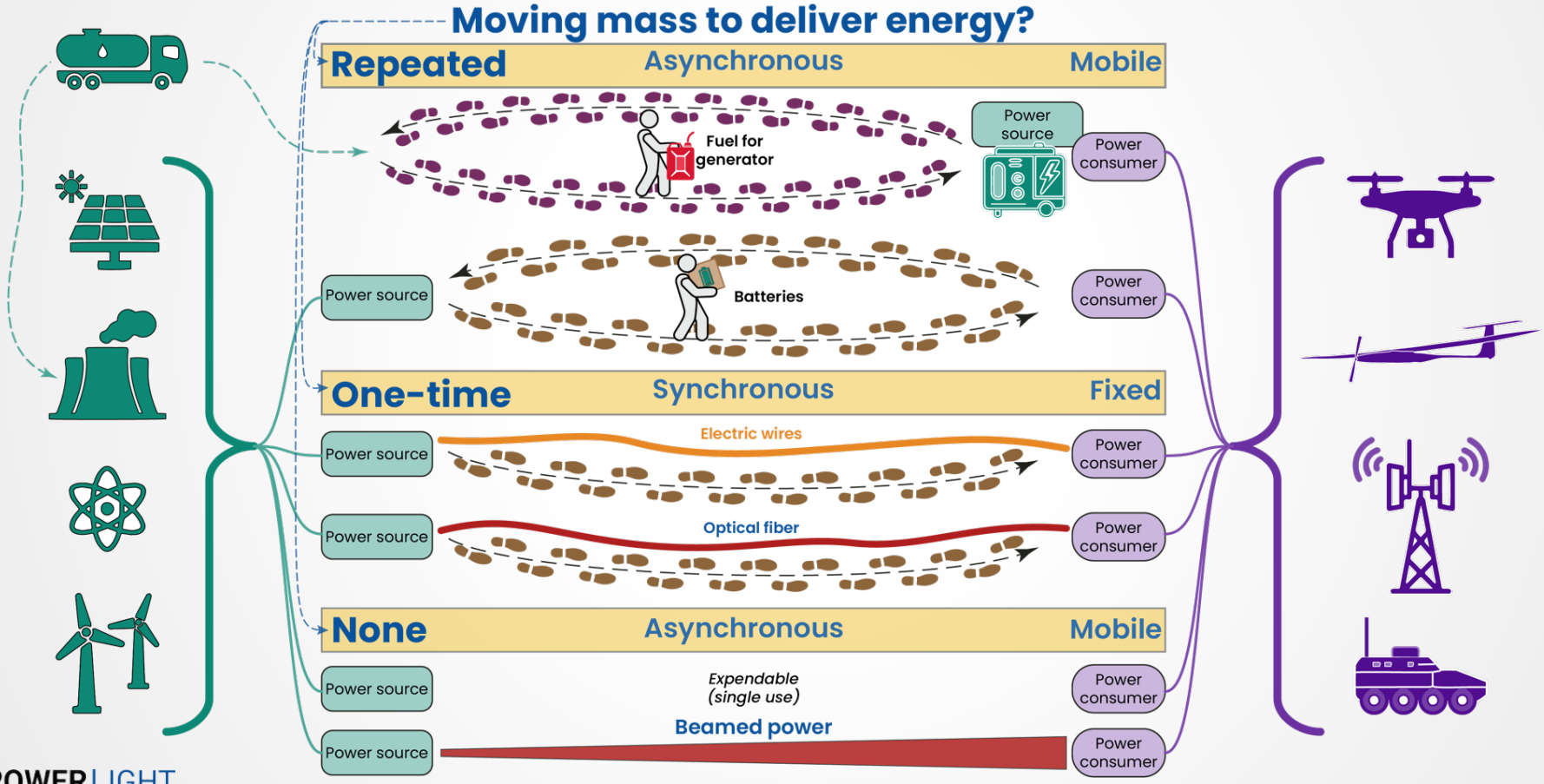
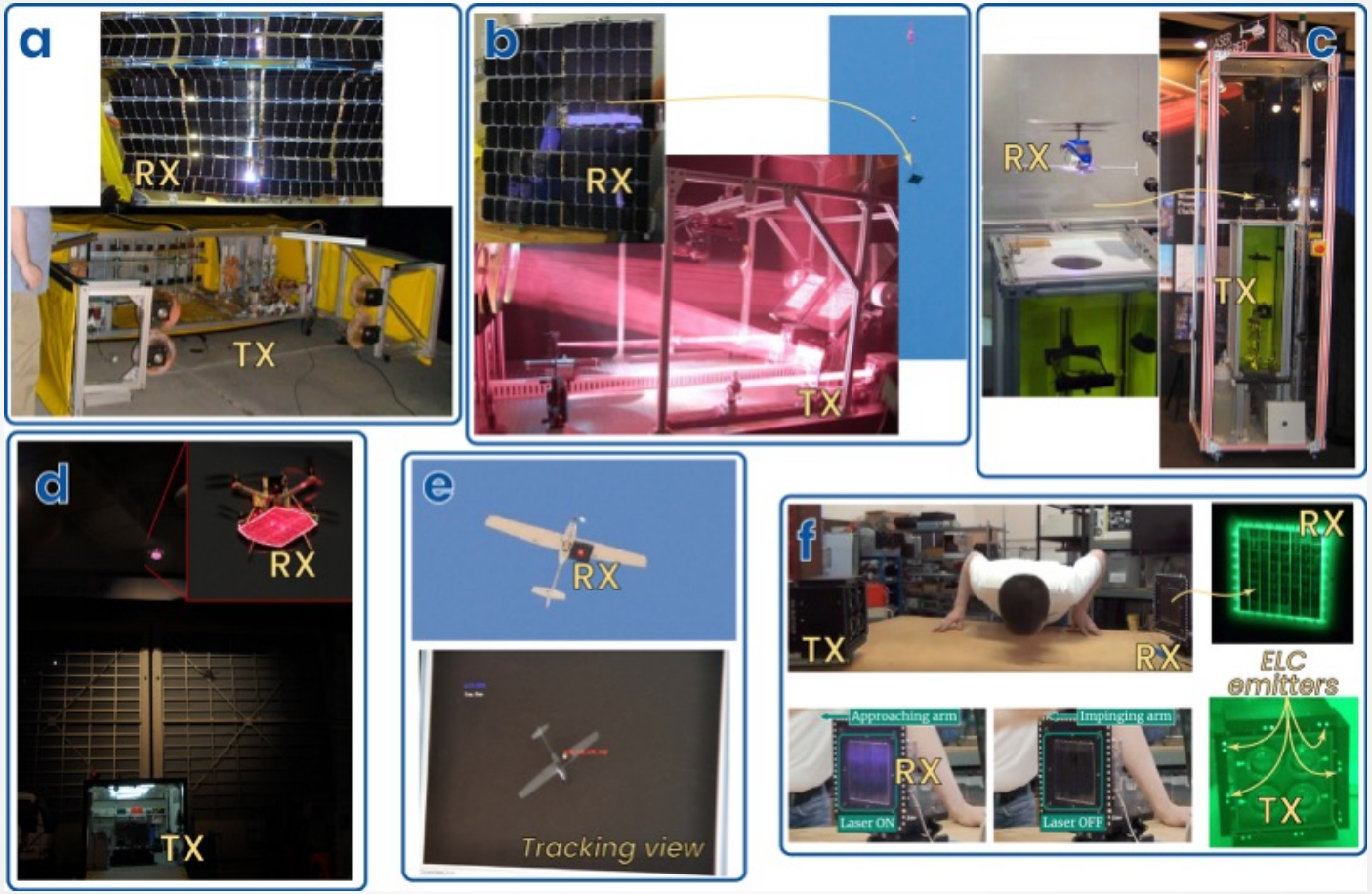

