AIM AT 2030
Artificial Intelligence Mission Austria

2. Vernetzungstreffen im Rahmen des AI Policy Forums 2023

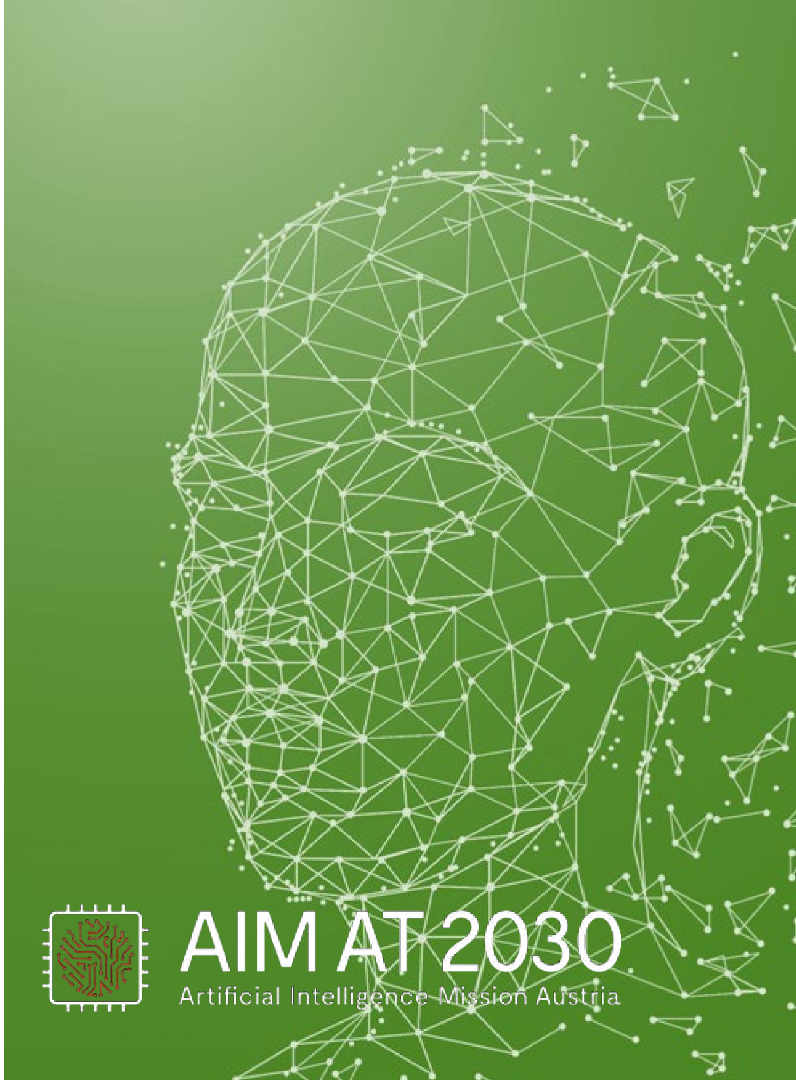
AI for Green:

Wie werden Klimaneutralität und Künstliche Intelligenz ein Paar?

11. Oktober 2023

Bundesministerium
Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

Bundesministerium
Finanzen



Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Willkommensworte

Daniela Murhammer-Sas

Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

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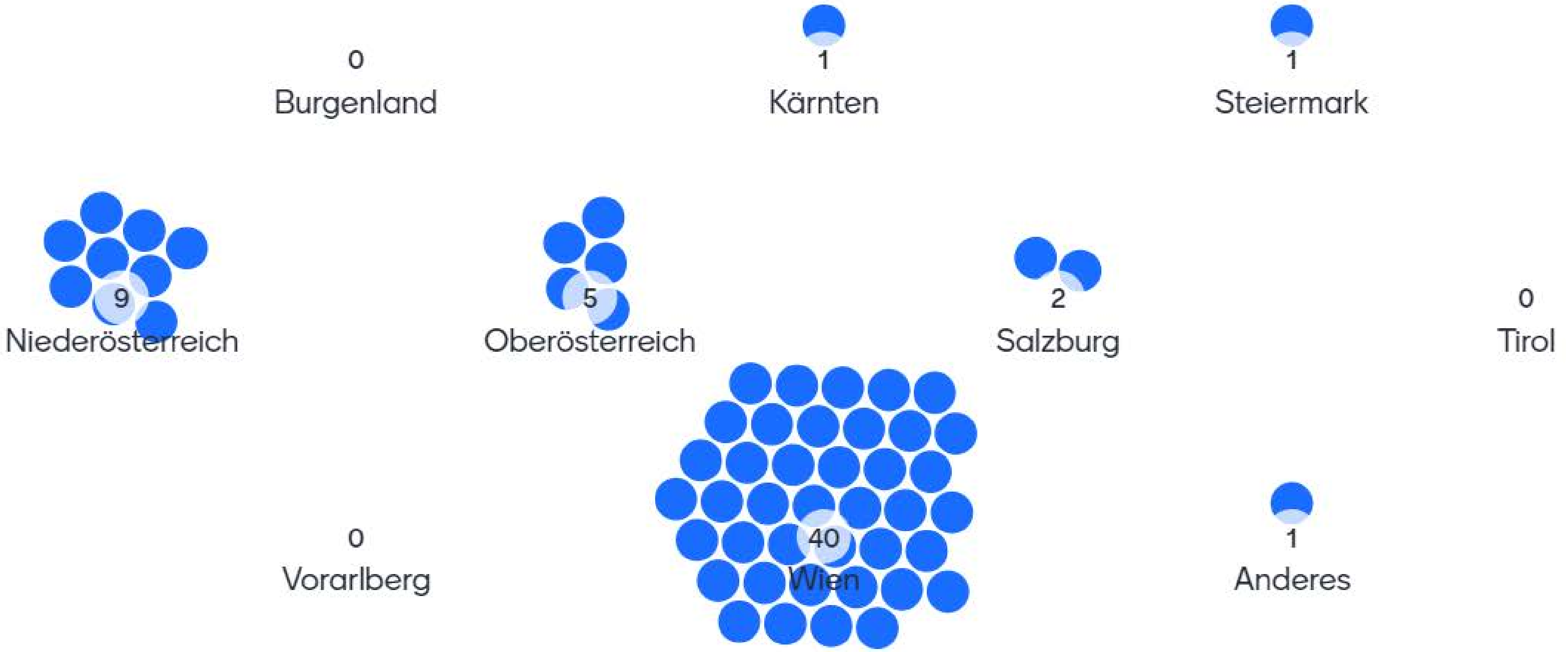
Mentimeter

Woher sind Sie heute angereist?



