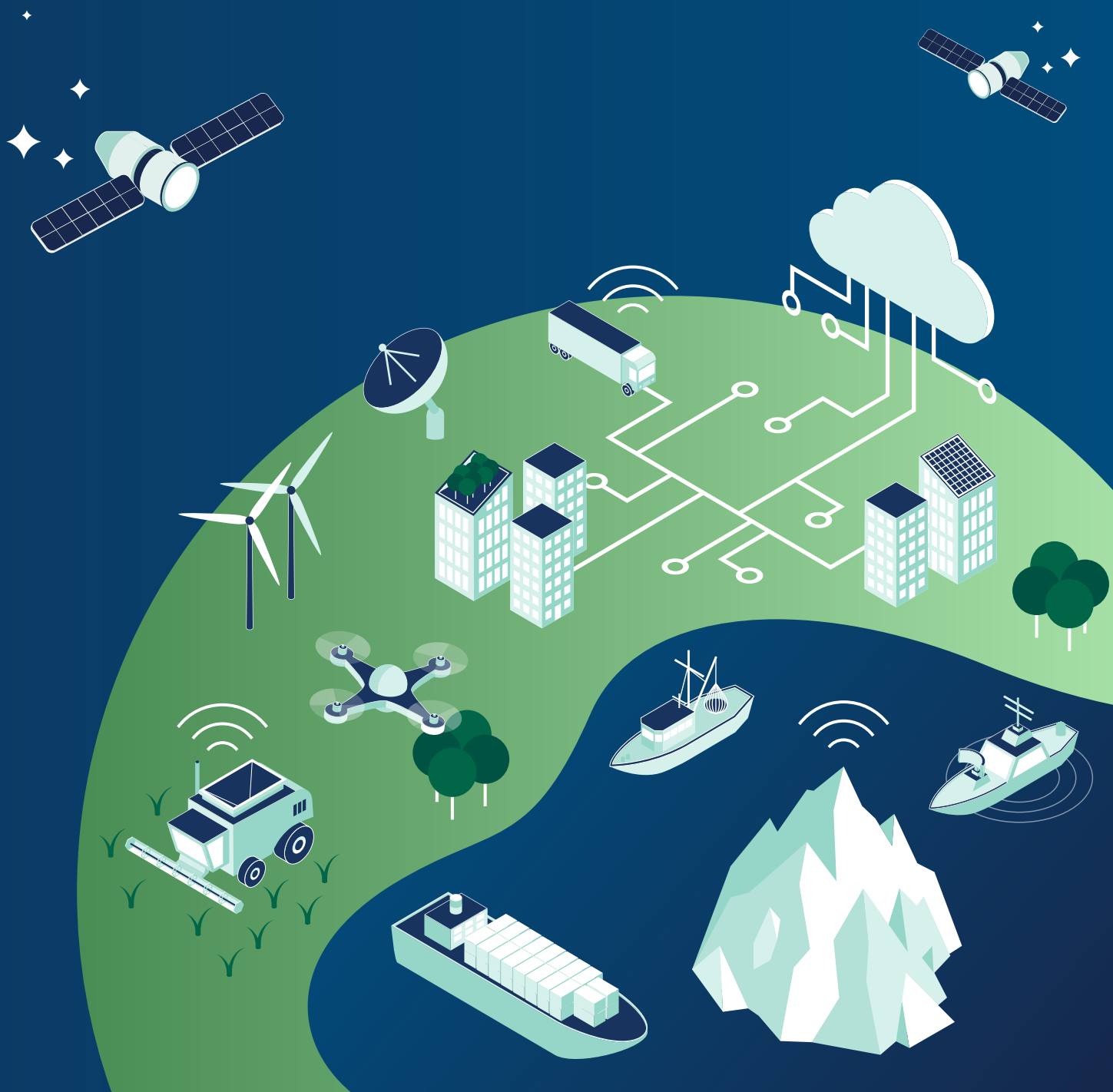
The Danish Government Executive Summary JUNE 2021

Denmark's national space strategy

Update of strategic objectives



June 2021

Ministry of Higher Education and Science
Børsgade 4
DK-1215 Copenhagen K
Tel: +45 3392 9700
E-mail: ufm@ufm.dk
Web: www.ufm.dk

ISBN 978-87-93823-66-2 (digital version)
ISBN 978-87-93823-65-5 (trykt version)
2020/21:14

Design: Urgent.Agency
Layout: Urgent.Agency

Fotos:
Page 4: Jens Honoré
Page 18: ESA

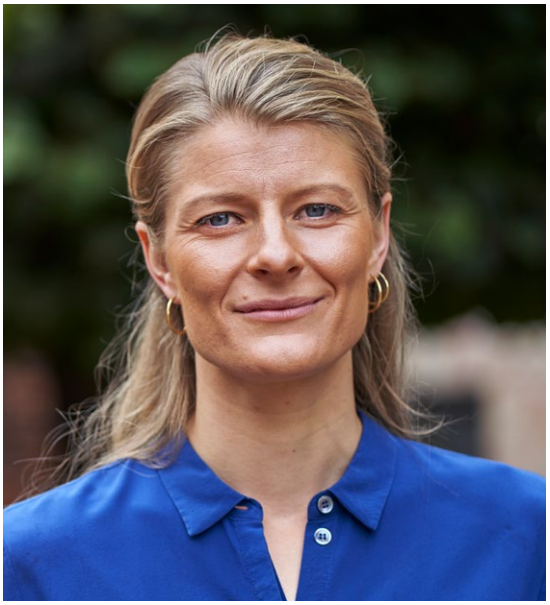
This publication can be downloaded from
www.regeringen.dk / www.ufm.dk/publikationer

Preface by Minister for Higher Education and Science

Space-based infrastructure in support of green transition.

