Aligning AI with climate change mitigation

Lynn Kaack
Assistant Professor, Hertie School
Co-founder and Chair, Climate Change AI

The green transition and artificial intelligence – friend or foe?

SPIEGEL International

Artificial Intelligence

How High-Tech Tools Are Helping C Climate Change

AI is helping researchers, urban planners, activists and even companies the climate. Algorithms can be used to detect forest destruction, reduc even eavesdrop on animals in the ocean.

By So
01.09

Künstliche Intelligenz

Klimahelfer oder Klimasünder?

Künstliche Intelligenz könnte viele Branchen effizienter machen. Doch dafür benötigt sie viele Daten und somit viel Energie. Schadet KI vielleicht mehr, als sie hilft?

Von Eike K

13. Juli 2022, 18

Artikel höre

MIT Technology Review

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ARTIFICIAL INTELLIGENCE

Training a single AI model can emi carbon as five cars in their lifetime

Deep learning has a terrible carbon footprint.

By Karen Hao June 6, 2019

MIT Technology Review

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ARTIFICIAL INTELLIGENCE

We're getting a better idea of AI's true carbon footprint

AI startup Hugging Face has undertaken the tech sector's first attempt to estimate the broader carbon footprint of a large language model.

By Melissa Heikkilä November 14, 2022

~~Friend or foe?~~

Understand the impacts and make it a friend

nature climate change

PERSPECTIVE

https://doi.org/10.1038/s41558-022-01377-7

Check for updates

Aligning artificial intelligence with climate change mitigation

Lynn H. Kaack[1,2,3]✉, Priya L. Donti[4,5], Emma Strubell[4], George Kamiya[6], Felix Creutzig[7,8] and David Rolnick[9,10]

There is great interest in how the growth of artificial intelligence and machine learning may affect global GHG emissions. However, such emissions impacts remain uncertain, owing in part to the diverse mechanisms through which they occur, posing difficulties for measurement and forecasting. Here we introduce a systematic framework for describing the effects of machine learning (ML) on GHG emissions, encompassing three categories: computing-related impacts, immediate impacts of applying ML and system-level impacts. Using this framework, we identify priorities for impact assessment and scenario analysis, and suggest policy levers for better understanding and shaping the effects of ML on climate change mitigation.

As artificial intelligence (AI) and particularly machine learning (ML) are increasingly being deployed across society[1], there has been a surge of interest in understanding the effects that ML may have on climate action[2–4]. To explicitly and consis-

Related literature on assessing the impacts of information and communications technologies (ICT) has often distinguished between the energy- and hardware-related GHG emissions of ICT ('direct' impacts) and the emissions impacts of ICT's applications

