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ETHICS AND GOVERNANCE OF ARTIFICIAL INTELLIGENCE

MASTER 1 SCIENCE DE DONNÉES ET INTELLIGENCE ARTIFICIELLE (SDIA)

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2023-2024

LESSON 9 : ENERGY CONSUMPTION AND SUSTAINABILITY

AI, A POWER-HUNGRY TECHNOLOGY

- AI is a rapidly growing technology, with a wide range of applications, including facial recognition, recommendation, prediction, and translation. However, AI is also a power-hungry technology.

THE ENVIRONMENTAL IMPACT OF AI

- AI's energy consumption is due to a number of factors, including:
  - Training AI models
  - Running AI applications
  - Cooling data centers

- According to a study by Stanford University, AI could account for up to 10% of global energy consumption by 2030. The study also estimated that AI could be responsible for 0.3 to 0.7% of global greenhouse gas emissions.

# REDUCING THE ENVIRONMENTAL IMPACT OF AI

- There are a number of strategies that can be implemented to reduce the environmental impact of AI, including:
  - Using efficient machine learning techniques
  - Using more efficient computing infrastructures
  - Improving the energy efficiency of AI devices and systems
- These strategies can help make AI more sustainable and environmentally friendly.

THE ETHICAL IMPLICATIONS OF AI'S ENVIRONMENTAL IMPACT

- The environmental impact of AI has a number of ethical implications.

- For example, if AI is responsible for a significant increase in greenhouse gas emissions, this could exacerbate climate change and have a negative impact on the environment and vulnerable populations.

Energy Demand (TWH) vs Percent of Global Electricity (%), 2010–2050
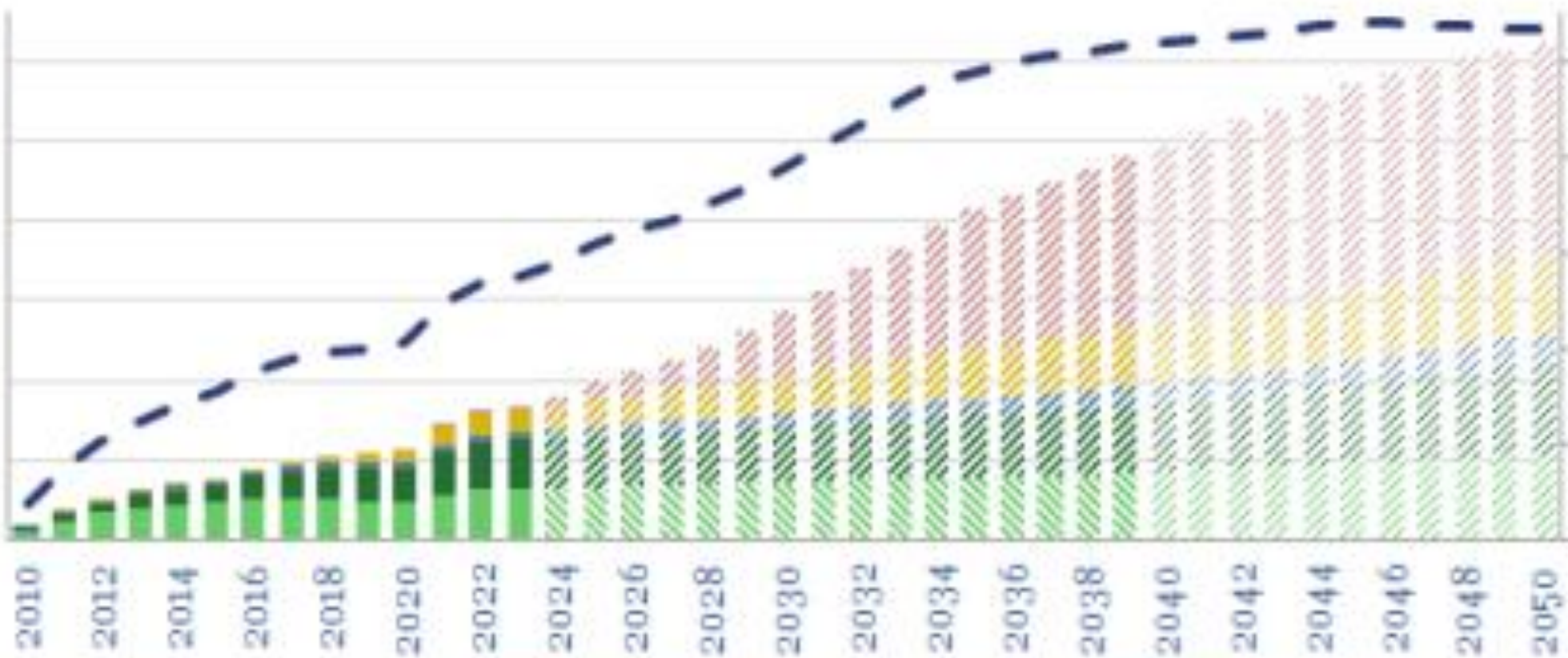
Legend: Data Centers | Transmission | Networking | Blockchains | AI | Percent of Global Electricity

