

Sample Charts Technology

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Technology Approach

Technological progress is the most important driver of competitiveness and prosperity. The importance of technological progress will likely become even more pronounced in the coming years as increasing political and societal tendencies towards protectionism negatively affect other traditional growth drivers such as world trade. However, in most conventional industry analyses the focus is usually on the traditional economic question of "What is produced?" Technological progress often only plays a minor role in these analyses.

This analysis follows a different path. BAK Economics, together with the Swiss Federal Institute of Intellectual Property, has developed a new approach based on the international patent system to compare and to evaluate regions in respect of the quality of their research activities and technological expertise. The focus shifts from "What is produced?" to "How is it produced?" With this approach, structural changes are much more visible through technological progress. In addition, detailed regional technology portfolios and core technological advantages can be presented which would remain hidden when focusing solely on industries.

The analyses are linked with new technology definitions that make it possible to identify and to evaluate regional activities in «cutting edge» technologies. The key question is: "Is the region active in the right fields, and is it good at what it does?" In overall terms, this means strengths, weaknesses and dynamics in the technology portfolios of regions can be analysed more effectively, and that consistent comparisons between regions can be drawn for the first time.

Technological performance and world class innovation

The assessment is based not only on the quantity of patents, but also on the quality of each individual patent in a specific technology. In order to measure the quality, all patents were evaluated and a rating in deciles was created where the top 10% patents in the world in every technology are being defined as world class patents. The number of world class patents can be interpreted as reflecting the level of research quality, while the share of world class patents is a sign of the research efficiency.

How to measure innovation - patent quality and patent activity

Technology Relevance – Patent Quality

External evaluation – how third parties assess the relevance of a company's patent.

Definition: worldwide citations received from later patents, adjusted for age and patent office practices

Argument: the more citations a patent receives, the higher its technological relevance compared to other patents in a technology field.

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Market Coverage – Patent Activity

Internal evaluation – how companies assess the relevance of their patents.

Definition: Market size protected by active patents in terms of countries covered adjusted for country size (gdp)

Argument: extending the coverage of a patent is very costly (up to 150.000\$ per year for bigger countries). Companies only invest these amounts in patents they consider relevant and important for their business.

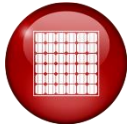
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Competitive Impact - Patent strength

The combination of patent quality and patent activity comprises the relative business value of a patent compared to other patents. The highest rated patents (top 10%) are called world-class patents.

Source: BAK Economics, Swiss Federal Institute of Intellectual Property (IGE), PatentSight

Overview BAK Cutting Edge Technologies



Materials

- Carbon
- Graphene
- 3D Printing Materials
- Advanced Coatings
- Smart Polymers, Composites



Systems

- Photonics
- Drones
- Autonomous Vehicles
- Robotics
- Sensors
- Carbon Capture
- Micromechanics
- Wearables
- Advanced Manufacturing
- Additive Manufacturing
- Premanufacture
- Space Technology



Energy

- Energy Storage
- Energy Transformation/Efficiency
- Energy Management/Smart Grid
- Energy generation
- Wind/Solar/Fusion



