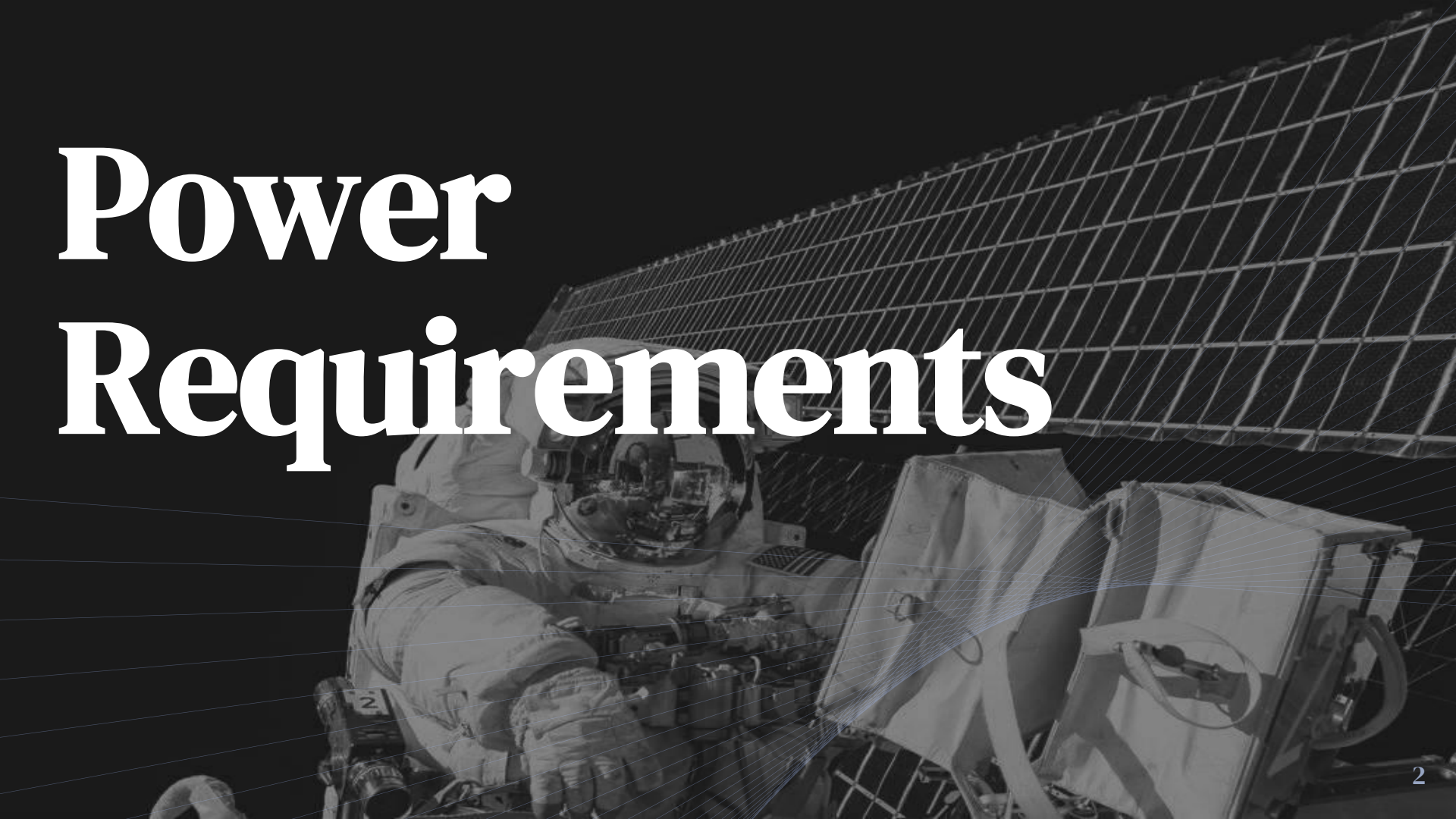




# Powering Lunar Operations and Settlements

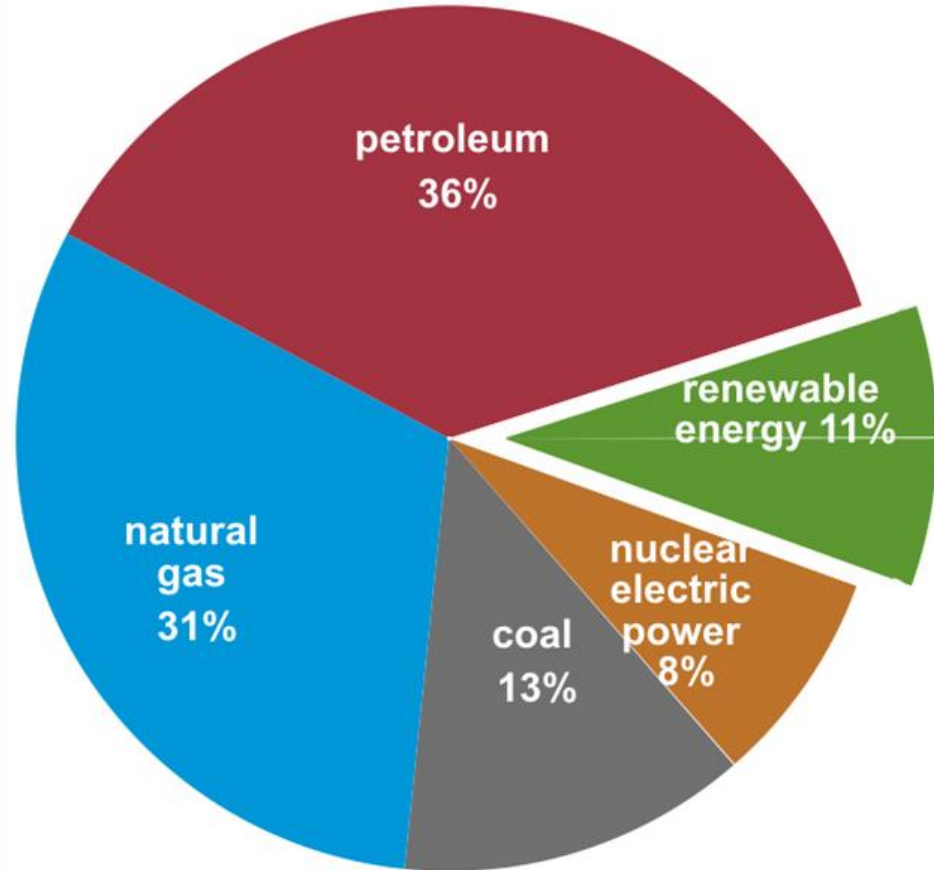
Jessica Rodriguez, Jenny Nnoli, and Diana Portugal

# Power Requirements

A black and white photograph of an astronaut in a full spacesuit working on a large solar panel array in space. The astronaut is positioned in the lower-left foreground, reaching towards the panel. The solar panel array is a large, grid-like structure that extends diagonally across the upper right portion of the frame. The background is the dark void of space.

