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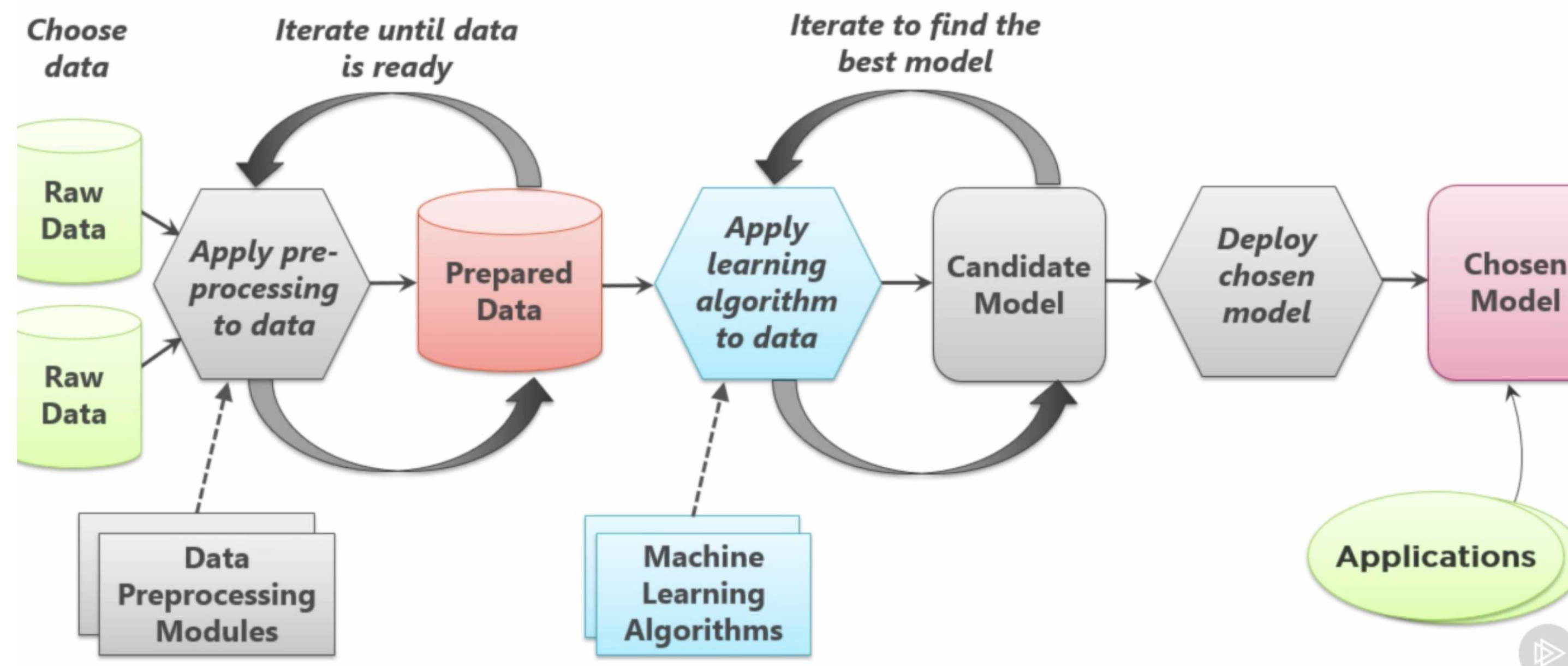
Artificial Intelligence for Sustainability

Contact: Florence d'Alché-Buc, LTCl, Télécom Paris, IP Paris
florence.dalche@telecom-paris.fr

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Data-driven AI is a huge energy consumer