POWERLIGHT
TECHNOLOGIES
Laser Power Beaming for the Moon & Mars
Space Technology Industry-Government-University Roundtable (STIGUR) Spring Meeting
Panel: Surface Power for Exploration and Surface Operations
Tom Nugent, CTO
2025-08-13

Power Beaming = Freedom of Movement



POWERLIGHT TECHNOLOGIES

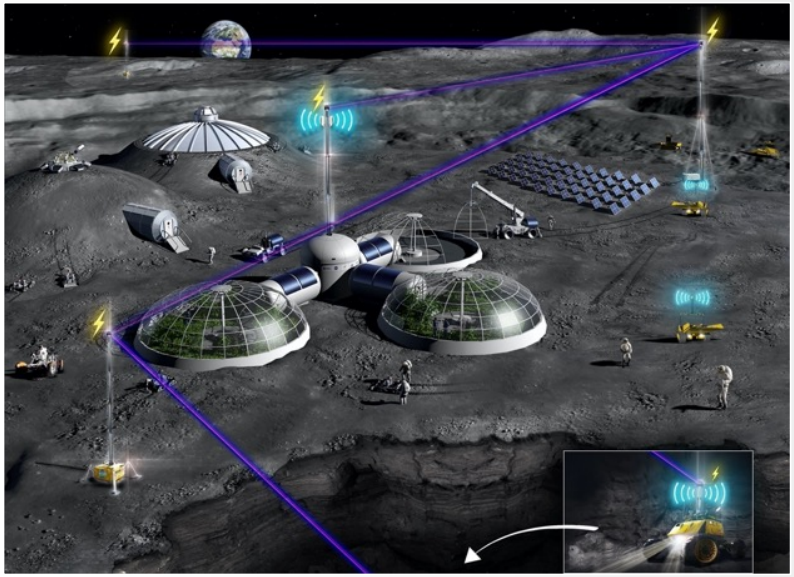
Free Space (aka Wireless) Power



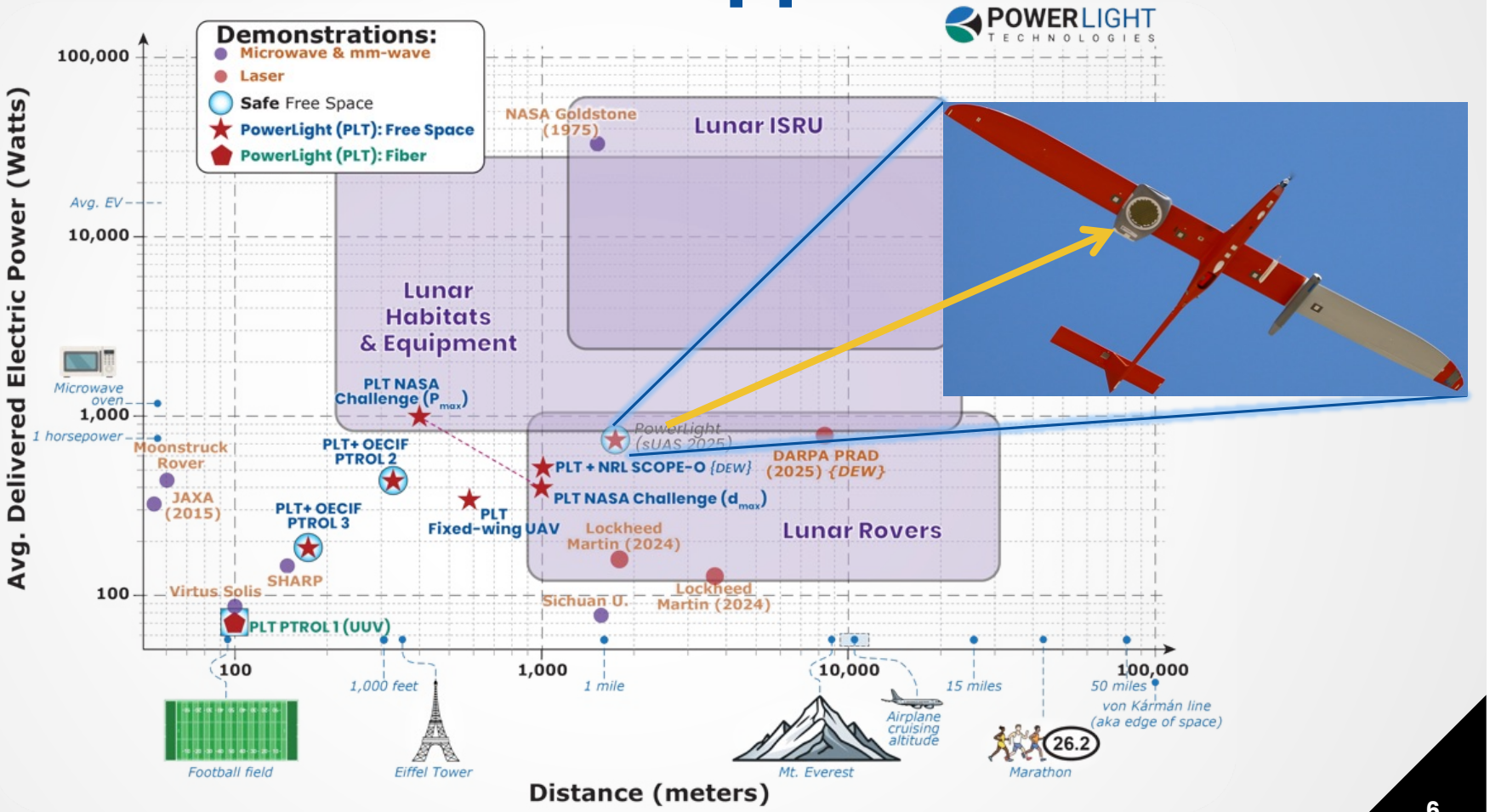
Free Space (aka Wireless) Power

Lunar Power Availability Challenge

- Transform the power problem from a **generation** problem to a **distribution** problem
- ...via laser power beaming:
  - **Flexibility** of operations and **mobility** of power usage will be crucial for early missions, especially without astronauts nearby to install & relocate power cables / solar arrays

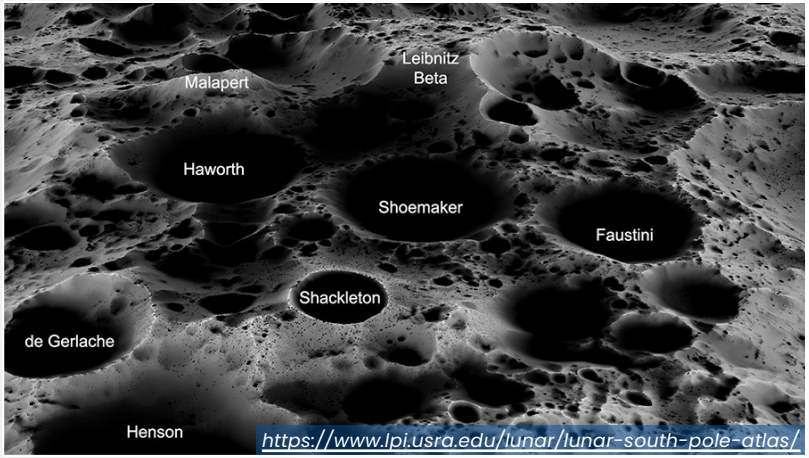


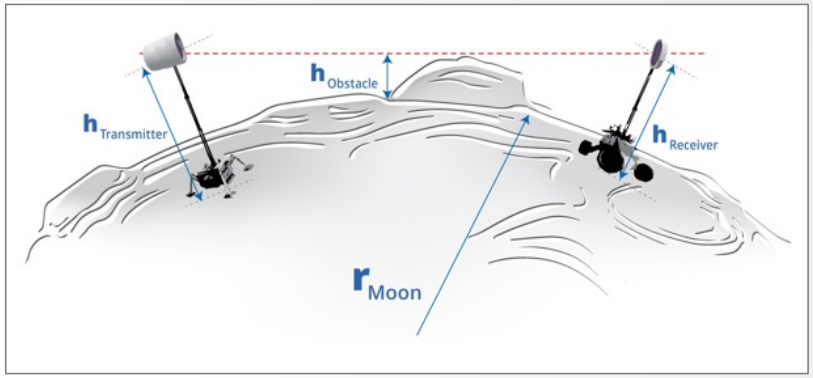
Power, Distance, and Applications

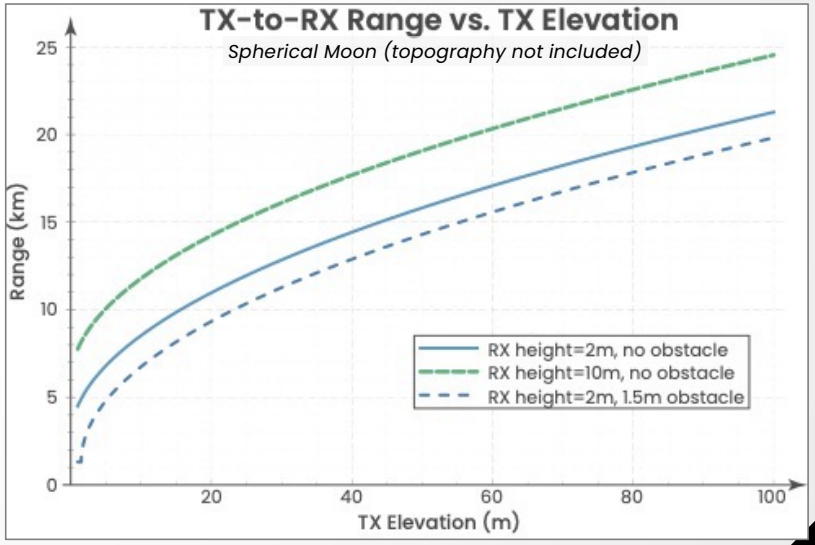


Horizon Distance

- Moon has smaller radius than Earth, meaning the distance to the horizon is shorter
- Horizon distance varies with the elevation of the TX aperture
  - Topography of the Moon (hills, valleys, boulders, etc.) reduce the actual ranges, creating "holes" in coverage due to shadows from taller features.
- Reaching tens of kilometers requires a very tall mast

