



STATE OF MEDICON VALLEY 2017

An Analysis of Life Science
in Greater Copenhagen

medicon valley **alliance**

Creating Opportunities

STATE OF MEDICON VALLEY 2017

An Analysis of Life Science in Greater Copenhagen

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PREFACE

Danish-Swedish Medicon Valley continues to reinforce its position as Scandinavia's leading life science region. The life science sector in the Greater Copenhagen region has demonstrated a strong ability to get through crises, as well as a capacity for renewal. In this year's edition of State of Medicon Valley, we show how sector drift is also becoming discernible in the regions' science parks, and the possibilities that materialise when biology and IT meet in new domains like e-health.

The life science sector is important for the region, and for Denmark and Sweden on the whole. It generates exports, new jobs, and substantial tax revenue. MVA's analysis shows that the tax contribution for the Danish life science sector is 15,4 billion DKK for 2015. The corresponding figure for the Swedish life science sector is 11,6 billion SEK.

Despite problems with pricing pressure and increased competition in the USA, we see that Novo Nordisk is continuing to grow on its home turf as well, as are Lundbeck and Ferring. The influx of new companies at Copenhagen Bio Science Park, COBIS, is stronger than ever, and the new companies are following the new trend: they are small, virtual and technology-oriented. On the Swedish side of the Öresund Strait in Lund, Medicon Village is growing so rapidly that a new building is being constructed. Owner foundations such as Novo Nordisk Foundation, Lundbeck Foundation and LEO Foundation are demonstrating solid responsibility for the sector with large donations to life science research, as well as investments in new biotech companies.

Looking at the countries comparatively, we see that Danish life science is continuing to grow in terms of exports, as well as the number of employees, whilst Swedish life science exports are losing momentum after an upswing in 2015.

Denmark and Sweden are currently competing with one another and a number of other countries as they vie for the appointment as the new host nation for the European Medicines Agency, EMA. Competition between the two countries instead of collaboration, is unfortunate and can negatively impact the chances of EMA being placed in Scandinavia. The situation illustrates that work still needs to be done to strengthen relations and improve willingness to communication between Sweden and Denmark. A stronger collaboration between the countries is absolutely vital for reinforcing the life science industry's competitive power in Scandinavia in general, and in Medicon Valley specifically.

State of Medicon Valley 2017 is part of an ongoing analytic collaboration between Medicon Valley Alliance and Øresundsinstituttet that commenced last year. This annual report is also supplemented by an interim report, where the focus is life science research at the universities and research centres in the Öresund Region/the Greater Copenhagen region.

Copenhagen and Malmö
10 November 2017

Petter Hartman
CEO Medicon Valley Alliance



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41 300

was the number of employees at life science companies in Medicon Valley in 2015. That is equal to 58% of the total number of employees in the life science industry in Denmark and Sweden. The number of employees has increased by 3.6% under 2015.

126 200 employees in the health care sector

The health care sector in the Greater Copenhagen Region employs 126 200, some 85 300 of whom are in Eastern Denmark. That means that close to 167 500 people in the region work within life science and health care. In addition to those are researchers at the region's universities.



PHOTO: NEWS ØRESUND

It's been a good year for Copenhagen Bio Science Park, COBIS. Forty new companies have moved in, and at the end of October the tenant Orphazyme made it known that it had sent an intention to float announcement to inform that they plan to offer shares on Nasdaq Copenhagen later this year.

6.3%

Danish life science exports continued their growth trend through 2016 with a growth rate of 6.3%, while Swedish life science exports dropped 2.7%.

– Biotech is closely associated with risks. Since the turn of the millennium, anything risky has had a hard time on the stock market. Slowly however, we have been able to see how biotech companies that were listed in Denmark around the start of the millennium, such as Bavarian Nordic, Novozymes and Genmab, have done increasingly better, says Carsten Borring, Head of Listing and Capital Markets at Nasdaq Copenhagen.



PHOTO: NASDAQ COPENHAGEN

15,4 bil. DKK

The tax contribution for the Danish life science sector is 15,4 billion DKK in 2015.

11,6 bil. SEK

The tax contribution for the Swedish life science sector is 11,6 billion SEK in 2015.



PHOTO: GENMAB

THE SUCCESSES CONTINUE IN MEDICON VALLEY

It can be hard to adjust to a lower speed when you've been going fast. In its strong years, the life science industry in the Danish-Swedish Medicon Valley counted new jobs in the thousands. Now that the sector giant Novo Nordisk has had problems in the USA and the biotech sector has matured, the new jobs are in the hundreds. The important thing is that new jobs – and new companies – are still being created. Biotech companies are in the midst of a new boom, but this time it's all about virtual companies with few employees. The science park COBIS in Copenhagen has had a record number of new companies as tenants, but they are small in terms of the number of employees. The same goes for Medicon Village in Lund, which can boast 19 listed companies.

The interest in the life science sector is greater than it has been for a long time. That is apparent in a variety of ways. At Copenhagen Bio Science Park, COBIS, the influx of new companies is record-high, says CEO Morten Mølgaard Jensen. In the past year, there have been 40 new companies. But they are small, virtual companies, and the majority of them are not strictly biotech companies; often, they have more of a technology company character. Sector drift is increasingly noticeable.

Of the companies at COBIS, the one that has attracted the most attention is Orphazyme, since it announced its IPO plans and a planned new share issuance of 600 million DKK in October. In Lund, Medicon Village can count 19 listed companies on its fifth anniversary. In 2016, 15 companies at Medicon Village brought in a total of one billion SEK in new issues. The interest in investing in stock is strong among private citizens in Sweden, and there are many business angels. As a result, many Danish companies are looking to the north and listing their shares on Nasdaq or Aktietorget in Stockholm.

PHOTO: GENMAB

The Swedish interest in the stock market has a long history. A favourable savings method in terms of tax called the Allemansfond (every-man's fund) was created in 1984 to stimulate private share ownership. It was a long-term investment, and it succeeded. In Denmark, profits on stock that exceed 51 700 DKK are taxed 42%. In Sweden, capital tax is 30%. There is now talk of reforming Danish tax on stock profits.

Long-sightedness is important; that's apparent from the successes of the Danish ownership model with foundation-run companies, among other things. The primary shareholders of successful life science companies such as Novo Nordisk, Lundbeck, Ferring and LEO Pharma are foundations. That creates long-term ownership without the fear of being bought up. In addition, the majority of the company's profits remain in Denmark, where the companies distribute billions to Danish life science research every year.

Foundation ownership is one of the reasons that Denmark's life science industry continues to grow. Sweden's two leading life science companies, Astra and Pharmacia, were sold, and their influence left Sweden. The former became AstraZeneca, which made drastic cutbacks in Sweden; neither its headquarters in Södertälje nor its research facilities in Lund remain. Things were worse for Pharmacia, which left Sweden after multiple ownership changes, though certain parts of it remain with other names and owners.

The vital Danish life science industry is a strength for the Swedish part of Medicon Valley. It is important that small companies have employees with experience from university research as well as big pharma. Many small biotech companies in Lund have Danish or Swedish employees with experience from large Danish companies. Hundreds of researchers and experts from Skåne work at the Danish life science companies on the other side of the Öresund Strait today. When foundation-owned Novo Seeds invests in new biotech companies, half of the money ends up in Denmark,

and one-third in Sweden. The Novo Nordisk Foundation is a very important player in the region. The foundation is a main shareholder in the successful Danish company Novo Nordisk, whose turnover increased from 15 billion DKK in 1996 to 112 billion in 2016. The life science industry is very important for societal-economic development in both Denmark and Sweden. The analysis shows that the Danish life science sector's tax contribution is 15,4 billion DKK

for 2015. The corresponding figure for the Swedish life science sector is 11,6 billion SEK.

Representatives for the life science sector have clearly succeeded in putting the sector's achievements on the political agenda in Denmark and Sweden. Early this year, the Danish Growth Team for Life Science presented the report "World Class Life Science", which contains 17 recommendations for further enhancing the sector. It was supplemented with five pieces of advice from the three largest Danish pharmaceutical companies, Novo Nordisk, Lundbeck and LEO Pharma,

which endorse the report. In Sweden, the appointment of the National Coordinator for Life Science, Anders Lönnberg, has been extended until 31 January, 2018.

Furthermore, the Swedish prime minister has highlighted life science in the National Innovation Council, as well as in the areas of strength emphasised by the government in its so-called strategic collaboration programme. The importance of life science for the countries' development is particularly apparent with regard to the countries' campaigns to become the host country for the European Medicines Agency, EMA, which must leave London as a result of Brexit. In its bid, the Swedish government in particular chose a different strategy than what was utilised when Sweden, together with Denmark and Norway, successfully bid to bring the European research facility, European Spallation Source ERIC, to the Danish-Swedish Greater Copenhagen region. Denmark and Sweden are joint hosts for ESS, whose research facility is being built in Lund, and the data centre for which has been established



"Biotech companies are in the midst of a new boom, but this time it's all about virtual companies with few employees."

in Copenhagen. With regard to EMA, Sweden chose to run a campaign of its own in competition with the Danish one. Leading politicians in the Danish-Swedish Greater Copenhagen collaboration recommended an alternative solution based on working together, where the countries would devote themselves to bringing EMA to Copenhagen, the industrially leading region for life science in the North. The national Swedish side has pointed out the advantages that Stockholm has through the research at Karolinska Institute and the authorities' existing collaboration with EMA.

The developments in the Danish and Swedish life science industry continue to move in different directions in terms of exports as well as employment and patent applications. Medicon Valley, which encompasses the majority of the Danish life science industry, is continuing to strengthen its position as

the dominant life science region in Scandinavia.

The Danish life science sector's leading position in the North has become stronger still over the past year; Denmark's life science exports increased 6.3% in 2016. As Danish exports rose, the recovery that was discernible in Sweden in 2015 and 2016 was interrupted, and Swedish life science exports fell by 2.7%.

There are also substantial differences on the regional level when it comes to the development of Greater Copenhagen/Medicon Valley and Stockholm-Uppsala. Employment in the Danish-Swedish region increased 3.6% in 2015, which is the most recent year for which statistics divided by sector are available. In total there were 41 332 people working in life science in Medicon Valley in 2015 (most recent statistics available that are divided by sector). In Stockholm-Uppsala, employment in the sector fell around 1.3%, to 15 392.

LIFE SCIENCE DEFINITION

Life science can be defined as the study of living organisms (including microorganisms, plants, animals and human beings), but when descri-

bing a life science cluster, life science is perceived in a broader context. It includes the pharmaceutical, biotechnology and medical techno-

logy industries, as well as the academic institutions conducting research within life science and hospitals treating patients in the clinic.



Mærsk Tower, Copenhagen.



Kerstin Tham, Vice-chancellor Malmö University.



Copenhagen Towers.



Anders Lönnberg, National Coordinator for the Swedish government.



ESS research facility in Lund.



Novo Nordisk Foundation.



TAX CONTRIBUTION: Life science in Denmark and Sweden

PHOTO: ASTRAZENECA

The life science sector contributes 15.4 billion DKK and 11.6 billion SEK in the form of income tax and corporation tax in Denmark and Sweden, respectively. Including other taxes and duties, the total tax contribution is estimated to 31 billion DKK for the Danish life science sector and 22 billion SEK for the Swedish life science sector.

- Employees at Danish life science companies paid 7.9 billion DKK in income tax in 2015, which is 52% more than in 2008, and Danish companies paid 7.5 billion DKK in corporation tax; this was a 160% increase from 2008.
- Employees at Swedish life science companies paid 6.6 billion SEK in income tax, and corporation tax amounted to 5 billion SEK; that is 1% more in income tax and 23% less in corporation tax than in 2008.
- Income and corporation tax only comprise part of the amount that life science companies and their employees pay in taxes and duties. The total payment to the public coffers in taxes and duties is estimated at around 31 billion DKK for the Danish life science sector and 22 billion SEK for its Swedish counterpart, read more on page 92.

TAX CONTRIBUTIONS FROM LIFE SCIENCE

This section presents figures for the life science industry's contribution to the public economy through income tax and corporation tax. Corporation tax is reported in the part of the country where the company headquarters are located; thus, figures for corporation tax on a regional level will not be presented. Regarding income tax, the respective figures for the Swedish and Danish parts of Medicon Valley are presented separately, because there are significant differences in the Swedish and Danish parts of Medicon Valley, with a higher income tax rate in Denmark than in Sweden due to the absence of general pay-roll tax in Denmark.

Denmark

The Danish life science sector contributes 15.4 billion DKK to the Danish treasury in direct tax contributions through employees' income tax and corporation tax. The 15.4 billion DKK are broken down into 7.9 billion DKK in income tax for employees and 7.5 billion DKK in corporation tax. Almost all income tax (7.2 billion DKK) is paid by the employees at life science companies in the Danish part of Medicon Valley (Zealand and the surrounding islands).

Corporation tax

Danish life science companies paid 7.5 billion DKK in corporation tax in 2015; that is 160% more than in 2008, and corresponds to an annual increase of 14.6%. As with employees' income tax, Danish life science companies' tax contributions have risen much more than for the economy as a whole, where corporation tax has increased 23% from 2008 to 2015, corresponding to an average annual increase of 3%.

Danish life science companies were the source of 13.2% of the total corporation tax collected from Danish companies in 2015. In 2008 they were the source of 6.3 % of the total corporation tax.

Income tax

Employees at Danish life science companies paid 7.9 billion DKK in income tax in 2015, which is 52% more than in 2008 and corresponds to an average annual increase of 6.2%. This is a far greater increase than for the Danish economy as a whole, where income tax rose by 16%, corresponding to an annual increase of 2.2% from 2008–2015. Part of the reason for the higher income tax contributions from the life science sector is, naturally, that employment in the sector has increased. From 2008 to 2015, there were 17% more employees in Danish life science companies. At the same time however, the average income tax per employee has risen 32% over the entire period of 2008 to 2015, corresponding to 4.1% annually on average; this indicates that the average income in the sector has also increased. The average income tax for employees of the Danish life science sector was 217 700 DKK in 2015. It is highest in the Capital Region of Denmark at 241 100 DKK, and the Capital Region of Denmark is also where the total income tax for life science employees, as well as the average income tax for each life science employee, has increased the most: 7.3% and 4.1% annually from 2008–2015, respectively.

Employees in Danish life science companies paid 2.1% of all income tax in Denmark in 2015. That number has risen from 1.3% in 2008, and it is higher in Zealand and on the surrounding islands, where the Danish life science sector is predominantly located. Employees at Danish life science companies in Zealand and on the surrounding islands pay 3.2% of all income tax collected from the residents of Zealand and the surrounding islands. That is an increase from 2008, when the number was 2.4%.

Sweden

The Swedish life science sector contributed 11.6 billion Swedish crowns in direct contributions through income tax for employees and corporation tax in 2015. Of the 11.6 billion in 2015, income tax made up 6.6 billion SEK, and corporation tax 5 billion SEK. Employees at life science companies in the Stockholm-Uppsala area are responsible for around half (47%) of the income tax contributions, while employees at life science companies in

Skåne pay 15% of all income tax collected from employees in the Swedish life science sector, which corresponds to the geographic distribution of employees in the country.

Corporation tax

Swedish life science companies paid 23% less corporation tax in 2015 than they had paid in 2008; this corresponds to an average annual decrease of 3.7%. The explanation for this development lies in the changes that the life science sector has undergone in Sweden, where many companies have been acquired by foreign concerns, and jobs have moved out. In the same period during which Swedish life science companies tax contributions fell 23% (2008–2015), the total corporation tax paid by the Swedish industry rose 30%, which corresponds to an average annual increase of 3.8%.

Swedish life science companies' share of the total Swedish corporation tax fell from 5.1% in 2008 to 3% in 2015.

Income tax

6.6 billion Swedish crowns in income tax were paid by life science companies' employees in 2015 – the same level as in 2008. The total income taxes for life science employees rose a modest 1% from 2008 to 2015, whilst the total income tax revenue in Sweden increased by 16%. The Swedish life science sector lost 17% of its employees in the period 2008–2015, but that is not expressed by an equivalent drop in income tax; the reason is that the average income per employee has increased. For the country in its entirety, the average income tax per employee in the life science sector rose by 27% from 2008–2015. The greatest increase was in Skåne and in the areas outside of the metropolitan counties. In Skåne the average income tax per employee rose 33%, corresponding to an average of 3.6% per year. The highest average income tax per life science employee is in the Stockholm-Uppsala region – 215 200 SEK – whilst the average annual income tax per employee in Skåne is below the national average.

The Swedish life science sector contributed a total of 1.8% of the total amount of income tax in Sweden in 2015, which is lower than the 2.4% of 2008.

Corporation tax is charged on the company level. Since a business may have offices and production facilities in other parts of the country than where their headquarters are located, figures showing a regional

TAX CONTRIBUTIONS IN LIFE SCIENCE

DENMARK

Income tax

7.9

BILLION DKK

Corporation tax

7.5

BILLION DKK

Income and corporation tax

15.4

BILLION DKK

SWEDEN

Income tax

6.6

BILLION SEK

Corporation tax

5.0

BILLION SEK

Income and corporation tax

11.6

BILLION SEK

Source: Statistics Denmark, the Swedish Tax Agency and Statistics Sweden



PHOTO: NEWS ØRESUND

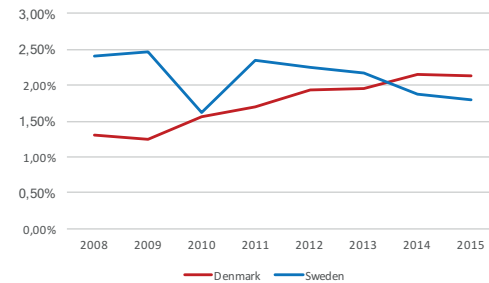
distribution of corporation tax may be misleading. Income tax, on the other hand, can be analysed on a regional level, based on the region in which the income was earned. Thus, this section only presents regional figures for income tax. As income is analysed according to workplace region, border commuters from Sweden and other employees residing abroad are also included in the assessment.

The respective figures for the Swedish and Danish parts of Medicon Valley are presented separately, since public expenditures are financed in markedly different ways in Sweden and Denmark. Denmark has no general pay-roll tax as in Sweden, where pay-roll taxes finance social security benefits. Instead, social security benefits are provided with funds from income taxation. Danish and Sweden tax contributions are thus not directly comparable. Yet another reason to avoid presenting a single figure for all of Medicon Valley is that the data in the statistics registers at Statistics Denmark and Statistics Sweden from which it has been possible to extract differ slightly in concept and definition.

PHOTO: NEWS ØRESUND

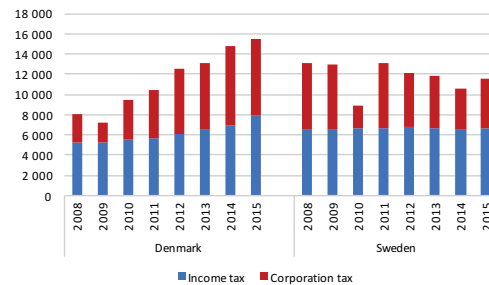


THE LIFE SCIENCE SECTOR'S SHARE OF THE TOTAL INCOME AND CORPORATION TAXES



Source: Statistics Denmark, the Swedish Tax Agency and Statistics Sweden

THE LIFE SCIENCE SECTOR'S CONTRIBUTION OF INCOME AND CORPORATION TAX



Source: Statistics Denmark, the Swedish Tax Agency and Statistics Sweden

DANISH AND SWEDISH TAXATION PROCEDURES

Financing of public expenditures and pension differs significantly in Denmark and Sweden. The most obvious difference is that there are no employer contributions in Denmark. In Sweden, the social security system is financed through employer contributions as a share of the employee's gross pay. Employer contributions and thus the respective taxpayer's contribution to the collective financing of the social security system are not visible on the payslip. This differs from the Danish payslip, since the social security system is financed by taxes. Employer contributions and financing for the social security system are not part of the income tax statement for people who live and pay taxes in Sweden, whilst the financing of Danish social security is part of the income tax. As pension is primarily financed through employer contributions in Sweden, and not, as in Denmark, primarily through individual's payments external to the taxation system, employer contributions are not included in the figures presented here. Nonetheless, it is impossible to compare the levels of Danish and Swedish income tax, since a larger portion of public expenditures are financed by taxes and duties in Denmark than in Sweden, and because it is impossible to distribute them among companies or people.

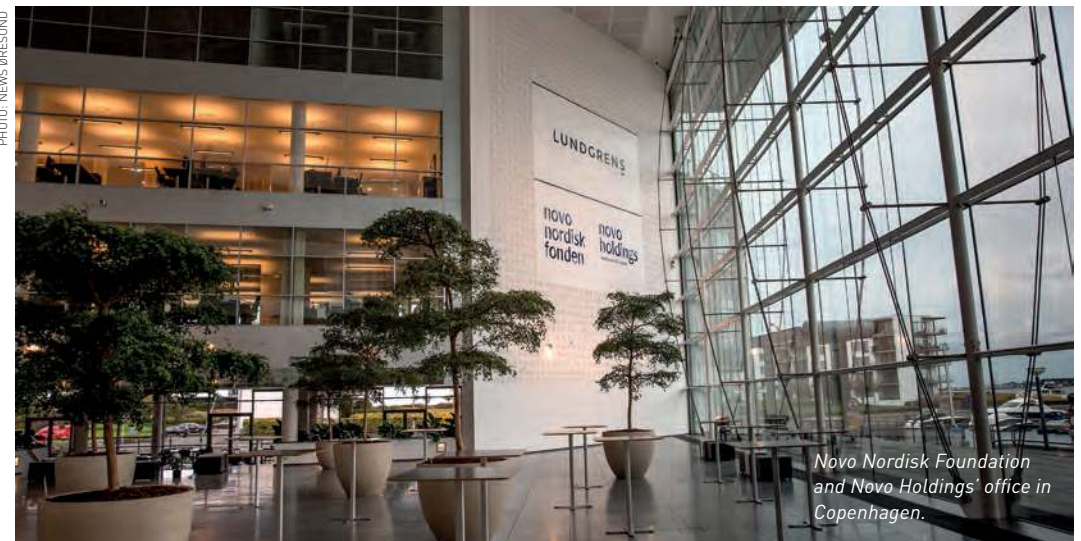
PHARMACEUTICALS – THE DANISH GROWTH ENGINE

Pharmaceuticals were the Danish economy's growth engine from 2008–2015. While other sectors were in a state of crisis in the aftermath of the financial crisis, turnover and added value grew well in the pharmaceuticals sector. Half of the Danish economy's growth of the period was created by pharmaceuticals. The growth contribution from pharmaceuticals was 0.2 percentage points annually, and the economy has grown 0.4% annually. The growth contribution from pharmaceuticals was strongest in the years that immediately followed the financial crisis, but decreased from 2013 to 2015 as the economy began to recover in general. In 2015, pharmaceuticals contributed 64.7 billion DKK to the Danish gross value added – almost doubled (94%) since 2008. Only two other sectors have had a greater gross value added growth, and both of those sectors take up significantly less room in the economy than pharmaceuticals: aviation increased its gross value added by almost 500%, but its benchmark in 2008 was incredibly low, and its gross value added a mere tenth of pharmaceuticals'. Gross value added in telecommunications rose 99% from 2008 to 2015, and the sector's gross value was about 70% of the gross value added in pharmaceuticals.

MEDICON VALLEY

Medicon Valley is the bi-national life science cluster spanning the island of Zealand in Eastern Denmark and the Skåne region of Southern Sweden. Today, the Danish-Swedish region is marketed internationally with the name 'Greater Copenhagen', and its increasing population has reached four million residents. In Sweden, the same geographical area is often called the 'Öresund Region'.

PHOTO: NEWS ØRESUND



Novo Nordisk Foundation and Novo Holdings' office in Copenhagen.

FACTS AND FIGURES: Solid development in Medicon Valley

PHOTO: ASTRAZENECA

Danish life science is a growth engine. That is supported by figures for exports, employment and the life science sector's contribution to economic growth. The exports are skyrocketing, the number of employees showed in 2015 the highest growth in the period 2008– 2015 and the Danish pharmaceuticals companies contributed half of the economic growth that took place from 2008 to 2015. The Swedish life science companies continue on their downturn. The rise in Swedish life science exports that seemed to be underway in 2015 did not endure into 2016, and employment numbers 2015 showed yet another drop in the number of employees at Swedish life science companies.

- Medicon Valley is continuing to strengthen its position as the dominant life science centre in Scandinavia. The number of employees in Medicon Valley's life science companies rose 3.6% in 2015.
- The number of employees in Danish life science companies rose 4.2% in 2015, and decreased 2.5% in Swedish life science companies.
- Danish life science exports rose 6.3% in 2016, while Swedish life science exports fell 2.7% in 2016.
- Life science tops the list of the number of patents sought by Danish companies from the European Patent Office (EPO) between 2008– 2016, and only medtech patent applications are among the ten technology fields within which Swedish companies apply for the greatest number of patents; biotech and pharmaceuticals place 16 and 20, respectively.
- The number of patent applications submitted to EPO by Danish life science companies rose 16% between 2008 and 2016, while the number of patent applications to EPO by Swedish life science companies fell 18%.
- One-third of the employees in Medicon Valley's life science industry have a higher education or research training. The share of highly educated employees rose from 26% in 2008 to 32% in 2015.

MEDICON VALLEY - THE SCANDINAVIAN LIFE SCIENCE HUB

Medicon Valley is the dominant life science centre in Scandinavia and is continuing to strengthen its position. New figures for exports, employment and patent applications demonstrate the solid development in Medicon Valley, expressed in an increasing number of employees, a greater number of patent applications and higher exports. As in previous years, the Danish part of Medicon Valley shows the strongest development, while employment in the Swedish part of Medicon Valley has continued to decline, as it has in the rest of the Swedish life science sector.

Figures for exports, employment and patent applications will be presented in the pages that follow. It is not possible to distribute the national figures for exports on a regional level, but in the case of Denmark, the major part of the life science sector is located in the eastern

part of the country; thus, the majority of exports originated there. Figures for employment and patent applications are presented on a national and a regional level, but the most recent regional statistics on patent applications available are for the year 2012.

EXPORT

Danish life science exports are soaring, and the growth trend continued through 2016 – exports rose 6.3% (measured in DKK). The hint of an upswing in Swedish life science exports in 2015 did not carry over into 2016; Swedish life science exports dropped 2.7% in 2016 (measured in SEK). In fact, Swedish life science exports are at the same level today as they were in 2009.

Global expenditures on medicine are expected to grow four to seven per cent in the period 2016–2021 to reach nearly 1.5 trillion USD (invoice prices), according to QuintilesIMS Institute. Today, the global market for pharmaceuticals is a 1.1 trillion USD industry and has shown a growth of 1.6% in 2016. The American market is by far the largest market for pharmaceuticals, with a spending of 462 billion USD in 2016, while China has cemented its position as the second largest pharmaceuticals market.

Danish pharmaceutical companies have increased their market shares by 0.1 percentage point in 2016 to 1.3% of the global market by increasing exports by 6.3% measured in USD, which is far more than the growth on the global pharmaceutical market.

Swedish pharmaceutical exports decreased by 3.9% measured in USD in 2016, and Swedish pharmaceutical companies lost 0.1 percentage point of their market share, and currently hold 0.8% of the global market. Danish and Swedish pharmaceutical industries’ largest foreign markets are the world’s biggest pharmaceuticals markets and the neighboring Nordic countries.

Measured in per capita export, Denmark is the fourth largest exporter of pharmaceuticals in the world. Despite declining exports, Sweden continues to hold tenth place in the ranking of the world’s largest pharmaceutical exporters measured in per capita export. Switzerland and Ireland are the two nations in the world with the highest export of pharmaceuticals per capita, with an

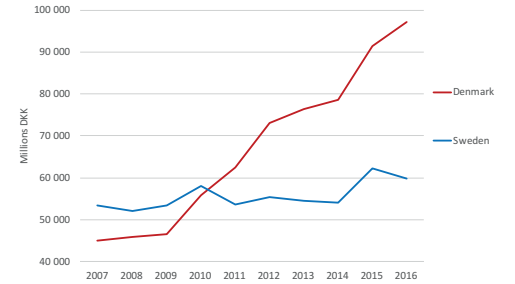
export three to four times higher than the Danish, amounting to about 9 000 and 8 200 USD per capita, respectively.

Danish life science exports (pharmaceuticals and medtech) have more than doubled in the period 2009–2016, accounting for 97 billion DKK in 2016. The strong growth path continued in 2016 with a 6.3% rise in exports measured in DKK. Life science products are well on their way to surpassing food and beverage exports as the country’s most important export business. The increase in life science exports to the Chinese, Japanese and the Swedish markets accounts for about 60% of the total increase in Danish life science exports in 2016, while exports to the USA have increased 1%, and exports to the fourth largest market – Germany – have decreased 11%.

While Danish life science exports soared, Swedish life science exports faced difficulties with mergers, cutbacks, and the closure of large research and production facilities in recent years, and Swedish life science exports receded to the same level in 2016 as in 2009. Swedish life science exports amounted to 60 billion DKK in 2016, decreasing 2.7% measured in the national currency from 2015 to 2016. The primary reason for the drop lies in the recession on the market in USA and the UK, while Swedish life science companies gained market in Japan with a 45% increase in exports. The losses on the American and British markets were almost three times as high as the gains on the Japanese market. In total, Danish life science exports made up 15% of all Danish exports, and Swedish life science exports 6% of all Swedish exports in 2015.

It should be noted, however, that export statistics do not present a complete picture; as in many other sectors, manufacturing is increasingly being established in various local markets and is thereby not covered by export statistics. According to Statistics Denmark, in 2015 Danish manufacturing companies sold goods abroad that were not produced in Denmark for the amount of 120 billion DKK – an increase of 112 billion DKK in a period of ten years from 2005 to 2015. Several examples of overseas production are Novo Nordisk’s investment of 13.6 billion DKK in two factories in the USA, and the hearing aid manufacturers Oticon and Widex’s relocation of production from Denmark to Poland and Estonia, respectively.

VALUE OF EXPORTS, IN MILLIONS (DKK)



Source: Statistics Denmark and SCB/Statistics Sweden.

THE PRINCIPAL EXPORT MARKETS FOR DANISH LIFE SCIENCE

	Exports in millions (DKK) 2016	Annual growth 08-16
USA	26 313	18%
China	7 456	27%
Germany	6 757	6%
Japan	5 313	9%
Sweden	4 982	3%
Great Britain	3 354	6%
France and Monaco	2 910	-1%
Norway	2 372	10%
Italy	2 351	6%
Finland	2 281	6%

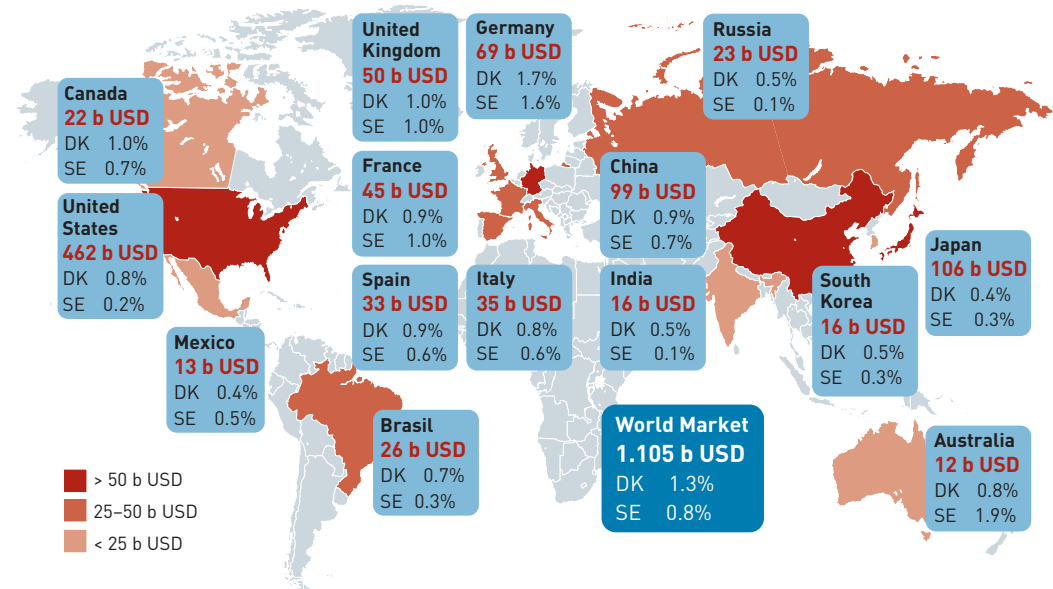
Source: Statistics Denmark

THE PRINCIPAL EXPORT MARKETS FOR SWEDISH LIFE SCIENCE

	Exports in millions (DKK) 2016	Annual growth 08-16*
Germany	9 765	6%
USA	7 692	0%
China	5 545	28%
Japan	3 987	25%
France	3 166	-6%
Norway	3 113	1%
Australia	2 624	2%
Great Britain and Northern Ireland	2 253	-2%
Belgium	2 020	-8%
Denmark	1 771	-2%

Source: SCB/Statistics Sweden and Riksbanken.
* Annual growth is calculated on figures in national currency.

