The Biopharma Landscape in Norway:
Current Status and Future Commercialization Opportunities

Final Report
26. September 2007

This report has been prepared for the Norwegian Association of Pharmaceutical Manufacturers (LMI) by The Boston Consulting Group
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1 Executive Summary

The Boston Consulting Group (BCG) analyzed the current status of, and future opportunities for, the biopharma industry in Norway for the Norwegian Association of Pharmaceutical Manufacturers (“Legemiddelindustriforeningen” - LMI). Our assessment:

(1) Describes where Norway stands in biopharma today.

(2) Compares – and draws lessons from – six global “bioclusters.”

(3) Assesses the opportunity space for biopharma in Norway.

(4) Makes recommendations for realizing the potential of the biopharma industry in Norway.

Our primary conclusion is that there is untapped potential related to translating the ideas, technologies, and capabilities coming out of Norwegian biopharma research into more commercial value creation. In short, Norway has a strong research platform that is not being fully commercialized. This presents an opportunity.

There are a number of reasons why this opportunity should be pursued:

- More actively entering the rapidly growing biotech industry will increase revenues and employment in Norway.

- A stronger biopharma industry will contribute to other core sectors in Norway, such as the health care, processing and petroleum industries. In turn, this may lead to better, more relevant research and improved higher education.

- Translating biotech research into solutions can help resolving some of Norway’s main challenges, including improving health, tackling environmental problems, and dealing with demographic issues.

- More active participation in the field of bioscience would enable Norway to influence the development of this challenging arena.

But Norway’s commercialization performance lags that of leading international “bioclusters.” For Norway to strengthen its commercialization of biopharma, the following gaps need to be closed:
• There needs to be a shared ambition for commercialization of research by the biopharma community in Norway.

• There needs to be a further strengthened collaboration among research institutions, hospitals, and business.

• The commercialization infrastructure needs to be more concentrated in order to increase capabilities and to improve visibility with international players.

• A set of new incentives and vehicles for commercialization need to be put in place. These mainly relate to general incentives for improving fast-growing R&D-based companies improving collaboration between key actors and strengthening protection of intellectual property rights. However, other instruments such as “industrial PhD’s” could also make a contribution.

• Norway also needs to attract private capital to the biopharma industry, and, in parallel, to capture the interest of management talent from outside Norway.

• Finally, Norway needs to further nurture its appeal as an attractive site for biotechnology to established industrials and large biopharma companies.

In order to seize the biopharma opportunity, a broad mobilization is suggested. Elements of this mobilization include the following:

• Norway’s biopharma community needs to reach consensus on a shared aspiration. This includes key actors such as research institutions, the hospital sector, business, related associations and research and innovation vehicles such as the Research Council of Norway and innovation Norway.

• Norway’s government must design appropriate incentives (that not only apply to biopharma but also more to generally) to drive value creation based on R&D and to improve the commercial infrastructure.

• The government must also put clear initiatives in place to attract international attention from managers, investors, and companies. These initiatives should be designed together with business, research institutions and the hospital sector.

In order for this to happen, we suggest a “Biopharma roundtable” with representatives of all relevant stakeholders. The roundtable should be chaired by the minister of trade and industry (with participation by the minister of health and care). This model is derived from “OG 21,” an initiative jointly developed by government and industry to realize the ambitions of the Norwegian petroleum industry. The “Biopharma roundtable” could form the nucleus of a mobilization process – and give clear direction to all relevant vehicles for change, such as Innovation Norway and the Research Council of Norway.
2 Introduction

This chapter will present a background to the project, both the scope and the deliverables. The method and data deployed are introduced.

2.1 Objectives of the study

The main objectives of BCG’s analysis were to conduct an in-depth study of the current status of, and opportunities for, the biopharma industry in Norway. In addition, BCG’s object was to outline how Norway can seize the opportunities identified. The four main deliverables of BCG’s analysis are illustrated in the figure below. These also form the main content of this report.

![Figure 1 – Project deliverables](image_url)

This report is intended to serve as a foundation for a dialogue on the future of the biopharma industry in Norway between relevant political authorities, business, research institutions, and other stakeholders. Such a dialogue seems important, and the report is meant to add insight and perspectives related to market opportunities and international “benchmarks.”

The understanding underlying the project – as agreed to up front – was as follows.

---

The project has four clear deliverables

1. Current biopharma landscape in Norway
   - Diagnosis of current situation for biopharma in Norway
     - Current companies
     - Value creation
     - Access to capital
     - National initiatives / vehicles
     - Ideas, results, patents, IP etc
     - Access to R&D
     - Industry attractiveness

2. Comparisons with, and lessons from other countries
   - Situation for biopharma in other, comparable countries
     - National ambitions
     - Interplay universities, public research institutions, industry, investors and government
     - Importance of MNCs
     - Development initiatives
     - Links with related industries
     - Lessons for Norway

3. Description of opportunity space
   - Areas in which Norway have a growth potential
     - What advantages exist?
     - What measures are required?
     - What can achieved if this potential is fully exploited?
     - Direct and indirect benefits
     - Timing: short vs. long term
     - Alternative levels of ambition

4. Recommendations for realizing potential
   - Industrial and political priorities
   - Development initiatives and support schemes
   - R&D implications
“Legemiddelindustriforeningen – LMI (the Norwegian Association of Pharmaceutical Manufacturers) seeks to develop a document addressing the current status and potential of the biopharma/biomedicine industry in Norway. The document is meant to form the basis for dialogue with political decision makers, with the purpose of initiating immediate steps related to improving the conditions for the biopharma industry in Norway:

- The scope of the document is the pharmaceutical industry, including the biotechnological industry related to drugs.

- The aim is to map and describe the parameters of research, development, and production of pharmaceuticals in Norway (compared to that in other countries). This should be used to develop suggestions for creating a strategy to establish an internationally competitive biopharma industry in Norway.

- It should also provide the background for initiating a broad dialogue on how research, development, and production of pharmaceuticals are placed on the political agenda.

The role of BCG was defined up front as follows:

- BCG is responsible for delivering an analysis of the market and the opportunities.

- However, BCG will not support or be involved in lobbying activities or attempts to influence political decision making on behalf of the Norwegian pharmaceutical or biotech industry.

- Finally, BCG retains the right to decide how its contributions to the project are presented in the media or in relation to decision-making authorities.”

2.2 Project organization and timeline

The entire project was conducted within a three-month period. The phases, deadlines, and main activities are outlined in the figure below.
The project team consisted of consultants from The Boston Consulting Group, headed by BCG partner Knut Haanæs, PhD. The Reference Group of the project consisted of members of LMI and affiliated partners from the Federation of Norwegian Industries and Spekter.

2.3 Project approach and methodology

The project has drawn on an extensive number of sources, both primary and secondary. More than 30 interviews were conducted, as well as a series of workshops and presentations. Also, a database was built comprising detailed data on all biopharma companies in Norway to track aggregated growth and development over time. A set of international bioclusters was studied through detailed data collection and interviews.

The main data-gathering process is outlined in the table below. In addition, a more complete list of data sources can be found in the appendix.
### Extensive information gathering exercise

<table>
<thead>
<tr>
<th>Primary sources</th>
<th>Desktop research</th>
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<tr>
<td><strong>Interviews and workshops with more than 60 individuals</strong></td>
<td><strong>Norwegian company/market data</strong></td>
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<td>Norway</td>
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<td>• Several Big pharma, biotech and biopharma companies</td>
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<td>• Investors</td>
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<td>• Healthcare and research institutions</td>
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<td>• Norwegian industry reference group</td>
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<td><strong>Biotech cluster benchmarking and profiling</strong></td>
<td>• Statistical service agencies</td>
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<td>• In-depth review of published sources, databases, industry organizations and interviews from world leading clusters and regions</td>
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<td><strong>BCG global research and analysis support</strong></td>
<td>• Biotech forums and associations</td>
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<td><strong>Topic experts</strong></td>
<td>• Norwegian government and Ministries</td>
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<td>• Senior experts with experience from healthcare overall, pharma, biotech, clusters</td>
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<tr>
<td><strong>BCG reports and case experience</strong></td>
<td>• Research programs and centers of excellence and innovation</td>
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<td>• review of several published reports and internal materials</td>
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<td><strong>BCG global research and analysis support</strong></td>
<td>• PUBMED database</td>
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<td><strong>Researchers</strong></td>
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<tr>
<td>• International researchers</td>
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**Figure 3 – Sources of data**

### 2.4 Structure of the report

This report sums up BCG’s findings, highlighting our main observations and recommendations. The report is complemented by a presentation – a set of about 150 slides – showing the underlying analysis. Some of the slides from the accompanying presentation are included in the report.
2.5 Description of the main terms used in this report

The main terms related to biopharma are utilized as follows in the report:

- **The biotech industry** encompasses all companies (except those in Pharma/Bio) that are involved, partly or in whole, in biotech-related activities. For companies with activities extending beyond biotech, we assessed only those activities related to biotech. Biotech comprises activities within pharma, marine, agri, and equipment/technology. The OECD has defined biotech as: “the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods, and services.”

- **Biopharma** is the application of biological technology to develop pharmaceutical products. Biopharma has two origins: (1) biotechnology, and related portion of the pharma/bio companies, and (2) the pharma part of the biotech industry.

- **Pharma/Bio** comprises all pharmaceutical companies that conduct activities within biotechnology, partly or in whole. BCG assessed these companies’ pharmaceutical and biotechnology-related activities.
2.6 Note to the reader

The report attempts to sum up our analysis in a readable way. For instance, instead of academic sourcing we have chosen to list all sources in an appendix. The figures within the report, however, include full sources. The financial and market assessments contained in this report are based on publicly available sources.

