Lunar Innovation Park

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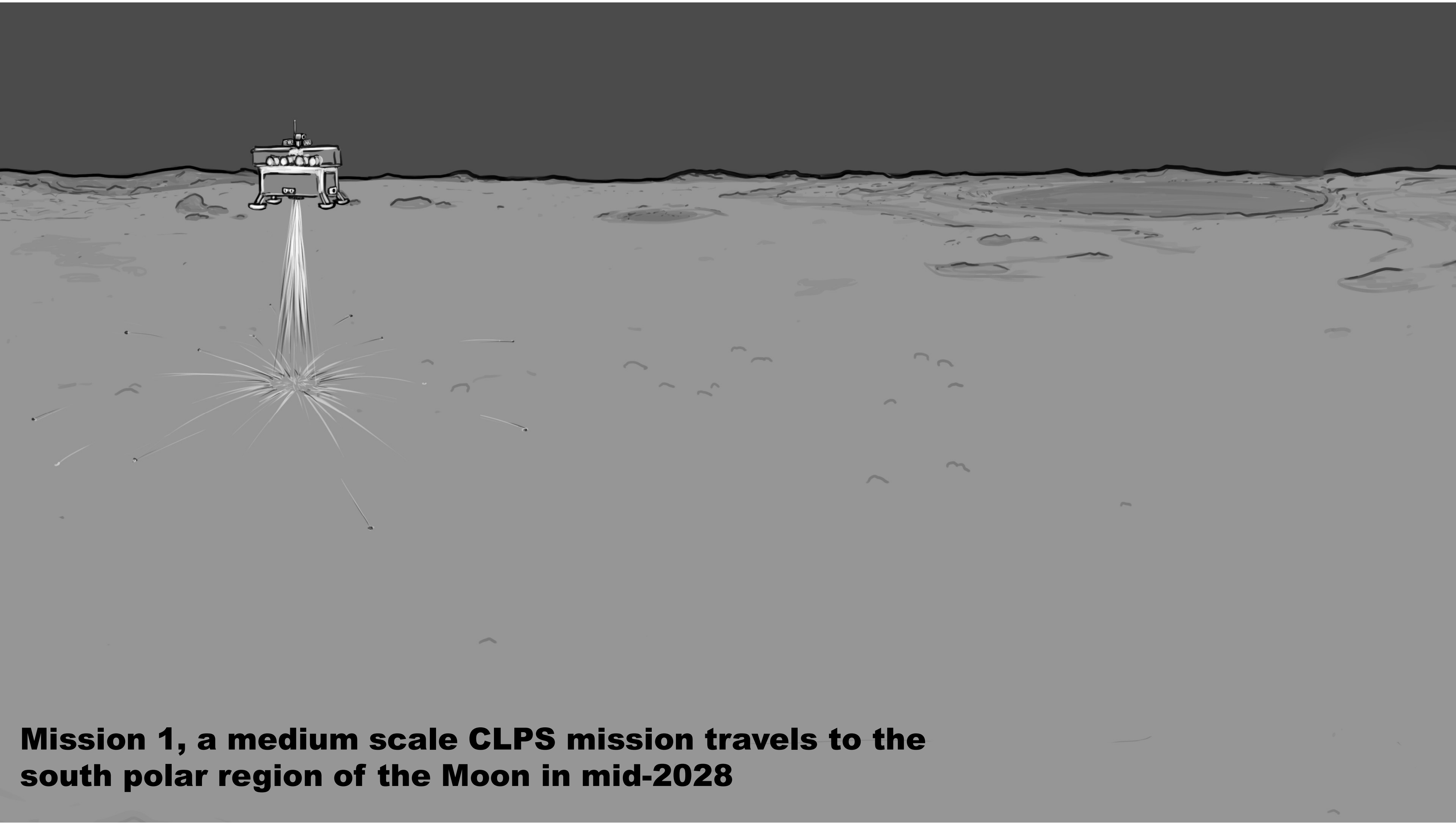
4/1/26

Lunar Innovation Park – Core Tenets

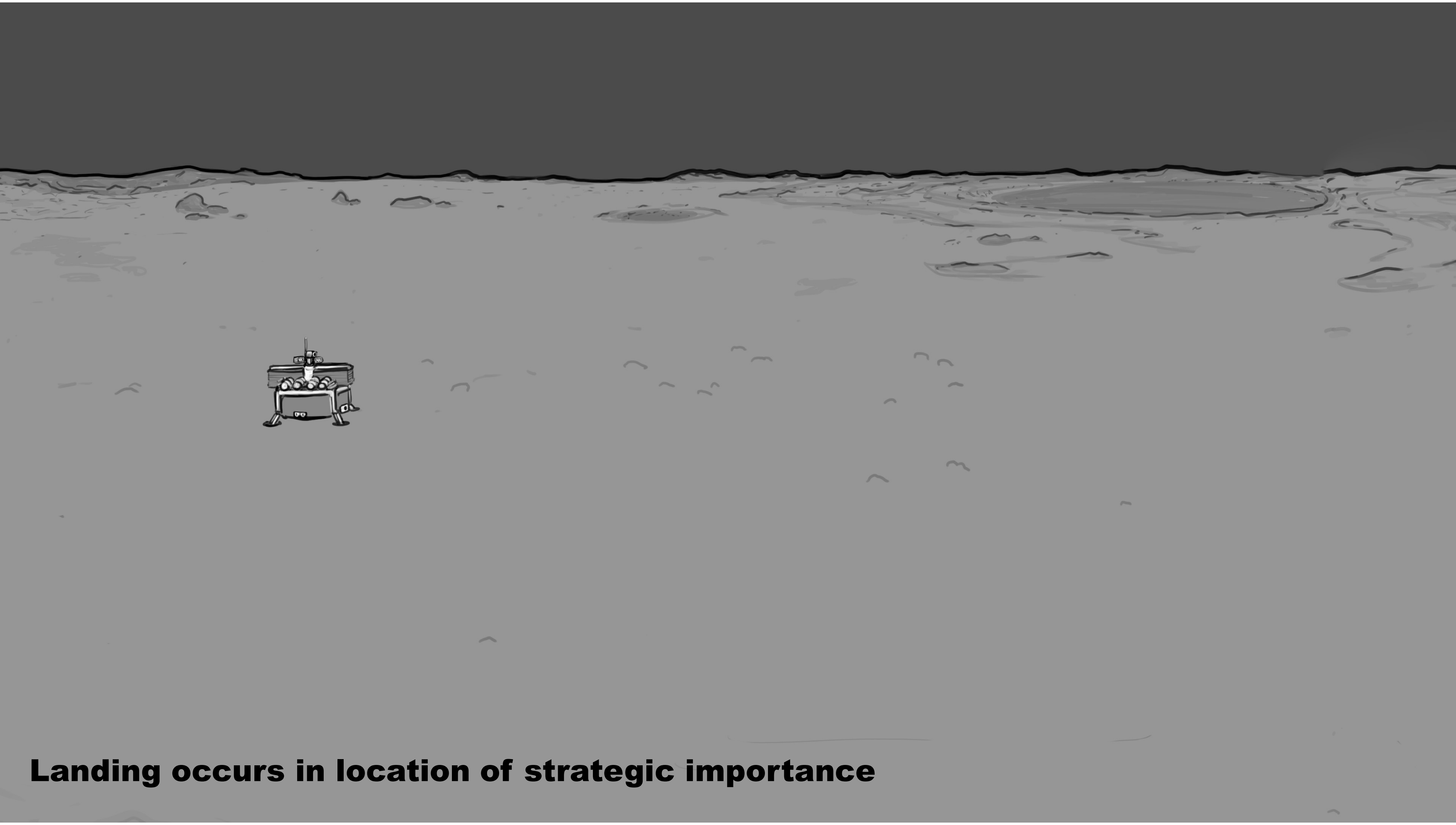
- **Seek the fastest path to sustained lunar presence – "Go Do" not "Go Study"**
- **Risk reduction and demonstration of the "art of the possible" for Artemis Program**
- **Demonstrate critical technologies to kickstart a space resource-based economy**
- **Emplace minimum viable infrastructure and transfer to industry as soon as possible**
- **Land in extreme proximity to reduce mission costs and logistics complexity**
- **High risk – high reward environment**
- **Replicate at locations of strategic interest to "claim" land**
- **Humans not required**
- **Applicable to Fission Surface Power missions**
- **Publications pending on Infrastructure to Kickstart lunar economy, Site Layout and Bulk Regolith Feature Design, Construction Operations Analysis, and Mission Design and Feasibility Analysis**

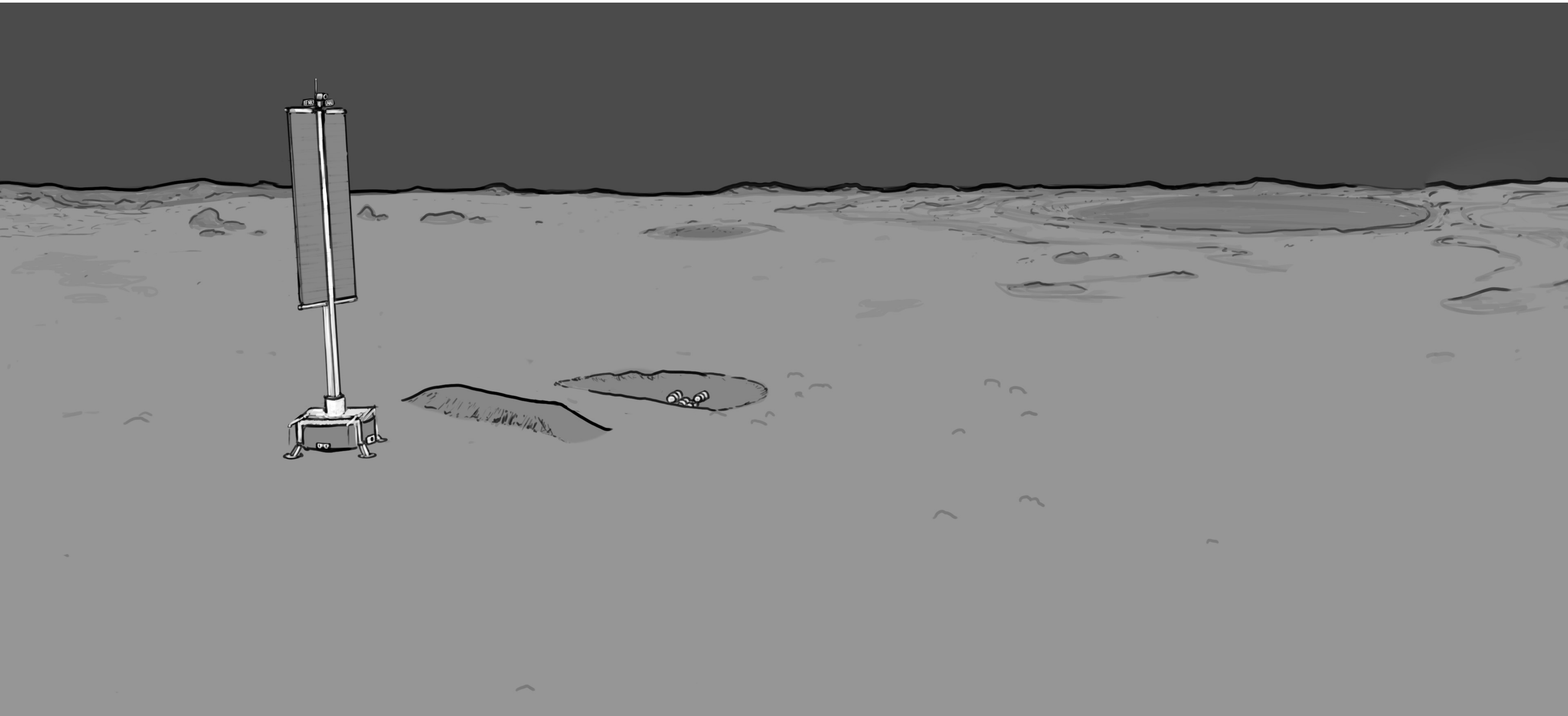
With urgency of action and appropriate funding, it is possible to:

- **<u>Land first two missions in 2028</u> to survive the night, build a berm, and demonstrate PSI ejecta mitigation for proximity landings (before current Administration ends)**
- **<u>Land first three missions in 2030</u> to commission a lunar power grid (before the EO target date for "initial elements of a permanent lunar outpost")**

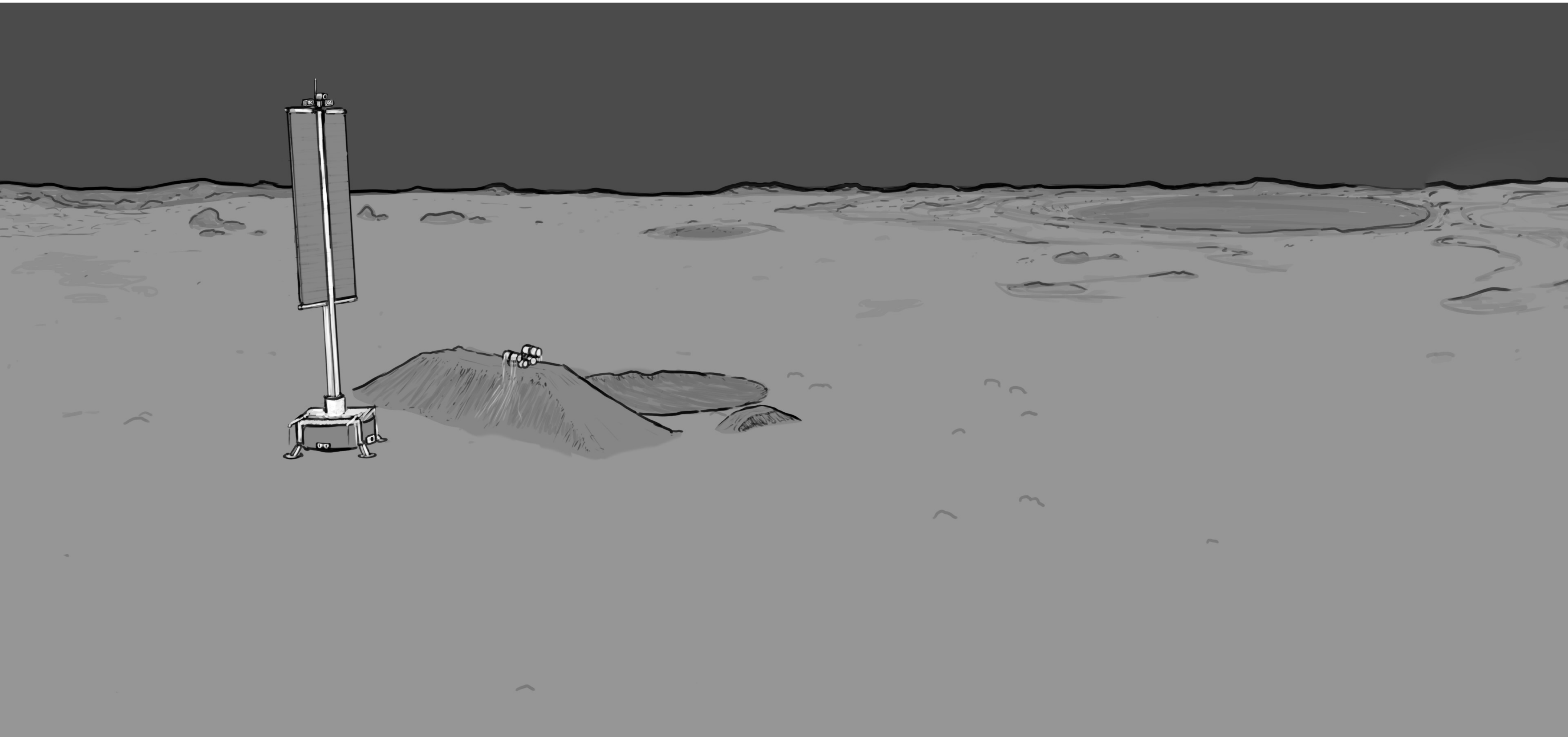


Mission 1, a medium scale CLPS mission travels to the south polar region of the Moon in mid-2028