# The Numbers

- The US's primary power source is Petroleum
- Producing 10 Billion Watts
- Standard sources
- Renewable energy



U.S. Energy Information Administration, Monthly Energy Review, Table 1.3 and 10.1, April 2019, preliminary data

- Fridge
- Blender
- Iphone charger

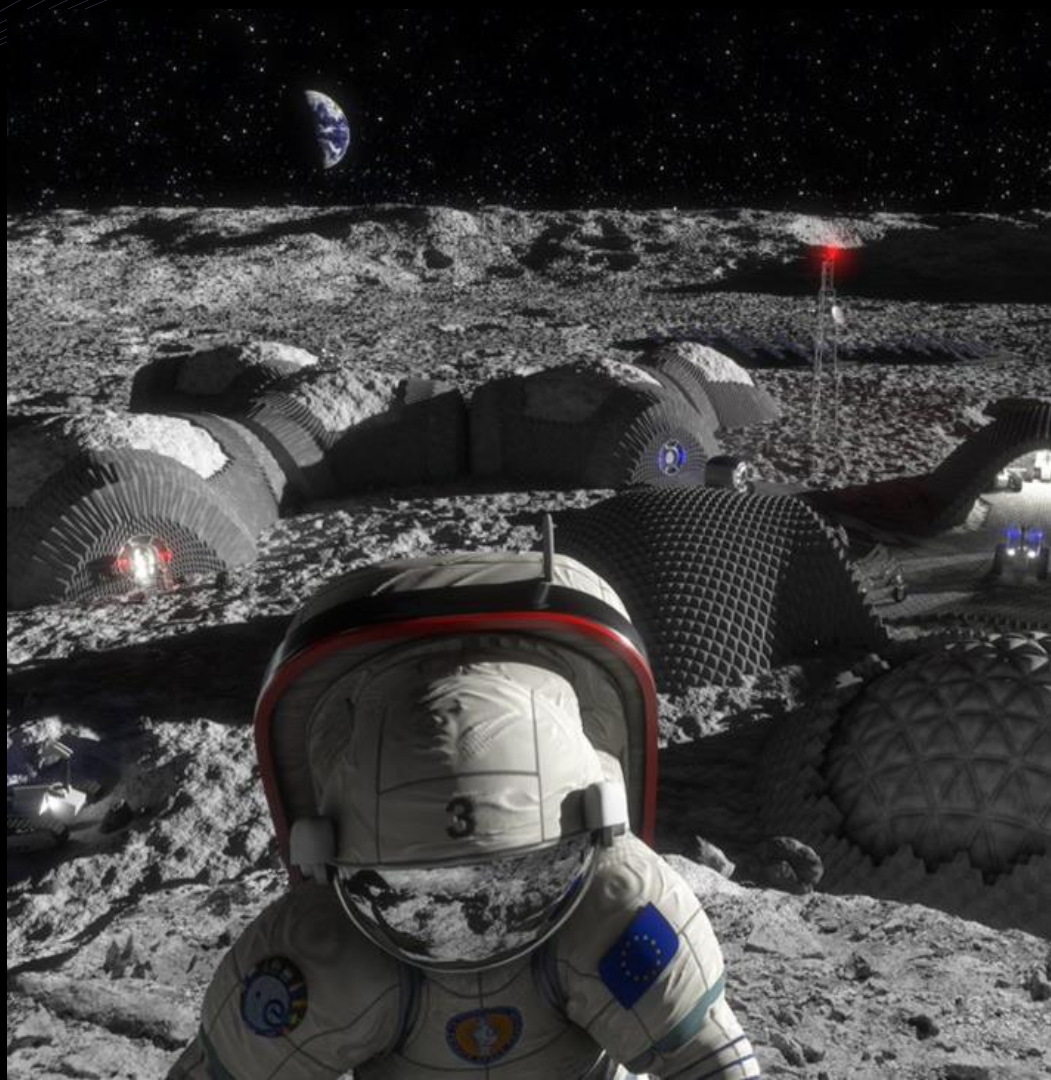


# UC Santa Barbara

- 24,346 Students
- 989 Acres of Land
- 87.9 Gigawatt-Hours per year (2018)



