

A satellite view of Earth from space, showing a curved horizon and a mix of blue oceans and brownish-green landmasses. The image is used as a background for the document cover.

**NEWANGLIA**

Local Enterprise Partnership  
for Norfolk and Suffolk

**SPACE STRATEGY  
FOR NORFOLK AND  
SUFFOLK 2022**

# 02

## CONTACT

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ASTROAGENCY

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# 04

## LIST OF ABBREVIATIONS

<b>AIS</b> Automatic Identification System	<b>NERC</b> National Environmental Research Council
<b>BEIS</b> Business, Energy & Industrial Strategy	<b>ORE</b> Offshore Renewable Energy
<b>BIC</b> Business Incubation Centres	<b>PML</b> Plymouth Marine Laboratory
<b>CEFAS</b> Centre for Environment, Fisheries and Aquaculture Science	<b>RFID</b> Radio Frequency Identification
<b>DASA</b> Defence And Security Accelerator	<b>ROV</b> Remotely Operated Vehicles
<b>DEFRA</b> Department for Environment, Food & Rural Affairs	<b>RPAS</b> Remotely Piloted Aircraft Systems
<b>DIT</b> Department of International Trade	<b>SAC</b> Satellite Applications Catapult
<b>DOT</b> Department Of Transport	<b>SAR</b> Synthetic Aperture Radar
<b>EA</b> Environment Agency	<b>SBSP</b> Space Based Solar Power
<b>EEEGR</b> East of England Energy Group	<b>SDG</b> Sustainable Development Goals
<b>EO</b> Earth Observation	<b>SEI</b> Space Energy Initiative
<b>ESA</b> European Space Agency	<b>SEL</b> Space Enterprise Lab
<b>FCDO</b> Foreign, Commonwealth & Development Office	<b>SME</b> Small and Medium Enterprise
<b>GIS</b> Geographic Information Systems	<b>SOV</b> Service Operation Vessel
<b>HPO</b> High Potential Opportunity	<b>SMR</b> Small Modular Reactors
<b>IoT</b> Internet of Things	<b>SPRINT</b> SPace Research and Innovation Network for Technology
<b>KTN</b> Knowledge Transfer Network	<b>STEM</b> Science, Technology, Engineering and Mathematics
<b>LEO</b> Low Earth Orbit	<b>STFC</b> Science, Technology and Facilities Council
<b>LEP</b> Local Enterprise Partnership	<b>UEA</b> University of East Anglia
<b>LIDAR</b> Light Detection And Ranging	<b>UoS</b> University of Suffolk
<b>LoRa</b> Long Range	<b>UKRI</b> UK Research and Innovation
<b>LoRaWAN</b> Long Range Wide Area Network	<b>UKSA</b> UK Space Agency
<b>MOD</b> Ministry Of Defence	<b>UN</b> United Nations
<b>NA</b> New Anglia	<b>VMS</b> Vessel Monitoring Systems
<b>NAAME</b> New Anglia Advanced Manufacturing and Engineering	<b>VSAT</b> Very Small Aperture Terminal
<b>NASA</b> National Aeronautics and Space Administration	

# 05

## FOREWORD

The UK's growing space sector presents exciting opportunities for Norfolk & Suffolk where not even the sky is the limit!

A number of businesses, education and research institutions in the area are already engaged with this sector. However, we need a stronger voice and focus to promote these capabilities to the rest of the country and beyond to maximise its potential. There are a range of exciting uses of space technologies that can – and should – be promoted far more extensively for the benefit and growth of the whole region. New Anglia LEP is leading this work, along with regional partners, to help drive forward the activity through not only producing this strategy but also forming a space cluster group and identity. This activity brings together a diverse range of leading industry, and research and education experts from across multiple sectors and innovation clusters.

Collectively we are building strong relationships with the European Space Agency, UK Space Agency and Satellite Applications Catapult to help create new opportunities in line with the National Space Strategy, launched by the Government in 2021. This will help to identify applications of space and satellite technologies to boost jobs and support diverse sectors such as food and agriculture, offshore wind, coastal and marine science, transport and logistics.

Meanwhile, our existing technology strengths and innovation assets such as Adastral Park, Norwich Research Park, Hethel Innovation, OrbisEnergy, CEFAS, UEA, University of Suffolk and others, present exciting opportunities for Norfolk and Suffolk to become a UK leader in the supply chain for the global space sector.

*C J Green – Chair, New Anglia LEP*

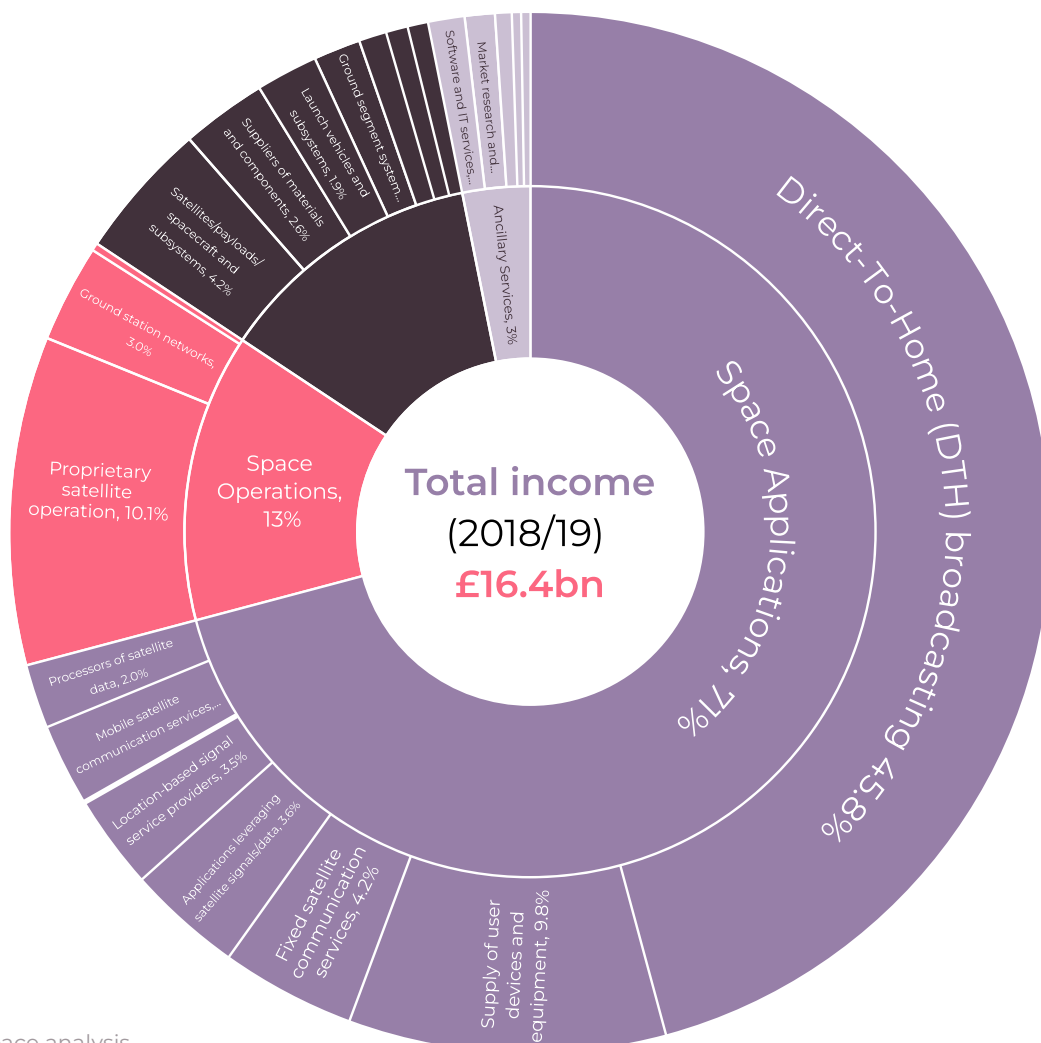
*Johnathan Reynolds, Chair, Norfolk and Suffolk Innovation Board*

# 06

## INTRODUCTION

The UK space sector is worth more than £16.4 billion per year (2018/2019) and currently directly employs more than 45,000 people (UKSA Size & Health of the UK Space Industry 2021). Space plays a critical role in our daily lives with satellites connecting us, monitoring our climate, keeping us secure, helping us navigate roads and seas, providing weather forecasts and a whole host of other applications that support the economy, the environment and underpin our society at large. Space presents a significant opportunity and the global space market is projected to grow from £270 billion to £490 billion by 2030.

### UK space industry income by segment and activity, 2018/19

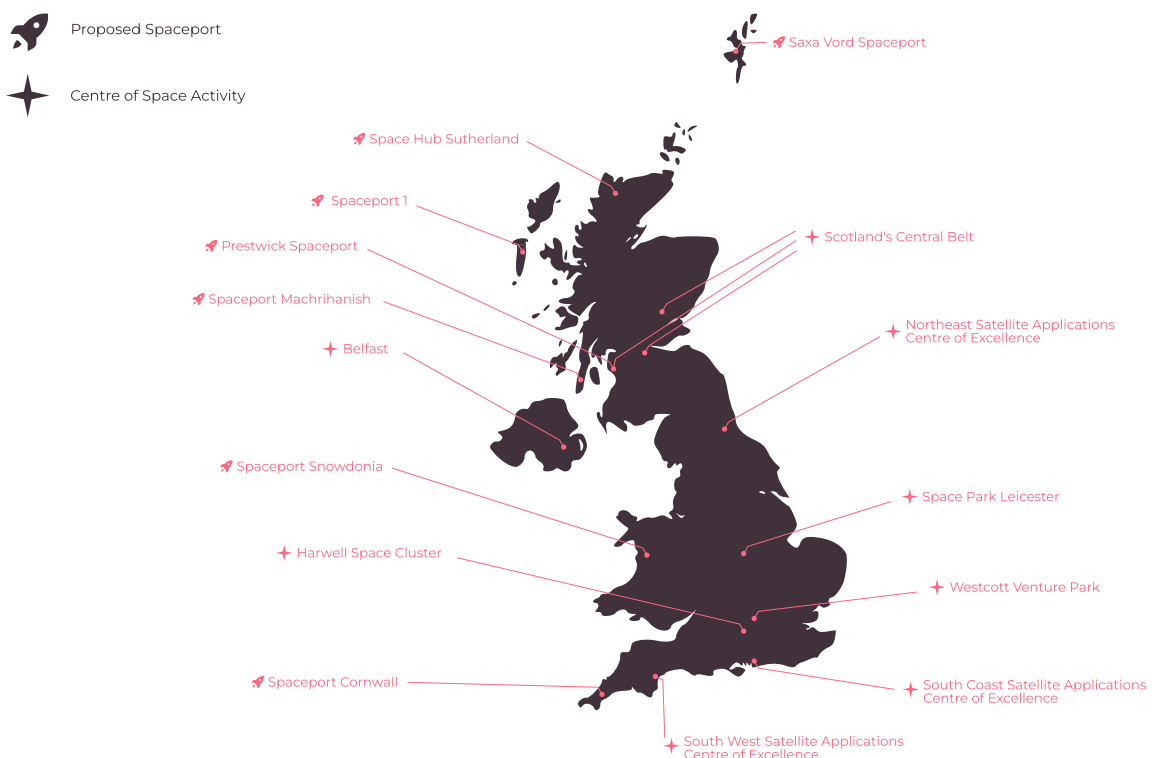


# 07

## INTRODUCTION

It has also demonstrated resilience, as one of few industries to continue its rapid rate of development throughout the COVID-19 pandemic. Recognising the clear opportunity offered by the sector, the UK's National Space Strategy — published in 2021 — aims to unlock growth in the UK space sector, foster international collaboration, and enhance the country's reputation as a science and technology superpower.

The UK National Space Strategy aims to develop space ecosystems regionally, by interacting with the established Harwell Space Cluster and the Oxford-Cambridge arc of space related activity. Currently, the UK space sector has no formally represented cluster or space-centred hub in the East of England to provide local support and representation in the space industry. Compared to other regions of the UK, however, the area has made greater use of space technology in certain sectors, such as agriculture and marine. The East of England region also boasts the largest communications and IT cluster in the UK, with extensive satellite ground station facilities at Aosta Park, capable of playing a key role in supporting the national space strategy, yet this is not widely known outside the region. This is one example of the myriad opportunities to leverage the regional space expertise in these sectors and grow new businesses, as well as to provide knowledge to the wider UK and internationally.



# 08

## INTRODUCTION

To capitalise on the opportunities presented by a growing space sector, clusters of space activity centred on a single location such as a locally organised space hub, (or multiple cluster locations within a region), have been successful in highlighting space activity in order to drive inward, and in many cases outward, investment. Examples of this include the North West Space Cluster, located at a single site, and the Scottish Space Cluster, composed of a collection of local clusters of space activity, both of which have demonstrated increased economic growth, and greater investment in a skilled workforce.

“ *In the 1960's, the UK government considered launching the Black Arrow rocket into orbit from the Brancaster on the North Coast of Norfolk* ”

This strategy, initiated by the New Anglia Local Enterprise Partnership (LEP), seeks to capitalise on and showcase the existing regional expertise in space services and applications, while harnessing diverse business capabilities across the region. This will boost space activity and lay the foundations for turning Norfolk and Suffolk into a recognised player in the UK space industry and contributing to the industry's strategic aims, whilst aligning with the UK's National Space Strategy, and with several of the areas of activity mapping to the UN Sustainable Development Goals. It has already been highlighted that this sector has high growth potential and this strategy aims to help Norfolk and Suffolk and capture an increased slice of this growth.

To do this, the strategy identifies new areas of opportunity and highlights potential additional revenue streams for existing businesses in the region, providing the capability to level up growth across the entire region rather than in specific locations, and to use space to develop sustainable solutions in the drive towards net zero.

