



A Techno-Economic Evaluation of Metal Powders for Use in Energy Storage Applications

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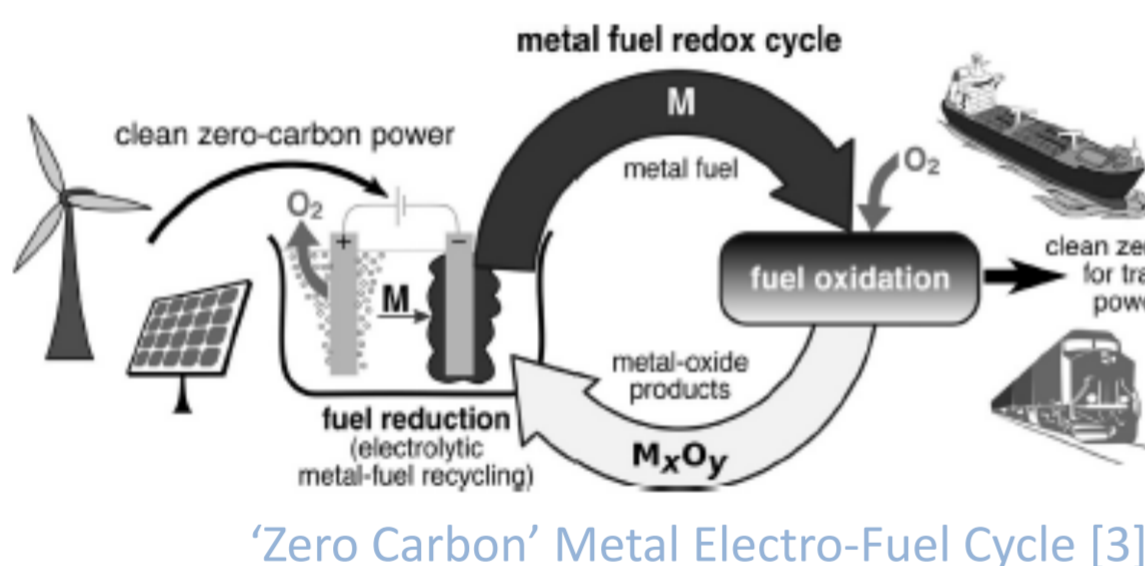
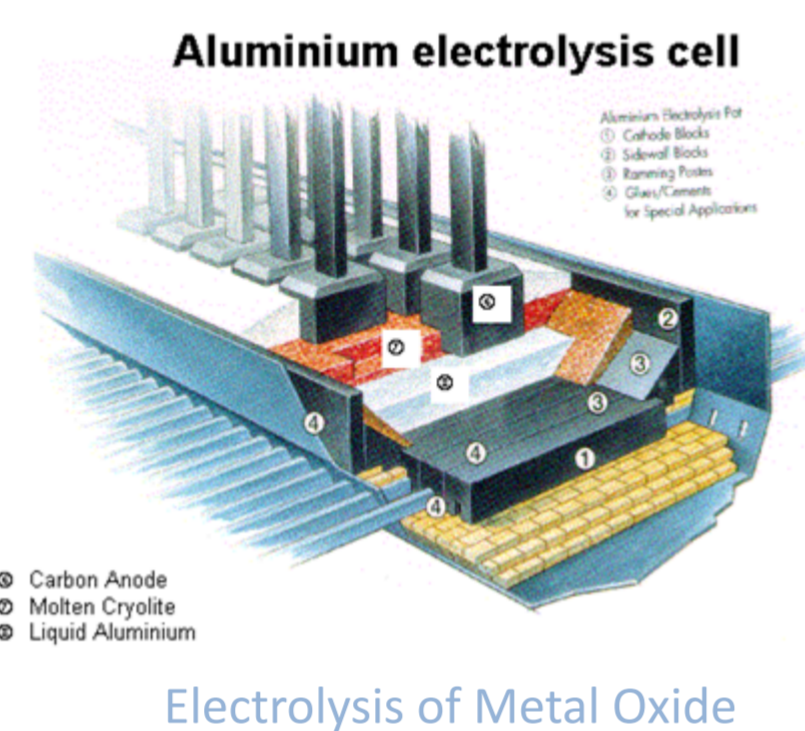
BACKGROUND

An emerging area of interest is the use of metal powders in stationary power generation and industrial heat processes. Their high energy densities provides an avenue to decarbonize the energy sector [1]. This project discusses possible scenarios for its application.