Machine learning and climate change

ML applications in climate change mitigation

Emissions from ML computation & hardware

ML applications that increase emissions

ML's system-level impacts

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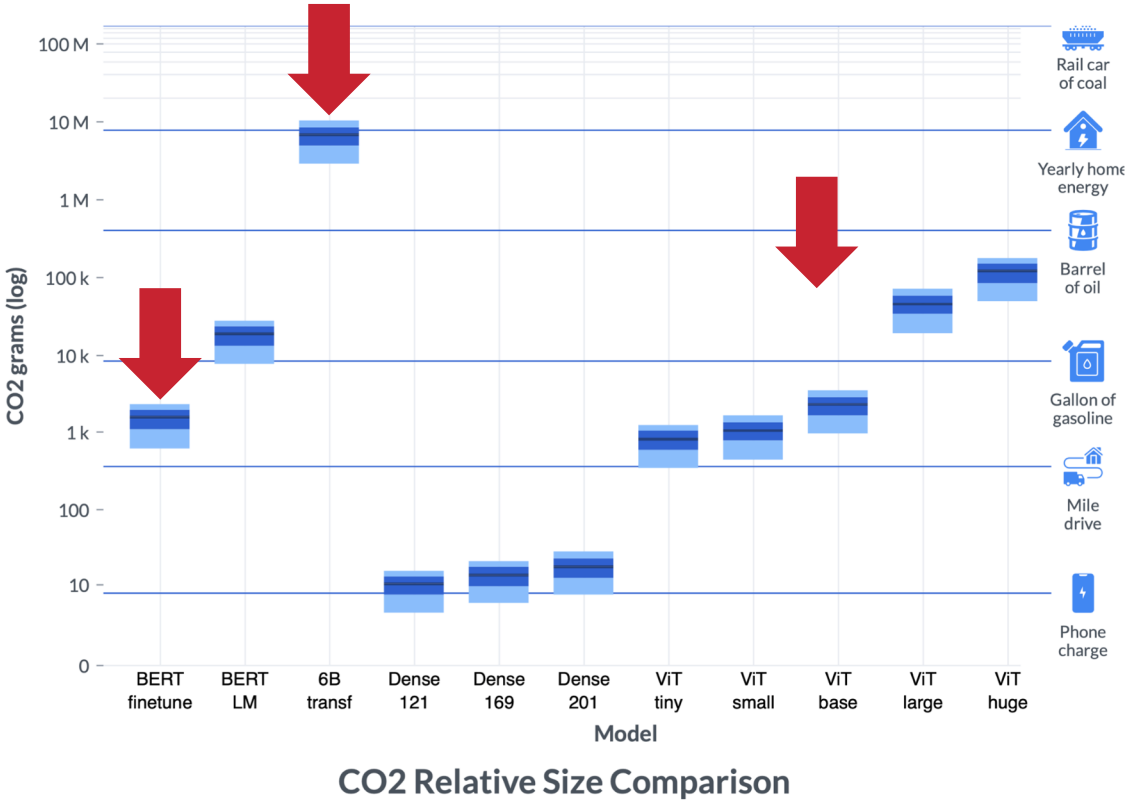
Emissions from ML computation

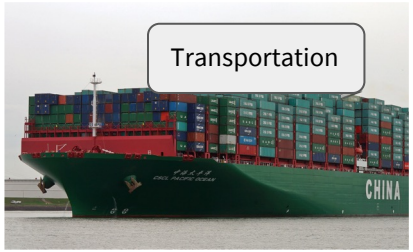


Dodge, J., Prewitt, T., Tachet des Combes, R., Odmark, E., Schwartz, R., Strubell, E., ... & Buchanan, W. (2022, June). Measuring the Carbon Intensity of AI in Cloud Instances. In *2022 ACM Conference on Fairness, Accountability, and Transparency* (pp. 1877-1894).