SALES AND MARKET SHARES ON THE 15 BIGGEST PHARMACEUTICAL MARKETS (2014)



Source: International Federation of Pharmaceutical Manufacturers & Associations, QuintilesIMS Institute, Statistics Denmark and Statistics Sweden. Figures for World Market and United States are from 2016, other figures are from 2014.

EMPLOYMENT

Medicon Valley is continuing to strengthen its position as the dominant life science centre in Scandinavia. The number of employees in Medicon Valley’s life science companies rose 3.6% in 2015, while the number of employees in life science companies in the Stockholm-Uppsala region decreased 1.3%. Medicon Valley employed a total of 58% of those in the Danish and Swedish life science sectors in 2015, and the Stockholm-Uppsala region employed 21%.

Employment in the Danish life science sector continued its growth path in 2015 with a growth of 4.2% – the largest from the period for which we have figures in this report, 2008–2015 – according to figures from the register-based labour market statistics (RAS) from Statistics Denmark, as well as figures from the largest life science companies themselves. At the same time, the number of employees in the Swedish life science sector continued to decrease, with a drop of 2.5% in 2015, according to figures from the register-based labour market statistics (RAMS) from Statistics Sweden.

In less than ten years, the balance of power between the Danish and Swedish life science sectors has done an about-turn. The Swedish life science industry has gone from employing 3% more than the Danish life science industry in 2008 to employing 23% fewer than the Danish life science industry in 2015. Danish life science companies significantly augmented their workforce between 2008–2015. A total of 11% more employees entered Danish life science companies during the period 2008–2015, although the total employment for the whole economy has yet to reach the level that

it was before the financial crisis, remaining 3% lower in 2015 than in 2008.

While the Danish life science sector has been in a real-life fairy tale in terms of growth since 2008, the reality has been much harsher for Swedish life science companies. The closure of Astra Zeneca’s research facility in Lund and cutbacks at GE Healthcare BioSciences and Pharmacia are some of the explanations for the falling Swedish employment numbers in life science. Whether Astra Zeneca’s 2.3 billion SEK investment in a new facility in Södertälje will bring employment in Swedish life science back on a growth path is yet to be seen, as the factory will be completed in 2018. A total of 31 200 are employed in Swedish life science companies, while Danish life science companies employed 40 600 in 2015. Furthermore, there are 1900 employees at biotech research companies in Denmark and 1100 in Sweden, and an additional 13 100 in Denmark and 16 400 in Sweden work at companies that conduct scientific research.

Medicon Valley continues to strengthen its position as the dominant life science centre in Scandinavia. Medicon Valley employs a total of 58% of those in

58%

of those employed in the Danish and Swedish life science sectors are employed in Medicon Valley. That is more than double the number employed at Scandinavia’s second-largest life science cluster in the Stockholm-Uppsala region.

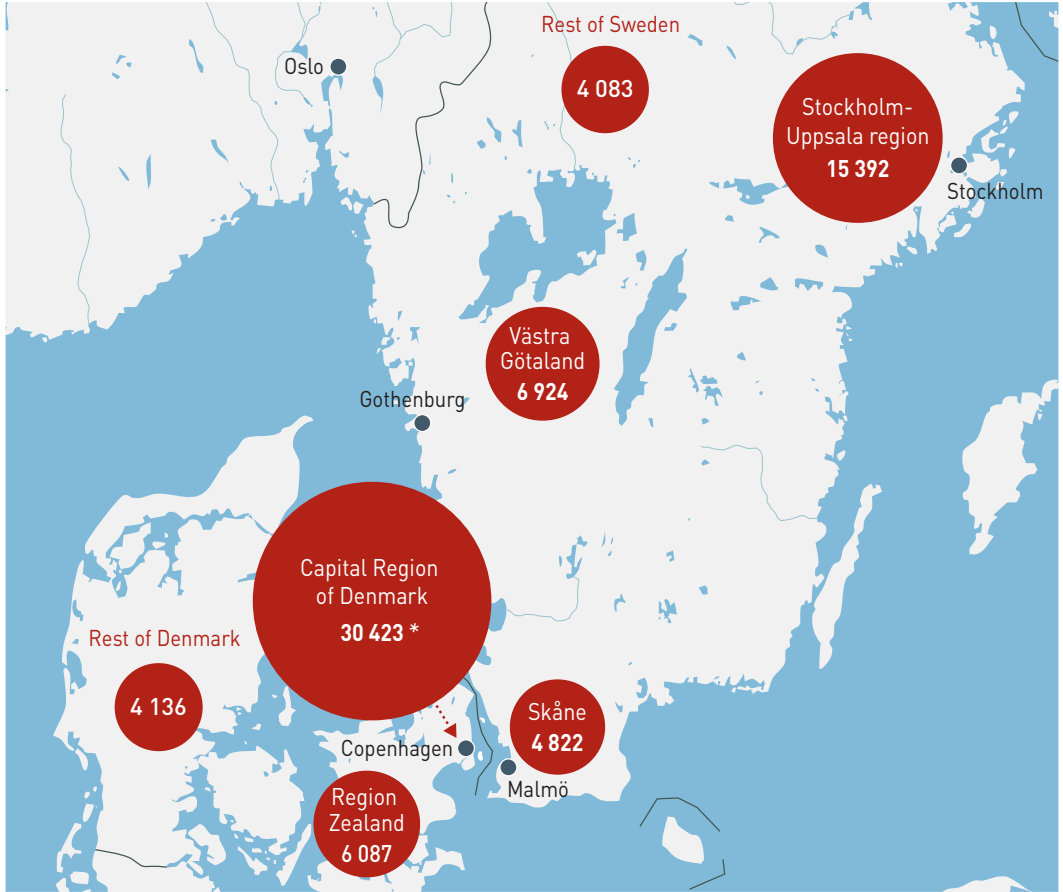
5%

more have been employed by life science companies in Medicon Valley between 2008-2015, while the Stockholm-Uppsala region has lost about one in five jobs (-19%).

32%

of those employed at life science companies in Medicon Valley have a higher education or research training.

EMPLOYMENT DISTRIBUTED BY REGION IN DENMARK AND SWEDEN



Source: Statistics Denmark, Statistics Sweden and information from the biggest life science companies in Denmark.

EMPLOYMENT AND CHANGE OVER TIME*

	2015	Change 2014-15	Annual change 2008-15
Denmark	40 646	4,2%	1,4%
– Capital Region of Denmark	30 423	4,8%	1,9%
– Region Zealand	6 087	3,5%	0,7%
– Denmark, rest of	4 136	1,3%	-0,7%
Sweden	31 221	-2,5%	-2,7%
– Skåne	4 822	-3,0%	-5,1%
– Stockholm-Uppsala region	15 392	-1,3%	-3,0%
– Västra Götaland	6 924	1,5%	0,5%
– Sweden, rest of	4 083	-11,8%	-3,1%
Medicon Valley	41 332	3,6%	0,7%

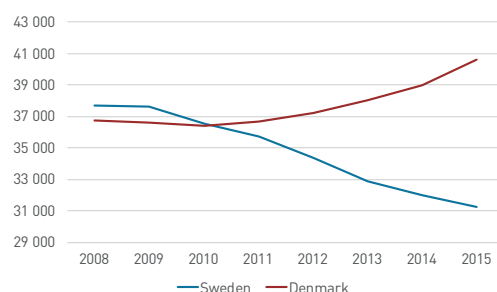
Source: Statistics Sweden, Statistics Denmark and information from the biggest life science companies. * The figures from last year’s report have been adjusted due to a more systematic review of the employment figures for all the Danish municipalities within Medicon Valley. Corrections of the figures have been made to take two types of sources of error into account: 1) Companies, which have changed their industrial classification code to life science during the period 2008-2015 have been included in the entire period 2) Life science companies with a non-life science industrial classification code have been included (for instance Novozymes. As a result, the figures from last year’s report cannot be compared directly with this year’s figures.

the Danish-Swedish life science sector; this is more than twice as many as the second-largest Scandinavian life science cluster, the Stockholm-Uppsala region, where 21% of the Danish-Swedish life science sector was employed in 2015.

While 3.6% more job positions were created in Medicon Valley in 2015, the number of employees in life science companies in the Stockholm-Uppsala region dropped 1.3% in 2015. Between 2008-2015, the Stockholm-Uppsala region lost approximately one in five jobs (-19%) in life science, whilst the life science companies in Medicon Valley saw a 5% increase in employees.

65% of those employed in the life science industry in Medicon Valley are employed in pharmaceuticals, whilst medtech companies provide employment for 12%, and 17% are employed in wholesale trade businesses. The majority of the 41 300 employees in the life science sector in Medicon Valley are employed on the Danish side of the Öresund: a total of 36 500 are employed on the Danish side and 4 800 on the Swedish side of the Öresund. The Capital Region of Denmark is dominant in Medicon Valley with 74% of all jobs, and has strengthened its position during 2015 with an employment growth of 4.8% – this is higher than the employment growth in Region Zealand of 3.5%. The previous years' development tendency of increased employment on the Danish side and decreased employment on the Swedish side continued in 2015; in Skåne, life science companies cut back their workforce still further. In Skåne, there was a 3% drop in life science employment in 2015. In Region Skåne, a total of 31% of the positions in life science have been eliminated since 2008; the closure of Astra Zeneca

LIFE SCIENCE EMPLOYMENT



Source: Statistics Sweden, Statistics Denmark and information from the biggest life science companies

in Lund is the primary explanation.

The life science sector is concentrated in a few municipalities. Eight of the in total 79 municipalities in the Greater Copenhagen region provide employment for three-fourths of those employed in the life science industry in the Greater Copenhagen region. On the Danish side, the five largest municipalities for life science are Gladsaxe, Ballerup, Copenhagen, Kalundborg, and Hillerød; on the Swedish side, the three largest municipalities are Malmö, Lund, and Helsingborg.

Gladsaxe: 8 900 employees

Located in the Bagsværd district are the headquarters and large facilities for the pharmaceuticals company Novo Nordisk and its subsidiary Novozymes, which works primarily with industrial biotechnology. Novo Nordisk has expanded its staff in Bagsværd from 2 813 employees in 2011 to 4 577 at the end of 2016. Novo Nordisk also has 1 823 employees in Søborg, a part of Gladsaxe Municipality. Around 2 000 of Novozymes' 2 600 employees in Denmark are located in Bagsværd.

Ballerup: 5 700 employees

Novo Nordisk, LEO Pharma, BASF, GN Hearing and Symphogen are some of the more than thirty life science companies active in Ballerup Municipality. Novo Nordisk has 2 626 employees at their facility in Måløv and Leo Pharma has in total around 2 000 employees at their headquarters and production site in Ballerup at the end of 2016.

Copenhagen: 5 500 employees

Two of Denmark's larger pharmaceuticals companies have large facilities in the Danish capital. H. Lundbeck, which had 1 451 employees in Denmark in 2016, has its headquarters and factory in Valby, whilst Ferring Pharmaceuticals with its 555 employees in Denmark has a large research facility in Ørestad. The biotech company Biogen and Novo Nordisk are also established in Ørestad.

Kalundborg: 4 100 employees

The port city in western Zealand is the location of Novo Nordisk's largest production unit, which had 3 540 employees at the end of 2016. There is also a factory belonging to the subsidiary Novozymes, with around 600 employees.

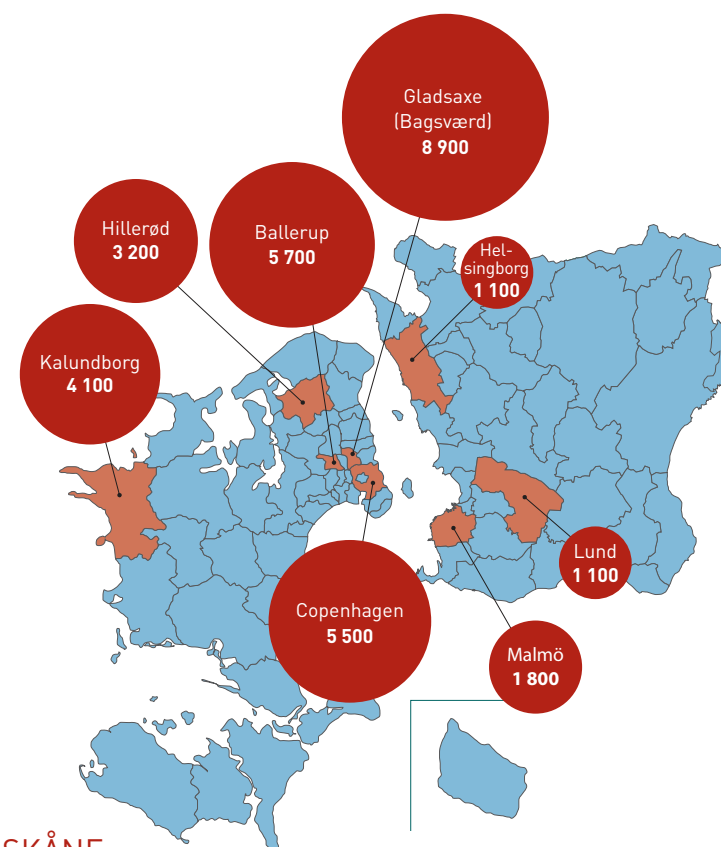
Hillerød: 3 200 employees

Novo Nordisk is also a major employer in Hillerød, where the company had 2 210 employees at the end

EMPLOYMENT IN LIFE SCIENCE IN SKÅNE AND ZEALAND BY MUNICIPALITY*

Source: Statistics Denmark and Statistics Sweden

* The map shows the five biggest life science municipalities in Denmark and the three biggest in Skåne.



of 2016. The American Biogen, which has invested a total of four billion DKK in their production site in Hillerød, has 740 employees. PolyPeptide and Zymenex are also established in Hillerød.

Malmö: 1 800 employees

Today, Malmö is a larger city for pharmaceuticals than Lund as regards the number of employees at life science companies, but Lund is the centre for life science research in Skåne. Companies such as Rechon Life Science, PolyPeptide Group, Nordic Drugs, Qpharma and Eurodiagnostica are here; all of them are in some way related to Ferring Pharmaceuticals, which still has a sales office in its old hometown after moving to Ørestad in Copenhagen and Switzerland. At Medeon Science Park there are companies such as Biora, Galencia, and Tigran. But Malmö has also become a city with

numerous national and regional headquarters from the life science sector – Lundbeck, LEO Pharma and Novo Nordisk are also here.

Lund: 1 100 employees

With university research, Ideon Science Park, Medicon Village, the research facilities MAX IV and the still in-progress ESS, Lund is indisputably Skåne's centre for life science research, but with regard to the number of employees in life science companies, Lund has faced difficulties. Medicon Village runs a kind of amplified science park in Astra Zeneca's former research premises, and is expanding with a new office building that will accommodate 600 experts, which will be ready in 2018/19. A total of about 1 600 employees in member companies from Lund University, Region Skåne, and around 130 businesses – 50 of which are manufacturing companies and 70 service

companies. 15 of the companies issued new shares totalling around one billion SEK in 2016. Among these companies are Alligator Bioscience, Immunovia and Sezagen. Adjacent to the premises is Ideon Science Park, with companies such as BioInvent, Camurus and Probi, and Active Biotech is in a neighbouring building. The approximately 400 companies at Ideon Science Park employ around 9 000 people.

Helsingborg: 1 100 employees

Despite sharp cutbacks and shutdowns over the years, Helsingborg remains one of Medicon Valley's larger life science municipalities. The municipality is home to many life science companies, large and small; one of the very largest today is McNeil, owned by the American Johnson & Johnson, which was formerly known as LEO as well as Pharmacia. Today, the company has a staff of around 630 in Helsingborg.

Whether the positive trend within employment has continued after 2015 is uncertain; there have been positive as well as negative indications from the sector since then.

In 2015

- Novo Nordisk decided to invest 2.1 billion DKK in a new factory in Hillerød, 500 million in a new Danish central depot for raw materials in Hillerød, and a factory in Måløv in Denmark, at the same time as plans were being made for an addition to the company's large manufacturing facility in Kalundborg (DK).

- Novozymes decided to build a new research centre in Lyngby (DK) with space for 800 employees and the possibility for expansion for 2 500 employees.

In 2016

- The pharmaceutical company Ferring announced that it was investing billions in a new research facility, Soundport, which is being built not far from Copenhagen Airport in Kastrup. There will be space for 750 employees there; i.e. about 50% more than those accommodated in the current facilities in Ørestad.

- The hearing aid company Widex announced that 400-500 Danish jobs would disappear when the company's production was moved to Estonia.

- William Demant Holding (Oticon) announced that the company's hearing aid production would move from Thisted in Jutland to Poland within the next two years.

- In September Novo Nordisk announced that they would be cutting 1 000 jobs due to pressures on prices in the USA, 500 of which were in Denmark. Several months later, the company announced that the European headquarters with 62 positions would be moving from Switzerland to Copenhagen.

- Leo Pharma has revealed that it is initiating a restructuring plan that will mean the dismissal of a total of 400 employees, but also create 200 new positions. The news came a few months after the announcement of a strategic partnership with Astra Zeneca. The partnership covers potential new medicines for atopic dermatitis and psoriasis, and with the partnership, LEO Pharma is entering into biological medicines in dermatology.

- The American Biogen has announced that it will employ 100 extra employees after having invested 130 million USD in augmenting production capacity at their site in Hillerød.

In 2017

- In January, Novozymes made it known that it will be moving resources to growth markets, and thus dismissing 198 employees, 62 of whom are in Denmark.

- Shortly after the announcement that Bavarian Nordic is stopping its Phase 3-study with the pharmaceutical candidate Prostatevac for the treatment of castration resistant prostate cancer, the Danish pharmaceutical company announced that it has secured a contract with the US Department of Health to deliver its freeze-dried smallpox vaccine IMVAMUNE. The initial base award of the contract is 100 million USD and includes options valued at an additional 439 million dollars. Bavarian Nordic also made public their investment of about 75 million USD in the construction of a fill/finish manufacturing line at its facility in Denmark.

- Novo Nordisk has strengthened its position on the American market for the treatment of obesity in recent years, and in October the Danish healthcare company's closest competitor, the American biotech company Orexigen, announced that it is investigating possible routes to ensure the company's survival.

- The pharmaceutical company Xellia is beginning the spadework for an augmentation of the Copenhagen site worth 25 million USD.

- In October, a panel of medical experts from the American Food and Drug Administration (FDA) recommended approval of Novo Nordisk's Semaglutide, a GLP-1 drug to treat diabetes while reducing weight. Definitive approval of Semaglutide

is expected in early December at the latest, and it will strengthen Novo Nordisk against its closest competitor on the GLP-1 market, Eli Lilly.

One-third of the employees in Medicon Valley are highly educated

In Denmark as well as Sweden, highly educated employees or those with research training make up a larger share of those employed in the sector in 2015 than they did in 2008. This development is particularly apparent in Sweden, where 87% of the positions that disappeared from the life science sector from 2008–2015 are of the sort competed for by employees with a lower level of education, while only 13% of the positions are competed for by highly educated job-seekers. In Denmark, 76% of the positions created in the life science sector from 2008–2015 were competed for by people with a high level of education, and a mere 24% more jobs were created for people with a lower level of education.

The larger percentage of highly educated people in the life science industry can be explained by the fact that many manufacturing positions have been moved abroad, whilst companies have concentrated their Nordic activities on research and development. One example is Ferring, which closed its production facility in Vanløse, Copenhagen in 2008 and moved production to the Czech Republic and Switzerland. In August 2016, Oticon announced that the company's hearing aid production would be moving from Thisted in Jutland to Poland within the next two years. Shortly before that, Oticon's competitor Widex had announced that 400-500 Danish jobs would be eliminated when the company's production was moved to Estonia.

One-third of the employees in Medicon Valley's life science industry have a higher education or research training. The share of highly educated employees rose from 26% in 2008 to 32% in 2015. Increased employment in the life science industry has given more jobs to the highly educated than to those with other levels of education. Seven out of ten new jobs at life science companies in the Danish part of Medicon Valley went to those with a higher education from 2008–2015. In Skåne, where the number of employees in life science companies fell 31% from 2008 to 2015, the drop did not hit those with a higher education quite as hard. Only one out of four jobs that were eliminated were held by a highly educated employee.



PHOTO: NEWS ØRESTAD

STOCKHOLM AND COPENHAGEN CONTENDING FOR EMA

At this very moment, discussions are taking place in the EU regarding the future location of the European Medicines Agency, based on the evaluation of 19 applications submitted this summer. EMA is moving from its current premises in London as a result of Brexit. The decision was previously expected on November 20th, but it has now been said that it may take additional time before an announcement can be made.

EMA is responsible for the scientific evaluation, inspection and safety surveillance of pharmaceuticals developed by companies for sale in the EU. The authority has around 900 employees and thousands of associated experts. It is expected that EMA will draw around 36 000 annual visits, which will benefit the city in which the agency is located. Among the 19 candidates competing for the agency are Stockholm, Copenhagen, Amsterdam and Milan.

Denmark has offered EMA 20 years without rent in the Copenhagen Towers in Ørestad, worth an estimated 1.7 billion Danish crowns. Stockholm has offered the agency three years rent-free and a customisation of the Life City Building, which is currently under construction in Hagastaden, where the Karolinska Institute is located. Amsterdam in turn is enticing the agency with a single-payment rent subsidy of 18 million Euros for offices in the 19-storey Vivaldi Tower near the Schiphol airport. Milan has offered a total rent discount of 15 million Euros, where EMA would start with one rent-free year followed by a gradual rent increase until 2022. The office would be located in the Pirelli Tower, which the Regional Council of Lombardy would then vacate.

PATENTS - LIFE SCIENCE IS DENMARK'S AREA OF STRENGTH

Life science tops the list of the number of patents sought by Danish companies from the European Patent Office (EPO) between 2008–2016, while ICT and mechanical engineering within transport head the list in Sweden, according to statistics from the European Patent Office (EPO). The number of patent applications submitted to EPO by Danish life science companies rose 16% between 2008 and 2016, while the number of patent applications to EPO by Swedish life science companies fell 18%. Medicon Valley filed more than twice as many patent applications to the EPO within medical or veterinary science than the Stockholm-Uppsala region, according to the most recent regional statistics available for the year 2012 (priority date).

Statistics from EPO show that life science is the sector in Denmark in which the greatest number of patents were sought from the European Patent Office (EPO) between 2008–2016, whilst Sweden's areas of strength are ICT (digital communication and telecommunications) and mechanical engineering within transport. This is measured by publication date, which is 18 months after the filing of the national application. The number of Danish life science patent applications to EPO in the period 2008–2016 increased 16%, while the number of Swedish life science patent applications to EPO declined 18%. In total, Danish companies applied for 4 871 life science patents (biotechnology, medical technology and pharmaceuticals) from EPO from 2008–2016, and Swedish companies applied for 3 375 life science patents. Within the technological fields, where Swedish companies sought the most patents from EPO, ICT and mechanical engineering within transport, Swedish companies applied for 11 820 patents from 2008–2016.

From 2008 to 2011, Danish applicants filed about 20% more patent applications within the life sciences with EPO than Swedish applicants, but from 2012, the difference increased; Danish applicants have filed about 70% more patent applications within the life sciences than Swedish applicants since then.

Biotech is the technology field within which Danish applicants filed most patent applications during the period 2008–2016 (2 127) and also for the year 2016 (234). Medtech is the technological field for which Danish applicants filed the second most patent applications in the period 2008–2016 (1 611) as well as in 2016 (195). Pharmaceuticals, which held the third place from 2008–2016 (1 133), was ousted and pushed down to fifth place in 2016, when Danish applicants filed 132 patents applications within pharmaceuticals. Instead, audiovisual technology and mechanical engineering within engines, pumps and

turbines took the third and fourth places with 140 and 133 patents applications, respectively.

Swedish applicants filed the most patent applications within digital communications (7 010) during the period 2008–2016, as well as for the year 2016 (940). Telecommunications and mechanical engineering within transport are the technology fields for which Swedish applicants filed second and third most patent applications from 2008–2016 (2 486 and 2 324 respectively). For 2016, mechanical engineering within transport assumed second place (283) and medical technology moved upward to third place (204).

In 2016, Danish companies filed a total of 561 patent applications in the life sciences with EPO, and Swedish companies filed 329. That corresponds to 98 and 33 life science patent applications per 1 million inhabitants, respectively.

Medical technology is the patent category for which most applications were filed to the EPO from 2008–2016, as well as in 2016 (12 263), whilst biotechnology and pharmaceuticals held the last two places on the top ten in 2016, with 5 744 and 5 754 patent applications to the EPO respectively. The total number of patent applications from all countries to the European Patent Office (EPO) for life science rose by 9% between 2008 and 2016. From 2015 to 2016, the number of patent applications fell 2% however, due to an extraordinarily high number of patent applications in 2015.

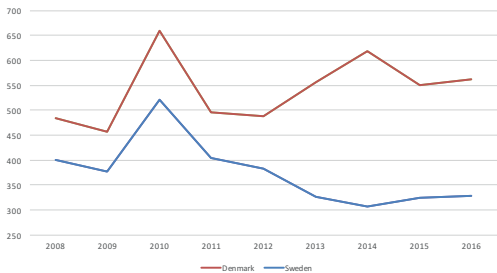
Leading life science companies such as Novozymes and Novo Nordisk are among the 25 top applicants to EPO for 2016: Novo Nordisk in the categories medical technology, biotechnology and pharmaceuticals, and Novozymes in biotechnology. Besides Novozymes, which is the third most frequent applicant

in biotechnology at EPO, the Technical University of Denmark (DTU) is also among the 25 top applicants to EPO within biotechnology. The only life science company with activity in Sweden on the top 25 list is Astra Zeneca (pharmaceuticals), but its presence owes to research activity in other countries than Sweden.

Moving to the regional level, Medicon Valley is leading in Denmark and Sweden with the overall

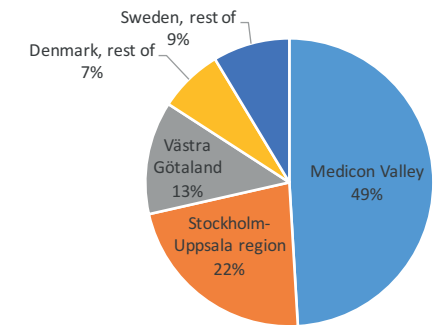
highest number of patent applications to the EPO within medical or veterinary science, and more than twice as many patents as from the Stockholm-Uppsala region in 2012 (priority date), as the most recent figures available from Eurostat show. Approximately 50% of the Danish and Swedish life science patent applicants are situated in Medicon Valley.

LIFE SCIENCE PATENT APPLICATIONS TO EPO FROM SWEDEN AND DENMARK



Source: EPO

PATENT APPLICATIONS TO EPO - MEDICAL OR VETERINARY SCIENCE 2012



Source: Eurostat

TOP TEN TECHNOLOGY FIELDS REPRESENTED IN DANISH AND SWEDISH PATENT APPLICATIONS FOR THE PERIOD 2008–2016 AND 2016 (IN PARENTHESES)

SWEDEN			DENMARK	
Place	Technology field	Number of applications	Technology field	Number of applications
1	Digital communication	7010 [940]	Biotechnology	2127 [234]
2	Telecommunications	2486 [164]	Medical technology	1611 [195]
3	Mechanical engineering; transport	2324 [283]	Pharmaceuticals	1133 [132]
4	Medical technology	2139 [204]	Mechanical engineering: engines, pumps, turbines	1123 [133]
5	Computer technology	1595 [162]	Civil engineering	1098 [117]
6	Mechanical elements	1308 [96]	Audio-visual technology	864 [140]
7	Instruments; measurement	1150 [135]	Mechanical engineering: other special machines	690 [98]
8	Civil engineering	1128 [119]	Food chemistry	676 [76]
9	Machine tools	952 [107]	Electrical machinery; apparatus, energy	646 [71]
10	Other special machines	858 [96]	Instruments; measurement	554 [73]
...				
16	Pharmaceuticals	708 [51]		
20	Biotechnology	528 [74]		

Source: EPO. Reading this table: The first figure denotes the number of patent applications for the entire period of 2008–2016 within the respective technological fields. The figure for the number of patent applications in 2016 is in parentheses. The year indicates the publication date, which is 18 months after the filing of the national application.

BIOTECH IN FOCUS: Recovery and a New Generation of Companies

Biotech is trendy again, this time with young researchers as well as investors. In recent years, Danish Genmab, Bavarian Nordic and Zealand Pharma and others still have come into the stock market spotlight. Numerous small companies from Lund have begun listing their shares.

- Many of the Danish biotech companies that began listing their shares in the 1990s or at the turn of the millennium have grown up and are now in focus on the stock market, including Genmab, Zealand Pharma and Bavarian Nordic. The latter-most experienced a sharp plummet earlier this year as a result of a failed phase III study.
- Danish biotech is making a comeback on Nasdaq Copenhagen with the listing of Orphazyme – a company located in Copenhagen Bio Science Park whose shareholders include e.g. Novo Ventures and Sunstone Capital.
- Since 2014, numerous Danish biotech companies have chosen to list their shares on Aktietorget or Nasdaq First North in Stockholm. Sweden has lower taxes on stock profits than Denmark, as well as a tradition of private investors and business angels.
- In the past three years, a large number of Swedish biotech companies have listed their stocks on Aktietorget or Nasdaq First North in Stockholm. At Medicon Village in Lund alone, 13 companies have begun selling stock since 2014, and most of them are in biotech. There are 19 listed companies at Medicon Village today.
- A few large companies dominate when it comes to Nordic venture capital for life science: Novo Seeds/ Novo Venture, Lundbeckfonden, Sunstone Capital and Healthcap. Novo Holdings and Swedish Saminvest are prepared to act as co-financiers for new, long-sighted foundations focused on Scandinavia.

STRONG, BUT VOLATILE SHARE DEVELOPMENT

Lucrative and risky. The biotech sector both entices and frightens away investors on the market. During the financial crisis, more experienced experts at the few remaining large and long-sighted venture firms like Sunstone Capital and Healthcap, as well Novo Holdings and Lundbeckfonden, were the ones who continued to invest in biotech companies. For a few years now however, the stock market party has been warming up again, and share price increases of several hundred per cent have made biotech companies interesting, even if the level of risk is still high.

Right now, Genmab is the exemplification of success for Danish biotech. With a total rise of more than 400% in the past three years, the Danish success company's share value has reached almost 80 billion DKK, making Genmab one of the Nordic biotech giants. Only the more industrially-focused Danish biotech company Novozymes has a greater share value

With a history that goes back to 1999, Genmab belongs to an older generation of biotech companies

that have now begun to mature and reach grander successes. Genmab began listing shares already in 2000, taking in 1.56 billion DKK in new issues at the same time. In 2004 and 2006, Genmab brought in an additional 1.3 billion DKK in two new issues. When the financial crisis swept in a few years later, the company was well prepared.

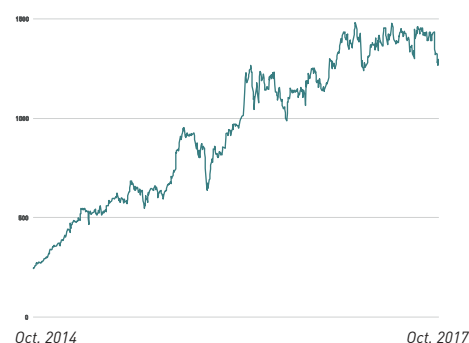
The ability to bring in as much capital as possible when possible and is something that Nas-

Upward trend for pharma- and biotech shares in Denmark and Sweden

In recent years, the share price development for pharma- and biotech shares has been a very positive one. On Nasdaq Copenhagen, the Danish pharmaceutical giant Novo Nordisk has dominated, thanks to its size. Smaller biotech companies have also drawn attention on the stock market, but companies with strong shares like Bavarian Nordic and Hansa Medical have also experienced highly volatile development due to announcements on successes and failures. Danish Genmab is in a class of its own with a strong and relatively smooth market capitalisation.

