INTELSAT

WHITE PAPER

The Role of Satellites in Decarbonisation

MARCH 2023

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Executive Summary

The current debate on space sustainability, from collision avoidance to de-orbiting satellites, is primarily focused on ensuring that Earth orbit remains usable for future generations. However, another key side of this debate should be more actively considered by all stakeholders, including policymakers leading these discussions – how satellites can help sustainability on Earth and assist with decarbonisation efforts.

This paper explores the varying tools that satellites provide to assist the Green Transformation, from boosting connectivity in rural areas that could assist in smart agriculture to supporting the rollout of autonomous vehicles which will drive down CO2 emissions. Concentrating on using satellites in the fight against global emissions and reinforcing other sustainability initiatives will bring faster and decisive results, as demonstrated through the economic insight throughout the paper.

This paper will also outline examples of how satellite companies like Intelsat are leading global and regional sustainability initiatives. The company is already providing better connectivity services in hard-to-reach areas, driving down energy consumption of freight, and reducing the CO2 emissions of launching new satellites through orbital refuelling.

Creating a more agile policy environment to support the proliferation of satellite services for decarbonisation should be a priority for policymakers. Regulatory frameworks should be more open to collaboration with the space industry, with cross-sectoral cooperation being the key to taking full advantage of what satellites have to offer for sustainability.

About Intelsat

Intelsat's fleet of over 50 satellites offers high-performance connectivity coverage to over 99% of populated regions. As the manufacturer of the world's first commercial communications satellite in 1965, Intelsat continues to lead in technological innovation and satisfying the growing connectivity demands of the future.

Headquartered in Luxembourg, Intelsat partners with public and private entities across the globe to provide governments, corporations, and NGOs with the necessary connectivity solutions. Intelsat is building the future of global communications with the world's first hybrid, multi-orbit, software-defined 5G network designed for simple, seamless, and secure coverage precisely when and where customers most need it.

Leading in Sustainable Initiatives

Satellite Manufacturing

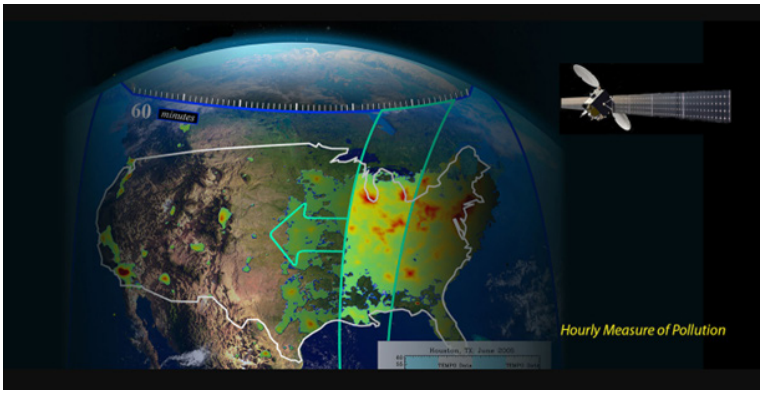
Decarbonization needs to be done through a full cycle and holistic approach – from manufacturing and managing supply chains, all the way to using tools to actively help combat CO2 emissions. In the satellite industry, this starts with building satellites. Intelsat carefully manages its fleet to increase satellites' lifespan and reduce waste.

Intelsat has moved away from the use of chemical propellants on board satellites, with all new satellites using a clean gas, Xexon, for propulsion.

A recent example of how Intelsat is also furthering this goal, is the company's partnership with SWISSto12 to acquire a new geostationary satellite.[1] The future satellite, Intelsat 45, will be based on the HummingSat model, which was designed in a private-public partnership between SWISSto12 and the European Space Agency. The model, which is three to ten times smaller than conventional satellites that are placed in geostationary orbit and fully 3D printed will require less energy and materials than other satellites, ensuring a full-cycle approach to decarbonization.