BCG has not independently verified all of the data and assumptions used in these analyses. Changes in the underlying data or operating assumptions will clearly impact the analyses and conclusions.
3 The biopharma industry

This chapter presents the overall biopharma industry and outlines why the industry will be important in the future. It also sets out what makes the biopharma industry different from most other industries in Norway.

3.1 The global biopharma industry

The biotech industry is a recent and rapidly growing industry. The United States is dominating the global biotech industry in terms of both biotech revenues and employees. The market capitalization of all U.S. public biotech companies (Figure 5) shows that the industry has recovered from the 2000 crash, and that the value of public biotech companies doubled from 2003 to 2005. There are other positive signs, one of which is a global revenue pool of U.S.$73.4 billion in 2006 for listed biotech companies alone – a 14 percent increase from the prior year. Similarly, public biotech companies represent an employment pool in excess of 190,000 “full-time equivalents” (FTEs).

The industry is maturing, as more biotech drugs gain blockbuster status. It is also finally approaching profitability, lead by strong growth in the United States. The rest of the world is expected to follow, and optimistic forecasts indicate that biotech could
constitute 30 to 40 percent of the global economy within a few decades. Countries like China, India and South Korea are making substantial efforts to develop new industries around biotech.

Globally, the industry is still dominated by U.S. companies, which make up two-thirds of the employees, three-fourths of the revenues, and four-fifths of R&D expenses. U.S. companies have delivered an annualized growth in market capitalization of 26 percent over the past ten years, taking the total value to U.S.$410 billion in 2005.

This continuous growth has allowed ongoing investment into an industry in which the science actually is the business. Expectations of further growth are still underpinning the increase in both investments and market capitalization. The expectation of further growth in biopharma is seen coming from strong product pipelines, driven by greater research productivity with accompanying increases in financing.

11

Further biopharma growth expected from strong pipelines and strong financing of new companies

![Graph showing increasing research productivity driving growth of pipelines at top biotech and pharma](image)

![Graph showing financing of new biotech projects is also continuing to increase](image)

It seems likely that a high long-term growth in financing (currently 13 percent per year) will continue, as seen since 2001. Although, because financing in 2001 dropped 40 percent from its peak of U.S.$38 billion in 2000, this growth has yet to take the industry back to its highest level.

A couple of fundamental observations are worth noting about the biopharma industry. First, there is a very direct link between research and commercial success in biopharma, and second, the pharmaceutical industry is increasingly using biotech as...
an “innovation engine,” making open innovation models and intellectual property right (IPR) strategies critical for commercial success.

The figure below illustrates how the international pharmaceutical industry is looking to biopharma for innovation.

![Figure 7 – Biotech innovation](image)

Finally, the structure of the biopharma industry is driven by innovation and commercial expansion. Small, fast-growing research-intensive companies are important engines for value creation in the industry. The figure below illustrates this.
Small, research intensive growth companies are important engines for value creation

### Figure 8 – Illustration of importance of growth companies in biopharma (global numbers, 2003)

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<th>Phase II</th>
<th>Phase III</th>
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<td><strong>Top 10 Pharma</strong></td>
<td>83</td>
<td>101</td>
<td>41</td>
<td>17</td>
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<tr>
<td><strong>11 – 20 Pharma</strong></td>
<td>57</td>
<td>72</td>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td><strong>Other Pharma</strong></td>
<td>76</td>
<td>154</td>
<td>46</td>
<td>38</td>
</tr>
<tr>
<td><strong>Top 10 Biotech</strong></td>
<td>21</td>
<td>28</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td><strong>Smaller Biotechs</strong></td>
<td>510</td>
<td>798</td>
<td>259</td>
<td>83</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>747</td>
<td>1,153</td>
<td>388</td>
<td>150</td>
</tr>
</tbody>
</table>

1. Total of 70 companies (over and above the top 20)
2. Source: Pharma Projects Feb 2003, BCG Analysis

The fact that fast-growing R&D-intensive companies are critical is important for Norway in several ways. First, if Norway wants a stronger biopharma industry, there is a need for incentives and vehicles to assist the growth of small R&D-intensive companies. Second, there is a need to acknowledge that large pharmaceutical companies (which are critical to value creation) actually mainly seek growth companies. They are less disposed to look into the myriad of new ideas and small start-ups without a clear strategy.

### 3.2 Why Biopharma is different from other industries in Norway

Norway has a business structure in which natural resources and knowledge resources go hand in hand. Strong sectors – such as oil and energy, aquaculture and fisheries, metals and maritime – are built on the natural advantages enjoyed by Norway. Biopharma is different.

- First, biopharma is – more than other industries – derived directly from research excellence, and the opportunities in this arena are direct outcomes of research. (However, while quality research is necessary, it is not sufficient – commercial strategies are critical.)

- Second, as a consequence, IPR strategies are critical to commercial success in biopharma.
• Third, biopharma is inherently a global industry, in which there is no place for local solutions.

3.3 The importance of the biopharma industry to Norway

Norway stands to benefit from a thriving biopharma industry in several ways: First, Norway can realize direct benefits, such as increased revenues and employment, from the rapidly growing biotech industry. Second, biopharma also contributes to other core sectors in Norway, such as the health care sector, process industry, aquaculture and petroleum. Third, biotech may help resolve some of Norway's main challenges, including environmental issues, improved health and demographic challenges. Finally, increased participation in the field of bioscience enables Norway to influence developments in this (ethically and socially) challenging arena. These points are further elaborated below.

While Norway is a very small player in global biotechnology, it can realize direct benefits in terms of increased revenues and employment by taking part in the development of the knowledge-intensive biotech industry. In order to do so, however, it is necessary for Norway to leverage its unique biotech-related assets, which include marine biotech and aquaculture, world-leading biobanks, a strong hospital sector, a highly skilled population, and strong research within biopharma niches.

In addition to direct benefits from a growing biotech industry, biotechnology also helps develop other industries and sectors in Norway through application of products and research, some examples include:

• Better diagnostics tools and biotech based drugs may lead to improvements in patient treatment in hospitals.

• The Norwegian petroleum industry is dependent on biochemical drilling mud.

• Progress in meeting emission targets in the process industry, which uses biochemical purification plants.

• Increased yields in food production (through improved crops).

• Advances in university education (through biotech industry research and experience).
Biotech can also help resolve some of Norway's main societal challenges, such as in the areas of demographics (more effective drugs are required to treat patients more effectively and help an aging population); the environment (issues related to sustainability, global warming, and waste reduction); “Norway beyond oil and gas” (the future of Norway's knowledge-intensive industry and value creation); and Norway's national security.

However, at the same time that biotechnology is maturing, controversy still exists over such issues as cloning, gene-manipulation, and application of the use of stem-cells. Public opinion toward biotechnology in Norway has become much more positive over the past few years. But Norway is still among the most skeptical countries in Europe. Further development in these, and other, areas will influence the life of Norwegians. In order to have an impact on biotechnology's direction, it is necessary that Norway not only understands the field, but also participates in its development.
4 Norwegian biopharma – lack of harvesting mechanisms

So far, despite years of growth, biopharma remains a small part of the overall industrial landscape in Norway. It is, however, rapidly gaining importance as overall growth of pharma continues. Though it is worth noting that despite double digit growth over the past ten years, biopharma has not closed the gap to the ICT or the oil and gas industry. Also worth considering is that, at a value-creation level, this growth has been, to a large extent, derived from areas considered more aligned to pharmaceuticals than biotechnology. Looking at the status of the current biotech landscape in Norway, and at recent developments across the industry as a whole, seven observations stand out:

- The Norwegian biopharma industry is marginal in the international landscape, and it has only a limited presence within the overall Norwegian business landscape.

- Despite a strong research base in Norway in several biopharma areas, there is underutilized commercial potential.

- There are clear gaps in terms of the commercialization of biopharma in Norway.

- Some positive developments are emerging in biopharma in Norway.

- Despite these positive signs, we are not seeing Norway dramatically changing its current path.

- International linkages are still limited and lacking compared to what is needed for success.

- Commercial success in biopharma cannot be created overnight.

In essence, Norway appears to have an solid research base from which to build, but lacks appropriate harvesting mechanisms required to realize its biopharma commercialization potential. The observations forwarded above will be addressed in turn below.
4.1 The Norwegian biopharma industry still marginal

We see today, despite a healthy growth rate in the past several years – in excess of 10 percent – in terms of companies (11.4 percent per year), value creation (10.4 percent per year), and bio-related revenues (12.5 percent per year), biopharma’s position within the greater business landscape in Norway is marginal. As can be seen in Figure 9, this is also reflected on a global scale, where Norway’s biotechnology contribution (on a revenue basis) is modest.

This can also been seen more generally when looking at the Norwegian footprint. Today, there are 53 widely recognized bioclusters around the world, of which none are Norwegian. Similarly only 7 out of 150 listed biotech companies in Europe are from Norway. The figure below shows that Norway is a small actor in global biopharma, and that the industry is small in the Norwegian context.

However, biopharma in Norway is rapidly gaining in importance through steady growth. The combined number of pharma/bio and biotechnology employees in Norway has grown to around 6,000 FTEs. This represents an annual growth above 8 percent over last few years. This growth is taking place in an overall profitable environment. Looking at the joint pharma/bio industry there was an aggregate profit of NOK2.4 billion in 2005. This figure needs to be interpreted with a bit of caution because 90 percent of the aggregate profit is generated by the seven largest biopharma companies. The majority of this contribution is also attributed to “traditional” pharmaceutical-related activities. In this way, the biopharma industry in Norway is no different from that in most other countries.
Though biopharma is a small part of the industrial landscape in Norway, it is gaining in importance.

Biopharma industry is growing steadily

There is over time employment growth...