GENMAB

Share price development



BAVARIAN NORDIC

Share price development



COPENHAGEN



Nasdaq OMX Copenhagen Pharmaceuticals and biotech index

Source: Nasdaq 27 October 2017

HANSA MEDICAL

Share price development



GENOVIS

Share price development



STOCKHOLM



Nasdaq OMX Stockholm Pharmaceuticals and biotech index

daq Copenhagen's Head of Listings and Capital Markets, Carsten Borring, emphasises as a success factor for biotech companies. We are in an upswing right now and the market climate is good, but sooner or later the tide will change once again. Now, in the middle of the economic upswing, the next generation of Danish biotech companies is on its way to the Copenhagen stock exchange. First up was Orphazyme, which was founded in 2009 and has its operations at Copenhagen Bio Science Park, Cobis. In late October of 2017, Orphazyme announced its plans to take in 600 million DKK in new capital in conjunction with its listing on Nasdaq Copenhagen. If the plans are carried through, it will be the first Danish biotech company to be listed in Copenhagen since 2010. There are two other important Danish investors behind Orphazyme: Novo Holdings and Sunstone Capital.

Since 2014, a series of small Danish biotech companies have chosen to list their shares as small businesses in Stockholm, the reason being that there is a strong Swedish tradition for investing in shares that goes back to tax regulations that were created in the mid-1980s to encourage a more popular stock culture. It was successful. Today, there are a large number of business angels in Sweden and the private investors are many. The tax on stock profits is higher in Denmark, but there are proposals for creating better conditions for private stock investors.

The wave of Danish listings in Stockholm started when the biotech company Saniona in Ballerup listed its shares in Stockholm in March of 2014. Afterward, a number of other Danish companies listed their shares in Stockholm: Nuevolution from Copenhagen and Oncology Venture from Hørsholm were both listed in 2015. Last year, MPI in Hørsholm; ExpresS2ion Biotech from Hørsholm; Synact Pharma from Holte, and Acarix from Lyngby followed suit. This year, Initiator Pharma from Åbyhøj listed its shares on Aktietorget.

The strength of share listing in Stockholm is that Danish companies can benefit from the Swedish stock market culture. Even relatively small companies can look for capital on the open capital market. A disadvantage for investors is that the level of risk with the newly listed small businesses is high. On pages 44-45 of this analysis, we show the development of 40 listed biotech companies from Medicon Valley. The list is not exhaustive; we have chosen to show both large and more mature

What are the new trends in Danish and Swedish biotech?

Martin Bonde Chairman
Dansk Biotek and CEO at
Vaccibody, Norway



PHOTO: VACCIBODY

I don't think there is any discernible change in the last year, but in the past decade. Globalisation has reached our industry. We are in a position where we can benefit from standardised biology. In the past we did it ourselves, but now it can be done in China and other low-salary countries for half the cost.

It's a challenge, because Scandinavian jobs are lost in the process. The biotech industry has had to move toward what creates most value for companies.

We need to be very astute and focused on the core business. In the past ten years we've learned a lot about what can be outsourced. You can't outsource biotech management; it goes far too slow. You can't outsource the core research.

There is a general trend for biotech companies to only hire people in the core business, and everything else is outsourced.

Jonas Ekstrand
Director General, Swedenbio



PHOTO: SWEDENBIO

A clear trend that we are seeing right now is that our life science ecosystem is developing and becoming more and more virtual. In the wake of big pharma's cutbacks, there are a great number of highly experienced people involved in R&D companies. Many of them are micro-companies with fewer than ten employees. How can it be possible to carry out the development of pharmaceuticals in organisations that size? The answer is that an equal number of people are involved as consultants, or services are bought from full-fledged service companies. They have in turn employed many former big pharma researchers and are doing groundbreaking development work. It's important that the development companies are well financed, to keep the wheels in motion and the competence levels at the top. It's also important to train a new generation of pharmaceutical researchers in this intellectual craft.

companies as well as smaller and younger biotech companies. The list shows how luck shifts between various companies, and also moves over time. Even larger companies have a volatile development; this is most apparent with Bavarian Nordic, which went from a solid rise in early 2015 and at the end of the year 2015/2016 to a drastic plummet in share prices in early 2016 and now also in 2017. Share prices in biotech companies with finished products are event-driven. Setbacks can cause shares to plunge. Positive announcements about various drug studies result in corresponding boosts on the market.

Generally speaking, 2017 hasn't been as good a year on the stock market as 2015 and 2016 were. Hansa Medical from Lund and Genmab's share prices have been at a standstill after last year's intense rises.

Novo Seeds' managing partner Søren Møller points out another disadvantage with listing companies in an early phase. Swedish business angels can contribute capital, but they usually don't supply a contact network or the great sector competence that the big venture players can. At Novo Seeds, the youngest companies get help building an international management team and board. In addition, Novo Seeds is willing to syndicate its investments, so companies also have contact with international financiers.

The Danish strength goes back to the foundation system, which has created a long-term and stable ownership for the big and successful Danish pharmaceutical companies. As the main shareholder, the foundations have a large flow of capital from successful pharmaceutical companies. The profits are used for donating billions to Danish drug research, and for investing in new companies.

The interesting thing about the Danish system is that the foundations are not sentimental when it comes to the new biotech companies. With the exception of the seed phase, the Danish pharmaceutical companies' owner foundations invest all

over the world, searching for the best companies to invest money in. At home, the new Danish biotech companies don't have the same ownership protection as the large Danish pharma companies; for that reason, Danish biotech is significantly more global today, even in terms of ownership.

"We are in an up-swing right now and the market climate is good, but sooner or later the tide will change once again."



Carsten Borring, Head of Listing & Capital Markets at Nasdaq Copenhagen.

Even when the new biotech companies grow up, like Genmab, they are still relatively small companies in terms of staff. Running a virtual company where only those with the most specialised skills are employed means that the large company Genmab, worth almost 80 billion DKK today, only has around 200 employees in Denmark, the Netherlands and the USA. That can be compared with how the industrial biotech company Novozymes, worth around 100 billion DKK, has 6 441 employees, approximately 2 600 of whom are in Denmark.

The increased interest in the new biotech companies has to do with research taking new steps

forward, as well as the business model in life science itself, which has matured and developed. Today, the new biotech companies work as research departments for big pharma that are innovative, mobile and more willing to take risks. New models have also been necessary for funding the new biotech companies. At the same time, the importance of publicly financed research at universities for the development of a business is becoming clearer, as well as the importance of the new infrastructures being built in Medicon Valley, with large research facilities such as MAX IV and ESS, as well as growing science parks on both sides of the Øresund.

Medicon Valley's structure in the border region between Denmark and Sweden can offer great opportunities if utilised well. On one side of the Øresund is the Danish potential, with successful, Danish-owned pharmaceutical companies, owned by companies that allow billions from profit to go back to university research and investments in new companies. On the Swedish side of the Øresund, there is potential with a large popular interest in stocks, with many business angels, as well as the research facilities MAX IV and ESS.



PHOTO: NEWS ØRESUND

MANUFACTURING IN FOCUS: NEW COLLABORATION IN ZEALAND

In three or four years, a new centre dedicated to production, education and startups in biotech could be complete in Kalundborg – that was the vision when a number of public and private actors gathered in the project Knowledge Hub Zealand. Now they are looking for funding for the centre, which will cost an estimated 280 billion DKK to build.

A development centre for biotech production, innovation environments for biotech startups and a biotechnology education centre. Those are the components of the centre Knowledge Hub Zealand, proposed to be built in Kalundborg in western Zealand. The initiative was started by Novo Nordisk, the Kalundborg Municipality, the Capital Region of Denmark and a number of educational institutions, including the University College Absalon.

– As an overarching time frame, we hope that Knowledge Hub Zealand will be complete in three to four years. The centre has yet to be funded, but there are discussions underway, says project leader Christian Beenfeldt.

Novo Nordisk produces a significant amount of its insulin in Kalundborg, Novozymes has enzyme production there, and an industrial collaboration is already established between the companies in the city. According to figures from 2015, the municipality has around 5 500 industrial workplaces. As stated in the report "Vækstviår 2017" (Growth

Conditions 2017), economic growth in Kalundborg has been stronger than in the country as a whole, powered by the medical industry in the city. The initiative for the project was taken in order to safeguard production capacity in the region by investing in education, research, and innovation.

Although the centre has not secured funding yet, a new biotech engineer education has already begun, arranged by the University College Absalon.

– The programme started this autumn, and the attendance is fantastic, with 48 students. The instruction is in temporary premises until the Knowledge Hub Zealand centre has been built, says Christian Beenfeldt.

Copenhagen Economics was commissioned by Knowledge Hub Zealand to evaluate the social-economic benefit of the project. They concluded that the centre's activities would create a profit of around 240 million DKK annually upon completion. Copenhagen Economics estimates that the centre would cost around 278 million DKK to build, and its annual expenses would be approximately 34 million DKK. According to the calculation, the investment would be returned 5-10 years after opening.

Knowledge Hub Zealand is a foundation and a partnership. Its board includes representatives from Region Sjælland, Kalundborg Municipality, Novo Nordisk, Roskilde University, University of Southern Denmark, University College Absalon and Zealand Institute of Business and Technology.

"SOMETHING IS HAPPENING IN DANISH BIOTECH!"



Many small Danish biotech companies have chosen to list their stocks on Aktietorget or Nasdaq in Stockholm instead of on the Copenhagen stock market. One explanation is Denmark's high tax on equity gains, at 42%, says Carsten Borring, Head of Listing & Capital Markets at Nasdaq Copenhagen.

When the Danish biotech company Orphazyme announced plans to list its shares on Nasdaq Copenhagen in late October, 2017, it was the first time since Zealand Pharma was listed in 2010 that the Copenhagen stock exchange saw the entry of a new biotech company. In recent years, a series of small Danish biotech companies have chosen instead to list their shares on Nasdaq or Aktietorget in Stockholm, where there is a stronger tradition of business angels and other private investors than there is in Copenhagen.

"Something is happening in biotech! Danish biotech is in splendid form – the Danish company Orphazyme just sent an intention to float announcement to inform of their upcoming listing on Nasdaq Copenhagen", Head of Listings & Capital Markets at Nasdaq Copenhagen Carsten Borring wrote with enthusiasm on LinkedIn when the news broke on 24 October.

Carsten Borring relates how Danish biotech companies have had a good journey on the Copenhagen stock exchange in recent years, and that biotech

is attractive all over the globe. In August, Zealand Pharma's stock was dual-listed on the stock markets in Copenhagen and New York. This year alone, more than 25 companies in healthcare have been listed on the Nordic stock markets. So far this year, every third listing in the USA has been related to a company within healthcare.

– Biotech is closely associated with risks. Since the turn of the millennium, anything risky has had a hard time on the stock market. Slowly however, we

DANISH STOCK LISTINGS IN STOCKHOLM

(Life science companies listed on Aktietorget and Nasdaq First North in Stockholm)

Saniona, Ballerup, April 2014
Nuevolution, Copenhagen, December 2015
Oncology Venture, Hørsholm, July 2015
MPI, Hørsholm, June 2016
ExpreS2ion Biotech, Hørsholm, July 2016
Synact Pharma, Holte, July 2016
Acarix, Lyngby, December 2016
Initiator Pharma, Åbyhøj, March 2017



Alex Gouliaev, CEO, Nuevolution

have been able to see how biotech companies listed in Denmark around the start of the millennium, such as Bavarian Nordic, Novozymes and Genmab, have done increasingly better. Genmab has had a fantastic development, and it is the largest biotech company in the Nordic countries today.

Carsten Borring emphasises that before its listing in 2000, Genmab brought in a record 1.56 billion DKK in new capital. Now, in 2017, the market climate appears to be good once again for biotech companies on their way toward an IPO.

– There is every reason for biotech companies to keep their eyes open to funding opportunities on the capital markets in Denmark and in the Nordic countries. But look transnationally as well, especially at the American market, says Carsten Borring, who encourages young biotech companies to bring in money when they can, and emphasises that a stock listing also increases a company's visibility, which is a good thing for the future.

In recent years, more Danish companies have chosen to list their stock on the Swedish Aktietorget, or Nasdaq First North in Stockholm. Lower taxes on stock profits in Sweden, a Swedish tradition with many business angels, and private investors facilitate the listing of smaller companies.

– Nasdaq is in Copenhagen and Stockholm, says Carsten Borring.

Nuevolution is one of the Danish companies that have chosen to list their shares in Stockholm, on Nasdaq First North Premier.

– We considered several options, including Nasdaq US, Euronext, Oslo, Copenhagen and Stockholm, before deciding on Nasdaq First North, Stockholm. We concluded that Stockholm was the most vibrant stock exchange at the moment with good infrastructure in the investor-, banking- and analysis areas, and high investor activity, which was a good fit with our stage of development and future plans, says CEO Alex Gouliaev.

Listing in Stockholm does not only have advantages, however. Nuevolution needed to start a Swedish parent company, and all material needs to be produced in Swedish and English.

– The Swedish parent company, Nuevolution AB, is based in Stockholm. So far, the parent company is managed from the Copenhagen-based Danish operating company, Nuevolution A/S, and board meetings are held in Stockholm and Copenhagen.

What are the new trends in Danish and Swedish biotech?

Björn Odlander CEO and a founder, Healthcap, Stockholm



In the last years, we have observed a maturing biotech sector able to attract capital from global investors. In particular, we have seen a strong Scandinavian IPO window providing high quality companies access to public financing.

Among private companies we see similar tendencies of high valuations to what we saw around the turn of the millennium, and as an investor one has to be selective and careful. Looking at specific subsectors, there is a rising number of innovative digital health companies with the potential to change medical practice.

Orphan diseases remains a therapeutic area with high unmet medical need and attractive investment opportunities, suitable for venture capital investments.

Ebba Fåhraeus
 CEO SmiLe Incubator,
 Medicon Village, Lund



First of all, we see a continuous interest in the Cell Therapies and Regenerative Medicine Space, with many new companies emerging. In parallel, we see more companies in MedTech developing new solutions to support this progress, e.g. through new media. Secondly, Gut Microbiota is another area that is getting more and more attention, not only as a way to cure diseases but to promote a healthy life style. I believe we will witness a growing focus on this area, as a balanced gut microbiota is fundamental in strengthening the immune system. Thirdly, we are just in the starting blocks with respect to digitalisation of Health Care, with AI-powered health applications providing advanced solutions for diagnosis and predictions. AI is particularly useful in diagnostics, as it enables the creation of personalised treatment plans.

A 700 MILLION USD-BREAKTHROUGH

The first breakthrough came in 2011, when the research area immuno-oncology became generally accepted after a competitor's first product was approved. "From standing around talking in tiny, dark rooms, as if by magic we were suddenly in focus at conferences with 10 000 participants". That's how Alligator Bioscience CEO Per Norlén describes the change for the little Lund-based biotech company. The economic breakthrough came in August of 2015, with a licensing agreement with Janssen Biotech worth up to 700 million USD. The company was listed the following year.

Up to this point, Alligator Bioscience is a model of success as far as biotech companies go, with the exception of one detail: share price development. Since the listing on 23 November, 2016, the company's share price has fallen from the initial price of 32.50 SEK to 29.00 SEK on 24 October, 2017. But biotech companies are long-term investments, and Alligator Bioscience has many devoted followers. On 19 October this year, the Swedish investment bank Carnegie raised the price target for Alligator Bioscience's stock from 35 to 40 SEK and recommended purchase.

One man who knows the long-term work involved in starting a biotech company is the professor and serial entrepreneur Carl Borrebaeck from Lund University. He started Alligator Bioscience in 2001 on the protein optimising technology Find. The company has since come a long way in the development of antibody-based pharmaceuticals for the treatment of cancer.

In the beginning, the new company focused on work with proteins. It wasn't until seven years later that they shifted their focus to immuno-oncology antibodies.

– We took that step because we believed immuno-oncology would be the next big thing, and realised that antibodies would be key to success. For the first product we did not yet have our own antibody library and had to enter an option agreement with Bioinvent International to get access to the starting material. Using our FIND technology we managed to engineer the antibody to a new product with superior properties, ADC-1013. Bioinvent exercised their co-development option in 2013 but we were able to acquire all rights to

the project in 2014, says Per Norlén.

That proved to be a brilliant move. On 12 August, 2015, Alligator Bioscience sent out a press release announcing that they had signed an exclusive, worldwide agreement with the Johnson & Johnson subsidiary Janssen Biotech Inc. The agreement was for ADC-1013, and it was worth up to 700 million USD. On top of that were high single digit to low double digit royalties on all future sales if the development work proved successful and the product was commercialised. Janssen

Biotech also became a shareholder in Alligator Bioscience.

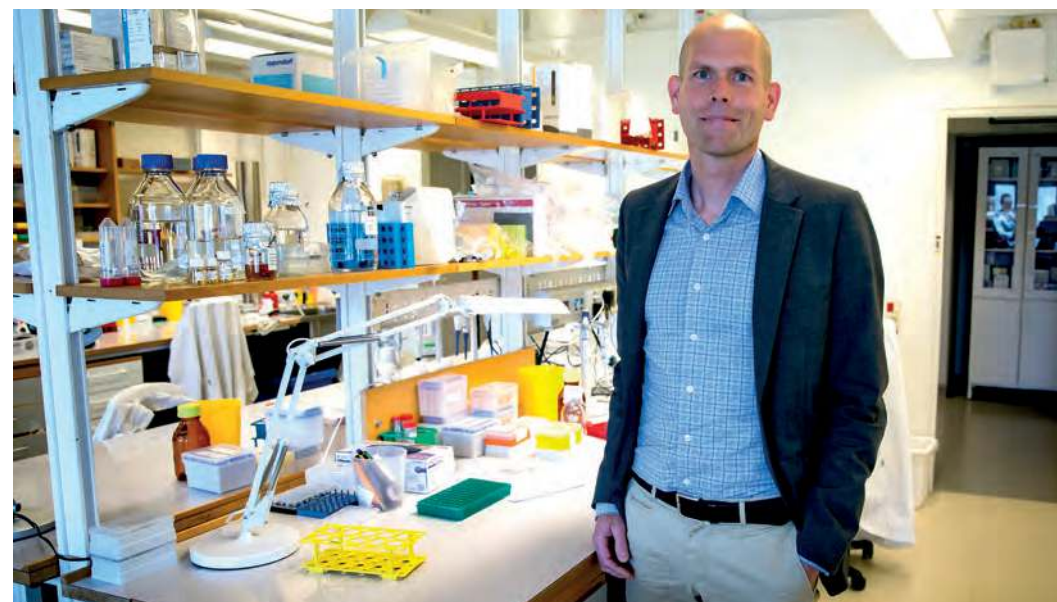
One of the company's main shareholders, Sunstone Capital, was also active in the deal. They had not only contributed capital in the company's early stages, but also shared their network and expertise on the business aspect through their representative in the Board, Chairman Peter Benson.

A few years prior, these successes were not self-evident, says Per Norlén.

– The scepticism was strong, and it had a lot to do with the fact that no one had succeeded in immuno-oncology before 2011. We were presenting

in dark, crowded rooms at tiny conferences where the audience could practically start laughing and saying that it would never work. But in 2011, the sector's first product was approved, followed in 2012-2013 by the new PD-1 blockers, which dominate today with no unprecedented effects and lower toxicity. Suddenly, as if by magic, we were in focus at conferences with 10 000 participants.

The breakthrough for their technology not only meant more attention; it also means working in the same realm as big pharma. But Per Norlén isn't afraid of the new competition. The agreement with



There are many promising biotech companies in Lund, says CEO of Alligator Bioscience, Per Norlén.

Janssen Biotech and the subsequent share issue at the IPO in November 2016, means that Alligator Bioscience has more 600 million SEK in the bank.

– We have funding for the next four years, and it is a terrific opportunity, not least because Janssen Biotech is a great partner. Our agreement with them is also very important for our status on the international arena.

– The big companies are ahead of us in many aspects. But there are many unexplored paths, and we have today a highly competitive pipeline with five first-in-class products. In my world, unique innovations take place in small companies, and then big pharma picks up the products and creates large research programmes around them. I strongly believe that testing new, daring ideas is the key to success for small biotech companies.

In terms of competence, Alligator Bioscience has benefitted greatly from being in a region with strong universities and many large pharmaceutical companies, which act as plant nurseries for new talents. Per Norlén has experience from Astra Zeneca and 25 years' worth of experience in pharmacological research. The founder and serial entrepreneur Carl Borrebaeck is a professor at Lund University. Many employees are from other biotech in the region, both Danish and Swedish.

– What we're missing in Lund today is a really

big player. For now, we can still harvest the fruits of Astra Zeneca's former presence, but in a number of years, that will change, says Per Norlén, who is pleased with the company's positioning in Medicin Village, which was created in Astra Zeneca's former premises in Lund.

Comparing the situation in Lund with Stockholm-Uppsala, he sees large companies there that have come closer to the market with their products.

– But I believe that innovation is stronger here. Camurus, Hansa Medical and Alligator are very promising companies.

Today, Alligator Bioscience has 45 employees and is continuing to recruit. The agreement with Janssen Biotech is important, even from a recruitment perspective. The company has become a more attractive workplace. Workplace satisfaction also increases with success and when colleagues know that a company has a long-term plan and funding.

– It's a fantastic environment to work in; we have a wonderful team spirit and our staff is truly the key to our success. Mutual respect is incredibly important for us, both internally and externally, and there is enormous commitment through working towards a common goal; to develop innovative tumor-directed immunotherapies to improve patients' lives.

PHOTO: NEWS ØRESUND



Professor Carl Borrebaeck in Lund is a serial entrepreneur who has been involved in starting companies such as Alligator Bioscience, Bioinvent, Senzagen and Immunovia.

"IT'S COOL TO BE A YOUNG ENTREPRENEUR"



Søren Møller, Managing Partner at Novo Seeds.

Invest in fewer companies, and put in more capital right from the start. Ensure that the new companies have a global focus when recruiting management, directors and advisors. Create a virtual organisation where the start-up company only owns the core competence. These are just a few words of wisdom from Novo Seeds' first ten years, says managing partner Søren Møller. He works in the part of the Novo Nordisk Foundation's subsidiary Novo Holdings that works with early seed investments in new biotech companies. It makes him happy that becoming an entrepreneur is seen as cool by young researchers, but finds that there are too few venture investors after the financial crisis. That's why Novo Holdings announced that they are willing to enter as a limited partner into venture funds that strategically invest in Scandinavia.

Novo Seeds is a part of Novo Holdings, which is the most successful example of the Danish concept of business ownership and research funding through foundations. The Novo Nordisk Foundation is via Novo Holdings the main shareholder of Scandinavia's largest pharmaceuticals company Novo Nordisk, and of the biotech company Novozymes. That gives the company long-term ownership with roots in Denmark, and takes away the risk of being bought up. The foundation's profits are partially reinvested in research and the funding of new companies, from startups to large and established companies such as Chr. Hansen, Convectec, etc.

Novo Seeds managing partner Søren Møller says that the Novo Nordisk Foundation's operations are based on holistic thinking. The foundation donates billions to research every year. Pre-seed grants help researchers on the first part of their journey, from research results to the establishment of a company. Then come Novo Seeds' early investments with focus on the Nordic countries. Novo Seeds follows

they have built up with seed investments all the way to exit and through to follow-on offerings.

– At Novo Seeds, we work with early stage biotech in northern Europe, with Denmark and Sweden as our major hubs. Looking at our deal flow statistics in Novo Seeds, half are coming from Denmark and one-third from Sweden.

When Novo Seeds celebrated its ten-year anniversary recently, they summarised the experience they have gathered to date. One clear conclusion was the importance of putting more capital in right from the start phase.

– Today, we go in with twice as much money, and the investors we collaborate with also go in with twice as much. Accordingly, there is significantly more money, so we can work with ideas more before the next time the company has to raise capital in a global competition. Every year, around 350 researchers and innovators contact Novo Seeds to fund their new biotech compa-

nies. After careful evaluation, around four companies are chosen in which Novo Seeds invests. Furthermore, about eight companies receive so-called pre-seed grants.

– If you're starting a company in an early phase that will require investments of several hundred millions of dollars before it can become commercial, it should make a big difference for patients. It shouldn't just be something new; it needs to be better. Another reason that we decline applications might be that we don't think applicants' data is good enough or doesn't support their hypothesis sufficiently. A third reason might be the team, but that's something that we can help with. There is also a question of chemistry – whether people can work together, says Søren Møller.

In its first ten plus years, Novo Seeds has invested in 35 companies. Søren Møller declines to give any figures, but he can confirm that Novo Holdings is satisfied with the results.

– We have exited four companies and have 16-17 companies in our portfolio. We have also closed a few companies.

He notes that there has been a clear trend for many years for the sector to move from the 1990s model, where the aim

was to build complete, but very expensive organisations, to creating smaller and more virtual companies.

– One shouldn't do things oneself if those things can be bought; only the things that are important for a company's platform should be built up internally.

– I also think that we've become more international. We require internationalised management, directors and advisors. We also syndicate all of our large investments. In doing so, we want to expose our portfolio company to critical questions from other investors.

One problem that Søren Møller is looking at is the shortage of investors in life science in Scandinavia.

– Before the financial crisis there were a lot of Scandinavian investors; today there aren't. Creating a new venture fund is not easy. There's a Swedish initiative where Saminvest is willing to supply risk capital for venture funds. We have taken a similar initiative and announced that we are willing to act as a limited partner in venture funds that strategically invest in the life sciences in Scandinavia.

One positive trend that Søren Møller highlights is that the interest in entrepreneurship has grown among young university researchers.

– One might say that being a young entrepreneur has become cool. That is a change. We have seen a good model with an experienced professor and a young postdoc who have been project leaders and taken on the role of company creator. Then we can help with finding a chairperson and in the long run maybe an experienced CEO. And there you have the research history from 30 years of work in the project.

In his work, Søren Møller has noticed numerous research groups in Denmark and Sweden with an experienced professor acting as a repeat entrepreneur.

– We are one of the region's most important investors, and we work opportunistically with everyone when we are out scouting. If we look at venture-financed deals in the early stage, we see basically all of them our deal flow and we invest in a third of them.

Like his colleagues at Novo Seeds, Søren Møller has many years of experience from the life science sector. After completing his PhD at the Technical University of Denmark and having been a postdoctoral fellow at Stanford University, his career has gone on

to companies such as Novo Nordisk, Novozymes, Exiqon and Bioimage. In 2008 he was voted into the board of directors of the Danish Biotech, and in 2011 he was appointed managing partner at Novo Seeds. He emphasises that the experience and the contact net that Novo Seeds can contribute is just as important as the access to capital it offers.

– The structure that we have at Novo Holdings can help academic researchers. Someone can come with an idea, and then we work together to build up the company, finance it and bring it out into the world. We have a large network of experts that we bring into the company when it becomes relevant. We build a data package and a business plan that can attract sufficient capital. The company creation process can take between six and nine months. Often we contribute with part or all of the capital in the start phase. The objective is that the company will be able to do an investment round with European venture capital firms that can finance the development of a drug for clinical proof of concept.



"Before the financial crisis there were a lot of Scandinavian investors; today there aren't. Creating a new venture fund is not easy."

"POSITIVE DEVELOPMENTS IN DENMARK"

Mette Kirstine Agger is Managing Partner at the Danish Lundbeckfonden Ventures and follows developments in international life science with a focus on biotech. She believes that we are going to see a rapid increase in big data use in the future that will lead to patients' increased involvement, and that it will become more and more common for communities to become involved via internet. On her home turf, she points out the successes of Genmab and Bavarian Nordic, which demonstrate that new, large biotech companies can indeed be built up in Denmark.

Mette Kirstine Agger has been with Lundbeckfonden Ventures since it was started eight years ago. Prior to that, her career path led her through companies such as Neurosearch and included Bavarian Nordic and other biotech startups before she founded her own company, 7TM Pharma.

– I know what it's like to be an entrepreneur.

As an investor, she works internationally and sees Danish and Swedish biotech companies from a global perspective.

– My job is to create profit; it doesn't matter whether that happens in Europe or in the USA.

Mette Kirstine Agger points out that an advantage of Lundbeckfonden Ventures is that they can operate somewhat more long-term than many American investors. She emphasises however that they focus hard on returns, so longer ownership requires a continual and satisfactory increase in value.

– It's extremely important for us that the companies in which we invest have a drug candidate that is based on a clear unmet medical need, and that they are run by an experienced team. We invest primarily in drug candidates, but also in technological platforms on the condition that there is a drug candidate, or plans for a drug candidate, that is commercially attractive and that demonstrates that the company can handle the research aspect as well as the strategic establishment of a company.

What she misses in Denmark is the freedom of movement between the academic and business sectors of the USA – where there is also better access to experienced CEOs who have "been there,

done that". She also sees a greater willingness to take risks in the USA.

– We have actually seen that here in Denmark, in the IT sector. But the time horizon is shorter there, and many successful entrepreneurs pour capital back into new companies. We also need to be aware that the time horizon is much longer in

biotech, and the need for capital is three or four times greater; that makes the sector more difficult for private investors to access.

Mette Kirstine Agger hopes that the interest in investing in stock will increase in Denmark, and she points to Sweden as a good example. She also hopes that large Danish investors will realise the

positive developments that have taken place in Danish biotech since 2014, though perhaps not on Nasdaq Copenhagen in particular.

– Santaris was sold to Roche. Egalet, Forward Pharma and Ascendis were listed in the USA. Several Danish companies have been listed on Nasdaq in Stockholm.

Lundbeckfonden is a primary shareholder in H. Lundbeck, but also in ALK and Falck. The foundation is the largest contributor to Danish publicly funded neurological research. The globally-focused Lundbeckfonden Ventures was started in 2009. In 2012, Lundbeckfonden Emerge was started; it is the unit within Lundbeckfonden that focuses on early investments. Emerge helps Danish researchers and innovators commercialise their life science research through investments and active involvement in projects.



Genmab and Bavarian Nordic show that it is possible to build large, new biotech companies in Denmark, says Mette Kirstine Agger.

INTERNATIONAL MANAGEMENT IS KEY

He views the creation of new biotech companies as a relay race in which his own team is good at financing the in-between stretches. One Nordic dilemma is that there are too few big investors who can bring in billions in the final stage of a company's journey onto the market. Peter Benson is managing partner at Sunstone Capital in Copenhagen. He has seen the pendulum swing from investments in potentially large, complete organisations in the late 1990s to today's hybrid and focussed investments. He states that most biotech companies are successful on their second or third shot at the goal.

Sunstone Capital was founded in Copenhagen in 2007, when they started a venture fund that took over the Danish Growth Fund's holdings in 33 IT- and biotech companies. At the same time, five Danish and Swedish pension firms brought in funds, so the fund capital totalled 2.9 billion DKK. Swede Peter Benson, whose background is in Kabi, Pharmacia Upjohn and a series of small biotech companies, started the process as Partner for the Growth Fund and became Managing Partner of Sunstone Life Science Ventures. Founding Sunstone Capital was part of the restructuring of the Nordic venture capital market.

– In 2000, there were 25 venture funds focused on biotech in the North.

Today, the only ones left of the independent investors are us and the Swedish Healthcap. Along the way we took over BankInvest's portfolio, the largest biotech venture fund in the North.

In the years from the turn of the millennium until the financial crisis, Peter Benson learned the importance of broad competence in management. Around the turn of the millennium, financiers and researchers dominated young biotech companies' and the ideal from the 1990s was to build complete mini pharma.

– When we studied 150 biotech companies in 2006, it hit us how many company directors lacked transaction experience, and that the boards usually had a shortage of competencies in production and clinical development.

Peter Benson also wants to introduce some nuances to criticism of the business model of the 1990s. He points out that many successful companies have their

roots around the turn of the century – Genmab, Symphogen, Zealand Pharma and Santaris/Cureon. Bavarian Nordic was started already in 1994.

The pendulum has swung since then. The venture sector's new ideal are focused, virtual companies that gradually add competences that is not part of their core area.

– The pendulum swung from one extreme to the other. We have now arrived at a more hybrid state and with one single exception, all of our successful investments have been successful on the second or third shot at the goal. Fundamentally, we always invest with a ten-year horizon, so what we

are working on today will be successful in 2025. That means that you have to decide quickly what your prime clinical candidate is. You need a good technological platform, and something unique that will make investors' eyes gleam.

What Peter Benson is missing in the North today are more big investors who can bring in billions in a company's final relay stretch on their journey to the market.

Regionally speaking, he sees Danish strength in a greater international openness – "In Sweden, even communication between Stockholm and Skåne is difficult" – as well as in the Danish life science industry, which has remained in Danish control thanks to foundation ownership.