59

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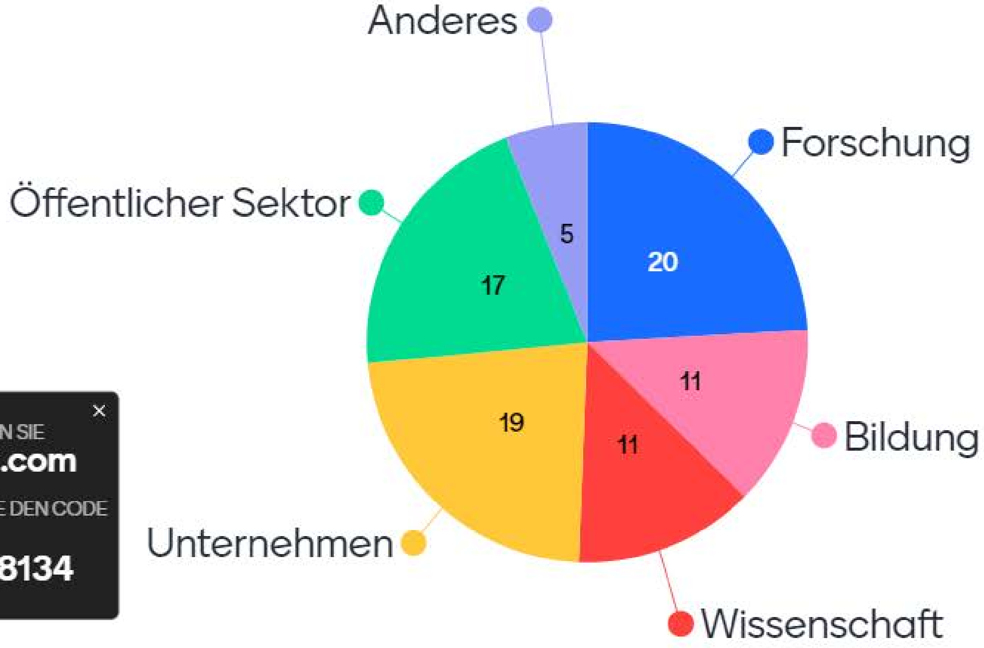
Mentimeter

Welcher Kategorie würden Sie sich zuordnen?



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Mentimeter

Was erwarten Sie sich vom heutigen Tag?

93 responses

47

Wo Sie die Chancen für KI in Bezug auf Klimaneutralität sehen

Analyse von Herausforderungen und **Finden neuer Lösungen**

Erhöhung der Transparenz von Klimadaten und Co2 Ausstößen

Simulation grüner Zukünfte und **Reaktion** auf ökologische Entwicklungen

Unterstützung der **Wissensvermittlung und Stärkung des Verständnisses** in Bezug auf Klimawandel Mitigation

Verbesserte Effizienz und Prozessoptimierung (z.B. Mobilität, Energie, Logistik, andere Technologien..)

Reduktion des **Co_2 Fußbadrucks von KI**

Verstärkte **Grundlagenforschung**

Mehr **Zusammenarbeit** zwischen den Disziplinen

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Agenda (1/2)

10:15	Keynote: **Teil der Lösung oder Teil des Problems? Die ambivalente Rolle von Künstlicher Intelligenz in der Klimafrage** Ivona Brandic, TU Wien
10:45	**Vorstellung neuer FZÖ-Fördermöglichkeiten**
10:55	**Vernetzung der Teilnehmenden mit Good Practices**
13:00	Mittagspause
14:00	Eine gemeinsame Vision für **die Zukunft von AI for Green in Österreich**
14:45	Keynote: **Vom Traum zur Realität – Das Lösungspotenzial von AI in der Praxis,** Jasmin Lampert, AIT

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Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

Bundesministerium Finanzen

Agenda (2/2)

15:30	Keynote: **Wie wird KI eine grüne Technologie? Ein Blick in die Zukunft,** Felix Creutzig, Mercator Research Institute on Global Commons and Climate Change
16:00	**Gemeinsame Diskussion** der Chancen von KI für die Klimaneutralität in Österreich
16:45	**Abschlussworte durch Michael Wiesmüller**, Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
17:00	Voraussichtliches Ende der Veranstaltung
Ab 18:00	Beginn des **Abendprogramms durch den 3. Trustworthy AI Stammtisch** powered by AI Austria & aws

