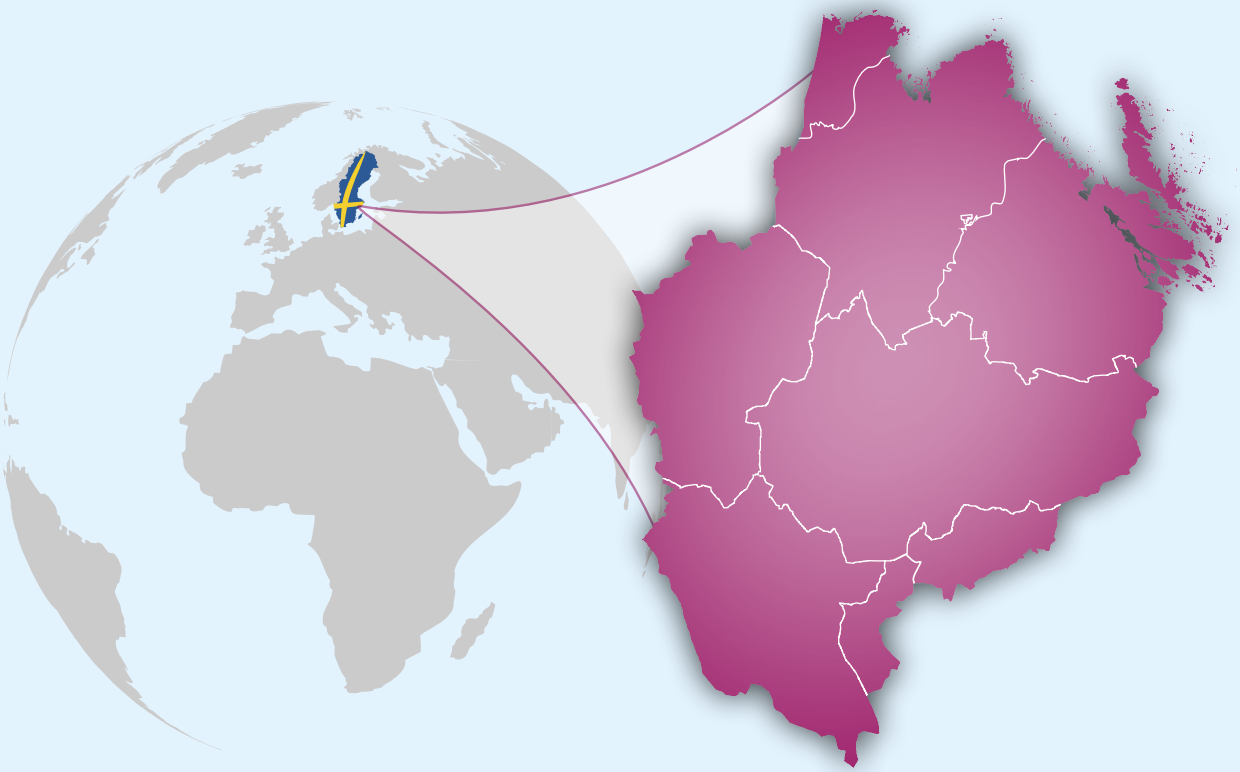
Region Uppsala

Smart Specialisation Strategy for Uppsala County 2022–2027.

Strategy for sustainable development and growth through challenge and knowledge-based innovation in Uppsala County.



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Summary

The Uppsala Region (Uppsala County) is a wonderful place to live and work. A region that offers its inhabitants a small town feel with all the benefits of the metropolitan area it's located in. The region is characterised by a thriving rural community and has a strong knowledge centre that has driven innovation for over 500 years, all for the benefit of humanity. Add to that a growing labour market with a multifaceted business sector and a welcoming environment for people's entrepreneurial dreams and ideas. Close to everything, at the heart of Sweden's growth engine. To maintain a competitive edge, a healthy and growing business sector is needed to create jobs and take full advantage of the business opportunities of tomorrow. Jobs are vital to be able to finance schools, healthcare, nursing, public transport, etc.

The Uppsala Region has and continues to need a healthy and diverse business sector. This smart specialisation strategy focuses, however, on the part of industry that builds its capabilities, innovations and business on solving urgent and, oftentimes, complex societal challenges – challenges that require knowledge and open, inclusive collaboration. These ventures tend to be born, establish themselves and grow at the intersection of research, education, cross-sectoral skills, public needs and driving forces. This phenomenon is summarised in the title of the strategy: "challenge and knowledge-based innovation for sustainable development and growth".

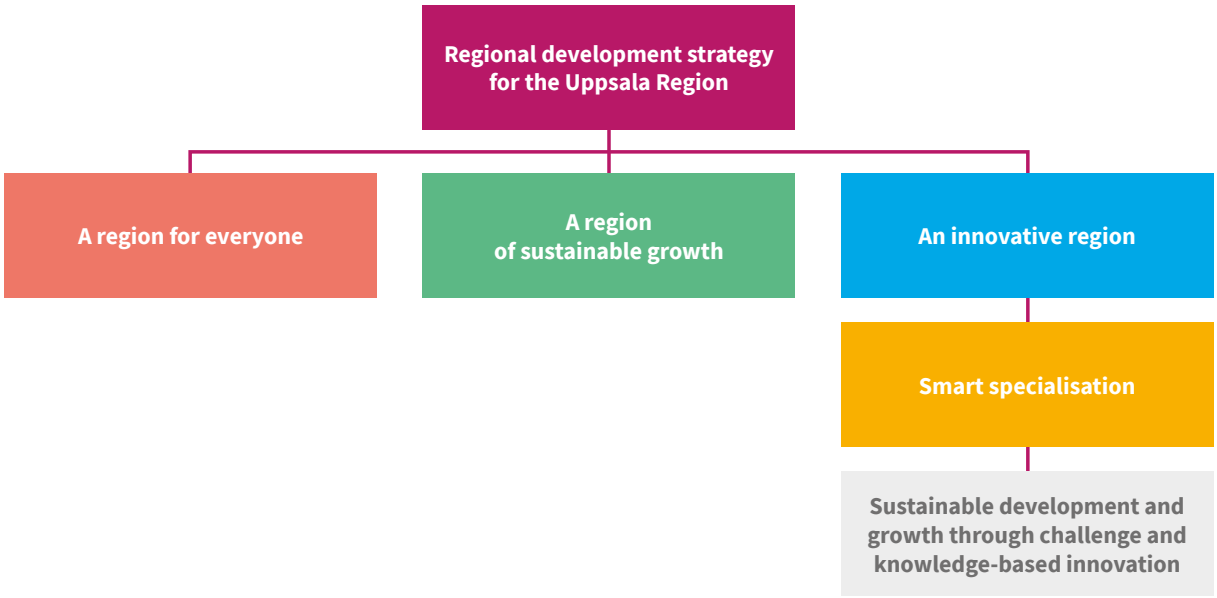
Through four thematic strength areas, all with underlying innovation themes, as well as three horizontal priorities, the strategy highlights the areas where the Uppsala Region is particularly well-equipped to provide innovative solutions for societal challenges, take advantage of the business opportunities of tomorrow and create jobs. The strategy is a framework and guide for challenge and knowledge-based innovation for sustainable development and growth for the entire Uppsala Region, and is an important stepping stone towards a stronger Uppsala Region and Sweden as leading innovators.

Thematic strength areas	Horizontal priorities
• Innovative materials • Life Science for the future of health and healthcare • Sustainable energy solutions in integrated energy systems • Circular bioeconomy	• Tech • User-driven innovation & system transformation • The business and innovation support system

The “Smart Specialisation Strategy” (S3) concept was launched by the European Commission while defining the guidelines for the European Regional Development Fund, which plays a critical role in financing large portions of the implementation of the regional growth policy in Sweden. The goal of the regions’ S3 strategies are to strengthen and highlight the strength areas and innovation capabilities of Europe’s regions.

As the regional development leader, Region Uppsala has, broadly speaking, taken charge of developing the strategy. In its implementation, Region Uppsala plays a driving and mobilising role in utilising the opportunities that the strategy highlights for the continued development of the Uppsala Region as one of Europe’s most innovative regions.

Lastly, a few words on the role of the strategy and how it relates to societal development in the Uppsala Region. The need for efforts to strengthen and sustain the region’s societal development is discussed in the regional development strategy (RDS), as well as in the 2030 Agenda strategy, which was reviewed and approved by the Regional Council in 2021. The efforts are organised into 3 focus areas: A region for everyone, A region of sustainable growth and An innovative region. These efforts are all guided by the vision, “A good life in an innovative, sustainable and knowledge-oriented region with international renown”.
In the “Innovative region” area, opportunities and challenges are discussed on a general level regarding both broad economic development and the need for collaboration in renewables and innovation. The smart specialisation strategy for the Uppsala Region explores and creates an understanding of the areas where our region has the greatest potential for challenge and knowledge-based innovation.



2. The Uppsala Region is one of Europe's most innovative places.

The innovation index below illustrates the Uppsala Region's strengths and capabilities within research, innovation and growth, all of which give our region a prominent role in Sweden, in Europe and in the world.

There are several indices for innovation and renewal capabilities that show the region's strong capabilities and conditions. Of those, the Swedish Institute follows several global indices where Sweden as a country, and consequently the Uppsala Region ranks highly.

In an international benchmark[1] study comparing eleven cities in the world (San Diego, Austin, Boston, Barcelona, Zurich, Munich, Oslo, Copenhagen, Tel Aviv, Singapore and Seoul), Uppsala was used as a benchmark in three main categories with the underlying parameters: 1) Knowledge intensity, 2) Relative economic potential and 3) Innovation power. The Uppsala Region ranks highly as an internationally competitive knowledge region that is well equipped for a future of innovation and renewal.

Uppsala's ranking in the aforementioned international benchmark study. (GRP=Gross Regional Product)				
#1 Proportion of highly educated in the population	#2 Real GRP growth per capita	#3 Real GRP growth	#3 Proportion of R&D of GRP	#6 Patents per capita

The Uppsala Region's two universities, Uppsala University and the Swedish University of Agricultural Sciences, both have strong international renown and work on a global level with research and education characterised by their breadth and depth. The universities, with their research-driven and innovative environments, are important knowledge-based "innovation engines" that can and should be utilised to an even greater extent.

According to the European Commission's "European Innovation Scoreboard", Sweden has ranked number one for several years. The index evaluates the national innovation systems of European countries based on a range of indicators that can be linked to a strong and healthy climate of innovation. A national innovation index is being developed by Reglab based on 3 main parameters with subsequent underlying parameters: 1) Basic conditions, 2) Renewal capabilities and 3) Ability to package and commercialise an idea on the market. In the national index, the Uppsala Region ranks well overall. The latest survey indicated that our region was second overall in the country and first in renewal capabilities. Uppsala is a particularly strong innovation region that is well equipped moving forward. In the State of the Nordic Region report from the Nordic Council of Ministers, the Uppsala Region was recognised as having the highest Regional Potential Index for a non-capital city region, and therefore the largest growth potential.

[1] International benchmark study, Regional review STUNS

For all of us working with innovation and economic development within the Uppsala Region, these rankings are further confirmation of what we experience every day: the strong culture of collaboration within the business and innovation system steadily and consistently contributes to the emergence of entrepreneurs and growth companies through innovations that present ground-breaking solutions to society's challenges.[2]

[2] The Uppsala Region's business and innovation support systems, which comprise all of the activities that, in different ways, promote the development of entrepreneurship, innovation and businesses, has strong national and international renown. For example, the Uppsala Innovation Centre is ranked globally in the top 5 incubators with university connection by UBI Global.

3. About Smart Specialisation...

The concept "smart specialisation" was launched by the European Commission in collaboration with European Regional Development Fund (ERDF). The ERDF is important as being one of the largest funders of Sweden's regional growth policy. Its purpose is to strengthen and highlight the innovation and growth capabilities of Europe's regions based on societal challenges, research and innovation. In order to benefit from the structural funds focusing on research and innovation, there is one necessary condition. In practice, this condition dictates that Europe's regions must identify, describe and continue to develop regional strength areas where the potential for challenge and knowledge-based innovation and sustainable development and growth is deemed to be greatest, i.e. a smart specialisation strategy.

What do the words mean?

- SMART: Identify regional assets and resources in areas where we have particularly strong potential for challenge and knowledge-based innovation and sustainable development and growth.
- SPECIALISATION: Prioritise competitive strength areas that focus on sustainable growth.
- STRATEGY: Vision for, mobilisation of and investments into the prioritised strength areas.

4. … with a focus on challenge and knowledge-based innovation for sustainable development and growth.

A healthy business sector is essential for funding schools, healthcare and nursing, and a wide variety of businesses are needed to meet inhabitants' service and commercial needs. However, the smart specialisation strategy addresses how to create the best possible conditions for the part of economic development that is based on challenge and knowledge-driven innovation and offers business opportunities far outside the region's borders.

Explanation of challenge and knowledge-based innovation

Just like so many other regions in our own country and abroad who are facing serious societal challenges, our region is standing face-to-face with a number of issues that we have to solve. We are no exceptions; we have to quickly and dramatically reduce our carbon footprint, replace fossil material flows with bio-based solutions, make healthcare more effective and adapt it for an increasingly aging population and finally ensure that the people who feel left behind or detached from societal development are seen and given a chance. And as if that was not enough, the pandemic has fundamentally impacted our health and forced us to assess our living conditions.

In debate after debate, these challenges are so often seen as problems. Perhaps we need to shift our perspective and view tomorrow's challenges as necessary steps in our development journey – challenges that we all as individuals need to confront, where our own choices and actions have just as much of a chance of affecting change as anything else. That's how we choose to view the situation in the Uppsala Region. The key to success is inclusive, goal-oriented and courageous collaboration between the business, research and public sectors. No one single person has the solution. All of us together have to produce knowledge and link arms to transform knowledge into innovation and entrepreneurship into tangible solutions for humanity and society. And we think we're pretty great at collaboration in Uppsala.

So, if there is one thing you should remember from this strategy, it's that, in Uppsala, we don't just talk about the problems – we solve them. Every day we get a little closer to answering the largest riddles of our time. Sometimes the solutions are marvellous and ground breaking, but just as important are the small persistent steps towards progress that workers, researchers, students, public servants and politicians make every day when they go to work and collaborate. Every day, knowledge is produced through the collaboration between business, research and public organisations, which is turned into products, services and tangible solutions to society's urgent problems.

Solutions include more sustainable materials for the manufacturing industry, technology that extracts water from the air and more accurate pharmaceuticals and medical technology that improve care and patients' quality of life. This is the essence of challenge and knowledge-based innovation where there is strong potential for business development in markets outside of Sweden. It benefits our business sector, while also enabling us, in Uppsala, to help make the world a better place. Through smart specialisation with a focus on challenge and knowledge-based innovation, our region will be important not just for ourselves, but for others, too.

The conditions are good to say the least. For anyone who believes in the power and possibilities of industry, the Uppsala Region is an amazing place to live and work. The region is a smorgasbord of exciting businesses in a wide variety of industries: a strong steel and engineering industry in the north east, a burgeoning life science industry and tech sector in the city, and transportation and logistics in the south – just to name a few. Additionally, we have a very green region with a lot of forest and rural businesses that will be essential in the transition from fossil energy and materials to bio-based solutions. If we take our strong business sector, and add the fact that we have two universities (Uppsala University and the Swedish University for Agricultural Sciences), a university hospital and multiple expert agencies (the Medical Products Agency, the Swedish National Food Agency, the Swedish Forest Agency, etc.), while also taking into account our small geographical size, Uppsala becomes a much more important point on the world map.

The second thing we want you to remember from this strategy is that although we, of course, are capable of so much in Uppsala, we can't do everything. We are dependent on and always open to dialogue and collaboration from outside the region's and country's borders. Our ambition for the region is clear. Uppsala is and can become an even more important actor in Sweden's continued growth as a leading nation of innovation towards a more sustainable world. The smart specialisation strategy for challenge and knowledge-based innovation is a tool on that journey.

4.1 Explanation of strength areas and innovation themes?

The flesh and bones of this strategy are the Uppsala Region's strength areas and their respective innovation themes.

- A strength area thematically classifies the weighted capabilities, resources and innovation potential in research, education, industry and the public sector. This region-specific measurement must also be complemented by a demand from outside the region for what the strength area offers. To put it plainly, there isn't much benefit in investing in knowledge and innovation that no one needs. This is where societal challenges enter the equation – those challenges bring with them a need for new knowledge, ideas and innovation that create business opportunities and collaboration in global markets. In a nutshell, a strength area identifies and communicates where the Uppsala Region is particularly well equipped to generate challenge and knowledge-based innovation based on a range of regional capabilities tied to a market demand.
- Innovation themes are presented within each strength area, under which are listed the collective competencies within research, education, industry and the public sector that are being transformed into new ideas, innovation and business in markets inside and outside of Sweden's borders. Thus, the innovation themes function as a representation and clarification of the strength areas vis-a-vis the outside world from an innovation perspective.

