The Luxembourg Perspective on ISRU and the Development of a Commercial Space Ecosystem

M. Link[1], B. Lamboray[2] and G. Martin[3]

[1,2,3]Luxembourg Space Agency Luxembourg, Luxembourg; 21 boulevard Royal, L-2449 Luxembourg,

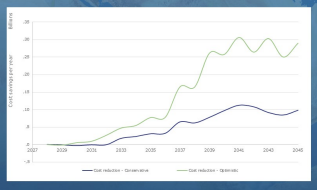
The SpaceResources.lu initiative

"Luxembourg aims to contribute to the peaceful exploration and sustainable utilization of space resources for the benefit of humankind"

Five Strategic Pillars

1. Ensure national political support and promote international cooperation
2. Build clear legal framework and engage internationally
3. Promote long-term public support and workforce engagement through education and R&D
4. Provide dedicated support for industrial research and development activities
5. Develop long-term funding instruments

Total costs savings to 2045 were evaluated; 85 B€ (conservative scenario) and 254 B€ (optimistic scenario)



Optimistic scenario

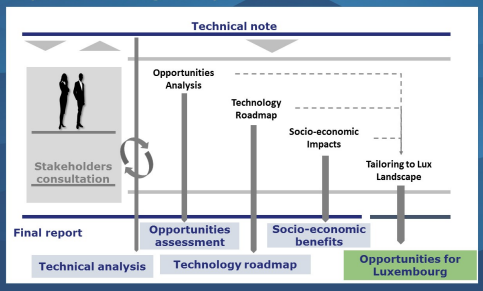
Cumulated savings of 254 B€
Average of 12 B€ euros per year

Conservative scenario

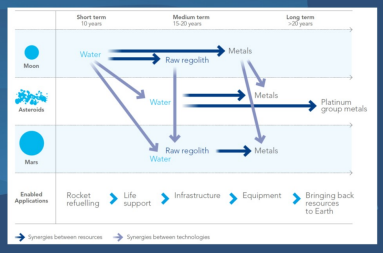
Cumulated savings of 85 B€
Average of 4 B€ per year

Cost savings per value chain	Conservative scenario	Optimistic scenario
Propellant for rockets	68 B€	166 B€
Water for life support	1 B€	3 B€
Regolith & Ni/Fe for construction	16 B€	85 B€

In 2018, we ran a study to analyze the likely market, technology and socio-economic impacts, allowing us to focus our initiative



The main drivers and risks were discussed, leading to conclusions reflecting the highest consensus within experts



- SRU will support exploration missions' feasibility, cost efficiency and autonomy
- Provision of propellant will be the first application to target
- Scientific missions led by space agencies will be the first customers
- Earth mining industry needs to be involved for their expertise and practical understanding

- The challenge in refining the "geological" knowledge remains a strong barrier
- Strong skepticism on the realism of bringing back PGM

The potential value chains for SRU were characterized on the basis of applications, resources and mission profiles

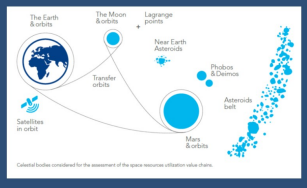
1. Applications

- Life support to astronauts
- Propellant for launch vehicles and other space vehicles
- Construction of in-situ infrastructure
- Radiation shielding
- Manufacturing of equipment in space
- Earth-based use of Platinum Group Metals (PGM)

2. Resources

- Water, and others: H, O, N, C
- Methane
- Metals (Fe, Ni, Co)
- Regolith
- Platinum Group Metals (PGMs)

3. Mission Profiles



SRU value chain

Prospect → Establish → Mine → Transport → Refine → Manufacture → Supply

Key outcomes and messages of the study

- **SRU** must and will materialize. **It is only a matter of feasibility timeline.**
- **Substantial costs savings** and added **autonomy** for space missions.
- **Prospecting** is key!
- Collaboration between the **space and the terrestrial mining industries** should be encouraged.
- Support activities, such as **legal and financial frameworks** or provision of **deep space communications** and **energy,** will be mandatory enablers.
- Public actors are expected to play a key role in the support of SRU activities, mostly as being **the first customers.**

Download Summary Report at: *https://space-agency.public.lu/dam-assets/publications/2018/Study-Summary-of-the-Space-Resources-Value-Chain-Study.pdf*

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