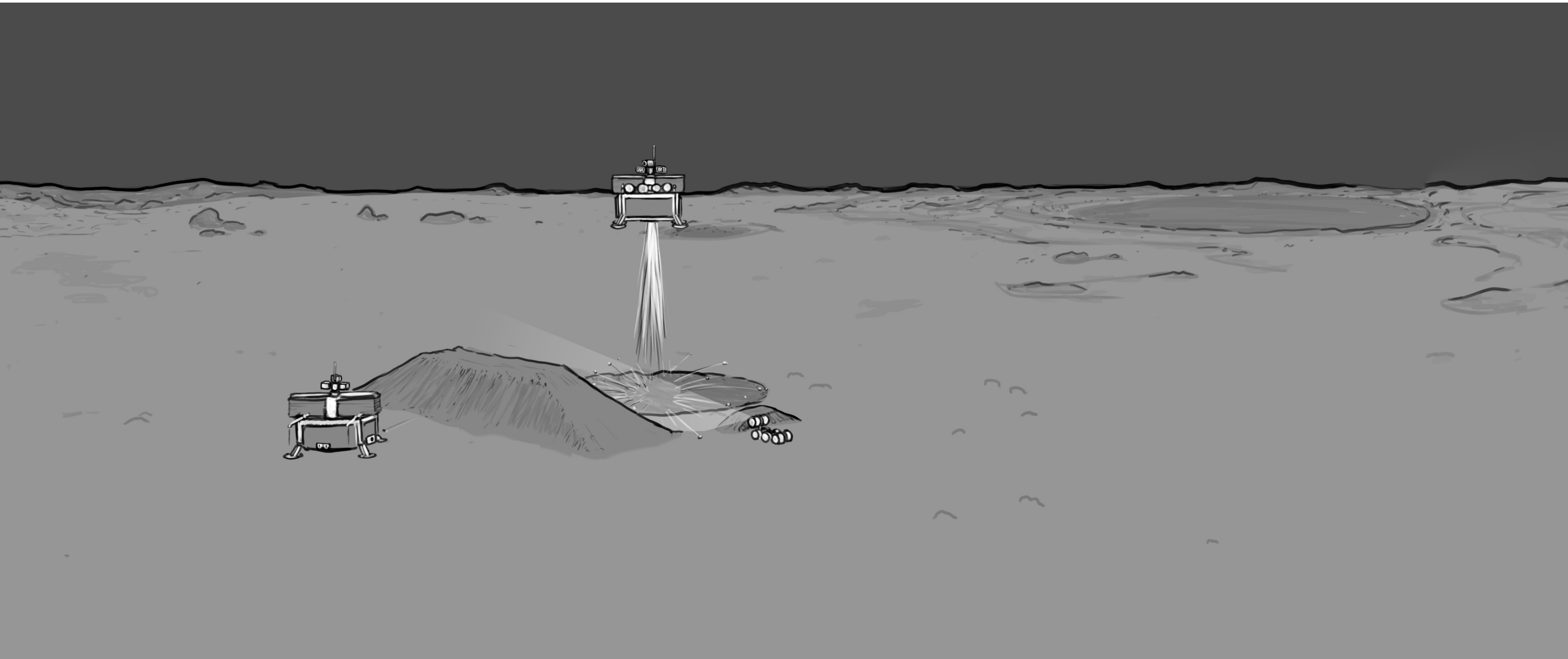

Landing occurs in location of strategic importance



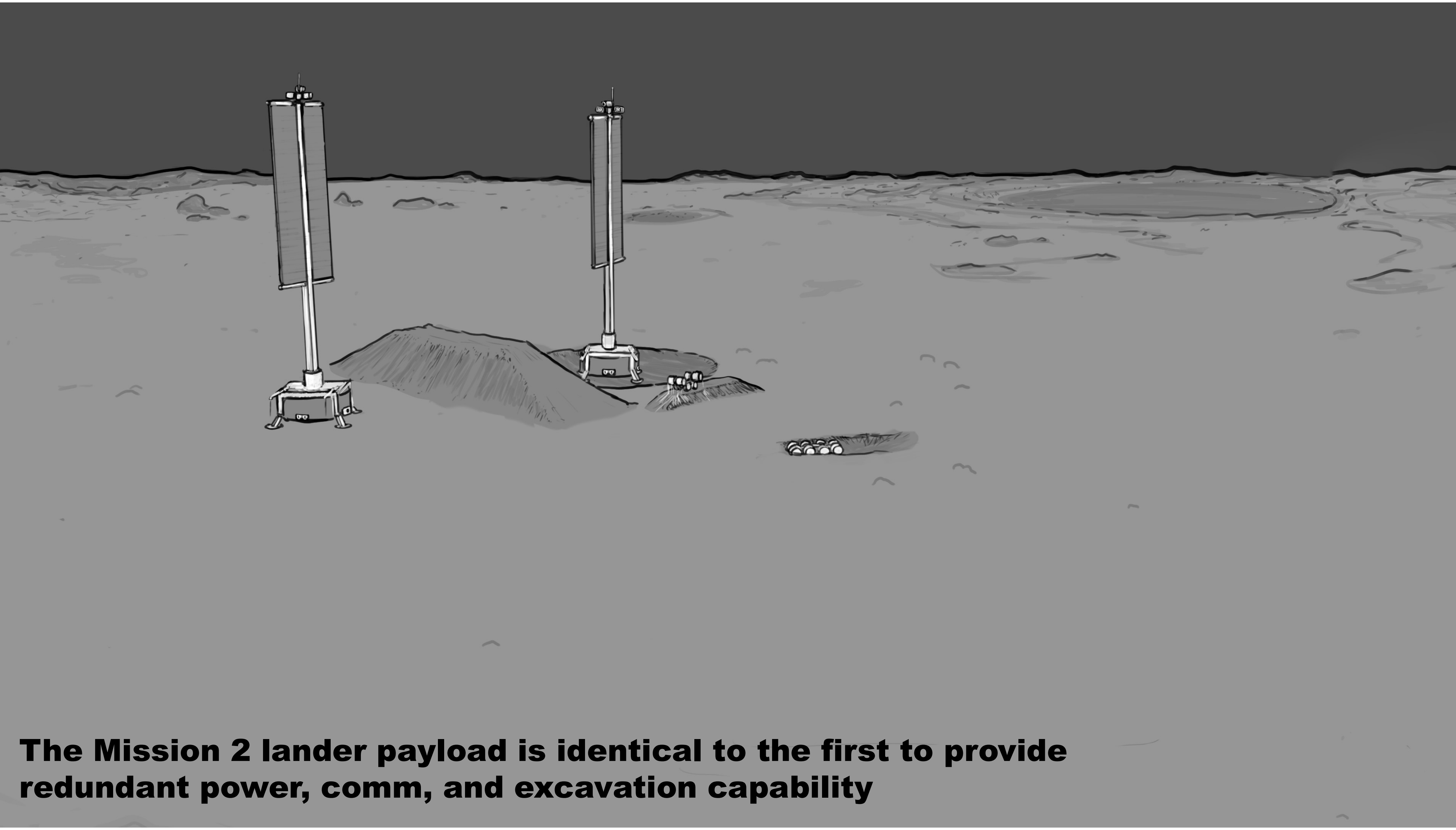
- **A Vertical Solar Array (VSAT) and communications are deployed**
- **An excavation robot (IPEx) maps the region and then builds a bulk regolith berm**

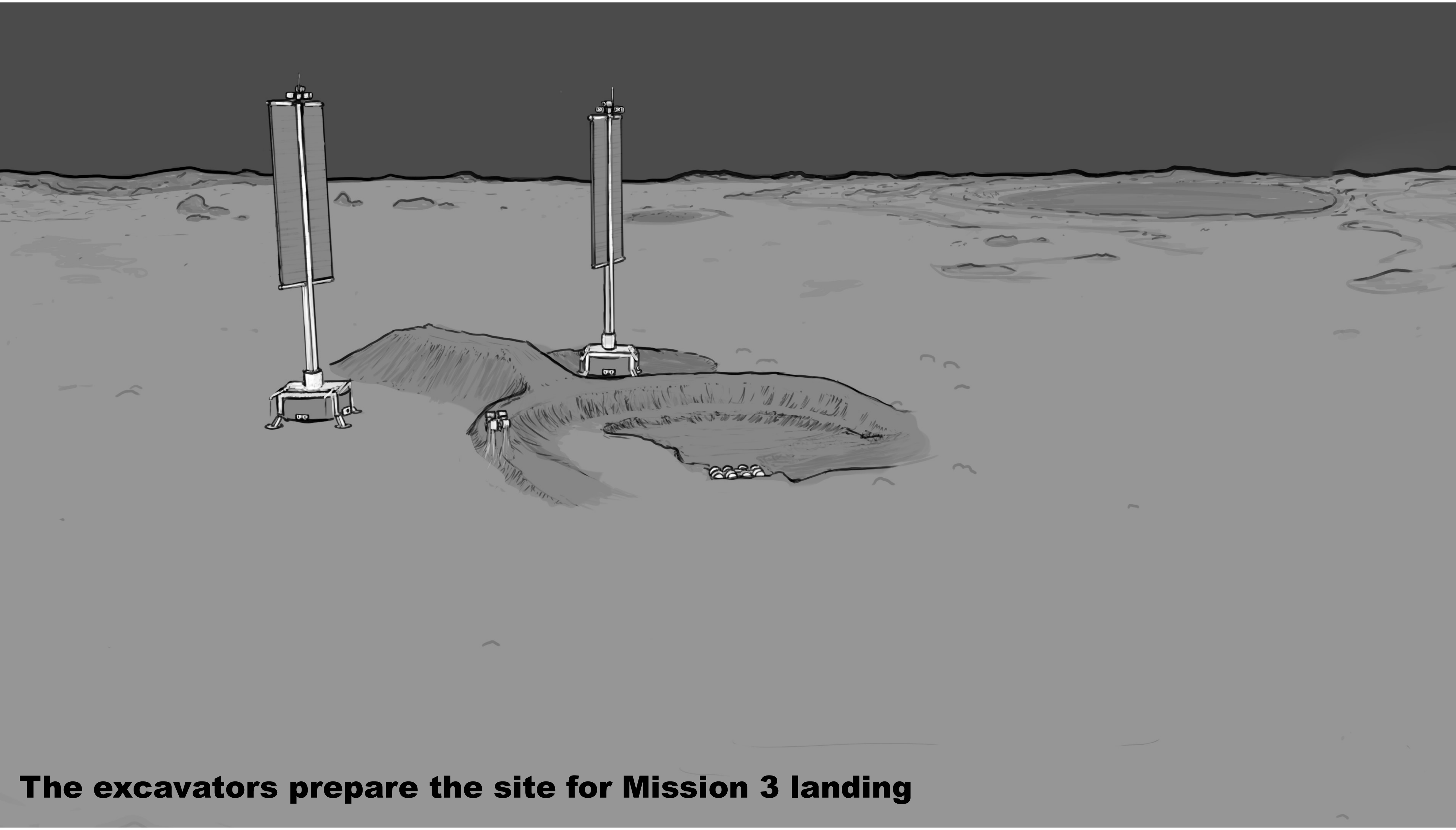


- **The berm and an adjacent bulk regolith flat, level, rock free landing site are finished**
- **The distance between landing sites is ~20 m**