# Lunar Colony









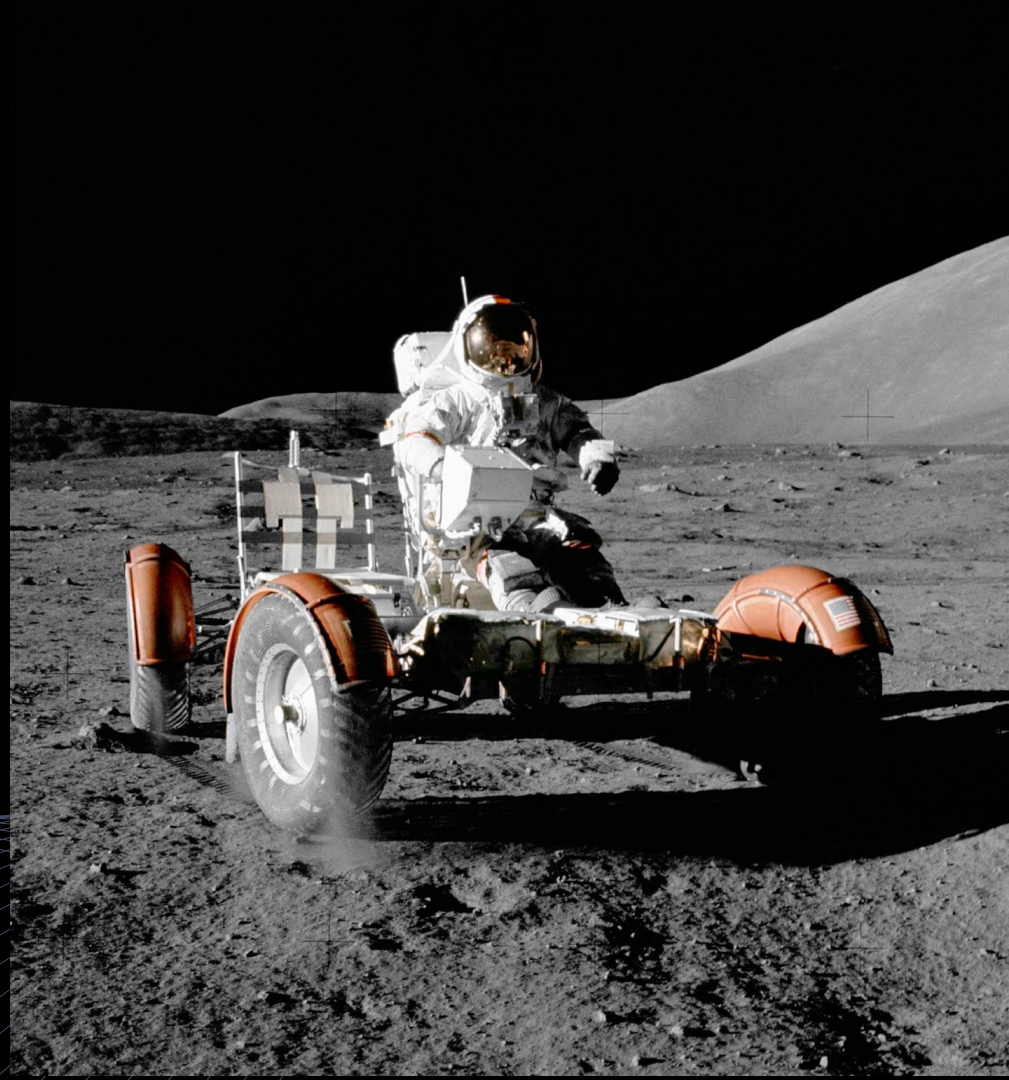


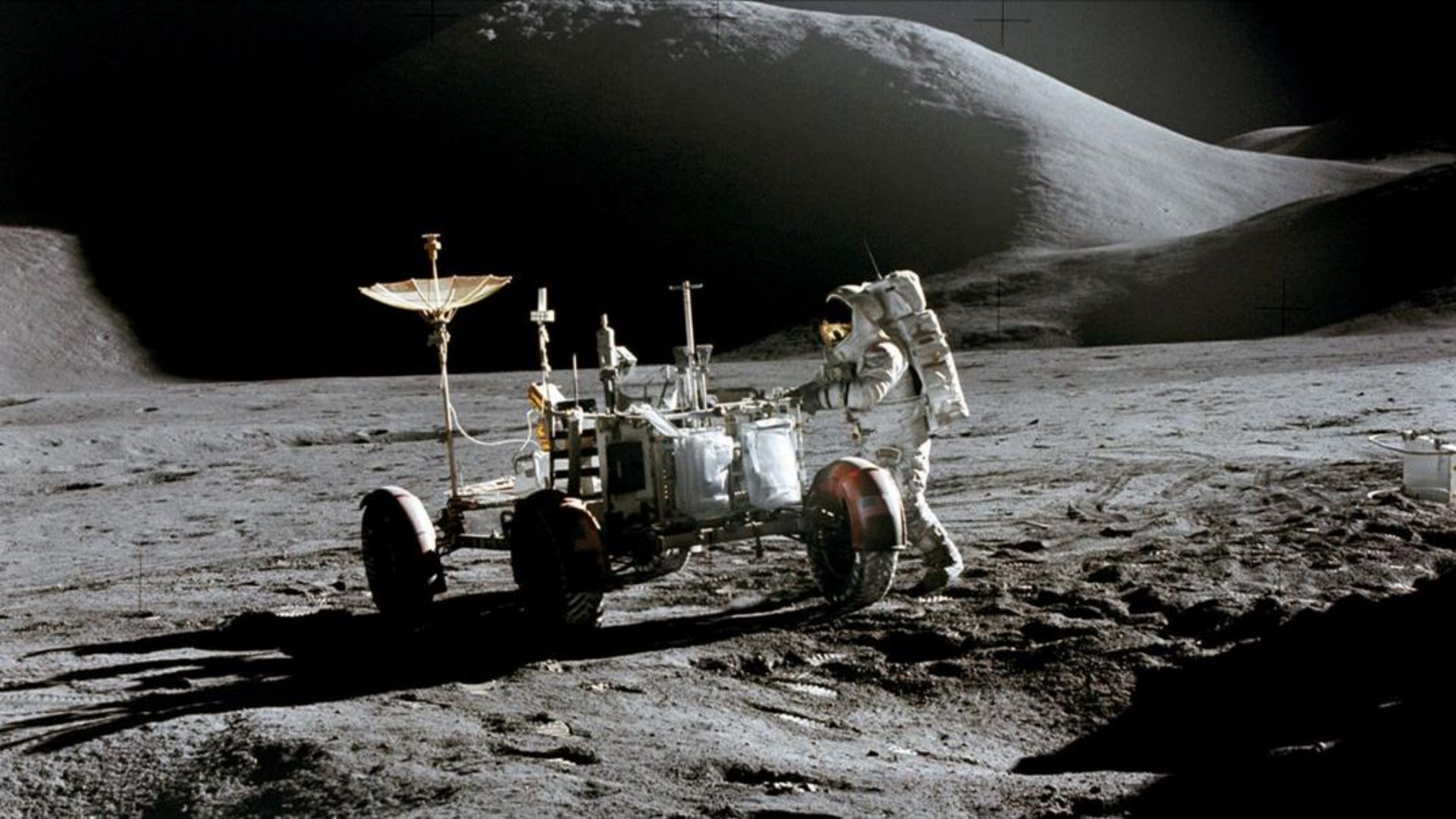


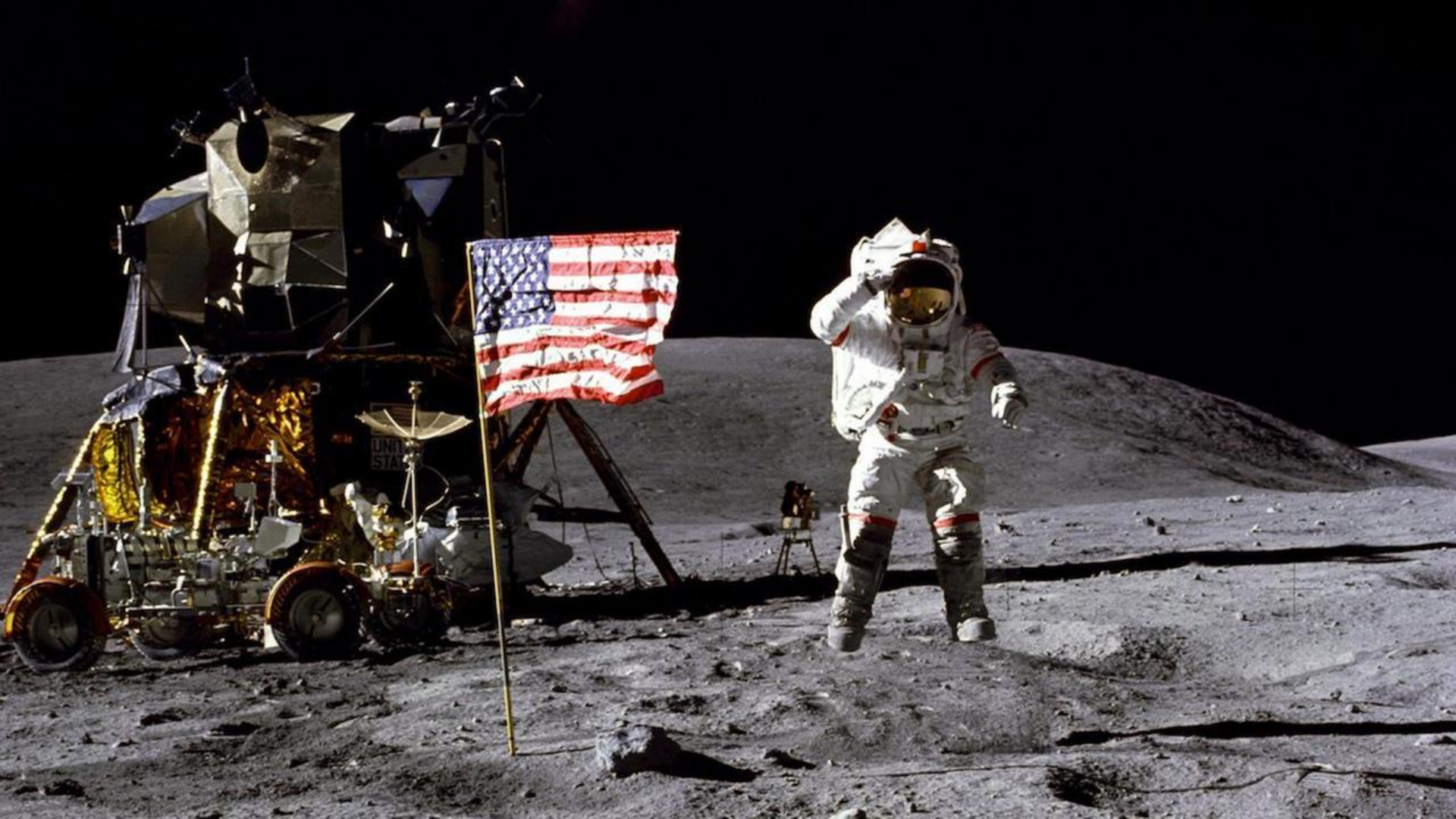
# Additional Amenities

- Utility Manufacturing Centers
- Theaters
- Libraries
- Communication Centers
- Recreation Centers
- Work Spaces
- Fueling Sites
- Maintenance
- Spaceport

# Lunar Exploration







# Power Sources

A black and white photograph of an astronaut in a full space suit working on a large solar panel array in space. The astronaut is positioned in the lower-left foreground, looking towards the camera. The solar panel array is a large, grid-like structure that dominates the upper-right portion of the image. The background is a dark, starry space.

A grayscale illustration of a lunar base. In the foreground, several large solar panels are laid out on the ground. In the middle ground, there are several dome-shaped structures, some with external ladders or access points. In the background, a lunar rover is visible on a small hill. The sky is dark with some faint stars. The overall scene is a detailed depiction of a future moon landing site.

# Solar Energy

<https://www.independent.co.uk/life-style/gadgets-and-tech/news/moon-space-european-agency-esa-lunar-surface-a9292986.html>