...and the companies are making money

The Norwegian Pharma/Bio and biotech sector has a joint profit of 2.4 BNOK for 2005

- 90% of this profit is generated by the seven most profitable companies
- Most of the profit would still appear to be from pharma related activities
- Majority of the smaller companies still have negative results

The Norwegian biopharma landscape is mostly made up of small companies, two-thirds of which have fewer than ten employees – and only nine of which have more than 250 employees. The average number of employees in biopharma companies in Norway is 38.

Not unexpectedly, activity within the bio-landscape in Norway is dominated by the biopharma sector. There are 94 biopharma companies, as compared to a total of 71 companies across biomarine, bioagri, equipment/technology, and other biotech companies. Biopharma companies also take the lead in employment (85 percent), revenues (89 percent), and value creation (94 percent). The greatest difference, as can be expected, is in net profitability, where biopharma, in aggregate, contributes more than 100 percent of total industry profitability. This is illustrated in figure 11.
4.2 Underutilized commercial potential despite solid research base

Taking a step back, we find that despite healthy growth over the past decade, there is still unrealized potential. A relatively strong research base in several biopharma areas, as well as globally recognized strength in the smaller biomarine segment, is not yet fully reflected commercially.

In recent years, only a limited number of biotech companies in Norway have been publicly listed. From 2005 to 2007, stock market listings (actual and planned) have been limited to NorDiag, Biotec Pharmacon, Algeta and Clavis Pharma. This is a small number out of a total of 110 listings during this timeframe. Looking at “pure” biotech revenues (those that do not include biopharma revenues of big pharmaceutical companies), 16 percent growth per year since 1999 only amounted to approximately NOK3 billion in 2005, which is less than half the equivalent of that of Sweden (where more biopharma revenues are linked to major pharmaceuticals).

The growth rate of new bio-companies in Norway has been 18 percent per year – excluding pharmaceutical companies, which have emerged at a lower rate of 8 percent per year – with a total of 165 new biopharma companies overall to the end of 2005. Unfortunately, there are still relatively few success stories among bio-companies in the Norwegian market, most of which have their origin in the past decade – for example, Dynal (now Invitrogen) (1986), Biotec Pharmacon (1990), Pronova BioPharma (1991), Photocure (1993), and Axis-Shield (1999).
This is in sharp contrast with Norway’s strong position on the research side of biopharma. In terms of research “quality” (as measured through international citation indexes), Norway has moved from an index value of 88 (100 is the world average) in 1992 to surpassing all the Nordic countries, with the exception of Denmark, since 2004. This is especially significant because 60 percent of all Norwegian scientific publications are within the life sciences field. This has brought Norway to 0.6 percent of the world’s biotech publications, twice Norway’s share of world GDP in 2006.

Citations are a good indicator of research excellence. Using the research areas of focus with the “Norwegian centers of research excellence” as a guide, it is possible to compare Norway’s total volume and share of both Nordic and worldwide citations in more narrowly defined fields (for example, immunology). In doing so, focusing on recent history, or the latest developments in these areas (from July 2006 through June 2007), we find that within the Nordic region, Norway ranks second (in aggregate) – only after Sweden – over all the topics in the comparison. (See figure 12).

More importantly, we also see that in several areas – such as immunology, stem cell, DNA, neurology, and marine biotech – Norway has, over the past year, held a leading position. This shows Norway’s relative strength compared with its Nordic neighbors across many areas, and some presence on a more global scale in a few – for example, immunology and marine sciences. In fact, in a selection of 20 countries with leading or emerging positions in the biopharma industry (including the United States, China, India, and the United Kingdom), Norway ranks eleventh, just ahead of the other Nordic countries. (See figure 13).
Interviews with leading companies, researchers, investors, and industry commentators confirm this impression. On the science side, Norway is increasingly described as a biotech research stronghold in Europe, “clearly in the A league,” with recognition of the availability of “world class know-how” and the potential of becoming an “ideal location to execute clinical trials.” There are many examples of Norway’s internationally competitive research, including the center for molecular biology and neuroscience and the wider institute for cancer research, both located in Oslo, MabCent in Tromsø, and the center for biology of memory in Trondheim.
Patenting represents an intermediate step between science and commercial applications. Norway here lags its neighboring countries in converting ideas to applications, as can be seen in the figure below. In Norway, the flow of new biotechnology patents filed is between 15 and 20 percent of the flow seen in Sweden and Denmark. This lag in translating research into patents is only an indicator, but one that is puzzling when considering Norway’s research excellence.

Norway has a much stronger position in research than the commercial results indicate

Despite strong growth, biotech revenues are not even half of those in Sweden...

...and we are outclassed in terms of patent quantity by our neighbors

Figure 14 – Commercialization gap
4.3 Challenges of commercializing biopharma

We have identified several challenges in the greater environment and infrastructure for the commercialization of biopharma in Norway. The two most noted, and most frequently identified, gaps in Norway’s potential for commercializing biopharma are limited access to competent capital (as it applies to biopharma), and a small talent pool of those experienced in biopharma entrepreneurship and commercialization.

Although venture capital and private equity activity in Norway is growing, it is not yet strong in the area of biopharma. There are currently 56 management companies administering 85 funds across all industries, with NOK 45 billion of raised capital in existing funds. Of these, 15 new funds were established in 2006, raising NOK11.4 billion. But, there is a limited focus on biopharma; only five of the companies and NOK1.8 billion are directly relevant to biotech and life sciences in general. As can be seen in Figure 15, when assessing investments on a share of GDP basis, private equity and venture capital investments are significantly lower than those in comparable countries, such as Sweden, Denmark, and the United Kingdom.

Local management expertise and entrepreneurship are also limited within the pharmaceutical industry with a small talent pool to draw from for new ventures as well as growing current ones. There are several reasons for this. Without a large established pharmaceutical industry to draw upon – the total number of employees is now roughly 6,000 – we see a capacity challenge related to talent with the right
expertise. This is partly reflected in the low number of new ventures, which indicates limited growth in Norwegian start-up and commercialization expertise.

Beyond this there are several challenges in going to market in Norway. Industry analysts highlight that the challenges of “going-to-market” are often underestimated by companies emerging from a research background – or as one industry insider phrased it: “medical hierarchy can be an obstacle, there is little appreciation of the challenges involved in taking a product to market.” Another frequent observation is that ideas are pushed out to the market too soon to have a realistic chance of being “sold” to interested parties. The amount of time and effort needed to create a venture with commercial potential is usually underestimated: “Most ideas are believed to be much further down the value chain than they really are. They are operating with too short time horizons,” according to the executive of one global pharmaceutical company.

Expectations often held in many areas of research for an immediate, and future, financial return are another obstacle, linked to a lack of appreciation of marketability as a key determinant of financial potential. Or, as it has been put more simply, there is, according to a successful entrepreneur, “a need to get past unrealistic expectations of what an idea is worth. If it can’t be taken to market it isn’t worth much at all, and that is hard.” There is also a widely held perception that current incentive and tax structures are a disincentive for forming new companies. The lack of tax incentives and co-investment options is seen as limiting the appetite for investment and risk. As pointed out by one international investor: “Though there are researchers and some ideas in Norway, there are no real incentives to establish businesses, unlike in other countries.” This captures the essence of numerous views and opinions. Other elements referred to as limiting access to capital and talent in Norway include fund restrictions and tax disadvantages. This is in direct contrast to the substantial attention incentives and funding biopharma is receiving in many other countries. Figure 16 below outlines some of the schemes and ambitions that are identified internationally.
Biopharma is receiving substantial focus, incentives and funding in many other countries

Global biopharma becoming more competitive as industry matures

Figure 16 – Global emphasis on biopharma

There is consensus among key actors that there is a need to attract and mobilize international capital for the commercialization of biopharma in Norway. In this regard, Norway has to meet a general challenge related to early-phase innovation funding.

- There are no tax incentives in Norway to encourage investments in private equity and venture capital. Nor are there any specific vehicles for supporting the creation and growth of innovative high-potential start-ups (so called “Young Innovative Companies” – YIC). There is no special company tax rate for small and medium-sized companies (SMEs), and though generally seen as not being highly uncompetitive, the company tax rate of 28 percent is slightly above the European average of 26.2 percent.

- Fiscal research and development (R&D) incentives are also limited. Norway offers a few incentives for business R&D expenditure and R&D capital expenditure through the Research and Development Tax Credit and SkatteFUNN, and some for cooperation between firms and research institutes/universities. Private incentives are also harder to come by, with Norway ranking unfavorably compared with other European countries with regard to the taxation of capital gains and income of private individuals.

4.4 Some positive signs in Norway
There are however some positive signs. Public opinion in Norway, just as in other European countries, has shifted in favor of biotechnology. However, as can be seen in Figure 17, support is more moderate than in neighboring countries – Denmark in particular. There has also been distinct signaling from Norway’s government that biotechnology will be important for Norway in the future, such as its inclusion as one of three technology platforms prioritized in the parliamentary bill “Stortingsmelding 20 – Vilje til forskning.”

The increase in technology transfer offices (TTOs) within university and hospital circles – accompanied by expressed intentions to focus on commercialization – is also a sign of heightened attention to commercialization.

Norway is also seeing the emergence of new structural formations and commercialization platforms that may represent a potential going forward. Among other new platforms within Norwegian sciences, a total of 35 SFIs (centers for excellent innovation) and SFFs (centers for research excellence) have been formed. At least eight of these are directly involved in biotechnology:

- Centre for Stem Cell Based Tumor Therapy is an SFI with partners from both academia (the National Hospital [“Rikshospitalet”] / the Radium Hospital and the University of Oslo) and industry (for example, Affitech, Invitrogen, and Photocure).
• Centre for Molecular Biology and Neuroscience is an SFF hosted by the National Hospital (“Rikshospitalet”) / the Radium Hospital and the University of Oslo.

