

ANNEX G

SSAC REPORT – Scotland’s Space Sector: Exploring potential future opportunities

Comparison of International Markets in Commercial Space Applications

15 March 2024

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1. Executive Summary

This report aims to present a comparative study of international space markets reflecting status of the national space strategies and activities across some of the countries similar to Scotland. These countries include some of the EU nations including Sweden, Luxembourg, Israel, Lithuania, and Belgium, along with Norway, Denmark, Finland. Starting with a general outlook of the global commercial space sector opportunities, a brief on the status of Scotland is presented. This is followed by reflecting strategic position of specific space-active nations and key highlight of their space programs and achievements. Scotland's relative position compared to other countries is summarised highlighting potential competitors and collaborators. Finally gap areas in current space strategy of Scotland are noted in comparison to similar countries and actions to fill those gaps are suggested. Summary of the space strategy of included nations are provided in the end notes, for each country. By its nature, this report is not intended to be comprehensive but aims rather to provide an impression of space-related activity in several countries based on freely available public domain information. It will not cover all aspects of space activity in the selected countries, and there will be a degree of subjectivity in the review.

The space industry is on the brink of significant expansion in the next two decades due to increased private sector involvement, technological advancements, and improved regulations. Long term opportunities are abundant in satellite manufacturing and operation, launch, data communication, and space tourism. Scotland's space sector is also experiencing rapid growth in recent years, driven by its ambition to lead Europe's space endeavours by 2030. With a focus on small satellite innovation and production, and leveraging expertise in data analytics, Scotland aims to gain a significant share in the global space market. Despite potential competition from countries like Sweden and Belgium, Scotland's strengths in small satellite manufacturing and its environmentally conscious approach position it well for future growth.

Scotland could work with countries like Norway, Denmark, and Finland, who are trying to do similar activities in space and could also learn from Luxembourg and Israel in their approaches to exploiting space resources. Scotland faces gaps in strategic activities and resources for space resource utilisation and in comparison, to Luxembourg, and Israel. Also, Sweden, and Belgium would appear to be a future competitor in the small satellite manufacturing segment. In satellite launch activities, it will be competing with countries like Sweden and Luxembourg. In areas such as space tourism and satellite data processing based value added services, Scotland also faces competition from Sweden, Denmark, France, and Italy. However, applications in sectors like forestry and agriculture could provide rich application areas to exploit Scotland's position. While Scotland enjoys government support similar to countries like Sweden and Finland, it may be able to learn from Luxembourg's proactive regulatory approach, while acknowledging the UK government's role in this area.

Some of the actions to close the gaps with other nations may also include the following: initiatives for space resource utilisation and asteroid mining, fostering collaborative partnerships and incentivising innovation. Although, the UK national space strategy reflects intentions to develop activities in the emerging areas such as in-orbit servicing, in-space manufacturing and in-situ resource utilisation, other prospects for Scotland include developing long-term satellite manufacturing infrastructure and expertise, promoting international collaboration, exploring opportunities in space tourism and energy generation, encouraging entrepreneurship, and increased focus on data processing capabilities. Further, participating in regulatory framework development in the rapidly evolving space industry and exploring new business opportunities that may derive from that activity.

2. Future Opportunities and Vision within the Global Space Sector

The global space sector appears set for significant growth over the next 20 years, with numerous opportunities emerging. Space agencies such as NASA, ESA, ISRO, and private companies like SpaceX and Blue Origin are driving exploration, satellite deployment, and interplanetary missions, creating a favourable outlook for the industry.

The space sector is expected to witness substantial growth with opportunities in areas such as space tourism, commercial recovery of space resources, satellite manufacturing, and satellite launch. The global space economy is projected to expand, offering opportunities for private sector participation and technological advancements.

Growth Factors

The driving factors behind the growth of the global space sector include increased private sector participation, technological advancements, growing demand for space-related services, favourable policy changes, and the development of a robust regulatory framework. These factors are expected to contribute to the expansion of the global space economy and the emergence of new commercial opportunities.

Other factors affecting the growth of the space sector include collaborations between government agencies and private parties, the development of space parks as manufacturing hubs for space-related technology, and the potential for international collaborations. The talent and low-cost engineering mindset in certain countries are also identified as prime drivers of their emergence in the global space industry.

Upstream Commercial Opportunities

In the short term, upstream commercial opportunities include setting up ground stations for space craft, applications of space technology for upstream applications including materials manufacturing, processing, design of novel propulsion systems, reusable rockets for low-cost access to orbit, in-orbit servicing, and component manufacturing. The surge in demand for supplementary services is poised to increase the space economy, leading to more innovative startups and businesses entering the sector.

Long-term upstream commercial opportunities include satellite manufacturing, satellite launch, and the development of new technologies and services for satellite or space missions. In addition, other opportunities will arise from deep space explorations, advanced launch vehicle development, and space resource utilisation. The global space economy is projected to accelerate, offering substantial potential for private sector participation and collaboration with space agencies in other countries.

Downstream Commercial Opportunities

Short-term downstream commercial opportunities include areas such as data communication and cloud services, media and entertainment provision, and space-related tourism. The ease of doing business in the space sector is expected to increase, allowing for more SMEs and startups to enter the market and contribute to its growth.