Intelsat is also pursuing many new initiatives around the globe to reduce its carbon footprint. Within its internal operations, Intelsat achieved LEED Gold certification and Well Health-Safety Ratings as a reflection of the environmental considerations implemented within its operational policies, maintenance protocols, emergency plans and stakeholder education.[2]

TEMPO



Intelsat 40e in April 2023 was launched into geostationary orbit. The commercial communications satellite has a unique payload, which will detect and measure air pollution from space. The Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument is a UV-visible spectrometer and the first ever space-based instrument to monitor air pollutants hourly across the North American continent during daytime.[3] The observations taken from the Intelsat 40e will dramatically improve the scientific data record on air pollution – including ozone, nitrogen oxide, sulphur dioxide and formaldehyde.[4]

Sustainability in The Space Sector

Satellites present limitless decarbonising potential for the global economy. Through satellite navigation, communication, and the Internet of Things (IoT), satellites are already helping to reduce global carbon outputs by 1.5 gigatonnes per annum, equivalent to the combined outputs of the UK, France, and Germany combined.[5] Nevertheless, there is still significant, untapped potential to radically shape the environmental landscape that policymakers are failing to utilise.

This paper presents the cross-sectoral impact of the satellite industry on existing and upcoming decarbonising initiatives.

Sustainability in Orbit

The concept of sustainability can manifest in several ways within the space and satellite sector. Beyond the scope of this discussion is the principle of sustainability in orbit. Sustainability in orbit requires international cooperation, discussion and agreements designed to ensure that outer space is safe, secure and peaceful.

Whilst contributing sustainable outputs across global industries, the satellite sector itself is constantly evolving to produce more sustainable. For instance, Intelsat made history in this field in 2020, when the Intelsat 901 satellite docked with Northrop Grumman's first-ever Mission Extension Vehicle (MEV-1).[6] Intelsat has since been working closely Northrop Grumman Cooperation and SpaceLogistics LLC to create a satellite servicing spacecraft, Missions Extension Vehicle 2 (MEV-2).[7] The spacecraft was designed to dock to an ageing commercial communications satellite, helping to extend their operations in orbit.

In April 2023, Intelsat ordered a new Mission Extension Pod (MEP) from Northrop Grumman Corporation's SpaceLogistics, which will add life to another Intelsat satellite and provide uninterrupted services to many customers. The MEP "jet pack" will be installed by SpaceLogistics' mission robotic vehicle (MRV) on an Intelsat satellite operating in geosynchronous orbit, ensuring continuity of satellite service for at least six years beginning in 2026.

Sustainability on Earth

Space and sustainability on the planet have become increasingly aligned thanks to the benefits that satellite technologies can bring to improve the accuracy and efficiency of infrastructure. Satellites can help achieve sustainability on the planet through their innovative capabilities.

Global satellite providers such as Intelsat wish to create a unified global network that secures land, air, and sea coverage. This ambition provides enormous potential for satellite technologies to support decarbonisation by improving operational efficiency and reducing wasted emissions across vertical industries worldwide.

Satellite providers contribute significantly to UN Sustainable Development Goals, with Intelsat producing initiatives to empower refugees and connect schools and communities. Improving connectivity within rural communities can significantly decarbonise by bringing substantial benefits to the quality and efficiency of healthcare, education, financial services, transport, energy, agriculture and more.

Connectivity Solutions & IoT

Connectivity is essential to the success of renewable energy infrastructure. Satellite communication technology can help countries navigate mitigation and adaptation practices to meet climate goals that can have tangible implications in practice. Connectivity alone has the potential to reduce EU emissions by approximately 500MtCO2 in 2030, equivalent to 15% of the EU's total emissions in 2017.[8]

The expanse of IoT brings a significant dilemma on how to ensure that everything stays connected in a secure way, while also ensuring that new carbon-intensive infrastructure does not need to be constantly deployed. To this end, Intelsat has recently collaborated with Deutsche Telekom IoT to integrate its Intelsat FlexEnterprise, with the intended outcome of expanding the application of its IoT offering to support renewable energy infrastructure and green IoT environmental monitoring.[9]