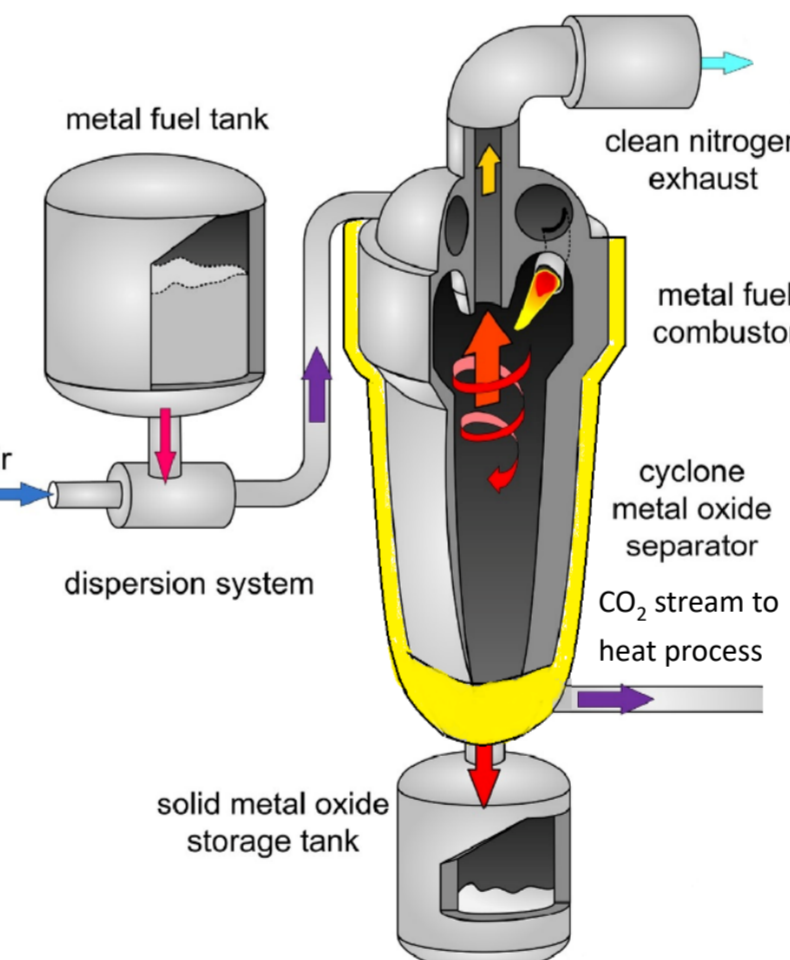
AIM

- Develop and carry out detailed analysis of potential Metal Electro-Fuel cycle scenarios.
- Identify best combination of technologies for implementation.
- Propose a suitable combustion technology for metal powders.

