Anexo I. Registro del Título del Trabajo Fin de Grado (TFG)

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Título provisional del TFG:

"Artificial intelligence in the service of the common good and cooperation. Study of business models." Environmental Impact of AI-Driven Business Models

ADJUNTAR PROPUESTA (máximo 4 páginas: Índice provisional, objetivos, metodología y bibliografía)

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Thesis Introduction -"Environmental Impact of AI-Driven Business Models"

The goal of this paper is to assess how AI-driven business models can reduce their environmental footprint while exploring AI's sustainability potential. By researching and reviewing a number of different current strategies that companies use the paper aims to increase awareness and understanding regarding the sustainable use of AI in businesses. By highlighting and analysing the different current strategies the paper may encourage other companies to follow suit and adopt the sustainable strategies themselves. This paper will focus on some of the biggest environmental problems that comes with the use of AI and suggest sustainable strategies on how companies can decrease their energy consumption of AI systems, how they can source critical minerals in a more environmentally friendly way and how they can decrease their e-waste.

AI is revolutionising business models across all industries, from optimising operations to driving innovation. Artificial intelligence (AI) based techniques can help reduce emissions in a variety of ways, like as facilitating the development of low-carbon technologies, improving sales forecasts, limiting system waste, satellite imagery, improving energy efficiency, predicting vehicle emissions from smartphone GPS traces, boosting single buildings, highlighting behavioural patterns, and planning and running low-carbon infrastructure (ScienceDirect, 2022).

However, AI's role in sustainability is not all positive. The energy consumption of AI systems is a prime example of the negative effect AI has on the environment. Although AI is a promising and powerful technology for sustainability, its application creates a huge carbon footprint, which represents a direct form of rebound effects. A single AI model training can emit carbon dioxide equivalent to the lifetime of five cars and a request made through ChatGPT, an AI-based virtual assistant, consumes 10 times the electricity of a Google Search (‘Electricity 2024 - Analysis and forecast to 2026’, 2024). This is assuming that the energy source remains the same and as AI grows and becomes more complex it is highly likely that more energy will be used meaning their carbon footprint will grow more and more. AI models strongly depend on data and thus indirectly contribute to IT's global carbon footprint. AI models can spur huge energy-consuming datasets and big data centres. (Nishant, Kennedy and Corbett, 2020)

The energy consumption of AI systems is only the start of the environmental issues regarding AI. The hardware used to create and power AI for example Data Centres, GPUs and servers all require

critical minerals like cobalt and lithium. However, their supply is in jeopardy – they have complex, volatile and opaque supply chains that are already at capacity (*Deloitte US*, no date). These minerals are also sourced through environmentally and socially harmful mining practices. Several studies (*Worlanyo and Jiangfeng*, 2021) conducted on the impact of mining have pointed out that both surface mining and underground mining have caused substantial adverse impact on the environment as well as land. The microchips that power AI need rare earth elements, are often mined in environmentally destructive ways (WEF, 2024).

E-Waste and AI- Driven hardware is another environmental problem regarding AI. Data centres produce electronic waste, which often contains hazardous substances, like mercury and (WEF, 2024) AI infrastructure also has short hardware cycles, which means companies must constantly update and replace their old systems. For example, the creation of new data centres and the upgrading of systems. The proliferating data centres that house AI servers produce electronic waste. They are large consumers of water, which is becoming scarce in many places (WEF, 2024).

"There is still much we don't know about the environmental impact of AI but some of the data we do have is concerning," said Golestan (Sally) Radwan, the Chief Digital Officer of the United Nations Environment Programme" (WEF, 2024).

This paper seeks to is present the challenges faced by companies regarding the environmental impact of AI-driven business models. It will examine how these companies can address these challenges and promote sustainable practices. The positives of AI regarding sustainability are well documented and it seems that most of the focus around AI and sustainability is based on the enthusiasm surrounding AI's potential to drive sustainability such as how it helps reduce waste and improve energy efficiency. However, there is a significant gap in research and literature on the negative impacts of AI on sustainability. As previously mentioned, AI has many negative effects environmentally and there has not been nearly enough attention on the environmental costs of AI for example energy consumption and E-Waste. These negative environmental effects can be observed across all aspects of AI, from the huge energy-consuming datasets and big data centres to the short hardware cycles and e-waste, these problems are not given enough attention.

The aim of this study is to explore ways in which companies can reduce their environmental footprint by integrating AI while simultaneously identifying key challenges and opportunities to minimise negative environmental effects. This will help show that the negative environmental impacts are as important if not more important than the positive ones and in turn will offer insights that businesses could consider using and adapting in the future.

