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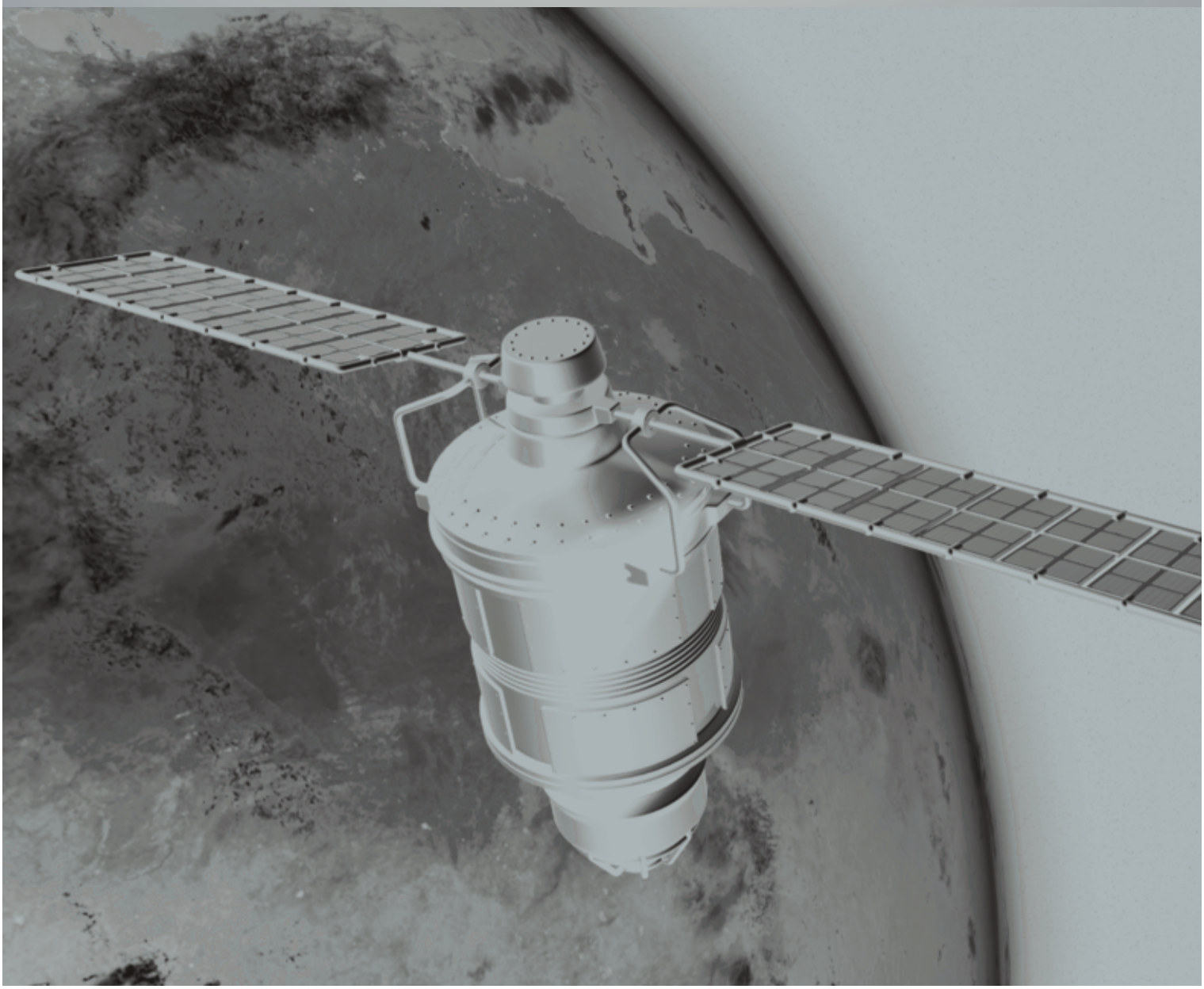
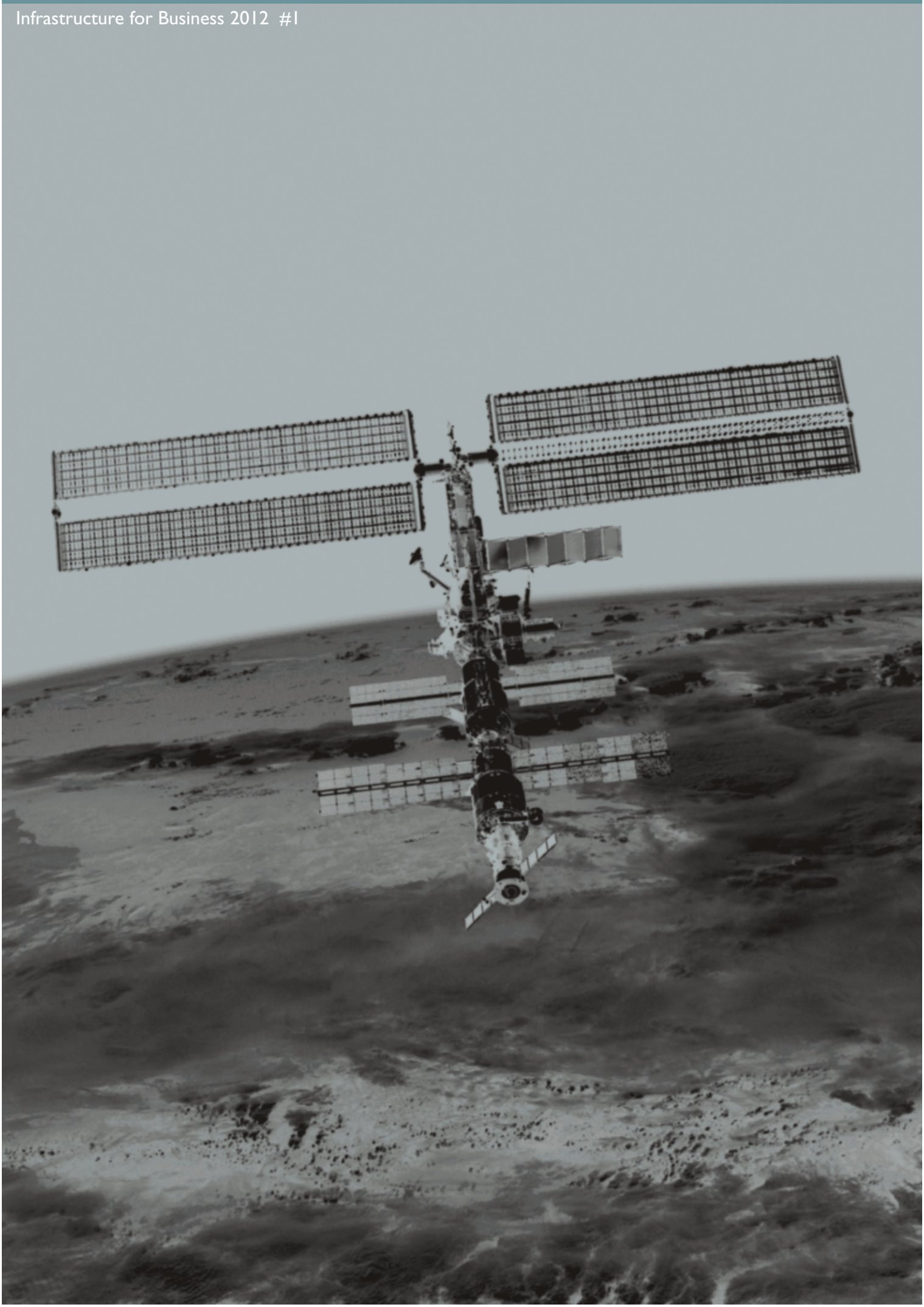
Space: Britain's New Infrastructure Frontier