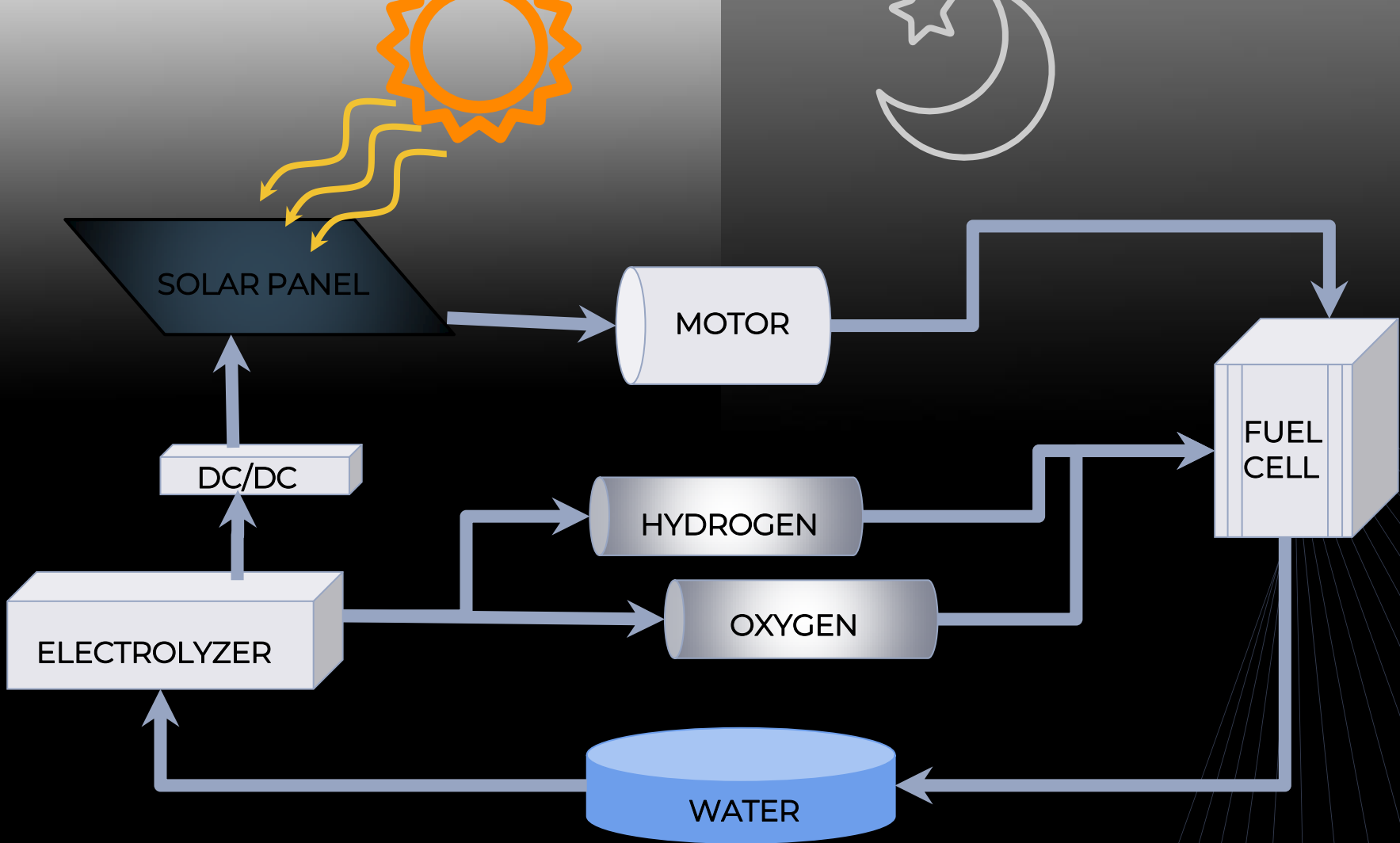
# Peaks of Eternal Light

- Rims of the Moon's craters located at the southern pole, receive direct illumination for **80% of the time**
- How are we going to power when there is no light? The other 20% of the time





# Regenerative Fuel Cells



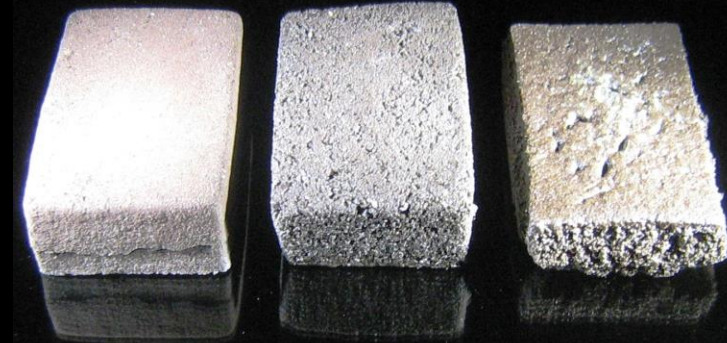
A black and white photograph of an astronaut on the moon, wearing a full space suit and carrying a large backpack. The astronaut is standing on the lunar surface, which is covered in dust and small rocks. The background shows the dark sky and the curved horizon of the moon. The text 'Thermal Energy' is overlaid in a large, white, serif font across the center of the image.

# Thermal Energy

<https://www.newscientist.com/article/2188164-breathing-in-moon-dust-could-release-toxins-in-astronauts-lungs/>

# Lunar Bricks

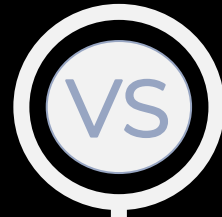
- Lunar soil is made up of regolith
- Lunar Bricks are made up of condensed regolith
- Heat the bricks over the lunar day, then store the heat to be released slowly to provide energy during the lunar night



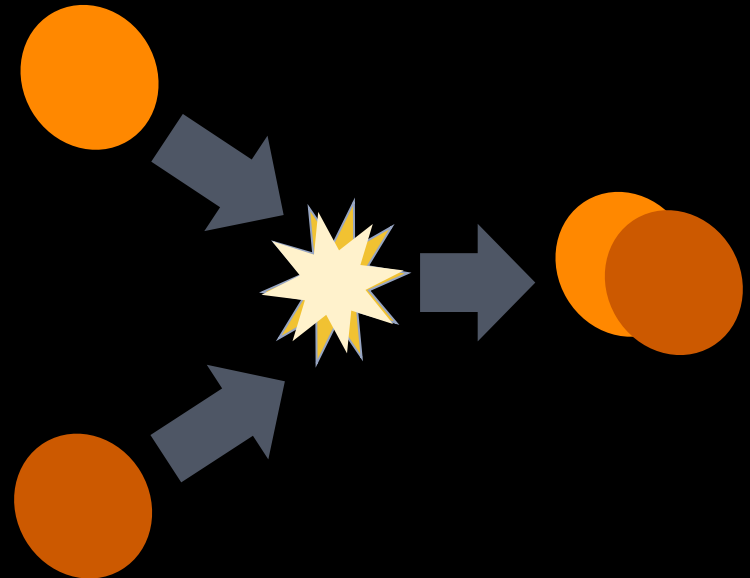
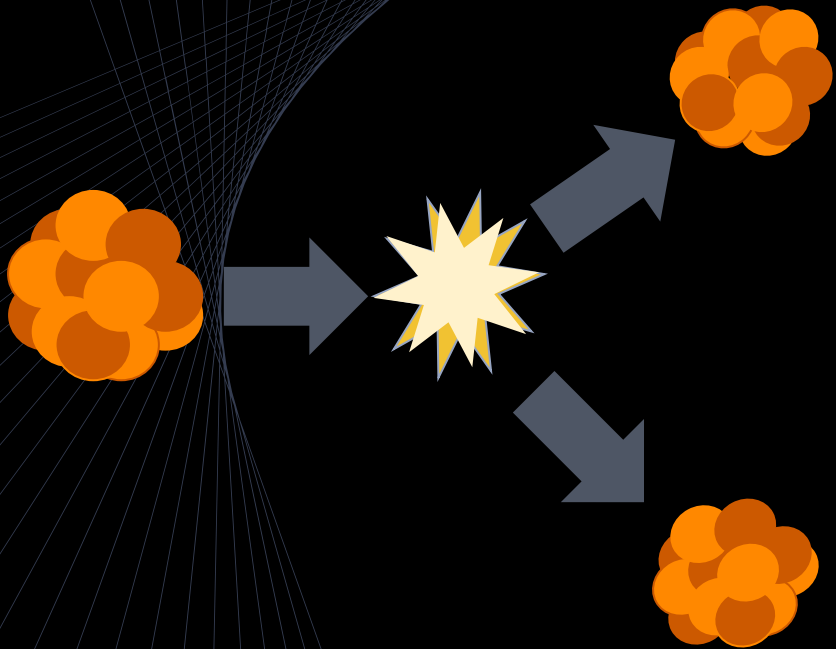
# Nuclear Power

A black and white illustration of a Mars outpost. The scene is set on a rocky, cratered surface. In the foreground, there are four large, circular solar panels mounted on tall, thin poles. Two small, humanoid figures are standing on the ground, one near the center and one to the right. A network of thin lines, possibly power or data cables, runs across the ground, connecting the solar panels and the figures. The background shows a vast, desolate landscape with numerous small craters and a horizon line.

