# North Highland and Moray Space Cluster Strategy Appendix 2

Cluster Development Analysis

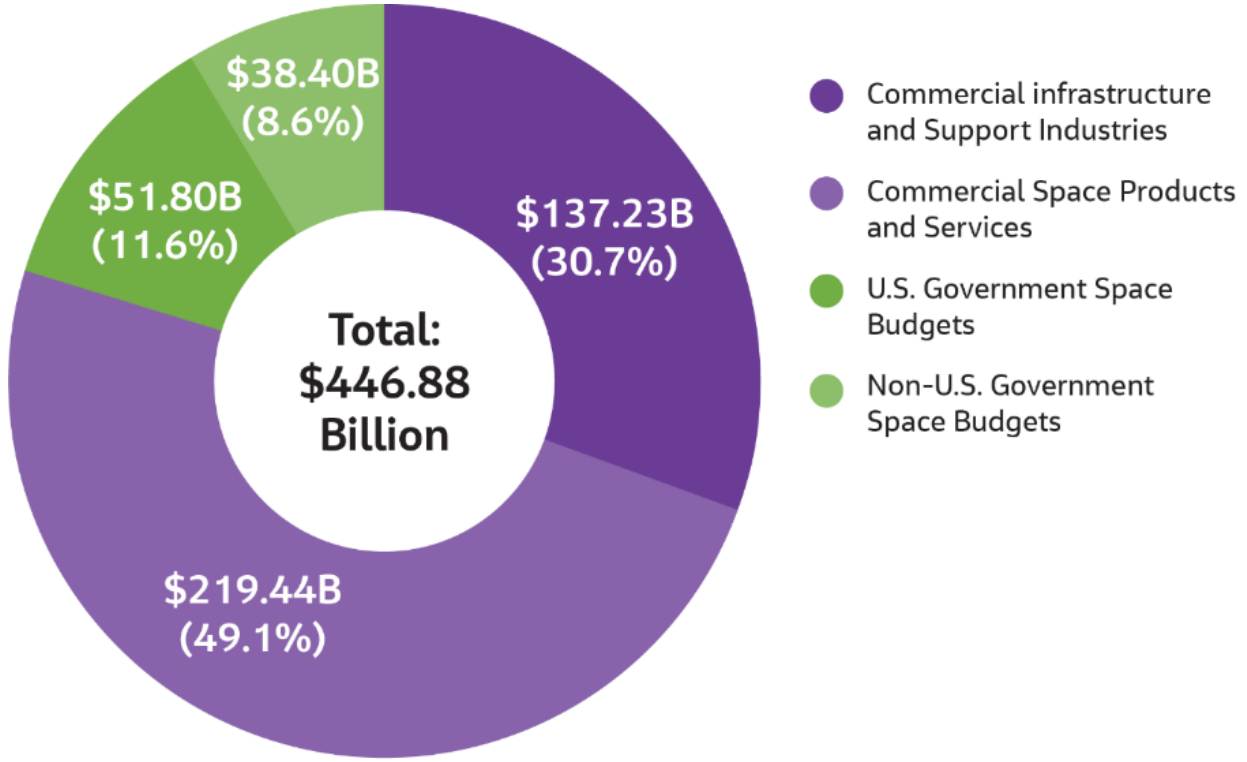
September 2021

# Part 1: Space - The Economic Opportunity

# The Global Opportunity

Demand is surging for constellations of small satellites in Low Earth Orbit, developing, and in some cases replacing, market opportunities associated with the large, more expensive Geosynchronous Orbit satellites that were the foundation for the first wave of commercial space activity.

New models of funding are arising including billions of pounds from equity funding, upending the traditional processes of both the commercial sector and government space programmes although the sustainability of these new funding approaches remains to be determined.




*Source: Space Foundation database*

**Global Space Investment Budget 2021, USD**

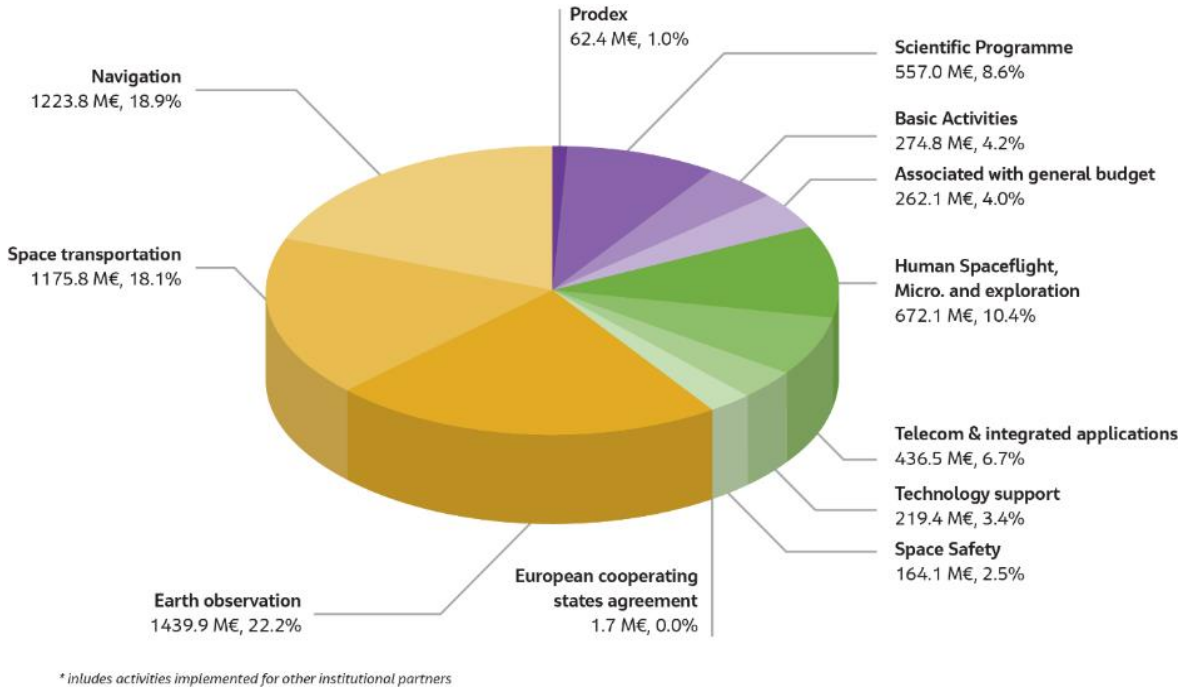
# Size and Growth of the Global Space Economy

Over the past decade, the space economy, incorporating both commercial space activity as well as government spending by spacefaring nations, has grown at an average annual rate of approximately 7% to reach a total of nearly $447 billion in 2020. Commercial activity constituted 79.8% of the total in 2020, . Within the commercial sector, most of the revenue is derived from direct-to-home satellite television, an industry whose growth has slowed in recent years. Telecommunication operators have diversified into provision of internet and other data services via satellite.

In Europe, the top four programmes funded through the European Space Agency (ESA) are Earth Observation, Space Transportation, Navigation (primarily paid for by the EU), and Human and Robotic Exploration. At the 2019 ESA Ministerial Council, the UK Government committed to contribute £374 million annually to ESA over the next five years. although most of the funding is committed to a single project — development of the Ariane 6 launch vehicle.

As an enabler for all other space activities, the orbital launch industry has been the focus of a great deal of attention in recent years. Many nations (and multinational organisations such as ESA) are aware that reliable and frequent access to space is essential if there is going to be a sustained expansion of commercial activities in space, and they are investing accordingly. This is one of the reasons why the Space Transportation line in ESA's budget is so large, although most of the funding is committed to a single project — development of the Ariane 6 launch vehicle.

To support launch vehicles, a range of locations across the globe are being considered for spaceports. Despite the ultimate goal of stimulating commercial space activity, these spaceports are rarely approached as commercial developments but are generally seen as a government infrastructure investment. In many cases, funding is provided both by a national government and the local or regional government where the proposed spaceport is located.




**Global Space Activity in 2020 [Source: Space Foundation Database]**

# Private Investment in Space

In the past decade, there has been a surge of investor interest in space, with a dramatic increase starting in 2015. Nearly $31 billion has been invested in more than 400 space infrastructure companies by non-government sources of capital since 2009, and a new annual record of $8.9 billion was set in 2020. Of the total funds committed by non-government sources in the past decade, 64% has flowed to US companies, followed by UK companies at 15%.

The influx of capital has changed the relationship between different actors in the space industry with many organizations' moving from being the sole funder or customer for their contractors to one of many customers.

Other emerging sectors such as private space stations, manufacturing in space, private exploration, and space resource harvesting have generated a substantial amount of hype but to date have attracted little capital. Another element that is often overlooked is that major space companies are still often dependent on government contracts. For example, SpaceX has received more than $6.7 billion in private investment and more than $9.2 billion in contracts and grants from the US government. SpaceX also generates revenue from launches for commercial customers, but external investment (whether from government or private sources) remains critical for the company's survival and its development of new hardware.

A further challenge facing the space industry is that the sources of private capital are not very diverse with the majority from government funding and venture capital. As a source of funding, government processes tend to be slow and bureaucratic to ensure public resources are managed prudently, whereas venture capital firms tend to expect speed and offer limited oversight of the technology development in order to rapidly generate returns for their investors. Governments have consciously supported the growth of space start-ups, including through direct and indirect investment in incubators and accelerators, the most notable of which are the ESA Business Incubation Centres. Unfortunately, many of the businesses that emerge from these programmes fail to secure the additional investment or sales revenue that would enable them to thrive, resulting in their disappearance after a few years. Managing the transition from incubators to operational status remains a challenge worldwide, and not just for the space industry.

The Venture Capital (VC) system is designed to rapidly scale a product or service to capture a large market share and exit by means of a merger and acquisition (M&A) transaction or an initial public offering (IPO). While this has the potential to accelerate product development, the VCs may suddenly pull the plug on a start-up company if they do not see a sufficiently rewarding M&A or IPO in the near future. The best-case scenario is usually M&A executed by a traditional government space contractor. Ultimately, the VC system is not currently designed to reward companies that grow steadily and constantly produce innovation over time, which has unfortunate implications for the future of the space sector.

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# Forecasts of Economic Value

As a relatively young economic sector, there are many different forecasts for growth of the space industry. To achieve a space economy size of $926 billion to $2.7 trillion (by 2040 or 2045, depending on the forecast) requires a compound annual growth rate of between 4.5% to 7.5% before inflation is factored in. While this is a respectable rate for some investors, it does not meet the criteria of others such as VC firms who are looking for returns of at least ten times their initial investment.

The value of space extends beyond the revenue generated by the industry itself and existing economic models find this difficult to capture. For example, Global Positioning System (GPS) is estimated to have produced a cumulative private-sector benefit of approximately $1.4 trillion for the United States alone from 1984 through 2017 (with most of the benefits accruing in the last decade of that period). To ensure that stakeholders and potential funders are able to make informed decisions on how to manage their resources and policies the space sector needs to develop a more comprehensive and integrated approach to estimating its direct value and how it supports wider value creation through the services and products that it enables across society.

