

Goal 12: Zero Waste



Prevent the production and disposal of waste on the lunar surface.

Goal 12 aims for zero waste to achieve sustainable habitation on the Moon, with associated targets and drivers listed in Table 4.13. Future long-term lunar crewed missions will require significant amounts of food, water, and propellant supplies. Carrying these supplies from Earth or relying on resupply missions is impractical, which makes closed-loop systems a necessity for long-term lunar exploration missions. Disposal of waste will have to be managed and regulated to avoid leaving waste on the Moon.

- A model of accumulated human waste during long duration crewed missions has been developed, which estimates the amount of waste expected from the LOPG and a mission to Mars, based on waste produced on the Space Shuttle and the ISS (Linne, et al., 2014). The waste model predicts a total of 1,046 kg of waste for a LOPG mission, which includes :
 - 115 kg of clothing
 - 99 kg of wipes and tissues
 - 324 kg of human waste
 - 253 kg of food packaging
 - 29 kg of foam packaging from launch
- Closed-loop systems are able to reclaim and recycle water and other waste (e.g., urine, feces, and carbon dioxide) into drinking water, food, oxygen, and fuel, reducing the necessary amount of supplies and waste, as shown in Figure 4.15.
- Currently, researchers at NASA are working on an "Advanced Exploration Systems Logistics Reduction and Repurposing" project (LRR) that aims to identify and develop the most efficient waste recycling systems for future long-term missions (Broyan, Chu and Ewert, 2014).
- LRR systems already operate onboard the ISS. However, they are quite limited and not yet capable to fully recycle everything onboard and to provide all the necessities for such long-term missions (ESA/Erasmus, 2010).

Simplified Life Support Systems Schematic

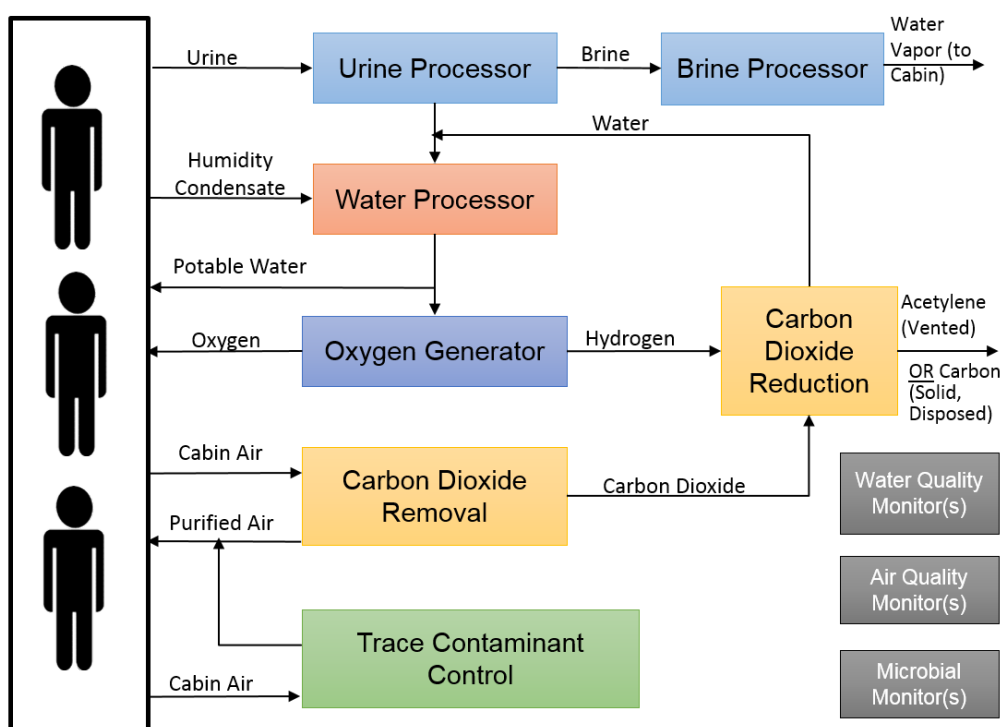


Figure 4.15. Simplified life support systems schematic (NASA, 2016)

Table 4.13. Targets and drivers for Goal 12: Zero Waste

Targets	Drivers
12.1 Limit waste production of lunar missions.	12.11 Design zero waste systems for lunar missions.
	12.12 Use and develop lunar environment-friendly materials, designs and recycling technologies.
	12.13 Promote reduced production and consumption during lunar missions as well as the efficient use of resources.
	12.14 Commit to developing lunar missions that do not entail the production of waste.
	12.15 Establish international guidelines setting out protocols for safe and sustainable waste management and disposal.
	12.16 Integrate the notion of Zero Waste in the application of Goal 5: "Education and Outreach".
	12.17 Ensure that the development of lunar activities on Earth are undertaken in accordance with the UN Sustainable Development Goals.