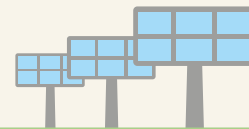
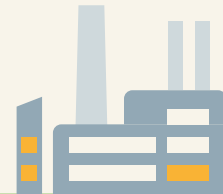


Accelerate energy transition for a sustainable society – a brief summary

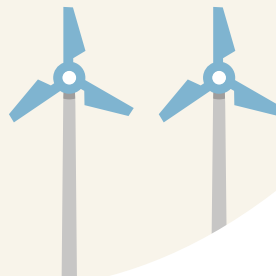
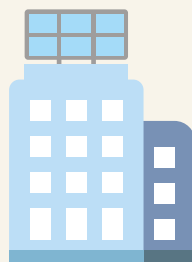
A summary of the Swedish Energy Agency's input for research and innovation in the energy area 2021-2024.



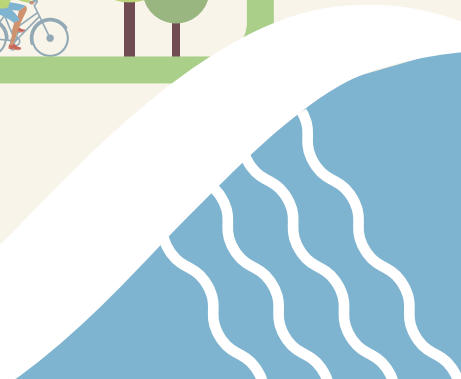
RESEARCH



INNOVATION



2021-2024



The Swedish Energy Agency take overall responsibility for the energy transition in Sweden and have a wide range of tools for facilitating successful research and innovation. This is a brief summary of the report Accelerate energy transition for a sustainable society that was published and handed in to the Swedish government in November 2019. The report includes an analysis of conditions and long-term needs of research and innovation in the Swedish energy sector for the period 2021-2024.

Sweden needs to gather strength to become the world's first fossil-free welfare society. The energy sector is responsible for the greater part of the global emissions that are affecting the climate. The energy system is vital to society, which means that energy transition is very significant for many of the challenges facing society and for the possibility of achieving the goals for sustainable development in Agenda 2030.

The Swedish Energy Agency's support for research and innovation helps to achieve both the energy and climate policy goals of the national energy agreement and the economic, environmental and research policy goals. It is also a prerequisite for building knowledge and competence and for developing new solutions to reach the system changes that can accelerate the transition. Challenge-driven research and innovation in the field of energy needs to be managed from a holistic perspective, together with other tools for energy transition. The solutions need to have an impact in society much faster than today. This requires system transformation, changes in all areas, sectors and industries of society.

Energy transition is largely about making the transport, industry and building sectors fossil free, which can be achieved by means of renewable energy and more efficient use of resources.

The pace of transformation must increase

A significantly greater leap forward than previously is needed for the climate, for which reason the Swedish Energy Agency proposes that energy research funding is increased annually from SEK 1.57 billion in 2020 to SEK 2.17 billion by 2024.

Breakthrough research and innovation with the potential to transform society in the short term needs to increase. At the same time, efforts are needed in the longer term, not least to ensure long-term competitiveness of the commercial and academic sectors. This is necessary in order to achieve Sweden's research policy goal of being one of the world's leading countries in research and innovation and a leading knowledge-based nation. Against this background, it is a cause for concern that in its latest budget bills the government has reduced funding for research and innovation.

The Swedish Energy Agency provides support for research and innovation from basic research to market introduction

The Swedish Energy Agency has overall responsibility for the transition of the Swedish energy system and manages a diverse range of tools where support to research and innovation is one among many different tools. The Swedish Energy Agency's competence and holistic perspective is also used in ongoing collaboration between different government agencies and other societal actors that addresses societal issues.

When Sweden shows the way, Sweden benefits

The research supported by the Swedish Energy Agency maintains high quality and relevance and it creates results that contribute to achieving the desired effects in society. There are positive opportunities for Sweden when is an active driving force globally. Swedish researchers and companies are global leaders in many energy related areas and Swedish policy for energy transition stands as a role model internationally.