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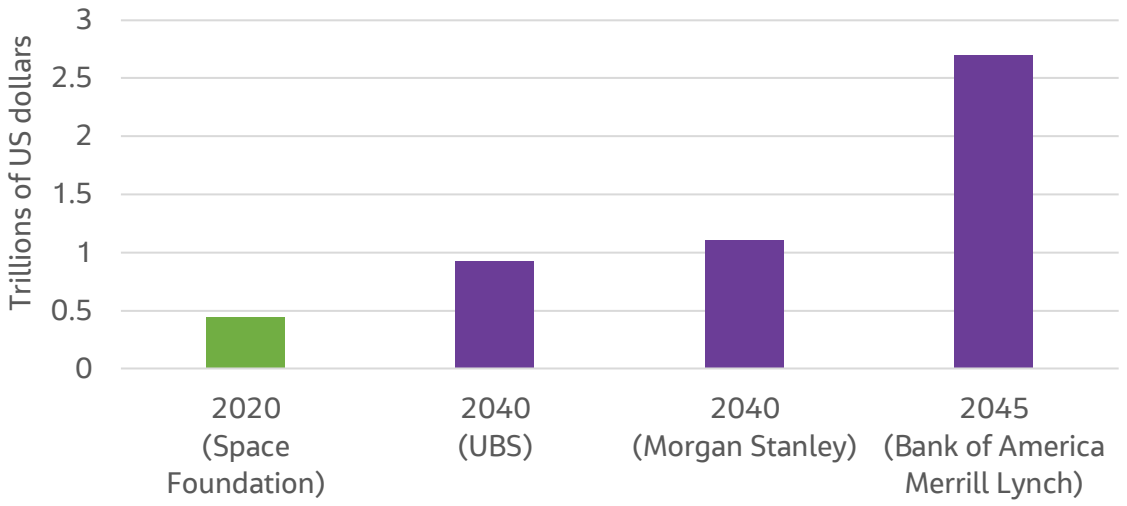

# Launch Activity Growth

Supporting the steady increases in traditional launches, advances in technology combined with lower launch costs have led to a boom in nanosatellites (spacecraft weighing 10kg or less) and small satellites being launched. By April 2021, more than 4,000 active satellites were in orbit, having nearly doubled from 2,200 in December 2019[1] and operators of global spanning communications networks have ambitions to launch constellations that will require tens of thousands more. The parallel trends of demand for small satellites and an increase in launch activity bode well for the emerging small-satellite launch industry. These satellites currently reach orbit either through ride-sharing on a large launch vehicle or through dedicated services provided by relatively inexpensive small vehicles.

In 2019, there were more than 70 small launch vehicles (those capable of carrying a maximum of 1000kgs to Low Earth Orbit) that were either operational or in development, mostly the latter. These efforts were spread across 15 nations or multinational partnerships, highlighting the global competition for the small-satellite launch market.
Launch vehicles require a spaceport that can accommodate the unique needs of small launch vehicle operators and their customers. In 2019, there were 40 active spaceports with 10 more in development and a further 13 in proposal stage.
In the case of both small-satellite launch vehicles and spaceports, the general expectation is that many will prove not to be economically viable in the long term. As with other emerging industries, there will likely be a first-mover advantage that enables some participants to take a commanding lead, and there is now a global race to secure that position.

In this respect, the UK is positioned well, with space legislation in place, a regulatory framework being formulated, two launch sites funded for development, and commitments from three launch operators. Space Hub Sutherland is in a particularly good state, with two launch operators developing vehicles specifically with the spaceport in mind, and the capacity to bring in additional operators.

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# The Opportunity for the UK

The UK is well positioned to take advantage of the economic opportunities presented by the emerging new era of space activity. The UK's existing space sector is vibrant and healthy with existing clusters in the Midlands of England and the Scottish Central Belt.  However, the lack of a National Space Strategy, may lead to missed opportunities. The transfer of responsibilities to from UKSA to BEIS has been interpreted as a positive step in some quarters in encouraging the Space Sector to be more commercially minded.

To better plan for cross-sector synergies and taking a holistic view of the opportunities for economic development, ideally a National Space Strategy would mesh into a National High-Tech Strategy and similar strategies in other strategic sectors.

# The Opportunity for Scotland

The development of Space Hub Sutherland is a natural addition to the portfolio of space activities already present in Scotland, offering customers a complete value chain from design and manufacture to launch and operation of satellites. According to Size & Health of the UK Space Industry 2018, the latest in a series of reports periodically commissioned by the UK Space Agency, more small satellites are built in Glasgow than any other place in Europe, and 18% of all UK space jobs are based in Scotland.

That translates to more than 7,500 Scottish space jobs, distributed amongst more than 130 space organisations. Of these organisations, 83 are headquartered in Scotland and generate a combined income of £140 million, or 0.9% of total income generated by UK space organisations in 2016/17.

The disparity between Scotland's 18% share of UK space employment and its 0.9% share of UK space income is due in part to the report's methodology, which attributes all of a company's income to the region where it is headquartered. Given that the UK space industry is heavily concentrated, with 13 organisations accounting for 83% of income and the remainder being split amongst 935 smaller organisations, it is not surprising that a large proportion of Scotland's space workforce is employed by large organisations headquartered elsewhere.

Looking across the entirety of the Scottish space sector, the value in 2017 was estimated to be £2.5 billion, and there are ambitions to grow to £4 billion per year by 2030.

# Part 2: Space Sector Needs

# Jargon-busting: Cluster, Ecosystems & Hubs

Three key terms are worth definition at this point: **Cluster**; **Ecosystem** – and **Hub**.

A **cluster** is the "concentration of specialized industries in particular localities" benefitting from 'economies of scale', such as a shared supply chain (of both services *and* skills) and advantages of co-location such as efficient (i.e. easier) sharing of ideas and collaboration on higher risk, innovative projects. This leads to more efficient development and production of new products – particularly in new and innovative sectors. Simply, the more dense the "concentration" of businesses in a given sector in a given area, known as "agglomeration" in economics theory, the more productive, competitive and successful those business are likely to be, and the greater the benefits for the local economy.

**The Ecosystem** is the wider network in which the cluster forms. This includes:

- The non-sector specific supply chain – general services such as business services and facilities management;
- The regulatory and legal environment that can either enable or hinder the development of new products;
- The network of state support to provide the start-up funding, capacity building, business skills development that the market will not – due to perceptions of risk, lack of understanding of the opportunities, or where (simply) no single firm can make a profit;
- The supply of private finance, in particular Venture Capital (VC), to fund the start-up and scale-up individual businesses.

A **Hub** is a *physical space* provided for innovative firms to operate on flexible, lower cost terms and co-locate with similar innovative firms. Hubs both help to lower the "barriers to entry" for new companies by reducing the cost of starting up and provide a platform for collaboration with other innovative firms. An example of this would be the Horizon Scotland hub on the Enterprise Park in Forres. A hub is an *enabler* of a cluster, and – along with anchor businesses – a potential nucleus.

Other key means of support of innovative firms, and the promotion of clustering include:

- **Incubators** – physical workspaces specifically designed to nurture the most innovative firms at their very earliest stages, such as the ESA business incubation Centres [citation], and;
- **Accelerator** programmes, which provide intensive business support – in particular how to access finance - when these firms are ready to make the leap to operating and producing at scale.

# Anatomy of the space sector – the three streams

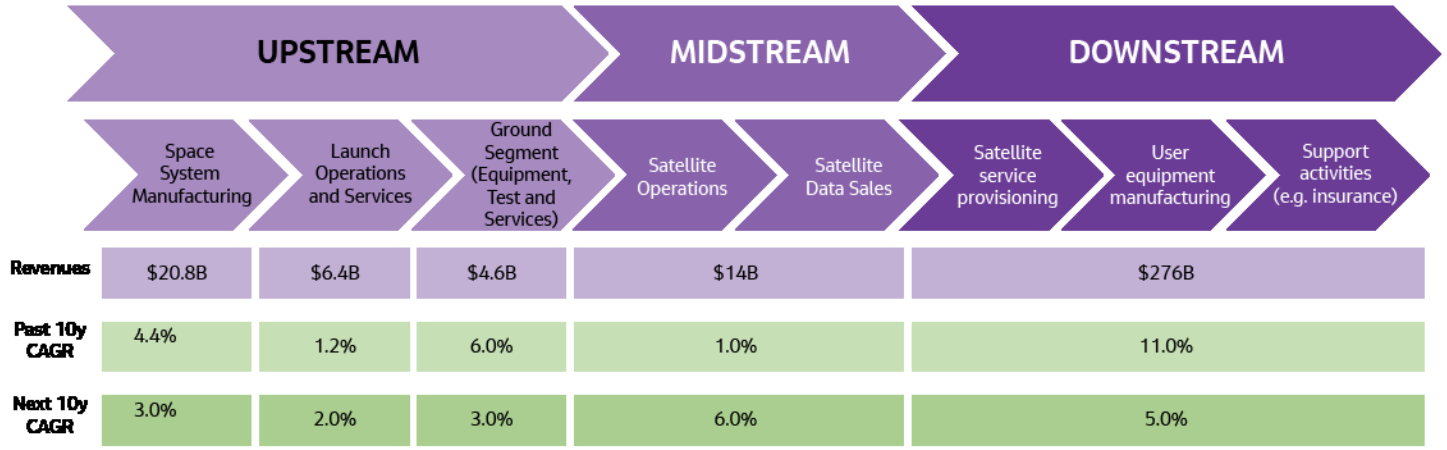
To understand the needs of the space sector, and how North Highland and Moray can seize its opportunities, it's useful to first define a model of the space industry.

Space benefits a rapidly evolving and disruptive industry, there are a number of different models in use to understand the structure of the global space sector. For clarity, this strategy and the action plan that underpins it is based on a three-stage model of the space value chain .

This model comprises three supply chain "segments" – Upstream, Midstream and Downstream. Firms in each of these segments play a role in ultimately supplying goods and services to consumers. This is illustrated in figure x below.

It should be noted that many firms will operate "horizontally" across sectors - and will supply space and other innovative / high tech sectors in particular aviation, defence and telecommunications.

**Global Space Market Revenues 2018 ($ Billion) and CAGR (%)**




*Source: Euroconsult Report 2019, SpaceTec Partners Analysis*

# The Space Supply Chain

# Upstream

The first stage in the space supply chain is the **Upstream** segment – often termed "space manufacturing". This segment involves the development and manufacture of software, components and Original Equipment for launch vehicles and satellites. This also includes supply and operation of ground-based facilities required for launch and establishment of the assets in space, such as space launch facilities (range control) and mission control. In terms of value, the upstream sector accounts for 10-20% of the potential space market.

The development of Space Hub Sutherland and the vehicle assembly, engine testing and mission control centre at Forres means that the upstream sector is a particular opportunity for North Highland and Moray. While space launch makes up only a small proportion of the total space market, the **upstream** sector and space launch is particular focus of this strategy and action plan.

For this strategy, we have defined the needs of the **Upstream** segment as follows. This has been used for the Gap Analysis in Part 4.

### Orbit heights and launch weights

The space launch sector accounts for just over 1% of the total value of the global space market. The iconic power of space launch and the power of a spaceport to act as a nucleus of a space cluster should not be underestimated. Space launch is grouped into two types – vertical and horizontal launch.

Vertical launch is the established means of launching satellites and assets into orbit – and is exemplified by the SpaceX falcon 9 and Rocketlab's Electron launch vehicle. Horizontal launch is more experimental, with a number of experimental systems under development, including the Virgin Galactic system.

***insert orbex launch classification***

The upstream sector accounts for 10-20% of the potential space market

| Sub-segment | Supplier category |
|---|---|
| Space Systems Manufacturing | R&D – aerospace |
| | R&D - all sectors |
| | Advanced Engineering – aerospace |
| | Advanced Manufacturing – aerospace |
| | Advanced Engineering - all sectors |
| | Advanced Manufacturing - all sectors |
| Launch Operations | Propellant (gases) manufacture & processing |
| | Launch & Range Control |
| | Airport Services |
| | Specialist Logistics |
| | Payload integration |
| | Business services – insurance, HR and accountancy |
| | Tourism & hospitality |
| | General site services |
| Ground Systems | Ground Stations (data download and transmission) |
| | Mission Control |

# Midstream

In terms of the value, the Midstream segment currently accounts for 5-10% of the potential space market. The Midstream is less dependent on close physical proximity to space manufacturing and launch facilities than the upstream, but the skill sets, and supply inputs are common to both segments, meaning that a midstream cluster is more likely to form around a focus of existing upstream activity.

As Low Earth Orbit (LEO) becomes increasingly congested with constellation satellites, the risk of collisions with space debris increases and the technology for the maneuver of micro satellites in space improves, the active management of assets in space – otherwise known as "space situational awareness" is expected to grow. Along with the transfer of "raw" space data to earth via ground stations and its intermediary storage in data centres, this comprises the Midstream segment in the space value chain.

