

Appendix – Sub-themes:

Energy and storage

Innovation Fund Denmark (IFD) invests in research and innovation in the field of energy with the aim to promote a cost-effective green transition of the energy system, including production, distribution, storage and increased energy-efficient consumption in all the sectors and the society in a broad sense.

The energy system is undergoing a huge green transition with significant increase in the share of renewable energy. Large proportions of renewable energy in the system require smart management of the energy flows and increased digitalisation of the energy sector. IFD therefore invests in solutions for an optimised energy system, including the development of new robust business models. In addition, efficient energy storage is one of the major challenges in the green transition with large shares of renewable energy. IFD wants to invest in energy storage technologies and the conversion of electricity into storable medias, including the production of alternative fuels and / or chemical building blocks, which is a part of various Power-2-x

No solution alone can solve the climate challenges; the huge challenge of reaching the Danish goals can only be solved through the interplay of many technologies and IFD promotes interdisciplinary cooperation throughout the energy sector and across sectors. In this respect, IFD sees e.g. Power-2-X technologies as important technologies to promote sectoral coupling.

Climate

IFD wants to invest in research and innovation within all scientific fields and transdisciplinary research areas, which support climate change mitigation, climate adaptation, sustainable society, biodiversity enhancement and enable the green transition in all parts of society both in Denmark, Arctic and globally.

It also includes research into resulting societal changes, e.g. international conflicts derived from climate change.

Climate friendly agriculture and sustainable food

IFD invests in innovation projects contributing to a green transition of the agricultural- and food industry sector.

This includes facilitating climate and environmental friendly farming, organic production, plant-based production and alternative protein sources, resource efficient processing and distribution of food and food ingredients, and sustainable use of bio resources from the ocean.

The above includes:

- projects aiming to reach a net-zero emission of greenhouse gasses from Danish agricultural and food industries by 2050 whilst strengthening the environment, retaining the biodiversity, and creating data to secure the base for a better and more accurate future regulation
- identification of alternative protein sources providing a sufficiently high quality for use in feed as well as in food
- data driven management and increased automation in the entire agricultural and food sectors, including the use of robotics, drones and other new technology
- focus on the entire food value chain
- consumer behaviour

To meet these ambitions, we need research and innovation in rethinking agricultural and livestock farming, with the aim to secure higher efficiency while reducing emission of methane and nitrous oxide by adaptation of the farming practice and technology. In this area, IFD will for example invest in creating an improved knowledge base for understanding how to optimise feed composition and –utilisation, improve manure management, facilitate precision farming, enlarge the exploitation of data and make conventional as well as organic animal and crop production more efficient.

Other important initiatives to reduce greenhouse gas emission, is reducing food waste. There is a significant value to gain from ensuring that a larger portion of manufactured food ends up being consumed and is not wasted, and a potentially even larger value to gain from reusing and upgrading both food waste and side streams from the primary sectors, the food industry, retailers and private households. IFD will invest in altering practices and behaviour in food manufacture and handling throughout the entire value chain enabling the green transition.

Climate and environmentally friendly transport

The transport sector contributes significantly to our greenhouse gas emissions, not least because of the continued dependence on fossil fuels. The current political ambitions to reduce emissions from the transport sector is challenged by the continued growth in both passenger and freight transport. The transport sector therefore has a significant potential for reductions in greenhouse gas emissions, and it is essential that large proportions of the transport sector is converted to using green fuels to achieve Denmark's target of a 70% reduction in greenhouse gas emissions.

IFD invests in research and innovation in order to accelerate the green transformation of the transport sector. The Innovation Fund considers power-2-X technologies as essential technologies in the production of alternative green fuels similar to applications within energy conversion and energy storage. In addition to an increased electrification of the transport sector (both via electric vehicles and via alternative green fuels produced by power-2-X), there is a significant potential for increased use of biofuels in the transport sector. However, it is important to note that biomass is a limited resource and that a discussion of optimal utilisation of biomass is necessary. In relation to the usage of new alternative fuels (both electricity based via power-2-X or bio-based) and an increased electrification of the transport sector, these new fuels / electricity require new infrastructures that are adapted to the fuels. Both research and development of these infrastructures is necessary to secure implementation. However, it must be borne in mind that the

Danish infrastructure is not necessarily the same as in the rest of the world, and global strategies must therefore be included when considering technology exports. In addition to an increased share of alternative green fuels in the transport sector, there is also a significant potential for reducing greenhouse gases by incorporating smart mobility and smart infrastructure in the future transport sector.