Sweden shall be the world's first fossil-free welfare state

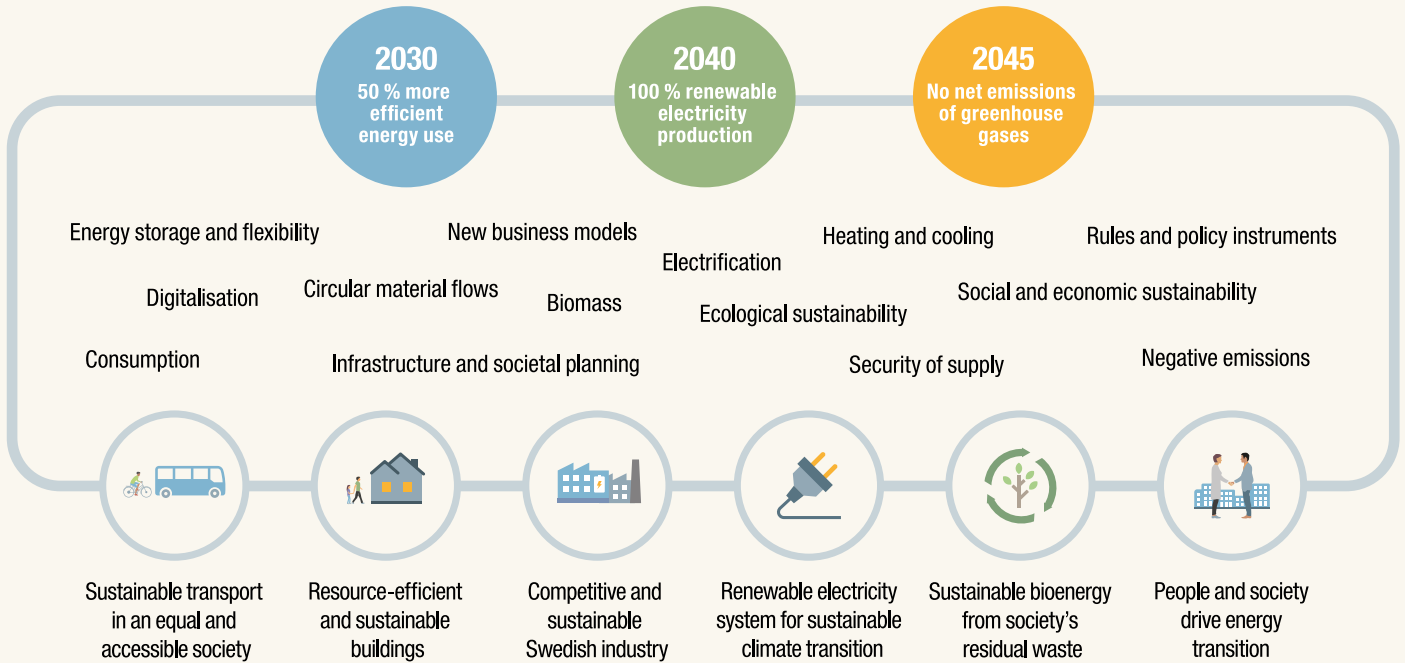


Figure 1. The purpose of the Swedish Energy Agency's six overall research and innovation areas is to contribute to the energy and climate policy goals of the energy agreement. The six areas are linked together by a number of cross-sector areas. There are close connections and synergies between the different research areas.

All-in-all, the energy transition can be regarded as one of Sweden's strengths. Swedish innovations can help to increase growth in Sweden while reducing environmental and climate impacts globally. However, maintaining and developing this position of strength will require further ambitious efforts, not least in research and innovation.

