

METALS AS LONG TERM AND TRANSPORTABLE ENERGY STORAGE VECTORS – THE EU HORIZON PROJECT REVEAL-STORAGE

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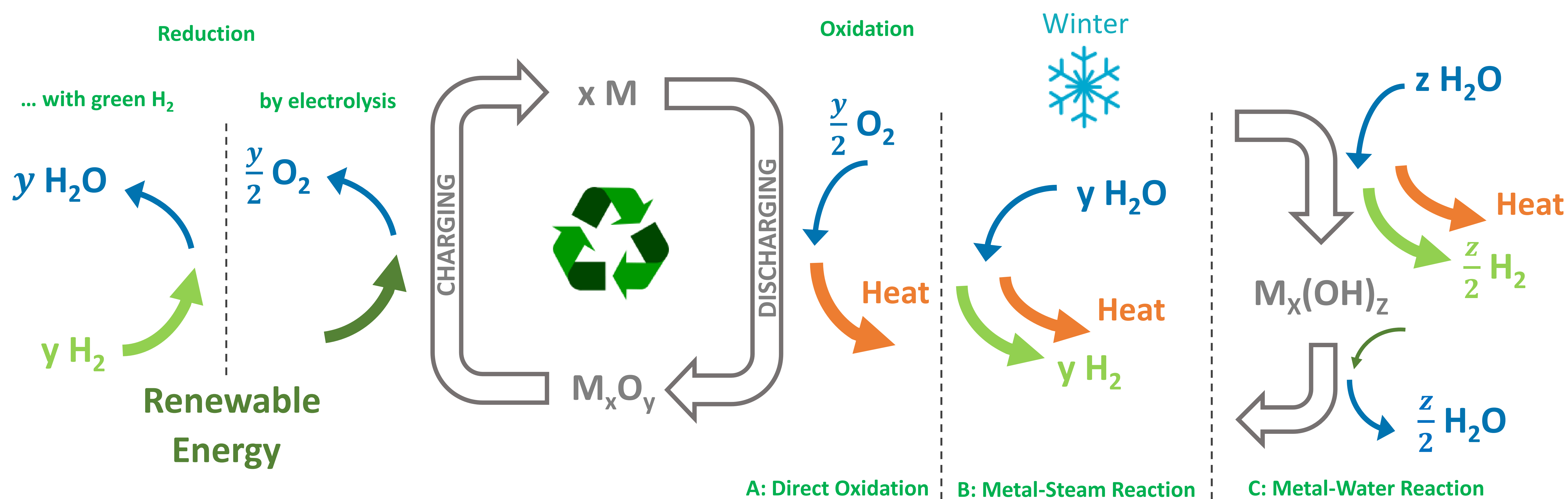


Figure 1: Energy storage cycles based on the reduction and oxidation of bulk metal (M) species

INTRODUCTION TO REMEC

ReMEC – Renewable Metal Energy Carriers - store renewable electricity by reducing metal oxides (charging). The energy is stored chemically in the solid metal, which can be transported over long distances and stored without loss for months. The energy can be released again by oxidation (discharge). For the charging and discharging of the metal (M), different chemical reaction pathways and processes are possible (Fig.1).

Aluminium (Al) and iron (Fe) are considered the most promising candidates due to their high availability and abundance in the earth's crust, low cost, as well as other favourable properties [1,2,3].

OUTSTANDING ENERGY DENSITIES

Aluminium and iron as bulk materials show outstanding energy densities of **23.4 MWh/m³ (Al)** [4] and **16.1 MWh/m³ (Fe)** on a volumetric (solid block) base and 8.7 kWh/kg (Al) and 2.05 kWh/kg (Fe) on a gravimetric base.