All of the strength areas and innovation themes in this strategy vary in how close they are to implementation and an intended market – from experimental research to already commercialised and industrialised capabilities and innovation. Naturally, between these strength areas, there is also variation in the level of "systematisation", which is to say how we structure and coordinate ourselves and work together within the region to create the best possible conditions to transform valuable knowledge into renewal and innovation into tangible results for

people and businesses. Certain strength areas are characterised by strong ecosystems of collaboration and knowledge flows that have organically and intentionally developed over a long period of time, while others are less organised and structured from a regional innovation perspective. Be that as it may, the key message in this strategy is that the Uppsala Region offers a critical mass of knowledge necessary for innovation and renewal that is in line with the 2030 Agenda – today and tomorrow.

Strength areas and innovation themes have been chosen through discussion, analyses and a number of selection criteria:

- Excellent research and education that are important for innovation, renewal, skill support and growth in both the region's and country's business sector.
- Important, urgent and transformative societal challenges with strong innovation and growth potential beyond the region's and country's borders.
- Ongoing strategic processes, research centres, innovative environments, public will, national strategies, etc.
- Connection to regional industry:
  a) there is a critical mass of companies that are directly or indirectly connected to the chosen areas,
  b) transformative knowledge areas with potential to create new industries and/or contribute to investments and establishments in the Uppsala Region,
  c) Evidence for or assumption of future potential for novel entrepreneurship and university spin-offs.

4.2 Explanation of horizontal priorities

Horizontal priorities denote the capabilities and resources that, in different ways, support the continued development of all the strength areas as well as the development of the Uppsala Region as a whole. Given that these capabilities are cross-sectoral, they are unable to be sorted or isolated thematically. Instead, they have to tie into and interact with all of the strength areas. For example, there are digital solutions everywhere that challenge our accepted views of business models, industries and the creation of renewal and innovation, all of which is happening at an exceptional pace.

Understanding societal development, human needs and behaviours, as well as how renewal is interpreted, received and implemented, can be crucial in order for revolutionary knowledge and innovation to have the practical means to bring both utility and value. People with ideas, entrepreneurs and businesses all need support on their development journeys, regardless of the industry they belong to or the strength area they're linked to. In summary, horizontal priorities allow for the necessary conditions and context that enable the practical application of knowledge and ideas.

4.3 Target groups of the strategy

The Uppsala Region has and needs to continue to develop a broad, diversified and healthy business sector. This smart specialisation strategy focuses on the part of industry that builds its capabilities, innovations and business on solving urgent and, often, complex societal challenges – challenges that require knowledge and open, inclusive collaboration. These companies tend to be born, establish themselves and grow at the intersection of research, education, transferable skills and public needs.

The strategy's ultimate objective is to create tomorrow's jobs and businesses through new knowledge and innovation. With that objective in mind, the primary target groups are in the fields of Research, Education and Industry. Because the final stage of this strategy relates to the business sector, the strategy places particular focus on:

- Companies that are transforming societal challenges into solutions for national and international markets.
- Companies that, either wholly or partially, are building their innovation and business off of academic knowledge.
- Companies – existing companies and spin-offs, big and small – that require access to and the input of research and knowledge in their development journey.

5. Purpose – how does smart specialisation help the Uppsala Region?

The overall value of this smart specialisation strategy depends, of course, on ambition level and how the strategy is ultimately used in concrete terms and implemented into day-to-day innovation efforts within the Uppsala Region. Below are explanations of the strategy's concrete benefits and assumed value.

- A financially stronger region: the Uppsala Region meets the "necessary condition" in the European Regional Development Fund (ERDF) 2021-2027 and is therefore able to continue to apply for EU funding from the ERDF for East-Central Sweden. Smart specialisation seems to rank higher and higher on the European Union's innovation policy agenda, and similar "necessary conditions" with requirements for specialised regions may also apply to more financial instruments and initiatives, nationally and within the EU.

- A clearer region: The Uppsala Region's smart specialisation strategy identifies and communicates the knowledge and collaboration we as a region offer to the world in terms of innovation. Europe's regions are competing for attention. By having a clearer profile, the Uppsala Region strengthens its competitiveness for establishments, venture capital, bigger public investments and new collaborations around the world.

- A smarter region: The Uppsala Region's smart specialisation strategy brings with it opportunities to capitalise on our common capabilities and resources – within research, development, industry and the public sector – in an even smarter and more goal-oriented way. Using our strength areas as a basis, we are challenging our ecosystems and accepted work patterns, and we are rethinking and improving to accelerate our pace of innovation even more – from ground-breaking knowledge to value-generating innovation with activity in markets regionally, nationally and internationally.

- A prepared region: The Uppsala Region's smart specialisation strategy equips the region for the future. Just like so many other regions in our own country and abroad who are facing serious societal challenges, our region is standing face-to-face with a number of issues that we have to solve. Our strength areas constitute an overview of our capabilities within the research, industry and public sectors that all need to interact in order to prepare the region for the necessary "transformation" within several areas.

6. Uppsala Region's strength areas and innovation themes.

6.1 General framework for sustainable & inclusive communities in the Uppsala Region

6.1.1 The interaction between technical achievements, human behaviour and conditions

The societal value of innovation is about diffusion, utilisation and benefit. Oftentimes, notions of innovation are too narrowly limited to the technical and medical fields, thereby risking the prevention of fully realising the societal and cultural values of innovation. Today, research and innovation are increasingly expected to address current societal challenges on multiple levels. In its new framework programme, Horizon Europe, the EU is strengthening its economic investment in sustainable and inclusive societies with a particular focus on culture and creativity in the broadest sense. The UN's global sustainable development goals – the 2030 Agenda – are often at the centre of the innovation debate, which itself requires a diversity of perspectives from all scientific fields, especially from the humanities and social sciences. Technical development must go hand in hand with a holistic view of society that is both aware and responsible, where issues regarding quality of life, inclusion and equal treatment are all taken into account. Transformative innovation and renewal for a truly sustainable societal transition require a holistic view, entailing that a range of scientific perspectives – historical, cultural, economic, geographical, legal, ethical, philosophical, linguistic, behavioural – are allowed to build a knowledge framework of how technical development best benefits a sustainable and inclusive society.

This knowledge and experience – the mutual dependence between technical achievements, human behaviour and conditions – both exist in the Uppsala Region. As a knowledge-centric environment, Uppsala is unique for many reasons, including the education and research conducted through its universities. The Uppsala Region is also characterised by its high percentage of highly educated inhabitants – a human capital with strong receptivity to new knowledge and life-long learning, wanting to challenge old ways of thinking and be innovative – across companies, organisations and public institutions where they are employed.

It is within the framework of this broad approach that the Uppsala Region's strength areas and horizontal priorities should be understood and implemented.

6.1.2 Smart specialisation and diversification at the same time

The region's strength areas within this strategy are classified and thematically discussed. The knowledge and relationships within each area have either a scientific or industry-specific organisational home, with their own development logic as well as inherited relationships and networks. Indeed, well-defined headings and themes establish a clear profile that the outside world can use when looking for capabilities and solutions from competing regions. Thus, the Uppsala Region becomes an even clearer and attractive partner in the global market from a communications perspective.

Solutions to the oftentimes complex societal challenges will, however, grow from the intersection between our strength areas and horizontal priorities. In order for the Uppsala Region to continue to be a strong region of innovation globally, our view of innovation and renewal will be as important as open-minded, solutions-oriented collaboration that extends across technical and society-oriented knowledge areas and industry lines – private and public. The Uppsala Region's strength areas are characterised by their mutual dependence and how they challenge and build off each other. Smart specialisation, by way of regional strength areas, also requires "smart diversification" in the daily efforts within and between these areas. We have to be prepared to think broadly, to rethink and to innovate; being open to what we cannot predict in the here and now is inherent to innovative thinking. The exchange of knowledge is vast, open and inclusive – locally, regionally and globally. Ideas develop quickly and just keep getting better – with the Uppsala Region at the centre of those global markets.

6.1.3 Overview – strategic framework, strength areas and innovation themes

Sustainable and inclusive societies

Strength area	**Innovative materials** – development of materials adapted to human, society and industry needs	**Life Science – the future of health and healthcare** – development of products and services for tomorrow's health and healthcare that improve and save lives
Innovation themes	Materials for batteries and energy storage	Biological and synthetic pharmaceuticals – formulation, production and accurate supply
	Material for solar cells	Medical diagnostics
	Materials and additive production methods	Medical technology
	Nanomaterials for a sustainable society	"One health"
Strength area	**Sustainable energy solutions in integrated energy systems** – development and testing of tomorrow's smart energy solutions for a faster transition to climate-smart products/services	**Circular bio economy** – development of green products and energy sources founded on primary production for a bio-based societal transformation
Innovation themes	Transition to and integration of renewable energy	Combined circular biogas and hydrogen production
	Management and optimisation of energy systems	Green products and chemicals from agriculture and forest raw materials
	Testing and integration of sustainable energy systems in physical environments	Digitalised, electrified and automated agriculture
		Circular energy and food production

6.2 Strength area: Innovative materials – adapted to industrial, human and societal needs

Material development will play an even bigger role in achieving the goal of a truly sustainable society. The materials have to be lighter, more durable, have a sustainable composition and be able to be sustainably produced and reused. Materials are and will remain an important part of the larger ecosystem, economically, environmentally and socially. The Uppsala Region offers world-class capabilities in material innovation, developed at the intersection of research, industry and society, which can generate activity in international markets and make the world a better place. Strong research and education sectors combined with a knowledge-intensive manufacturing industry together build a strong ecosystem for the collaborative creation of knowledge and new technical achievements in material production. Within the region's industry, modern manufacturing technology opens the door for new and innovative materials that are transformed into more sustainable components and solutions, all with the ultimate purpose of benefiting humanity and society. Within healthcare, innovate material development in Uppsala is helping lay the groundwork for more effective diagnostics and treatment of sick patients in unprecedented ways. Add to that the region's expansive societal development, the aim of which is the gradual transition away from fossil energy and material flows. In that transition, the development of bio-based, lighter, more durable, non-toxic, reproducible and recyclable materials plays a key role. The future of material development will pave the way for increased circulation and recycling in brand new ways within closed-loop material flows. Waste and obsolete materials from one company can be used in another, existing value chains are reimagined, and new ones develop and create more jobs regionally.

The "Innovative materials" strength area is based on the region's research and education, where material knowledge is implemented together with industry and public bodies under four specific innovation themes. Although each area comprises knowledge that varies in how close it is to implementation and an intended market – from experimental research to more applied material development – Uppsala offers a critical mass of knowledge necessary for innovation and renewal that is in line with the 2030 Agenda – today and tomorrow.

6.2.1 Materials for batteries and electrification

Uppsala acts as the hub of the scientific and industrial ecosystem for battery development in Sweden and Europe. Here, actors gather from all along the value chain to work on tomorrow's batteries, from universities and companies developing materials and manufacturing cells to industries that understand the implementation of battery systems and represent their use. The region's research consistently focuses on the improvement of current batteries, while also developing innovative material alternatives with higher energy content that may be vital components of future battery cells. These capabilities also interact with the region's electrical research, which place battery development within a larger system context, such as electricity distribution and systems for energy storage and electric drive lines.

6.2.2 Materials for solar cells

The Uppsala Region is at the international forefront of thin-film and tandem solar cell development, and the region's research ranks high in setting the world record for best efficiency. The thin solar cells are adaptable, lightweight, more environmentally friendly than other solutions and able to be priced more competitively thanks to the increasing efficiency of the cells. Additionally, Uppsala is leading the way internationally with its knowledge of solar electricity integration in both construction and the energy system. The Uppsala Region is also characterised by its openness to test out new solar cell technology.

The use of the region's physical spaces as test beds for solar cell development creates beneficial conditions for collaboration and innovation all along the solar cell value chain.

6.2.3 Materials for additive manufacturing (AM)

There must be symbiosis between the development of materials and the development of new production methods in order for new, ground-breaking materials to be approved for industrial use and not stuck in research laboratories. Today, we are at the precipice of a new industrial revolution where new manufacturing methods, including additive production methods (AM), also known as 3D printing, are paving a brand-new path for a competitive Swedish industry. AM radically changes our understanding of what we can produce and how. The Uppsala Region occupies the perfect position between innovative material development and AM. The region offers industrial and academic capabilities all along the additive value chain, from powder manufacturing to material development, design, additive manufacturing, post-processing and the use of printed components and products. Through AM, sustainable materials are transformed into new component design solutions within a wide range of important industrial sectors for the Uppsala Region and the country, such as life science, engineering, vehicles and energy.

6.2.4 Nanomaterials for a sustainable society

The Uppsala Region has a strong education and research environment for nanotechnology and functional materials. This includes, for example, materials for the more accurate supply of pharmaceuticals, bone tissue regeneration, or nanocellulose-based materials with different biomedical applications, energy storage and biodegradable packaging. Although the research is in an experimental phase, it still garners international industrial and scientific attention and is the perfect breeding ground for entrepreneurship and material innovation.

6.2.5 The common resource base

6.2.5.1 Business Sector

The Uppsala Region is characterised by its material and production-centric business sector. In our region, we have world-class knowledge-intensive industrial companies with advanced production in areas including medical technology, pharmaceuticals and biological products, pulp manufacturing, nuclear power, powder metallurgy, tool manufacturing and special casting and cabling. There are manufacturing and material-dependent companies located across the region, and they promote a growing local knowledge-intensive service sector. The development of this industry also has a ripple effect, where jobs in the industry generate jobs in other surrounding industries.

Within transformative areas where material development plays an integral role, such as additive manufacturing, solar cells, energy storage and biological pharmaceuticals, the Uppsala Region acts an international meeting place for industry and academia from around the globe. Our region also co-produces knowledge that challenges and transforms accepted business logic and value chains. Additionally, Uppsala distinguishes itself through the growth of its small knowledge-intensive material companies, many of which offer production technology solutions, which enables the upscaling and industrialisation of innovation for broad industry segments internationally. The region acts as a breeding ground for innovation and entrepreneurship offering revolutionary solutions to the material-related challenges highlighted in the 2030 Agenda, such as health challenges, resource efficiency, biodegradability, recyclability and sustainable energy solutions.

BUSINESS SECTOR

The Uppsala Region has a material and production-centric business sector

The region's manufacturing industry employs about 11,756 people. The combined turnover has increased to SEK 48 billion. The employment rate has increased by 6% (nationally -7%) since 2009, and the combined turnover has increased by 74% (nationally 36%).

The Innovative materials area is led by larger businesses within the manufacturing industry, material-intensive growth companies, university spin-offs, development projects and innovative start-ups.

Source: SCB 2019, regional processing.

6.2.5.2 Research & education

Uppsala University (UU) is breaking new ground with its achievements in material technology, where knowledge of everything down to a material's smallest components, at the atomic level and in nano dimensions, is essential for the development of new and improved material properties. The core of the work is a synthesis of materials and a coherent chain of experiments, from laboratories to large international facilities with industrial and scientific collaboration around the world.

UU has strong international **renown in battery research** where its knowledge of materials is essential for batteries' storage capacity, environmental impact, safety, weight, size as well as pricing. The research on batteries also ties in with investments in electricity science and electric drive systems. Through BATTERY 2030+, UU is co-ordinating battery development in Europe.

The consortium is accelerating Europe's development of battery cells, with particular focus on improving current lithium batteries and paving the way for entirely new and innovative materials chemistry. UU is also leading Sweden's collaborative battery initiative, "Batteries Sweden", the goal of which is to strengthen the national value chain of batteries, from the mining and development of materials to production, use, reuse and recycling.

UU is also a global leader in **solar cell material** production. Solar cells will be cheaper, more environmentally friendly and build on highly efficient material combinations that are also possible to manufacture at large scale. The research focuses on understanding materials' ability to convert sunlight into electricity in an effort to develop alternative solar cell materials that can replace silicon, which currently dominates the field. In the hunt for increased efficiency and longer-lasting solar cells, various thin-film materials are being combined in tandem solar cells. UU is also a global research leader in thin film technology (CIGS) with the potential to create material-efficient, flexible solar cells and cheaper solar cell-generated electricity. The research also covers how sunlight can be converted into fuel and sustainable chemicals, for example, hydrogen as an energy carrier, storage medium or basic chemical in sustainable materials.

In order to make innovative materials available for industrial production, UU is also coordinating **material development adapted for additive manufacturing (AM) methods**. The core of the work is an interdisciplinary research team and two AM laboratories for broad material technology research and education and its broad industrial applications, for example, 3D-printed components, specially adapted for biomedical research and healthcare. The university hosts AM4Life, which brings together industries, research and the public sector in Sweden and internationally with a focus on material innovation and 3D-printed components and solutions for life science and healthcare.