Space: Britain's New Infrastructure Frontier

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Executive summary

The UK space age isn't a distant pipe dream. Britain's space sector has enjoyed a decade of expansion barely seen anywhere else and looks set to maintain BRIC-style rates of growth well into the future. Globally, the squeeze on public space agencies such as NASA is leading to a private sector space revolution, with steep cuts in the cost of getting cargo into orbit. A massive opportunity beckons for the UK, should we choose to understand and embrace it.

This report describes a real British success-story, and sets out how a few regulatory and infrastructure developments, including licensing a spaceport, would help the space sector really lift off.

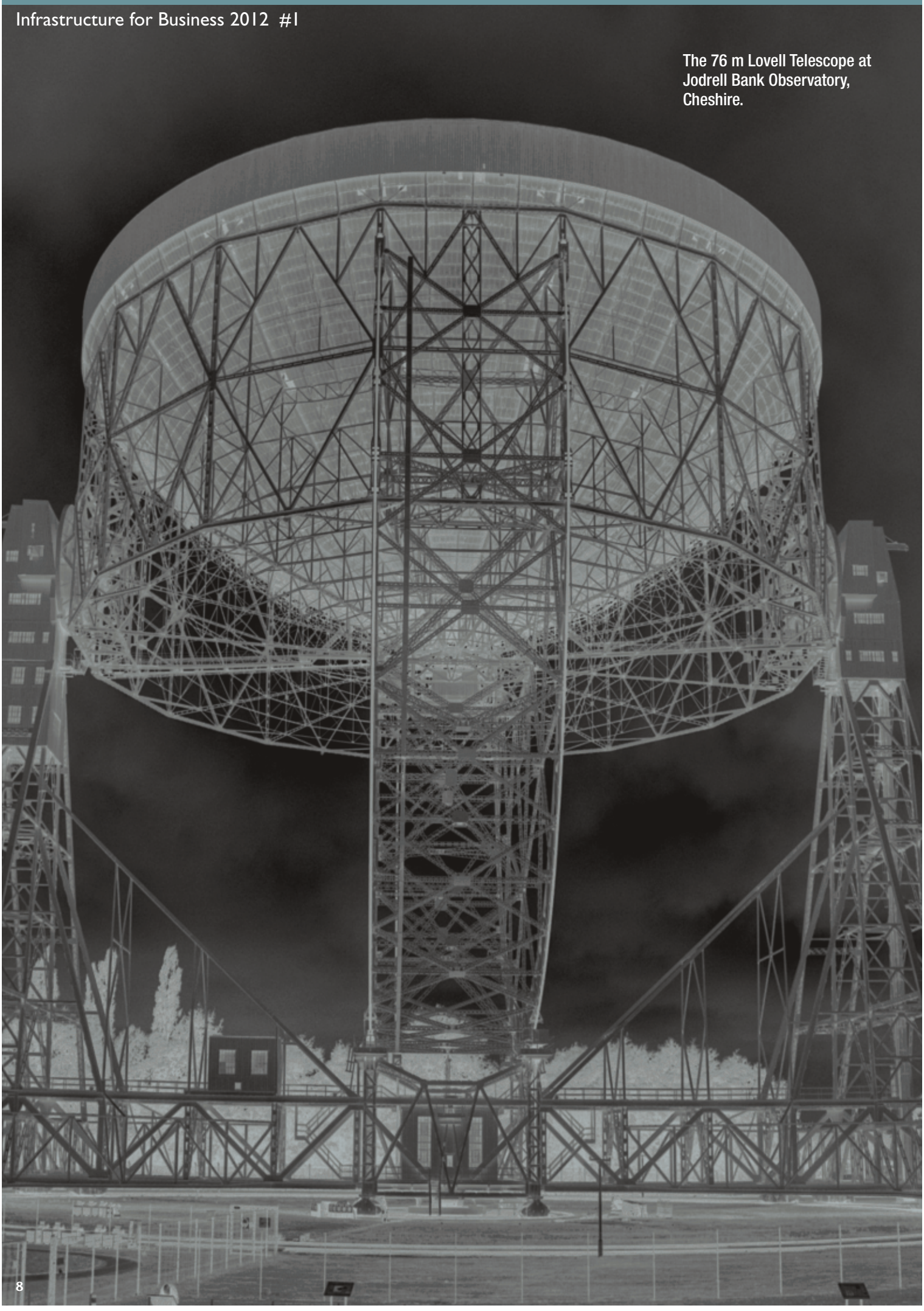
The key findings of this report include:

- The £8 billion UK space sector employs around 25,000 people, supporting a further 60,000 jobs indirectly. It has more than doubled in size over the last decade, and if job growth continues at the 15% rate of the last few years, employment in the sector will reach 100,000 by 2020.
- The UK's space sector came about largely thanks to the benign and unforeseen consequence of the early adoption of satellite broadcasting in this country, allowing the UK to draw on the skills of overlapping world-class aerospace and defence industries. By contrast, the government has had very little to do with it. The UK Space Agency receives all of £313 million in public funding – a mere 0.73% of the combined global space agency budget of $65 billion in 2010 – making the space sector one of the least subsidised parts of the UK economy.
- The end of NASA's Space Shuttle programme is leading to a private sector space revolution, with a host of companies competing to provide space taxi services. Private sector innovation is rapidly lowering the cost of getting cargo into space. SpaceX, for example, already has contacts with NASA worth over $4 billion to launch cargos to the International Space Station and deliver satellites into orbit. Its Falcon 9 vehicle has lowered the cost per kilo to Low Earth Orbit to just over $5,000, compared with between $18,000 and $60,000 for the Space Shuttle.
- A spaceport would be a key piece of infrastructure for the UK's space sector, operating as a hub for space tourism, research and development. Space tourists are willing to pay $200,000 for a mere three hours in space, and will have considerable disposable income that would help the wider local economy. The private sector could help fund the costs of a spaceport.
- A spaceport would have several requirements, including a long runway and its own undisturbed high altitude air corridor, which narrow down the location options. Lengthening the runway of an RAF base in Scotland or Northern Ireland would be a possibility, while the South West of England could represent an alternative prospect.