• Centre for Cancer Biomedicine is an SFF hosted by the University of Oslo.

• Centre for Software components for biomedical flows is an SFF focused on IT and biomedicine.

• MabCent is an SFI focused on marine bioactives and drug discovery, hosted by the University of Tromsø, with (among others) Biotec Pharmacon as a commercial partner.

• CREATE – Centre for Research-based Innovation in Aquaculture Technology – is an SFI hosted by SINTEF.

• Aquaculture Protein Centre is an SFF located at the University in Ås that cooperates with DuPont, Solae, and Norferm.

• Center for the biology of memory, an SFF at NTNU in Trondheim (which coexists with the Kavli institute for systems neuroscience).

Another set of positive signs includes the fact that the FUGE program at the Research Council of Norway has decided to move more focus into commercialization going forward, and that we now see established companies moving into (marine) biotech (Aker Biomarine is a case in point). Also the establishment of initiatives such as Oslo Cancer Cluster is a positive move in the direction of commercialization.

It is worth noting how this increase in commercial focus and corresponding growth in TTOs have manifested themselves practically. There is now in place a complex, geographically oriented commercialization “instrument,” with ambitions and responsibilities across all fields of research, as is shown in Figure 18. Oslo is, so far, the only region with specialized TTOs; there is a lack of focus on biotechnology at the national level. There are reasons to believe that the particular nature of biopharma requires a more focused effort to succeed – in particular to build necessary scale and capabilities.
The TTO structure is complex and geographically oriented
Oslo is the only region with specialized TTOs for different research fields

4.5 Norway is not dramatically changing path

Regardless of the positive signs in recent developments, we do not see any evidence that Norway is dramatically changing its current path when it comes to commercialization and development of the biopharma industry. One clear example can be seen by comparing the biopharma product pipeline in Norway with that in Denmark and Sweden. In 2006, Sweden’s pipeline was 1.8 times that of Norway, and Denmark’s pipeline was 5 times larger than that of Norway. This is shown in figure 19.
We also see that increased attention to biopharma has yet to result in increased resources dedicated to commercialization. In 2005, we saw approximately NOK 1 billion in public R&D funds allocated to biotechnology with about the same in private funding. Two-thirds of the public funds made available are channeled through the Research Council of Norway. The majority of the funds are earmarked for research activities through funding programs like FUGE. Of this, the Research Council directs about NOK 75 million to commercialization each year. This corresponded to 13.5 percent of the total funding in 2006 and 12 percent in 2005, spread across approximately 50 projects – an average of NOK 1.5 million to each project.

### 4.6 Limited international commercial linkages

Traditional life sciences clusters are made up of a number of players that together generate sufficient mass to drive ongoing development. Some of these entities may be closely located geographically but others may not be. In the Norwegian market, some of these entities are already present to a greater or lesser extent – such as healthcare, public institutions, basic research, and education.

Accessing core resources not available locally is important for Norway. Several resources that are either not present or only marginally so include established biotech’s, funding entities, and such core supporting players as specialized suppliers and advisory services. The figure below shows that there are clear opportunities for Norway related to certain international linkages.
International commercial linkages limited compared to what is necessary for success

Traditional life sciences clusters are composed of many different entities...

...many of which Norway will need to be accessed through international linkages

Norway’s international connections are significantly stronger in research-related areas of scientific communities than in the areas with a commercial focus. Establishing the presence of foreign biotechnology and pharmaceutical companies will be critical to Norway’s success in further building the industry. Looking at current inflows of R&D investments in Norway, we see that about 80 percent come from the 26 most R&D-intensive companies. Of these, four companies – representing 12 percent of the inflow – are from the pharmaceutical or biotechnology sectors. This trails inflows of R&D investments to Norway in other areas such as offshore/energy (31 percent), process industry (19 percent), and ICT (19 percent). The figure below shows the proportion of inward business inflows of R&D investments constituted by biopharma.
4.7 Commercial success in biopharma will take time

When assessing the current landscape in Norway, it is important to realize that even with a new and more ambitious strategy, it will take both time and a sustained effort to achieve commercial success. We have seen a steady increase in research quality, resulting from a concerted effort on the science front, over the past decade in Norway. Drawing lessons from developments in other parts of the world, an increased effort in biotech in Norway will be a long process. As highlighted in Figure 22, we see that this is a rather slow process, as commercial capabilities will have to be developed over time. Filling gaps in commercial capabilities will, in many instances, require significant growth from a low base in areas such as management resources and commercial networks. For example, Boston’s life sciences cluster, which has positioned Massachusetts as one of the world’s leading bioclusters, took 40 years to develop.
A new more ambitious strategy will take time to deliver
There is limited possibility to create commercial success in biopharma overnight

Even with a base in place...
...building a sustainable biopharma industry is a long process

1970: Biogen is incorporated in Switzerland – moves to Boston in its early years
1980: The first biotech companies in the Cambridge (UK) area are established – the beginnings of a cluster is already in place
1983: Gen-Probe is established – first biotech company in San Diego
1986: Genentech is established – first biotech company in San Francisco
1997: Medicon Valley is launched as a brand name, and a cluster
2002: Massachusetts announce ambition to achieving global leadership in the life-sciences economy by 2010
2007: Oslo Cancer Cluster is still in a shaping phase

Figure 22 – Timeline for development of Boston biopharma cluster

Many goals have been communicated publicly in Norway since 1985 (see figure 23). There is so far a clear disparity between intentions, visible actions, and results. In 1985, biotechnology was mentioned as one of five national research focus areas. As shown in Figure 17, it is now prioritized by the government as one of the three technological platforms to be prioritized for the future research effort.
Communicated intentions and efforts in biotechnology have yet to manifest itself in commercial results

So despite high ambitions and certain initiatives in Norway it is not clear that the overall position of Norwegian biotech business has been strengthened during the last decade. An important reason for this is that other countries and regions have put so much emphasis on this industry, as pointed out in the next chapter.
5 Learning from global bioclusters

This chapter describes six leading bioclusters and identifies the success factors of relevance for Norway. Based on our analysis, we propose a model for establishing a competitive biopharma industry. Finally, we point to some of the successful initiatives we observed in emerging bioclusters.

5.1 Overview – bioclusters spread all over the world

The biotechnology industry originated in the early 1970s with the discovery of DNA and its potential applications. Stanford University and the University of California were the two pioneer institutions within this new field. Today, over 30 years later, biotech applications are diverse, ranging from drug development (biopharma) to energy (biofuel). Previously a marginal research field, the biotech industry has become big business with promising bioclusters emerging all over the world. There are currently at least 50 recognized bioclusters worldwide, and some 100 smaller locations striving to obtain this same “status.” The interest of governments wanting to catch the next technology wave is increasing, as is the interest of a wide range of investors.

Bioclusters can be divided into two groups: established and emerging. The first is characterized by world-class research institutions, complete entrepreneurial infrastructures, and companies in all life-cycle phases. While being competitive in certain areas, the emerging clusters have an incomplete business foundation. This is mostly a consequence of these bioclusters still being in an early phase of cluster development.

5.2 Regional/cluster profiles

In our study of international biopharma, we have paid particular attention to six bioclusters – three established bioclusters in California (United States), Massachusetts (United States), and Cambridge (United Kingdom), and three emerging bioclusters in Medicon Valley (Denmark/Sweden), France, and Ireland.

The established clusters represent best practice examples, not necessarily applicable to Norwegian biopharma. Nonetheless, they illustrate the dynamics of the industry. Two reasons underlie our selection of the emerging clusters: Medicon Valley is built from a base comparable to that in Norway, while Ireland and France are often referred to as success stories in biopharma, thus providing some important lessons. What follows is a brief description of each of the bioclusters.
5.2.1 California (United States)

Genentech, the first biotech company established in California, is regarded by many as the founder of the biotech industry. Since then, this pioneering biocluster has grown considerably, maintaining its position as the industry leader. In 2006, the revenues reported by the top five biotech companies in California totaled over U.S. $31 billion. These five are: Amgen (U.S.$14.3 billion), Genentech (U.S.$9.3 billion), Allergan (U.S.$3.1 billion), Gilead (U.S.$3.0 billion), and Watson Pharmaceuticals (U.S.$2.0 billion).

In this highly research-intensive industry, the importance of academic excellence is critical. Thus, the presence of quality universities – such as Stanford, UC Berkeley, UC San Diego, and UCLA – was a prerequisite for California’s success over the years. The biopharma industry has an “appetite” for new ideas, and together with other world-class research institutions and hospitals, these universities serve as the foundation of the whole industry.

Because most new biotech ventures require large long-term investments, the industry has a significant need for long-term risk capital. Access to capital is essential to any biocluster. California is the best funded biocluster, attracting almost half of the total venture capital going into U.S. biotechnology. In addition, it holds first position on the list of research funding from the National Institutes of Health (NIH). In 2006, the total capital raised by California’s bio-related companies and institutions amounted to U.S.$5.3 billion, of which U.S.$3.1 billion were funds from the NIH and the remaining U.S.$2.2 billion were venture capital. On a global level, this kind of capital base is exceptional and it enables California’s biocluster to pursue a wide range of ventures and to more efficiently manage the inherent risks of biotech.

The presence of the pharmaceutical industry and other related businesses in California is important for both R&D and investors. The research institutions profit from the investors’ knowledge about market demand and commercial trends, and investors are highly dependent on the international pharmaceutical companies in order to execute their strategies. In California, international pharmaceutical companies are an integrated part of cluster dynamics, with active participation from such companies as Novartis, Johnson & Johnson and AstraZeneca. Academic institutions in California are able to profit from this presence through both formal and informal forums (such as sponsored PhD’s and commercial alliances).

