Nobel prizes awarded to chemists, biologists and physicians attest the internationally outstanding quality of research in Switzerland.

Expenditures on research by the chemical and pharmaceutical industry in Switzerland in 2008 amounted to 5.3 billion CHF, corresponding to 44% of total private research spending in the Swiss industry. Measured as research expenditures per employee the Swiss chemical and pharmaceutical industry is at the top of the sector world-wide.
Employees in R&D in Switzerland

Research staff in the industry

Total 2008: 39'830 employees

The chemical and pharmaceutical industry is an important employer of research staff in Switzerland.

The chemical and pharmaceutical industry is one of the most important employer of research staff in Switzerland; it employs 29 % of total research personnel in the Swiss industry.

In 2008, it employed 11'633 highly qualified persons in research.
Exports are financing R&D expenditures in Switzerland

Research and Development in Switzerland has to be financed by exports of intermediates and finished products to all countries of the world.

The ten major companies in the sector spent in 2011 around 7.0 bn CHF for research and development in Switzerland. The turnover of these companies in Switzerland amounted to only around 2.8 billion CHF. Even if all this income could be used for financing R&D (i.e. if manufacturing and marketing of these would not incur costs), a huge financing gap arises.

This gap can only be closed if part of the sales profits made abroad are transferred to Switzerland. Without this repatriation of profits, the Swiss research location with its central management functions would be inconceivable.

Funding via a comprehensive licensing of the research results is not possible given the present scale of research. The most important method of funding is and continues to be the export of goods from Switzerland. The manufacture of intermediates and finished products - particularly of active ingredients - in Switzerland and their export to subsidiaries and third parties is an economic necessity for our industry.
Strong dependency on export

Imports and exports are vital

Sales into regions

Total exports and domestic sales 2011: 78.5 bn CHF

The Swiss chemical and pharmaceutical industry is highly dependent on foreign trade.

The strategy of specialised products and the limited size of the domestic market are the reason for the heavy dependency on foreign trade. Only approximately 5% of the sales are in the home market; 95% of the industry’s production are exported.

The highest portion of exports, over 55%, goes to the EU countries. Together with exports to the other European countries, nearly two thirds of exports go to Europe.

All raw materials for the chemical and pharmaceutical production have to be imported. More than 80% of the industry’s demand are imported from EU countries.
Important export industry

Total Swiss exports (2011: 208.1 bn CHF)

The chemical and pharmaceutical industry is the number 1 industry in exports; it ranks number 1 in the export balance as well.

The chemical and pharmaceutical industry ranks as number 1 measured as share of total Swiss exports; measured as net export (2011: 37.2 bn CHF) as well it is Switzerland's most important sector, followed by the watch industry (2011: 16.3 bn CHF) and the engineering industry (2011: -5.6 mio CHF).

The exports of the chemical- and pharmaceutical industry have to be seen in the context of the companies' internal international networks: more than three quarters of their exports are supplies to subsidiaries. Part of these supplies are intermediates to affiliated companies which process them into finished products. This two-stage procedure enables the companies to benefit from economies of scale in the chemical synthesis of ingredients and on the other hand to optimally adapt the products to local conditions and regulations.
Growing importance of exports

The chemical and pharmaceutical industry is the most dynamic export industry in Switzerland

The industry's share of the total Swiss exports has increased continuously since 1980. In 2011 the share amounts to more than one third.

In the period from 1980 to 2011 the exports of the chemical and pharmaceutical industry grew 25.4 % annually, while the total growth rate of all sectors of the Swiss industry was 13.5 % per year.
Significant trade surplus

International comparison of the export surplus of the chemical and pharmaceutical industry

The Swiss chemical and pharmaceutical industry represents a sector with a particularly high level of added value.

With exports of 74.6 bn CHF and imports of 37.4 bn CHF in 2011 the chemical and pharmaceutical industry earned a trade surplus of 37.2 bn CHF. It thus contributed the largest export surplus of all industrial sectors to the trade balance of Switzerland.

The export surplus of the chemical and pharmaceutical industry is 9 times higher than that of tourism and would be sufficient to finance Switzerland’s total food imports, as well as all imports of textiles, clothing and shoes for a whole year.
The chemical and pharmaceutical industry in Switzerland achieved an export surplus per capita which is one of the highest in the world. In 2011 it amounted to over 3'600 EUR, which is 7 times higher than the comparable figure in Germany.
Production and employment

Contribution to Gross Domestic Product

Contribution of selected industries to the gross domestic product 1998 - 2009

The chemical and pharmaceutical industry is the second most important industrial sector of Switzerland; it contributes significantly to Switzerland's Gross Domestic Product.

With over 4% share in the Gross Domestic Product, the chemical and pharmaceutical industry is one of the most important industries in our country since decades. It ranks second behind the engineering industry, continuously increasing its share.
The chemical and pharmaceutical industry is a dynamically growing sector.

The chemical and pharmaceutical industry is a particularly dynamic part of the Swiss economy. Production grew between 1995 and 2011 at an average annual rate of 12.4%; the whole Swiss industry achieved only a figure of 2.8%.
The chemical and pharmaceutical industry is a major industrial employer in Switzerland.

