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Solar powered in-situ resource utilization and extraction of water in the lunar regolith

Jessica Roche

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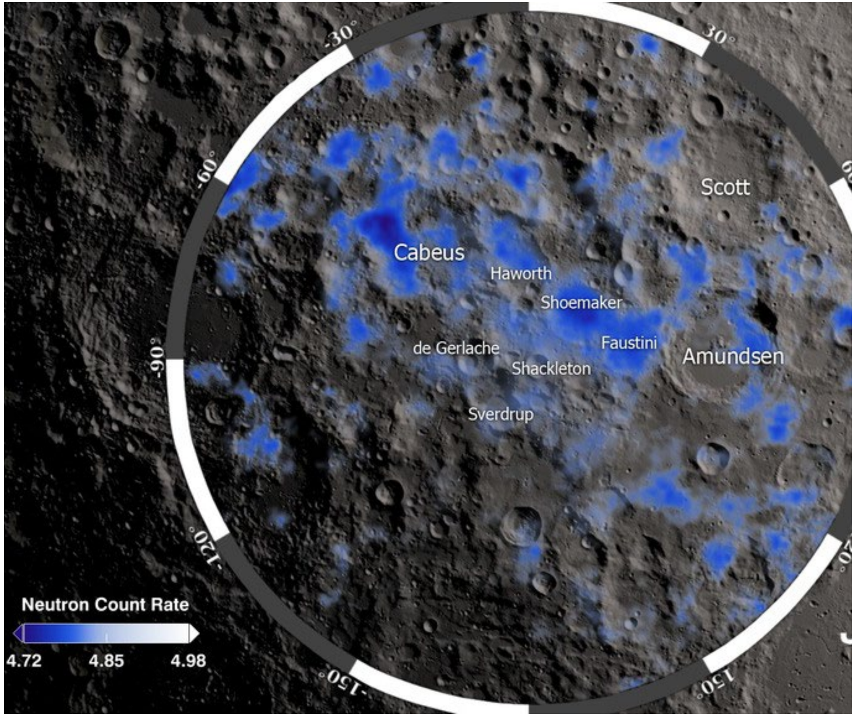
In-Situ Resource Utilization (ISRU)

- Cabeus Crater = 6.13% H_2O [1]
- Location: 84.9˚S, 35.5˚W [2]
- Electricity requirements:
  - 10 kW = 14.78 kg of water in 30800 seconds [3]
- Solar Plant Design:
  - 20 kW energy production
- Location of solar plant near Cabeus Crater: 80˚S, 35.5˚W
- Irradiance at 80˚S: 1090.2 W/m^2 [4]



[5]

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Solar Plant Design

- Azur Space 32% Quadruple junction GaAs solar cells [6].
- Fill Factor:

$$FF = \frac{V_{mp} I_{mp}}{V_{oc} I_{sc}} = \frac{(3025\,\text{mV})(433.5\,\text{mA})}{(3451\,\text{mV})(457.6\,\text{mA})} = 0.83$$

- Efficiency:

$$\eta = \frac{31.8\%}{1367\,\text{W/m}^2}(1090.2\,\text{W/m}^2) = 25.4\%$$

- Number of Solar Cells: 15256
- Solar Cell Area: 46 m^2

Azur Space Design Specification	Value [6]
Cell Area (cm^2)	30.18
Average Open Circuit Voltage, V_{oc} (mV)	3451
Average Short Circuit Current, I_{sc} (mA)	457.6
Voltage at Max. Power, V_{mp} (mV)	3025
Current at Max. Power, I_{mp} (mA)	433.5
Average Efficiency η_{bare} at 1367 W/m^2	31.8%

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Battery Storage

- Solid state battery storage
- Higher specific energy
- Better suited for Lunar temperature shifts

  -280˚F to 260˚F [7]

Battery Type	Energy Density (Wh/kg)
Traditional Lithium-ion [8]	Maximum 250
Ion Storage Systems: Ceramic Electrolyte [8]	300
Solid Power: multi-layer solid-state lithium metal [9]	330 - 400

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