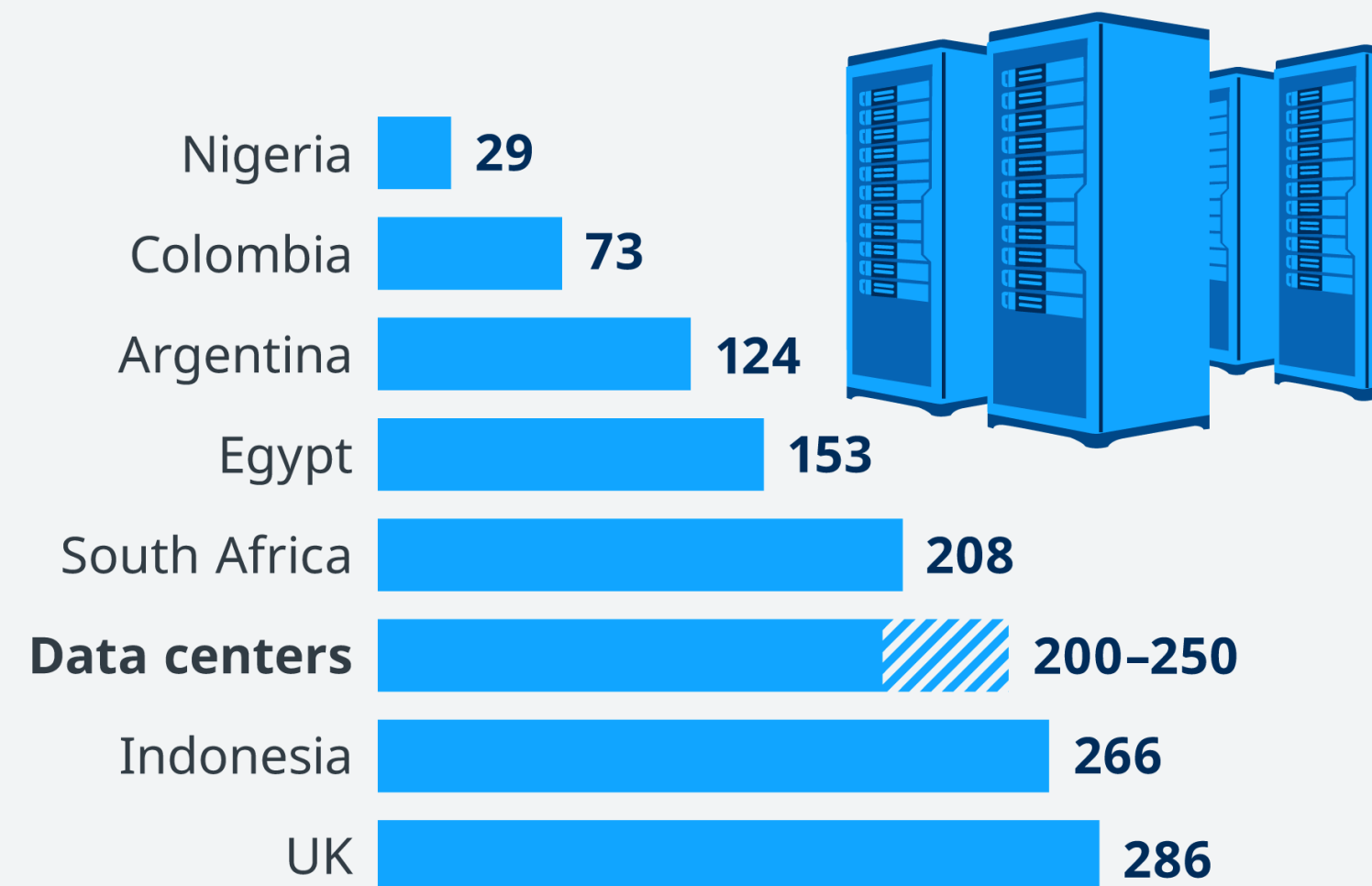
The Machine Learning Process



Data centers: greedy and thirsty

Data centers use more electricity than entire countries

Domestic electricity consumption of selected countries vs. data centers in 2020 in TWh