For this strategy, we have defined the needs of the Midstream segment as follows. This has been used for the Gap Analysis in Part 4.

The Midstream segment currently accounts for 5-10% of the potential space market

| Sub-segment | Supplier category |
|---|---|
| Ground Systems | Ground stations (near earth observation and data download) |
| | Data Centres |

# Downstream

By far the largest and most valuable stage in the space supply chain is the "downstream" segment. This involves the processing (adding value to) data collected in space and sale to end consumers, and the development and manufacture of equipment and provision of ancillary services for the application of space data. Together, provision of these services and develop and manufacture of equipment account for 70-85% of the total space market.

This includes firms engaged in the supply of:

- Satellite navigation services
- Direct to The Home (DTTH) broadcasting services;
- Meteorology and climate services;
- Other earth observation services – including land use monitoring and asset management;
- Satellite internet

With the growth of constellation satellites – such as the Anglo-Indian OneWeb, the US StarLink and Amazon networks, and the Canadian Telsat, the consumer market for satellite internet services is expected to grow significantly over coming years.

While the greatest economic opportunities are concentrated in the downstream segment, these industries are far more mobile and globalised – and can be located anywhere in the world, wherever the comparative advantage (costs, ease of trade and business operations) dictates that it is most economic for the firms to do so.

The Upstream segment currently accounts for 70-85% of the total space market

| Sub-segment | Supplier category |
|---|---|
| Downstream applications | Satellite data processing |
| | Satellite data applications: R&D |
| | Satellite data applications: manufacturing |
| | Telecoms & media - any |
| | Earth Observation (EO) - any |
| | Satellite navigation - any |

# Skills for Space

# Skills

The space sector employs the most highly educated workforce of any sector in the UK with three quarters of employees holding at least a primary degree. The UK Government has announced ambitions for 119,100 people to be working in the space sector by 2030. In 2019, some 45,100 people were already doing so. Scotland accounts for 17% of space sector employees (around 7,650 jobs) and is home to 173 space organisations including 96 space sector company head offices.

Over half of space companies across the UK (54%) are expecting to employ more staff in the coming three years. As with any rapidly developing sector, there are challenges in ensuring that a suitable set of skilled individuals are readily available to meet the demand arising from companies. According to the UKSA Space Skills Survey 2020 Report, around two-thirds of space sector companies reported difficulty in recruiting into their company with more of a challenge identifying people with specialist space skills. The lack of a single focus for training and development at under-graduate level and above as the types of jobs required are so niche makes it particularly challenging to develop space skills quickly.
Key reasons for recruitment difficulties in the sector (given in descending order of reported importance as reported by space companies) are:

- A lack of experience within the space sector
- A lack of specialist skills, knowledge or qualifications
- Challenges in attracting European candidates post Brexit (likely to be exacerbated by the global Covid pandemic)
- Perceived competition attracting talent both from other sectors and within the space sector
- Challenges to attract people to work in the locations where space sector companies are located
- A lack of appropriate specialist training provided by UK educational institutions
- Perceptions of uncompetitive pay or conditions
- Shortfall of interest from young people in technology/science/engineering and maths
- Perceptions of applicants lacking required behaviours, attitude, motivation or personality

Another pressing challenge for the space sector is to ensure diversity of staff to maximise productivity within the sector.  The industry hires people from across the world, particularly from Europe, providing a depth of knowledge and cultural sharing and ensuring efficient engagement with international partners and clients. There is no reported under-representation of minority ethnic groups within surveys undertaken. However, women are still under-represented in the space sector, in part, due to lower proportions of females studying STEM subjects in schools and universities.

For the North Highlands and Moray to overcome these skills challenges will require leveraging the existing skills advantages that the region can offer over elsewhere in the world and building and expanding on the many schemes that are already developed to support skills training and increasing diversity across the UK, Scotland and locally.

Space businesses reported the following skill gaps or limitations among their workforce. Multiple responses were allowed and encompasses a variety of engineering skills, artificial intelligence and machine learning, data analytics and calibration and testing skills gaps within the existing workforce.

In 2020, around two-thirds of space sector companies reported difficulty in recruiting into their company

# Space - Infrastructure Needs

# Energy

By their nature, Research and Development (R&D) and manufacturing have higher energy needs than other industrial sectors such as warehousing. The midstream segment – in particular data centres for storage and processing of data are some of the most energy-hungry of all business operations, and access to High Voltage power networks is likely to be a key driver of where these data centres choose to locate - along with access to national and international data cable networks.

# Digital

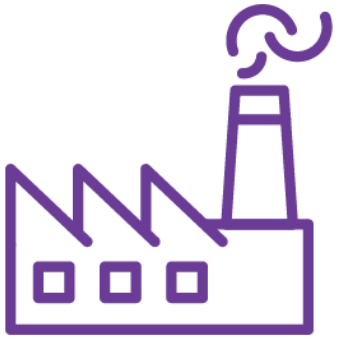
Access to digital infrastructure – gigabit broadband - to enable the reliable and high-speed transfer of data to and from points on the earth is critical for all high-technology and data-driven businesses. The space sector is no exception. Direct and convenient access to national and international data cable “backbone” networks is particularly vital to growth of the midstream segment, most importantly ground stations and data centres, which collect, store and then distribute data collected from space.

# Transport

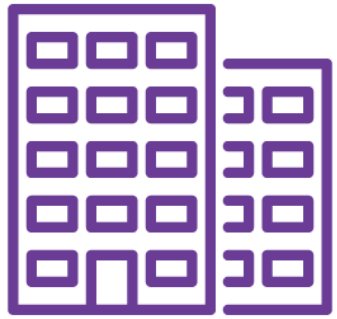
The efficient movement of goods is also particularly critical for the upstream segment (satellite and launch vehicle development and manufacturing), for safely moving assets, launch vehicles and gases (fuel and purge gases) to launch sites. Efficient and reliable transport of goods is vital to those parts of the downstream segment engaged in manufacture and supply of components and equipment. The free movement of people across a cluster, to enable the face-to-face collaboration and sharing of ideas to drive innovation and productivity is also critical.

# Real Estate and Facilities

The availability of appropriate facilities for space businesses is also a key factor in attracting and retaining firms operating in the R&D and manufacturing sections of the upstream (satellite and launch vehicle development and manufacture) and downstream (equipment development and manufacturing) segments. Specialist facilities include clean rooms and flexible office space, expanding with the needs of these often small and agile businesses.



# Liveability



The liveability of an area can often be the determining factor in attracting new firms to locate in an area, and attracting and retaining the human capital – talent – needed for any cluster to grow.

Liveability includes: the quality of social services such as schools, Further Education (FE) and Higher Education (HE); health services; leisure opportunities; the supply of affordable, good quality housing, and; the quality of the natural environment. Ease of access to major population centres via good national and international transport links also contributes to the liveability of an area, and its appeal as a place to live, work and invest.

Liveability can be the decisive factor in a firm or an individual's choice to invest in an area – and can be a key differentiator in the competitive and globalized downstream sector.

# Geography – Space Launch-specific

Latitude and the availability of real estate for launch ranges is a factor in where the upstream space launch operations locate. Higher latitudes are more optimal for the launch of satellites into Low Earth Orbits and a location near the sea and remote from population centres mitigates the risks from abortive launch. While this is only relevant for one small part of the overall space sector, the potential for space launch and spaceports to form the nucleus of a wider cluster, including ground stations and vehicle assembly means that geography may also be a differentiator in the midstream and downstream segments.

# Regulatory and Legal

A mature national legal and regulatory environment that reduces the risk of innovation and protects Intellectual Property (IP) is a critical enabler of any innovative industry, including space.

- International agreements that enable frictionless trade – in terms of supply of goods and of licensing of Intellectual Property (IP)
- International agreements that allow the reciprocal sharing of technology with other leading space nations, in particular the USA
- Intellectual Property law, ensuring that technologies and products developed are protected and indemnified against piracy
- Cybersecurity infrastructure, and the ability of a nation state to guarantee the security of intellectual property assets
- Rule of law and ability to guarantee security of physical assets (in particular launch operations)
- Business-friendly regulation for higher risk operations in the upstream segment - engine testing and space launch.

Like any growth sector, space businesses require a favourable national and local planning environment, including local planning guidance that gives developers and businesses confidence. This is particularly relevant for higher risk engine testing and launch operations, which require a higher level of scrutiny and examination.

# Inward Investment & Access to Finance

# Access to Finance

Many of the firms in a new and disruptive industry – such as space - will be wholly new businesses, often spinning out of research institutions. A high proportion of firms operating in a space cluster may be start-ups – developing products and solutions at proof of concept or validation stage. Due to the high risk and uncertain rewards of new and innovative technologies, private finance (usually in the form of equity, as these firms lack the assets against which to secure loans) is often hard to come by. These firms face very high set up costs, and even higher costs for moving from concept to prototype to full production.

The availability of public funding to provide the capital to individual firms that the market may not is vital for the development of any innovation cluster – and space is no exception. The injection of US public funds in the form of grants to satellite communication firms in order for them finance launches with SpaceX was critical to their later global success.

# Inward Investment

Inward Investment is the new investment of capital by firms headquartered outside of an area in the expansion of their existing local operations; their merger and acquisition of local firms – or the formation of new joint ventures with existing local firms.

A key focus of Inward Investment activity is the attraction of Foreign Direct Investment (FDI) by firms from overseas, in particular the USA . For a cluster to grow, a coherent and high value proposition to potential investors is critical – and may be the differentiator in the highly competitive downstream segment.

# Transferable Lessons from Case Studies

# Enabling success at the North Highland and Moray Space Cluster

### Recognizing the importance of leveraging workers from adjacent sectors

Given the space sector is a niche and rapidly growing sector, future employees are likely to arrive from adjacent sectors. For example, in New Zealand there was a deep pool of local knowledge and skills in carbon composites derived from yacht building for the American Cup and medical technologies.  Both of these are transferrable to the space sector. For the Highlands and Islands, there is a need to ensure reskilling of the skilled workers available from the nuclear sector, oil and gas, food and drink, renewable energy sector and defence sector who are well represented in the local area.

In addition, while it is recognized that the Highlands and Moray Region provides a good quality of life, it is still a relatively remote location. While this is mitigated by well-developed air and sea services, the region may struggle to attract a globally mobile space workforce in the mid and downstream segments where co-location with a spaceport is not required. This strengthens the requirement to retrain the local existing highly skilled workforce.

There is a strong need to ensure job opportunities arising within the space industry are widely advertised and there are ample opportunities for interactions between companies from different sectors.

### Enabling infrastructure improvements to support the launch facility will stimulate a wide range of jobs beyond the space sector and local area

Mahia in New Zealand is a small rocket launch site developed entirely by the private sector. While the local job numbers associated with the launch facility has provided high skilled employment the much larger boost in job creation arose locally from the upgrade to the local infrastructure required to support a launch pad, such as improved roads and broad band, has acted as an enabler to a wide range of organisations and improved productivity levels of existing companies.

The launch facility has also stimulated employment in the research and development and manufacturing of space vehicles at a national level with space clusters emerging in both Auckland and Christ Church.

# Supporting Ecosystem Development

### Adapting the regulatory and trade environment

The Highlands and Moray region will be competing with a range of countries to attract space companies and to find clients for space launch facilities. The Space Industry Regulations 2021 was introduced to compliment The UK Space Industry Act 2018 to provide a collective detailed regulatory framework for commercial space activities (involving both launch to orbit and sub-orbital spaceflight) and the development of spaceports in the UK. The new regulatory framework details more specifically the requirements for the spaceport operator licensing, public and operator safety requirements and the compliancy with international compliance of the United Kingdom.

As a comparator, New Zealand who were also starting with a history of no launch facilities was able to establish a space agency, pass launch-related legislation and manage an orbital launch attempt over a 2 year period between 2016 and 2017.