New Anglia LEP already has a growing number of companies that contribute to the UK space sector. *This strategy will provide an outline of existing space activity in the region, identify current and future collaborative opportunities, and highlight new business opportunities that can galvanise future growth.*



# 09

## INTRODUCTION

A Norfolk and Suffolk space cluster could already differentiate itself from most other UK space clusters in a number of sectors, building on the opportunities for convergence between space and a wide range of other industries, for which the Norfolk and Suffolk region is already active, most notably leveraging the strengths of the existing communication and IT cluster - this covers areas including **Satellite Communications, Broadcast Technology, Mobile Sat Comms and Optics / Photonics**. The Agritech sector in the region already makes extensive use of space applications and services, and the size of the agritech market in Norfolk and Suffolk, offers a greater opportunity for adoption of space services for this sector. This existing use of space data could provide an opportunity for a Norfolk and Suffolk space cluster to lead the UK space community, and export expertise internationally. Space applications and services are used extensively for marine / aquatech in the Norfolk and Suffolk region, and represent a clear opportunity for a local space cluster to provide national leadership in this domain. Having extensive renewable energy generation in the form of wind and solar farms, a nuclear power station, and developments around a Hydrogen based economy provides an opportunity for convergence of space technologies with terrestrial infrastructure monitoring technologies.

The space sector for Norfolk and Suffolk, to date, could be described as something of a quiet, understated success story. However, the region's space capabilities need to be championed to the wider industry and beyond. There are a range of exciting uses of space technology that can — and should — be promoted far more extensively for the benefit and growth of the whole region.

**The time to demonstrate Norfolk and Suffolk's space strengths with a substantial space cluster is now.**

# 10 VISION

A thriving region of space activity will be driven by a large space cluster at Adastral Park, with space clusters in Norwich, as well as on the coast, at locations such as Lowestoft, all working collaboratively to provide advantages in the space sector for businesses, organisations and educational establishments across the region. The vision for space in Norfolk and Suffolk seeks to ensure that all sectors and areas within the region benefit from a coherent space strategy that builds on existing strengths, takes advantage of specific opportunities within the region and drives convergence between space and terrestrial solutions. A Norfolk and Suffolk space cluster would establish itself as a key player in the UK space community, engaged in various aspects of the space sector, and boasting a local presence from the UKSA, ESA BIC, Satellite Applications Catapult Space Enterprise Lab and Living Labs, as well as a plethora of local space ambassadors to promote the Norfolk and Suffolk region.

This enhanced hub of activity will draw in companies outside the region, eager to work with and relocate, growing the market further and faster. The Norfolk and Suffolk region has the capability to become the UK leader in space communications, with space data flowing down via radio and laser transmissions first to a cluster at Adastral Park, and then later to the other clusters in the region as they grow. The Norfolk and Suffolk region will also be able to provide UK leadership regarding the use of space applications and services, and to provide knowledge and expertise not only to the rest of the UK, but further afield. The vision is for the Norfolk and Suffolk region to seize that opportunity and to establish the capability and reputation over the next few years, before building on the foundations this lays, to export this expertise globally.



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## VISION

Using Norfolk and Suffolk's extensive experience of the agriculture, marine and energy sectors, along with the academic research on climate change, there is a real opportunity for the region to play a lead role in sustainability and the drive to net zero in a space context, and over the next few years establish thought leadership in the use of space for real world sustainability applications, and be a player in the Space Energy Initiative, engaging in the national Space Based Solar Power and Space Nuclear projects.

There will be greater interoperability between sensor systems using the Internet of Things, through leveraging the cluster's space based communications systems, to provide an intermediary between different systems and initiatives. This will drive convergence with ground based systems, aerial systems and marine systems, supporting the agricultural, marine, transport and energy sectors.

An aspect of the vision for a Norfolk and Suffolk Space Cluster sees an expansion of launch related activity to support microgravity initiatives, and much greater engagement in space opportunities by the University of East Anglia and the University of Suffolk, including more collaboration with existing space related academic projects, and microgravity research for agritech and health initiatives.

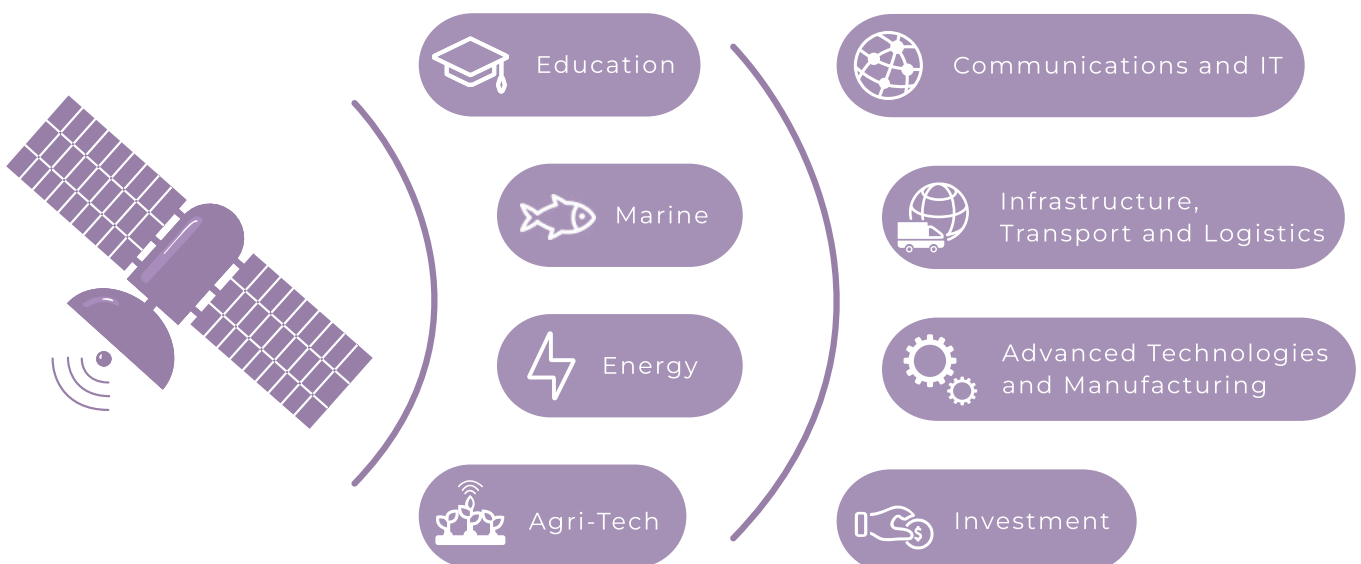
# 12

## MISSION

The Norfolk and Suffolk region will build on its existing contributions to the UK space sector to put us on the map and attract more space industry into the region. **We intend to lead the way in innovative use of space services across a wide range of industries, including Agritech, Offshore Wind, Nuclear, Marine, Communications, Advanced Manufacturing and Education.** Our space cluster concept will inspire companies, organisations and individuals that have a shared interest and passion in the space industry to help each other and open up opportunities for new businesses to become part of the industry. Norfolk and Suffolk will form a space cluster that benefits all areas of business in its region, represented by the diverse range of industries that use space services or create space-related products.

We aim to be a strong cluster that will support collaboration, growth and development to promote the region and space related activity already present in the region and further bolster development for delivery of the space industry as leaders, steering technology and development. This will help accelerate economic growth, with the opportunity to explore new areas of activity. **The aim is to transform the region, inspire collaboration and raise the profile of Norfolk and Suffolk. To promote success by sharing the existing benefits of the space industry and inspire others to contribute as well.**

### Sectors using space data



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## OVERVIEW

Norfolk and Suffolk's **strengths are in the many practical uses of space** within the Agritech, Energy, Marine and Communications industries. This gives the region a solid foundation of partnerships that can collaborate to strengthen the presence in the area and deliver innovative technical solutions.

Norfolk and Suffolk currently provide strong representation in all areas of space usage through their local industries. Leveraging the development of new space opportunities throughout the region will unite many of the businesses within the cluster in collaborative and innovative advancements, **building more convergence between industries in the region and the space sector**. Substantial practical applications exist for data, the Internet of Things, cutting-edge drone technology, robotics, AI and machine learning and practical growth in applications as diverse as food security, health monitoring and the Hydrogen economy, all of which can benefit through the integration of space technologies into their operations.

Benefits delivered by Norfolk and Suffolk include several established technology business parks that can form segments of the cluster, allowing for the region to connect with the area's strengths and build on them to establish a powerful space cluster. With facilities including Adastral Park, Norwich Research Park, Scottow Enterprise Park, Hethel Innovation Centre, and PowerPark, the support is in place for enabling space-related activity to flourish at any of these locations.

Norfolk and Suffolk have a unique opportunity to build on their extensive experience of using space services in several industries to position the region as the cluster that will help businesses into the space industry. The region can also leverage and develop new opportunities for business **to collaborate with established space industry businesses and guide them towards funding opportunities and further innovation**. This will help businesses and the cluster expand and contribute to the growth of the region's economy.

Whilst the Satellite Applications Catapult space capabilities database lists 13 companies in the Norfolk and Suffolk area who are active in the space sector, because of the tendency within Norfolk and Suffolk for companies to be modest about their achievements, this significantly under-represents the use of space applications in the region and omits an area of activity in which extensive local expertise has been developed.

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## OVERVIEW

There are numerous space-related successes within the region that should be communicated to the wider UK space sector. **The extent to which Earth Observation data and space-based navigation systems are widely adopted within the region is poorly recognised in general,** yet align with the National Space Strategy, and offer an opportunity for Norfolk and Suffolk to better support the wider UK space industry.

Additionally, the existing communications and IT cluster in Suffolk, sees a proportion of use for space-based communications data through the Ground Station at Aosta Park, which is again little recognised outside the area. There are also industries in other regions that could benefit from guidance on the practical use of space services and applications.

A newly formed space cluster would be well placed to begin an initiative that champions the space sector and would provide the opportunity to highlight the region's space strengths, given a cluster's usual level of engagement with the wider space community.

When highlighting the widespread local use of space applications and technology, the cluster will also provide knowledge of the enhanced capabilities provided by the sector to wider UK industry, which in turn, provides the opportunity for attracting new business across sectors as diverse as agriculture, health, transport and logistics, energy, infrastructure, education, climate change research and sustainability.

Many sectors within the region already use space technology or space-based data. The opportunities exist for Norfolk and Suffolk to not only use this technology but also become integrated into the process of technology development. This creates a homegrown and sustainable approach to the growth of the space sector in the area either via an enhanced supply chain or the establishment of new business, and in the process, build even more synergy with the National Space Strategy.

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## POTENTIAL SPACE INDUSTRY MARKET OPPORTUNITIES

NASA

The extensive, yet under-promoted use of space industry solutions in the Norfolk and Suffolk region demonstrates the breadth of the reach of the downstream element of the space industry, yet there are still significant gains to be had through the convergence of space services, through greater integration of Earth Observation data, Satellite positioning data with the growing opportunities around the Internet of Things, drones, AI and machine learning, with substantial opportunities for new companies to become involved at a stage where the sector is still exhibiting significant potential.

### 1 SPACE DATA

The scope of the space data market was reported as a £6 billion industry in 2020 (Allied Market Research), and already the Norfolk and Suffolk region is making extensive use of Earth observation and navigation data. The key to achieving significant revenue is not only in the applications, but in supplying the services that use space data and the data applications. Norfolk and Suffolk already have considerable expertise in this market thanks to the extensive use of these technologies by the agritech and maritime industry, as well as the expertise in AI and machine learning in the region's research institutes. Coupling this existing expertise with new developments in space data technologies presents an area for Norfolk and Suffolk to provide UK leadership, demonstrating how convergence of services can be achieved at a practical level. Space Data is also an area where there are potential opportunities for building partnerships with adjacent areas, for example because of the physical communications links from the region to Cambridge. These interregional links already exist, for example Innovation Martlesham and its extensive cluster

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## POTENTIAL SPACE INDUSTRY MARKET OPPORTUNITIES

### 2 DATA CENTRES

The huge amount of data generated by ever more powerful and numerous satellite sensors will require a huge amount of storage and processing. This creates an opening for data centres which can support the space data market for large scale applications. Due to the energy needs of data centres, there are potential opportunities to liaise with the renewable and nuclear energy sectors to investigate co-location to reduce energy losses and mitigate emissions. CEFAS already have data cubes in house, and receive, process and analyse data, before integrating it with higher level products, and this overlaps with the first market opportunity above too, demonstrating the level of interoperability.

### 3 SMALLSATS

There is still plenty of room in the market for more smallsat companies, especially with commercial applications in areas including agriculture, marine, energy efficiency of the built environment and transportation. The sensor side of smallsats is a particularly crucial segment of the market which will become even more critical as the next generation of small satellites incorporate sensors for imaging in the Thermal IR, Multispectral, Hyperspectral and SAR wavebands. The strong engineering expertise in the Norwich area at the Hethel Innovation Centre and the Scottow Enterprise Park combined with the Norwich Research Park, and the existing capabilities at the University of East Anglia, provide an environment suitable for nurturing new smallsat development and the supply chain.

### 4 SUSTAINABLE LIFE SUPPORT AND FOOD SYSTEMS

Developments for space life support and food sustainability could be applied on Earth in vertical farming, hydroponics, and aquaponics. These are areas of development in which Norfolk and Suffolk could provide expertise, potentially partnering with AgriTechE and CEFAS locally, as well as drawing in the Satellite Applications Catapult's Agri Living Lab and Healthy Living Lab, as well as providing leadership on the use of the Internet of Things for sensor monitoring of closed loop environments, where the various systems have to be self-contained. With the NASA Artemis initiative to return people to the Moon in the second half of this decade, and then on to Mars, agritech expertise is an often overlooked, but key requirement. US initiatives, US initiatives in conjunction with the UK, and European initiatives will be needed to address sustainable life support and food systems in the next few years, to ensure there is sufficient time before they are deployed operationally.



