New Bio-based Materials, Products and Services

SIO programme description

MISSION (of the SIO programme): ***Create the best conditions to increase the added value in the Swedish bio-based sector***

VISION (of the strategic innovation area): ***Sweden makes the conversion to a bio-based economy in the first half of the 21st century***

EXECUTIVE SUMMARY

The SIO programme in your hand is a plan to initiate a decisive phase in Sweden's journey to develop a strong position in the bio-based economy. The SIO programme will largely contribute to Sweden's ability to develop a strong position in the globally arising bio-based economy, and it will unleash the potential of Swedish bio-based resources from forests, fields, waters and waste to be used in cost and energy efficient production processes. The SIO programme shows how governmental resources support the actors in the strategic innovation area to bridge traditions, boundaries and structures, and to establish new cooperation and development in interaction with existing efforts. Expected effects are new innovations leading to bio-based materials, products and services that give increased international competitiveness for Swedish enterprises and increased export value for Sweden.

Behind the SIO programme stand more than 50 important representatives for enterprises – including large owners of forest– and research, where every company and organization has identified specific market opportunities that can be reached with the right mix of collaborative development. This SIO programme does not aim for one single market, but for several different markets driven by a strong cooperation network between globally competitive enterprises and excellent research environments in Sweden. Many actors already have strong national and international positions, and together they have a critical development potential that can be released through the SIO programme.

In new cross-boundary cooperation, the SIO programme will initiate and implement large and pervasive strategic innovation projects that will drive the development within bio-based materials, products and services. Specific investments in analysis and learning on market conditions and new value chains will provide results that constitute the basis for these projects. Through open calls, the SIO programme will capture additional ideas and opportunities that will further contribute to the renewal and development of the strategic innovation area.

All efforts will be part of an integrated approach on innovation, spanning from political prerequisites and market conditions over research and development to demonstration and product/service development.

The success of the SIO programme is ensured by a strong organisation with clear and challenging commitments from the participating actors. The organisation is lead by people that – supported by the resources made available – have the necessary conditions to turn vision into reality. This SIO programme paves the way for Swedish enterprises into the bio-based economy, and opens up for new and innovative solutions to the demands of the future. ■

Content

1 The strategic innovation area

The world needs a transition from a fossil-based to a bio-based economy. This will generate business opportunities where Swedish enterprises can take a globally leading role by developing new bio-based materials, products and services for the new and existing markets that the bio-based economy provides. This will give increased international competitiveness for Swedish enterprises, increased export value for Sweden, and a sustainable society for our children.

A bio-based economy is the name of our underlying strategic research and innovation agenda. This is an economy based on the utilisation of biomass from forests, fields, waters and waste for a sustainable production. This is an economy that reduces climate impact and the use of fossil-based resources. This is also an economy that optimises the added value from eco system services and provides new market opportunities.

The EU bio-economy has an annual turnover of € 2 trillion and employs more than 22 million people. The European Commission (IP/12/124 13/02/2012) estimates that each euro invested in bio-economy research and innovation will trigger € 10 in added value by 2025, and that the EU bio-economy will generate an added value of € 45 billion and 130 000 new jobs by 2025. The bio-based economy is a powerful driving force of future global markets.

VISION: ***Sweden makes the conversion to a bio-based economy in the first half of the 21st century***

1.1 DEFINITION OF THE STRATEGIC INNOVATION AREA

The starting point is the vision of a bio-based economy in the middle of the 21st century. Based on renewable resources we define our strategic innovation area as the prioritised areas Chemicals & Energy, Materials, Construction & Design and New Utilisation. These are areas with a strong Swedish position and a potential to substantially contribute to and capitalise on the conversion to a bio-based economy. These are also areas that have a potential to develop new cross-sector cooperation for increased innovation and increased value of the Swedish bio-based raw material.

Chemicals & Energy

Materials

Construction & Design

New Utilisation

These are the prioritised areas in which the SIO programme's actors will deliver new innovations leading to bio-based materials, products and services. The development of the prioritised areas will thus strengthen the global competitiveness of the bio-based sector in Sweden, while contributing to solutions of global societal challenges by an eco-efficient utilisation of Swedish biomass for a cost-efficient production. This development will be the back bone in the conversion to a bio-based economy in Sweden by 2050.

The sub sections below give a flavour of relevant opportunities within the SIO programme. The descriptions should be seen as indicative and are based on clearly expressed interest from actors in the application phase. Chapters 2 and 4 elaborate on how such efforts will be prioritised and further developed in cooperation with VINNOVA.

1.1.1 Chemicals & Energy

In Sweden the chemical industry consists of around 450 enterprises with in total 34 000 employees. Just like the global chemical industry, they face a shift in raw materials base due to gradually declining fossil resources and an increasing oil price. Moreover, they are put under pressure to eliminate processes and products which are environmentally less sound and also face an increasing demand for "green" and sustainable products from their customers and the market. To stay competitive, the Swedish chemical industry is therefore in need of new technology for an efficient utilization and conversion of bio-based raw materials from forest, agriculture, sea and different waste streams into a number of platform chemicals that can be further processed into e.g. surface coatings, adhesives, binders, plastics, etc. Also fine and specialty chemicals are of high interest as compounds for pharmaceutical and food industry, as are biofuels such as ethanol and biodiesel.

In these types of biorefineries raw material like lignocelluloses or grains is fractionated into a number of useful fractions, such as cellulose, hemicelluloses, lignin, starch, sugars and food, with the aim of maximizing the value of the feed stock. The various fractions can then individually be converted into value-added products such as chemicals, materials, biofuels, electricity and heat with the right process technology. Cellulose sugars can be converted to bio-ethanol and then reconverted to ethane, the world's most important building block for the chemical industry. Cellulose based ethane can give new innovative products, but can also be a sustainable bio-based substitute for fossil based raw materials for today's chemical products. To maximize the value of the feed stock, which is different from the less complex fossil raw material, new and innovative technology platforms for separation, fractionation, extraction and conversion of the biomass is needed. The overall process must also be as resource and energy efficient as possible in order to be competitive to fossil based processes.

The biorefinery of the future will bring together different industries for a production of for instance high-value low-volume functional chemicals in combination with low-value high-volume transportation fuels.

Section 4.7.1 lists candidates for strategic projects (mainly B2B projects), which would be coordinated with already existing projects such as Bio4Energy, Swedish gasification centre and Biosyngas.

1.1.2 Materials

In the bio-based economy, materials from bio-based resources need to replace the function of materials that today are produced from fossil resources. Hence, by developing new carbon-sequestering materials from renewable biomass and using them in materials-intensive products that have long service life, the greenhouse gas emissions will be reduced.

Examples are construction and insulation material that can be developed from fibre materials, as well as moisture barrier materials. Another example is cellulose-based textiles, which are an excellent alternatives to fossil-based fabrics as well as chemical- and water-intensive cotton products. By utilising smart packaging that enables new logistical solutions as well as lighter transportation (lower energy demand), food can be stored more efficiently (less waste), and food and medicine can be distributed more safely and be less exposed to the spread of infection. Within healthcare and Life sciences, bio-based products are well suited. Antibacterial surfaces stain or easily washed surfaces and integrated sensors and intelligent features are promising possibilities.

Several other types of materials can be developed on an ever-increasing scale – bio-based plastics and composites, carbon fibre, chemicals and energy products. Also the wood products industry has great potential for significantly higher growth as it is important to develop new wood-based, functional and innovative products that are technically suited to efficient production flows

Section 4.7.1 lists candidates for strategic projects.

1.1.3 Construction & Design

Sweden uses 0.5 m^3 wood per capita annually, while the corresponding figure for EU is 0.13 m^3. Around 70 % of the wood is used in the sectors "Building with wood" and "Living with wood", where the new build and renovation sector are important both in Sweden and in the other EU countries. There is therefore a substantial opportunity in developing bio-based products and systems for these sectors that can be manufactured in an environmentally friendly and cost efficient way.

Strong innovation in product design, market adaption and production systems are needed, which would enable efficient production of small series in a big scale. Further opportunities for increasing the long-term carbon sink lie in the development of new bio-based construction materials as well as methods for improvement of service life for wood products.

Section 4.7.1 lists candidates for strategic projects.

1.1.4 New Utilisation

New utilisation is where the SIO programme anticipates the unexpected – it is crucial to stimulate innovation and innovative solutions, including business models, companies and technologies that do not yet exist. To meet this, the SIO programme will be based on challenge-driven innovation, as elaborated in chapter 4. We expect that also others than the actors in the strategic innovation area will be needed to come up with all the best proposals and opportunities, and therefore there will be a need for open calls and supporting projects. This is elaborated further in the effect logic in section 2.6 and in the Appendix – target B is specifically about this.

1.2 CURRENT POSITION OF THE STRATEGIC INNOVATION AREA

The strategic innovation area with its four prioritised areas contains strong enterprises in the forest, textile, chemical, energy, construction and other areas. There are strong research clusters with universities and institutes, which are connected to public bodies on a national and regional level.

The strategic innovation area is of fundamental importance for the Swedish economy, which is exemplified by the table below, where figures are for 2012. In addition, several other enterprises are involved, such as machinery manufacturers, ICT companies, construction companies and energy suppliers. Sweden has 1 % of the world's forest land, but is the second largest exporter of forest industry products. The export value of the forest industry alone equals the Swedish net trade balance. The annual grain production in Sweden is more than 5 million tons and is expected to increase with 10 % by 2020. Sweden also has 700 000 ha under- or unutilised agricultural land that could be used for future biomass production.