"The space sector is a real British success story. A few regulatory and infrastructure developments, including a spaceport, would help the sector really lift off."

Ariane 5 carries payloads weighing more than 10 metric tons to geostationary transfer orbit. Today, it has 21 share-holders from 10 European countries.

- Crucial as a spaceport is, the UK's space sector needs a proper regulatory framework for journeys out of the atmosphere. Britain has no safety, environmental or flight regulations in place for trips into space. With nothing in place, it's harder for space pioneers to insure and calculate the cost of setting up – and hopefully clustering – upstream companies that build space hardware and downstream firms that offer space-related services in Britain. Options are being examined for regulatory control of UK-based spaceflight, and it is essential that this moves forward as quickly as possible.
- Most of the UK's existing public space funds are channelled via the UK Space Agency to the European Space Agency. Wider international cooperation, particularly with America's private space entrepreneurs and NASA, could help to bring costs down and tangible results up.
- In the new space economy, you can be small and succeed. The Isle of Man is an excellent example of a small economy with a thriving space sector, with 30 of the 54 companies working on satellites located on the island, and a cluster of companies handling the financing, insuring, leasing and legal ramifications of space assets. For the UK, there is plenty of scope for further cooperation close to home.



The 76 m Lovell Telescope at Jodrell Bank Observatory, Cheshire.

1. The UK space sector – a BRIC-style success story

In these uncertain times, it is easy to forget that there are parts of the economy still performing extremely well. The UK's space sector has quietly posted BRIC-style rates of growth for many years, and looks set to continue to thrive.

GROWTH AND SIZE

The UK space sector has enjoyed a decade of expansion barely seen anywhere else and has proved to be remarkably recession-proof. As Table 1 shows, turnover has more than doubled in the last ten years, with growth of over 6% in the year following the 2008 financial crash.

TABLE 1

UK space sector turnover – upstream, downstream and total, £million

Year	Upstream	Downstream	Total
1999/00	565	2,924	3,489
2000/01	548	3,464	4,012
2001/02	620	3,790	4,410
2002/03	603	4,110	4,713
2003/04	785	4,374	5,159
2004/05	803	4,541	5,344
2005/06	840	4,839	5,679
2006/07	877	5,307	6,184
2007/08	995	5,962	6,957
2008/09	930	6,581	7,511
2009/10	950	7,043	7,993

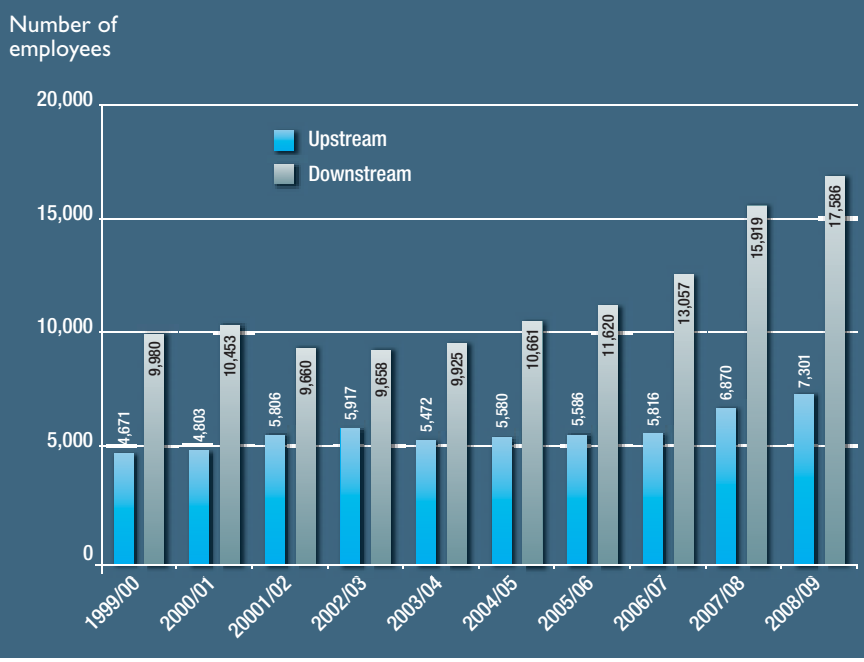
Sources: *The Times;* and UK Space Agency, *The Size and Health of the UK Space Industry,* November 2010.

The £8 billion UK space sector employs around 25,000 people, supporting a further 60,000 jobs indirectly. Between 1999-00 and 2008-09, the average annual employment growth rate was 6%, or twice the national average.[1] As Chart 1 shows, most of the growth came from downstream – from 9,980 to 17,586 – compared to upstream – from 4,671 to 7,301.[2]

[1] See http://nds.coi.gov.uk/content/Detail.aspx?ReleaseID=416420&NewsAreaID=2
[2] Oxford Economics, The Size and Health of the UK Space Industry, November 2010
[3] See Daily Telegraph 8th February 2012 http://www.telegraph.co.uk/finance/newsbysector/industry/9067254/UK-seeks-funds-to-get-ahead-in-the-space-race.html

CHART 1

UK upstream and downstream space industry employment



Job growth in the space sector has been accelerating, and is now at 15% per annum. If it continues at that rate, employment will reach 100,000 by 2020.[3]

Impressive as all of this is, the UK is still a pretty small player in the global space economy, which was estimated by the Space Foundation to be $276 billion in 2010.

ORIGINS AND SHAPE

To the outsider, space may appear to be all about rockets and astronauts. For Britain today, it's actually a lot more diverse and – if you'll forgive the pun – down to earth: satellite manufacture, ground support, subscription-based live TV broadcasting and satellite launch insurance.

The UK's space sector came about largely thanks to the benign and unforeseen consequence of the early adoption of satellite broadcasting in this country. This pushed the technological envelope for satellites and what they could deliver to the consumer. As the growing worldwide demand for always-on information continued, the UK was also able to draw on the skills of overlapping world-class aerospace and defence industries, which brought new possibilities and skills into the nascent space sector.