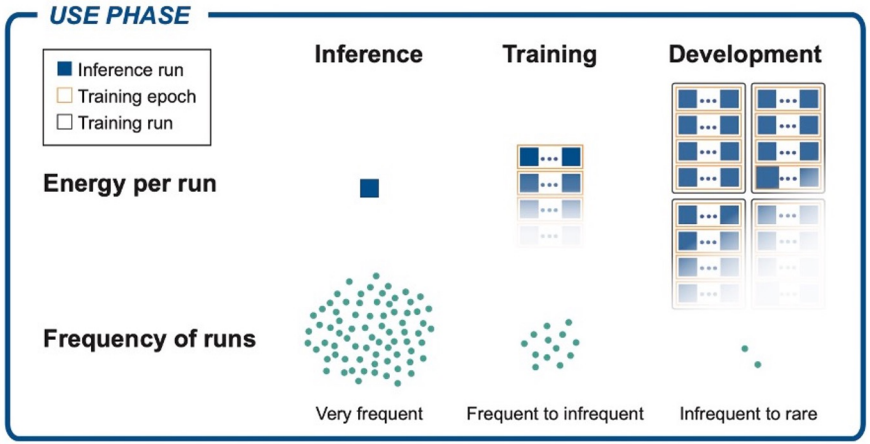
Impacts from ML computation & hardware

Operational emissions
from energy consumed during computation

Embodied emissions
from production and end-of-life of hardware



Computing-related emissions from ML



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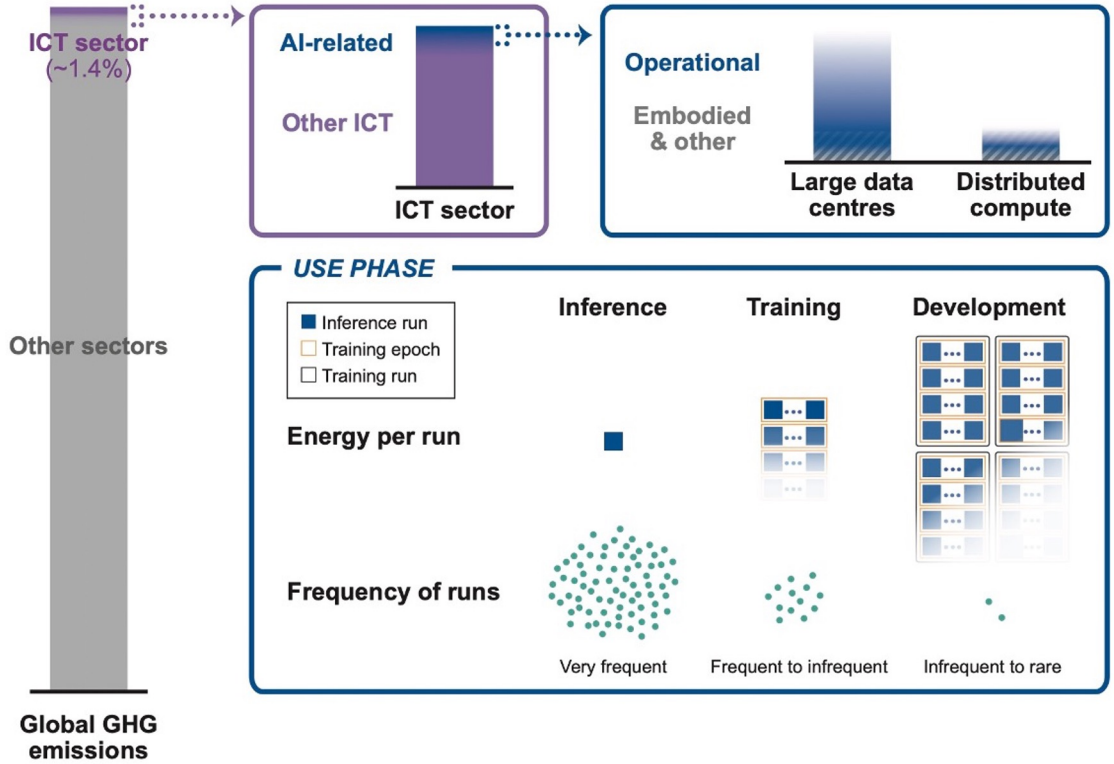
Computing-related emissions from ML

[2020 estimate]



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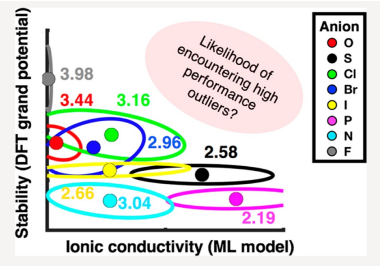
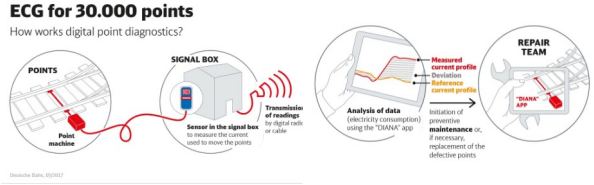
AI applications for climate change mitigation and adaptation

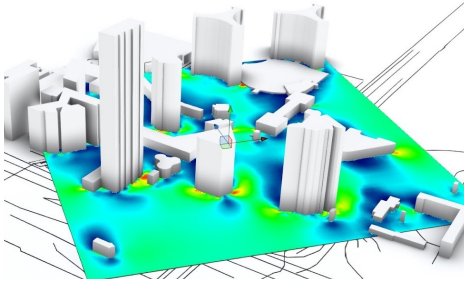


Aionics' software provides a 10x speedup in the process of designing better batteries.