Sector	*Direct employees*	*Annual export value [SEK]*
Forest industry	60 000	123 000 000 000
Textile industry	7 000	20 000 000 000
Chemical industry[1]	34 000	100 000 000 000
Sum	**101 000**	**243 000 000 000**

The sectors of industry in the table above are competitive on the highest international level, with a leading production infrastructure, a wide range of pilot plants, efficient growth of high-quality biomass, substantial intellectual assets and a strong networked research infrastructure. During the last decades, Sweden has invested billions in test and demo facilities for up scaling and verification of technologies and processes like gasification, torrefaction, hydrothermal/biochemical conversion and lignin separation. These resources, the qualifications of this area, and the willingness of the industry to change provide Sweden with strong competitive advantages.

Important research providers within the strategic innovation area are internationally leading or have unique research groups. Eleven universities and five research institutes, all centrally positioned

1 Oil refineries excluded

in bio-based R&D&I have delivered input to this SIO programme and have also made Statements of Intent describing their interest, engagement and possibilities. See attachment with Statement of Intent, where the respective areas of expertise are also described.

1.3 INTERNATIONAL COMPETITION FOR THE STRATEGIC INNOVATION AREA

Sweden holds internationally leading positions regarding industrial and technical expertise and business knowledge in the strategic innovation area, and is home for several companies that are globally competitive, especially in high-end products. Swedish companies are challenged by low-salary countries, where the biomass grows several times faster, and where production impact on environment and climate is low on the agenda. On the other hand, countries like China can be expected to be leading in clean tech in a few years.

The strategic innovation area is a hot area in large parts of the world, and there is a strong growth of programs and projects globally. So far, there is an aspect of competition among these, while the SIO programme is about cooperation. There are some larger funding efforts in the world within this area, and these initiatives are important cooperation partners. Contacts have already been made in the following.

- A European Consortium leads the EU-supported ***Bio-based PPP*** (http://biconsortium.eu/)
- A European Consortium leads the EU-supported ***SPIRE PPP*** (http://www.spire2030.eu/)
- A Finnish consortium leads the Tekes-supported ***Design driven value chains in the world of cellulose*** (http://web.aalto.fi/en/current/news/2013-10-02/)
- A Canadian consortium leads the ***Bio-pathways*** and ***Construction value pathways*** programs (http://www.fpac.ca/index.php/en/page/value-pathways)
- European Technology Platforms within the strategic innovation area include
  - The Forest-based sector Technology Platform (http://www.forestplatform.org/)
  - The European Technology Platform for Sustainable Chemistry (http://www.suschem.org/)
  - European Technology Platform for the Future of Textiles and Clothing (http://www.textile-platform.eu/)

1.4 CONTRIBUTIONS TO SOLUTIONS TO GLOBAL SOCIETAL CHALLENGES

The bio-based economy provides a sustainable solution for our continued existence on this planet. Use of renewable raw material, reduced energy use, carbon neutral energy supply and reduced climate impact are obvious factors of importance. Add to this the new bio-based materials, products and services that will improve everyday life in areas like hygiene and health care, packaging and transport, lightweight constructions, food and many more.

The strategic innovation area by definition has a large potential to contribute to a sustainable society. Ecologically by the sustainable use of bio-based resources, economically by sustainable growth through added value rather than through plundering of finite resources, and socially by leaving a sustainable planet to our children.

The strategic innovation area has identified the following five societal challenges as the most important of those defined by EU Horizon 2020:

- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy
- Climate action, environment, resource efficiency and raw materials
- Secure, clean and efficient energy
- Health, demographic change and wellbeing
- Smart, green and integrated transport

The strategic innovation area will contribute to solutions to these global societal challenges – directly or by the development of key enabling technologies. These challenges will also be strong

drivers of new markets. This means that the strategic innovation area has the opportunity to provide solutions to global societal challenges while doing business. This combination gives the area a very strong potential.

1.5 VISION AND FUTURE POTENTIAL FOR THE STRATEGIC INNOVATION AREA

VISION: ***Sweden makes the conversion to a bio-based economy in the first half of the 21st century***

The strategic innovation area contains some of the strongest and most important industrial sectors in Sweden. This position will need hard work to keep, and the foundation for this work has been laid by developing a strategic research and innovation agenda. The agenda identifies some of the global societal challenges to be strong drivers of new markets that this area will address. The transformation to a bio-based economy will put high demands on Swedish enterprises, but the agenda also identifies key issues for success. The conclusion is that we need to support and accelerate focus shifts to products with higher customer value, from research to innovation, and from coexistence to cooperation. It is of great importance to cooperate through the entire value chain and across previous sector boundaries.

The strategic innovation area contains actors from adjacent sectors that have had too little cooperation historically, and this is where the innovation area needs strengthening. By new cooperation that has a focus on pairing valorisation of the Swedish bio-based raw material with a market demand for bio-based products, we will see new material and value streams as well as mutual learning of process technologies and customer focus. New strong innovation strategies will develop as well as new business models for new bio-based materials, products and services with high competitiveness on a global market.

This will lead to a large number of job opportunities in the entire bio-based sector in Sweden. Growing and harvesting biomass from forest, fields and water will increase, as will reuse, recovery and recycling. Value chains will be closed to value circles. Furthermore, new small and innovative companies will emerge and find markets by providing new bio-based solutions to the global societal challenges. Among such future Swedish companies we will see global success stories.

1.6 MOST IMPORTANT NEEDS TO FULFIL WITHIN THE STRATEGIC INNOVATION AREA

The strategic innovation area needs help to break existing boundaries and structures, and powerful intervention outside the structures is therefore needed. This is where the cross-boundary SIO programme with its governmental funding comes in – the SIO programme needs to be structure changing and to develop an ability of strategic leadership. Other reasons for governmental funding are to facilitate for SMEs to contribute to and benefit from the desired development, and to support innovation processes at critical TRL (Technology Readiness Level) thresholds. Some competing countries have governmental funding support, which makes it important for Swedish enterprises to have similar terms.

The strategic innovation area needs new views and new cooperation. It is therefore important to be open for new actors, and the open calls that are planned within the SIO programme are one important way to support this.

No single present actor within the strategic innovation area has a position that makes a holistic perspective of the entire area possible, and no single actor has the mandate to take up the leading role in such a context. Therefore the SIO programme and its external funding are necessary to make the desired development come true. This also demands from the SIO programme actors to establish a strong and legitimate Programme Board and Programme Management.

Present actors within the strategic innovation area already invest in research and innovation, and most of the substantial research and development resources already available will be put into efforts in line with the vision of the innovation area. The SIO programme and its governmental funding will strengthen existing efforts by supporting the systematic focus shift and the development of new forms of cross-boundary cooperation, thus facilitating the innovations that are made possible only through the new cooperation. By actively working to get existing actions and activities more in line, the SIO program will benefit greatly from those efforts to reach the SIO programme targets. There will therefore be cooperation criteria in the SIO programme to prioritise integrated approaches with explicit efforts to achieve synergies with actions and activities with funding inside and outside the SIO programme.

Failure to meet the need for focus shift and cross-boundary cooperation will be disastrous for our sectors of industry, and would decrease our competitiveness, export value and job opportunities remarkably.

2 SIO programme

The SIO programme is about creating necessary conditions for the desired development of the strategic innovation area.

- A systematic focus shift to products with higher customer value, from research to innovation, and from coexistence to cooperation
- The development of new forms of cross-boundary cooperation, thus facilitating the innovations that are made possible only through new cooperation

MISSION: ***Create the best conditions to increase the added value in the Swedish bio-based sector***

2.1 TARGETS OF THE SIO PROGRAMME

The targets of the SIO programme are limited to what the programme can take full responsibility for. They have been created by a systematic decomposition of the vision of the strategic innovation area, through the results and effects that are expected within the strategic innovation area but that are outside the SIO programme.

The targets of the SIO programme sum up to the mission via the two bullet points above. The targets are given in the first table in the Appendix, together with effects in the strategic innovation area and the expected impact by 2035. To facilitate an evaluation of the efforts in the SIO programme, timed and measurable quantities for the targets are also detailed in the Appendix.

The full effect logic is further elaborated in section 2.6, where it is shown how the most important targets at the top of the list are built upon the ones below. In addition to this, expected results and effects are stated explicitly for the respective activities and actions described in sections 4.3 and forward.

2.2 CONTRIBUTIONS FOR RENEWAL OF THE STRATEGIC INNOVATION AREA

The primary renewal of the strategic innovation area is the conversion to a bio-based economy – this is a profound revitalisation. This renewal will be realised through the SIO programme by initiating and supporting a systematic focus shift and the development of new forms of cross-boundary cooperation.

The SIO programme will contribute to this by facilitating cooperation along the entire value chains and across previous sector boundaries. The latter is multi-faceted, and means cooperation between

different sectors, but also between large and small companies, between academia and enterprises, and specifically includes new innovative companies. A more active role in European research cooperation will also be promoted.

New and essential competence will come in areas such as customer focus, business models (including knowledge on how to develop new bio-based materials, products and services with competitiveness on a global market), innovation strategies, process technologies, and bio supply. These new competences will emerge through mutual learning in the planned new cooperation, and knowledge transfer and information activities will therefore be important parts of the SIO programme.

To ensure sufficient input, and to accelerate the process, the SIO programme will engage in cooperation with chosen outside actors that can stimulate the renewal of the strategic innovation area. Examples are cooperation with other SIO programmes and existing or planned national advocacy platforms (påverkansplattformar), e.g. Food, Resource efficiency, Forest and CelluTex. Cooperation with UE and other international initiatives mentioned in section 1.3 are also examples. Another important aspect is that the SIO programme will continuously be open to new actors, both in the programme organisation and through open calls. This is to ensure an influx of new views, and to facilitate new cooperation. New and outside actors will be needed to support the renewal of the strategic innovation area.

