SPACE GENERATION ADVISORY COUNCIL

Environmental Impacts of Rocket Fuel

U.S. Task Force, Space Generation Advocacy & Policy Platform

Overview

The space industry is now a huge platform for economic growth in the United States, with a projected revenue of $1 trillion by 2040 (“Investing in Space Exploration,” 2020). An expansion in the economic viability of satellite technology is leading to more space stations, research, and commercial activity in space. This has resulted in a dramatic increase in the frequency of rocket launches over the last decade – from 70 launches in 2010 to 132 in 2021 (Roberts, 2022). There remains little regulation on the types of fuel used to launch rockets on American soil.

Environmental Impact of Rocket Fuel

Toxic rocket fuels are disastrous to the environment. They contaminate the upper atmosphere, where the accumulation of combustion byproducts contributes to ozone layer loss (Dallas, 2020). Rocket propellant also harms ecosystems on Earth: one notable example is unsymmetrical dimethylhydrazine (UDMH), a fuel dubbed “Devil’s Venom” by the Soviet scientists who invented it. Russian proton rockets launched with UDMH from the Kazakh Steppe resulted in multiple major accidents (the Nedelin disaster of 1960 and a similar failure in 2013), contaminating the local environment (Gingerich, 2015). The US is in a position to set a global precedent for regulating rocket fuels, avoiding similar disasters on American soil. There are four commonly used propellant classes (Ross, 2018):

Propellant	Recent Use	Environmental Impact
Solid ($A1/NH_4ClO_4 \pm$ HTPB)	Space Shuttle (NASA), Ariane V (ESA), Atlas V (Lockheed Martin)	Large environmental impact (acid rain, ozone depletion)
Liquid hydrogen/liquid oxygen (LO_x/LH_2)	Space Shuttle (NASA), Space Launch System (NASA), New Shepard (Blue Origin)	Water is the only byproduct, very low environmental impact
Hypergolic (UDMH)	Proton (Russia)	Extremely toxic
Kerosene (LO_x/RP-1)	Falcon 9 (SpaceX), Soyuz (Russia)	CO_2 byproduct causes ozone depletion

Existing Policy Framework

Currently, rocket fuel is sparsely regulated at both the international and national levels, and regulations that do exist do not address the full scope of rocket emission impact. The 1987 United Nations Montreal Protocol is concerned with phasing down the use of ozone depleting substances (ODS), but it is not currently applied to hazardous substances produced by rocket fuel (Ross, 2018). Domestically, the 1974 National Environmental Protection Act (NEPA) requires any new companies working with rocket fuel to prepare an Environmental Impact Statement (“What is the National Environmental Policy Act?,” 2022). However, these reports are not peer-reviewed and may be inaccurate, causing a lack of proper attention to potential environmental impacts (Ross, 2018).

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Some regulations from the Environmental Protection Agency (EPA) apply directly to substances used in rocket fuels, but these policies don't present a comprehensive stance on the impact of rocket launches from American soil.

1. In early 2022, the EPA announced that it will not regulate perchlorate in drinking water ("EPA Announces Plan," 2022). Perchlorate is a common component of rocket fuel and has been shown to have significant negative health impacts ("Perchlorate," 2017).
2. In 1973, the EPA ruled that launch sites must ensure that the concentration of beryllium does not exceed a certain threshold within a certain time period ("Beryllium," 2022).

There are a slew of regulations that label hazardous substances in rocket fuel, but the result is a handful of policies that regulate the disposal of these dangerous materials rather than their use.

Conclusion

American policy regarding the environmental impact of rocket launches is minimal. The longer this persists, the longer we risk negative impacts on our environment: both on the ground and in the skies. This regulatory gap necessitates increased research into the effects of current and emerging rocket propulsion methods, as well as policies aimed at reducing the environmental impact of rocket launches.

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