



# **Danish Technology Specialties**

**Denmark's Current  
Innovation Activities**

This report from the Danish Academy of Technical Sciences shows how well Denmark is performing in key technology sectors. This race is no longer just about competitiveness; it's also about security, both for Denmark and the EU as a whole.

**The analysis is divided into two parts.** The following pages map Denmark's current innovation activities within technological niches under 16 critical technology domains.

In the second part of the report  **16 Critical Technology Domains** provides an explanation of how the 16 areas were selected. Denmark's overall innovation ability in these 16 technology domains is benchmarked against the world's 30 leading tech regions.

The analyses supporting the report were prepared for ATV by the Danish Technological Institute.

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**Find background analysis** from the Danish Technological Institute, both sub-reports and presentation material here:



# Time to Prioritize

It is crucial for Denmark to develop a strategy for how we should participate in the global race for critical technologies.

The global trade war coincides with intense competition to define future technologies. Currently, Denmark and the EU are being significantly outpaced by the USA and China, where substantial investments in R&D have rapidly commercialized and scaled new technologies globally.

This poses a threat to our future prosperity, security, and resilience. Especially in a time when traditional geopolitical alliances are shifting, and technological independence is more vital than ever.

Denmark cannot compete with the scale of investments by superpowers. However, we can invest more in technologies where Denmark has an innovation advantage and can strengthen the EU's technological competitiveness. We should also invest more in new, disruptive technologies like artificial intelligence and quantum technology, where Denmark may not lead, but building knowledge and innovation capacity is essential for our future competitiveness. This highlights the need for significantly greater investments in technical and scientific research.

This report by ATV sets out a clear framework for where the technology race is headed and what opportunities Denmark has.

The report examines Denmark's relative global innovation strength across 16 critical technology areas and maps out our current innovation activities within these. These areas have been identified by the EU as crucial for the EU's security and competitiveness. In addition, there are technologies highlighted by Denmark's innovation and business promotion system as Danish strengths, or recognized globally as 'technologies of the future.'

We hope the government will use this analysis to formulate a plan for Denmark's role in the global technology race and support the EU's efforts to achieve technological sovereignty. It's time to prioritize. It's time for a technology strategy.

Happy reading.

**Charlotte Rønhof**  
 Chair of ATV's Guide Committee

# Executive Summary

**This report presents ATV's analysis of Denmark's opportunities in the global power struggle over critical technologies. It showcases the main findings from a comprehensive analysis of 16 technology areas expected to have significant impact on Danish competitiveness and security.**

Amidst geopolitical instability and a global contest for critical technologies, it has never been more crucial for Denmark to stay ahead in technological development.

Technological solutions are vital for maintaining our competitive edge and building resilience against challenges threatening our society, including geopolitical threats, climate change, and health and demographic issues.

At the same time, a new and more unpredictable world order is emerging. Traditional alliances are shifting, and technological independence has become a cornerstone of security and resilience. This is why it's essential for nations, including Denmark, to invest in and prioritize critical technologies. The EU, along with European countries like the Netherlands, Sweden, and the UK, are developing targeted technology strategies.

This report is ATV's take on technology areas that will be crucial for Denmark's future economy, security, and resilience.

## Main Conclusions

**Denmark is losing ground.** Over the past decade, Denmark has lost ground in 12 out of 16 critical technology areas compared to our international competitors, measured by quality patents per capita.

**China is pulling ahead.** Compared to China, Denmark has fallen behind in all critical technology areas. The same is true for the EU, all the while China is steadily gaining in on the US.

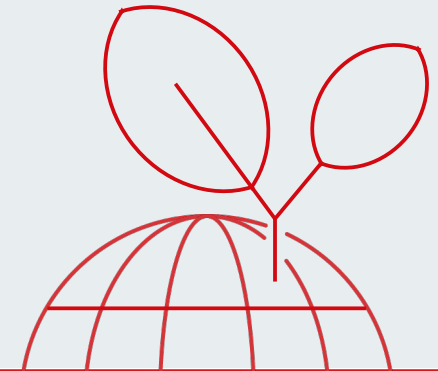
**Security as an innovation catalyst.** Security and 'dual use' are major drivers of innovation in most technology areas, especially in AI, quantum technology, robotics, drones, and space technology.