2.3 ENERGY RELEVANCE

Industrial production processes use large quantities of energy. Looking only at electricity, the industry branches participating in the SIO programme use 29 TWh annually, which is nearly a quarter of all electricity used in Sweden 2012. Hence, the SIO programme has high energy relevance and will in several ways impact Sweden's political environment and energy targets.

The use of bio-mass for energy in Sweden is today approximately 135 TWh annually, 70 TWh being used in industry. The short-term additional Swedish potential is 30–45 TWh annually and a long-term total potential can be estimated to up to 240 TWh. This potential must be used in the most responsible way when biomass is to replace fossil resources in order to realize the vision of a bio-based economy.

There is no doubt that a bio-based economy requires a strong focus on energy and resource efficiency. The energy aspects are crucial and should be considered in all major biorefinery studies regardless of product produced. In a bio-based economy, production processes are optimised to give the highest added value with the lowest use of raw material and energy. By pairing production of bio-fuels, high value added chemicals, materials etc. with energy generation, the total economy of a process can be substantially improved, creating competitive advantages.

With the definitions available, a biorefinery can be anything from one stand alone single machine for conversion of biomass up to a complex polygeneration plant integrated with an industry, e.g. pulp and paper, chemical/petrochemical, iron and steel or a district heating system. The energy consumption during transportation and production of bio-based products, especially bulk type ones, contributes considerably to the carbon footprint, i.e. the degree of sustainability, of the product and it can be highly influenced through a combination of process design and integration, new opportunities for recycling and overall system optimisation. Energy efficiency can hence influence the LCA of a bio-based product considerably. Opportunities in energy efficient production are therefore of high importance for all types of biorefineries. Hence, any new bio-based material, product or service developed within the SIO programme will need to present energy efficient processes.

In addition to the importance of energy efficiency, new bio-based materials and products can have a large impact on energy need indirectly. Examples include the following.

- Load carrying composites can replace steel in vehicles, decreasing weight and hence fuel consumption.
- Efficient bio-based foams can be developed for insulations purposes.

- More efficient and smarter packaging solutions will protect the transported goods resulting in less damaged goods and waste.
- Lighter packaging solutions will decrease fuel need for transportation.

2.4 OTHER AREAS INFLUENCED BY THE SIO PROGRAMME

The agricultural sector and food industry are directly affected by this SIO programme by being providers of biomass from primary crops and residuals from the agricultural production as well as from the food industry. Such side streams provide useful resources of biomass that can be valorised in a biorefinery to value added compounds. The pharmaceutical industry also has a demand for bio-based excipients and molecules, and has a substantial knowledge about industrial biotechnology in relation to production of protein pharmaceuticals. The SIO programme will also involve industrial partners that are placed at the end of the value chain, e.g. the automotive, furniture, personal care and hygiene, medical technology and construction industries.

Industrial biotechnology has been identified as one of the priority key enabling technologies that will improve European industrial competitiveness. It includes the use of microorganisms and enzymes for the production of industrially useful products, fuels, chemical building blocks and substances. The contribution of industrial biotechnology to European economy is expected to grow together with an expected annual growth of bio-based chemicals with 40–50 %. Europe is currently the world leader in key industrial biotechnologies such as enzyme technology and fermentation. Sweden has a strong position with key competencies and research and demonstration facilities in this area which in the bio-economy could grow into a competitive industry with large importance for the development of biorefineries involving chemical and forest industries.

Technology development and systems development for sustainable harvest of forest biomass are generic, and can therefore be exported as well as applied to other sectors in Sweden, e.g. within the mining and process industries.

2.5 GLOBAL CHALLENGES OR DEVELOPMENTS THAT INFLUENCE THE SIO PROGRAMME

The strategic innovation area covers a broad sector of society, and there is thus a wide range of aspects that will convene interaction to and from global challenges and developments. A majority of these will naturally be covered by the activities described in chapter 4. It will be important to evaluate to what extent Swedish actors and the SIO programme can affect such circumstances.

Access to and cost for energy on a global scale will be important, as will be the political development in regions with raw material supply. Access to sustainable supply of bio-based raw material on a competitive market will be a crucial corner stone for the SIO programme, and this must be balanced considering all aspects of sustainable use of eco system services and profitability along the supply chain. Long-term political scenarios – both domestic and international – will significantly influence the development, as well as consumer behaviour globally will control future markets, and it will be necessary to monitor and predict such aspects and tendencies. The global economic situation generally will also be important to monitor.

All the above constitute risks, challenges and opportunities, depending on how they develop and are met. For the SIO programme, this puts demands on global awareness and on continuous analysis and learning from facts and trends. The SIO programme targets D-H – further developed in the effect logic in section 2.6 and in the Appendix – are specifically introduced to build such ability.

2.6 EXPECTED RESULTS AND EFFECTS

The expected impact by 2035 of the SIO programme is offensive, although the outcome will depend also on external factors outside the responsibility of the programme.

✓ At least ten new bio-based application/product areas within existing industries have emerged, with a contribution of more than 25% value to Swedish exports from the industries involved

✓ At least 20% of existing fossil-based products have been replaced with bio-based products

- ✓ A large number of new seed companies have been founded, out of which 5–10 have developed into established global enterprises
- ✓ More than 30% of bio-based innovations comes from cross-disciplinary technologies and/or collaborations, for instance new biorefinery concepts

The targets of the SIO programme have been created to give the best possible conditions to reach the desired results and effects of the strategic innovation area – substantial and versatile – described here, which in turn are expected to substantially contribute to the vision of a Swedish bio-based economy. The outcome on this level also depends on realities outside the responsibility of the SIO programme, e.g. global economy and domestic politics. Within the next decades, we expect the following results and effects.

- ✓ A number of different bio-based products – including chemicals, materials and energy – are co-produced in biorefinery concepts to maximise raw material utilisation and added value.
- ✓ The share of bio-energy and bio-fuels has increased and vastly exceeds the fossil-based alternatives.
- ✓ Bio-based materials have replaced fossil-based to a large extent in products that are accepted on the market.
- ✓ A substantial number of new enterprises have been established, based on innovative technologies with needs-driven development and customer focus.
- ✓ New business constellations and partnerships – between large and small companies and between academia and enterprises – have been created and have enhanced ground-breaking innovations.
- ✓ Swedish participation in European research cooperation has increased markedly.

The effect logic of the SIO programme is elaborated in the Appendix. Timed and measurable targets for the activities and actions are given there, together with expected effects and impact.

- ✓ ***New processes, products and services*** and ***New opportunities*** use strategic and supporting projects to provide complete and evaluated contributions to the expected effects and impact in the strategic innovation area. Open calls are used to capture opportunities not discovered within the SIO programme, and thus contribute with new perspectives and ideas.
- ✓ Formed consortia explore defined areas and work out prerequisites for the desired development. This is done by increasing the ability of ***Political influence*** and thus affecting the ***Political prerequisites*** through efficient channels. This is also done by new understanding and development of ***Market conditions***, and thereafter by the forming of ***New value chains and cross-sector cooperation***. These targets together systematically provide conditions for the new opportunities and the new processes, products and services.
- ✓ ***New cooperation forms*** constitute the arena and the starting point of the development processes. This is where creativity is provided for new ideas and cooperation. This is where consortia are formed that enable the work within all other target areas.
- ✓ The result from and the learning in activities and actions are absorbed in ***Systematic learning and development***, which builds knowledge and experience that all targets and the entire strategic innovation area benefit from by systematic coordination and support from the programme management. This is the core of the SIO programme that ensures the joint development power and that all results come to maximal use within the programme.

The SIO programme will – by its construction – create the necessary conditions for the desired development of the strategic innovation area. The credibility in delivery on stated impact is founded in a solid analysis of the opportunities in the four prioritised areas described in section 1.1. The underlying strategic research and innovation agenda elaborates this further, but already a careful estimate of around five strategic projects with successful outcome will considerably contribute to this impact.

2.7 ACTORS

The strategic innovation area affects a large number of different actors. During the process of developing the SIO programme, several workshops, seminars and separate meetings with companies and associations, authorities, researchers and clusters have taken place. Actors from many different categories have expressed their interest to participate and to become stakeholders. The programme's content has emerged from this interaction.

Invitations to become member of the SIO programme's General Assembly have been communicated to a large number of potential stakeholders. All tentative stakeholders have each expressed an explicit Statement of Intent to participate and contribute. During the autumn 2013, meetings with potential stakeholders have taken place. The SIO programme initiative has raised large interest from different groups and many of them have expressed their interest to support and participate. Up to February 2014 more than 50 companies, organisations and universities have submitted a Statement of Intent. Half of the intents come from companies, and one quarter from universities, technical colleges and research institutes. The complete list is attached to the application as stated in the call for applications.

The stakeholder companies represent the entire strategic innovation area. This group includes large textile, chemical and forest industry enterprises, as well as SMEs. Enterprises from other sectors have also joined, e.g. energy, builders, architects, designers etc. The research institutes and universities range from Sweden's five largest universities to privately owned R&D companies. The stakeholders have been involved in the SIO programme planning face on different levels, but all have had and explicitly used the possibility to participate in defining and prioritising candidates for strategic project. Targeted groups are also specified in the table in section 4.2.

To ensure a future broadened engagement, the planned organisation is built upon active engagement in networks for the four prioritised areas, but also formally via the General Assembly. Contacts are established with healthcare (counties and local authorities) and the food industry. Via the planned activity ***Functional meeting places*** the stakeholder group is expected to be enlarged. This is also the expected way to open up new value chains involving new and existing customer groups.

The SIO programme will always be open for new actors, from paying members in the General Assembly to specific partners in different projects – this includes the possibility to suggest and take part in strategic projects and open calls. New and broad cooperation is important for the renewal of the strategic innovation area, and it is important that any interested actor can participate and influence the SIO programme.