In the long term, downstream commercial opportunities are expected to expand in areas such as, health and social care, climate change assessment and mitigation, disaster management, navigation, maritime, broadband and cloud services. In addition, a wide variety of public services can be improved, and even new public services may be enabled utilising the space-based data from satellites. Some of the examples include the traditional public services such as environmental monitoring, agriculture and food security, urban planning and smart city, natural resources management, transportation and logistics, crisis response and resilience. The development of a robust regulatory framework and schemes to promote ease of doing business for space technology are likely to further enhance these opportunities.

3. Scotland's Position in Space Sector and countries similar to Scotland

Scotland's space industry is rapidly growing, and it aims to become Europe's leading space nation by 2030, with a £4 billion share of the space market. The country has a long and successful history of manufacturing, particularly in electronics, aerospace, and oil and gas engineering, which are now contributing to its dynamic and fast-growing space sector. Scotland is already recognised as the largest producer of small satellites in Europe, and with five spaceports under construction, and two near completion, and is making significant headway in realising its ambition. Scotland's space strategy reflects focus on developing and strengthening world-class space infrastructure for manufacturing small satellites and launch facilities across coastal region, growing domestic and international customer base and utilising existing expertise in data analytics, and enhancing collaboration within UK, ESA and worldwide

The space sector in Scotland is expected to be a significant contributor of the country's economy, with the potential to become a huge economic driver. The sector's revenue currently accounts for 14% of the total UK space economy, and nearly a fifth of all jobs in the UK space sector are based in Scotland. The country's space sector is built on broad expertise and experience in various fields, including defence, electronics, photonics, aerospace, manufacturing, and engineering. Scotland's environmentally conscious approach to space aims to generate green and impactful jobs.

Countries Similar to Scotland with Comparable Space Programs

There are countries which share some similarities with Scotland in terms of their size, economic focus, as well as involvement and ambitions in the space sector, making them potential candidates for collaboration or competition in the global space industry. These include, Sweden, Luxembourg, Israel, Lithuania, and Belgium, along with Norway, Denmark, Finland, and others having similar ambitions and potential. Most of these countries have shown increased level of activities in similar periods between 2018 and 2022, with a national space strategy drafted or updates and ambitions declared. Some countries have even proposed and passed space-oriented laws recently.

A short review of the space strategy and activities of the above-mentioned nations is summarised in the *'endnote titled - Brief Notes on the Space Strategies of Various Countries'*. Information from these notes as well as from additional sources is used in the sections ahead to find the similarities, gaps and potential for a collaboration or competition for Scotland in the forward journey in commercial space sector. In comparison to the other mentioned countries, Scotland's focus on small satellite manufacturing, data analysis, and its ambitious growth plans, positions it as a significant player in the European space sector. Highlights of the specific features noted in the space programmes and national strategies of Scotland and similar countries are presented in Table-1 below.

Table-1: Program Highlights of Space Active Countries Similar to Scotland

Country	Population	GDP/capita (£)	Space Program Highlights
Scotland	5,436,600	34,457	Glasgow is small satellites manufacturing hub (more than anywhere in EU), space strategy launched 2021, space hub in Sutherland, SaxaVord spaceport in Shetland, plus three more. Small launch vehicle development. Earth Observation community. Environmental strategy for space industry, instruments for missions such as James Webb space telescope. International space advisory group. UK partner participation includes ESA, LISA and ExoMarse.
Sweden	10,327,589	43,656	Small satellite platforms, PRISMA satellites, and the contribution to various ESA missions, RIT project (Space for innovation and growth) for 8 years completed.
Luxembourg	650,000	104,299	Partner in first European spaceport, Arctic space centre and James Webb Space Telescope participation; 50+ companies and two public research organisations.
Lithuania	2,692,798	19,550	ESA business incubation centre established in 2022, LT space hub, several space startups established; NanoAvionics (small and micro spacecraft, including nanosatellites and CubeSats), Vilnius University Institute of Space and Earth Sciences.

Belgium	11,700,817	39,295	High-performance scientific and industrial fabric in the space sector, focusing on “small” missions and applications for public authorities and citizens.
Israel	9,760,640	32,131	Beresheet mission, Israel’s first lunar lander, expertise in Earth observation with satellites like Venus and TecSAR, Amal mission to Mars
Norway	5,367,580	72,996	Focus on the Arctic region and small satellite technology. Building the first launch base for satellites on the European continent at Andøya Spaceport. Establishing Arctic Space Center – innovation hub. Several companies and institutions in global space supply chain - Kongsberg Satellite Services. Partner in James Webb Space Telescope, the Copernicus Earth observation program, and the Galileo navigation system.
Denmark	5,932,654	53,411	Similar to Norway, partner in international space missions and projects; several institutions active in space supply chain.
New Zealand	5,133,820	38,501	Electron rocket (Rocket Lab), enhancing regulatory frameworks, swiftly gained prominence

4. Strategic position of selected Space-active countries

National space strategies of the Scotland, and other similar nations e.g. Sweden, Luxembourg, Israel, Lithuania, and Belgium, along with Norway, Denmark, Finland, was reviewed using published official strategies where available, plus other reports and articles reflecting the space policy as available in the public domain.

In the endnotes, cumulative information from various sources on the space strategies of individual countries is summarised for each country researched. Here, in the Table-2, a selection of some of the specific features of the space program is presented to help illustrate the comparative position of the countries.