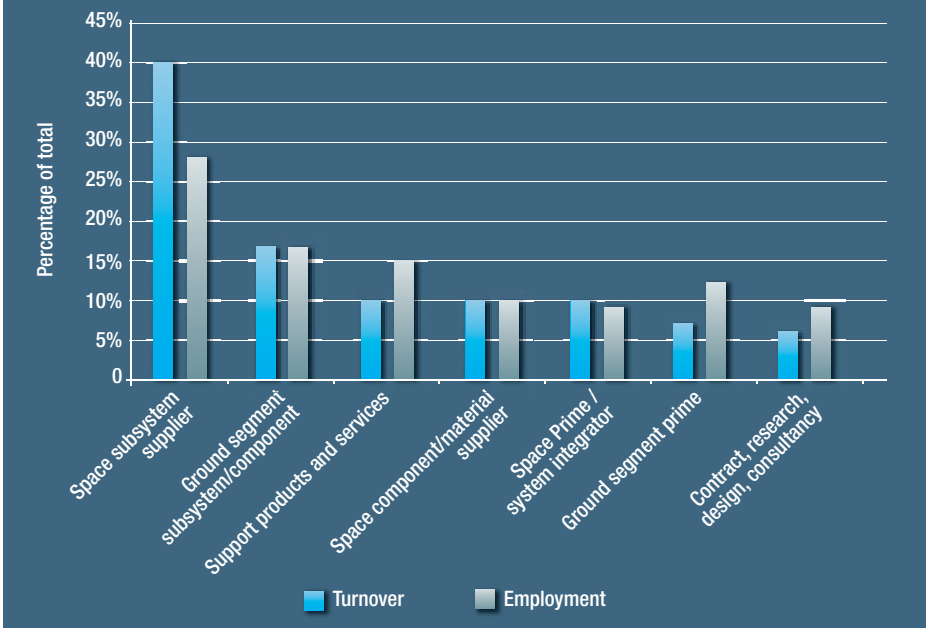
The conventional breakdown of the space economy is between upstream and downstream. In the UK's case, upstream is satellite manufacturing and front-line space services like ground control. The value of civil spacecraft and satellites manufactured in the UK was estimated at £275 million in 2010.[4] This would include players like EADS-owned Astrium who have a majority shareholding in QinetiQ (defence technology), Logica (supporting systems and software for a third of the world's satellites) and Vislink (satellite uplink and downlink technologies).

Probably the most famous niche was created by Surrey Satellite Technology, which was spun out of the University of Surrey. It realised that many satellite launch rockets were

[4] Department for Business, Innovation and Skills, The Space Economy in the UK: An economic analysis of the sector and the role of policy, BIS Economics Paper No. 3, February 2010

CHART 2

Upstream sector - turnover and employment by business category, 2008/09 [5]

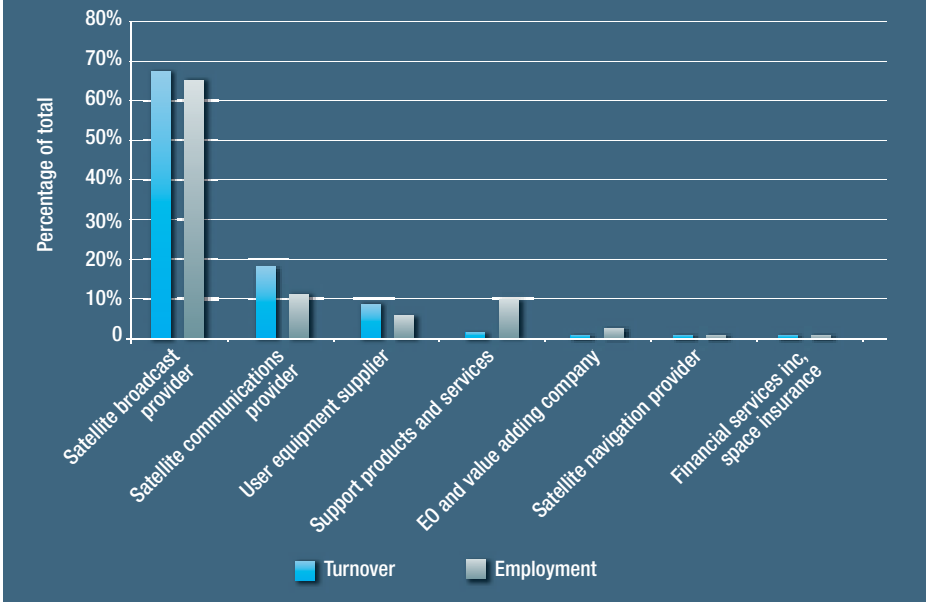


not filling up 100% of their launch payload capacity and that a market could be created for microsatellites to be inserted in the left-over space next to the big satellites. All of a sudden, nations like Nigeria and India wanted, and got, satellites at an affordable price. The company is now also majority-owned by EADS Astrium.

The downstream sector is dominated by satellite broadcasting at around 70%, mostly by BSkyB, the biggest player in the UK space economy. Other downstream players

CHART 3

Downstream sector - turnover and employment by business category, 2008/09 [6]



[5] Oxford Economics, The Size and Health of the UK Space Industry, November 2010, Charts 6 and 7
[6] Oxford Economics, The Size and Health of the UK Space Industry, November 2010, Charts 8 and 9

The Soyuz TMA-16 launches from the Baikonur Cosmodrome in Kazakhstan.

Picture credit: NASA/Bill Ingalls

include Inmarsat which grew out of the International Maritime Organisation. With a fleet of 11 geostationary satellites, it has become a leading provider of global mobile satellite communications, far beyond its original market of enabling ocean-going ships to stay in constant contact by phone.

There is no denying the massive impact BSkyB has had on the UK space economy and without which it would be half the size, probably less. Its innovation – originally as Sky – back in 1989 was to offer direct-to-home satellite television services on an encrypted subscription basis, at once creating further demand for additional satellites, transponders (TV satellite channel slots) and related services.