Fig. A | Annual number of AI publications by AI cluster

Number of publications (y-axis): 0, 20k, 40k, 60k, 80k, 100k, 120k
Years (x-axis): 2000, 2005, 2010, 2015

AI cluster
- Planning and Decision making
- Computer Vision
- Fuzzy systems
- Machine Learning and Probabilistic Reasoning
- Neural networks
- Search and Optimization
- NLP and Knowledge Representation
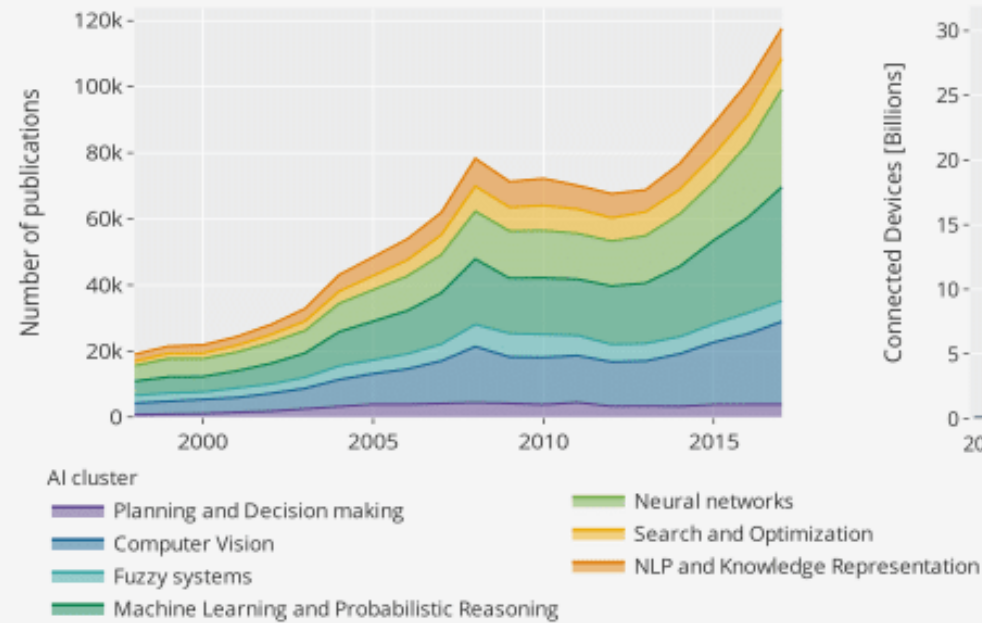
Fig. B | Forecast for the annual stock of connected devices

Connected Devices [Billions] (y-axis): 0, 5, 10, 15, 20, 25, 30
Years (x-axis): 2010, 2015, 2020, 2025, 2030
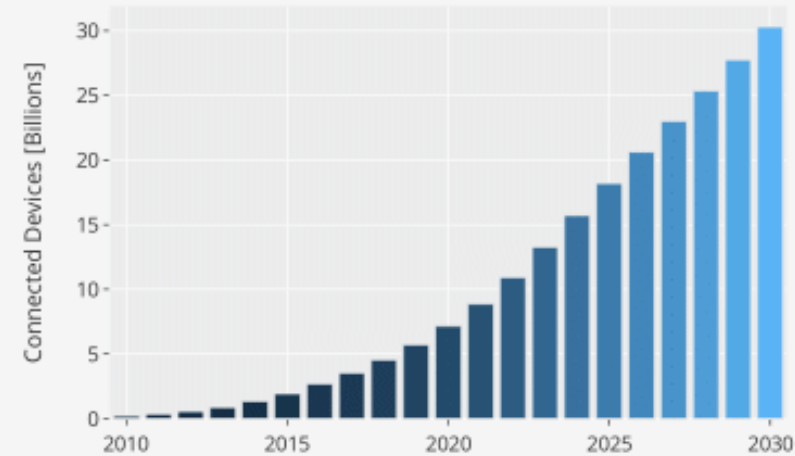
Fig. C | AI Strategies and Policies (EU)