AIM AT 2030
Artificial Intelligence Mission Austria

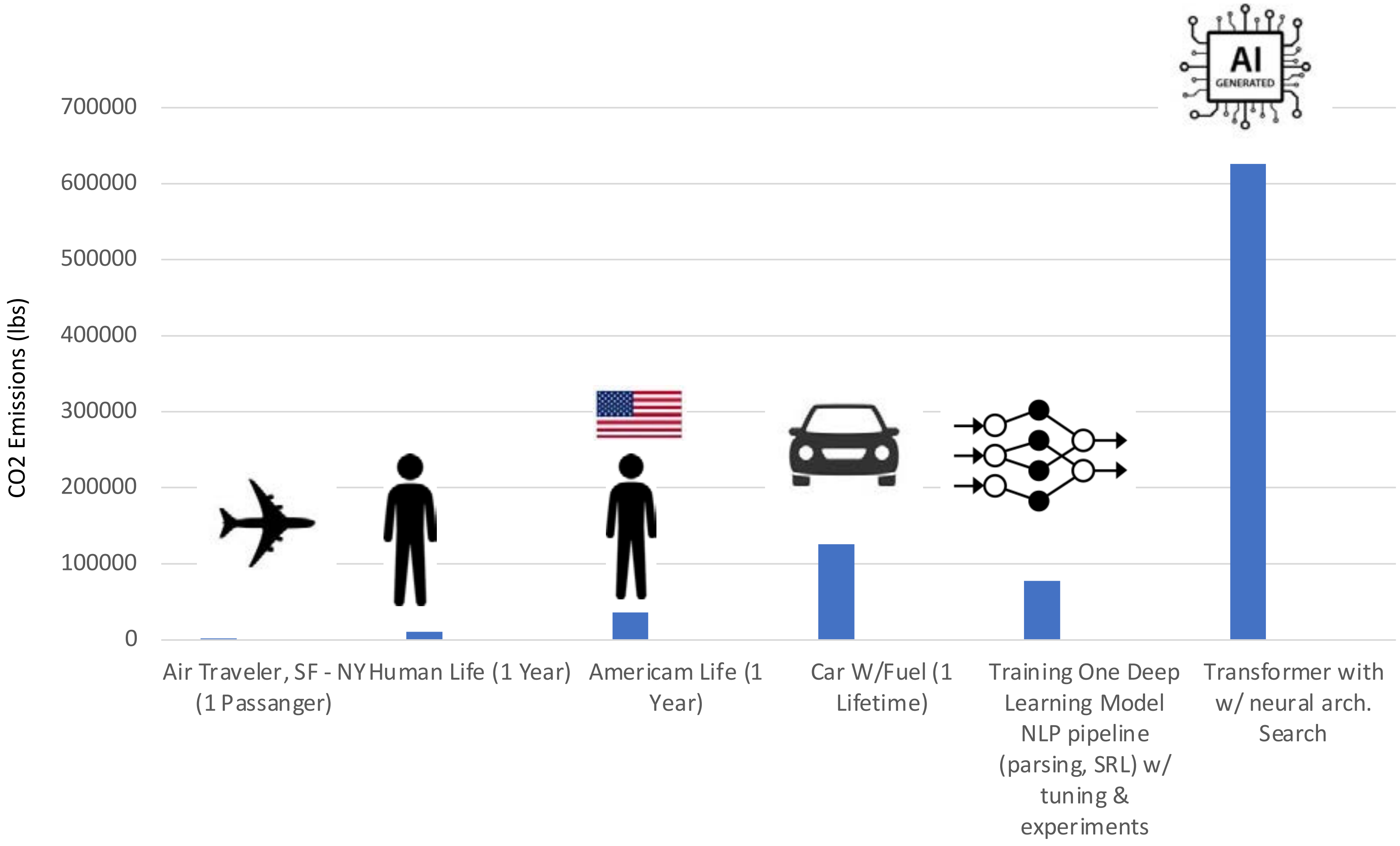
Keynote

Teil der Lösung oder Teil des Problems? Die ambivalente Rolle von Künstlicher Intelligenz in der Klimafrage

Ivona Brandic, TU Wien

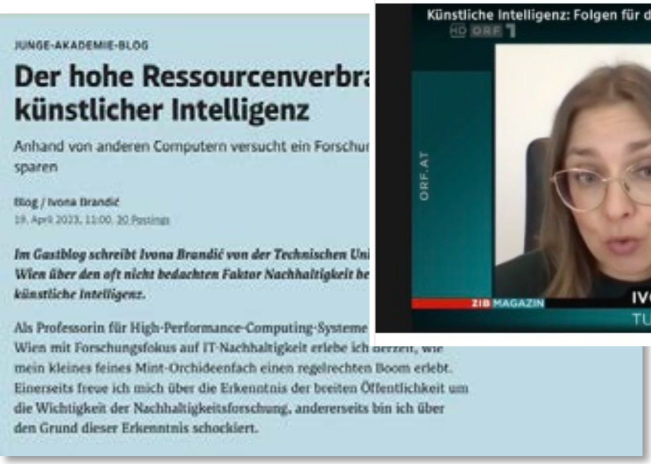
Source: @mileszim on Twitter

CO_2 Footprint of NN and Transformers



Source: Emma Strubell, Ananya Ganesh, Andrew McCallum: Energy and Policy Considerations for Deep Learning in NLP, ACL (1) 2019: 3645-3650
Inspiration for Visualisation: Keren Bergman, Multicore World 2023 https://2019multicoreworld.files.wordpress.com/2023/02/bergman-keren-23.pdf

Informatikerin zu ChatGPT - ZIB Magazin vom 10.04.2023 um 20:03 Uhr



JUNGE-AKADEMIE-BLOG

Der hohe Ressourcenverbr[...]
künstlicher Intelligenz

Anhand von anderen Computern versucht ein Forschu[...] sparen

Blog / Ivona Brandić
19. April 2023, 11:00, 20 Postings

Im Gastblog schreibt Ivona Brandić von der Technischen Uni[...] Wien über den oft nicht bedachten Faktor Nachhaltigkeit be[...] künstliche Intelligenz.

Als Professorin für High-Performance-Computing-Systeme [...] Wien mit Forschungsfokus auf IT-Nachhaltigkeit erlebe ich derzeit, wie mein kleines feines Mint-Orchideenfach einen regelrechten Boom erlebt. Einerseits freue ich mich über die Erkenntnis der breiten Öffentlichkeit um die Wichtigkeit der Nachhaltigkeitsforschung, andererseits bin ich über den Grund dieser Erkenntnis schockiert.

ZIB Klima (Austrian National Broadcast) about energy consumption of AI, broadcast at March 11th 2023

CO2-FUSSABDRUCK

Die dunkle Seite der KI

Künstliche Intelligenz (KI) ist momentan nicht aus den Schlagzeilen wegzudenken, vor allem die computergenerierten Texte von ChatGPT sorgen international für Aufsehen. Das hat zu einem regelrechten Wettlauf der KI-Riesen geführt – der auch zulasten der Umwelt geht, denn der Stromverbrauch der verschiedenen KIs ist enorm. Schnelle Abhilfe gibt es keine, sagen Fachleute.

20. Februar 2023, 6.26 Uhr

Teilen

Die Großen der Branche lassen keine Zweifel: KI ist die Zukunft. Erst kürzlich haben etwa Google und Microsoft ihre Pläne vorgestellt und [...]

Source: https://orf.at/stories/3303661/

JUNGE-AKADEMIE-BLOG

Künstliche Intelligenz für mehr Sicherheit im Straßenverkehr

Zwei Projekte der TU Wien geben Einblick, [...] Intelligenz haben kann

Blog / Ivona Brandić
1. Juni 2022, 13:48

Die Informatikerin Ivona Brandić schreibt im G[...] künstliche Intelligenz im Straßenverkehr und b[...] kann.

Es gibt kaum einen Bereich in unserem Leben[...] die Digitalisierung beeinflusst wird. Gesundhe[...] *power grid*, intelligente Transportmittel sind n[...] [...]avon betroffen sind. Eine der wichti[...] [...]de, eigentlich exponentiell steigend[...] Informations- und Telekommunikat[...] [...]tren verbrauchen derzeit ein Prozen[...] [...]n Modell sagt sogar voraus, dass, w[...]

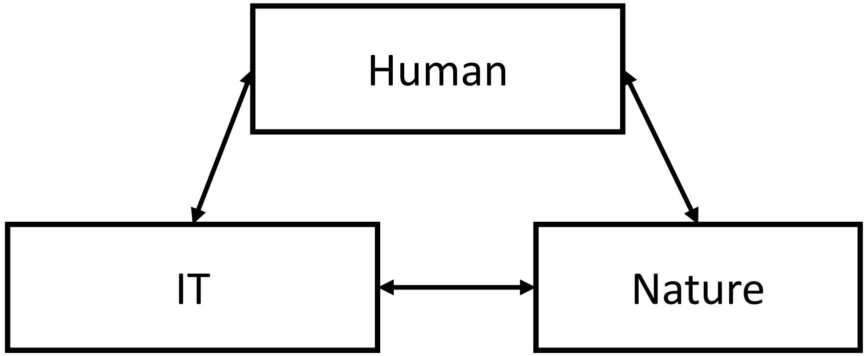
Extremer Energiehunger von KI und IT: Was wir tun können

Wie viel Energie verschlingt ChatGPT?