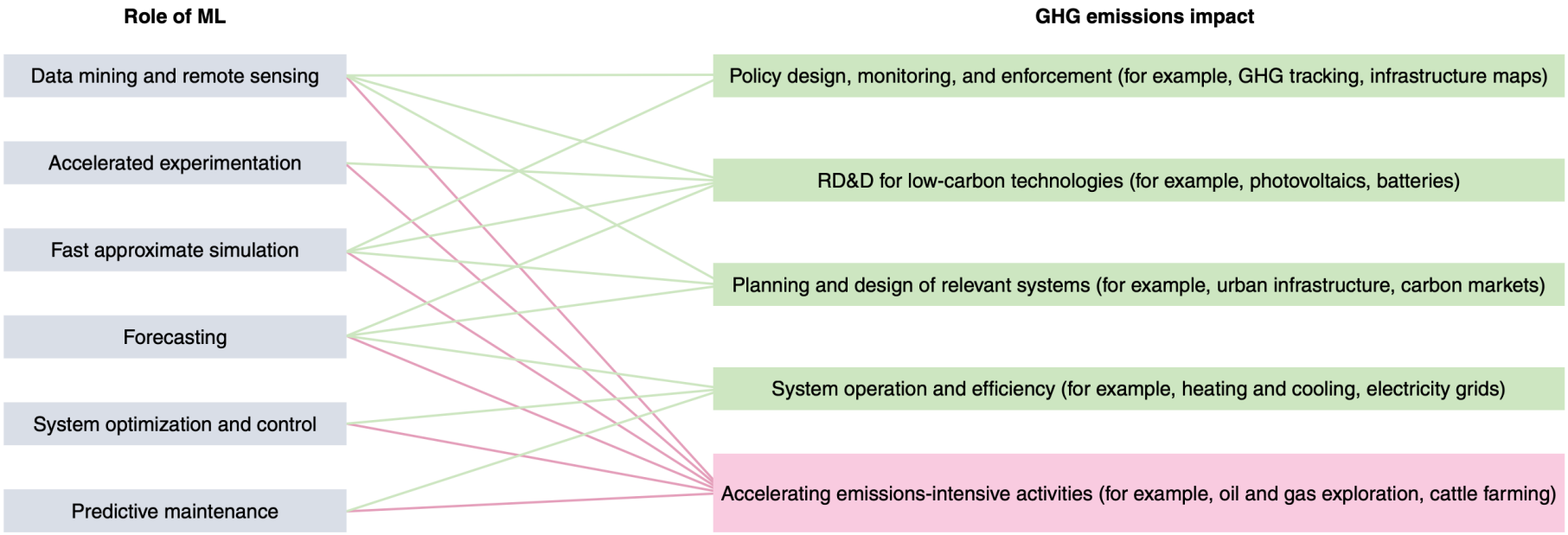
Deutsche Bahn uses predictive maintenance to increase reliability and cost-competitiveness of rail.

Kuzi, by Kenyan company Selina Wamucii, uses AI to predict locust outbreaks in East Africa.



InFraReD of the Austrian Institute of Techn. improves urban design by modeling the urban microclimate in seconds, rather than hours.