RESEARCH & EDUCATION

Around 60% of Sweden's material research is conducted in the Stockholm-Uppsala region.

UU is coordinating battery research in Sweden and Europe through Batteries Sweden & BATTERY 2030+.

UU is conducting seminal research on solar cells.

UU is conducting seminal research on material development for additive production methods for a range of industry sectors, such as life science, engineering and energy.

At UU, there is industry-leading infrastructure for material and component testing, such as the Centres for Photon Science and Neutron Scattering (MyFab), the X-Ray Laboratory, the Freia Laboratory & the Tandem Laboratory.

Source: 60% is based on research grants from the Swedish Research Council in 2017.

6.2.5.3 Public will of the region

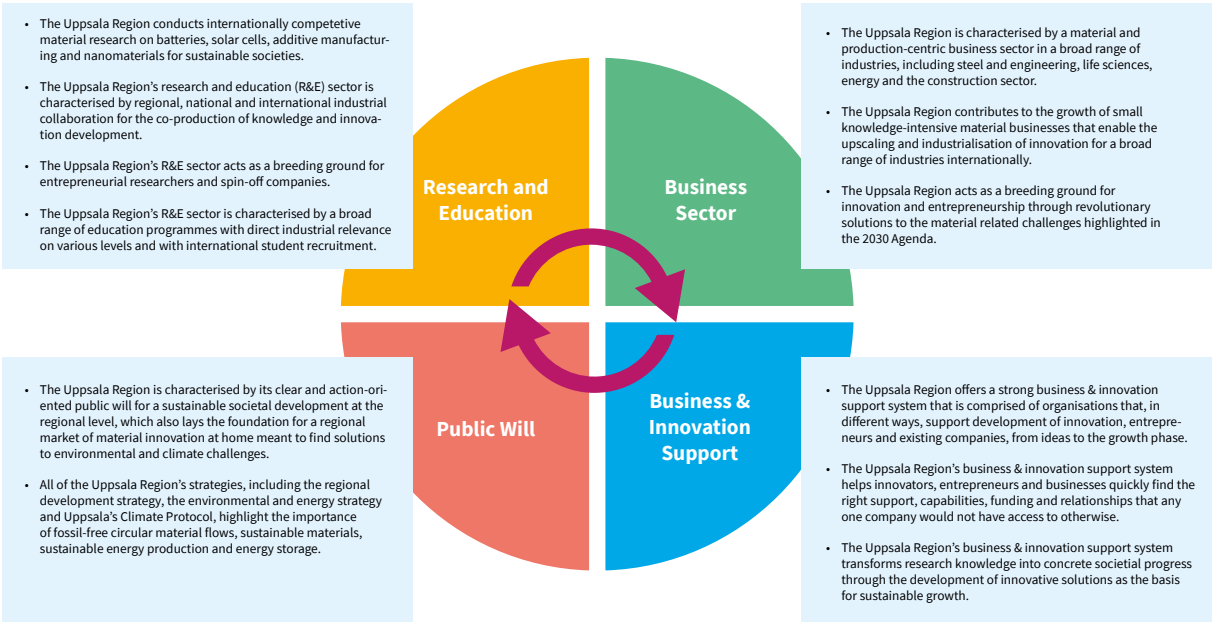
There is strong and clear public will in the Uppsala Region for sustainable societal development. Many of the threats and possibilities of sustainable societal development are ultimately governed by both the limitations and the positive sustainable properties of materials. There is considered to be a strong potential for using innovative materials as tools to solve environmental problems and climate challenges, not to mention the potential for those materials to help improve quality of life and increase competitiveness in the business sector.

The regional development strategy, as well as the 2030 Agenda strategy, for the Uppsala Region includes goals and measures that directly or indirectly strengthen continued investments in the "Innovative materials" strength area as a bridge towards a fossil-free society. The goal is to *"develop reliable and fossil-free socio-technical infrastructure"*. The transition to a fossil-free society means that water, energy, nutrient and material flows would be handled within local cycles to a considerably greater extent, placing new demands on technical infrastructure. Increased coordination between the large and small-scale production of renewable energy, like solar, wind and water, also becomes more important. To be able to secure energy access, different kinds of energy storage need to be created.

Additionally, the **Climate and Energy Strategy for the Uppsala Region** lays out ambitious goals where the region's capabilities regarding sustainable materials, sustainable energy production and energy storage will play an important role. Renewable energy, like solar, wind and biofuel, are highlighted as key initiatives. The strategy's priorities also include indirect climate impact through smarter choices of sustainable materials and the management of resources with energy, power and materials.

The **Uppsala Climate Protocol** puts together a network of companies, public bodies and associations with the aim of collaboratively achieving Uppsala's climate goals: *a fossil-free Uppsala by 2030 and climate-positive Uppsala by 2050*. Many of the highlighted climate challenges are wholly or partially dependent on material substitution and the development and use of renewable materials, such as the production of solar power, fossil-free and renewable fuel, construction with wood, climate-neutral concrete, circular construction materials and fossil-free, recyclable plastics, as well as working towards a sustainable cycle, for example, through the manufacturing of biochar from organic waste.

6.2.5.4 Summary of the regional resource base

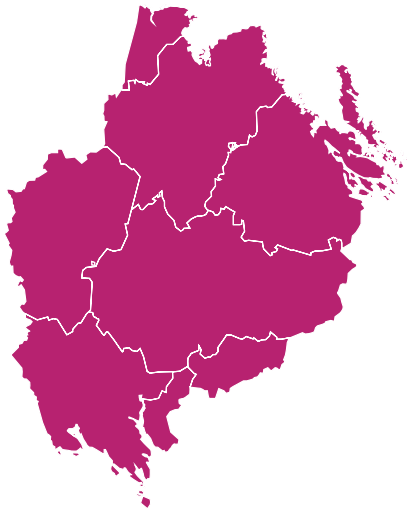


6.2.6 Desired position and target by 2030

Desired position & target by 2030

The Uppsala Region is a solutions-oriented and attractive place in the world where innovative materials, adapted to industry, human and societal needs, are developed and used to create solutions for sustainable societal development.

The Uppsala Region is an exciting place, perfect for researchers, innovators, entrepreneurs, business founders and investors.



6.3 Strength area: Life Science for the future of health and healthcare – Development of products and services for tomorrow's health and healthcare that improve and save lives

The life science sector employs over 6,200 people in the Uppsala Region and turns over more than SEK 33 billion. Uppsala's life science sector is largely international and works on a global market. The companies whose primary operations are within life science, including pharmaceuticals, biotechnology, medical technology and diagnostics, very clearly contribute to the development, employment rate and attractiveness of the Uppsala Region.

Success within Uppsala's life science sector is strongly rooted in the world-class research conducted at the region's two universities, as well as the region's strong business sector. There is also strong collaboration and a close relationship with the region's health and healthcare, in particular Uppsala University Hospital, which has been essential in enabling the industry to test out and implement therapies, products and services in healthcare. The collaboration has developed over a long period of time, characterised by its unique interaction between industry, research and education, as well as the healthcare and nursing sector. On top of that, there is also a world-renowned business and innovation support system, diverse research and innovation infrastructure and test beds for the development of future products and services, paving the way for new, innovative and viable companies in the region.

Today, the Uppsala Region, Sweden and the world at large are increasingly affected by multiple mega trends that are driving the development of the life science sector, which places increased demand on knowledge, product and service development and the ability to order services.

- *The fourth industrial revolution* – a fusion of technical, biological and digital technologies are changing the playing field and redefining industry rules, which in turn requires new forms of collaboration and interaction to secure future competitiveness.
- *Development within precision medicine* – where new technology for analysing gene sequences is enabling personalised therapies and treatment, where modern biological pharmaceuticals are increasingly important.
- *Pandemics* – place new demands on open and available data, transnational collaboration and agile development capacity for new vaccines, treatment methods and knowledge sharing.
- *Spread of antibiotic resistance* which hinders the treatment of different diseases and impacts food production.

- *Demographic shift* with an increasingly aging population, leading to increased multimorbidity rates and care needs.

Through continued collaboration to develop knowledge and innovate, the Uppsala Region's life science ecosystem is well equipped to transform these challenges into solutions for the future of health and healthcare. The following innovation themes hold the greatest potential:

6.3.1 Biological and synthetic pharmaceuticals – formulation, production & accurate supply

The Uppsala Region has both large and small pharmaceutical companies at the forefront of their field, and there is a strong start-up scene marked by the emergence of new companies and innovation. Thanks to its excellence in research and healthcare, the Uppsala Region offers an attractive and innovative environment for the design and development of tomorrow's biological and synthetic pharmaceuticals. With its strong ecosystem perfect for the development and production of biological pharmaceuticals, as well as strong driving forces within precision medicine, the Uppsala Region is well equipped for the medical revolution at the intersection of biology, process engineering and digitalisation. The region's capabilities and expertise span the entire production process of biological pharmaceuticals – from cell culture and purification of the medicinal substances (with excellence in both filtration and chromatography) to upscaling production from the lab to industry scale. Uppsala is also a national hub for the secure supply of pharmaceuticals, meaning the way in which medicinal substances are efficiently and accurately delivered to and received by the patient.

6.3.2 Medical technology & e-health

This area covers all tools used to diagnose and treat diseases, which spans multiple science fields. The Uppsala Region has a unique ecosystem and environment where research, healthcare and industry all work together to create products and services within medical technology for better health and healthcare. Uppsala's capabilities and driving forces are located at the intersection between the region's highly specialised healthcare and the technical development capabilities within industry and academics, including radiation therapy within oncology, medical sensor technology for advanced diagnostics, computer-assisted surgery, e-health, etc.

6.3.3 Medical diagnostics & decision support

This area, which includes the diagnosis of patients' health status and the identification of diseases, is strongly linked to products and services within medical technology. The Uppsala Region's capabilities range from research into disease mechanisms as a basis for new applications in diagnostics and treatment to catalysation of research knowledge, clinical diagnostics and final implementation in healthcare. Within the field of diagnostics, there is a wealth of businesses that also act as a breeding ground for innovation and entrepreneurship.

6.3.4 "One health"

With this field, there is a growing understanding of how diseases transmit between animals, the environment and humans, as well as the spread of antibiotic resistance. The area, which is considered to have strong market potential in the future, complements and strengthens the Uppsala Region's life science ecosystem. Health systems and translational medicine are central knowledge themes, in which the Uppsala Region offers strong capabilities within, for example, foodborne illnesses, zoonotic diseases, new protein sources and new antibiotics. Low antibiotic use in Swedish agriculture lessens the risk of resistance and increases the value of agricultural and food products for consumers. In addition to the scientific part of antibiotic development, Uppsala also has strong capabilities in terms of economic models to create market incentives for the development of new antibiotics. All in all, the capabilities of the Uppsala Region answer important societal challenges on a global level and give rise to innovation and renewal.

6.3.5 The common resource base

6.3.5.1 Business Sector

The life science sector has historically held a strong position within the Uppsala Region, and it continues to be a strong driver of challenge and knowledge-based innovation for better health around the world. The Uppsala Region is the home base for a range of global life science businesses that are at the forefront of their respective niche markets and have billions in investment plans for increased production capabilities for current operations, as well as for production facilities for new products and solutions. The regional life science industry is characterised by early research and development, as well as production for global markets, with the largest business sectors being pharmaceuticals, biotechnological tools and equipment, contract manufacturing and in vitro diagnostics. In addition, the Uppsala Region has a strong start-up scene for entrepreneurs with a steady flow of knowledge-intensive companies every year, most of which stem from academic research.

Around the life science industry, there is also a variety of supportive and complementary industries, such as specialised small biotechnology companies, venture capital Samverkan har utvecklats under lång tid med ett unikt samspel mellan näringsliv, forskning och utbildning samt vård och omsorgssektorn. Actors, specialised legal advising and specialised service companies within, for example, industrial IT and technology. As a strength area in the Uppsala Region, the life science sector acts as an engine for the knowledge and innovation-based economy in adjacent industries.

The Uppsala Region is highly qualified in molecular biotechnology and bioprocessing, with a rich environment of technology companies built on academic ideas or as spin-offs from other companies. A key to success has been the region's strong history of scientific biomedical research in combination with industrial engineering expertise, as well as industrial and scientific teamwork in an emerging ecosystem of precision health and biological pharmaceuticals.

With its unique open test bed meant to accelerate the development of innovation, from ideas at laboratory scale to industrial production, Uppsala helps strengthen Sweden's competitiveness globally within the future of production systems for new generations of biomedicine. The Uppsala Region is industrially and scientifically well equipped for the medical revolution at the intersection of biology, process engineering and digitalisation.

BUSINESS SECTOR

The region's life science sector employs approximately 6,200 people. The combined turnover has increased to SEK 33 billion. The employment rate has increased by 55% since 2005, and the combined turnover by nearly 280%.

Uppsala is one of the biggest life science regions in the country, employing approximately 15% of the country's total workforce within the industry.

The life science sector is headed by a number of large influential companies with global markets, university spin-offs, strong environments of innovation, development projects and proximity to a world-class healthcare system.

Source: SCB 2019, regional processing

6.3.5.2 Research & education

The Uppsala Region's research and education sector is at the forefront of the life sciences, helping find and research solutions to the largest health challenges of our time, such as antibiotic resistance and widespread diseases, including cancer, diabetes, heart and vascular disorders and age-related diseases. Capabilities cover everything from understanding the origin of diseases and developing nanomaterials for biomedical application to northern Europe's largest research centres for pharmaceuticals, medicine, biomedicine and medical biochemistry. Within Sweden's largest clinical academic research organisation (*The Uppsala Clinical Research Center*) and in a shared laboratory environment (*The Rudbeck Laboratory*), research and education are combined with the hospital's clinical work and meetings with patients, all under one roof.

Uppsala also hosts the national research centre, SciLifeLab. With knowledge of everything related to life at the molecular level as its jumping-off point, the centre acts as a national resource offering specialists from both the research community and industry world the opportunity to discover and develop prototypes of new candidate medications

(*SciLifeLab Drug Discovery and Development Platform*). That knowledge ties into research into how pharmaceuticals can be delivered to and received by patients in as secure and accurate a way as possible (The Swedish Drug Delivery Platform).

The research and education sector of the Uppsala Region is also well equipped in the fields of precision health and targeted drugs (biological therapies) of the next generation, from cell culture, purification of medicinal substances to scaling up production from laboratory to industry scale. The Region's two universities (Uppsala University and the Swedish University of Agricultural Sciences) mobilise collaborative capabilities and resources.

(*The U-Share/Cells for Life Platform*) that, together with the clinical research in healthcare, provide industry-leading knowledge within medical cell biology, materials technology, image analysis, immunology, genetics and pathology. In an international open test bed in central Uppsala (*Testa Center*), researchers, students and companies collaborate using innovative production methods to create biological pharmaceuticals. Uppsala is also home to a national infrastructure in precision medicine (*Genomic Medicine Sweden*) for research and innovation in precision diagnostics, individualised treatments and better data for scientific studies.

The Uppsala Region's two universities (Uppsala University and the Swedish university of Agricultural Sciences) are also working together on two critical issues affecting humanity: antibiotic resistance and diabetes. The region offers an international and multidisciplinary research environment with a focus on antibiotic resistance (*Uppsala Antibiotic Center*), covering many aspects, from microbiology and pharmaceutical development to economic models, law and socioeconomic factors, in order to develop new antibiotics and new diagnostics for doctors and patients. The research on antibiotics ties into the field of "One health", whose focus is how diseases arise and spread between animals, environments and humans, the origin of epidemics and pandemics and the spread of antibiotic resistance. Uppsala also touts unique cross-sectoral capabilities in diabetes research (*Uppsala Diabetes Centre*), from the cellular level all the way to the societal level. The goal is to become a leading international forum whose mission is the decreased rate of people affected by the disease, improved treatment and minimised complications.

RESEARCH & EDUCATION

Approximately 70% of Sweden's research in life sciences is done in the Uppsala-Stockholm region.

Uppsala University (UU), the Swedish University of Agricultural Sciences and the clinical research at the region's two university hospitals, Uppsala University Hospital and the University Animal Hospital, are all drivers of the Uppsala Region's research and education sector.

The region offers a rich environment of knowledge within the life sciences, paving the way for scientific and clinical breakthroughs for the future of healthcare.

Source: 70% is based on research grants from the Swedish Research Council in 2017.

6.3.5.3 Public will of the region

There is strong and clear public will in the Uppsala Region for sustainable societal development. A central goal of sustainable societal development is happy and healthy inhabitants and health-enhancing societies that are dependent on a well-functioning and constantly progressing healthcare system, as well as research, education and innovation within the life sciences.