Source: Enerdata, IEA

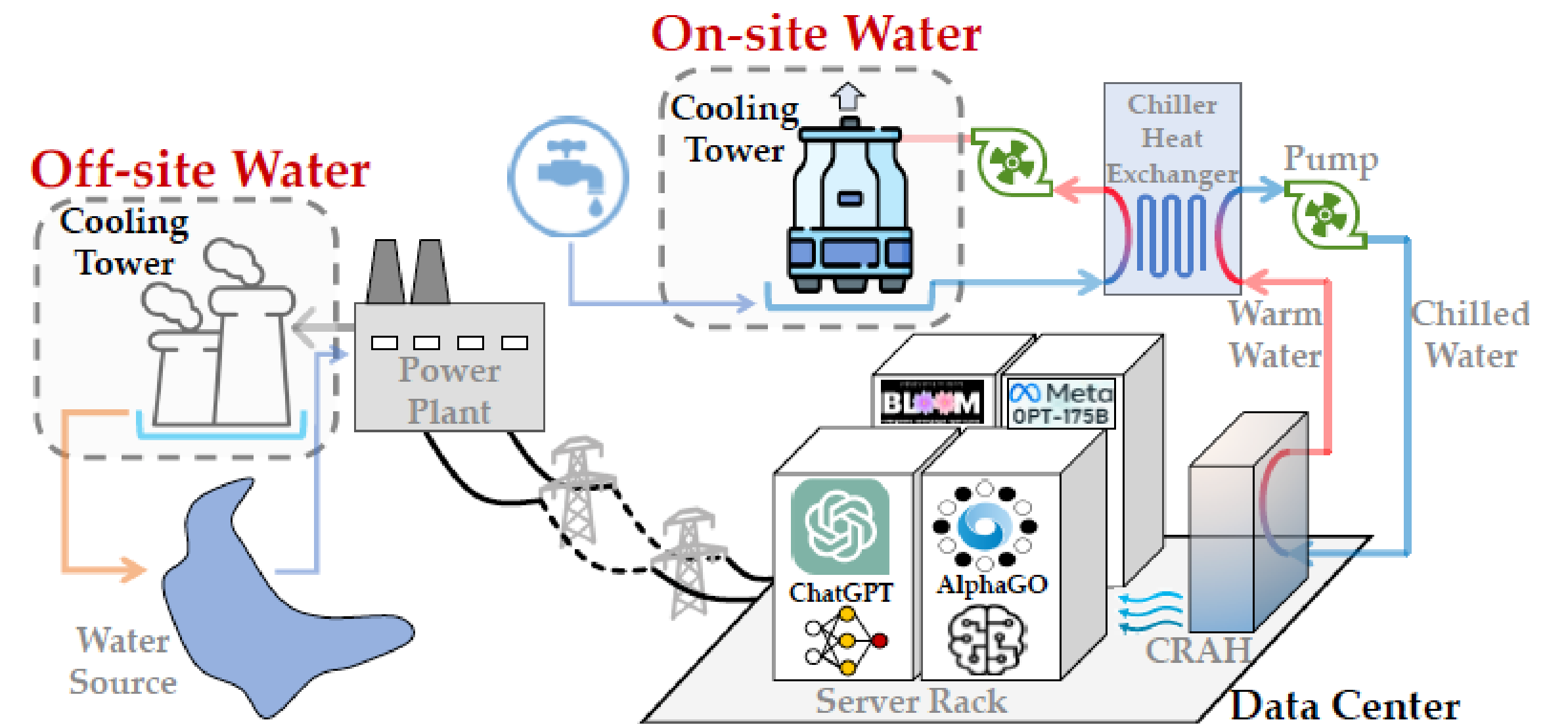


Figure from Li et al.'s arxiv paper (oct 2023) on how making AI less thirsty

(very) Large Language Models

- Training

CO2 Equivalent Emissions (Tonnes) by Selected Machine Learning Models and Real Life Examples, 2022

Source: Luccioni et al., 2022; Strubell et al., 2019 | Chart: 2023 AI Index Report

