

# **An Evaluation into the Sustainability of Global Spaceports and the Role of Space Technologies in Supporting Sustainable Practices**

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## **Abstract**

An overview into the main environmental and social sustainability implications faced by global Spaceports and how associated space technologies can help identify, monitor, and implement sustainable practices.

Research found many common implications faced by global Spaceports which can affect site sustainability. Some of the main implications identified include emissions from launch, water mitigation, effects on wildlife, noise/air pollution and environmental/social requirements which must be met by the Spaceport. Including broader issues of concern which can be seen to impact the future sustainability of Spaceports, including space debris, and the congestion of the earth's orbit.

Research also uncovers the potential to aid Spaceport sustainability through the utilisation of space technologies including satellite imagery, earth observation analysis, water mitigation management and land/ habitat change using land classification mapping. While being enhanced by technology such as acoustic monitoring, to identify and monitor sustainability change on a Spaceport site.

**Keywords:** Space Sustainability, Climate Challenges, Space Helping Space

## **Methodologies**

This project was conducted as part of the UK Space Agency SPINtern programme, working with GlobalTrust a UK based environmental services company. The aim of this project was to investigate environmental and social implications for UK and Global proposed, developing, and functional Spaceports. How these implications are/ can affect Spaceport operations and in what way they identify, monitor and solve these issues impacting sustainability.

Data was collected through secondary research, including environmental analyses, academic journals, planning reports and environmental assessments. Primary data was also used through interviews and meetings with over thirty global Spaceports, National Space Agencies, Government departments and associated space committees.

Work with GlobalTrust allowed further investigation into possible monitoring and space technology solutions. This led to the project outcome of key social and environmental implications on Spaceport sustainability and identification of possible solutions.

## **1 Findings**

There is no doubt that there will be an increase in the number Spaceports and frequency of launches worldwide. This is already evident in the UK with seven proposed Spaceports, many of which will be launching in 2023-2024. If we are not careful with the entry and retrieval of space vehicles, we could jeopardise the 1000s of satellites we have learnt to depend on. Issues such as the congestion in space and space debris are largely a concern within the industry. Spaceports have a crucial part in ensuring space sustainability – From facilitating sustainable and reusable launch vehicles to developing sustainable Spaceports which can hold frequent launches, becoming a gateway to the space economy.

Some of the main environmental concerns identified from this research include the often complex land management process during the construction and planning stages of launch. This stage of development often identifies environmental implications, including water mitigation, peat management, and the negative effects on biodiversity.

There is also a wider concern regarding the emissions emitted from launch vehicles, the unknown data regarding emissions and expected increased yearly launches. Regarding emissions associated with launch it is crucial to mention that the emissions with launch depend on several variables including, type of launch vertical or horizontal, fuels used, location, payload and distance travelled.

Soot particles released in the earth's atmosphere are recognised as a concern, and the effect they may have around climate. It is not quite understood the effects of these emissions on the earth's atmosphere and with more research needed. But currently emissions such as carbon dioxide from space launch are low compared to other industries such as aviation. A study in 2022 showed that Spaceport Cornwall's expected CO<sub>2</sub> launch emissions output (2025 onward), only accounts to 0.05% of Cornwall's total CO<sub>2</sub> emissions using 2016 baseline data (Yan, 2022). This does not include Radiative Forcing (Emissions from high altitudes), but when just reviewing ground emissions these are low. However, it is important to recognise that as launches increase globally this will have a more significant impact on the planet.

An issue which was widely discussed across many Spaceports was the impact on wildlife, specifically around construction, testing and launch. Specifics include, birds nesting which can restrict launch and testing periods as well as other animals such as deer which may be in the area. Often there are requirements to complete environmental reporting to local authorities or environmental agencies. Such requirements are often set by local authorities and can include obligations such as carbon emissions outputs, restriction of noise levels, traffic management, air quality measurements and restricted launch periods.

Work can be done to offer support for these identified implications, often many involve the use of space technologies. Such technologies include satellite imagery, earth observation analysis, water mitigation management and land/ habitat change using land classification mapping. Technologies such as these allow the identification of potential issues which may impact the sustainability of a Spaceport. Furthermore, monitor and provide solutions for issues such as water mitigation. Where water run off on a site can be measured, monitored and then evaluated and managed to prevent negative effects on sustainability. Further examples include environmental monitoring of operations such as changes in biodiversity, vegetation degradation and water quality.

Research gives an understanding of some of the main environmental and social implications effecting sustainability and possible solutions using space technologies to help the space industry.

#### References:

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