Supplementary Information for:

Synthetic Biology for Sustainable Abundance: Biomining, Electromicrobial Production, and Hyper-Engineerable Microbes

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Supplementary Information Notes

Note S1. Total CO_2 addition to the atmosphere since the start of the Industrial Revolution.

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Note S1. Ratio Between Power Use of Civilization and Earth's Biosphere

The most recent estimate of power use by human civilization is 592.22 exajoules (EJ) in 2024 [EnergyInst2025a], corresponding to an instantaneous average power consumption of 18.80 terawatts (TW). This corresponds to an increase of almost 12% from 529.47 EJ per year or 16.79 TW since the last time we examined this issue in 2016 [Adesina2017a]. This corresponds to an average annual growth rate of 1.4%. In contrast, the total power use of the biosphere is ≈ 130 TW [Steger2005a]. Thus, the biosphere channels ≈ 7× as much power as is used by human civilization.

Supplementary Information References

[Adesina2017a] O. Adesina *et al.*, "Embracing Biological Solutions to the Sustainable Energy Challenge", *Chem* 2(1): 20-51 (2017). doi:10.1016/j.chempr.2016.12.009

[EnergyInst2025a] Statistical Review of World Energy, 74th Edition, Energy Institute (2025).

[Steger2005a] U. Steger *et al.*, "Sustainable Development and Innovation in the Energy Sector", Heidelberg, Springer (2005).