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A CASE FOR MARKET-BASED EMISSION CONTROL IN THE SPACE INDUSTRY

**Abstract**

As spaceflights increase in frequency and the climate crisis grows in urgency, there is a case to be made for the implementation of market-based emission control measures in the space industry. The benefits of space exploration come at the cost of significant environmental impact. A model by the American Geophysical Union found that 400 spaceflights per year, as notably proposed by Virgin Galactic, would generate enough greenhouse gas emissions over 40 years to cause up to an additional 1C warming in the Arctic. There is currently little incentive for space agencies and companies to design for sustainability. As a result, we are unlikely to see a change in their behaviour without imposing economic measures.

Implementation of market-based emission control has led to significant reduction in carbon emissions. For example, as of 2018, the European Union's Emissions Trading System led to a 29% reduction in emissions from stationary structures since the introduction of the program in 2005. By instituting a cap on total emissions and creating a market for companies to trade emission allowances, we can incentivize sustainability and drive the innovation of cleaner technologies. Such market-based measures are already in development for similar industries like aviation, where the United Nations' Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) sees airlines buying offsets to compensate for increases in their own emissions. CORSIA's pilot phase is underway, with mandatory participation for members of the International Civil Aviation Organization to follow.

This work assesses the need for and feasibility of implementing market-based emission control in the space industry. It considers how such schemes in neighboring industries could be adapted for space, and discusses their drawbacks. It explores consequences unique to spaceflight, such as ozone depletion and emissions in the upper atmosphere, considering their impact in the development of emission credit metrics. Decisions required to move forward with a market-based solution are also discussed, including national versus international scoping and the involvement of public versus private organizations.

The scale of impact from decisions made on space missions motivates sustainability efforts focused in this field. This work aims to kickstart the adoption of an emission pricing scheme in the space industry and encourage consideration of environmental impact in mission design decisions.