In June 2020, the US and UK signed a Technology Safeguards Agreement (TSA) which will allow US companies to participate in space launches from the UK. Several concerns have been raised about this agreement being unreasonably restrictive to members of the UK industry around sourcing of sub-component parts and if it restricts other countries from coming to the UK to use launch facilities.

### Providing support to the development of early-stage companies

The space sector employs highly skilled and highly adaptable workers – many of whom over time may wish to establish their own companies. This process will support the evolution of an ecosystem over time which can be further enhanced by carefully planned business support services. The most successful clusters within the space sector arise from the colocation of regulatory developers, private companies and public sector organizations. To support the ecosystem requires anchors from global space companies and attractors for innovative SMEs.

# An Environment for Innovation

Across the world, the public sector frequently uses incentives to encourage companies to locate, remain and expand within their borders. For example, The Florida Space Coast offers streamlined permitting, low operating costs, aggressive and targeted incentives and access to a wide and deep space related talent pool.

Academic evidence has shown that job creation tax credits and job training grants are more effective at supporting local economies than incentives such as investment tax credits, research and development tax credits and property tax reductions.

### Providing support for rapid scaling up of companies and their activities

Given the rapid growth of the space sector there are benefits for locations that can provide advice in how to scale up operation. For example, Orbex are looking to grow their existing workforce from 90 persons to around 400 locally within the next 5 years.

Phase Four are an in-space propulsion company that spun out of the University of Michigan. They specialize in cost effective electric propulsion systems and have been learning from locally based local automotive manufacturers about how to increase their manufacturing outputs. Phase Four are adopting Kaban techniques (a scheduling system for lean manufacturing adapted from Toyota) to allow them to build up to 50 propulsion systems per month.

### Acknowledging the requirements for co-location of companies and the launch facility

The need for different types of companies to be co-located next to the launch pad is still unclear. While there will be a requirement for clean facilities to support last minute checks on launch vehicles and payloads, many of the other requirements will be delivered to site. This means that there is a requirement for excellent local logistics providers but other companies may not need physical proximity to the launch pad itself. Instead, a supportive business environment, access to highly skilled individuals and a well-established ecosystem will be of greater importance.

The New Zealand government has acknowledged that the launch facility has benefitted the initial seeding of the space sector within the country but going forward intend to have a stronger push for supporting companies in the downstream part of the sector where they see opportunities for greater job creation and economic growth.

# Social and Economic Synergy

### Linking research and development with commercial companies to create new opportunities

With the growth of propulsion technology, it is increasingly likely that commercial constellations will be launched on larger rockets with small rockets assisting with replenishment. However, there will inevitably be new opportunities for lighter payloads that will need launch facilities. The close interaction between universities, wider research and development and commercial companies needs to be supported to ensure early adoption of new technologies.

### Growing and Diversifying the Workforce

Given the space sector's requirements for high level skills and current struggle to attract women into the sector there are a wide range of approaches adopted internationally and locally to help make the space sector a welcoming, inclusive and attractive sector to work within.

### Developing educational programmes

Both NASA and ESA have well developed education programmes engaging with schools, colleges and universities, from early years through to post-graduate level.  They are increasingly providing online content which is incorporated into local curriculums. This is important for increasing awareness of the opportunities that the space sector offers for improving everyday lives through to providing opportunities for employers and the future workforce to engage with each other.

### Promoting early years engagement

Critical for diversifying the space workforce is early years engagement so that children and in particular young girls start to picture themselves working in the industry and are not discouraged from studying the subjects that will make that a possibility in the future. In line with this is the need to train up teachers, who themselves may be lacking STEM skills.

### Retaining existing highly skilled workers in the region

Retraining of highly skilled workers is essential for the space sector and is critical to retain the highly skilled workforce being released from Dounraey and the Ministry of Defence activities in the Northern Highlands and Moray region.

### Enabling effective supply chain management

The space industry is already well recognized for providing training and work placement opportunities for new entrants into the sector. To further stimulate the development of the space ecosystem requires effective supply chain management as well as individual companies providing training opportunities. For example, NASA mandates through a penal contracting system that its primary contractors use SMEs and importantly, SMEs who are owned by under-represented groups, within their subsequent supply chain to provide services for NASA. This encourages more diverse entrants into the space sector. Similarly, effective supply chain management can boost the provision of apprenticeships and training opportunities if these are mandated within supply chain contracts. A new level 4 space engineering technician apprenticeship has been set up by the University of Leicester, UK Space Agency and Airbus and is expected to have more than 50 apprentices begin their training by the end of 2021.  A level 6 (degree level) apprenticeship standard is currently in development

# Part 3: North Highland and Moray 2021 - the existing ecosystem

# The North Highland and Moray Space Cluster

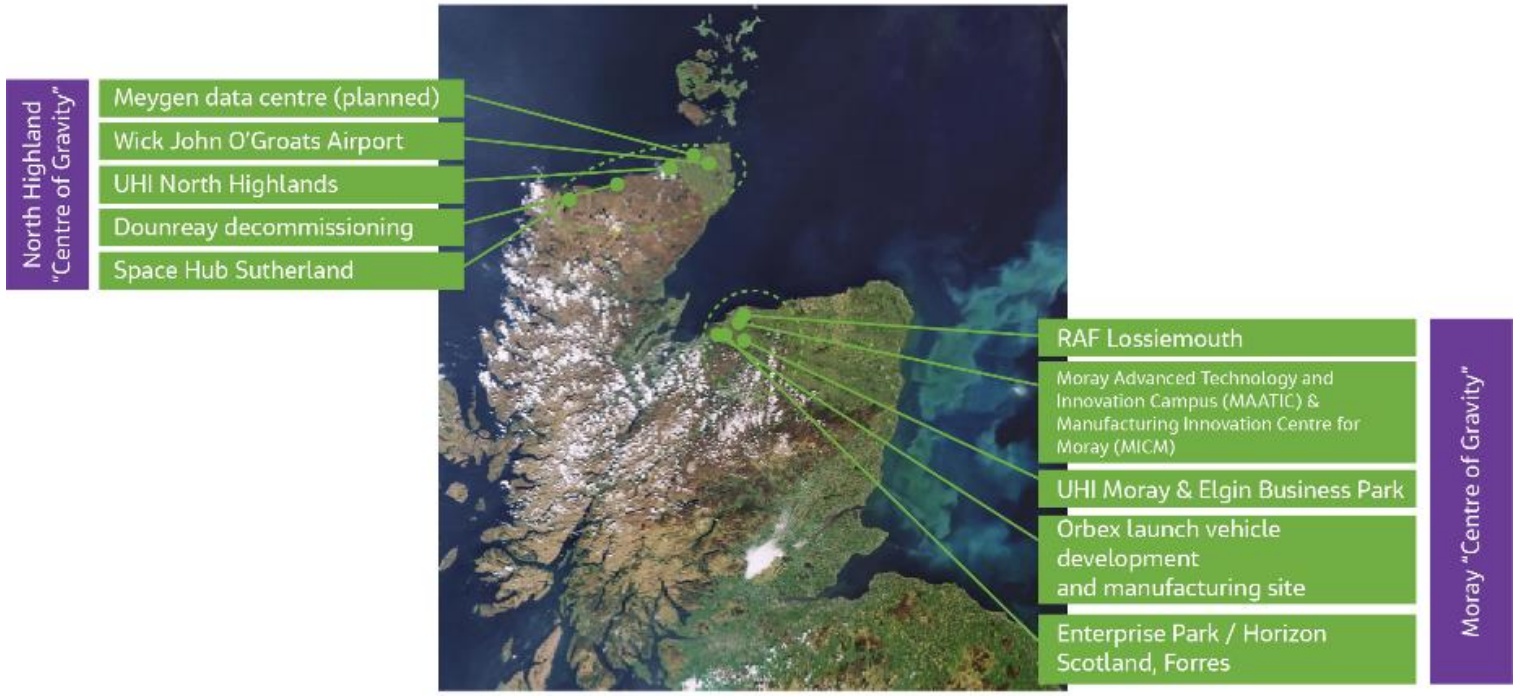
The focus of this strategy is the North Highlands, focused around Space Hub Sutherland (centred around the Dounreay Travel to Work Area) and Moray, focused around the Orbex testing, manufacturing, and mission control centre at Forres (centred around the Elgin Travel to Work Area).

These two 'zones' or 'centres of gravity' form the potential nuclei for the regional North Highland and Moray Space Cluster.

In support of this strategy a comprehensive local ecosystem audit was undertaken by Caithness Chamber of Commerce, supported by Moray Chamber of Commerce and Highlands and Islands Enterprise (HIE).

The detailed evidence base prepared is provided at **Appendix 1** and summarised in this section.

**Ground zero: A North Highland & Moray Space Cluster**



# Existing Supply Chain

The supply chain audit has shown that in the North Highland (Caithness) sub-region, a number of firms are already engaged in high value manufacturing – including optics, imagery and advanced materials, supplying the Dounreay nuclear research facility, the oil and gas sector. None currently supply the space sector. Business services, construction and general support services are well represented.

In the Moray sub-region, the expanding Orbex launch vehicle development and manufacturing facility at Forres forms a growing nucleus for the space sector – suggested by the location of a UK Launch Services Ltd (UKLSL) regional office in the Horizon Scotland hub.

There is the potential for a general clustering of innovative businesses at the Forres Enterprise Park, served by the 'Horizon Scotland' growth hub, complementing the existing aviation and defence sector supply chain and talent pool serving RAF Lossiemouth. The food and drink sector in Moray also utilises a highly skilled workforce and advanced engineering supply chain.

# Existing Skills and Talent

Across the region, the Defence and Energy sectors are specifically contributing highly skilled technical engineers with continued investments and project opportunities.

The Moray Aerospace, Advanced Technology and Innovation Campus (MAATIC) aims to create hundreds of new student places and provide the skills needed for working in the aviation sector. It is one of the key projects of the £100m Moray Growth Deal. The MAATIC project concept and design phase is due to start in March 2021 and will take the project to the next step towards the construction phase due to start in April 2022. Discussions between HIE, UHI, Moray College and private partners such as Boeing and Orbex on the services to be provided at the centre have a growing focus on space.

Additionally, both the North Highland and Moray Colleges are providing industry specific training and assessment centers to enable the students to train and practice skills required for work within Oil and Gas industry.

North Highland and Moray Colleges are also participants within the Developing the Young Workforce Programme managed by the Scottish Government which aims to better prepare young people for the world of work.

# Existing Infrastructure

## Energy

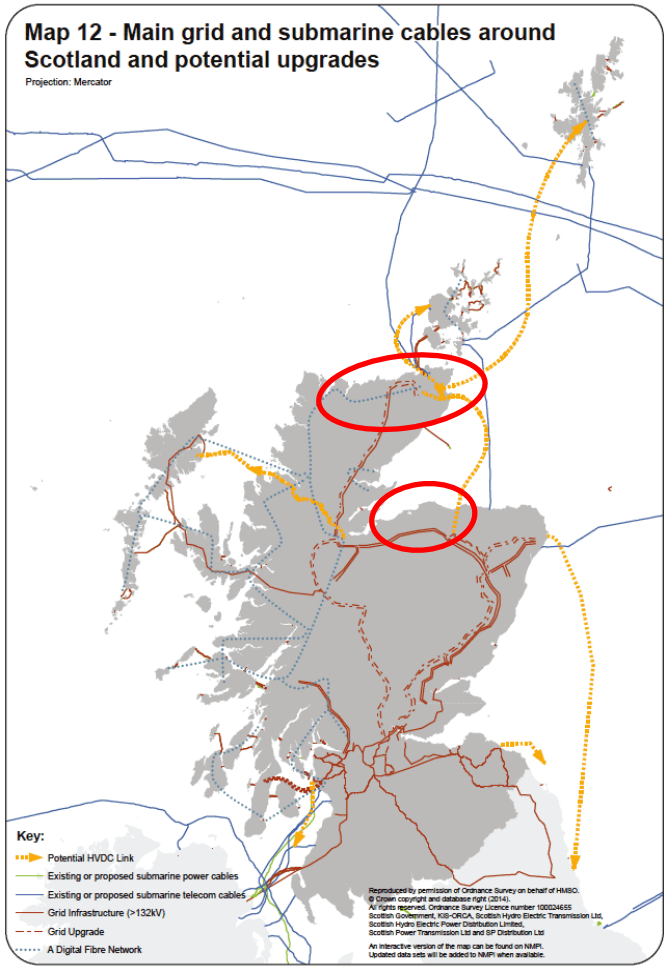
While much of the North Highland Region (28%) is not on the UK gas network, energy for heat and light in urban centres and business parks is affordable and stable.  As summarised in figure x-x, the region hosts existing and planned landing points of offshore power cables. With the expected coming onstream of offshore and onshore wind farms in the region and plans for the manufacture of hydrogen using renewable sources, and the opportunities of tidal power in the Pentland Firth, the region can be expected to offer a plentiful and expanding supply of renewable energy (wind and tidal) in the medium to long term.