3 Coordination of SIO programme

The SIO programme will be performed in the four programme formats described in section 4. All actions and activities will be monitored by the SIO programme, including quality assurance and target fulfilment. The SIO programme will suggest and prioritise activities, projects and calls, and will also manage result communication and overall studies.

During the last six months there has been an open process involving a broad group of interested partners. Workshops have served as important arenas for open discussions regarding the SIO programme and its organisation and financial model. Workshop participants have clustered to formulate strategic projects of interest. As a result more than 50 organisations have been engaged in signing Statements of Intent expressing support as well as concrete suggestions regarding strategic investments and commitments. Within the SIO programme proposal there are now several strategic projects ready for start-up, and the organisational and financial models are well anchored.

3.1 ORGANISATION AND LEADERSHIP

During the course of the SIO programme, the vision will stand firm, but an unassuming attitude will be required towards the possible need to update the targets on the basis of new knowledge that emerges and of changes in the business environment. Ensuring that the operations always have distinct and relevant goals is secured through a functional dialogue with participants and consumers. One way of

maintaining such a dialogue, not only with those who are already participants, is to jointly create a common arena, the "Functional meeting places" referred to in section 4.5 and in the effect logic.

The process from the initial planning of activities and actions is to be documented, thus illuminating the priorities and selections made, but also ensuring a learning process and improved applications by means of documented feedback. In addition to being documented, it is also important that the process is transparent, so that all relevant participants can keep up with it and its results and can also propose improvements. In respect to the allocation of resources or contribution to target fulfilment, no importance will be attached to whether or not an actor has previously participated in the agenda work – as such, the SIO programme is to be open. All decisions taken in the process must be well motivated, and how they contribute to the SIO programme's target fulfilment must be documented.

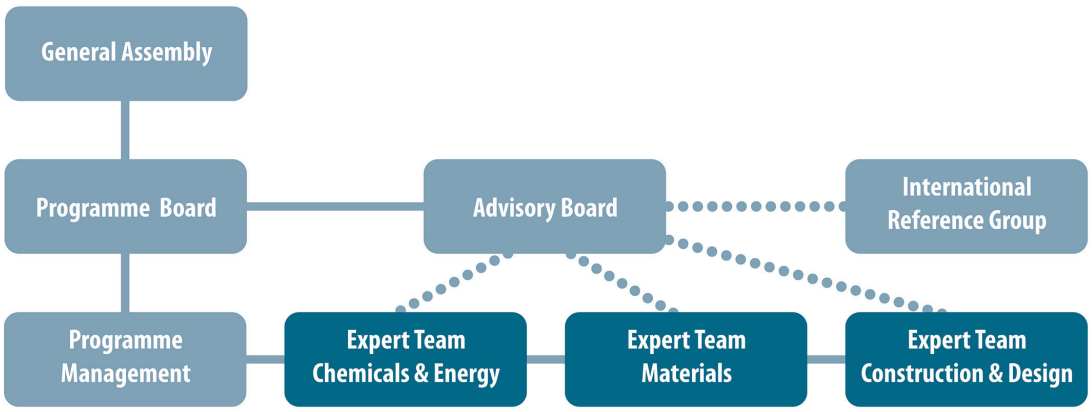
ORGANISATION STRUCTURE

The management of the SIO programme will be organised in three groupings: the General Assembly, the Programme Board and the Programme Management. A dialogue through workshops, targeted seminars and monthly newsletters involving a broad target group of organisations was established in 2012 when the strategic research and innovation agenda "A bio-based economy" was developed. The agenda work has broadened and deepened the cooperation far beyond the original participants. This has created a good start for the dynamic and ongoing development of the organisational structure and its functions. The General Assembly will act as a very important arena for networking, having large impact on the development of the SIO programme. As the General Assembly is composed by those who have expressed their intent to finance both the organisation and projects, it ensures that the program now and in the future has the best possible conditions to implement the strategic agenda.

The Programme Board should reflect but not "democratically" represent the collection of actors. It is expected that the board members will be well-known and respected by the General Assembly, but also free to take difficult decisions guiding the Programme Management.

The Programme Management will, under leadership of the Programme Board, develop and implement the SIO programme. Special attention will be paid to getting actors come together across sector boundaries and to make it possible for large and small enterprises to operate in partly new value chains. The Programme Manager will have a crucial significance for the programme's success. The recruitment has already started.

The overall organisation of the SIO programme is illustrated in the figure below, with a following description of the different roles.



GENERAL ASSEMBLY (GA): Paying members. Emphasis on companies rather than academy. Approximately 1 meeting per year (first year 2–3 times). Appoints Programme Board, Advisory Board and Expert Team chairs, decides on main direction of strategic projects, approves evaluations and accountings, and initiates programme activities.

PROGRAMME BOARD (PB): Board with 7–9 permanent chairs representing enterprises (3–5), academy (2), public sector (1) and a neutral chair person. VINNOVA and the Energy Agency can be adjunct to PB (1–2). Normally 3–4 meetings per year. Decides on strategic projects and calls, approves project start and project reporting, and decides on programme activities.

ADVISORY BOARD (AB): Advisory to and quality assurance for PB with 10–12 members. Competence from enterprises and academy, at least one member with international experience. Will appoint additional cross-disciplinary competence. Evaluates proposals for strategic projects and call texts.

INTERNATIONAL REFERENCE GROUP (IRG): Global expertise on specific areas, without own responsibility. Need-based group for quality assurance.

EXPERT TEAMS (ET): One group per prioritised area, with experts nominated by the SIO programme members. Chairs are nominated by GA, and are members of AB. ETs invent, develop, evaluate and prioritise proposals for activities and strategic projects.

PROGRAMME MANAGEMENT (PM): Consists of two full time equivalents. Supported by the Expert Teams. Runs the daily operation, including economic administration. Prepares and executes decisions on calls, information, projects, evaluations and other programme activities. The Programme Manager is draftsperson in PB.

FINANCIAL MODEL FOR PARTICIPATION

The first step for participation in the SIO programme organisation is a basic membership. This is a cash contribution of 50 000 SEK per year for larger organisations and 5 000 SEK per year for SME companies. The basic membership renders a chair in General Assembly, access to network meetings with other members, and the right to submit a Statement of Intent to influence the prioritisations of the SIO programme.

Projects run within the SIO programme will be funded by the actors in the interval of 30 % – 70 % of project costs, where contributions can be cash or in kind. In certain specific cases, when properly motivated, co-financing from industry can be zero. Additional project costs will be covered by public funding bodies in cash. Companies will only fund projects where they have a direct interest.

STAFF

Contacts have been made with several of the stakeholders to quickly occupy the important positions in the organisation. Representatives in GA from each actor will be appointed by the signer of the respective Statement of Intent. The composition of PB before the first formal GA meeting has also been discussed with stakeholders, and in this interim phase Camilla Rööst (Södra) will serve as chairman with Elin Lydahl (Teko) and Nils Hannerz (IKEM) as the only members. The interim board will also act as nominating committee and have already identified and received positive feedback regarding eminent eligible persons ready to work in PB.

The PM will be hosted by Skogsindustrierna. Recruitment of Programme Secretary has commenced and preliminary agreements have been made. Until the formal hiring process is completed, an interim PM will be composed by the interim board complemented with Per Edström (Mid Sweden University) and Jan Lagerström (Skogsindustrierna), the latter as interim Programme Manager. For staffing of the other groups only simple soundings have been done so far.

3.2 PROJECT PLAN FOR THE COORDINATION OF THE SIO PROGRAMME

3.2.1 Start up phase

The start up phase of the SIO programme will start long before the evaluation of this application. This choice is made so that the programme can have a flying start directly after the VINNOVA decision, but also to illustrate how important the SIO programme is to its actors. This initial phase is lead by PM and the Programme Manager. The start up phase during 2014 will roughly follow the plan below.

✓ ***April:*** First GA meeting for information and for decision on a SIO programme call for strategic projects
✓ ***May:*** SIO programme call for new activities and strategic projects
✓ ***June:*** GA decision on PB, on organisation for prioritised strategic projects, and on an open VINNOVA call for new opportunities
✓ ***August:*** Startup meeting with VINNOVA and PB
✓ ***September:*** Start of first program activities, and open VINNOVA call for new opportunities
✓ ***August-November:*** Negotiation of terms and agreements with VINNOVA, including IPR agreement for the SIO programme and template IPR agreement for projects
✓ ***October:*** PB discussion and prioritisation of new activities and strategic projects
✓ ***November:*** Open call closed, expert evaluation, PB recommendation and VINNOVA decision
✓ ***December (at end):*** Start of first strategic projects

3.2.2 Operating the SIO programme

The daily operation of the SIO programme is handled by the Programme Management, following the structure of the effect logic. The PM will run activities to create the best conditions to reach the SIO programme targets. This makes PM main responsible for target areas C-H, see Appendix, while the programme actors run actions for target areas A-B. It is central for the PM to uphold a dialogue with and between stakeholders, and to open for new actors to engage through the "Functional meeting places". It is important that the PM provides inspiration to contribute to SIO programme targets, but also to support projects as they run. One specific task of the PM is also to continuously review target fulfilment and results of efforts, and a process evaluation will be run for continuous evaluation and support.

In the implementation of the SIO programme, the four programme formats in chapter 4 will be used. A requirement to start larger efforts in the SIO programme will be that they are based on documentation and studies that clarify political prerequisites and market conditions. Efforts that are included in the SIO programme can be of both short-term and long-term nature, and the TRL concept is to be applied for all projects. In contrast to a traditional R&D programme, this SIO programme presupposes that the first steps on the TRL scale have already been completed. The four programme formats thereby constitute natural checkpoints.