Digital/IT

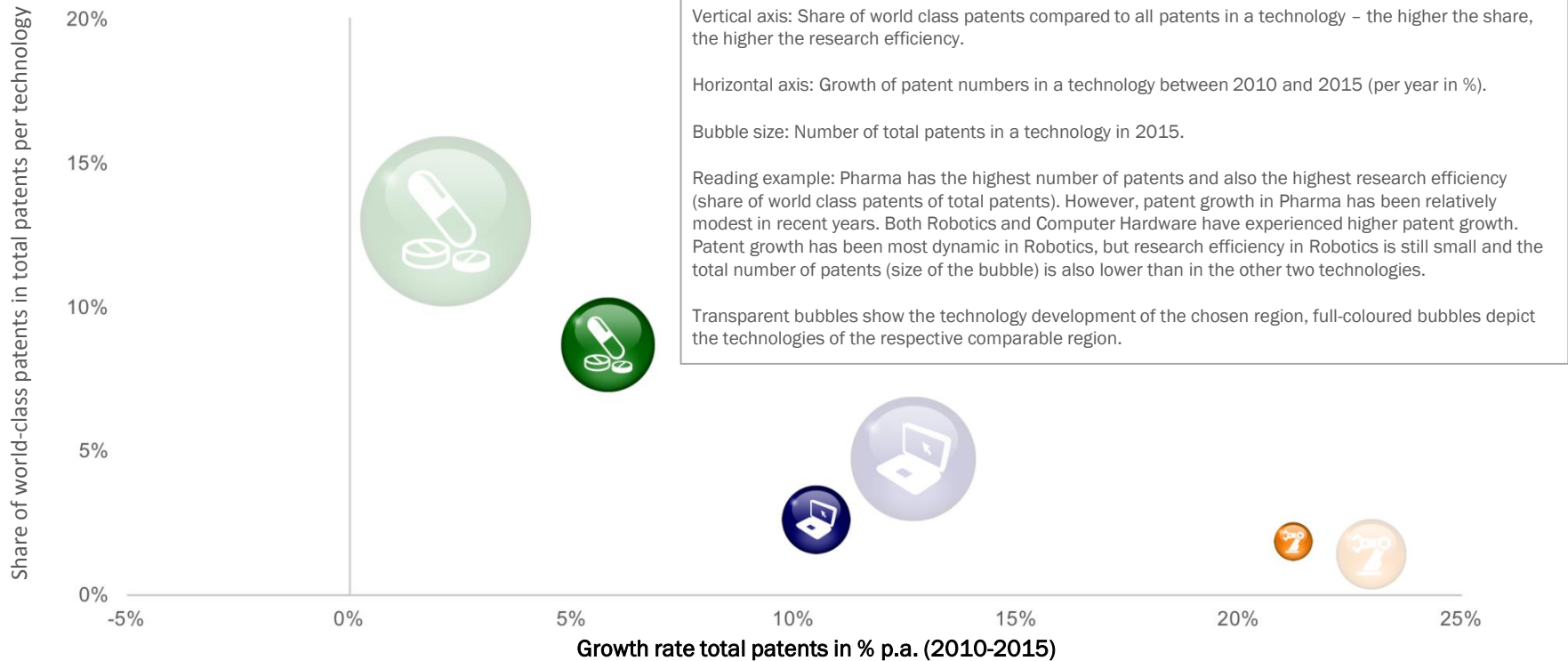
- Smart House
- Smart City
- Cyber Security
- BigData
- Crowd sourcing
- Quantum Technologies
- FinTech
- Process Automation
- Artificial Intelligence