– Denmark has a great many people who have worked internationally in the big life science companies, and who are an asset for the new biotech companies. In Sweden the general gap is pronounced and it will take time to build new experiences.



Peter Benson is pleased that the portfolio company Orp-hazyme will be listed with Nasdaq Copenhagen.

DENMARK AND SWEDEN, CHANGING PLACES

Increasingly more biotech companies are being listed on one of the three lists at Aktietorget, NGM and Nasdaq First North in Stockholm. The listings are about more than money. The companies get new shareholders and more attention, and the increased requirements imposed by the listing agreement spur them on. Interestingly, Sweden – a large-business nation – has also a tradition of private investors and small listed businesses in life science, while Denmark, which is characterised more by small- and medium-sized companies in life science, is dominated by a few large pharmaceutical companies, whose owner foundations are important financiers for research as well as for new companies.

The listing frequency is high – that's apparent from e.g. the science park Medicon Village in Lund. Of the 19 listed companies at Medicon Village, 13 have listed their shares in the past three years:

BrainCool, 2014
 Cantargia, 2015
 CombiGene, 2015
 Idogen, 2015
 Immunovia, 2015
 RHoVAC, 2015
 Invent Medic Sweden, 2016
 Alligator BioScience 2016
 Xintela, 2016
 BIBB Instruments, 2017
 Norinvent, 2017
 Senzagen, 2017
 AcouSort, 2017

As far as the smaller listed companies are concerned, ownership is often personal and involved. A good example of long-term personal engagement is the Scanian business family Sandberg's ownership in the Ideon business Camurus. For generations, the Sandberg family has had capacity for and interest in investments in new, innovative business ideas – everything from Aimpoint's weapon sight to Granuldisk's environmentally friendly dishwashers and the biotech company Camurus.

The well known real estate entrepreneur Erik Paulsson's family business Backahill is also a shareholder at Camurus, while Hansa Medical is still owned via Farstorps Gård and was previously controlled by the businessman Bo Håkansson, who was skilled in life science. One of Malmö's largest business families, Grandlund, is a shareholder in Galinica.

In terms of owners, it's interesting to see how the structure breaks the mould in Denmark and Sweden. Sweden is usually pointed out as a coun-

try of big businesses, and Denmark is a country of small and medium-sized companies. When it comes to life science, the opposite is often true.

When it comes to life science, ownership of the big businesses Astra Zeneca and Pharmacia has left

Sweden, and the cutbacks have been massive. Developments at Medicon Village, with a long line of listings for small innovative companies, are instead based on a new, more small-scale structure. An important reason for this small-scale development is that for decades, Sweden has built up a culture and stock

market structure in which private actors invest in shares. Now, numerous Danish biotech companies are attracted to listing their shares in Stockholm, while the Danish government, inspired by Sweden, is interested in changing taxes on stock profits.

In Danish life science, big businesses are dominant, with Novo Nordisk and Lundbeck at the forefront. The companies' owner-foundations have enormous retained earnings at their disposal, and these are used to promote Danish university research, as well as to fund new Danish biotech companies. This trend means that Danish, but also Swedish biotech companies that receive early funding from e.g. Novo Seeds or Lundbeck Emerge gain access to more capital, comprehensive advice, and international networks.

The foundations often work with venture investors like Sunstone Capital, Industrifonden or Healthcap. That means that companies like Bonesupport in Lund or Nuevolution and Orphazyme in Copenhagen have a strong combination of fund capital and independent venture investors in their list of shareholders.

"In Danish life science, big businesses are dominant, with Novo Nordisk and Lundbeck at the forefront."



The biopharmaceutical company Hansa Medical, with headquarters near Ideon in Lund, is in the midst of a positive development. The company's share price has risen 727% in the last three years, and recently the American analysts FBR began following the company. Hansa Medical is developing novel immunomodulatory enzymes for transplantation and acute autoimmune diseases. One of Hansa Medical's neighbours, Active Biotech, has fallen 69% and plans to close its research facility at Ideon because of reduced local need due to research setbacks.

BIO-EUROPE TO BE HELD IN MEDICON VALLEY NEXT YEAR

The annual European biotech conference BIO-Europe will be arranged in the Danish-Swedish Medicon Valley next year. In recent years, the conferences have had more than 3 600 participants representing almost 2 000 companies from 63 countries, and around 100 exhibitors. BIO-Europe consists of a conference- and an exhibition section, as well as an estimated circa 20 000 one-to-one meetings, according to the arranger EBD Group. Next year from the 5-7 November it will be time once again.

– That Medicon Valley as a whole is behind the initiative – two countries and a close collaboration – has made it possible to attract the conference, says Ann-Sofie Andersson, Business Development Manager Life Science at Copenhagen Capacity. She continues:

– This is the first time that BIO-Europe is being held outside of the German-speaking countries; it is a historic event. The owners look at the region, the country and the life science scene, and whether it

is strong enough to be a factor that draws people. The other, perhaps deciding, bit is whether or not the conference can be sustained financially. That's something about which we and Invest in Skåne have been engaged in a dialogue with the industry, and they have shown great dedication to holding the conference here. When it has been held in Germany, the host cities have often paid, but in this the case, the industry has put up most of the money, she says.

The conference will take place at Bella Center in

Copenhagen and right now, the owners behind the conference are working with its sponsors to create a programme. In this year's edition of the conference, Copenhagen Capacity and Invest in Skåne host the closing reception in Berlin, and will extend the invitation to the arrangement in Medicon Valley next year.

Read about more large meetings and conferences being arranged in Medicon Valley, as well as a selection of international meeting places, on page 97.



Ann-Sofie Andersson
 Business Development Manager, Copenhagen Capacity.

LISTED BIOTECH COMPANIES IN MEDICON VALLEY

Since 2014, the stock market's interest in biotech companies has increased, and so has the number of listings. In Copenhagen, Orphazyme is preparing to start listing its shares on Nasdaq Copenhagen, as well as bringing in 600 million DKK in new issues. Orphazyme will be the first new Danish biotech listing in Copenhagen since 2010. Instead, in recent years many small Danish companies have chosen to list their shares on Aktietorget or Nasdaq First North in Stockholm, where a large number

of Danish and Swedish companies are listed. Share prices change quickly among the new and often quite small companies, and there are also companies that have lost more than 90% of their stock value in recent years. After a 410% rise in three years, Danish Genmab has become a big player in Scandinavian biotech. The data below also includes the industrial biotech companies Novozymes and Chr. Hansen. Stock developments refer to the period up to 27 October 2017.

Share development in per cent

Company	City	Country	Jan-Oct. 2017 *	Last 3 years	
A1M Pharma	Lund	Sweden	-65	-86	Nasdaq First North Stockholm
Acarix	Lyngby	Denmark	-23		Nasdaq First North Stockholm
AcouSort	Lund	Sweden			Aktietorget, Stockholm
Active Biotech	Lund	Sweden	-34	-69	Nasdaq OMX Nordic Stockholm
ALK-Abelló A/S	Hørsholm	Denmark	11	56	Nasdaq OMX Copenhagen
Alligator Bioscience	Lund	Sweden	-20		Nasdaq OMX Nordic Stockholm
Ascendis Pharma A/S	Hellerup	Denmark	58		Nasdaq USA
Bavarian Nordic	Kvistgård	Denmark	5	40	Nasdaq Copenhagen
Biolinvent International	Lund	Sweden	-15	-8	Nasdaq OMX Nordic Stockholm
Bonesupport	Lund	Sweden			Nasdaq OMX Nordic Stockholm
Camurus	Lund	Sweden	2		Nasdaq Stockholm, Mid Cap
Cantargia	Lund	Sweden	35		First North Sthlm
Chr. Hansen Holding	Hørsholm	Denmark	41	129	Nasdaq Copenhagen
Clinical Laserthermia Systems	Lund	Sweden	17	24	First North Sthlm
CombiGene	Lund	Sweden	-37		Aktietorget, Stockholm
European Institute of Science	Lund	Sweden	-7	2	Aktietorget, Stockholm
ExpreS2ion Biotech	Hørsholm	Denmark	73		Nasdaq First North Stockholm
Follicum	Lund	Sweden	-48		Aktietorget, Stockholm
Gabather	Malmö	Sweden	-54		Aktietorget, Stockholm
Genmab	Copenhagen	Denmark	11	410	Nasdaq Copenhagen
Genovis	Lund	Sweden	53	30	First North Sthlm
Glycorex	Lund	Sweden	-16	-12	NGM Nordic Growth Market, Stockholm

Source: *avanza.se*

* until 27 October 2017

This list is a compilation of 40 selected listed biotech companies from Medicon Valley



+410%

GENMAB'S SHARE PRICE DEVELOPMENT
OVER THE PAST THREE YEARS

Share development in per cent

Company	City	Country	Jan-Oct. 2017 *	Last 3 years	
Hansa Medical	Lund	Sweden	85	727	Nasdaq Stockholm
Idogen	Lund	Sweden	-66		Aktietorget, Stockholm
Immunovia	Lund	Sweden	8		Nasdaq First North Stockholm
Initiator Pharma	Åbyhøj	Denmark			Aktietorget, Stockholm
Invent Medic Sweden	Lund	Sweden	40		Aktietorget, Stockholm
LifeAssays	Lund	Sweden	-59	-94	NGM Nordic Growth Market, Stockholm
MPI	Hørsholm	Denmark	-49		Nasdaq First North Stockholm
NeuroVive Pharmaceutical	Lund	Sweden	21	-92	Nasdaq First North Stockholm
Novozymes	Bagsværd	Denmark	44	29	Nasdaq Copenhagen
Nuevolution	Copenhagen	Denmark	23		Nasdaq First North Stockholm
Oncology Venture	Hørsholm	Denmark	-41		Aktietorget, Stockholm
PharmaLundensis	Lund	Sweden	4	-52	Aktietorget, Stockholm
Respiratorius	Lund	Sweden	-20	434	Aktietorget, Stockholm
RHoVAC	Lund	Sweden	-7		Aktietorget, Stockholm
Saniona	Ballerup	Denmark	-5	251	Nasdaq Stockholm Small Cap
SenzaGen	Lund	Sweden			Nasdaq First North Stockholm
Spago Nanomedical	Lund	Sweden	-29	-8	Aktietorget, Stockholm
Synact Pharma	Holte	Denmark	13		Aktietorget, Stockholm
Veloxis Pharmaceuticals	Hørsholm	Denmark	-21	-58	Nasdaq Nordic, Stockholm
WntResearch	Malmö	Sweden	-54	-53	Aktietorget, Stockholm
Xintela	Lund	Sweden	-17	-21	Nasdaq First North Stockholm
Zealand Pharma	Glostrup	Denmark	11	81	Nasdaq Copenhagen and New York

Source: *avanza.se*

* until 27 October 2017

This list is a compilation of 40 selected listed biotech companies from Medicon Valley

THE BEACONS OF MEDICON VALLEY: The Growth Continues

The companies of Medicon Valley are successful, with the four large groups Novo Nordisk, Lundbeck, Ferring and LEO Pharma at the forefront. New biotechnology companies are being created on both sides of the Øresund Strait, for example in the relatively new science park Medicon Village in Lund and in Copenhagen Bio Science Park, and there is a new beacon being raised in the region with the materials research facilities MAX IV and European Spallation Source, ESS.

- Industrial foundations have contributed to the stable development of Medicon Valley's four largest pharmaceutical groups: Novo Nordisk, Lundbeck, Ferring and LEO Pharma, all of which are located in and around Copenhagen.
- The large pharmaceutical companies have nurtured many researchers and company leaders, which has also benefitted many of the new biotechnology companies that have emerged since the end of the 1990s.
- The foundations have also contributed risk capital for new companies and resources for new research, generating a good circular flow in the region.
- Increased pressure on prices and the phasing in of a new generation of technology with biological medicines has led to large companies needing to make cutbacks as well as new investments. As a result, the situation in Medicon Valley can be difficult to interpret.
- Six large science parks bring know-how and new companies close together. Three of them are located in and around Copenhagen, one is in Malmö and two are in Lund. The result is a new kind of "multicellular" big business.
- The equilibrium between Medicon Valley's Zealand and Skåne regions will be more even with the new beacon being constructed in Lund: the two materials research facilities MAX IV and European Spallation Source with data centre in Copenhagen. Life science will be a crucial area. Lund is growing into an even more significant city for research.

THE PIECES FELL INTO PLACE IN 2016

2016 actually shouldn't have been one of those years where the number of employees in Danish life science beacons increased. Lundbeck was still in a costly transition from older to newer pharmaceuticals and had been reducing its workforce for several years. Novo Nordisk had been hit by pricing pressure and headwind in the USA. 2016 was the year when the small successes of many companies accumulated.

In terms of workforce, it was a year of many tiny successes among the beacons of Medicon Valley, most of them on the Danish side. At Copenhagen Bio Science Park, COBIS, a record number of new companies moved in in 2016. With 40 new, small companies, the number of people working in the centrally located science park near Rigshospitalet in Copenhagen increased by 80. Its Swedish counterpart Medicon Village accepted around 20 new companies and has noted an increase of some hundred people in the science park, which is now being expanded with a new main building that will accommodate 600

people. Ferring Pharmaceuticals' workforce grew by 75 people, and it is investing 1.1 billion DKK in the new research facility Soundport, which is currently being built on the shore of the Øresund, right next to Copenhagen Airport.

American Biogen added around 120 people to its number of employees in Denmark, primarily at its factory in Hillerød. On the other side of the Øresund, McNeil in Helsingborg expanded its workforce by several dozen in the past year. LEO Pharma, which has both dismissed and engaged

employees, ended the year with a total increase in workforce of more than 600 people globally.

When companies cut back their staff last year, the numbers stayed small. Danish Coloplast and Baxter in Lund both decreased, but with less than a hundred people each.

Sometimes, things turn out better than expected. Lundbeck, which develops and manufactures drugs to treat neurological illnesses, is one good example. When the former director of Novo Nordisk Kåre Schultz took over as CEO of the hard-pressed Lundbeck in Valby, Copenhagen in the early summer of 2015, the stock market was expecting the large cutbacks in cost and staff to continue. He has a reputation as a strong turn-around leader.

The result of his two short years as Lundbeck's CEO (he'll soon take over as CEO of the Israeli Teva Pharmaceutical) was an about-turn from losses to increased profits and a share price that, until October of 2017, increased by almost 200%. The company's workforce decreased by only around a hundred employees globally in 2016. In Denmark, the number of employees increased by a few dozen.

The mood was sombre at the Danish pharmaceutical giant Novo Nordisk in 2016. Pricing pressure and competition grew on the all-important Ame-

rican market, which stands for around half of the company's sales. Novo Nordisk changed its CEO and announced impending staff- and cost cutbacks.

Four out of ten Novo Nordisk employees are at home in Denmark, where the result for 2016 was a continued workforce growth of about 700 employees. New figures for 2017 show that the staff cutbacks have started to take effect this year, however, although the decline in employment seems to have stopped at around 500 of 16 500 employees. But that the comet of growth that is Novo Nordisk is cutting back staff is a noteworthy event in Denmark.

There is no shortage of glimmers of hope for Novo Nordisk, however. In October, the American Food and Drug Administration's expert panel recommended their new diabetes drug Semaglutide for approval.

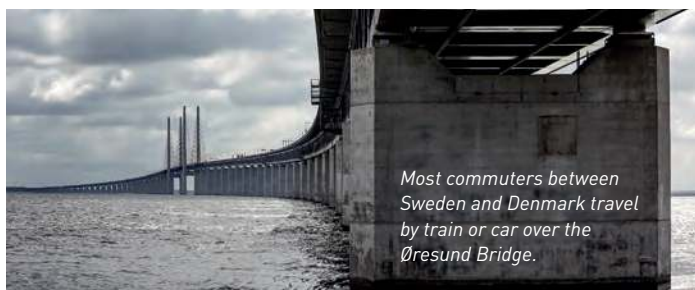
Already in August, Novo Nordisk decided to invest 13.6 billion DKK in new factories in the USA and Denmark for the manufacture of the anticipated future hope that is Semaglutide. The drug is a slow-release GLP-1 biological medicine that only needs to be taken once a week. Semaglutide is also said to contribute to weight loss, and research is being done to determine whether it can be used to treat Parkinson's as well.

In 2015-2016, Novo Nordisk decided to invest further billions in Denmark for a new factory and a depot for raw materials in Hillerød, as well as a new factory in Kalundborg.

HUNDREDS OF LIFE SCIENCE EXPERTS COMMUTE OVER THE ÖRESUND

According to Medicon Valley Alliance's calculations, almost 800 people commute over the Öresund to a well-paid life science job in the neighbouring country every day. The large Danish life science companies benefit from the skills on Medicon Valley's Swedish side. Most commute from Skåne to Zealand, but in e.g. Medicon Village in Lund, there are biotech companies with Danish employees. Five of the large life science workplaces for Öresund commuters in 2017 are:

Novo Nordisk
212 Öresund commuters
Ferring
121 Öresund commuters
Lundbeck
73 Öresund commuters
Chr. Hansen
27 Öresund commuters
Medicon Village
35-40 Öresund commuters



Most commuters between Sweden and Denmark travel by train or car over the Öresund Bridge.

PHOTO: NEWS ØRESUND

THE BEACONS OF MEDICON VALLEY

Pharmaceutical and biotechnology companies in Greater Copenhagen are a regional success story characterised by a few large companies in pharmaceuticals that are complemented by successful biotechnology companies. But Medicon Valley is more than pharmaceuticals and biotechnology. The

region also has successful medical technology companies, growing science parks and the two large materials research facilities MAX IV and European Spallation Source, the latter of which is currently under construction in Lund, and ESS data management centre DMSC in Copenhagen.

4 PHARMACEUTICAL COMPANIES with headquarters in the Zealand region dominate Medicon Valley's largest groups in pharmaceuticals and biotechnology. The four large groups Novo Nordisk, Lundbeck, Ferring and LEO Pharma and the foundations that own them have also been a venture capital investor and a nursery for many of the researchers in Greater Copenhagen. Since the end of the 1990s, a number of smaller biotechnology companies have emerged, such as Genmab, Zealand Pharma, Bavarian Nordic and Symphogen in Denmark and Alligator Bioscience and Camurus in the Skåne region.



Novo Nordisk



LEO Pharma



Ferring



Lundbeck

PHOTO: NEWS ØRESUND, FERRING, LEO PHARMA

9 UNIVERSITIES. Greater Copenhagen's academic spectrum within life science is broad, with nine learning institutions that perform research in the field. Globally leading diabetes research and neuroscientific research take place at the University of Copenhagen, as well as at Lund University. The learning institutions also have other strong life science research, for example within metabolic diseases and plant biology. In addition, DTU and Malmö University are both highly advanced in areas such as bioengineering and biological surfaces.



UNIVERSITY OF COPENHAGEN

PHOTO: COPENHAGEN UNIVERSITY



PHOTO: NEWS ØRESUND

6 SCIENCE PARKS. A growing phenomenon, not least in biotechnology, is that many small companies group together in science parks: COBIS, Scion DTU and Symbion are in and around Copenhagen, whilst Skåne is home to Medeon in Malmö and Ideon and Medicon Village in Lund.

THE NOVO NORDISK FOUNDATION GROUP

NOVO NORDISK FOUNDATION is an industrial foundation whose objective is to act as majority shareholder in the publicly traded Novonordisk and Novozymes, as well as to support scientific, humanitarian and social causes. In 2016, the foundation distributed around two billion DKK in grants. Since 2007, the Foundation has given a total of 3.6 billion DKK toward the establishment of four research centres and a national biobank in Greater Copenhagen.

- Danish National Biobank
- Center for Basic Metabolic Research
- DTU Biosustain - Center for Biosustainability
- Center for Protein Research
- Section for Basic Stem Cell Biology

NOVO HOLDING is the Foundation's wholly owned subsidiary. It manages the Foundation's endowment and its controlling interests in the publicly traded companies Novo Nordisk and Novozymes.

- **Novo Seeds** is the name of the early-stage investment in new biotechnology companies. To date, investments have been made in 35 companies. Novo Seeds works with early stage biotech in northern Europe, with Denmark and Sweden as major hubs. According to Novo Seeds' deal-flow statistics, half are coming from Denmark and one-third from Sweden.

- **Novo Ventures** invests in companies that are further in the development stage. So far, Novo Ventures has



PHOTO: NEWS ØRESUND

invested 8 billion DKK in more than 120 companies and successfully exited over 30 companies through trade sales and IPOs. The emphasis is on companies in the USA and Great Britain.

- **Novo Principal Investments.** With its late-stage investment activity, Novo Principal Investments has twelve larger-scale investments, including investments in five Danish companies - Chr. Hansen, Sonion, Symphogen, Veloxis Pharmaceuticals and Xellia Pharmaceuticals.

NOVO NORDISK is the original company behind the group, and today it is Denmark's largest pharmaceutical company and a globally-leading producer of insulin. The company is publicly traded and has its headquarters and a large facility on the outskirts

of Copenhagen, in Bagsværd, and several large research and production facilities elsewhere in Zealand. The company also makes drugs for obesity, haemophilia and growth disorders. The company's growth has been strong; since 2014, its turnover has increased by 26% and since 1996 it has increased by 650%. In 2015, the company decided to invest two billion USD in a new pharmaceuticals factory in the USA with 700 new jobs, and one new pharmaceutical factory in Måløv (DK) with 100 jobs. In addition, it also decided to build a new filling plant for medicines in Hillerød (DK), with 450 new production and engineering jobs. In the autumn of 2016, Novo Nordisk decided cut back its workforce by 1 000 employees, 500 of whom were in Denmark.

Turnover 2016: 111.8 billion DKK

Number of employees 2016: 41 971, of whom 17 036 in Denmark and 81 in Sweden.

Facilities in Medicon Valley: Headquarters in Bagsværd and offices in Ørestad and Malmö. Research facilities in Måløv and Hillerød. Production facilities in Værløse, Søborg, Måløv, Gentofte, Køge, Kalundborg and Hillerød.

NOVOZYMES was founded in 2000 as a demerger from Novo Nordisk. Novozymes is a publicly traded biotechnology company and a globally leading manufacturer of industrial enzymes as well as a major producer of microorganisms. The company's headquarters is in Bagsværd outside Copenhagen. The largest mar-

kets are in agriculture, bioenergy, food & beverage, household care, leather, pulp & paper, textile and water solutions. Enzymes for laundry detergents are the largest goods class, accounting for one-third of the turnover. In the autumn of 2016 Novozymes gave NCC a 633 million DKK contract to build a new research facility in Lyngby-Taarbæk Municipality (near the Technical University of Denmark) for 800 employees. It will be completed in 2018.

Turnover 2016: 14.1 billion DKK.

Number of employees 2016: 6 441, of whom approx. 2 600 in Denmark.

Facilities in Medicon Valley: Headquarters and R&D in Bagsværd and production facilities in Kalundborg and Copenhagen.

CHR. HANSEN Although Novo Holdings is Chr. Hansen's largest shareholder, Chr. Hansen is not a subsidiary of Novo Holding, but instead represents principal investments. It is a global biotechnology company with clients in the pharmaceutical industry, food and health industries, and agriculture.

Turnover 2016/17: 1 062 million Euros

Employees 2016/17: >3 050

Facilities in Medicon Valley: Headquarters in Hørsholm and facilities in Hvidovre and Roskilde.

THE LUNDBECK FOUNDATION

THE LUNDBECK FOUNDATION is an industrial foundation whose objective is to maintain and expand the activities of H. Lundbeck and to provide funding for scientific research. The Foundation annually grants between 400 and 500 million DKK to research, with particular focus on promising researchers who wish to establish their own research groups at Danish universities. The Foundation is the largest shareholder in the publicly traded companies H. Lundbeck and ALK-Abelló, as well as in Falck A/S. The Foundation also invests in life science companies, as well as in the commercial development of scientific projects.

Lundbeck Foundation Emerge:

- Has three investments in Denmark; of these, IO Biotech is located in Copenhagen.

Lundbeck Foundation Ventures:

- Has investments in 20 companies, two of which are in Medicon Valley - Veloxis Pharmaceutical in Hørsholm and Bonesupport in Lund.

H. LUNDBECK is a global pharmaceutical company specialising in psychiatric and neurological disorders. The company is publicly traded and has its headquarters in Valby, Copenhagen. Several new compounds

have been launched in recent years against for example depression and schizophrenia, while other, earlier patents have expired.

Turnover 2016: 15.6 billion DKK

Number of employees 2016: 5 120, of whom 1 633 in Denmark and 77 in Sweden.

Facilities in Medicon Valley: Headquarters and production in Valby/Copenhagen and production in Odsherred. Office in Malmö.

ALK-ABELLÓ is a publicly traded global company that researches allergies and manufactures vaccines for them. Its headquarters are located in Hørsholm in Zealand. The company's turnover has increased almost 10% since 2011, and the number of employees



PHOTO: NEWS ØRESUND

has increased by 11%.

Turnover 2016: 3 billion DKK

Number of employees 2016: 2 197, of whom 795 in Denmark.

Facilities in Medicon Valley: Headquarters and R&D in Hørsholm.

FERRING PHARMACEUTICALS

FERRING PHARMACEUTICALS is a wholly privately-owned pharmaceutical company with its roots around the Öresund. It was founded in Malmö in 1950 and moved to Limhamn in 1956, with subsidiaries in Denmark and Germany that are now a group. In 2002, operations in Copenhagen and Limhamn were consolidated and moved to the iconic black high-rise in Ørestad, and in 2004 the company headquarters moved to Switzerland. In 2019 Ferring International PharmaScience Center and Ferring Pharmaceuticals will move from Ørestad to the new research facility Soundport (pictured), which is currently being built near the Öresund Strait, walking distance from Copenhagen's airport, in Kastrup. Soundport is a 1.1 billion DKK investment and will be able to accommodate 750 employees, which is a 50% increase compared to the facility in Ørestad. Ferring develops and produces peptide-based and biotechnologically developed medicines with a focus on urology, reproductive health, gastroenterology and endocrinology. Ferring is run by Frederik Paulsen through the Dr. Frederik Paulsen Foundation.

Turnover 2016: 1.8 billion EUR

Number of employees 2016: 5 864, of whom 555 in Denmark and 19 in Sweden

Facilities in Medicon Valley: Ferring Pharmaceuticals A/S, also called Ferring International Pharma Science Centre, and Ferring Lægemedler A/S in Ørestad, and a sales office in Malmö and API-manufacturer Syntese in Hvidovre Municipality. Headquarters in Switzerland.



PHOTO: NEWS ØRESUND

Ferring is still represented in its former hometown Malmö, where it has an office. There are also a number of pharmaceutical companies in Malmö with a historic link to Ferring.

Ferring's original factory in Limhamn in Malmö is still there, with the name Rechon Life Science. Since 2007, it has been owned by the Chinese pharmaceutical company Dongbao.

Poly Peptide Group is also in Limhamn with its office and production. It is a demerger from Ferring and part of a separate group of companies. Other companies with a historic link to Ferring are Qpharma, Nordic Drugs and Euro-Diagnostica, all of whom are active in Malmö.

LEO PHARMA

LEO FOUNDATION was established in 1984 to secure LEO Pharma's future as an independent, research-based Danish pharmaceutical company. The foundation also supports international research with focus on dermatology.

LEO PHARMA is a wholly privately/foundation-owned pharmaceutical company with focus on the development and production of medicines for dermatology and thrombosis.



PHOTO: LEO PHARMA

Turnover 2016: 9.9 billion DKK

Number of employees 2016: 5 446 of whom 1 985 in Denmark

Facilities in Medicon Valley: Headquarters, R&D and production in Ballerup outside Copenhagen.

NEW RESEARCH FACILITIES BOOST PHARMACEUTICAL RESEARCH

European Spallation Source (ESS), which is currently under construction on the outskirts of Lund, and its neighbour **MAX IV**, which was inaugurated early this summer, are becoming world-class research beacons bringing new possibilities for research as well as business to Greater Copenhagen. Both research facilities are expected to generate an influx of thousands of researchers from abroad, and one of the important fields of research for ESS and MAX IV is life science – read more on page 58.

THE SYNCHROTRON LIGHT FACILITY MAX IV was inaugurated in 2016 and helps researchers study material and life science down to the nano-level. Max IV is a Swedish national research facility that is open to other countries and companies that wish to invest in their own beamline.

Investment: Around 4 billion SEK incl. the first 14 beamlines. There is space for 26-28 beamlines, and when complete, costs for the facility are expected to reach 6 billion SEK.

Expected completion: 2026

THE NEUTRON SOURCE FACILITY EUROPEAN SPALLATION SOURCE, ESS, is a European venture. The research facility is currently being built adjacent to Max IV in Lund, and the ESS data management centre DMSC was inaugurated last year in the science park COBIS in central Copenhagen.

Investment: The budget is 17.7 billion SEK, or 1 843 billion Euros (2013 price level). Sweden is contributing 35%, and Denmark 12.5%.

Completion: ESS will produce the first neutrons in 2019 and the construction phase will be complete in 2025.

COLOPLAST

COLOPLAST is a publicly traded medical technology company with its headquarters in Humlebæk in Fredensborg Municipality, south of Helsingør. The company's original product, stoma bags, remains an important part of the plastics manufacturer's product assortment, which now includes products for ostomy care, urology and continence care, as well as wound and skin care.

Turnover 2015/16: 14,7 billion DKK

Number of employees 2015/16: 11 092, of whom approx. 1 430 in Denmark and 46 in Sweden

Facilities in Medicon Valley: Headquarters in Humlebæk in Fredensborg Municipality and production in Mørdrup in Helsingør Municipality.

WILLIAM DEMANT HOLDING

WILLIAM DEMANT HOLDING is one of Medicon Valley's three large hearing aid manufacturers (the other hearing aid manufacturers are GN Store Nord / Resound and Widex, located around Copenhagen).

Turnover 2016: 12 billion DKK

Number of employees 2016: 12 000, of whom 1 432 work in Greater Copenhagen.

Facilities in Medicon Valley: Headquarters in Smørum in Egedal Municipality and R&D in Snekersten/Helsingør.

LARGE FOREIGN-OWNED LIFE SCIENCE COMPANIES

BAXTER (FORMERLY GAMBRO) in Lund, which is an important producer of for example dialysis equipment. Gambro's roots are in Lund, where the company invented the single-use kidney. In Sweden the company has 721 employees in Lund (Gambro Lundia) and 103 in Kista (Baxter Medical).

MCNEIL in Helsingborg manufactures medicines to stop smoking and was once part of the large Swedish group Pharmacia, but is now part of the American pharmaceuticals giant Johnson & Johnson. The company has approx. 630 employees in Helsingborg.

BIOGEN has its Danish offices in Copenhagen and production facility in Hillerød. It has around 770 employees in Denmark.

WILLIAM COOK EUROPE in Bjæverskov develops, manufactures and sells medical technology products and distributes products from the rest of the Cook group. The company has approx. 700 employees in Bjæverskov.



PHOTO: NEWS ØRESUND

RECORD-HIGH NUMBERS MOVING INTO COPENHAGEN BIO SCIENCE PARK - AND A FORTHCOMING LISTING

It's been a good year for the Copenhagen Bio Science Park, COBIS. Forty new companies have moved in, and at the end of October the tenant Orphazyme made it known that it had sent an intention to float announcement informing of its plan to offer shares on Nasdaq Copenhagen later this year.

In the past year, 40 new companies have become tenants at COBIS, which means that there are now almost 100 companies at Copenhagen's centrally located, biotech-focused science park.

– It's the largest new influx of companies to Cobis since its start in 2009, says COBIS' CEO Morten Mølgaard Jensen.

There are a total of 98 organisations and companies with a total of 350 employees on-site at COBIS; among them is European Spallation Source (ESS) Data Management and Software Center (DMSC).

– ESS is a fantastic tenant and has created new activities at COBIS. When construction as ESS in Lund is finished, DMSC will be COBIS' window on the research.

The new companies are relatively small and have few employees. Two-thirds of them are not strictly biotech companies, but more focused on technological solutions aimed for the health-care sector and services and medtech. Morten

Mølgaard Jensen interprets it as an effect of the current sector drift toward new realms like e-health. But he thinks it's too early to say that it's a new trend at COBIS, even if he confirms that the science park's focus has grown broader.

While the number of small companies is rising, there are fewer growing large at COBIS:

– It's somewhat worrying, says Morten Mølgaard Jensen.

At the same time, he has noted increased interest from new investors looking at the companies being developed at COBIS; these include players such as Hadean Ventures, Merck Ventures, Syncona, Pontifax, J&J Innovation, GSK, Sunstone Capital, Seed Capital and Novo Seeds.

