

System innovation for a sustainable future

Vinnova's proposals for the
Government's research bill

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Preface

The Government's overall goal for Swedish research policy is for Sweden to be a prominent research nation, where research and innovation achieve a high standard and contribute to the development of society and competitiveness of the business community.

Addressing major societal challenges that we now face requires new knowledge and innovation throughout society. Our ability to successfully deal with these challenges is crucial for our future as a competitive knowledge nation, for our business sector and for our welfare. In this respect, research and innovation policy plays a pivotal role.

In this report, Vinnova presents the proposals that the Government has requested as a basis for the upcoming research policy bill. Extensive work has been carried out and we have involved many different actors and employees. The complete analysis that forms the basis for Vinnova's report is presented in our analysis appendix "Prerequisites for system innovation for a sustainable future".

Vinnova's report supplements the supporting material that Vinnova has produced together with the Swedish Research Council, the Swedish Energy Agency, Forte, Formas and the Swedish National Space Agency.

Vinnova in October 2019

Darja Isaksson
Director-General

Göran Marklund
Director and Deputy Director-General

1 Introduction

Sweden and the world are in the midst of complex challenges. The ecological, economic and societal challenges highlighted in the 2030 Agenda require radical changes. New knowledge and innovation are required in every part of society.

In order to succeed, academia, industry, the public sector and civil society must work together towards common goals. In addition, the challenges and many of the value chains that need to be changed are global in nature. Our ability to contribute to successfully addressing these challenges is a crucial factor for our future as a competitive knowledge nation, for our business sector and for our welfare. Research and innovation policy play a pivotal role in terms of Sweden's opportunities to achieve these goals in both the short and long term.

Vinnova considers the following initiatives to be crucial for developments that strengthen Sweden's position for the future:

Mobilise for a sustainable society:

- National missions to provide focus
- Demonstrate system innovation
- Further develop strategic innovation programmes
- Increase international links

Strengthen strategic research and infrastructure:

- Holistic approach to research infrastructure and its ecosystem
- Use full potential of Sweden as a big science nation
- Establish programmes to address societal needs

Strengthen Sweden's innovative ecosystems:

- Connect strategic research and experimental economics
- Strengthen support for innovative startups
- Strengthen intellectual property support

- Develop smart policy development and regulation
- Develop innovation leadership in public sector
- Innovative and sustainable investments
- Strengthen lifelong learning and develop cooperation incentives for higher education institutions

2 Mobilise for a sustainable society

“Societal challenges are complex. More complex than going to the moon, which was mainly a technical feat. To solve them requires attention to the ways in which socio-economic issues interact with politics and technology, to the need for smart regulation, and to the critical feedback processes that take place across the entire innovation chain. It also requires stronger civic engagement.”¹

Mariana Mazzucato

Professor in the Economics of Innovation & Public Value

2.1 National missions provide focus

The Sustainable Development Goals in the 2030 Agenda highlight a common and sustainable direction as a guide for the selection of missions. The seventeen goals are all interrelated and many of the goals are strongly interdependent. The challenges are therefore complex, and they are difficult, sometimes impossible, to break down into increasingly smaller sub-goals that individual actors have the ability or responsibility to take on. We therefore need governance and processes that help to shift the entire system as well as its individual parts. Moreover, the societal challenges are global in nature. Therefore, international cooperation is a prerequisite for the solutions and knowledge required. At the EU level, missions have been identified as a tool for focusing and aligning resources. A mission-oriented way of working with clear processes is employed with the objective of systematic change. Actors from different sectors, industries and disciplines unite around bold, inspiring and measurable goals.

The nature of the societal challenges necessitates change and cooperation within all policy areas. Broad constellations of various actors from industry, research and the public sector are required to successfully address these. Strategic coordination and collaboration across policy areas and close collaboration between academia, industry, the public sector and citizens will be crucial. The participation of people and civil society will also be a key success factor in a time when new technologies are rapidly changing the face of society.

¹ https://ec.europa.eu/info/sites/info/files/mazzucato_report_2018.pdf

Purposeful development of methods for policy, system analysis and collaboration will be required.²

The approach involving missions is therefore a central part of the Horizon Europe framework programme, which will soon be the world's largest research and innovation programme. Several Swedish delegates participate in the mission boards working at EU level.³

Mission-based priorities and strategies will increase Sweden's competitiveness within the framework of the EU's next framework programme Horizon Europe. Processes for formulating such goals are of great importance for engaging and mobilising different actors to achieve common goals, which has great potential to strengthen Swedish innovation capacity, competitiveness and sustainable development in international collaboration.

Mission processes are also very valuable from a national perspective. Today, there are many different strategies and roadmaps established, for different areas, sectors, industries, technology areas and regions. Most of these are good when viewed in isolation, but in many cases the connections and interaction between them are weak. This hinders the alignment of resources required for the system innovations necessary to create transformation and competitive solutions to major societal challenges. Strategies and roadmaps need to be put into larger system-wide goals, strategies and initiatives that enable cross-border synergies and the focusing of joint resources.

Missions require an "engine" to drive the processes, forums for dialogue on regulations and policies, implementation projects in real environments, actor-driven programmes and international collaboration. Vinnova believes that such an engine should operate within the national collaboration programmes.

What is needed?

National mission processes are used to focus, formulate goals and identify the system solutions needed. The processes include actors from industry, the public sector, academia, research institutes and civil society. The collaboration programmes and other mobilisation processes for a sustainable society should work in a mission-oriented manner. This makes it possible to develop strategic portfolios of research and innovation projects for system innovation within key areas of challenge. They also create the conditions for Swedish initiatives to be more strongly linked to Horizon Europe. Vinnova has begun to take an active role in the formation of such processes, and it should be commissioned to mobilise actors for national mission processes with the aim of strengthening the links between Sweden and Horizon Europe and mobilise for system innovation.

² Chapter 2 The 2030 Agenda and system innovation, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

³ https://ec.europa.eu/info/news/commission-announces-top-experts-shape-horizon-europe-missions-2019-jul-30_en

2.2 Demonstrate system innovation

In order to successfully address major societal challenges, we need to work to develop the interfaces and interaction between technology development, ethics, laws and regulations. It is about creating innovation environments that can attract leading global companies to participate with knowledge and technology in testing and demonstrating solutions to complex societal challenges. But for the business community to contribute to addressing societal challenges, while at the same time developing their own knowledge and technology, this development needs to take place together with other parts of society. Major societal challenges require focus and alignment of resources from all actors involved such as regions, municipalities, businesses, higher education institutions, other institutes and national authorities.

Vinnova has long emphasised the importance of practically testing new solutions under realistic conditions. This is a central part of the development process for most innovations and not least applies to system innovation. Through testing in real environments, the dynamics of the system can be understood, and you quickly see what is possible and what the limiting aspects are. Test beds and demonstrators provide opportunities for technical and business innovations, but to become more transformative, “deep demonstrations” are needed where regulations, ethics and demand are deeply integrated. We therefore see a great need to further develop test beds and demonstrators in order to create the conditions and resource focus for deep demonstrations in a real environment. Deep demonstrations need to be more clearly linked to strategic goals and priorities and require much stronger anchoring among local and regional actors.

Deep demonstrations in a real environment create unique and competitive solutions with high international demand. Deep demonstrations involve testing advanced technology, market-leading products and services, behavioural design and standards.⁴ At the same time, regulations, organisational forms and policies are being developed. This is done both in the form of “rapid prototyping” and through large-scale testing.

Deep demonstrations must have a high national and international profile and strong international ties. The life of a deep demonstration should vary between three and ten years. Sweden, with its well-functioning public sector and many developed system solutions, is well suited to this mobilisation approach.

