LUWEX

Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center
Technische Universität Braunschweig
LIQUIFER SYSTEMS GROUP
ThalesAlenia Space
Wrocław University of Science and Technology
Scanway imaging space
Funded by the European Union

LUWEX

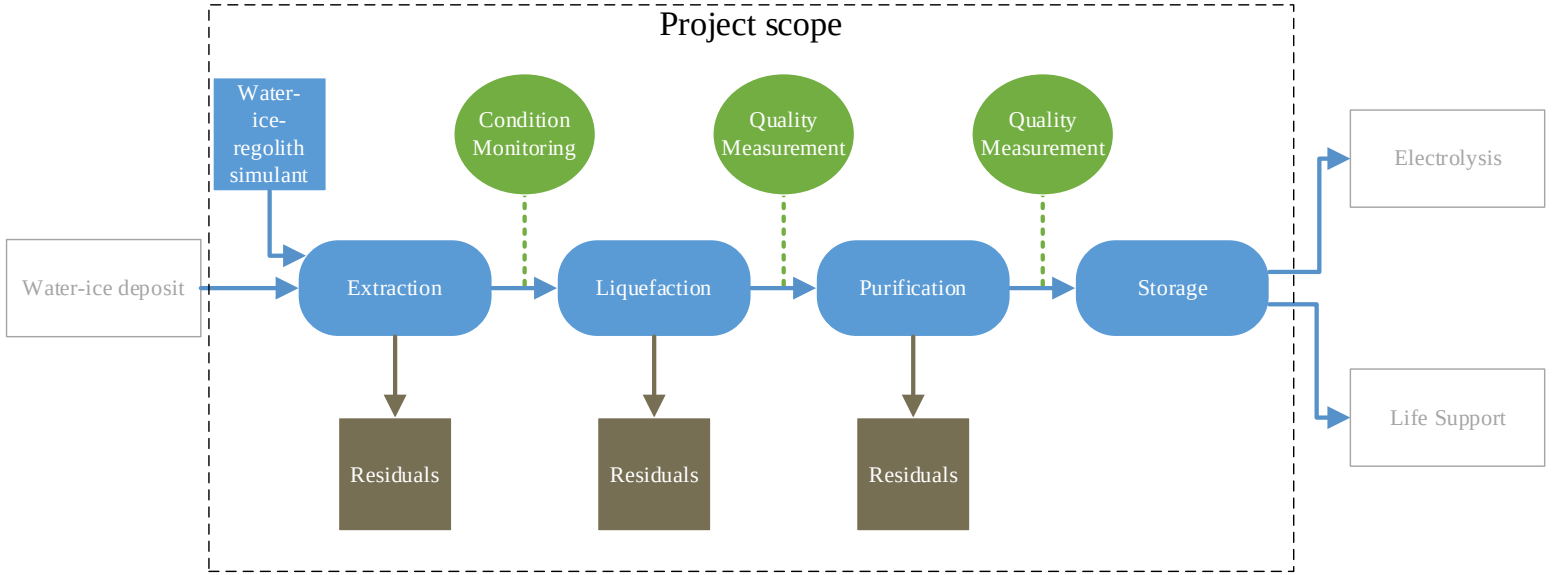
Validation of Lunar Water Extraction and Purification Technologies for In-Situ Propellant and Consumables Production

Duration: Nov. 2022 – Oct. 2024.

EU-funded with 1.5 million €

Objective

The development, integration and validation of lunar water extraction and purification technologies for in-situ propellant and consumables production for future space exploration missions



DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

Technische Universität Braunschweig

LIQUIFER SYSTEMS GROUP

ThalesAlenia Space

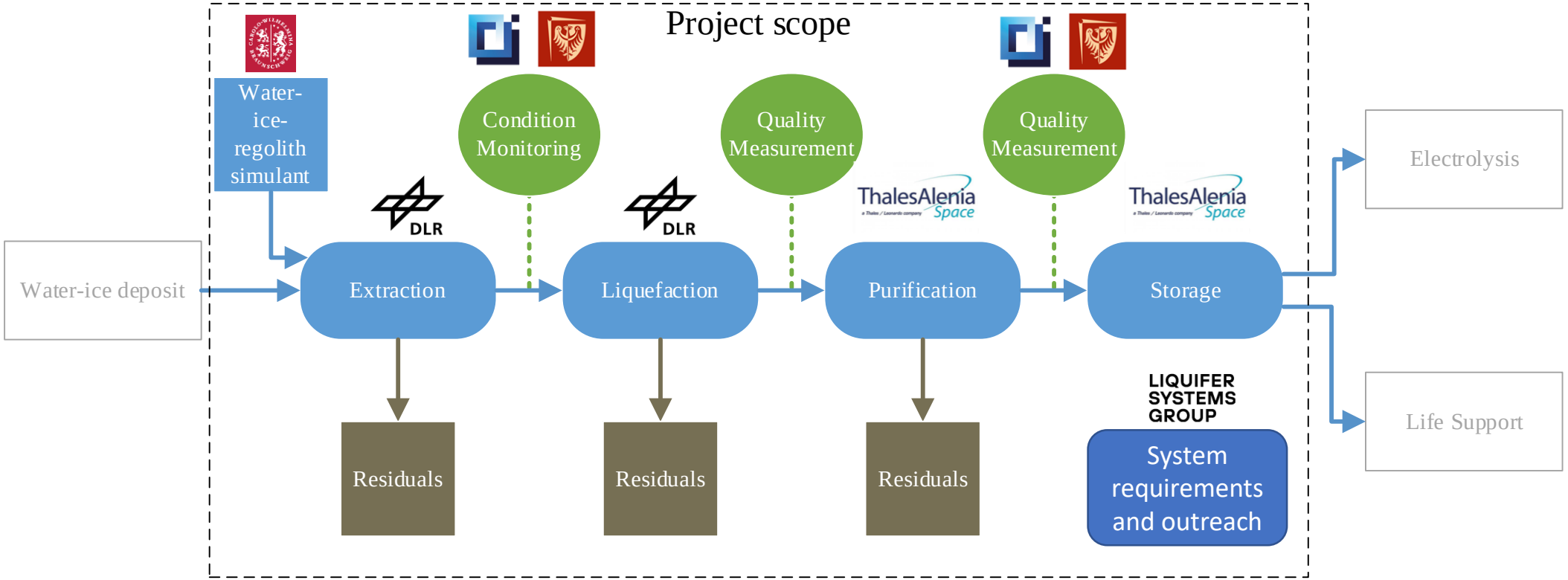
Wrocław University of Science and Technology