The fact that COBIS' tenant Orphazyme, whose shareholders include Novo Seeds and Sunstone Capital, has now decided to take in 600 million DKK in new capital and list the company's shares on Nasdaq Copenhagen is tangible proof of the increased interest in investing



Morten Mølgaard Jensen, CEO, Copenhagen Bio Science Park, COBIS.



Copenhagen Bio Science Park, COBIS.

in biotech. Likewise, IO Biotech and Acesion Pharma have also contributed large amounts of capital over the past year.

Morten Mølgaard Jensen also sees how the massive investments in Danish basic research have begun to bring results.

– We're starting to see increased activity from the new research centres that have been formed.

Right now, he is working on building up and entering strategic partnerships so that the current incubators at COBIS, which more or less function like a temporary office space today, can be expanded to become a more complete offering,

with labs and advice, similar to what SmiLe Incubator at Medicon Village in Lund has.

As far as the general development of biotech in Denmark is concerned, Morten Mølgaard Jensen has noted increased interest in creating new companies. The challenges involve the continued lack of capital in the early stages.

– Investments are needed that link research and commercialisation of new companies in better ways. Either more public investment in early stages, or we make saving in shares more economically attractive in Denmark. There is an interesting proposal for a new stock savings plan.

SCIENCE PARKS IN THE REGION CONTINUE TO EXPAND

For 34 years now, six large science parks have been growing in Medicon Valley. With almost 500 companies, science parks have become a vital beacon in Medicon Valley. The growth is continuing, and since 2009 two new science parks with a pure life science focus have been established: COBIS in Copenhagen, and Medicon Village in Lund.

The region's first science park, Ideon, was founded in 1983 in Lund, and two years later Medeon opened in Malmö. In 1996, six researchers founded Symbion in Copenhagen, and in 2004 Scion DTU saw the light



PHOTO: NEWS ØRESUND

of day. Five years later, Symbion and Scion DTU started the biotechnology park COBIS near Rigshospitalet in Copenhagen, and in 2012 Medicon Village opened the doors of a new science park in Astra Zeneca's former research facility in Lund.

Even if the latest science parks concentrate exclusively on life science, IT-businesses have always been an important part of science parks with a broader scope of focus. Today, there are over 1 000 companies in the Region's six large science parks (see description on the next page). Of these, about half of the companies are active in life science. However, not all of the employees work in life science companies; universities and public organisations are also some of those with representation at many science parks.

The science parks' growth offers researchers and entrepreneurs increasing opportunities to start new companies in close proximity to other development companies and the universities' research. The science parks of the region have varied profiles. Symbion calls itself 'community offices' on its website, while Medeon in Malmö emphasises its collaboration with COBIS, Medicon Valley Alliance, SmiLe, Lund, KI Science Park in Stockholm and Sahlgrenska Science Park in Gothenburg. COBIS in Copenhagen also lets space to ESS – it is the location of the research facility's data management centre DMSC. COBIS was founded in 2009 by the science parks Scion DTU and Symbion in order to give Copenhagen's biotechnology companies a good working environment near Rigshospitalet.



A six-storey-high main building is being added to Medicon Village in Lund.

ON ITS FIVE-YEAR ANNIVERSARY, MEDICON VILLAGE IS ADDING ON

Medicon Village in Lund is celebrating its five-year anniversary by adding a new complex that will accommodate 600 experts from the life sciences. Today, there are 1 600 people working in over 120 different operations in Astra Zeneca's former buildings. Last year, 15 of the companies in the science park brought in a billion SEK in new issues.

Like COBIS in Copenhagen, Medicon Village in Lund is growing rapidly. In the past year, the science park has expanded with around 20 new organisations, and the number of people working there has risen by more than 100 people.

Now, a six-storey-high main building is being added to Medicon Village. It is expected to be complete in 2018/19, and will accommodate about 600 people. The first to move into the new building will be the largest tenant, Trial Form Support, TFS, with around 100 employees.

In five years, Medicon Village has grown, and the science park now accommodates more than 120 organisations with around 1 600 people on-site. Most of the companies have fewer than ten employees, and there are not quite a dozen with more than 15-20 employees. The developing companies have access to around 70 service companies

that can help with everything from pre-clinic to clinic and business development. Most of the companies have been started in the past five years.

19 of the companies at Medicon Village list their shares on e.g. Aktietorget and Nasdaq First North. Together, 15 companies at the science park brought in a billion SEK in new issues in 2016. Among the successes are Senzagen, which develops technology that replaces animal testing with genetic testing in test tubes, and Alligator Bioscience, which develops tumour-directed antibodies for immunotherapy for cancer.

The link to Lund University is important. Medicon Village is the home of around 40 research groups from the university who perform cancer research, as well as the Regional cancercentrum syd (Southern Regional Cancer Centre) and Region Skåne's biobank.

6 SCIENCE PARKS IN MEDICON VALLEY



COPENHAGEN BIO SCIENCE PARK, COBIS, Copenhagen

Owner: The science parks Symbion and Scion DTU
Incubator: Copenhagen Entrepreneur Lab for Life, CELLS
Number of companies: 98
Number of employees*: 350
Founded: 2009



IDEON SCIENCE PARK, Lund

Owner: The IDEON trademark is owned by a foundation for collaboration between Lund University and businesses, 'Stiftelsen för samverkan mellan Lunds University and Näringslivet, SUN'. The buildings on the original Ideon site are owned by Wihlborgs fastigheter. The trademark company Ideon AB is owned by the real estate companies Wihlborgs, Castellum and Vasakronan.

Incubators: Ideon Innovation, The Creative Plot, LNC and Venture Lab.
Number of companies: about 400
Number of employees*: 9000
 17% of the companies are active in life science
Founded: 1983



MEDEON SCIENCE PARK, Malmö

Owner: City of Malmö and Wihlborgs Fastigheter
Incubator: Medeon Incubator
Number of companies: 65
Number of employees*: about 450
Founded: 1985



MEDICON VILLAGE, Lund

Owner: Mats Paulsson Foundation for Research, Innovation and Societal Development
Incubator: Smile Incubator, formerly Lund Life Science Incubator
Number of companies: >120
Number of employees*: 1 600
Founded: 2012, Foundation est. 2011



SCION DTU, Hørsholm and Lyngby

Owner: Technical University of Denmark, DTU
Incubators: Scion DTU Innovation, The Green Entrepreneur House (Det grønne Væksthus) and DTC. A Biotech incubator is currently being planned. Also makes growth investments such as Vækstmotor and Danish Tech Challenge.
Number of companies: 280, of which about 130 are in life science
Number of employees*: about 3 000, of whom about 1 650 in life science
Founded: 2004



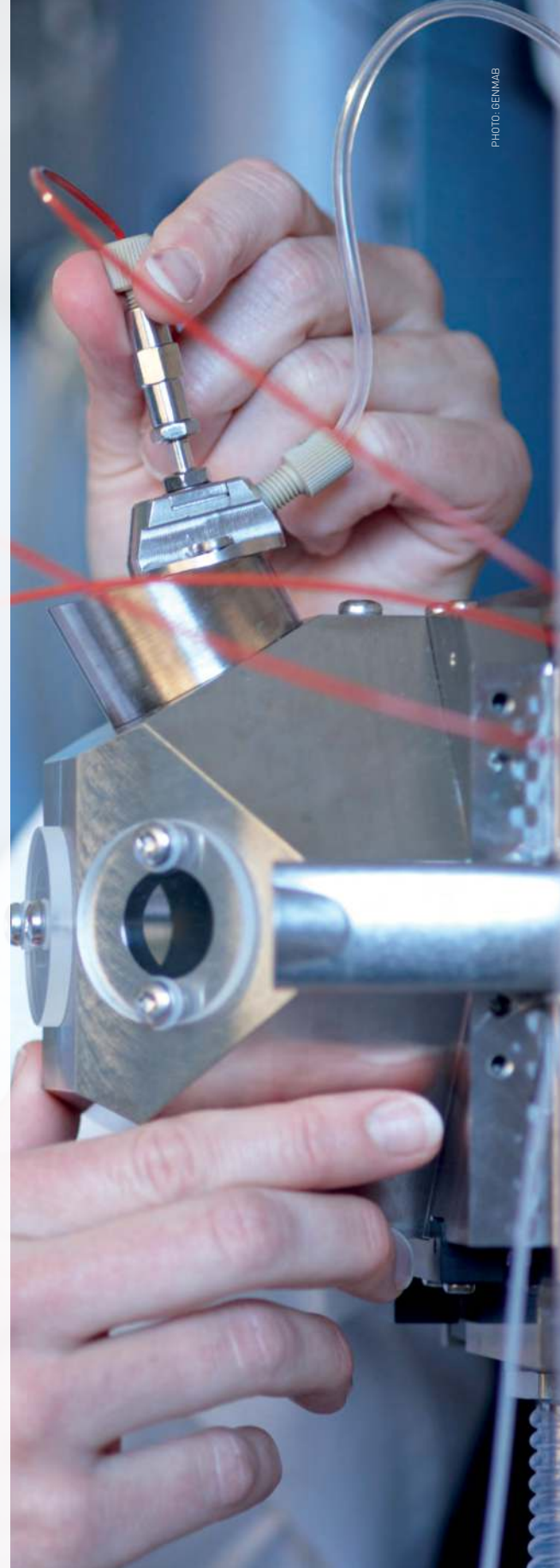
SYMBION, Copenhagen

(also runs The Orbit in Ørestad, Creators Floor in Frederiksberg and Univate on Amager)
Owner: Symbion Foundation, Nordea, Lønmodtagernes Dyrtidsfond, Magistrenes Pensionskasse, University of Copenhagen and Copenhagen Business School
Incubator: DTU Symbion Innovation
Number of companies: >250
Number of employees*: n/a
Founded: 1986

Sources: Representatives from the science parks and information from their websites.

*Number of employees incl. the employees of the companies renting the space

IN-HOME MEDICAL CARE: A growing trend



The differences between Danish and Swedish primary care mean that the countries have different prerequisites for change. Technological developments present new options for coping with an aging and growing population, but they also challenge the healthcare sector and place new demands.

- Research states that there are differences in tasks, organisation, economic conditions and history in the organisation of Danish and Swedish health- and medical care. While they face many of the same challenges, the reform needs differ, as do the conditions for improvement strategies.
- A problem with primary care in Sweden and Denmark is that companies lack a natural course if they have a new method and want to influence how work is done, says professor Anders Anell at Lund University. An arena is needed for how improved primary care should look, with longer-term planning and space for experimentation and the testing of different solutions, he says.
- A large-scale telemedicine project with at-home measurement in Denmark made it clear that access to broadband and mobile networks is a challenge. It led to negotiations with the telecommunications industry, and a more widespread sharing of antennae to ensure mobile coverage all over the country.
- The Danish Local Government Reform carried in 2007 consolidated 14 counties into five regions, and merged 271 municipalities into 98. In conjunction with the reform, 20% of the responsibility for funding hospital care was transferred to the municipalities.
- Region Skåne is currently investing in a new IT system and has around 60 active projects in e-health. Mobile and remote work, access to a journal system, and involving patients is a natural development, according to the authority.
- The term digiphysical processes is used to describe the development with digitalisation in the health care and implies that physical contact and empathy cannot be replaced entirely by technical solutions.

HEALTHCARE IS MOVING IN

Technological developments in healthcare present new options for coping with an aging and growing population, for example with more in-home healthcare, but they also challenge the role of the doctor and place certain demands on journal systems. The differences between Danish and Swedish primary care mean that the countries have different prerequisites for change. The municipal reform in Denmark led to fewer hospitals and a large-scale telemedicine project. Region Skåne is investing in e-health and is currently about to put billions into a new IT system.

Danish-Swedish differences

There are differences in the organisation of Danish and Swedish health- and medical care. Professor at Lund University's Department of Business Administration Anders Anell has studied the question, looking mainly at primary care in the two countries. According to his research, there are differences in tasks, organisation, economic conditions and history. While they face many of the same challenges, the reform needs differ, as do the conditions for improvement strategies, he says. Danish primary care for example consists mainly of private doctors who receive

remuneration based on a national agreement between the State, regions, and the Medical Association.

– The Danish system is well established and works well in many ways from the patient's perspective, but it is difficult to reform and influence. One might say that primary care doesn't always work well in Skåne, but is easy to change, says Anders Anell.

There are no restrictions on the establishment of private healthcare centres in Sweden. 40% of the healthcare centres in Skåne are private, and risk capital firms can own national chains. There is no

free competition situation in Denmark; instead, only general practitioners can own clinics, and there is a limit to how many one can own. While private Danish doctors can negotiate remuneration and conditions, in Skåne conditions are written unilaterally by the Region, Anders Anell explains. As a result, doctors often complain about a lack of foresight. There are also differences in staffing on either side of the Strait.

– In Sweden, we have fewer resources in primary care, with fewer general practitioners and more of other types of staff at healthcare centres than at Danish clinics. The healthcare centres are larger and can have a staff of 40–50; a Danish clinic often consists of 2–3 doctors and a few secretaries, says Anders Anell.

Another consequence of the system is that it can be more difficult to move treatments that used to be the responsibility of a hospital to primary care in Denmark, since Danish doctors refer to the agreement and bring it into payment negotiations.

– One difference is that Danish healthcare is under more state-wide control; that has consequences for e.g. investments in infrastructure. Out-patient treatment with clinics is one single system in Denmark, and in Sweden there are many different systems, Anders Anell says.

According to Anders Anell, hospitals can often choose to try new things and become their own engines for development, but that is more difficult in primary care. That there is neither room nor a mission for testing new things is a deficiency he sees on both sides of the Strait.

– A problem with primary care in Sweden and Denmark is that companies lack a natural course if they have a new method and want to influence how work is done. With whom do they talk? An arena is needed for how improved primary care should look, with longer-term planning and space for experimentation and the testing of different solutions. It is difficult to do bottom-up; it needs to be done on a more comprehensive level, says Anders Anell.

He believes that more in-home medical care in Sweden has been motivated by other things than purely economical factors.

– When it comes to the elderly population, in terms of cost it would have

been better to have more people living in residences; there is a breaking point where in-home medical care becomes expensive. The possibility to receive care at home in Sweden has been driven by other factors than economy; otherwise, the development would have been a different one. Reports indicate the need for different kinds of assisted-living residences in the future that are lacking today, says Anders Anell.

Assisted living of this kind could take in the growing group of elderly people whose physical health is too good to warrant residential care, but who require more support than can be offered in their own traditional home, he says.

Fewer hospitals and less digitalisation in Denmark

Healthcare Denmark, whose task it is to market Danish healthcare, is mandated by the Ministry of Health and others. It has encountered great interest in the transformation of healthcare to deliver more care outside of hospitals. The Danish Local Government Reformstructural reform carried out in 2007 consolidated 14 counties into five regions, and merged 271 municipalities into 98. In conjunction with the reform, 20% of the responsibility for funding hospital care was transferred to the municipalities, which has entailed that municipalities have become more involved in rehabilitation and preventive efforts

today, according to Hans Erik Henriksen, CEO at Healthcare Denmark. Furthermore, the hospital's role has changed with the reforms of the past ten years.

– There is now a master plan for what a hospital should be able to do. Since the structural reforms, hospitals have become specialised and also decreased in number due to consolidations and closures. We had 98 hospitals in 1999, and today we have 32. We've increased hospital efficiency by 30% since 2003 – in part through consolidation, but also by working to increase productivity in general, says Hans Erik Henriksen.

According to Hans Erik Henriksen, healthcare needs to be delivered differently. The demographic development, with more elderly people and life-style-related illnesses, new technology and more expensive medicines make it necessary to transform the health care

"A problem with primary care in Sweden and Denmark is that companies lack a natural course if they have a new method and want to influence how work is done."



Anders Anell, Professor at Lund University's Department of Business Administration.



PHOTO: NEWS ØRESUND

sector if taxpayers' money is to be enough in the future. He believes that delivering more healthcare outside of hospitals is part of the solution, but not for everyone.

– The experience has been that a large part of the population is ready and in a position to participate in his or her healthcare. But there is still a sizeable part of the population with social difficulties, and these people's circumstances do not allow self-treatment. They need to be taken care of, otherwise the changes cannot be made, Hans Erik Henriksen says.

A large-scale telemedicine project with at-home measurement was done for patients with COPD (Chronic Obstructive Pulmonary Disease). The project has attracted a lot of interest from abroad. Other examples include video cameras on ambulance ceilings for specialist assistance from hospitals, as well as blood tests and ECG monitors that can be used remotely. Access to broadband and mobile networks is a challenge.

– That has led to negotiations with the telecommunications industry, and the more widespread sharing of antennae to ensure mobile coverage all over the country, says Hans Erik Henriksen. Hans Erik Henriksen believes that changes in Danish healthcare in the last

decade have had an effect on primary care.

– Finding doctors' new roles in a changing healthcare sector is a challenge for several reasons. Privately practising doctors are gatekeepers in healthcare, and they are the ones who direct patients to specialists and hospitals. Transforming healthcare with telemedicine and in-home care is difficult if we also want to preserve the gatekeeper role. Doctors

also need to be employed in the municipalities when they are working with preventative measures and rehabilitation. Data-sharing also presents some challenges, he says.

There is a national 'health portal' in Denmark today, sundhed.dk, that facilitates the development.

– Citizens can log in to the health portal and get access to their journal and healthcare history since 1977, see their medicines, renew prescriptions and get lab results. If someone is in another region, they can see all of their data. That has advantages; since patients are better informed, they don't call to ask. They don't need to wait on hold to contact a doctor; instead they can book a visit electronically and have

"The experience has been that a large part of the population is ready and in a position to participate in his or her healthcare."



Hans Erik Henriksen, CEO of Healthcare Denmark.

PHOTO: HEALTHCARE DENMARK

a consultation via email. I consider national data of that scope to be a strategic enabler for new technologies, Hans Erik Henriksen says.

The comprehensive electronic health data facilitates the Danish goal to introduce telemedicine on a national scale by 2019, and he believes that the personalised medicine strategy recently launched by the Danish healthcare sector is essential. Healthcare Denmark receives around 50 foreign delegations every year who are interested in finding new solutions to the challenges of healthcare. Making reforms in healthcare creates new possibilities for companies, and it also increases the importance of finding common solutions for the public and private sectors, says Hans Erik Henriksen.

E-health and a new journal system for Skåne

In September, Region Skåne reached a decision about which supplier they'd like for their new healthcare IT-system. The decision has been appealed, and while e-health coordinator Jonas Gallon cannot speak about the nature of the process, he can say that a new solution is necessary.

– The situation today is unsuitable as far as the journal system is concerned. We have different journal systems for primary- and in-patient care. On a macro-level, one could say that we need to free up time and not be so bound by administration. We need an IT-system for management, processors and support. Calling it a journal system is actually inaccurate; it's a technological platform and in turn part of a larger-scale transformation programme, he says.

Examples of projects where healthcare has shifted into the home are the taking of specimens and self-treatment of patients with chronic illnesses, e.g. cardiac insufficiency, COPD, or diabetes. Remote healthcare generates a need to introduce new reading and writing functions to the journal system.

– As far as in-home healthcare is concerned, a new journal system is thus of vital importance. The existing system is a hinder for us today. It needs to work regardless of where a patient is on the healthcare chain. In extension, it will also be possible to link it to medtech equipment, says Jonas Gallon.

The reason behind the reforms being done in Region Skåne is that the aging population, longer life expectancy and patient's expectations will make it impossible to continue working as one does today in the future.

– Healthcare has hardly been at the forefront when it comes to digitalisation. Mobile and remote work, access to a journal system, and involving patients is a natural development. Taking better advantage of the resources we have, creating a better work environment for our employees and improving accessibility for patients. Together, those give better healthcare, says Jonas Gallon.

Jonas Gallon believes that without a shared journal system, we cannot take advantage of all of the health data we have. The need for reform is substantial in Skåne as far as the journal system goes, if he compares it to many other counties/regions in Sweden. However, it is a complicated realm to change, among other things regarding the Patient Data Act, medical responsibility, and the Public Procurement Act.

– It's actually not an IT question; it's an overhaul of how we work. We are on the threshold of a revamp and radical reform, says Jonas Gallon.

Today, Region Skåne works via the national platform 1177.se with a number of e-health solutions. Region Skåne has around 60 projects in e-health right now. Among them is an app being developed for 1177, and they are looking at self-monitoring for COPD- and cardiac insufficiency patients, in-home testing for IBS patients, and an upgrade of blood sugar monitors for mobile transmission. They have also begun bringing treatments online, such as CBT and opportunities for young people with psychological disorders to chat in the evenings and at weekends, and they are investigating the possibilities for primary care to get online.

– We are looking at the technical requirements necessary for healthcare centres to be able to handle patients online. That might even involve increased digitalisation of 1177 to meet patients, for example via video or chats, says Jonas Gallon.

"People talk about digiphysical processes nowadays. We cannot get to a point where the digital replaces the physical entirely. Empathy and physical contact shouldn't be digitalised into oblivion."



Jonas Gallon, e-health coordinator at Region Skåne.

PHOTO: REGION SKÅNE

Jonas Gallon feels that there would be advantages if the municipalities in Skåne could work toward the technical solutions that Region Skåne will have in the future.

– While we cannot determine that for the municipalities, there are obvious gains if we are using the same technical solutions. There are different alternatives and platforms for facilitating transfers between operators, but it isn't quite the same as using a unified system, he says.

When e-health is being discussed, the question of accessibility for everyone comes up often.

– The most important answer is that not all digital solutions will be replacing the physical solutions. If the patients who are ready for digital solutions can be taken care of in a more cost-efficient way, it will leave more room to take care of other patients in different

ways. We don't make that requirement, but sometimes one is surprised by the interest of certain groups that one didn't expect to be interested, Jonas Gallon says.

He says that it's also a question of remembering to whom one is speaking; there is no single solution that suits everyone.

– People talk about digiphysical processes nowadays. We cannot get to a point where the digital replaces the physical entirely. Empathy and physical contact shouldn't be digitalised into oblivion. It's about making it as accessible as possible, and we haven't always gotten plus points from patients and our staff. Today, an average primary care practitioner logs in to very many different systems in the course of a workday. We need to take a stronger hold, and a coherent environment is the foundation, he says.

DANISH AND SWEDISH HEALTHCARE

The health care sector in the Greater Copenhagen Region employs 126 200, some 85 300 of whom are in Eastern Denmark. That means that close to 167 500 people in the region work within life science, companies included, and health care. In addition to those are researchers at the region's universities.

According to figures from OECD, Sweden's healthcare expenditures total 11.0% of the BNP. The corresponding figure for Denmark is 10.3%. The USA is highest at 16.9%. Looking instead exclusively at public spending on healthcare, Germany tops the list at 9.4%, while Sweden is at 9.2% and Denmark 8.7%.

In the Danish Local Government Reform of 2007, the number of regional and municipal authorities was reduced. Today, Denmark has five regions and 98 municipalities, compared with its former 271 municipalities and 14 counties. Sweden has 20 counties/regions and 290 municipalities. One difference between Danish and Swedish primary care is that in Denmark, it is predominantly under private management with national agreements on functions and remuneration to actors. In Sweden, 60% of the healthcare centres are public, private actors have freedom of establishment, and the region can change requirements and remuneration at any point and without negotiations.

There is currently a national investigation in Sweden that aims to reorganise and modernise healthcare, with a focus on primary care. It should be complete in March of 2019. The investigator is Anna Nergårdh, formerly Chief Medical Officer at the Stockholm County Council. Upon her appointment, the Swedish Ministry of Health and Social Affairs announced that the investigation is one step

in a large-scale reform of the system and structure of healthcare, and the foundation can be found in the investigation "Effektiv vård" (Effective Healthcare), conducted from 2013–2016.

Eight overarching goals for healthcare were proclaimed in Denmark last year. Behind them are the Danish Ministry of Health, Danish Regions, and KL Denmark. The goal is to get all actors, including hospitals, municipalities and primary care, to work in a common direction, and to make it easier to determine what needs improvement. In June of this year, they announced that progress has been made on two-thirds of the objectives.

IN-HOME MEDICAL CARE

Healthcare outside of the traditional hospital environment might be e.g. the elderly or severely ill, who receive healthcare at home (palliative care); advanced self-care of chronically ill patients in the home with adapted devices, e.g. related to dialysis; clinical research trials in the home; e-health with internet-based healthcare and apps – so-called mobile health; patient monitoring, e.g. of diabetic children, with connected health.

Among the arguments brought forth in discussions about healthcare outside of traditional hospital environments are issues such as e.g. increased freedom of choice and quality of life; new risks and feelings of desertion; the transfer of responsibility and follow-up on kin; vulnerability regarding usability, reliability and functionality for equipment, and questions regarding ethics and confidentiality.

NEXT-DOOR DIALYSIS CAN HELP MORE PATIENTS

Among other things, the medtech company Baxter manufactures dialysis products and delivers them right to patients' homes. It has seen an increased interest in self-administered treatments and begun looking at additional services in what they call next-door dialysis. The company is also expanding its operations in Lund with aseptic processing of pharmaceuticals – an area in which they want to challenge Danish regulations.

Globally speaking, renal care in the Nordic countries is very advanced in terms of self-administered treatment, even if the figures could still be much higher. That's how Baxter's Nordic CEO Magnus Lindholm, who develops products in the field, sees it.

– In our contact with kidney clinics all over the country, we are encountering people who dig in their heels when it comes to expanding home dialysis. The working method needs reform, but changing the existing structures takes time, especially when there are personnel shortages. There are also considerable geographic variations in Sweden, even within regions, he says.

A dialysis patient who administers her own treatments can experience a greater sense of freedom, for example by eliminating waits at hospitals and long transportation times there and back. Furthermore, it reduces the cost of care from 150 000–200 000 SEK per patient annually. Today, around 1 000–1 100 patients in Sweden administer their own treatments at home. According to Magnus Lindholm, some of the obstacles are e.g. shortages of resources and space, the design of the compensation models, attitudes regarding how much a patient can handle himself, and the tradition of treating at hospital rather than making those patients who can and wish to administer their own treatments more active in their therapy.

Dialysis involves filtering the blood to remove waste when the kidneys are no longer able to perform that function themselves. There are two types of dialysis: haemodialysis and peritoneal dialysis. Peritoneal dialysis uses the peritoneum in a person's abdomen as a filter, and it is the most common kind of home dialysis. A lot has happened in the field since the first home dialyses in the late 1960s, says Magnus Lindholm. Among other things, the machines are simpler

and there are more resources for educating patients, in addition to home delivery and product service at home. Baxter also offers a transportation service where products can be delivered to patients at holiday resorts, even abroad. Baxter has between 160–170 patients who receive dialysis products at home on a regular basis. From their distribution centre in Lund, the company also delivers to Denmark and has a customer service centre in Søborg, near Copenhagen. Baxter has invested a lot in simplifying dialysis treatments and making them easier in general.

– We don't just work with the product when the patient needs it; we also assist hospitals with

pre-dialysis; that is, before the patient needs dialysis. We give nurses training in how to avoid unexpected starts. An early, acute start is never good for a patient since it leaves fewer options for future treatments, and it is also more costly than a planned start of dialysis. We have had this training for many years, and it has probably played a part in the number of people administering their own treatments in Sweden, which is high in comparison with many other countries, says Magnus Lindholm.

Dialysis at hospitals is done three times weekly, but a person's kidneys work every day.

– The treatment should be more frequent, because patients feel better and can live longer, he says.

A factor that can lead to patients stopping their self-administered dialysis is that they no longer want to have responsibility for their own treatment. Baxter thus works to help healthcare workers motivate, train and talk to patients. They are also investigating possibilities of developing dialysis at still another location.

– We call it next-door dialysis – it's a kind of

"We call it next-door-dialysis - it's a kind of landing station that will improve geographic accessibility for self-administering dialysis patients who have to travel long distances to a hospital."



Baxter is looking at additional services in what they call next-door-dialysis to complement their existing dialysis products developed for self-administered treatment, says Nordic CEO Magnus Lindholm.

landing station that will improve geographic accessibility for self-administering dialysis patients who have to travel long distances to a hospital. Similar developments were made in optometry with cataract operations, where the process became easier and cheaper than it had been previously. I'm convinced that we can do the same here. We have an ongoing dialogue with several clinics that would like to start as soon as possible, Magnus Lindholm says.

Baxter is also working to develop home treatments in other areas such as e.g. nutrition and antibiotic treatments for patients with severe infections that require long-term therapy.

Baxter's facility in Lund comprises the former medtech company Gambro, which the company acquired in 2013. Gambro specialised in dialysis treatment, and now the operations in Lund are expanding to include Baxter's therapeutic areas such as the aseptic processing of pharmaceuticals.

– It has been important for us to build up the company's activity around other things than dialysis, in order to strengthen and diversify Lund as a centre. For the same reason, we are also planning to make more pharmaceutical preparations, and if we can change the regulations in Denmark our options will be very different, says Magnus Lindholm.

According to Danish law, pre-mixed pharmaceutical products cannot be imported; preparations must be mixed by a pharmacy in the country. This is a rule that Baxter would like to change.

In Baxter's model for aseptic preparation, sterile intravenous solutions are combined with phar-

maceutical ampoules of e.g. antibiotics, with the help of an adaptor in a sterile chamber. According to Magnus Lindholm, the method has a number of advantages; for example, it reduces the risk of healthcare workers' accidental exposure, makes processing in the department more expedient, and facilitates more efficient utilisation of the medicines – as well as of personnel's time.

– We will be starting in Lund in early 2018. It was expected to take 24 months to establish, but things have gone markedly faster. We see a broader potential area for the use of what we are building up in Lund in the future, for example within oncology. By making the preparation in sterile chambers, we can extend its keeping qualities and make a standard dose, which reduces the hospitals' need to discard of products. We've calculated that we can save the health care services between 10–15 per cent; in the Skåne region alone, around 200 million crowns worth of these pharmaceuticals are used every year, says Magnus Lindholm. He emphasises that Baxter has a competitive edge as a major buyer of pharmaceuticals in these areas.

Baxter hopes to serve the large regions in Sweden, Denmark and Norway with preparations of this kind. If that becomes a reality, the facility in Lund will expand, and new talent will be recruited.

During the preliminary phase, the company has chosen to train personnel at its facilities in England, but they hope to recruit locally in the future.

– The expertise that we need was in Lund before, with Astra Zeneca, and it is important that it doesn't disappear from the area. That is one of our concerns, says Magnus Lindholm.

DANISH WIRELESS ECG MONITOR SOON ON THE EUROPEAN MARKET

A wireless ECG monitor that first and foremost makes the diagnosis of patients with heart arrhythmias easier, and can also be expanded to capture more metrics to quickly evaluate general health as well as transmit the ECG in real-time for remote patient monitoring. That's the business model at the Danish medtech company Cortrium, which expects to start selling its product in Europe early next year.

The Danish company Cortrium is currently awaiting approval to begin selling its wireless ECG monitors in Europe. Germany is the first market on which they've set their sights, and they have also signed contracts with distributors in Spain and Italy. The product is finished, however, the sensor is continuously being elaborated to expand the user experience and field of operations; e.g. conducting water-resistance performance studies. The primary objective is to replace the portable ECG monitor. The vision is for a single device to capture up to five metrics that provide the indications of a patient's general health status: heart rate, respiratory rate, pulse oximetry, temperature and blood pressure.

– We have been focusing on ECG signals and on simplifying the patient's journey when being monitored for heart arrhythmia, but the product is now ready for additional parameters, and we are already investigating them in our research projects. The idea is that the apparatus can be used as soon as someone is injured, in the ambulance or in the emergency ward. It can relieve the entire patient flow at hospitals, says Erik S. Poulsen, CEO of Cortrium.

He believes that additional parameters combined with more detailed software will offer more possibilities down the line.

– Another exciting research project we're working on is for patients taking cytotoxic agents; if they have an infection or a fever, they can't have their treatments, and have to take antibiotics instead. In the project, we look at the technology that can be used to make the assessment from home, so patients don't have to go to the hospital unnecessarily.

There are two ways to use the ECG device. The first is to send it home with patients who need to be evaluated for heart arrhythmia. The devices used today have long wires, and Erik S. Poulsen believes that a smaller, wireless device will make it possible to get more patients to use the equipment. It is simpler to use, and it costs less, he says.

Cortrium has also put a lot of effort into simplifying the manual operation for healthcare professionals, through software that makes it possible to quickly remove data from the unit and assess it. The goal is for the process to take seven minutes, says Erik S. Poulsen.

