It is time for International Coordination on Space Solar Power

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The Urgent Need for New Energy Solutions

We must transition more than ~3 Billion in “current economies” to net-zero carbon energy by 2050 AND Provide Sustainable Energy to some ~6 Billion in “emerging economies” by 2100

EURASIA (Western & Northern Asia)
Population Today: 0.93 Billion
Energy Today: 19,100-kWh/person
Population in 2100: 1.1 Billion

CHINA
Population Today: 1.47 Billion
Energy Today: 26,500-kWh/person
Population in 2100: ~1.09 Billion

NORTHERN OCEANIC
Population Today: 1.03 Billion
Energy Today: 58,000-kWh/person
Population in 2100: 1.1 Billion

LATIN AMERICA & CARRIBEAN
Population Today: 0.65 Billion
Energy Today: 11,000-kWh/person
Population in 2100: 0.68 Billion

SUB-SAHARAN AFRICA
Population Today: 1.09 Billion
Energy Today: 5,900-kWh/person
Population in 2100: 3.7 Billion

MEDITERRANEAN AFRICA & MIDDLE EAST
Population Today: 0.53 Billion
Energy Today: 27,500-kWh/person
Population in 2100: 0.93 Billion

INDIA
Population Today: 1.45 Billion
Energy Today: 7,800-kWh/person
Population in 2100: 1.45 Billion

SOUTH-ASIA & OCEANIA
Population Today: 0.71 Billion
Energy Today: 14,600-kWh/person
Population in 2100: 0.79 Billion

Note: Based on UN & EIA Data & Projections

2/14/22

Time for International Coordination on SSP

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How Would Space Solar Power Work?

**THE SUN**
- Can power 2,880 trillion light bulbs
- 1.4 million kilometer diameter
- The Sun has enough hydrogen fuel for billions of years

**SPS-ALPHA SPACE-BASED HARVESTING**
- ~6 km reflector array
- ~1.8 km solar PV panels + wireless power transmitter array
- ~7 km backbone structure
- Modular, robotic construction
- Cheap to launch; less than $1,000/kg
- 99.95% Available Power

**MICROWAVE ENERGY TRANSFER**
- Precisely controlled transmission of energy
- Less than 20% of summer sunlight
- Can be “shared” across receivers and coordinated with ground-based solar

**GROUND STATION**
- 2 GW delivered
- ~6km diameter (elevated 5-10 m)
- Outside metro areas
- Mesh RF ‘Rectifying Antenna’ system
- Batteries to modulate supply to existing grid

**EXISTING INFRASTRUCTURE**
- DC or AC fed into the local grid
- Resembles Hydroelectric Power – but...
- “Always” available
- “Shareable” across markets

**HOMES AND BUSINESSES**
- Base Load low cost electricity
- No carbon emissions
- Supports use at all hours of the day
SPS-ALPHA
(PS by means of Arbitrarily Large Phased Array)

- SPS-ALPHA represents a novel class of space system design that uses a physical / optical configuration to distribute energy by photons coupled with local thermal management...
- SPS-ALPHA comprises the following characteristics:
  - Very low hardware cost, via “Cubesat-scale” (1-10 U) modules that can be mass-produced
  - Simple, modular interconnections among diverse module types and mass-produced modular robotics
  - Local solar power, management and distribution
  - On-board Wi-fi integrating all modules
  - RF payload modules (diverse, retro-directive phase control)
  - Deployable moderate-scale thin-film reflectors
  - Stand-alone propulsion and attitude control modules
Proof that critical Hurdles CAN be overcome: LEO Mega-Constellation Production

Description
Initial Constellation: 4,400 Satellites
- RF Satellites
- Solar-powered (@ ~5 kW)
- Dry Mass: @ 260 kg
- @ $500,000 each)

Manufacturing Capacity
@ 120 Satellites / Month
@ ~30 MT / Month

Estimated Development “CER”
~$300,000 / kg
Estimated Mfg Curve: ~0.66

H/W Cost Reduction: >99%
Proof that critical Hurdles **CAN** be Overcome: Low Cost Space Launch

**PAST**
Government Launch  
Costs ~ Unchanged in 60 years  
@ roughly $20,000 / kg

**ETO:**  
A Classic “Chicken-and-the Egg” Problem

**Now & Forward**  
New Systems driving Costs Much Lower

Launch Cost Changes  
2000 @ ~ $20,000/kg  
2022 @ < $2,000 / kg  
2025+ @ < $200 / kg??

**Dramatic Launch Cost Reductions:**  
> 90% in 2021  
Launch Cost Reduction > 99% by 2025??

Launch Cost Changes

<table>
<thead>
<tr>
<th>Year</th>
<th>Cost per kg</th>
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<tr>
<td>2000</td>
<td>~ $20,000</td>
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<tr>
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<td>&lt; $2,000</td>
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<tr>
<td>2025+</td>
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By the mid-2020s, establish the technical foundation that will enable Space Solar Power to meet sustainable terrestrial & space commercial and government needs.

By the mid-2020s, develop capabilities that enable production of SSP systems suitable for sustainable delivery of net zero carbon energy to markets on Earth at commercially-competitive prices.

By the mid- to late-2020s, resolve spectrum management and other regulatory issues, working through appropriate US and international organizations.

By the mid- to late-2020s, demonstrate an SSP system delivering power from low Earth orbit to the Earth’s surface – delivering not less than 1 kW.

By the late-2020s, develop, deploy and operation an SSP pilot plant delivering net-zero carbon power to one or more markets on Earth at 100 MW or greater, and scalable to 1 GW or more to support commercial operations in a wide range of terrestrial markets.
The International Academy of Astronautics has formed a Permanent Committee on Space Solar Power
This committee will discuss and coordinate key topics of international concern regarding Space Solar
- International cooperation
- Spectrum Allocation
- Space Launch Considerations
- Sustainability and Space Debris
- Others...

An initial International Workshop will be organized September 2022
- Members / observers of UNOOSA / COPUOUS are invited to participate in this important first meeting
- For additional information, contact: john_c_mankins@yahoo.com