The Swedish Energy Agency has a sophisticated process for strategic prioritisation: based on the goals for energy and climate policy, this will guide research and innovation efforts. Using an approach that is guided by the challenges and goals, the Swedish Energy Agency has identified six overall areas for research and innovation:

- A renewable electricity system for sustainable climate transition
- Sustainable bioenergy from society's residual waste
- Competitive and sustainable Swedish industry
- Sustainable transport in an equal and accessible society
- Resource-efficient and sustainable building
- People and society drive energy transition

Based on these six areas and also with external input, the Swedish Energy Agency analyses which needs for development and new knowledge are the greatest and where research and innovation efforts can bring the greatest possible benefits.

International collaboration on research and innovation gives benefits

International collaboration in research and innovation is of course important for achieving a wider perspective and a breakthrough for the transition. The EU framework programme for research and innovation (Horizon Europe) highlights energy issues in many ways and the mission framework that the EU applies is in line with the perspective driven by challenges and goals applied by the Swedish Energy Agency. The Swedish Energy Agency intends to continue to develop its work of strengthening Swedish participation in international collaboration within the EU and in other international fora.

Seven key solutions to achieve the goals

The Swedish Energy Agency has identified seven key areas for action, or key solutions, where both the opportunities for changing up a gear and the needs for reinforcement are great in order to meet the energy and climate goals. These key solutions are included in the Swedish Energy Agency's research areas, but the resources for them need to be increased during 2021–2024. A common factor for all of these areas is that the key does not lie in the technical solutions themselves, but rather in their interaction with the people and the systems where they are used. The Swedish Energy Agency proposes increased efforts in systems-oriented research and innovation within the following areas. The key solutions are presented below.

Digitisation

Digital solutions and new business models that are facilitated by artificial intelligence, automation and data platforms will contribute to more substantial steps in the transition. At the same time, this also raises challenges in terms of security and integrity. Efforts are also needed to create interdisciplinary collaborations and attract new participants to the energy sector. Moreover, the objective is to be a driving force in international contexts by developing and promoting cooperation at the intersection of the energy and IT sectors.

Electrification

Electrification is one of the key solutions for transforming the energy system in Sweden, especially for the industrial and transport sectors, which account for the largest share of climate emissions. Security of supply is one prerequisite for maintaining competitiveness and prosperity. Large investments in renewable electricity production must be made together with a range of solutions that have the capacity to create a flexible and robust system. Research on and innovation in different solutions, in terms of technology as well as market models and services, need to be increased.

Energy storage

Different solutions for storage, and batteries in particular, will play a key role in creating the necessary flexibility in the energy system and transforming the transport sector. With the increased efforts, the Swedish Energy Agency intends to promote the development and manufacture of battery technology in order to facilitate the transition to a more electrified society and establish a complete European circular value chain for batteries. There are important opportunities and challenges in terms of new business models, a broader sustainability perspective, as well as increased cross-sectoral cooperation.

Negative emissions

Solutions for negative emissions will be required to meet the climate goals. Sweden has good prerequisites for implementing bioenergy with carbon capture and storage, but in the long term there may also be potential in other methods for carbon capture. Increased efforts are needed for research on and innovation in different solutions in order to contribute to negative emissions, as well as infrastructure, logistics solutions, business models, policy tools and the perception of the general public.

Circular flows

Circular flows of resources constitute a key solution for minimising the use of new resources, which are often energy-intensive processes and can have an impact on both

ecological and social aspects. Research and innovation are needed to develop the energy sector towards circular flows and to facilitate efforts to secure the availability of sustainable materials for transforming the energy system.

Sustainable society

The way in which the energy system in society is developed and integrated with other social systems is of vital importance for the opportunity to create changed practices and to reorient society in a more sustainable direction. The efforts should also contribute to cross-sectoral activities, to the development of innovative policy and, by means of digitisation and servitisation, to identifying other forms of business ideas that can meet the major challenges facing society.

Economic and social sustainability

The energy transition needs to take place in a way in which fundamental human rights are respected and no groups are disadvantaged by formal or informal structures. The efforts are aimed at research and innovation that take into account broad economic and social sustainability issues related to the green economy and differences in the capacity of various groups to act in the transition.