## Digital

In the Moray region more than 40,000 homes and businesses have access to the fibre network, making it one of the best-connected local authority areas in the Highlands and Islands region. However, there are still some areas of North Highlands which lack access to superfast broadband or 4G mobile connectivity.  Is this being addressed through some Scottish Government or UK rural broadband programme?

Business facilities are available in North Highland and Moray with gigabit / full fibre connections – in particular Enterprise Scotland Business Park and other serviced sites in the region.

The onshoring of international data cables in the region, in particular the Farice international cable near to Castletown in the inner sound of the Pentland Firth, and potential to connect to the UK digital backbone network also offers the potential for hyper-connectivity businesses in the medium to long term.




**Strategic Power and Digital Infrastructure the North Highland and Moray Region [Source: Marine Scotland, 2018]**

# Existing Infrastructure

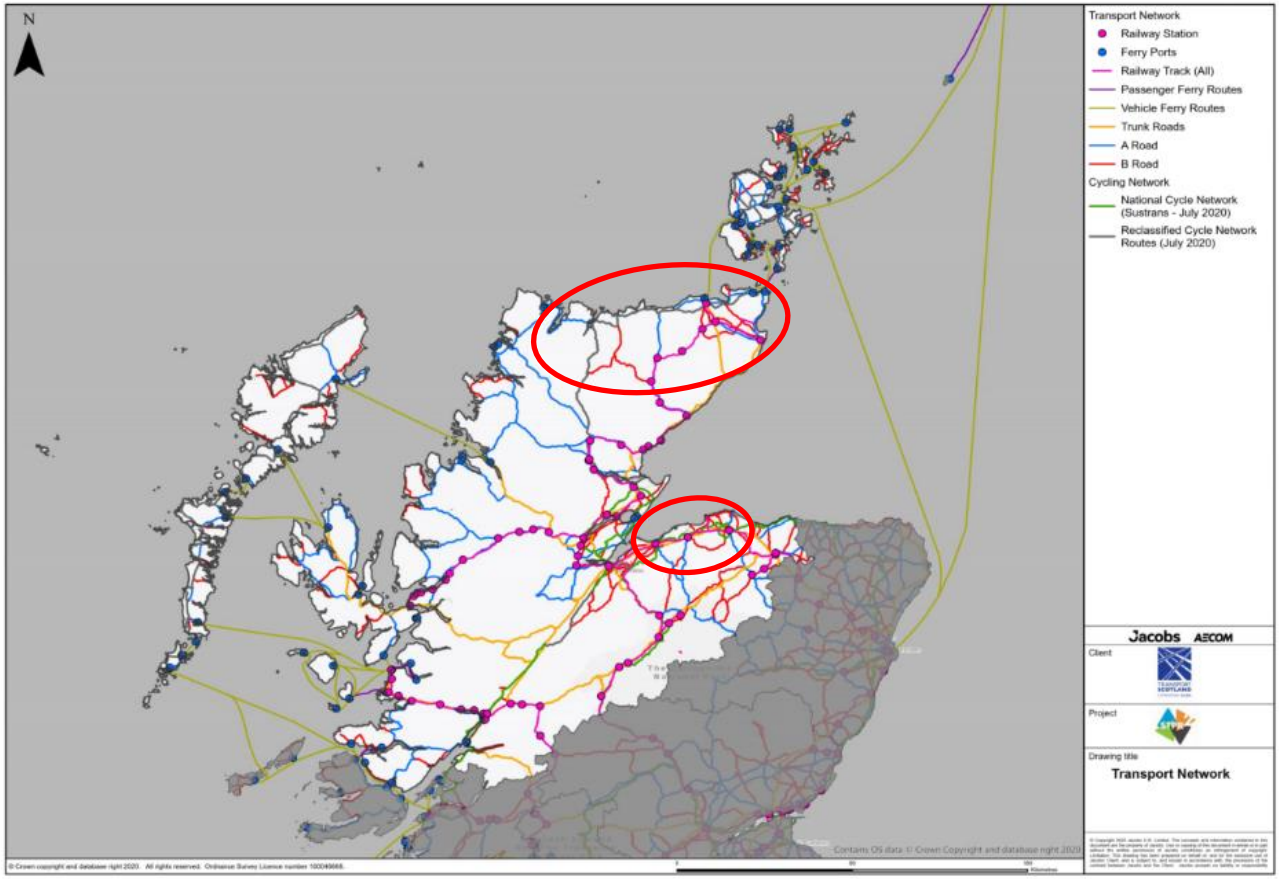
## Transport

Road and rail links into the North Highland sub region have limited capacity, with commuting from the economic centres in the central belt not currently feasible. Business travel to North Highland region is more practical by air or sea with well-developed and efficient services to serve the oil and gas and growing offshore renewables industry. Transport links within the Moray region are more efficient, although rapid access to the growing space cluster in Glasgow and other centres in England is challenging due to distance. According to the Scottish Index of Multiple Deprivation (SIMD) the North Highland and Moray scores lowest in Scotland for geographic access.

## Real Estate and Facilities

Within the North Highlands and Moray there are multiple business parks and commercial facilitates suitable to host SMEs and startups. Importantly – given the key role for the state support of early-stage companies, Highlands and Islands Enterprise (HIE) the regional development agency, own and operate Enterprise Park, Forres and many sites in the H&I region. Highlands and Moray councils also provide advice on commercial property available to buy or lease in the surrounding areas alongside locations suitable for specific industrial use.

Highlands and Islands Enterprise (HIE), working with Highlands and Moray Council, provides  support service linking businesses in the region or wishing to locate in the region to premises and business support services, with a team of account managers.




**Transport Network in the North Highland and Moray Region [Source: Transport Scotland / AECOM Jacobs JV 2021]**

# Existing Infrastructure

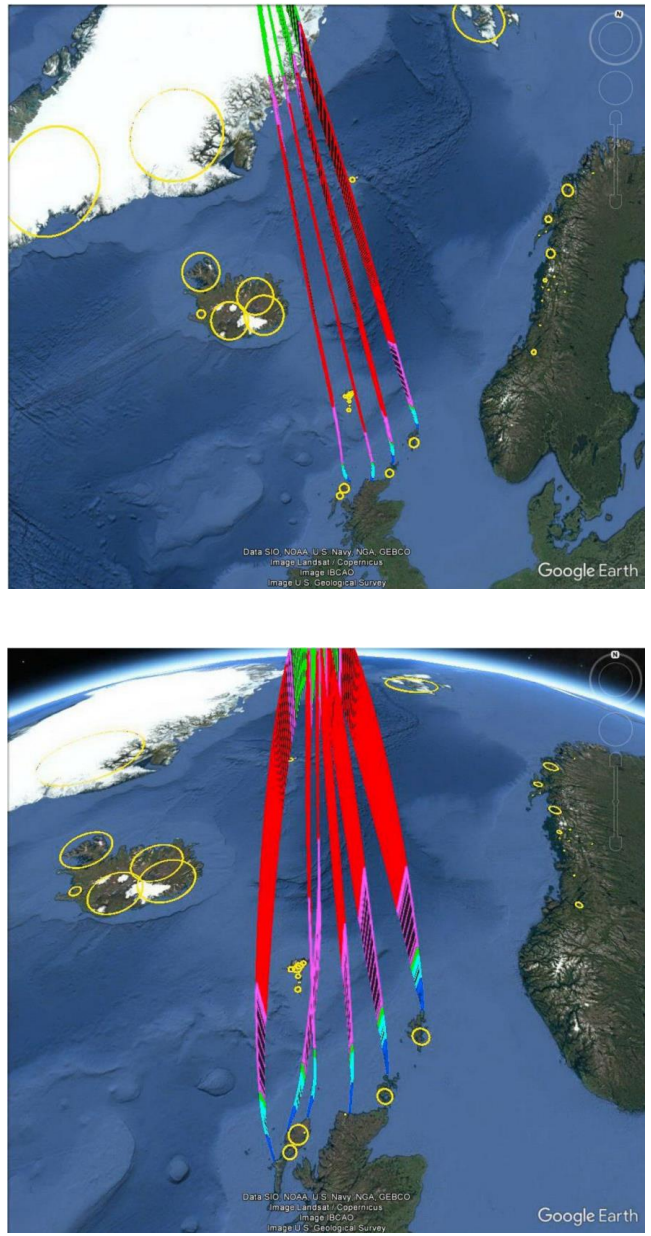
## Livability

The livability of the North Highlands and Moray area is a key factor in attracting talent and investment to the area.

The region has plentiful access to green and blue space, with education and healthcare facilities in the North Highland sub-region being under-capacity and achieving good outcomes for students. However, changes in work patterns with more home working and increased demand for holiday let properties in the UK has placed pressure on the local housing market impacting affordability across both sub-regions.. Significant housing developments have been identified in the Moray Local Plan, and current pressure on the housing market may be expected to ease in the medium term as these sites are developed out. As mentioned previously, according to the Scottish Index of Multiple Deprivation (SIMD) the North Highland and Moray scores lowest in Scotland for geographic access. This score include access to community facilities such as primary and secondary schools, GP surgeries, retail centres, and post offices.

## Geography – Space Launch-specific

While equatorial launch is more efficient, North Highland proves launch access to the Polar and Sun-Synchronous orbits due to the trajectories that can be achieved from the region. The Caithness region. Each of these orbits are considered a Low Earth Orbit (LEO) and are favored for earth observation as the orbit passes over the same location at the same local time.




**Possible LEO launch trajectories from the North of Scotland [Source: SCEPTRE report / HIE 2017]**

# Readiness of Local Economy for the Opportunities of space

In support of this strategy, an online survey was addressed to businesses in the Caithness and Moray Chamber areas to understand the reach of their own supply networks, growth plans and awareness of the opportunities of space sector.

The majority of respondents (19 of the 21 responses) supplied one or more of the parallel industries to the space sector – such as renewable energy, defence, nuclear or oil and gas, although none were currently supplying the space sector.

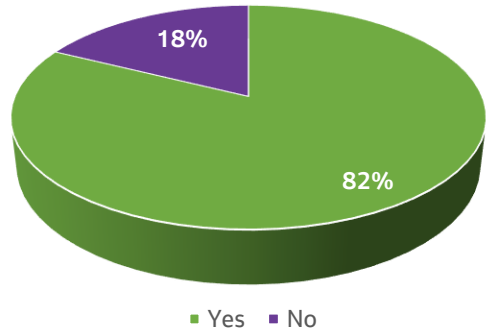
The responses demonstrated the self-sufficiency within the North Highlands and Moray businesses with the majority of respondents claiming that on average over 60% of their supply chain is local.

The manufacturing, engineering and designs firms identified that key barriers to their future growth plans were 'Regulation/Red Tape', 'Macro Economic Disruption' and 'Quality of digital infrastructure'.