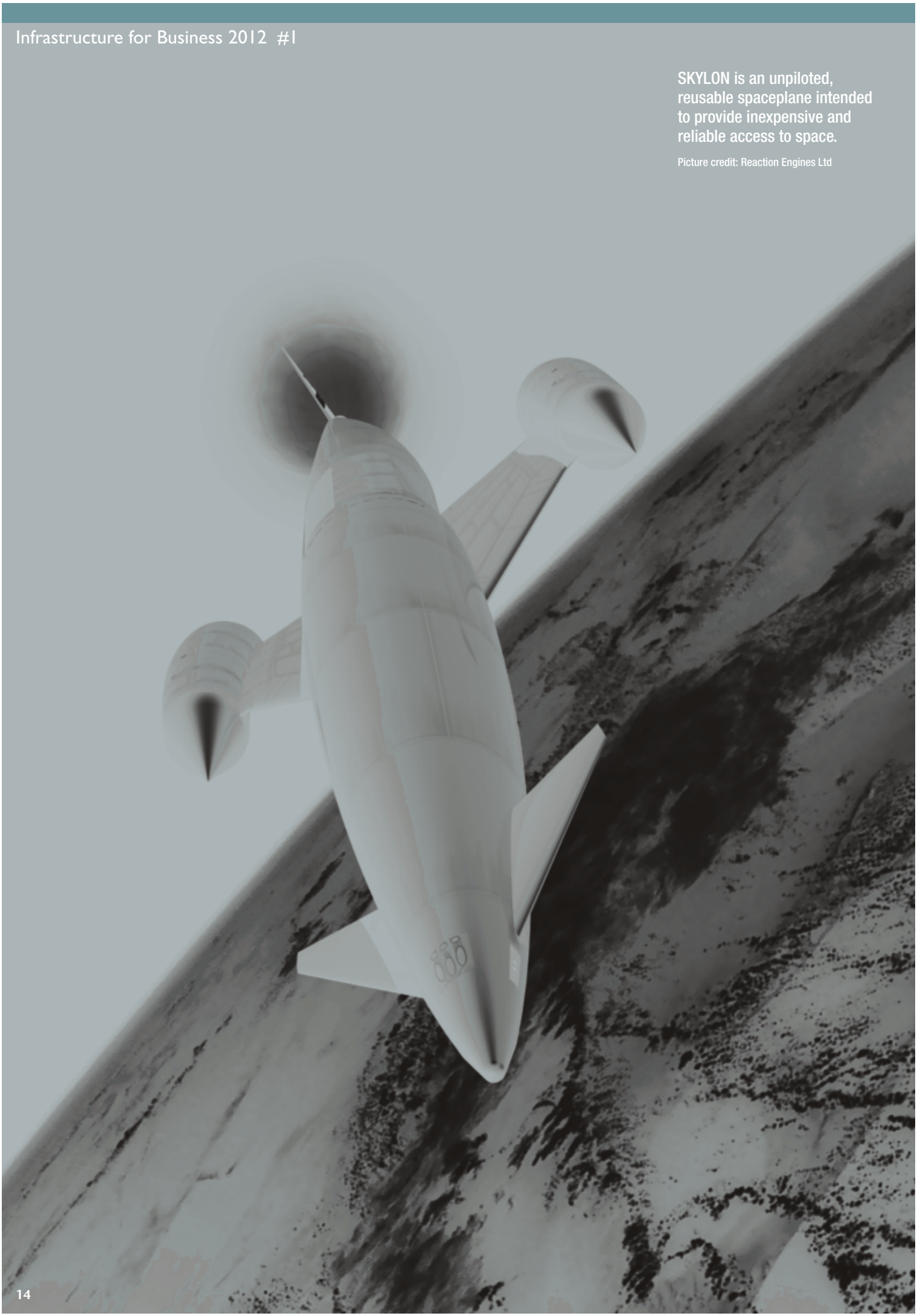
ROLE OF GOVERNMENT

The UK's space sector seems likely to continue its BRIC-style growth of nearly 10% per annum for many years to come. Unlike in the US, the taxpayer has had very little to do with it. The UK Space Agency today receives all of £313 million from government,[7] making the UK space economy one of the least socialised parts of the British economy in a traditionally big government arena. The UK's public finding for space is a mere 0.73% of the combined global space agency budgets of $65 billion in 2010.[8]

It was the previous government that finally woke up to the potential of the UK space sector. To that end, in February 2010, the business department published the *Space Innovation and Growth Strategy*, a joint government, industry and academic study that outlined a 20 year vision for the UK space sector. The ambition was to double the UK's global market share to 10% by 2030, estimated by then to be worth £40 billion, and in so doing, create 100,000 high value jobs. This strategy was subsequently largely endorsed by the Coalition Government, who also agreed to the creation of the UK Space Agency.

"The UK's space sector seems likely to continue its BRIC-style growth of nearly 10% per annum for many years to come. Unlike in the US, the taxpayer has had very little to do with it."

[7] See http://www.bis.gov.uk/ukspaceagency/who-we-are/how-we-work/uk-space-funding
[8] OECD, Space at a Glance 2011



SKYLON is an unpiloted, reusable spaceplane intended to provide inexpensive and reliable access to space.

Picture credit: Reaction Engines Ltd

2. Unlimited possibilities

Space is the one industry in the world where the sky is emphatically not the limit. No wonder then that billionaires are opening their cheque books to fund a new space race, only this time free of superpower rivalry. Britain can continue to have a major role in the new space economy.

CUTTING THE COST OF GETTING CARGO INTO SPACE

In space engineering, the technologically feasible never quite trumps the financially viable. The greatest rocket engineer, Werner von Braun, discovered this to his chagrin in 1970 – not long after the first manned Moon landing – after his plans for a manned mission to Mars were rebuffed by NASA. Space costs have always been inherently high because a large amount of infrastructure has to be spread among a small number of events. There are, however, certain key cost metrics that have been improving gently since then and may soon be set for a breakthrough. These are:

i) The cost of getting a given payload into space

The cost per kilo to Low Earth Orbit (LEO – from 100 to 1,240 miles up) is generally calculated by dividing the estimated cost of a launch vehicle by its payload capacity. Getting a cargo into orbit is so expensive because of the enormous energy requirements to leave the earth's gravitational pull and perform manoeuvres when it gets there. In the early 1990s, surplus Russian and Chinese rockets increased competition to American and European suppliers and brought down launch costs by a third. Few agree about the true cost of the Space Shuttle. Never a fully commercial vehicle, had as many being built and launched as often as originally planned (a wholly unrealistic 50 times annually rather than 7-8), some forecasts show a much lower cost per kg to LEO.

TABLE 2

Cost per kilo to Low Earth Orbit (LEO)

Vehicle/technology	Years in operation	Cost per kilo to LEO	Technological Readiness Level
Space Shuttle	1981-2011	$18,000 - $60,000	N/A
Atlas V	2002 onwards	$13,812	9
Ariane 5	2002 onwards	$10,476	9
Falcon 9	2010 onwards	$5,359	9
Proton	Variants since 1965	$4,302	9
Falcon Heavy	2013 onwards	$1,000 – $2,204	6.5
Skylon	2021 onwards?	$1,000	5
Space Elevator	2035 onwards?	$10 - $100?	1

Sources: Futron Corporation, various. NASA's Technological Readiness Level is a method used to assess the maturity of evolving technologies on a scale of 1-9 where 9 is ready and mature and 1 is at the very beginning of Basic Technology Research. The TRLs ascribed in Table 2 are estimated by the author, not by NASA.

The main developments to note over the last 20 years are the growing role and success of ex-Soviet satellite launches (Proton) and increasingly, private companies like SpaceX, who launch the Falcon vehicles. The Falcon 9 already has a $1.6 billion contract with NASA to launch cargoes to the International Space Station. It also has a $2.5 billion order book to deliver satellites into orbit. Not all vehicles, however, can deliver cargoes as far as a geostationary orbit about 22,000 miles above the Earth's surface – the preferred location for meteorological and communications satellites.

British-based Reaction Engine's Skylon is the only single stage reusable satellite-carrying vehicle that may exist in the near future. Skylon is a 75 ton hydrogen-fuelled pilotless plane will take off like a conventional aircraft, achieve great speed as it leaves the atmosphere, deposit 15 tons of cargo and return to repeat the operation just 3 days later. Each launch could cost only £8 million, and each aircraft could be reused 200 times.