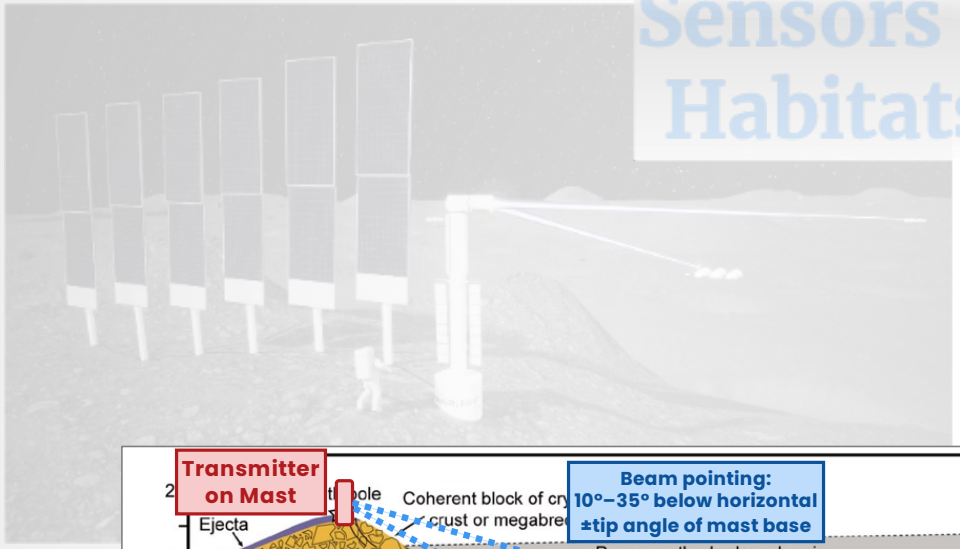




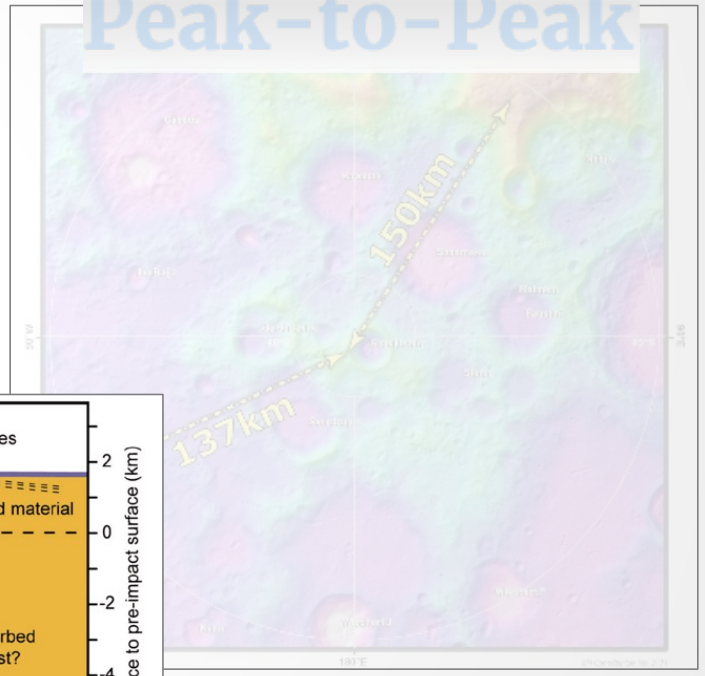


Range, Flexibility, and Mobility

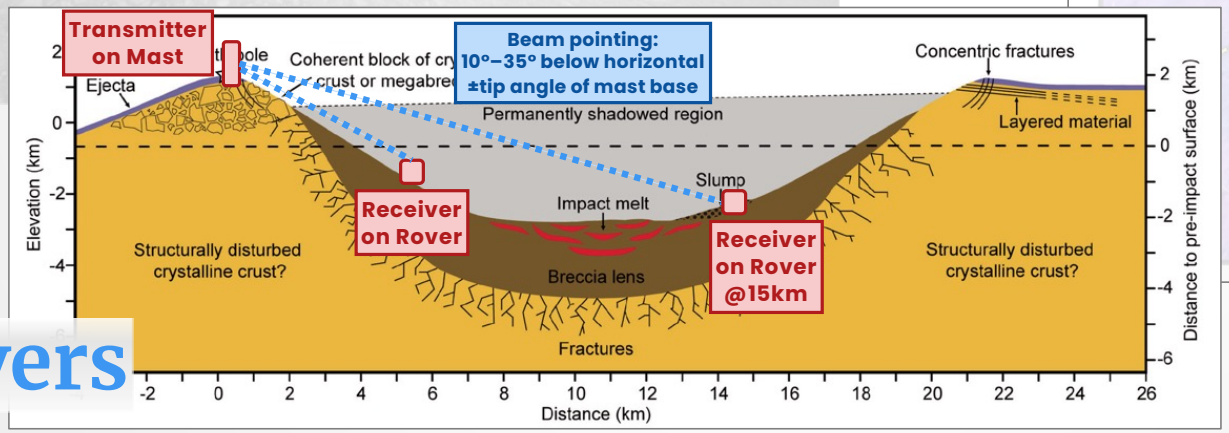
Sensors & Habitats



Peak-to-Peak



Rovers



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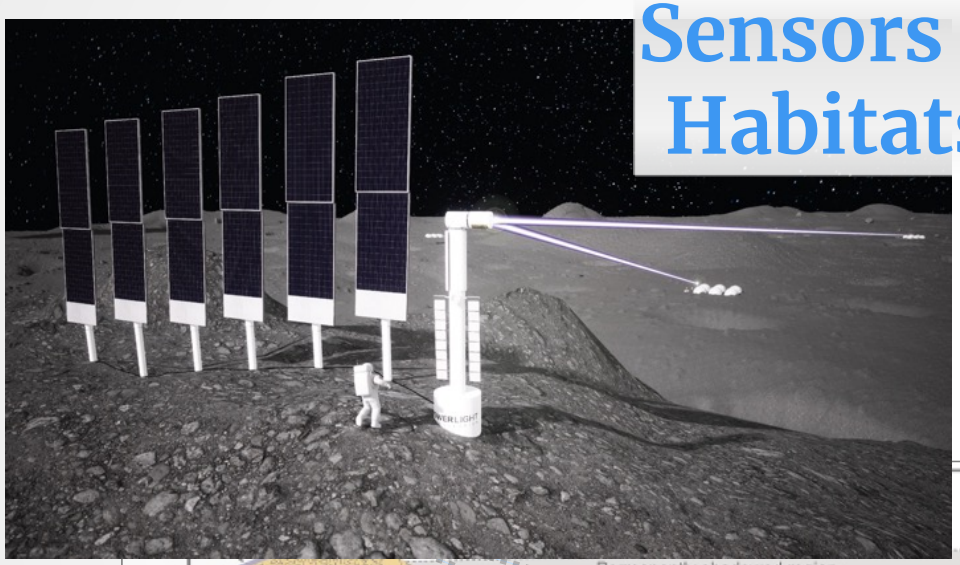