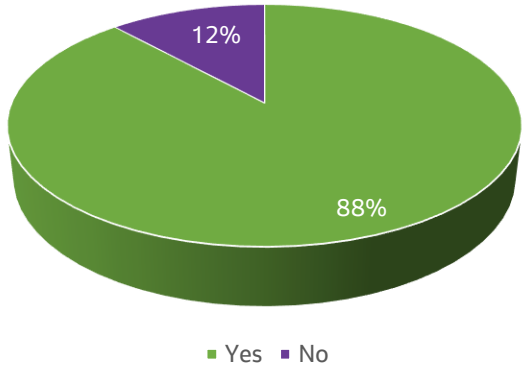
In terms of space awareness, all respondents expressed interest at the opportunities proposed by Scotland's Space sector. In terms of their SME entering the space market, most respondents answered that seeking **networking opportunities** would be the best strategy to learn how they can help support the emerging sector.

Lastly, the barriers most likely faced by the companies looking to enter the market are, 'Regulation/Red Tape', 'Uncertainly of the market', and 'Supply of Talent and Skills'.

**Are you aware of the UK Government's plans to grow the space sector?**




**Are you considering offering your existing goods or services to the space sector?**



# Part 4: North Highland and Moray 2021 - Towards a Space Cluster

# Gap Analysis

## Aspect 1 - Supply of Services and Skills for Space

Using the rich dataset of the detailed ecosystem audit undertaken by Caithness Chamber of Commerce and a targeted online survey of businesses undertaken in Spring 2021, triangulated against ONS and Beauhurst data on the local industrial base and qualitative engagement with local stakeholders including Highlands and Islands Enterprise (HIE), Melness Crofter's Estate and key local businesses, set out in Part 3, it is possible to map the existing capability of the North Highland and Moray area against the needs of the space sector set out in Part 2.

This enables a multi-criteria analysis – a gap analysis - to be undertaken to assess the potential of the area as seed-bed for a future space cluster, to inform development of the cluster development strategy and action plan. In doing this we have considered the North Highland and Moray as a whole, and the two economic sub-regions, the "centres of gravity" identified in Part 3 – **North Highland** (including Thurso, Dounreay and the launch site) and **Moray** (including the Enterprise Business Park and the Orbex mission control and launch vehicle manufacturing facility at Forres).

In the matrices that follow, cells coloured red indicates no current provision. Amber indicates that there is some current provision in the local economy – in terms of at least one existing supplier currently capable of supplying these services, or three existing suppliers that could potentially convert to supply the space sector. Green indicates existing firms currently able to supply these specialist services.

A qualitative assessment of the potential for Caithness and Moray area to develop a local capability in each line of supply has been conducted based on existing provision, and underlying infrastructure and local skills supply.

An indication of the potential economic value of each line of supply has been derived from the estimated GVA per job (using a proxy sector) compared to the UK / Scotland average – and where the greatest value may be secured for the local economy.

This gap analysis indicates that the North Highland and Moray cluster has current advantages in terms of launch vehicle development and launch operations – with potential for development of midstream applications (ground stations and data centres) in the mid to long run, due to the strategic advantages of the onshoring of HV power lines and international data cables for these ultra high energy and data demand businesses.

# Gap Analysis – current services and skills, potential for clustering – upstream and midstream

| Segment | Sub Segment | Supply Need | Existing Supply Chain (SMEs and Skills) | | | | | Potential for clustering in North Highlands and Moray | Economic Impact (GVA per job, Multiplier, Effects) |
|---|---|---|---|---|---|---|---|---|---|
| | | | North Highland | | Moray | | UK | | |
| | | | Suppliers | Skills | Suppliers | Skills | Suppliers | | |
| Upstream | Space Systems Manufacturing | R&D – Aerospace | | | | | | High | High |
| | | R&D – All Sectors | | | | | | High | High |
| | | Advanced Engineering – Aerospace | | | | | | High | High |
| | | Advanced Engineering – All Sectors | | | | | | High | High |
| | | Advanced Manufacturing – Aerospace | | | | | | High | High |
| | | Advanced Manufacturing – All Sectors | | | | | | Medium | High |
| | Launch Operations | Propellant Manufacture and Processing | | | | | | Medium | Medium |
| | | Launch and Range Control | | | | | | Medium | High |
| | | Airport Services | | | | | | High | High |
| | | Specialist Logistics | | | | | | Medium | Medium |
| | | Payload Integration | | | | | | High | High |
| | | Business Services | | | | | | High | Medium |
| | | Tourism and Hospitality | | | | | | High | Medium |
| | | Estate Management | | | | | | High | Medium |
| Upstream / Midstream | Ground Systems | Ground Stations | | | | | | Medium | High |
| | | Mission Control | | | | | | High | High |
| | Satellite Operations | Asset Management (SSA) | | | | | | Medium | High |
| | | Data Centres | | | | | | Medium | High |

# Gap Analysis – current services and skills, potential for clustering – downstream

| Segment | Sub Segment | Existing Supply Chain (SMEs and Skills) | | | | | Potential for clustering in North Highlands and Moray | Economic Impact (GVA per job, Multiplier, Effects) |
|---|---|---|---|---|---|---|---|---|
| | | North Highlands (Sutherland and Cathness) | | Moray | | UK | | |
| | | Suppliers | Skills | Suppliers | Skills | Suppliers | | |
| Downstream | Satellite Data Intermediary Services | | | | | | Too early to say | High |
| | Satellite Data Processing | | | | | | Too early to say | High |
| | Satellite Data Applications: R&D | | | | | | Too early to say | High |
| | Satellite Data Applications: Manufacturing | | | | | | Too early to say | High |
| | Telecoms & Media – Any | | | | | | Too early to say | High |
| | Earth Observation (EO) – Any | | | | | | Too early to say | High |
| | Satellite Navigation – Any | | | | | | Too early to say | High |

# Gap Analysis

## Aspect 2 – Infrastructure for Space

Based on the definition of **space infrastructure needs** set out in **Part 2** and the assessment of **current infrastructure** in **Part 3**, the following matrix sets out a gap analysis of the current underlying or 'enabling' infrastructure against the needs of an innovative space cluster. This includes energy, digital connectivity,  transport connectivity, availability of appropriate serviced business space and – critically - liveability and quality of place.

As stated above. the liveability of a place – the supply of quality housing and social services (schools, health) and access to quality green spaces is often a decisive factor in attracting and retaining both businesses and talent to an area, irrespective of sector.

This analysis indicates that the North Highland and Moray area has existing constraints in terms of energy – with many homes not being on the national gas grid, the region has the potential to connect directly to the onshoring of HV cables, the capacity and strategic importance of which will increase in the coming years as offshore wind farms come onstream. While the rural nature of the North Highlands means that broadband to dispersed settlements is a structural challenge, connectivity – fixed broadband – services for business premises in larger settlements is not a substantial barrier. For example, the Melness Peninsula – the location of Space Hub Sutherland - benefits from a newly-installed ultrafast fixed broadband backhaul. With the onshoring of transatlantic data cables in both the North Highlands and Moray, the region offers the exiting potential for hyperconnectivity in the medium to long term.

Access to the North Highlands from the main economic centres in Scotland and the wider UK by land transport remains a challenge, although well-established air and sea links to both North Highland and Moray have been developed as a legacy of the oil and gas industry. The supply of good quality serviced business space in the Moray area in particular, and the business support offered across the entire region by Highlands and Islands Enterprise is a key strength.

While there are signs that the current (Summer 2021) trend of 'urban flight' – a general movement of population from cities to more rural areas with the structural shift to home working following COVID-19 – is placing pressure on the local housing market, the high quality of the natural environment, access to green spaces is a key strength. The northerly latitude of the North Highlands means that it has a unique advantage as one of the few locations in the UK able to host vertical launch, as identified in Part 2.

# Gap Analysis – enabling infrastructure for a space cluster

| Category | Criteria | North Highland | | Moray | | North Highland & Moray |
|---|---|---|---|---|---|---|
| | | Raiting | Overall Raiting | Raiting | Overall Raiting | Overall Raiting |
| Energy | How constrained is the current energy network (HV and gas) in its ability to meet the needs of new energy-hungry businessess? | Partially | AMBER | Partially | GREEN | AMBER |
| | Is there existing or potential to establish energy infrastructure to meet the needs of ultra-high energy-hungry businesses in the area? | Yes | | Yes | | |
| Digital | What is the current availability of superfast, ultrafast and full fibre in the area compared to the national (Scotland) average? | Below Average | AMBER | Average | AMBER | AMBER |
| | How does the Fixed Broadband compare to other proposed vertical launch site council areas (eg Shetland, Comhairle nan Eilean Siar) in Scotland? | Above Average | | Above Average | | |
| | Is there good existing mobile data coverage in the area from at least two suppliers (2021 OFCOM data)? | Partially | | Yes | | |
| | Does the region have any strategic advantages for the establishment of strategic digital Infrastructure – e.g. proximity to national data backbones or onshoring of international data cables? | Yes | | Yes | | |
| Transport | How does the capacity and performance of the highway network serving the area compare to the national (Scotland) average? | Below Average | RED | Average | AMBER | AMBER |
| | How do the frequency and affordability of the public transport (rail and bus) services serving the area compare to the national (Scotland) average? | Below Average | | Average | | |
| | Are other modes of travel - air and sea - available to move people and goods in and out the area? | Yes | | Yes | | |
| Real Estate and facilities | Is there an existing supply of flexible and serviced office space, appropriate to the needs of innovative, high-growth firms in the area? | Partially | AMBER | Yes | GREEN | GREEN |
| | Are (publicly-funded) services available to support inward investment, and to link innovative businesses with places to locate in the area? | Yes | | Yes | | |
| Liveability | Local housing supply – how affordable are local house prices compared to national (Scotland) average? | Average | AMBER | Average | AMBER | AMBER |
| | Local schools and colleges – how do local schools and FE / HE compare to national (Scotland) average for quality of provision? | Average | | Above Average | | |
| | Local health and social services – how does the availability of primary and secondary health care and other social services compare to the national / UK average | Average | | Above Average | | |
| | Shopping and recreation; ease of access to a variety of retail facilaties, cinemas, theatres, sporting facilities and other recreation? | Below Average | | Average | | |
| | How does the quality of local amenity (green space) and access to natural environment compare to wider UK? | Good | | Good | | |
| Geography – space launch and space data specific | Does the region have an appropriate latitude for LEO launch? | Yes | GREEN | N/A | N/A | GREEN |
| | Are local residents and businesses positive towards the opportunities of space launch? | Yes | | N/A | | |
| | Is land available for locally for safe launch operations (safe distance from buit up areas, proximity to the sea) | Yes | | N/A | | |

# Synergies: UK and European network of Space Ports & Centres of Excellence

At time of writing (Summer 2021), Space Hub Sutherland is one of a number of proposed spaceports across the UK – three offering exclusively vertical launch (all in Scotland) and four offering horizontal launch (two in Scotland, one in England and one in Wales).

As a statement of national ambition and reflecting the UK's advantageous northerly and island location on the edge of European landmass, the UK hosts more potential spaceports than any other European nation (seven) – a figure comparable to the entire EU (eight). None of these spaceports are yet operational, and each is at a different stage of maturity.

While estimates for the Total Addressable Market (TAM) for small launch varies, it is likely that the combined offer of these multiple sites will stimulate considerable commercial interest in the upstream market segment – where the North Highland and Moray space cluster has particular advantages. As these space ports are commercial propositions, ultimately the market will decide which progress to launch and long-term viability.

The national network of Satellite Applications Centres of Excellence, coordinated by the Satellite Applications Catapult and supported by the UK Space Agency, are intended to enable innovative space businesses – across all segments – to Connect Locally, Develop Nationally, Transform Globally.