By testing and innovating entire systems in real environments, in pilot form and on a limited scale, an understanding of what is possible is created regarding, for example, climate adaptation or the restructuring of the healthcare system. We see how new system solutions interact with surrounding society and how development can take place in a collaboration between industry and the public sector, with development support from

⁴ Chapter 2 Agenda 2030 and system innovation, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

universities, university colleges and research institutes. The tests quickly result in solutions and learning that can be scaled up.

It is of central importance that test, and demonstration environments are continuously developed and operated jointly by solution owners and stakeholders in real-life environments. The initiative is demand-driven by the public and private actors who are deeply involved in system innovation with a view to conversion. The national collaboration programmes should serve as a platform for dialogue and collaboration in order to set direction and priorities.

Examples of tackling problems from a systems perspective and integrating technical and business innovation with, for example, regulations and the public sector as facilitators are Electricity⁵ and Hybrit⁶. The concept of deep demonstrations for this developed form of demonstrators also partly derives its inspiration from the “deep demonstrations” initiative by the EU’s large-scale innovation network Climate-KIC,⁷ but is also related to the approach in the Swedish regional venture Digital Demo Stockholm⁸ and the strategic innovation programme Viable Cities⁹.

What is needed?

Priority deep demonstrations with a budget that increases over time are needed. The initiatives will be co-financed by actors involved and linked to method development and initiatives in Horizon Europe’s programmes. They should be supported by a development team from national authorities such as Vinnova, the Swedish Agency for Economic and Regional Growth, the Swedish Energy Agency and the National Agency for Public Procurement. They should be given the necessary support for upscaling and dissemination at a national and international level.

2.3 Further develop strategic innovation programmes

Since 2012, the strategic innovation programmes, SIP, have created transboundary collaboration on priorities, goal formulations and initiatives between different sectors, industries and actors in several strategically important areas.¹⁰ A total of 17 programmes are established today.

Now the first programmes, which have been running for six years, are being evaluated. The division of responsibilities between the authorities and the actors has worked well. Early

⁵ <https://www.electricitygoteborg.se/>

⁶ <http://www.hybritdevelopment.com/>

⁷ <https://www.climate-kic.org/>

⁸ <https://www.digitaldemostockholm.com/>

⁹ <http://viablecities.com/>

¹⁰ Chapter 9 R&D collaboration and research environments, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

results from the evaluations show that the programmes have succeeded in creating an alignment of resources and gathering relevant actors while at the same time attracting new actors and working in an open and transparent way.

Collaboration within strategically important areas creates conditions for sustainable solutions to global societal challenges as well as increased international competitiveness. Continued development is needed to strengthen international links. Similar initiatives in other countries show that many have learned from Sweden, but also that the second and third generation of such programmes tend to be larger and have fewer priority areas. The latest international initiatives also integrate policy development.

The 17 strategic innovation programmes have the potential to develop their strategic work by adjusting goals and initiatives in response to the rapid changes happening in the world and are based on the missions that are being developed nationally and at the EU level. It will be increasingly crucial to have this type of actor-driven resource-aligning national initiative in pace with the rapid societal changes that are going on nationally and globally. The next generation programmes should address areas of broad societal relevance to a greater extent to ensure greater system effects and be able to utilise research infrastructures and deep demonstrations for faster impact and upscaling.

In summary, we see a need for the state to continue to invest in actor-driven collaboration programmes. Collaboration and a capacity for renewal and innovation are Swedish strengths¹¹ – actor-driven collaboration programmes are an important instrument for strengthening these capabilities. In the next generation, they should consider both experience in terms of the strengths evident in the mobilisation we see today, and lessons learned from similar programmes in other countries. The focus of the programmes should be discussed, but they should build on Swedish strengths and contribute to Swedish competitiveness and solutions to societal challenges. Societal actors and business stakeholders should be active and driven in identifying needs and areas that are important to Sweden.

What is needed?

Vinnova, the Swedish Energy Agency and Formas should be given the opportunity to further develop the strategic innovation programmes jointly and in dialogue with the innovation system actors. The aim is to increase Sweden's capacity for renewal and resource alignment in order to address societal challenges and contribute to competitiveness. The work should start during the period 2021–2024, with a budget maintained at the 2019 level, i.e. a total of SEK 800 million per year from the state. With the help of the margin in the budget created when the current 17 strategic innovation

¹¹ Chapter 9 R&D collaboration and research environments, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

programmes decrease in volume, new strategic innovation programmes – SIP 2.0 – can be initiated and grow.

2.4 Increase international links

The major societal challenges and value chains that need to be changed in order to successfully address them are global in nature. Much of the knowledge and solutions required will need to be developed in international collaboration and for an international market. There is a global race under way in terms of knowledge building and innovation capacity. Sweden is well positioned to be an important player in joint international projects aimed at sustainable development.

During the implementation of the current research and innovation bill, several initiatives have been taken to further strengthen international links.¹² Several of these are listed below:

- Establishment of the international coordinating function international co-operation, which is used to coordinate Swedish research sponsors' initiatives in order to strengthen collaborations outside of Europe.
- Introduction of Team Sweden, which assembles public sector aspects of export promotion. The Government's export strategy, which governs efforts of Team Sweden, indicates that Sweden's strength as an innovation and knowledge nation should be a more important part of Sweden's comprehensive promotional efforts.
- Signing of innovation partnerships with strategically significant countries. Since 2016, the Government has signed innovation partnerships with Germany, France and India.
- Launch of an investigation regarding the internationalisation of Swedish universities.

Since the companies that provide a significant share of the research and innovation investments are global, with the research also being international in nature, Vinnova deems it necessary to maintain and continue to develop Swedish research and innovation actors' international links. It does however take time to develop international relations, which is why Vinnova believes that efforts of increased internationalisation should be characterised by continuity and efforts concerning EU coordination function and international coordination function should continue.

¹² Chapter 11 EU cooperation and international links, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future

The EU's next framework programme, Horizon Europe, will be the largest research and innovation programme in the world.¹³ There is great potential to develop Sweden's ability to utilise European programmes and international collaborations to provide leverage for Swedish initiatives. Horizon Europe will establish a mission-based approach linked to the new partnerships within Horizon Europe, but also to efforts planned by the Commission as part of the "Green New Deal". National capacity to use a mission-based approach and to develop and align resources internationally will be of major significance.

For universities, research institutes, the public sector, civil society and business community to continue to benefit from the funds granted by the European Commission to partnership programmes, increased importance is placed on access to national funds for co-financing. Without this type of co-financing, Swedish actors risk missing the chance to become part of the European networks that drive innovation development forward.

The European Commission has announced that the partnership programmes will become fewer in number but larger in scope and cover longer periods of time than the current programmes. It is positive to have fewer and larger partnership programmes with a clear link between basic research and application, and to link research and "disruptive" innovation. The suggested partnerships will provide wide coverage for the majority of Horizon Europe, which is indicative of a need for coordination and to align resources to promote Swedish participation.

Ahead of the implementation of Horizon Europe, the EU coordinating function, EU co-operation, has conducted an evaluation of the national support structure with a focus on national contact points, NCP. This evaluation found that since the start of Horizon 2020 in 2014, Swedish participants have contracted projects in which the European Commission has granted EUR 1.43 billion, which is equivalent to SEK 15 billion.

With such a large proportion of research funding being provided by the EU, the evaluation underscores the need to have a national goal of Swedish participation. Furthermore, the evaluation finds that analyses and statistics require significant development if they are to form the basis of a strategy for Swedish participation. In order to further utilise the opportunities presented by Horizon 2020 and Horizon Europe, the evaluation makes a point of highlighting the necessity to bolster the NCP organisation with more full-time positions.