Every day, space technology and satellite services contribute to making life on Earth better, greener, and more secure. For man and society.

Satellite data help the IPCC - UN's Intergovernmental Panel on Climate Change predict climate development, and they support the global community in attaining the UN Sustainable Development Goals. Authorities use satellite data to protect our nature, climate, and the environment when monitoring emission targets and pollution, and when regulating agriculture and fishery. Cities use satellite data to design smart and sustainable cities capable of handling the increasing climate challenges. The business community uses satellite data to develop new digital solutions, the transport sector to optimise logistics and route planning, and the defence sector to communicate and get an awareness of our territory and possible risks.



With its global scope, high degree of digitalisation, and technological development opportunities, the space sector is particularly suitable for assisting Denmark and the world on the path towards green transition. When space is to unfold its potential in the green transition, research, innovation, and development are called for. These capabilities and competences are already present in Denmark, but they can and must be focused and enhanced even more.

Denmark got its first national space strategy in 2016. The strategy has helped us set a clear direction for the space sector, gather the national space environments, and support growth and public service. We will now update the objectives of the strategy with a strong green profile in order to support the contribution from the space sector to an agenda with which the ability to aim for a green transition will be defining for our entire society and economy.

I would like to convey my thanks to all authorities, knowledge institutions, businesses, and others having created with their expertise, inputs, and ideas a broad foundation for the updated objectives.

Yours faithfully,
Ane-Halsboe Jørgensen

Executive summary

Five new objectives in Denmark's national space strategy will show how space-based technology and infrastructure contribute and support opportunities and potentials in relation to reduction and climate targets, smart cities, an efficient digital public sector, green value creation, as well as security and contingency preparedness.

Space-based data, information, and infrastructure today are of a quality that supports solutions within a large number of societal challenges. For a long time, satellites have supported our ability at the national and international levels to observe weather, climate, and climate change, communicate over large distances, and navigate safely afloat, ashore, and in the air. Increasingly, we use satellites to protect our nature, environment, and biodiversity, identify the best location of renewable energy sources, or monitor and control fishery, agriculture, forestry, and enforce the sustainable use of our natural resources.

More and more, satellite-based information will be important in attaining smarter and more sustainable communities and cities. In other words, how we handle increasing requirements for a circular and sustainable economy, but also how we warn about and handle extreme weather situations and climate change, avoiding loss of values and human life.

A large number of functions crucial to society depend increasingly on knowledge, data, and services from satellites, and these services are increasingly important to our economy, sustainable growth, and development. The security of supply of these systems, therefore, is a key aspect. The more integrated space-based services become in our everyday lives and economy, the more vulnerable we are to possible outages of these services.

Also, there is an increasing focus on the importance of space for the security of the Kingdom, its sovereignty and contingency preparedness, not least in the Arctic.

In combination with an increasingly digital society and an economy where the capacity for handling and reacting to large data quantities is decisive, space-based solutions contribute with relevant data, communication, along with timing and navigation. A contribution qualifying the data basis on which decisions are made. The space contributes in this way to knowledge about climate and climate change, optimisation and control of environment and resources, protection of values, and our common security.

Already back in 2016, Denmark's national space strategy captured the importance of satellites for a number of aspects of our societal development, but not all. The time has now come to look into the objectives of the strategy in order to adjust the framework for Danish exploitation of space in the coming years in a green, digital, sustainable, and security perspective.

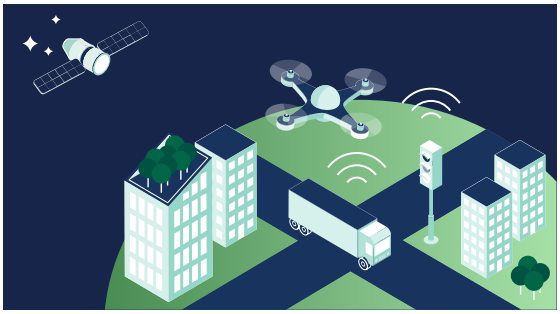
To capture the opportunities of space to the benefit of Denmark, five new objectives have been identified to set the direction for Denmark's space initiatives in the future.

1

Space-based infrastructure and data will contribute to more and better knowledge about climate, environment, nature, and biodiversity

The space sector contributes with a significant part of the knowledge we have about the Earth's climate and state - and in the future it will contribute even more with data and digital infrastructure supporting researchers, businesses, and authorities in finding sustainable and cost-effective solutions to the challenges we are facing within climate, environment, nature, and biodiversity.

2



Space-based infrastructure and data will contribute to smarter and more sustainable cities

On a daily basis, space contributes with information and services supporting a smarter, better, and more digital daily life for cities and citizens. Space-based data and services in the future will to an even higher extent support the need of cities for smart solutions within transport, digitalisation, circular economy, climate adaptation, and environment.

3

Space-based infrastructure and data will contribute to better and more efficient public service

The use of data from satellites contributes to the digitalisation of public service at national, regional, and local levels. In the future, space-based information and services will further support the potential where satellite data are a substantial part of the solution for control and monitoring of the implementation of national and European targets within environment, climate, nature, and biodiversity.