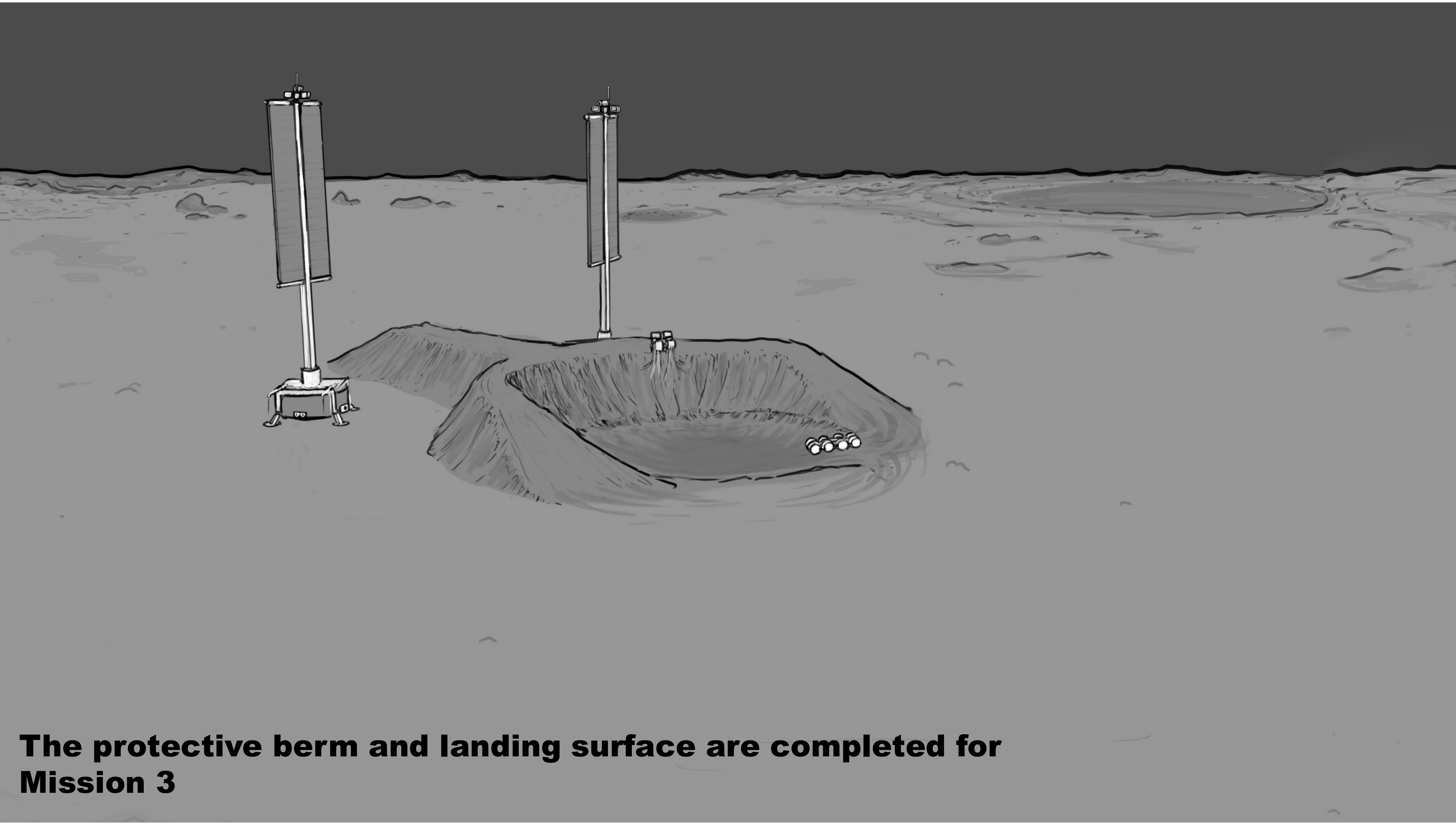


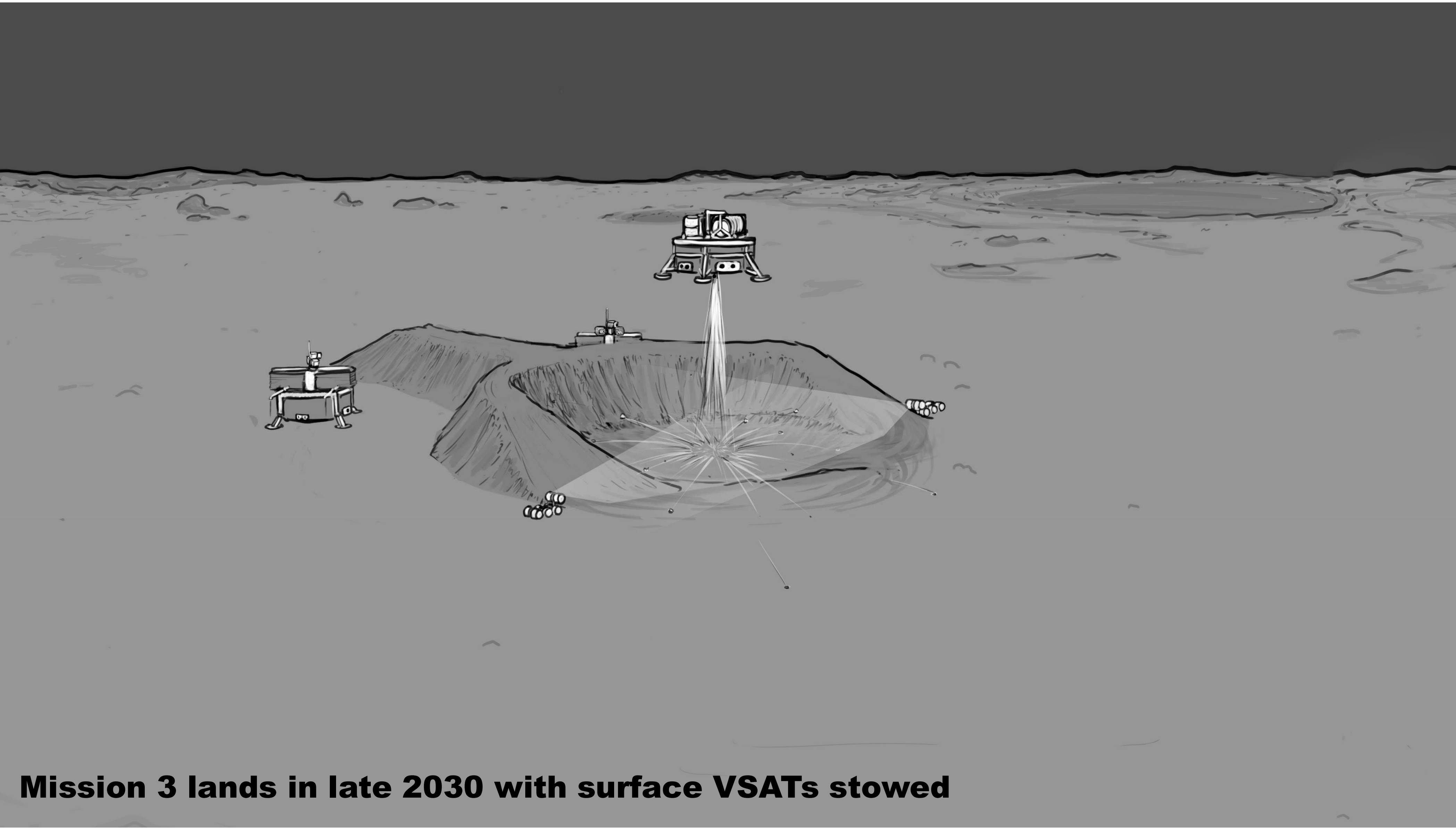
- In late 2028, Mission 2 lands while the VSAT is stowed, and the excavation robot surveils the Plume Surface Interaction (PSI) effects
- Extreme landing precision is enabled by a high-res topo map and landing aids
- The berm protects the first lander from PSI ejecta


The Mission 2 lander payload is identical to the first to provide
redundant power, comm, and excavation capability

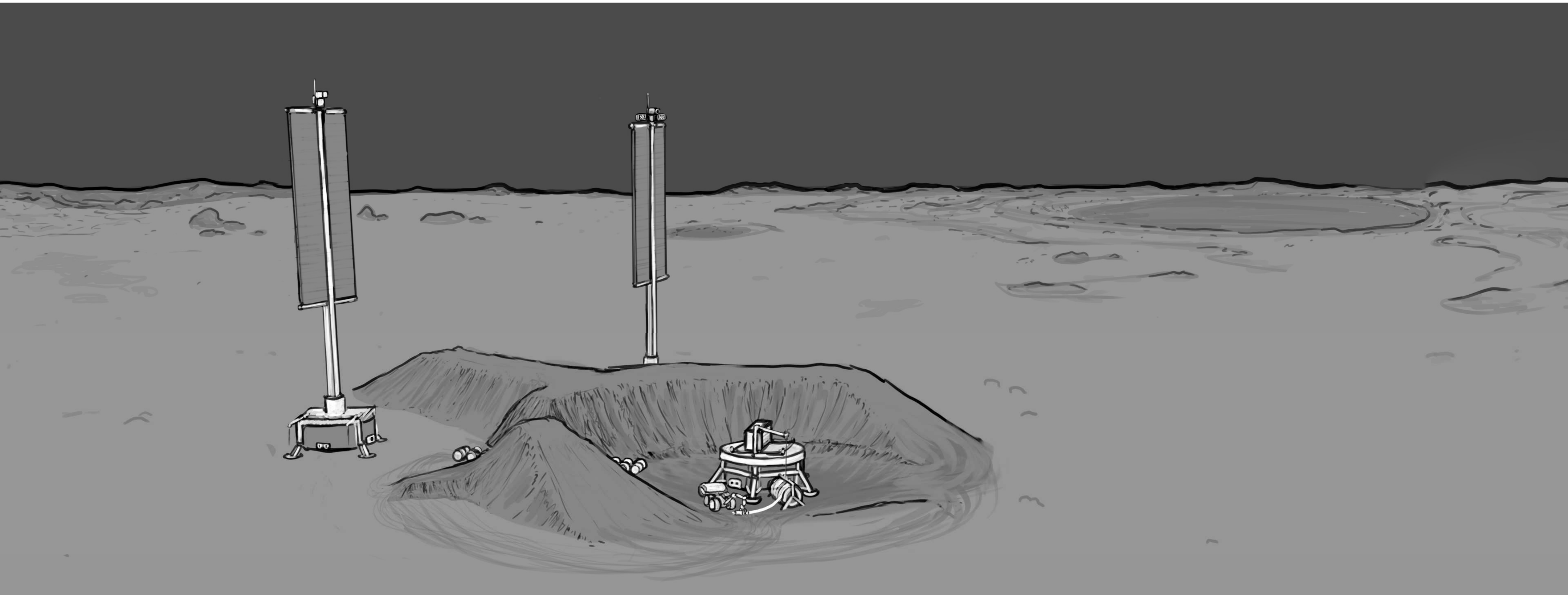


The excavators prepare the site for Mission 3 landing

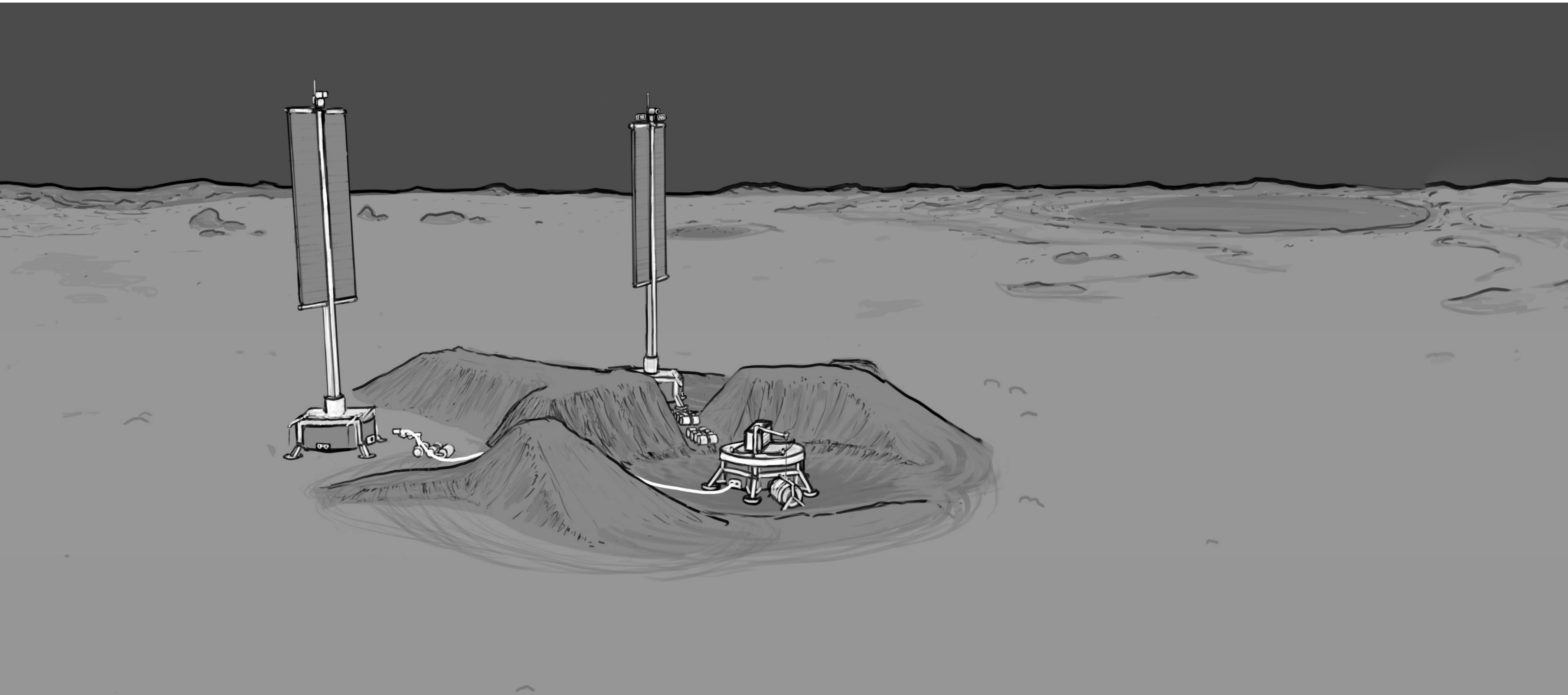

The protective berm and landing surface are completed for Mission 3



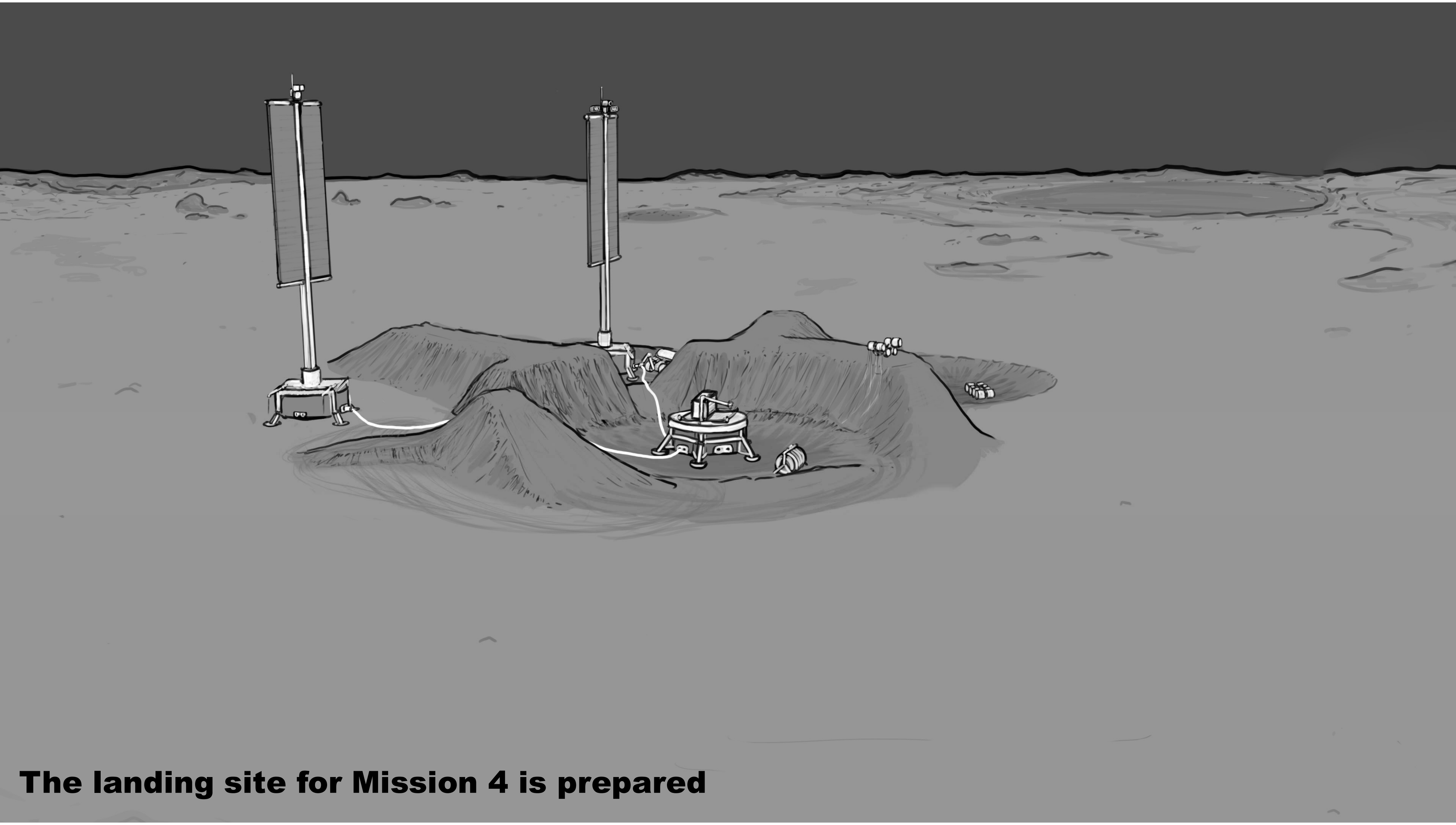
Mission 3 lands in late 2030 with surface VSATs stowed