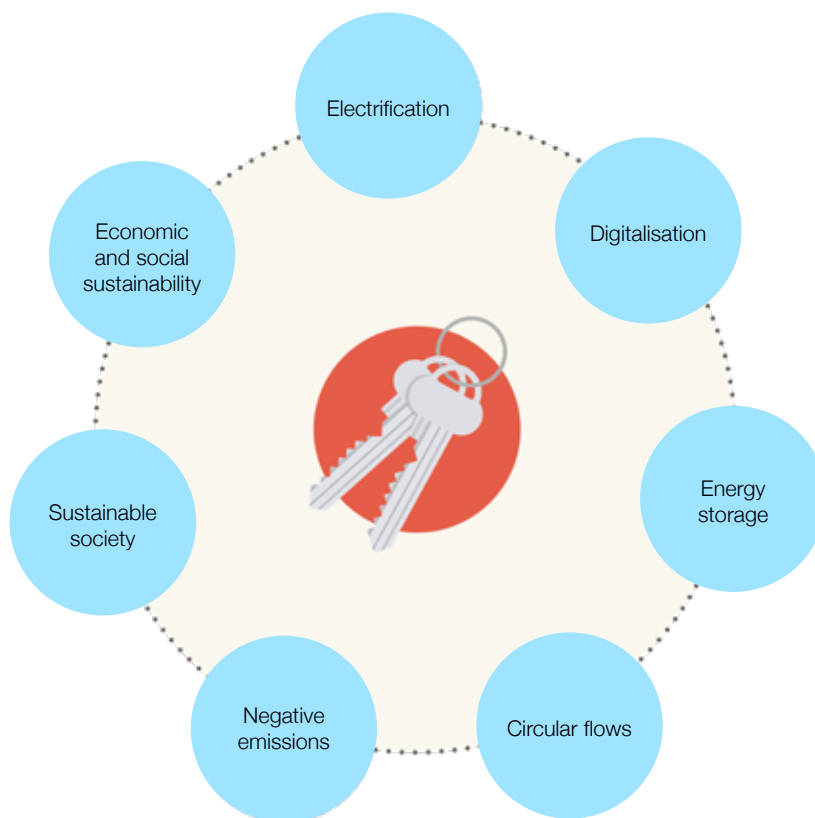


Figure 2. Seven key areas for action, or key solutions, where the opportunities for changing up a gear and the needs for reinforcement are great in order to meet the energy and climate goals.

Tools to shorten the time to market for innovations

To achieve the much more substantial leaps needed for the transformation to a sustainable energy system in time, the results from research and innovation must be utilised more quickly in society in Sweden and the world. How the Swedish Energy Agency intends to increase investment in tools that are effective and necessary for accelerating the pace of innovation, and in solutions that can reach a global market, is described below.

1. Commercialisation of energy innovations

The Swedish Energy Agency proposes increased funding for small and medium-sized companies, as well as start-ups, to develop new solutions from research to market.

The commercialisation of energy innovations makes a great contribution to opportunities for meeting Swedish energy and climate policy goals, as well as making it possible for Sweden to take a global lead. However, the commercialisation of innovative products and services needs to accelerate, and they need to reach out to both national and global markets at an even higher rate than today. This will increase economic growth and export opportunities, provide more job opportunities and enhance the attractiveness of establishing large companies and industrial ventures in Sweden.

2. Pilot and system demonstrations provide knowledge and experience

The Swedish Energy Agency proposes increased funding in order to expand the efforts in the pilot and system demonstrations for the energy transition.

Many solutions required for a sustainable energy system are available today but need to be demonstrated in a relevant environment or scaled up, which is a key step in order for them to gain entry into the energy system and the market. System demonstrations are required to create better conditions leading to the implementation of the solutions including, for example, the economic, infrastructural, regulatory and political conditions that are relevant to the technology or system in question.

3. Internationalisation of Swedish energy innovations

The Swedish Energy Agency proposes increased efforts for 1) the internationalisation of Swedish innovations, 2) an international presence and 3) to attract investors to the energy sector.

