

**United Nations / Jordan Workshop:  
Global Partnership in Space Exploration and Innovation**



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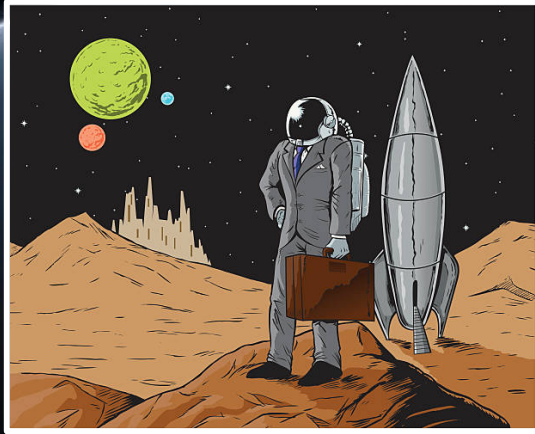
# **Planetary Protection Issues of Private Endeavours in Research, Exploration, and Human Access to Space: an Environmental Economics Approach to Backward Contamination**

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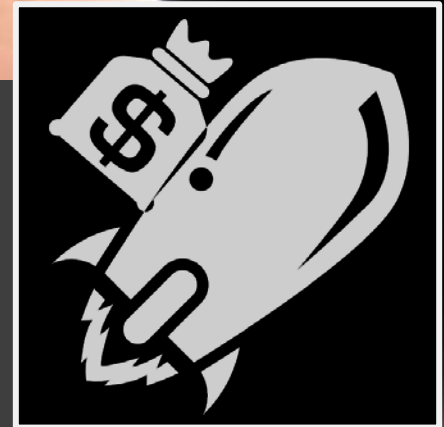
**UNITED NATIONS  
Office for Outer Space Affairs**

# Introduction

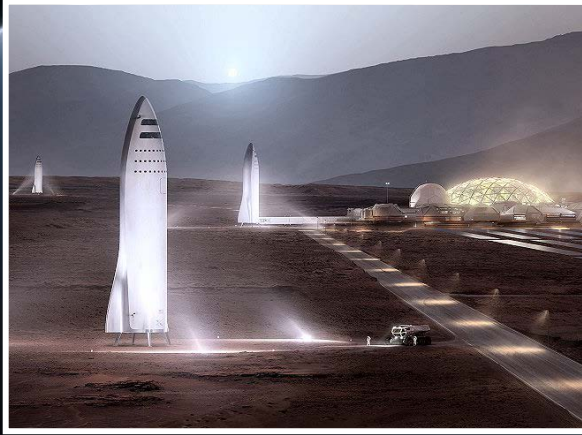


Due to the emergence of the current space commercialization paradigm, private space endeavours may soon be able to target the novel market segments of space research, science, exploration, space resources utilization, and human access to space.

NASA's recently-launched "Commercial Lunar Payload Services" bidding scheme opens up lunar exploration to private contractors. Commercial sample-return and space tourism missions to the Moon are now real business objectives of certain private actors.

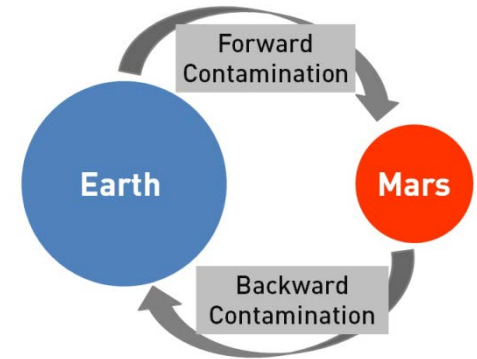


# Introduction



An envisioned long-term expansion of the value offering from lunar to Martian commercial sample-return and human spaceflight missions is not infeasible. Since Mars is a “restricted Earth-return” body, policy-making should be prudent, before an uncontrollable increase of commercial interests occurs.

There is a need to harmonize Planetary Protection guidelines with technological advances and business visions. Planetary Protection is defined as a set of guidelines concerning the avoidance of bidirectional biological material exchange between the Earth and other celestial bodies.