4

Space-based infrastructure and data will contribute with further green value creation

Space-based technology and competences contribute with growth and value creation within the green transition, including climate adaptation and reduction targets. In the future, space-based technology and infrastructure will contribute further to increased use of green technologies and digital solutions in Danish industry to the benefit of Denmark and Danish exports.

5

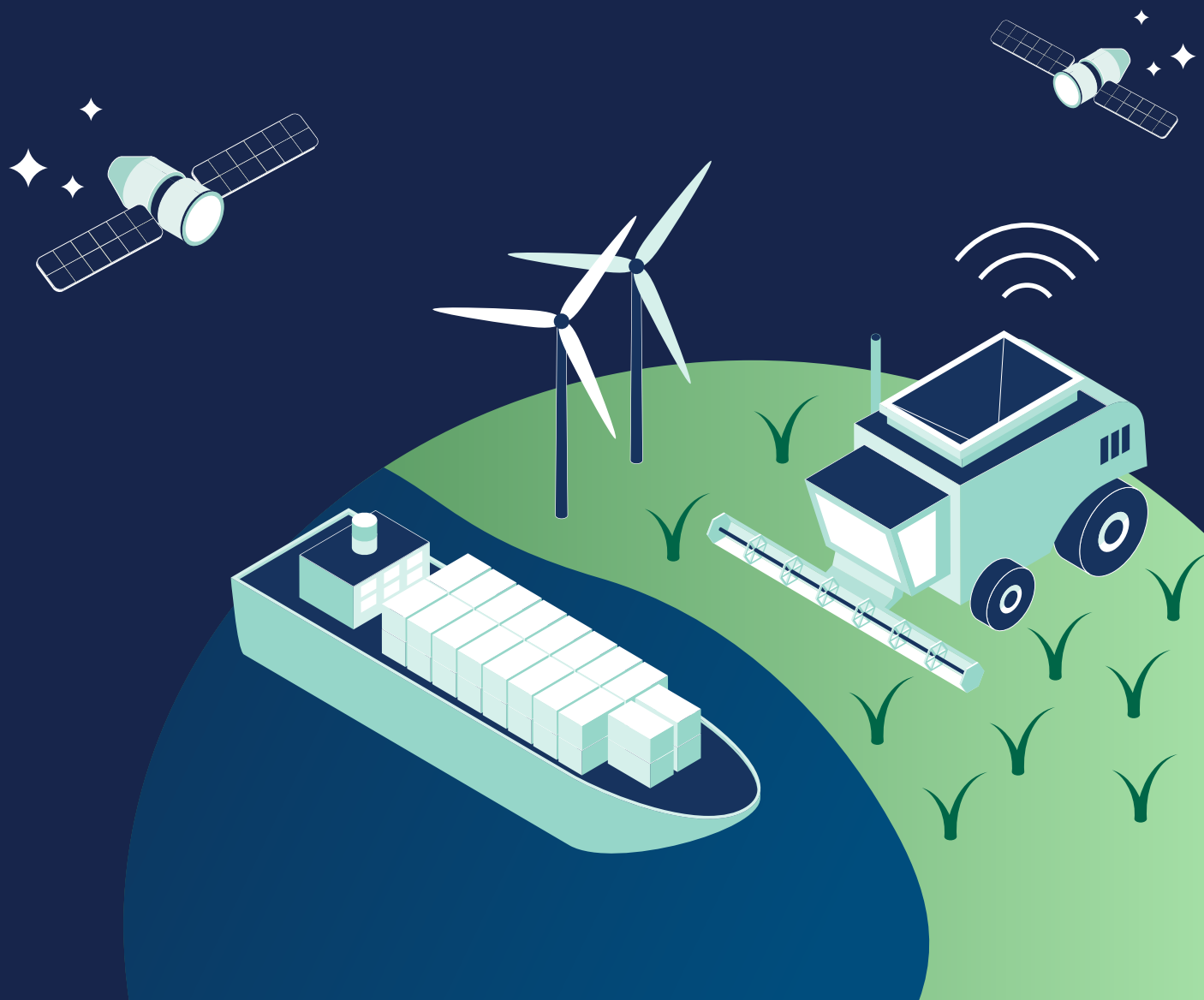
Space-based infrastructure and data will contribute to higher and better security and contingency preparedness

Still more tasks of crucial importance to society depend today on space-based systems being accessible, resilient, and reliable, and in the future the systems will contribute to further security and contingency preparedness, not least in the Arctic. By using satellites, the Danish Defence and other authorities can become better at handling extreme weather and natural events, rescue operations, enforcing safety in the air and at sea, and enforcing the sovereignty of the Kingdom.

Objective 1

Space-based infrastructure and data will contribute to more and better knowledge about climate, environment, nature, and biodiversity.

The space sector contributes with a significant part of the knowledge we have about the Earth's climate and state - and in the future it will contribute even more with knowledge and digital infrastructure supporting researchers, businesses, and authorities in finding sustainable and cost-effective solutions to the challenges we are facing within climate, environment, nature, and biodiversity.



Through research and innovation based on the daily monitoring of the state of the Earth and reception of precise positioning and time signals space infrastructure can be turned into green solutions for the challenges we are facing within climate, environment, nature, and biodiversity.