Table-2: Position Comparison of Space Active Countries Similar to Scotland

Country	Upstream Commercial Elements	Downstream Commercial Elements	Global Supply Chain Relevance	Space Funding, and Organisations	Academic Strength, Excellence Areas
Scotland	Managed launch & orbital services, Potentially largest launch capability in Europe, Environmental sustainability strategy, satellite manufacturing & development	Emphasis on green technologies, Data analysis and research	multiple satellite and delivery vehicle manufacturing facilities and launch sites.	UK Space Agency and the Scottish government	Satellite technology, space engineering and astrophysics.
Sweden	Satellite manufacturing, launch services and systems, propulsion systems, space exploration technologies	Satellite data analysis, Earth observation applications and telecoms.	Saab and OHB Sweden are renowned for expertise in satellite manufacturing Espace Space Center (launch service)	Swedish National Space Agency, European Space Agency funds; both public and private.	Espace Space Center, KTH Royal Institute of Technology and Lund University, specialised programs in aerospace engineering and space science.
Luxembourg	Space resource utilisation and mining, satellite manufacturing	Satellite data analytics, Earth observation services, Telecoms	Favourable regulatory environment for space mining companies and hosts satellite operators like SES.	Luxembourg Space Agency, and the Luxembourg Future Fund, supporting startups and companies	University of Luxembourg and the Luxembourg Institute of Science and Technology space law, satellite comms, and space resource utilisation.

Israel	Satellite manufacturing & development, launch services, Space exploration technologies	Earth observation applications, Satellite comms, Space-based technologies, Commercial space industry collaboration	Israel Aerospace Industries and SpacEL expertise	Israel Space Agency, and the Ministry of Science & Technology, supporting R&D and commercialisation.	Technion – Israel Institute of Technology and the Weizmann Institute of Science. Aerospace engineering, astrophysics, and satellite comms.
Lithuania	Satellite manufacturing & development launch services	Earth observation applications, Satellite data analytics	International collaborator for satellite projects and applications	Lithuanian Space Association, and the European Space Agency	Vilnius University and Kaunas University, aerospace engineering, satellite technology, and space science.
Belgium	Satellite manufacturing & development Space exploration technologies, Launch services	Satellite data analysis, Earth observation applications	Thales Alenia Space Belgium, supporting satellite manufacturing, space research & exploration	Belgian Science Policy Office, and the European Space Agency	Université libre de Bruxelles, and the University of Liège. Aerospace engineering, astrophysics, and satellite comms.
Norway	Satellite manufacturing & development, Space research & development	Earth observation applications, Satellite data analysis	Hosts ground stations and satellite research facilities, supporting international space missions.	Norwegian Space Agency and the Research Council of Norway fundings for research, development, & commercialisation efforts	University of Oslo and the Norwegian University of Science and Technology

Denmark	Satellite manufacturing & development, launch services and systems	Earth observation applications, Satellite comms	Companies GomSpace and Terma, contributing to satellite development and space exploration	Danish Space Research Institute, and the European Space Agency fundings	Technical University of Denmark, University of Copenhagen, aerospace engineering, astrophysics, and satellite comms.
Finland	Satellite manufacturing & development, Space research & development	Earth observation applications, Satellite data analysis	Collaborates with international partners for satellite projects and applications.	Finnish Meteorological Institute and ESA grants, research, development, educational initiatives	Aalto University and the University of Helsinki, satellite technology space physics, and climate monitoring.

5. Scotland's relative position in comparison with similar countries

Scotland aims to become a leading European space nation by offering end-to-end satellite manufacture, launch and operational data analysis, with a focus on earth observation and environmental data. Almost one-fifth of all UK jobs in the space sector are based in Scotland. Further, Scotland has well known expertise for small satellite manufacturing and hosts the largest centre for informatics in Europe (Edinburgh Informatics Forum). Having noted that, EU nations and other countries also have strong relative positioning in space programmes and are evolving their ambitions. The current state of these countries in commercial space development is broadly comparable although not necessarily superior to Scotland. These countries were a few years ahead in designing and announcing their national space strategy in second half of the past decade, still the fact remains that Scotland appears to be ahead of those countries in certain segments, particularly in small satellite manufacturing. However, with the growing ambition of these European countries, and because many are already working collaboratively under ESA platform, it is likely that there could be significant competition among those countries and Scotland in future. Nonetheless, the strength of those countries suggests that there are opportunities for collaboration as well as prospects for exploring into those strategic areas not yet covered by Scotland. The brief below attempts to highlight such areas of potential.

Potential Competition

Sweden and Belgium may emerge as competitors for Scotland in the space sector. These countries have well-established aerospace and defence industries, with expertise in *satellite manufacturing, launch services, and space research*. Competition may arise in areas such as satellite deployment, commercial space missions, and attracting investment for space-related ventures.

Potential Collaboration

Norway, Denmark, and Finland could be potential collaborators for Scotland in the space sector. These countries share similarities in terms of technological advancements, research capabilities, and a *strategic focus on satellite technology and space exploration*. *Collaborative efforts could lead to joint satellite missions, research projects, and technology development initiatives*.

Luxembourg and Israel have some unique strengths and focus in the space sector compared to Scotland. Luxembourg is positioning itself as a leader in *space resource utilisation* and commercial space activities, whereas Israel is renowned for its innovation in satellite technology and space exploration missions. However, their priorities and approaches may differ from Scotland's objectives. *In this case, collaborative efforts could lead to exchange in those areas*.