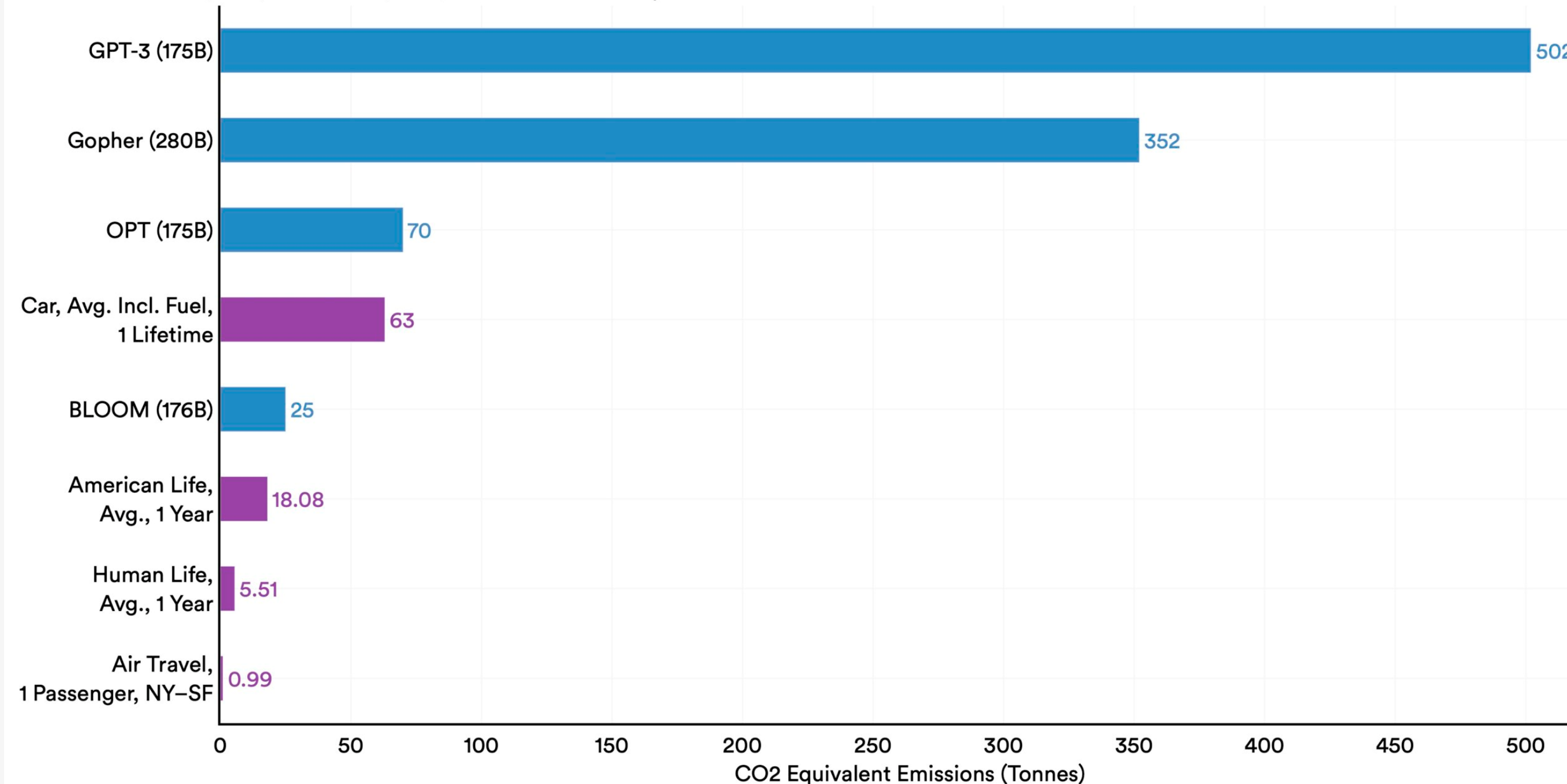


Fig: AI index Stanford report 2022

- Test (query)

1 Each query 4.32g of CO2

Using a CO2 calculator and some basic math, ChatGPT produces more CO2 per query than Google (apparently, each search query in Google results in 0.2g CO2 per query.)



4 92,593 queries will get you from San Francisco to Seattle and back



Not that we expect one person to do this on their own, but 92,000+ queries emit **400kg CO2** - as much as a round-trip flight from San Francisco to Seattle.