Mayr's Magazin ([ORF](ORF)) commenting the current technological AI race

Computational Sustainability

Actors:



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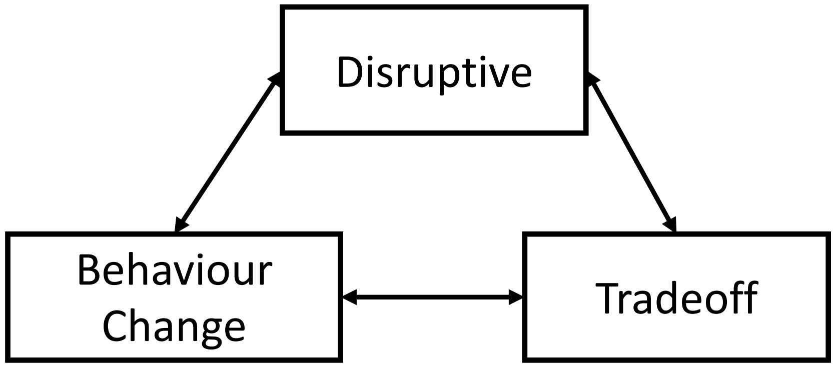
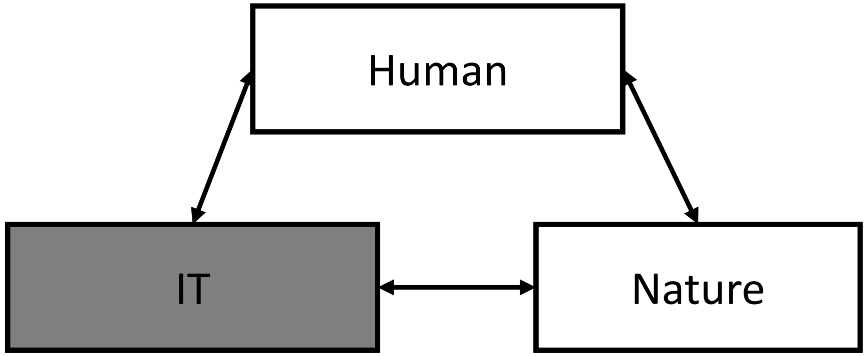


Computational Sustainability

Actors:



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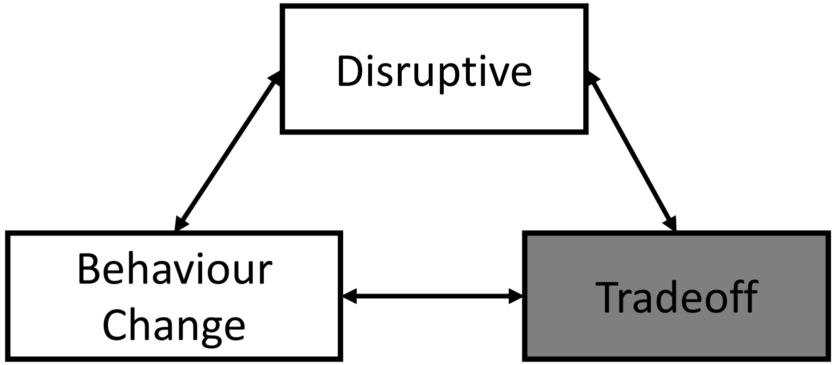
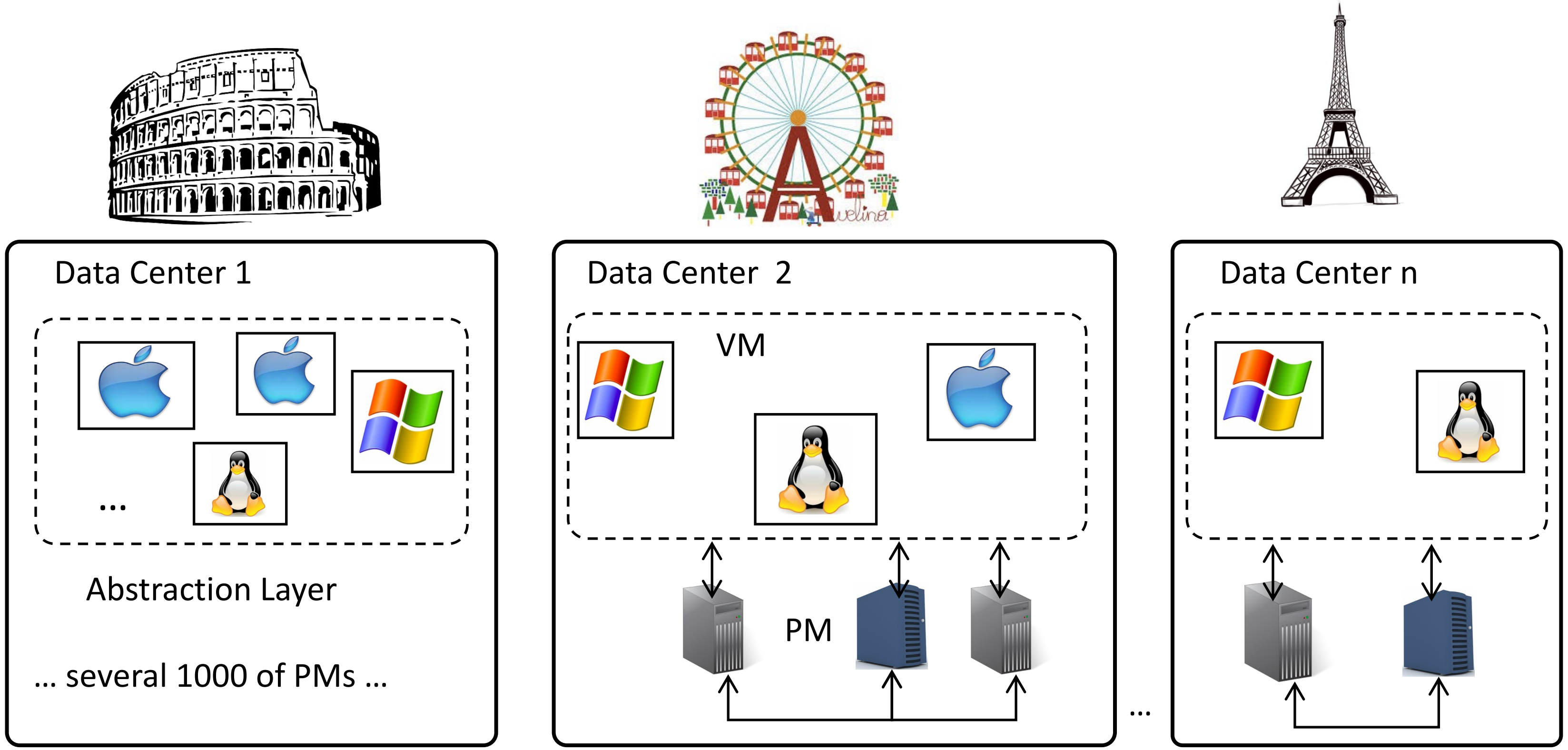
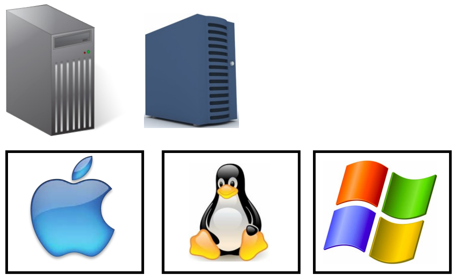