Life Science

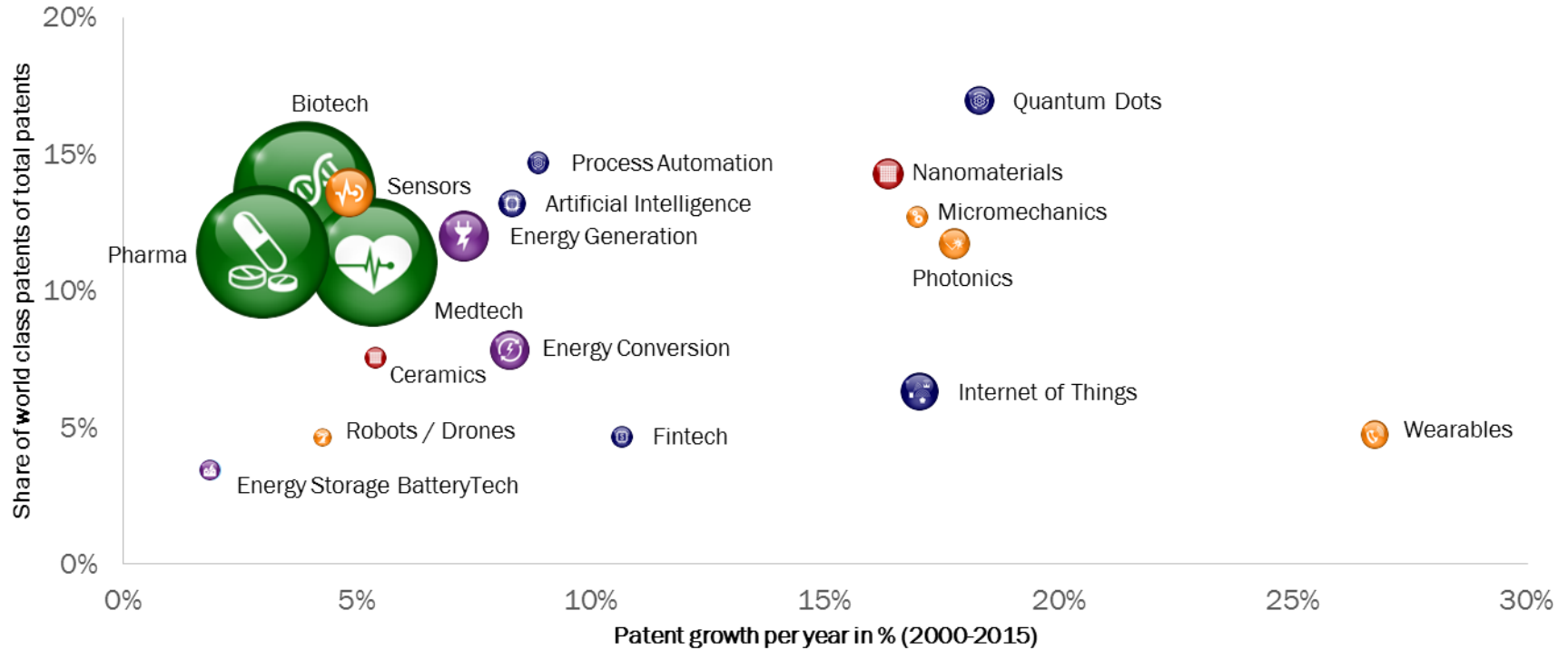
- Biomechanic
- Human/artificial interaction
- Lab-on-a-Chip
- Drug targeting
- Biosensors
- Bioprinting
- Virus/Antibody
- Nutraceuticals
- Omics, (genomics, proteomics..),Gene Editing
- Pharma, Biotech, Medtech

Reading Example Technology Profile



Source: BAK Economics, IGE, PatentSight

Technology Profile Øresund



Source: BAK Economics, IGE, PatentSight

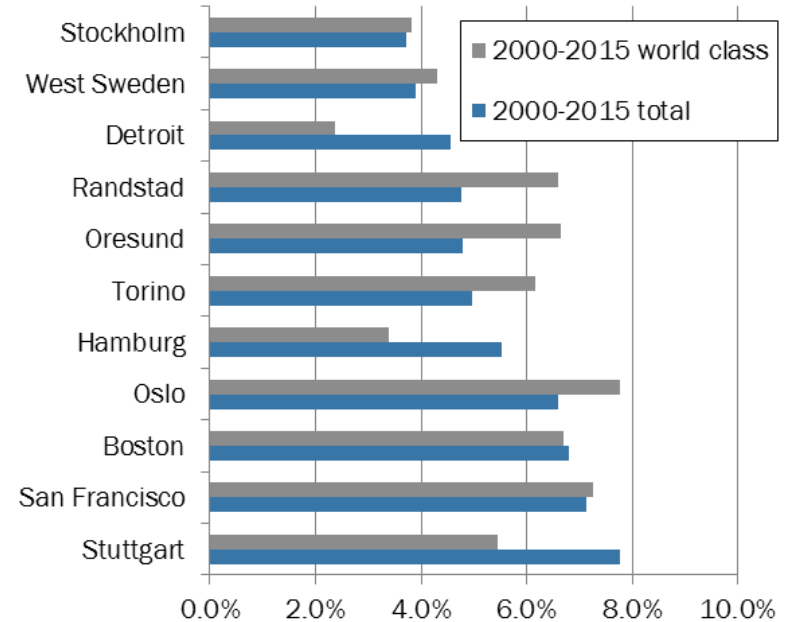
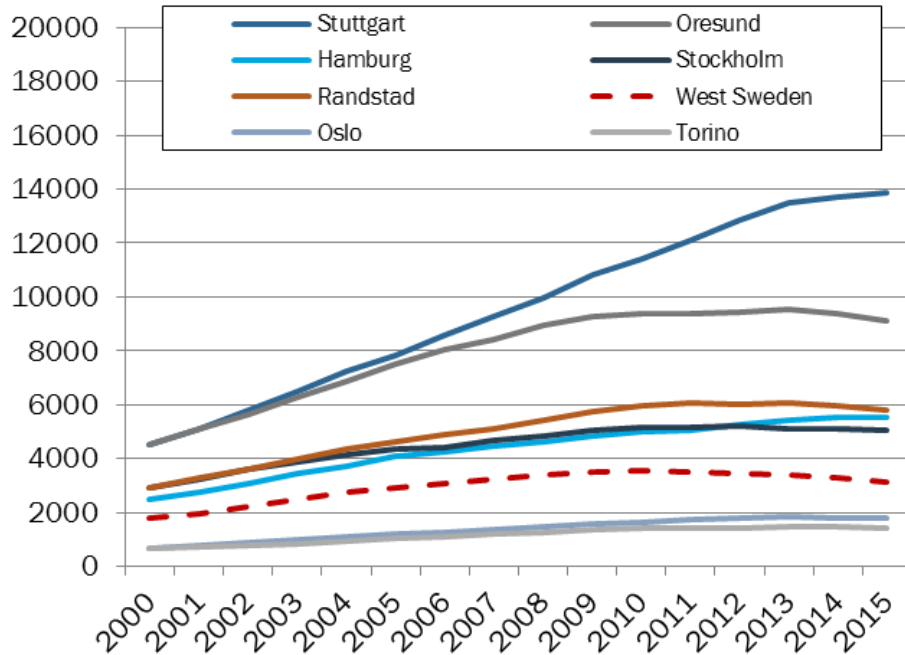
Technology Profile Øresund