– The measurement can be done offline, since not everyone has access to an internet connection. The risk group is primarily the elderly, so we want to make it as simple as possible. The only thing you need to do is put it on, and it turns off by itself when you take it off. It can be sent back and forth in the mail. IKEA's furniture manual was our inspiration for the instructions that we send out to patients, Erik S. Poulsen says.

The other way to use the device is through telemetry, transmitting the measurement data via internet and thereby being able to monitor patients wherever they are, as well as automatising it so that the system sends an alert if there are irregularities.

Cortrium was started by engineers who lost their positions at Nokia in 2013. They put their severance payments towards the development of a wireless ECG-monitor that could be used in sports, with big football clubs in mind. Erik S. Poulsen entered as CEO when the company changed direction in 2014.

– The product was a bit before its time. In 2014, we made changes and began to focus completely on healthtech. A relatively short time after that, we were chosen for the Bayer Healthcare accelerator in Berlin and received 50 000 Euros for conducting further research and product development. In Germany, we saw the possibility to sell to doctors with private practices and private clinics, and that became our primary focus. We are also investigating interest at insurance companies, he says.

They have also been collaborating with Pfizer's Healthcare Lab in Berlin for two years. Erik S. Poulsen believes that both of these collaborations have been defining for Cortrium.

– As a small medtech company, it is difficult to

"We want to use new technology to face the silver tsunami."



Cortrium's CEO, Erik S. Poulsen, estimates that sales of their wireless ECG-monitor will start in the first quarter of the coming year.

build up sales. For that reason, our collaborative partners have been incredibly important. We'll be selling primarily through distributors and collaborative partners to begin with. We'll also have our own sales, but it's impossible to make a great leap into the German market if we have one person in Berlin, Erik S. Poulsen says.

There are competitors developing similar ECG monitors in the Europe and the USA. What sets Cortrium apart, according to Erik S. Poulsen, is that they display three ECG signals, where many others only have one or two, that they have no wires at all, that they utilise standardised stickers that are already in the healthcare environment today to attach the device, that the device has an inbuilt wireless connection, and their collaboration with big players like Pfizer, among other things. As regards measuring multiple vitals, the competition is less.

– The market is much bigger for vital parameters compared to long-term ECG, but since we want to get on the market quickly and start creating value, we are starting there. When we are accredited and get this product on the market, we can elaborate and add other functionalities like wireless communications and additional parameters, Erik S. Poulsen says.

He estimates that sales of the product will start in the first quarter of the coming year.

– Then we can begin mass-producing and selling the first units. The first version is 3D-printed, and now we need to decide how the production

process should look.

Cortrium's ECG monitor has already been approved for use in research for several years. Erik S. Poulsen believes that being able to show published scientific articles that endorse the product is important for establishing credibility. He is a trained doctor and engineer and has been able to draw on both of these areas, but he has felt the lack of others.

– As far as marketing goes, being a startup company has been a crash course. There is a lot to learn, and that knowledge doesn't come cheap, he says.

Today, Cortrium has 8 employees. The majority of them are in Copenhagen, and two are in Århus. Denmark will continue to be important for Cortrium in the future as well, Erik S. Poulsen says.

– Production is local right now, but when we start making a lot of units, we will probably end up outside of Denmark. We would like to keep the primary technical development and base in Copenhagen; the environment is good and there are interesting big pharmaceutical companies here.

An important part of Erik S. Poulsen's engagement is trying to influence the remuneration model in Denmark. In his opinion, the number of patient visits to a healthcare establishment should not be an important parameter, but the focus should instead be on optimising the course of a patient's visit.

– We want to use new technology to face the silver tsunami. Another problem is that the system cannot support many hospital visits in the future; thus, more diagnostics will have to move into primary care, he says.

RESEARCH IN MEDICON VALLEY: Strong Niche Positions in the Life Sciences



PHOTO: NOVO NORDISK

There is important and internationally respected research in the life sciences being done within the fields of medicine, science, and engineering in the Medicon Valley area – with examples such as neuroscience, diabetes and cancer research, and research in biorefinery, biofuel and bio-based raw materials. Above all else, the strength of the region lies in its strong niche positions. That goes for companies like Novo Nordisk, but also for university research, where more narrow research areas such as genomics and sports medicine at the University of Copenhagen and coagulation research in Lund are internationally prominent, and a small but specialised university like the Swedish University of Agricultural Sciences in Alnarp features high on global ranking lists.

- In the international competition, strong research in specialised areas is an opportunity that the universities in Medicon Valley are prepared to seize. That goes for entire universities – like the Swedish University of Agricultural Sciences in Alnarp and the Technical University of Denmark – and more specialised research areas and centres such as the Novo Nordisk Foundation Center for Protein Research at the University of Copenhagen.
- There are high hopes hung on the materials research facilities ESS and MAX IV, which will make it possible to for example study biological matter and life processes in new and more advanced ways, and potentially generate greater exchange with international researchers.
- Representatives from Danish universities want more collaboration between Swedish and Danish universities. Not only does it mean the advantage that comes from sharing experience and a greater number of collaborative partners in the region, but it also defines how research can complement, rather than compete with, the research being done at other universities.

GREAT EXPECTATIONS FOR ESS AND MAX IV – ALSO IN THE LIFE SCIENCES

Medicon Valley is a strong region for the life sciences, with nine universities in the area, nearly 7 000 researchers at universities and still more at the region's university hospitals, state institutions and organisations, and over 8 000 peer-reviewed articles published by university researchers in the life sciences in 2015. Whilst still a notch below the absolute highest-rate research regions, seen internationally, there is strength in the niche areas of the Greater Copenhagen region. Now that research has commenced at MAX IV and the start is growing nearer at ESS, hopes and expectations are mounting that the two facilities will give life science research in the region a further boost.

The large, international materials research facilities ESS and MAX IV in Lund, which will be the most advanced in the world in neutron and synchrotron light research, respectively, will entail great opportunities for life science research. MAX IV was inaugurated in the summer of 2016 and to date, two beamlines have opened with potential for research in the life sciences: NanoMAX and BioMAX. According to plan however, work is still being done on the beamlines and experiment set-ups, which

are not quite complete. ESS will be inaugurated in 2023, and one of the first experiment stations that will give opportunities for life science research will focus on small angle neutron scattering, which can be used to study e.g. soft matter – for example how pharmaceuticals reach their target in the body. When the facilities are fully operational, the possibilities will be enormous, allowing for e.g. the study of living materials.

Throughout the region, the belief is strong

that the research facilities will fortify research in e.g. structural biology. Despite – or rather, owing to – their international nature, which means that local researchers will compete on equal terms with researchers from all over the world for research time at the facilities, it is anticipated that greater numbers of international researchers will come to the Medicon Valley area, and can collaborate with and inspire those already working in the region. That awareness of the potential of ESS and MAX IV has spread is plainly evident in the number of projects and initiatives started to ensure that local and regional researchers and businesses will be able to exploit the potentials of the two research facilities to the fullest.

ESS and MAX IV also balance out the Danish and Swedish parts of Medicon Valley to a degree. As eastern Denmark is a capital region and the location of the region's largest and most successful university, in terms of research there is a clear emphasis on the Danish side of the Øresund. The two facilities' placement just north of Lund offsets that somewhat.

Denmark has also made significant investments in both ESS and MAX IV, however. ESS' data centre has been placed in Copenhagen, as Denmark and Sweden are both host countries for ESS, and Danish collaboration at MAX IV comprises e.g. the beamline DanMAX.

One important way to reinforce a region's research is to attract outstanding researchers from around the world. On that particular front, the conditions in the Medicon Valley area aren't quite as good as those at the large American and British universities, where the language advantage and lucrative regulations have facilitated recruitment for a long time.

Another difference that Kristian Helin, Vice Dean of Research at the University of Copenhagen's Faculty of Health and Medical Sciences, points out is that the large American universities have been able to focus on being elite research universities, admitting only the very best students from America and abroad, whilst the large Danish and Swedish universities have a broader assignment and need to encompass their entire respective countries.

Novo Nordisk's Vice President for R&D Academic Partnerships Uli Stilz estimates that the

Copenhagen region is among the world's top 50 life science clusters.

He points out that in many European countries universities have a broader education mandate, with teaching and supportive administrative tasks taking a larger share of faculty responsibilities. In contrast, in particular elite American universities are very selective in student enrolment and provide an excellent research environment with a competitive advantage to attract international researchers.

According to Kristian Helin, the University of Copenhagen has also invested in establishing more specialised elite research environments over the past decade. In addition, the university has worked hard to recruit successful researchers, gladly with an international background.

Another way to reinforce the region would be to invest still more in its successful areas of particular strength, according to Uli Stilz. His employer, Novo Nordisk, is itself an example of a company within a strong therapeutic focus that has grown from its local position in a small country to a global

leadership position. Diabetes and metabolic diseases are also a large and important research area in Medicon Valley, where there is a symbiotic relationship between research and industry – not least because Novo Nordisk invests in life science research at the region's universities through its foundation.

This survey of life science research in Medicon Valley shows that the University of Copenhagen is clearly the largest actor in all areas. The university has the most comprehensive and successful research in the field, and ranks comparatively high on international ranking lists. It is followed by Lund University, likewise a large university that places in the top 100 on most ranking lists. The Technical University of Denmark (DTU), which is more specialised in engineering, is currently investing in an expansion of its life science research. The Swedish University of Agricultural Sciences (SLU) in Alnarp has its niche in agriculture and plant research, and taking its size into consideration, it can be considered internationally successful.

Among the region's smaller universities, Malmö University conducts the most research in the life sciences, with a dental health education programme and e.g. research in biofilms and biobarriers.

The life science research at Roskilde University includes for example green chemistry and enzymes,

whilst health sciences are an import research area at Kristianstad University. Aalborg University in Copenhagen has a campus in Copenhagen where research is done in biorefinery and non-coding RNA and RNA therapeutics. The National Institute of Public Health, which is officially part of the University of Southern Denmark but is located in Copenhagen, has a national mission in public health research.

The University of Copenhagen is by far the region's largest university, and employs more than half of the total number of the life science researchers at the region's universities – more than 4 000 of nearly 7 000 researchers. Thus, the region's largest research areas correspond to a great extent to the areas that are largest at the University of Copenhagen. In addition to diabetes and metabolic diseases, which were mentioned above, these include cancer, protein research, research in genetics, DNA and RNA, plant research and stem cell research. Neuroscience is also a growing area that was previously largest at Lund University, but the University of Copenhagen is also focusing its efforts there.

Parallel to that, the University of Copenhagen has long since had flourishing research in sports medicine, an area within which Lund University is also becoming stronger.

Another area of research at many of the region's learning institutions – including DTU, Lund University, SLU in Alnarp, Malmö University, Roskilde University and Aalborg University in Copenhagen – is the use of biobased raw materials for biobased products, pharmaceuticals or fuel.

There are also a number of research areas that rate strongly in international comparisons although they do not employ as many researchers in the region. Among them are pharmacy research – which concerns the development of new medicine – at the University of Copenhagen, and coagulation research at Lund University. The research on chemical ecology at the Swedish University of Agricultural Sciences is thriving, although it is not very broad.

As Uli Stilz from Novo Nordisk and others have pointed out, there is potential in locating more specialised, niche areas for the universities in the Medicon Valley area. The Swedish University of Agricultural Sciences in Alnarp is a good example of the value of concentrating an institution's efforts on a more defined area. Although the university is significantly smaller than the University of Copenhagen and Lund University, it ranks number four in the world within its area of focus, Agriculture



PHOTO: NEWS ØRESUND

and Forestry, on the QS World University Ranking, and ninth in the world among small universities in Times Higher Education's ranking The World's Best Small Universities 2017.

In a broader research perspective, it is clear that the learning institutions on the Swedish side are aware of the collaborations with the larger University of Copenhagen, and like to emphasise them. The University of Copenhagen on the other hand prefers to look outward, emphasising its international collaborations and membership in exclusive research networks such as IARU, the International Alliance of Research Universities.

Representatives of the University of Copenhagen are, however, calling for increased collaboration over the Øresund. There is also potential for the region in that wish, where – with the exception of several distinct areas – Swedish-Danish local research collaborations are not particularly comprehensive today. If knowledge of the other learning institutions in the region increases – and in extension, also contact – the advantage will be a greater exchange of experience and more potential collaborative partners in the region, and it will also become clearer how research at each university and in each group can find its own niche and complement the work being done elsewhere, both regionally and nationally, rather than compete with it.

7 000

There are nearly 7 000 life science researchers working at universities in the Medicon Valley area – from over 4 000 at the University of Copenhagen to around 30 at Kristianstad University. Still others work at hospitals and other research institutions.

Bigger is better

The University of Copenhagen, followed by Lund University and DTU, generally places highest in the region on the most prestigious of the international ranking lists. But the specialised area at the Swedish University of Agricultural Sciences is also prominent.

Research in Medicon Valley

Read more in MVA and Øresundsinstituttet's interim report from 2017



PHOTO: NEWS ØRESUND

Metabolic diseases such as diabetes and cancer, and stem cells and neuroscience are some of the region's largest and most successful medical research areas. In a broad definition of life science, there is also a significant amount of research in bio-engineering, biorefinery and bio-based raw materials.

2 611

international researchers worked in Denmark in 2016, according to how many used the country's tax relief scheme.

The topics in this chapter are discussed in greater detail in the progress report "Research in Medicon Valley 2017 – An Analysis of Life Science Research at Universities in Greater Copenhagen", published in August, 2017, and like this report, prepared by Øresundsinstituttet for the Medicon Valley Alliance.

The progress report contains a more comprehensive review of each university, regional placements on the most renowned international ranking lists, examples of some of the region's most successful research groups, an overview of Swedish and Danish national life science politics, as well as a review of research centres with special state funding – and more.

Furthermore, it presents a number of initiatives whose aim is

to ensure that the industrial and academic sectors will be able to take advantage of the new possibilities that will accompany the research facilities ESS and MAX IV. Among them are the Danish project LINX, which represents a portal created collaboratively by the University of Copenhagen, the Technical University of Denmark (DTU), and Aarhus University to help the industry take advantage of the new possibilities to which the materials research facilities give rise, and the project Linxs, which aims to invite top international researchers to undertake research of the methods used at ESS and MAX IV, as well as to develop new methods in the hopes of increasing the region's attractiveness whilst also marketing it all over the globe.

Malmö University gets an upgrade and keeps its focus on interdisciplinarity

3 QUESTIONS FOR KERSTIN THAM

Vice-Chancellor of Malmö University



PHOTO: MALMÖ UNIVERSITY

How will Malmö University change when it is granted official university status on 1 January 2018?

– We'll be following our Strategy 2018-2022, which focuses on how we can strengthen and augment our research in relation to education, and in doing so also reinforce the quality of education and its research relevance. Over the next five years, we'll strive to create good conditions for long-term and internationally first-rate research that addresses important societal challenges, and to increase research and research training from one-fifth of the university's activities (2017) to one-third (2022).

The university will receive 90 million SEK extra for research spending in 2018; how will that money be distributed?

– The resources will be distributed according to our current resource division model for research, based

on Strategy 2018-2022, which means that in the coming five years, we'll focus on creating strong and transdisciplinary academic environments. There is a need for a special

Malmö university will receive 90 million SEK extra for research spending in 2018.

investment in professors and the time they have for research, which will increase at the end of the year, but particular investments are also needed for PhD positions.

Are there any reforms planned when it comes to teaching and research in the life sciences in the future, especially in terms of the increased funds for research?

– We will be reviewing the education on offer and investing more in advanced level education than previously. The vice-chancellor has a new advisor in the area, Professor Thomas Arnebrant at the Department of Health and Science, who has the particular responsibility of representing and contributing to the coordination of "Materials and Life Sciences" at Malmö University that is based on a multidisciplinary perspective. The core funding for our multidisciplinary research centre "Biofilms and Biointerfaces" will increase as of 2018, and it is growing well. We recently initiated a multidisciplinary research network that is planning to hold a series of seminars on Equity in Health. One of our main focuses is promoting health and preventing illness (and major national diseases) with a multidisciplinary perspective.

Collaboration contract to give a double view of research

The research facilities ESS and MAX IV signed a contract in May that aims to create scientific collaboration in materials and life science, exploiting complementarity between X-rays (MAX IV) and neutrons (ESS). In addition, they plan to collaborate on practical issues such as how to build and maintain a large research facility and host guest researchers from all over the world.



PHOTO: NEWS ØRESUND

9 that's how many universities in Medicon Valley perform life science research. Five of them are in Denmark, and four are in Sweden.

DIABETES, NEUROSCIENCE AND CANCER RESEARCH PREDOMINATE



1. UNIVERSITY OF COPENHAGEN

Life science researchers: 4 243
of which professors: 519
of which doctoral students: 2 031
Life science students: 12 697



2. TECHNICAL UNIVERSITY OF DENMARK (DTU)

Life science researchers: 736
of which professors: 55
of which doctoral students: 238
Life science students: 2 283



3. ROSKILDE UNIVERSITY

Life science researchers: 55
of which professors: 6
of which doctoral students: 19
Life science students: 459



4. AALBORG UNIVERSITY IN COPENHAGEN

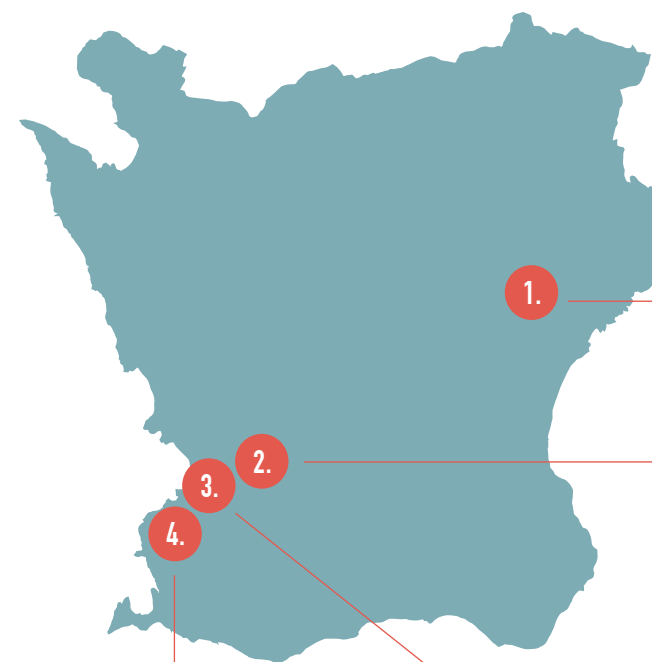
Life science researchers: 24
of which professors: 4
of which doctoral students: 6
Life science students: n.a.



5. THE NATIONAL INSTITUTE OF PUBLIC HEALTH (NIPH), UNIVERSITY OF SOUTHERN DENMARK

Life science researchers: 67
of which professors: 8
of which doctoral students: 12
Life science students: 0

Life science research is performed at nine learning institutions in the Medicon Valley area, but two of the largest universities dominate clearly: the University of Copenhagen and Lund University. The most comprehensive and outstanding research in the region concerns diabetes and metabolic diseases, neuroscience, stem cells, and cancer.



1. KRISTIANSTAD UNIVERSITY

Life science researchers: 75
of which professors: 18
of which doctoral students: 9
Life science students: n.a.



2. LUND UNIVERSITY*

Life science researchers: 1 271
of which professors: 217
of which doctoral students: 1 069
Life science students: About 2 800

Source: The universities themselves. See footnotes in the Appendix for more information about the figures. *The numbers for Lund University are not complete.



4. MALMÖ UNIVERSITY

Life science researchers: 98
of which professors: 20
of which doctoral students: 25
Life science students: About 2 000



3. THE SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCE IN ALNARP

Life science researchers: 221
of which professors: 28
of which doctoral students: 25
Life science students: 635

There is an obvious connection between the largest pharmaceutical companies in the region and the largest research districts at the universities and learning institutions. Diabetes and metabolic diseases and neuroscience are Novo Nordisk and Lundbeck's areas, respectively; with their foundations, both of them also fund research in the region.

Stem cell and cancer research are also strong areas that can be found at both of the large universities. The University of Copenhagen performs world-class research in for example genomics and metagenomics, whilst Lund University is currently building up a large research centre with young researchers of regenerative medicine, with support from the Wallenberg Foundation.

But life science research in the region is not

limited to medicine. Biorefinery, biofuels and biomass are research areas at a number of learning institutions, including Lund University, the Swedish University of Agricultural Sciences in Alnarp, Malmö University, Roskilde University and Aalborg University in Copenhagen.

Collaboration between the universities and learning institutions is widespread in the region; while it is primarily on the national level, there is also a certain degree of transnational collaboration.

A number of the smaller learning institutions focus on applied research and collaboration with the business sector rather than basic research, which is primarily performed at the University of Copenhagen and Lund University.

8 175 PEER-REVIEWED ARTICLES IN 2016

As employees of the region’s largest university, life science researchers at the University of Copenhagen have published the greatest number of peer-reviewed articles in recent years, followed by their colleagues at Lund University and DTU. The table below should be read with a certain reserve, since the universities use different sources and methods for the extraction and compilation of data. Nonetheless, it provides a more comprehensive overview of the publication frequency in the life sciences in Medicon Valley than was previously available.

CWTS Leiden Ranking, to the right, shows clearly how a specialised learning institution like the Swedish University of Agricultural Sciences (SLU), with a campus in Alnarp, Skåne, can be successful in its own specific field.

The data compiled shows that the number of peer-reviewed articles generally corresponds to the size of the university in terms of the number of life science researchers. According to figures from 2015, which in this compilation are more complete than those from 2016, the University of Copenhagen published approximately twice as many peer-reviewed articles as Lund University. It is important to bear in mind that the total number of articles from Lund University has not been counted (see pages 93-94). DTU follows with a significantly higher number of publications than the remaining, smaller universities, whose researchers published between several dozen and several hundred scientific articles in 2015. It can be noted that the publication frequency at Malmö University is slightly elevated with regard to its size.

If one looks at the share of articles co-produced with international researchers, Roskilde University is highest. Around 90% of the university’s articles involve an inter-

national collaboration, whilst this figure is generally between 50 and 70% for the other universities.

In the CWTS Leiden Ranking, researchers at the University of Copenhagen published more than one third as many articles in the area ‘Biomedical and Health Sciences’ than Lund University, the second-most productive university in the region from 2012-2015. The University of Copenhagen also places highest in the region in ‘Life and Earth Sciences’, and SLU follows close behind.

However, SLU’s prominence does not extend to the most frequently cited articles in the region – DTU and the University of Copenhagen rank best in the region in that department.

Compared with the period from 2008-2011, the region’s universities have increased their production of scientific articles on the whole. Furthermore, the articles are increasingly the most frequently cited in their fields.

ARTICLES AND CO-PRODUCTIONS

	2016			2015			2010		
	Peer-reviewed articles	of which co-published with international researchers	Per cent co-published with international researchers	Peer-reviewed articles	of which co-published with international researchers	Per cent co-published with international researchers	Peer-reviewed articles	of which co-published with international researchers	Per cent co-published
University of Copenhagen	4 780	2 888	60,4%	5 496	3 244	59,1%	n.a.	n.a.	n.a.
Lund University	2 076	1 247	60%	2 838	1 784	63%	2 378	1 356	57%
Technical University of Denmark	790	555	70%	838	522	62%	527	282	54%
Malmö University	281	135	48%	237	126	53%	139	49	35%
The Swedish University of Agricultural Sciences in Alnarp	134	78	58%	158	100	63%	116	72	62%
Roskilde University	82	70	85%	99	90	91%	106	88	83%
Kristianstad University	32	12	38%	41	8	20%	12	8	67%
National Institute of Public Health/ University of Southern Denmark	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Aalborg University in Copenhagen	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Sources and comments: See pages 93-94. Each university has provided its own data. The table cannot be used as an exact comparison since different methods and sources have been used to extract and compile the data.

CWTS LEIDEN RANKING

Biomedical and health sciences

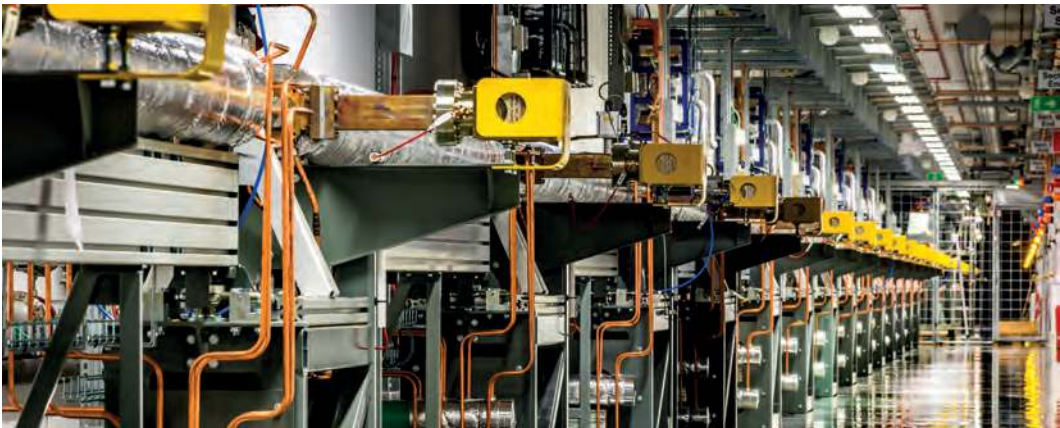
	2012-2015				2008-2011			
	Number of publications	PP (top 10 %)	PP (top 1 %)	World ranking	Number of publications	PP (top 10 %)	PP (top 1 %)	World ranking
University of Copenhagen	6 525	12.9%	1.3%	25	4 570	12.6%	1.2%	38
Lund University	3 959	10.1%	0.7%	78	3 716	9.0%	0.9%	60
University of Southern Denmark (partly in the region)	1 989	10.2%	0.8%	206	1 327	11.4%	1.0%	257
Aalborg University (partly in the region)	795	8.5%	0.5%	464	404	6.3%	0.2%	559
DTU	646	12.5%	2.0%	511	546	10.3%	0.9%	479

Life and earth sciences

	2012-2015				2008-2011			
	Number of publications	PP (top 10 %)	PP (top 1 %)	World ranking	Number of publications	PP (top 10 %)	PP (top 1 %)	World ranking
University of Copenhagen	2 206	13.2%	1.5%	9	1 838	11.8%	1.2%	13
SLU (partly in the region)	1 924	11.6%	1.1%	21	1 547	11.1%	1.1%	29
DTU	1 224	14.1%	1.6%	69	960	15.4%	1.3%	78
Lund University	1 023	12.9%	1.2%	99	943	13.2%	1.3%	84
Aalborg University (partly in the region)	216	12.2%	1.5%	588	132	11.7%	0.5%	653

Sources and comments: pages 93-94. PP (top 10% / top 1 %): The proportion of a university’s publications that, compared with other publications in the same field and in the same year, belong to the top 10% / 1% most frequently cited.

LIFE SCIENCE RESEARCH IS ROLLING AT MAX IV



Studies of molecules’ three-dimensional shapes, substances that can function as antibiotics, bone grafting and nerve structures. These are a few of the areas within life science for which researchers have utilised the beamlines opened at the synchrotron light facility MAX IV so far. The neutron research facility ESS, which is still being constructed, has set up a support lab for crystallising samples in collaboration with Lund University.

MAX IV was inaugurated in June of 2016, and life science research is possible at two of the beamlines that are running so far: BioMAX, an X-ray macromolecular crystallography beamline, and NanoMAX, a hard X-Ray nanoprobe that can be used for e.g. biomedical imaging.

The former of the two beamlines is the one used most for life science research, where researchers from 50 different projects have studied for example various protein functions in a biomolecular context in order to improve their understanding of medical protein functions, and looked for so-called inhibitors that can give the proteins an antibiotic function.

One of the first people to use BioMAX was Jette Sandholm Kastrup, professor in Biostructural Research at the University of Copenhagen, who was granted research time this summer for her project on ionotropic glutamate receptors (iGluRs), which form part of the central nervous system. Problems with iGluRs have been linked to depression, Parkinson’s and Alzheimer’s diseases and epilepsy.

The beamlines are still in an initial start and optimisation phase, but the number of applications to use them is growing already.

– We have 45 research applications for around 150 different projects for the next period, from

March to early July of 2018. They are from all over Scandinavia, but also from Poland, Germany and the USA. Now they are going to be evaluated by an independent panel that will review them and determine how much time each project can get at BioMAX, says Uwe Müller, group manager and beam line manager at BioMAX.

The User Program at ESS will open in 2023, but the first experiments are expected already in 2021. The first instrument that can be used for life science research will be a small angle neutron scattering instrument. One anticipated research area related to it concerns drug delivery.

Currently, preparations are being made for future operations at the same time as the facility itself is being constructed. Among other things the life science support lab DEMAX has been started in collaboration with Lund University. Users will get help with selectively deuterating their samples prior to neutron experiments; i.e. normal protons will be replaced by heavy protons. This is done to create contrast in e.g. a large protein complex whose individual components would otherwise be difficult to discern. The method provides unique possibilities to elucidate and understand complex, multi-component systems.

INTERNATIONAL PARTICIPATION IN THE REGION

The research world is international, and a number of universities in the region are working actively to recruit excellent researchers from other parts of the globe. Providing support in the process are the national tax relief schemes, the Danish version of which is more advantageous than the Swedish. Students from abroad – not least research students – are in great demand, and in the study year 2015/16 there were 3 253 international students at universities in the region.

Denmark and Sweden both offer special tax schemes for foreign employees, aimed to facilitate the recruitment of highly qualified international employees. The Danish system is distinctly more advantageous, which is apparent in statistics that show how often it is used.

While a key employee in the Danish scheme needs to earn a minimum of 63 700 Danish crowns per month including employee benefits, a foreign expert in Sweden needs a monthly salary of 89 600 Swedish crowns to be approved. In 2016, the Danish tax scheme was used 6 251 times; of these, 2 611 were researchers, according to statistics from the Danish Ministry of Taxation, while 838 applications were made to the commission that deals with the tax relief scheme in Sweden, Forskarskattenämnden; of these, 581 were approved.

Additionally, the Danish scheme does not require the employee to reside in Denmark; s/he may also reside in a neighbouring country. That provides Medicon Valley with unique possibilities, as the combination of a high salary on the Danish side and a lower cost of living on the Swedish side can be a further financial incentive in the recruitment process.

A total of 3 253 international students were studying in life science programmes in Medicon Valley in the study year 2015/16; of them, 1 132 were PhD students. 1 078 of the 3 253 international students – including exchange students, foreign PhD students and free mover students who organise their studies in the country of their own accord – were conducting their studies in Skåne.

The number of international life science students in the Medicon Valley area has increased 63% since 2008, due to an increase in international life science students in the Capital Region of Denmark.

According to an evaluation carried out by the Swedish Higher Education Authority on behalf of the Swedish government, tuition fees have entailed fewer international students from countries outside of the EU/EEA, and the fees have also had a negative impact on recruitment to research programmes. The report also shows that the number of paying female students had dropped to 40% in the study year 2015/16 since tuition fees were introduced.

While Denmark also requires students from countries outside the EU/EEA to pay tuition fees, the system was already introduced in the early 00’s and does not affect the statistics of recent years.

NUMBER OF INTERNATIONAL STUDENTS IN THE STUDY YEAR 2015/16

	Number of students	of whom in research programmes	Change 2008/09 - 2015/16
Skåne	1 078	332	18%
Stockholm-Uppsala region	3 613	1 589	25%
Västra Götaland	832	243	6%
Sweden, rest of	1 747	319	16%
Sweden	7 270	2 483	19%
Eastern Denmark	2 175	800	99%
Denmark, rest of	1 562	317	64%
Denmark	3 737	1 117	82%

Source: Customised analysis from Statistics Denmark and Statistics Sweden

ANALYSIS: National Committees and EMA - Life Science on the Agenda



PHOTO: BAVARIAN NORDIC

The life science industry plays an important role for societal and economic developments in both Denmark and Sweden. The analysis shows that the tax contribution for the Danish life science sector is 15,4 billion DKK for 2015. The corresponding figure for the Sweden life science sector is 11,6 billion SEK.