The California State Government is committed to the biopharma industry and supports programs to ensure continued global leadership within biotech. Initially, this support was substantial and very actively focused on setting up research parks. Today, competitive forces and collaboration within clusters make California’s biotech

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1 California is a bioregion with clusters in Los Angeles, San Diego, and San Francisco. The dynamics among these locations is proof of a larger entity, thus we treat California as whole.
wheels “spin on their own,” and public initiatives are more focused on creating a favorable environment for the biopharma industry.

Nonetheless, California’s biocluster is facing increased competition from other U.S. states offering tax incentives and stimulating regulations in order to build a stronger biotech industry of their own. One of the states currently giving this kind of stimuli is Massachusetts.

5.2.2 Massachusetts (United States)

Although it is the result of a more recent effort, the biocluster in Massachusetts is also well established. Biogen is seen to be the first biotech company established there. The company was initially established in Geneva by several leading biologists. These biologists were connected to U.S. universities, and they moved to Boston in 1978. However, the real commitment to building a biocluster in the state was not made this early.²

Massachusetts is the second largest biocluster in the United States, housing more than 300 companies that represent approximately 20 percent of the U.S. biotech population. Genzyme, Biogen IDEC, and Millipore are the major players, generating revenues of U.S.$3.2 billion, U.S.$2.7 billion, and U.S.$1.3 billion respectively in 2006. The academic institutions in the cluster are also highly respected: Harvard and MIT. In collaboration with the most important international pharmaceutical companies, the academic base provides both applied world-class research and a pool of scientific and managerial talent.

The Massachusetts biocluster raised close to U.S.$3.5 billion in 2006; however, more than 75 percent of this originated from the National Institutes of Health (NIH). Access to venture capital is not as good as in California, yet the total funding allocated to this biocluster is, without doubt, excellent compared to the funding provided to any other biocluster. So, Massachusetts is able to pursue a broad range of ventures based on world-class research from multiple institutions. Whereas California has few policy incentives to fund biopharma, Massachusetts officials are more “tuned in” to stimulating the industry with favorable regulations. One of the most attractive incentives is the “Single Sales Factor,” allowing companies to make adjustments in order to reduce the corporate tax burden. For the biotech value chain with high R&D costs, this tax incentive is particularly favorable. In addition to a favorable regulatory environment, the state is actively committing to further developing the biocluster by earmarking financial resources to support biotech research – for example, a U.S.$1 billion fund for stem cell research.

² Massachusetts includes players from Boston and Cambridge, but also from smaller cities such as Fall River and New Bedford. We refer to Massachusetts as “one” biocluster.
5.2.3 Cambridge (United Kingdom)

The Cambridge biocluster is significantly smaller, on most dimensions, than its U.S. rivals. Still, the biocluster has a unique position and history within European biotech, in part due its world-class research base. The first Cambridge-based biotech company was formed in the mid-1980s, and today there are approximately 235 companies in the biocluster. Shire (with 2006 revenues in the order of U.S.$1.8 billion), Cambridge Antibody Technology (part of AstraZeneca since June 2006), and Acambis constitute the leading trio of biotech companies in Cambridge.

There are several world-class research institutions in Cambridge, the most reputable being LMB, the Sanger Centre, and EBI. Fourteen science parks facilitate the biocluster's R&D activities. These science parks serve as an arena for interaction between academia and the industry – represented by both global pharmaceutical companies and related multinational companies – thus securing the applicability of research activity. Even though most of the multinational companies are not as geographically close to the cluster as they are to the U.S. clusters, collaboration is widespread between research institutions and the industry.

The venture capital allocated to the biocluster in Cambridge is very volatile, actually hitting its lowest level on this side of the millennium – in 2005. In total, Cambridge raised a modest U.S.$110 million that year, only representing 5 percent of the total in California. This has been a major concern in the past couple of years, resulting in active M&A strategies for major European players. Both AstraZeneca and GlaxoSmithKlein have recently acquired biopharma companies from Cambridge. Pharmaceutical companies use acquisitions of biopharma to sustain further growth, and biopharma investors turn to global pharmaceutical companies as an exit strategy when other financing becomes too expensive. Failing to raise sufficient risk capital, Cambridge has also grown more dependent upon government funding. In 2005, the U.K. government allocated U.S.$1.1 billion to fund stem cell research.

Thanks to this kind of direct governmental support and to some extent internally generated cash flows, the biocluster is able to fund future growth and maintain its position as a successful biocluster. In addition, we observed that the pharmaceutical industry represents a third source of capital through M&A activity. This tendency is supported by U.K. policymakers, making it easier for large corporations to invest in small companies through corporate venturing. Being smaller compared to the bioclusters in California and Massachusetts, Cambridge has built up several international networks and alliances with other bioclusters around the world. This enables Cambridge to remain competitive on R&D excellence and commercialization – even measured against the larger U.S. bioclusters.

5.2.4 Medicon Valley (Sweden/Denmark)

Between 1996 and 1997, the southern region of Sweden and Copenhagen formed an alliance aimed at building a thriving biocluster. Ten years later, this has become a reality and the cluster has grown to include Gothenburg (Sweden) and Aarhus (Denmark). Medicon Valley has about 150 biotech companies, with Alk-Abelló and
Bavarian Nordic being the major players (2006 revenues of U.S.$70.5 million and U.S.$31.0 million respectively).

The academic platform offered by institutions such as Lund University and University of Copenhagen are considered to be world-class within certain fields, especially neuroscience, diabetes, inflammation, and cancer. In addition, several well-equipped research parks housing both academic and commercial players and high-quality public hospitals enable Medicon Valley to have one of the strongest drug pipelines in Europe. To further improve the applicability of its R&D, this biocluster has set up formal collaboration among universities, hospitals, and industrial players. This collaboration (the so-called Triple-Helix model) is focused on leveraging R&D excellence already present by inviting in large international pharmaceutical companies. Both Sweden and Denmark have a stronger history with pharmaceutical companies than Norway, and this model is regarded as one of the best collaboration models within biopharma. Initiatives such as the formation of technology transfer offices (TTOs) aim to build a supportive infrastructure based on this model.

Access to capital is not close to that of the U.S. bioclusters. R&D in Medicon Valley is much more focused on a few key areas within biopharma. In 2006, Medicon Valley raised U.S.$235 million in total venture capital, up from U.S.$192 million the year before. As the biocluster is maturing, public equity markets have increasingly become a more important financing source, with U.S.$628 million from public issues in 2006.³ It is difficult to pinpoint the exact size of public funding allocated to Medicon Valley. However, there is no reason to believe that the level of public funding should be much different from the level of private funding. Denmark has earmarked part of its national venture/seed fund, “Vaekstfonden,” to finance biotech ventures.

Having entered the biopharma industry at a later stage in the lifecycle, committed support from the two governments has been and still is, a prerequisite to building a successful biocluster. Both countries have lifted biopharma to become an industry that is supposed to play an important role within knowledge-based economies. As part of this strategy, the biocluster has to build strong international networks and leverage international experience within both research and management. Medicon Valley has realized that capitalizing on its R&D resources is unrealistic unless they attract international human resources.

5.2.5 France

France actually made several attempts to build a biotech industry in the early 1980s, but it was not until the late 1990s that it really started succeeding. The French home market for pharmaceuticals is the second largest in Europe, thus it can leverage the strong presence of international pharmaceutical companies. The largest biotech companies in France are Eurofins Scientific (U.S.$463 million), Cerep (U.S.$67

³ Please note that this figure is affected by large IPOs that, by definition, are one-time incidents. Still, it is our view that public equity markets have become more important to Medicon Valley.
million), and Flamel Technologies (U.S.$56 million). In 2005, the total number of companies in the biotech industry in France was about 350.

The R&D quality is globally competitive in several areas, and France has a particularly strong track record in drug development. French universities and national research centers are known to be of high standard, providing a solid base for biotech R&D. Recently, there has been a shift of direction to focus on building a few competitive bioclusters (mainly in Paris, Lyon, and Lille) instead of further pursuing a broad effort. The new focused strategy also aims to foster better collaboration among academia, hospitals, and industry. The strong presence of the top ten pharmaceutical companies such as Sanofi-Aventis, GSK, Eli Lilly, and Pfizer, gives this collaboration commercial focus.

The financial landscape for biopharma in France has improved over recent years. The access to risk capital is relatively solid, with about U.S.$200 million in venture capital and U.S.$130 million from public offerings. There are few sources that specify the total direct public support allocated to French biopharma, however, in 2002, an official biotech plan launched by the national authorities committed about U.S.$160 million to finance foreign acquisitions and indigenous start-ups. Moreover, several other initiatives, such as setting up an innovation bureau, back up the declared ambition to build a thriving biotech industry in France. A key element in this ambition is the Young Innovative Company (YIC) incentive which gives strong incentives for forming start-ups by offering multiple tax exemptions and cheap debt financing. The fact that 30 to 40 biotech start-ups come out of France every year, indicates that this initiative stimulates growth.

5.2.6 Ireland

Irish biopharma is in an early stage of development, and it is a result of a broad, national ambition aimed at strengthening Ireland as a knowledge-based economy. Initially, the focus of Irish biotech was to attract active international pharmaceutical companies to boost development. They succeeded in attracting the large industrial players, and Ireland is already among the top 25 global biotech locations. However, most of the activity on Irish territory has been in production, and there are currently only about 50 locally based biotech companies. Elan is the largest among them, with revenues of U.S.$621.3 million in 2006.

The authorities have taken into account that in order to become more dynamic, there is a pressing need for improved R&D activity. Irish academic research within biotech has yet to be rated among the best overall, and the international pharmaceutical companies have not contributed significantly in this regard. Irish biopharma does not yet have a good track record in raising capital, neither private nor public. However, we observed a change of attitude toward Ireland, with stronger collaborations between academia and the international pharmaceutical companies.