**Danish strengths.** When measured by quality patents per capita, Denmark is above the global average in energy technology, food technology, and audio technology. Excluding China, Denmark also ranks above average in agricultural technology, biotechnology, and climate technology.

**Technological niches.** Denmark's innovative strength across the 16 technology areas is driven by selected technological niches where the Danish innovation activity is particularly concentrated.

## Guide to a Resilient Denmark

This report is part of the ATV project: 'Guide to a Resilient Denmark'. The project accelerates the technological transition towards a more resilient Denmark.  
(See page 13)



### RECOMMENDATIONS

- 1 Prioritize technical and scientific research.** Increase public investments in research and innovation to at least 1.5 percent of GDP, and ensure at least 50 percent is directed towards technical and natural science research.
- 2 Develop an inter-ministerial technology strategy.** A national technology strategy should reinforce technological niche areas where Denmark has an innovation advantage, as well as sectors critical to Denmark's infrastructure, economy, and security.
- 3 Prioritize "dual use" in defense research.** Allocate 2 percent of Denmark's increased defense budget to research, focusing on cross-sector collaboration on "dual use" technologies that can be applied for both civilian and defense purposes.
- 4 Establish a strategy for STEM skills.** Create a STEM strategy to support an upcoming Danish technology strategy. The STEM strategy should include binding goals for primary, secondary, and higher education levels.
- 5 Focus holistically on risk management.** A national unit should assist with comprehensive assessments that include elements like security, research potentials, knowledge levels, Science Diplomacy, etc.

See detailed recommendations on page 12.

# Denmark's Innovation Activity

Denmark may not match the tech investments of major powers, but we have the potential to stand out by focusing on technological niches where Denmark demonstrates strong innovation.

ATV has mapped Denmark's current innovation activities in 16 technology fields that will be key in the future global competition for critical technologies. The analysis mainly describes the early part of the innovation chain, where new knowledge is created and developed.

Within each technology area, sub-technologies are identified where Danish companies and research institutions have focused their innovation activities through a mapping and weighting of:

- **Patents.** Indicating which new technologies actors believe in and invest in to protect future commercial use. Weighted by citations per patent.
- **Research Publications.** Indicating the foundation for future technological breakthroughs. Publications in peer-reviewed journals are weighted by citations per publication.
- **Publicly and privately funded R&D projects.** Indicating where resources are actively allocated to promote innovation. Weighted by grant size.

By focusing on the period from 2014 to 2024, insights are gained into which technological niches current innovation activities are concentrated.

## Activity Level Defines Specialization

Denmark's technological specializations are defined by identifying the sub-technologies that collectively have the highest innovation activity in patents, research publications, and R&D projects.

Sub-technologies within each technology area are subsequently ranked by comparing their innovation activity with the average innovation activity for all sub-technologies in that area. This is called the 'innovation score'.

$$\text{Innovation score} = \frac{\text{Innovation activity for sub-technology}}{\text{Average innovation activity for all sub-technologies}}$$

An innovation score over 1 means the relative innovation activity for the sub-technology is higher than the average, while an innovation score below 1 indicates an activity level below average.

## Niches with High Innovation Activity

The chart on page 7 highlights the technological niches with the highest innovation scores within the 16 main technology areas. These are the niche areas where Danish companies and research environments have had the greatest innovation activity measured by patents, research publications, and publicly and privately funded R&D projects.

[→ READ MORE](#)

For further details on tech niches, innovation activities, and the most patenting and publishing actors, refer to the **background analysis**.