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## POTENTIAL SPACE INDUSTRY MARKET OPPORTUNITIES

### 5 GROUND STATIONS

Due to the large number of smallsat constellations being planned for broadband internet, Internet of Things and Earth Observation services, the need for both radio and optical ground stations to relay the significant growth in data will increase steadily. A 2022 EuroConsult report highlighted that the market demand for more ground stations is forecast to increase in the second half of this decade, which one would expect as more satellite constellations are orbited. This presents an opportunity for businesses and landowners in the Norfolk and Suffolk region in terms of more ground station coverage to augment the ground station at Adastral Park, and also opportunities for ground station or ground station subsystem manufacture, installation, and maintenance. With new orbital satellite broadband constellations such as those of OneWeb and Starlink, there will be opportunities for establishing small ground stations for new applications in agriculture, helping build convergence between agritech and space communications.

### 6 IN-SPACE MANUFACTURING

While currently at a low level of technological readiness, In-Space manufacturing will grow in importance as commercial space stations are launched into orbit after the retirement of the International Space Station in the second half of this decade. Companies that have experience or are building products for this use can gain a useful advantage in this market, and the advanced technologies and manufacturing needed for in-space operations still need to be constructed on Earth first. It is important for the Norfolk and Suffolk region to be aware of such future opportunities.

### 7 MICROGRAVITY

The microgravity market has traditionally been seen as requiring spacecraft conducting research in Earth orbit, such as onboard the International Space Station. There is an increasing understanding however, that microgravity enabled by suborbital rockets and even drone-based solutions can meet the requirements of a subset of the microgravity market. This is a market where innovative launch developments within the Norfolk and Suffolk region are well placed to take advantage and lead regionally and nationally.

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## ACTION PLAN



The action plan outlines **three key phases** required to advance Norfolk and Suffolk's space offering into a more structured, formalised proposition, in order to enable the region to be more able to champion its successes and capabilities in the space sector, and in order to bid for funding to help support space sector growth in Norfolk and Suffolk. Each step will **require ownership, development and execution**. It is recommended that a working group is set up to focus on each tangible milestone via a concise, separate and specific action plan focused on delivering the details of the objectives stated below.

### 1. FORMALISE THE SPACE CLUSTER

Despite existing space activity, a supportive Local Enterprise Partnership, an established steering group for space and a wide range of exciting opportunities to be capitalised upon, there is no current formalised entity to act as a gateway and catalyst for enabling space activity in the region. The creation of the Norfolk and Suffolk's Space Cluster would put the area on the UK space map, supporting the National Space Strategy, and immediately aligning Norfolk, Suffolk, and potentially Cambridgeshire, Essex and Lincolnshire with other established UK space clusters. These other clusters have been formalised as entities (such as Space Hub Yorkshire, the Northern Irish Space Special Interest Group, Space Wales or Space Scotland) or via UK Space Agency funding and recognition for regional space clusters.

If formalised as a not-for-profit entity, similar to other UK space clusters, the space cluster should assemble a Board of Directors for governance, elect a Chairperson (potentially securing an Executive Director or Cluster Manager depending on funding), and adopt a clear mission statement with oversight from stakeholders across business, academia and other constituted bodies. It will also be important to include industries and organisations which use space products and services too, including Agri-TechE, ORE, CEFAS, Innovation Martlesham, NAAME, Norwich Research Park, TechEast and Hethel Innovation.

Once the cluster has been formalised, to build credibility, support marketing and promotion a regularly updated website presence is needed —ideally with a repository that includes a capability map, news section and contact information for collaboration— would be a natural next step.

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## ACTION PLAN

Given the amount of industrial activity occurring in the large geographical area of the Norfolk and Suffolk region, as well as the need to ensure inclusion of all strengths and capabilities throughout the wider Norfolk and Suffolk region, a “metacluster” model consisting of three combined space hubs would offer the most effective way of benefitting the entire region. This approach would energise growth, solidify collaborative links and provide a clear ‘lightning rod’ for space to support the levelling up agenda.

With space activity in Norfolk and Suffolk already occurring across a range of sectors, the most obvious space hubs would be located at Adastral Park in Suffolk, Norwich Research Park in Norfolk, as well as a space hub based around marine activity at Great Yarmouth and Lowestoft. The clear positives around credibility and heritage to be derived from hosting BT at Adastral Park should be emphasised as the centre-piece of the cluster. However, the economic value of establishing a formalised approach will be realised by leveraging that credibility to attract further activity and inward investment. This will encourage the establishment and nurturing of local space start-ups or spin-outs and provide support for sectors that currently use, or would benefit from, space technology.

## 2. ENGAGE & PROMOTE THE CLUSTER

An ongoing theme throughout the interviews used to shape this report was that the space sector capabilities of Norfolk and Suffolk are poorly mapped and there were many occurrences of quotes such as “I didn’t know we had that here” or examples of local businesses failing to promote their innovative, space-related activities either locally or outside of the region. This is a clear area for improvement in order to enhance the space proposition. Once the space cluster is formally established with its own identity, messaging, positioning and branding, it will be vital to develop a marketing plan for promotion locally, nationally and internationally, both within the space sector and outside.

At a local level the space cluster should be visible, reaching out to space-related businesses to grow its membership and build a community, while fostering collaboration and relationships. The cluster should highlight local success stories in space and illuminate areas for further growth, as well as building capabilities in the region and forging links between businesses and universities.

At a national level, the space cluster should connect with other clusters and learn as much as possible from them by engaging in events, collaborating on competitions and sharing new technology while continuing to establish connections and grow the cluster’s network, whilst aligning with the National Space Strategy. The space cluster should also apply for national funding calls, both to develop the region and to gain visibility at a national level.

# 20

## ACTION PLAN

Existing business incubators should be informed of the benefits of the space cluster and what is offered to encourage the expansion of space SMEs into the region. This in turn will help encourage venture capital funding into start-ups in the area. The space cluster should also solicit input from the investment community as to what facilities, characteristics, and capabilities they would be interested in investing into the region.

At an international level, the space cluster should connect with other emerging space leaders, particularly those that complement the space applications and services strengths of Norfolk and Suffolk. Opportunities for trade, partnerships, and international investment should also be sought, ideally taking advantage of the nearby freeport.

Promotion and engagement at all three levels—local, national, and international—should take advantage of established marketing techniques via a robust integrated plan covering digital marketing, PR, business development, enquiry funnel analysis and attendance at exhibitions and conferences. Additionally, visiting online webinars, space networking gatherings both online and offline, distributing promotional materials, joining relevant space working groups or committees and communicating with non-space media outlets can help build the profile, engagement levels and credibility of the newly established space cluster.

### 3. GROW THE CLUSTER

With the cluster formalised and a plan for promotion underway, the priority will be to grow membership, investment, facilities, and capabilities, as well as interconnections and collaboration. The first step in growing the cluster will be establishing a baseline and metrics to measure progress, such as space sector turnover in the region, number of members in the space cluster, or number of new deals/partnerships signed.

To grow the membership, the cluster will require new entrants in the form of start-ups and existing businesses pivoting to the space sector to engage with entrepreneurs from academia and business. Norfolk and Suffolk's expertise in space communications and data insights will enable pivots of business into the space sector.

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## ACTION PLAN

Investment in the cluster could be sought from the Local Enterprise Partnership or tenders from organisations such as the UK Space Agency. Further funding could be obtained from venture capital for start-ups or calls from other governmental departments.

In terms of growing the facilities in the region, there are three key features it would be particularly beneficial to establish. The first is the presence of the Satellite Applications Catapult, who are already looking into establishing a Space Enterprise Lab in the region. This would better network the region with other UK clusters, while offering local services and support. The second is an enhanced presence from the UK Space Agency, potentially with the allocation of a physical space for use at one or more of the hubs, to better familiarise itself with the local space market and find ways to enable and promote the industry. The size of the facilities at Adastral Park, the existing use of space services and the newly developing space companies provide an opportunity for the UKSA and region to create a 'new Harwell' for the East of England. The presence of an ESA Business Incubation Centre would provide high profile credibility and valuable regional support to accelerate the growth of space-related start-ups, scale ups, and spin outs, strengthening the cluster and investing in its future.

Growing the capabilities of the cluster will result from increasing cluster membership, investment, and developing the facilities available. However, the capabilities of the cluster will also develop if companies are supported and kept informed by the space cluster. Providing business development support and skill development opportunities will also attract and retain companies which add to the overall capabilities of the cluster. Connecting these companies to one another will help foster collaboration, forge partnerships, and present interesting new opportunities to grow the capabilities of the cluster.



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## PROPOSED STEPS



**ESTABLISH A NORFOLK AND SUFFOLK SPACE CLUSTER BOARD** and where necessary and applicable, create working groups from member organisations throughout the cluster as appropriate to address challenges and opportunities based on the regional strengths, clear terms of reference and objectives would need to be established to ensure forward momentum and growth can be maintained. Ensure the stakeholders include the main industries / markets in the Norfolk and Suffolk region to guarantee awareness within the region of what activities use space or are directly involved with space. This in turn enables new opportunities and collaborative ventures to be supported. **Suggested Timeframe: Q4 2022**

**FORMALISE A NORFOLK AND SUFFOLK SPACE CLUSTER**, coordinated initially by the New Anglia LEP. Define the terms of reference. Decide on a formal name for the Norfolk and Suffolk Space Cluster to ensure consistency and clear messaging. Define the structure. Define the form of the legal entity. Create a business plan and marketing strategy, roadmap, engage stakeholders - local and central government, academia, business. **Suggested Timeframe: Q4 2022 – Q1 2023**

**IDENTIFY FUNDING OPPORTUNITIES** for cluster establishment from both the New Anglia LEP and the UK Space Agency through direct engagement and application for funding such as the UKSA space cluster funding to support the growth of a Norfolk and Suffolk space cluster, as well as establishing an online presence (website, social media) that allows the Norfolk and Suffolk Space Cluster to provide public visibility, direction and raise awareness. The engaging and establishing of presences of UKSA, ESA and the Satellite Applications Catapult would help provide more confidence for private investors, drawing in the venture capital community as more innovation and opportunity arises, and expanding the arc of opportunity for private investment from Silicon Fen to a wider area Eastwards. **Suggested Timeframe: Q4 2022 Onwards**

**BUILD BRAND AWARENESS** of a Norfolk and Suffolk Space Cluster both online and offline through attendance at space-related events nationally and internationally. This has proven an effective way for other space clusters to develop at pace, building connections and marketing their capabilities and the opportunities they offer. **Suggested Timeframe: Q4 2022 Onwards**

**ESTABLISH A UKSA PRESENCE** in the Norfolk and Suffolk region with a view to building a formal relationship with the UKSA that ensures that the region is integrated into the UK space ecosystem, so it can take advantage of any resultant opportunities, and that there is widespread awareness of the space cluster's areas of expertise. **Suggested Timeframe: Q1 2023 – Q3 2023**

# 23

## PROPOSED STEPS

**ENGAGE WITH THE ESA AMBASSADOR** covering the Norfolk and Suffolk region, to ensure that the Space Cluster can benefit from collaboration with ESA.

**SECURE AN ESA BIC** in the region to support the growth of new space businesses in Norfolk and Suffolk, and draw on the established network of ESA BICs throughout Europe to broaden collaboration.

**SUPPORT THE ESTABLISHMENT OF A SATELLITE APPLICATIONS CATAPULT SPACE ENTERPRISE LAB** in the Norfolk and Suffolk region to build closer connections and support collaboration with the Satellite Applications Catapult.

**LEVERAGE THE UNIQUE OPPORTUNITIES OF THE CLOSELY LOCATED FREEPORT**, to support the added value of the Space Cluster. Being the first UK space cluster with a connection to a Freeport, will provide benefits at a regional, national and international level, since it is such an unusual capability.

**INVESTIGATE THE POTENTIAL FOR A SPACE ACADEMY** run from Adastral Park with support from BT. This could be run at 2 levels - first year of sixth form and as a summer school at the end of the second year for undergraduates. It would represent an opportunity to highlight space as a career, generate native area talent, generate a skills pipeline across space (and several other sectors all working together for the good of all). It should integrate the University of Suffolk, the University of East Anglia, and the wider network that is already established such as Cambridge (ITC comms) and Lincoln (Agritech).

**REACH OUT AND ENGAGE WITH THE SPACE ENERGY INITIATIVE** regarding opportunities for Norfolk and Suffolk around:

- a) Space Based Solar Power (SBSP) - Rectenna off the Norfolk or Suffolk coast, opportunity for manufacturing in the region, and expertise in electricity grid development for existing wind based renewable energy. The University of Suffolk / Suffolk Sustainability Institute is already engaged in this initiative, and there is a clear opportunity to grow this engagement at a formative stage.
- b) Space Based Nuclear - Rolls-Royce and Satellite Applications Catapult at Westcott already involved - opportunity for nuclear expertise within Suffolk and Norfolk with Sizewell B currently, and Sizewell C in the future, and drawing in EDF.

# 24

## PROPOSED STEPS

### **SEIZE THE OPPORTUNITY FOR A NORFOLK AND SUFFOLK SPACE CLUSTER TO EXPAND THE SUPERGRID**

that goes to Cambridge to the whole region, to provide opportunities for establishing centres of excellence for data analysis to build on and support the existing activity in both the agricultural sector and the marine / aquatech sector.

A Norfolk and Suffolk Space Cluster should leverage its expertise in the convergence of space communications and data for agriculture and aquatech / marine to provide webinars in space sustainability strategy and services for stakeholders such as the Environment Agency, DEFRA and BEIS, as well as offering secondments in organisations.

**DEVELOP MEASURABLE INDICATORS** which need to be defined by a Space Cluster steering group or a working group to track progress.

