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AI and Sustainability
A Difficult Ethical Conundrum

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Who am I?

MA Theology and Religious Studies & Philosophy (KU Leuven 2013, 2015)
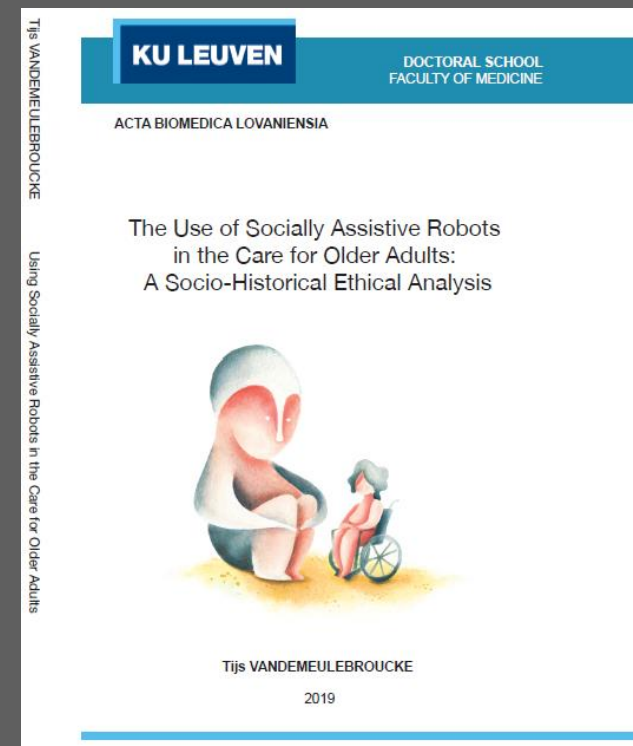
Ph.D. in Biomedical Sciences (KU Leuven, 2019)

Post-doc research (Sustainable AI Lab, University of Bonn, Germany)

- Prof. dr. Aimee van Wynsberghe
- "A Global Care-Ethical Approach to Sustainable AI in Healthcare"

The Bonn Sustainable AI Lab

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Outline

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Disruptive evolutions: The natural crises and AI

AI and sustainability

• AI for sustainability

• The sustainability of AI

Where to go from here?

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Disruptive evolutions
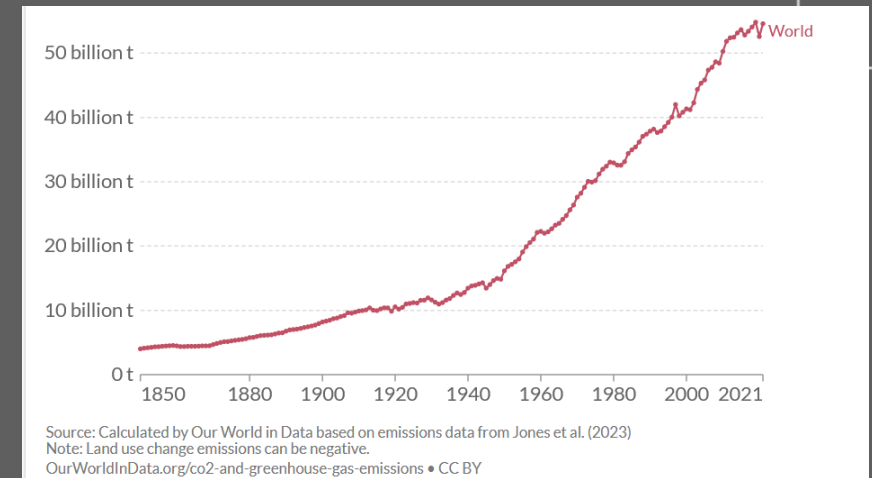
The natural crises and AI

Disruptive evolutions

Climate crisis

- Increasing greenhouse gasses emissions (CO2, methane, fluorocarbons, …)
  - Increase slows down but remains (Emissions Gap Report 2022)
    - Worldwide emissions increased by almost 50% since 1990
  - Climate disturbances
    - Changing temperatures, changing weather patterns, growing sea levels, increasing acidity of the sea, loss of land and biodiversity,…

Source: Calculated by Our World in Data based on emissions data from Jones et al. (2023)
Note: Land use change emissions can be negative.
OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