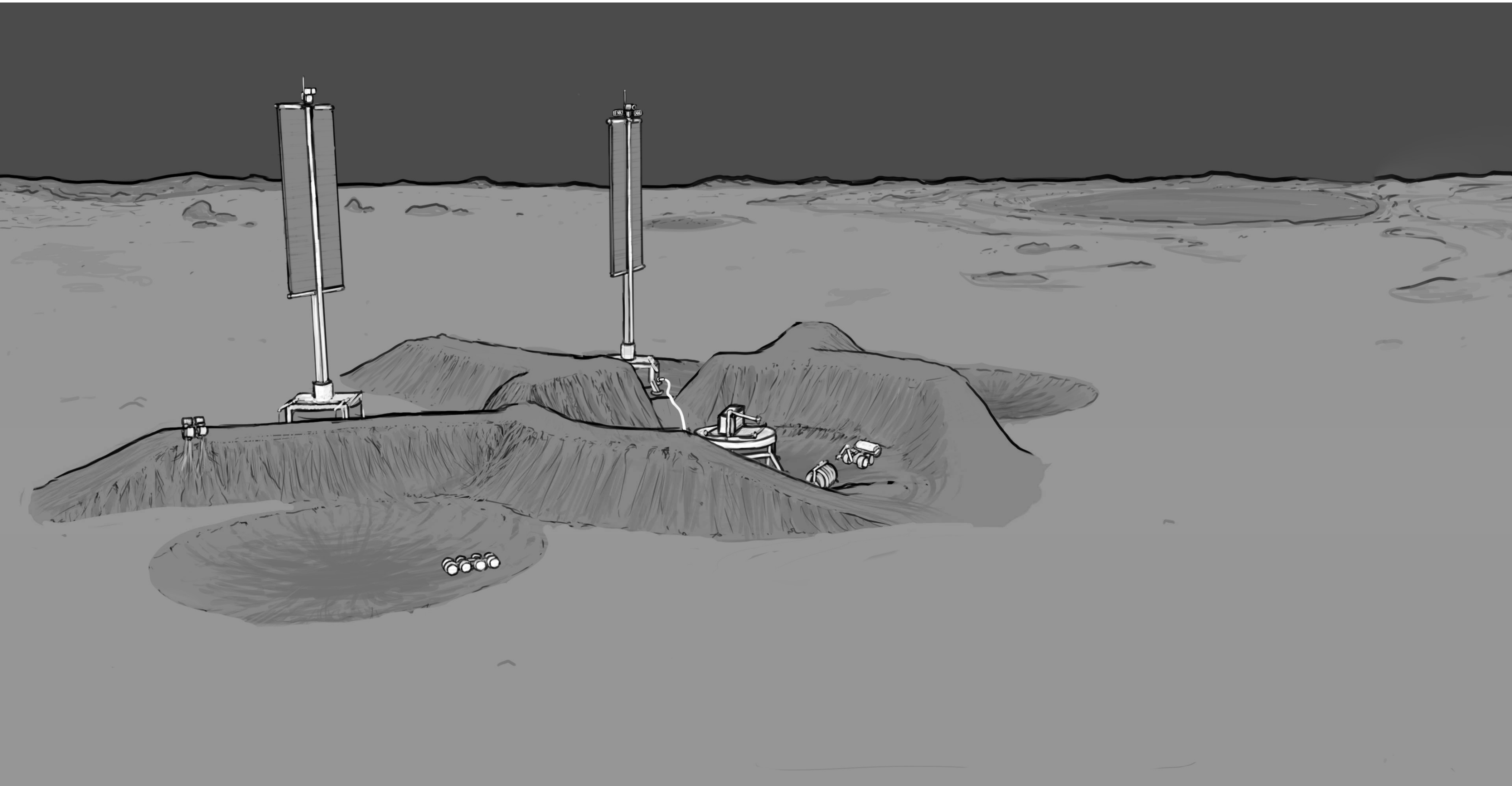
- **Mission 3 augments Park power with increased energy storage and power distribution hardware**
- **An evolved IPEx with modular interfaces for implement swapping is delivered that can do limited logistics**
- **Implements include a logistic arm, compactor, cable reel, and excavation drums**



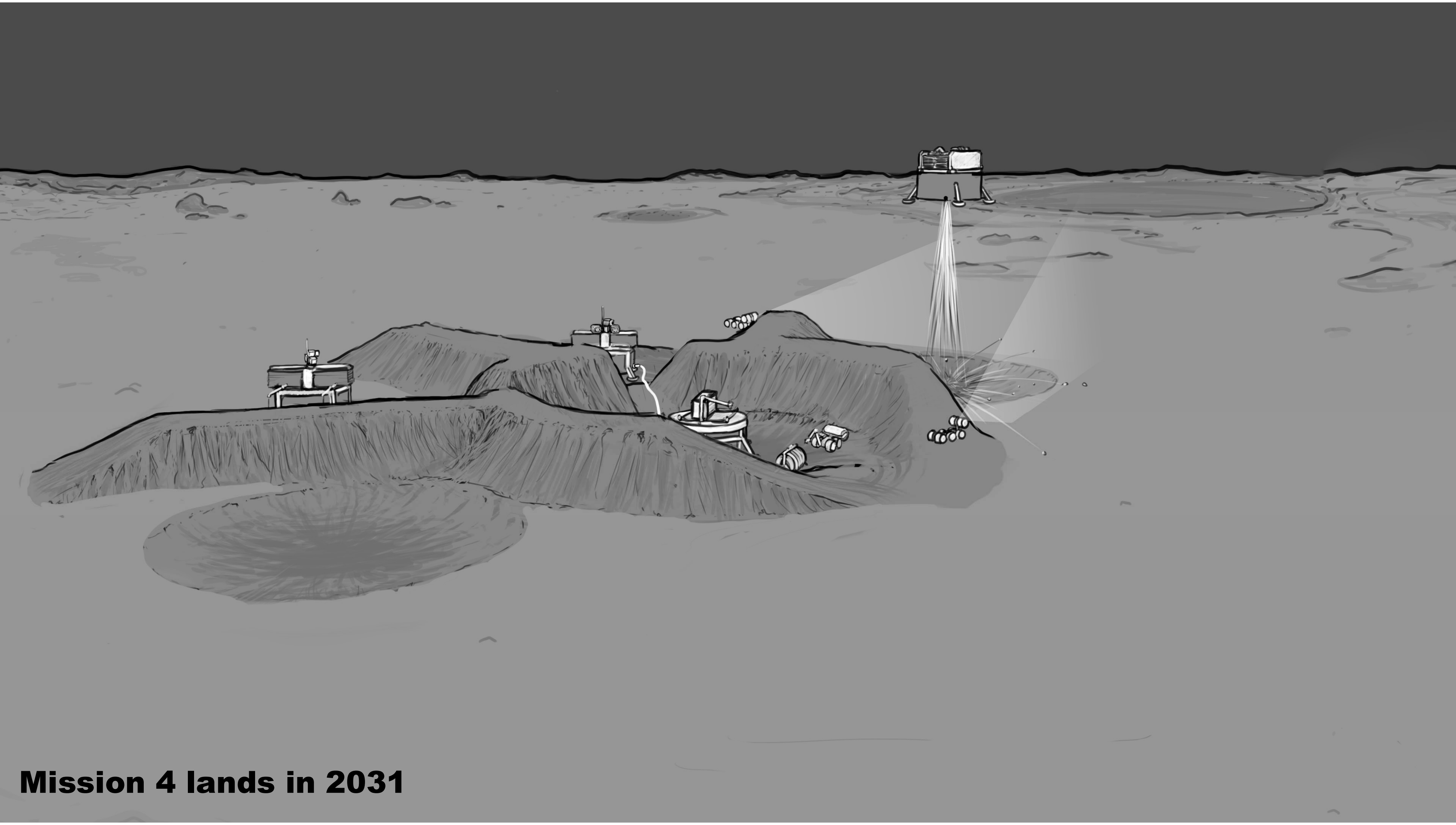
- **The excavators cut through the berms between landers**
- **The logistics robot pulls cables and mates dust tolerant connections between the power assets creating the first lunar power grid**



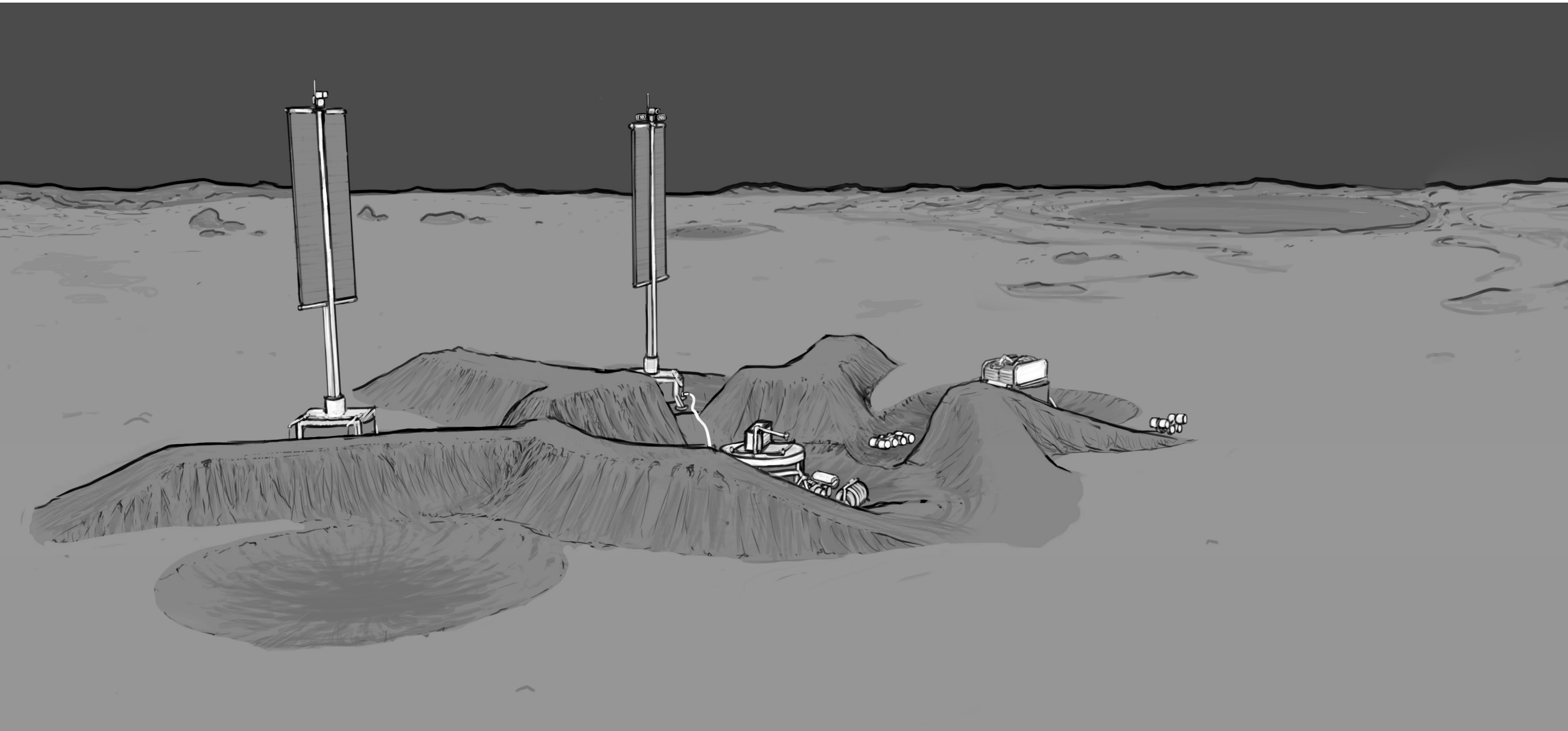
The landing site for Mission 4 is prepared



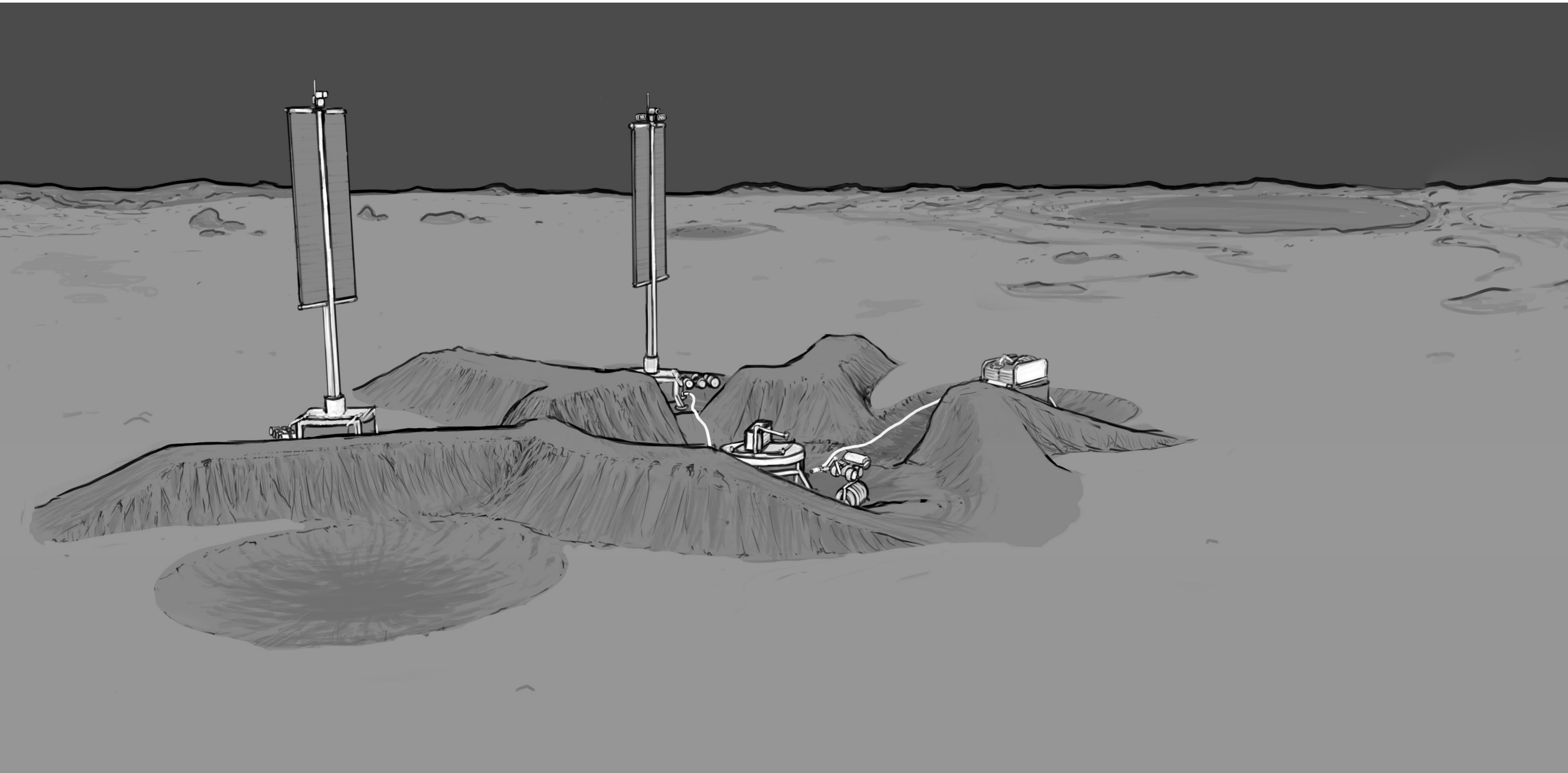
A landing site is prepared for Park services Customer 1