Strong and already existing networks provide a base for dissemination of results and for collection of new ideas and alternative financing possibilities. Finally, the financial engagement by stakeholders in the General Assembly will provide control and incentives for the PM and the programme actors.

3.3 BUDGET FOR COORDINATION OF THE SIO PROGRAMME

3.3.1 Budget for start up phase

As indicated in the table in section 4.2, several processes and activities will be initiated in the start up phase to make the SIO programme fully functioning. The allocated budget for the start up phase is 10 MSEK, whereof 0.5 MSEK is staff costs. Financing is 40 percent VINNOVA and 60 percent SIO programme actors.

3.3.2 Budget for operating the SIO programme

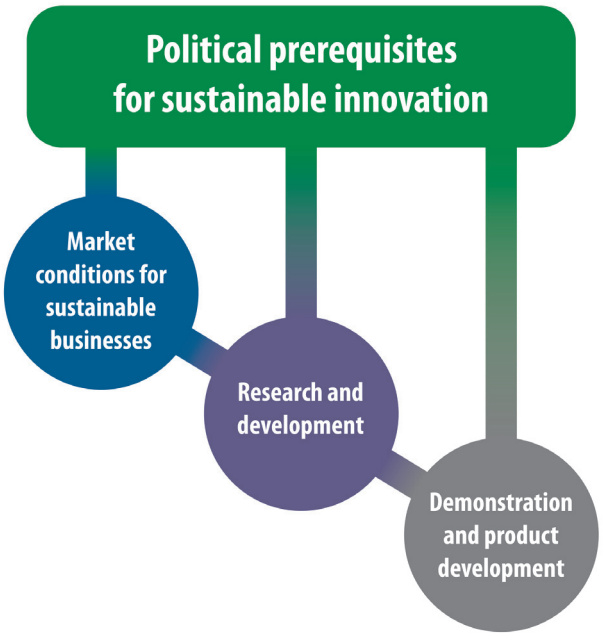
The SIO programme coordination is composed of traditional Programme Management functions like running the organisation, arranging meetings, organising calls and collecting requests for actions, but also of more resource demanding tasks such as setting up and running activities and actions. It is also important to establish a strategic leadership and a systematic learning process. This indicates the need of having financial possibilities not only for salary and office costs, but also for a relatively large number of consultants or other temporary interventions as project workers.

For the period 2015-2020, the allocated budget for operating the SIO programme is 600 MSEK, whereof half is covered by VINNOVA and half by SIO programme actors. Of this sum, 90 MSEK is for activities run by the PM and 510 MSEK is for strategic projects and open calls.

4 Proposed activities and actions in the SIO programme

PROGRAMME FORMATS

Four programme formats are proposed to implement the SIO programme, as illustrated in the adjacent figure. Activities and actions can be performed in one or more of the programme formats. The programme format ***Political prerequisites for sustainable innovation*** aims to create and secure the conditions for a bio-based economy. The programme format ***Market conditions for sustainable business*** addresses the demand side perspective in order to create new supply chains, produce a specification of requirements for new materials, and connect participants from various parts of the supply chain. The programme format ***Research and development*** includes more traditional research and development of new and innovative products and processes, but will also expose existing technical possibilities or solutions to industrial actors with different needs. If the research shows promising results and matches the market conditions, the work can be further pursued in the programme format ***Demonstration and product development***, which supports prototype development, process up-scaling and basis preparation for investment decisions. The relevant programme formats for different activities and actions are indicated for the different targets A-H in the effect logic table in the Appendix.



Activities – mainly within the two first programme formats – will be run within the SIO programme, e.g. as different kind of investigations performed by consultants. Actions – partly within programme format two but mainly within the two last programme formats – will be run by actors in the strategic innovation area. Actions will be defined in cooperation with VINNOVA. Communication will be a joint effort for the entire SIO programme. A prerequisite to start larger efforts in the SIO programme will be that preceding programme formats are passed or otherwise covered. Larger efforts will also have control points, at least once a year, where the direction can be changed or the effort can be stopped.

CHALLENGE-DRIVEN INNOVATION AS PORTFOLIO STRATEGY

The SIO programme will be based on challenge-driven innovation. It is crucial to stimulate innovation and innovative solutions, including companies and technologies that do not yet exist. Therefore, all efforts will be directed to selected global societal challenges and market demands. This is to ensure openness and to avoid to get trapped in traditional projects with traditional partners and traditional results, which would implicitly select partners and technologies in advance.

The starting point is the set of global societal challenges from EU Horizon 2020 that the SIO programme addresses, and the prioritised areas that the SIO programme aims to develop. All project proposals should relate to these frames, and should motivate the choice of challenges to meet and the approach to meet them.

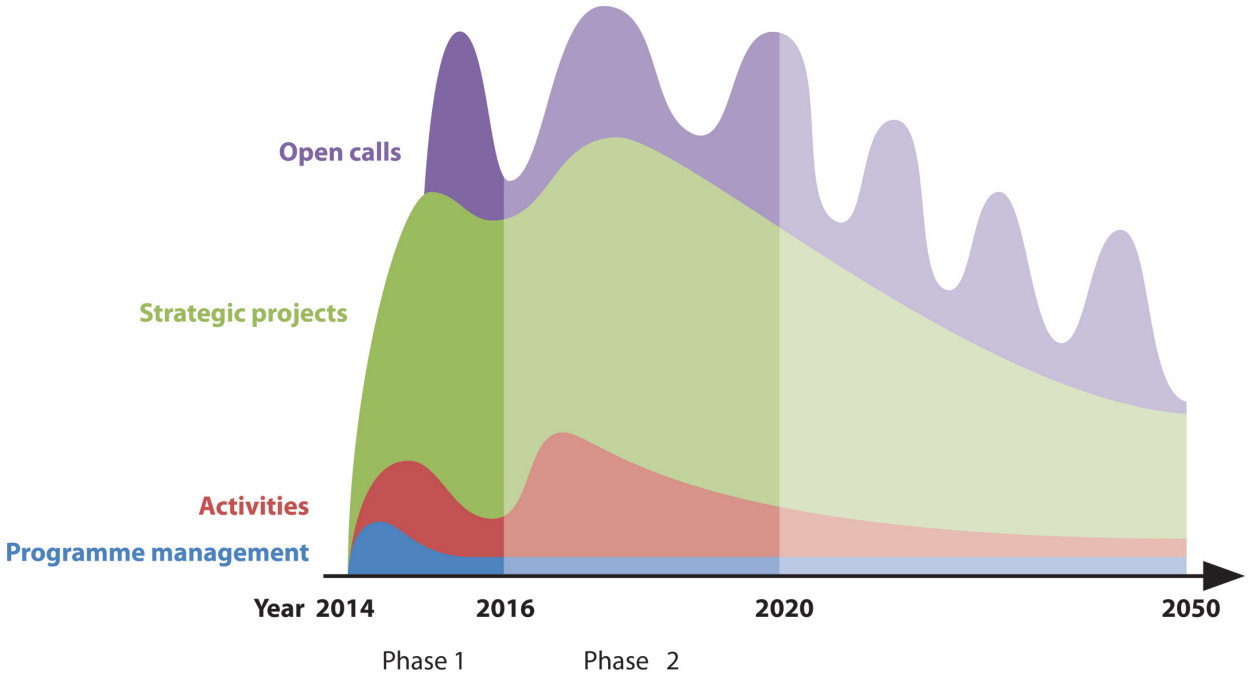
4.1 EXISTING ACTIVITIES AND ACTIONS TO BE USED WITHIN THE SIO PROGRAMME

Present actors within the strategic innovation area already invest in research, development and innovation, and appropriate resources already available will be put into efforts in line with the vision of the innovation area. A large number of actors have stated their interest to participate in the SIO programme, see section 2.7. But there are also a number of already existing initiatives in the area that offer cooperation without signing Statements of Intent. Examples where contact is established through the signing actors are a number of VINNOVA initiatives (VINNVÄXT, Advocacy platforms, Challenge-driven innovation) Mistra (Future Fashion), Formas (call on Bio-based Economy) but also a number of research colleges (ProWood, FORIC, FIRST) and large EU-funded projects with Swedish management (for example R4R – Chemical regions for resource efficiency).

The existing activities and actions will make up for the majority of the efforts in the strategic innovation area, but all with their own respective driving forces. The SIO programme has an integrated approach, and will strengthen existing efforts by supporting a systematic focus shift and the development of new forms of cross-boundary cooperation, thus facilitating the innovations that are made possible only through new cooperation. By actively working to get existing actions and activities more in line, the SIO programme will benefit greatly from these to reach the SIO programme targets. There will therefore be cooperation criteria in the SIO programme to prioritise integrated approaches with explicit efforts to achieve synergies with actions and activities with funding inside and outside the SIO programme.

4.2 SUMMARY OF ACTIVITIES AND ACTIONS

The diagram below indicates the total financial volume and the balance between different efforts in the SIO programme, as well as the planned timing of them. For convenience, the colour coding of the different efforts in the diagram is used also in the following summary table.