**Planned Space Ports in Europe [Source: SpaceTec Partners 2020]**

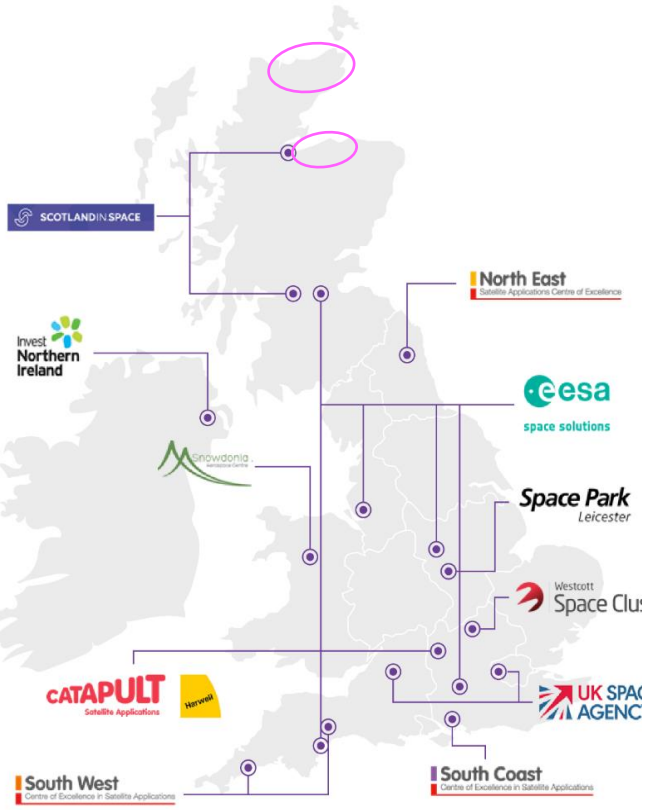
# Synergies: UK and European network of Space Ports & Centres of Excellence

A particular development initiative that may provide a template for other local space clusters is the Disruptive Innovation for Space Capability (DISC) facility at Harwell. This hub – providing specialist facilities for space sector SMEs - will offer useful lessons for development of similar facilities as the UK space industry evolves.

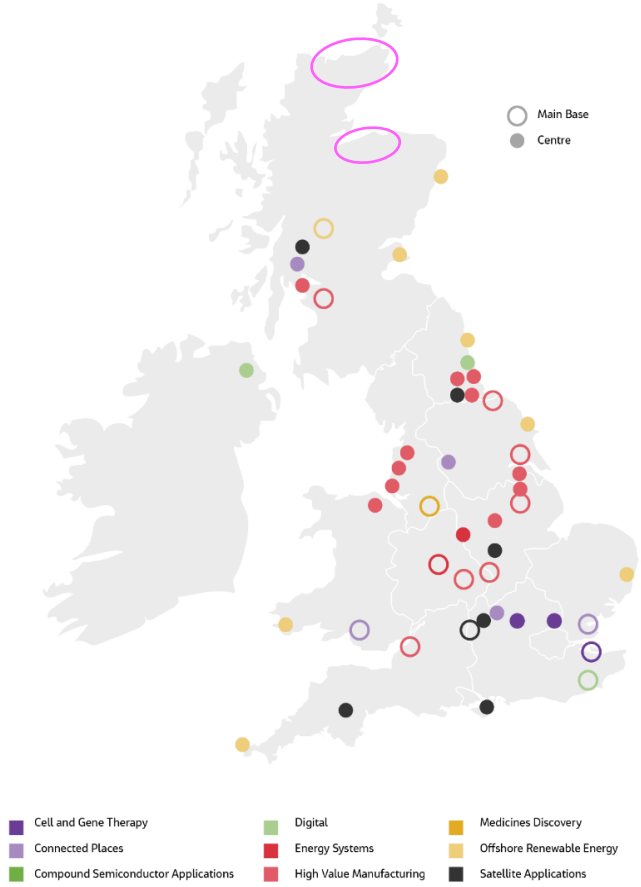
Solutions Network. While the UK may not be able to access the European structural funds, the ESA network provides access to investors and collaborators across Europe – synergies and contacts that may be decisive in attracting firms to a nascent space cluster.

As the space sector overlaps with other sectors – with many firms in the downstream segment offering services horizontally, for example developing applications that can be used across the telecommunications, advanced manufacturing and transport sectors and space - there are also synergies with the wider network of Catapults across the UK.

In particular, this includes Digital, High Value Manufacturing and Connected Places Catapults..




UK Space Network [Source: UKSA / BEIS 2020]




UK Innovation Catapult Network [Source: UKRI / BEIS 2020]

# Synergies: Local Growth Priorities

The current HIE Economic Plan 2019-2022 prioritises the following sectors:

- Energy
- Tourism
- Food & Drink
- Life Sciences

This is complimented by a programme of investment identified under the Moray Growth Deal which prioritises development of high value, innovative industries (in particular aviation and life sciences), and the Moray 2026 Plan for the Future which identifies a growing, diverse and sustainable economy as is the top priority at the heart of the future success of Moray.

Key synergies with the needs of space are summarised in the table here.

| Sector | Synergies |
|---|---|
| Energy | ▪ Shared supply chain. With **Hydrogen** economy: gases for launch vehicles, health and safety. With **offshore renewables**: Shared supply of STEM skills<br>▪ Shared constraints and opportunities, and need for transport (road transport) and energy (distribution) infrastructure improvements to fulfil potential |
| Tourism | ▪ Space launch and space "brand" as a catalyst for tourism, building on the "North Coast 500" brand<br>▪ Shared constraint, and need for transport (road transport) infrastructure improvements to fulfil potential |
| Food & Drink | ▪ Shared supply chain and talent – precision engineering, clean facilities needed by both food and drink and Space sector<br>▪ Shared constraint, and need for transport (road transport to efficiently move goods and people into the area and to national and international markets) and energy (distribution) infrastructure improvements to fulfil potential |
| Life Sciences | ▪ Shared supply chain and talent – precision engineering, STEM skills, clean facilities<br>▪ Similar plant and facilities needs – hub space can be dual purposed for life sciences, health care (telemedicine) and satellite applications<br>▪ Similar finance and funding needs for start-up and scale up innovative businesses. Space, green energy, food tech and have potential to present a coherent and diverse portfolio, focussed in one area, to the VC market<br>▪ Shared constraints and need for transport (road transport) improvements to fulfil potential |

# Synergies: Existing Supply Chain & Talent

North Highland and Moray has a mature supply and skills (talent) supply in the following sectors. All of which retain opportunities of synergy with the emerging space sector.

- Oil & gas
- Nuclear
- Defence

These synergies are summarised in the table here.

The following slide summarises the Strengths, Weaknesses, Opportunities and Threats (SWOT) to the North Highland and Moray area as a potential Space Cluster.

| Sector | Synergies |
|---|---|
| Oil & Gas | ▪ Shared supply chain – specialist logistics, project management, facilities and asset management, health and safety, professional services, manufacturing, component supply (pipework, high purity clean room manufactured components)<br>▪ Shared talent base – remote asset management, earth observation |
| Nuclear | ▪ Shared supply chain – specialist logistics, project management, facilities and asset management, health and safety, professional services<br>▪ Shared talent base – STEM and physics/mathematics skills and expertise required for both nuclear and space applications |
| Defence | ▪ Shared supply chain – specialist logistics, facilities management, health and safety, professional services<br>▪ Specific synergies with upstream and midstream sector - space launch and launch vehicle development, avionics and propulsion (engines), project management, air traffic control, specialist rocketry and ballistic skills and technical expertise<br>▪ Shared talent base – Engineering, aviation, air traffic, near earth observation and rocketry systems skills and expertise |

# SWOT Analysis of a North Highland and Moray Space Cluster

| Strengths | Weaknesses |
|---|---|
| ▪ Prestige – First to launch into LEO in UK?<br>▪ Potential cluster nuclei – Forres and Space Hub Sutherland<br>▪ Geography – ideal for polar launch<br>▪ Quality of local services, education and environment<br>▪ Existing aerospace, advanced engineering supply chain<br>▪ Existing non-specialist supply chain<br>▪ Local leadership and partnership<br>▪ Planning Policy and site readiness | ▪ Specialist space launch services – launch and range control<br>▪ Geography – remote from other clusters, barrier to attracting talent?<br>▪ Space not a Moray Growth Deal priority<br>▪ No specific comparative advantage for downstream growth<br>▪ Local digital connectivity (North Highland)<br>▪ Local road transport infrastructure (North Highland) |
| **Opportunities** | **Threats** |
| ▪ Synergies:<br>  • Existing skills base: Oil and Gas, Nuclear<br>  • Offshore renewables<br>  • Food and drink (Moray)<br>  • Life sciences<br>  • Defence and aerospace – RAF Lossiemouth, MATIC<br>▪ Mid and downstream – offshore renewable / HVDC & data cable landings enable green ultra-high energy need and hyper-connected businesses<br>▪ Tourism & visitor economy – North Coast 500<br>▪ Synergies with Hydrogen economy, Greenports (Cromarty Firth), wider Scottish Space offer | ▪ Demographic trends - declining population<br>▪ Competition from other small launch sites<br>▪ Competition from other UK & Europe space clusters for midstream and downstream growth<br>▪ Regulation and policy – terms of TSA, UK and Scot Gov priorities?<br>▪ Limitations of small launch market and Total Addressable Market<br>▪ Bulk of constellation satellite launch is likely captive to heavy launch operators (e.g. Space X) – gap in market for small launch |

# Part 5: Space - The ‘size of the prize’ for North Highland and Moray

# Background

Space Hub Sutherland will play a critical role in bringing income and employment to the North Highlands and Moray region. It will help to retain highly skilled individuals in the North Highlands and offer opportunities to young people to help stem the flow of depopulation. It is vital to sustain the emerging Moray space cluster as without a space port it is highly likely that existing launch providers will relocate. Space Hub Sutherland will unlock further development of the Moray space cluster and support UK and Scottish government objectives for growing the space sector.

There are already around 7,700 people working in the Space Sector across Scotland. This section estimates the number of additional jobs and value created from Space Hub Sutherland and potential growth in the wider space sector within the Highlands and Islands region. Investments in the space port will lead to increases in employment beyond those who may be directly employed either building or operating the facility. A global standard approach to estimate the amount of total employment and value that is created through a particular investment is a statistical technique using multipliers.  Two types of multipliers are typically calculated: Type 1 calculates the amount of employment created in a supply chain to a particular industry (known as indirect effects) and Type 2 calculates the amount of employment created due to the uplift in spending overall (known as induced effects). The figures calculated are in addition to the direct employment from the construction and operation of the Space Hub Sutherland.

Furthermore, the payloads launched into space by rockets at Space Hub Sutherland will unlock further employment and value in the midstream and downstream parts of the space sector. We have for the first time, made a conservative estimate to the numbers of jobs and value associated with this.

# Assumptions

For the sake of continuity, the Jacobs' economic impact model adopts the same ratios of cost per launch and investment to calculate Gross Value Added and Full Time Equivalent (FTE) jobs as applied within the evidence base for the planning application for the space port. This covers impacts associated with the following activities:

- Construction of the space port
- Spaceport and site management
- Launch activities
- Tourism
- Accommodation to support launch activities

However, based on more recent information and studies we have updated assumptions about the launch cadence that is anticipated, the expected numbers of tourists to the site and Orbex's announcements about anticipated employee numbers. Furthermore, we have included construction activities associated with the maintenance of the spaceport facility as well as the original build. The following assumptions have been made for the base-case scenario:

### Construction and maintenance of spaceport

- The construction of the spaceport will take 2 years with an investment profile at 10% in Year 1 and 90% in Year 2 (as used in the Frontline report).
- From Year 3 onwards we have assumed a maintenance budget for the space port of 5% of capex costs based on a benchmarking comparator.
- This will provide employment for construction and civil engineer workers during the construction phase and thereafter for site maintenance.

### Space port and site management

- The Jacobs' Economic Impact Model retains the assumptions used within the original planning model of 17 FTEs at the space port when it is fully operational with 12 launches per year. For preceding years, FTEs are pro-rata'd according to the number of launches.
- The operation of the site will provide employment in technical support, site security, administration amongst other roles.

### Launch Activities

- The first launch from the site will be towards the end of the second year of construction, this will ramp up to 3 launches in the following year, 7 launches in the next year and to a maximum of 12 launches per year from year 5 and beyond. For comparison, RocketLab in New Zealand has successfully launched 21 missions since its first rocket launch in May 2017.
- The original Frontline economic impact model associates the numbers of employees with the number of planned launches. As not all of the work undertaken at Orbex is directly linked to the Sutherland Space Port facility, we have extended the initial assumptions to account for planned growth publicly announced by Orbex. Orbex have stated that they intend to increase their number of employees in the Highlands and Moray region from 90 at the end of 2021 to 400 by 2030.