In addition to EU-related collaborations, it is also important to strengthen the links with countries outside of the EU. Vinnova is already a central actor in the implementation of the Government's innovation partnerships and research agreements, with ongoing cooperation with countries including China, Brazil, Japan, Israel, USA Germany, Canada and France. However, great interest in collaborating with Swedish actors is evident in many countries across the world. With bolstered resources, Vinnova can continue to contribute to strengthening the innovation dimension of the Government's Team Sweden work, and

¹³ Chapter 11 EU cooperation and international links, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future

promote the establishment of links between Swedish actors and growing innovation economies.

What is needed?

A common strategy, development and coordination of Sweden's international research and innovation links through continued financing of EU co-operation and international co-operation should be made possible. Vinnova believes that the budget needs to be bolstered to meet the Government's raised ambitions for international cooperation, such as signing innovation partnerships. Against the background of the European Commission's clear ambitions to continue the partnership programmes within fields that are important to Sweden, Vinnova suggests returning the budget-level for the EU coordinating function to SEK 200 million per year, as per the 2017 budget. Vinnova also suggests that national resource alignment within the scope of the national partnership programmes and other national mission efforts be linked to the EU's mission initiative. In order to enable more involved collaboration with countries outside the EU, it is proposed that the funding for international co-operation is increased. This will help strengthen the innovation partnerships and improve the conditions for solving challenges together in a global context.

2.5 Proposals and goals

These are Vinnova's proposals for mobilisation with the goal of a sustainable society:

- The Government introduces mission processes linked to the initiatives within Horizon Europe.
- Major societal challenges require different actors to align their resources. As such, Vinnova suggests deep demonstrations that solve complex challenges through innovation. These are tests conducted in a realistic environment where innovative solutions are combined with ethical considerations, the development of regulations and conditions for procurement, which demonstrate what is possible and what the limitations are, and thus quickly results in solutions that can be scaled up.
 - State financing: SEK 50 million by 2021, SEK 100 million by 2022, SEK 200 million by 2023 and SEK 500 million by 2024, with co-financing from businesses and regions in an amount at least equal in size.
- Bolstered Swedish resource alignment is made possible by tasking Vinnova, the Swedish Energy Agency and Formas with further developing the strategic innovation programmes (SIP)
 - Long-term state financing according to the levels of 2019: SEK 800 million per year for 10 years, co-financed by the business community and other actors, contributing an amount at least equal in size.
- Aligning resources for Sweden's participation in the European mobilisation for system innovation through the EU framework programme Horizon Europe and other EU initiatives:
 - Vinnova is given renewed responsibility to coordinate the national coordination function EU Co-operation with an appropriation level increased to SEK 200 million per year and a bolstered support function for NCP.
 - EU co-operation is tasked with developing a national strategy for European research and innovation collaboration within the next framework programme, Horizon Europe.
- Further developed international resource alignment outside the EU through increasing resources to the international coordination function, international co-operation to SEK 50 million per year.

Goals

The goals for national mobilisation in Sweden for a sustainable society are to have developed the following within five years:

- An internationally prominent approach and processes for formulating goals and strategies, that have in turn led to the alignment of resources for system innovation.
- Internationally unique system solutions within the business community and the public sector for green adaptation, digital transformation and healthcare challenges.
- Strengthened competitiveness within the business community and improved quality and efficiency within the public sector through unique system solutions and expertise.
- European resource alignment through missions within the scope of Horizon Europe, which has significantly increased the system effects of Swedish deep demonstrations.
- Internationally prominent policy collaborations on the national and regional level, providing strong policy synergies for system innovation to address societal challenges.

3 Strengthen strategic research and research infrastructure

Research is pivotal to a country's competitiveness and for addressing the major societal challenges facing the world. Internationally successful research is dependent on advanced research facilities. Today, Sweden has access to top-tier research facilities in the form of ESS, MAX IV and SciLifeLab.¹⁴ They contribute to strengthening the innovative abilities and competitiveness of Swedish business on an international market, while also providing infrastructures that attract world-renowned scientists. Sweden maintaining its role as a country that prioritises research and innovation is crucial to our competitiveness and continued development. As a smaller country, we need to prioritise funding, coordination, development and the use of the large-scale research infrastructure and its ecosystem.

3.1 A holistic approach to research infrastructure and its ecosystem

Sweden has made major investments in research infrastructure over the years in the form of ESS, MAX IV and SciLifeLab. For Sweden to reap the full benefits of these investments, measures and investments are required in multiple areas. Sweden needs to stimulate widespread Swedish use of the facilities. Knowledge of the facilities needs to increase, and new interested parties and user groups must be contacted and engaged. Additionally, there is a need to raise the visibility of the initiatives taken, coordinate ongoing and planned initiatives, and support currently active actors. This requires a holistic approach nationally and the prioritisation of funding for large-scale research infrastructure, as well as a coherent commitment to international research infrastructure.

Large-scale research facilities are expensive to build and to run. As such, Sweden should investigate the possibility of creating long-term frameworks for these costs to ensure that previous investments are beneficial to society, the business community and research to the greatest possible extent. Therefore, a review of the forms of organisation, governance and financing of major national research infrastructures should be conducted to determine any necessary structural changes, with the aim of optimising the outcome of these investments to benefit national research.

¹⁴ Chapter 10 Research and innovation infrastructure, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future

What is needed?

In order to benefit from the large investments already made, a national, holistic view and long-term financing solutions for operation and development is required. This also means that a clear division of responsibilities is required for the funding and new funding reforms for long-term commitments regarding deliveries to research infrastructures. An investigation should be launched as soon as possible with the task of finding alternatives for long-term funding investments in the facilities' capacity in the form of instruments and experiment stations. Such an investigation should look for solutions that also attract international and private capital. Funding should be allocated to enhance the environments with the service and expertise required to meet the needs of the business community, and to increase access to smaller research infrastructures at universities and research institutes.

3.2 Use full potential of Sweden as a big science nation

In order to realise the full potential of the investments in research infrastructure, a holistic approach is required regarding Sweden as a big science nation. We need to stimulate the utilisation of and deliveries to research infrastructure within and outside Sweden.¹⁵ Coordination and knowledge-developing efforts are needed. Swedish researchers and business community both benefit from Swedish deliveries to the research facilities. This also contributes to retaining the expertise and capacity needed to develop different types of instruments for research and commercial applications. Therefore, we should continue Vinnova's investments in knowledge development and funding of Big Science Sweden¹⁶.

Increased knowledge and expertise among Swedish researchers regarding the opportunities to utilise the facilities within fields other than those directly linked to neutron and synchrotron technologies has the potential to stimulate both research application and industrial use of the facilities.

Research infrastructure leads to major contributions to the business sector. Among other things, the companies that help develop the infrastructure create innovative technological solutions, which in turn creates opportunities for growth on international markets. The infrastructure also leads to opportunities for needs-based research for the business community, which is significant to long-term competitiveness. A good example of this is SciLifeLab, a company which is now of great value to the business sector thanks to it offering a unique infrastructure with advanced technology and highly competent personnel.

¹⁵ Chapter 10 Research and innovation infrastructure, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

¹⁶ <https://www.bigsciencesweden.se/>

Advanced research infrastructure is of great significance to the research and innovation required to successfully adapt to the changing climate, for example, in the analysis of new batteries, new bio-based materials and new foodstuffs. Therefore, the business community's use of infrastructure needs to be stimulated, developed and prioritised. By offering cutting-edge expertise, as well as supplementary research and innovation infrastructure to the business community, research institutes such as RISE can help increase the value of investments made by the state.

The facilities are surrounded by an ecosystem of actors, research and industry. For the investments to be of as much benefit as possible, this ecosystem needs to be developed and coordinated. Vinnova's government assignment report regarding a technology park function was submitted at the end of 2019, and conclusions should be incorporated in the development strategy. Sweden should also have an investment perspective to attract public and private capital, both nationally and internationally.