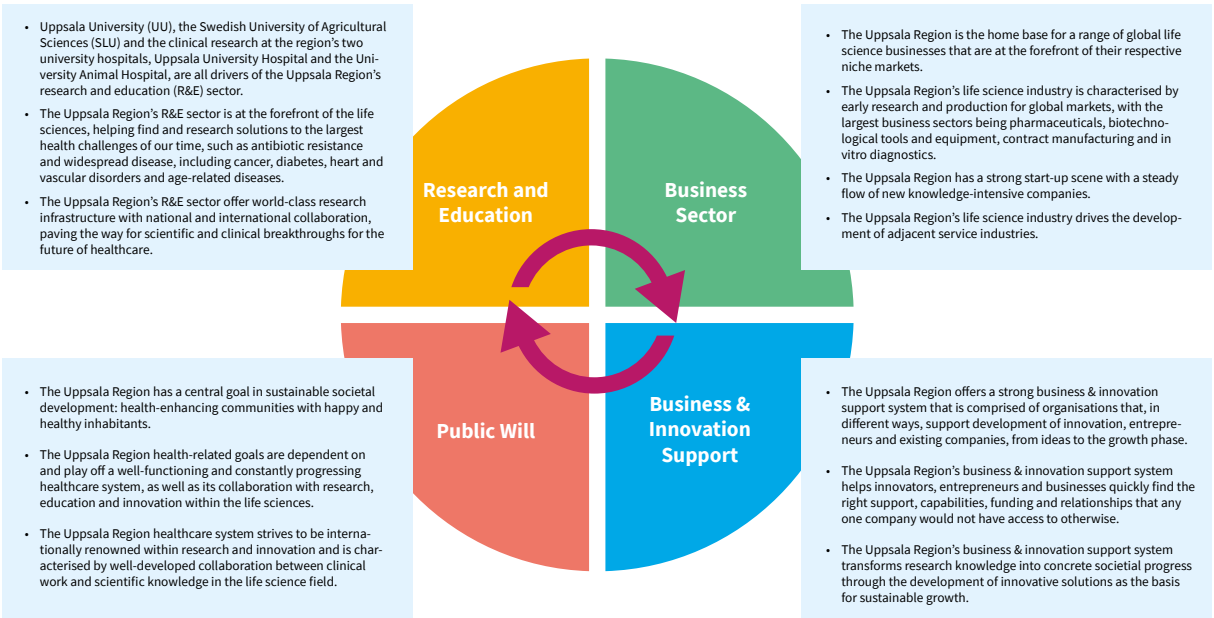
The regional development strategy, just like the 2030 Agenda strategy, for Uppsala County highlights the importance of "*Planning for societies that promote health and the transition to efficient and local healthcare.*" The Uppsala Region's work bridging health gaps are based on health determinants in community planning. The goal of local and efficient healthcare should permeate all ongoing work and the entire value chain, especially in terms of the opportunities offered by digitalisation. The two health-oriented objectives are supported by the goal of *developing the regional business and innovation system*, which emphasises the importance of meeting places and environments that foster knowledge flows and collaboration between research, industry, the public sector, entrepreneurs and investors.

The research strategy for healthcare in Region Uppsala 2021–2024.
In line with the Regional Council's strategic goal of becoming *Internationally renowned within research and innovation*, this research goal underlines the significance of research and innovation as a means to renew Region Uppsala's healthcare system and the services offered to inhabitants. Research and innovation should be world class, with beneficial and positive effects on patients' treatment and experience of the healthcare system. Clinical research is the foundation for the development of tomorrow's healthcare. In order to maximise the region's resources, Region Uppsala and Uppsala University have chosen to combine their strengths in several disease areas: cancer, cardiovascular disease, diabetes, mental health and infectious diseases, including antibiotic resistance. To be able to carry out world-class research and clinical development within these and other areas, it is essential to strengthen certain method areas, ergo the importance of high-quality pathology, medical imaging, epidemiology and a well-established infrastructure for precision diagnostics and medicine. The four areas that make up the Uppsala University Hospital's Centre of Excellence are also prioritised areas: neurotrauma, inflammation, endocrine tumours, type 1 diabetes.

The innovation strategy for healthcare within Region Uppsala: "Innovative care – how healthcare chains become value chains".
The innovation strategy will help to create a healthcare system that delivers the highest quality of care and efficiency to patients with an open and innovative organisation culture, as well as stimulate the development of the business sector through innovative solutions for the healthcare sector. The goal is to dissolve the borders between suppliers and customers, care providers and patients, and to clarify mutual dependencies and values. At a higher level, the goal is to strengthen the healthcare sector as a partner in companies' development of innovation and to help foster more innovation based on clinical research.

Efficient and local healthcare by 2030 with the goal of developing a healthcare structure that better meets inhabitants' needs through regional and municipal collaboration. To make the healthcare process more efficient for inhabitants, the regional healthcare sector is working towards four target areas: local, efficient, preventative and health-enhancing as well as co-creative care.

6.3.5.4 Summary of the common resource base

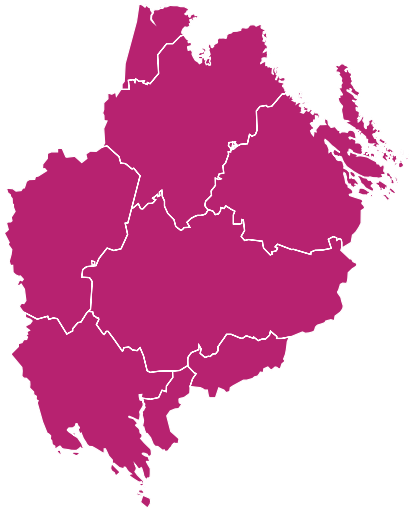


6.3.6 Desired position and target by 2030

Desired position & target by 2030

The Uppsala Region is a solutions-oriented and attractive place in the world for the development of innovative solutions for tomorrow's health & healthcare that improve and save lives.

The Uppsala Region is an exciting place, perfect for researchers, innovators, entrepreneurs, business founders and investors.



6.4 Strength area: Sustainable energy solutions in integrated energy systems – Testing & development of tomorrow's smart energy solutions for a faster transition to climate-smart products & services

The transition to a sustainable energy system, both nationally and globally, is one of the biggest challenges of our time. This strength area takes a systems-based approach to threats and opportunities within the field of energy. The world's, as well as the Uppsala Region's, energy use is a large complex system that is more or less interconnected. The system covers the entire value chain, from materials, production, storage, distribution and use to visualisation, testing, measuring and follow-up. Different energy sources and users impact and interact with each other in a myriad of different ways. At its foundation, the system is governed by market needs and political decisions. That said, we can also challenge and test out innovative energy solutions at the system level in physical environments from a needs and user perspective. This is where the Uppsala Region is well equipped and has strong potential as a catalyst for change in the transition to more sustainable, resilient and stable energy systems.

The Uppsala Region is characterised by forward-thinking climate leadership, which is largely driven by regional, municipal and national actors operating in the Uppsala Region. The climate work in the urban area of Uppsala has garnered attention thanks to a variety of distinctions and awards, such as "Global climate city 2018" and " The best climate city in Sweden 2020". The region's public leadership will also be bolstered by several development-oriented power grid companies that are testing out bold new solutions, forward-thinking property owners and a strong start-up scene for emerging entrepreneurs and start-ups within the field of energy. Uppsala has also become a national meeting place and test bed for energy and environment-related innovation in physical environments. The energy sector and the local/regional infrastructure for power and energy supply are reinforced by a strong environment for research and education within renewable energy sources, power distribution, energy storage systems, energy systems for buildings, energy data management and visualisation, etc.

Uppsala's Climate Protocol and the ambitious climate goals set out in the region's development strategy (as well as the 2030 Agenda strategy) provide a framework and roadmap for the continued development of the Uppsala Region as an action-oriented test bed, where innovation and renewal emerge and flourish at the intersection of various disciplines and industries. It is the region's broad expertise, strong

structures and courageous collaboration culture that make the Uppsala Region's energy industry so strong from a systems-based perspective.

The innovation themes below represent either the systems or the important subsystems that have to interact with each other.

6.4.1 Transition to and integration of renewable energies

A long-term goal for the Uppsala Region is the development of reliable and fossil-free socio-technical infrastructure. Renewable energy sources have to be integrated and interact with the energy system, where coordination between large and small-scale production of renewable energies, like solar, wind, water and bioenergy, plays an increasingly important role. In the Uppsala Region, research on renewable energy sources, sustainable societal transition and climate leadership are prioritised areas, and the region offers strong environments for technologies meant for everything from energy conversion and storage to fuel and energy transfer. The renewable energy production sector and its systems are a breeding ground for innovation that can also lead to the emergence of new actors and companies.

6.4.2 Energy system management and optimisation

There are several driving factors for innovation and renewal within the field of energy system management and optimisation. First, there is broad consensus regarding the benefit and need of energy usage that is more efficient if we are to achieve a sustainable energy system. Second, the capacity limitations of the region's and Sweden's power grids require freeing up grid capacity through local production flexibility, user flexibility and smart grids. Third, in line with the increased importance of renewable weather-dependent and seasonal energy sources within the energy system, there is also an increased need of understanding efficiency, identifying optimal circumstances for energy production vis-a-vis energy needs, balancing energy sources, etc. The Uppsala Region is at the forefront of knowledge and research and currently acts as a test bed for energy system management and optimisation. Within the region's research and education sector, there is knowledge of energy resource and system modelling and simulation in the built environment, as well as knowledge of measuring technology and methods that can be applied within the field of energy systems. Property owners already act as users and stakeholders in the development of new and improved methods for energy management. The Uppsala Region also has northern Europe's most comprehensive and open test bed for solar cell installation with its own energy portal where users can access open data from solar power plants in operation.

6.4.3 Testing & integration of sustainable energy systems in physical environments

This innovation theme is not necessarily about energy technology, rather about the process experience of consolidating needs with innovative solutions within the field of energy. The Uppsala Region has a wealth of experience in testing and experimenting with innovative solutions in physical environments with the collaboration of stakeholders, students, researchers and industry. New technology for solar and wind power production, new materials for energy storage and new management and optimisation methods are being tested out and developed across the region. The Uppsala Region is and can, to an even greater extent, become an open and attractive place for the development of sustainable energy solutions and systems that is driven by knowledge and curiosity and adapted to real needs. This development is led by a strong business and innovation support system that acts as an engine and collaborative force between property and industry stakeholders and solution and information suppliers. All in all, the Uppsala Region possesses the expertise, networks and process experience to continue to act and grow as an open and innovative region for testing and developing sustainable energy solutions.

6.4.4 The common resource base

6.4.4.1 Business Sector

It is not an isolated observation of the magnitude of the energy industry that makes the Uppsala Region interesting. Rather, it is the region's desire, knowledge and ability to test out new solutions – to genuinely test out solutions in physical environments through the collaboration of energy users and customers, as well as of producers, distributors

and small innovative companies that present new solutions to energy-related challenges. Our region is characterised by multiple development-oriented power grid companies that are testing out bold new solutions, by forward-thinking private and public property owners, by water, plumbing and energy actors, as well as by a strong start-up scene for emerging businesses within the field of energy. In this challenge-based system of actors, students and researchers from the region's universities are an invaluable resource that challenge, contribute knowledge and present new solutions to stakeholders' challenges and needs – solutions that also lead to new businesses within the field of energy. In summary, the Uppsala Region's action-oriented collaboration culture and ecosystem of private and public actors are what position the region as a positive catalyst for change in the energy transition and issue of grid capacity.

It is not solely the "energy sector" that will develop solutions to facilitate the energy system transition and remove power grid limitations. Historically, Uppsala Region has been and continues to be a flourishing "breeding ground" for emerging entrepreneurs and businesses that fall outside the traditional definitions of the energy sector, but whose innovative ideas and solutions have led to sustainable achievements within the field of energy.

Examples include innovative materials that enable electricity-producing windows, renewable cathode materials for batteries, AI solutions for optimal electric car charging and 3D printing to significantly reduce CO_2 emissions in industrial production.

Our region is breaking new ground at the crossroads between disciplines and industries. In the Uppsala Region, advanced solutions meant for space capsules and satellites are being transformed into direct energy solutions for societies on Earth, like drone technology for monitoring energy systems or energy savings in buildings. In our region, technical innovation is interwoven with knowledge of issues affecting regulations, human behaviours and attitudes, which is a key to success to truly achieve a sustainable energy transition.

BUSINESS SECTOR

The core of the energy sector within the Uppsala Region consists of 60 businesses within nuclear power, renewable energy production, power distribution, energy efficiency and district heating, all of which employ a total of 2,333 individuals. The employment rate has increased by 50 % within the last 10 years.

The Uppsala Region has built its experience as industry leaders around experimental development in physical environments through private and public collaboration for a sustainable energy transition.

Historically, the Uppsala Region has been and continues to be a flourishing "breeding ground" for emerging entrepreneurs and businesses whose innovations have led to sustainable achievements within the field of energy.

The energy industry is headed by large innovative power companies, public and private property owners, energy efficiency companies, university spin-offs, innovative start-ups, development projects as well as physical test environments within private and public businesses.

Source: Regional processing of data based on the report, "Structural Transformation and Academisation – the Changing Energy Industry 2007-2017" (The Swedish Energy Association)

6.4.4.2 Research & education

The Uppsala Region's two universities, Uppsala University (UU) and the Swedish University of Agricultural Sciences (SLU), are a collective resource of world-class research and education in the field of energy.

Within the region's research sector, there is a broad spectrum of knowledge, from cutting-edge technology to systems-based knowledge for tomorrow's sustainable energy supply. Within renewable energy production, much of the research is going into, for example, artificial photosynthesis, solar cells as well as water, wave and wind power. The region's research also offers revolutionary capabilities in bio-based energy supply from agriculture and forestry in the form of solid biofuel, biogas and biofuels for cars, electricity and heat. The research into a sustainable energy transition also ties into the development of algorithms and software that provide the energy industry with solutions to large-scale technical problems, for example, within power plants, power systems, atmospheric research, ocean research and the automotive industry.

Knowledge of seasonal and weather-dependent energy production interacts with knowledge about power distribution and systems for energy storage. The region's strong material capabilities help steadily improve current battery technology and pave the way for electric energy storage that is entirely based on renewable organic materials. With knowledge of green nanotechnology and magnetic materials as the basis, solutions are also being developed that open the door for innovative energy-saving technology. This research also facilitates the electrification of society. Research-heavy areas include everything from electric power trains and smart material choices for electric machines to grid integration and charging infrastructure, all of which are characterised by scientific and industrial collaboration (for example, within *"Swedish Electromobility Centre"* and *"Electric Aviation in Sweden"*).

RESEARCH & EDUCATION

At Uppsala University and the Swedish University of Agricultural Sciences, there is a broad spectrum of knowledge development, from cutting-edge technology to systems-based knowledge for tomorrow's sustainable energy supply.

Knowledge of solar cells and water, wave and wind power play an active role in innovative material development, ground-breaking energy storage solutions and electrification.

The Uppsala Region also offers expertise and instrumentation for the testing and development of fusion energy to world-class facilities across the globe.

The region's research environments produce students, innovators and companies that all present crucial solutions to the energy transition.

The region's research is also heavily marked by academic and industrial collaboration at both the national and international levels. As part of the European initiative, "*KIC InnoEnergy*", the Uppsala Region contributes both programmes and innovation projects, where academia and industry actors work together to develop technology for smart power grids and electric energy storage. Within *"STandUP for Energy*", the region's universities have teamed up with other strong research entities to find solutions to climate change and the transition to a sustainable energy supply. Most of the programmes at the bachelor's and master's levels create a pool of capable and innovative individuals and companies that are heading the energy transition. A successful example is *"Energy Stories*" where students and stakeholders work together to develop new solutions to specific energy-related challenges.

6.4.4.3 Public will

Regional development strategy – with the goals of developing reliable and fossil-free socio-technical infrastructure as well as a transport-efficient society with accessible and sustainable transports. The region's environmental and energy-related challenges are primarily reflected in the goals of *Developing reliable and fossil-free socio-technical infrastructure and a transport-efficient society with accessible and sustainable transports*. Increased coordination between the large and small-scale production of renewable energy, like solar, wind, water and bioenergy, is becoming increasingly important. To be able to secure energy access, different kinds of energy storage need to be created. The issue of electric power is a major challenge as well as one of the most important regional coordination issues. The increasing electrification of society is evidence of the importance of a well-coordinated development of primary energy supply, power production and power distribution that goes in step with technology shifts, increased construction and expansion of the business sector. A transition to efficient and sustainable freight transports is essential, and electrification and digitalisation play important roles in that. For sustainable transports, it is also necessary to secure increased access to renewable fuels, along with more efficient transport patterns and vehicles. This includes electricity, as well as expanded infrastructure for charging and refuelling.