**RUN SPACE NETWORKING EVENTS** similar to the Satuccino events run at Harwell, at locations such as Adastral Park, TechEast, Scottow Enterprise Park and Hethel Engineering Centre to build awareness within the region of what capabilities exist, and to broaden networks across a range of sectors. This can then be extended to space networking events at the other clusters within the Norfolk and Suffolk region.

**PLAN A SERIES OF SPACE HACKATHONS** to solve regional challenges using space services and products, these could be periodic, and could focus on a different industry sector each time, or cover several sectors each time, and could be held at the University of East Anglia, University of Suffolk, Adastral Park, TechEast, Hethel Engineering Centre, Scottow Enterprise Park.

**INITIATE A SPACE CONFERENCE** to be held in the region, potentially at Adastral Park or in Norwich or Lowestoft, to focus on the strengths of Norfolk and Suffolk in the space sector, namely; communications, agritech, marine and energy.

**ORGANISE AT LEAST ONE WORKSHOP FOR LOCAL BUSINESSES** on the space funding landscape, highlighting private Investment vehicles such as Seraphim Capital and E2MC, as well as public sector organisations offering space industry support, such as UKSA, ESA, InnovateUK, DASA, Horizon Europe, STFC, SPRINT, NERC and the Satellite Applications Catapult.



# 25

## PROPOSED STEPS

**INVESTIGATE THE FEASIBILITY OF A CENTRE OF RESEARCH IN THE REGION FOCUSED ON COASTAL EROSION, WATER MANAGEMENT AND CLIMATE CHANGE IMPACTS** There are a number of space-based observational opportunities to support researching coastal erosion, water management and the impact of climate change, as well as the impact on water management and climate change, and carbon storage capabilities of the fens. A centre of research or a research institute specialising in these areas could firstly benefit the region in terms of engaging with bodies such as the Catapult for both funding and knowledge transfer, and for learning from mitigation methods used by other countries with regions suffering similar issues. This would then provide an opportunity for international collaboration and eventually export of knowledge and expertise internationally.

**SUPPORT AND CAPITALISE ON EXISTING REGIONAL SPACE RELATED RESEARCH ACTIVITY** through more support through a space cluster, for building more international knowledge export of the work undertaken by organisations like CEFAS, Tyndall and the SSI.

**SUPPORT AN INITIATIVE FOR THE REGION TO DEVELOP A SPACE DATA-USING EARLY WARNING WATER USAGE SYSTEM** Such an initiative for the region could be co-ordinated by a Norfolk and Suffolk Space Cluster, and would rely on a partnership between the farmers who use satellite geospatial data to measure crop yield and soil moisture, and the local water infrastructure bodies such as Anglian Water and the Environment Agency, with potential involvement from UEA with their existing collaboration with Anglian Water, as well as the Suffolk Sustainability Institute. Using satellite data, Internet of Things sensors and local knowledge, farmers would be able to monitor the levels of water across their own land with greater granularity using recently developed Earth Observation and Internet of Things satellite constellations. The data would then be fed back to the water infrastructure agency as part of an early warning system to allow preventive measures to be taken, possibly reducing the flood risk to land and property downstream. Such an initiative could even be run by the Space Cluster if suitable government funding was available, since it would showcase the use of space data in a cross-sectoral initiative, in an area of increasing importance to the nation.

# 26

## SUMMARY

The establishment of a formal Norfolk and Suffolk space cluster will enable the support of projects, applications and services that provide benefit beyond the space industry with cross-sectoral links and convergence with sectors of importance to Norfolk and Suffolk (namely agritech, communications, the marine environment and sectors such as energy and logistics through the Internet of Things). There are clear benefits to being able to use the latest generation of Earth Observation Satellite data, Low Earth Orbit satellite constellations and positioning data to drive convergence and improve efficiencies across agriculture, marine / aquatech, transport, healthy living and renewable energy for providing more detailed insights for businesses to enable more accurate and timely business decisions to be made.

Throughout this strategy, the ways in which the emerging space cluster can align its activity to support the UK National Space Strategy and the UN sustainability goals have been highlighted. With the UK's drive towards a net zero society and focus on clean growth, there is an opportunity to leverage the region's many strengths in this area to ensure that the cluster is developed with future-proofing and can lead by example in this area due to existing assets.

A Norfolk and Suffolk Space Cluster has the opportunity to build on the existing strengths and areas in the region where it can really add value and new insights to the UK, namely:

- Renewable energy and nuclear energy.  
  
Demonstrating the convergence between satellite-based Earth Observation and agritech and aquatech, and the convergence of satellite data and satellite positioning system data with applications such as the internet of things for remote health monitoring and pollution monitoring, drones for delivery and for remote infrastructure and transport inspection and precision agriculture.
- Use of a freeport as part of the value proposition - a unique feature for a UK space cluster.
- Leading communications expertise (few UK space clusters have the space communications facilities at Adastral Park).
- Earth Observation and agritech in conjunction with Agri-TechE, and marine and aquatech in conjunction with CEFAS.
- Climate Change Research at the UEA.
- Sustainability as a cross sectoral need in agritech, marine, energy, transport and infrastructure.

# 27

## SUMMARY

There is clear interest and enthusiasm for building on space activity in the Norfolk and Suffolk region. Not only that, but there are natural locations across the region in terms of hubs of closely located facilities which would benefit a cluster of space activity. There is a real opportunity to “fill the gap” in the map of UK space activity, and for Norfolk and Suffolk to play a significant role in driving forward space growth on a regional and national level.

In the time spent to develop this strategy it was very clear that the Norfolk and Suffolk region is the working example of each area in the space industry. Satellite communications is represented with Adastral Park. Earth Observation is represented firstly by: Agritech in the form of the Eastern Agri-Tech Innovation Hub and Norwich Research Park, and businesses developing use case examples. And secondly, by Marine, which is strongly represented with CEFAS (marine and freshwater science) headquarters in Lowestoft. Energy, which is home to Sizewell and substantial offshore wind resources, and Launch, which is represented by Gravitilab developing a novel partial gravity flying lab with world beating potential, as well as a sea launch platform.

To say the Norfolk and Suffolk region is the unsung powerhouse of the UK would not be false. The breadth and diversity of Norfolk and Suffolk is impressive without even shouting from the rooftops. The start of a space cluster will help broadcast the already strong foundation that is so readily available in the region, and help drive the convergence between space and terrestrial. applications, to enable business growth and efficiencies to aid the move towards net zero.

# 28

## CAPABILITY MATRIX. UPSTREAM

		Norfolk		Suffolk	
		Suppliers	Users / Operators	Suppliers	Users / Operators
Satellites	Systems	◆	◆	◆	◆
	Subsystems	◆	◆	◆	◆
	Components	◆	◆	◆	◆
	Satellite Systems Testing	◆	◆	◆	◆
	Advanced Manufacturing	◆	◆	◆	◆
	Machining	◆	◆	◆	◆
	Engineering Analysis for Satellites	◆	◆	◆	◆
Launch	Launch Vehicles	◆	◆	◆	◆
	Microgravity Services	◆	◆	◆	◆
	Payload Services	◆	◆	◆	◆
	Subsystems	◆	◆	◆	◆
	Components	◆	◆	◆	◆
	Launch Brokerage	◆	◆	◆	◆
	Launch Operations Testing	◆	◆	◆	◆
	Advanced Manufacturing	◆	◆	◆	◆
	Machining	◆	◆	◆	◆
	Engineering Analysis for Launch	◆	◆	◆	◆
Ground Stations	Large Ground Stations	◆	◆	◆	◆
	Mobile Satellite Terminals	◆	◆	◆	◆
	Ground Station Subsystems	◆	◆	◆	◆
	Ground Station Components	◆	◆	◆	◆
	System Monitoring & Control	◆	◆	◆	◆
	IT and Networking Systems	◆	◆	◆	◆

◆ Capability Exists

◆ Potential Capability / Potential to supply space market

◆ Capability not identified

# 29

## CAPABILITY MATRIX. DOWNSTREAM

		Norfolk		Suffolk	
		Suppliers	Users / Operators	Suppliers	Users / Operators
Satellite Data	Satellite Broadband	◆	◆	◆	◆
	Satellite Broadcast	◆	◆	◆	◆
	Satellite Internet of Things	◆	◆	◆	◆
	Earth Observation (Optical)	◆	◆	◆	◆
	Earth Observation (Infrared)	◆	◆	◆	◆
	Earth Observation (SAR)	◆	◆	◆	◆
	Position, Navigation & Timing	◆	◆	◆	◆
	Meteorology	◆	◆	◆	◆
Space Support Services	IT Services	◆	◆	◆	◆
	AI and Machine Learning	◆	◆	◆	◆
	Robotics	◆	◆	◆	◆
	Engineering Analysis	◆	◆	◆	◆
	Space Systems Testing	◆	◆	◆	◆
	Education & STEM	◆	◆	◆	◆
	Business Consultancy & Support	◆	◆	◆	◆
	Funding & Investment	◆	◆	◆	◆
	Legal Services for Space Industry	◆	◆	◆	◆
	Insurance	◆	◆	◆	◆

◆ Capability Exists

◆ Potential Capability / Potential to supply space market

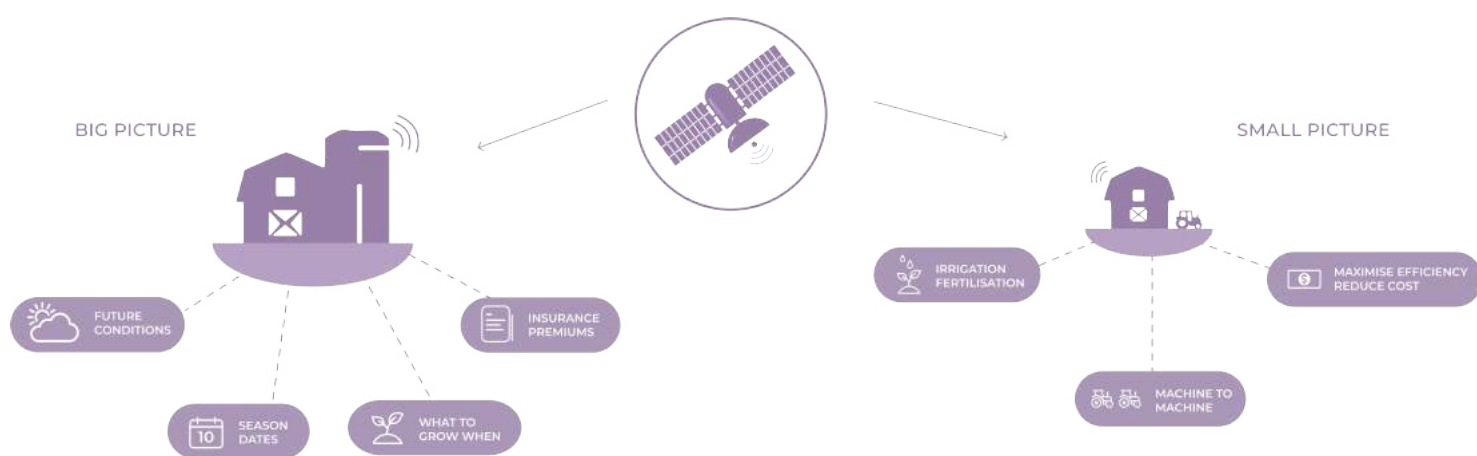
◆ Capability not identified

# NORFOLK AND SUFFOLK SPACE RELATED ACTIVITY

# 30

## AGRITECH

### Space Data Usage in Agritech



The agricultural industry in the Norfolk and Suffolk region has widely adopted space technology, although it is so well-integrated that many outside of the sector remain unaware of its use. **Precision agriculture is dependent on the use of space technology, namely satellite navigation systems for crop cultivation.**

For agricultural intelligence of crop health, space-based Earth Observation data is used for agricultural intelligence of crop health via satellite imagery, but generally at a broad, rather than fine scale. Ground or air-based monitoring solutions complement satellite imagery and can add greater value, allow finer granularity of data, and are much cheaper, although this last factor will change as new competitively priced space imagery datasets become available.

Communications within the agricultural industry have moved towards the radio spectrum. Internet of Things (IoT) technologies based on terrestrial radio networks (e.g., LoRa/LoRaWAN) are playing an increasingly significant role, ranging from in-field sensors to remote sensing of grain stores. The introduction of Low Earth Orbit satellite data constellations such as OneWeb could be a game-changer by providing cost-effective, high-bandwidth communications. Additionally, with the growth of other low Earth orbit satellite constellations such as those provided by Lacuna Space and Spire Global, narrowband data services can now be provided more cost effectively for sensor systems.

# 31

## AGRITECH

“ *Crop Angel, a Norfolk company, is developing crop spraying by UAV/drones, using satellite positioning technology to ensure accurate spraying.* ”

The Norfolk and Suffolk region is also at the forefront of robotic agriculture, with robotic crop planting and harvesting using precision satellite navigation. The region collaborates with academic partners external to the area (e.g., the University of Lincoln) on the latest robotic agricultural technologies, and the region benefits from the experience of Agri-TechE supporting the growth of the agritech cluster in the area, as well as the expertise on food, genomics and health at Norwich Research Park.

From an educational perspective, UEA is part of the Norwich Research Park eco-system, and work closely with major world-leading research institutes with view to Norwich Research Park exploring areas including population, animal, and plant health, as well as the increasing use of drones and satellite imagery for areas such as crop monitoring for production and disease control.

From an agricultural perspective, space data is used at a broad scale for Vegetation Index Estimation and to track land use changes and resource use. Satellite services are integral to Crop Supply Chain Management, Irrigation/Water Management, and the assessment of soil health. With the increasing issues around food security, and the impact on crops due to water stress, the Anglian Centre for Water Studies (a joint activity between Anglian Water and UEA) also plays a key role.