Finally, the facilities' international role and position should be considered and utilised, both for societal and business-related needs and needs pertaining to research, and as a strategic resource in relation to other global, large-scale research facilities. A comprehensive, national commitment to international, large-scale research infrastructure based on a clearly defined investment perspective is needed.

What is needed?

In order to enable Swedish actors to contribute to the deliveries made to the facilities, both nationally and globally, the funding of Big Science Sweden as a Tech Transfer Office and International Liaison Office for Sweden should be assigned to Vinnova.

In order to utilise advanced research infrastructure for vital areas relating to climate adaptation, we propose that Vinnova's investments in industry's use of national and international facilities be made permanent and developed.

The business community's access to and use of SciLifeLab needs to be stimulated and made more efficient to realise the full potential of the infrastructure. Additionally, international cooperation and collaboration with healthcare providers needs to be strengthened.

The ecosystem surrounding the research infrastructure needs to be developed and coordinated in a national strategy for development, use and participation. The strategy should clarify the responsibilities of each of the actors. The national ecosystem surrounding the facilities must be bolstered and developed in order to make the most of and reinforce the facilities' inherent attractiveness. Depending on the specification of the current government assignment to the Swedish Research Council and Vinnova and what it means for the implementation plan specified in the assignment, roles and responsibilities concerning operation, funding, development and use should be reviewed. It is also

important that investments in knowledge development regarding the use of the facilities continue.

3.3 Establish programmes to address societal needs

A strategic alignment of resources regarding important fields of research is crucial for a country as small as Sweden. Previous experience has shown that processes for strategic research areas contribute to the alignment of resources and the development of robust research environments.¹⁷ Today, there is an increased need for this capacity, and there are important fields in Sweden that need to be strengthened.

Sustainable energy systems

A sustainable conversion of the business sector and society requires renewable and fossil-free energy sources and systems. Aligning resources for ground-breaking research within this field must be a top priority. Innovative material research will also be pivotal for the research and development conditions within all fields. At the same time, the use of resources must be considerably more sustainable and efficient. New materials will be crucial for the development of climate-promoting technologies, for example, batteries, materials for circularity and other applications for industrial climate adaptation.¹⁸ Sweden is a leader within this field of research, with new industries and new value chains are being continuously developed. Growing companies specialising in new materials, such as graphene, have the potential to be the industry titans of the future.

Digitalisation of the future

The multinational companies' role in global value chains is vital to Sweden's competitiveness.¹⁹ Their offerings and production processes are currently being digitalised at a rapid rate, in collaboration with academia and other businesses. Companies with digital expertise are also more productive and profitable.²⁰

Long-term investments in strategic research and innovation within creative, enabling technologies and areas of expertise for the digital transformation will be of great significance to Sweden's long-term competitiveness, as well as Sweden's ability to

¹⁷ Chapter 9 R&D collaboration and research environments, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

¹⁸ Chapter 5 Global value chains, industry structure and the competitiveness of the business sector, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

¹⁹ Chapter 5 Global value chains, industry structure and the competitiveness of the business sector, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

²⁰ The Swedish Agency for Growth Policy Analysis: Digital expertise – what is the current and future situation in training systems and the business sector?

contribute to the EU's goal of achieving digital sovereignty.²¹ Today, Sweden is aligning its resources surrounding vehicle-centred strategic research and innovation, and there is a corresponding need to invest in enabling technologies for digitalisation, as these affect all parts of society. Areas that require additional resources include, for example, artificial intelligence, quantum technologies and encryption, cybersecurity, robotics, but also the ability to address systems by systems, and the link between communication technologies and new materials and biology.

The solutions of tomorrow for both industry and urban planning also require world-class digital infrastructure. Access to this kind of infrastructure determines what kind of innovations are possible. This also means that there is a great need for digital infrastructure within everything from national research infrastructures to testing and demonstration environments, technology parks and other places in Sweden where resources are currently being aligned. Larger investments in digital infrastructure are needed for these environments, which includes infrastructure in the form of the latest linking technology. Efforts need to be focused on incentives and conditions for securely sharing and processing data between these environments. Incentives and conditions for data sharing are required, as well as access to calculation capacity and secure data storage, which can satisfy needs relating to security, robustness, reliability, speed and privacy.

Precision healthcare for everyone

Individualised care with access to more customised treatments is under rapid development. Precision healthcare will enable the right patient to receive the right treatment at the right time, based on, for example, a broad genetic profiling. Sweden is at the forefront of this research and has the potential to position itself as an international test market with cutting-edge expertise and important infrastructure to attract new investors for patient-oriented research and development. The international competition is fierce however, with national initiatives in both the Nordic region and in Europe. At the same time, these new treatments also challenge current regulations and financing models. Sweden needs to build on its long tradition of collaboration between academia, the healthcare sector and industry, a collaboration that has resulted in many new innovations.

Since 2017, Genomic Medicine Sweden²² – a unique alignment of resources by Sweden's medical faculties, seven regions, SciLifeLab and the business sector – has been developing an infrastructure aimed at making Sweden a global leader within the clinical implementation of precision healthcare within the healthcare sector. The initiative requires long-term and persistent national financing. A successful development phase with strong participation from both the business community and the healthcare sector will in the coming year transition to a national phase of implementation and accessibility, which requires increasing resources. Additionally, the regions have signalled that their budget will

²¹ Chapter 4 Digital transformation in society and the business sector, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

²² <https://genomicmedicine.se/>

shrink in the coming years, which will make it more difficult to maintain the current level of co-financing.

In 2016, the Government tasked Vinnova and the Swedish Research Council with jointly formulating a national programme for protein research, methodology development and production of biological pharmaceuticals. The work was carried out in collaboration with the Knut and Alice Wallenberg Foundation and AstraZeneca. The programme is a part of the Government's strategic healthcare and life science initiative. Even though the programme is set to run from 2016 to 2023, Vinnova has been granted funding for 2016–2019. It is Vinnova's assessment that the programme should continue, and as such be granted funding for the full period up to 2023.

What is needed?

Supplementary strategic research and innovation programmes with a long-term perspective should be launched within three fields where resource alignment is currently pivotal to ensuring Sweden's competitiveness: sustainable energy systems, digitalisation of the future, and precision healthcare for everyone. The investments will enable Swedish actors to become part of major initiatives taking place at the European level, where Swedish researchers possess attractive expertise.

Strategic investments are needed for new materials for future energy storage and energy use in collaboration with other relevant actors, such as the Swedish Energy Agency.

National investments are required in digital infrastructure for industry platforms relating to industry needs and advanced testing and demonstration environments, based on agreements between actors in the business sector and those affected in the public sector.

In order to secure a continued alignment of resources to make precision medicine available to Swedish citizens, the investment in Genomic Medicine Sweden should be secured in the crucial implementation phase for at least an additional three years.

The Government needs to provide the remaining funding for the national programme for protein research, methodology development and biological pharmaceutical production in order to ensure the programme's survival in accordance with the initial plan.