To date, the research work has been done, but there is now a steep curve of $12 billion of private capital to be raised in development funding until the first prototype is ready in the early 2020s – if all goes to plan and competitors like SpaceX don't establish an unassailable lead in cost, experience and orders. Should that happen, it may be that Reaction Engines' similar LAPCAT (Long-Term Advanced Propulsion Concepts and Technologies) project, for a suborbital Mach 4-8 Supersonic airliner, may be a better prospect, as it is currently without competition and would work from a conventional airport alongside other airliners.

Space Elevators remain a distant dream – perhaps like Fusion power, always a few decades away. The argument for them is still compelling and Google is rumoured to be researching the possibility. Build a structure or cable that reaches all the way to geostationary orbit, attach an elevator (more likely a maglev vehicle on rails) press the up button, release the payload and come back down again. Running costs would be extremely low but the capital costs enormous. And then there are the physics. The biggest obstacle is that there are no materials in existence in quantity strong and light enough not to collapse under the combined weight of 22,000 miles. Perhaps the first place we'll see a space elevator is the Moon. There, kevlar would be a strong enough material as gravity is six times lower than the earth and would make it easier for spacecraft to reach the surface safely in an atmosphere-free location.

ii) The insurance premium per commercial launch

According to Neil Stevens of the Atrium Space Insurance Consortium, the leading space insurance provider at Lloyds of London, a typical launch to geosynchronous orbit costs $300 million. A typical insurance premium on that would be 10% of the total launch cost, which includes the first 365 days, and which is then renewed once a year as an in-orbit fee, at a typical 1% for the rest of the 15 year lifespan of the satellite. In recent years, this premium has held steady but the launch price has been going up as satellites have become more heavy and complex.

Commerical launch insurance premiums offer us a key insight into the technological progress made towards greater reliability. Between 1957 and 1999, 390 launches failed out of 4,378 – just under 9%. In the years to come, as launch vehicles crash less often, premiums will start to drop and investors will take greater risks.

"Space is the one industry in the world where the sky is emphatically not the limit, but the technologically feasible never quite trumps the financially viable."

HOW NASA'S SQUEEZE IS LEADING TO A PRIVATE SECTOR SPACE REVOLUTION

In the US, after the demise of the Space Shuttle, NASA has been forced to become the customer rather than the competition. Unable to procure the budget for a shuttle replacement, NASA started funding space taxi development work at Boeing as well as at three private companies – SpaceX, Sierra Nevada Corp and Blue Origin. [9]

[9] See: "NASA budget plans saves telescope, cuts space taxis", 15 November 2011 http://www.msnbc.msn.com/id/45317181/ns/technology_and_science-space/t/nasa-budget-plan-saves-telescope-cuts-space-taxis/#.TtT-8GM1T80

Since the Shuttle was retired last year, NASA has been dependent on Russia to fly crews to the International Space Station at a cost of more than $50m per person. The plan is that, from 2016, these new vehicles will replace this costly and somewhat embarrassing inability of the world's largest space agency to launch its own astronauts into space.

These new companies have been not only able to tap into the private wealth of billionaires, but also into technological capabilities like GPS, horizontal launch to orbit and autonomous rather than pilot-driven operation. And unsurprisingly, not only are they ambitious, they have shown themselves to be far more cost-sensitive than their government forebears.

For example, last year, Elon Musk, a founder of PayPal and now SpaceX, expanded at length on why mankind should become a multi-planet species helped by their proposed reusable space transportation system. All very exciting. And in the deep future such ambitions may well come to pass. The fascinating point about SpaceX though is how it has gone from a standing start in 2002 to a multi-billion dollar order book today.

In the UK, by far the most ambitious and audacious space project is Reaction Engine's Skylon, detailed in the previous section. The brainchild of Alan Bond, Skylon was born out of the 1980s government-financed HOTOL (Horizontal Take-Off and Landing) programme by Rolls Royce and British Aerospace to design an air-breathing suborbital craft. HOTOL was axed by the British government in 1988.

Alan Bond, who was working on HOTOL, left to start Reaction Engines and went back to the drawing board to overcome the major design flaws. The company came up with Skylon, a vehicle which would carry twice the cargo, would be genuinely reusable and could still take off into space from an airstrip and re-enter the atmosphere and land like a plane. Moreover, Skylon would be fully automated, turn around and do it again a few days later. Should Mr Bond succeed, Skylon will have a huge impact on lowering the cost of cargo to space, so much so that hotels in space and colonies in Mars will start to look not so far off. As explained in the previous section, however, Skylon's steep capital-raising curve remains.

"There are certain key cost metrics that have been coming down and may soon be set for a breakthrough."

Skylon – the most ambitious space project in the UK.

Picture source: Reaction Engines

Virgin Galactic's VMS Eve and VSS Enterprise test flight over the Mojave.

Picture credit: Mark Greenburg

3. Why the UK needs a spaceport

The UK's space sector has been a real success, and there is enormous potential for the future. Impressive as the progress has been, however, there are some hurdles that need to be cleared if the UK's space sector momentum is to be maintained and taken to the next stage. The most important piece of infrastructure development would be a spaceport.

THE BENEFITS OF A SPACEPORT

Many agree that Richard Branson's private sector spaceport in New Mexico will lead to the development of many more, but not enough is being done to make the case for the next one in Britain. And it could be done at a fraction of the $200 million first-of-a-kind cost of Spaceport America.

Usually when discussing future transport infrastructure investment for rail, road or airports, the value case is made on making it easier, quicker and cheaper to move people from A to B. But according to Jim Bennett,[10] author of a forthcoming book on space investment, space economics are really quite different.

Bennett argues that spaceports are not going to move high volumes of people, in numbers comparable to a major airport, into space for a very long time. Instead a spaceport should be looked at as a seed crystal to catalyze business incubators or research labs, be close to a university with a science and technology faculty and be dual-use in attracting non-space innovative aviation firms who could use it for testing. As such, a spaceport would constitute an excellent regional development opportunity.

Space tourism, however, should not be forgotten. Space tourists are willing to pay $200,000 a ticket for a mere three hours in space. Crucially though, they will spend much longer within the vicinity of the spaceport and will no doubt have a lot of disposable income that would help the wider local economy. To the extent a region is already an attractive tourist destination, a spaceport can be synergistic with existing attractions.

The core spaceport facilities will most likely not be private businesses themselves. Most of the licensed spaceports in the US are run by local airport or development authorities. Where private businesses might find a role, and help fund some of the costs of the project, is by developing the research park as a for-profit property development project. Authorities might consider deeding vacant land near the facility to such developers, allowing them to fund the building of the facilities and profiting by their resale as the park becomes mature. Some of the property would look like any research park, but there is also a role for private development of hangar space to be sold or leased to operating companies in aviation or space who become tenants at the spaceport.