	Action/ activity	Description	Targeted groups	Duration (start/ end)	Funding 2014 kSEK		Funding 2015-2020 kSEK	
					Vinnova	Other	Vinnova	Other
Programme management	***Start up***	• Start up phase of the SIO programme	Programme management	2014-03—2014-12	1 000	2 000	0	0
	Coordination and support	• Develop and apply methodology and routines for opportunity reviews, holistic analyses, feedback and learning • Process evaluation • Systematic coordination of efforts and actors • Information activities	Actors in the strategic innovation area	2014-09—2020-12	1 000	1 000	12 000	12 000
Activities	***Functional meeting places***	• Identify cooperation opportunities and needs • Establish forums and cooperation forms that meet the needs • Provide professional process support, and use and develop functional meeting places systematically	Actors, and potential actors, in the strategic innovation area	2014-10—2020-12	1 000	1 000	25 000	25 000
	Investigation, analysis and influence	• Establish knowledge and understanding regarding political conditions, market opportunities and new value chains • Evaluate and prioritise possible strategic projects • Present scenarios to visualise future possibilities	Enterprises in the strategic innovation area Politicians and authorities	2014-11—2016-12	2 000	1 000	8 000	8 000
Strategic projects	***Strategic projects***	• Plan, man and run prioritised strategic projects through the programme formats all the way to demonstration and prototype • Systematically coordinate efforts, actors and learning between all strategic projects	Enterprises in the strategic innovation are	2015-01—2020-12	0	0	205 000	205 000
Open calls	***Supporting projects***	• Specify contribution opportunities using the programme formats • Open call with evaluation • Plan, man and run winning supporting projects	All interested actors	2015-01—2019-12	0	0	50 000	50 000

4.3 START UP

4.3.1 Description

The start up process initiates the SIO programme organisation and structure well before funding is granted. When the programme is fully activated, the activities and actions in the summary table in section 4.2 are all established and have initiated their respective processes towards the targets described in the effect logic.

4.3.2 Expected results and effects

The result of the start up process is a rigged and activated organisation that from 2015-01-01 works at full force to lead and support the SIO programme. Follow up of this process is done continuously through the checkpoints in the plan.

4.3.3 Time plan and budget

The start up process is initiated at submission of this proposal, and will be finished by 2014-12-31, following the time plan in section 3.2.1 and the budget in section 3.3.1. This shows how a number of activities will be initiated and performed to ensure an immediate ignition of the programme after a positive funding decision. During the start up phase, activities within Coordination and support, Functional meeting places and Investigations, analysis and influence will also be initiated. The total budget for the first year is estimated to 10 MSEK.

4.3.4 Targeted groups

The start up phase primarily targets the Programme Management. However, all actors and stakeholders are central for mobilisation of engagement and for communication on the course of the start up process.

4.3.5 Communication and knowledge transfer

The start up process will design a specific communication plan, which identifies and develops learning that can be useful in the overall communication strategy of the SIO programme. It will be established during the start up phase, and will be developed throughout the programme.

4.4 COORDINATION AND SUPPORT

4.4.1 Description

Coordination and support is the SIO programme hub. This is where questions, results and learning from the activities and actions are collected and analysed. Conclusions are passed to the strategic projects and to ongoing and planned activities and actions, and to actors in the strategic innovation area. The learning is also administered in a holistic perspective for the development of the programme and its deliveries.

The work is performed by the Programme Management in a structured dialogue with responsible for the respective activity/action, and in cooperation with actors inside and outside the strategic innovation area. The Programme Management is supported by the Advisory Board and the Expert Teams, according to a working model established during the start up phase.

4.4.2 Expected results and effects

EXPECTED RESULTS (MEASURABLE TARGETS)

- *During 2014:* Routines and resources are established for continuous data collection, analysis, learning and communication in relation to targets as a part of the start up phase.
- *From 2015:* 2–5 research projects focusing on different aspects of the SIO programme performance. Research performed by research bodies within and/or outside the strategic innovation area.
- *From 2015:* Quarterly learning report to ongoing projects and to all actors in the strategic innovation area.
- *From 2015:* Annual learning conference.
- *From 2016:* Annual SIO programme development report.

EXPECTED EFFECTS

- *From 2015:* Systematic learning from programme activities and actions are detectably enriching the development of the SIO programme.

4.4.3 Time plan and budget

This is a continuous work with deliverables according to the above plan. The total budget for this activity is calculated to 4 MSEK per year, summing up to 24 MSEK.

4.4.4 Targeted groups

Two target groups are prioritised – active actors within the SIO programme activities and actions, and actors in the strategic innovation area.

4.4.5 Communication and knowledge transfer

Communication and knowledge transfer is a core activity that is general for the entire SIO programme. In topic matters it is managed and coordinated in the activity Coordination and support. Each activity provides relevant material in dialogue with the Programme Management.

The communication is managed partly through systematised channels to fixed target groups, and partly through adapted efforts according to a template communication plan for activities and actions. All communication will carry messages that are adapted for the respective target group.

Basic communication strategies and plans, including template communication plans for activities and actions, will be established during the start up phase. This includes a web site for the SIO programme, but also a national communication platform for a development towards more complex biorefineries, and a national communication portal for bio-based materials, products and services.

4.5 FUNCTIONAL MEETING PLACES

4.5.1 Description

This is a strategic activity supported by well-proven tools and professional process management – systematic development and utilisation of functional meeting places will provide all necessary conditions for the SIO programme actors to meet and define new cooperation. This is a central prerequisite to reach the target ***New value chains and new cross-sector cooperation***, but also important for reaching the other targets. One specific outcome that the SIO programme will promote from the functional meeting places is also the forming of cross-sector consortia around innovative concepts with global potential. These consortia will be expected to propose investigations, analyses and strategic projects to be supported by the SIO programme.

The formation of creative relations that break old structures and boundaries with a high level of trust is the basis for the functional meeting places. Three kinds of meeting places are suggested:

- Bilateral executive meetings
- Virtual academy
- Innovation fertilization arenas

4.5.2 Expected results and effects

EXPECTED RESULTS (MEASURABLE TARGETS)

- *During 2014:* Methods are established for long term cross-disciplinary cooperation and development.
- *From 2014:* Annual "Connection Conference" based on innovative and efficient methods for creative meetings and establishment of new cooperation.

EXPECTED EFFECTS

- *From 2016:* An open-minded and creative platform for cross-disciplinary dynamic relations and connections is established, maintained and continuously developing.

4.5.3 Time plan and budget

This is continuous work with deliverables according to the above plan. As this will be a very important part for the programme, and the Programme Management will have to put large efforts in developing and running these activities, the budget is estimated to 10–12 MSEK per year in the beginning and decreasing during the programme running time. The total budget for this activity is 50 MSEK.

4.5.4 Targeted groups

All actors in the strategic innovation area are a primary target group. A secondary target group is potential new such actors.

4.5.5 Communication and knowledge transfer

See section 4.4.5.

4.6 INVESTIGATION, ANALYSIS AND INFLUENCE

4.6.1 Description

These activities pertain to the SIO programme targets ***Political influence***, ***Political prerequisites***, ***Market conditions***, and ***New value chains and new cross-sector cooperation***. These target areas are approached systematically in the following steps.

a) Data collection and study

b) Analysis and processing of knowledge

c) Identification of possible routes of action

d) Choice of direction

e) Work on relations, communication, education and/or influence

Through these continuous development processes, new knowledge, new relations and new ways to work are established. Scenarios will be used to create and visualise future possibilities. All these activities will provide the industry with a future development framework, as well as strengthen the strategic and supporting projects in the SIO programme.

4.6.2 Expected results and effects

EXPECTED RESULTS (MEASURABLE TARGETS)

From 2014:

- Annual major "Market Challenge Workshop" with thoroughly prepared deep analysis input
- Annual "Market Challenge Report", with input from and to workshop
- Established relations to 5–10 defined key enterprise actors

From 2015:

- One major "Value Chain Workshop" with following consortium, development, evaluation and prioritising processes
- 2–3 viable "Value Chain Packages" delivered every year
- Quarterly "Market Challenge Newsletter", with input from and to workshop
- Established personal and organisational relations to 5–10 defined national and EU key politicians, and to 3–5 defined relevant national and EU key authorities
- Planned timely dialogue-based activities to develop and maintain those relations and their insight
- Regularly planned activities to develop and maintain those relations and their insight

From 2016:

- 2–3 "Value Chain Workshop" with following processes established every year

EXPECTED EFFECTS

By 2016:

- Key Authorities and politicians on national and EU level are continuously equipped and willing to take action in line with vision and targets of the SIO programme
- Key enterprise actors continuously influence their contacts among Swedish and EU politicians and in Swedish and international authorities in line with vision and targets of the SIO programme

By 2018:

- 5–10 well-defined "Value Chain Packages" are utilised by strategic projects or supporting projects – large and small enterprises are deeply involved
- 5–10 well-defined "Market Challenges" are accepted by strategic projects or supporting projects – large and small enterprises are deeply involved
- The SIO programme value chain and market challenge methodologies are used regularly by actors in the strategic innovation area

4.6.3 Time plan and budget

The Programme Management initiates efforts in the form of investigations etc. to best support the development of the SIO programme and its activities/actions. The Programme Management is supported by the Advisory Board and the Expert Teams. This activity will be most important and costly in the beginning of the programme. A total budget of 16 MSEK is estimated.

4.6.4 Targeted groups

These activities have different target groups depending on which of the SIO programme targets C-F is in focus.

- *Political influence:* Key enterprise actors
- *Political prerequisites:* Key national and EU politicians and authorities
- *Market conditions:* Actors within the strategic innovation area
- *New value chains and new cross-sector cooperation:* Actors within the strategic innovation area

4.6.5 Communication and knowledge transfer

See section 4.4.5.

4.7 STRATEGIC PROJECTS

4.7.1 Description

InIn order to reach large-scale effects in all parts of the strategic innovation area, there is a need for strategic projects. These will typically be very large, and substantial funding will be ordinary resources of different actors. The funding from the SIO programme for the strategic project will provide means for coordination and cooperation between the actors of the strategic project and within the SIO programme as a whole, and for new cooperative innovation activities and actions. The support of the SIO programme will thus facilitate joint efforts to develop new bio-based materials, products and services that could not have been developed by one branch of industry alone.