In order to explore how AI-driven business models can reduce their environmental footprint while exploring AI's sustainability potential this study will adopt a mix of both quantitative and qualitative approaches. The research methodology will include literature reviews of existing research on AI's environmental impact, case studies on companies who are leading in sustainable AI practices, conducting surveys on those companies and analysing their sustainability reports.

Bibliography:

A circular economy for critical minerals is fundamental for our future | Deloitte US (no date). Available at: https://www2.deloitte.com/us/en/pages/energy-and-resources/articles/circular-economy-critical-minerals-fundamental-our-future.html (Accessed: 22 October 2024).

AI has an environmental problem. Here's what the world can do about that. (no date a). Available at: https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about (Accessed: 22 October 2024).

AI has an environmental problem. Here's what the world can do about that. (no date b). Available at: https://www.unep.org/news-and-stories/story/ai-has-environmental-problem-heres-what-world-can-do-about (Accessed: 22 October 2024).

Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review - ScienceDirect (no date). Available at: https://www.sciencedirect.com/science/article/pii/S0148296320305191 (Accessed: 22 October 2024).

Broadening the perspective for sustainable artificial intelligence: sustainability criteria and indicators for Artificial Intelligence systems - ScienceDirect (no date). Available at: https://www.sciencedirect.com/science/article/pii/S1877343523001586 (Accessed: 22 October 2024).

Climate change and COP26: Are digital technologies and information management part of the problem or the solution? An editorial reflection and call to action - ScienceDirect (no date). Available at: https://www.sciencedirect.com/science/article/pii/S0268401221001493 (Accessed: 22 October 2024).

Data centers and AI: How the energy sector can meet power demand | McKinsey (no date). Available at: https://www.mckinsey.com/industries/private-capital/our-insights/how-data-centers-and-the-energy-sector-can-sate-ais-hunger-for-power (Accessed: 22 October 2024).

'Electricity 2024 - Analysis and forecast to 2026' (2024).

Evaluating the environmental and economic impact of mining for post-mined land restoration and land-use: A review - ScienceDirect (no date). Available at: https://www.sciencedirect.com/science/article/pii/S0301479720315486 (Accessed: 22 October 2024).

Kar, A.K., Choudhary, S.K. and Singh, V.K. (2022) 'How can artificial intelligence impact sustainability: A systematic literature review', *Journal of Cleaner Production*, 376, p. 134120. Available at: https://doi.org/10.1016/j.jclepro.2022.134120.

Mensah: Environmental impacts of mining: a study... - Google Scholar (no date). Available at: https://scholar.google.com/scholar_lookup?title=Environmental%20impacts%20of%20mining%3A%20a%20study%20of%20mining%20communities%20in%20Ghana&publication_year=2015&author=A.K.%20Mensah&author=I.O.%20Mahiri&author=O.%20Owusu&author=O.D.%20Mireku&author=i.%20Wireku&author=E.A.%20Kissi (Accessed: 22 October 2024).

Nishant, R., Kennedy, M. and Corbett, J. (2020) 'Artificial intelligence for sustainability: Challenges, opportunities, and a research agenda', *International Journal of Information Management*, 53, p. 102104. Available at: https://doi.org/10.1016/j.ijinfomgt.2020.102104.

People and Post-Mining Environments: PPGIS Mapping of Landscape Values, Knowledge Needs, and

Future Perspectives in Northern Finland (no date). Available at: https://www.mdpi.com/2073-445X/7/4/151 (Accessed: 22 October 2024).

Programme, U.N.E. (2024) *Artificial Intelligence (AI) end-to-end: The Environmental Impact of the Full AI Lifecycle Needs to be Comprehensively Assessed - Issue Note*. Available at: https://wedocs.unep.org/xmlui/handle/20.500.11822/46288 (Accessed: 22 October 2024).

Sheoran, V., Sheoran, A.S. and Poonia, P. (2010) 'Soil Reclamation of Abandoned Mine Land by Revegetation: A Review'. Available at: https://hdl.handle.net/20.500.14394/30708 (Accessed: 22 October 2024).

Training a single AI model can emit as much carbon as five cars in their lifetimes (no date) *MIT Technology Review*. Available at: https://www.technologyreview.com/2019/06/06/239031/training-a-single-ai-model-can-emit-as-much-carbon-as-five-cars-in-their-lifetimes/ (Accessed: 22 October 2024).

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