[10] Jim Bennett is a consultant, former space launch entrepreneur and Space Fellow of the Economic Policy Centre

The Mojave (California) Air and Space Port (http://mojaveairport.com/), the first facility licensed by the US FAA as a commercial spaceport, is a good model of a small airport that has successfully turned itself into a spaceport and development centre for innovative aviation and space entrepreneurs. This, more than Spaceport New Mexico, is probably the useful economic model for the UK to follow.

"The Mojave (California) Air and Space Port is a good model of a small airport that has successfully turned itself into a spaceport and development centre for innovative aviation and space entrepreneurs."

WHERE COULD A SPACEPORT BE SITED?

A spaceport would have a number of requirements, all of which would narrow down the choice of location:

- Ideally, a spaceport would be situated in an isolated, low-population density location where the noise would not impact urban populations.
- For suborbital space tourism – probably amongst the smallest but most publicity-generating of the opportunities to come – a spaceport would be best sited for quick access to scenery from space or for polar orbit satellite launch. These requirements tend to point to existing RAF bases in Scotland.
- Runways will also have to be long. As a rule, all aircraft require at least twice their allotted take-off length to slow down in an emergency aborted take-off. That means, for example, that Skylon D1 would need a runway of 16,400 feet to slow down to a stop. Virgin Galactic want a minimum of 10,000 feet, although some proposed vehicles like XCOR Lynx II could use much less – 8,000 feet. Today, the longest runways in the UK are at major civil airports, like Heathrow at 12,800 feet or Gatwick at 10,800 feet, followed by military ones up to 10,000 feet long.
- Spaceports must at present have their own undisturbed high altitude air corridors, which means that spaceports cannot be situated anywhere near areas of undivertable high air traffic flow, ruling out the South-East for now. Future technological advances, however, are likely to make it easier to combine a spaceport with an airport.
- A spaceport, or possibly a separate one, should also be capable of providing vertical take off (VTO) and landing facilities – a fly-back first stage design favoured by Blue Origin, a privately funded aerospace company set up by Amazon.com founder Jeff Bezos. At some stage, one would also have to factor in propellant facilities for rocket-powered take-off and high standards of safety and security. Historically in the United States, VTO spaceports have been placed next to either uninhabited land or open ocean where a cleared launch range could be assured.

For the UK, the most obvious option would be to lengthen the runway of a redundant military airport in Scotland or possibly in Northern Ireland. RAF Lossiemouth or a number of other Scottish RAF bases, with runways of around 9,000 feet long, stick out. It's also conceivable that an independent Scotland may want the RAF bases to go. That could be an opportunity for one of these bases to become a spaceport. Should secession happen after they were established, the operators would then face regulatory uncertainty and the opportunity would become a threat.

Should either of these scenarios happen and/or the strategic landscape with Russia drastically changes, air defence covering the North Sea could be far more flexibly and deeply covered by the Royal Navy's Fleet Air Arm from the future Queen Elizabeth aircraft carriers rather than static, big target RAF airbases in Scotland.

Given that Scotland is still such an unknown, another location that is being looked at

again with new eyes for a spaceport is in South West England. This is based on a 2003 proposal led by Michael Stephen for a major new airport in the Severn Estuary – Severnside International. Very like "Boris Island" in the Thames, the report by HOK (master planners for Hong Kong Airport) anticipated building Severnside International Airport on a man-made island in the Bristol Channel at the then seemingly paltry cost of £2 billion.

It was rejected by the government but has many of the same advantages as a Thames Estuary Airport – no aircraft flights over residential areas, a free source of tidal power and a major regional development opportunity in a less affluent part of Britain. Just as London is set to grow eastwards with the onset of the Olympics, continued redevelopment and just maybe a new high capacity airport, a similar consideration could be made for air transport demand between London and Bristol. Cardiff will eventually be unable to meet growing local demand for international and intercontinental flights and its catchment area won't all want to fly from the far side of London. A dual-purpose space/airport at Severnside could possibly be a new way forward, although the problem of a spaceport at present needing its own undisturbed high altitude air corridor would still remain.

"Not enough is being done to make the case for the next spaceport in Britain."

VSS Enterprise flies over the runway dedication ceremony at Spaceport America, New Mexico. Credit: Mark Greenberg

The Isle of Man from space.

4. Regulation and cooperation

It's not just a spaceport that is required. Crucial as that new piece of infrastructure would be, the UK's space sector needs a proper regulatory framework for journeys out of the atmosphere. Greater international cooperation would also open up the possibility for further cost reductions. Importantly, in the middle of a fiscal squeeze, neither of these developments would lead to higher public spending

REGULATION

It is an irony that the 1875 Explosives Act prevented any British research into rockets in the inter-war period, unlike Nazi Germany, whose expertise in hitting London with rockets was later used by the Americans to take men to the Moon. Today's regulatory concern is how to attract space entrepreneurs to the UK to bring about suborbital and orbital flight services – not just from Virgin.

There are four main categories that these near-future vehicles fall under:

- **Horizontal Take Off (HTO) suborbital (including air drop/air launch)**
- **HTO orbital (including air drop/air launch)**
- **Vertical Take Off (VTO) suborbital**
- **VTO orbital**

Britain has a host of internationally recognised aviation regulations but has no safety, environmental or flight regulations in place for what will be a riskier journey out of the atmosphere. With nothing in place, it's harder for space pioneers to insure and calculate the cost of setting up – and hopefully clustering – upstream companies that build space hardware and downstream firms that offer space-related services in Britain.

The irony is that the UK is the market leader in insuring spacecraft today. Global premiums on satellite insurance run to $700 million per year and 40% are retained by Lloyds and the London insurance market. With an internationally attractive regulatory regime, it is quite likely that the market share of insurance would go even higher.

Options are being examined for regulatory control of UK-based spaceflight, and whilst a speedy resolution is desirable, getting it right is more important. The industry is developing along global lines rather than regional blocs like the EU. So a regulatory scheme that takes into account the entire worldwide environment – that companies like Virgin Galactic plan to operate in – will serve British interests best.

INTERNATIONAL COOPERATION

Although the space economy is largely in the private sector in the UK, cooperation at the state-to-state level is still important. Most of Britain's existing public space funds are channelled via the UK Space Agency to the European Space Agency. This has not been a bad relationship. But it would almost certainly be in our interest to expand and rebalance the range of contacts and programmes beyond Europe to NASA and some Commonwealth space agencies. There is great potential for driving down costs for the space programme by working with the US, India, Canada and Australia and not just Europe.

"The UK has a host of internationally recognised aviation regulations but has no safety, environmental or flight regulations in place for what will be a riskier journey out of the atmosphere."

In the new space economy, you can be small and succeed. You don't need astronauts to be in the space business. The Isle of Man's ManSat which provides space services like access to geostationary orbits and associated radio frequencies, is a case in point. And Virgin Galactic, a harmonious combination of British management and marketing, American technology and Emirates financing speaks volumes about the future internationalist dimension to space use and exploitation.

"In the new space economy, you can be small and succeed. You don't need astronauts to be in the space business."

