‘Novel Scenarios’ on the energy transition for 2024 onwards

J P Sykes[1,2,3,4], *A Trench*[5,6,7,8,9], *T C McCuaig*[10,11], *M Jessell*[12,13,14], *and D Blyth*[15,16]

1. PhD Candidate, Centre for Exploration Targeting (CET), School of Earth Sciences, The University of Western Australia (UWA), Crawley, WA, 6009. Email: john.sykes@uwa.edu.au
2. Lecturer (MBA), Business School, UWA, Crawley, WA, 6009.
3. Strategist, MinEx Consulting, 49 Surrey Road, South Yarra, VIC, 3141.
4. Director, Greenfields Research, Glenewes House, Gate Way Drive, Yeadon, Leeds, West Yorkshire, LS19 7XY, United Kingdom (UK).
5. Professor (MBA Director), Business School, UWA. Email: allan.trench@uwa.edu.au
6. Senior Research Leader (Risk & Value), CET, School of Earth Sciences, UWA.
7. Associate Consultant, CRU, 1st Floor, MidCity Place, 71 High Holborn, London, WC1V 6EA, UK.
8. Director, Emmerson Resources, 3 Kimberley Street, West Leederville, WA, 6007.
9. Advisory Board Member, Wireline Services Group, 24 Sarich Court, Osborne Park, WA, 6017.
10. Head of Geoscience Excellence, BHP, 125 St Georges Terrace, Perth, WA, 6000. Email: cam.mccuaig@bhp.com
11. Adjunct Professor, CET, School of Earth Sciences, UWA.
12. Winthrop Professor, CET, School of Earth Sciences, UWA. Email: mark.jessell@uwa.edu.au
13. Project Manager, West African Exploration Initiative (WAXI), CET, School of Earth Sciences, UWA.
14. Director, Agate Project, Level 5, 105 St Georges Terrace, Perth, WA, 6000.
15. Adjunct Associate Professor (MBA), Business School, UWA.
16. Managing Director, 2nd Horizon, Perth, WA. Email: david@2ndhorizon.com.au

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Theme: Energy Innovations – The interaction between global energy markets and future minerals demand

AUTHOR’S NOTE

This work is based on an update of a draft chapter for my pending PhD thesis. The thesis chapter will mainly focus on the 2016 version of these scenarios, as this was part of the original research programme. This paper will be based on the ongoing 2023-24 update of these scenarios, which has been undertaken for academic and commercial reasons, and to aide the PhD completion.

An early version of this updated 2023-24 work is to be published as an abstract and presentation at the AusIMM Critical Minerals Conference in Perth in November, 2023 (Sykes et al., 2023a, 2023b); however the intention is for the full paper to be published at this AusIMM International Future Mining Conference.

The contemporary and ongoing nature of the work also means that it will likely require some update from the abstract below, based on near-future geopolitical, environmental, and other relevant events. The intention is for the paper to be updated to the submission deadline (~April 2024) and the presentation to be updated to the conference itself (September 2024).

ABSTRACT

The energy transition is underway; however, its nature and its impact on the mining industry and minerals markets remains unclear. Contemporary events including the major re-start of hostilities

between Palestine and Israel and the Russian invasion of Ukraine, natural gas shortages and volatile fossil fuel prices, the USA-China (and China-Australia) trade wars, the Covid-19 pandemic, more notable artificial intelligence (AI) technologies, ESG investing, recent substantive government and private investment in 'green technologies' and the hydrogen economy, and the continued rise of electric vehicle companies, such as Tesla and BYD (China), exemplify the mixed signals emerging from the energy transition. How these mixed signals translate into implications for minerals markets and mining and exploration companies is even less clear.

For the interpretation of the future of complex problems like the energy transition, scenario planning is commonly used by private, public sector, and non-governmental organisations, including many large mining and energy companies. One such example is the Centre for Exploration Targeting 'Future of Mining and Exploration' Scenarios (CET Scenarios). The workshops were run in Perth in 2016 and involved over 60 experts in mining, exploration, and other relevant fields. Since then, work has continued in understanding the implications of the scenarios and updating the scenarios in line with contemporary developments.

One set of scenarios arising from the original CET Scenarios programme were the 'Novel Scenarios' (Sykes and Trench, 2016, 2017, Sykes et al., 2016a, 2017a, 2017b, 2017c, 2017d, Sykes, 2017a, 2017b, 2018) – based on famous books, which included four scenarios covering the progression of the energy transition:

1) **Discworld:** the 'old world' and the fossil fuel economy,
2) **Wardrobe:** a world in transition – in part, the present, and two potential future worlds:
3) **Wonderland:** a successful unified energy transition driven by a collective sense of purpose, international cooperation, the advent of major disruptive technologies, and the commercial and social forces of globalisation, or,
4) **1984:** a partially successful, fragmented energy transition characterised by panic and reaction in different parts of the world, business and society, nationalistic government policy, and competing approaches to the energy transition.

Over the last year, a major update of the 'Novel Scenarios' has been underway. The main effort has involved a contextual scanning exercise covering the last ten years, utilising The Economist's online archive of publications (The Economist, 2023). A 10-year retrospective on the relevant trends in the mining industry was published in the 'Strictly Boardroom' column on MiningNews.net (Sykes and Trench, 2023a, 2023b, 2023c) and an early-stage presentation was made at the AusIMM Critical Minerals Conference (Sykes et al., 2023a, 2023b), both in late 2023.

This paper and presentation will continue the comprehensive update of the 'Novel Scenarios' to help explain the contemporary events described above and their implications for the energy transition, minerals' markets, and the mining and exploration industry. The 'Novel Scenarios' framework (Sykes et al., 2023a, 2023b) will be used to plot the position of key energy transition technologies (renewables, batteries, hydrogen, carbon capture, nuclear power, the circular economy, geoengineering, etc.,) and critical minerals (lithium, rare earths, vanadium, nickel, etc.,) in the energy transition.

The initial conclusions suggest, that whilst the overall 'Novel Scenarios' structure, and the individual scenarios remain the same, there have been some key changes in the relevant position of various energy transition technologies and critical mineral markets in relation to the scenarios (Sykes et al., 2023a, 2023b).

Electric vehicles, and solar and wind energy, along with lithium-ion batteries will be part of the future green economy to some level, though whether they make up the core of the transition technologies alone (aligning with a 'Wonderland' scenario), or just as a part of a broader suite of energy transition technologies (aligning with a '1984' scenario) remains unclear (Sykes et al., 2023a, 2023b). For example, lithium-ion batteries do not currently seem amenable to deployment in large vehicles, shipping, and flight, or in grid levelling and storage (Sykes et al., 2023a, 2023b). Will lithium-ion batteries get better and eventually fulfill these roles ('Wonderland') or will alternative technologies, such as sodium or vanadium batteries, or the 'hydrogen economy' fulfill these roles ('1984')?

Indeed, the variety of alternative technology options has once again opened up ('1984'), not just with new technologies, such as sodium-ion batteries, but also the re-emergence of some ideas, such as hydrogen and nuclear power, which previously seemed to have been left behind (in the 'Old World' or 'Discworld').

The answers for the mining industry and critical minerals markets are similarly unclear (Sykes et al., 2023a, 2023b). Lithium looks likely to be important, but to what 'transformational' order of magnitude remains is not known (Sykes et al., 2015a, 2015b, 2016b). Whether the energy transition will be dominated just by a major increase in lithium battery metals (e.g., lithium, nickel, cobalt, and manganese) demand, or whether other technologies will cause substantive demand increases in other minerals markets is a key question for mineral economists.

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