3.4 Proposals and goals

Here are Vinnova's proposals for how to strengthen Swedish research and research infrastructure:

- Invest in world-class research infrastructure and align resources for increased utilisation by researchers and the business sector in Sweden, and within the scope of EU cooperation.
 - Initiate a review of the forms for financing, organisation, and governance of major national research infrastructures. Focus should be placed on a long-term perspective, bolstered collaboration and developed conditions for open access to and efficient sharing of research data and register data. Ensure that the review follows through the investments in MAX IV, ESS and SciLifeLab.
 - A quick investigation should be initiated as soon as possible to review different alternatives for long-term financing of the facilities, and the possibilities of attracting capital from the business sector and other national research financiers.
 - Task Vinnova with bolstering user support for open access and maximum utilisation of existing research infrastructures – SEK 80 million per year.
 - Permanently establish the support for deliveries to research infrastructure initiated in 2017 through the project Big Science Sweden, SEK 20 million per year.
- Strategic research investments with a long-term perspective for competitive digital transformation, sustainable energy systems and precision healthcare for everyone.
 - Task Vinnova with conducting a strategic investment in enabling digital technologies, data sharing, cybersecurity and digital infrastructure, in the same order of scope as FFI, around SEK 400 million per year in state funding with at least the equivalent amount in co-financing from the business sector and regions.
 - Task Vinnova, potentially in collaboration with other relevant actors such as the Swedish Energy Agency, with conducting strategic investments for new materials for future energy storage and energy use.
 - Task Vinnova with conducting a strategic research and innovation programme in the field of precision healthcare for everyone, SEK 100 million per year.
 - Ensure the long-term stability of ongoing investments in life science by securing funding for Genomic Medicine Sweden in the amount of SEK 60 million per year in 2021–2023, in addition to SEK 40 million per year in 2021–2023 for a national programme for biological pharmaceuticals.

Goals

The goals of strengthening strategic research and research infrastructure are for Sweden to have developed the following within five years:

- Efficient national strategic governance and funding of research infrastructure that attracts international and private long-term capital.
- Established structures and financing opportunities for Swedish businesses to use national and international large-scale research facilities.
- Research infrastructure that has attracted world-renowned researchers and innovative businesses, in addition to having made significant contributions to world-leading research environments and centres of excellence in fields of research that are strategic for Sweden.
- Enough access to all research infrastructure and strengthened research and innovation ecosystems in Sweden through all researchers and businesses having an overview of said infrastructure and making sure they can use it and contribute to its development.
- International links and cooperation with internationally prominent research environments, centres of excellence and research infrastructures that has bolstered the attractiveness and competitiveness of Swedish research environments and research infrastructures.
- World-leading research environments within research fields and centres of excellence that enable green adaptation, digital transformation, a renewed healthcare system and enhanced competitiveness.
- Strengthened conditions and driving forces for the strategic governance of universities and university colleges, which has resulted in higher quality research, education and life-long learning, as well as quality-enhancing and efficiency-generating digital transformation within these institutions.

4 Strengthen Sweden's innovative ecosystems

Today's innovation systems are characterised by rapid growth and the development of radical technological breakthroughs with new technologies in many technological fields.²³ Many of these emerging technologies are closely related to and dependent on each other. Innovation is required to utilise the great opportunities provided by this rapid development in order to help solve societal challenges and deal with the significant challenges posed by the rapid and sweeping societal changes.

Individual entrepreneurs and innovators, startups and small innovative companies, and innovative operations within large enterprises and the public sector are all vital to ensuring the innovative power and capacity required to benefit from new technologies.²⁴ At the same time, existing regulations and established approaches are being challenged within both large enterprises and government agencies. The public sector's ability to act in its capacity as a stakeholder, client and regulation developer is pivotal to future competitiveness. We see that Sweden needs to develop and strengthen its ability to utilise these new technologies in research-related collaboration between large and small enterprises, and between the business sector and public sector.

4.1 Connect strategic research and experimental economics

The ability to quickly translate research into innovations that raise new research questions is a decisive factor for both innovative businesses and successful researchers.²⁵ The ability to generate innovative power in global value chains by opening them up to individual entrepreneurs and startups is also a central component.

R&D collaboration between higher education institutions and businesses plays a vital part in the mobility of PhDs between academia and the business sector. Recruiting personnel with a PhD increases a business sector's level of scientific expertise, while also widening and deepening the research contacts between academia and the business sector. For higher education institutions, this promotes the recruitment of internationally prominent researchers and international mobility as well as the establishment of long-term international networks and collaborations.

²³ Chapter 4 Digital transformation in society and the business sector, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

²⁴ Chapter 6 Innovative ecosystems, startups and SMEs, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

²⁵ Chapter 9 R&D collaboration and research environments, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

The institutions' career development systems and career paths do however inhibit the R&D collaborations and mobility between academia and the business sector. Therefore, it is important to bolster the incentives to develop the career development systems and career paths to make R&D collaboration with businesses and the mobility between higher education institutions and businesses equivalent to other academic qualifications.

Close cooperation is essential for success and requires that there are both physical and digital arenas for interaction, where everything from data to lessons learned and results can be shared. The strategic innovation programme and the "Vinnväxt" initiatives are some of these clearly mobilising arenas for cooperation.

Research institutes have great potential as a form of organisation in a research and innovation system that places high and growing demands on the ability to connect different stakeholders, companies, researchers and other actors. The institutes also serve an important function as coordinator in international projects, both within and outside the EU. Therefore, it is important that an internationally competitive RISE can act as a mobilising force in the Swedish research and innovation system.

New cooperation environments are now appearing at a rapid rate. One example is "AI Innovation of Sweden", which gathers a wide variety of actors from both academia and small and large enterprises looking to develop the Swedish AI field.²⁶ Another example is the innovation hubs, where research-related innovations are created through collaboration between major Swedish companies and innovative teams in smaller businesses. At AstraZeneca's BioVentureHub, located in the middle of AstraZeneca's research facility in Mölndal, many smaller businesses and academic groups have been given access to AstraZeneca and its infrastructure.²⁷ The purpose is to promote life science in Scandinavia by utilising resources and capacity in a new manner. Other examples include Mobility Xlab²⁸ and Testa Center²⁹. Together, they facilitate the ability to innovate in highly technological fields, known as "deep tech". These fields are important to both competitiveness and for creating successful new growth companies. However, they do require significantly more research and longer development phases than other fields. Examples of these fields include advanced materials, AI, biotechnology, blockchains, robotics, photonics, electronics and quantum computing, where applications are apparent in every industry.

These environments constitute parts of innovative ecosystems, which when combined with innovation offices, technology parks and incubators funded by both industry and private actors, create attractive environments for Swedish and international talent.³⁰ It is important to assume a national level of responsibility to ensure that these are linked to international investments and are made internationally visible as the national resources that they are.

²⁶ <https://www.ai.se/>

²⁷ <https://www.azbioventurehub.com/>

²⁸ <https://www.mobilityxlab.com/en>

²⁹ <https://testacenter.com/>

³⁰ Chapter 6 Innovative ecosystems, startups and SMEs, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

Additionally, cooperation between innovation environments in different parts of the country needs to be strengthened to clear structural barriers for businesses and promote common learning so that younger companies in their rapid growth phase throughout Sweden can benefit from local areas of strength. It is also important that the state continues to stimulate the development of our incubator system through the type of funding that Vinnova has provided over the years, most recently within the scope of the so-called “Excellenceprogrammet” (The Excellence Programme), the purpose of which has been to support the incubators’ capacity to support innovative businesses with growth potential.

Access to relevant networks is crucial for new innovative companies to grow with Sweden as a base. Technology parks and industrial innovation hubs have a major part to play here. Their international links need to be strengthened in close collaboration with regional export centres. Platforms such as Nordic Innovation House³¹ have proven effective as links to other countries with ecosystems that are valuable but difficult to navigate, with more platforms needing to be launched in regions such as China, Brazil and Sub Saharan Africa.³²

Sweden’s innovative power is currently limited by the fact that there are many social groups whose entrepreneurial competence and innovative capabilities are not being utilised. This is especially true for groups of immigrants, women and people living in rural areas. Diversity and gender equality are undoubtedly success factors, which an increasing number of multinational companies are using strategically, as they can clearly see that it is pivotal to their future competitiveness. Small innovative companies, especially within deep tech, are characterised by being vastly male dominated. We can see the same pattern when it comes to capital supply and ownership. This is further supported by studies showing that women who start businesses have relatively lower chances of receiving funding compared to men.³³ Representatives from major Swedish companies testify as to how difficult it is to recruit women, and how necessary these recruitments are. In other words, there are both cultural and structural obstacles in the way of gender equality and diversity. These are complex issues that require a system perspective, where to a certain extent the groundwork is laid early in life for the skewed ratios we see today in, for example, our engineering programmes. Our Swedish innovation environments play an important part and need knowledge and resources to better achieve and engage under-represented groups, so that we may better utilise the innovative potential across Sweden.