Fig: <https://piktochart.com/blog/carbon-footprint-of-chatgpt/>

... but AI is revolutionizing the way we solve technical problems...

Environment



Enabler

Inhibitor



<https://doi.org/10.1038/s41467-019-14108-y>

OPEN

The role of artificial intelligence in achieving the Sustainable Development Goals

Ricardo Vinuesa^{1*}, Hossein Azizpour², Iolanda Leite², Madeline Balaam³,
Virginia Dignum⁴, Sami Domisch⁵, Anna Felländer⁶, Simone Daniela Langhans^{7,8},
Max Tegmark⁹ & Francesco Fuso Nerini^{10*}

An interdisciplinary teaching and research chair @Télécom Paris dedicated on AI & Sustainability

- Create a leverage effect to lead novel researches
- Impulse a novel dynamic among students + professors + companies
- Use the chair as a think tank and a hands-on lab to understand and study AI & sustainability
- Move from « we should do » to « we prove that it can help »

Topics of the chair

AI for Sustainability



Sustainability for AI

AI for Sustainability

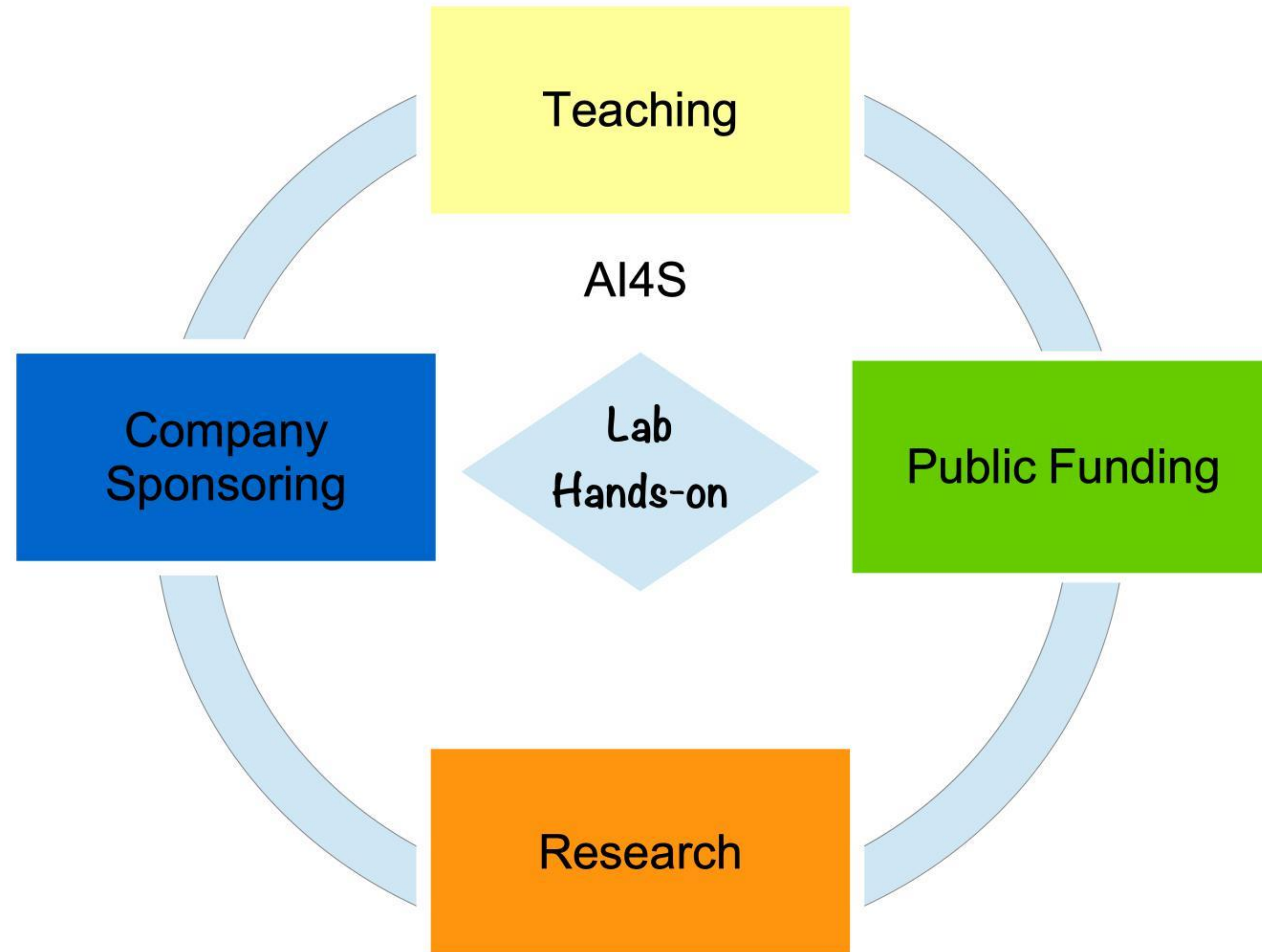
- AI for Resource optimisation and control: energy, water, waste
- AI for biodiversity / environment monitoring
- AI for Material discovery
- AI for Affordable health
- Impact of law & regulation in AI for sustainability