The Uppsala Region's climate and energy strategy with an action programme to reduce climate impact. The country's quantitative goals within the climate and energy fields are also shared by the Uppsala Region. Additionally, the energy system must also be robust and competitive, with a low climate impact. In order to operationalise the climate and energy strategy, an action programme to reduce climate impact has been put together. The action programme lays out a number of measures within the prioritised areas of transport and work machines, energy and

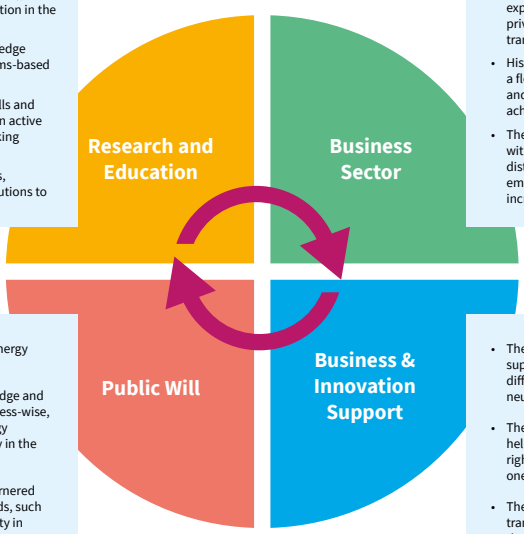
power efficiency, renewable energy and the indirect climate impact of consumption. The programme also includes proposals of actions to inspire people to adopt more climate-smart lifestyles, visualise climate, energy and sustainable development in schools as well as educational and information initiatives for decision-makers. The areas concern the region's important sectors of agriculture and forestry, knowledge, innovation, entrepreneurship and community planning, which includes the public sector. The region's actors are invited to sign the Sustainability Promises by committing to implement climate and energy measures from the action programme.

The Climate Protocol – mobilisation to accelerate climate work.

Uppsala's Climate Protocol is a network of companies, public organisations, universities and associations that work together and inspire each other to achieve the Uppsala Municipality's climate goals: fossil free and renewable by 2030 and climate positive by 2050. 42 members consisting of 38,000 employees are collaborating to accelerate the transition and tackling 30 formulated climate challenges within the areas of: energy, transport and work machines, travel, as well as other indirect climate impacts. The approach laid out in the Climate Protocol was inspired by the UN's Climate Convention and helps Uppsala achieve its long-term environmental and climate goals.

6.4.4.4 Summary of the common resource base

- The Uppsala Region's two universities, Uppsala University (UU) and the Swedish University of Agricultural Sciences (SLU), are a collective resource of world-class research and education in the field of energy for industry, commerce and society.
- Within the region, there is a broad spectrum of knowledge development, from cutting-edge technology to systems-based knowledge for sustainable energy supply.
- The Uppsala Region also offers knowledge of solar cells and water, wave and wind power. That knowledge plays an active role in inovative material development, ground-breaking energy storage solutions and electrification.
- The region's research environments produce students, innovators and companies that all present crucial solutions to the energy transitition.



- The Uppsala Region has built its leading experience around experimental development in physical environments through private and public collaboration for a sustainable energy transition.
- Historically, the Uppsala Region has been and continues to be a flourishing "breeding ground" for emerging entrepreneurs and businesses whose innovations have led to sustainable achievements within the field of energy.
- The region's private energy sector is made up of 60 companies within nuclear power, renewable energy production, power distribution, energy effecieny and district heating, all of which employ a total of 2,333 individuals. The employment rate has increased by 50 % within the last 10 years.

- The public will of the Uppsala Region regarding the energy sector is clear and reinforces the strength area.
- The public will emphasises the importance of knowledge and challenge-based innovation – technology-wise, business-wise, socially and organisationally – to accelerate the energy transition, intensify climate work and free up capacity in the power grid.
- The climate work in the urban area of Uppsala has garnered attention thanks to a variety of distinctions and awards, such as "Global climate city 2018" and "The best climate city in Sweden 2020".

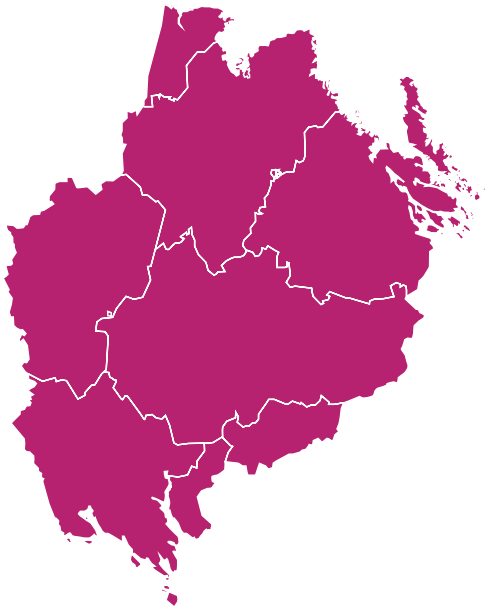
- The Uppsala Region offers a strong business & innovation support system that is comprised of organisations that, in different ways, support development of innovation, entrepreneurs and existing companies, from ideas to the growth phase.
- The Uppsala Region's business & innovation support system helps innovators, entrepreneurs and businesses quickly find the right support, capabilities, funding and relationships that any one company would not have access to otherwise.
- The Uppsala Region's business & innovation support system transforms research knowledge into concrete societial progress through the development of innovative solutions as the basis for sustainable growth.

6.4.5 Desired position and target by 2030

Desired position and target by 2030

The Uppsala Region is a solutions-oriented and globally attractive place for the co-creative and experimental development of sustainable energy solutions.

The Uppsala Region is an exciting place, perfect for researchers, innovators, entrepreneurs, business founders and investors.



6.5 Strength area: Circular bioeconomy – development of new products and energy sources founded on primary production for a bio-based societal transformation

A region's "green growth" is often equated with the development in its green industry, which is to say the companies that have their basis in primary production, such as agriculture, forestry and fishing. Sometimes, industries that are farther down the green value chain are also included, such as the food and forest industries. According to these metrics, the Uppsala Region doesn't stand out from an employment perspective. Within the region, close to 3,000 people are employed in the green industry, and the industry's 63% growth in the region over the last 10 years is on par with the rest of the country. However, a look back shows that the Uppsala Region's green industry is performing better than the rest of the country based on a value added and turnover perspective. While Sweden's green industries have increased their turnover by 113% and their value added by 132% over the last 10 years, the Uppsala Region's green industries increased by 131% and 184%[3], respectively.

As the journey towards a post-fossil society continues, it also becomes interesting to estimate the demand for bio-based materials within other industrial sectors, rather than solely assessing the magnitude of the green industry in isolation. The combined turnover of the Uppsala Region's bioeconomy is estimated at approximately SEK 27 billion, 50% of which stems from the green industry and the other half from industries that are not normally defined as "green".[4] The transformation into a bioeconomy means renewed value chains, which would give rise to a new production logic and new types of businesses based on bio-based raw materials. The Uppsala Region has a material and production-centric business sector, which serves as proof of the region's openness to the development and use of new bio-based solutions.

The Uppsala Region is also characterised by large pieces of land for agriculture and forestry, where the forest companies also use somewhat larger pieces of land than the average company in the country and a significantly larger proportion of the companies work in crop production. In the bioeconomy, future green industries within primary production can be seen as broad suppliers of bio-based materials for other industries that will be gradually weaning off their fossil dependency. Bio-based waste streams (branches, twigs, sticks, straw, lignin, cellulose, etc.) from agriculture and forestry can be used more efficiently to produce high-value green products and chemicals, as well as fuel, electricity and heat. Wood, pulp and food will all remain fundamental, but new products and services will be added when the fossil material flows are replaced by biomass and the need for sustainably produced food increases. For that, Uppsala can provide world-class research on ecosystem services, bio-based production systems, sustainable materials and renewable energy.

The market for bio-based raw materials is global, but also regional. The expansion of the southern parts of Uppsala, together with other societal development in the region, can serve as early testbeds where biological cycles meet technical cycles. Nutrients, circular biogas, green hydrogen and organic materials will be the basis for new products and energy solutions (biological cycle) that are continuously recycled within closed-loop flows (technical cycle). Green products in circular flows will also help the bio-based societal transformation. The keys to success in this green transformation include technology, the economy as well as behaviours. Here, the Uppsala Region plays an important research and knowledge role in Sweden's journey to become a fossil-free welfare state by 2045.

[3] SCB 2009–2019

[4] 2019: Regional processing of "Breakdown of bioeconomy in Swedish industry", SCB 2017: Agriculture, forestry, fisheries, food, pulp/paper and wood production: 100%, Energy 24%, Water and waste 30%, Construction 17%, manufacturing of chemicals and pharmaceuticals 15%, machine manufacturing 11%, manufacturing of plastic and rubber 7%, services 0.3%.

Through continued collaboration to develop knowledge and innovation, the Uppsala Region can develop an ecosystem for a circular bioeconomy within the innovation themes below.

6.5.1 Combined circular biogas & hydrogen production

The World Wide Fund for Nature, WWF, has named Uppsala the "The best climate city in Sweden 2020", and biogas is highlighted as a very important part of Uppsala becoming fossil free by 2030. Through public and private collaboration, Uppsala has, for a long time, had established circular production, distribution and use of biogas, which also includes returning biofertiliser for agriculture. In conjunction with the biogas production, the region is also well equipped in terms of knowledge and capabilities for the production of green hydrogen as fuel from solar and wind, for energy storage or as a "raw material" for green fertiliser and materials.

6.5.2 Green chemicals and production from agriculture and forest resources

Wood and plants can be used for a lot more than simply manufacturing paper or burning for energy. Bio-based materials can replace the fossil-based content of construction materials, packages, plastics and textiles, as well as contribute other value-adding product properties, such as lightweight, strength, management and storage of energy and health-enhancing properties. This kind of processing requires knowledge of the connection between primary production and raw material properties, from the nano to the macro levels, in order to produce industrially useful bio-based materials, meaning renewable materials that help achieve renewability in many of the industrial sectors that must decrease their fossil dependence. The Uppsala Region has that knowledge. Uppsala offers leading knowledge of the entire value chain, from primary production in agriculture and forestry to the properties of different materials and fuels. Uppsala's unique expertise focuses on the question of how bio-based waste streams from agriculture and forestry can be utilised efficiently and sustainably to produce, for example, products, fuel, electricity and heat.

6.5.3 Digitalised, electrified and automated agriculture & forestry

Uppsala is a national innovation hub with a blend of strong research expertise in optimal agricultural and forestry conditions on one end and industrial digital solutions for precise cultivation and fossil-free and automated machines for agriculture and forestry on the other. That expertise combined with the two physical test beds for the development of digital agricultural and forestry technology lays the groundwork for the emergence of digital innovation for a more efficient agriculture and forestry industry and more sustainable primary production for food.

6.5.4 Circular energy and food production

The Uppsala Region combines both research and industry knowledge within several of the subsystems that have to interact in order to address a global societal challenge: the production of more food for a growing population with fewer resources, where the use of raw materials, input goods, land and water is optimised, while waste and garbage decrease and the recycling of water, energy and nutrients increases. In a circular system, the food chain's waste and by-product streams can also become new sources of food and energy or other processed products with higher value for both society and individual entrepreneurs. More sustainable food production also ties into the need for "food innovation", where Uppsala is able to offer both expertise and entrepreneurship with regards to health-enhancing, climate-smart and protein-rich food for future generations.

6.5.5 The common resource base

6.5.5.1 Business Sector

The definition of the Uppsala Region's green industry needs to be expanded to also include companies that, to an increasing extent, use bio-based materials as well as contribute technical and digital solutions, services and new green design solutions. In the bioeconomy, tomorrow's green industries within primary production will continue to be seen as important suppliers of bio-based materials that are refined and transformed into green solutions, products and services in other industries that are gradually becoming fossil independent.

BUSINESS SECTOR

The Uppsala Region is among the country's fastest growing regional bioeconomies.

The bioeconomy in the Uppsala Region employs approximately 6,922 people. The total turnover has increased to SEK 27 billion, 13 billion of which is connected to green industry. SEK 14 billion stems from industries that are not normally classified as "green".

The employment rate has increased by 40% (nationally 37%) since 2009 and the total turnover by 88% (nationally 87%).

The bioeconomy is headed by the green industries and other industry sectors that are gradually phasing out fossil-based materials and fuels with bio-based solutions.

Source: Regional processing of "Breakdown of bioeconomy in Swedish industry 2009-2019", SCB.

From the statistically rough descriptions of the bioeconomy's introduction into Swedish industry on a national level, it is possible to deduce a number of sectors of strategic importance for the Uppsala Region, such as the life sciences and biofuels, as well as industry sectors that process polymeric, cellulose-based and metallic materials, including, for example, the construction sector and the engineering industry. Around the manufacturing industry, there is also a supporting service sector emerging.

The bioeconomy's significance in the entire economy of Sweden's regions can be expressed as the proportion of the total value added and the total turnover that is thanks to the bioeconomy. The bioeconomy's value added on the national level has increased to approximately SEK 289 billion, of which the value added for the Uppsala Region has increased to SEK 9.1 billion. The bioeconomy's turnover and value added are growing somewhat faster in the Uppsala Region than the national average. Between 2009-2019, the value added of the bioeconomy increased by 90% in the Uppsala Region, compared to the 85% national average. Although marginal, the bioeconomy's turnover in the Uppsala Region has increased more than in the country as a whole over the last 10 years: 88% in the Uppsala Region compared to the 87% national average.

The bioeconomy in the Uppsala Region also appears to be growing in terms of employment, with an expanding job market. The Uppsala Region's bioeconomy is estimated to employ just over 6,900 people. Between 2009-2019, the employment rate tied to the bioeconomy increased by 40% in the Uppsala Region, compared to the national average of 37%. All in all, albeit marginal, the Uppsala Region's bioeconomy stands out in comparison to the rest of the country based on value added, turnover and employment rate. Based on these metrics, the Uppsala Region appears to be climbing the list of Sweden's bioregions.[5]

6.5.5.2 Research & education

The Uppsala Region's universities, the Swedish University of Agricultural Sciences (SLU) and Uppsala University (UU), are important "knowledge engines" in the bio-based transformation of society. Examples of the region's unique expertise include how bio-based waste streams from agriculture and forestry can be utilised efficiently and sustainably to produce, for example, green chemicals, fuel, electricity and heat, as well as how people, thanks to nanotechnology, can use renewable organic materials for energy storage, hydrogen and biomedical applications. The region's universities offer a range of programmes at the bachelor's and master's levels, establishing a pool of capable and innovative individuals who provide the region's industry with vital skills and are driving the development towards a bio-based economy and the energy transformation.

Within the research platform, **bio-based materials and fuels**, interdisciplinary knowledge and collaboration come together, from primary production within agriculture and forestry to the production of new bio-based materials and fuels. Here, research is being done on the connections between primary production and raw material properties, from the nano to the macro levels, which serves as a basis for the production of raw materials with desired properties.

This research also leads to critical knowledge about raw material processing, i.e., understanding the fuels, as well as how these can be produced in a sustainable and financially profitable way, using, for example, life cycle analyses, automation and cycle technology. Within the field, programmes are offered connections between biological raw materials and

[5] 2009-2019: Regional processing of "Breakdown of bioeconomy in Swedish industry", SCB 2017

RESEARCH & EDUCATION

The Uppsala Region's universities are important "knowledge engines" in the transformation – from fossil-based materials and fuels – to bio-based solutions.

The Uppsala Region's research & education is interdisciplinary and carried out in collaboration with the business sector, everything from agricultural and forestry enterprises, paper and mass, producers and distributers of food, to the energy, automotive and construction sector.

Treesearch, Bioinnovation, Mistra Food Futures, Blue food, SustAinimal och Plant based proteins are a few examples of investments where the Uppsala Region's research contribute with bio-based innovation.

desirable properties in bio-based materials and at the introductory, master's and research levels. On the energy side, the area of expertise is supported by **The Centre for Biogas** with its own biogas facility just outside of Uppsala's urban centre. The full-scale production facility provides capabilities across the biogas production chain.

The Uppsala Region's research is also a part of **Treesearch** and **Bioinnovation** – national initiatives that are laying the groundwork for research-based production processes, future materials, green chemicals and innovation from the forest, helping make Sweden a leader in achieving a circular bio-based economy. Through broad academic and industrial collaboration, the competitiveness of the Swedish industry is strengthened and young talent is attracted to aid in the transition from fossil material flows to bio-based solutions.