Immediate application impacts



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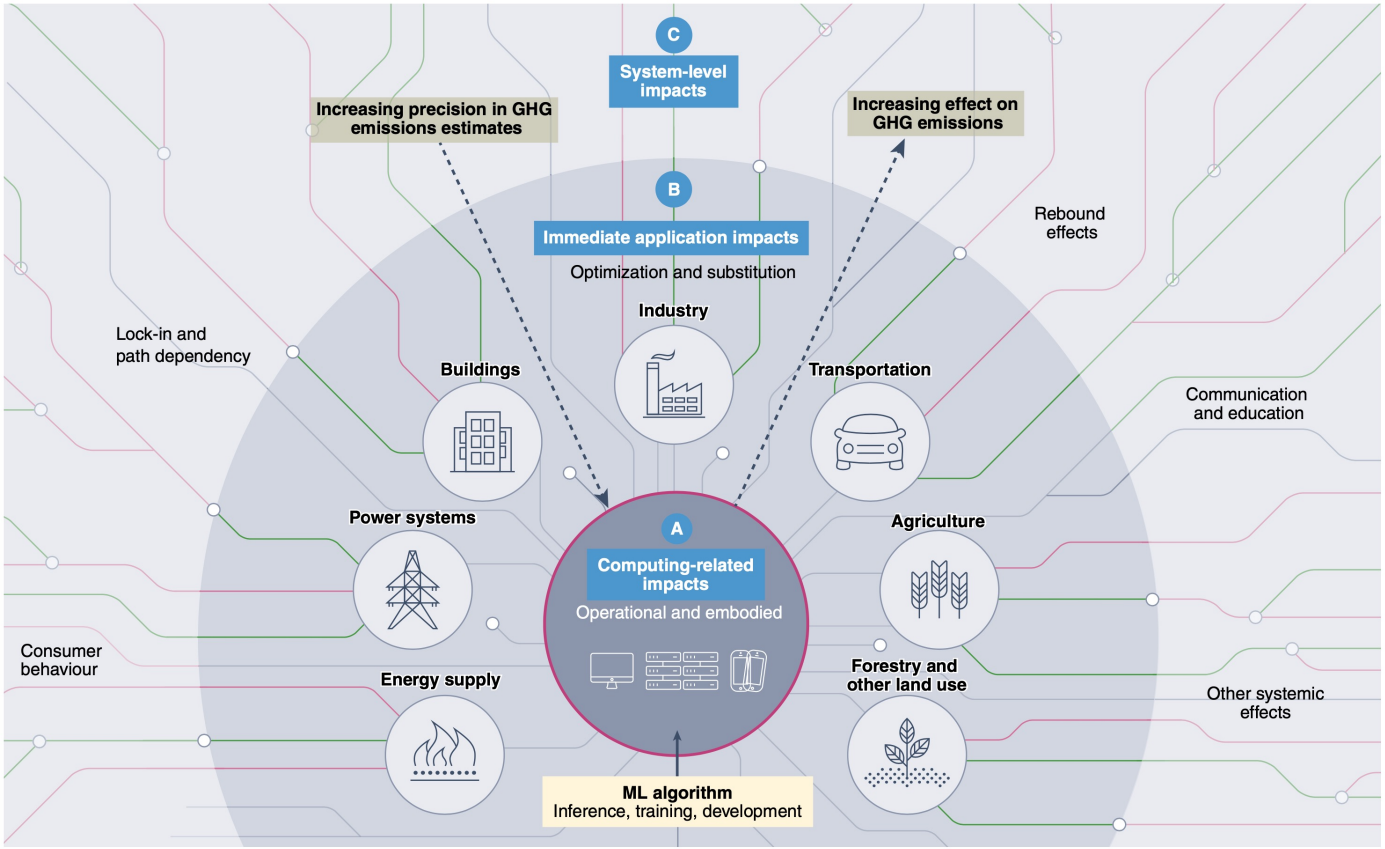
ML's carbon footprint