What is needed?

Research and research environments, where higher education institutions collaborate with businesses and other organisations, between stakeholders and researchers are pivotal if

³¹ <https://www.nordicinnovationhouse.com/>

³² Chapter 11 EU cooperation and international links, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

³³ Chapter 6 Innovative ecosystems, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

Sweden is to become a leading country in terms of research and innovation. R&D collaboration between higher education institutions and businesses plays a vital part in the movement of PhDs between academia and the business sector. Collaboration programmes such as centres of excellence, strategic innovation programmes and challenge-driven innovation are of great significance in this context and need to be enhanced and developed further. Internationally competitive research institutes, such as RISE, are needed as a mobilising force.

The higher education institutions' career development systems and career paths do however inhibit the R&D collaborations and mobility between academia and the business sector. Therefore, it is important to bolster the incentives to develop the career development systems and career paths to make R&D collaboration with businesses and the mobility between higher education institutions and businesses equivalent to other academic qualifications.

A national programme is needed for innovation ecosystems to ensure a holistic approach to the Swedish innovation environments, utilise learning and synergies, and counteract the fragmentation that currently exists in the system. This includes further developing strategic innovation hubs for collaborations between large and small enterprises in research-related fields. This is one of the most efficient ways of stimulating the renewal process in the Swedish business sector. Policy instruments and national regional policy collaborations need to be developed within the scope of a national programme for innovative ecosystems. National learning needs to be established between these environments and other parts of the supporting ecosystem, such as innovation offices, incubators and technology parks. Bolster the development of accelerator functions that enable those involved to reap greater benefits from the different locations' thematic areas of strength. An international perspective and strategic prioritisations in relation to EU investments should be integrated in these initiatives, as should a priority to strengthen the international links, for example, through supporting the establishment of more hubs like Nordic Innovation House and establishing landing spaces in Sweden for foreign scaleups. Within the scope of a programme of this nature and in the coordination of the innovation support functions, it is necessary to make a vigorous effort to increase the opportunities and conditions for strategically increasing innovative entrepreneurship and ownership among women and under-represented groups.

An important aspect is that the development of a new programme is conducted in collaboration with other government actors. It is likely that structural funds will also have a clear focus on research and innovation in the coming programme period between 2021–2027. Through a strong national programme for innovative ecosystems development, and joint planning requirements with the Swedish Agency for Economic and Regional Growth, good conditions are created for the strategic use of resources from the structural funds, synergies between regional and national investments, and the establishment of strong ecosystems across the country.

4.2 Strengthen the support for innovative startups

A dynamic and healthy innovation ecosystem that stimulates experimentation is characterised by a large influx of new ideas, including those originating from research. The verification funding has proven vital when new technologies and ideas are tested within the scope of, for example, innovation offices and incubators.³⁴ Verification funding provide opportunities for testing and validating ideas both technically and commercially, i.e. taking it from a laboratory to real-life application. Quickly determining whether an idea is worth moving forward with or if it should be disregarded is incredibly important and creates learning and leads to better utilisation of resources. Government funding is of pivotal importance.

Even though there are plenty of new innovative companies being started in Sweden, we see major challenges in the later phases. Companies with growth potential that operate in fields that require major investments of capital have different prospects in different parts of the country when it comes to funding the phase known as the industrialisation phase, also known as “the valley of death”. Demand has been validated through prototypes, but capital is needed to proceed to production and scaling. Venture capital is often lacking, except when the company has the potential to grow into a so-called “unicorn company”³⁵ or when the field is of interest to a knowledgeable business angel.

Even though financing through loans is generally viewed as the most appropriate form of funding for growing companies, there are strong arguments to be made for an enhanced grant component. Many of the most promising startups are active in fields where the step from idea to a rapid growth phase is very big. This is especially true for deep tech companies built on advanced technologies and which pursue high-risk, capital-intensive R&D projects. Certain fields also require regulatory processes, which delays solutions going to market. The consequence of this is that the high-risk period is extended. During said extension, it is difficult to obtain private funding and there is not enough security for loan financing, which demonstrates a need for government-sponsored grant funding, including in the initial accelerator phase. One alternative would be for the state to offer guarantees so that the commercial banks can step in and offer loans even if there is a lack of customary security. This is done on a European level through the instruments funded by the EU’s research and innovation programme and implemented by the European Investment Fund. Swedish actors such as Almi Invest, Norrlandsfonden and the Swedish Export Credit Corporation currently utilise these guarantees.

“Scaleups” represent an important potential for Swedish growth. Scaleups are companies with more than 10 employees, a turnover of around SEK 20 million per year and growth of 20 per cent annually for three years. Far from every startup is successful, but those that do succeed have a major impact on society in the form of new technologies, services and

³⁴ Chapter 6 Innovative ecosystems, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

³⁵ Tech startups with a value of over USD 1 billion.

employment.³⁶ This is a group that makes up around 13 per cent of the total number of companies with more than 10 employees, and a group that we in Sweden do not have sufficient knowledge of.³⁷

Internationally, there is Scaleup Institute in the United Kingdom³⁸ and Scaleup Nation in the Netherlands.³⁹ In Sweden, we need to expand our knowledge about scaleups, not only to better understand the need for funding but to understand the whole context of needs and success factors, to create the right conditions for scaleups to grow in Sweden.

Another reason to continue significant investments in these areas is that the European Commission is expected to allocate a substantial amount of resources to invest in growth companies in the field of deep tech, and to build robust ecosystems within the scope of the European Innovation Council. Many of the European investments will require national co-financing for Sweden to gain access to the EU funding. In other words, bolstering initiatives within the field will present opportunities for increased national funding with support from the EU.

What is needed?

Going forward, Vinnova should retain its mandate and resources to provide verification funding offered via innovation offices and incubators.

The national incubator and science park programme proposed in a previous section should include an enhanced accelerator function.

A study that outlines the challenges and growth obstacles facing Swedish scaleups and which can serve as policy basis for Swedish public actors to provide Swedish scaleups with the conditions they need.

4.3 Strengthen intellectual property support

Intellectual properties are developed in and are the result of innovation processes. Managing intellectual properties (IP) is often a major challenge for both new and more established businesses.⁴⁰ This is particularly a challenge for SMEs, as it affects their prospects on an international market. Even if many tech companies chose to prioritise

³⁶ The Bold Ones – High-impact Entrepreneurs Who Transform Industries, WEF Report (2014) http://www3.weforum.org/docs/AMNC14/WEF_AMNC14_Report_TheBoldOnes.pdf

³⁷ Scale-ups in the Nordics –Statistical Portrait 2008-2016 (Nordic Innovation 2019), <https://norden.diva-portal.org/smash/get/diva2:1295424/FULLTEXT02.pdf>

³⁸ <http://www.scaleupinstitute.org.uk/>,

³⁹ <https://scaleupnation.com>

⁴⁰ Chapter 6 Innovative ecosystems, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

speed above patenting these days, there are many fields where a strong IP strategy is necessary.

Vinnova has developed a model for IP checks that has been tested and verified. The model and the processes linked to this initiative have proven successful. However, the model needs to be scaled up for larger system effects. This also requires the initiative to reach SMEs across the country. That is why increased resources are proposed for a national initiative regarding IP checks, and that they be distributed to incubators and innovation offices via Vinnova. The Swedish Patent and Registration Office, PRV, plays an important role by increasing the level of knowledge surrounding intellectual properties.