Recycle Bin
VLC media player
Adobe Reader 9
Asterisk Document...
AoA Audio Extractor
Eclipse
Avira Control Center
ImTOO Video Converter U...
Mozilla Firefox
Parallels Desktop
Parallels Share...
Virtual Machine (VM) 1
VM 2
VM 3
VM 4
11:19

Clouds

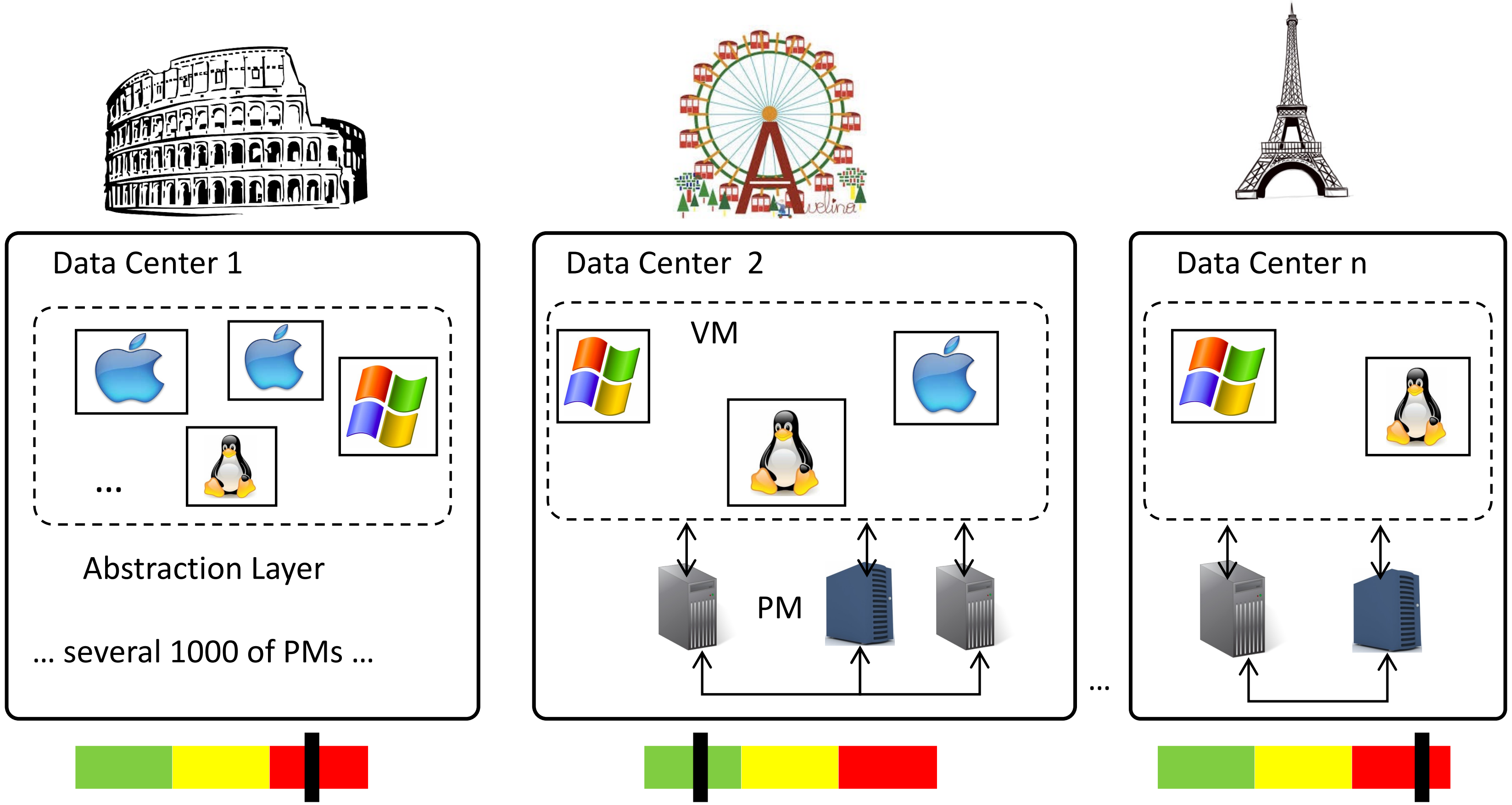




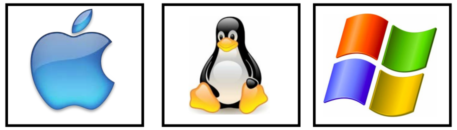
Physical Machine (PM)

Virtual Machine (VM): Abstraction of a physical machine, *“simulation of a computer”*