**Chemical and pharmaceutical industry: 65'000 (2011)**

With 65'000 employees the chemical and pharmaceutical industry is one of the largest industrial employers in Switzerland.

Our sector employs an above average number of qualified staff. According to the last census, not less than 7'500 of our employees are university graduates. However, the term qualified staff covers a broader range. 62 % of employees in our companies are assigned to a higher qualification category by official statistics, compared to an average 42 % of staff in all industries.

The workforce of the Swiss chemical and pharmaceutical companies is growing at above average rates in the big foreign markets. The increase of employees abroad are a prerequisite for safeguarding jobs in Switzerland. Thanks to the value added on the world's markets, existing jobs in Switzerland are safeguarded and new ones created.
The chemical and pharmaceutical industry is composed of companies of different size; it has a regional spread throughout Switzerland.

In addition to the well-known large companies, the sector consists of around 1'000 smaller and medium-sized enterprises, geographically spread over the whole of Switzerland, though with a concentration in the north-western region. 95% of all companies in Switzerland employ less than 250 persons; only around a dozen companies have a workforce of more than 1'000.

The smaller and medium-sized enterprises, which generally produce predominantly in Switzerland and export their products throughout the world, have succeeded in occupying market niches. Their great flexibility often makes the SME’s perfect outsourcing partners for the big companies in our sector.
The Programme

The RESPONSIBLE CARE Programme (RC) is a voluntary initiative of the chemical industry operating world-wide with the aim of improving the performance in the areas of Safety, Health and Environmental Protection. RESPONSIBLE CARE is an important contribution of the chemical industry to Sustainable Development. To date 47 countries have joined the programme.

scienceindustries has assumed the patronage of the programme “Progress with Responsibility” for the Swiss chemical and pharmaceutical industry. The programme is based on the 7 scienceindustries principles for safety, health and environmental protection published in 1991. Around 90% of the member companies, representing more than 95% of the turnover of the Swiss chemical and pharmaceutical industry have signed up to these principles. They thereby proclaim that Safety, Health and Environmental Protection rank highly in their priorities.

The activities surrounding the RESPONSIBLE CARE programme have a long tradition in Switzerland. The Swiss industry has attained a high international standard in these areas. RESPONSIBLE CARE is not only the confirmation of these achievements but also the driving force for further improvements.
Principles for health, safety and protection of the environment

Scienceindustries member companies are conscious of the fact that their activities affect the environment. In their company policies, safety, health and protection of the environment are afforded high priority. In addition to the legal regulations they make efforts on their own account to maintain the high degree of safety, health protection and protection of the environment already achieved, and to continue to develop their endeavours in these fields.

Scienceindustries member companies conform to the Guidelines for the protection of the Environment of the European Chemical Industry Council (CEFIC) approved in 1988, while at the same time they take into consideration other principles such as the Business Charter for Sustainable Development of the International Chamber of Commerce (ICC-Charter). In the chemical industry all these activities are summarised in the RESPONSIBLE CARE programme.

As scienceindustries member company we declare ourselves committed to the Swiss RESPONSIBLE CARE programme, the principles of which are listed as follows:

1. We regard safety and the protection of people and the environment as a prime concern in all areas where our products, processes and installations are involved.

2. We endeavour to develop and manufacture products which can be transported, used and disposed of in a safe manner and with compatible input on the environment as well as to operate our installations so that a high degree of safety, health protection and protection of the environment is ensured.

3. We are partners of a dialogue with the public and respect differing opinions; we are willing to provide in a appropriate manner information on our products, processes and installations, the effects on man and the environment as well as information on preventive protective measures.

4. We advise our customers on the safe transportation and handling of our products as well as the use and disposal in a safe manner and with compatible input on the environment. We accept our responsibility to man and to the environment in the transfer of technology.

5. We improve our knowledge and promote research on potential effects of our processes, products and wastes on man and the environment.

6. We strive, in cooperation with the authorities, to develop legal regulations, agreements, emergency plans and other measures for the protection of employees, the public and the environment, and we are also willing to cooperate with other organisations towards this end.

7. We promote the RESPONSIBLE CARE programme through the exchange of experience within scienceindustries and develop criteria for the assessment of safety, health and the protection of the environment in the Swiss chemical industry.
Parameters as Indicators of Performance

Within the framework of the scienceindustries RESPONSIBLE CARE programme criteria have been established for the assessment of the measures taken by members in the area of Safety, Health and Environmental Protection. Since 1993 these criteria have been expressed in the form of parameters.

**RC parameters help to identify weak points and initiate necessary improvements**

These parameters are used by companies as a management tool and give them the possibility of demonstrating performance and progress, identifying weak points and adopting necessary corrective measures. An increasing number of companies use the parameters also as a basis for their environmental reports or for corresponding comments in their Annual Reports. scienceindustries uses the consolidated RC-parameters to illustrate and communicate the performance of the chemical and pharmaceutical industry in the area of Safety, Health and Environmental Protection.