Disruptive evolutions

Biodiversity crisis

- Past 50 years 69% of biodiversity reduced (Living Planet Report 2022)
  - Of 150,388 (evaluated) species, **42,108 threatened** with extinction (IUCN Red List 2022)
  - 41% of amphibian species; 13% of bird species; 27% of mammals; 21% of reptiles…
  - 2,345 species of insects (of 12,441 evaluated)
  - 253 species of corals (of 831 evaluated)

- **5 million hectares** of forest is lost every year (> of the Netherlands) (Our World in Data 2022)
  - **95% of deforstation** occurs in the tropics
  - From **909 (1996) to 5,336 (2022)** of species of plants critically endangered (IUCN Red List 2022)

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Disruptive evolutions

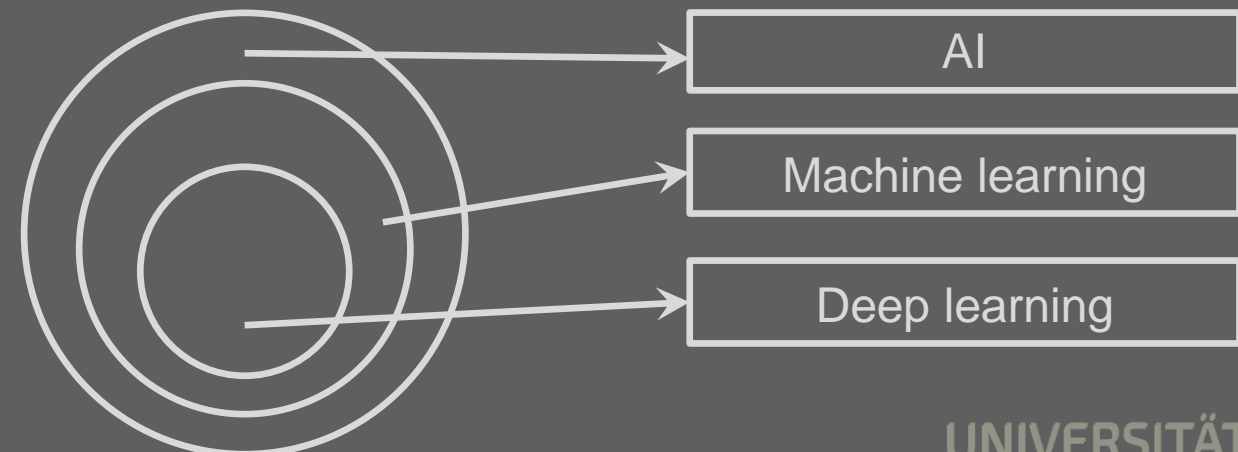## Artificial intelligence…

"[… being] defined as the ability of machines to mimic and perform human[/animal-like] cognitive functions. These include reasoning, learning, problem-solving, decision-making, and even the attempt to match elements of human behavior such as creativity." (Brevini 2021, p. 35)

Narrow AI – General AI

Automated statistical analysis, data analysis, pattern analysis,…

| AI |
| Machine learning |
| Deep learning |

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Disruptive evolutions

The conundrum of technology

*"[We need] to become capable – and urgently so – of **facing the many new and unprecedented technological and ecological challenges that the Anthropocenic and thoroughly 'Earthbound' condition will present to a planetized humanity that is threatened by its own technology yet destined to start remedying this situation through this very same technology**, by explicitly taking care of its increasingly instable, unreliable and precarious earthly habitat (Blok 2015). As such, [we need] to develop an understanding of, on the one hand, what it means for technology having to become more "earthly" (Blok 2017) and, on the other, for the Earth to become increasingly technological (Blok 2014)."*

(Lemmens, P, Blok, V & Zwier, J. (2017). Toward a Terrestrial Turn in Philosophy of Technology. Guest Editor's introduction. Techné: Research in Philosophy and Technology 21(2-3), 114-126. DOI: 10.5840/techne2017212/363. Words between brackets are my own modifications)