Satellites can designate the most suitable lowland soils in agriculture to be set aside

Earth observations from satellites have the potential to survey and monitor the content of nutrients and water in soil along with its ability to bind carbon, thereby contributing to the identification of the most suitable lowland soils.

Satellites can provide the data basis for a holistic regulation of environment, nature, and climate

Using Earth observation data as the basic input, it will be possible in theory to establish a high-resolution monitoring model of all natural resources and ecosystems in Denmark, and this will enable researchers and authorities to provide input to decisions on expedient regulation and its effects on the government's targets within climate, nature, environment, and biodiversity.

Satellites are being put to use in agriculture, but their potential is far from being fully exploited

24% of farms are using navigation satellites for more precise runs of tractors or harvesters, while only 4% of farms are using satellite images to produce more precise maps as a basis for applying fertiliser and pesticides.

Satellites optimise transport routes and can build a bridge to the green fuels of the future

A preliminary estimate has shown that precise real-time positioning through satellites in combination with a national data sharing infrastructure holds the potential to considerably reduce emissions from road freight transport.

Satellites reduce costs for investments in renewable energy and energy efficiency

Satellite data can contribute to reducing the costs for a transition of the energy generation of the world in the location of solar and wind energy facilities.

Satellites develop our global climate models and will soon designate emission sources on the Earth

In the coming years, satellites from the EU will allow for the identification of the sources of greenhouse gas emissions.

Satellites provide us with knowledge about how best and most cost-effectively to adapt to climate change

The development of climate models is decisive for our ability to forecast the magnitude and speed of climate change that may potentially have major consequences.

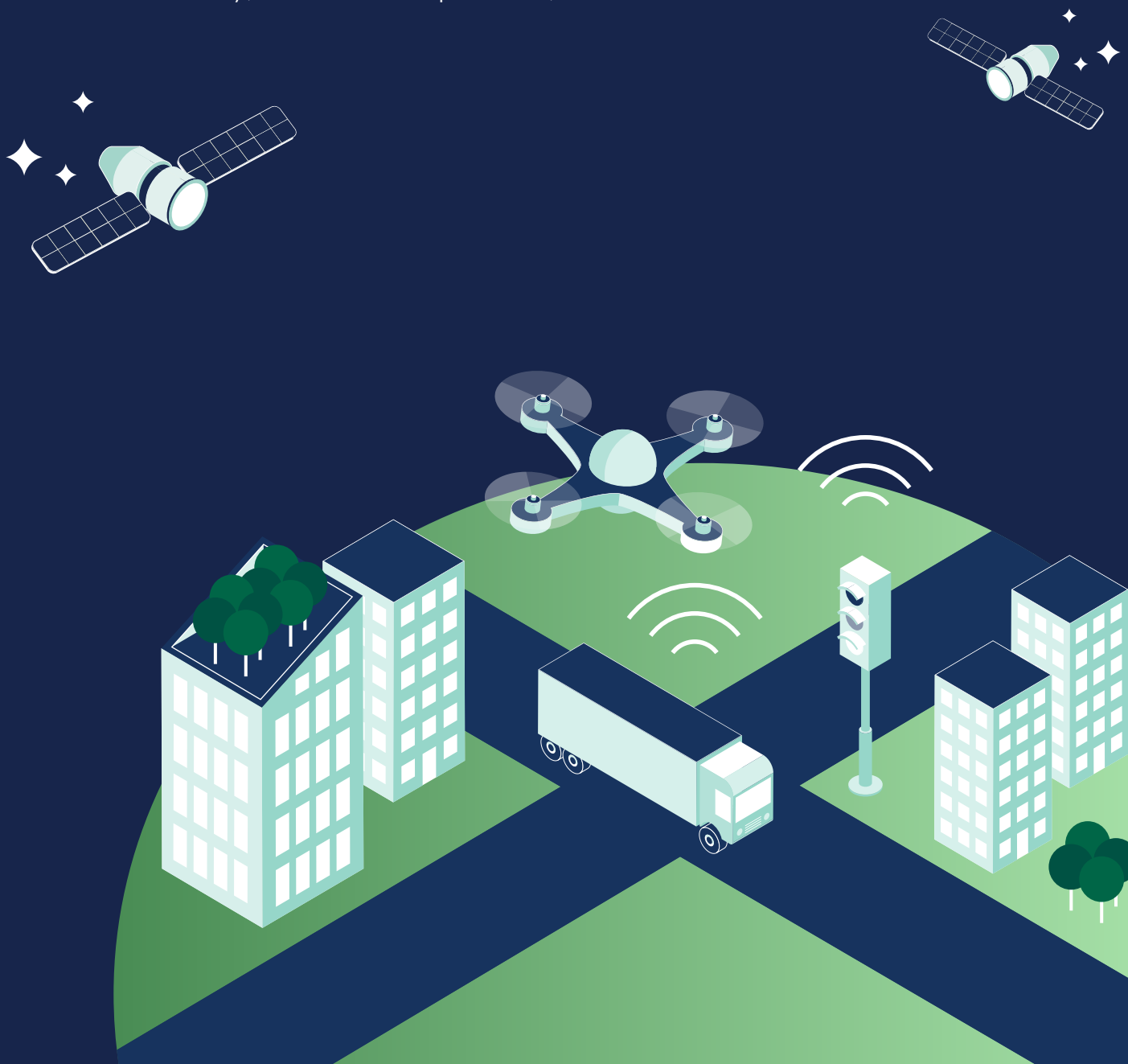
The following three focus areas will support the potential and the opportunities under the objective:

1. **Prioritisation of green space programmes and missions in the EU, ESA, and EUMETSAT**
2. **More knowledge about the importance of satellite data in the attainment of the government's climate, nature, environment, and biodiversity targets as well as the UN Sustainable Development Goals.**
3. **Support to government's green research missions**

Objective 2

Space-based infrastructure and data will contribute to smarter and more sustainable cities

On a daily basis, space contributes with information and services supporting a smarter, better, and more digital daily life for cities and citizens. Space-based data and services in the future will to an even higher extent support the need of cities for smart solutions within transport, digitalisation, circular economy, climate adaptation, and environment.