# Fission

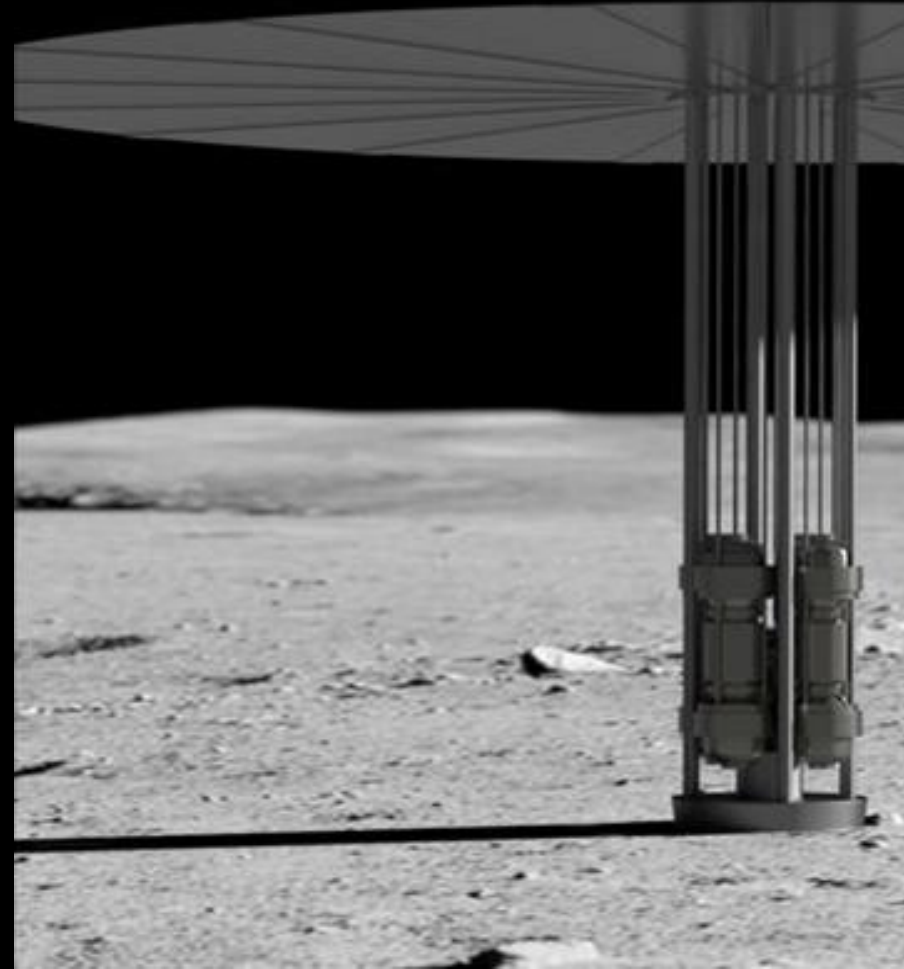


# Fusion



# Nuclear Fission

- Kilopower is lightweight mobile nuclear fission reactor developed by NASA and the US Department of Energy's National Nuclear Security Administration (NNSA)
- Produces 10 kilowatts continuously over 10 years
- Leaves lots of waste







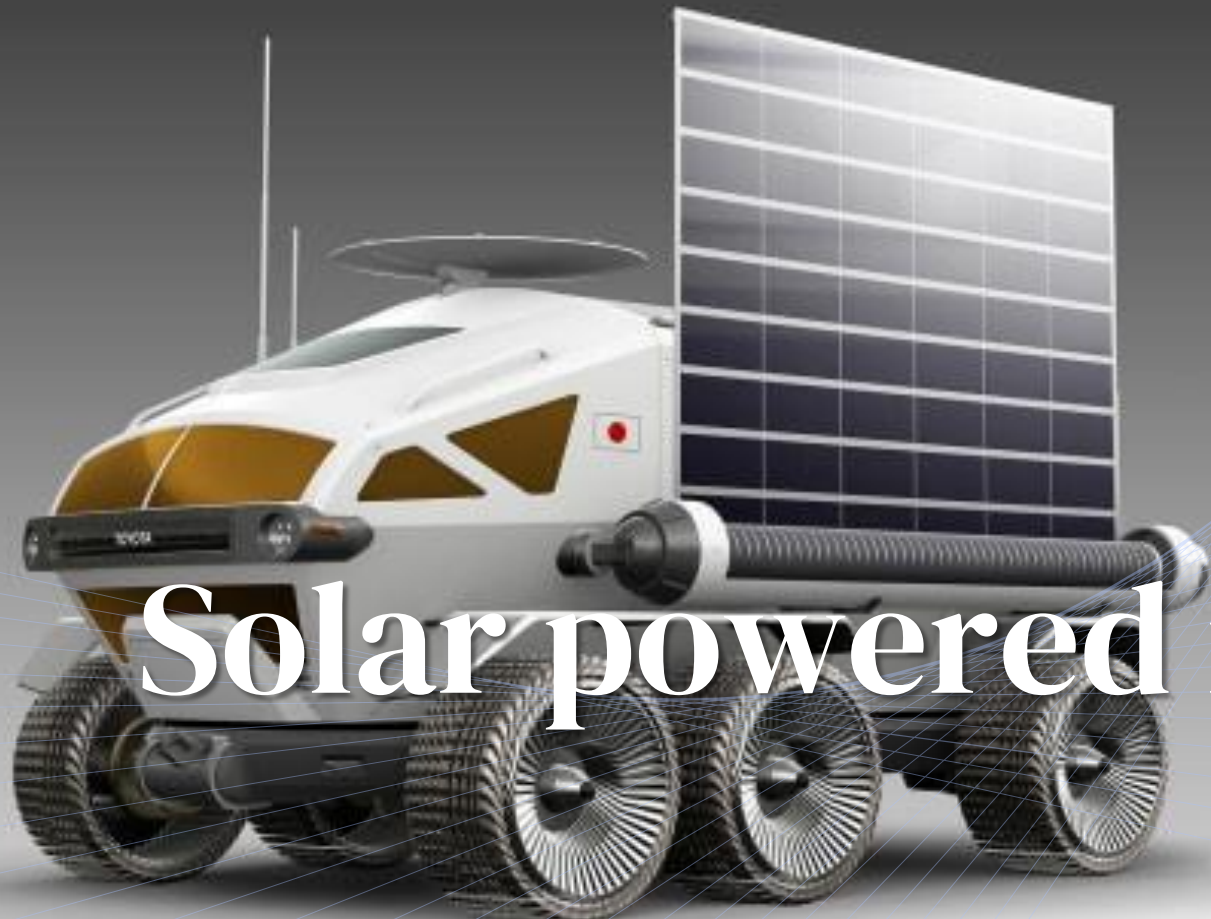
# Nuclear Fusion

- Nuclear fusion is the same process that powers the sun
- Involves the smashing of hydrogen atoms together to produce helium
- Helium-3 can be used to produce electricity more efficiently than with hydrocarbons