Scanway imaging space

Funded by the European Union

LUWEX

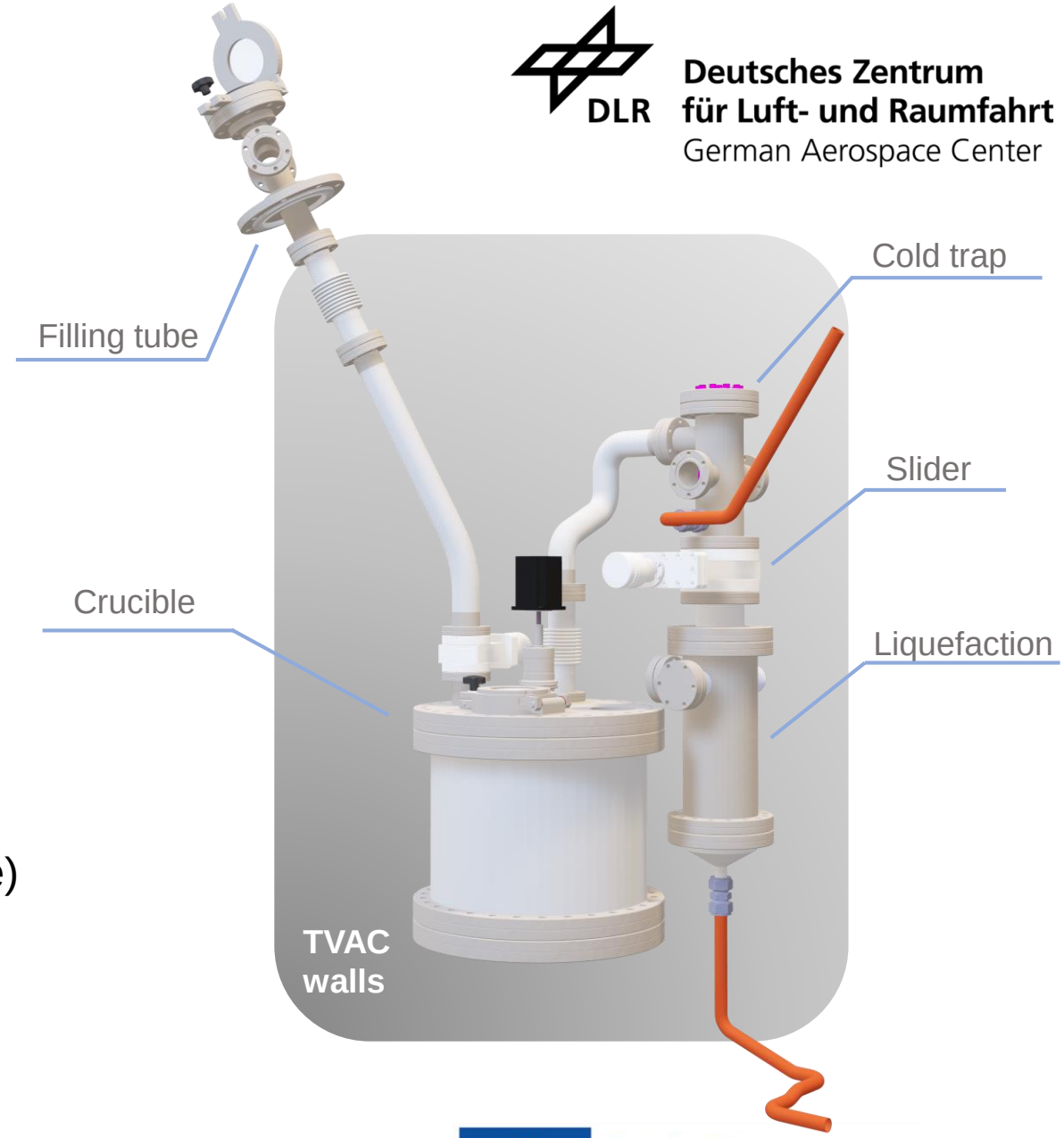
Validation of Lunar Water Extraction and Purification Technologies
for In-Situ Propellant and Consumables Production



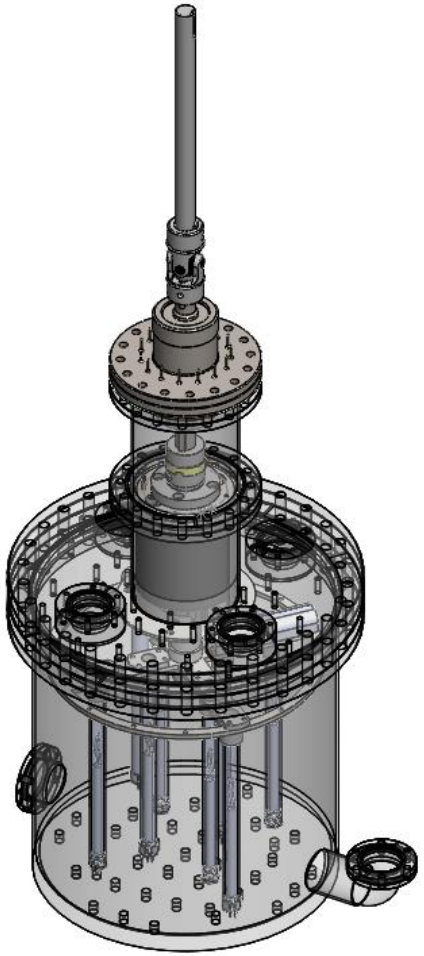
Extraction and capturing process

- Design for extraction and water capturing chosen using simulations and trade-offs.

