Paper ID: 67496
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35th IAA SYMPOSIUM ON SPACE POLICY, REGULATIONS AND ECONOMICS (E3)
Economic analysis of both actual and potential future benefits from space activities and applications to nations and peoples. (3)

Author: Prof. Alex Ellery
Carleton University, Space Exploration and Engineering Group, Canada

THE CASE FOR SOLAR POWER SATELLITES OVER TERRESTRIAL RENEWABLE ENERGY SOURCES

Abstract

The COP 26 UN Climate Change Conference (Oct/Nov 2021) proposed to reach net-zero for greenhouse gas emissions by 2050 to restrict global warming below 2oC (currently around 1oC). Currently, there are no sustainable solutions to achieve net-zero by 2050. The fraction of renewable energy, although growing, is still minuscule in comparison with fossil fuel combustion. It is clear renewable energy growth cannot keep pace with the growth in energy demand. Economic (and, ipso facto, energy) growth is unreliably predicted by past-extrapolated trends and often takes no account of new energy consumers on the horizon. The pervasive effects of cloud computing (server farms are an increasing fraction of energy consumption), internet-of-things (all human products will be electronically tagged requiring vast data storage), water desalination plants (as aquifers recede), etc. are not. We have exceeded Earth's capacity and are being driven to exploit space for practical reasons. The primary problem with substitution by renewables – dominated by terrestrial solar power and wind power – is that their power densities are significantly inferior to non-renewables. We shall be examining these options in detail. They all introduce severe problems in increasingly competitive land-use demands - indeed, ecological footprint analysis (EFA) is fundamentally based on land use area. Comparison of fossil fuel, terrestrial renewable and solar power satellite energy sources in terms of their intermittency of supply, load matching and power densities suggest solar power satellites offer the closest match to the desirable characteristics of fossil fuels. We present the case for solar power satellites in terms of its superior performance. However, launch costs would exceed world GDP if solar power satellites are rolled out to global scales of 20 TW. The only solution is to bypass launch costs entirely by using space resources that are "out there" in space already. We present how this may be achieved by adopting a lunar industrial ecology with emerging self-growth capabilities based on 3D printing facilities. It is an approach that is robust and is the only approach that rapidly offers the production of 100 percent globally clean energy, guaranteeing world net-zero greenhouse gas emissions within around a decade. Such a facility will require new forms of governance and distribution.