The players in the Irish biocluster are well aware of the limitations when it comes to academic research, and several alliances with established clusters in the United States
and with emerging clusters in destinations such as India have been set up. There is also a focused public commitment to build world-class R&D within certain fields, backed up by both favorable taxation and capital. The corporate tax rate in Ireland is 12.5 percent, attracting large foreign direct investment from international pharmaceutical companies, and the Irish government recently allocated close to U.S.$3 billion to build a stronger research base, mainly focusing on biotech. An important part of the strengthening of Irish biotech research is international networking.

Credible public commitment, more active international pharmaceutical companies, and a growing academic base are setting the scene to attract both venture capital and general international interest – and to make biotech a significant contributor to the future of the Irish economy.

5.3 Key success factors in establishing a successful biotech industry

Benchmarking of international bioclusters reveals several common key success factors. It is difficult to rank them based on their importance, and none of these factors is, in isolation, sufficient to establish a successful biotech cluster. Lacking one, on the other hand, may impede building a cluster. Figure 24 sums up nine key success factors identified across bioclusters.

![Benchmarking reveals several common Key Success Factors](image)

**Figure 24 - Nine common key success factors across bioclusters**
World-class R&D with applied focus constitutes the base of all bioclusters. Ireland initially started building the industry without having a world-class R&D foundation. After a short period of large foreign direct investment, the growth of the cluster fell off and few new biotech companies were created. Of course, the bioclusters have different fields of expertise, and the quality varies from broad excellence in established clusters to more focused distinctiveness in more emerging clusters.

The broad focus of bioclusters in California and Massachusetts is an advantage both from a cost-effectiveness perspective and for stimulating groundbreaking research. However, it is unrealistic to expect smaller clusters to obtain such critical mass, and we see from Medicon Valley and France that emerging bioclusters need to more narrowly focus their R&D. Medicon Valley has its areas of expertise and focuses on these when conducting research and allocating resources. It is also important to know the market that the research is meant to supply in the future. Thus, the translation of R&D activities to application is given considerable attention in the all these clusters.

Because of the inherent complexity and research intensity of the biotech industry, having access to both private and public capital is essential to successfully pursuing the best new ideas. Public investments are important to encouraging start-ups through seed financing, whereas private capital, such as venture capital, typically is needed to bring development closer to market. The difference in access to financing between U.S. and U.K. clusters is striking. It is noteworthy, however, that Cambridge, despite lagging the United States, still has good access to capital compared to other European bioclusters.

A third key success factor is a broad supply of research and management talent. The first group is typically closely linked to research institutions, hence inherent in a world-class R&D base. The challenge here is retaining the best researchers and attracting internationally competitive competencies in certain areas. Management talent, on the other hand, is an even more complex matter, closely linked to both private capital and the presence of a life science infrastructure. Successfully bringing a new product to market requires business and life science experience. Cambridge has a strong internal supply of scientists graduating from prominent universities and attracts research talent from all over the United Kingdom. With the presence of large international pharmaceutical companies in the biocluster, industry experience on how to commercialize biopharma ideas is also present.

Collaboration among complementary players is a key element in general cluster dynamics. In the established U.S. clusters, collaboration among academia, hospitals, and the industry is an integrated part of the stimulating “competition” within the cluster. In the emerging bioclusters, collaboration has to be coordinated and facilitated. Medicon Valley has made the Triple-Helix model a vital part of its biopharma ambition. This model is committed to providing infrastructure, facilitating the interaction among the different players. Formal collaboration models like this are important to leverage the R&D potential in an emerging biocluster. Ireland did not initially formalize a collaboration model when first committing to the biotech
ambition, but soon became aware of this vital element when all biopharma activity concentrated on production, with less attention to research and innovation.

Favorable tax regulation is clearly not a prerequisite for a successful biocluster, as California is the global leader without the benefit of tax incentives. Still, this kind of public support has proven to be effective stimuli for several of the other bioclusters. Ireland has become a preferred location, outside the United States, for a majority of international pharmaceutical companies in part because of the very low corporate tax rate (across industries). From being a rather modest player in biopharma, Ireland has emerged into a global player. France has targeted tax incentives toward start-ups, resulting in strong commercialization.

As biopharma is becoming increasingly global, international networking is becoming a prerequisite for smaller clusters. Being more focused in their activities, emerging bioclusters have to rely on importing missing core competencies. Medicon Valley has built alliances with the United Kingdom to promote strategic collaborations. Also, networking with Swedish pharmaceutical companies has been an important factor in building the Danish biotech industry. In Ireland, building international networks is essential in order to lift the quality of its research to a level where Irish biotech can be more than just production.

Biopharma is incomplete without pharma. The infrastructure needed to develop pharmaceutical products is different from most other industries because of very strict regulations on R&D and the long timeframe required to reaching market. Moreover, the general public opinion of the pharmaceutical industry plays an important part because of its effects for instance on politics and recruiting. With companies such as AstraZeneca, Sweden has a stimulating infrastructure for life-science-related activity, both within politics and the general domestic business environment.

Biocluster benchmarking reveals that all of the clusters studied receive public commitment. For emerging clusters, it is clear that private actors typically await credible public commitment before investing. The first Irish attempt was not accompanied by committed authorities, hence the industry responded by setting up drug production in Ireland without investing in Irish research. The same happened in France in the early 1980s.

Having an environment in which good ideas can easily be transformed into start-ups is also common ground for bioclusters. The established bioclusters already have stimulating cluster dynamics in place, encouraging risk taking and investments in new ideas. The YIC initiative in France is an example of a targeted incentive. Additionally, Vaekstfonden (Denmark) is important for start-ups in Medicon Valley because of its commitment to biotech and business expertise in the commercialization of pharmaceutical R&D. Vaekstfonden provides tailored capital structures and consulting services to early-stage biotech ventures. However, following the trend in other countries, Vaekstfonden may be becoming more focused on
venture capital rather than seed financing because of increased pressure to deliver returns.

5.4 Prerequisites for a successful biocluster

Looking at some of the broader implications of our benchmarking, we have identified several preconditions for a successful biocluster. Naturally, these prerequisites exist in varying degrees, even in the most successful bioclusters. Nonetheless, the lessons are relatively consistent, as shown in the figure below.

**Analysis shows that there are several premises that shape the potential to establish a biotech industry**

<table>
<thead>
<tr>
<th>Foundation</th>
<th>Competitive environment</th>
<th>Long-term Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong scientific research and development base, with world class expertise in specific areas is a prerequisite for any significant development</td>
<td>Access to competent capital – both seed and venture</td>
<td>Developing industry through a step change</td>
</tr>
<tr>
<td></td>
<td>Established industrial locomotives, MNCs and big pharma</td>
<td>Unlocking potential by leveraging competitive advantages</td>
</tr>
<tr>
<td></td>
<td>&quot;Talent&quot; and management with commercialization experience and industry expertise</td>
<td>Enabling competitive rivalry to drive ongoing development</td>
</tr>
<tr>
<td></td>
<td>International networks and partnerships</td>
<td></td>
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</tbody>
</table>

**Public support structures**

- Strong commercialization support infrastructure and incentives adapted to biotech needs
- Focus on core areas with stable long-term parameters and support

Internal competition is promoted through proximity of players across hospital, universities, industry and complementary entities accelerates growth and maturation of industry

Figure 25 - Premises that shape the biotech industry

At the core of any successful biocluster is a strong R&D base. However, this is, in itself, not sufficient. The smaller clusters need to focus on areas in which their R&D activities are at the forefront, thus aiming for global competitiveness in certain niches. Beyond focused investments, basic research must also be maintained on a continuous basis if a biocluster is to grow strong in the long term. These R&D efforts provide a platform for ongoing talent development, thereby securing access to highly qualified employees.

Leveraging the basic premise of scientific excellence, there are a set of major prerequisites that shape the potential to succeed within biotech. These are divided into two main components: the competitive environment and public support structures.
5.4.1 The competitive environment

The competitive environment consists of four main categories: access to capital (both seed and venture), established industry locomotives (such as international pharmaceutical companies), management with commercialization experience and industry expertise, and international networks and partnerships.

Capital

Successfully realizing an idea or a scientific breakthrough requires significant funding, over a prolonged period of time, from laboratory through trials. Further, because of the long investment window compared to many other industries and technologies, it is necessary for potential investors to understand the irregular risk profiles in biotech ventures. Capital does not necessarily have to be provided by national investors, though a domestic venture capital environment is likely to hold greater knowledge of local conditions and opportunities, especially in the early stages of financing. Finally, biotech ventures are best when public and private capital complement each other, thereby matching external effects and financial considerations. The general view is that social benefits are what create a common ground for public and private investments.

Established industrial locomotives (such as international pharmaceutical companies)

The presence of established large pharmaceutical companies has several positive implications for a local industry. First, access to experienced local management and highly educated and talented researchers contributes to academic R&D with both scientific and commercialization insight. Second, industrial companies are typically the first customers of biopharma companies, making their presence equal to a greater domestic customer base. Third, international pharmaceutical companies provide access to local production and distribution partnerships, thereby facilitating product development and keeping costs at a lower level. Finally, an industrial presence establishes feedback loops to build ongoing knowledge and expertise across the value chain.

Management with commercialization experience and industry expertise

The importance of management experience and expertise is twofold. Management teams with experience and track records as entrepreneurs within the industry not only improve and speed up the commercialization process but also are a key consideration for potential investors. As stated by one entrepreneur interviewed: “I spent three years on doing a good exit in one of my first companies. A few years later, I spent three months on a similar deal using the contacts and experiences I made the first time.” In fact, venture capitalists are known for being skeptical of first-time management without a proven track record; thus having access to a pool of management talent makes capital more accessible.