- A water extraction crucible and a cold trap capturing device are placed in a “dusty” TVAC.
  - Temperature ≈ 80 – 100 K.
  - Pressure ≈ 10e-6 mbar.
  - Crucible size = ⌀30 cm x 30 cm.
  - Icy regolith simulant mass up to 15 kg.
  - Amount of water present 5 wt.%, 750 mL (baseline)
  - Presence of volatiles: CO_2 & Methanol



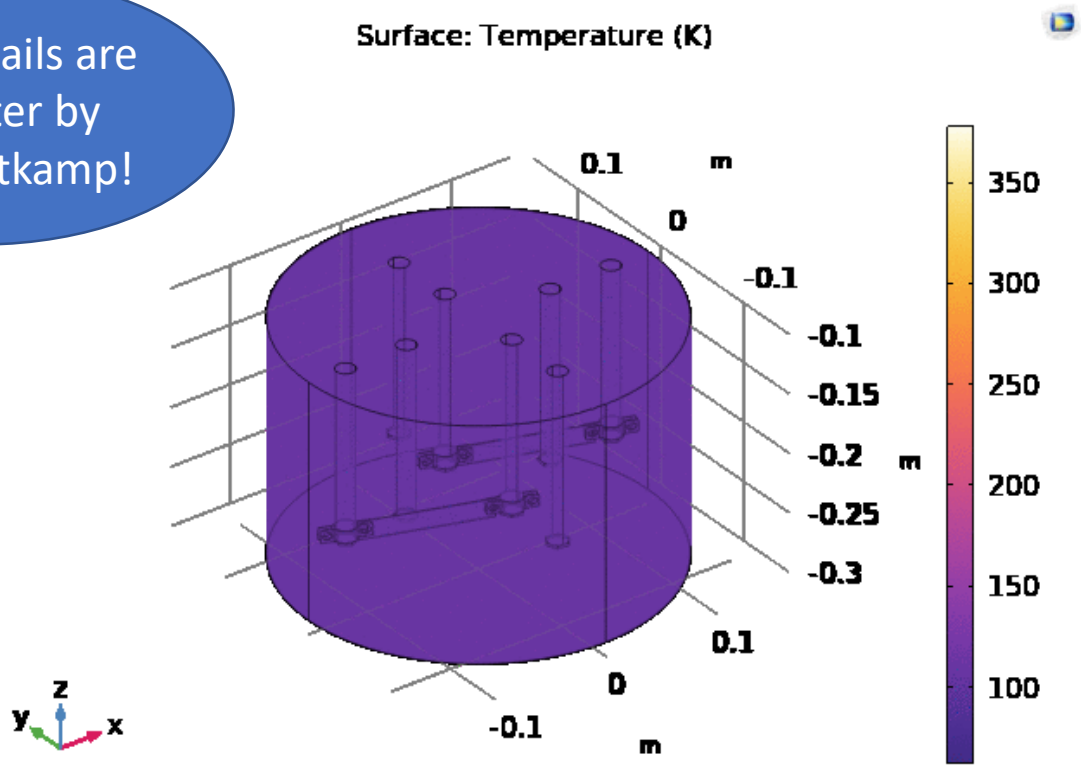
Extraction and capturing proces



Crucible

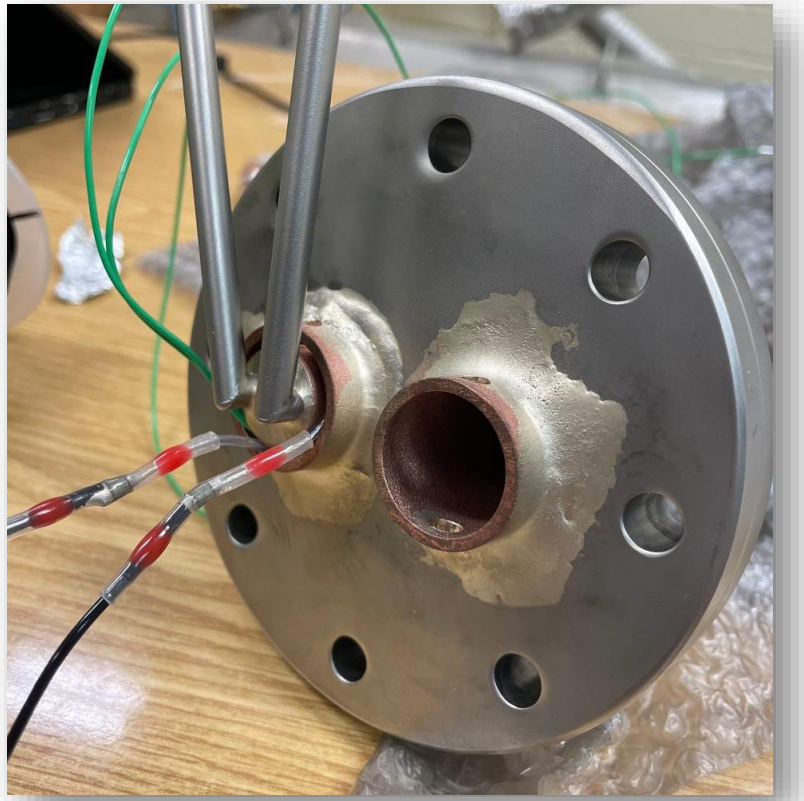
Extraction and capturing process

More details are on poster by Mart Heitkamp!