Space-based Earth observation has an important role to play in the sustainability of agriculture by helping to define carbon stocks for government reporting, as well as verifying compliance with requirements, optimising irrigation and the use of agricultural chemicals, monitoring crop health, and providing valuable insights to crop insurers.



# 32

## ENERGY



The renewable energy industry is key to the national energy strategy. The Norfolk and Suffolk region leads the country in terms of large offshore wind provision, with 25% of national offshore wind resources in the southern North Sea. *The space industry already supports the renewable energy industry through the use of satellite observations to monitor the impact of wind turbine pylons on waves, the investigation of wakes behind turbine pylons (which have an impact even as far as the Dutch coast), the use of navigation satellites for positioning during offshore wind turbine installation and satellite communications for turbine health monitoring.*

Suffolk and Norfolk are at the forefront of bringing together energy producers along the coast for a clean energy bid, “The Sunrise Coast”, which aims to develop research and innovation on sustainable energy as part of the Strength in Places Fund run by UKRI. This incorporates offshore wind farms, nuclear power stations, and future planning for the hydrogen economy. The bid brought together UEA, CEFAS, the Offshore Renewable Energy Catapult, EEEGR, the New Anglia LEP and Opergy to deliver a clean energy strategy.

“ *Norfolk has 1 million solar panel installed at 21,103 solar plants.* ”

2020 figures show that Norfolk has the sixth most solar plants in England, with a combined capacity of about 500 Megawatts, composed of a total of 21,103 solar plants ranging from small installations to large scale solar farms. The next decade will see a major expansion of solar generation capacity in the region, providing a significant impact on the reduction of carbon emissions.



# 33

## ENERGY



As well as extensive renewable energy provision in the region, significant nuclear power is also situated on the Suffolk coast, with the current Sizewell B power station, due to be augmented by the proposed Sizewell C power station in the next decade. The original Sizewell A power station is currently being decommissioned. **The monitoring of structural integrity and environmental monitoring requires extensive networks of sensors, with a greater degree of autonomy in IoT sensor systems becoming more common. The use of space systems in conjunction with terrestrial sensors can help provide more rapid and responsive solutions for large power stations.**

The development of a Hydrogen economy will help solve the energy storage challenge, since as well as being used as a substitute for natural gas, Hydrogen produced from renewable and nuclear energy will be used in fuel cells, a technology first developed for NASA's Apollo Moon Programme.

Fuel cells provide a means of storing energy in the form of Hydrogen and Oxygen, which is combined to electricity with water produced as a byproduct. This presents an opportunity for Norfolk and Suffolk to expand existing Hydrogen technological capabilities in the energy and manufacturing sectors by working with existing UK space capabilities using Hydrogen (such as companies using it as rocket fuel). This will also provide the potential for collaboration with OrbisEnergy, hydrogen developments at PowerPark, Hydrogen East and the Offshore Renewable Energy Catapult.

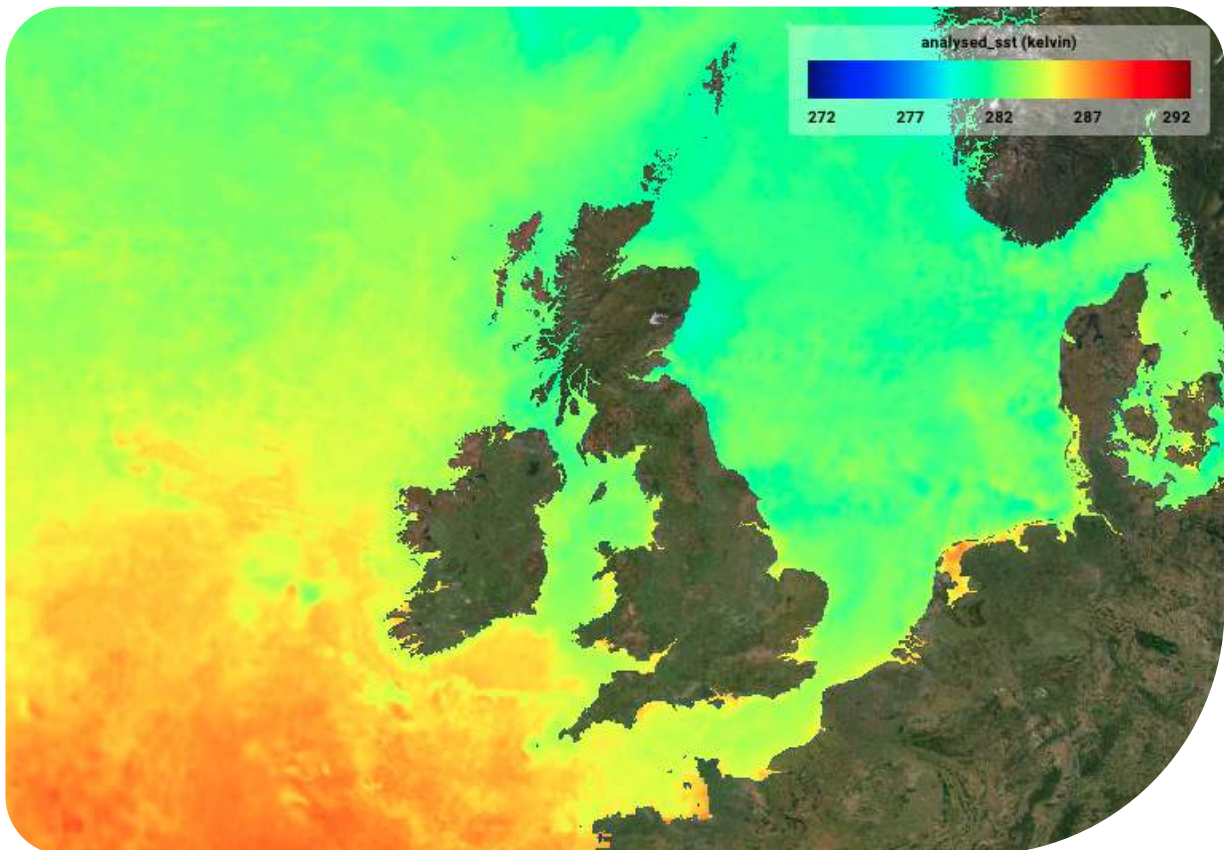
**THIS IS AN ADJUNCT INDUSTRY THAT WOULD BENEFIT FROM THE GROWTH IN THE SPACE SECTOR**

**MOVING CONCURRENTLY AND IN PARALLEL**

# 34

## MARINE

The marine industry in Norfolk and Suffolk is already an extensive user of space services and space data, through marine situational awareness, marine data, monitoring of coastal erosion and pollution, in addition to the offshore renewable energy industry. There is a shift in monitoring in the marine environment from carbon-intensive local ship measurements to satellite observations, and the region is well-placed to lead UK efforts in this transition.



Satellite image of Sea Surface Temperature (CEFAS)

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) in Lowestoft, are leaders in monitoring and researching the marine environment. CEFAS uses technology to collect, analyse, and re-use scientific data to work on tackling serious global problems of climate change, marine litter, overfishing and pollution to secure a sustainable blue future for all. They help keep the seas clean and healthy by monitoring and measuring water quality and pollution.

# 35

## MARINE



Satellite Communicating Waveglider (CEFAS)

CEFAS also assess the physical and biochemical factors impacting the seas and coastlines, and they even use satellite data to measure suspended particulates in the marine environment (the level of turbidity or haziness in water determines if divers or Remotely Operated Vehicles (ROVs) are used).

CEFAS has marine buoys and Autonomous Surface Vehicles (ASV) making use of space technology through satellites such as the Orbcomm and Iridium satellite networks. Satellite data is used to provide a cost-effective solution for applications such as measuring waves, with data sent every half hour. Offshore communications via satellites are also key, and using satellite systems offers Norfolk and Suffolk's marine sector more frequent, lower latency data transmission.

CEFAS takes marine data and uses in-house data cubes to process, analyse, and interpret the data before integrating it with higher level products for DEFRA, FCDO, BEIS, PML as well as pan-European organisations. CEFAS's international reputation means that their expertise in satellite Earth observation of the marine environment is sought for remote work in marine areas as far afield as the Caribbean. CEFAS also undertake joint activities with UEA, with the Collaborative Centre for Sustainable Use of the Seas (CCSUS (Collaborative Centre for Sustainable Use of the Seas)).

Space-based situational awareness is also widely used in the maritime sector, with VMS (Vessel Monitoring Systems) employing AIS (Automatic Identification System) for both offshore and inshore vessels. This satellite technology is key for stock assessment, as well as establishing the duration of trawler operations and the length of trawler tow lines. Another space-based system —satellite synthetic aperture radar— can be used to detect vessels during illegal operations in which satellite tracking is intentionally switched off.

# 36

## MARINE

Satellite Synthetic Aperture Radar technology is also used for emergency responses to oil spills where satellite remote sensing is key to identifying the size and extent of the damage, as well as to determining where the spill is going and helping with mitigation efforts.

The coastal environment can be protected using satellite LIDAR data in conjunction with aerial data to measure coastal stability and mitigate potential land collapse caused by coastal erosion. Satellite data can be used to monitor coastal and marine hazards including shipping hazards and algal blooms. There are also follow-on benefits for the insurance industry having more detailed knowledge of this environment, which benefits insurance underwriting as well as damage assessment for managing claims.

# 37 COMMUNICATIONS AND IT

Adastral Park, covering an area of 100 acres and with 4000 people on-site, is the location of the UK's largest Communications and IT cluster, as well as the hub for Innovation Martlesham and BT's Global R&D HQ. Adastral Park is one of 28 Department for International Trade High Potential Opportunity (HPO) sites in the UK. These are promoted through the Foreign & International Development Office, and international investment into all of these HPO sites is sought by UK embassies around the world. Adastral Park is an ideal location to enhance existing capabilities in Communications and IT and accelerate space-related ambitions, as well as innovate new technologies.

“ *Europe's first satellite transmission service was launched in April 1982, with Adastral Park's satellite dishes beaming television signals to the Orbital Test Satellite, run by Eutelsat.* ”

Innovation Martlesham, hosted at Adastral Park, consists of blue-chip companies such as BT, Cisco, Nokia and Ericsson, and forms an ecosystem centred on the communications and IT cluster at their location. Several companies involved in space or space-related products and services are already members of Innovation Martlesham, or are established at Adastral Park, such as Geographic Information Systems (GIS) experts ESRI and Satellite Navigation specialists Chronos, or are moving to the Adastral Park site (Arqit in 2022), or are at other locations in the region such as satellite equipment supplier AST in Great Yarmouth.

# 38 COMMUNICATIONS AND IT

BT has had a long association with the space industry through its downstream satellite communications activities, and through working with the space sector supply chain. Satellite communications are essential for parts of the world with no terrestrial communications infrastructure. Even in the UK parts of the country not connected through undersea cables or cabled phone lines, require satellite connections for not only voice and data communications but also for TV distribution. The telecom giant has a huge presence at Adastral Park, and with the Arqiva owned satellite ground station located on site is a clear indication of the extent of their space-related association. BT is engaged with the space industry through its work on Quantum Key Distribution (QKD) with ArQit, as well as engaging with satellite broadband company OneWeb, IOT applications such as working with satellite company Lacuna Space, BT Global's Very Small Aperture Terminal (VSAT) line and through the on-site labs, related areas such as 5G, Robotics, Immersive Video and a range of AI applications – all of which are directly applicable to space related applications. BT has already published its space strategy in April 2022, and is looking into applications that might be of interest to BT Consumer and EE.

Furthermore, through IoT technologies such as Arqiva's Sensors as a Service, as part of their Hybrid Connectivity Programme, the ability to monitor energy, infrastructure and transport through the use of both cellular and space-based technologies helps enable flexibility of choice for data communications services for sensor systems.

# 39

## ADVANCED TECHNOLOGIES AND MANUFACTURING

Advanced technologies and manufacturing within the Norfolk and Suffolk region are already responsible for significant space industry success stories. The New Anglia Advanced Manufacturing and Engineering (NAAME) and TechEast industry sector groups are collaborating with ventures such as the new regional engineering and technology hub at Productivity East in Norwich, which has space sector potential inherent in its robotics lab. Other initiatives using space technologies include the Offshore Renewable Energy catapult and the technologies developed at CEFAS in Lowestoft based on satellite communications and data services.

From a space industry upstream perspective, the Hethel Engineering Centre already hosts Knowles Capacitors who have been engaged in development of products used on Mars rovers and the International Space Station. Gravitilab, based at the Scottow Enterprise Park in Norfolk, are working on the development of launch vehicles and innovative drone-based microgravity solutions, and have conducted test rocket launches in Scotland and Australia as well as a range of educational rocket launches.

Whilst drone technology development in the region is currently more relevant for sectors such as agriculture and maritime applications, developments in the future will have crossover technologies relevant to the space sector.

For instance, avionics systems and software developed through commercial and research initiatives in the region can be repurposed for low-cost planetary missions, as proven on space missions such as NASA's Mars helicopter, which made use of numerous off the shelf systems.

The UK has always had a reputation for having a solid base of design, technology and manufacturing. Norfolk and Suffolk have been a frontrunner in a multitude of manufacturing areas. When researching the area from the manufacturing perspective, **there are over 2 dozen main companies that contribute in one way or another to the economy and at least a dozen that have a connection to the space industry.** There is an opportunity to build on the existing industry expertise and help them, and others, to pivot into the space industry.

It is noted that during the COVID pandemic, many manufacturing companies were able to pivot and adjust to the needs of the public. A similar pivot is one that the cluster could advise on, helping a company transition into the space industry. The opportunities in the region to create connections for the manufacturing of products and the export of them will contribute to the space industry. This creates connections for Norfolk and Suffolk as well as the UK to innovate, expand, grow and lead in the expanding space industry.