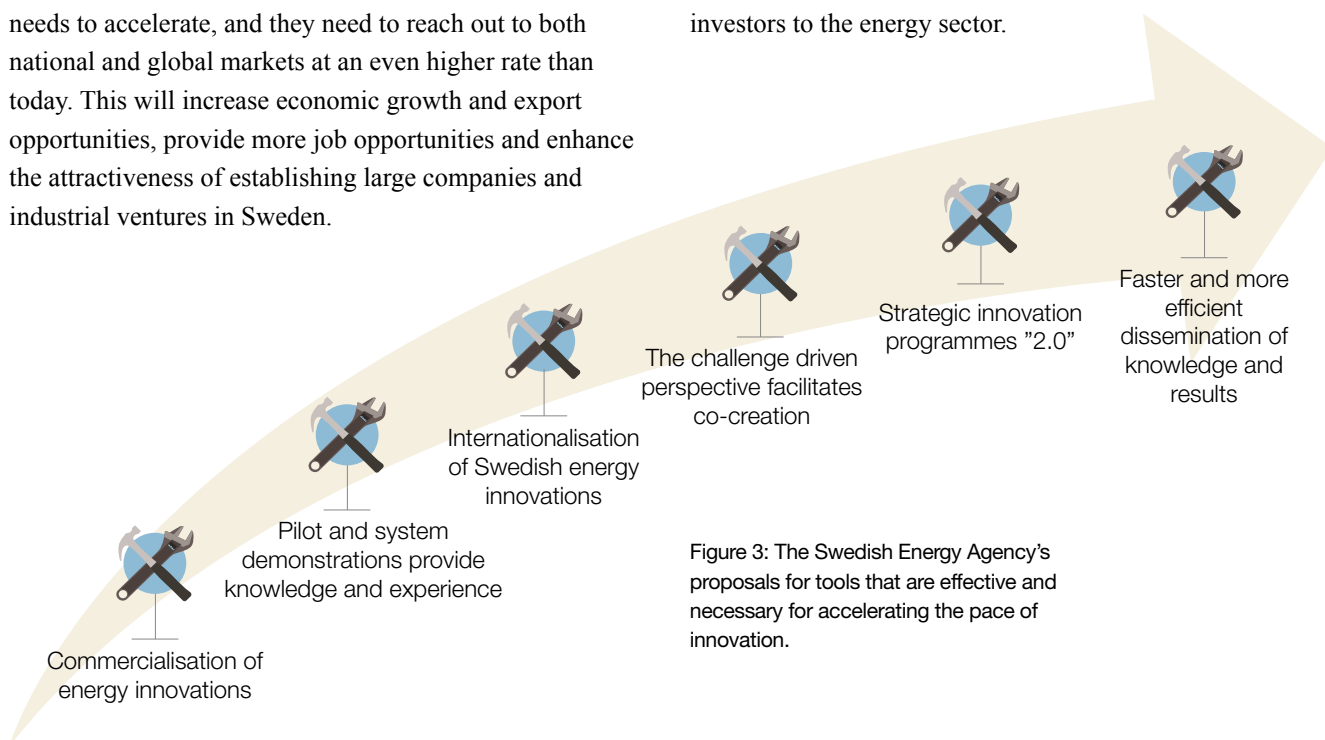
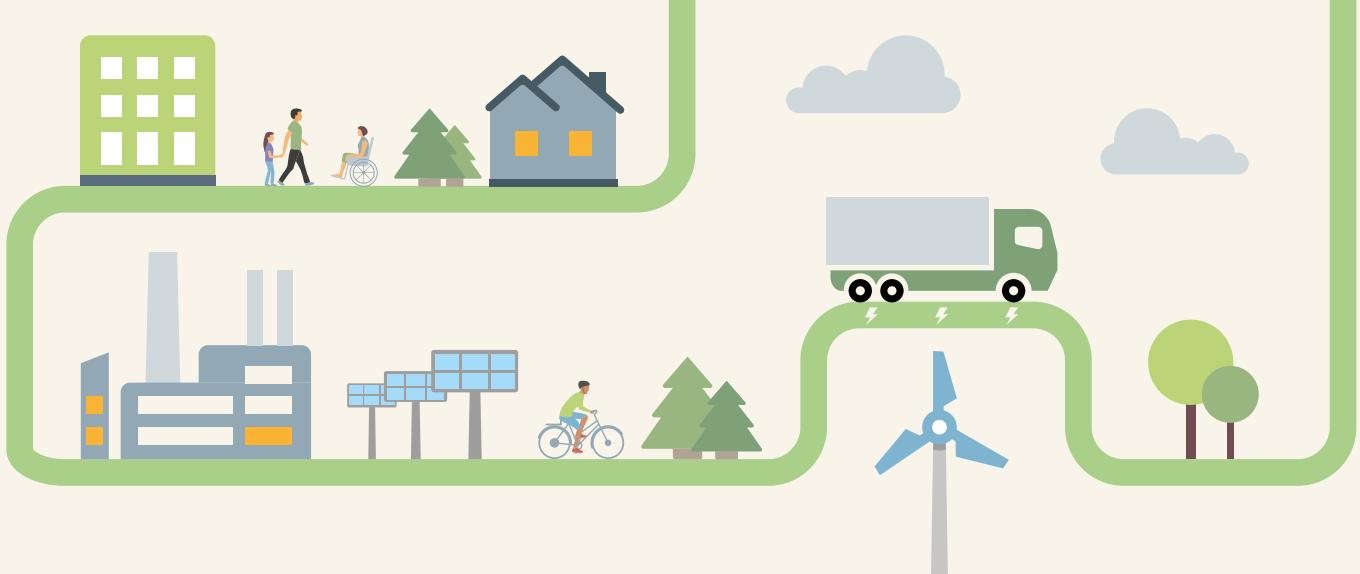