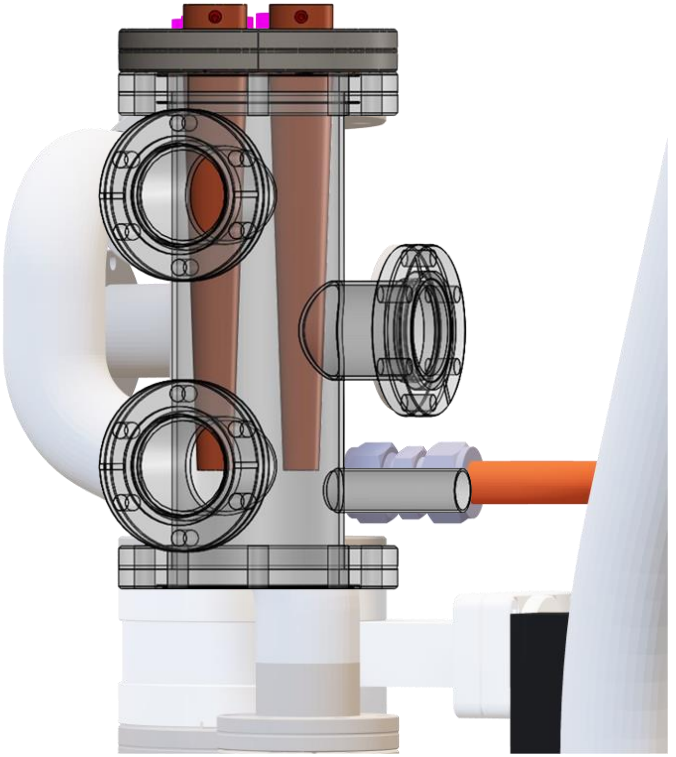


Crucible

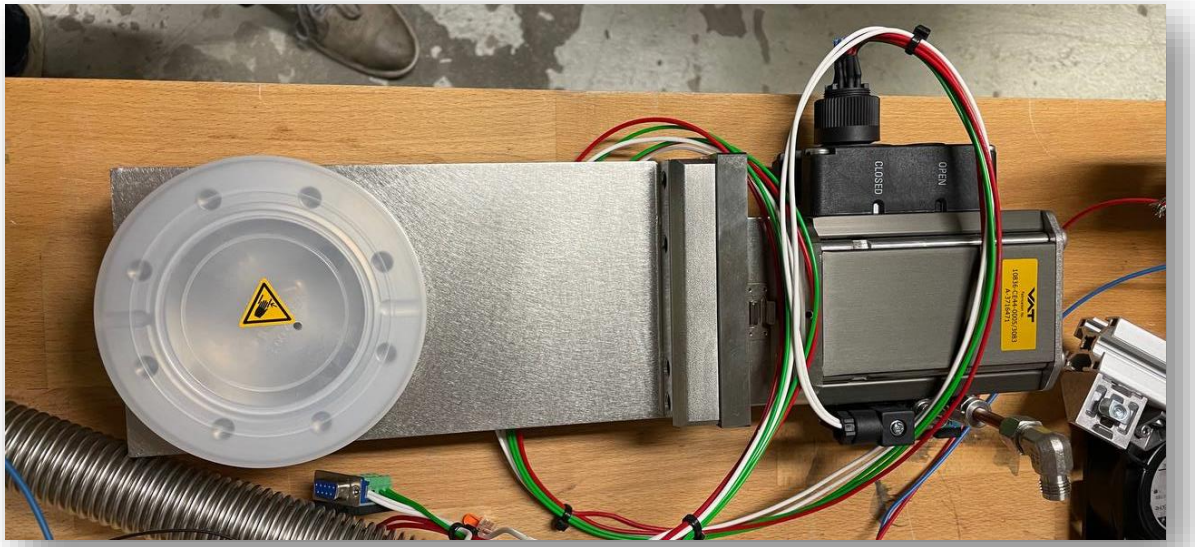
Extraction and capturing overview



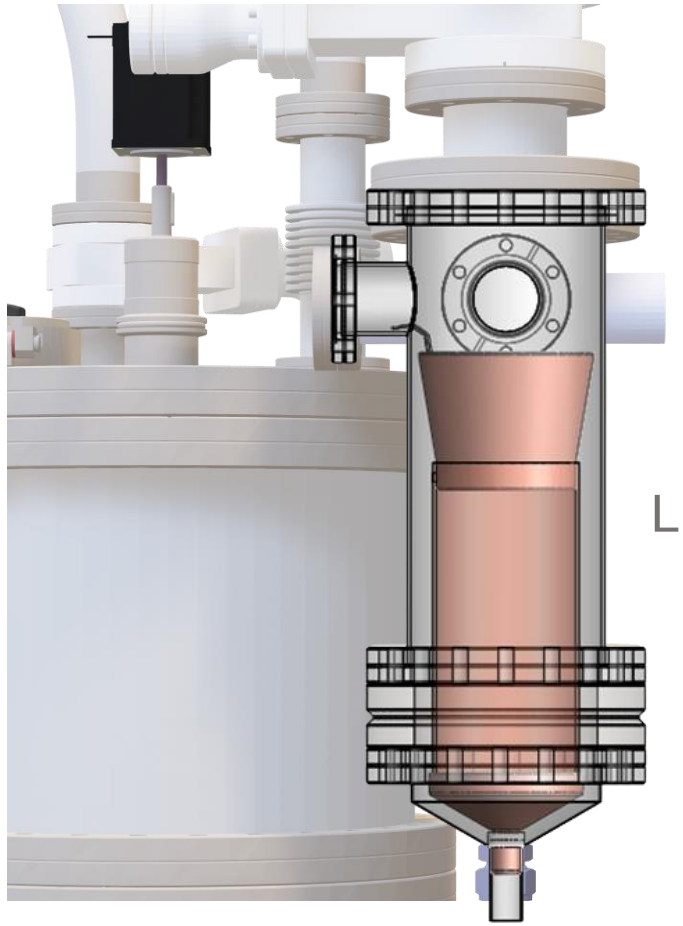
Cold trap



Extraction and capturing overview



Extraction and capturing overview



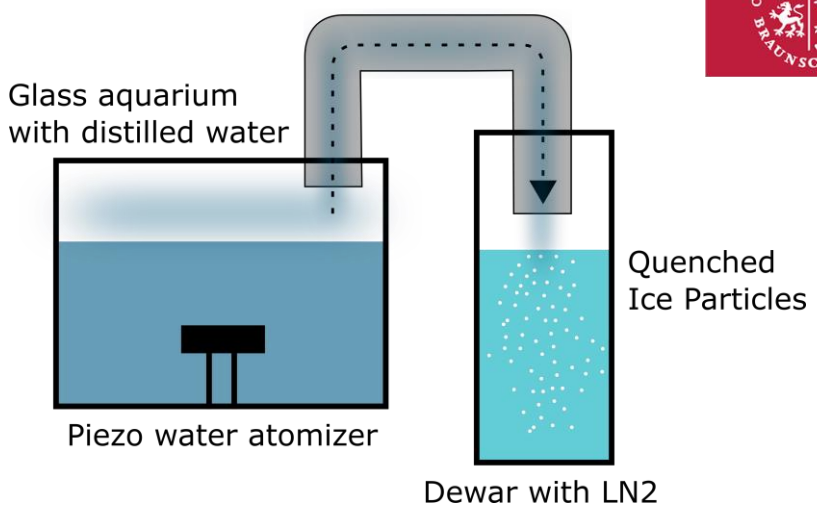
Liquefaction

Technische Universität Braunschweig

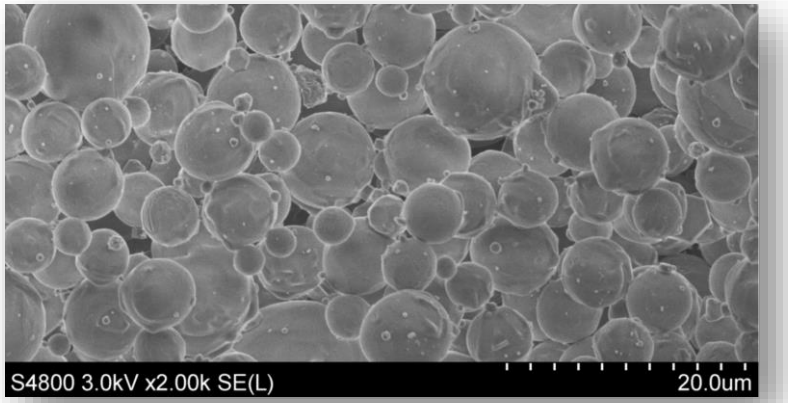
Lunar icy regolith simulant

- Lunar regolith simulant by Lunex Technologies in Berlin