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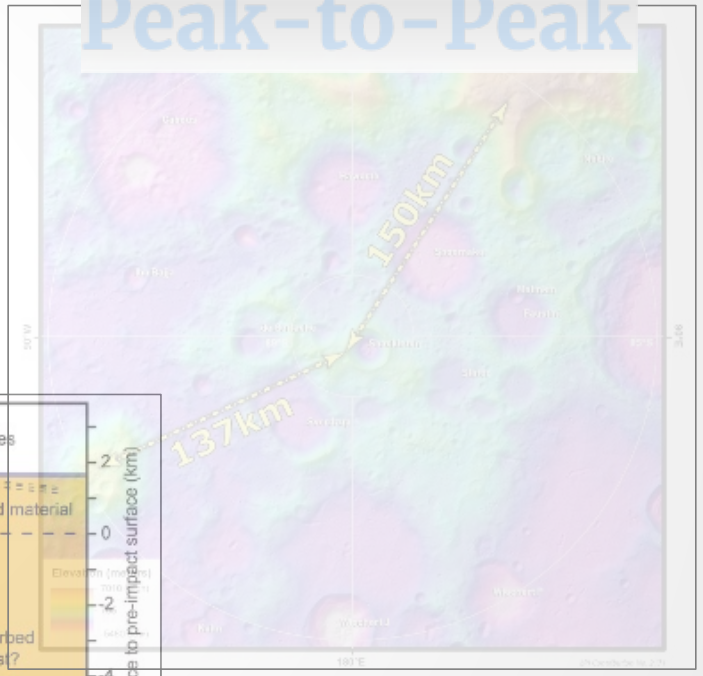

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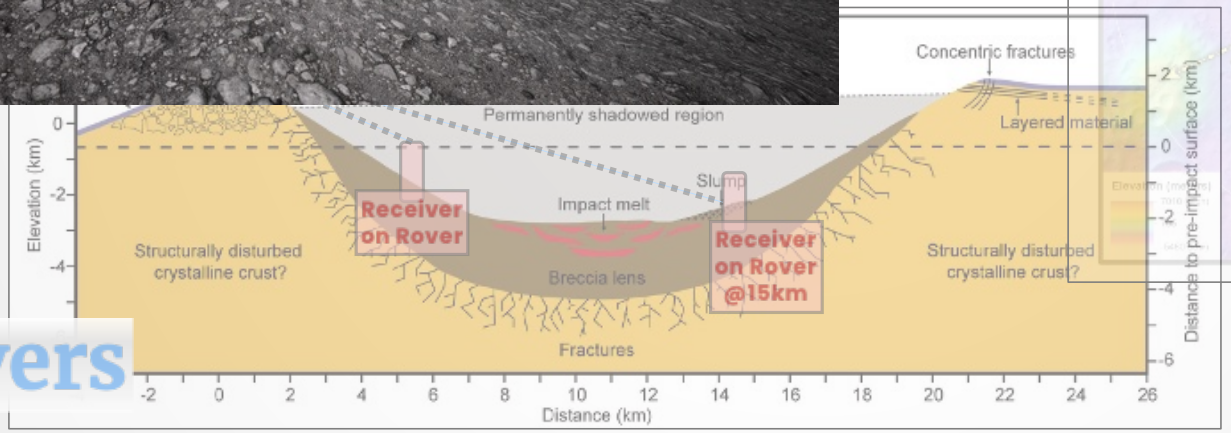
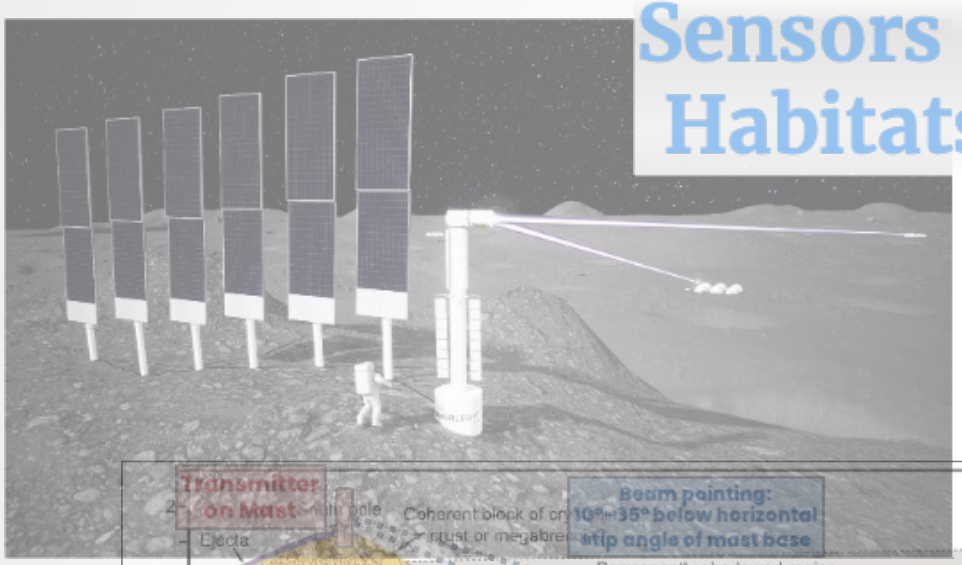