It is estimated that digital technologies could reduce emissions by 20% by 2050 in the three highest-emitting sectors: energy, materials, and mobility.10 Satellite technology plays a critical role in this by enabling solutions such as IoT and mobile connectivity. Research has estimated that full adoption of satellite technologies could make it possible to reach net zero by as early as 2040.11 Satellite services and next-generation satellite-enabled connectivity could also ensure the communications systems remain operational during inevitably difficult situations, such as natural disasters, and address the limitations faced by the present terrestrial telecommunication network. Satellite technology could also help to monitor deforestation

Boosting Connectivity in Rural Areas

Satellites are critical in supporting social and economic development in poor, rural communities. Broadband initiatives create new digital highways in areas where conventional terrestrial networks are out of reach. Delivering affordable and fast internet supplies give communities revolutionised approaches to healthcare, infrastructure, and education, essential to escalating social and economic development. Intelsat is running several initiatives, throughout the continent of Africa and beyond, with the ambition to promote education. Partnering with education charity Mindset, Intelsat provides free access to satellite capacity and technology that allows for the broadcast of educational content to over 1,600 schools, 1,025 healthcare facilities and 6 million homes across Africa.[12]

Significant work must continue to provide better connectivity for half of the world's unconnected populations. Africa represents the most considerable potential for progress as it harbours the lowest number of internet connections, with only 22% of the continent with access.[13] Intelsat is committed to igniting lasting change and has set about leading on regional campaigns such as the Democratic Republic of Congo (DRC) Connectivity Forum in Kinshasa. In partnership with Ragasat, the forum brought together key stakeholders involved in the promotion of the telecommunications sector. Intelsat is enabling Service Providers and Mobile Operators in DRC to expand their network coverage anywhere in the country, connecting more subscribers, land areas, roadways and IoT.[14]

Building Factories

Satellite technology has been instrumental in solving obstacles met by construction in remote areas. Satellite connectivity can be used to monitor buildings and structures, where other types of communication are either impossible or economically inexpedient.[15]

Very Small Aperture Terminal (VSAT) satellites have been especially useful in rural areas, as a satellite terminal can be deployed quickly to establish communication and transfer data on the state of construction objects. These findings can be communicated to a computer centre located very far from the specific objects.

Satellites can further assist in the operational maintenance of developed infrastructure, which can be incredibly challenging in remote regions. Drone technology, when used in conjunction with precise positioning services, can safely and effectively inspect and service renewable energy infrastructure. Drones can also be extremely helpful in combating illegal logging through constant monitoring of areas that would otherwise be hard to reach, without sufficient connectivity infrastructure, such as in national parks or similar protected areas.

Agriculture

The space sector has aided the implementation of precision agriculture operations through innovative technology, such as remote sensing, robotics, machine learning and the Internet of Things (IoT), in conjunction with the well-established practice of satellite imagery. The precision farming market is predicted to grow from $7.08 billion in February 2023 to $12.99 billion by 2030.[16] This will only see farmers increasingly depend on reliable connectivity. Satellite connectivity has been instrumental in accessing and leveraging modernised tools to enhance production, manage costs, and sustain growth.

Intelsat has dedicated significant resources to powering the modernisation of the agricultural industry and smart farming to support this core pillar of sustainability in agriculture. Intelsat's FlexMove network offers connectivity solutions designed to meet the needs and challenges of a modernising agricultural industry.[17] It delivers enterprise-grade connectivity, allowing farmers to send and receive real-time data and telematics for maintenance and troubleshooting and ensuring constant connectivity to the cloud via Intelsat teleports. Intelsat recognised the emerging opportunities in the IoT and machine-to-machine (M2M) sectors.

An open satellite-services architecture can allow M2M communications in rural areas. Open HTS systems differentiate themselves by allowing users to choose their preferred ground equipment, whether an installed base or a newly selected deployment. Using existing ground equipment in open systems can lead to substantial cost savings for the customer. This technology, in turn, helps to improve logistics and supply chain tracking.