<http://www.mynewsdesk.com/uk/chalmers/pressreleases/deceleration-of-runaway-electrons-paves-the-way-for-fusion-power-2023834>

# Transportation Of Energy





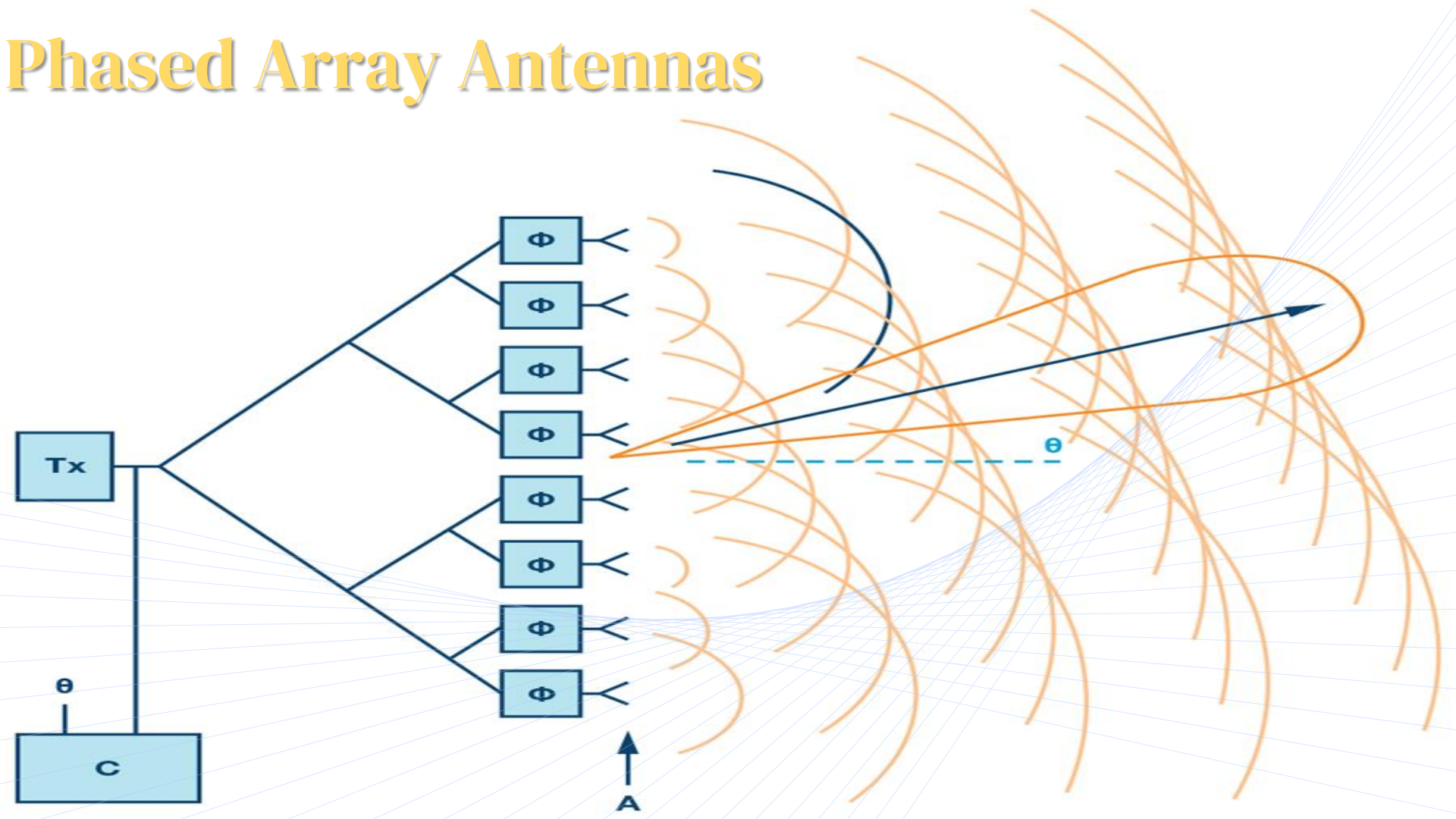
# Solar powered rover

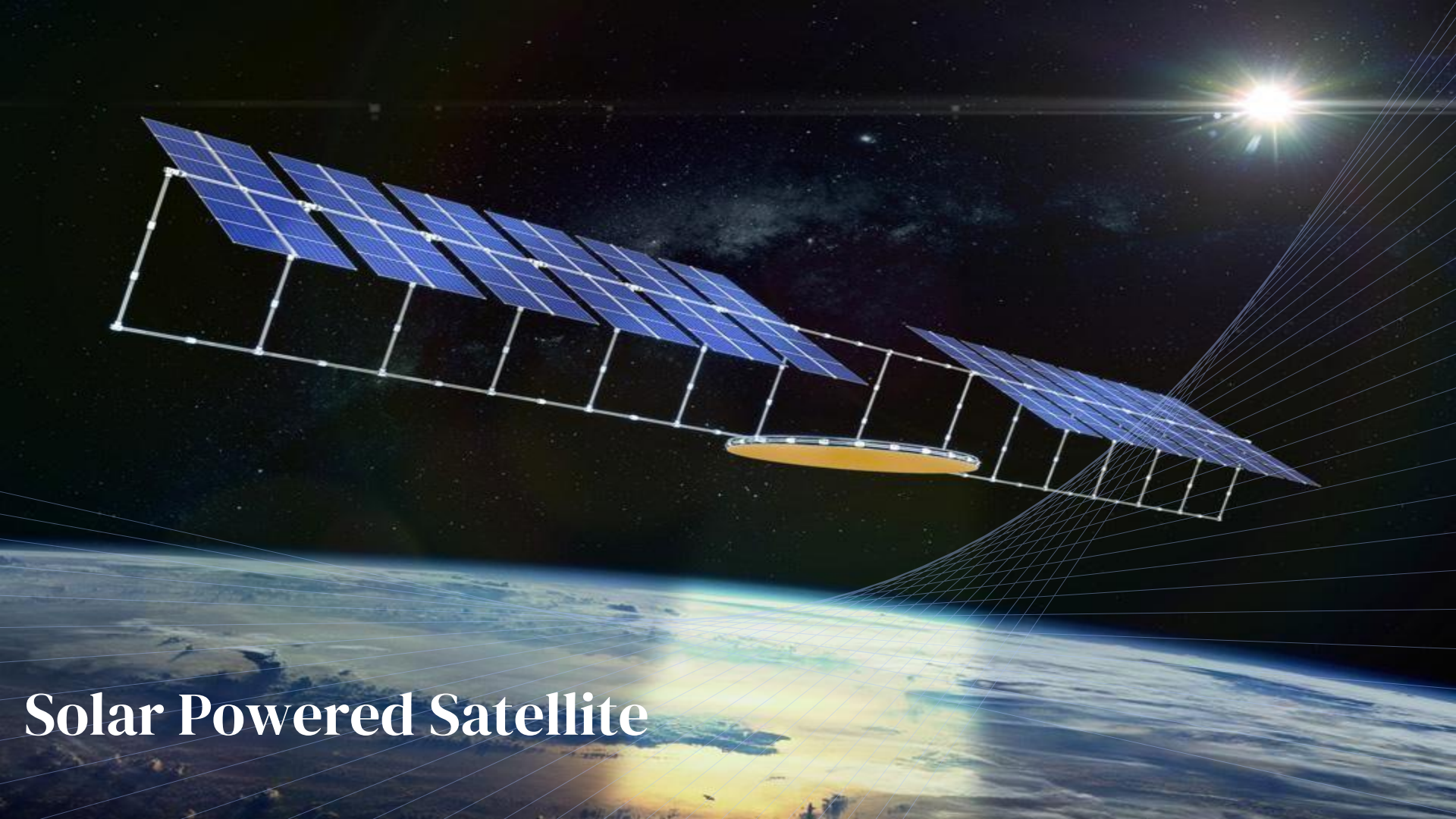


A night scene of a cable-stayed bridge. A bright purple laser beam originates from a point on the right side of the bridge, extending diagonally across the sky