Pursuing a legal dispute entails a major financial risk, which makes it practically impossible for an actor with limited capital to protect its intellectual properties. In other countries such as the United Kingdom and Germany, a system has been introduced that limits the inherent financial risks of a patent dispute. For Sweden to maintain its position as a strong knowledge nation with a competitive business sector, we need to improve the protection of intellectual property rights and make qualified advice available to both individual innovators and innovative SMEs.

What is needed?

A national programme for knowledge and processes regarding intellectual property, developed and run by PRV and Vinnova, is needed. The programme includes development of a national IP data platform with the purpose of making IP data available to innovators, businesses and policy actors. The programme should also include support in the form of IP checks and IP support through public and private business consultants, incubators and innovation offices, as well as funding for innovation actors to provide individual innovators with advice. A research element that can serve as a basis for upcoming policy development within the field should also be included. Vinnova sees a need for an inquiry that describes the interplay between the structures in the ecosystem, primarily innovation offices, incubators and technology parks, in supporting the innovation actors. An inquiry of this nature should consider how the legal system and these publicly financed support structures can be developed in order to improve the support and protection for actors with limited capital.

4.4 Develop smart policy and regulation

The public sector needs to manage the rate of change and the complexity of societal developments. System innovation to create a sustainable society is not accomplished through individual innovation projects alone. A reactive approach to new technologies among legislators and regulatory authorities can lead to legal uncertainty and inefficiency, as well as risks to citizens, businesses and society at large.

In Sweden, the public sector's role and significance in collaborative and innovative processes is highlighted in the National Innovation Council and the Government's strategic collaboration programmes. Over the past few years, the World Economic Forum, OECD, the EU and national governments have taken initiatives internationally to not only gain a better understanding of, but also act based on how different sets of regulations impact the innovation climate. We need to gain a better understanding regarding how sets of regulations and policy processes and needs for system innovation changes the conditions for policy development.⁴¹

There are many examples of initiatives aimed at accelerating a smarter and more experimental policy development. Many countries have introduced regulatory sandboxes within the field of finance, and to an increasing extent in other areas too (including the United Kingdom, Singapore, Japan, the Netherlands, Denmark and Canada). The idea is to allow entrepreneurs and innovators to develop and test new products and services under controlled circumstances, while giving regulatory authorities an opportunity to better understand what possibilities the companies are exploring and what the regulatory limitations are. In the United Kingdom, the Department for Business, Energy & Industrial Strategy has started a fund of GBP 10 million (the equivalent to SEK 118 billion) where regulation drafting and implementing authorities may apply for project funding. The purpose is to create the mandate and conditions for proactive policy development.

Vinnova believes a promising process for improving the cooperation of regulatory authorities has been developed (in the previous government commission to strengthen cooperation between authorities for a comprehensive innovation process). The goal was to bolster Sweden's role as a test bed for new innovations. These experiences have been used in Vinnova's investment in policy labs that have been design-driven processes to draft suggestions for changes to regulations, forms of organisation and business models. The effects can already be seen in the complex challenge of developing modern approaches regarding the development and assessment of legal regulations and financial instruments. There is great potential of achieving greater effects by continuing to build up the demand for and the capacity of such approaches.

Participating in design-driven development projects creates trust and collaboration between units from each participating authority, between the participating authorities and between authorities and participating businesses and citizens. The methods and the work have contributed to increasing the understanding of the different parties' roles and responsibilities and provided a deeper insight into misunderstandings and established preconceptions.

What is needed?

⁴¹ Chapter 7 Public services – R&D and the power of innovation, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

As in the United Kingdom, an initiative is needed to fund investments in proactive policy development and regulatory sandboxes. The Government should create the conditions in the form of legislative proposals and opportunities to apply for exemption from national legislation. The Committee for Technological Innovation and Ethics, KOMET, has proposed that Vinnova should be tasked with financing projects aimed at proactive policy development, as well as collaboration and innovation efforts at regulatory authorities. The experiences from the United Kingdom show that a programme of this kind needs to be combined with a methodological and process support to achieve the desired effects. As such, the capacity should be included in the investment through the establishment of a national policy lab.

The policy lab should be initiated by Vinnova, coordinated with KOMET, work in tandem with the proposal in the final report of the Delegation for Trust-Based Public Management regarding the establishment of a government-affiliated development environment, RUM, to create the conditions needed for coordination of other relevant initiatives.

4.5 Develop innovation leadership in the public sector

We will soon be faced with major welfare and societal challenges that will truly test our innovative leadership.⁴² In a public sector innovation survey, less than 20 per cent say that their place of work is characterised by a culture that promotes experimentation and risk-taking. The same survey shows that only around 33 per cent claim that they have access to the expertise, processes, methods and tools to support innovation and innovative efforts.⁴³

The knowledge about innovation management with the goal of facing the complex and cross-sectoral challenges is currently fragmented and difficult to understand. It is difficult for individual organisations to know where they should turn for information about how they should systematically lead their innovation efforts. This concerns everything from idea generation and taking stock of ideas, to implementation, scaling and spreading.

Over the course of 2018 and 2019, Vinnova has tried packaging the knowledge developed through projects funded by the programme “Innovation management and organisation in a needs-driven innovation management support”. The pilot phase of the support programme has been implemented by researchers and consultants with the expertise and ability needed to face the challenges of the project. Preliminary results indicate that the efforts have improved the conditions to work systematically to increase the innovative ability both internally and in external collaborative constellations. Collaboration between authorities is also an important part, one we believe houses great potential to explore further. There are

⁴² Chapter 4 Digital transformation in society and the business sector, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

⁴³ Chapter 7 Public services – R&D and the power of innovation, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

international examples of this cooperation a collaboration in Singapore through the efforts at “InnoLab”⁴⁴, as well as different co-working spaces such as “Superpublic”⁴⁵ in France.

Innovation procurements houses great potential for municipalities, county councils and regions. It is an umbrella term for several different tools that make it possible to procure solutions from knowledge intense businesses and where new ways of thinking and development is rewarded.⁴⁶ Public innovation procurement has been on the innovation policy agenda for more than a decade and has historically played a central part in the development of Sweden’s innovative ability. It has also been part of the latest national innovation strategies and has resulted in multiple government commissions. Knowledge and examples need to be disseminated. Resources to reduce the risks associated with using these tools are also needed.

The Government also has high ambitions to make Sweden the best in the world at utilising the possibilities of digitalisation. However, studies have shown that the public sector has major problems utilising digitalisation,⁴⁷ which causes it to miss out on opportunities for innovation. Vinnova has launched a collaboration with the Agency for Digital Government, DIGG, along with the Swedish Association of Local Authorities and Regions (SALAR). Both parties are important actors in increasing Sweden’s ability to use data as a strategic resource. An increased understanding of, and knowledge about, how direction and management is used to create a secure and efficient information-sharing process are also prerequisites for an accelerated development within the field.

What is needed?

A national arena for sharing knowledge about innovation procurement, innovation management and information sharing aimed at the Swedish public sector should be developed by Vinnova in collaboration with DIGG, SALAR, the National Agency for Public Procurement and other relevant actors. The arena should be based on a model that encourages and enables authorities to share their expertise of the fields in question. Those working in the public sector need more opportunities to work with experimental development, different types of laboratory and test activities, as well as working together beyond the borders of their organisations. This entails serving as a hub for building capacity for approaches that also include the regional and municipal sector, RISE and other relevant actors who can contribute to the increasing the capacity for approaches across the country.

⁴⁴ <https://www.innolabs.io/>

⁴⁵ <http://hallesciviques.org/>

⁴⁶ Chapter 6 Innovative ecosystem, startups and SMF and Chapter 7 Public services – R&D and the power of innovation, Vinnova’s Analysis Appendix, Prerequisites for system innovation for a sustainable future.