Denmark is facing ambitious climate targets and growing challenges in the form of climate adaptation, demographic changes, and new shifts between rural and urban areas. This puts pressure on infrastructure and resources in an intersection between green transition, welfare, and development.

Satellites contribute with significant data for continuous digitalisation of cities

Key technologies are monitoring, communication, navigation, and precise timing - they contribute continuously with relevant real-time data on weather, environment, climate, biodiversity, built-up areas, positioning, timing, authentication, geo data, and safe and reliable communication between units.

Satellite navigation is essential to sustainable transport and autonomous robots

Intelligent traffic management and logistics optimisation of goods in and around our cities will have a direct effect by helping to reduce emissions, thereby affecting air quality and our health.

Satellites create knowledge about essential climate adaptation and critical resources

A mapping of exposed areas helps cities in their risk mitigation by securing embankments, piers, ports, bridges, roads, and buildings so as to avoid loss and damage, for instance from flooding caused by climate change.

Enhanced business potential for smart city solutions with space data

It is assessed that we have global export opportunities for green and smart urban solutions meeting climate change challenges, as cities are particularly vulnerable to increasing precipitation, higher water level, and higher temperatures.

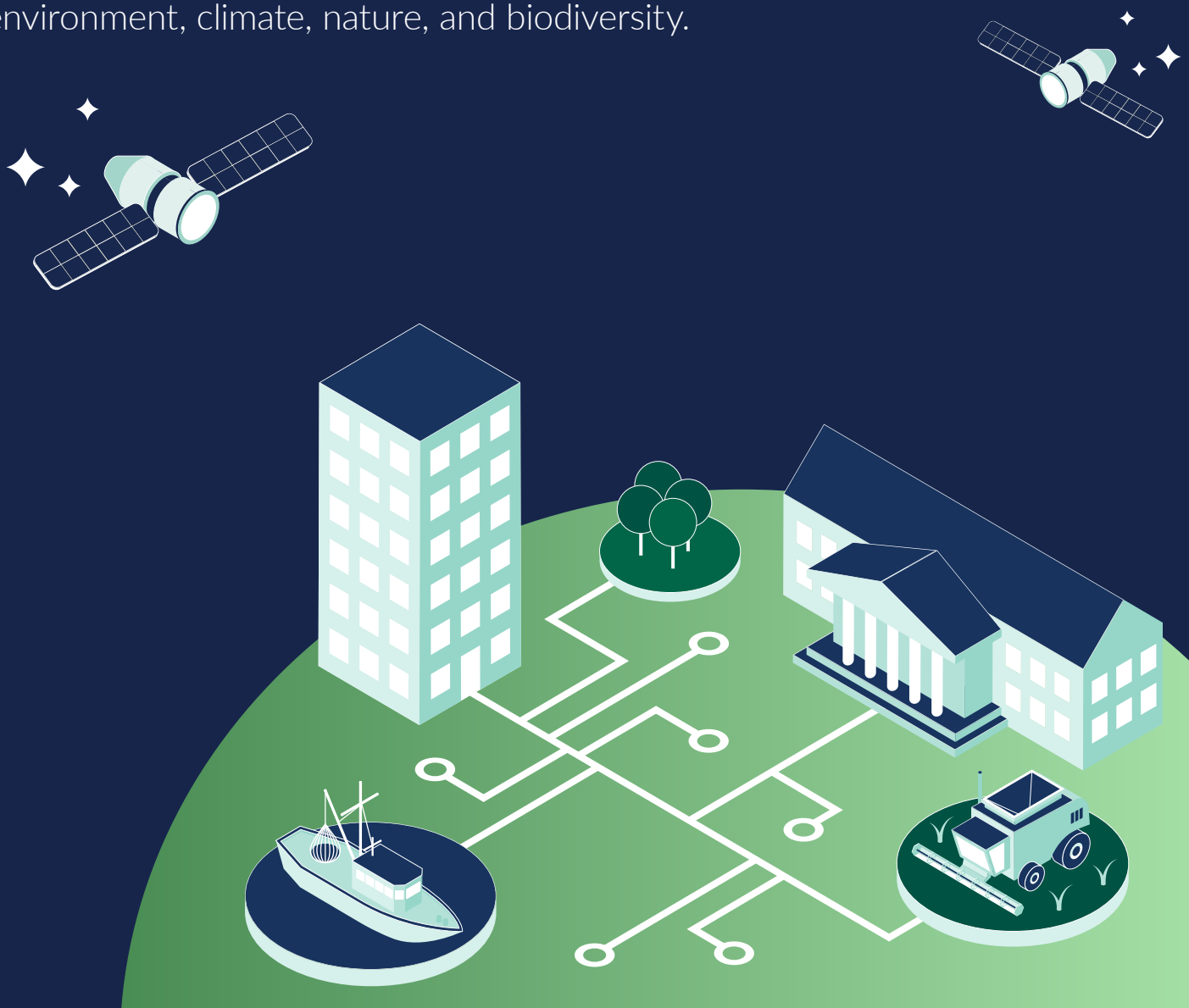
The following three focus areas will support the potential and the opportunities under the objective:

1. **Supporting the uptake and integration of space-based data in smart sustainable solutions**
2. **Closer dialogue with key purchasers of data driven solutions**
3. **Supporting smart social solutions in the European space cooperation**

Objective 3

Space-based infrastructure and data will contribute to better and more efficient public service

The use of data from satellites contributes to the digitalisation of public service at national, regional, and local levels. In the future, space-based information and services will further support the potential in the field of environment and nature where satellite data can be a substantial part of the solution for control and monitoring of the implementation of national and European targets within environment, climate, nature, and biodiversity.



Digitalisation of the public sector in Denmark is a world leader according to the UN. Today, satellite data play a small, yet increasing role in the public digitalisation within control and monitoring of, among others, coastal protection, raw material extraction, agriculture, forestry, and fishery. There is a particularly high potential for using satellite data to make control and monitoring measures in the green field more efficient.

Denmark as a frontrunner in the EU

Danish authorities continuously adapt to new EU requirements for satellite monitoring. Within agriculture and fishery, Denmark has been a technological frontrunner in the introduction of satellite-based monitoring and control.

A green case for use of satellites in nature and environment administration

It is assessed that there is a particularly high potential for using satellite data to make control and monitoring measures in the green field more efficient. The use of satellite data in combination with artificial intelligence and machine learning tools ensuring automated recognition of species and nature can be a substantial part of the solution for Danish authorities.

Barriers for more extensive use in public administration

Three general barriers for a better exploitation of satellite data in public administration have been identified. They are associated with:

1. Access, quality, frequency, and accuracy of satellite data,
2. Education and competences relating to use,
3. Competences and knowledge are dispersed across authority fields.

The following three focus areas will support the potential and the opportunities under the objective:

1. **More and better knowledge about the value of digitalisation through satellite data**
2. **Cooperation with Danish businesses and knowledge institutions**
3. **Focused and active Danish influence in ESA and the EU**

Objective 4

Space-based infrastructure and data will contribute with further green value creation.

Space-based technology and competences contribute with growth and value creation within the green transition, including climate adaptation and reduction targets. In the future, space-based technology and infrastructure will contribute further to increased use of green technologies and digital solutions in the Danish business community to the benefit of Denmark and Danish exports.

The commercial benefit to be harvested from the space sector is a focal area in Denmark's national space strategy. According to an OECD study, investments in the space sector often lead to higher productivity and efficiency, savings, and new products and services in many sectors. Concurrently, satellite data play an increasing role for the economic development of society and for a wide range of societal functions.

Focus on green space technology

Green space technology and value creation are to be understood as instruments and technologies for satellites and ground control systems, and as the application of data and signals from satellites in different green solutions.

Development of long-term green and digital competences in Denmark based on space data

The ability to understand, develop, and disseminate knowledge based on Earth observation and positioning data is expected to gain in commercial importance in the future. It sets high professional requirements for researchers, authorities, and businesses wishing to use and develop new digital solutions.

Focused effort to increase participation in relevant EU programmes and policy fields

A targeted focus on Danish participation in different EU policy and programme fields is called for, as space will also gain in importance here. Therefore, Danish actors must be encouraged even more to have focus on broad participation in the EU.