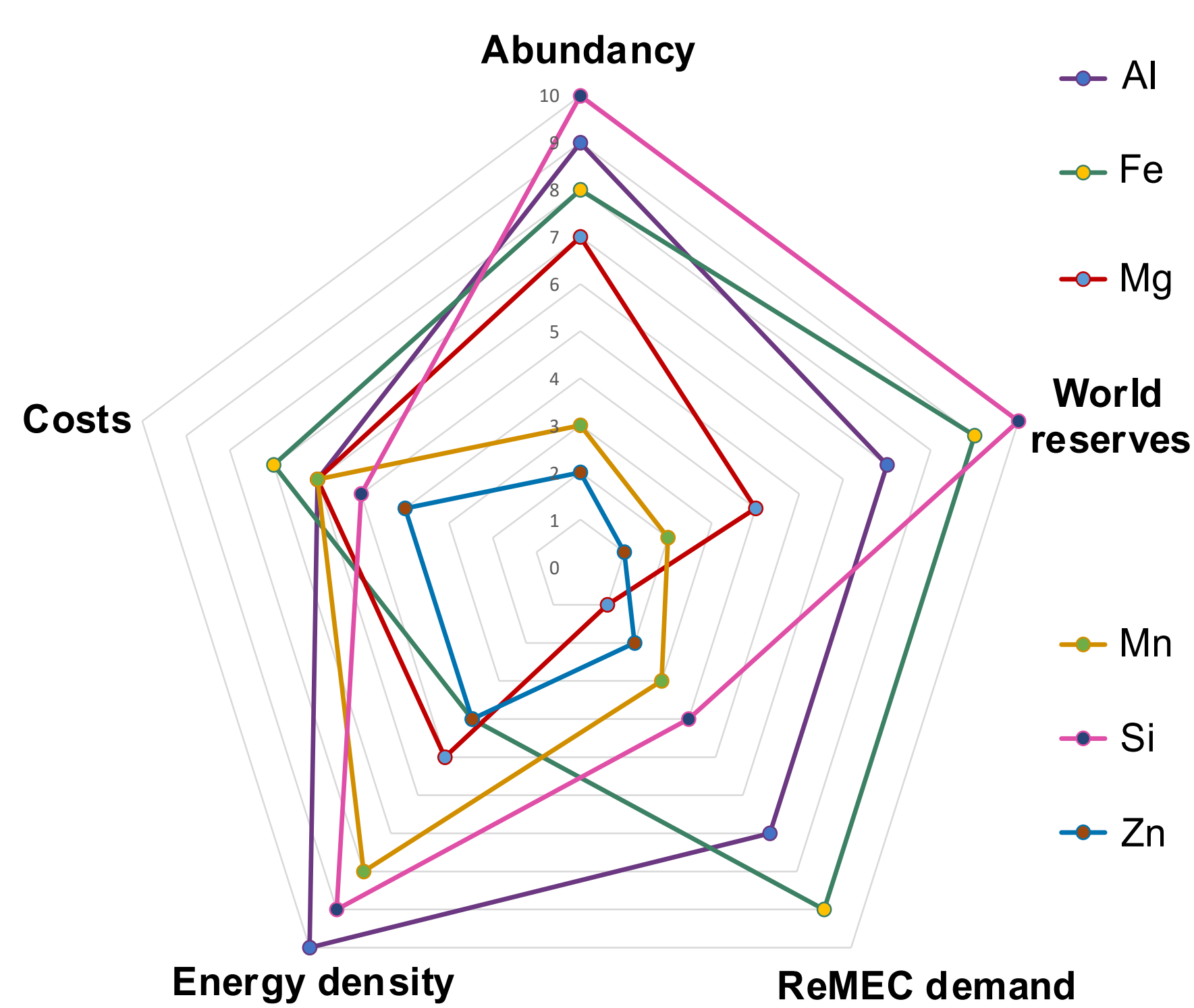


Figure 2: Comparison of metal candidates for ReMEC: 10 = best performance, demand relative to current global production

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HORIZON EUROPE REVEAL-STORGE PROJECT

From renewable electricity to winter energy supply

Within the EU Horizon Europe project REVEAL, aluminium is produced from its oxide by inert anode electrolysis (charging process) [5], then cast into granular form, transported to the point of use and discharged by oxidation with water as an oxidant. Two different paths of discharging have been tested: low-temperature metal water reactions [6] and high temperature metal steam reactions [7]. Detailed analyses of charging, discharging, including also analysis of cost and LCA, are presented in individual contributions to ISEC 2026.

KEY TAKEAWAYS

- **ReMEC energy storage decouples renewable energy production and use in location and time**, enabling renewable energy to be stored where it is generated and delivered where and when it is needed
- Very high energy density, enabling **compact storage and efficient transport** using existing infrastructure
- No need for cryogenic or pressurised storage, **simplifying storage infrastructure**
- **Safe and non-toxic**, in granular form no explosion or fire risks
- **Currently at Technology Readiness Level (TRL) 4** (of 9) at the end of the REVEAL project, requiring further development towards commercial deployment

REFERENCES

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