The SIO programme will put in efforts to get the best strategic project proposals. This includes value creating activities as described in the effect logic in section 2.6 and in the Appendix. These processes are open also to new actors, and are expected to continuously generate new opportunities. The start and terms for the strategic projects will be determined by the SIO programme and VINNOVA, and funding will come from the reserved budget of the SIO programme.

SIGNIFICANT CRITERIA FOR STRATEGIC PROJECTS

The bullet list below gives significant criteria for the evaluation of strategic project proposals. The criteria should be used for prioritisation between proposals, but they also serve two other purposes. On the one hand the criteria are demands put on any actor planning to propose a strategic project, and on the other hand the criteria are assurances to VINNOVA from the SIO programme.

- Motivation of choice of global societal challenge to meet
- Approach to meet selected challenge, and targeted prioritised areas
- Focus on identified needs and customer value
- Integration of considerable amounts of ordinary resources from the project actors
- A permanent broadening of cooperation
- Global potential and competitiveness for the Swedish bio-based sector
- Innovation strategy
- Actors and new cooperation
- Life cycle analyses and energy efficient processes are included
- Suggested control points to continue, change direction or stop the strategic project
- Systematic learning to the benefit of the SIO programme as a whole

There will also be cooperation criteria to prioritise integrated approaches with explicit efforts to combine several societal challenges or prioritised areas, or to achieve synergies with actions and activities with other funding. The strategic projects are expected to permanently change structures in the strategic innovation area.

Strategic projects will ***not*** be granted for proposals that ordinary resources could fund. All strategic projects also need to relate to the frames of challenge-driven innovation stated under a separate heading in chapter 4 above.

CANDIDATES FOR STRATEGIC PROJECTS

Candidates for strategic projects are given in the list below. These are solid examples that have been suggested by the actors during the application process and that are supported in the Statements of Intent. Note that these are examples, and that they are ***not*** given in a prioritised order. Further refining and prioritisation will be done in cooperation with VINNOVA.

THE SUGAR PLATFORM: Bio-based polymers, proteins, biofuels and drop-in-chemicals, functional chemicals to replace e.g. toxic phthalates, or bioactive molecules for pharmaceuticals can be produced from cellulose, hemicelluloses and/or starch.

LIGNIN: Bulk chemicals such as aromatics from lignin as well as biodiesel for transportation fuels are within reach. Interesting functional molecules for use in pharmaceuticals or hygiene products probably have longer time horizon.

REGENERATED CELLULOSE – DISSOLVING WOOD TO YARN: High-yield dissolving pulping technology, including the viscose process, and following spinning processes are essential for efficient wood-based supply to textile applications. By replacing fossil-based as well as chemical- and water-intensive materials, this would generate a more sustainable lifecycle for all kinds of textile products – from interior decorations to clothing and technical textiles.

EXTRACTIVES DERIVED FROM BARK, BRANCHES OR GRAINS can be valuable sources for production of e.g. antioxidants used as additives in hygiene products or in functional food.

DEVELOPMENT OF MORE COMPLEX BIOREFINERIES for conversion of cellulose, hemicelluloses, lignin and starch to value-added products and energy.

BIO-BASED COMPOSITES: The development of load-carrying building elements, foam-based lightweight materials and freely mouldable composites generates immense possibilities. Among many applications, the automotive industry is one of the most promising.

NEW PRODUCTS OF NON-WOVEN AND TEXTILE MATERIALS: Manufacturing of non-woven and textile materials in paper machines can provide an extremely efficient textile production for volume products such as sound absorbents, insulation, and agricultural or greenhouse drapes.

BIODEGRADABLE PACKAGING: As many materials do not end up in the recycling systems, there are great opportunities from an environmental and social perspective for developing biodegradable packaging.

HARVEST AND STORE ELECTRICITY: Materials of large surface area produced roll-to-roll for a global market need of million square kilometres annually. Product demonstrations should include also control systems and infrastructure.

DURABLE AND ENVIRONMENTALLY FRIENDLY WOOD PRODUCTS for outdoor use.

DEVELOP A RANGE OF MATERIALS THAT WILL ENABLE ENTIRELY BIO-BASED BUILDINGS (above ground). This can include the interior products sector as well. Key elements are the development of eco-efficient products such as insulation, structural components, boards and barrier materials and wood modification and treatment methods. Customer adapted product design, where the aesthetic features of wood and bio-materials are utilized is crucial.

SIGNIFICANTLY INCREASE SWEDISH PRODUCTION AND EXPORT of industrially produced buildings and tailor-made products and system solutions for renovation. Key elements in this effort include innovative customer and market driven product design and significantly improved production processes along the entire value chain from raw materials to the final products.

4.7.2 Expected results and effects

EXPECTED RESULTS (MEASURABLE TARGETS)

- *From 2014:* Annually 1–3 strategic projects with defined qualities and specifications initiated
- *From 2016:* Annually at least 1 new material, product or service delivered for operation, or further development, by enterprises or actor constellations in the innovation area

EXPECTED EFFECTS

By 2020:

- At least 2 new enterprises with market-changing new products or services have emerged out of actor constellations in the strategic projects
- At least 2 more such enterprises are under development
- At least 4 new bio-based new materials/products/services have emerged in new or existing enterprises and are successfully established on the market
- At least 5 new bio-based new materials/products/services are under final development with prepared market strategies

4.7.3 Time plan and budget

This is continuous work with deliverables according to the above plan. Since this is planned to be the core process in the SIO programme, this is also where the main budget resources are allocated. A total of 410 MSEK is planned for the period.

4.7.4 Targeted groups

All actors in the strategic innovation area are concerned by the strategic projects. During the course of the projects, focus will move from potential actors to active actors and stakeholders.

4.7.5 Communication and knowledge transfer

See section 4.4.5.

4.8 SUPPORTING PROJECTS

4.8.1 Description

We expect that more than the actors in the strategic innovation area will be needed to come up with proposals and opportunities, and therefore there will also be a need for open calls. Calls will be open in all four programme formats, and the details in calls and evaluation of proposals will be developed in cooperation between the SIO programme and VINNOVA. All supporting projects need to relate to the frames of challenge-driven innovation stated under a separate heading in chapter 4.

Due to time restrictions, one open call is planned in the period 2014 to 2016, but as the SIO programme is planned to continue also thereafter, there will be additional open calls in coming years.

Open calls of this type will be run entirely through ordinary VINNOVA routines.

SIGNIFICANT CRITERIA FOR SUPPORTING PROJECTS

Supporting project proposals will be evaluated against the same kind of criteria as strategic project proposals.

4.8.2 Expected results and effects

EXPECTED RESULTS (MEASURABLE TARGETS)

- *During 2014:* 1 open call with evaluation
- *From 2014:* Annually 2–4 supporting projects with defined qualities and specifications are initiated

EXPECTED EFFECTS

By 2020:

- Documented findings from 5–10 supporting projects are used in strategic projects
- 2–5 supporting projects have entered an initiating process for new strategic projects

4.8.3 Time plan and budget

This is continuous work with deliverables according to the above plan. Two open calls are planned, one at the beginning of phase one (2015-2016) and one at the beginning of phase two (2016-2020). The volume for the respectively call is planned to be 50 MSEK, in total 100 MSEK.

4.8.4 Targeted groups

All actors in the strategic innovation area are concerned by the supporting projects. The supporting projects also serve the specific purpose to attract relevant actors also outside the strategic innovation area.

4.8.5 Communication and knowledge transfer

See section 4.4.5.

5 Risk analysis for the SIO programme

The proposed SIO programme is a large effort, and a fundamentally important step in the renewal of the strategic innovation area. It is therefore important to identify the main risks associated to the effort, and also to take appropriate measures to eliminate them. A SWOT analysis and a risk analysis provide a suitable basis for this.

5.1 SWOT ANALYSIS

STRENGTHS

- The strategic innovation area contains some of Sweden's strongest and most important industrial sectors
- These industrial sectors have expressed a willingness to be a part of the transition to a bio-based economy
- Sweden holds internationally leading positions regarding industrial and technical expertise and business knowledge in this area
- Sweden has a strong research base in the area, based in Swedish universities, institutes and enterprises
- The process leading up to the SIO programme, and its strong internal management, ensures a broad engagement among the actors
- The four programme formats ensure that activities and actions are launched based on a solid basis
- The rich supply of biomass in Sweden
- The openness of the SIO programme

WEAKNESSES

- The SIO programme involves actors from adjacent sectors that have had little cooperation historically, which may prove to be a challenge to the collaborative efforts
- Financing is not guaranteed at start for the whole programme life time, which might mitigate long-term initiatives
- The wish to find use for and add value to the Swedish bio-based raw material cannot be pursued without a clear market demand

OPPORTUNITIES

- With fossil resources becoming increasingly expensive and finally exhausted, the Swedish industry will have an opportunity to provide competitive and sustainable solutions from bio-based raw materials
- Public awareness about climate change is increasing, presenting a market opportunity for bio-based and "green" products

- Sweden has a competitive advantage with comparatively good access to bio-based raw materials from forest, agriculture and other sources, which can be utilised in new processes and for new materials, products and services

THREATS

- Global competition might put Sweden behind if we do not act fast enough
- Competition for or limited access to certain raw material supply might limit the planned development
- Political decisions and international conflicts might limit the conditions for development
- The development might be slowed down due to a continued supply of low cost fossil resources from e.g. hydraulic fracking for shale gas

5.2 RISK ANALYSIS

- The SIO programme's main contribution is an integrating perspective that enables cross-sector activities leading to new thoughts and viable solutions. Failure to establish a strategic leadership of the process may put the effort at risk.

  The SIO programme meets this risk by a powerful central organisation and target areas that continuously enrich the holistic perspective.

- Strong individual actors in strong existing structures demand a unifying SIO programme structure with ***very*** strong and firmly established central organisation, leadership and working forms. Without those qualities the programme is endangered.