# 40 ADVANCED TECHNOLOGIES AND MANUFACTURING

The multi-faceted network of innovation hubs based at locations such as Innovation Martlesham, Norwich Research Park, Scottow Enterprise Park, Hethel Innovation Centre, and OrbisEnergy and PowerPark, in Norfolk and Suffolk, enable connected innovation and are in an ideal position to support the supply chain manufacturing for space and ancillary markets; for example components, reagents or materials used during the manufacturing that are a part of the industry but not intended for the final product going into space.



Gravitilab

# 41

## INFRASTRUCTURE, TRANSPORT AND LOGISTICS

A14 Corridor - Port of Felixstowe

Transport in the Norfolk and Suffolk region has challenges in terms of providing wide accessibility via road and rail, however, where the physical infrastructure is less developed, satellites can be used to provide more robust data links, and the constrained transport links present opportunities for evaluating satellite tracking for transport modelling. The effect of flooding in the region on Critical National Infrastructure such as rail transportation, can be monitored using solar powered Internet of Things sensors, leveraging hybrid networks of terrestrial and space based narrowband data communications.

The freeport, Freeport East, offers the provision of a coalition of international and local businesses, academic institutions, ports and local authorities. The freeport is offered as a secure customs zone where business can operate inside a country's land border but where different tax and customs rules apply. Businesses can benefit from: tax reliefs, simplified customs procedures and wider government support. Freeport services already use space technology through satellite tracking technologies and the Internet of Things, for asset management, and monitoring the end-to-end carbon footprint of goods. Whilst use of the Internet of Things sensors in this context often goes unnoticed, it is of key importance because the use of space-based satellite tracking technologies with the sensors provides such a complete tracking and audit record for logistics companies and their customers.

The £4.4 million Live Labs research project "A Smarter Suffolk", is funded by the Department for Transport (DfT) as part of the SMART Places Live Labs programme. "A Smarter Suffolk" is using innovative technologies including space positional services in order to increase digital innovation and the use of smart data to support highways services in urban, rural and coastal locations. A Smarter Suffolk Hackathon run in 2021 brought together the University of Suffolk, Suffolk County Council Suffolk Highways and BT to tackle new approaches to solving transport challenges.

# 42 INFRASTRUCTURE, TRANSPORT AND LOGISTICS

The current plan in the Norfolk and Suffolk Economic Strategy is to build more housing and commercial space where it is needed, and to integrate road, rail and green infrastructure to build communities and places that people want to live. Economic growth for the improvement of the East West Rail line has been planned according to the East West Rail Eastern Section Rail Prospectus and the case for investment in capacity enhancements outside of Ely is made and will shape the region's transport improvements.

The challenge has been the wider impact of the many facets of the LEP going from grey to green and implementing the successful and succinct delivery of the infrastructure, making manufacturing cleaner, greener and more sustainable. There is a need to understand the applications of traffic movements, energy measures and earth observations as they apply to Infrastructure, Transport and Logistics.

Smart transport logistics is used across a wide variety of applications including; alternate driving routes when there is traffic congestion, speed sensors in road vehicles, weather conditions to avoid getting caught out, being at a bus/train stop and seeing how long until the next bus/train is coming, accessing timetables through mobile phones, traffic and accident management using satellites is already carried out in most of the UK, but people are unaware that it is delivered from space. As is often the case with space related technologies, they work seamlessly in the background, and the challenge is to convey the message that the systems rely on space technologies and to connect the dots for people living in the region to be able to understand how space is playing a part in their everyday lives.

# 43

## EDUCATION



The Tyndall Centre for Climate Change Research at the University of East Anglia (UEA), has an international reputation in climate-change research, and whilst it is well-known within the academic sector, there is a real opportunity to demonstrate to a wider audience how this research benefits, and can further benefit the drive towards Net Zero. UEA ranks in the UK top 20 for research quality, and 91% of UEA research has been ranked as world-leading.

UEA also works with Norwich Research Park, whose satellite/telecoms background plays an important role in applications using upstream hardware systems and downstream data, presenting a key opportunity for growing space related research. The UEA led UK-India Future Networks Initiative is researching the engineering challenges associated with the drive for diversification of the digital communications supply chain and the integration of fixed, wireless and Satcom networks, and this will result in very relevant benefits in terms of helping to provide a highly skilled workforce within the region.

The UEA School of Computing Sciences already has internationally leading research strengths in AI, Machine Learning, Internet Technologies, Vision Systems, Cloud-Edge Computing as well as Future Networks (covering converged wireless, optical and Satcom communications) and Data Analytics, all of which can be applied in space industry applications. UEA also has an initiative with the University of Cambridge and the University of Essex, developing collaborative proposals for large scale test beds and holographic conferencing, with interest from BT in being involved.

Currently, the presence of IT and cybersecurity companies at Adastral Park, some in the same building as the University of Suffolk, will enable new opportunities to arise around space security. BT's research programme is built upon a suite of partnerships between academia (including over 40 universities) and collaborations across industry. Although currently, BT's most frequent and closest university partner is the University of Surrey, due to their 30 years + in working in the space sector, with their Space Research team working jointly with the 5G innovation centre, there is considerable opportunity for BT to work with the University of Suffolk and the University of East Anglia, and with the recently published BT Space Strategy, any ventures in this regard would be timely.

# 44

## EDUCATION

One of the ways that the University of Suffolk is tackling the causes of climate change is through the Suffolk Sustainability Institute. An expert multidisciplinary team is driving innovation to enable sustainable use of the Earth's resources as part of the larger issue of addressing climate change and environmental degradation. The SSI undertakes research that provides genuinely impactful solutions to support the move to Net Zero emissions not only locally and regionally, but in a global context.

The Institute's new Ecolab Living Laboratory provides test facilities and research covering the SSI's main themes of green Infrastructure, Energy and Resource Management and Sustainable and Healthy Communities.

The University of Suffolk is also looking at how the SSI can develop a centre for sustainable space solutions, including space energy infrastructure.

For the last 3 years, Gravitilab have provided launch operations for a national launch event supported by the UK Space Agency through ESERO, to provide practical STEM learning for students. Given the shortage of trained rocket scientists and engineers with the growth of launch activity in the UK, this provides an effective means to address the market shortages, by rapidly providing a vital baseline of practical skills.

# 45 SWOT ANALYSIS

One of the findings from the research to evaluate the viability of the local space sector and regional investment was the theme of lack of awareness and knowledge of companies connected to the space sector. This then translates into investment opportunities being missed because it is the best kept secret of the Norfolk and Suffolk region.

Agri-Tech has a good working relationship with space technology, and regional funding has been high, but the move towards implementation and collaboration with businesses that can benefit from the space technology has a lot more growth potential.

From an investment perspective, one key point raised was that a space strategy needs to be published before investors and companies might have the confidence to “jump on the space bandwagon.”

It is important that the sectors which benefit from using space technology and services are noted, and their market capabilities identified, so there can be clear understanding of the product or service created, for investors to see the lineage into the space industry. By forming links between the existing capabilities in the region and the wider UK space ecosystem, areas where other companies have the potential to pivot into this sector will be discovered.

The freeport in the region was highlighted for its untapped potential to align with investment opportunities. The freeport benefits from secure customs zones where businesses can operate inside a country's land border, but where different taxes and customs apply. Given the generous tax reliefs, simplified customs procedures and wider government support, the benefits this can offer both new businesses and relocating businesses, could deliver substantial new revenue streams and investment to the Norfolk and Suffolk region, with space-based tracking technology widely used for the logistics aspect.

# 46 SWOT ANALYSIS

The previous section provided an overview of existing space sector activity in the Norfolk and Suffolk region. A broader view is now presented, identifying various technologies, themes, gaps and opportunities for space growth in the region. These are grouped into Strengths, Weaknesses, Opportunities, and Threats.

## S STRENGTHS IDENTIFIED



- Communications (including Satellite Communications, Broadcast Technology, Mobile Sat Comms, Optics / Photonics) - this would be a key strength for a Norfolk and Suffolk Space Cluster compared to most other space clusters.
- The agritech industry in Norfolk and Suffolk already extensively uses space applications and services, and this is a key regional strength where a local space cluster could provide a lead for the UK space community.
- Marine / Aquatech already extensively uses space applications and services to a much larger extent than is indicated by any other UK space cluster, and this represents a clear opportunity for a local space cluster to provide national leadership in this domain.
- Drone expertise in agricultural and marine environments.
- Suborbital Launch.
- Existing facilities at the large communications and IT cluster at Adastral Park.
- Renewable and Nuclear Energy, with existing use of space technologies for wind energy systems, and potential synergy with nuclear expertise for space nuclear developments.
- Automotive sector advanced manufacturing has strong support potential.
- AI and machine learning expertise is widely applicable to analysing Earth Observation data.
- Established Internet of Things use in sectors such as Agriculture, Marine and Transport.
- Robotics development can support planetary exploration and automated manufacturing. Quantum technologies and cryptography.
- UK Microgravity services currently mainly serve orbital projects, however, because of sub-orbital microgravity development in Norfolk, there is a clear opportunity to provide a UK lead for sub-orbital microgravity.

# 47 SWOT ANALYSIS

## W WEAKNESSES

- Low visibility beyond the region.
- Lack of external awareness of existing capabilities and knowledge in Norfolk and Suffolk.
- Lack of awareness of opportunity for existing companies to develop new business streams in the space sector.
- Insufficient marketing.

## S W O T

- Underuse of facilities.
- Activity across multiple industries, not to mention academia, is very siloed, leading to lack of cross-sectoral awareness and communications.
- Untapped freeport potential.
- Poor road and rail transportation links.

## O OPPORTUNITIES

- Norfolk and Suffolk should capitalise on the specific strengths of the region that are not covered by other clusters.
- Focus on the use of space services by the agritech and marine industries.
- Focus on the strong communications cluster of activity.
- Focus on highlighting and leveraging the extensive research on climate change and sustainability solutions.
- Cluster opportunities around Great Yarmouth and Lowestoft with OrbisEnergy / PowerPark and CEFAS.

## S W O T

- Space industry leadership for the UK for specialist sectors.
- The established technology cluster at Adastral Park can be leveraged to develop new space opportunities.
- Connections between space cluster activity and the freeport present a unique selling point for the region.
- Cluster opportunities around Norwich with Productivity East, Hethel Engineering Centre and Scottow Enterprise Park.



# 48 SWOT ANALYSIS

## T THREATS



- Lack of promotion of the strengths that the region brings to the space industry, including existing extensive space services use, and use of Adastral Park as an ideal location for new space businesses.
- Other space clusters formally established.
- Other clusters have seen greater investment by being established for longer, and having higher visibility.
- Other clusters actively raising their visibility.



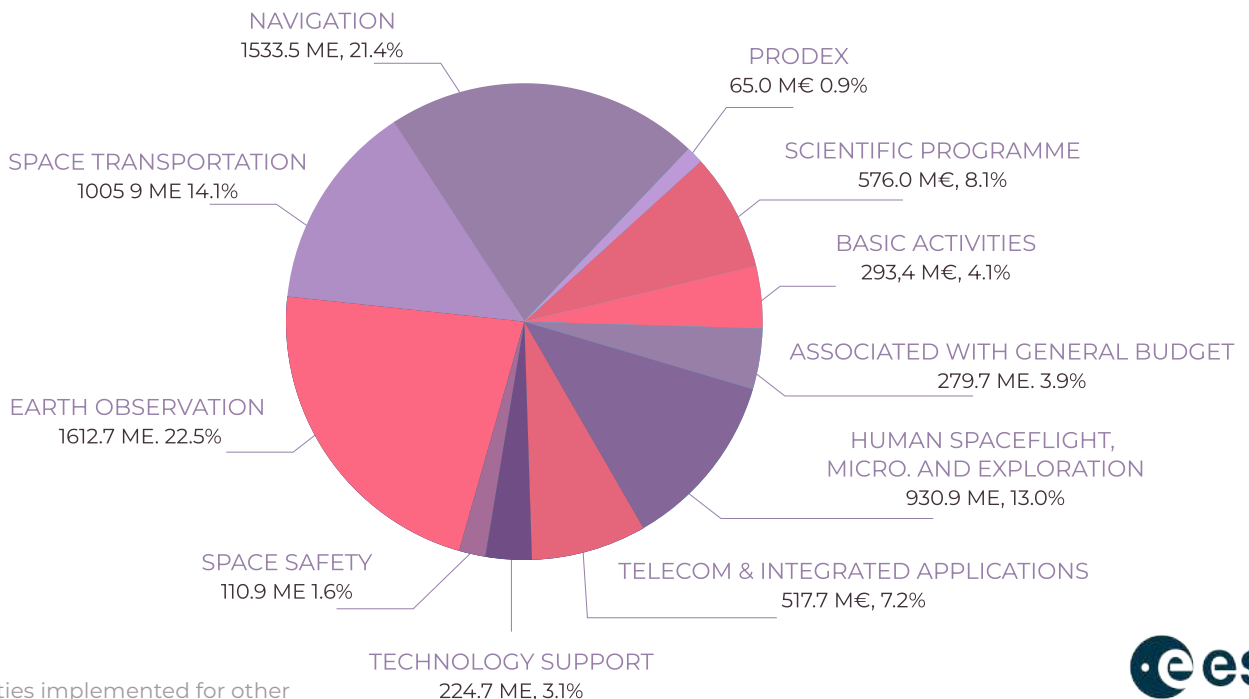
# 49

## OPPORTUNITIES

This section explores the opportunities for expanding space sector activity in the Norfolk and Suffolk region in greater detail. These opportunities primarily centre on harnessing the latest developments in space technology to benefit companies across Norfolk and Suffolk, many of which are already using space-related technologies. Further opportunities will result from the identification of developing or future space industry markets that fit with Norfolk and Suffolk's aspirations. The UK National Space Strategy plan for space data procurement, which builds on the UK Geospatial Data Strategy, seeks to improve access to Earth observation space data and space-enabled technologies. This in turn provides opportunities in several of the areas outlined below. Additionally, the space sector provides opportunities for meeting several UN Sustainability Goals, and these are noted where relevant in each sector description.