The publication of these parameters aims at improving the transparency of the RC-activities of the chemical and pharmaceutical industry in Switzerland.
Workplace Safety

No. of workplace accidents per million working hours (LTIR)

The number of workplace accidents fell continuously over the last decade.

The protection of employees in the workplace has enjoyed a long tradition in the chemical and pharmaceutical industry.

Organizational and technical measures are continuously being taken to reduce the number and severity of workplace accidents. Thanks to focused training on a periodic basis of all employees workplace accidents could be significantly reduced over the last decade.

The accident coefficient LTIR (Lost Time Incident Rate) as measured in number of accidents per 1 million working hours has been cut to half from 13.0 in 1993 to 5.9 in 2007.
Energy Consumption

The energy consumption per production unit has dropped significantly. Thanks to increasing energy efficiency total energy consumption has fallen in spite of higher production volumes.

The chemical and pharmaceutical industry consumes some 3% of the total Swiss energy production. With its share of some 15% of the total industrial energy consumption it ranks as a major industrial consumer alongside the cement, glass, paper and engineering industries.

Throught efficient use of the energy the consumption rose during the periode 2002-2007 by only about 12 % from 27'123 to 30'591 TJ despite of a production volume increase of about 50 %.

PU is an index taking into account the change in total production volume, measured in value (CHF).

The energy consumption per production unit has dropped significantly. Thanks to increasing energy efficiency total energy consumption has fallen in spite of higher production volumes.
**CO2 Emissions**

**CO2 emissions in tons per production unit.**

PU is an index taking into account the change in total production volume, measured in value (CHF).

**The chemical and pharmaceutical industry is the leader in reducing CO2 emissions in tons per production unit.**

Between 1993 and 2010 the CO2 emissions in the chemical and pharmaceutical industry dropped by 17% from 940,000 to 780,000 tons. The production volume increased in the same period to about 314%.

The CO2 emissions from the Swiss chemical and pharmaceutical industry amount to less than 3% of total Swiss CO2 emissions. Two thirds of the energy used by the chemical and pharmaceutical industry is generated from fuel oil, gas and waste.

According to the Swiss CO2 Law the total CO2 emissions in 2010 have to be reduced to 10% below the 1990 levels until 2010. The Swiss chemical and pharmaceutical industry has already achieved this goal: the CO2 emissions in the period 1990-1999 fell to 17% below the 1990 level.
VOC emissions have been continuously reduced thanks to modern installations and processes.

Around 250'000 tons of VOC are used annually in the production processes of the chemical and pharmaceutical industry as starting materials or as solvents. Through appropriate measures only a small part escapes into the environment. Between 1993 and 2010 the VOC emissions could be lowered from 3500 to 860 tons annually corresponding to a reduction by more than 75 % and thus equivalent to less than 1% of the total amount of VOC actually used.
Water Consumption

Over the period between 1993-2007 the consumption of cooling water could be lowered by 15.5 %, which amounts to some 262 million m3. Cooling water is not polluted by any chemical process.

The consumption of industrial water was reduced from 46 to 17.3 million m3 in the same period. This reduction of polluted industrial water resulted in a reduced loading of the wastewater treatment plants and avoiding extensions or new constructions of such plants. The industrial water consumption has been reduced to less than 10 % of the cooling water used.
scienceindustries has been founded in 1882 in Zurich as the "Swiss Society of Chemical Industries", the umbrella organisation of the chemical and pharmaceutical industry, handling topics of economic policy. Its objective is to promote and protect the interests of the chemical industry; it represents the industry towards the public, governmental authorities and international organisations. At present (2012), the society counts some 250 member companies.

scienceindustries is legally constituted as an association with a general assembly and a Board of Directors. The Society maintains a permanent office in Zurich since 1945. It runs the business along the principles of a flexible issue management, assigning the resources timely to issues according to priorities set by the Board. All members have electronic access to the comprehensive status of affairs via the membertnet, enabling them to contribute to the further direction of work at any time.

In view of the industry's heavy dependency on foreign trade, it is hardly surprising that for a long time, the main activities were in the field of trade policy. Over the years, the range of issues has broadened. In particular the topics of environment, biotechnology and the pharmaceuticals sector have assumed increasing importance. Since the beginning the society evaluates and comments the industry's position towards Swiss draft legislation.

Since its foundation, scienceindustries has been promoting an industry friendly regulatory environment for its activities, both in Switzerland and abroad. The objectives in the field of foreign trade are:

• Creation of liberal, stable and sustainable basic conditions for the world economy, e.g. within the framework of the WTO and the European Union.
• The removal of technical trade barriers through international harmonisation of trade relevant legal provisions in different countries, or via the mutual recognition of such provisions
• Securing an appropriate compensation of corporate research efforts, among others through internationally improved protection of intellectual property.

scienceindustries is committed to close collaboration with similar organisations of the chemical and pharmaceutical industries in other countries; it is an active member of a large number of industry associations, active in Europe as well as internationally.