Manufacturing Industry and materials

Innovation can lead to significant improvement in energy utilization across global industries, e.g. optimisation of process heating using combined heating and power systems. Electronic control systems, as well as AI, improved data collection, sharing and use, can all help optimise industrial production and reduce greenhouse gas emissions.

IFD wants to invest in a circular approach to construction, industrial processes and energy use across sectors in order to achieve improvement in industrial productivity and emission reductions. Materials should be recyclable and reused in other value chains. Alternative materials and the potential use of oxygen-enriched combustion (oxy-combustion fuel), carbon capture and use (CCU technology) may be a future commercial solution and export option.

There is a request for of increased focus on circular economy and recycling of materials; thus, circular design is particularly relevant.

Sustainable nature and environment

The research and innovation goals are a cost-effective green transition with decoupling of growth from environmental impact as well as efficient use of resources incl. plastic for value creation, for a sustainable society and the future climate. To achieve these goals, IFD wish to invest in research and innovation projects, for example, strengthening biodiversity, focusing on cost-effective instruments in nature protection and nature management, clean air, soil, water including water-saving initiatives and technologies, rich ocean environment, circular economy and bio-economic solutions. Reducing emissions from agriculture is included as an important area of action.

Sustainable cities and community

These include, for example, sustainable construction and housing, as well as recycling of materials, minerals and waste.

Population growth and increased urbanisation emphasises the need to prioritize lower energy consumption, lower emissions and reduced material consumption in new constructions. Renovation and retrofitting of existing buildings can result in environmental and climate benefits. Intelligent buildings and urban infrastructure equipped with intelligent user interface, AI, IoT and full integration with the energy grid offer great potential for reduced emissions. It is necessary to introduce full life cycle and circular principles, such as circular design, to ensure cost-effective disassembly and material recycling.

IFD wish to invest in research and innovation that contributes to the continued development of sustainable quality construction, construction processes, building materials, physical infrastructure, attractive cities, and to promote solutions for energy efficiency and circular economy in the construction sector.

Behavioural aspects in relation to green transition

A large part of the anthropogenic greenhouse gas emissions originates from human behavior; accordingly, many of the solutions to the green transition will rely on changes of lifestyles.

Citizens and societies, through their behavioral change and change in daily practices, can contribute to reducing greenhouse gas emissions. Some of the examples are changing to climately friendly transport options, recycling, changing shifting to plant-based diet, saving electricity and water, etc. These are only few examples among many, on how people's engagements can reduce Denmark's carbon footprint. The change in behavior can be stimulated through many ways, for example, by nudging, which is a low-cost and efficient way of motivating people to behave in a certain eco-friendly way. Other initiatives include information/education, monetary or non-monetary rewards, design of sustainable urban environments, etc. Choices (made by citizens, communities, enterprises, etc.) relate to traditions, habits, values, beliefs, economic incentives, physical space, among others. Each social and human science has a different approach and we are willing to invest in the best ideas that provide sustainable solutions to reduce greenhouse gas emissions in Denmark.

Another relevant fragment of solutions to climate change mitigation relies on how ready the society is in order to adapt new green technologies. The society's participants (people, municipalities, etc.) will accept or reject new green-technologies and define if such technologies will become successful or not. If a new technology cannot be integrated in the society, then its value is lost because nobody is willing to use it. Therefore, social and human scientists' knowledge is important for the implementation of new green technologies in the society.

Our Grand Solution program encourages diversity in the partnerships. Having different points of view, from engineers to social scientists, from private to public sector, will bring innovative and successful projects that will help reach the Green Transition targets, both in 2030 and 2050. The partnerships need to be optimal for each case, making the solution to a specific problem plausible to implement.