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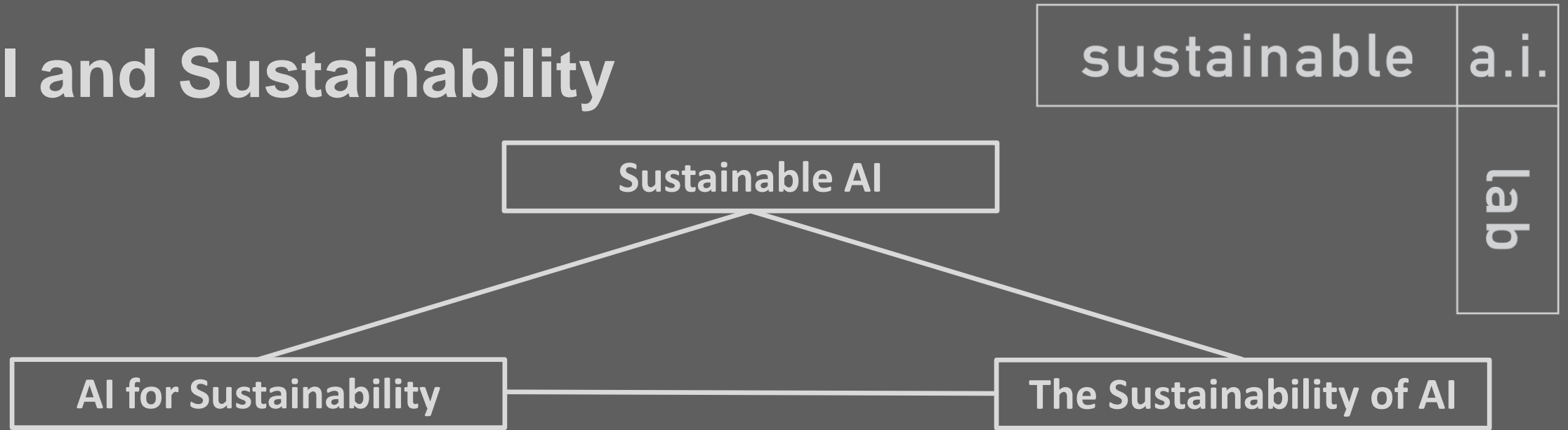
AI for Sustainability & the Sustainability of AI

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Sustainability

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Our Common Future, p. 41)

3-pillar model: **ecological**, economic, and social sustainability

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AI for Sustainability

AI as an isolated tool to combat crises? → Prediction, mitigation, adaptation

- AI for efficiency gains while keeping standard of living

- AI for combatting climate change effects

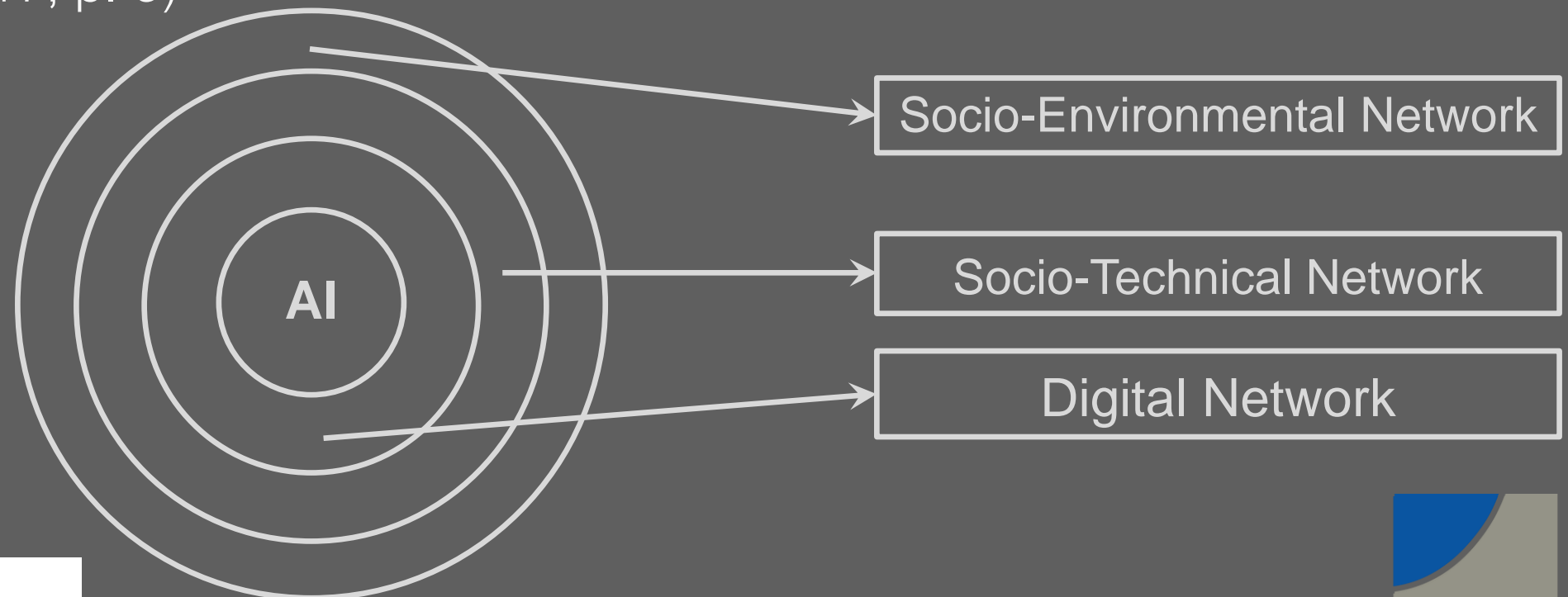- AI for assessing policy for climate change