Figure 3: The Swedish Energy Agency's proposals for tools that are effective and necessary for accelerating the pace of innovation.



Swedish energy innovations are in great demand. Local presence and the opportunity to demonstrate new technology in relevant target markets are important factors for success. The Swedish Energy Agency intends to continue its efforts to attract investors in order to redirect the large capital flows to sustainable solutions for the global energy transition.

4. The challenge driven perspective facilitates co-creation

The Swedish Energy Agency proposes increased efforts in cross-sectoral collaborations and collaboration with clients and need-owner networks.

More collaboration is required between providers of research and innovation, both from academia and the business sector, on the one hand, and users, clients and investors in society on the other. There is also a need for more interdisciplinary and cross-sectoral project constellations. Collaboration and co-production enhance the conditions for the efforts implemented to meet the needs, and for the subsequent results to be disseminated efficiently and rapidly.

5. Strategic innovation programmes "2.0"

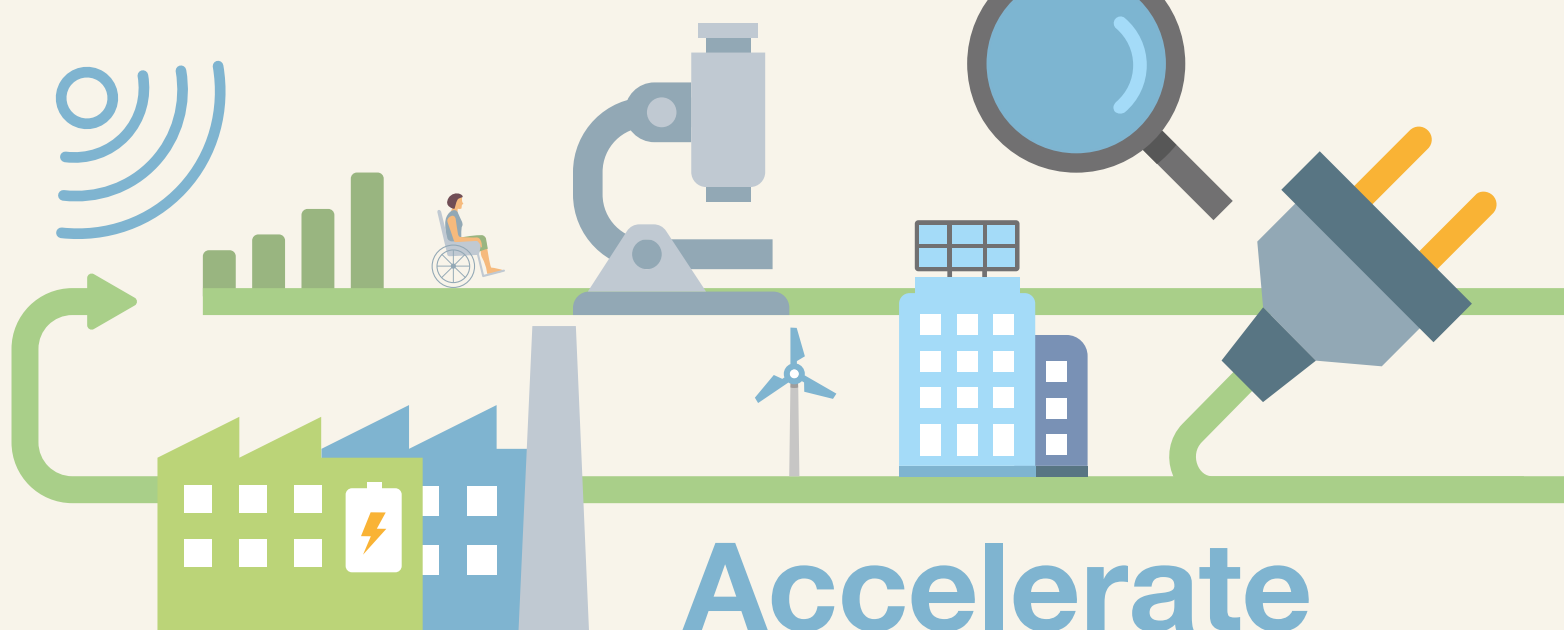
The Swedish Energy Agency proposes the further development of participant-driven collaboration programmes with a maintained budget level as for 2019.

The strategic innovation programmes bring together many of the participants in the innovation system. The next generation's programmes should address areas of broad societal relevance, and be fewer in number but with larger budgets in order to further increase their efficacy and impact. The starting point is a continuation with unchanged budget levels.

6. Faster and more efficient dissemination of knowledge and results