Norway, Denmark, and Finland share commonalities with Scotland in terms of their *strategic emphasis on satellite technology, and collaboration with international partners*. These countries prioritise innovation, research, and investment in the space sector, aligning with Scotland's objectives in space-related activities. *Here, collaborative efforts could potentially be in promoting research exchange and innovative joint ventures in complementing supply chain*.

6. Potentially overlooked opportunities and gap areas

6.1 Upstream Activities

Major Gap Area

Scotland does not seem to have known strategic activities or dedicated resources in space resource utilisation and asteroid mining, where Luxembourg and Israel have made significant strides.

Minor Gap Area

Scotland currently holds a leading position and is further focussing at making small satellites, such as Spire and AAC Clyde Space with a reputation for agility and innovation. However, in Sweden, companies like Saab and OHB Sweden have been long established (1930s, and 2004) with diverse portfolio of products and services, including military aircraft, submarines, radars, and electronic warfare systems, satellite manufacturing, space systems, and related services with a strong reputation and collective experience and know how. Luxembourg, Israel, and Belgium are also good at making small satellites. For example, Luxembourg has SES, Israel has Israel Aerospace Industries, and Belgium has Thales Alenia Space Belgium

In satellite launch activities - Scotland might have to compete with countries like Sweden, which has the Esrange Space Centre and has been launching satellites since 1966. Since its creation, the space centre has expanded its capabilities to include satellite tracking, telemetry, and command services, as well as hosting ground stations for satellite communication and Earth observation Luxembourg, although not directly offering launch services, is positioning itself as a centre for space activities, including potential partnerships for satellite launches.

6.2 Downstream/Midstream Activities

Major Gap Area

In other activities, Scotland has not yet targeted opportunities in areas such as space tourism and space-based energy generation utilising space resources, while countries like Sweden and Denmark are actively pursuing such prospects and initiatives along with EU countries.

Minor Gap Area

Scotland is likely under-utilising its well-known capability and strength in data processing and analysis currently compared to countries in possible competition in this area in the EU (ESA countries: France, Sweden) and globally. The use of space data is a potential area of the space industry with one of the greatest levels of growth opportunity for Scotland. For example, ESA's Copernicus Land Monitoring Service program uses space data for land monitoring insights and other companies provide value added services based on Copernicus data. Some EU countries (France and Italy) have developed strong capabilities in providing value-added services based on satellite data. These countries offer specialized analytics, software platforms, and solutions tailored to specific industries or applications such as environmental monitoring, urban planning, policymaking, agriculture, and climate monitoring for example, The European Image Mosaic (EIM) product, a part of the Copernicus Land Monitoring Service, provides a comprehensive, seamless, and cloud-free mosaic of satellite images from across Europe. This visual representation serves as a powerful tool for developing a deeper

understanding of Europe's geography and landscape; and such data can be processed and used for value added services.

Scotland could further enhance collaborations with sectors such as agriculture, fishing, forestry, environmental monitoring, and developing other satellite-based application solutions. That being said, some recent startups, such as Trade in Space, have started exploring or developing activities in this area.

Learning from countries in the EU, as well as elsewhere (Israel, Australia), Scotland may look to exploit opportunities to foster more entrepreneurship and innovation in downstream space activities supporting startups and small businesses establishing a widening space supply chain within Scotland.

6.3 Other Areas

Regulatory Environment and Government Support

Scotland benefits from a supportive regulatory environment and government support for the space sector, similar to countries like Sweden, Norway, Denmark, and Finland. However, there may be learnings from Luxembourg – which has been particularly proactive in creating a favourable regulatory framework for commercial space activities and offering attractive incentives for companies to operate in the country.

Defence-enabled Space activity

While Scotland is rapidly growing its space industry, it does not appear to have leveraged the same advantages from aerospace and defence industries that countries like Sweden, Norway and Israel have, where technology transfer from these industries into the commercial sector is starting to be seen.

7. Suggested actions to close these gaps

Gap Area	Action
Upstream Activities	
Major Gap Area	<p>Explore the potential for initiatives for space resource utilisation and asteroid mining.</p> <p>Establish strategic objective and activities to foster partnerships and provide incentives for innovation and investment</p>
Minor Gap Area	<p>Enable infrastructure for advanced manufacturing and test of satellite equipment producers in view of long-term competition developing across the EU and worldwide.</p> <p>Explore actual potential for international collaboration and promote it</p>
Midstream/Downstream Activities	
Major Gap Area	<p>Explore Scottish potential and long-term opportunities in space resource and data uses for space tourism and space-based energy generation.</p> <p>Promote entrepreneurship and innovation activities and industry-academia collaborations</p>
Minor Gap Area	<p>Support data processing and analysis capabilities for applications, including the use of cyber security and artificial intelligence as differentiators.</p> <p>Study business models emerging worldwide and explore Scotland relevant prospective business models and opportunities for value added space data uses</p>
Other Areas	
Regulatory Environment	<p>Work with the UK and EU governments to initiate and accelerate regulatory framework for the emerging space industry in sync with the space industry growth.</p> <p>Introduce improvements in the licencing process to allow the sector to react and respond to the commercial opportunities created by the launch sector in Scotland. Review the number of launches allowed and potential for on-demand services.</p>