Sustainable AI

- measuring AI energy consumption (carbon footprint, water)
- identifying when data-driven are relevant in contrats to other AI/digital approaches.
- lowering energy consumption of AI (data-efficient & model-efficient methods)
- understanding (sociology) and promoting (regulation) practice changes in AI
- frugality while maintaining high level trustworthiness of AI

AI4S: the « how »



A lab « hands-on »

A **lab hands-on** open to *students, researchers, engineers, professors* ...to design and develop proof-of-concept projects linked to AI and Sustainability



AI4S chair in a nutshell

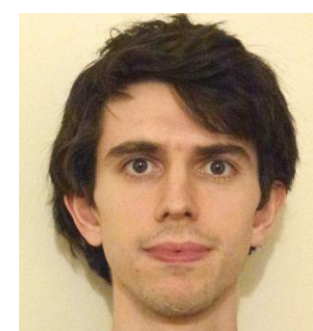
For companies

- Interactions and collaboration on dedicated research topics
 - * Targetted postdocs and PhD theses
 - * Collaborating in grant applications (public funding)
- Projects & challenges, use-cases presentation
 - * Building up an AI4S curriculum @Télécom Paris
 - * Priviledged interactions in the hands-on lab
- Scientific animation:
 - * Scientific & technical workshops 2/year
 - * Tooling session: code demo

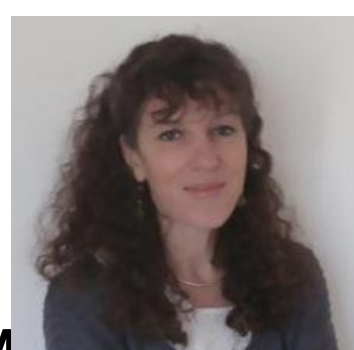


Ready to start !

Enzo Tartaglione Olivier Fercoq Pavlo Mozharovskyi Charlotte Laclau Mathieu Fontaine



Florence Tupin Philippe Ciblat Maria Boritchev Stéphan Cléménçon Thomas Le goff



and Matthieu Labeau Stéphane Lathuilière Ekhine Irurrozki Winston Maxwell

Already 1 workshop, 2 european projects: OMEGA-X and ELIAS

+ ELLIS Doctoral Symposium on AI & Sustainability in Paris

26 August - 30 August 2024



AI for Sustainability: focus on ML/Stats tools

- Modeling and forecasting spatio-temporal data
- Signal processing on graphs
- Remote sensing
- Anomaly detection
- Robustness and calibration
- Reinforcement learning & online learning
- Multi-task learning
- NLP, Complex output prediction
- Physics-inspired modeling

Sustainable AI: methods and tools

- Focus on frugal AI:

Data-efficient methods: transfer learning, zero/few-shot learning, meta-learning, active learning

Model-efficient methods: low-rank approaches, sparse representations, network regularization, network compression, network pruning