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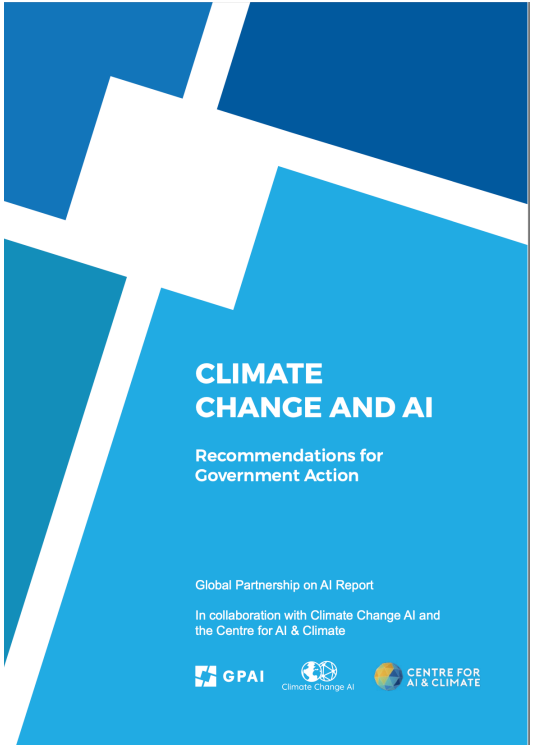
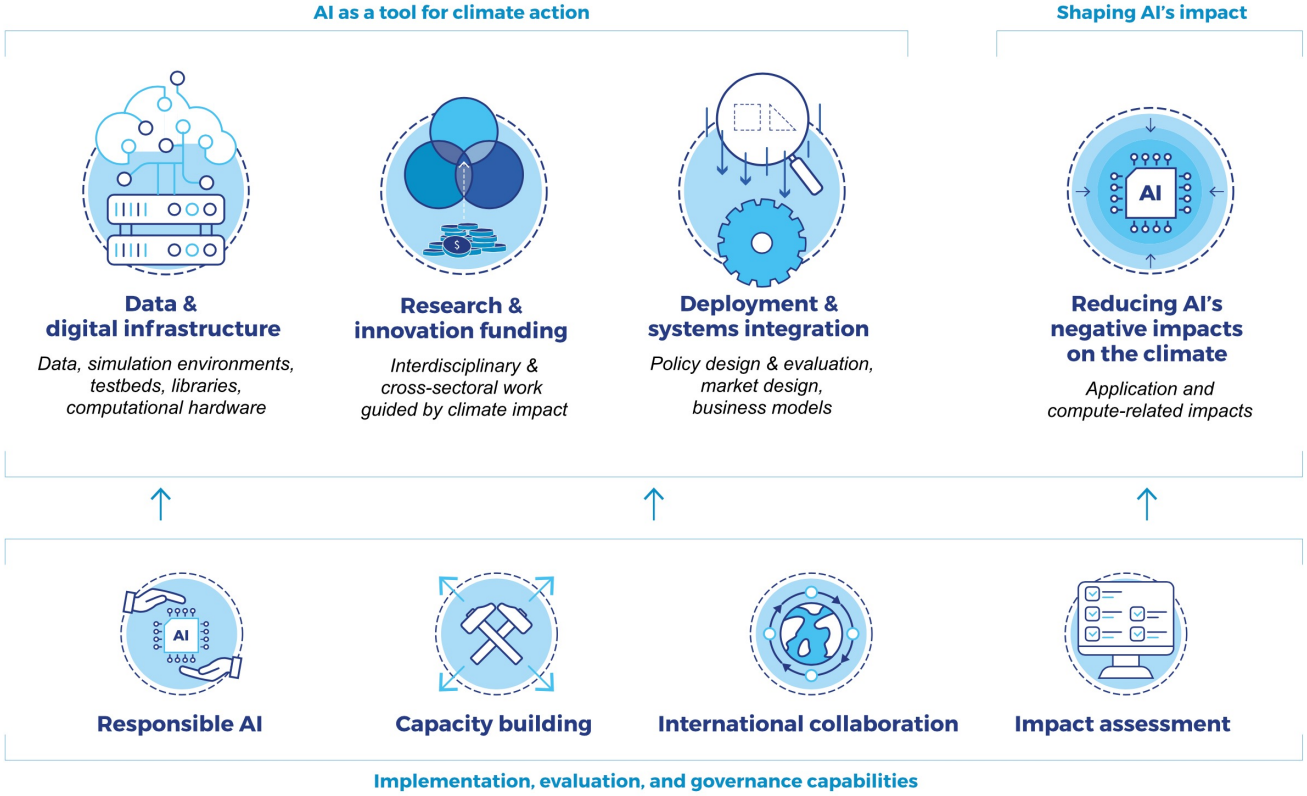
Policy approaches

- “General” climate policies and actions are important, e.g. carbon pricing
- Specific approaches to align AI with climate change goals:
  - fostering applications that help address climate change
  - requiring transparency and accountability in cases where AI could increase emissions
  - incorporating a climate focus in technology assessment for AI and AI-driven technologies



Recent report by GPAI, Climate Change AI and Center for AI & Climate

Fostering applications to address climate change



Areas of action for governments in supporting the responsible use of AI in the context of climate change

Requiring transparency

- Tools for measuring computing-related operational energy consumption:
  - ML CO2 Impact: https://mlco2.github.io/impact/
  - Carbontracker: https://github.com/lfwa/carbontracker
  - CodeCarbon: https://codecarbon.io
- We don’t understand use patterns: Need transparency from data center operators
- Need for full life-cycle analysis (LCA) including embodied emissions and application impacts
- Application impacts potentially large, more difficult to estimate

```python
from codecarbon import EmissionsTracker

tracker = EmissionsTracker()
tracker.start()
# GPU Intensive code goes here
tracker.stop()
```

Government initatives

STUDY

Requested by the AIDA committee

European Parliame

The role of Artificial

Department of Energy

DOE Announces $29 Million for Ultramodern Data Analysis Tools

MARCH 26, 2021

Energy.gov » DOE Announces $29 Million for Ultramodern Data Analysis Tools

Machine Lea

WASHINGTON

new tools to ar

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Künstliche Intelligenz für Umwelt- und Klimaschutz

FFG Forschung wirkt.