Clouds

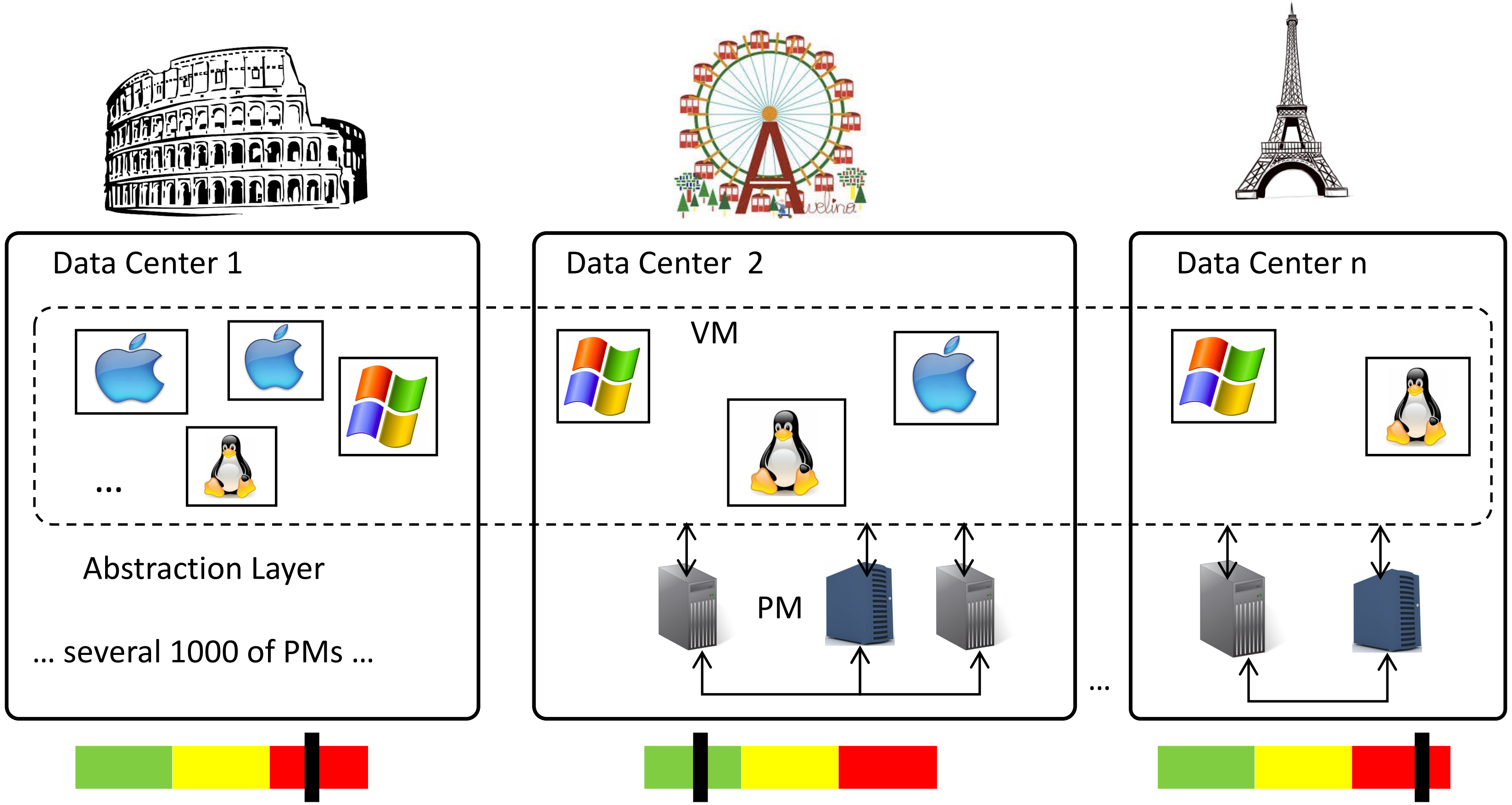


Physical Machine (PM)

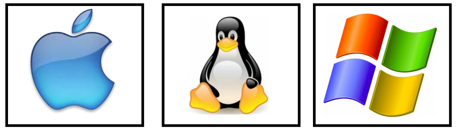


Virtual Machine (VM): Abstraction of a physical machine, *"simulation of a computer"*

Clouds



Physical Machine (PM)

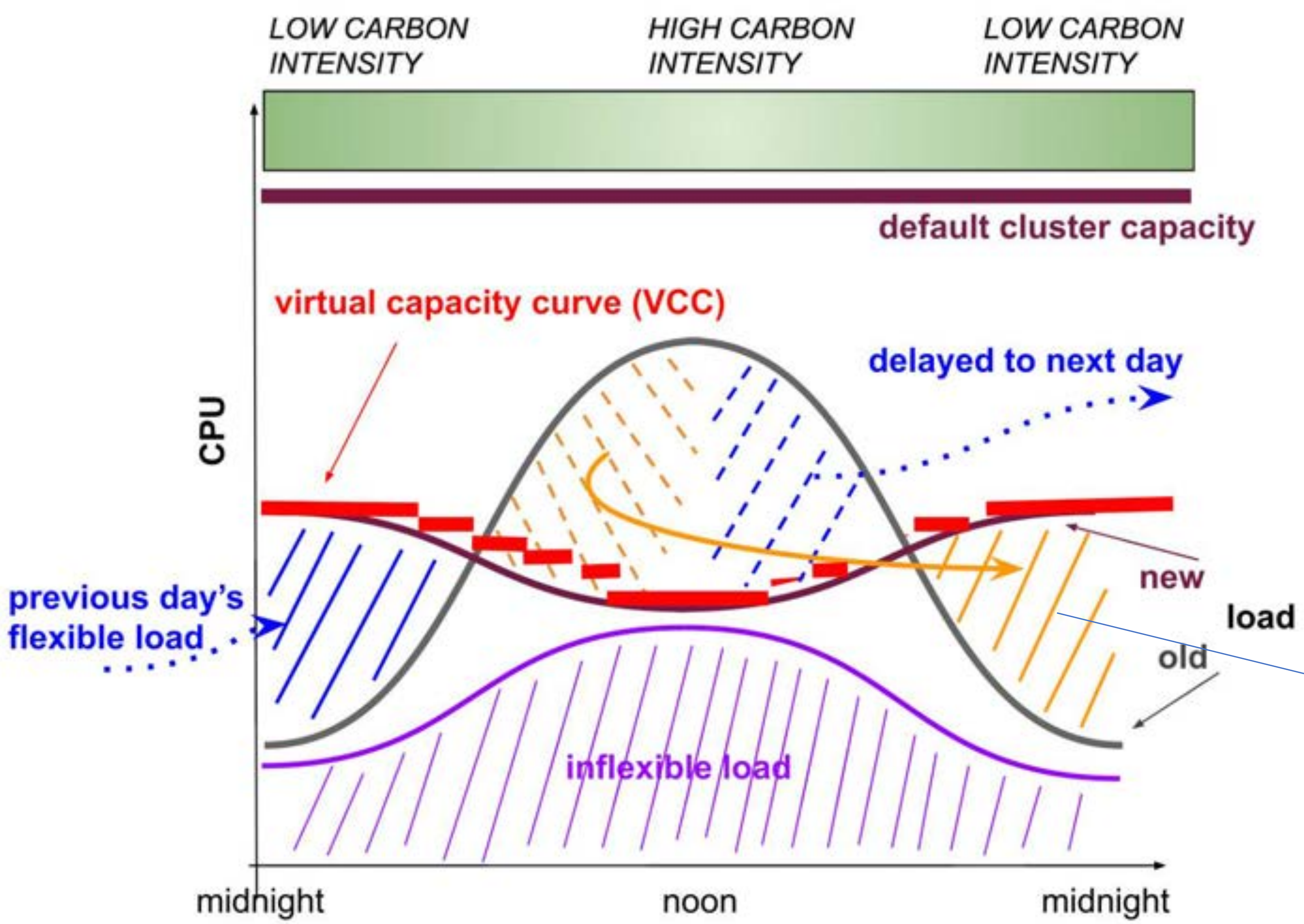


Virtual Machine (VM): Abstraction of a physical machine, *"simulation of a computer"*