Satellites have further supported a transition towards sustainable agriculture practices, helping the industry change where and how they source materials. Increasing demand for sustainable products is also driving companies worldwide, including major consumer packaged goods businesses, to change where and how they source materials significantly. For example, Orbital Insight, another geospatial analytics firm based in California, announced a pilot project with Unilever, the consumer giant behind Dove, Ben & Jerry's and many other household products that rely on palm oil. The project aims to track Unilever's palm oil supply chain to prevent deforestation.

As of 2018, global emissions due to agriculture were 9.3 billion tonnes of CO2 equivalent (CO2eq).[18] In the US, Agriculture accounts for 11% of all Greenhouse gases (GHGs).[19] There is a need to reduce emissions while ensuring food security. Satellite-based IoT has the potential to achieve this through precision farming and traceability to reduce resource wastage. Precision farming could increase crop production by 4% and reduce water consumption by 4%.[20] Supply chain management and food safety can be improved by ensuring that food waste can be recovered and food products arrive to consumers with target freshness. Satellite-based IoT could provide economic benefits equivalent to 0.5 to 1 % of GDP by 2030.[21] Satellite technologies could also reduce the damaged crop and livestock production (estimated to be more than USD 108 billion) due to natural disasters by improving disaster resilience.[22]

Vertical Industries: Satellites Cutting C02 Emissions

Environmental, Social and Governance (ESG) standards matter more to businesses than ever, with increased investment trends into reaching sustainability goals. The space sector has the most significant role to play on the environmental side, with innovative technologies helping businesses track and meet their climate change targets..

Deforestation

Deforestation management has relied on satellite technology for decades. For example, illegal logging, farming, and land development led to the Brazilian government launching its deforestation control programme in the Amazon. An integral part of this programme included satellite monitoring systems to track illegal activity and to measure the damage of logging roads from an aerial perspective. Using satellite technology, environmental scientists have unparalleled oversight over deforestation.

Satellites' impact on deforestation initiatives has received global recognition, with heightened national investment from environmentally conscious states. Since 2008, Norway has invested $1.2 billion in Brazil's Amazon fund, with their public-private partnership illustrating how satellites are integral to combatting deforestation.[23]

Space technology has supported companies in finding alternative materials for their products, which has had tangible impacts on prevented deforestation measures. For example, consumer giant, Unilever, launched a pilot project with Orbital Infight, to help track Unilever's palm oil supply chain to support analysis for sustainable alternatives.

On land, Intelsat has dedicated over one thousand acres of property at its Hawaii Teleport for land conservation, agricultural use, farming, and water retention easements all by promoting planning of trees, including environmental requirements on all construction projects and designs.

Coastal Erosion

Intelsat remains instrumental in supporting environmental monitoring by equipping scientists with accurate and reliable data to determine the effects of climate change. Working closely with the Army Corps of Engineers in Paumalu, Hawaii, Intelsat has implemented a four-camera surveillance system specially designed to make scientific measurements of the waves, currents, and beach health. The results present valuable insights into the local hydrodynamics and sand movement, allowing for better management and determining future-proofing strategies. It further informs an understanding of the natural variability of the beach and how best to protect it.

Transport and Logistics

Low- and Medium-Earth orbit (LEO and MEO) satellites have significant potential to support global transport and logistics. Operators can provide a range of services from global internet providers to data collection.

Freight Forwarders

Satellites can be used to address the carbon outputs of the global freight industry, which is currently estimated at 1.1 gigatonnes of CO2. By 2050, this is expected to top 1.1 GT Co2. According to the International Maritime Organisation (IMO), this is between a 90 – 130% increase in emissions since 2008.[24]

Satellite communications-enabled technologies and the savings they can deliver for shipping are wide-ranging. Intelsat's maritime solution, FlexMaritime is a globally secure, fully managed connectivity solution dedicated to solving complexities surrounding bandwidth availability, configuration, and management of network infrastructure for those at sea.[25] This is an integral tool for enabling productivity improvements through remote diagnostics of ship performance. To keep maritime operations secure, Intelsat is the only commercial satellite operator with an independent third-party cybersecurity accreditation, ensuring protection against threats while utilising multiple applications.