The Swedish Energy Agency proposes increased efforts for faster and more efficient dissemination of knowledge about the results of the research and innovation carried out.

To create the conditions for this increase in pace, the knowledge and skills generated by the research need to create change right here and now. The Swedish Energy Agency will therefore increase the efforts to disseminate the results of the research and innovation carried out. This is a question of analysing, following up and producing statistics for the results from the support for research and innovation, of supporting project implementers in the communication of their results, and of creating forums for participants to meet and share the knowledge generated.



The Swedish Energy Agency is leading the energy transition into a modern and sustainable, fossil free welfare society - applying our credibility, a comprehensive approach and courage.

We contribute with facts, knowledge, and analysis of supply and use of energy in the society, as well as work towards security of energy supply.

Research on new and renewable energy technologies, smart grids, as well as vehicles and transport fuels of the future receives funding from us. We also support business development that allows commercialisation of energy related innovations, and ensure that promising cleantech solutions can be exported.

Official energy statistics, and the management of instruments such as the Electricity Certificate System and the EU Emission Trading System, are our responsibility.

Furthermore, we participate in international collaboration with the aim of attaining Swedish energy and climate objectives, and develop and disseminate knowledge for a more efficient energy use to households, industry, and the public sector.



Swedish Energy Agency, P.O. Box 310, 631 04 Eskilstuna, Sweden

Phone +46 16-544 20 00, Fax +46 16-544 20 99

E-mail registrator@swedishenergyagency.se

www.swedishenergyagency.se