Within the area, **Sustainable and secure food supply**, leading research groups from a range of different areas are working, and the Uppsala Region's universities are spearheading and participating in a number of multidisciplinary and industrial collaborations for tomorrow's sustainable food systems. The capabilities range from the potential of bio-based raw materials in the future supply of food, such as crops, legumes, berries and proteins from marine plants, to food security, microbiology and food technology.

The transformation of the food system also requires an understanding of system innovation in experimental food production using bio-based raw materials. That knowledge also exists in the Uppsala Region's research and education environments.

6.5.5.3 Public will of the region

The public sector's ambitions regarding the theme, bioeconomy, fit generally into the regional development strategy for the Uppsala Region, primarily under the goals for a sustainably growing region:

- Develop reliable and fossil-free socio-technical infrastructure
- Viable natural environments and sustainable food supply

These goals are matched with the strategy's goals for an innovative region with an emphasis on renewal and innovation in the business sector.

- Develop the regional business and innovation support system
- Develop and connect companies, academia and public organisations.

The transition to a fossil-free society means that water, energy, nutrient and material flows would be handled within local cycles to a considerably greater extent, placing new demands on technical infrastructure. Increased coordination between the large and small-scale production of renewable energy, like solar, wind, water and bioenergy, is becoming increasingly important. In order to enable sustainable food production in accordance with the 2030 Agenda, the region's fertile land needs to be fully utilised. Sustainable production depends on an efficient use of resources, regard for ecosystem services, reduced environmental impact and long-term financial viability. There is a wealth of knowledge on these topics within the region, which is a very important resource for innovation.

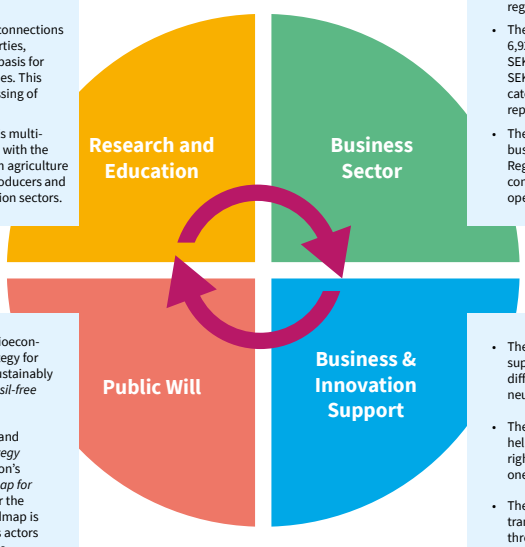
There are also good examples of public businesses acting as driving forces within the market thanks to their demand for fossil-free solutions. The region's public transit fleet will also be fossil-free starting in 2022. The amount of renewable fuel has also increased from 62.8% in 2018 to 72.2% in 2020, where the increase in the amount of ethanol, compressed natural gas, HVO, electricity and electric

hybrids comes at the expense of petrol and diesel. In terms of materials, the healthcare sector now has bio-based alternatives for nearly every product on the reduction list for consumables, which is a governing document within the sector's environmental management system, ISO 14001.

The more specific investments into the environment and energy are formulated in the Climate and energy strategy for the Uppsala Region, as well as in the Uppsala Region's environmental goals & action programme, "Roadmap for a sustainable region", which acts as a driving force for the bio-based societal development of the region. The production of renewable electricity and renewable fuel is one of four prioritised areas because it requires increased investments to achieve 100% renewable electricity production and reduced climate impact from the transportation sector. Making energy usage more efficient and switching to renewable fuels and efficient technology are both guiding principles for transports as well as material and energy use. Four action programmes are included in the roadmap that was put together and is being implemented through the broad collaboration of the region's actors within operational innovation teams and focus groups for areas such as sustainable urban development, which helps increase the use of recycled/renewable energy and fossil-free fuel, phase out fossil-based plastic and produce solar cell-generated electricity.

6.5.5.4 Summary of the regional resource base

- The Uppsala Region's universities are leading "knowledge engines" for the transition from fossil-based materials and fuel to bio-based solutions.
- In the Uppsala region, research is being done on the connections between primary production and raw material properties, from the nano to the macro levels, which serves as a basis for the production of raw materials with desired properties. This research leads to critical knowledge about the processing of bio-based raw material.
- The Uppsala Region's research and education sector is multi-disciplinary and flourishes thanks to its collaboration with the region's business sector, consisting of everything from agriculture and forestry companies, pulp and paper as well as producers and distributors from the food, automotive and construction sectors.



- The Uppsala Region has one of the country's fastest growing regional bioeconomies.
- The bioeconomy in the Uppsala Region employs approximately 6,922 people. the combined turnover has increased to SEK 27 billion, 13 billion of which is tied to the green industry. SEK 14 billion stems from industries that are not normally categorised as "green", i.e., other industries that are gradually replacing fossil material flows with bio-based solutions.
- The bioeconomy entails new value chains and new types of businesses founded on bio-based materials. The Uppsala Region has material and production-centric industry and commerce, which serves as proof of the region's continued openness to bio-based solutions.

- The public sector's ambitions regarding the theme, bioeconomy, fit generally into the regional development strategy for the Uppsala Region, primarily under the goals for a sustainably growing region: For example, *Develop reliable and fossil-free socio-technical infrastructure*.
- The more specific investments into the environment and energy are formulated in the *Climate and energy strategy for the Uppsala Region*, as well as in the Uppsala Region's environmental goals and action programme, *"Roadmap for a sustainable region"*, which acts as a driving force for the bio-based social development of the region. The roadmap is implemented in broad collaboration with the region's actors within operational innovation teams and focus groups.

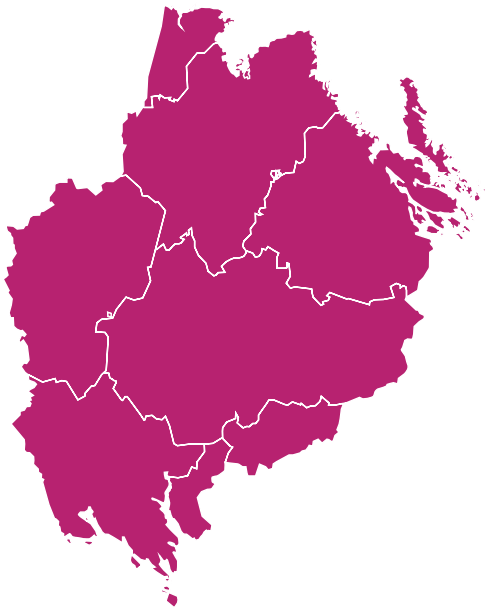
- The Uppsala Region offers a strong business & innovation support system that is comprised of organisations that, in different ways, support development of innovation, entrepreneurs and existing companies, from ideas to the growth phase.
- The Uppsala Region's business & innovation support system helps innovators, entrepreneurs and businesses quickly find the right support, capabilities, funding and relationships that any one company would not have access to otherwise.
- The Uppsala Region's business & innovation support system transforms research knowledge into concrete societial progress through the development of innovative solutions as the basis for sustainable growth.

6.5.6 Desired position and target by 2030

Desired position and target by 2030

The Uppsala Region is a solutions-oriented and globally attractive place for innovation and new kinds of businesses that accelerate the replacement of fossil-based resources with renewable ones and enable the transformation of linear material flows into efficient cycles, where waste is turned into resources and new products.

The Uppsala Region is an exciting place, perfect for researchers, innovators, entrepreneurs, business founders and investors.



7. Horizontal priorities that reinforce all strength areas

7.1 "Tech" – digitalises, automates and/or develops production, products and services based on software.

Tech is, by and large, part of all development and innovation processes and has a crucial impact on the future of products, services and on societal development at large. Tech improves our businesses and makes them more efficient, while challenging our accepted views of business models, industries and the creation of renewal and innovation, all of which is happening at an exceptional pace. At the same time, there is a tendency to equate both digitalisation and "connectivity" with "smart". The ultimate benefit is just as much in the actual technology, as it is in the understanding of the user, business and the actual significance of digitalisation in revolutionary innovation and transformation. The Uppsala Region has a broad range of capabilities within digitalisation – everything from in-depth research into the fundamentals of digitalisation, including artificial intelligence, machine learning, data technology/systems, visualisation and simulation, to a diverse business sector that transforms digital capabilities into software and hardware with wide range of applications. The Uppsala Region also offers a strong start-up scene for small innovative businesses with digital solutions for consumers, industries and society. Uppsala's research and education as well as its business sector infuse the region with young digital generations with the potential to integrate both digital expertise and natural digital approaches into a wide range of industry sectors within the region.

In summary, the regional capabilities within this area are general – a broad "superpower" that challenges and creates entirely new conditions for all industries and businesses.

7.2 "User-driven innovation & system transformation" – a building block for transformative renewal and innovation.

Promoting innovation often tends to focus on technology as well as the emergence and realisation of revolutionary ideas. However, the ultimate societal value that innovation brings is about distribution, use and the actual benefits created. Support structures and knowledge dissemination for innovation are, for the most part, adapted to technology and scientific research, while research and innovation are, to an increasing extent, expected to address current societal challenges in the 2030 Agenda, where perspectives from the social sciences and humanities are needed. The "hardware at the tip of the iceberg" created by sustainable societal development, which comes in the form of new technology and physical solutions in physical geographical spaces, must incorporate and interact with knowledge of human needs, behaviours and actual conditions, such as norms, laws and rules. That kind of "system transformation", built on social and more humanities-based perspectives, paves the way for technological achievements as well as healthy and inclusive societies.

Transformative renewal and innovation for the sustainable transition of society requires challenging scientific questions, experimental methods and innovation that is understood and accepted by civil society, from, for example, ethical and behavioural perspectives, in order to be able to spread and create value. The societal perspective of transformative knowledge & innovation also includes regulatory issues that need to be challenged, tested and maybe even renewed in order for value to have the practical means to be realised. To achieve a modern knowledge-based society built on transformative innovation, it is perhaps necessary for society to act as a lab, i.e. a *"community lab"*.

The Uppsala Region is well equipped for this broader approach to transformative and value-creating innovation. Various methods for involving stakeholders and customers have been developed and tested for a long time (Hackathons, AIMdays, service design, etc.), a few of which have also been "exported" and used far outside the region's borders. The region also offers theoretical research and education as well as practical experience regarding the interaction between societal development and human behaviours, ethical stances and philosophies. Law, community planning and balancing different public interests in development issues are also prominent fields within the region's research and education. In summary, "User-driven innovation & system transformation" is a necessary ability that reinforces all the Uppsala Region's strength areas.

7.3 "The business and innovation support system" – a world-class ecosystem for entrepreneurship, innovation and utilisation of research.

Several rankings show that the Uppsala Region is one of Europe's most innovative regions with continued strong growth potential. To fully utilise our incredible conditions for innovation and growth, the Uppsala Region's business and innovation support system is important because knowledge-intensive development requires different types of support, management and collaboration in order to succeed. "The system" supports all of the strength areas with its capabilities, innovation development, business development, business building, funding and contacts with cross-industry capabilities that any one innovator would not have access to otherwise. We have a wide range of exciting companies and innovators in an array of different industries in all parts of the Uppsala Region. Inclusive collaboration, openness and courage between the system's leading actors and businesses, regardless of where they are based geographically, are all culture-bearing key words that continue to put our region on the map of industry-leading innovation regions in Europe. In summary, the Uppsala Region offers a comprehensive, interconnected, and reputable business & innovation support system that drives the development of innovation and growth in breadth and depth. Broken down into general sections, "the system" can be summarised as the following:

- University-connected innovation and entrepreneurship. (For example, Uppsala University Innovation, Uppsala University Collaboration, Ångström Materials Academy. University-connected innovation and centre of excellence, STUNS, RISE)
- Innovation parks and incubators. (For example, Uppsala Innovation Center, Green Innovation Park, BASE 10, Uppsala Science Park, Uppsala Business Park)
- Cluster organisations and innovation platforms. (For example, STUNS Life Science, Region Uppsala Innovation, STUNS Energi, Testa Center)
- Business-supporting private actors. (For example, Almi, Almi Invest, The Stockholm-Uppsala Chamber of Commerce and Industry, the Regional Export Collaboration, Drivhuset, Connect Uppsala)
- Public business-supporting public actors. (For example, Region Uppsala, the region's 8 municipalities, the County Administrative Board).

8. External demand for Uppsala Region's capabilities within the strength area

Thus far, the region's resources within each respective strength area have been presented. To be impactful, Smart Specialisation, as a method, emphasises the importance of looking beyond known industry and current business logic. That is why we, in the Uppsala Region, account for and understand the significance of trends and priorities in the world around us. It clarifies the connections between the geographically-bound perspective for our region and national and global circumstances. The "region-specific" description of our research, education, industry and public ambitions given thus far must be complemented with a perspective on demand from outside the region.

In short, is there any demand for our capabilities and resources, both today and tomorrow? Can the Uppsala Region, as a very small geographical point in the northern hemisphere, further strengthen its position as a solutions-oriented partner of knowledge and innovation in international markets?

The UN's global sustainable development goals, the 2030 Agenda as well as national and international strategies and programmes all identify complex and urgent societal challenges. These challenges indicate the acute need for solutions, investments, emerging markets, and new business logic for a sustainable world. In this development, the expertise and innovation capabilities of the Uppsala Region within the strength areas have a very important role to play.

The world needs the Uppsala Region to become more sustainable.
The 2030 Agenda as well as national and international strategies indicate an acute need for solutions, investments, and emerging markets.

In this development, the expertise and innovation capabilities of the Uppsala Region within the strength areas have a very important role to play.

8.1 Connecting the strength areas to the 2030 Agenda

The regional development strategy for the Uppsala Region is also the region's 2030 Agenda strategy. In practical terms, this means that all development efforts conducted are, either directly or indirectly, in line with the 2030 Agenda. The agenda provides direction for strategies and processes and supports Uppsala, Sweden and the world on their journey towards sustainability. The present smart specialisation strategy clarifies and underlines the importance of innovation in solving both the challenges of the Uppsala Region and the challenges and goals laid out in the 2030 Agenda. Here, we have great opportunities for challenge and knowledge-based innovation, while also making the world a little better place. The Uppsala Region's strength areas and horizontal priorities serve as powerful tools to achieve the 2030 Agenda goals, and they position our region as a solutions-oriented place in the world.

Innovative materials: Sustainable societal development largely depends on the possibilities and limitations of materials as well as the extent to which achievements within the field of materials have practical industrial and societal use. Here, the Uppsala Region and this strength area provide both capabilities and continued opportunities for innovative solutions. This strength area is strongly connected to Goals 7, 8, 9, 11,12 and 13.

Life Science for the future of health and healthcare: Good health is a fundamental requirement for a sustainable society. This strength area of the Uppsala Region very clearly supports the development of solutions to tomorrow's challenges within health and healthcare through new and improved diagnostic methods, new medical technology tools, new targeted therapies, and an even deeper understanding of how diseases spread between animals, environments and humans. This strength area is strongly connected to Goals 3, 8, 9, 11 and 13.

Sustainable energy solutions in integrated energy systems: In a sustainable society, access to renewable energy and clean fuels is necessary to be able to tackle many of the challenges facing this world. This strength area of the Uppsala Region can provide solutions for the transition to and integration of renewable energy, management and optimisation of energy systems as well as testing and integration of sustainable energy systems in physical environments. This strength area is strongly connected to Goals 7, 8, 9, 11, 12 and 13.

Circular bio economy: A sustainable society is dependent on the transition to a bio-based national economy, i.e., a more resource-efficient economy founded on renewable raw materials produced through the sustainable use of ecosystem services. This strength area of the Uppsala Region provides solutions for a circular bioeconomy through combined circular biogas and hydrogen production, green chemicals and products from agriculture and forest resources, digitalised, electrified, and automated agriculture and forestry as well as circular energy and food production. This strength area is strongly connected to Goals 2, 3, 7, 8, 9, 11, 12, 13, 14, 15 and 17.

8.2 Examples of national and international strategies and programmes that are relevant to the strength areas

Descriptions of the programmes and strategies pictured below are included in the appendix.

8.3 The Uppsala Region as a part of smart specialisation in East-Central Sweden

East-Central Sweden (ECS) is made up of five counties: Uppsala, Örebro, Östergötland, Sörmland and Västmanland. The ECS area represents a NUTS-2 region according to the EU's definition for the allocation of funds from the European Regional Development Fund. The ECS area is home to a well-developed regional innovation support system comprised of universities and colleges, incubators and business accelerators, science parks, research institutes, clusters and innovation platforms. However, no one region or actor has the knowledge or resources necessary to be able to solve all of tomorrow's challenges alone. The regions must therefore work together using smart specialisation to promote strong growth, competitiveness and future innovation capabilities. The goal is a more cohesive, strong and interdisciplinary innovation system within and between the regions that will be available to companies regardless of the region they are based in. With the respective regions' smart specialisation strategies as a jumping-off point, we have identified 4 areas in which we share collective strengths, opportunities, and challenges. Below is a table of examples showing how the Uppsala Region's strength areas relate to the ECS Region's collective challenge areas.