Space Industry Growth	<p>Explore space industry supported business and growth opportunities and establish programs to exploit the potential, possibly including a “space innovation hub” and impact acceleration activities.</p> <p>Make better use of existing facilities (Robotarium, NMIS, Universities)</p>
Parallel Technology Exploitation	<p>Harness Scotland’s strengths in photonics, laser communications, quantum communication and sensing, science missions, space robotics, cybersecurity, and life sciences for space industry with better coordination and communication.</p>
Defence and civilian balance	<p>Review the current defence and civilian exploitation of space sector in UK. Aim for the right balance of space funding and private investment. Identify opportunities to promote the mutual growth prospects including development of the supply chain.</p>

Brief notes on the space strategies of various countries

This end note includes a brief on space strategies of countries similar to Scotland, including space ambitions, upstream and downstream activities, defence interest in space and space clusters engagement presented for each country separately.

Country strategy summary - Sweden

Sweden's space activities began in the early 1970s with the establishment of the Swedish National Space Agency (SNSA), marking the inception of its formal space programme. Over the decades, Sweden has evolved into a significant player in the global space arena. The Swedish Space Corporation (SSC) has been instrumental in advancing the nation's capabilities, contributing to both civilian and defence-related initiatives.

Space Activities and Ambitions

Sweden's space activities span a wide spectrum, from satellite ground station services and launch services to data analytics. The SSC, a key player, is actively engaged in providing advanced space services and has joined the “Exponential Roadmap Initiative” to align its activities with sustainability goals. There is a commitment to leveraging space data for applications such as climate change monitoring.

Upstream Commercial Activities

The SSC is at the forefront of upstream commercial activities, providing spacecraft operations and engineering services for the international space market. With a focus on sustainability and climate integration, Sweden aims to expand its capabilities in the upstream sector, ensuring a robust presence in the evolving global space industry. Following are the major activities:

- **Satellite Manufacturing:** producing advanced satellite systems for various purposes, including communication, Earth observation, and scientific research.
- **Launch Services and Systems:** robust presence in the field of launch services, providing reliable and efficient launch systems for satellites. Companies like SSC (Swedish Space Corporation) offer launch services, including sounding rockets and satellite deployment.
- **Propulsion Systems:** engaged in the development and manufacturing of propulsion systems for satellites and launch vehicles.
- **Space Exploration Technologies:** investing in and developing technologies related to space exploration. This includes advancements in space propulsion, robotics, and other exploration-related capabilities.

Downstream Commercial Activities

In addition to upstream activities, the SSC is actively involved in downstream commercial services, particularly in data analytics. Future strategies involve further development and expansion of downstream services. Following are the major activities:

- **Satellite Data Analysis:** leverage satellite data for various analytical purposes, including environmental monitoring, climate studies, and resource management.
- **Earth Observation Applications:** monitoring and analysing changes in the Earth's surface, weather patterns, and natural phenomena for applications in agriculture, forestry, and environmental protection.
- **Telecommunications:** utilising satellite technology for communication services. This includes satellite-based internet services, broadcasting, and telecommunication infrastructure.
- **Space-Based Technologies:** include technologies derived from satellite data, such as navigation systems, remote sensing technologies, and global positioning systems.

Defence Interests in Space

Recognising the strategic importance of space in national defence, Sweden is actively pursuing a dedicated defence strategy for space. This involves enhancing military capabilities and strengthening national defence through space-related activities.

Space Clusters

Sweden has strategically positioned itself with the ESRANGE Space Center, situated above the Arctic Circle, owned, and operated by the SSC. This centre serves as a crucial hub for space activities, enabling regular contact with passing satellites. The ESRANGE Space Center, along with other space clusters like the Kiruna Space Campus and Stockholm Space Alliance, fosters collaboration, innovation, and research within the Sweden's space industry.

Country strategy summary – Luxembourg

Luxembourg has been actively involved in space activities since the 1980s, establishing a solid foundation for its space program. The nation's space sector has made significant contributions to its GDP, ranking among the highest in Europe. In 2018, Luxembourg intensified its commitment to space endeavours with the creation of the Luxembourg Space Agency (LSA), further solidifying its position as a key player in the global space community.

Space Activities and Ambitions

Luxembourg's space activities encompass a wide spectrum, ranging from satellite-telecom infrastructure to global communications and data traffic. The nation has pioneered advancements in TV and radio broadcasts and developed high-tech components for satellites, positioning itself as a hub for commercial space innovation. The SpaceResources.lu Initiative, launched in 2016, has reinforced Luxembourg's status as a leading commercial space innovator in Europe.

Upstream Commercial Activities

Luxembourg aims to create new space industries by nurturing entrepreneurial space research and business. It has recently implemented a legal framework and provides diverse financial tools, including tax incentives and direct aids, to support companies throughout their business lifecycle. Following are the major activities:

- **Space Resource Utilisation and Mining:** there is significant interest in space resource utilisation and mining. The country aims to be a leader in the exploration and extraction of valuable resources from asteroids and other celestial bodies.
- **Satellite Communications:** a strong presence in the satellite communications sector. The country supports companies engaged in satellite communications services, fostering advancements in satellite technology for global connectivity.
- **Satellite Manufacturing:** supports and invests in companies involved in the design and development of advanced satellite systems.