The breakdown of the European Space Agency (ESA) budget for 2022 provides a good indication of the areas of highest priority and greatest funding. Earth Observation and Navigation are the largest areas of priority, and given their widespread use in Norfolk and Suffolk within agritech, marine, transport and logistics, a space cluster would provide focus for funding for new space related initiatives within these areas.

### ESA BUDGET BY DOMAIN FOR 2022: 7.15 BE€\*



\*includes activities implemented for other

# 50

## AGRITECH

The Norfolk and Suffolk region already makes extensive use of space services, namely using satellite imagery to support the agricultural industry and satellite-enabled navigation for precision farming.

The experience that has accumulated in these areas can be used to provide expertise to other regions looking to adopt precision agriculture or to use Earth observation data to feed into sustainability initiatives, and to support the UK National Space Strategy in using space technology to fight climate change.

Satellite-based Earth Observation complements ground and air-based monitoring solutions, and the latest generation of Earth Observation satellites can provide resolution of less than 0.5 metres in wavelengths from visible through to thermal infrared. This rich source of geospatial data enables better-informed decisions to be made regarding crop growing efficiency and cultivation and providing a larger-scale overview of land utilisation. The reduction in the costs of satellite data and the increasing number of satellite passes, as more Earth Observation satellites are launched, are both providing an effective return on investment in precision agriculture. Granular, local data also allows local research and policy development to be carried out in line with the UN's Sustainable Development Goals, 2 - End hunger, achieve food security and improved nutrition and promote sustainable agriculture, and 15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. In addition to the crop growing enhancements geospatial data can bring, the same data sets can be used to highlight issues with water resources. This can include soil moisture, drainage and flooding all of which directly impact the agritech sector, as well as addressing regenerative agriculture and efficiency of water resource use.

This would present a perfect opportunity to further develop space and agritech convergence through involving organisations such as Norwich Research Park, Agritech-E and the Satellite Applications Catapult Agri Living Lab, as well as forming collaborative partnerships between space data users and government agencies where further research would lead to the benefit of all. It would also demonstrate the wider benefits of space data use to the local communities by helping with issues, such as localised flooding and its prevention, driven by climate change, as well as addressing the increasingly important issue of food security.

# 51

## AGRITECH

### POTENTIAL CASE STUDY / PROJECT

With the increased risk to many areas of the UK from seasonal flooding, there is an opportunity for the agritech and space sector to work collaboratively to help fight the problems this causes.

The Environment Agency's Flood and coastal erosion risk management report: 1 April 2019 to 31 March 2020 (Updated 15 March 2022) states that flooding in England caused an economic loss of £330 million from November 2019 to March 2020 alone, with this figure set to rise as the effects of climate change increase.

An initiative for the region would rely on a partnership between the farmers who use satellite geospatial data to measure crop yield and soil moisture and the local water infrastructure bodies such as Anglian Water and the Environment Agency.

As the farmers monitor the levels of water across their own land, they can use local knowledge as well as the data to understand and predict increasing water volumes with a specific catchment. This data would then be fed back to the water infrastructure agency as part of an early warning system to allow preventive measures to be taken, possibly reducing the flood risk to land and property downstream.

This is an example of the type of initiative that could be co-ordinated by a Norfolk and Suffolk Space Cluster, or run by the Space Cluster given suitable government funding, since it would showcase the use of space data in a cross-sectoral initiative.

# 52

## AGRITECH



Monitoring crops from satellites sensitive to specific thermal infrared wavebands, allows the detection of changes in crop health days to weeks before damage occurs. This is a step beyond visual monitoring approaches and enables much earlier mitigation measures such as the use of precision irrigation and other smart farming practices.

Using high-resolution satellite observations of the Norfolk and Suffolk region to generate high-value agricultural insights is an opportunity for both the commercial and academic sectors in the area. Such datasets would have the capacity to provide more reliable data for crop yield modelling and would enable the cultivation of crops with higher margins and a better commercial return.

There are opportunities for the Norfolk and Suffolk area companies and organisations to use their valuable knowledge of agricultural Earth Observation to support stakeholders including Governmental bodies such as DEFRA, the Environment Agency and the National Environmental Research Centre (NERC). Other opportunities include providing support to research institutes and specialist financial, climate or environmental sector entities operating at national and regional levels. A space cluster would be able to champion this expertise, and act to propagate the knowledge of this expertise more widely, possibly by forming a working group between the farming community and the governmental agencies to disseminate the benefits of space data across all agritech areas.

The massive potential for use of Internet-of-Things (IoT) sensors connected to emerging satellite broadband networks represents an opportunity for the agricultural industry in Norfolk and Suffolk to develop agricultural technologies which take advantage of space-enabled wireless networks, in conjunction with companies such as BT and Arqiva.

# 53

## ENERGY



With the focus on Net Zero and clean growth, the increasing adoption of renewable energy projects makes power generation more decentralised, and it will become increasingly important to monitor the power distribution network at high spatial and temporal resolution, in order to ensure consistent energy can be supplied across the region and the UK. This is also aligned with UN Sustainable Development Goals, 7 - Ensure access to affordable, reliable, sustainable and modern energy for all, and 12 - Ensure sustainable consumption and production patterns.

Data from Earth Observation satellites can be used to detect vegetation encroaching on the above-ground power distribution network, enabling mitigating measures to be undertaken in advance of potential damage.

Meanwhile, offshore, there is a need to monitor the effects of monopile wind pylons on the marine environment. Windfarms in deeper water can bring plumes of cold seawater to the surface, and there is a need for thermal satellite imagery at high frequency to measure and analyse the significance of such behaviours.

Activities such as these two examples offer opportunities for new space-centred business ventures to support and augment the energy sector by analysing space data, and support the UK National Space Strategy's goal to improve public services through space technology. This also presents new opportunities for academic research in the region using the existing expertise in data analysis and machine learning. In addition, there will be requirements for environmental impact assessment, environmental compliance, as well as insurance of energy assets, which can be carried out remotely and effectively using data from the latest generations of satellites.

The UKSA's Space Energy Initiative (SEI) is an innovative programme looking into Space Based Solar Power generation and Space Based Nuclear Power generation. Given Norfolk and Suffolk's expertise in renewable energy, nuclear energy and electricity distribution, there is a clear basis for becoming involved at an early stage and shaping these projects by drawing on the local expertise in energy generation and distribution, and indeed, the University of Suffolk and the Suffolk Sustainability Institute are involved in the space based solar power aspect of this programme.

# 54

## ENERGY

The nuclear expertise in Norfolk and Suffolk centred on large fission reactors can not only be applied to small modular reactors (e.g. Rolls-Royce SMRs), and the creation of Hydrogen for a Hydrogen economy, but also presents the opportunity to align with the nuclear aspect of the UKSA's space energy initiative. This cutting edge scientific and engineering research, is investigating opportunities around extending small reactor technology towards space applications such as Lunar bases and deep space missions within the next decade.

The space energy initiative is also undertaking trailblazing research into evaluating space-based solar power stations, in which the stations of around 2GW will be placed in Geostationary Earth orbit to beam down power to a large collecting area on Earth (known as a "rectenna"). While this research is at an early stage and a low level of technology development, the Norfolk and Suffolk region is ideally placed to host such a rectenna, potentially offshore, without damage to the marine ecosystem, and such a system could benefit from the area's existing power distribution network from the offshore wind farms, bringing cost reductions in the required ground infrastructure. The University of Suffolk has already investigated the possibility of establishing a rectenna either at Bradwell or offshore North of Norfolk where an onshore distributor of energy could be established from waste energy regeneration in Boston, Lincolnshire.

# 55

## MARINE

Whilst the Norfolk and Suffolk region is already a leader in using space data for the marine environment, there are several areas which could be taken advantage of and an increase in large-scale mapping of marine areas of interest would be of great value, as well as meeting with UN Sustainable Development Goal 14 - Conserve and sustainably use the oceans, seas and marine resources for sustainable development. The marine environment is under-sampled compared to the land environment, meaning that there is less data available for analysis. There is a need to use the data from the latest generations of satellites to increase spatial and temporal resolutions. New smallsat constellations will offer opportunities for increased data availability, but conversely the approaching end-of-life of ESA's Sentinel 1A satellite will hamper data availability.

Technologies such as **multi-spectral and hyperspectral imaging** are starting to become useful because they allow biological information to be extracted from satellite datasets, which benefits both aquaculture and shoreline flora and fauna due to the need for sustainable fish stocks. There is, however, a need for increased resolution in these datasets, and the latest satellite technologies are becoming able to support this. For instance, hyperspectral imagery at 50m resolution supports the extraction of data on suspended sediments, chlorophyll, as well as eddies shed by platforms. Chlorophyll is key, and the introduction of new satellites with higher resolution sensors at the wavelengths required to detect it will have significant benefits.

The integration of marine data from Remotely Piloted Aircraft Systems (RPAS) and satellites is an area where a great deal more work is required. At present the Environment Agency supports RPAS companies who can provide surveys, but there needs to be more connection with the satellite data providers. CEFAS is active in using wave glider autonomous vehicles which are used to collect water samples in the North Sea for monitoring temperature, salinity, and chlorophyll. This technology benefits from using Low Earth Orbit satellites for bi-directional transmission of data, as well as use of navigation satellites for location. Whilst this technology is not yet routine, the concept is being proved in Norfolk and Suffolk.

Finally, CEFAS and DEFRA could feasibly be interested in a CubeSat with the appropriate sensors, and this presents an opportunity for universities and the advanced technology sector in the area to focus on providing a solution.



# 56 COMMUNICATIONS AND IT

The extensive communications and IT activity at Adastral Park offers a natural location for a space cluster centred on space communications, and would align with a number of points of the UK National Space Strategy, namely unleashing innovation across the space sector, developing world class space clusters, and through the innovations emerging, improving public services with space technology and helping upskill and inspire a future space workforce. This strategy outlines the need to develop resilient space capabilities and services, including space communications, Earth Observation, command-and-control and space capability management, and Position, Navigation and Timing (PNT). Space centred communications also aligns with UN Sustainable Development Goal 9 - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

With the rollout of 5G to augment 4G and fibre broadband, there are challenges regarding ensuring cost-effective rural broadband provision, challenges that can be addressed through the use of Low Earth Orbit satellite broadband constellations to augment terrestrial capabilities. **Satellites can fill in the gaps in terrestrial coverage, provide support when terrestrial links are severed, and enable continuous coverage for mobile applications, whether in transport, logistics or drones.** Fleets of Low Earth Orbit satellites (constellations) are revolutionising satellite broadband connectivity with their faster connection speeds, due to the satellites being in lower orbits than traditional communications satellites.

This satellite connectivity is able to play an important role in addressing health and wellbeing challenges, and the Satellite Applications Catapult Healthy Living Lab, has a number of initiatives underway which drive the convergence between satellite and terrestrial technologies, and the convergence between space and the health and wellbeing sectors. This aligns well too, with Point 7 of the UK National Space Strategy, "Improve Public Services with space technology".

Given the initiatives underway in Norfolk and Suffolk, though Norwich Research Park, NNUH, the University of Suffolk, and BT, as well as the rural nature of large areas of Norfolk and Suffolk, there is an opportunity to connect with the Healthy Living Lab to trial the initiatives with various space-based projects, such as the connected ambulance and remote health monitoring, as well as space data analysis for identifying potential isolation and vulnerability to mental health issues. Similar opportunities for convergence between space technologies and assistive living could be explored through the Suffolk County Council Cassius Service, which provides assistive technologies for care and support to enable independent living, and the Showcases facility at Aadastral Park which could benefit from working with the UKSA and ESA Space Solutions space enabled hospitals initiative, which showcases how space enabled solutions can be used to enhance healthcare.

BT has a pivotal role to play due to its vast communications expertise, which will enable the organisation to act as a focal point and ambassador for the space cluster. Additionally, BT has a vision for how satellite and terrestrial Internet of Things technologies can be brought together to address environmental objectives of government departments (e.g., DEFRA), as well as to serve the interests of water and logistics companies – an area also under development by Arqiva with its Sensors as a Service as part of its Hybrid Connectivity programme. There are significant opportunities around IoT use in agriculture and the marine environment, but challenges remain in data transmission that could be resolved through use of orbital satellite constellations - an area that not only BT and Arqiva, but other companies in Norfolk and Suffolk can likely help support.

There is potential for Aadastral Park to undergo similar development in terms of space sector growth, to the Harwell Space Cluster in Oxfordshire, with the added value of a wider diversification of industries. The key component is BT, and with the growth of data services due to new low Earth orbit constellations, there is real opportunity to pivot the existing communications cluster towards the space sector. A local space cluster at Aadastral Park has the potential to lead the UK on space communications, and could catalyse innovation and enable companies to showcase their products and services, as well as promote their capabilities to forge new partnerships.

# 58

## COMMUNICATIONS AND IT

The extensive IT expertise at Adastral Park also provides opportunities for building on the quantum cryptography expertise for space-based quantum key distribution, an area of development which is already seeing CubeSat-sized satellites launched into orbit for testing and evaluation.

New generations of satellites will increasingly use laser-based communications (photonics) in the next decade. Already some satellite constellations such as SpaceX's Starlink are exploring in-orbit laser communications. This creates a market opening for companies that manufacture optical components and optical subsystems and systems for both satellites and ground stations using laser communications. These companies will be at the forefront when optical ground stations start to become more widespread. The existing activities at Adastral Park indicate that it is the most logical location for growing this area of the space market.