Range, Flexibility, and Mobility



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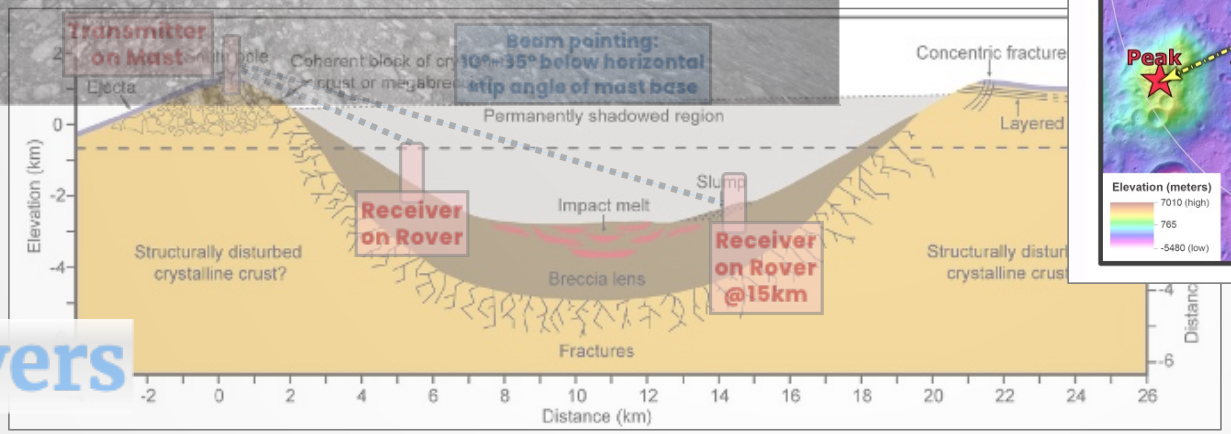

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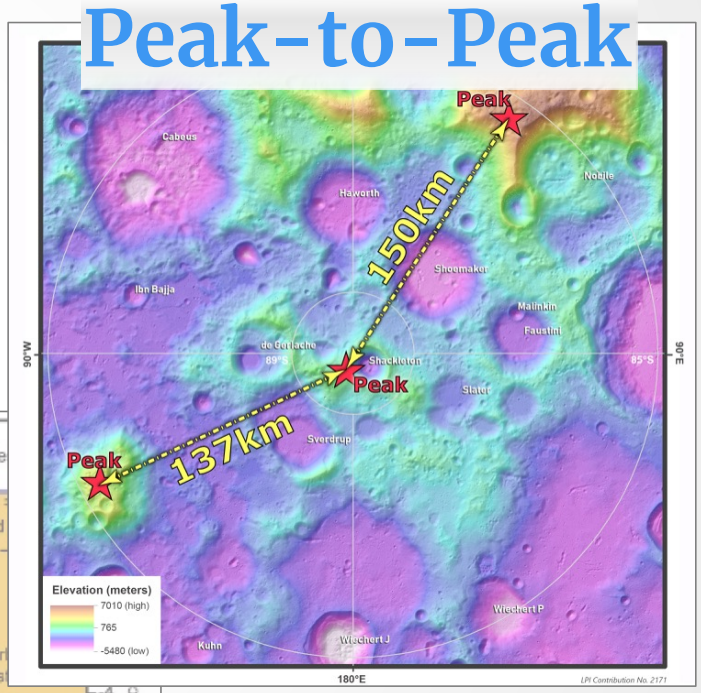
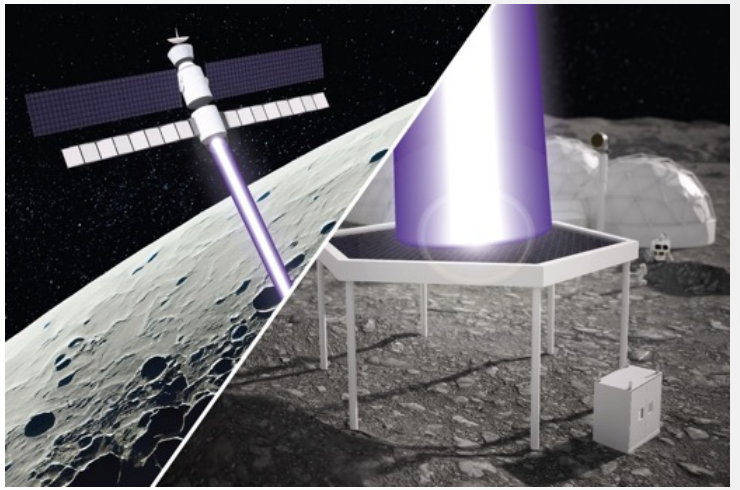
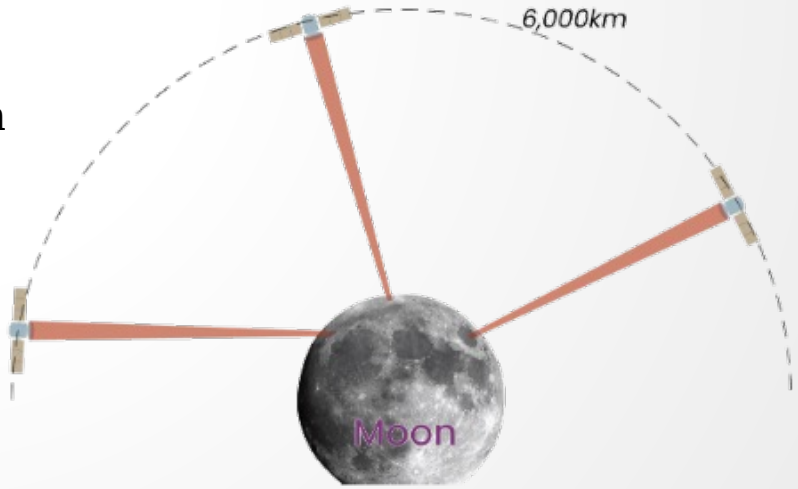