Downstream Commercial Activities

There is a concentration of dynamic space companies involved in manufacturing satellite and instrument structures, system integration of micro-satellites, electric propulsion, robotic payloads, in-space manufacturing, composites, RF payloads, and FPGA. The country has implemented a range of measures to support these highly innovative companies, ensuring a thriving ecosystem and addressing the diverse needs of the downstream space sector. Major activities include:

- **Satellite Data Analytics:** utilising satellite data for analytics, focusing on applications such as Earth observation, climate monitoring, and environmental assessments.
- **Earth Observation Services** includes applications in agriculture, forestry, urban planning, and environmental protection.
- **Telecommunications:** satellite-based telecommunications, supporting services such as satellite broadcasting, broadband, and other communication applications.

- **Space-Based Technologies:** promotes the development and application of space-based technologies, including navigation systems and remote sensing technologies for various industries.

Defence Interests in Space

Luxembourg positions itself as a European hub for commercial space activities, with the space and satellite sector accounting for almost 2% of the country's GDP. The government's efforts to establish Luxembourg as an attractive and vibrant ecosystem for space business are reflected in its growing economic importance. While not traditionally focused on defence-related activities, Luxembourg contributes to the European space landscape through its commitment to fostering a robust and sustainable space economy.

Space Clusters

Luxembourg is home to a thriving space industry, hosting over 50 companies and two public research organizations. The European Space Resources Innovation Centre (ESRIC) further cements Luxembourg's position as a hub for commercial space activities.

Country strategy summary – Lithuania

Lithuania's Space Journey

Lithuania has a remarkable potential in the space industry, with a history of involvement in space research and technology. The country has been participating in European and global space exploration for decades, and in 2014, Lithuania launched its first satellites, marking a significant milestone in its space endeavours.

Space Activities and Ambitions

Lithuania positions itself to play a pivotal role in the space technology revolution and is an Associate Member state of the European Space Agency. It has plans for a Business Incubation Centre showing the commitment to supporting space-related business ideas and commercial start-ups, highlighting the country's dedication to technological advancement and entrepreneurship in space.

Upstream Commercial Activities

Upstream commercial activities of the Lithuania space industry include the development of systems and elements for space shuttles, as well as participation in joint international projects. The country's future strategy involves furthering its involvement in international space programmes and expanding its role in the development of consumer applications for the space industry. Following are the major activities known:

- **Satellite Manufacturing and Development:** plans to contribute to satellite manufacturing through collaborative efforts with other European nations or private entities involved in satellite projects.
- **Launch Services:** does not have its own launch services but may collaborate with other countries or private entities that offer launch services for satellites.

Downstream Commercial Activities

Downstream commercial activities of the Lithuanian space industry encompass the launch of satellites, spaceflight experiments, and the establishment of a space business incubator to expand the range of space-related companies. Lithuania aims to more than double the number of companies participating in space supply chains within the next five years, indicating a strong focus on downstream commercial activities and future growth in this sector. Major activities are:

- **Earth Observation Applications:** for various applications, including environmental monitoring, agriculture, and land-use planning.
- **Satellite Data Analytics:** satellite data analytics, extracting valuable insights for applications such as climate studies and disaster management.

Defence Interests in Space

While specific details about Lithuania's defence interests in space are not readily available, the country's membership in the ESA indicates a commitment to contributing to peaceful applications of space technology. Lithuania is expected to play a role in various areas such as environmental

monitoring, climate change research, and telecommunications, aligning its space activities with broader European initiatives for the peaceful use of outer space.

Space Clusters

Lithuania is actively shaping its space ecosystem, fostering synergies with businesses and organizations outside the traditional space sector. Efforts are focused on encouraging the development of new space industries and expertise.

Country strategy summary – Belgium

Belgium's involvement in space activities spans over 40 years, highlighting a rich history in innovative space exploration. The establishment of the Belgian Space Office (BELSPO) in 1986 formalised the nation's commitment to space, bringing together a diverse cluster of space expertise, including notable entities like the satellite manufacturer Aerospacelab.

Space Activities and Ambitions

Belgium's space policy operates within an international framework, emphasising bilateral and multilateral cooperation. As the 5th largest contributor to the European Space Agency, Belgium actively participates in co-financed projects and strategic initiatives. The country's space policy is strategically aligned to stimulate projects close to commercial markets. The European Investment Bank has entered a deal with Belgium's southern region, Wallonia, to explore funding and advisory support for the space industry. This partnership aims to support the growth of the space economy and develop the region's aerospace cluster, including co-financing opportunities.

Upstream Commercial Activities

Belgium aims to mobilise investment to maintain a central position in space exploration. The nation's future strategy focuses on encouraging the development of key skills and expertise, creating new space industries, and nurturing entrepreneurial space research and business. This forward-looking approach is aimed at ensuring that all stakeholders, including industrial, scientific players, and users, can fully benefit from the advantages of space, reinforcing Belgium's position as a key player in the global space arena. Major upstream activities are:

- **Satellite Manufacturing and Development:** contribute to satellite manufacturing through its involvement in collaborative projects within the European context.
- **Space Exploration Technologies:** space exploration technologies, contributing expertise and resources to collaborative space exploration missions.

Downstream Commercial Activities

Investments in space research programs have not only led to scientific advancements but also provided significant fiscal returns and job creation in the broader economy. Major activities include:

- **Satellite Data Analysis:** utilises satellite data for various downstream applications, including Earth observation and data analysis for environmental monitoring, climate studies, and urban planning.
- **Earth Observation Applications:** provide valuable data for agriculture, forestry, disaster management, and other purposes.
- **Telecommunications:** supporting services such as satellite broadcasting, broadband, and communication technologies.