Øresund is a major industrial region and also a leading business location for advanced scientific research and development. The region offers a large and broad technological base (over 9000 patents in the five technology categories). Moreover, research efficiency is high in most technologies which is reflected in the high share of world class patents.

Patent numbers have increased in all technological areas between 2000 and 2015. Among the Life Sciences technologies, where most patents of Øresund lie, Medtech patents have shown the highest increase in recent years, although it is quite modest compared to technologies with a very high dynamic such as Wearables, Quantum Dots and Internet of Things.

Patent numbers in Quantum Dots have increased robustly in Øresund since 2010. Furthermore, the quality of research (shown by the share of world class patents) is highest in this technology. Although the technology Wearables shows the highest patent growth, the research efficiency in this field is still small and the total number of patents is also lower than in other technologies.

Regional development of total patents in cutting edge technologies



Notes: Total number of patents in cutting edge technologies; Patent growth in cutting edge technologies per year between 2000 and 2015 in %

Source: BAK Economics, IGE

Regional development of total patents in cutting edge technologies

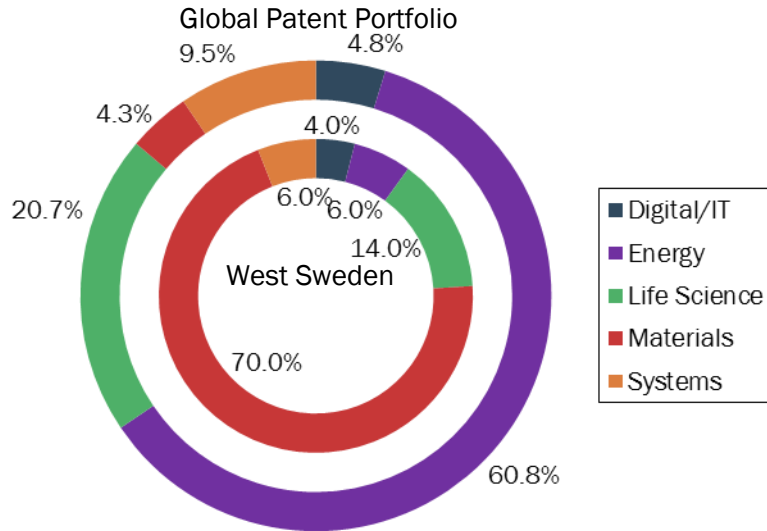
Between 2000 and 2015, the relevance of cutting edge technologies increased significantly. This is reflected in the growth of patent numbers in these technologies.