TECHNOLOGY AREA	DANISH TECHNOLOGY NICHES	INNOVATION SCORE
Advanced Materials	Nanotechnology for Materials and Electronics	2.02
Advanced Semiconductor Technology	Electronic Components	1.64
Advanced Sensor Technology	Electro-optic Sensors	2.56
Biotechnology	Industrial Biotechnology	2.79
Digital Connections	Mobile Communication	2.74
Energy Technology	Wind Energy	3.17
Pharmaceutical Technology	Biological Drug Formulation and Development	2.34
Food Technology	Innovation, Development, and Ingredients	1.71
Climate Technology	Monitoring and Forecasting Technology	2.00
Artificial Intelligence	Machine Learning	2.45
Quantum Technology	Quantum Computing	3.39
Agricultural Technology	Animal Production Technology	1.47
Audio Technology	Signal Processing and Amplification Technology	1.85
Medical Technology	Therapeutic Medical Equipment	1.78
Robotics	Industrial Robots	2.40
Space and Propulsion Technology	Communication Systems	1.85

The innovation score indicates how much the level of patenting, publishing, and R&D projects exceeds the average activity level for all sub-technologies in the specific technology area. Source: Technological Institute

# Danish Areas of Strength

Technological niches in sectors where Denmark excels in international patenting are key indicators of Danish areas of strength.

Denmark holds a strong global position in energy technology, food technology, and audio technology. In the EU, Denmark also has a significant standing in biotechnology, climate technology, pharmaceutical technology, and agricultural technology.

Denmark has an innovation advantage within these 7 technology areas in Europe, as we produce more quality patents per capita than the average of the EU's tech regions (See [16 critical technology areas](#) for benchmarking).

## Technological Niches within Denmark's Strength Areas

TECHNOLOGY AREA	DANISH TECHNOLOGY NICHES	INNOVATION SCORE			
		TOTAL	PATENTS	PROJECTS	PUBLICATIONS
Biotechnology	Industrial Biotechnology	2.79	3.65	1.70	3.03
	Environmental Biotechnology	1.89	0.69	1.59	3.38
Energy Technology	Wind Energy	3.17	7.14	1.14	1.22
	Energy Storage and Conversion	2.38	0.54	2.60	4.00
Pharmaceutical Technology	Biological Drug Formulation and Development	2.34	2.44	2.03	2.55
	Drug Delivery	1.35	1.22	1.45	1.37
Food Technology	Innovation, Development, and Ingredients	1.71	1.94	1.85	1.33
Climate Technology	Monitoring and Forecasting Technologies	2.00	1.02	1.26	3.73
Agricultural Technology	Animal Production Technology	1.47	1.16	1.57	1.68
	Farming Technology	1.39	0.85	1.25	2.07
	Plant Breeding Technology	1.06	1.75	1.14	0.29
Audio Technology	Signal Processing and Amplification Technology	1.85	2.55	1.24	1.76
	Acoustic Technology	1.47	0.47	2.33	1.60
	Psychoacoustics and Musical Perception	1.32	0.30	1.25	2.41



ATV's analysis shows that over the past 10 years, Denmark has particularly specialized in 15 technological niches within seven technology areas.

## The Innovation Engine of Danish Strength Areas

Among the technological niches where Denmark stands out globally are:

**Wind Energy.** Denmark leads the world in the development and production of wind turbines, with strong research environments focusing on optimizing wind energy technology and offshore wind.

**Energy Storage and Conversion.** The development of battery technology, Power-to-X (PtX), and hydrogen-based energy systems are key areas where Danish players contribute to the future energy infrastructure.

**Industrial Biotechnology and Environmental Biotechnology.** Danish actors lead in enzyme technology, microbial solutions, and bio-based production processes that support the green transition.

**Biological Drug Formulation and Development.** Denmark boasts a strong pharmaceutical sector with globally leading companies developing advanced medicines and biological treatments.