Defence Interests in Space

While specific details about Belgium's defence interests in space are not explicitly outlined, the strategic considerations and priority areas in its space policy indicate a broader focus on security and

defence in space. Belgium's alignment with ESA's objectives and its active participation in multilateral space initiatives contribute to the broader European efforts to ensure the security and resilience of space assets.

Space Clusters

Belgium's thriving space industry is supported by a robust cluster of space expertise that has evolved over the years. These space clusters have served as catalysts for collaboration, innovation, and knowledge exchange, reinforcing Belgium's role as a central hub in the European space community.

Country strategy summary – Israel

Israel's ventured into space in 1983 with the establishment of the Israel Space Agency (ISA). Over four decades, Israel has built a robust space infrastructure, with a focus on satellite development, communication services, and remote sensing.

Space Activities and Ambitions

Israel's space strategy is aimed at capturing 1% of the global market share, emphasising economic growth, scientific advancement, and enhanced international status. The ISA leads the charge, promoting innovation, supporting new space-related projects, and strengthening the civilian space industry as a sustainable growth engine. Israel's ambitions in space extend beyond national borders, aiming to position the country as a global leader in the space industry.

Upstream Commercial Activities

Israel's future strategy is geared towards cultivating a vibrant space ecosystem that nurtures entrepreneurial space research and business. The private space sector in Israel is actively developing diverse technologies with global applications. The country aims to scale its capabilities, becoming a significant player in the international space market. Activities include:

- **Satellite Manufacturing and Development:** there is a robust satellite manufacturing and development sector. Companies like Israel Aerospace Industries (IAI) and Rafael Advanced Defence Systems are actively involved in producing satellites for various purposes, including communication, Earth observation, and military applications.
- **Launch Services:** Israel has developed its launch capabilities through entities like the Israel Space Agency (ISA) and private companies like Spacell. The Shavit launch vehicle has been used for satellite launches.
- **Space Exploration Technologies:** active in developing space exploration technologies, including unmanned lunar exploration missions. Notably, Spacell's Beresheet mission aimed to land an Israeli spacecraft on the Moon.
- **Research and Development** invests in research and development in space-related technologies, contributing to upstream elements that drive innovation in satellite systems, propulsion, and other space technologies.

Downstream Commercial Activities

Israel's private space sector is actively engaged in satellite development and operation, communication services, remote sensing, and other space-based applications. The emphasis is on developing technologies with diverse applications across industries to attract international customers and investors. Following are the major activities known:

- **Earth Observation Applications:** including monitoring environmental changes, agriculture, water resources, and disaster management.
- **Satellite Data Analytics:** satellite data analytics for various purposes, such as extracting insights for agriculture, urban planning, and environmental monitoring.

- **Satellite Communications:** actively engaged in satellite communications, providing satellite-based communication services, broadband, and telecommunication infrastructure.
- **Space-Based Technologies:** application of space-based technologies to various downstream areas, including navigation systems, remote sensing technologies, and global positioning systems.
- **Commercial Space Industry Collaboration:** Israel collaborates with private companies involved in downstream activities in telecommunications, Earth observation, and other applications.

Defence Interests in Space

While specific details about Israel's defence interests in space are not explicitly outlined, the strategic investments in the civilian space industry are anticipated to have broader implications for national defence and security capabilities.

Space Clusters

Israel's space industry is characterized by a robust private sector actively involved in all aspects of space planning, development, and operation. The country has established cooperation agreements with international space agencies.

Country strategy summary – Norway

Norway commenced its venture into space during the 1960s. The Norwegian Space Agency (NOSA) was formally established in 1987. Over decades, Norway has evolved into a key player in the global space community. In 2020, the country adopted a new national space strategy, emphasising its dedication to the space industry and its potential contributions to economic growth and scientific research.

Space Activities and Ambitions

Norway's space activities are inspired by the ambition of becoming a leading player in the global space industry. The country aims to leverage its space capabilities for economic growth, scientific advancement, and enhancing its international status. Norway's space efforts also focus on addressing communication, navigation, surveillance, and preparedness needs in the “High North.”

Upstream Commercial Activities

Norway's future strategy involves cultivating a vibrant space ecosystem that supports entrepreneurial space research and business. The country's space industry, characterized by a robust private sector actively involved in all stages of planning, development, and operation, is integral to this strategy. The Norwegian government expresses its ambition to develop Norway into a space nation capable of supporting national defence, aligning space activities with broader strategic interests. Activities include:

- **Satellite Manufacturing and Development:** contribute to collaborative satellite projects within the ESA or other international frameworks. Norway does not have an extensive independent satellite manufacturing sector so far.
- **Space Research and Development:** Norway invests in research and development in space-related technologies, contributing to upstream elements that drive innovation in satellite systems, space exploration technologies, and scientific instruments.