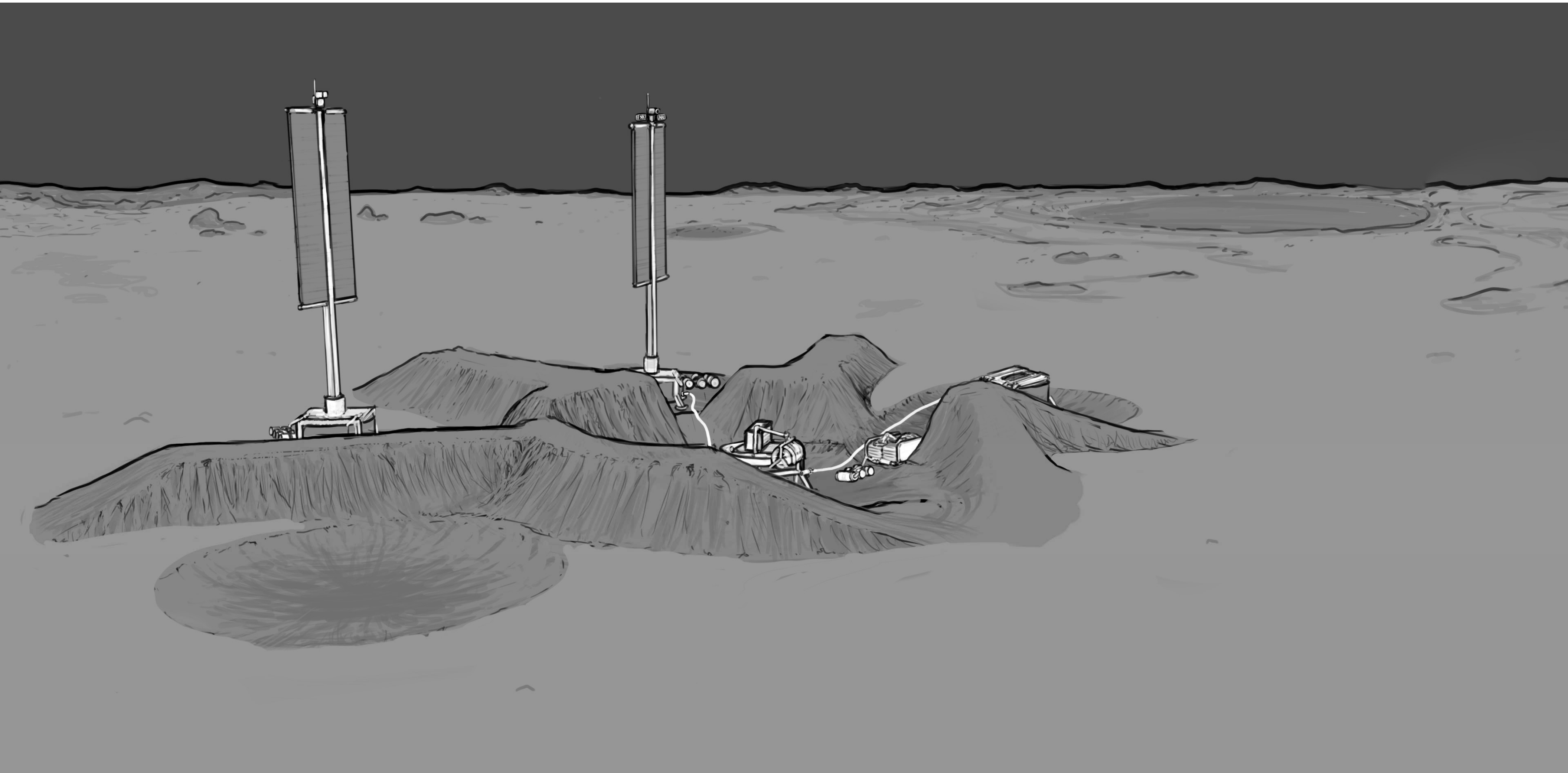
Mission 4 lands in 2031



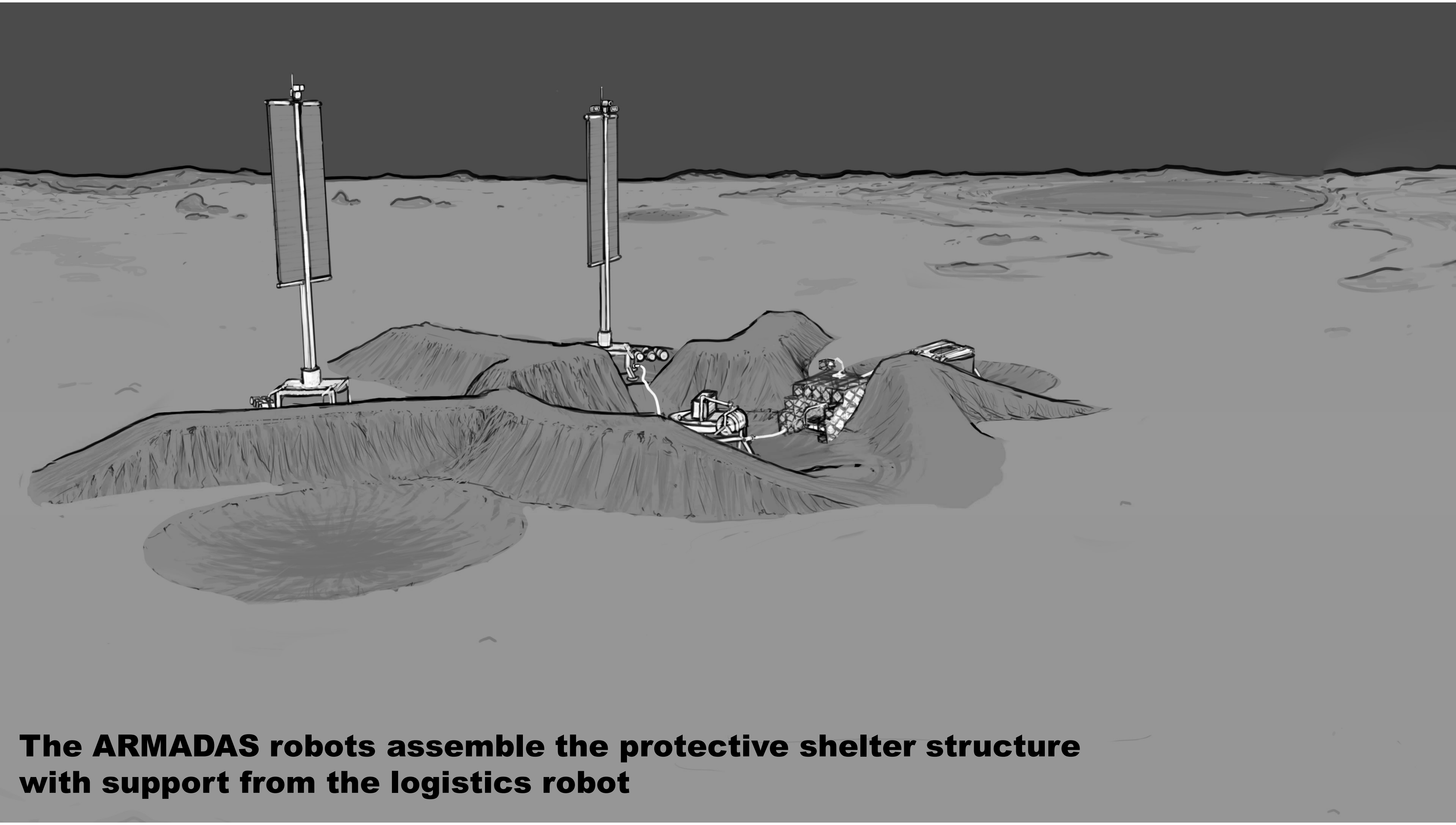
- Mission 4 brings ARMADAS assembly robots and structural elements to build an unpressurized protective shelter
- The excavators clear an area through the berm



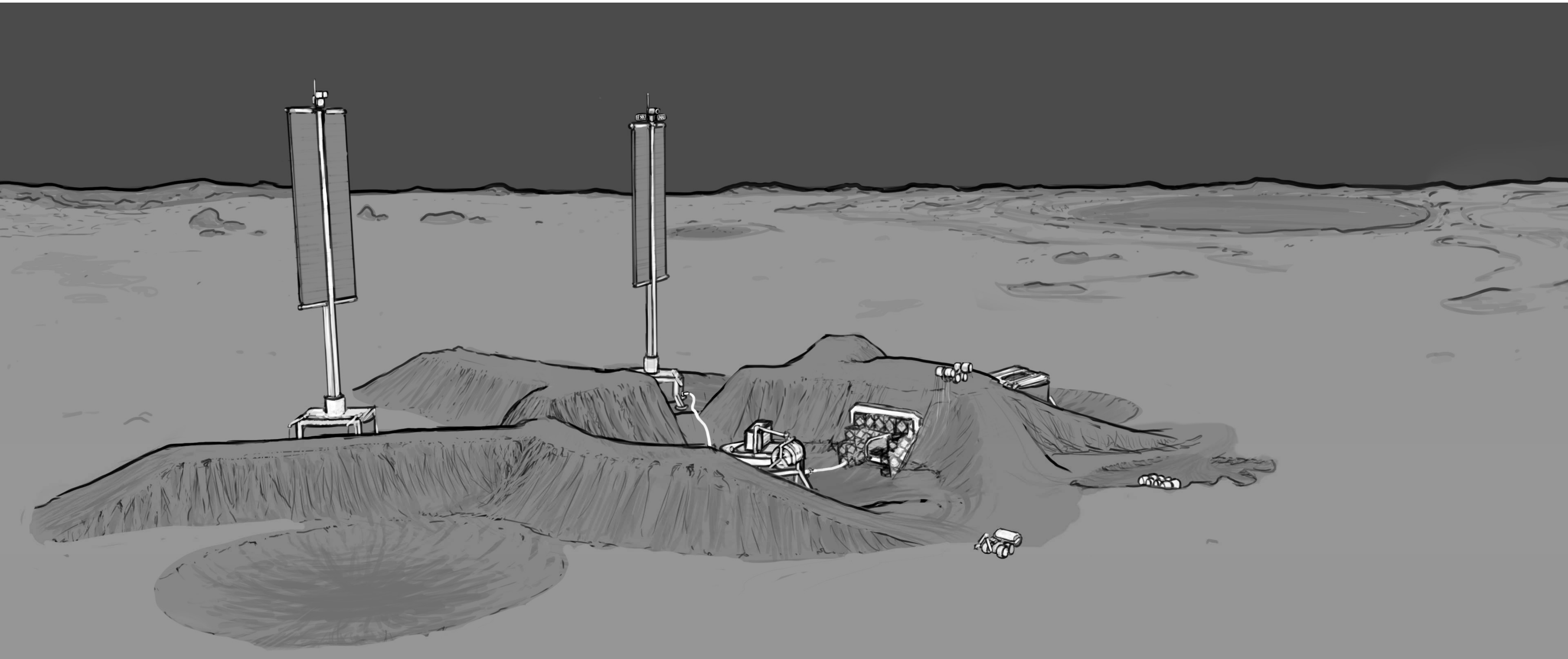
- **Power is connected to the fourth lander**
- **The foundation is prepared for the unpressurized shelter**