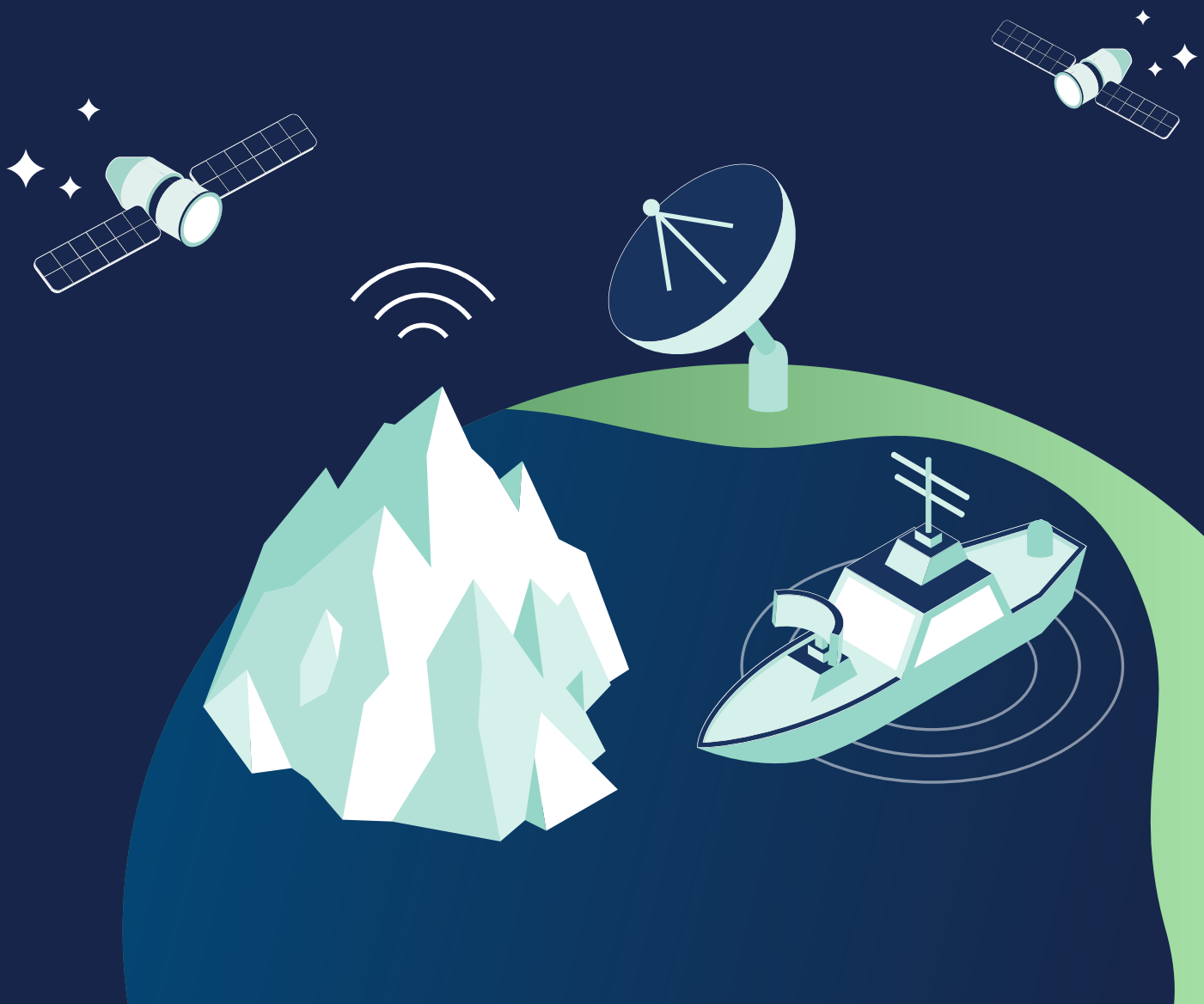
The following four focus areas will support the potential and the opportunities under the objective:

1. **Optimal framework for programme participation and technological development in ESA**
2. **Enhanced focus on interdisciplinary competences in the exploitation of space-based information and data**
3. **Strengthening of authority coordination of Danish participation in joint European activities**
4. **More focus on export of applications and uptake of space-based services in the Danish business community**

Objective 5

Space-based infrastructure and data will contribute to higher and better security and contingency preparedness

Still more tasks of crucial importance to society depend today on space-based systems being accessible, resilient, and reliable, and in the future the systems will contribute to further security and contingency preparedness, not least in the Arctic. By using satellites, the Danish Defence and other authorities can become better at handling extreme weather and natural events, rescue operations, enforcing safety in the air and at sea, and enforcing the sovereignty of the Kingdom.



Being one of the most digitalised societies of the world, Denmark uses satellite data for everything from weather monitoring, environment, and agriculture, to transport, communication, and bank transactions. Space-based systems are decisive for our society working as we know it.

Security of supply and accessibility of space-based systems

With increasing dependency on space-based systems come new vulnerabilities and potential threats, not least for the satellite-based services contributing today to solving important societal tasks. A higher and more sophisticated threat landscape places high requirements for security and resilience of satellites, the associated Earth stations, users' receiving equipment, and the signals passing between them.

Defence and security

Satellite communication and data are decisive for the Danish Defence to be able effectively to react to crises and conduct military operations. Especially in the Arctic, the Danish Defence meets an increasing need for satellite data to be able to monitor movements in the air and at sea in the large and very thinly populated area, thereby enforcing the sovereignty of the Kingdom.

Support to search and rescue operations in the Kingdom of Denmark

There is a potential for better exploiting satellite data in the civil contingency preparedness. For example, satellite data can be used to forecast and detect extreme weather and to monitor areas at risk of rockslides, coastal erosion, embankment breaches, and flooding, which authorities can use to draw up contingency plans. In addition, satellites contribut to better search and rescue operations in remote areas or during extreme weather.

Safe navigation and identification ashore, afloat, and in the air

The rapid development within drones, autonomous ships, and self-driving cars along with an expected increase in traffic density, including in the Arctic, enhances the requirements for accurate and reliable navigation data and for the traffic monitoring systems that are to prevent accidents, breakdowns, and in the worst-case scenario the loss of human life.

The following three focus areas will support the potential and the opportunities under the objective:

1. **Enhanced focus on the maintenance of security around space infrastructure and accessibility, reliability, and robustness of satellite data**
2. **Further use of satellite data to support civil search and rescue operations**
3. **Further use of satellite technology and data in the assignment execution of the Danish Defence**

Five new strategic objectives

Five new objectives will create the impetus in the future for the contribution of space to the green transition, climate challenges, digitalisation, and the need for increased security and contingency preparedness.

To capture the opportunities of the space sector to the benefit of Denmark, five new objectives have been identified as a follow-up to Denmark's national space strategy from 2016 to set the direction for Denmark's space initiatives in the future.