⁴⁷ Digital mognad i offentlig sektor 2019, <https://www.digitalforvaltning.se/wp-content/uploads/2019/05/StatusrapportDigital-Mognad2019.pdf>

4.6 Innovative and sustainable investments

The development of, and the driving forces behind, the finance market will play a pivotal part for global and national climate conversion. Activating finance research and the finance sector to direct funding towards innovative and sustainable investments is crucial for society's ability to readjust to sustainability.

Since 2008, "Finansmarknadsforskningsprogrammet" (the Finance Market Research Programme) has supported the development of internationally competitive research that is highly relevant to private and public actors as well as the financial market, while also developing and establishing strong research environments and facilitating skill provision. Vinnova's investments into this programme has amassed private funds equivalent to the contributions made by the Government (SEK 30 million per year) and distributed the funds through open calls for proposals. Among other things, Vinnova funds the Swedish House of Finance⁴⁸ at the Stockholm School of Economics, as well as individual projects, such as support for finance technology hubs and policy labs implemented alongside the Swedish Financial Supervisory Authority. There are many investments within the field where Vinnova has not been financially involved, such as Stockholm Sustainable Finance, which is managed by the Stockholm Environment Institute and the Stockholm School of Economics.

We see that an investment in the field would have a greater effect by being more closely linked to Vinnova's other efforts, such as policy labs and market-affiliated development.

What is needed?

A continued long-term assignment to Vinnova to work with innovation within the financial market. This would serve to achieve a conversion and to reinforce competitiveness in Sweden. An expanded investment with a strong focus on sustainability will help contribute to a more expedient conversion and a bolstered competitiveness not just within the Swedish financial sector, but all other fields that are dependent on this sector.

4.7 Strengthen life-long learning and cooperation incentives for higher education institutions

The rapid rate of change taking place will affect all sectors, industries, businesses, public sector operations and people. The requirements to change and develop among individuals and businesses are growing. This means that the life-long learning process will become even more vital for knowledge and skills provision.⁴⁹

⁴⁸ <https://www.hhs.se/en/houseoffinance/>

⁴⁹ Chapter 8 Research systems and the triangle of knowledge, Vinnova's Analysis Appendix, Prerequisites for system innovation for a sustainable future.

The rapid digital development and conversion places high demands on being able to learn throughout our professional lives. As the labour market has begun to shift more rapidly, the demand for different forms of education and learning has grown. Skill development within the private and public sector needs to evolve. Similarly, single individuals need better opportunities to continuously develop their and validate their competence throughout their professional careers. Validation and opportunities to have your skills recognised are important to increase labour market mobility, improve matching rates and secure skills provision. Representatives from the business sector highlight the importance of the life-long learning process, as well as improved gender distribution at technical study programmes to not miss out on competence.

New opportunities for education and learning are also being developed. Digital matching of individuals for both jobs and learning is growing, and technologies such as virtual and augmented reality changes the learning conditions in both industries and society. A great deal of learning takes place in collaborative environments where results, skills development and learning are achieved through interaction. Innovative solutions to everything from validation and matching to new learning environments is therefore an important theme for innovation.

The education systems of today are largely based on people being trained early for a life-long professional career, and that the knowledge acquired as part of their education can be utilised throughout their career. Any learning later in life is largely insufficient, nor is it validated or valued to the degree required by the new jobs currently emerging. The current system is adapted to a society that develops slowly, and it is not well-adapted to the current rapid technological developments.

In other words, there is a substantial need to improve the opportunities for transition, continuing professional development and changing careers, both for those already working as well as single individuals wishing to develop their skills further.

In accordance with Vinnova's comments to the Government regarding long-term, coordinated and dialogue-based university direction (SOU2019:6), we are of the opinion that the Government should initiate a reformation of the resource allocation system. Over the coming years, steps should be taken to begin work on "development contracts". These may initially be limited but pressing fields that currently have weak initiatives, such as the life-long learning process. They can be divided into specific resource-allocation investments based on development contracts, which gives universities incentives to boost their efforts regarding the life-long learning process. Funding for this could be obtained from an allocation pot used for redistribution. Vinnova's experience from previous government commissions is that relatively limited funds give a major signalling value and bolstered driving force for development.

What is needed?

There is a need to promote the life-long learning process, gender equality and diversity by developing incentives and conditions for universities, higher vocational education institutes and other education actors to take more responsibility in the life-long learning process by coming together to offer short courses adapted to the needs and capabilities of professionals. The commission given to Vinnova in 2017, to develop short, flexible courses for professionals, needs to be broadened. This is needed in order to continue encouraging universities and higher vocational education institutes to develop their course selection to match the demand for life-long learning from the business sector, the public sector and from private individuals. The commission should also include promoting innovativeness, gender equality and diversity for the development of learning, validation and matching approaches and tools of tomorrow.

4.8 Proposals and goals

The following is Vinnova's suggestion for strengthening Sweden's innovative ecosystem:

- Task Vinnova with running a national programme for innovative ecosystems, SEK 250 million per year:
 - The development of new industrial innovation hubs and further development of incubation and upscaling with a focus on deep-tech companies.
 - Bolstered learning between different innovation environments, strengthened international links, increased gender equality and diversification in Sweden's innovation ecosystem.
 - Continued investments in providing means of verification.
- An investment in continuously analysing and clarifying how Sweden can improve its opportunities for scaleups.
- Give PRV and Vinnova a shared assignment to run a programme for knowledge and processes regarding intellectual property, SEK 60 million per year.
- Promote innovation and experimental development in the public sector by:
 - The Government creating space for regulatory trial activities in the public sector through trial legislation and a process to be exempted from national legislation.
 - Task Vinnova with funding the experimental development of regulations, as well as initiate and coordinate a national policy lab. The initiative should be developed and operated in close collaboration with KOMET, RISE and other relevant actors. Should be financed via Vinnova, with SEK 30 million per year, starting in 2021.
 - Task Vinnova to, in collaboration with the relevant authorities, build a national arena for knowledge and cooperation for innovation procurement, innovation management and sharing information. Funded by SEK 20 million per year.
- A continued assignment to work with innovation within the financial market, with a focus on a green conversion, SEK 50 million per year.
- Promote the life-long learning process by:
 - Developing incentives and conditions for universities and other education actors to develop their course selection through national and international collaboration in a manner that is accessible and attractive to professionals.
 - Expand Vinnova's task to support projects aimed at developing short, flexible courses for professionals, as well as stimulation innovation when it comes to the future of learning, validation and matching, to be funded with SEK 60 million per year for the years 2021–2024.
- Develop the universities' merit system and career paths so that R&D collaborations with companies and mobility between universities and businesses are put on an equal level to other academic merits.

Goals

The goal of bolstering Sweden's innovative ecosystem is for Sweden to have developed the following within five years:

- World-class innovative ecosystems and international collaborations with globally prominent ecosystems that has generated three times more Swedish growth companies compared to today, and that continues to have Sweden as an important foundation for expertise, innovation and growth, and that contributes to the digital transformation and sustainable conversion through its solutions.
- The ability to demonstrate innovative leadership, policy development and innovation procurement in collaboration with the business community and the public sector, along with a vastly improved ability to use the digital transformation to develop working life, work environment and skills development for employees and citizens.
- Policy collaborations between different policy actors at the national, regional and municipal level, which has significantly enhanced the overview of, and the synergies within, the ecosystems for innovation for innovators, businesses and policy actors.
- Expertise, processes and regulation development for the management of data, data sharing and data security, which in turn has generated increased quality and efficiency within the public sector and the business community.
- A substantial, positive change regarding gender equality and diversity in innovation and entrepreneurship, with at least a 40 per cent increase in the proportion of new, innovation-based companies founded by women or members of other underrepresented groups.

Vinnova Rapport VR 2020:06

System innovation for a sustainable future

VINNOVA
Sveriges innovationsmyndighet