  - 75% Terrae – 25% Mare
  - 0 – 1 mm particle size
- CoPhyLab granular ice particles
  - Spherical particles with 2.4 ± 0.1 µm radius

Lunar regolith simulant

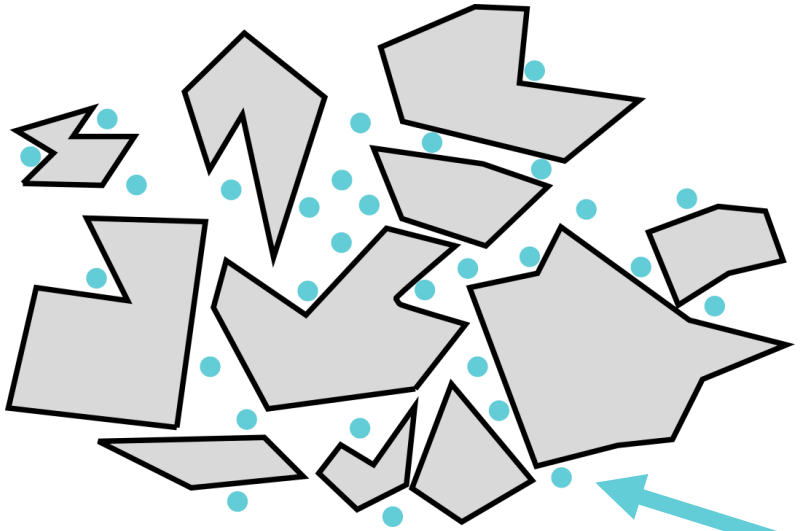


Schematic setup of ice machine for production of granular ice particles



Scanning Electron Image of ice particles (Kreuzig et al. 2023)

Lunar icy regolith simulant

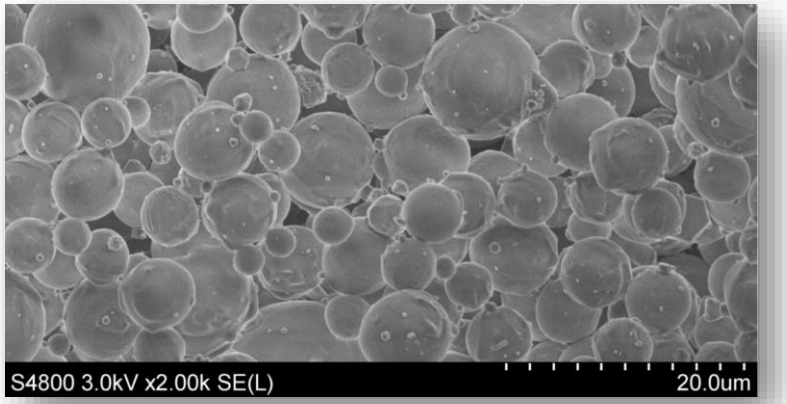


More details are on poster by Henning Wache!