New strategic objectives not only demonstrate the willingness to set a direction, but also the aim to opt for long-term opportunities and potentials. Opportunities and potentials, by nature, develop and change over time. For that reason, every objective will be followed up by a number of focus areas creating an opportunity for a concrete, but over time also flexible follow-up and action plan. The Interministerial Space Committee in its annual reports will follow up on objectives, focus areas, and derived initiatives, and the Committee will make current evaluations of these elements.

Common to all objectives is that they will only be attained through continuous development, research, and innovation efforts. Therefore, the objectives must be read and understood as a supplement to, for instance, the government's green research strategy, a national strategy for dynamic data based on satellite navigation, climate objectives, and other sector strategies, action plans, etc.

Traditional space research disciplines such as exploration of our solar system, including the Moon and Mars, manned space flights, astrophysics, and astronomy are not neglected and will continue to be an important and central part of the Danish membership of ESA. The update of the strategic objectives, however, will focus on the direct and immediate societal value of space-based systems that call for broad cross-sectoral backing.

Ministries in the Interministerial Space Committee

Ministry of Industry, Business and Financial Affairs

Ministry of Finance

Danish Ministry of Defence

Danish Ministry of Energy, Utilities and Climate

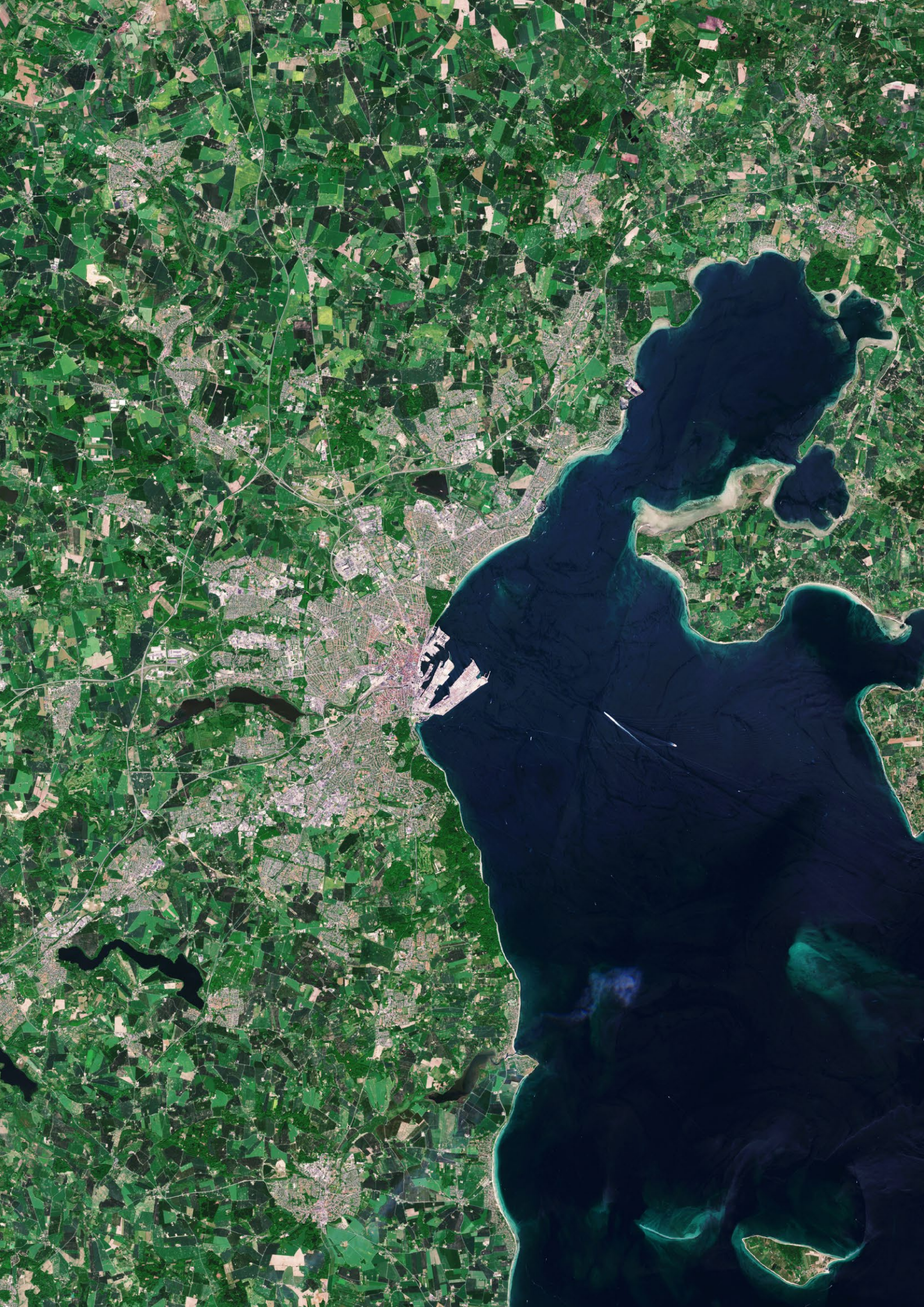
Ministry of Environment of Denmark

Ministry of Food, Agriculture and Fisheries of Denmark

Ministry of Transport

Ministry of Higher Education and Science Denmark

Ministry of Foreign Affairs of Denmark



Ministry of Higher Education and Science
Børsgade 4
DK-1215 Copenhagen K
Tel: +45 3392 9700
E-mail: ufm@ufm.dk
Web: www ufm.dk