**Monitoring and Forecasting Technology.** Technologies that enable systematic monitoring, analysis, and prediction of climate changes and their impacts.

**Innovation and Ingredient Development.** Danish companies and research environments have a strong tradition of developing bioactive ingredients, fermentation technologies, and food improvement.

**Animal Production Technology.** Denmark holds a leading position in advanced production systems that optimize animal welfare, sustainability, and food quality.

**Signal Processing and Amplification Technology.** Danish companies are global leaders in hearing aids, speakers, and advanced audio processing systems.

These niches are a crucial engine for Denmark's forward-looking innovation activity within the seven technology areas.

← The innovation score indicates how much higher the level of patenting, publishing, and R&D projects is compared to the average activity level for all sub-technologies within the technology area. Source: Technological Institute

# Disruptive technologies

It is crucial for Denmark to build knowledge and capacity within disruptive technologies like quantum technology and artificial intelligence, which are central to the global technology race.

Denmark, like the rest of Europe, is heavily dependent on the US and China for a range of disruptive technologies that are vital to our infrastructure and security. This makes us vulnerable, especially during geopolitical conflicts, like now, when the world's major powers are isolating themselves.

Technology areas such as advanced materials, digital connectivity, artificial intelligence, quantum technology, robotics, space and propulsion technology, and sensor technology are all categorized by the EU as 'critical for the economy and security of EU member states.' At the same time, these areas are crucial for our ability to innovate and speed-up within other technology areas. Therefore, it is essential for Denmark to build knowledge and capacity—and contribute to building the EU's technological sovereignty—in these areas.

## Focus on disruptive niches

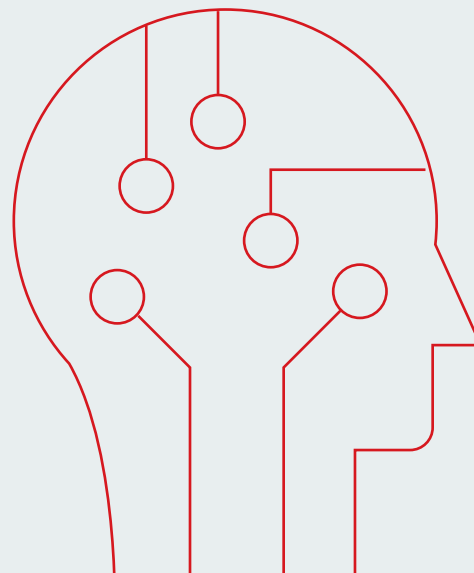
Denmark will not be able to match the major nations' innovation investments in disruptive technology areas, but we can achieve a stronger position in niche areas within the global knowledge ecosystem.

In some niche areas, Denmark has already succeeded in strengthening its position. For example, large private and public funds have jointly invested in quantum technology, AI, and biotechnology. This has resulted

in Denmark having a unique academic environment in the quantum area that is part of NATO's Diana collaboration. We also have strong research environments in AI niches, and the supercomputer Gefion provides us with digital capabilities that can enhance Danish research in many areas.

It is absolutely central that we, as part of a long-term technology strategy, continue to focus on these significant areas. Not just as an annual negotiation element in the research reserve negotiations.

ATV's analysis shows that over the past 10 years, Denmark has particularly specialized in 17 technological niches within the aforementioned seven disruptive technology areas.