BOX 1

The Isle of Man's mighty space sector

The Isle of Man (IOM), a self-governing Crown Dependency of the UK, has – somewhat incredibly – carved out an impressive space sector of its own. With a GDP of £3.5 billion and just 85,000 residents, the IOM government nonetheless anticipates the value of space related turnover for the 3 years to 2013 at £1.1 billion. So just what are they doing and how did they do it?

Like many micro-nations, the IOM has a history of quickly adapting to fast emerging industries – from fishing to banking to financial supervision to the film industry to e-gaming and e-commerce and now space. Obviously, having a 0% rate of corporation tax and just 10% on personal income helps bring in investors. The island can also boast perhaps the longest run of political stability, courts that recognise some foreign jurisdictions including the US and last but not least, access to the City of London. But the real key has been in achieving a cluster effect of major companies, mostly in the downstream arena.

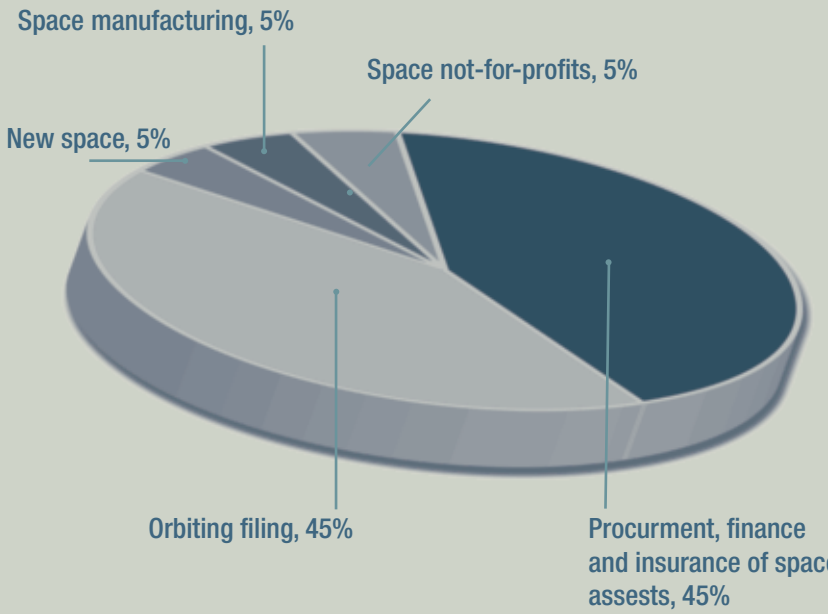
Today 30 companies working on satellites are located on the island today – out of a world total of 54. These include big companies like Inmarsat, SES and organisations like the Space Data Association – which pools orbital data for the top five satellite companies. Manx even hosted the Google Lunar X Prize in 2010. The island can also boast a home-grown space champion – ManSat – that handles all of the filing of orbital slots for the IOM government, which then passes it on to OFCOM for further submission to the International Telecommunications Union (ITU) in Geneva. The rules are that the ITU only allocate orbital slots – i.e. parking places for satellites – to countries like the IOM and not companies, a system which tends to favour small countries.

This has led to a clustering of companies in the IOM that handle the financing, procuring, insuring, leasing and legal ramifications of space assets. They have some space manufacturing too – as represented by CVI Technical Optics – who made the optics for the Mars Phoenix Lander. And, since October 2011, the island has been able to boast one highly-advanced satellite on its own slot – ViaSat-1 registered at 115 degrees West – which covers all of North America and Hawaii.

The island's government positively wallows in being pro-space, even registering and running a website entitled www.spaceisle.com. And for space education, it can draw on its own satellite campus on the island. Since 1987, 3,000 students have graduated from the campus, part of the Strasbourg-based International Space University, with 100 working today in the IOM.

CHART 4

The Isle of Man's space sector – approximate breakdown



"Virgin Galactic, a harmonious combination of British management and marketing, American technology and Emirates financing speaks volumes about the future internationalist dimension to space use and exploitation."

Conclusions

Space has always been a risky business. There will be more failures in this new space race and government inspired targets with round numbers, like that of the Space and Innovation Strategy Group, have a habit of not being met. But the ubiquitous demand growth for real-time data and always-on communication is powering the industry forward.

Without the legacy of a stifling bureaucracy like NASA and the opportunity to create a regulatory framework of its own, the UK's prospects are much brighter than commonly understood. London already has in place leading law and insurance firms but has yet to become a financing centre for space business that New York and Paris already are.

The Isle of Man shows how quickly a powerful niche can be built by a very small player. As an English-speaking mid-sized wealthy country, the UK is well-placed to compete in "New Space" – today's era where private companies cooperating across borders participate, innovate and launch vehicles and services, just as the major state-sponsored space agencies of the 20th Century accelerate their long retreat from the marketplace.

A few developments would help to ensure further rapid growth. A spaceport would be a crucial piece of infrastructure, while a proper regulatory regime would help to attract entrepreneurs to the UK to bring about suborbital and orbital flight services. Greater international cooperation, particularly with America's private space entrepreneurs and NASA, could also help to bring costs down and tangible results up.

The UK's still-formidable strengths in conventional aerospace seem well-suited to ensure that British forms and actors will be present in a wide range of space commercial ventures. One way or another, an exciting future, should policymakers and investors choose to understand and embrace it, beckons for the UK's space sector.

"The UK is well placed to compete in the new space economy. Its prospects are much brighter than commonly understood."

About the Infrastructure for Business series

The UK's infrastructure was once the best in the world. Great innovators like Brunel and Stephenson were pioneers of the railway, which revolutionised the way people and goods moved around the country.

Faster, better and cheaper infrastructure helped fuel the rapid growth of the industrial revolution, giving businesses the platform they needed to thrive at home and export to the world. In the last century, Britain continued to develop new forms of travel, leading the way in aviation and building an extensive motorway system.

The UK still benefits from its infrastructure inheritance, and parts of our network function relatively well. But we have lost our lead, as we try to squeeze too many onto too little. Our roads are congested, many of our trains are standing room only, and planes are forced to circle in stacks before getting a landing slot at our main airport. High taxes on driving and flying, and big rail fare increases, have made getting around more expensive.

And there are risks to the security of our energy supply, as replacements for our ageing coal and nuclear power stations are not built quickly enough and environmental regulations and taxes, which should be better focused on reducing emissions in the cheapest way, push up the cost of powering the country.

Infrastructure for Business is a new series of papers looking at the key energy, transport and technology infrastructure developments that would help the UK regain competitiveness and encourage a thriving private sector. We need to put Britain back in the lead again to help our firms compete in the world.

For more information, please email corin.taylor@iod.com

Infrastructure for Business

Infrastructure for Business is a series of papers by the IoD looking at the key energy, transport and technology infrastructure developments that would help the UK regain competitiveness and encourage a thriving private sector.