THEORY AND METHODOLOGY



metal-air burner



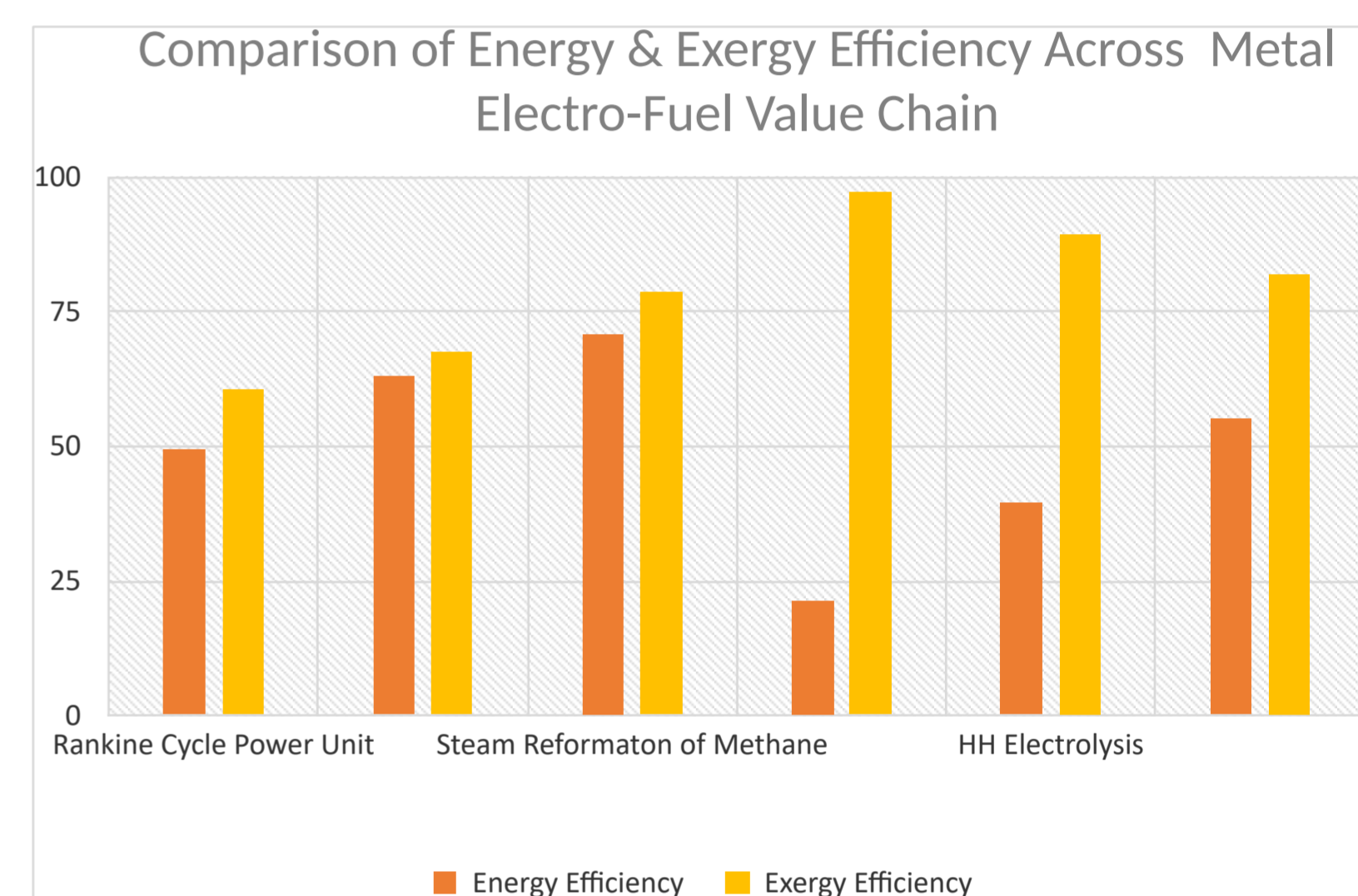
Metal Combustion Unit [2]