- Life science is on the national agenda in both Denmark and Sweden. Both governments have chosen to focus on the sector by setting up national committees.
- Life science export has been uniquely successful in Denmark since 1996. The developments have taken two great leaps: between 1996-2001 and 2007-2014.
- One contributing factor to the great successes for Danish life science goes back to the fruitful merger between Novo Foundation and Nordisk Insulinlaboratorium in 1989, which laid the ground for the company Novo Nordisk.
- The Danish life science sectors' leading position in the North has become stronger still over the past year; Denmark's life science exports increased 6.3% in 2016. As Danish exports rose, the recovery that was discernible in Sweden in 2015 and 2016 was interrupted, and Swedish life science exports fell by 2.7%.
- There are also substantial differences on the regional level when it comes to the development of the Danish-Swedish region Medicon Valley (Greater Copenhagen) and Stockholm-Uppsala. Employment in Medicon Valley increased 3.6% in 2015. In total there were 41 332 people working in life science in Medicon Valley in 2015 (most recent statistics available that are divided by sector). In Stockholm-Uppsala, employment in the sector fell around 1.3%, to 15 392.
- In recent years, biotech has made a comeback in both Sweden and Denmark. "Danish biotech is in splendid form", says Carsten Borring, Head of Listings & Capital Markets at Nasdaq Copenhagen.

NATIONAL FOCUS ON LIFE SCIENCE

Life science is on the national agenda in both Denmark and Sweden. Both governments have chosen to focus on the sector by setting up national committees. It has come to the forefront as the countries compete to win over the European Medicines Agency, EMA. Sweden has chosen to rival with rather than collaborate with Denmark, which they did in the establishment of ESS. Essentially, the sector makes a very large financial contribution to societal development. MVA's analysis shows that the tax contribution for the Danish life science sector is 15,4 billion DKK for 2015. The corresponding figure for the Swedish life science sector is 11,6 billion SEK. Danish life science's success continues in exports as well as in employment.

Life science has been uniquely successful in Denmark since 1996. The developments have taken two great leaps: between 1996-2001 and 2007-2014. One contributing factor to the great successes for Danish life science goes back to the fruitful merger between Novo Foundation and Nordisk Insulinlaboratorium in 1989, which laid the ground for the company Novo Nordisk. A

glance at Novo Nordisk's turnover development is enough to realise the company's importance for the evolution of Danish life science. In 1996, Novo Nordisk had a turnover of 15 billion DKK; last year, Novo Nordisk's turnover was 112 billion.

In 2002, Ferring Pharmaceuticals moved from Malmö to Ørestad in Denmark and enhanced the

sector's expansion. Even if its headquarters are in Switzerland, Ferring still has a growing research unit in Ørestad and is now investing billions in moving to the facility Soundport, currently under construction in Kastrup near Copenhagen Airport, where it will have a view of Malmö.

When things are going well for the large, foundation-owned Danish companies, there is a positive spillover effect for Danish research. Together, the Novo Nordisk Foundation and Lundbeck Foundation donate billions to Danish research each year. In addition to strengthening university research in the companies' core areas of diabetes and neurological disorders, a research-based biotech industry has emerged that is also producing favourable outcomes.

The life science industry plays an important role for societal-economic developments in both Denmark and Sweden. The analysis shows that the tax contribution for the Danish life science sector is 15,4 billion DKK for 2015. The corresponding figure for the Swedish life science sector is 11,6 billion SEK.

A reason that the sector generates such high tax revenue is that there are many highly educated employees with high salaries active within it, as well as advanced research that, when it goes well, has an appreciable impact on the countries' export statistics. There is another motor in the Danish-Swedish Greater Copenhagen region, as research, employees, and capital travel over the Öresund. Hundreds of Swedish researchers work in pharmaceutical companies in the Copenhagen area. New Danish biotech companies have discovered the sizeable Swedish interest in stocks and the possibility to list shares in Stockholm. The money also goes in both directions, however. Danish Novo Seeds, which provides capital for new companies, invests half of its money in Danish companies and one-third in Swedish.

Representatives of the life science sector have apparently succeeded in putting the sector's achievements on the political agendas in Denmark and Sweden. Early this year, the Danish Growth Team for Life Science presented the report "World Class Life Science", which includes 17 recommendations for further advancing the sector. The report was supplemented with five pieces of advice from the three largest Danish pharmaceuticals companies, Novo Nordisk, Lundbeck and LEO Pharma,

which endorse the investigation. In Sweden, the appointment of the National Coordinator for Life Science, Anders Lönnberg, has been extended until 31 December of 2018. Furthermore, the Swedish prime minister has highlighted life science in the National Innovation Council, as well as in the areas of strength emphasised by the government in its so-called strategic collaboration programme. The importance of life science for the countries' development is particularly apparent with regard to the countries' campaigns to become the host country for the European Medicines Agency, EMA, which must leave London as a result of Brexit. In its bid, the Swedish government in particular chose a different strategy than what was utilised when Sweden, together with Denmark and Norway, succeeded in bringing the European research facility, European Spallation Source ERIC, to the Danish-Swedish Greater Copenhagen region. Denmark and Sweden are joint hosts for ESS, whose research facility is being built in Lund, and the data centre for which has been established in Copenhagen. With regard to EMA, Sweden chose to run a campaign of its own in competition with the Danish. Leading politicians in the Danish-Swedish Greater Copenhagen collaboration recommended an alternative solution based on working together, where the countries would devote themselves to bringing EMA to Copenhagen, which is the industrially leading region for life science in the North. The national Swedish side has pointed out the advantages that Stockholm has through the research at Karolinska Institute and the authorities' existing collaboration with EMA.

The developments in the Danish and Swedish life science industry continue to move in different directions in terms of exports as well as employment and patent applications. Medicon Valley, which encompasses the majority of the Danish life science industry, is continuing to strengthen its position as the dominant life science region in Scandinavia.

The Danish life science sector's leading position in the North has become stronger still over the past year; Denmark's life science exports increased 6.3% in 2016. As Danish exports rose, the recovery that was discernible in Sweden in 2015 and 2016 was interrupted, and Swedish life science exports fell by 2.7%.

Last year, the greatest export successes for Danish life science companies were in China, Japan and Sweden. The USA remains the largest market for



At MVA's 20-year anniversary, Professor Nils Brünner from the University of Copenhagen and Professor Carl Borrebaeck from Lund University emphasised that being able to collaborate over the Öresund Strait is a strength and an asset.

Danish life science exports, but the growth slowed in 2016. That confirms the problems that Novo Nordisk had on the American market in 2016, with increased price pressure and stiff competition. Novo Nordisk was not alone in the Danish life science sector when it announced cutbacks in 2016. In 2017 however, there have been fewer negative announcements from Danish life science companies.

One company that continues to do well in the USA is Lundbeck, which maintains that it has not experienced the same pricing pressure. And in October of 2017, Novo Nordisk received a sign that new and substantial successes in the USA might be on the way again. An expert panel for the American Food and Drug Administration, FDA, recommended Novo Nordisk's new drug Semaglutide for approval. The FDA's decision is expected on 5 December of this year. Semaglutide is a hormone that delivers good blood sugar control and a feeling of fullness, meaning that it can promote weight loss. Semaglutide is a so-called GLP1 drug for the treatment of type 2 diabetes that only needs to be taken once a week. GLP1-drugs are not subject to the same kind of price pressure that afflicted Novo Nordisk's other diabetes drugs, and it is expected to become a bestseller in the future.

While the achievements continue for Danish life science, the Swedish life science sector has continued to be met with setbacks since the power of the former Astra and Pharmacia left the country, and the large cutbacks and closures that ensued. The primary reason behind the downturn for Sweden is to be found in a slump on the markets in USA and Great Britain, whereas the Swedish

life science companies gained market in Japan with an increase in exports of 45%. The losses on the American and British markets were almost three times as high as the gain on the Japanese market. In total, Danish life science exports make up 15% of all Danish exports, and Swedish life science exports 6% of all Swedish exports in 2015. Although it remains an uphill struggle for the Swedish life science industry, there are also glimmers of hope; for example, there are billions (SEK) being invested in three new factories focused on biological medicines: Pfizer in Strängnäs, GE Healthcare in Uppsala, and Astra Zeneca in Södertälje.

There are also substantial differences on the regional level when it comes to the development of Greater

DANISH PHARMACEUTICALS - GROSS VALUE ADDED MILLION DKK 2010-PRICES CHAINED VALUES 1966-2015



Source: Statistics Denmark

Copenhagen/Medicon Valley and Stockholm-Uppsala. Employment in the Danish-Swedish region increased 3.6% in 2015, which is the most recent year for which statistics divided by sector are available. In total there were 41 332 people working in life science in Medicon Valley in 2015 (most recent statistics available that are divided by sector). In Stockholm-Uppsala, employment in the sector fell around 1.3%, to 15 392. Novo Nordisk warned of large cutbacks in Denmark in the autumn of 2016. Novo Nordisk has also had a large investment programme; in addition, Novo Nordisk Europe, with 88 employees, moved from Switzerland to Ørestad in early 2017. As a whole, Novo Nordisk's workforce grew slightly between December of 2015 and December, 2016.

Companies such as Lundbeck and Ferring have expanded their workforce in Denmark over the past year, albeit to a relatively modest extent. Thus, the downturn in Danish life science that threatened previously did not become reality. On the contrary, a positive development is also discernible for many small biotech companies, even if the effect on the total employment is relatively small, since they are increasingly organised as virtual companies with few employees in Denmark.

In terms of patents, Denmark and thus also Medicon Valley also have a clear head start in the

area. Biotech and medtech are the areas for which Danish companies submit the greatest number of patent applications, while Sweden does not submit as many patent applications in the same areas.

In recent years, biotech has made a comeback in both Sweden and Denmark. "Something is happening in biotech! Danish biotech is in splendid form", said Carsten Borring, Head of Listings & Capital Markets at Nasdaq Copenhagen, after the announcement that Orphazyme would be the first Danish biotech listing on the Copenhagen exchange since 2010. Among the successes are also positive developments for companies such as Danish Genmab and Alligator Bioscience from Skåne. One development for Danish Bavarian Nordic also shows how sensitive the companies are when it comes to setbacks, however. The company's shares plummeted on the stock exchange after an announcement that an independent data-monitoring committee recommended discontinuation of Bavarian Nordic's phase 3 study of Prostavac in metastatic prostate cancer. The company's share price partially recovered when Bavarian Nordic received an order with a potential value of 539 billion USD for its freeze-dried smallpox vaccine from BARDA, a division of the US Department of Health and Human Services. If we look at COBIS in Copenhagen, where Orphazyme has its office, the rising of the biotech

sector is apparent through the influx of the around 40 new companies that have moved to the science park over the past year. Interestingly, small, virtual companies are often those with a more technology-oriented, rather than traditional biotech, focus in their operations. That can be interpreted as a sign of the ongoing sector drift.

Small, virtual companies are also a current trend in biotech. Another trend is that funding is becoming increasingly more global, even for small biotech companies. When Danish Novo Seeds invests in new companies, international competence is a prerequisite, and they would like to see partners from other countries as investors. An interesting initiative from the shareholder Novo Holdings and the Swedish government-owned Saminvest is that they have announced themselves willing to enter as a holding partner if large foundations want to begin long-term strategic investments on the Scandinavian market. The number of venture players in Scandinavia decreased dramatically after the financial crisis.

Sweden is attracting Danish companies through greater interest in stock investments and a tradition of many business angels. For that reason, numerous Danish biotech companies have chosen to list their shares in Stockholm instead of Copenhagen, where higher taxes on stock profits are also seen as a deterrent. Among the Danish companies that have listed their shares in Stockholm are Saniona and Nuevolution. The increased interest in investing in biotechnology is also apparent at the research park Medicon Village in Lund, where 15 biotech companies have brought in around one billion SEK in new capital over the past year.

Investors are attracted by the upswing discernible for biotech companies that has been since 2014 in Denmark as well as Sweden. Today, Danish Genmab is Scandinavia's largest biotech company. Since October 2014, Genmab's share price has increased by 400%. Despite the setback earlier this year, Bavarian Nordic has seen its share price increase by 40% from October 2014 until October 2017.

The new wave of companies that have moved in at COBIS shows that sector drift is gaining speed; now, companies whose focus is on technological solutions are also moving in to the research park. Big data, AI, e-health, and mobile- and connected health are paving the way for new research

possibilities, as well as new business opportunities directed right at patients.

The economic wave of success for biotech companies that we're seeing right now is in many ways the harvest of investments made in the 1990s and the early 2000s. The sector drift that we're seeing currently is about future possibilities, but it also creates new challenges for entrepreneurs and financiers, as well as the established sector and the healthcare sector.

Technological developments in IT and life science create an interesting sector drift and new possibilities, and also offer new ways of managing an aging and growing population – and an opportunity to do rapid and more comprehensive analyses with AI and big data. They also open up for a new generation of entrepreneurs. Healthcare's challenges and new technological solutions are beginning to make contact. Healthcare can be moved into the domestic setting and closer to patients. Metrics can be sent directly from patients to their doctors; researchers can procure better data for their work, and patients can have a greater influence on how and when their healthcare should be carried out. As a result, perhaps development and economy will no longer need to contradict one another. E-health and digital development are a topic of discussion in relation to human contact in healthcare.

MVA's analysis spotlights interesting differences in how Denmark and Sweden manage digital care, respectively. How quickly the healthcare sector will be able to benefit from the new technologies depends a number of factors, including how primary care is structured, which differs in Denmark and Sweden. If managed properly, collaboration can enhance both countries' development, if both countries draw on each other's experience. The important thing is to create points of entry to healthcare for new entrepreneurs to be able to test new solutions. Another important matter is the basic technology, in terms of mobile coverage all over the country.

As a relatively small region, Medicon Valley has been a competent and clever world player in clearly defined research niches, as MVA's analysis of life science research at the universities of Zealand and Skåne shows. Cancer, diabetes and neurological disorders are just a few examples of strong research areas in the region.



Bavarian Nordic's headquarters and manufacturing in Kvistgaard, Denmark.

PHOTO: BAVARIAN NORDIC

SWEDISH AND DANISH GOVERNMENT INITIATIVES WITHIN LIFE SCIENCE

Both the Swedish and Danish governments have their attention directed to the life science sector. In Denmark, a special growth team has been appointed for life science, and in Sweden, so-called strategic collaborations have been launched, where life science is one of five areas of emphasis. Furthermore, the Swedish government appointed Anders Lönnberg as National Coordinator for the Life Sciences. The task began in 2015 and will continue until the 31st of December, 2018. The scope of the task has been broadened, so the coordinator has also been assisting the government in Sweden's campaign to relocate the European Medicines Agency, EMA, to Sweden.

The Danish Growth Team for Life Science is headed by the CEO of the Danish pharmaceuticals company Lundbeck, Kåre Schultz. In the autumn of this year, he announced that he would leave Lundbeck to become the new CEO of the Israeli Teva Pharmaceuticals. In March of 2017, the Danish Growth Team submitted its final report "Life science i verdensklasse" (World-Class Life Science), with 17 recommendations for the Danish government.

There was a particular focus on the export of pharmaceuticals and medical products until 2025 in the Danish Growth Team's assignment.

– Danish life science companies make a significant contribution to the Danish economy. The government wants to augment Denmark's international position within life science and create the right conditions for the sector to continue the very positive economic development of the past 10 years. That is why the government appointed a growth team to come up with concrete recommendations for what is central in order to continue this development until 2025, says Troels Lund Poulsen, Denmark's Minister for Business and Growth. The Danish government's outline plan "Sammen for fremtiden" (Together for the Future) from June 2015, states that: "The government will support a strong Danish research-performing pharmaceutical

and medical industry by simplifying conditions and procedures for clinical research as well as prioritising the improvement of procedures and waiting time for the approval of new pharmaceuticals."

In Sweden, a broader initiative was taken in June 2016, when the prime minister pointed out important societal challenges that the country was facing and launched five collaboration programmes. In addition to life science, these also include travel and transport; smart cities; circular, biobased economy, as well as smart industry and new materials. Among other things, it was asserted that "the collaboration between health, business and academia is necessary for new innovative pharmaceuticals, health care methods, and medical technology to reach society, many with solutions that make use of the digital technology". The work is expected to continue until the end of 2018.

As national coordinator, Anders Lönnberg's task has been to give the Swedish government an outline of the work to "strengthen Sweden's position within life science", and also be a link between actors in the sector and the government's work. In February of 2017, Anders Lönnberg presented the first interim report to the Swedish government.

Like Sweden and a further 17 European countries, Denmark showed its interest in becoming the new host country for the European Medicines Agency, EMA, which must leave London due to Brexit. The Danish campaign has been led by Novo Nordisk's former CEO Lars Rebien Sørensen. Among other things, Denmark offered EMA 20 years without rent in Copenhagen Towers. The Swedish campaign to become the EMA's host country has been led by the ambassador Christer Asp, with support from the Swedish life science coordinator Anders Lönnberg. Sweden has offered three years rent-free and customisation of the new Life City Building in Stockholm's Hagastaden, among other things.



Kåre Schultz, was head of the Danish Growth Team for Life Science.

COLLABORATIONS AND AGREEMENTS THAT KEEP RESEARCH IN SWEDEN

When Sweden's National Coordinator for the Life Sciences for the Swedish Government Anders Lönnberg sums up the work done over the last year, he highlights the new collaborations between universities and university hospitals, as well as an agreement between the Karolinska Institute and American Johnson & Johnson that means that research will stay in Sweden. What he spent the most time on, however, was the government mission to bring the European Medicines Agency, EMA, to Sweden.

Unlike the Danish Growth Team's work to develop a recommendation, Sweden's National Coordinator for the Life Sciences for the Swedish Government Anders Lönnberg's work is more process-oriented, with an assignment lasting over several years.

– In my opinion, the biggest thing that has happened in the last year is that all of the universities and university hospitals are working together to get the new medical technologies. We've looked at genetic medicine, cell therapies, oncology, and more, says Anders Lönnberg.

He explains that economic steering measures helped strengthen the new collaborations.

– We told everyone that they wouldn't receive money from Vetenskapsrådet or Vinnova before they had reached an agreement.

He also points out that economy can be a good guiding instrument to drive development in e.g. e-health and telemedicine.

– There is potential to carry out many more out-patient visits through telemedicine, and in the future the fees won't be the same. In the short-run however, it can be important to keep the current fees to get a surplus to telemedicine, in order to increase accessibility.

As far as the Swedish life science industry is concerned, Anders Lönnberg highlights that Pfizer's billion-crown-investment in a new facility in Strängnäs generated a new agreement for the manufacturing of biological medicines for Sobi. Astra Zeneca has also started building its facility in Södertälje, and GE Healthcare has started construction of its factory in Uppsala. The two manufacturing facilities are focused on the production of biological medicines, with a budget of over three billion SEK.

– Increasingly more companies are investing in innovation hubs near universities. Pfizer decided to create ten hubs, three of which will be in Europe, specifically in London, Berlin and Stockholm. That is extremely positive. Hopefully we can bring additional hubs to Sweden next year, and not only



Anders Lönnberg, National Coordinator for the Life Sciences for the Swedish government.

to Karolinska, but maybe to Gothenburg or Lund. Anders Lönnberg also gives emphasis to the university agreement created between Johnson & Johnson and the Karolinska Institute.

– It means that innovations will not simply be bought and carried off to the USA anymore. Now the development will continue at Swedish universities.

When Anders Lönnberg's assignment as national coordinator was extended to January 31 2018, his mission was also expanded to encompass Sweden's campaign to relocate the European Medicines Agency, EMA, to Sweden.

– In an ideal situation, we would have made sure that there was a shared Nordic candidate for EMA. Now Helsinki and Copenhagen are candidates, as well as Stockholm.

– We have nothing against collaborating with Denmark if they win the bid for EMA. Whoever it is, they will need to collaborate.

While the statements of interest submitted to the EU for EMA were focused on the physical possibilities, with buildings, residences and airports, as well as their potential to contribute to a smooth transition, Anders Lönnberg also chose to focus on a third question: how EMA should renew itself.

– The most important question is how EMA should develop in the future, and how the new technologies should be managed.

THE DANISH LIFE SCIENCE GROWTH TEAM'S 17 RECOMMENDATIONS

The large Danish pharmaceutical companies Novo Nordisk, Lundbeck and LEO Pharma support the 17 recommendations presented by the Danish government's Growth Team for Life Science in March of 2017. Danish life science is already successful, but it has the potential to go even further, say the three companies, which presented a report of their own: "Sund vækst" (Healthy Growth).

The Danish government's Growth Team for Life Science, headed by the CEO of the pharmaceuticals company Lundbeck, Kåre Schultz, presented the report "World Class Life Science" with 17 recommendations for the Danish government, in March of 2017. One goal is to double the exports of Danish life science by 2025.

1. Denmark should allocate more resources for and set goals for public research, as well as increase private research, which is the foundation of innovation in Danish life science. Education of highly qualified researchers for the public and private sectors should also be reinforced.
2. Coordination of clinical research in Denmark should be gathered under the existing NEXT collaboration. The new NEXT 2.0 should be anchored between the state, regions, and companies. Opportunities for clinical research at hospitals should be enhanced.
3. Efforts should be made to create the framework for a transparent and reliable public-private collaboration between the healthcare sector and companies.
4. IT and health data should be utilisable in a secure way for the research and development of new and innovative forms of treatment, and contribute to an improved, more secure and more comprehensive healthcare system.
5. The Danish Medicines Agency should be made stronger and become one of Europe's best.
6. There should be more notified bodies in Denmark (bodies that certify medical equipment) with relevant and high quality competence to meet demands.
7. Denmark should be a pioneer country for personal health technology.
8. The Danish educational system should be organised thus that it can, to the best of its ability, deliver world-class employees with the right skills for the entire value chain of the Danish life science industry.
9. Danish life science is global, and the conditions for attracting and retaining international talents should be among the best in Europe.

10. Focus should be increased on entrepreneurship and innovation in life science research and education environments, and these should also be improved.
11. The way should be paved for more life science companies through better access to early financing.
12. Danish life science companies' possibilities for attracting capital should be reinforced.
13. Tax incentives should be improved for companies with elaborate research and for investors.
14. Life science companies should have a favourable framework for manufacturing in Denmark that is based on R&D.
15. Work to support a flexible, stable, rational domestic market that encourages innovation should continue, and the domestic market should be able to work as an international showcase.
16. A national export strategy for life science should be drawn up, and the strategy should be supported with new funding. The objective is to double the exports of Danish life science solutions by 2025. Work should also be done on an action plan that will serve as the basis for increased, targeted efforts toward international investments in Danish life science.
17. A growth plan should be drawn up with the help of these recommendations, and a permanent life science office should be established "that refers to the Danish Ministry of Industry, Business and Financial Affairs".

Sund Vækst

In their report "Sund vækst", the three companies emphasise that life science is one of the industries that contributes most to the Danish economy, with a turnover of 170 billion DKK since exports doubled in 2009. More than 38 000 Danes are employed full-time in Danish life science. Furthermore, it creates employment in other sectors. Every year, Novo Nordisk, Lundbeck and LEO Pharma place orders worth 12 billion DKK that include everything from raw materials to office supplies. The Danish ownership form, where private foundations are the main shareholders of the big life science companies, strengthens research. Each year, the owner foundations distribute billions to research at the country's universities.

ONE-POINT ENTRY IN GREATER COPENHAGEN

One-Point Entry Service wants to attract more foreign delegations to the Greater Copenhagen region with tailored visiting programmes. The number of enquiries to the organisation is on the rise, and experience has shown that there are great advantages to coordinating visits on both sides of the Øresund Strait.

Since 2015, the Greater Copenhagen region has had its very own welcoming division for foreign delegation visits, called One-Point Entry Service. The service creates customised visiting programmes, and is headed by the public investment promotion organisation Copenhagen Capacity. The collaboration also includes the City of Copenhagen, Invest in Skåne and City of Malmö, and the objective is to professionalise the way that visits are managed and ensure that the potential they hold is looked after properly.

– We collaborate on enquiries, we have a shared platform and a shared contact database. We can distribute delegations and handle delegations that want to visit both sides of the Strait, says Jakob Norman-Hansen, Head of the Secretariat at One-Point-Entry in the Greater Copenhagen region.

One-Point Entry received 308 enquiries last year, and has already received 362 enquiries this year. Jakob Norman-Hansen's assessment is that the demand is growing steadily. Most delegations choose to focus on one side of the Strait during their visit, but a number are interested in both.

– We have had 12 joint delegations so far this year, so we have already surpassed our goal, which was ten visits in 2017. Among others we have had property developers from India and a number of American delegations that have visited both Malmö and Copenhagen, says Jakob Norman-Hansen.

The visitors are predominantly delegations from cities and public institutions, but also a number of companies and organisations.

So far this year, One-Point Entry has received eleven enquiries in life science. Demand is what guides the visiting programme to be created.

– On the Danish side, there has been a lot of focus on the urban development with architecture, smart cities and climate change adaptation. The Skåne side has come further with visiting programmes in the life sciences, Jakob Norman-Hansen says.

Will you be focussing more on life science in the future?

– We are more than happy to offer our competences and experiences where there is demand in the life science sector he says, and continues:

– In the future we hope to work more proactively and not only process the enquiries that we receive, but also actively reach people who we believe should come here, and make programmes for them. They might be in urban development as well as in other areas such as life science. We'll be able to draw on the experience that we have gained from organising visits and also involve companies, says Jakob Norman-Hansen.

Funding for the organisation is secured for all of 2018, and there is an ongoing discussion with the project's partners about what lies ahead. One possibility is also that the companies will finance part of the organisation's activity in the future.

– The aim is to have a kind of partial funding from the companies that we collaborate with in the future. We have been

in a development stage, and first we needed to prove that we can create value. We have also needed time to find out what we need to focus on, gain knowledge about the companies, their products and the markets they want to focus on, so we can align with them. That is where we can generate the most value and create an international network that they can use as export support, Jakob Norman-Hansen says.

"We collaborate on enquiries, we have a shared platform and a shared contact database."



Jakob Norman-Hansen, Head of Secretariat, One-Point Entry Service, Greater Copenhagen.

APPENDIX: Definitions and facts

PHOTO: BAVARIAN NORDIC

Statistics and methodology

Describing the life science sector with statistics is a challenge. The sector is far from homogenous, and there are shifts over time. There are only five sub-areas included in the national statistics as exclusively life science sectors; the remainder are spread out over a long string of sector codes. The same is true for the universities where life science is not a clearly defined research area. Therefore, the exclusive use of statistics from the national statistics offices cannot provide a satisfactorily complete and comprehensive representation. We have thus also chosen to complement the statistics with facts from the Nordic Business Key, as well as information provided by the companies and universities themselves.

The macro-level numbers in this report and certain special figures, such as for example domestic and international students, have been specially requested from Statistics Denmark and Statistics Sweden. We have used the following statistic divisions to define the life science sector and export of life science products:

SNI and DB07-sector codes are exclusively life science sectors, used for figures regarding employment:

21 Manufacture of basic pharmaceutical products and pharmaceutical preparations
26.60.10 Manufacture of hearing aids and supplies
26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment
32.5 Manufacture of medical and dental instruments and supplies
46.46.10 Wholesale trade of medical goods and nursing supplies.

The following codes are used for the description of scientific research and employment:

72.11 Research and experimental development in biotechnology
72.19 Other research and experimental development in natural sciences and engineering.
These two industries encompass companies with research in natural sciences as their main purpose and not life science production companies.

Some of these are life science companies; however, since the sectors also contain research within other areas than life science, the sectors are not included in the figures for employment in the life sciences, but are instead presented separately.

The commodity groupings (SITC) in trade statistics utilized to describe exports:

54 – Medical and pharmaceutical products
872 – Medical Instruments and appliances and similar

ABOUT THE FIGURES

TAXATION, PAGES 10-15

Defining the Danish life science sector to calculate taxes

In the statistics over the number of employees in the life science sector, the sector is defined according to the

sector of the workplaces. This definition cannot be used in the calculation of the sector's tax contributions, since corporation tax is paid on the company/concern level, and the main sector of a workplace does not necessarily correspond to the company's main sector. The following method has thus been used:

1. For each year, the number of full-time employees who work at a workplace whose main sector is life science is tallied.
2. Information is retrieved for the companies/concerns to which these workplaces belong. The number of employees who work in life science branches at these workplaces is tallied, as well as the number of employees on the company/concern level.
3. For a given year, a company/concern in the life science sector is included if:
 - a. The company/concern has employed more than 50% of its employees at workplaces in the life science sector during the year in question; or
 - b. The company/concern meets criterion a) throughout the entire period 2008-2016 for the majority of its active period.
 It has been necessary to include criterion b) in order to encompass companies/concerns that pay taxes via a holding company certain years, and in others via the producing company.

The source for the Swedish figures of income and corporation tax is the FRIDA database. FRIDA is a combined individual database and firm register for all Swedish companies. The life science sector has been defined according to the sector of the company's headquarters.

Corporation tax

Corporation tax for Danish life science companies is defined as the corporation tax paid by companies/concerns that fulfil the above criteria. For Sweden corporation tax is the company's final tax, which consists of state tax (bologsskatt) on the year's result (22% of reported surplus) plus other taxes that may be applicable, e.g. yield tax.

Income tax

Income tax for people employed in the life science sector is defined for people employed in the companies/

concerns that fulfil the criteria described in 'Defining the Life Science Sector'. Geographically, income tax is determined according to where the income is earned, and not where the employee resides. Thus, border commuters from Sweden are included in the analysis of Danish income tax. Residents of Denmark who work abroad are in turn not included in the analysis of Danish income tax.

Income tax is calculated from the total personal income; i.e. it includes income from salary and self-employment, as well as any transfers of income that are subject to taxation.

In Denmark, income tax is equivalent to the total personal final tax on income, including labour market contributions. The total personal final tax includes state tax, health care tax, municipal tax, preliminary corporation tax, tax on stock dividends and stock profit, and labour market contributions. Final tax is determined after the deductions have been made and various tax additions have been included.

The amount of labour market contributions paid for employees in the life science sector is calculated by inferring that the labour market contributions comprise the same share of the total income tax, including labour market contributions, for the life science sector in its entirety as for the economy as a whole. The income tax, excluding labour market contributions, for employees in the life science sector is divided by the share of the total income tax including labour market contributions comprised by the labour market contributions for the economy as a whole, to calculate the income tax including labour market contributions for employees in the life science sector.

In Sweden, income tax is equal to the total income tax on gainful employment. The source for this data is

the Swedish income register for the period 2008–2015. Income from gainful employment includes income from a position of staff employment including benefits, surplus from business operations, sickness benefits, unemployment benefits and pension income after general deductions. These may be social security duties to another country, alimony or social contributions.

Calculation of the total tax and duty contribution

Income and corporation tax comprise only part of the amount contributed to the treasury through taxes and duties; of which value-added tax is the absolute largest in both countries. In Sweden, duties and other taxes include e.g. a municipal property tax, burial tax, duties to religious communities, vehicle tax and a series of excise duties on e.g. alcohol and tobacco. In Denmark there are a large number of taxes and duties in addition to corporation tax and income tax, for example municipal property tax, which is calculated based on value, registration duties on cars and a number of excise duties on other products such as tobacco, wine, spirits, chocolate and sugar.

For a concept of how much the employees and companies in the life science sector contribute in total to the national economies through taxes and duties, this is estimated based on figures for the economy as a whole. An enumeration factor has been calculated based on figures from the economy as a whole, and this enumeration factor is multiplied by the sum of the income and corporation tax. The enumeration factor is calculated as the total amount of taxes and duties for the economy as a whole, divided by the sum of the income tax and corporation tax for the whole economy.

EXPORT, PAGES 18–19

The figures for the global pharmaceuticals market are the amounts invoiced to pharmacies and hospitals by distributors. Those amounts are not equivalent to the amounts that manufacturers of pharmaceuticals receive for their products; discounts and other price agreements are not included.

The source for the information on the global market is the QuintilesIMS Institute. The source for the global market export is the UN Comtrade database and figures for the Danish and Swedish life science export is retrieved from Statistics Denmark and Statistics Sweden, respectively.

The Danish and Swedish life science sectors' exports are calculated as the export of Medicinal and pharmaceutical products (SITC 54), as well as Instruments and appliances, n.e.s., for medical, surgical, dental or veterinary purposes (SITC 87.2). The SITC classification is the UN's classification system for goods (Standard International Trade Classification). The sources are the foreign trade statistics from Statistics Denmark and Statistics Sweden, respectively.

