Goal 14: Sustainable ISRU

Ensure low environmental impact of activities that require the use of lunar resources.

Goal 14 focuses on the limited nature of lunar resources, such as minerals and regolith, but also frequencies, and orbitosphere, with associated targets and drivers listed in Table 4.15. To comply with Goal 6: Environmental Protection, lunar actors must commit to low environmental impact of resource utilization activities. Unlike some ecosystems on Earth, the Moon lacks regenerative environmental processes, making all damage permanent (Pernet-Fisher and Joy, 2016). Additionally, ensuring the sustainability of a long-term lunar habitation entails operating mostly with In Situ Resource Utilization.

- Oxygen, metals, and silicon will be necessary for sustaining long-duration lunar settlements, as they are required for structural elements, rocket fuel, and solar array materials production. These elements could be extracted from the lunar regolith as a raw material and then processed and used for the production of settlement features (Landis, 2007).
- Magmatic water abundances were recently discovered in lunar volcanic samples from the Apollo missions almost fifty years ago (Hauri, 2017). In 2009, the Lunar Reconnaissance Orbiter detected evidence of water ice in craters located in the lunar polar regions and in the surface regolith as shown in Figure 4.17 (Spudis, 2013). These discoveries support the potential development of water production on the Moon.
- The Hague International Space Resources Governance Working Group addresses ISRU in the 'building blocks'. These guidelines stipulate that the access to resources must be open and guaranteed to whoever is interested and capable. However they also ask for international legal bonds, thresholds, and limits, in accordance with the Outer Space Treaty and the Moon Agreement (International Institute of Air and Space Law, 2017).
- The use of Lagrangian points will also require regulation, and may benefit from an approach similar to GEO occupancy administration by the ITU, to permit fair use of the available slots for spacecraft positioning and to keep information available to everyone about each object (ITU, 2019).

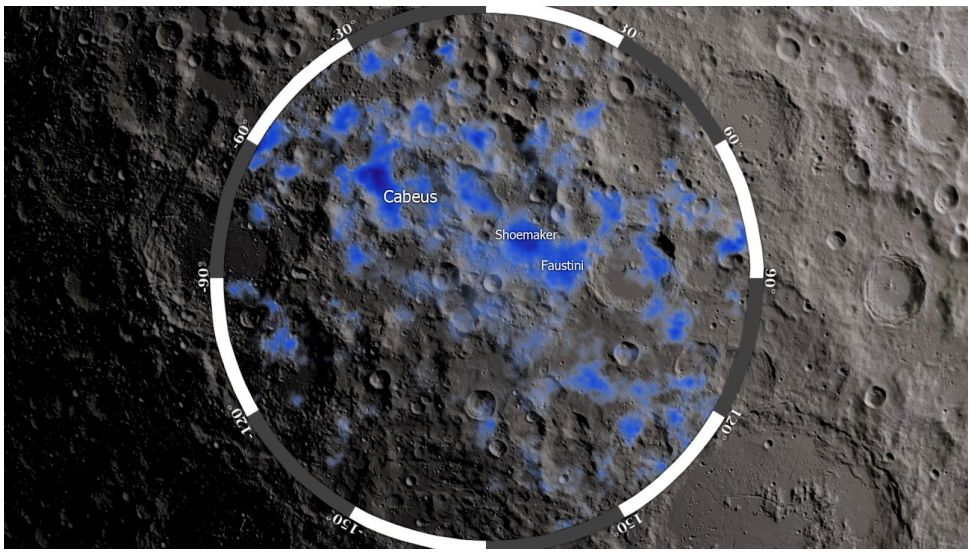

Figure 4.17. LRO observation of areas with possibly high deposits of frozen water (NASA, 2009h).

Table 4.15. Targets and drivers for Goal 14: Sustainable ISRU

Targets		Drivers	
14.1	Ensure the efficient use of lunar resources.	14.11	Support the development of alternative propulsion systems to reduce or eliminate fuel consumption for lunar missions.
		14.12	Promote the implementation of sustainable infrastructure to ensure that additional resources are not required in the long term.
14.2	Consider frequencies, orbits and Lagrangian points as limited lunar resources.	14.21	Support current and future recommendations for satellite frequency allocation and Earth-Moon space occupancy on the Moon.
		14.22	Support recommendations by institutions such as ITU and SFCG to protect future radio astronomy applications on the far side of the Moon.
		14.23	Coordinate and collaborate among space actors with regards to the use of Lagrangian points in order to not impede the free access to space of other actors.
		14.24	Ensure fair access and opportunity with regards to frequency allocations.
14.3	Transparency on the discovery of new resources.	14.31	Provide for the sharing of scientific data with regards to the lunar and cislunar environment.
		14.32	Focus on approaches to governing lunar activity in areas such as resource utilization.
14.4	Low environmental impact of resource utilization activities.	14.41	Commit to ensuring low environmental impact of the use of resources for transportation systems on the Moon.
		14.42	Reduce the environmental impact of settlements on the lunar surface.
		14.43	Encourage States and organizations with planned and undergoing operations on the Moon to work together in monitoring activities involving resource utilization.
		14.44	Ensure States and organizations remedy any harm done to the lunar environment as a result of resource utilization.