International networks and partnerships

Biotech is a global industry. Hence not only must products be developed for a global customer base to ensure sufficient demand, but the global market is a key supplier as
well. No individual country is self-sufficient in terms of access to research, patents, scientists, raw materials, and equipment. Evidently, the U.S. bioclusters are the largest players in the global market, and thereby more independent compared to smaller bioclusters. Nonetheless, they cannot remove themselves from the market without compromising on customer base, access to talent, capital, and so forth. As such, extensive international networking is a necessity – to draw on intellectual capital and assets, as well as to source key personnel.

5.4.2 Public support structures

The business environment in which a venture is developed has huge impact on its potential for success, both at an individual company level and for the industry as a whole. Hence creating a link between an idea and the path toward future application of the scientific effort requires a support system to ensure that the invention is brought beyond academia. The presence of public support structures is at the heart of this.

**Strong commercialization support infrastructure**

Strong vehicles such as technology transfer offices (TTOs) that are able to both encourage and support commercialization are necessary public support structures. In order to be effective, these require a certain scale (of ideas, networks, and other resources) as well as a strong focus and topic expertise. These vehicles must be given a strong mandate, so that when they commit to a project, they can leverage high-quality resources. Providers of support services such as investment promotion agencies, IPR and law firms, must be readily available to smaller players. There are substantial economies of scale in support functions, and the costs of these services are difficult to absorb for standalone start-up ventures.

Incentives should be structured to support successful growth as well as initial company establishment. The biotech industry is capital intensive throughout the research and development phase, making risk sharing top-of-mind for most investors. Public incentive systems that support long-term investments in R&D, as well as commercialization, contribute significantly toward a greater number of new product developments and new businesses. To ensure the quality needed for these support structures to stimulate the industry, the system must communicate with the market and create awareness externally. Arbitrary decisions and rigid systems impede entrepreneurship, hence making it difficult to build a biopharma industry.

**A focus on core areas with stable long-term parameters and support**

Success within this industry is based on developing one or more areas of core competence and then building both a “brand” (and awareness) and an industry ecosystem around that. This is a time-consuming task, hence long-term stability and predictability concerning industry conditions is essential to encourage long-term investments and efforts from both private and public players. Successful ecosystems then serve the role as incubators and stepping stones for other competencies, thereby moving in the direction of a dynamic cluster.
Underpinning these prerequisites for growth, the presence of internal competition promoted through the proximity of players across hospital, universities, industry, and complementary entities accelerates the growth and development of the biopharma industry.

5.5 Making it happen for a biocluster

Even assuming the presence of the prerequisites for a successful biocluster, achieving success on an industry-wide basis is not an easy task. The established bioclusters have set the structure for the rest of the industry. Though dynamic, this structure does not allow for local solutions. The global market is demanding, making the large pharmaceutical companies important in bringing new products to market. As a result, the emerging bioclusters must find their own place at the global table. The figure below shows the generic step of going from an emerging to a more established biocluster.

**Figure 26 - The generic structure of bioclusters**

International benchmarking clearly shows that successful emerging bioclusters accept the established structure and that they are actively working with their internal strengths and building international networks to access missing key resources. In this effort, we observed a wide range of initiatives, some of which are listed below:
• **R&D excellence.** Denmark allows for private funding of research parks. The purpose of this is, of course, to raise capital to finance R&D facilities. However, inviting commercial players into the academic world is crucial to the commercial appeal of R&D. These parks are excellent forums for interaction between academic and business experts. We observe the same tendency in Sweden, where sponsoring of industrial PhDs is widespread within life science.

• **Presence of international pharmaceutical companies.** In Sweden, international pharmaceutical companies are invited to take part in mapping the industry’s needs. Swedish authorities realize that pharma has to be heard on several important issues if Sweden is to build a biopharma industry. These issues involve access to capital, risk sharing, infrastructure, and regulations. Of course, no government can or will accommodate everything, but it is vital to involve these players in the process.

• **Competent capital.** Liquidity is a key concern for private investors. They want to see different exit possibilities before entering into ventures. Evidently, the presence of international pharmaceutical companies increases the liquidity of biopharma companies, both by giving venture capitalists more exit possibilities and because international pharmaceutical companies represent competent capital themselves. Hence all initiatives that attract international pharmaceutical companies also improve access to competent capital. In Denmark, Vaekstfonden plays a key role in providing such capital. In addition to providing venture and seed financing, the public fund offers general and business-specific consulting in order to capitalize on the company’s IPR. Vaekstfonden has a special biotech team with international and commercial experience, which adds crucial value. This team decides in which bioprojects the fund should invest, and it often takes an active role in investments going forward.

• **Access to talent.** For the smaller European clusters, retaining research talent has been a challenge. Ireland in particular is focused on retaining researchers because of Cambridge’s history of attracting some of the best talent graduating from Irish universities. To address this problem, Ireland now strives to offer cutting-edge research opportunities locally. This strategy goes hand in hand with a focused R&D base. Denmark also has to attract international talent. One initiative is a five-year tax break offered to foreign researchers. In addition, Denmark has a low general tax rate for foreign workers, hence also attracting management talent.

• **Public support structure.** Perhaps the most important public support offered to all the bioclusters in our benchmark study is credible public commitment. We see from both Medicon Valley and Ireland that public commitment is vital to boosting biopharma. Moreover, we have observed more targeted public support initiatives such as the successful YIC program in France. Denmark also succeeded in building an infrastructure embracing biotech entrepreneurship by focusing on market demand and industry needs rather than existing public
structures. One also sees initiative to strengthen collaboration between research, hospitals, (local and national) government and business in different versions of the mentioned “triple helix” model. This collaboration model (either explicit or more tacit) seems present in all successful bioclusters.
6 Description of the Norwegian opportunity

This chapter describes the gaps in Norway, but also how to address the commercial opportunities present.

6.1 Strengths to build on and gaps to fill

At present, several hundred regions worldwide are attempting to establish biotechnology clusters. In order to succeed within the global biotechnology industry it is necessary for Norway to leverage its competitive advantages. Norway has a number of strengths but also some significant weaknesses.

The strengths that can form the basis for growth within the biotechnology industry include pockets of research excellence in universities and institutions, a strong global position within marine-based biotechnology with world-class research and bioprospecting, exclusive access to marine raw materials, and a long tradition within fishery and aquaculture. Also, Norway possesses long-term and extensive mapping of its population by biobanks, and a strong knowledge-based community with a robust education in science. All these strengths can be further mobilized.

The gaps that Norway must close to move forward include the following:

- **Lack of shared ambition in biopharma commercialization.** There is only limited agreement among the main players – public and private – on joint challenges and ambitions. Instead, there are multiple agendas and an unclear understanding how to realize the potential of biopharma commercialization.

- **Fragmented commercialization infrastructure.** At present, Norway has a fragmented public/industry commercialization infrastructure for biopharma (for example, TTOs), which does not allow world class capability development, network building, branding, and clear "visibility" from outside of Norway.

- **Insufficient commercialization incentives.** There are insufficient incentives for fast-growing R&D-based companies. For instance, Norway needs to ensure that sufficient commercialization vehicles are put in place and to fill gaps related to seed funding and patenting.

- **Limited collaboration.** There is only limited collaboration between universities/hospitals and businesses in commercialization and new business formation. There seems to be an untapped potential related to improving the
rules of collaboration, and in developing joint initiatives. (The Oslo Cancer Cluster is here a good example).

- **Insufficient private capital.** It is difficult for start ups to access venture capital and private equity funding for biopharma companies in Norway. In part, companies simply lack visibility from key international investors and companies from outside of Norway.

- **Limited access to management and entrepreneurial talent.** There is an insufficient number of skilled managers and entrepreneurs with expertise acquired in biotechnology and pharmaceutical companies.

- **Few established large pharmaceutical companies.** Despite strong research in niches and solid hospitals, there is limited pharmaceutical activity in Norway. In addition, there is a lack of recognition of the importance of the pharmaceutical industry in Norway for R&D and new ventures.

### 6.2 An ambitious way forward for biopharma in Norway

Becoming a successful player within the field of biotechnology is not an easy task. It will be necessary for Norway not only to build on its advantages but also to invest considerable time and resources. Figure 27 shows a stepwise approach toward success in biotechnology. Step-by-step changes are required in order to advance, and only when a sustainable state is reached is it possible to advance to the next level. Norway is currently an R&D system, and the figure shows that the only possible next steps are either to continue business as usual in the R&D system, or to focus on how to enter the next step, here labelled “early commercialization”.

Success within biotech is not an easy task
A stepwise approach required

From the current characteristic as an “R&D system” with limited commercialization of generated ideas, the main issue is whether Norway now should make a commitment to develop a platform for biopharma commercialization.

We calculated the revenues Norway could attain and the number of potential biopharma (including biomarine) employees in Norway, assuming the same commercialization success for Norwegian companies as its leading European competitors.
Norway has an untapped R&D potential with respect to employees and revenues

Figure 28 - Norway has an untapped R&D potential compared to competitors

Figure 28 shows that Norway clearly has untapped potential with respect to both employees and revenues compared to its leading European competitors. In 2004, Norway’s average untapped potential with respect to employees was 590 FTEs. Its average untapped potential with respect to revenues was even higher – NOK 8.7 billion. The untapped R&D potential is estimated by assuming the same commercialization success per R&D spending for Norwegian companies as its leading European competitors.

Norway also has even greater potential for improvement – beyond that attainable by tapping its R&D potential – through closing the gap in R&D intensity with its European competitors. But closing this gap is not a reasonable goal until Norway’s current R&D potential has been fully realized.