The US regions of San Francisco and Boston not only own the largest patent portfolios in cutting edge technologies, they have also achieved dynamic growth rates in their patent numbers. Between 2000 and 2015, the number of patents in cutting edge technologies increased by 7.1% per year in San Francisco and 6.8% in Boston. The number of world class patents rose at roughly the same rate in these two US regions. Despite this laudable increase, the most dynamic region has been Stuttgart with an average patent growth of 7.8% per year. By contrast, Stockholm and West Sweden experienced the lowest growth rates of all selected regions. When looking only at world class patents, Oslo reached the highest growth rate in the last 15 years. However, despite this growth, Oslo's portfolio of world class, cutting edge patents is still quite small with only 203 in 2015 – the second lowest value of all sample regions.

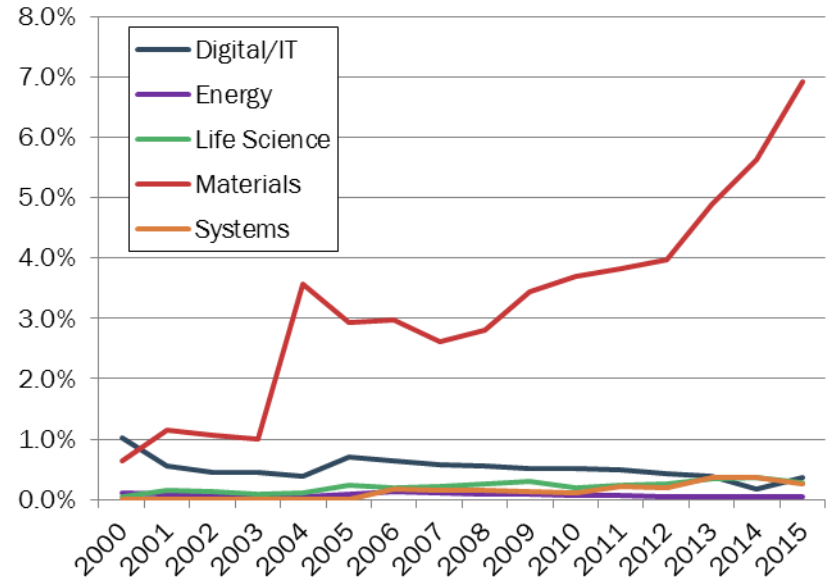
Remarkably, patent growth in cutting edge technologies has slowed down in all sample regions over the last five years. While the number of patents increased by an average of 8.0% per year in the selected regions between 2000 and 2010, patent growth has only been slightly positive since 2010 (+0.8% per year). This is also the case in West Sweden, where the number of patents in cutting edge technologies actually decreased by 2.4% per year between 2010 and 2015. The main reason for this trend is that the number of active Life Sciences patents has decreased in many regions in recent years. By contrast, the number of patents is still growing in the other cutting edge technologies (such as Materials, Systems, Energy, Digital/IT).

Cutting Edge Technologies of General Electric

Patent Portfolio in Cutting Edge Technologies



Share of Cutting Edge Patents Developed in West Sweden



Source: BAK Economics, IGE

Cutting Edge Technologies of General Electric

General Electric (GE) is an American multinational technology corporation that operates in various technology segments. The company owns one of the largest patent portfolios in the world. In total, GE held 11'782 patents in cutting edge technologies in 2015. According to patent numbers, GE's most important cutting edge research field is Energy technologies (share of 60.8% of all cutting edge patents). More precisely, the company has almost 5'500 valid patents in the subcategory of Energy Generation. Apart from that, GE also does a lot of research in the cutting edge technologies of Life Sciences and Systems.

Fifty of GE's active cutting edge patents were developed in West Sweden. GE's most important research is in Materials. In 2015, there were 34 patents developed by GE in the subcategory of 3D-Printing and 70% of GE's patents belong to the Materials segment. In addition, GE has developed some Life Sciences patents in Biotech and Medtech in West Sweden.

As GE is one the largest technology companies in the world with various locations worldwide, the share of cutting edge patents it develops in West Sweden alone is very small. The one exception to this is in the technology segment of Materials, or more precisely, in 3D-Printing. In 2015, an impressive 7% of all GE's Materials patents and almost 45% of all its 3D-Printing patents were developed in West Sweden.



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