Downstream Commercial Activities

Downstream, Norway's commercial activities revolve around satellite-based systems addressing communication, navigation, surveillance, and preparedness needs in the High North. The country's space industry is poised to significantly contribute to economic growth and job creation. Following are the major activities known:

- **Earth Observation Applications:** Norway utilises satellite data for Earth observation applications, including monitoring environmental changes, climate studies, and contributions to international Earth observation programs.
- **Satellite Data Analytics:** Norwegian companies and research institutions engage in downstream activities related to satellite data analytics. This involves extracting insights for environmental monitoring, maritime surveillance, and resource management.
- **Space-Based Technologies:** application of space-based technologies to various downstream applications, including navigation systems, remote sensing technologies, and global positioning systems.

Defence Interests in Space

Norway's strategic investments in the civilian space industry extend to broader implications for defence and security capabilities. The integration of space technologies into Norway's defence framework aligns with the broader national strategy.

Space Clusters

Norway's space industry works along with key organizations like Space Norway, responsible for managing and developing strategic space infrastructure to address crucial societal needs.

Country strategy summary – Denmark

Denmark's space interest and activities have evolved significantly in recent years, marked by a strategic focus on the commercial utilisation of space. The European Space Agency Business Incubation Centre (ESA BIC Denmark) was hosted in Denmark to bolster commercial space endeavours. Denmark has commitment to leveraging space for multiple societal benefits.

Space Activities and Ambitions

Denmark's space activities are driven by an ambition to exploit the commercial utilisation of space. The country aims to accelerate innovation and entrepreneurial space endeavours, positioning itself as a formidable player in the global space industry. The national space strategy emphasises the dual goal of economic growth and scientific advancement through strategic international collaborations.

Upstream Commercial Activities

Denmark's future strategy revolves around actively supporting new and established Danish companies in their commercial space pursuits. The nation is dedicated to cultivating a vibrant space ecosystem that encourages the development of crucial skills and expertise. Denmark's aspirations include solidifying its position as a hub for commercial space innovation, fostering a dynamic environment for space-related businesses to thrive. Activities include:

- **Satellite Manufacturing and Development:** Denmark does not have an extensive independent satellite manufacturing sector, although Danish institutions and companies participate in the development of satellite technologies in collaboration with European space agency and partners.
- **Space Research and Development:** Denmark invests in research and development in space-related technologies, contributing to upstream elements that support innovation in satellite systems, scientific instruments, and space exploration technologies.

Downstream Commercial Activities

Denmark's focus is on supporting the development of novel space industries and expertise. The nation is committed to nurturing entrepreneurial space research and business. Denmark's dedication to downstream activities aligns with its comprehensive strategy to capitalize on the full spectrum of opportunities in the evolving space sector. Activities include:

- **Earth Observation Applications:** Denmark utilises satellite data for Earth observation applications, contributing to environmental monitoring, agricultural assessments, and climate studies.
- **Satellite Data Analytics:** Danish companies and research institutions engage in downstream activities related to satellite data analytics such as extracting insights for environmental monitoring, urban planning, and resource management.
- **Space-Based Technologies:** application to various downstream areas, including navigation systems, remote sensing technologies, and global positioning systems.

Defence Interests in Space

Specific details about Denmark's defence interests in space are not readily available, the country's strategic investments in commercial space exploitation are anticipated to have wider implications for defence and security capabilities.

Space Clusters

Denmark's space industry thrives with the support of the European Space Agency Business Incubation Centre (ESA BIC Denmark), a key player in fostering innovation and supporting the growth of new space industries.

Country strategy summary – Finland

Finland initiated its space program in the 1980s, and the national space strategy underwent a transformative update in 2018, aligning with the New Space Economy's principles. This strategic overhaul focused on the emergence of small satellites and globally scalable business models. The Finnish Space Agency (FINSA), established in 2018, encapsulates Finland's commitment to staying internationally competitive in the evolving space industry.

Space Activities and Ambitions

Finland has ambition to become the world's most attractive and agile space business environment by 2025. The national space strategy, overseen by the Space Committee, guides Finland's direction, emphasising market access requirements, international influence, and research. The country aspires to leverage its competence to benefit companies, fostering efficiency, innovation, and economic growth on a global scale.

Upstream Commercial Activities

Finland's future strategy revolves around setting ambitious targets, aiming to secure a prominent position in the global space industry. The country envisions achieving these goals by actively supporting the development of new space industries and expertise. Following are the major space activities:

- **Satellite Manufacturing and Development:** Finland contribute to collaborative satellite projects within the ESA or other international partnerships. Finnish companies and institutions may participate in the development of satellite technologies.
- **Space Research and Development:** Finland invests in research and development in space-related technologies, supporting innovation in satellite systems, scientific instruments, and space exploration technologies.

Downstream Commercial Activities

There is commitment to nurturing entrepreneurial space research and business, with ambition to establish Finland as a leading player in the global space market. The strategic approach involves leveraging space-based applications for societal and economic benefits, positioning Finland as a pivotal player in the evolving space landscape. Major activities include:

- **Earth Observation Applications:** Finland uses satellite data for Earth observation applications, contributing to environmental monitoring, forestry, agriculture, and climate studies.
- **Satellite Data Analytics:** Finnish companies and research institutions may engage in downstream activities related to satellite data analytics.
- **Space-Based Technologies:** Finland applies space-based technologies to various downstream applications, including navigation systems, remote sensing technologies, and global positioning systems.

Defence Interests in Space

Specific details about Finland's defence interests in space are not available.

Space Clusters

Finland's space industry thrives within collaborative clusters, supported by the national space strategy. The strategy aims to create a vibrant and innovative space sector.

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