Unfused discrete icy regolith

- Heat transport through ice is minimal
- Very low thermal conductivity

Lunar regolith simulant

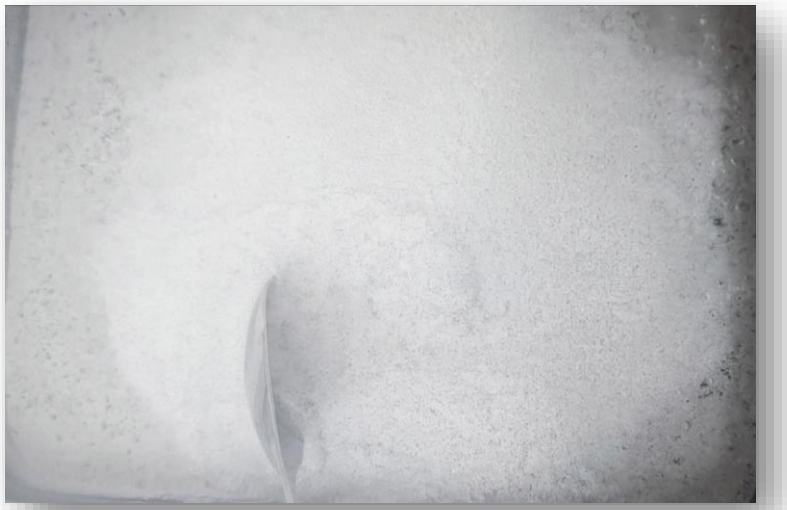


Scanning Electron Image of ice particles (Kreuzig et al. 2023)

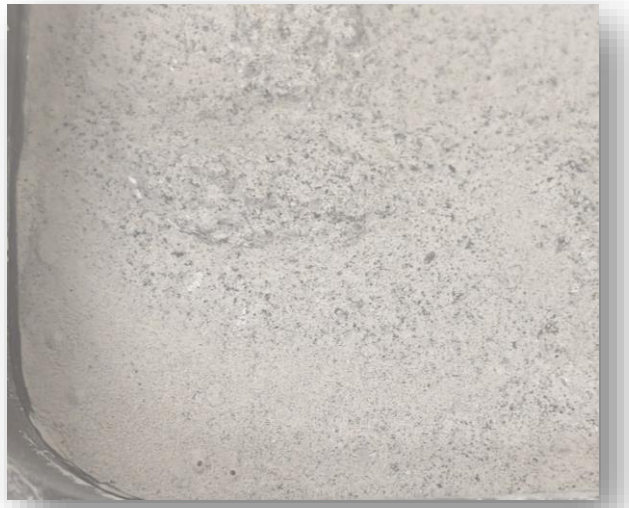
Lunar icy regolith simulant

- Addition of water-soluble contaminants easily possible e.g. methanol
- Mixing of ice and regolith in LN2-slurry
- LN2 will evaporate quickly