- …

Sustainability of AI

AI as an isolated individual technological object → AI as world object

"[…] objects that affect the world as whole, and not just a small corner of it"
(Feenberg, 2017, p. 5)

AI

Socio-Environmental Network

Socio-Technical Network

Digital Network

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Sergio Souza – https://www.pexels.com/nl-nl/foto/water-vuil-rotsen-abstract-6798013

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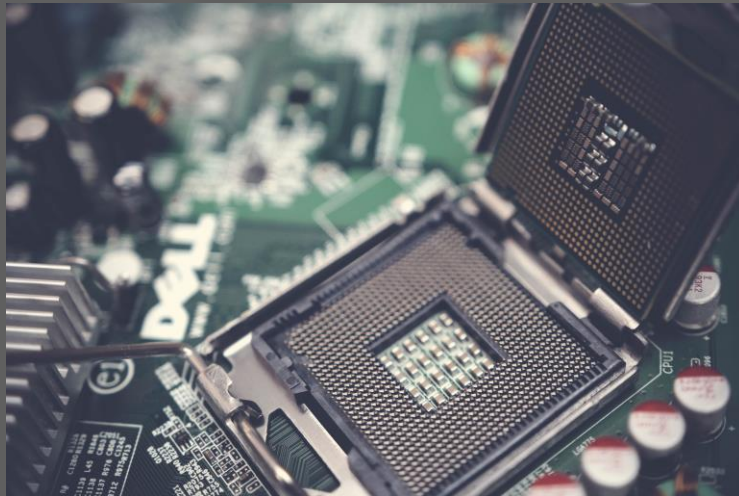
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Cottonbro Studio - https://www.pexels.com/nl-nl/foto/abstract-kleur-repareren-reparatie-4480541/

Manuel Geissinger – https://www.pexels.com/photo/black-server-racks-on-a-room-325229/

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Digital Network

Pixabay – https://www.pexels.com/photo/water-drop-40784/

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Where to go from here?

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Where to go from here?

Sustainability of AI

- Raising awareness about AI use and AI as "world object"

- Momentum in both climate/biodiversity and AI policy (e.g. EU AI Act)

- Accountability and transparency of big-tech/developers

- Avoid obsolescence of AI-technology

- AI-Need – AI-wish

AI for Sustainability

- Data acquisition → privacy, centralization of power,…

- Education

- …

Thank you!

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References – Literature

- Belton, P. (2021). The Computer Chip Industry has a Dirty Climate Secret. *The Guardian* 2021. Retrieved from https://www.theguardian.com/environment/2021/sep/18/semiconductor-silicon-chips-carbon-footprint-climate (Accessed 4th of June 2023).

- Bolger, M., Marin, D., Tofighi-Niaki, A. & Seelman, L. (2021). *'Green mining' is a Myth: The Case for Cutting EU Resource Consumption*. Brussels: European Environmental Bureau & Friends of the Earth Europe. Retrieved from https://eeb.org/wp-content/uploads/2021/10/Green-mining-report_EEB-FoEE-2021.pdf (Accessed on 4th of June 2023)

- Bolte, L., Vandemeulebroucke, T. & van Wynsberghe, A. (2022). From an Ethics of Carefulness to and Ethics of Desirability: Going Beyond Current Ethics Approaches to Sustainable AI. *Sustainability* 14, 3922. DOI: 10.3390/su14084472.

- Brevini, B. (2022). *Is AI Good for the Planet?* Cambridge: Polity.

- Coeckelbergh, M. (2021). AI for Climate: Freedom, Justice, and Other Ethical and Political Challenges. AI and Ethics 1, 67-72. DOI: 10.1007/s43681-020-00007-2.