Technological niches within disruptive technology areas

TECHNOLOGY AREA	DANISH TECHNOLOGY NICHES	INNOVATION SCORE			
		TOTAL	PATENTS	PROJECTS	PUBLICATIONS
Advanced Materials	Nanotechnology for Materials and Electronics	2.02	0.77	1.77	3.53
	Biomaterials	1.41	2.30	0.85	1.08
	Energy- Storage and Conversion Materials	1.40	0.88	1.70	1.62
	Polymer and Composite Materials	1.29	2.17	1.06	0.63
Advanced Sensor Technology	Electro-optical Sensors	2.56	1.93	2.76	2.98
	Chemical Sensors	2.29	1.55	1.68	3.65
	Biological Sensors	1.12	0.90	1.41	1.04
Digital Connections	Mobile Communication	2.74	4.58	0.87	2.77
	Internet of Things (IoT)	1.78	0.45	3.05	1.83
Artificial Intelligence	Machine Learning	2.45	1.62	3.05	2.68
Quantum Technology	Quantum Computing	3.39	4.94	3.59	1.64
Robotics	Industrial Robots	2.40	3.32	2.35	1.54
	Navigation and Collision Control	2.17	1.82	1.75	2.96
	AI-driven control and sensor integration	1.74	1.63	1.95	1.65
Space and propulsion technology	Communication systems	1.85	2.10	0.34	3.12
	Space-based observation technology	1.64	0.45	3.29	1.19
	Guidance, navigation, and control (GN&C)	1.33	3.38	0.07	0.55

The innovation score shows how much higher the levels of patenting, publishing, and R&D projects are compared to the average activity level for all sub-technologies within the technology area. Source: Technological Institute

# Recommendations

## ATV suggests enhancing Denmark's ability within technological development and adaptation through the following measures:

**Prioritize research in technical and natural sciences.** Public investment in research and innovation should increase from 1% of Denmark's GDP to at least 1.5% by 2030, aligning with recommendations from the Research Alliance between ATV, Danish Industry, Danish Metalworkers Union, and the Danish Society of Engineers - IDA. This increase should focus on technical and scientific research. The share of public research funds for these areas should rise from the current 40% to at least 50% by 2030, similar to the prioritization in countries like Finland, Switzerland, and Germany.

**Develop an inter-ministerial technology strategy.** Denmark can't compete with the large countries in research and innovation investments. However, we can strengthen our position in technological fields that offer strategic advantages internationally. ATV recommends creating an inter-ministerial technology strategy aimed at boosting Denmark's development and transition to technologies crucial for our economy, security, sustainability, and resilience.

**Prioritize "dual use" in defense research.** Denmark should promptly meet the European defense cooperation PESCO's goal of allocating 2% of defense spending to research. These funds should not be diverted from other research areas. The research must positively impact sectors beyond defense.

Therefore, a Danish technology strategy should include plans for cross-sector collaboration on "dual use" technologies, which can serve both civilian and defense purposes.

**Lay out a strategy for STEM skills.** A STEM education strategy is essential for implementing the technology strategy. Denmark is already facing a significant shortage of engineers, IT professionals, and other STEM professionals. The STEM strategy should build on the previous national science strategy, including binding goals for elementary, secondary, and higher education levels. It should also cover general education in areas like technological understanding and set targets for enrollment in technical and scientific programs at all educational levels.

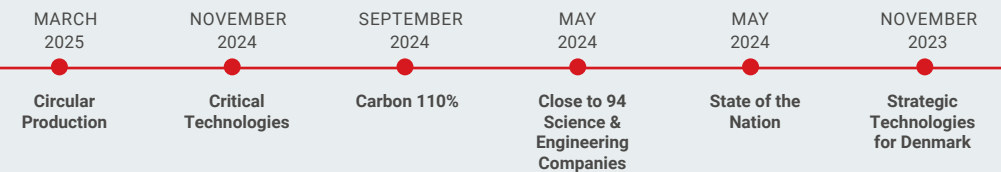
**Focus on holistic risk management.** The competition in technology and new geopolitical conditions call for a more holistic approach to risk management in international collaborations between universities and companies. A national organizational organ should assist with comprehensive evaluations, considering factors like security, research potential, knowledge levels, and Science Diplomacy. It's crucial for Denmark's competitiveness to remain as open as possible without compromising our safety.

# Guide to a Resilient Denmark

This publication is part of the project "Guide to a Resilient Denmark." The project's aim is to enhance Denmark's competitiveness, security, and sustainability through technological development and transformation.

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