The Uppsala Region's strength areas	The Uppsala Region's innovation themes	The ECS Region's collective challenge areas
Innovative materials…	• … for solar cells and solar power • … for batteries & electrification • … for additive manufacturing • … based on nanomaterials for a sustainable society	Smart industry Tomorrow's energy solutions
Life Science for the future of health & healthcare	• Biological & synthetic pharmaceuticals • Medical technology • Medical diagnostics & decision support • One Health	Life Science, welfare technology & e-health Smart industry
Sustainable energy solutions and integrated energy systems	• Transition to and integration of renewable energies • Energy system management and optimisation • Testing & integration of sustainable energy systems in physical environments	Tomorrow's energy solutions Smart industry
Circular bio economy	• Biogas and combined circular biogas & hydrogen production • Digitalised, electrified, and automated agriculture • Circular energy and food production	Smart industry Sustainable food supply Tomorrow's energy solutions

8.4 The Uppsala Region as a part of smart specialisation in Europe

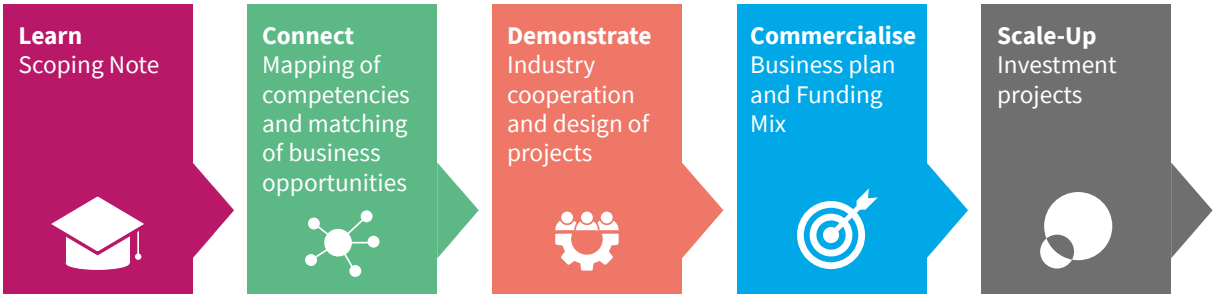
One of the EU's stated ambitions regarding these strategies for smart specialisation in European regions is that they will contribute to more coordinated and less fragmented efforts in Europe. As such, this work makes it easier to fully utilise every region's unique strengths, by effectively combining them with the unique strengths of other regions. The EU Commission has established the S3 platform, which collects information on identified strengths from around 200 regions[6]. Through information and activities, the platform acts as a tool to bring together regions within areas where there are collective capabilities, interests, and opportunities. Multiple collaboration initiatives, based on smart specialisation, are in development in Europe, led by regions committed to the prioritised areas. Through these initiatives, the Uppsala Region has the opportunity to establish new partnerships where our region's researchers, companies and entrepreneurs can help develop innovative solutions together with partners in Europe and the complementary capabilities they offer.

Examples of trans-regional thematic collaboration within the S3 platform include: Agri-Food, Energy and Industrial Modernisation. Within these initiatives, the EU is challenging the regions of Europe to jointly invest in building knowledge and European value chains that can help solve societal challenges and promote sustainable growth. Within each platform, European regions collaborate within thematic networks, each of which focuses on specific goals and fields. The coordination of each network is managed by a number of leading regions.

The S3 platform with three examples of thematic trans-regional collaboration:

- Agri-Food
- Energy
- Industrial Modernisation

The platforms build on an iterative flow of joint knowledge production and activities – learning, connecting, demonstrating, commercialising and, lastly, scaling up – for pan-European value creation.



[6] Home – Smart Specialisation Platform (europa.eu)

The “Industrial Modernisation” S3 Platform with thematic working areas

Personalised Medicine

Leading regions
East Netherlands, Netherlands
Flanders, Belgium
Limburg, Netherlands

Thematic working areas
Personal data management platform
Cell and gen hub
E-infrastructure for neurohealth

Medical Technology

Leading regions
Auvergne Rhone-Alpes, France
Lombardy, Italy

Thematic working areas
Emerging and Strategic Technologies for Healthcare
Open platform for accessing and analysing healthdata

Efficient and Sustainable Manufacturing

Leading regions
Auvergne Rhone-Alpes, France
Catalonia, Spain
Lombardy, Italy

Pilots within the Vanguard Initiative
3D-printing
Artificial Intelligence
New nano Enabled Products

Bio-economy

Leading regions
Lombardy, Italy
Randstad, Netherlands

Thematic working areas
Lignocellulose Refinery
Bio-methane as a fuel for heavy land and water transports

Hydrogen Valleys

Leading regions
Aragon, Spain
Auvergne Rhone-Alpes, France
Normandie, France
North Netherlands, Netherlands

Thematic working areas
Sectoral integration
Zero emission mobility
Hydrogen for heating and cooling applications
Hydrogen as industry feedstock

Advanced materials for batteries

Leading regions
Andalusia, Spain
Castile and Leon, Spain
Slovenia West, Slovenia

Thematic working areas
Solid state lithium-ion batteries
Sustainable Raw Material Extraction and Processing
Recycling of existing Lithium Ion Batteries
Liquid based-batteries (stationary)
Improved lithium-ion batteries

The “Energy” S3 platform with thematic working areas

Sustainable Buildings

Leading regions
Andalusia, Spain
North Great Plain, Hungary
North West Croatia, Croatia

Thematic working areas
Eco-construction, bioclimatism and insulation of buildings
Renewable energy integration in buildings
Systems of maximum energy efficiency in buildings and cities

SmartGrids

Leading regions
Basque Country, Spain
Provence-Alpes-Côte d’Azur, France

Thematic working areas
Foster the conditions for R&I and implementation of smart grids projects
Reinforcing governance models
Exchange of trans-regional experiences and best practices

Bioenergy

Leading regions
Castile and Leon, Spain
Lapland, Finland

Thematic working areas
Biomass installations in rural areas
Biogas installations
Thermal Energy – Heating and Cooling
Forest management modets
Small scale generation of electricity using pellets and wood chips

Solar Energy

Leading regions
Alentejo, Portugal
Extremadura, Spain

Thematic working areas
Construction of a solar large-scale power plant in Extremadura
Promotion of renewable electricity exports
Implementation of solar energy in the agro industry

The “Agri Food” S3 Platform with thematic working areas

High Tech Farming

Leading regions
Tuscany, Italy

Thematic working areas
Arables
Horticulture
Protected cultivations
Livestock

Traceability & Big Data

Leading regions
Andalusia, Spain
Emilia Romagna, Italy

Thematic working areas
Life cycles of the value chain
Smart monitoring of the value chain
Consumer experience in food chain decision making
Open data, interoperability, data governance and information security

Smart Sensors 4 Agrirood

Leading regions
Flanders, Belgium
Wallonia, Belgium

Thematic working areas
Creating awareness and building a trustzone
Evaluation of new technologies and digital solutions
Implementation and leverage creation

Nutritional ingredients

Leading regions
Flanders, Belgium
Wallonia, Belgium

Thematic working areas
New products and services based on novel ingredients/additives
Addressing technology gaps
Identification of investment opportunities
Analysis of consumer trends and market demands in regional markets

Consumer involvement

Leading regions
East-Central Sweden
Province of Gelderland, Netherlands

Thematic working areas
Joint Research and innovation
Awareness and public debate
Future business models

9. Strategy implementation – what happens now?

In its role as the head of regional development and the decision-making body for the strategy, Region Uppsala assumes general responsibility for the region's smart specialisation strategy. The management and implementation of a strategy of this kind is complex given that the strategy applies to the entire region, and, in fact, all actors. The complexity lies in the number of people and entities involved, the many important structures and processes that are dependent on one another as well as the fact that no one person has the authority to require the collaboration of another. We believe that successful implementation and progress within the strength areas is built on a mutual knowledge of each other's capabilities, a desire to grow, an ability to build partnerships, mobilise and take initiative as well as access to funding to move the region toward the determined target. Of course, the need for efforts can vary between each respective strength area.

The strategy is a framework and guide for challenge and knowledge-based innovation for sustainable development and growth for the entire region. The region's strong climate of collaboration is a key to success in turning the strategy's content into tangible results. This climate of collaboration is highly useful for creating a sustainable and credible platform for joint implementation. There are established structures and ongoing processes within more or less all of the identified strength areas. To a large extent, the work is about highlighting and strengthening what already exists in the region. Smart specialisation is a tool to strengthen the work that has already been done; however, by directing strategic efforts towards specific strength areas, we can become even better and have an even greater impact.

Development within and between the highlighted strength areas is primarily based on funding from external development capital that we, as a region, do not have any control over. Regions apply and compete for funding from a variety of different sources. Funding primarily comes from the European Regional Development Fund (ERDF) and, to a certain extent, the European Social Fund (ESF) for East-Central Sweden, Horizon Europe, Vinnova, the Swedish Agency for Economic and Regional Growth, national development funds for regions, private co-funding, etc. There are also funding options from other national and European funds and programmes, such as, the National Regional Fund Programme, the Swedish Rural Development Programme, the Swedish Energy Agency as well as funding connected to national strategies, etc.

In chapter 5, "How does smart specialisation help the Uppsala Region?", a number of the strategy's possible benefits are presented. If we break down the strategy's possible benefits and turn them into more operational efforts, the following is a list of potential ways to drive development within the strength areas:

- Enable financing from EU funds, in particular the ERDF.
- Mobilise actors to build up effort and implementation capabilities.
- Monitor and mobilise actors around regional and national calls for funding.
- Fund the incentive structure within the business and innovation support system.
- Prioritise the co-funding of project funds that generate growth.
- Support efforts related to the supply of skills and capabilities.
- Support/prioritise initiatives to solve societal challenges.
- Strengthen and develop environments and structures of innovation.

- Develop collaboration and coordination.
- Develop collaboration initiatives with surrounding regions, nationally and internationally.

Region Uppsala welcomes all stakeholders to see the possibilities for themselves and take part in bringing these efforts to life.

9.1 Different ambition levels for the implementation

Like all strategies, we decide our ambition level as to the extent to which and how we ultimately use the strategy. By "we", we mean all of the actors that, in different ways, see themselves as playing a role within challenge and knowledge-based innovation – our universities, actors in the business and innovation support system, the business sector, municipalities and other public organisations.

At Region Uppsala, we consider there to be roughly three different ambition levels that we could take:

- Reactive level: We shelf this strategy document and just ensure compliance with the EU, which is to say that we only fulfil the necessary condition and, therefore, are entitled to apply for funding from the European Regional Development Fund programme. Beyond that, it would be business as usual. In other words, the strategy would have no impact whatsoever on our continued work to promote innovation and develop business.

- Communication level: Using the strategy and our regional strength areas as a basis, we present to the outside world the collective skills and capabilities of the Uppsala Region, as well as what we offer to national and international markets. Clear communication with the outside world leads to increased funding, venture capital, new businesses and new partnerships. At this level, the strategy is used solely as a basis for communication, but otherwise has no impact on how we work.

- Proactive level: In addition to the strategy being used for communication, we use the strategy and its strength areas as a basis for reviewing how we actually work and collaborate all together. A number of areas are already characterised by strong, well-functioning ecosystems and collaborative relationships. Other areas are certainly characterised by strong capabilities and resources; however, those capabilities and resources may be spread out and fragmented, and we risk doing suboptimal work with the resources, capabilities and motivated individuals available in the region.

9.2 A 7-point agenda for the continued development of strength areas & priorities

The starting point of this strategy is the Uppsala Region's potential to develop innovation and solutions to global societal challenges, the upside of which is sustainable societal development and growth. The challenges are oftentimes complex as well as urgent, which places demand on both the pace of development and traditional collaboration patterns in knowledge production and innovation development. The term "transformation" is sometimes used to denote the need for change, a term that is equal parts troublesome and exciting. The transformation, regardless of if we're talking about the climate threat or challenges in the healthcare system, opens the door for new markets and new production logic. However, the paradox of new markets is that they represent opportunities that require investments to be realised, while their inherent uncertainty means the basis for investments cannot be precise. That paradox is why taking risks is a fundamental aspect of creating a new market across the board. In all transformation, where so much hope is put into the business sector, it is important to remember that research, education, innovation environments and cross-sectoral collaboration all play

a critical role in creating enough certainty through knowledge to be able to invest in the future.

With that as a jumping-off point, below is a list of seven general proposals for possible efforts that would give a face to the transformative Uppsala Region.

1. Strengthen existing test beds as well as the development of new test beds and demonstration environments, i.e., physical and virtual open environments where companies, researchers, students and other organisations can work together to test, develop and implement new technology, products and services within specific innovation themes. That also includes the continued availability of the universities' infrastructures for research and innovation as a meeting place for the co-production of new knowledge between academia and industry. The public sector also offers valuable innovation environments with natural access to community contacts, physicals spaces and operations in a wide range of areas. This is where the people and the businesses are that need welfare technology and experiences, in both physical and digital forms. Here there are also large demographic challenges that force the renewal and development of efficient community services within the framework of the state's duties, regardless of if they are carried out privately or publicly.[7]

2. Develop ecosystems that gather both technical and social-scientific capabilities in "community labs" with the aim of presenting ideas and solutions to challenges. This requires a systems-based understanding and collaborative action between the private and public sectors and over industry lines. The Uppsala Climate Protocol, Viable Cities, STUNS Sustainable societies are examples of innovative mobilisation for smart, sustainable, and climate-neutral cities. Of course, the value of the continued development of goal-oriented ecosystems focusing on solving thematic societal challenges lies predominantly in the solutions, but also in the marketing of the Uppsala Region as a model for systematic and deliverable collaboration.

3. Further strengthen thematic alliances between industry and academia. The Uppsala Region has a material-dependent and production-centric business sector that spans a range of industries and is also reinforced by a knowledge-intensive service sector. The region's industry is combined with research and education in areas of high strategic importance for companies' continued renewal and competitiveness. Within thematic alliances, strategic industrial interests interact with scientific innovation as a basis for shared priorities, solutions-oriented knowledge production and investments directed at a shared target. An alliance lays the groundwork for more efficient and targeted utilisation of common resources, creates a "landing platform" for public funding and establishes clear communication outside of the region's borders.

4. Nurture the region's unique collaborative culture and further develop the business and innovation support system. The concept of the business and innovation support system encompasses all activities that, in different ways, support companies and innovation. The more transparent, coordinated and efficient the interface between these activities and their target groups, the stronger the system will be, i.e., the utilisation of common resources and common experiences. In Uppsala, the system has emerged and developed over a long period of time and is now able to offer world-class support that creates value in terms of both the job market and national economy. The key to success, and the glue that holds the system together, is a strong collaborative culture – a desire to succeed and create value together. And that is something we should celebrate and continue to develop.

[7] Conversely, limited access to resources, strict legislation, generational shifts and high business pressure make it more difficult for the public sector to act and help sustain development efforts and innovation work. This inhibits innovation and makes it more difficult for new actors to develop services and products that gain traction within the sector. Here, investments are needed to accelerate innovation and development.

5. Stimulate the development and use of digital technology that has the potential to transform industry and the public sector. Take advantage of the potential that digital solutions offer for the transition to a fossil-free and circular economy, a more efficient industrial production system and more efficient local healthcare. The possibilities also lie in the development of new business and organisational models to fully utilise digitalisation's potential, especially when it applies to smaller businesses' ability to expand internationally, where digital tools make it possible to do business far outside the region's borders. Digitalisation also opens the door for the development of a remote business and innovation system that can support innovators and entrepreneurs, regardless of their geographical location, with Uppsala's capabilities and network as a basis. Digitalisation can further strengthen the Uppsala Region as an important actor in Sweden's global position as an industry and innovation leader.

6. Utilise students' curiosity and engagement as a driver of innovation and renewal.
   Uppsala has close to 55,000 students, and a large influx of young students from every corner of the globe, for example, through the partnership agreements of the region's universities with hundreds of international universities and international student exchanges. This represents an enormous resource for gaining new perspectives, access to knowledge, energy and talent that challenge us to think differently and create solutions. The Uppsala Region has a long and successful history of unleashing student power on identified challenges with the collaboration of the business and public sectors. And this is something we should continue, refine and develop.

7. Work together to ensure the outside world sees the benefit of investing in the Uppsala Region.
   The Uppsala Region needs to get better at attracting larger public funding, private investments and venture capital. Of course, this is a matter of strengthening our regional brand – our collective story – as a successful breeding ground for innovation and growing businesses. It is also a matter of coordinated, proactive and systematic efforts to gain both national and international funding. The goal is a more harmonious, collective work approach that is based on foresight, shared priorities and, ultimately, a region with more capital for the implementation of strategic initiatives.