Die FFG Förderungen Services und Dienstleistungen Informationen eCall

Förderungen suchen.

- Thema - - Zielgruppe - nationale Förderung internationale Förderung Aktuelle Ausschreibungen Förderungen und Services

AI for Green

AI-Technologien zur Bewältigung ökologischer Herausforderungen

Info Details Kontakt Ausschreibung Links & Downloads

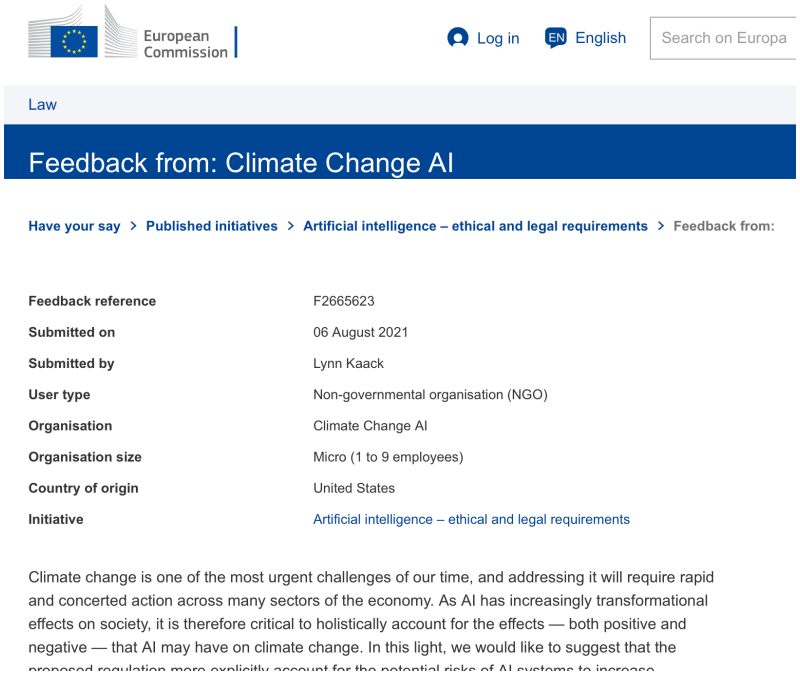
Der Schutz von Umwelt, Klima, Ressourcen und der Erhalt der Artenvielfalt sind zentrale Ziele für eine nachhaltige Entwicklung der Welt (SDGs). Nur durch weitreichende Transformationsschritte in allen Bereichen des Lebens wird es dem Menschen gelingen, eine lebenswerte Welt für nachfolgende Generationen zu sichern. Die Österreichische Bundesregierung hat sich in diesem Zusammenhang das Ziel gesetzt, bis zum Jahr 2040 die Klimaneutralität erreicht zu haben. Um diese Ziele zu erreichen, müssen Maßnahmen zum Klima- und Umweltschutz (Mitigation) als auch zur Anpassung an die Folgen des Klimawandels (Adaptation) gesetzt werden. Forschung im Bereich der Künstlichen Intelligenz/Artificial Intelligence (KI/AI) kann Technologie und Politik bei der Eindämmung des Klimawandels unterstützen und dadurch zum Schutz der Umwelt beitragen. Die Bereitstellung bzw. Weiterentwicklung von Algorithmen und AI-Systemen kann beispielsweise bei der Anpassung an die Folgen des Klimawandels helfen, indem sie den Sektoren Energie, Produktion, Land- und Forstwirtschaft oder dem Katastrophenmanagement präzisere Entscheidungsgrundlagen liefern.

AI for Green zielt konkret auf die Förderung von F&E-Projekten und Sondierungen ab, die folgende **zwei Ausschreibungsziele** gleichermaßen adressieren:

19

AI Act

- Recommendations:
  - **High risk**: application-related environmental and climate impacts (in addition to health, safety, fundamental rights)
  - **Transparency**: report environmental impacts where reporting is in place
- With amendments from parliament, AI Act now includes those
- Provided expert input in parliamentary hearing and ad hoc advice



Feedback from 2021

Thank you!

Contact

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