mm-sized ice clumps occur when using ice dried without LN2



Unmixed regolith-ice-LN2 slush



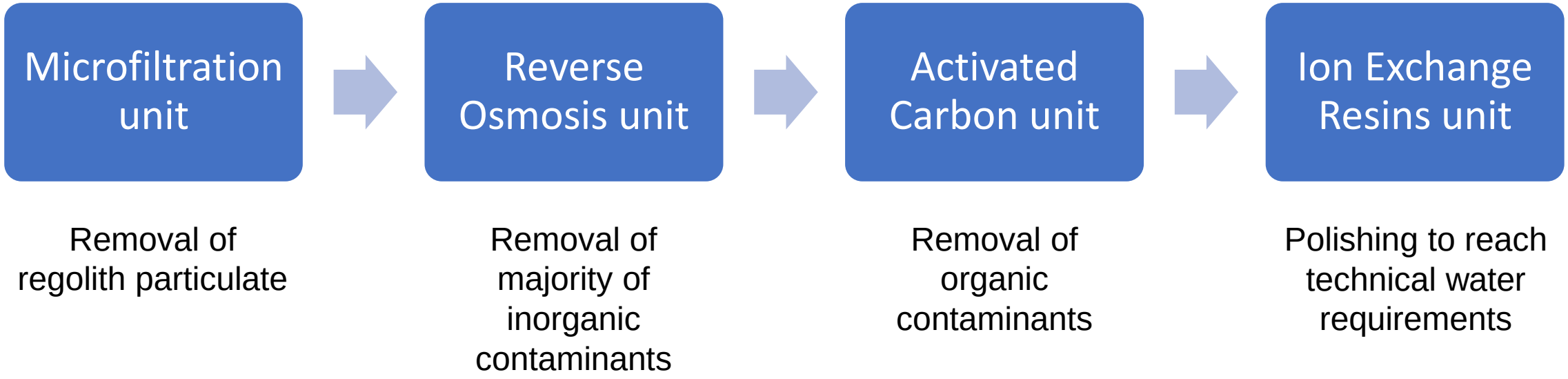
Icy regolith after mixing

Icy regolith after LN2 dried off

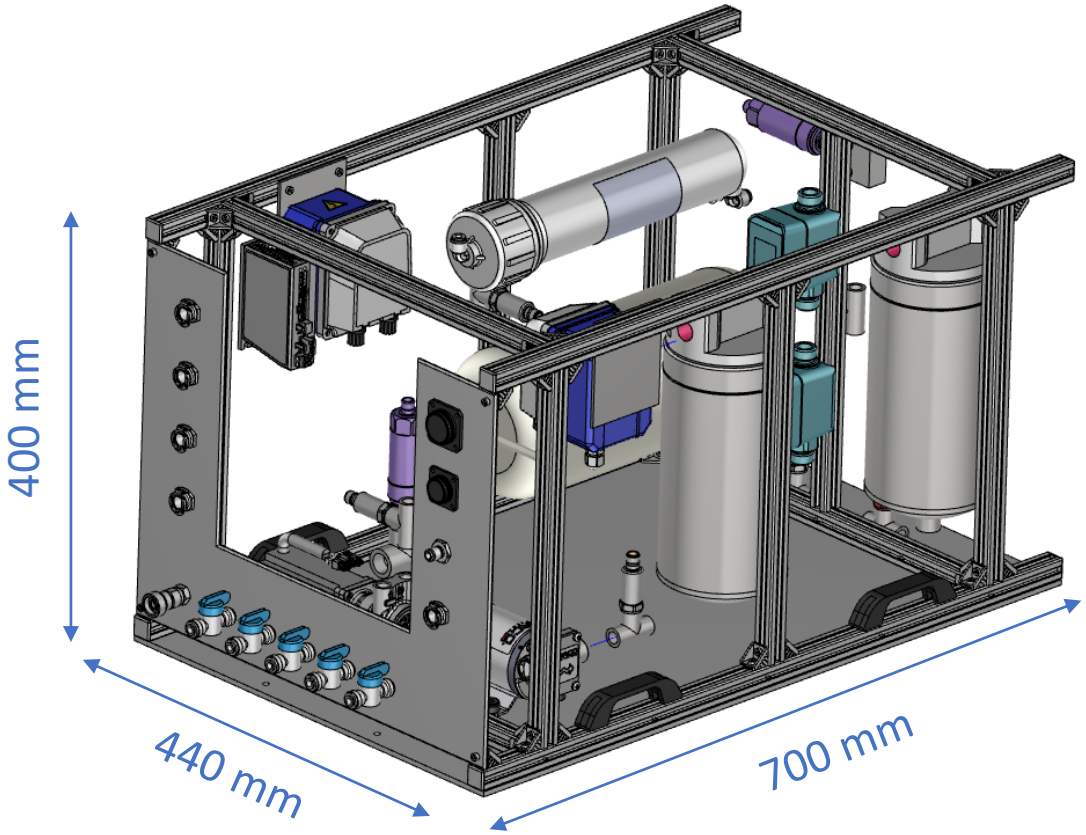
Water purification and storage subsystem

Main design features:

- Consuming less than 1 gram of onsumables per kilogram of product water
- Achieving target product water to feed ratio >95%
- Achievin target product water quality fo electrolysis applications and/or drinkable water



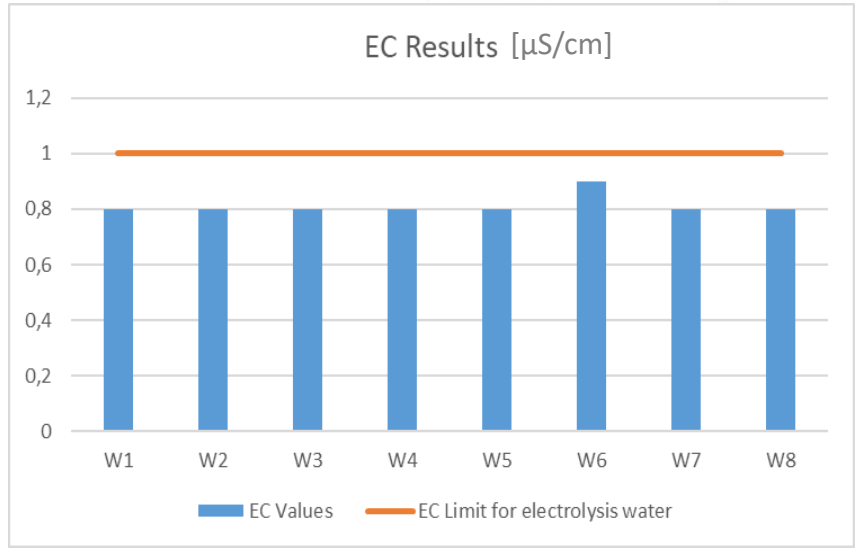
Water purification and storage subsystem