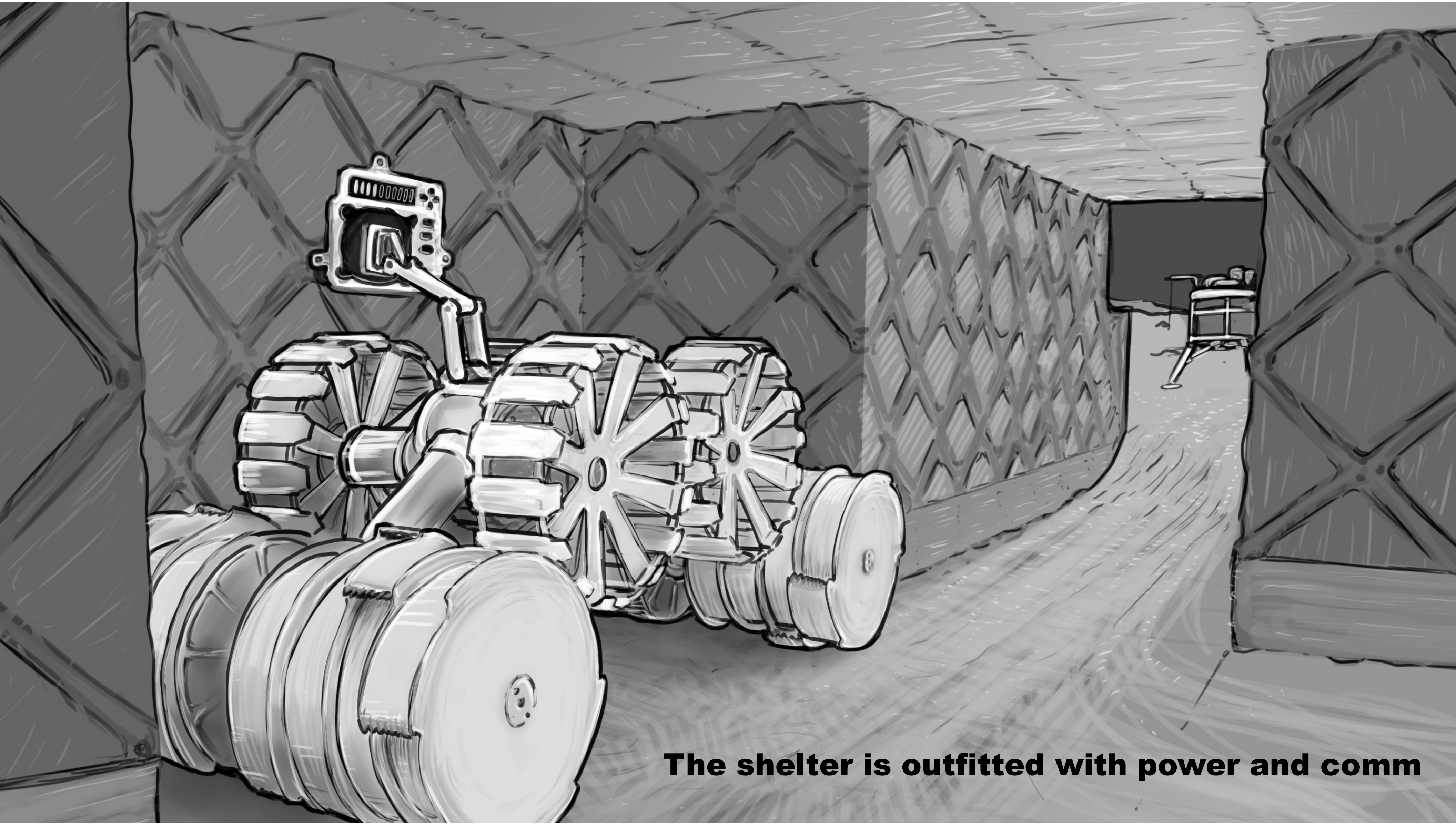
The ARMADAS elements are delivered to the shelter site, and the "cornerstone" of the shelter is placed

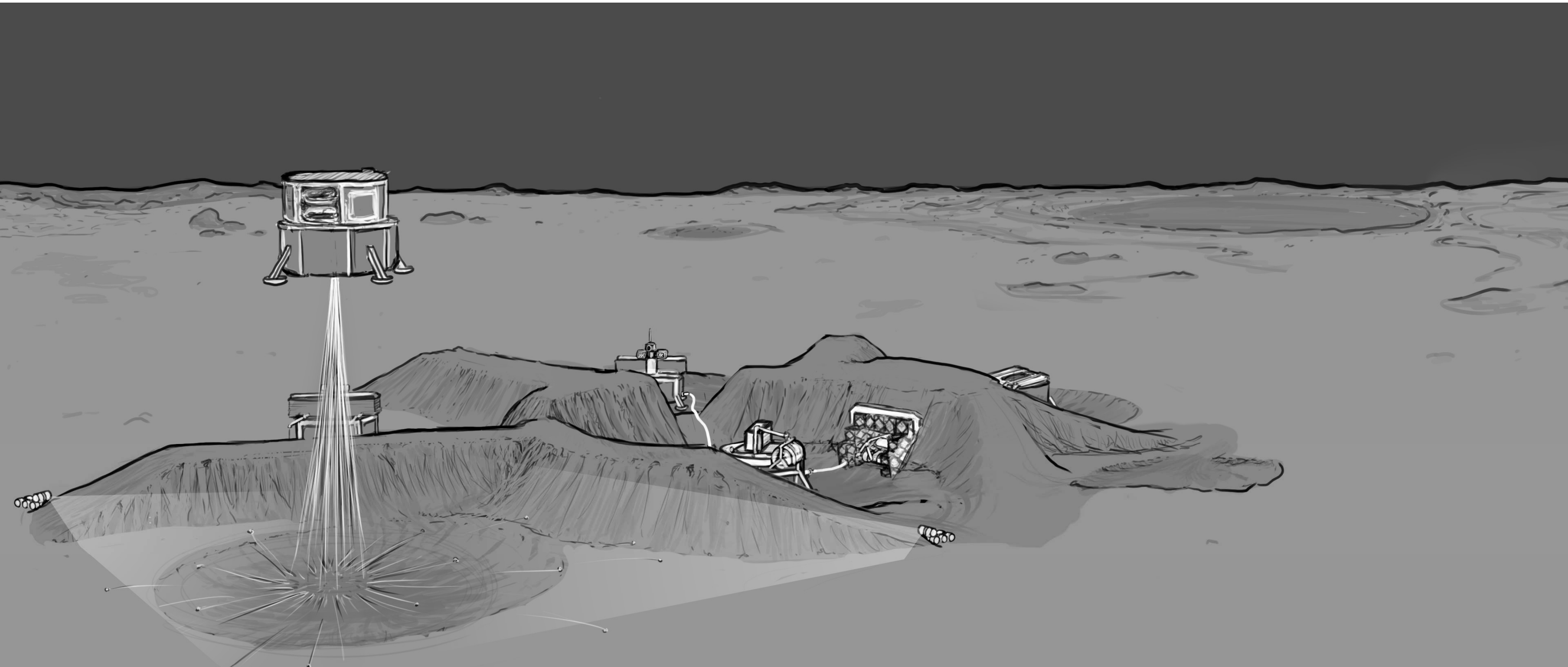


The ARMADAS robots assemble the protective shelter structure with support from the logistics robot

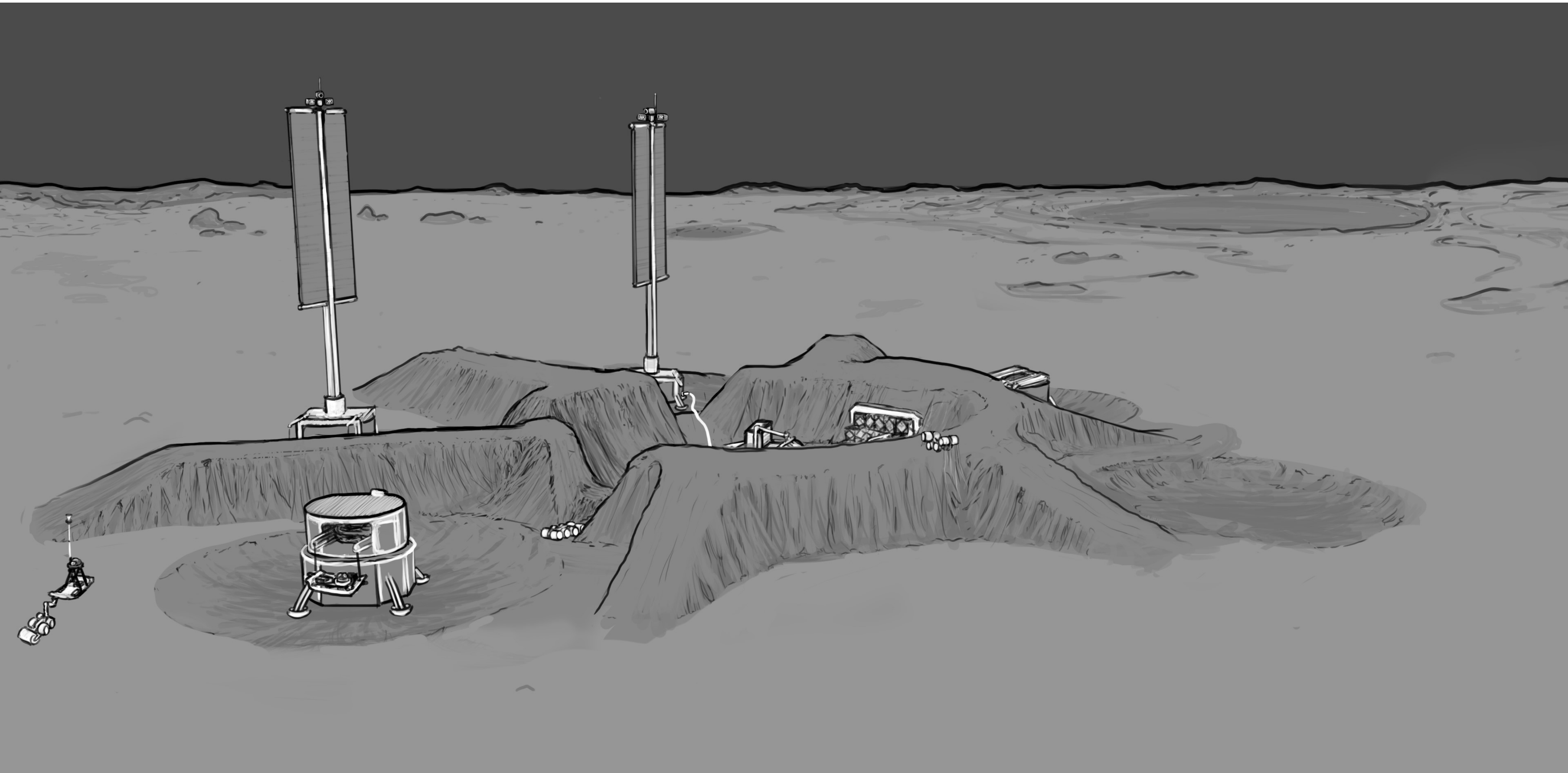


- The excavators bury the shelter with regolith
- The regolith provides protection from radiation and meteoroids and provides insulation to keep the shelter warm
- Sheltered space is available for Park assets and customers
- The site is prepared for the Mission 5 lander