CASES CONSIDERED

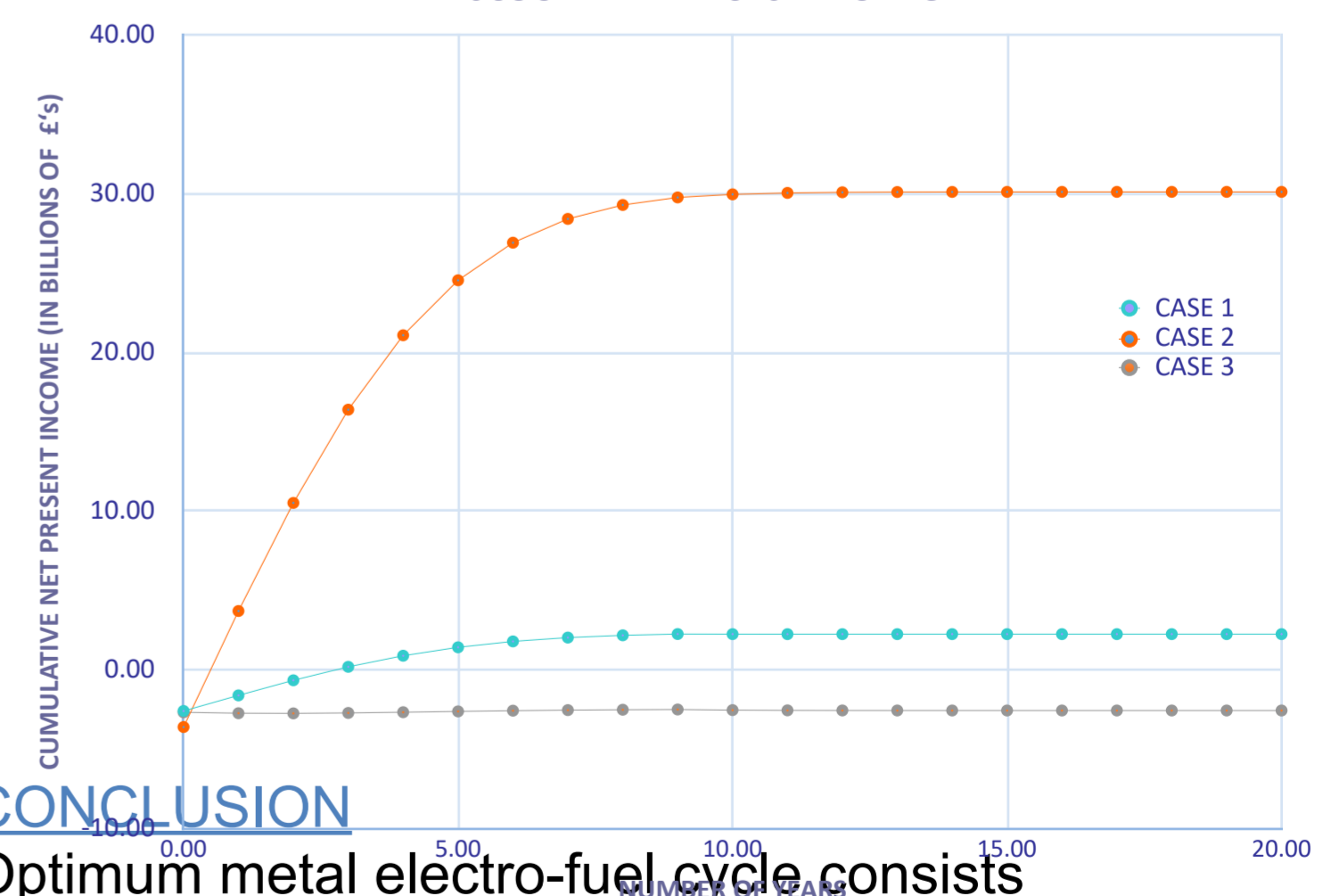
- Case 1: Rankine Steam Generator (RSG) coupled with Carbon Black Production process and Inert Hall-Heroult (IHH) process.
- Case 2: RSG coupled with Steam Reformation of Methane process and IHH process.
- Case 3: RSG coupled with Clinker Manufacture process and IHH process.

RESULTS



	Case 1 (with CBP)		Case 2 (with SRM)		Case 3 (with CnP)	
	Energy Efficiency (%)	Exergy Efficiency (%)	Energy Efficiency (%)	Exergy Efficiency (%)	Energy Efficiency (%)	Exergy Efficiency (%)
Rankine Power Cycle	49.24	60.55	49.24	60.55	49.24	60.55
Heat Process	63.13	67.60	70.89	78.80	21.47	97.03
Electrolytic Process	55.00	82.00	55.00	82.00	55.00	82.00
Total Cycle Efficiency	17.08	33.56	19.20	39.12	5.81	48.18

DISCOUNTED NET CASH FLOW GRAPH



CONCLUSION

Optimum metal electro-fuel cycle consists of a Rankine cycle steam generation unit coupled with a steam reformation of methane process and an Inert Hall-Heroult electrolytic process.

ACKNOWLEDGEMENT

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REFERENCES

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- [2] J. M. Bergthorson, S. Goroshin, M. J. Soo, P. Julien, J. Palecka, D. L. Frost and D. J. Jarvis, *Applied Energy*, no. 160, pp. 368-382, 2015.
- [3] J. M. Bergthorson, *Progress in Energy and Combustion Science*, pp. 169-196, 2018.