Given the size of the region however, a regional Norfolk and Suffolk space group may wish to explore the commercial opportunities for further ground stations, most notably in the North of the region to ensure strong continued coverage for Low Earth Orbit satellite constellations in North South / South North orbits (Polar and Sun-Synchronous Orbits).

# 59

## ADVANCED TECHNOLOGY AND MANUFACTURING

Leveraging the advanced manufacturing expertise within the Norfolk and Suffolk region has benefits in terms of developing more cost-effective techniques to manufacture satellites and launch vehicles, fitting well with the 3rd point of the UK National Space Strategy “unleashing innovation across the space sector”, in the form of advanced materials and manufacturing, robotics and smart machines, and AI and machine learning. Satellites and launch vehicles alike use a range of manufacturing technologies such as additive manufacturing and composite materials that are already available within the region, notably in the automotive industry with Lotus and Hethel Engineering. There are also a range of precision engineering companies which could provide support for the construction of satellite and launcher components and subsystems.

Advanced manufacturing also provides a means to move towards more sustainable manufacturing methods which waste fewer resources. Providing this option to the space industry — including the use of additive manufacturing for launch vehicles and satellite components — would contribute to reducing the environmental impact of the sector as a whole and would align with a number of the UN Sustainable Development Goals.

Advanced manufacturing techniques are of great benefit to the space sector as they help to reduce overall costs, shorten development cycles, allow for higher automation of production processes and help to provide a greater degree of standardisation. This allows more flexible satellite platforms to be developed with shorter lead times.

# 60

## ADVANCED TECHNOLOGY AND MANUFACTURING

With a need to level up economic growth across the country, the development of smart manufacturing, including additive manufacturing, machine learning, robotics, and automation, is a key area for space industry ventures. The fact that the Norfolk and Suffolk region has all these capabilities means that there is a pre-existing supply chain to support the growth of space industry manufacturing within the region, and even to consider the creation of smallsat developers. Additionally, the robotics developments at locations such as Aadastral Park, could have uses with off-world / planetary missions, where the planned increase in initiatives such as NASA's Project ARTEMIS lunar initiative will see missions to the Moon where robotics technologies will be key.

Smart manufacturing also encompasses connectivity, IoT and RFID capabilities, improving the use of equipment and facilities, and enabling the tracing of components throughout the supply chain.

The work underway in Norfolk and Suffolk on these technologies provides an opportunity to support the growth of cutting-edge smart manufacturing techniques within the space sector, enabling more sustainable practices and the monitoring of energy efficiency.

Drone technology is another area where the Norfolk and Suffolk region has the capability to support space activity. Drones are used as terrestrial analogues to planetary landers for space missions, and for actual use on other planets (NASA's Mars helicopter drone has already led to planning for a follow-on Mars mission with multiple helicopter drones). With NASA developments for commercial lunar landers and support of their lunar programme, the drone expertise within the region, notably at the University of East Anglia, combined with AI and machine learning expertise, provides an ideal combination to develop new services to support this growing opportunity.

# 61

## INFRASTRUCTURE, TRANSPORT AND LOGISTICS

There is a clear opportunity for a Norfolk and Suffolk Space Cluster to use space applications and services to aid the transition towards net zero. Earth Observation satellite data provides the means to identify traffic movements and density, as well as contributing to urban planning, construction, land management, hydrology, flood mitigation, and energy usage. Combined with ground-based sensors communicating with low Earth orbit satellites, Earth Observation data provides a much greater level of detail to infrastructure planners than traditional ground-based measurements.

The work underway by businesses and academia across the Norfolk and Suffolk region on the synergies between the Internet of Things and the use of satellites for consistent communication could provide regional infrastructure solutions and smart cities initiatives. Smart city initiatives already draw insights from a wide variety of sectors, and Norfolk and Suffolk could build on the region's industrial and research strengths to help shape the future of these initiatives, especially with the alignment of space services and application in this area to support UN Sustainable Development Goals, 9 - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, and 11 - Make cities and human settlements inclusive, safe, resilient and sustainable.

The Norfolk and Suffolk region is already engaged with infrastructure challenges and the opportunities they present from a research perspective. For example, the Norwich Business School is researching sectoral and economic barriers to reaching net zero, and smart cities initiatives have a stated aim of developing low carbon solutions.

Research into net zero could be a key contribution of the Norfolk and Suffolk Space Cluster to the wider UK space ecosystem, with stakeholders from multiple industries providing cross-sectoral expertise and enabling connections bridging different industries to be established.

Point 10 of the UK National Space Strategy highlights the need to use space technology to improve public services with space technology as well as to modernise and transform the UK transport system. In the Norfolk and Suffolk region, there are opportunities for businesses and academia to apply space technology with other advanced technologies to enhance the road and rail network. For example; advanced materials and components developed for launch vehicles and satellites have potential uses in transportation and the automotive industry. Equally, AI and machine learning used with satellite data could be applied to traffic monitoring and modelling.

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## INFRASTRUCTURE, TRANSPORT AND LOGISTICS

A14 Global Trade Corridor (NALEP)

A Norfolk and Suffolk Space Cluster would possess a unique feature not accessible to other space clusters - a freeport situated close to a potential cluster hub location. The existence of a Freeport very close to one of the proposed locations for the cluster hub has a number of potential benefits.

With existing knowledge accumulated with satellite tracking for asset management, there is an opportunity to export this expertise to the wider transport and logistics industry beyond the freeport ecosystem, especially in terms of demonstrating productivity and efficiency gains using space technology for road and rail transport, and the use of space IoT and navigational satellite constellations. Together with innovative software, which can be applied for monitoring carbon usage in end-to-end logistics supply, and productivity and efficiency gains, this can then help address the move towards net zero and increase the opportunity for clean growth.

Similarly, the presence of the freeport may also become increasingly relevant to space in the future with the increased cadence of international launches over the next decade. A space cluster that works with a freeport can leverage the expertise already identified in terms of the logistics operations required for a greater level of space related activity, along with the ability to transport systems and supplies via ship. This expertise can be highlighted nationally to position the Norfolk and Suffolk region as the “go to” space cluster for providing consultancy services regarding space logistics operations.

The freeport is already ring-fenced as a development area and would seem to be the perfect place to build facilities for a range of applications in support of this strategy. Other clusters have provided incentives for companies to start or relocate to their location and this is achievable for Norfolk and Suffolk. Proposed facilities could include start up units for newly formed SMEs, larger units and workshops for growing companies and potentially full buildings along with investment to attract developed space companies.

Other locations with similar incentives include Spacepark Leicester, Lincoln Science and Innovation Park and Westcott Venture Park all of which have seen a significant influx of companies (and associated investment), once facilities were in place.

Highlighting location benefits such as transport links for high-level logistics, tax incentives, existing facilities, proximity to the space cluster and the benefits that brings, also adds extra value to companies thinking of locating at the site.

# 63

## EDUCATION

Education is a key element of the UK National Space Strategy. Norfolk and Suffolk region has an opportunity to support this element by educating the next generation with relevant STEM skills at the University of East Anglia and the University of Suffolk, and also through upskilling workers for space jobs in non-university environments. The high-speed internet link between the University of East Anglia and the University of Cambridge could be augmented through research on satellite optical communications, demonstrating new capabilities and business opportunities for the region regarding the next generation of space-based optical communication, and drawing in the emerging capabilities at the University of Suffolk in telecom network software and cyber security, as well as the presence of the University of Suffolk at Adastral Park with their Digitech Centre, focused on their cyber security capabilities.

The plan for a proposed East of England Smart Emerging Technologies Institute (SETI) is currently under development as one of the recommendations from the BEIS East of England Science Innovation Audit. UEA has suggested that there could be potential opportunities for the incorporation of ICT aspects of the Space Strategy with the SETI plans, specifically where there are use-cases in key sectors that require innovations in ICT using AI/ML, IoT, Analytics, validation, and verification testbeds as well as the development of relevant courses for further developing a high skill workforce in the region, capable of supporting space activity.

There are specific needs for STEM skills that the University of East Anglia and the University of Suffolk can address, not only by educating a new generation of highly skilled graduates, but also by upgrading existing skills. One such example is building on Geographic Information System (GIS) skills with higher-level data skills such as programming and machine learning to glean insights from agricultural and marine datasets.

Academic CubeSat projects are a valuable way to build space capabilities and provide hands-on aerospace training to students, along with even smaller satellites such as Pocket Cubes and Chipsats. With the lower cost associated with the smaller satellites, there is a real opportunity for the University of East Anglia and the University of Suffolk to run workshops and hackathons to engage students in terms of building, programming and tracking small spacecraft. The resources needed to develop such ambitions are within the capabilities of any small work space.



# 64

## EDUCATION

The research at Norwich Business School on sectoral and economic barriers to reaching net zero can draw in space expertise that exists across several industries within the region to enable more insights to be derived regarding sustainability opportunities. This also provides opportunities to draw in other stakeholders in Productivity East, namely NALEP, and UEA's Schools of Engineering and Computing Sciences.

A research and innovation partnership between the freeport and universities could be an opportunity to help many facets of the region where universities and businesses come together to solve problems. Creating a regional competition (or hackathon) that benefits the universities, businesses and the space cluster could simultaneously address several aspects of space cluster development in the region. This would also highlight the educational strengths of these universities and the region as a whole, and broaden engagement to provide even more alignment with UN Sustainable Development Goal 4 - Ensure inclusive and equitable quality education for all and promote lifelong learning opportunities for all.

The Norwich University of the Arts interest in citizen science also presents similar opportunity for hackathon and workshop activities, offering an opportunity for wider public engagement through citizen science projects with a space or space related context, such as Internet of Things sensors for atmospheric monitoring for climate science, making use of satellite positioning or data communications technology.

# 65

## INVESTMENT



Norwich Research Park (NALEP)

In looking to expand the UK's National Space Strategy, the UKSA set out to create grants to help space clusters communicate the potential for new growth within the UK and to grow the 'space economy'. These grants are helping the selected areas grow and encompass space activities in a more robust way. Cluster development is a new concept bringing together existing companies in the space sector whilst helping newcomers enter the sector, either by developing the supply chain for their new products or by promoting collaborations and community-based partnerships. The concept is also useful in helping meet UN Sustainable Development Goal 8 - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Norfolk and Suffolk are frontrunners in many industries that are not widely publicised either inside or outside of the region. The area's existing strengths, as well as the abundant cross-sectoral use of space technology that occurs in the region, could be better leveraged, celebrated and promoted. Other UK regions such as Harwell, Cornwall and the Central Belt of Scotland go to significant lengths to showcase their abilities, something that Norfolk and Suffolk must replicate going forward if the area is to grow its space activity. In looking at other space clusters around the UK, it is often clear what their main focus is and how they apply existing capabilities to space in one form or another, enabling them to form a more robust space proposition to share locally, nationally and internationally. With the 'Silicon Fen' area around Cambridge nearby, there is an opportunity to extend the innovative, early stage investment ethos further East to Norfolk and Suffolk to support space activity, and provide a differentiator from other regional space clusters, in terms of developing a reputation for private investment for new space ventures. Funding and investment opportunities for space related activities are available from a wide range of sources, including: the UKSA, the Knowledge Transfer Network (KTN), Innovate UK, The Space For Smarter Government Programme, SPRINT, the National Space Innovation Fund and the regional catapults (most notably the Satellite Applications Catapult). Initiatives from government departments also address numerous sectors, and the DOT, BEIS, DIT, DEFRA and MOD are the most engaged government stakeholders in space-related activity.

Private funding through angel investment and venture capital is less available than in the US though the UK has more support for funding such space related ventures than Europe. A Norfolk and Suffolk space cluster could reach out to the Satellite Finance Network and Seraphim for guidance on the private investment opportunities, and in the process, may highlight existing opportunities these external organisations may not have been aware of.

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The existing investment and venture capital opportunities that are available within the Oxford-Cambridge arc need a space cluster or regional space ambassadors to highlight Norfolk and Suffolk's existing use of space services and how the wealth of suitable locations for advanced technology businesses, the supportive local enterprise partnership and councils, and the new space ventures can drive future growth.

There are international business opportunities within the space sector available to the Norfolk and Suffolk regions companies, both through UK trade visits and periodic calls for companies who are interested in international partnerships. The UK also contributes to the European Space Agency (ESA), and ESA have established a network of Business Incubation Centres (ESA BICs), as well as ESA Regional Ambassadors, who champion their region, and are able to keep local businesses and educational organisations aware of funding opportunities.

For the investment community, there are existing success stories within the Norfolk and Suffolk region's nascent space sector, most notably in terms of the agriculture and marine sectors. Investment into Internet of Things and drone ventures that leverage Earth observation data and space communications could drive the development of space services in the region, and opportunities for promoting space should be pursued with Tech East and NAAME [New Anglia Advanced Manufacturing & Engineering], through networking, presentations, and joint initiatives regarding space related projects.

Investment opportunities for Gravitilab's launch capability from the North Sea exist too, and with the close proximity of the Oxford-Cambridge arc, this presents a potential solution to establishing a pipeline of customers. The fact that a sea-launched jack-up barge of the type already in widespread use by the offshore wind industry could be operational from the Freeport, and using energy industry infrastructure, provides yet another form of convergence across industries. Whilst the sub-orbital rocket launch service requires investment through new stakeholders and partners, to ensure full development, the development of a world leading partial gravity drone solution also offers a greater near-term opportunity for the region too.

The extensive, yet under-promoted use of space industry solutions in the Norfolk and Suffolk region demonstrates the breadth of the reach of the downstream element of the space industry, yet there are still significant gains to be had through the convergence of space services, through greater integration of Earth Observation data, Satellite positioning data with the growing opportunities around the Internet of Things, drones, AI and machine learning, with substantial opportunities for new companies to become involved at a stage where the sector is still exhibiting significant potential.

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