2021 – Proposal for European legal framework for AI to address fundamental rights and safety risks specific to the AI applications

2022 – EU AI Act could enter into force in a transition period

2024 – earliest time the regulation could become applicable to operators with the standards ready and the first conformity assessments carried out

Fig. D | General uses of AI in the energy sector

AI in Energy
- Grid operation & optimisation
- Planning & renewable energy integration
- Virtual power plants & fault detection
- Energy demand management & distribution
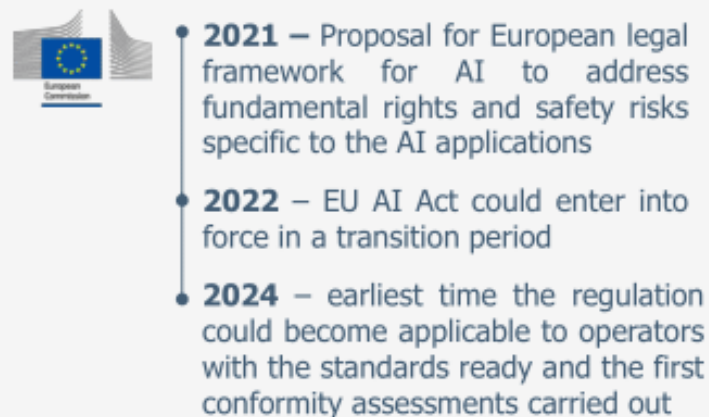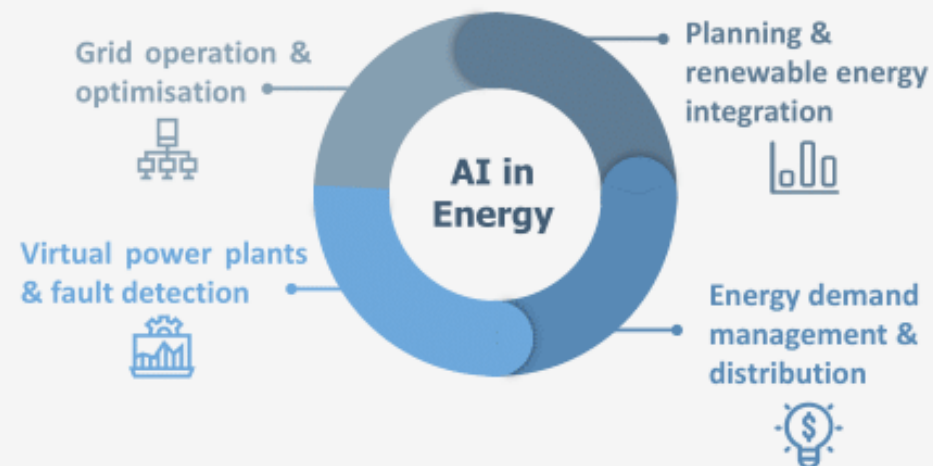
Data sources
A – Scopus and Elsevier, 2018.
B – EDNA Total Energy Model, 2020.
Policies – European Commission digital strategy, 2021.

THE CHALLENGES OF MAKING AI MORE SUSTAINABLE

- There are a number of challenges to making AI more sustainable.

- efficient machine learning techniques can be more complex and difficult to develop.