# Assumptions

### Visitor Numbers

Visitor numbers including sector and specialist visitors and tourists have been updated based on a study by The Moffat Centre for Travel & Tourism Business Development at Glasgow Caledonian University  who provide anticipated visitor numbers per launch to be as follows. The increase in visitors from year 3 is associated with a proposed introduction of a visitors centre and incremental improvements in local facilities such as retail and hospitality:

### Accommodation to Support Launch Activities

We retain assumptions from the Frontline report that in addition to the local workforce operating the space port, 30 workers will be located temporarily by the space port to support each planned launch and they will stay for an average of 28 nights per launch.

This will provide an increase in demand for local accommodation, food and drink and entertainment activities close to the Sutherland Space Port and an increase in jobs related to those activities.

| Year of Launch | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Visitor numbers per launch (midpoint of The Moffat Centre estimate) | 442 | 323 | 368 | 368 |
| Number of launches | 1 | 3 | 7 | 12 |
| Visitors per annum | 442 | 970 | 2,578 | 4,419 |
| Attraction life cycle stage | Growth Novelty Interest | Maturity | Decline | Decline and Stabilisation |

# Deadweight, Displacement and Leakage

Jacobs' economic impact model accounts for ***deadweight*** (the amount of space sector activity that would have been achieved without investment into Space Hub Sutherland), ***displacement*** (activities which would have existed but are attracted to the Highlands and Moray region from elsewhere to the detriment of economic activity in the former location) and ***leakage*** (where money leaves the area to other locations). For continuity, we have adopted the total deadweight, displacement and leakage GVA figures used within the original Frontline report. These are:

| | Highlands and Islands (%) | Scotland (%) | UK (%) |
|---|---|---|---|
| Construction | 15 | 20 | 25 |
| Site management | 0 | 0 | 0 |
| Launch activities | 40 | 25 | 15 |
| Tourism | 50 | 60 | 75 |
| Accommodation | 50 | 60 | 75 |

### Multipliers

Again, for the sake of continuity, the Jacobs' economic impact model adopts the same multipliers as applied within the evidence base for the planning application for the space hub. In addition, we have adopted the UK multiplier to account for construction related activities within the Jacobs model. Multipliers used in the model are:

### Growth Scenarios and Time Horizon

As set out in the introduction to this report, the space sector is growing steadily but with underlying rapid changes in the types of organisations involved, the implementation of different technologies and the funding being made available. Therefore, in addition to the baseline scenario set out above, we have modelled two different growth scenarios to better understand the uncertainty associated with the growth of the space sector. We identify how changes in the number of launches and visitor numbers may impact on job numbers and value created overall.

*Scenario 1 – slower ramp up and fewer launches in the longer run.*

For scenario 1, the ramp up in the number of launches is slower and the maximum capacity of rocket launches is 9 per annum. In addition, visitor numbers are reduced to the lower end of the Moffat Centre's estimates. The assumptions are as follows:

| Year of launch | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Visitor numbers per launch (low point of The Moffat Centre Estimate) | 412 | 303 | 343 | 343 | 343 | 343 |
| Number of launches | 1 | 2 | 4 | 6 | 8 | 9 |
| Visitors per annum | 412 | 606 | 1,372 | 2,058 | 2,744 | 3,087 |

### Scenario 2 – Quicker ramp up of launches and more visitors attracted

For scenario 2 the ramp up to achieve the maximum of 12 launches per year is achieved more quickly and the visitor numbers are increased to the upper end of the Moffat Centre's estimates. The assumptions are as follows:

| Year of launch | 1 | 2 | 3 |
|---|---|---|---|
| Visitor numbers per launch (low point of The Moffat Centre Estimate) | 472 | 343 | 393 |
| Number of launches | 1 | 7 | 12 |
| Visitors per annum | 473 | 2,401 | 4,716 |

# Timelines for modelling

For the baseline and two scenarios employment numbers and value created are estimated over three-time horizons:

Short term: 4 years to 2026 (to provide a focus for the growth deal)

Medium term: 9 years to 2030 (to provide a focus that aligns with the UK Space Strategy)

Long term: 29 years to 2050 (to provide a focus that aligns with infrastructure planning at a national level)

### Employment and Gross Value Added

The following figures have been estimated for annual average full time equivalent jobs (rounded to nearest 10). These figures account for the full development lifecycle of Space Hub Sutherland from construction through to operation i.e. to 2026 – the average employment supported by the investment between 2021 and 2026.

| | Baseline model | | | Scenario 1 | | | Scenario 2 | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | 2026 | 2030 | 2050 | 2026 | 2030 | 2050 | 2026 | 2030 | 2050 |
| Highlands and Islands | 290 | 390 | 480 | 210 | 280 | 360 | 330 | 410 | 490 |
| Scotland | 470 | 660 | 840 | 330 | 470 | 630 | 550 | 700 | 860 |
| United Kingdom | 520 | 730 | 940 | 360 | 520 | 700 | 600 | 760 | 950 |

The following figures have been estimated for average annual Gross Value Added (GVA) which is a measure of the value of goods and services produced in an area, industry or sector of an economy. Similar to employment these figures account for the full value created across the entire development lifecycle of Space Hub Sutherland from construction through to operation i.e. to 2026 – the average Gross Value Added created by the investment between 2021 and 2026.

| | Baseline model (£m) | | | Scenario 1 (£m) | | | Scenario 2 (£m) | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | 2026 | 2030 | 2050 | 2026 | 2030 | 2050 | 2026 | 2030 | 2050 |
| Highlands and Islands | 15 | 22 | 29 | 10 | 16 | 21 | 20 | 25 | 29 |
| Scotland | 23 | 36 | 47 | 14 | 25 | 35 | 31 | 40 | 49 |
| United Kingdom | 25 | 40 | 53 | 15 | 28 | 39 | 34 | 45 | 54 |

# Estimating the wider value and job impacts unlocked by activities at Space Hub Sutherland for the Space Cluster

Developing the UK's launch capability at Sutherland brings a multitude of benefits. It will provide vital local economic impacts for the region by offering a range of locally based employment opportunities and the chance to be at the forefront of an exciting emerging sector which will also bring indirect impacts to boost the already thriving tourism economy in the region.

As a highly innovative industry, the space sector encourages a wide range of other activities that can be difficult to forecast. Technologies developed for the space sector have since found many other beneficial uses and commercial opportunities on earth. NASA has tracked more than 2000 spinoffs since 1976 from memory foam to revolutionizing the design of HGVs using aerodynamic research. Similarly, ESA's Technology Transfer Programme has supported over 150 separate technological innovations over the past decade, fostering the creation of around 20 new companies and 2,500 jobs.

Space Hub Sutherland will be a key enabler for the emerging space cluster in the North Highland and Moray region. As the first vertical space launch facility in the UK, it will be able to leverage first-mover advantages. These include developing strong brand recognition, establishing key supply chains, and retaining and growing the existing highly skilled workforce in the North Highlands and Moray region. Space Hub Sutherland will also play a critical role in supporting the further development of other space ports across the country by identifying and sharing areas of improvements once the facility is established and operational.

The space cluster in the North Highlands and Moray will provide an opportunity to leverage and grow existing training facilities across the region boosting the economic activities of the Highlands and Islands University and other training providers as they develop new courses and facilities to meet emerging skills requirements.

Efforts are currently underway to engage and attract additional companies who are involved in space situational awareness to locate in the Highland and Moray region. Furthermore, companies involved in space applications including defence and earth observation are likely to be attracted to the emerging space cluster.

The approach used for the economic impact model by Frontline for the Space Hub Sutherland investment was to determine the value added and employment created by the establishment and running of the Spaceport and Launch Service Operator. It accounts for upstream activities, the design and build of the space port itself, the activities of the launch service operator on that site and the associated indirect and induced impacts. It does not attempt to estimate the further value unlocked by having a space port on the midstream and downstream activities of the wider space sector.

# Estimating the wider value and job impacts unlocked by activities at Space Hub Sutherland for the Space Cluster

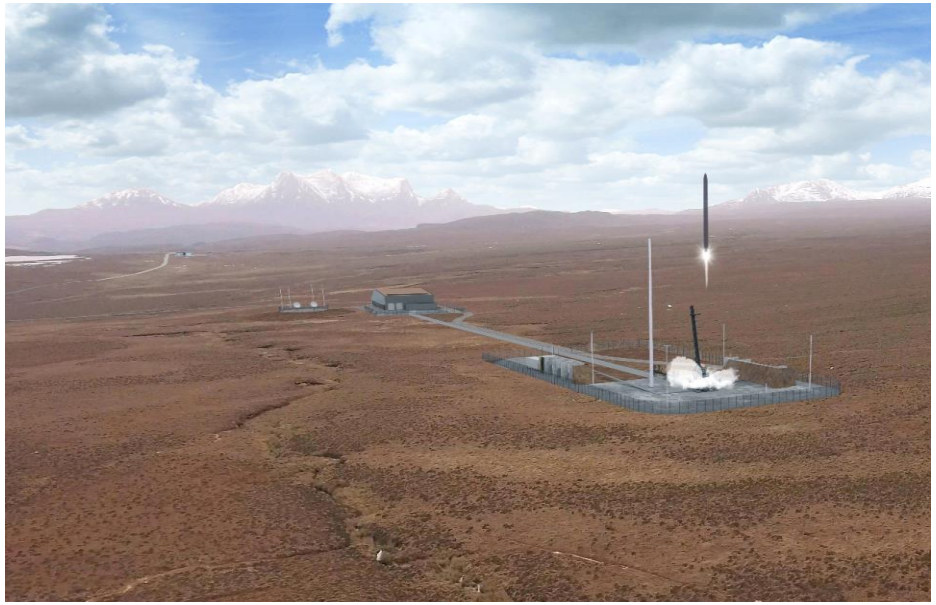
It is challenging to put a figure on the extent of opportunities that will be unlocked by Space Hub Sutherland and its associated space cluster. The Jacobs' economic impact model has been extended to account for the value potentially unlocked for the midstream and downstream activities that will be supported by the payloads being launched from the space port. The UK already has a thriving space sector with many midstream and downstream activities already underway despite the lack of a UK based launch facility. Therefore we have chosen to apply a transparent and conservative approach to model the likely increase in GVA and employment in the midstream and downstream activities derived from the new Sutherland Spaceport facility based on the experience of New Zealand whom have developed a similar launch capacity to what is proposed at Sutherland.

In New Zealand upstream activities account for 40% of the GVA of the space sector with midstream and downstream accounting for the remaining 60%. We have assumed that any increase in the upstream activities will have a linear impact on the downstream activities giving a multiplier of 2.49. That is for every £1 of GVA created by upstream activities a further £1.49 is unlocked in the midstream and downstream part of the space sector.

Similarly, for FTEs, 52% of the space sector in New Zealand are employed within upstream activities with midstream and downstream activities accounting for the remaining 48%. We have assumed that any increase in the upstream FTEs will have a linear impact on the downstream FTEs giving a multiplier of 1.91. That is for every 1 new FTE created by upstream activities a 0.91 FTEs are created in the midstream and downstream part of the space sector.

In 2020, it was estimated that the space economy contributed £6.6bn of GVA to the UK's economy and unlocked at least £360bn of GVA by supporting industries that are dependent on satellite services including navigation, meteorology, communications and earth observation. In our estimates we have identified that by 2030, Space Hub Sutherland will support the following full time equivalent jobs (rounded to 10) and value for upstream, midstream and downstream activities (rounded to nearest £m) summarised in the table here.

| | FTE | GVA (£m) |
|---|---|---|
| Highlands and Islands | 740 | 56 |
| Scotland | 1260 | 90 |
| United Kingdom | 1400 | 99 |



# End of Report