Source: R. Buyya, Ch. S. Yeo, S. Venugopal, J. Broberg, I. Brandic. Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. FGCS 25(6): 599-616 (2009)

Cloud: economic and ecological data center solutions

Workload Shift in Space and Time

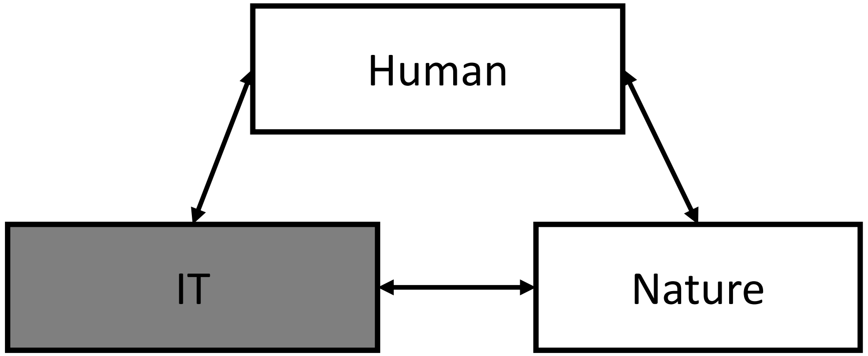


Ana Radovanovic & Shashi Ilager: Lecture at TU Wien: "Data Intensive Computing"

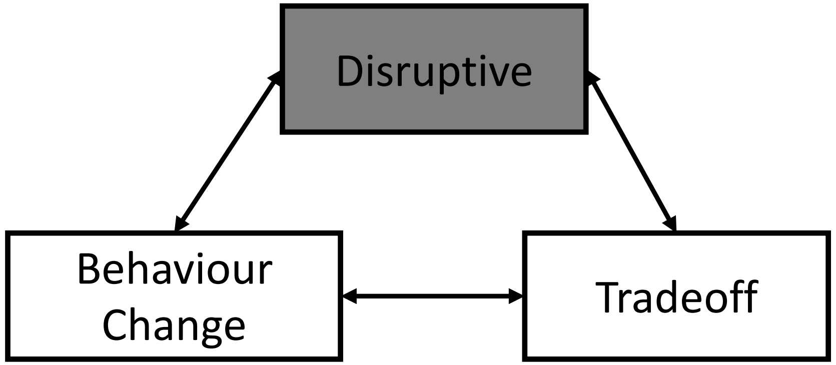
Source: Radovanović, Ana, et al. "Carbon-aware computing for datacenters." IEEE Transactions on Power Systems 38.2 (2022): 1270-1280.

Computational Sustainability

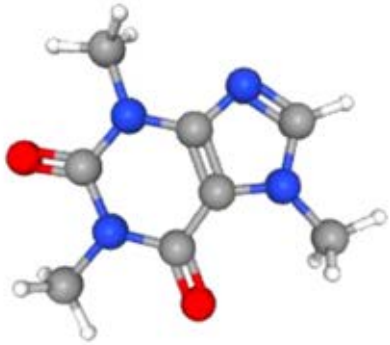
Actors:



Methods:



A cup of coffee?



- Representing the energy configuration of a single caffeine molecule at a single instant requires approximately 10^{48} bits in a classical computer

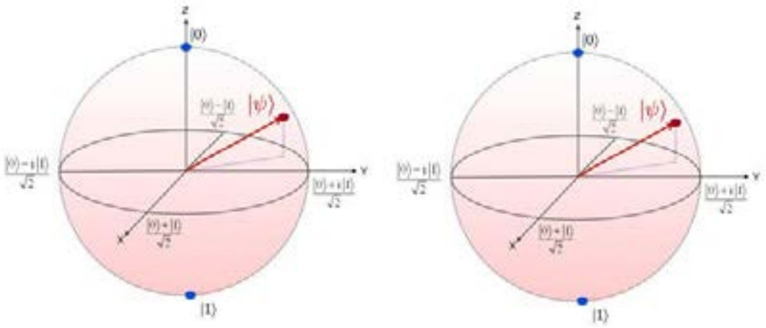
- Can be done using 160 logical qubits on a quantum machine

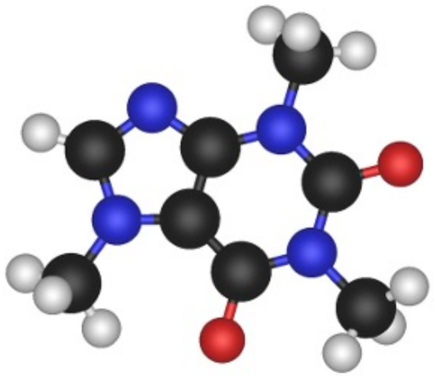
1 000 000 000 000 000 000 000 000 000 000 000 000 000 000 000 000 000 vs. 160