- using more efficient computing infrastructures can be costly.
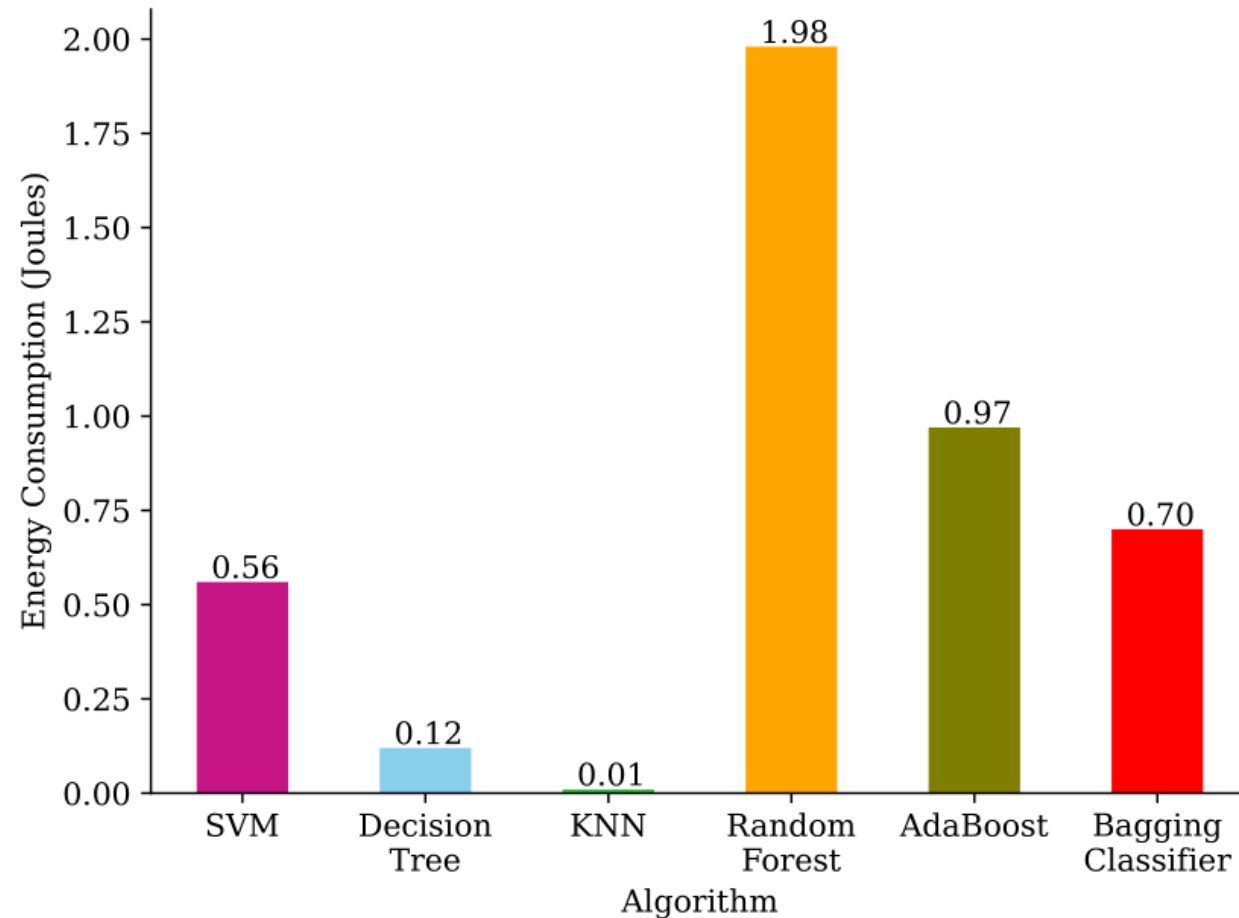
THE OPPORTUNITIES FOR AI TO SUPPORT A SUSTAINABLE TRANSITION

- AI can also be used to support a sustainable transition.

- For example, AI can be used to optimize the energy efficiency of buildings and transportation.

- Additionally, AI can be used to develop new green technologies, such as renewable energy.

TRAINING AI MODELS

The training of AI models is a computationally intensive process that can require a significant amount of energy.

- **Training a facial recognition model can require up to 100,000 GPUs running for several weeks.**

RUNNING AI APPLICATIONS

- AI applications can also be energy-intensive.

- For example, self-driving cars require a significant amount of power to run their sensors, cameras, and other systems.

- **A self-driving car can consume up to 20% more energy than a traditional car due to the power required to power its AI systems.**

COOLING DATA CENTERS

- Data centers that host AI systems require a lot of energy to cool their servers,

- **Data centers that host AI systems represent about 2% of global energy consumption.**

REFERENCES

o Eva García-Martín, Crefeda Faviola Rodrigues, Graham Riley, Håkan Grahn, Estimation of energy consumption in machine learning, Journal of Parallel and Distributed Computing, Volume 134, 2019, Pages 75-88, ISSN 0743-7315, https://doi.org/10.1016/j.jpdc.2019.07.007.