- Cowls, J., Tsamados, A., Taddeo, M. & Floridi, L. (2021). The AI Gambit: Leveraging Artificial Intelligence to Combat Climate Change – Opportunities, Challenges, and Recommendations. *AI & Society.* DOI: 10.1007/s00146-021-01294-x.

- Feenberg, A. (2017). *Technosystem: The Social Life of Reason*. Cambridge, MA; London: Harvard University Press.

- IUCN (2022). *The IUCN Red List of Threatened Species. Version 2022-2*. Retrieved from https://nc.iucnredlist.org/redlist/content/attachment_files/2022-2_RL_Stats_Table_1a.pdf (Accessed 4th of June 2023).

- Li, P., Yang, J., Islam, M. A. & Ren, S. (2023). Making AI Less "Thirsty": Uncovering and Adressing the Secret Water Footprint of AI Models. Retrieved from https://arxiv.org/pdf/2304.03271.pdf (Accessed 4th of June 2023).

- Marks P. (2014). Blood Minerals are Electronics Industry's Dirty Secret. New Scientist, 11 June 2014. Retrieved from https://www.newscientist.com/article/mg22229734-800-blood-minerals-are-electronics-industrys-dirty-secret/ (Accessed on 4th of June 2023).

- Mytton, D. (2021). Data Centre Water Consumption. *Npj Clean Water* 4(11). DOI: 10.1038/s41545-021-00101-w.

References – Literature

- Navas, G., D'Alisa, G. & Martínez-Alier, J. (2022). The Role of Working-Class Communities and The Slow Violence of Toxic Pollution in Environmental Health Conflicts: A Global Perspective. *Global Environmental Change* 73(1). DOI: 10.1016/j.gloenvcha.2022.102474.

- Nordgren, A. (2022). Artificial Intelligence and Climate Change: Ethical Issues. *Journal of Information, Communication and Ethics in Society* 21(1), 1-15. DOI: 10.1108/JICES-11-2021-0106.

- Ritchie, H. & Roser, M. (2021). *Forests and Deforestation*. Retrieved from: 'https://ourworldindata.org/forests-and-deforestation' (Accessed 4th of June 2023).

- Ritchie, H., Roser, M. & Rosado, P. (2020) - "CO_2 and Greenhouse Gas Emissions". Published online at OurWorldInData.org. 'https://ourworldindata.org/co2-and-greenhouse-gas-emissions' (Accessed 4th of June 2023).

- Strubell, E., Ganesh, A. & McCallum, A. (2019). Energy and Policy Consideration for Deep Learning in NLP. In Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (ACL), Florence, Italy, 28 July – 2 August 2019. Retrieved from https://arxiv.org/abs/1906.02243 (Accessed on 4th of June 2023).

- United Nations Environment Programme (2022). *Emissions Gap Report 2022: The Closing Window – Climate Crisis calls for Rapid Transformation of Societies.* Nairobe: United Nations. Retrieved from https://www.unep.org/emissions-gap-report-2022 (Accessed 4th of June 2023).

- Van Wynsberghe, A., Vandemeulebroucke, T., Bolte, L. & Nachid, J. (eds.) (2023). *Towards the Sustainability of AI. Multi-Disciplinary Approaches to Investigate the Hidden Costs of AI.* Basel: MDPI.

- Van Wynsberghe, A. (2021). Sustainable AI: AI *for* Sustainability and the Sustainability *of* AI. *AI and Ethics* 1, 213-218. DOI: 10.1007/s43681-021-00043-6,

- World Health Organization (WHO) (2021). Children and Digital Dumpsites: E-waste Exposure and Child Health. Geneva: World Health Organization.

- World Wildlife Fund (WWF) (2022). *Living Planet Report 2022*. Retrieved from https://livingplanet.panda.org/ (Accessed 4th of June 2023).

- World Commission on Environment and Development (1987). Our *Common Future*. Oxford: Oxford University Press.

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References – Images

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Slide 6 – OurWorldinData, Ritchie, H. & Roser ,M.(2020) | Greenhouse gas emissions graph – https://ourworldindata.org/greenhouse-gas-emissions (Accessed 4th of June 2023).

Slide 14 – Vlad Chetan | Mining Excavation On A Mountain – https://www.pexels.com/photo/mining-excavation-on-a-mountain-2892618/ (Accessed 6th of June 2023).

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