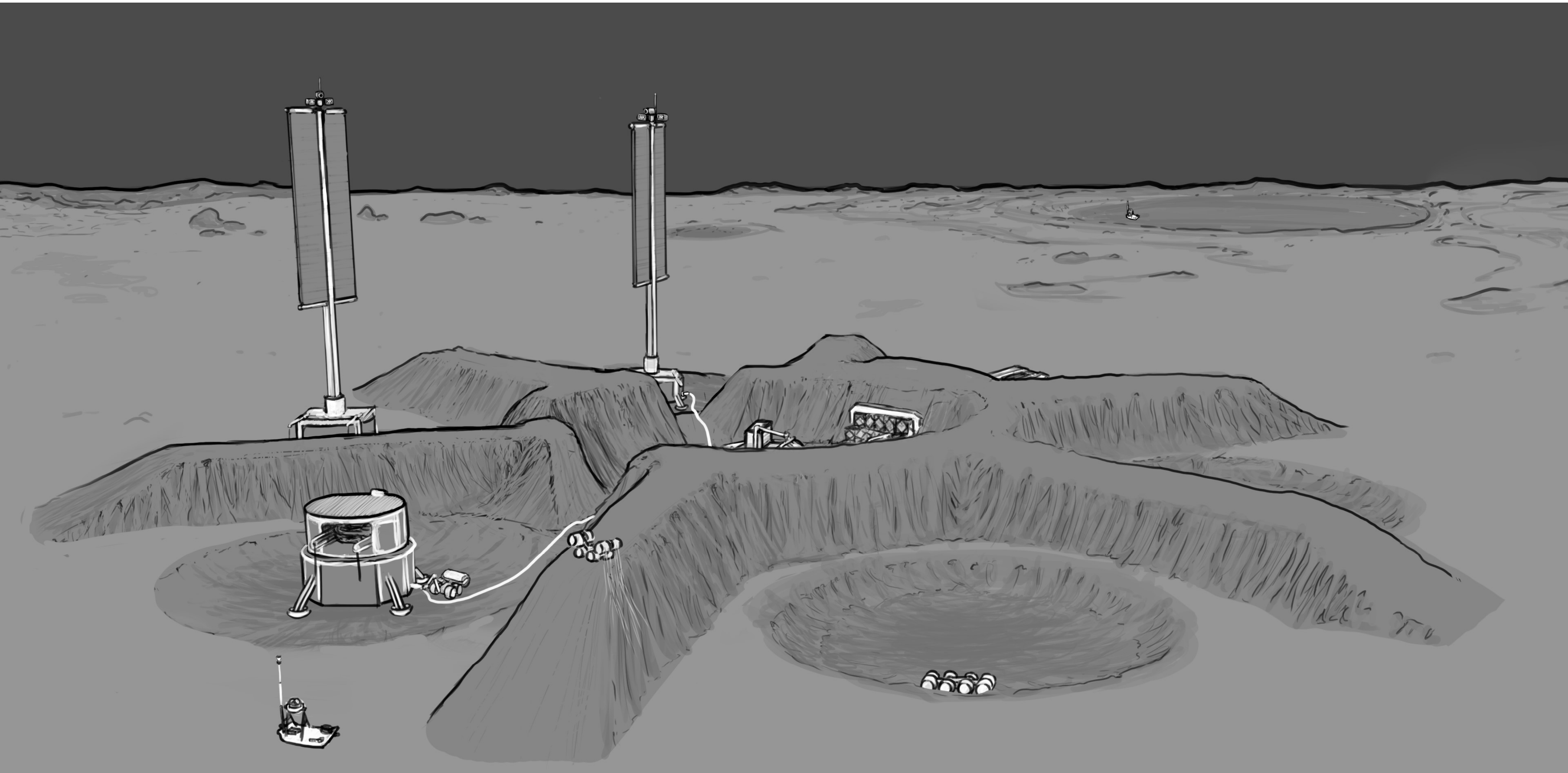

The shelter is outfitted with power and comm



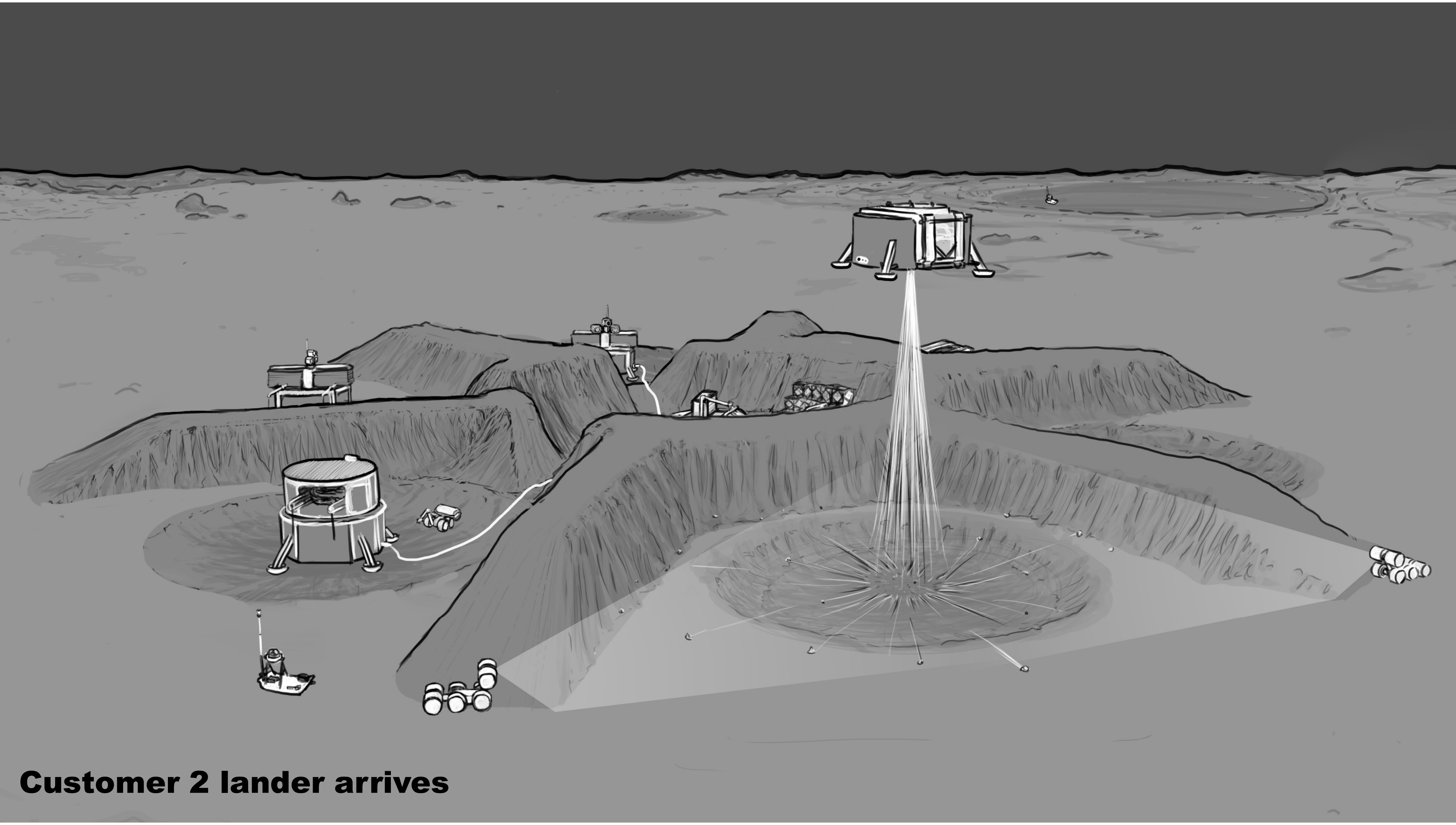
- Customer 1 lander arrives with technology development or scientific payloads who pay for park services (power, comm, transportation, regolith delivery, shelter, etc.)
- Customers with ISRU commodity production and/or reusable launch pad construction technologies are preferred for small scale demos



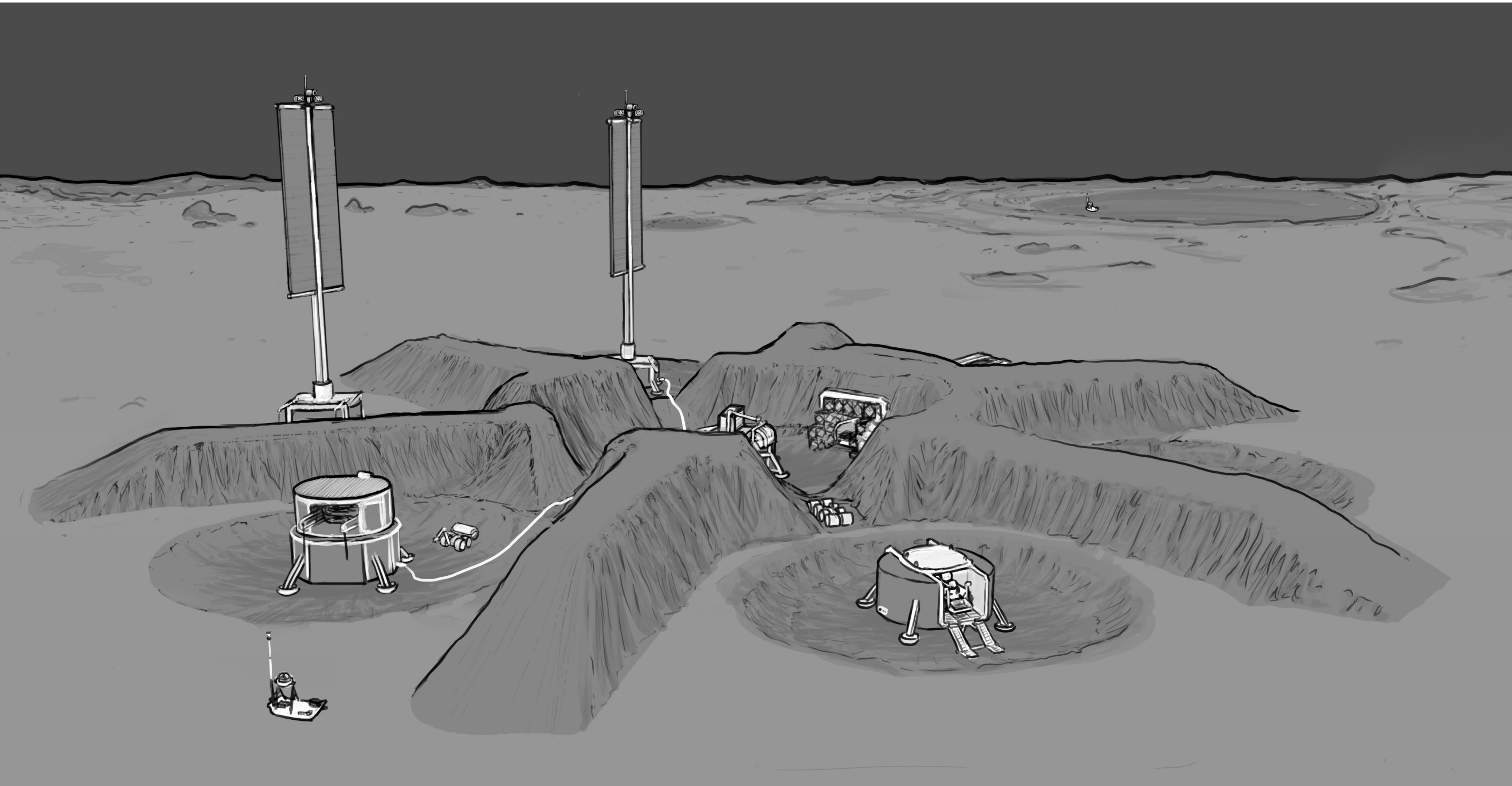
- A cut-through is made in the berm
- Customer operations are supported by Park services



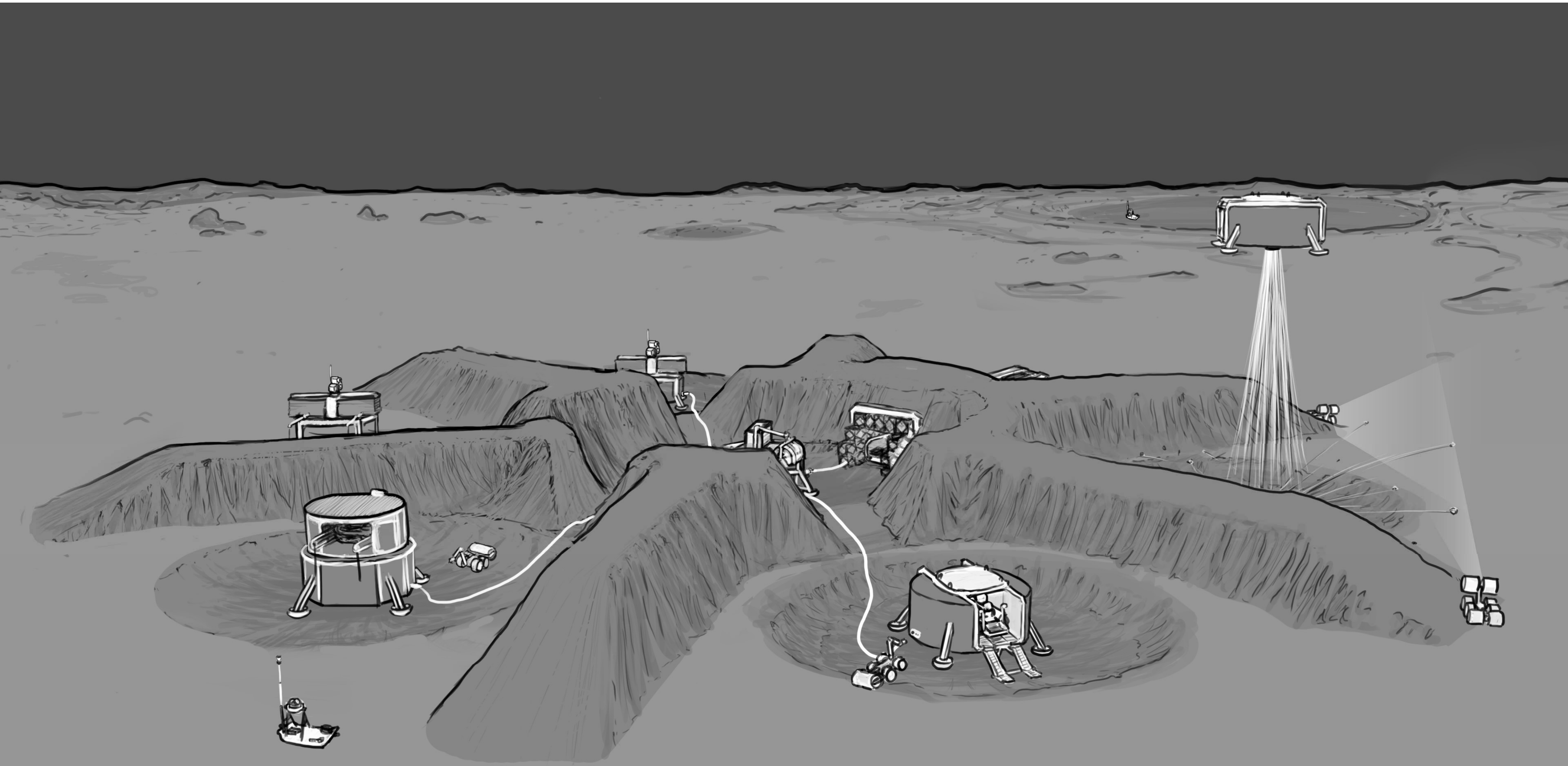
- Power is connected to the Customer 1 lander
- Customer 2 landing site is prepared