6.3 Potential benefits of tapping the potential

Norway can now take two different paths going forward: “business as usual” or “tapping the R&D potential to enter early commercialization”. We have estimated the potential benefits Norway could realize by 2015 through pursuing these paths, as well as a more comprehensive next step which implies closing the gap to the competitors (illustrated in Figure 29). The estimated number of biopharma (including biomarine) employees and revenues reached differs among the distinct levels of ambition.
Norwegian biopharma has experienced strong growth during the past five to ten years, and even if Norway continues along its current path, the number of employees in biopharma is anticipated to more than double by 2015 (the first step for 2015 in the figure below). We should however caution that the global competition for biopharma investments will further intensify. This will make it increasingly difficult to compete if Norway does not put a better commercialization infrastructure in place.

Creating a better commercial infrastructure seems to make sense from a value creation perspective. Tapping Norway’s R&D potential (step 2 for 2015) can lead to a substantial increase in the number of employees in biopharma. In this scenario, more new companies and a longer life span per company is expected. As more ideas reach commercialization, more Norwegian products will appear in the pipeline and (gradually) as approved drugs. R&D budgets within the industry are also expected to increase as biopharma companies grow larger. As a result, value creation is expected to gradually increase for the biotechnology industry in Norway.

Closing the gap with Norway’s European competitors (step 3 for 2015) has by far the highest potential, but it is also the most challenging of the scenarios. This step is, however, only realistic when Norway’s R&D potential has been successfully exploited; it is not an alternative at present.

Differing levels of ambition will result in different estimates in terms of the number of potential biopharma employees in Norway and the revenues Norway may obtain. Tapping R&D potential is a reasonable first step for the Norwegian biopharma industry, as this will enable the harvesting of Norway’s current and ongoing research.
This step would enable Norway to commercialize its R&D results as well as its competitors. It would require both a determination to translate science into commercial products and a continued focus on R&D within specialized fields. Only after this step has been completed, Norway should formulate a more comprehensive strategy in order to close the gap with leading European bioclusters. This may require Norway to increase public support for the R&D effort and intensified commercialization through substantial investment in activities along the whole value chain.
7 Recommended process going forward

In order to seize the commercial opportunity in biopharma, Norway needs to undertake a step-by-step process to meet the challenges and address the gaps described above: (1) lack of shared ambitions in biopharma commercialization, (2) a fragmented commercialization infrastructure, (3) insufficient commercialization incentives, (4) insufficient incentives for fast-growing R&D-based companies, (5) limited collaboration between universities/hospitals and businesses in commercialization, (6) insufficient private capital, (7) limited access to management and entrepreneurial talent, and (8) few established large pharmaceutical companies in Norway.

7.1 A suggested mobilization process

It is clear that Norway cannot attract international management and capital before it puts an improved commercial infrastructure in place. And, it does not seem likely that the Norwegian government will act until the biopharma community has reached consensus on a shared ambition and plan for the future. Thus we suggest a mobilization process in which all gaps are addressed in turn, as illustrated in Figure 30 below.

![Figure 30 – Mobilization process for building biopharma industry](image-url)
7.1.1 Building a shared vision

Today, there are many initiatives, organizations, companies, and players developing different agendas and visions for biopharma in Norway. Each of these has a valid point of view. However, the sum of voices is confusing, and may be suboptimal. In order to build momentum around biopharma in Norway, there may be a need for the many actors to join forces and develop a shared aspiration. Also, in order to engage the government to commit to biopharma, there is a need for a joint plan with recommended actions on:

- Establishing measures for collaboration among the main industry actors, including research institutions, hospitals and business.
- Articulating one vision and one set of priorities for the “biopharma” initiative.
- Defining a more efficient commercialization platform. Among the questions that need to be answered are: Which incentives need to be strengthened? How should Norway develop an appropriate infrastructure for commercialization (that is, how can Norway consolidate today’s structures)?
- Making joint recommendations for the Parliamentary bill on innovation (“Innovasjonsmeldingen”).
- Suggesting a “biopharma roundtable,” preferably with representatives from government, industry, research, and health institutions, led by the minister of trade and industry. The “biopharma roundtable” could set targets and provide guidance to Innovation Norway, the Research Council of Norway and others on the commercialization of biopharma.

7.1.2 Getting the Norwegian government aboard

Getting the Norwegian government to commit to promoting biopharma commercialization is critical. The opportunity for achieving this target is the forthcoming Parliamentary bill on innovation (“Innovasjonsmeldingen”). The plan outlined above should be used to enlist government support. The Parliamentary bill on innovation may be particularly fruitful if it:

- Defines incentives and vehicles related to seed funding, patents, international networks, and expertise.
- Outlines how to consolidate different structures and how to construct an infrastructure that better supports commercialization within biopharma.
• Suggests measures for improving collaboration between universities/hospitals and biopharma businesses.

• Presents a model for engaging Innovation Norway and the Research Council of Norway to focus on attracting international resources – for example, private capital, management talent, and established multinational corporations.

7.1.3 Attract international resources
Finally, there is a clear need to engage and involve the major international science and business players in Norwegian biopharma. Activity should explicitly focus on attracting international resources. In particular, initiatives should be target:

• Attracting private capital to invest in Norwegian companies.

• Attracting international pharmaceutical companies to more actively engage in Norway.

• Establishing and growing international relationships beyond those between academic institutions.

• Improving the visibility of Norwegian biotech – that is, ensuring an ongoing marketing effort to increase awareness of “ideas” and investment potential in Norway, and creating mechanisms for establishing collaboration.

• Supporting businesses and innovators to go outside of Norway to establish a presence and build relationships.

• Actively inviting skilled management and entrepreneurs from leading biotechnology clusters to work in Norway.

• Engaging the Research Council of Norway and Innovation Norway to develop a focused “Invent in Norway” vehicle.

7.1.4 Continuous upgrading
Once Norway has taken the first step to meet the challenge of commercialization, it is appropriate to adjust ambitions. It is clearly important that goals be made credible through real initiatives and decisions.
7.2 A note on incentives and vehicles for commercialization

Several incentives and vehicles would help address the biopharma commercialization challenge in Norway. These are mentioned briefly in the suggested mobilization process above. However, it is not clear that Norway should establish specific (“ear marked”) programs or mechanisms that favor biopharma above other industries. It may be more appropriate to identify general incentives and vehicles. A few potential instruments are described below.

- **Incentives to drive collaboration.** It is clear that better collaboration initiatives (so called “triple helix” model) between business, research, hospitals and government is needed, and these can be encouraged through appropriate network instruments.

- **Vehicles for strengthening IPR / patenting in Norwegian industry.** It is clear that Norway has to close the gap when it comes to IPR / patenting. This is of particular significance in the biopharma arena, but also applies more generally.

- **Tax incentives for fast-growing R&D-intensive companies.** There are good arguments for stronger tax incentives for R&D-based companies in the growth stage. One recommendation has been made to increase the tax incentive from 20 percent to 30 percent for companies that are less than eight years old and at which at least 15 percent of revenues are invested in R&D.⁴

- **Other tax incentives for early-stage innovation.** Several countries have developed tax incentives for investors in companies at the early stages of development. This may have a positive effect on attracting investments to innovation and commercialization in Norway.

- **Programs to improve networking with and direct access to international experts.** Usually, Norwegian incentives can only use local expertise. This is not appropriate in biopharma, where access to Norway-based experts and advisors with relevant capabilities and network is very limited.

- **Industrial PhD programs.** The biotech industry clearly needs more researchers with an interest in translating ideas into commercial applications. In this respect, the industrial PhD solution seems very relevant. This was suggested in the Parliamentary bill on research in 2004/2005 (“Stortingsmelding 20 – vilje til forskning”).

• **Initiatives to develop awareness of biopharma in Norway and “invest in Norway.”** A real effort to attract foreign investments – in particular, R&D investments – into Norway would make a significant difference for biopharma.

• **Programs to educate academics and physicians on commercialization.** Initiatives to educate hospital and research personnel on commercialization have been efficient in other countries, such as in Sweden. Much more could be done in this area in Norway.

### 7.3 Summary remarks

This work has clearly pointed out that there is an untapped potential related to commercializing more of the solid biopharma research that takes place in Norway. This clearly represents an opportunity. Seizing the full opportunity will take time, but it seems important to quickly point out a new commercialization ambition. The government will be important in addressing this opportunity, but to a large extent to trigger private R&D and venture funding. In making this happen it seems very important to be aware of the importance of attracting international resources – and to understand the potential of both building a few strong bioclusters in Norway, and of linking up to the strong Nordic biopharma landscape.
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Chemical & Engineering News (CHEM)
CIA World Fact book
Critical I: Comparative study for EuropaBio
CSUPERB
Datamonitor
Department for Business, Enterprise and Regulatory Reform (UK)
Dublin City University
Economic Development Alliance for Business (US)
ERBI (University of Cambridge)
Ernst & Young (several reports)
EuropaBio
European Commission
European Private Equity & Venture Capital Association (EVCA)
Evalueserve (EVS)
FoU-statistikken
Funksjonell Genomforskning (FUGE)
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Innovation Norway
Innovest
Lægemiddel Industri Foreningen (LIF, Denmark)
Lakemedelindustriforeningen i Sverige (LIF, Sweden)
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Lehman Brothers, IMS
MABIT: Mikroskopiske sjanser og andre muligheter med marin bioteknologi
Massachusetts BioManufacturing Center (MBMC)
Massachusetts Biotechnology Council (MBC)
Massachusetts Development (www.biotechwork.org)
Medicon Valley Alliance
MENON Business Economics
Michael Porter, Harvard Business School
Ministry of Trade and Industry, Norway (NHD)
National Institute of Health (US)
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NIFU STEP
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Panorama des Biotechnologies
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PricewaterhouseCoopers: Super Cluster, April 2007
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