EMPLOYMENT, PAGES 20–25

The employment figures cover the manufacturing sectors: 21 Pharmaceuticals, 26.60.10 Manufacture of hearing aids and supplies, 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment, 32.50.00 Manufacture of

medical and dental instruments and supplies and 46.46.10 Wholesale of pharmaceutical and nursing goods. The sources are the register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). Statistics Denmark and Statistics Sweden utilise national industry classification (DB07) and (SNI2007), both of which are based on and correspond to the European industry classification NACE. A company can perform business that is within more than one sector classification. In such cases, the company has a main sector and one or more additional sectors. In the register-based Labour Force Statistics, all of a company's employees are registered under the company's primary sector. An example is Coloplast, whose main sector is 21 Pharmaceuticals, and also has the following three additional sectors: 32.50.00 Manufacture of medical and dental instruments and supplies, 22.29.00 Manufacture of other plastic products, and 46.46.10 Wholesale of pharmaceutical and nursing goods.

Note that it is also possible that branch codes are assigned to companies differently in Denmark and Sweden.

Other industry subdivisions of the life science sector cannot be extracted, as they are placed within service sectors such as business services, which covers a significantly broader area than life science. The advantage of using the narrow definition of the sector is that it becomes possible to trace the industry's development over time, as well as to draw European and international comparisons. The disadvantage is that the life science industry is not shown in its entirety. Therefore, the figures are supplemented by figures for employees at life science companies not covered by the national statistical figures from Statistics Denmark and Statistics Sweden; an example of a company that we have supplemented with employee figures is Novozymes. The supplementary information has been collected from the relevant companies either via email, telephone or via the company website; from Nordic Business Key; www.allabolag.se; or from news articles.

PATENTS, PAGES 26–27

For patent applications figures from EPO and EUROSTAT for patent applications to the European Patent Office (EPO) distributed by priority date and publication date are used. Normally, a patent application to EPO is preceded by an application to the national patent office. The filing date for the application to the national patent office is the priority date for the subsequent application to EPO. The publishing date for a patent application to EPO is usually 18 months after the priority date. Patent information from United States Patent and Trademark Office (USPTO) is rather old at the time of publishing, and for that reason it has been chosen primarily to present data for EPO, even though the interest in patent applications at USPTO has grown as a consequence of the growth of the American medical market. Source for the regional distribution of patent application is EUROSTAT.

The source for the national figures for the number of patent applications in the life sciences has changed since

last year's edition of this report. In last year's report, we utilised statistics from OECD at a detailed level for international patent classification (IPC) in order to isolate life science patent applications from other categories. The Danish Patent and Trademark Office identified the relevant IPC categories for life science, which have been extracted from the OECD database. Since this data is relatively old at the time it is published (the most recent year is 2013), this year we chose to use statistics from EPO, which has more recent although we are aware that some patent applications may be included that do not belong to the category life science. Regarding regional statistics however, we present figures from 2012 from Eurostat, as there are no regional statistics available for later years.

DIABETES, NEUROSCIENCE AND CANCER RESEARCH PREDOMINATE, PAGES 74–75

University of Copenhagen

Life science researchers: full-time employees/head count for doctoral students.

Professors: full-time (including 197 clinical professors)

Doctoral students: 2 031 (full-time/head count)

Lund University

The numbers apply only to the Faculty of Medicine, as information could not be obtained from the Faculty of Science or the Faculty of Engineering.

Of the doctoral students, 316 are employed at Lund University, so only this number has been counted in the total number of life science researchers. The others are part-time doctoral students employed by Region Skåne.

Technical University of Denmark (DTU)

The figures are based on a search of researchers from DTU Vet, DTU Food, DTU Aqua, DTU Bioengineering, DTU Bioinformatics and DTU Biosustain.

Malmö University

Life science students: year-round

ARTICLES AND CO-PRODUCTIONS, PAGES 76–77

Each university has provided its own data. The table cannot be used as an exact comparison since different methods and sources have been used to extract and compile the data. Thus, they may vary slightly. Broadly speaking however, the table shows the position of the various universities in relation to one another in terms of publications and citations.

The number of peer-reviewed articles and articles co-published with international researchers refers to publications of researchers at selected faculties/departments at each university.

Additionally, it should be noted that the figures for Lund University are only for the Faculty of Medicine and the Departments of Biology, Chemistry, Biomedical Engineering, Immunotechnology and Food Technology, Engineering and Nutrition; the actual figures are probably higher.

SECTOR CLASSIFICATION

The definition of life science that we have used here is considered the most widespread, and is utilised by several trade organisations. For example, as SwedenBIO formulates it:

- **BIOTECHNOLOGY COMPANIES** develop products that are based on biological material such as cells, proteins and DNA.
- **PHARMACEUTICAL COMPANIES** develop pharmaceuticals. These may be large biological molecules or small chemical molecules.
- **MEDICAL TECHNOLOGY COMPANIES** develop technological products to improve people's health or make the everyday easier for those who are ill. Companies that develop diagnostic methods are often assigned to this category. Diagnostics products are used to analyse samples and tests to make a correct diagnosis.

Sources and comments

University of Copenhagen: Data from CURIS, the institutional repository of the University of Copenhagen, transferred to SciVal for calculation. Data for 2016 in CURIS is not complete and thus numbers are too low. Figures are missing for 2010 because of a comprehensive reorganisation of the life sciences at KU in 2012.

Lund University: Web of Science, articles and reviews, exported 170407. The figures are based on a search of researchers from the Faculty of Medicine, the Department of Biology, the Department of Chemistry, the Department of Biomedical Engineering, the Department of Food Technology, Engineering and Nutrition and the Department of Immunotechnology.

DTU – Technical University of Denmark: Clarivate Analytics' Web of Science Core Collection (SCI and SSCI). The figures are based on a search of researchers from DTU Vet, DTU Food, DTU Aqua, DTU Bioengineering, DTU Bioinformatics and DTU Biosustain..

Malmö University: SCI, SSCI och A&HCI.

SLU – The Swedish University of Agricultural Sciences – in Alnarp: Peer reviewed articles that have been registered in SLU's publication database SLUpub and have WoSID as a basis. Search results for these WoSID have been analysed in Web of Science Core Collection and InCites (Clarivate Analytics).

Roskilde University: The university's own register.

Kristianstad University: Articles – DiVA. Only the Health Sciences are included in the figures.

INTERNATIONAL RESEARCHERS AND STUDENTS, PAGE 79

International students

The figures for the number of students and their connection to the job market are retrieved from customised analyses by Statistics Denmark and Statistics Sweden. The selection of educational programmes was made from the programme classifications in Denmark and Sweden, and programmes have been chosen within which work in the sector is usually found after education is completed.

The figures for Denmark and Sweden are not directly comparable due to differences in the educational systems and the available data material.

The Danish and Swedish educational systems are structured differently. In Denmark, students – apart from exchange students – register for an entire programme at the bachelor or graduate level. In Sweden, it is possible to register for individual courses, and it is also possible to complete a master's degree by combining individual courses from different programmes. The criterion is that one must earn 120 ECTS points to complete a master's degree. A student who has registered for two courses in the same semester will thus be accounted for two times in the statistics. An attempt has been made to account for this in the extracts from the Swedish data. Students re-

gistered for more than one course at the same institution are only counted as one student; however, if that student is registered for courses at two separate institutions, s/he will be accounted for twice in the data material. The figures for the number of students are thus not directly comparable between Denmark and Sweden.

The definition of an international student depends on national definitions and the possibilities offered in the dataset at hand. Therefore, the definition differs in Danish and Swedish data extractions. In Sweden, an international student is defined as 1) a person from a country outside of the EU/EEA, who upon moving to Sweden reported that the move was motivated by studies, and where a residency permit has been issued for less than two years before the commencement of studies; 2) students who have moved to Sweden less than six months prior to the commencement of studies; and 3) other individuals lacking a Swedish personal identification number in the educational institutions' study administration systems. In Danish data, an international student is defined as such if s/he came to Denmark within a period from one year prior and three months after commencement of studies, and does not have a Danish secondary education.

International researchers

Data for foreigners who have not completed their education in the country are incomplete in the national statistics office's register of the population's education. Because of the poor data quality on the education of workers who have come to Denmark from abroad it has been necessary to use additional sources such as the utilisation of the tax relief schemes, and the Danish Agency for Labour Market and Recruitment's database Jobindsats.dk.

It is not possible to extract specific data material for the life science sectors in Medicon Valley from the data sources used here; however, by the use of the available complementary Danish sources, the Danish life science sector's need for highly qualified workers from abroad becomes clearly visible. The Danish Ministry of Taxation and the Forskarskattenämnden websites offer statistics about the utilisation of the tax relief scheme.

MISCELLANEOUS

We have also collected information from personal interviews, telephone interviews and in e-mail contact with experts and companies. This applies to the chapters on biotech companies, beacons, and in-home healthcare, among others. Data for the reviews of companies has been retrieved from Nasdaq, Avanza, and Bisnode, through contact with the companies and from their websites, as well as from media reports. We have also utilised the public investigations from within life science, as well as other reports from public actors and trade and networking organisations.

THE EFFECT OF SECTOR DRIFT AND SECTOR CHANGE

Statistics for the number of employees in the life science sector are based on figures from the register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). The employment figures cover the manufacturing sectors: 21 Pharmaceuticals, 26.60.10 Manufacture of hearing aids and supplies, 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment, 32.50.00 Manufacture of medical and dental instruments and supplies and 46.46.10 Wholesale of pharmaceutical and nursing goods. Sector drift and sector changes for individual companies can affect the figures to a greater or lesser degree. The more detailed statistics are for individual sectors and smaller geographic areas, the more visible sector drift and change of sector become. A sector drift is a slow change in a company's product portfolio that eventually leads to it belonging to a different sector than it did originally. A change of sector is the switch to another sector code without changes to the company's product portfolio.

Coloplast is an example of how a sector code can change over time. Three of the company's facilities changed their sector codes between 2008–2015, which is the period used in this report to describe employment developments. Coloplast has been selected since it is a company whose production units

can, in principle, be registered in the plastic industry as well as in the manufacture of pharmaceutical preparation, as the company manufactures stoma bags and products for ostomy care, urology and continence care, as well as wound and skin care.

Coloplast has three facilities in Denmark: the company's headquarters in Humlebæk in Fredensborg Municipality, production in Mørdrup in Helsingør Municipality, and in Thisted Municipality.

From 1995 to 2012, Coloplast took a journey into the life science sector in a purely statistical sense. The Danish headquarters (Coloplast Danmark A/S) in Humlebæk was already registered with the sector code 46.46.10 Wholesale of pharmaceutical and nursing goods, while the international headquarters, also located in Humlebæk, was not registered under the same sector code in the Central Business Register (CVR) until 2010. It was not until 2012 that the production facilities in Thisted and Mørdrup were registered as life science producers, when the production facilities changed their sector code from the plastics industry to the manufacture of pharmaceutical preparations. As a consequence, the employment statistics by sector show a rise in employment in the life science sector that is too high for the years in which the company switched sector code.

Coloplast is registered as follows in the Central Business Register:

Company	Coloplast A/S	Coloplast Danmark A/S	Coloplast A/S	Coloplast A/S
Location	Humlebæk Fredensborg	Humlebæk Fredensborg	Espergærde (Mørdrup) Helsingør	Thisted
Primary Sector	46.46.10 Wholesale of pharmaceutical and nursing goods	46.46.10 Wholesale of pharmaceutical and nursing goods	21.20.00 Manufacture of pharmaceutical preparations	21.20.00 Manufacture of pharmaceutical preparations
Primary sector period	01.01.2010 -	01.12.1995 -	01.01.2012 -	01.01.2012 -
Earlier primary sector 1	22.29.00 Manufacture of other plastic products		22.29.00 Manufacture of other plastic products	22.29.00 Manufacture of other plastic products
Earlier primary sector 1 period	01.01.1992 – 31.12.2009		01.01.2001 31.12.2011	16.01.1978 31.12.2011
Number of employees	500-999	20-49	200-499	200-499

Source: Central Business Register (CVR)

INTERVIEW LIST

- Mette Kirstine Agger, managing partner Lundbeck Foundation. Meeting, 2017-08-23.
- Ann-Sofie Andersson, business development manager Copenhagen Capacity. Telephone, 2017-10-18.
- Anders Anell, professor Department of Business Administration, Lund University. Telephone, 2017-09-20.
- Christian Beenfeldt, project leader Knowledge Zealand Hub. Mail, 2017-10-12.
- Peter Benson, managing partner Sunstone Capital. Meeting, 2017-09-14.
- Martin Bonde, chairman Dansk biotek. Mail, 2017-10-19.
- Carsten Borring, head of listings & capital markets Denmark NASDAQ Copenhagen. Telephone, 2017-10-19.
- Jonas Ekstrand, director general Sweden Bio. Meeting, 1 March 2017, and mail, 2017-10-19.
- Ebba Fähræus, CEO SmiLe Incubator. Mail, 2017-10-19.
- Jonas Gallon, e-health coordinator Region Skåne. Telephone, 2017-10-20.
- Alex Gouliaev, CEO Nuevolution. Telephone, 2017-10-23.
- Kristian Helin, vice dean for Research at the Faculty of Health and Medical Sciences, University of Copenhagen. Telephone, 2017-05-04.
- Hans Erik Henriksen, CEO Healthcare Denmark. Telephone, 2017-06-09.
- Magnus Lindholm, Nordic CEO Baxter. Meeting, 2017-08-30.
- Anders Lönnberg, coordinator for the Life Sciences for the Swedish government. Telephone, 2017-10-20.
- Rajmund Mokso, imaging group head, MedMax project leader, MAX IV. Telephone, 2017-09-20.
- Uwe Müller, group manager diffraction & scattering beamlines, BioMAX beam line manager, MAX IV. Telephone, 2017-09-21.
- Morten Mølgaard Jensen, CEO Copenhagen Bio Science Park. Telephone, 2017-10-23.
- Søren Møller, managing partner Seed Investments, Novo Holding. Meeting, 2017-10-05.
- Per Norlén, CEO Alligator Bioscience. Meeting, 2017-08-23.
- Jakob Norman-Hansen, head of secretariat One-point-entry Greater Copenhagen. Telephone, 2017-10-16.
- Sindra Peterson-Årsköld, senior advisor ESS. Telephone, 2017-09-21.
- Erik S. Poulsen, CEO Cortrium. Meeting, 2017-09-26.
- Uli Stilz, vice president for R&D Academic Partnerships, Novo Nordisk. Telephone, 2017-06-02.
- Kerstin Tham, vice-chancellor Malmö University. Mail, 2017-10-11.

In addition, we received data via email from companies, municipalities, trade organisations and other players.



Magnus Lindholm,
Nordic CEO, Baxter.
Page 64.

PHOTO: NEWS ØRESUND



Mette Kirstine Agger,
Managing Partner,
Lundbeck Foundation.
Page 40.

PHOTO: NEWS ØRESUND

LARGER MEETINGS AND CONFERENCES

Below are some of the larger meetings and conferences being arranged in the Greater Copenhagen-region in the coming year, as well as a selection of international meeting places where representatives from organizations and companies in the region's life science cluster will be participating.

- 13-14 November 2017, New York:
The Nordic-American Life Science Conference
- 15-16 November 2017, Düsseldorf:
Medica
- 20 November 2017, Lund:
Medicon Valley Alliance Oncology Network
- 24-25 November 2017, Malmö:
ESAU17
- 27-29 November 2017, London:
3rd Annual European Microbiome Congress
- 28-29 November 2017, Strasbourg:
BioFIT!
- December 2017, Copenhagen:
Medicon Valley Executive Club
- 29 January – 1 February 2018, Dubai:
Arab Health
- 1 February 2018, Rotterdam:
Innovation for Health
- 8 February 2018, Zurich:
Swiss-Nordic Bio 2017
- 12-14 March 2018, Amsterdam:
BIO-Europe Spring
- 22 March 2018, Lund:
The Future of Swedish and Danish Life Science
- 10-12 September 2018, Stockholm:
Nordic Life Science Days
- 10-12 October 2018, Yokohama:
BioJapan
- November 2018, Copenhagen:
Medicon Valley Alliance Annual Meeting
- 5-7 November 2018, Copenhagen and Malmö:
BIO-Europe – read more on page 43



PHOTO: NEWS ØRESUND

RECORD INTEREST IN THE NORDIC LIFE SCIENCE DAYS IN MALMÖ

The conference Nordic Life Science days was held in Malmö for the first time, from the 12th-14th of September this year. Relocating the conference to Malmö from its previous seat in Stockholm doubled the number of Danish participants. The total number of participants this year was 1 300 – a 20% increase from last year. Nordic Life Science Days was held at Malmömässan in Hyllie. The proximity to Copenha-

gen and to the two research facilities MAX IV and the forthcoming ESS in Lund attracted visitors from the USA, Canada and Australia, according to Bionordic, who jointly arranged the conference with BioSweden. Next year the conference will be held in Stockholm again from the 10th-12th of September, but according to Bionordic's CEO Olivier Duchamp, they plan on returning to Malmö/Copenhagen.

REPORTS AND FACTS

In the following is a selection of the recent years' reports from the life science area in Sweden, Denmark and Greater Copenhagen.

All of the 19 candidates who have expressed their interest in becoming the new host for the European Medicines Agency (EMA) are gathered on the Council of the European Union's website. Among them is the Danish offer: **"Copenhagen offers the optimal conditions"**, as well as the Swedish **"The Swedish offer to host the EMA"**. The EU commission has also published an evaluation of the bids under the name **"European Medicines Agency Relocation – General Assessment Summary"**. KPMG Switzerland did an evaluation of the candidate cities in the report **"New Home for the European Medicines Agency"**. The report was mandated by Novo Nordisk A/S.

In March, the Danish Growth Team for Life Science presented 17 recommendations for how the government can improve conditions for the sector. The report is called **"World Class Life Science"**, and the chair of the project was Kåre Schultz, former CEO of the pharmaceuticals company Lundbeck. In response to the Growth Team's recommendations, the companies LEO, Lundbeck and Novo Nordisk brought out **"Sund vækst – bidrag til en strategi for dansk life science"** (Healthy Growth – Contributions to a Strategy for Danish Life Science), in which they select the recommendations that they consider it most important for the government to address.

In April, the Swedish investigator Anders Lönnberg submitted his latest report to the Swedish Government, entitled **"Lägesrapport: Life science – beskrivning prioriteringar"** (Status Report: Life Science – Description of Priorities). Anders Lönnberg was appointed the national coordinator for life science in April 2015, and his post was extended until January 31 2018 at the end of last year.

The International Federation of Pharmaceutical Manufacturers & Associations, IFPMA, published the report **"The Pharmaceutical Industry & Global Health – Fact and Figures 2017"** in February.

The European Federation of Pharmaceutical Industries and Associations, EFPIA, issued its annual report **"The Pharmaceutical Industry in Figures – Key Data 2017"** in June. In that same month, their

annual report for 2016, entitled **"Unlocking Tomorrow's Cures"** was also released. Among other things, it shows that the pharmaceutical industry employs some 745 000 people directly in Europe.

In August of this year, the Danish trade association Lif and Danish Biotech published the report **"Klinisk forskning i Danmark 2016"** (Clinical Research in Denmark 2016). The study has been done by Lif since 2005, and in 2008 it was expanded with the members of Danish Biotech. According to the report, clinical research activities employ 2 180 full-time employees within the member companies – an increase of 702 positions since 2010. Lif also published the report **"Lægemedelindustriens nøgletal"** (Key Figures for the Pharmaceutical Industry) in June of this year.

According to the Danish Medicoindustriens report **"Ny branchestatistik: Medicobranschen – en vækstmotor i Danmark"** (New Sector Statistics: Medical Device Industry a Growth Engine in Denmark), employment, turnover, export and BNP contributions in the medical device sector have all increased in recent years.

Copenhagen Institute for Future Studies released the scenario report **"Fremtiden for det danske sundhedssystem (2030)"** (The Future of the Danish Healthcare System [2030]), which analyses mega-trends and describes four scenarios for future developments in Denmark's healthcare system.

The trade association Sweden Bio published an updated version of the report **"The Swedish Drug Discovery & Development Pipeline"** in December of last year. The report shows that 67 companies have one or more projects in clinical trials; in total, 144 projects are in phase I, II, or III.

The Swedish agency Growth Analysis brought out its report **"Towards a Swedish Megafund for Life Science Innovation"** this May. It evaluates how a Swedish megafund for life science innovations would affect startup companies in the early stages. In December, the agency investigated the sector's view of the change in the report **"Nya medicintekniska förordningar i EU – en möjlighet för Sverige?"** (New Medtech Regulations for Sweden – An Option for Sweden?).

This year, the foundation Forska!Sverige published the



reports **"Agenda för hälsa och välbefinnande – 14 konkreta åtgärdsförslag med handlingsplaner"** (Health and Welfare Agenda – 14 Proposed Measures with Action Plans), which is an elaboration on the proposals from 2015, as well as **"Lägesrapport 2017 – Sveriges satsningar på medicinsk forskning"** (Status Report 2017 – Sweden's Investments in Medical Research), which is a statistical review of the medical research situation in Sweden and other countries.

The Swedish trade association Lif prepares annual statistical reports for the hospital and health care sector, as well as the pharmaceuticals market in Sweden. Lif also issues an annual R&D report on the number of clinical trials in Sweden that is based on a survey of member companies. Last year, they also released the report **"Vinst för Sverige"** (Sweden's Gain), which shows the researching pharmaceutical sector's economic contributions through export and trade balance, tax revenue and jobs.

In three reports, the Danish consultancy company Iris Group has specifically analysed the life science sector in the region: **"Biotekklyngen kører på nedsat blus – rammebetingelser halter"** (The Biotech Cluster is Idling – The Framework Agreements are Limping); **"Danske life science vokster gennem universitets-samarbejde"** (Danish Life Science Growing through University Collaborations); and **"Analyse af perspektiver og vækstbarrierer for udvikling af dansk biotek"** (Analysis of Perspectives and Growth Barriers for Danish Biotech Development).

In August, the Danish Ministry of Higher Education

and Science published the plan of action **"Frem mod 2050: Handlingsplan for den fremtidige ESS-ind-sats"** (Toward 2050: A Plan of Action for Future ESS Efforts), which was prepared by an independent advisory group and focuses on initiating Danish contributions to the ESS-project. The Ministry also published **"FORSK2025 – fremtidens løfterige forskningsområder"** (FORSK2025 – Promising Research Areas of the Future) this summer, which contains a catalogue with 19 topics from four areas: new technological possibilities, green growth, improved health, and humans and society.

This April, the Confederation of Danish Industry (DI) published an addendum to the earlier report **"Sundhedsindustrien er en dansk vækstmotor"** (The Healthcare Industry is a Danish Growth Engine), which shows that the medical industry's annual contribution to the economy increased by 21.1 billion DKK from 2010-2015. DI also studied exports in the report **"Global vækst – sundhedsindustriens eksport er rekordhøj"** (Global Growth – the Health Industry's Exports at a Record High).

In its report **"Scandinavian Life Science Funding Report 2014-2016"**, the Stockholm-based venture capital investor Industrifonden analyses the investment landscape and financing activities in the sector in Scandinavia. The report was released in November of last year.

The website www.mediconvalley.com, which has for example a company database, maps and an overview of product pipelines in the region, is run jointly by Invest in Skåne and Copenhagen Capacity.

ORGANISATIONS



PHOTO: NEWS ØRESUND

Merete Daniel Nielsen,
Director of Cluster
Excellence Denmark

Trade and networking organisations:

- **ASCRO** – Swedish association focused on clinical research and clinical trials
- **Cluster Excellence Denmark** – a support function for clusters and innovative networks in Denmark co-funded by the Danish Agency for Institutions and Educational Grants and the regions
- **CHC**, Copenhagen Healthtech Cluster – Danish organisation that aims to create growth opportunities within health care
- **CHI**, Copenhagen Health Innovation – Danish organisation focused on developing new educational and development activities within health care
- **Dansk Biotek** – Danish trade organisation for companies in biotechnology
- **EuropaBio**, the European Association for Bioindustries – European trade organisation for the biotechnology industry
- **EFPIA**, European Federation of Pharmaceutical Industries and Associations – European trade association for the pharmaceutical industry in Europe
- **FOIN**, the Association of Innovative Settings in Denmark – Danish trade association for science parks and innovative settings, formerly Forskerparkforeningen/The Science Park Organisation
- **Healthcare Denmark** – Danish organisation with political mandate to market the Danish health care sector
- **IFPMA**, International Federation of Pharmaceutical Manufacturers & Associations – international trade association for pharmaceutical companies and associations
- **Kemi & Life Science** – Danish trade community and network for distributors and manufacturers of chemicals
- **Lif Danmark** – Trade association for the pharmaceutical industry
- **Lif Sverige** (researching pharmaceutical companies) – Trade association for manufacturers of pharmaceuticals
- **Medicoindustrien** – Danish trade association for companies that produce, sell, or have an interest in medical equipment
- **MVA**, Medicon Valley Alliance – Networking and mem-

ber organisation in the Danish-Swedish life science cluster Medicon Valley in Greater Copenhagen

- **Swecare** – Swedish member organisation that works for broad collaboration with the health and health care sectors
- **SwedenBIO** – Swedish trade association for the life science sector
- **Swedish Labtech** – Swedish trade association for companies working in diagnostics, laboratory equipment, analysis and biotechnology
- **Swedish Medtech** – Swedish trade association for medical technology
- **SISP**, Swedish Incubators & Science Parks – Swedish trade association for incubators and science parks
- In addition, there are the broader trade organisations Dansk Industri (Confederation of Danish Industry) and Dansk Erhverv (Danish Chamber of Commerce) and Handelskammaren (Sweden's Chamber of Commerce) and Svenskt Näringsliv (Confederation of Swedish Enterprise).

Public actors:

- **Copenhagen Capacity** – A public initiative to promote investments and economic development in Greater Copenhagen
- **Erhvervsstyrelsen** – Danish business authority that works to improve companies' competitive strength
- **Innovationsfonden** – Fund from the Danish Ministry of Higher Education and Science that invests in new knowledge initiatives
- **Invest in Skåne** – A public initiative to attract foreign investments to the region, promote exports and internationalisation for companies in the Skåne Region
- **Läkemedelsverket/Medical Products Agency** – Swedish authority that tests and approves pharmaceuticals
- **Lägemiddelstyrelsen /Danish Medicines Agency** – Danish authority that tests and approves pharmaceuticals
- **Patent- och registreringsverket/Swedish Patent and Registration Office** – Swedish authority for intellectual property rights
- **Danish Patent and Trademark Office/Patent- og Varemærkestyrelsen** – Danish authority for intellectual property rights
- **Styrelsen for Forskning og Innovation** – Danish authority that works to strengthen research and innovation
- **Tillväxtverket** – Swedish authority to strengthen companies' competitive strength
- **Tillväxtanalys** – Swedish authority with tasks such as analysing and evaluating Swedish growth policies
- **Vetenskapsrådet** – Swedish authority that works to develop Swedish research
- **Vinnova** – Swedish authority that works to improve opportunities for innovation and research
- **Wonderful Copenhagen** – Danish organization working to attract e.g. life science conferences to the Medicon Valley region

Media:

- **Dagens medicin** – Swedish journal about the health care sector
- **Dagens medicin, Dagens Pharma, Kommunal Sundhed and Praktisk medicin** – Danish journals about the health care sector
- **European Biotechnology News** – European journal about life science
- **Greater Copenhagen Life Science Magazine** – Scandinavian life science magazine published by the Danish marketing and advertising agency Nem Media
- **Kemivärlden Biotech** – Scandinavian journal for chemistry, chemical engineering and biotechnology

- **Labiotech.eu** – European news site on the biotechnology industry
- **Life Science Sweden** – Journal on the Swedish biotechnology, medical technology and pharmaceutical industries
- **Medwatch** – Danish news site on the medical and pharmaceutical industries
- **Nordic Life Science News** – journal and news site on the Nordic life science industry
- **Pharma Industry** – Swedish trade journal for the pharmaceutical industry

SELECTED CURRENT PROJECTS AND SPECIAL INITIATIVES

The supply of competence is one of the most important challenges in the Medicon Valley region, according to Medicon Valley Alliance, Region Skåne, Sweden's Public Employment Agency, and Multihelix Think Tank at Medicon Village, which started the initiative "**Kompetensförsörjning inom life science**" (Supply of Competence in the Life Science Industry) and will hold a meeting on 15 November in Lund.

Innovation Skåne is heading the project **Nordic Connected Health Start Track**, a community for startup companies in health- and medical care in the Nordic countries that focuses on mobile technology, sensors, big data and artificial intelligence. The project has partners from Sweden, Norway, Finland and Denmark.

Copenhagen Healthtech Cluster, CHC, is developing a **Healthcare Data Exchange** – an online catalogue listing Danish healthcare databases. The objective is to provide an improved overview of existing healthcare data and application procedures. Danish health data is spread out over hundreds of different registers and databases.

Open Lab is a collaboration between Malmö University, Lund University and SmiLe Incubator that strives to open up laboratories and make knowledge and equipment accessible. Life Science is one of three of the prioritised areas. The project is funded by Region Skåne and the EU's Interreg fund and is also supported by a number of local actors.

The Swedish Vetenskapsrådet and Vinnova are investing 100 million SEK in the creation of three

new centres with research environments in biological medicines: CAMP, which is led by Umeå University; CellNova, led by KTH; and NextBioForm, which is led by the research institution RISE.

The Capital Region of Denmark and the University of Copenhagen are working together on the project **Copenhagen Health Science Partners**, CHSP, to encourage collaboration between excellent research, clinical work, and education in the healthcare sector. A series of Clinical Academic Groups are being established in stages within the project, and the first four were presented this summer.

The project **Boost4Health** – The Life Science Hub of North-West Europe – is an interreg-funded project that will run from 2016–2019. The trade association Biopeople and the University of Copenhagen are the Danish partners. According to the project, companies are being hindered in their internationalisation by a lack of knowledge about the differences between healthcare systems and cultures.

The company Roche Diabetes Care has developed a blood sugar monitor, **Accu-Chek Guide**, that automatically gathers and shares data in real-time via an app that is being tested on 1 000 Danish diabetes patients in a collaboration with Region Sjælland.

For more information about the **Danish and Swedish governments' special initiatives** within life science, see page 86. On page 25, there is a summary of some of the 19 candidates who have expressed interest in becoming the new home for the **European Medicines Agency**, EMA.

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The exact sources are provided with the statistics in the respective chapters and on pages 91-95.

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- In Chapters 3 and 4, information was also used that was received directly from the companies, foundations and science parks, including their own webpages.
- In Chapter 6, the universities themselves were the primary references, via a survey and interviews.
- For a list of interviews, see page 96.

Behind the report:

MEDICON VALLEY ALLIANCE AND ØRESUNDSINSTITUTTET

Øresundsinstitutet and Medicon Valley Alliance have a long-term analysis collaboration. State of the Region is an annual analysis of the developments in Medicon Valley. In addition to this annual report, we publish a special report every year; this year's topic was "Research in Medicon Valley". Medicon Valley Alliance and Øresundsinstitutet are both member-based, and a selection of the member-actors are represented in the board of directors.

Board of directors:



MEDICON VALLEY ALLIANCE (MVA) is a non-profit membership organization in the Danish-Swedish life science cluster Medicon Valley, which is a part of Greater Copenhagen. Our 245 members, who together employ approximately 140 000 people, represents the region's triple-helix and include universities, hospitals, human life science business, regional governments and service providers.



Board of directors:



ØRESUNDSINSTITUTTET is an independent Danish-Swedish centre for analytics and information that brings together more than 100 actors from the industry, the public sector and academic institutions with the aim of strengthening knowledge about societal developments on both sides of the Øresund Strait. As a member of Øresundsinstitutet, you become part of our strong Danish-Swedish network – and gain access to network meetings, facts, analyses and news about developments in the Greater Copenhagen region.



The analysis "State of Medicon Valley" is prepared by Øresundsinstitutet and commissioned by Medicon Valley Alliance.

MEDICON VALLEY ALLIANCE

MVA is a Gold Label-certified, non-profit member organisation in the Danish-Swedish life science cluster Medicon Valley. Its 250 members include universities, hospitals, human life science businesses, regional governments and service providers that employ approximately 140 000 people and represent the Region's 'double triple-helix'. The activities in MVA focus on strengthening collaborations for a vibrant life science ecosystem in Medicon Valley through networking events and increased collaboration across borders and sectors.

THE VISION

The vision is to be a well-known and respected member-driven contributor to the realisation and positioning of Medicon Valley as the most competitive and vital life science cluster in Northern Europe.

THE MISSION

MVA is committed to realising Medicon Valley's potential by facilitating networking, knowledge-sharing, and collaboration, analysing challenges and potentials, and mobilising support from key opinion leaders.

CALL TO ACTION

Read more about the Danish-Swedish life science cluster organisation Medicon Valley Alliance's events and activities on www.mva.org, where you can also find more information about how YOUR company can benefit from a membership.