10. Appendices

1. The crucial importance of the horizontal priorities for innovation and growth (examples)
2. The Uppsala Region and connections to national strategies
3. The Uppsala Region and connection to European strategies
4. Overview of the process and target groups around the development of the strategy

Appendix 1

Below are examples of the crucial importance of the horizontal priorities for innovation and growth.

Enabling abilities	Strength areas: Innovative materials, Life science for the future of health & healthcare, Sustainable energy solutions & integrated energy systems and Circular bio-based economy.
Tech	The Uppsala Region offers digital capabilities that are essential for both everyday innovation and transformative renewal within all of the strength areas, such as: • Digital solutions for tomorrow's sustainable industry production • Digital solutions that enable circular production methods for sustainable food production • Digital solutions for measuring, following up on and managing sustainable energy solutions and systems • Digital technology to streamline and renew health & healthcare & preventative healthcare • Digital technology that enables new ways to do business, communicate and interact with customers and stakeholders in international markets
User-driven innovation & system transformation	The Uppsala Region offers sustainable leadership that includes capabilities and a holistic approach to sustainable societal transformation – the transformation's "hardware", through new technology and solutions in physical spaces, are connected to "software", i.e., human needs, behaviours and actual conditions from a "systems perspective". • Involvement of stakeholders and users in early innovation development • Development of communities and urban environments, civil dialogue and democracy • Development of innovative economic incentive models in the cases where the market is too slow with respect to an urgent need for innovation (for example, antibiotics) • Regulatory conditions for societal renewal and transformative innovation
The business and innovation support system	The Uppsala Region has a successful "system" of cooperative actors that, in different ways, support entrepreneurs and existing businesses on their development journey. Businesses and entrepreneurs can quickly find the right support and skills within: • Innovation and business development • Support in building a business • Funding • Cross-industry relationships

Appendix 2

The Uppsala Region and connections to national strategies.

National climate policy provides a framework and direction for the Uppsala Region's work to promote innovation

More recently, a number of political initiatives, programmes and strategies have been formulated whose purpose is to strengthen Sweden's position as a leader in climate work and to accelerate the energy transformation. These initiatives can also provide a framework and direction for the Uppsala Region's innovation efforts. In June 2020, the government published *A climate policy action plan ("A comprehensive climate policy")*, based mainly on Sweden's long-term climate goals and the government's ambition to make Sweden the world's first fossil-free welfare states[8]. Regulations that promote innovation must be improved, and the possibility of strengthening regions' and municipalities' authority and tools to reduce their climate impact must be reviewed. Additionally, the environmental and climate perspectives of regional growth policy should be strengthened.

In August 2021, the government commissioned the Swedish National Board of Trade to establish an advisory body to promote innovative and climate-focused standardisation. Parallel with that, the Swedish innovation agency, Vinnova, was commissioned to announce funding in line with the Council's work as well as the prioritised areas for standardisation connected to the business sector's climate transition. The purpose of these commissions is for Sweden to strategically work with and concert efforts around Swedish strength areas with a high degree of innovation, such as fossil-free steel, green hydrogen, sustainable batteries, non-toxic and bio-based products and sustainable cities. Standardisation, in particular, is a high priority in the Commission's 2022 work programme.

National strategy for a circular economy

The strategy maps out the work towards a circular economy. A central part of this strategy is to create long-term and technology-neutral instruments, including legislation, that promote work towards a circular economy. The strategy includes the focus areas: *"sustainable production and product design", "consumption and use of materials, products and services", "toxic-free and closed-loop cycles"* as well as *"innovation and circular business models"*. As part of national efforts, a number of material streams will be prioritised in the transition to a circular and bio-based economy: plastic, textiles, renewable and bio-based raw materials, food, the construction and property sector, which includes construction and demolition waste, as well as metals and minerals that are critical for innovation. Within the strategy's framework, the government commits to ensuring that the new EU regulation for batteries leads to a circular production of batteries with a high degree of recycling and phasing out of harmful chemicals. This work affects many parts of society and the business sector. Furthermore, the government has commissioned the Swedish Energy Agency, the Environmental Protection Agency and the Geological Survey of Sweden (SGU) to establish and develop cross-agency collaboration over the course of 2021 and 2022 in order to support the development of activities in Sweden that will be part of a sustainable and competitive value chain for batteries in Europe.

The national electrification strategy

In November 2020, the development of a national electrification strategy began, which was completed in autumn of 2021. The strategy will help to achieve

[8] Based on Sweden' climate policy framework including climate law, climate goals and a climate policy council. For the first time ever, Sweden has long-term climate goals beyond 2020 and an independent climate policy council that reviews climate policy. The reform is a central part of the work enabling Sweden to live up to the Paris Agreement.

fast, smart and economically efficient electrification as an important part of meeting the 2030, 2040 and 2045 climate goals. Using a holistic approach, the strategy will analyse technical, economic and policy conditions in the energy sector to enable increased electrification and present a plan to manage potential obstacles. The work with the strategy will also help to increase knowledge and collaboration between industry, regions, academia, other affected societal actors, agencies, and the Swedish Government Offices.

The national life science strategy & regional life science strategies

In December 2019, a national life science strategy was launched that provided direction for the continued development of Sweden as a leader in the life sciences. The Uppsala Region was highlighted as one of the country's leading life science regions, and many of the strategy's investment areas not only touch on the Uppsala Region's strengths, but also reinforce our region's position in challenge and knowledge-based innovation and as a partner in regional and national efforts. Precision medicine, utilisation of health data for research and innovation, research and innovation infrastructures, integration of research in healthcare, welfare technology and e-health are just a few of the Uppsala Region's strengths, where our region can contribute to achieving this goal.

Sweden has several strong life science regions that, in different ways, strengthen and complement each other and all help position Sweden internationally as a life science leader. In addition to the Uppsala Region, Stockholm, Skåne, Västra Götaland, Västernorrland and Östergötland are all well-equipped within the life sciences, and Uppsala should work together and collaborate with other life science regions to strengthen Sweden's business and innovation support system with respect to the life sciences. The Stockholm-Uppsala region accounts for about half of the jobs within the traditional life science sector, including pharmaceutical development, medical technology, and precision medicine. As a part of the capital and labour market region, the Uppsala Region should be especially open to collaboration and support with the ambitions expressed in the life science strategy for the Stockholm Region.

National strategic innovation programmes (SIP)

The purpose of the programmes is to solve societal challenges and strengthen Sweden's innovation capabilities and competitiveness through new, long-term and in-depth collaboration across universities, research institutes, industry, the public sector, etc. Vinnova is the largest national financier along with the Swedish Energy Agency and Formas. Several of the 17 programmes are directly or indirectly related to material development, such as *"Metallic materials", "Produktion2030", "SIO Grafen"*. The programme, *"Bioinnovation"*, also focuses on materials, given that its purpose is to develop strong, competitive and innovative materials, products and services based on renewable raw materials. The vision is for Sweden to have fully transitioned to a bio-based economy by 2050. The programme is based on the fact that most of what is made from fossil materials can be made with biomass. The programmes, *"Swelife"* and *"Medtech4Health"*, help to create a constantly growing life science sector that is competitive in the global market.

The programme supports innovation projects for better health that eventually could become successful companies, for example, within pharmaceuticals, medical technology, e-health, and diagnostics.

Within the programme portfolio, there are also a number of programmes that either directly or indirectly support a sustainable energy transition. *Viable Cities* invests in climate-smart cities by 2030 as a means to reduce climate emissions and increase innovation capabilities, find new ways of working and engaging residents. Within the Uppsala Region, the Uppsala Municipality and Enköping Municipality are involved in the programme. *Drive Sweden* pave the way for tomorrow's mobility systems and an increasingly connected, automated, electric, and service-oriented transportation sector. *IOT Sweden*, with a programme office at Uppsala University, works to help Sweden maintain its leading position in digital technology and connect the physical world with the digital, for example, through built-in electronics and

connected sensors with beneficial applications for a sustainable energy transition, such as, for example, visualisation and optimisation of solar cell-generated electricity, energy efficient homes and public spaces.

National innovation partnership programmes – Climate neutral industry as well as Health & Life Science

The government launched four strategic partnership programmes in February 2020. The programme, ”Climate neutral industry”, is based on the goal of Sweden having net zero greenhouse gas emissions in the atmosphere no later than 2045, and the efforts will help Swedish industry in its climate transition. The programme will strengthen Sweden’s export of climate-positive products and services and strengthen Sweden’s position in a growing bio-based economy that builds on resource efficiency, renewable raw materials and the transition to circular business models. The programme, ”Health & Life Science”, will act as a tool to facilitate the implementation of the national life science strategy. The programme will gather knowledge about national and regional initiatives in order to gain a clearer picture of the success factors and obstacles, as well as ideas for solutions or next steps within the areas of precision medicine, health data, crisis preparedness and resilience. Moreover, the programme has the possibility of providing input to the government regarding, for example, policy and regulatory changes and proposals for initiatives that would enable increased innovation capabilities within specific areas.

Appendix 3

The Uppsala Region and connections to European strategies. The European Regional Development Fund 2021–2027 (ERDF)

The ERDF is an important tool within EU's cohesion policy whose purpose is sustainable growth and the cohesive collective development of Europe's regions. Together with Östergötland, Örebro, Sörmland and Västmanland, the Uppsala Region makes up the geographical area of East-Central Sweden (NUTS-2) for the programme's funding. The programme opens the door for investments into the innovation and renewal capabilities of small and medium companies, as well as investments into environmental and climate measures. The programme includes two complementary political goals. The strategic jumping-off point in goal 1 is smart specialisation, where the overall ambition is to help create a smarter EU through innovation, digitalisation, economic transformation and support for small businesses.

At the cross-region level, smart specialisation refers to several highlighted areas where East-Central Sweden has common challenges as well as opportunities (cross-regional smart specialisation). These areas are:

- Smart industry
- Tomorrow's energy solutions
- Sustainable food supply
- Life science, welfare technology & e-health

Within goal 2, investments are being put into strategic efforts for a greener, more carbon-efficient Europe that prioritises energy transition, resource efficiency, renewable energy sources and smart energy grids with a focus on the following areas:

- Climate-positive buildings
- Fossil-free fuels
- Smart socio-technical systems
- A circular and non-toxic economy

The Energy Union's & Horizon Europe's climate, energy, and mobility efforts

May 2019 marked the completion of the Energy Union, which is the EU's collective strategy package to manage climate change, Europe's energy dependency and ageing infrastructure. The strategy underlines the importance of research and innovation, energy efficiency, an economy free of fossil fuels, energy security and an integrated internal energy market.

Horizon Europe, the EU's next research and innovation programme has a budget of EUR 95 billion. The areas of climate, energy and mobility are a prioritised theme (Cluster 5, under pillar 2: Global challenges and European industrial competitiveness) with an approximate budget of EUR 15 billion.

Cluster 5 is divided into six destinations: 1. *"Climate sciences and responses"*, 2. *"Cross-sectoral solutions for the climate transition"*, 3. *"Sustainable, secure and competitive energy supply"*, 4. *"Efficient, sustainable and inclusive energy use"*, 5. *"Clean and competitive solutions for all transport modes"* and 6. *"Safe Resilient Transport and Smart Mobility services for passengers and goods"*.

The EU's bioeconomy strategy & Horizon Europe's investments in bioeconomy

The EU's bioeconomy strategy from 2012 was updated in 2018 with the aim of revitalising efforts, growth, and investments in the EU. The purpose of the strategy is to improve and expand the sustainable use of renewable resources in order to address global and local issues, such as climate change and sustainable development, as well as to create 1 million new jobs in the bio-based economy. The strategy contains a number of investments, among which is a circular bioeconomic investment platform meant to generate bio-based innovation in the market and reduce the risks associated with private investments in sustainable solutions. Other highlighted investments include the development of sustainable biorefineries as well as a strategic agenda for the

establishment of sustainable food and agriculture systems, sustainable forestry and bio-based products. The EU's research and innovation programme, Horizon Europe 2021-2027, includes the bioeconomy, food, natural resources, agriculture, and environment, with an indicative budget of EUR 10 billion.

Horizon Europe – Health and cancer as prioritised themes

In the programme, health is a prioritised theme ("cluster" under pillar 2: Global challenges and European industrial competitiveness). The purpose of the theme is to better understand and manage health and diseases, including cross-border health risks and infections, in order to deliver integrated, individualised and equal healthcare all across Europe. The goal is a sustainable digital transformation of European healthcare systems with cross-border, secure and ethical data management and reliable supply chains. In addition to prioritised themes, Horizon Europe identifies five strategically targeted research and innovation missions, one of which is cancer. The purpose of a mission is to focus resources around a select number of societal challenges that require innovative solutions and a wide range of measures meant to achieve a bold, inspirational and measurable goal within a certain amount of time, with beneficial impacts on both society and policy, and that are relevant to a large portion of the EU's population.

Life – the EU's programme for climate and environmental measures

Life is the EU's purest sector programme for measures regarding the climate and environment. The programme supports the transition to a more resource-efficient, fossil-free, climate-resistant, environmentally-friendly society, characterised by biological diversity. In January 2021, the programme was given an indicative budget of just over EUR 5 billion between 2021–2027, where a substantial portion will go towards investments in climate measures, protection of ecosystems and biodiversity. Within the programme, funding was given to projects that aim to develop bio-based products with high added value from forest waste and with a broad range of uses, for example, using lignocellulose for more sustainable road construction.

The EU's industry strategy

The EU's industry strategy that was presented in 2020 was updated in March 2021 to ensure the strategy's industrial ambitions took into account the new circumstances following the Covid-19 pandemic. The strategy is based on a comprehensive investment in the green and digital transformation of industry, which includes measures to manage the EU's strategic dependencies, both technological and industrial, as well as the internal market's resilience, which was challenged during the pandemic. The Uppsala Region's efforts to transform industry can be ramped up and strengthened through several of the strategy's measure packages, in a green and digital direction, with a focus on strategic value chains of particular relevance to our region's industrial competitiveness, industry alliances and joint European projects.

Appendix 4

The region's smart specialisation strategy (S3) has been developed through analysis and region-wide dialogue

As the head of regional development for the Uppsala Region, Region Uppsala has managed and directed the development of a "Strategy for sustainable development and growth through challenge and knowledge-based innovation in Uppsala County – a smart specialisation strategy". The contents of the strategy were borne from broad dialogue with relevant actors across the research, innovation, and industry sectors. Most notably, Region Uppsala directed and led dialogue with primary target groups acting as representatives from the region's universities, business sector, business and innovation support system, partnership structures and public actors.

The process began in the autumn of 2020 through thematic workshops with a total 90 participants. The process and discussions did not start from a blank page – they were based on the focus areas defined in the county's regional development strategy (RDS), i.e., Life science, material and advanced production, green industries, the environment and energy and tech. The purpose was to understand and debate region-specific strengths, challenges and opportunities, adding depth, breadth and nuance to all three.

During the process, the theme "Sustainable societies" was brought up as a possible strength area.

Following the analysis of knowledge materials, statistics and the workshops, Region Uppsala conducted complementary bilateral discussions with experts and stakeholders from each area to gain an even deeper understanding and solid foundation, upon which future strength areas could be chosen. The strategy's contents and priorities are the result of weighing out the many perspectives.

In addition to focus areas, dialogue and analysis, the choices were based on the following selection criteria:

- Excellent research and education that are important for innovation, renewal, skill support and growth within both the region's and country's business sectors.
- Significant, acute and transformative societal challenges with strong innovation and growth potential outside of the region's and Sweden's borders.
- Ongoing strategic processes, research centres, innovative environments, public will, national strategies, etc.
- Connection to the regional business sector:
  - There is a critical mass of companies that are directly or indirectly connected to the chosen areas,
  - Transformative knowledge areas with potential to create new industries and/or contribute to investments and new businesses in the Uppsala Region,
  - Evidence for or assumption of future potential for novel entrepreneurship and university spin-offs.

A descriptive concept sketch of the strength areas and innovation themes were presented in the spring of 2021 to all the actors participating in the process (120 in total) in order to get feedback, confirm the direction and validate the content. The feedback led to additional bilateral discussions and refinement of the chosen areas. Region Uppsala would like to emphasise how important it was to discuss with and listen to the region's actors before finally deciding on the direction of the region's smart specialisation strategy. This was because the realisation of the strategy depended on the collective knowledge and capabilities of the region, as well as the desire to take full advantage of the business opportunities created through the collaboration of research, innovation, and industry with respect to challenge and knowledge-based innovation for sustainable development and growth.