CO2 emissions are tightly correlated with fuel consumption, the rate of which is affected by speed, weight, time of travel and weather conditions. Automation is part of the wide-ranging solutions satellites can offer decarbonisation of the freight industry. Partially or fully replacing crew with machinery and logistics software can reduce energy protection by controlling consumers and efficient voyage execution.

Aviation

The aviation industry currently contributes an estimated 0.92 gigatonnes of CO2 emissions and is plotted on an upward trajectory, with emissions expected to increase to 1.5 gigatonnes in 2040 and 1.8 gigatonnes in 2050.[26] In a similar vein to the maritime industry, satellite communication technologies can enable greater operational efficiency by optimising fuel use. In addition, such communication capabilities can further improve the effect of communications between airlines, operators, and air traffic control.

Intelsat is pioneering the delivery of reliable infight broadband services, providing commercial and executive flight operators with cost-effective, high-performance connectivity. Intelsat is uniquely positioned to operate industry-leading security and resilience practices, encouraging operational efficiencies, and making a significant contribution to global decarbonising efforts.

Earth Observation Satellites

The application of space technology to sustainable development starts with using Earth Observation satellites (EO). They have historically presented great potential in exploiting sustainable energy generation plants. Understanding the geological landscape is paramount to location assessments for developing renewable infrastructure. Satellites can facilitate the analysis of historical and changing weather data, including marine currents, solar irradiance, windspeeds and directions. They can further map topographic and orographic characteristics that influence renewable energy generation.

Copernicus, the European Union's Earth Observation Programme, has developed satellite monitoring services for this very purpose. The satellite's solar radiation modelling informs the optimal installation of solar panels, whilst similarly monitoring applications for wind and marine currents to influence the development of wind farms and tidal power generation plants.

Intelsat has made continued investment in global 5G software-defined network, acquiring two software-defined satellites from Thales Alenia Space, who specialise in earth observations and orbital infrastructures.[27]

Teleports

Intelsat has deployed an energy efficiency programme to support the upgrade of power consumption monitoring systems. With the ambition to reduce carbon footprint and the consumption of power, the new BMS and EPMS monitoring systems can monitor all power and tracks peak load periods to help engineers run a more efficient building and operations.

Policy Recommendations

For these innovations to be utilised to the fullest, a more agile policy environment is needed, which can be achieved by boosting:

Awareness

To develop a strategy for integrating space technologies into environmental efforts, policymakers must first develop a greater awareness of the satellite industries' potential to facilitate significant cross-sectoral decarbonisation efforts.

Intelsat welcomes the work that of the EU is following regarding the sustainability of Earth orbit and Space Traffic Management, seeing this as a necessary element to ensure fair and long-term access to space. The company however believes that policymakers should look at the broader image of how satellites and space assets can help sustainability and decarbonisation efforts to unlock the full potential of the industry's offerings.

Cross-sector Collaboration

To ensure that government-led research and development decarbonisation strategies incorporate satellite solutions, the space industry needs to collaborate with governments and vertical industry leaders. Progressive policy initiatives to tackle a global phenomenon could echo commercial, scientific and policy stakeholder voices.

Regulation

To support innovative approaches to decarbonisation efforts, a regulatory framework must be devised to support the scale of space sector integration within vertical industries. Regional, national, and international policymakers should be charged with delivering a regulatory framework, to protect and benefit people, businesses, and the environment and to support the economic growth of the sector.

Footnotes:

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About Intelsat

Intelsat's global team of professionals is focused on providing seamless and secure, satellite-based communications to government, NGO and commercial customers through the company's next-generation global network and managed services. Bridging the digital divide by operating one of the world's largest and most advanced satellite fleet and connectivity infrastructures, Intelsat enables people and their tools to speak over oceans, see across continents and listen through the skies to communicate, cooperate and coexist. Since its founding six decades ago, the company has been synonymous with satellite-industry "firsts" in service to its customers and the planet. Leaning on a legacy of innovation and focusing on addressing a new generation of challenges, Intelsat team members now have our sights on the "next firsts" in space as we disrupt the field and lead in the digital transformation of the industry.

Let's talk
intelsat.com/contact-us