# An Environmental Economics Approach to Backward Contamination



Environmental Economics is mainly dealing with the interactions between the human economic behaviour and the deterioration -or improvement- of environmental quality; terrestrial examples include environmental degradation due to industrial pollution, pollution-based human health effects, and compromisation of safety due to hazardous waste.

A central concept in this field is the notion of positive and negative externalities: effects exerted upon the welfare of one agent due to the economic behaviour of some other agent that exploits an environmental good. Most cases of environmental destruction are related to negative externalities (external costs).





# An Environmental Economics Approach to Backward Contamination



In Article IX of the Outer Space Treaty, “adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter” are to be avoided. The safeguarding of the Earth from potential backward contamination is also the highest priority during the exploration of Mars for COSPAR.

Earth-return commercial missions will also involve a post re-entry phase on Earth; any astrobiology-related environmental, health, and safety damages pertaining to this phase may be considered degradations of the quality of certain environmental assets due to the negative externalities of backward contamination.



# An Environmental Economics Approach to Backward Contamination



**Social Benefits = Private Benefits + Positive Externalities;**

**Social Costs = Private Costs + Negative Externalities;**

**Environmental Equity: the fairness in the distribution of the social costs and social benefits among different societal groups.**

For an Environmental Economics approach to a private project with the potential risk of backward contamination, one should first evaluate whether its social benefits are larger than its social costs; then, consider how to fairly distribute these social benefits and costs amongst different socioeconomic groups.



# The potential public opposition to post re-entry activities



The environmentally inequitable distribution of the expected social benefits and social costs, including the relevant negative externalities, as perceived by groups of the public, may potentially lead to heightened hostility. This is similar to the siting and construction of other location-sensitive and noxious development projects.

Unaccounted negative externalities → Local environmental equity issues → Division of the public → Emergence of opposition by some public groups → Litigation and formulation of obstructive public policy due to public opinion influence → Equity issues and potential degradation get translocated to more welcoming underprivileged States, where a breach incident would be even harder to remediate.



# The potential public opposition to post re-entry activities



The problem must be corrected at its source. The opposition of public groups to post re-entry activities may be dominated by the dreadful conceptualization of the negative impacts of backward contamination, due to a number of factors, while their probability may either carry too little weight or get neglected altogether.

Concerned public groups can be expected to utilize heuristics, imagination, analogies, and scientific evidence, combined with the assistance of external experts and scientists, to express their views; it can be expected that the relevant rhetoric will be based on the formulation of speculative but seemingly plausible arguments.





# Public participation: A potential solution to local community opposition



Modern groups of the public should not be perceived by the scientific community as obstacles to be surmounted and as unknowledgeable and irrational empty vessels that should be filled with scientific knowledge via patronizing communication and public engagement initiatives.

Public debate, deliberation, and inclusive participation in the definitions of benefits, costs, and risks should be promoted. Local citizens should be allowed to express their concerns regarding the potential environmental externalities and influence the decision-making process; the expressed concerns should not be dismissed as baseless, but get incorporated into a scenario-based thinking framework and help identify otherwise under-imagined events.

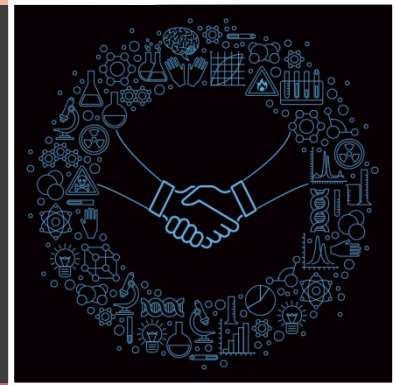


# Public participation: A potential solution to local community opposition



The goals of a commercial Earth-return mission should be aligned with the needs of the diverse public groups, to shift the social focus from a pure defensive control of potential negative consequences to a co-construction of social value and benefits. Deliberation should emphasize the public benefits to the local community, e.g. employment & economic growth, and the better solutions that may arise to compelling problems.

Environmental Economics may inform this discussion with tools and methods that can provide insights for both the valuation and the equitable distribution of the social costs and social benefits of post re-entry Earth-return activities, and may highlight the role of Planetary Protection as an enabler of and not a hindrance to commercial space endeavours.



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**Thank you for your attention!**



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