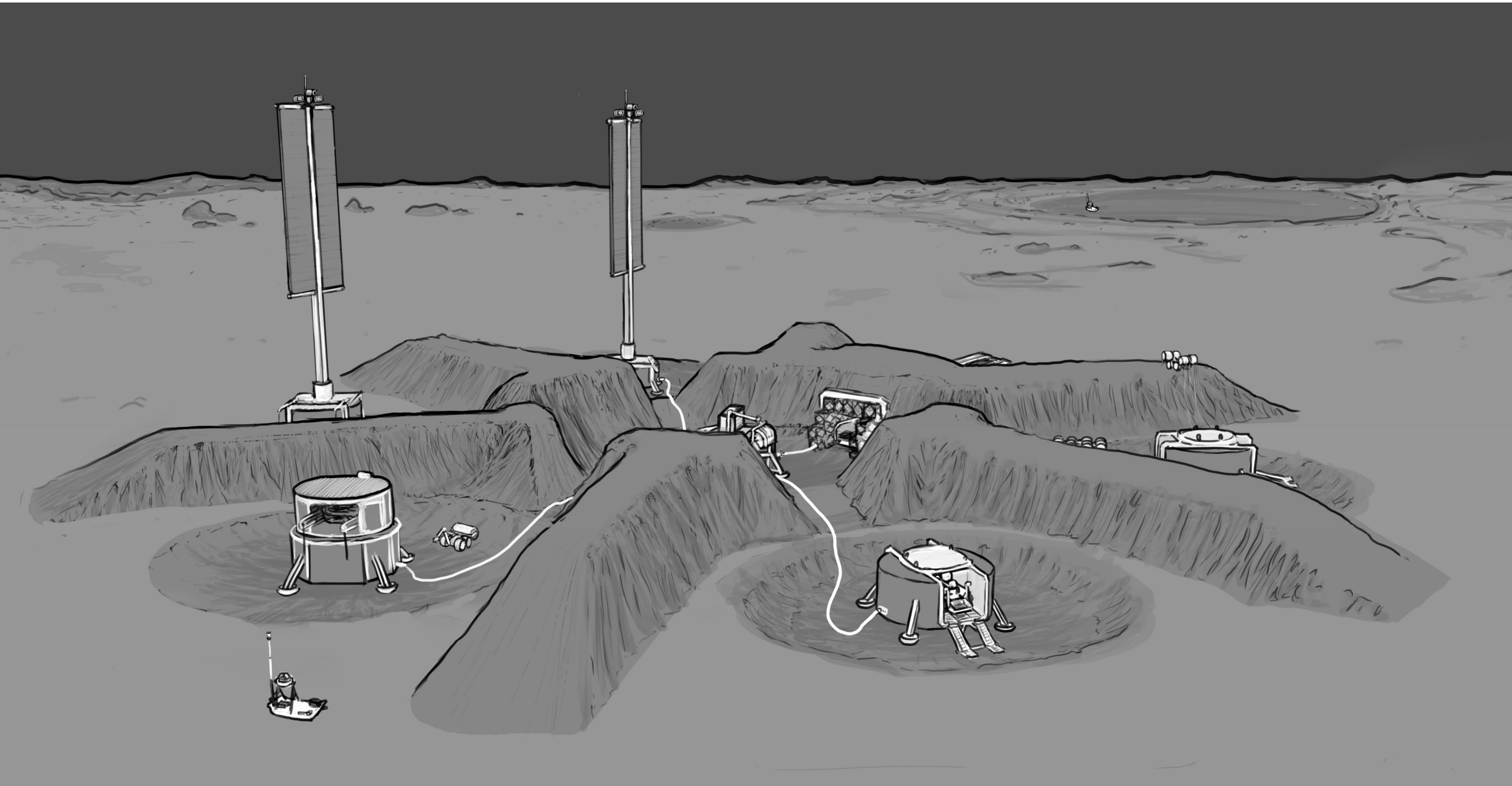
Customer 2 lander arrives



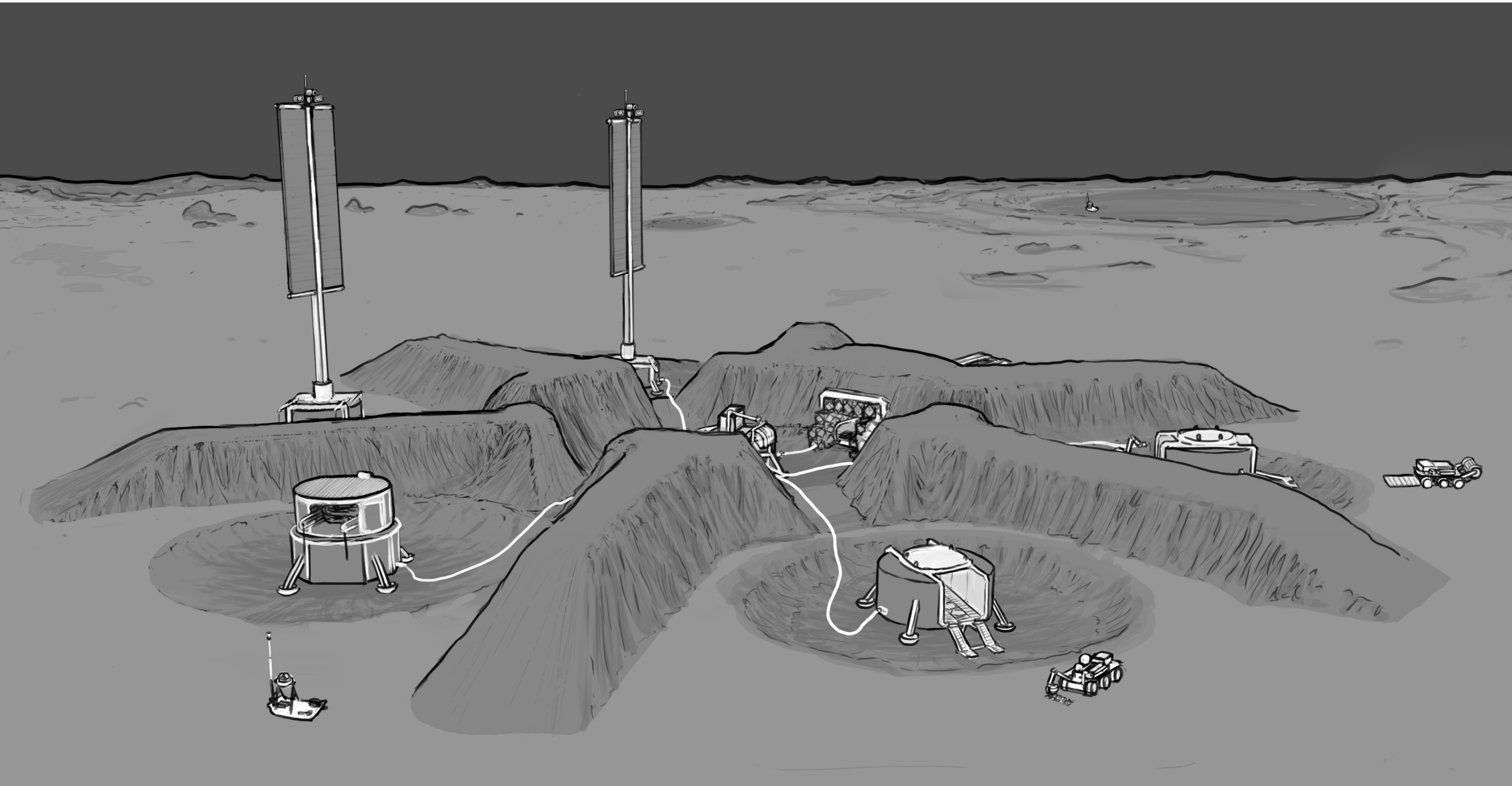
A cut-through is made to the Customer 2 lander



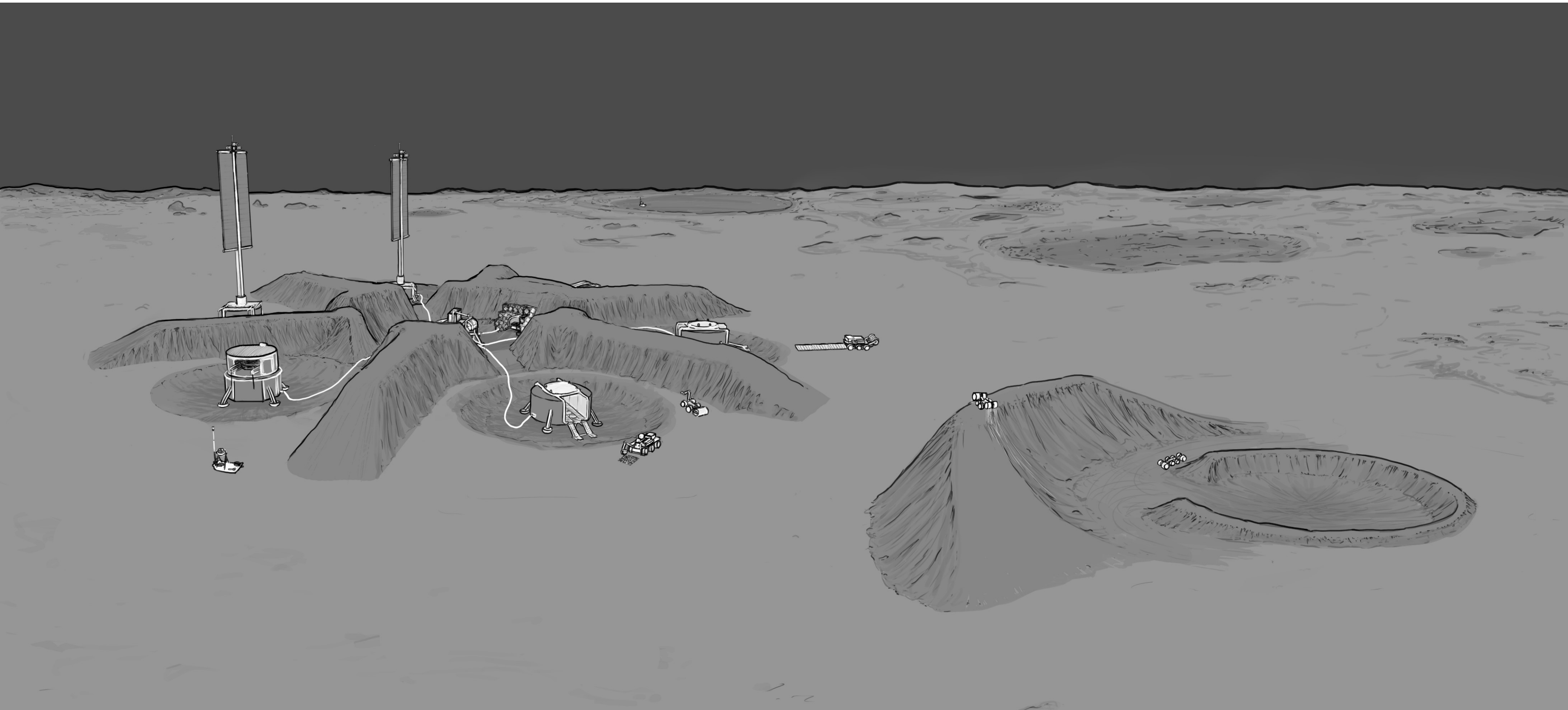
- **Power is connected to the Customer 2 lander**
- **Park construction Mission 5 lander arrives in 2032**



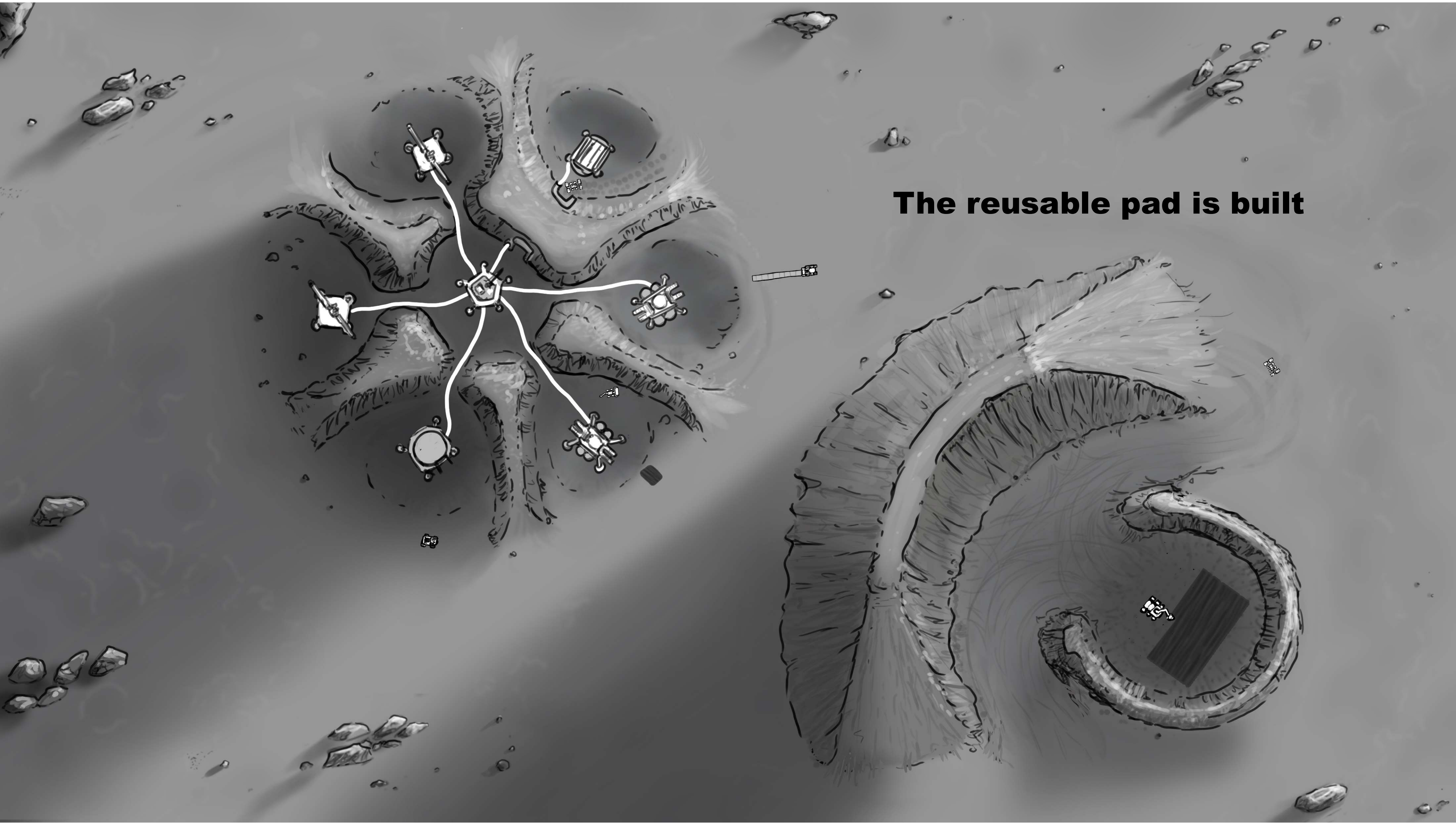
A cut-through is made to the Mission 5 lander



Power is connected to the Mission 5 lander

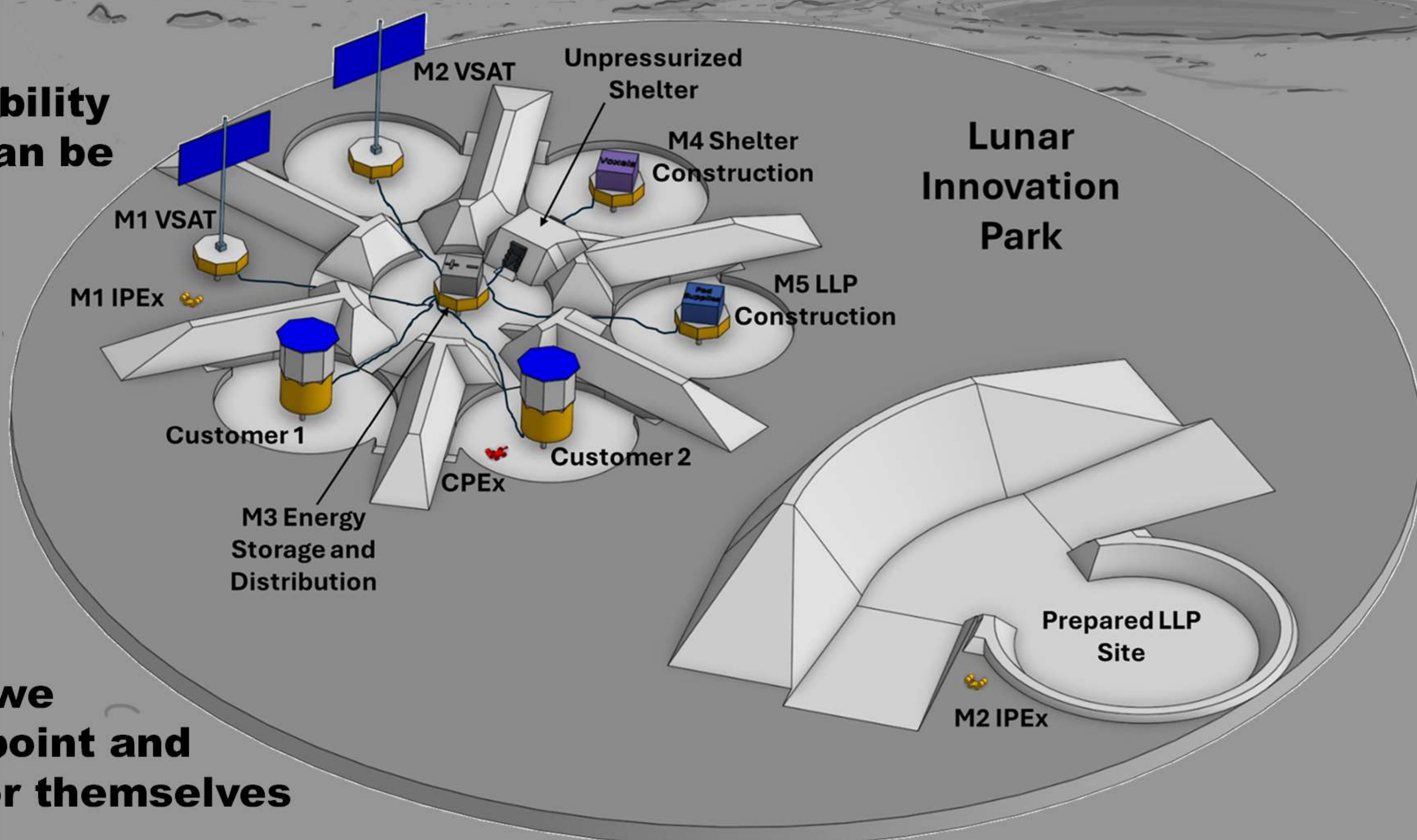


- **The reusable launch/landing pad regolith foundation and berms are for hardened pad construction operations**
- **The large berm protects all Park assets including VSATs in extended condition**
- **The smaller berm protects the entire region from PSI ejecta**


The reusable pad is built

Lunar Innovation Park

Once NASA/USA has established the capability to build Parks they can be reproduced at any/all areas of strategic importance



When industry becomes profitable, we are past the tipping point and Parks begin to pay for themselves