Power from Orbit

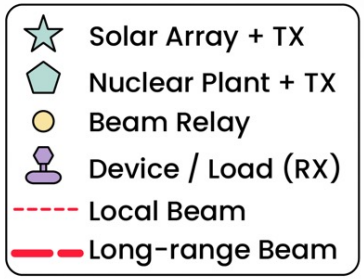
- **Survive the Lunar night** by beaming power down from satellites
- Regularly deliver electric power (and heat) multiple times each Earth day to devices on the surface.
  - *Example*:
    - 1,000 W_e on the surface only requires 7 m (22 ft) diameter solar array in orbit
    - 4 satellites @ 6,000km, 3 hours/pass: average of 700 W_e continual

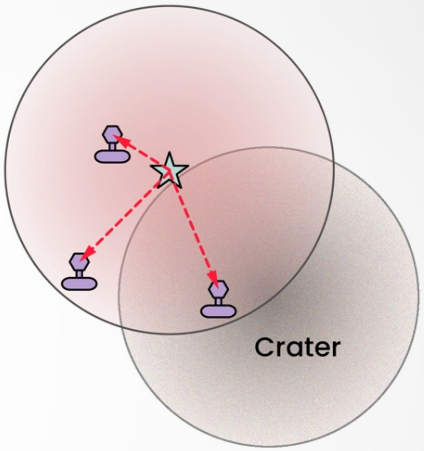




Expanding the Grid: Initial Stage

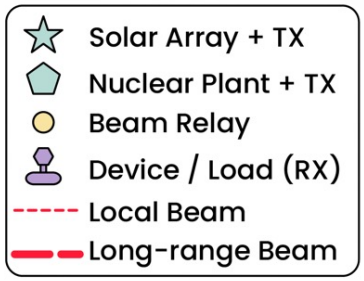
- Stage 1:
  - Solar + TX at crater rim for exploration
- Flexibility of pointing and placement enables locating TX at optimum solar site, and RX's can be mobile or sited for optimal usage (*instead of for power availability*)

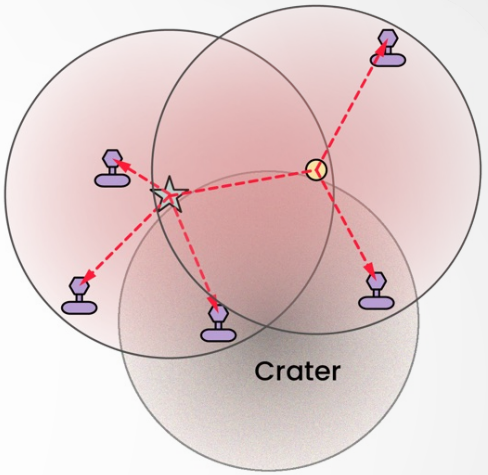




Expanding the Grid: Stage 2

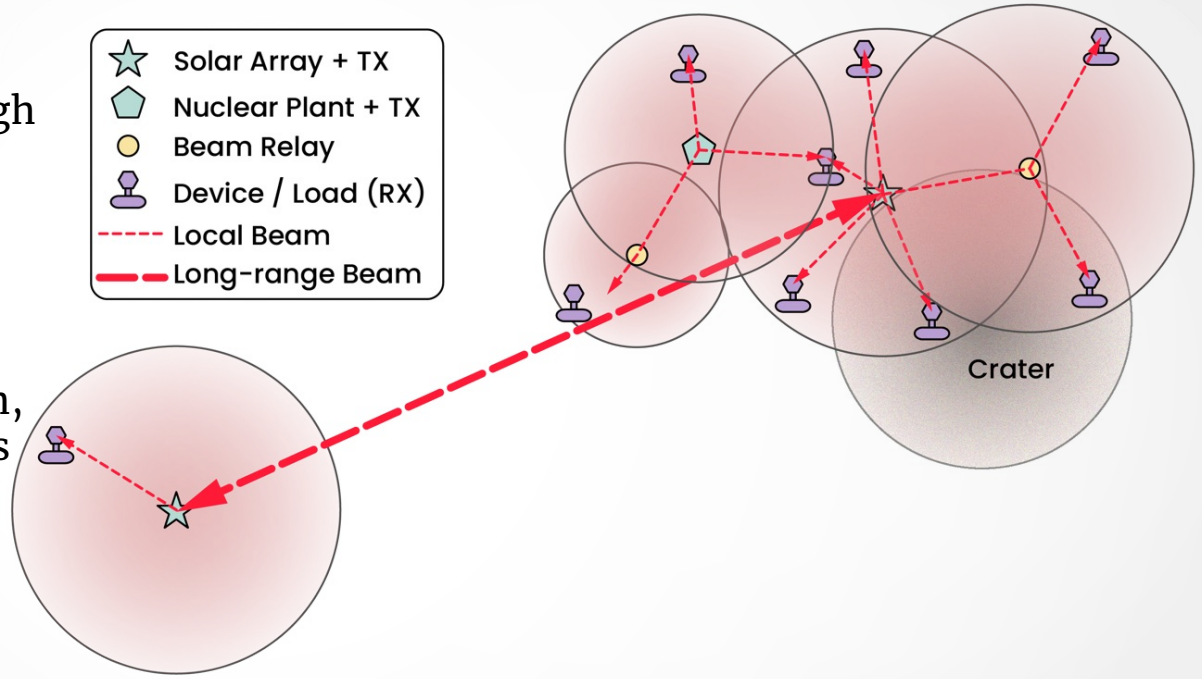
- Stage 2:
  - Beam relays can further extend the reach of transmitters
- Flexibility of placements enables re-locating devices (sensors, communications, etc.) as needed for mission optimization