towards the upper left. The bridge's cables and structure are visible in the background, illuminated by ambient light. The overall scene is dark, with the purple laser providing a strong focal point.

# **Power Transmitted Over Laser Project (PTOL)**

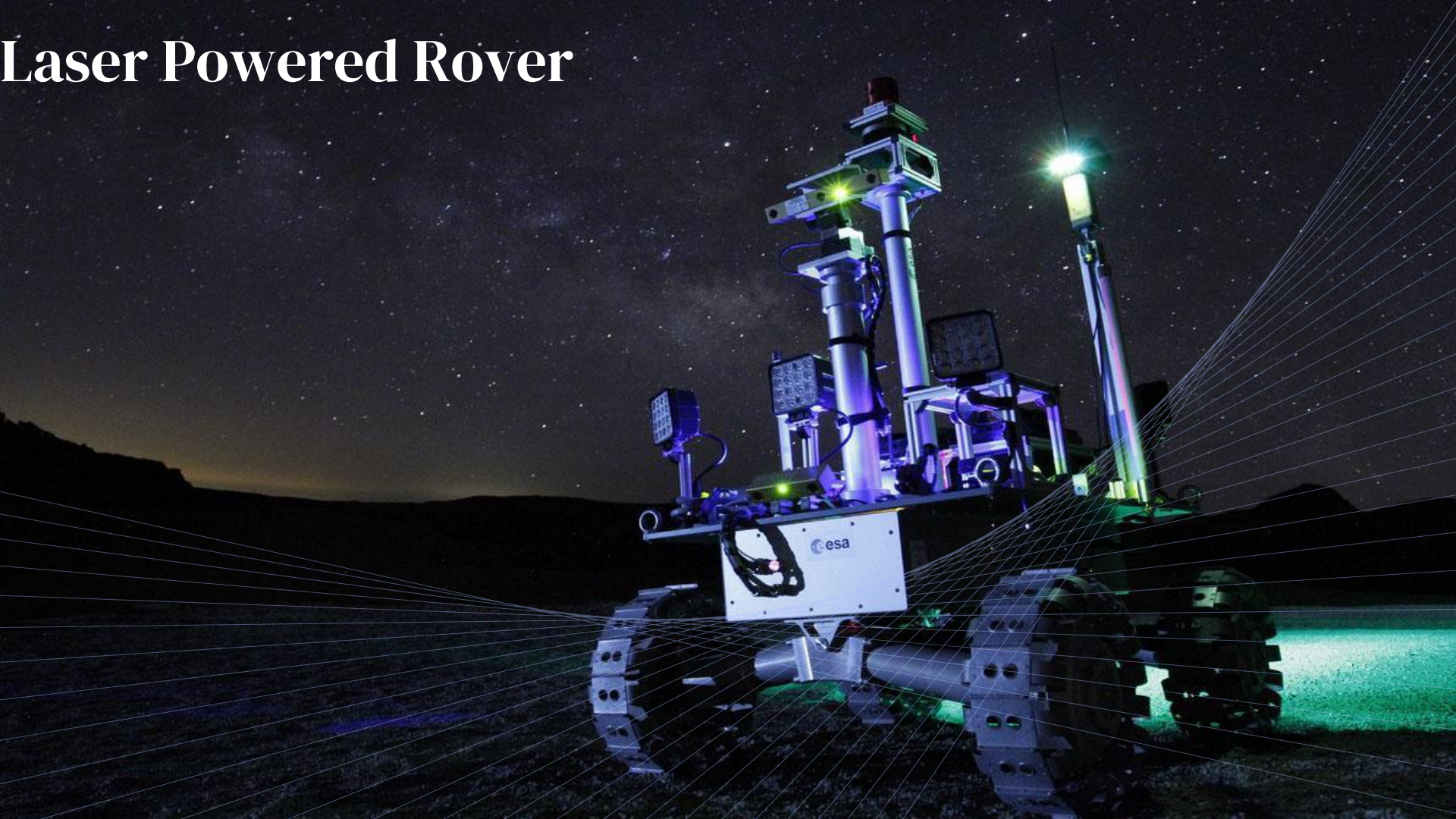
# Phased Array Antennas





**Solar Powered Satellite**

# Laser Powered Rover



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