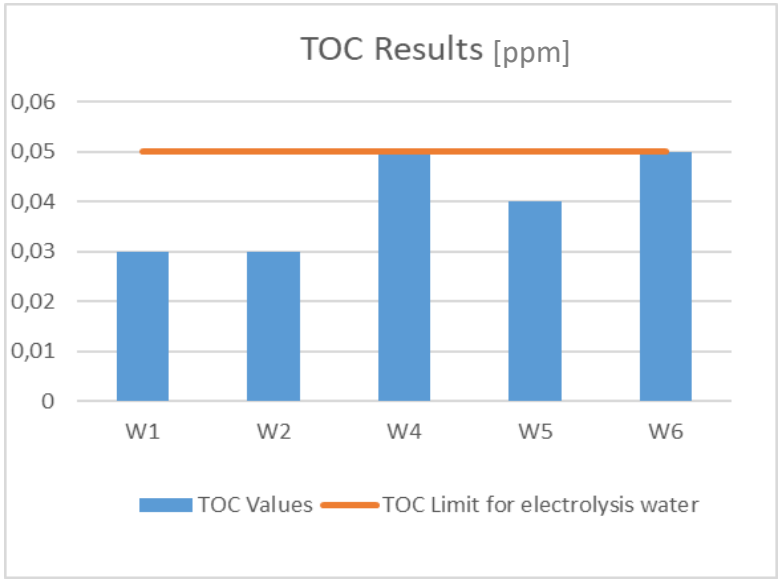


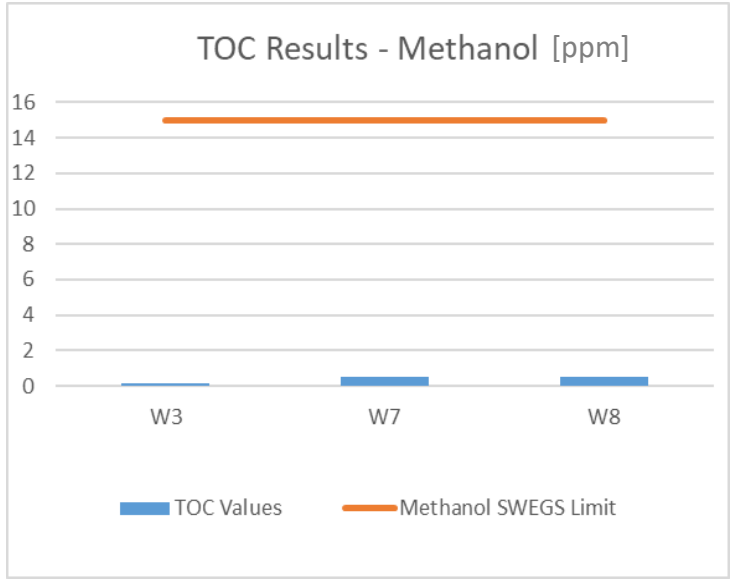
ThalesAlenia Space
a Thales / Leonardo company

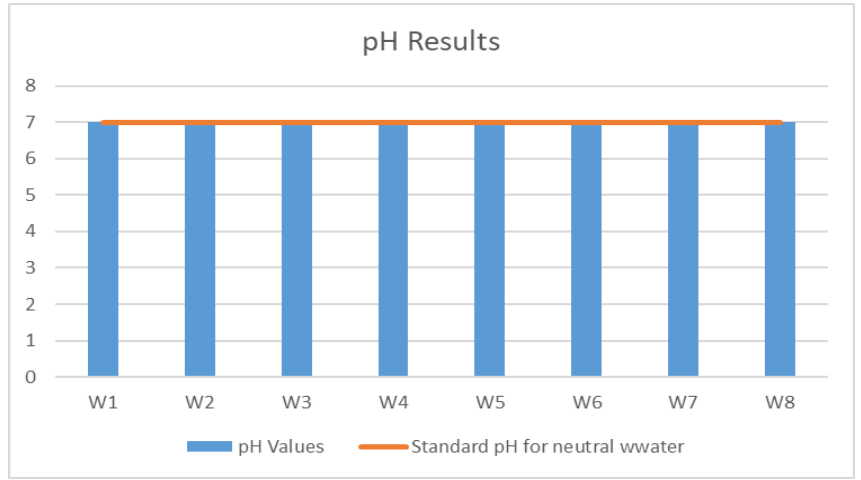
Water purification and storage subsystem

- Results of preliminary experiments with different raw water simulants
- Ultra-pure water contaminated with combinations of regolith, ammonia, sulfur dioxide and methanol



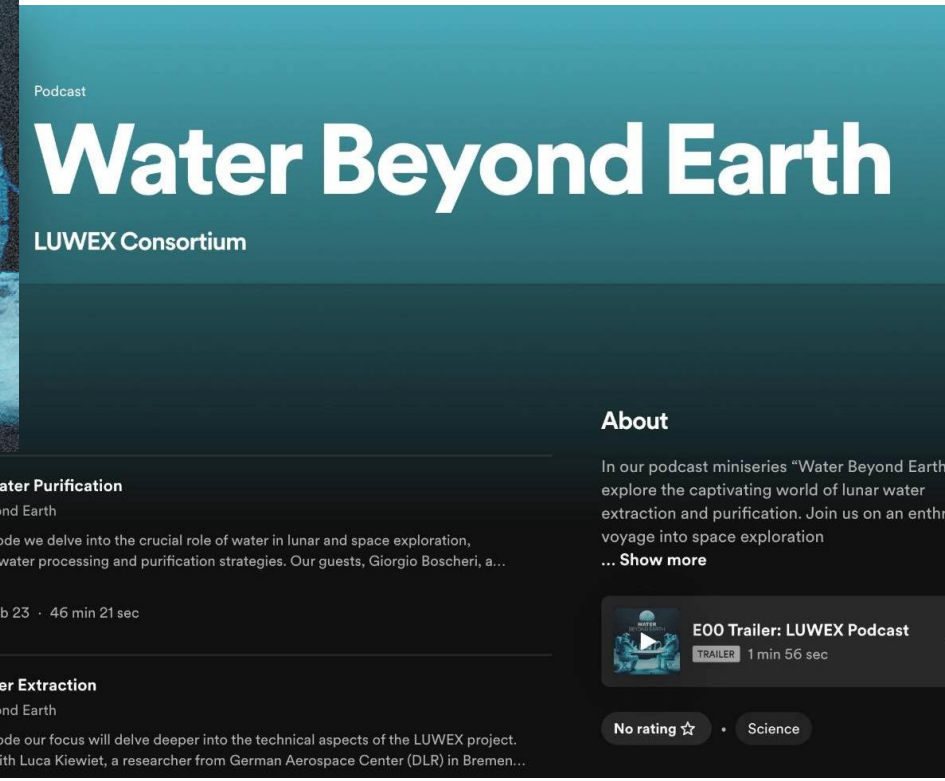






Dissemination, exploitation and communication

- Press releases
- Project flyer
- Podcast miniseries
- Videocast miniseries
- Next Nature exhibition
- Website: luwex.space



Expected Outcomes and Impacts

Project Results

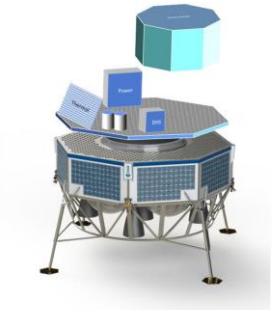
- Validated technologies
- Ice-Regolith simulant
- Lunar raw water simulant
- Experiment results

Medium-term outcomes

- Further development of technologies towards flight hardware
- Simulants and data for excellent science

Long-term impacts

- Innovative ISRU technologies
- Contribution to European lunar exploration mission



2022 - 2024 | **2024+** | **2030+**