  The SIO programme meets this risk by the construction of its organisation forms.

- Strong and large enterprises with influence and financial muscles may block the participation of small and medium sized enterprises, even unintended. In such a scenario the SIO programme will miss important opportunities.

  The SIO programme will focus consciously on the participation of small and medium size actors.

- The participation and engagement of actors needs to be substantial. Every actor, and every type of actor, has its own universe and an already full agenda. The SIO programme must continuously deliver a convincing answer to the question "What's in it for me?". Without true engagement from all kinds of actors the SIO programme will be empty and powerless.

  The SIO programme will construct a participation model that promotes such engagement.

- To raise the best conditions for development, the SIO collaboration must find, and be found by, the best-suited actors. Otherwise the power for development of the innovation area will not be optimal.

  Through strategic communication planning and through the functional meeting places, the SIO programme will consciously deal with this challenge.

- The focus shifts to customer value, innovation and cooperation are crucial ingredients in the SIO programme. Changing behaviour in and between many different organisations, types of organisations and organisational cultures is a major challenge. If the SIO programme does not mobilise the effort it takes to succeed in this matter, the wanted effect will fail to appear.

  The SIO programme will focus on these ingredients through the main target areas, as described in the effect logic.

- Operations and projects in the SIO programme will engage and consume a lot of energy. A great risk in this situation is that all energy focuses on the hands-on work. Then the programme will lose one of its central functions: the curious continuously searching reconnaissance efforts, looking for up to now unknown possibilities and perspectives.

  The SIO programme will guarantee this dimension through open calls and openness to new participants.

The strategic innovation area is well aware of the new demands in a changing world. The biggest risk is to not face the challenges. The biggest opportunity is the industry's willingness to change, and the possibility to make money by providing solutions to existing and future problems.

6 Appendix – Effect logic

ACTIVITIES and ACTIONS	TARGETS for the SIO programme	EFFECTS in the strategic innovation area	Expected IMPACT by 2035
STRATEGIC PROJECTS • Plan, man and run prioritised strategic projects through the programme formats all the way to demonstration and prototype • Coordinate efforts and actors within the strategic project • Systematically coordinate efforts, actors and learning between all strategic projects	A. NEW PROCESSES, PRODUCTS AND SERVICES New processes, products and services – based on C and D – are initiated in strategic projects with strategic actor constellations P2-4	***So that*** enterprises in the strategic innovation area use new and established processes, products and services in production and continued development in line with the bio-based economy, ***and that*** enterprises in the strategic innovation area use the tested cooperation forms and the new knowledge in the development of materials, products and services that contribute to develop the bio-based economy	• At least ten new bio-based application/product areas within existing industries have emerged, with a contribution of more than 25% value to Swedish exports from the industries involved • At least 20% of existing fossil-based products have been replaced with bio-based products • A large number of new seed companies have been founded, out of which 5-10 have developed into established global enterprises • More than 30% of bio-based innovations comes from cross-disciplinary technologies and/or collaborations, for instance new biorefinery concepts
SUPPORTING PROJECTS • Specify contribution opportunities using the programme formats • Open call with evaluation • Plan, man and run winning supporting projects	B. NEW OPPORTUNITIES Actors associated to the prioritised areas of the strategic innovation area have conditions for support to R&D and demonstration efforts P2-4	***So that*** good ideas are supported and contribute to the development of the strategic innovation area towards a bio-based economy	
INVESTIGATION AND ANALYSIS • Indentify and prioritise possible new value chains • Identify and gather actors • Evaluate and prioritise possible strategic projects in cooperation with the actors	C. NEW VALUE CHAINS AND NEW CROSS-SECTOR COOPERATION New value chains are identified, evaluated and prioritised in cooperation within adapted business constellations P2	***So that*** enterprises in the strategic innovation area use these value chains to contribute to the development of a bio-based economy, ***and that*** enterprises in the strategic innovation area use the SIO programme methodology for their own identification and development of value chains	
INVESTIGATION AND INFLUENCE • Inventory and study of existing and new markets • Create and develop knowledge and analysis ability	D. MARKET CONDITIONS The actors in the strategic innovation area understand the conditions for existing and new markets in the area P2	***So that*** the actors in the strategic innovation area have the ability to meet market opportunities and challenges in the conversion to a bio-based economy	
INVESTIGATION AND INFLUENCE • Establish knowledge on politically controlled conditions • Create understanding and establish relations for continued common view	E. POLITICAL PREREQUISITES Relevant political representatives understand the political prerequisites for a transformation to the bio-based economy P1	***So that*** relevant politicians and authorities have conditions to make decisions that facilitate the conversion to a bio-based economy	
INVESTIGATION AND INFLUENCE • Establish knowledge on politically controlled conditions • Create common knowledge among the actors in the strategic innovation area	F. POLITICAL INFLUENCE Key enterprise actors in the strategic innovation area understand and influence the political prerequisites for a transformation to the bio-based economy P1	***So that*** representatives for Swedish enterprises in the strategic innovation area stimulate political development that facilitates the conversion to a bio-based economy	
FUNCTIONAL MEETING PLACES • Identify cooperation opportunities and needs within target areas A-H • Establish forums and cooperation forms that meet the needs • Provide professional process support, and use and develop functional meeting places systematically	G. NEW COOPERATION FORMS Academy, institutes, enterprises and public sector bodies have conditions to establish efficient cooperation forms Strategic activity	***So that*** actors in the strategic innovation area act in efficient constellations for the bio-based economy	
COORDINATION AND SUPPORT • Develop and apply methodology and routines for opportunity reviews, holistic analyses, feedback and learning • Process evaluation • Systematic coordination of efforts and actors • Information activities	H. SYSTEMATIC LEARNING AND DEVELOPMENT The strategic innovation area is in continuous development through systematic learning, communication and cooperation PM activities	***So that*** actors in the strategic innovation area use new powerful and cross-disciplinary insights that support the development towards a bio-based economy	

P1-P4 indicates programme format, see chapter 4.

7 Appendix – Measurable targets

TARGETS	MEASURABLE TARGETS in the SIO programme	EXPECTED MEASURABLE EFFECTS in the strategic innovation area
A. NEW PROCESSES, PRODUCTS AND SERVICES	• 1–3 strategic projects with defined qualities and specifications initiated every year from 2014 • From 2016: Every year at least 1 new product, process or service delivered for operation, or further development, by enterprises or actor constellations in the innovation area	By 2020 • At least 2 new enterprises with market-changing new products or services has emerged out of actor constellations in the strategic projects • At least 2 more such enterprises are under development • At least 4 new bio-based new materials/products/ services have emerged in new or existing enterprises and are successfully established on the market • At least 5 new bio-based new materials/products/ services are under final development with prepared market strategies
B. NEW OPPORTUNITIES	• 1 open call with evaluation every year • 2-4 supporting projects with defined qualities and specifications are initiated and run every year from 2014	By 2020 • Documented findings from 5-10 supporting projects are used in strategic projects • 2-5 supported projects have become initiating processes for strategic projects
C. NEW VALUE CHAINS AND CROSS-SECTOR COOPERATION	• 1 major "Value Chain Workshop" with following constellation, development, evaluation and prioritising processes carried through every year from 2015 (with input from D-H) • 2-3 such processes established every year from 2015 • 2-3 viable "Value Chain Packages" delivered every year from 2015	By 2018 • 5-10 defined "Value Chain Packages" utilised by strategic or supporting projects • 5-10 defined "Value Chain Packages" utilised by enterprises in the strategic innovation area • The SIO programme value chain methodology used regularly by actors in the strategic innovation area
D. MARKET CONDITIONS	• 1 major "Market Challenge Workshop" with thoroughly prepared deep analysis input every year from 2014 • 1 "Market Challenge Report" every year form 2014, with input from and to workshop • 4 "Market Challenge Newsletter" every year from 2015, with input from and to workshop	By 2018 • 5-10 "Market Challenges" accepted by strategic or supporting projects • 5-10 "Market Challenges" accepted by enterprises in the strategic innovation area • The SIO programme market challenge methodology used regularly by actors in the strategic innovation area
E. POLITICAL PREREQUISITES	• From 2015 established personal and organisational relations to 5-10 defined national and EU key politicians • From 2015 established personal and organisational relations to 3-5 defined relevant national and EU key authorities • From 2015 planned monthly dialogue-based activities to develop and maintain those relations and their insight	By 2016 • Key Authorities and politicians on national and EU level are continuously equipped and willing to take action in line with vision and objectives of the SIO programme
F. POLITICAL INFLUENCE	• From 2014 established relations to 5-10 defined key enterprise actors • From 2015 regularly planned activities to develop and maintain those relations and their insight	By 2016 • Key enterprise actors continuously influence their contacts among Swedish an EU politicians and in Swedish and international authorities in line with vision and objectives of the SIO programme
G. NEW COOPERATION FORMS	• In 2014 established methods for long term cross-disciplinary cooperation development • From 2014 annual "Connection Conference" based on innovative methods for creative connecting, and forms for effective cooperation establishing	From 2016 • An open curious-minded and creative platform ("The Bio Brain") for cross-disciplinary dynamic relations and connections is established, maintained and developing
H. SYSTEMATIC LEARNING AND DEVELOPMENT	• In 2014 established resources and routines for continuous data collection, analysis, learning and communication in relation to A-G • From 2015: 2-5 research projects focusing on different aspects of the SIO programme performance. Research performed by research bodies within and/or outside the strategic innovation area • From 2015 monthly learning report to all projects and actors within the SIO-programme, and actors in the strategic innovation area • From 2016 annual development SIO programme report • From 2015: annual learning conference	From 2015 • Systematic learning from programme activities and actions are detectably enriching the development of the SIO programme