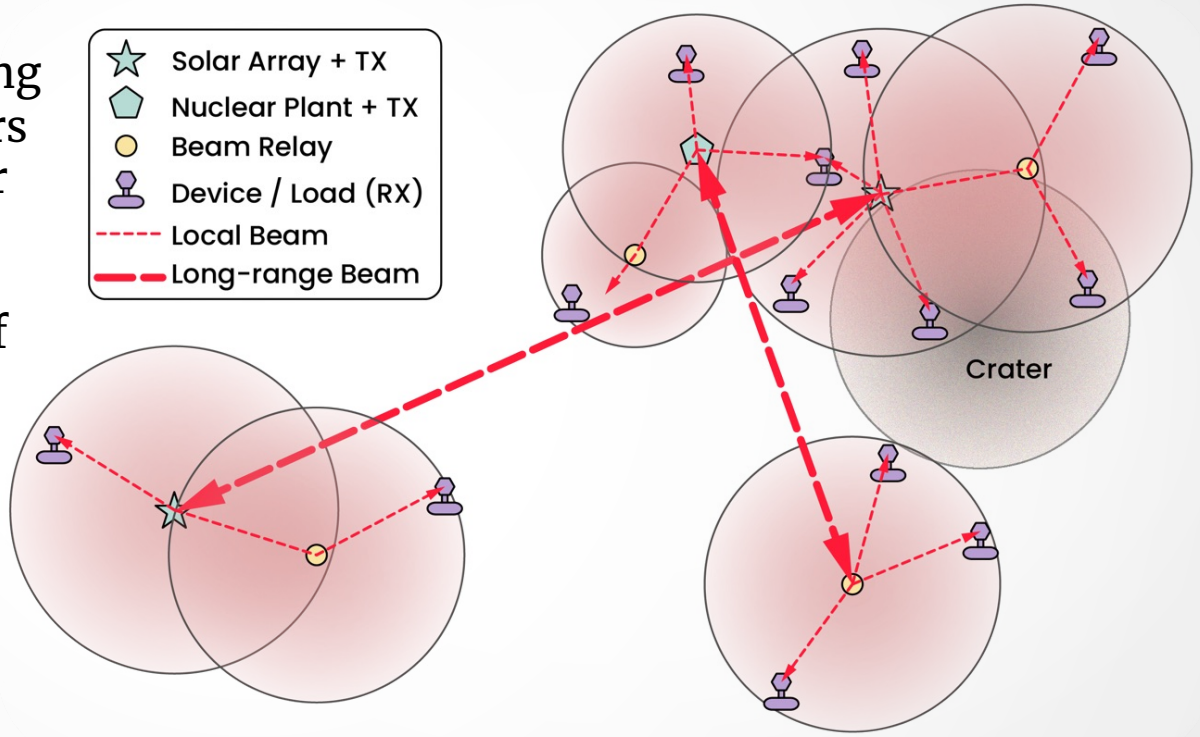
Expanding the Grid: Stage 3

- Stage 3:
  - Add “long-haul” (15-150km) transmitters at high elevations to share solar power when one peak is in shadow
  - Add nuclear power plant, and power beaming to distribute over the horizon, using the Moon itself (plus distance) as radiation shielding
- Adding mix of power sources improves reliability / availability of energy for diverse uses



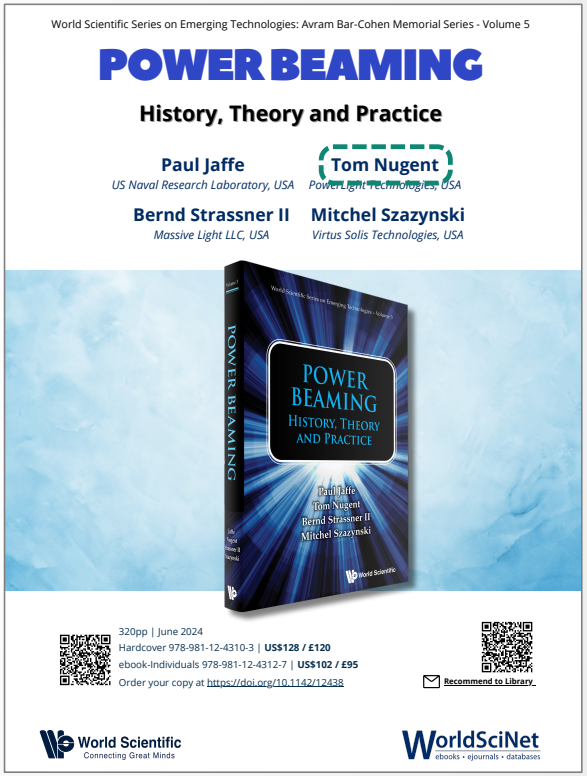
Expanding the Grid: Stage 4

- Stage 4:
  - Continue adding beaming nodes (both transmitters and relays) to the power distribution network to expand and fill in coverage across areas of interest.
- Flexibility of placement enables flexibility to grow the power distribution network



Summary

- Laser power beaming provides solutions to power distribution challenges for Lunar and Martian missions, and enables greater operational and positional flexibility as well as extended mission durations



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Questions?

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