Slide: Courtesy of Nico Einsiedler (IBM), TU Vienna Quantum Fall Fest 2022

Beyond 0 and 1

Quantum





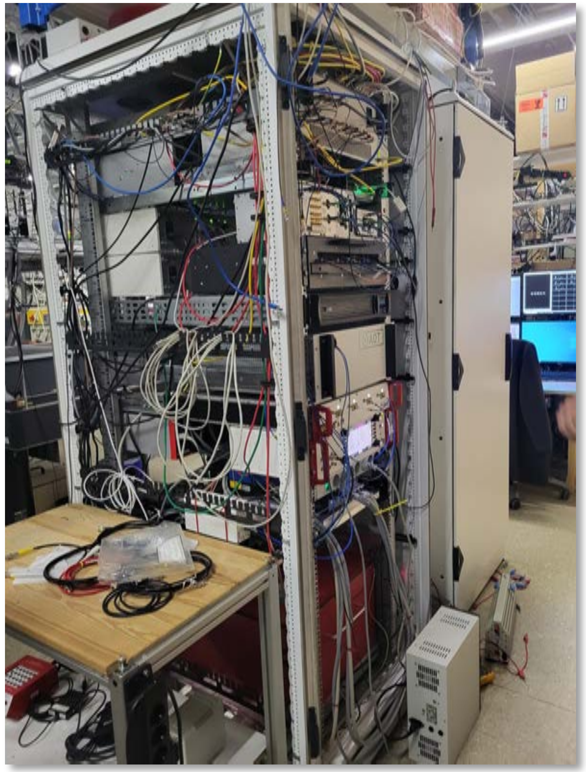
Von Neumann

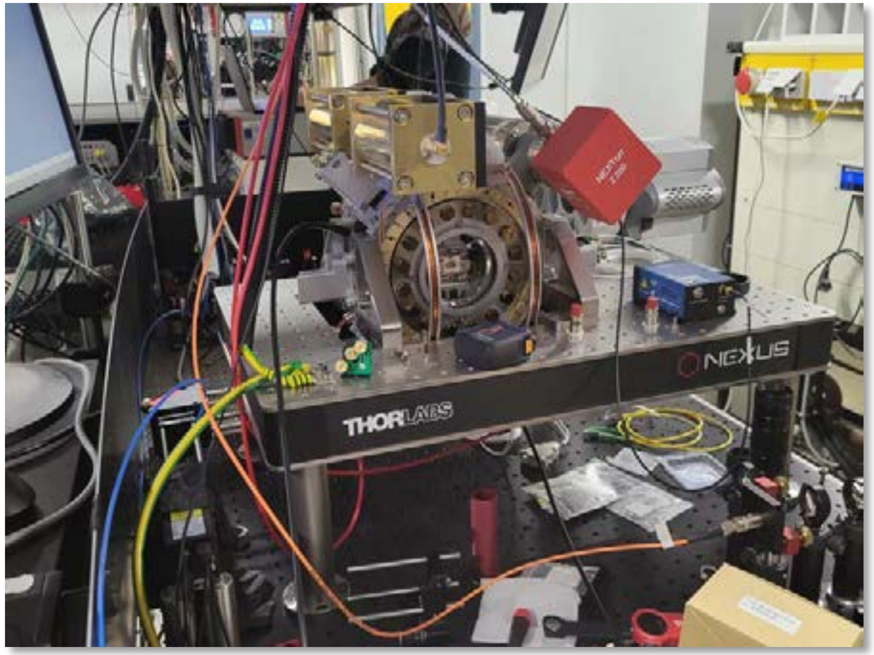
Bottom up approach

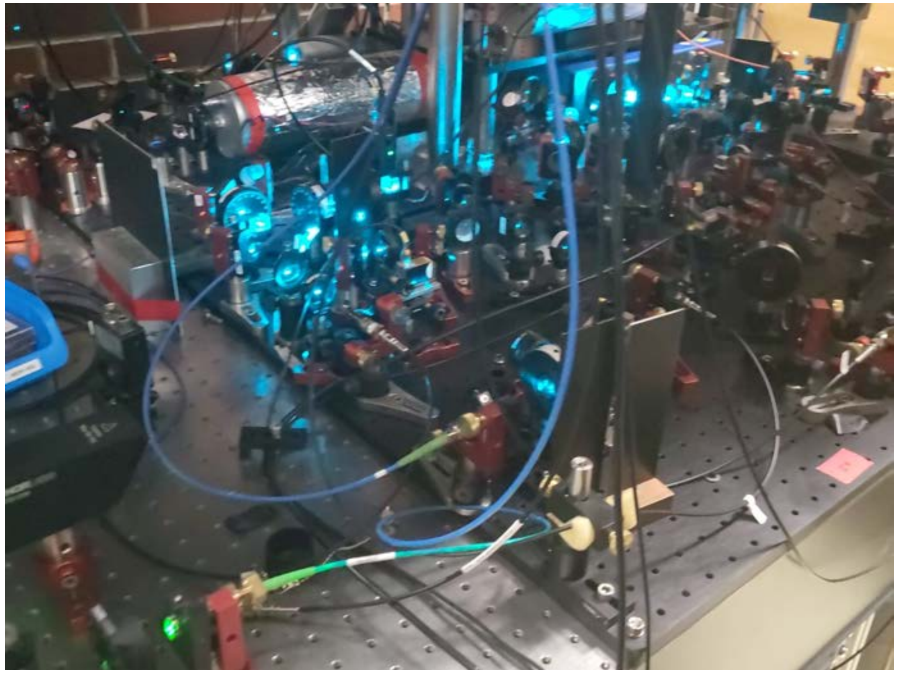
- *Variational Quantum Linear Solver (VQLS)*
- *Quantum Eigenvalues* –> Native 3d modeling of molecular dynamics applications

Problem: Currently quantum systems can be used by quantum researchers only!

FFG
Forschung wirkt.







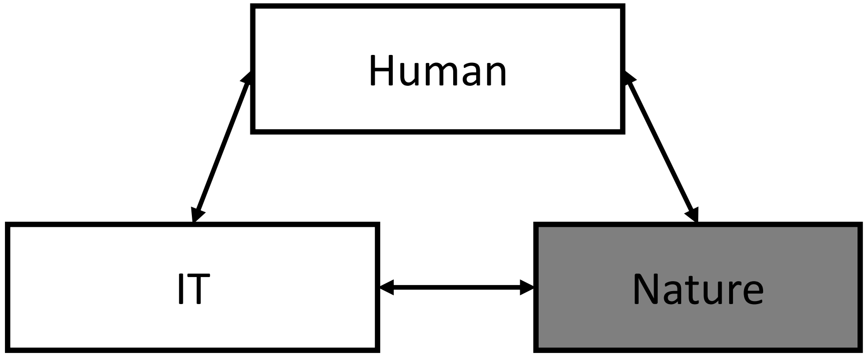
HPQC
HIGH-PERFORMANCE QUANTUM COMPUTING

Ion-trap quantum computer
Source: courtesy Experimentalphysik, Univ. Innsbruck
Picture: courtesy Vincenzo de Maio

FFG Flagship Project High Performance Integrated Quantum computing (HPQC)

Computational Sustainability

Actors:



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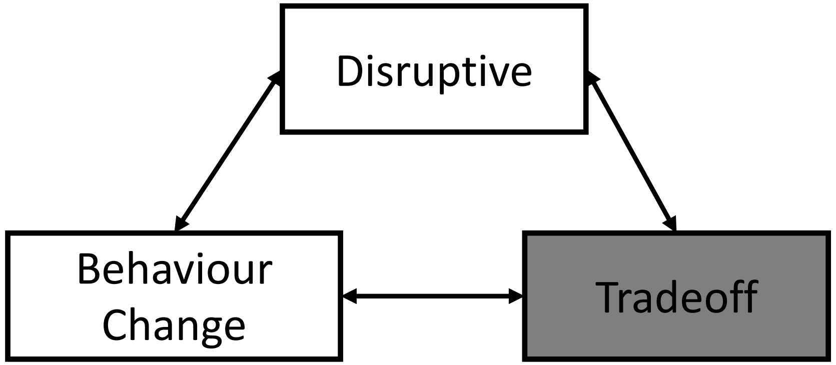


Siberia’s gateway to the underworld

Source: https://www.science.org/content/article/siberia-s-gateway-underworld-grows-record-heat-wave-thaws-permafrost

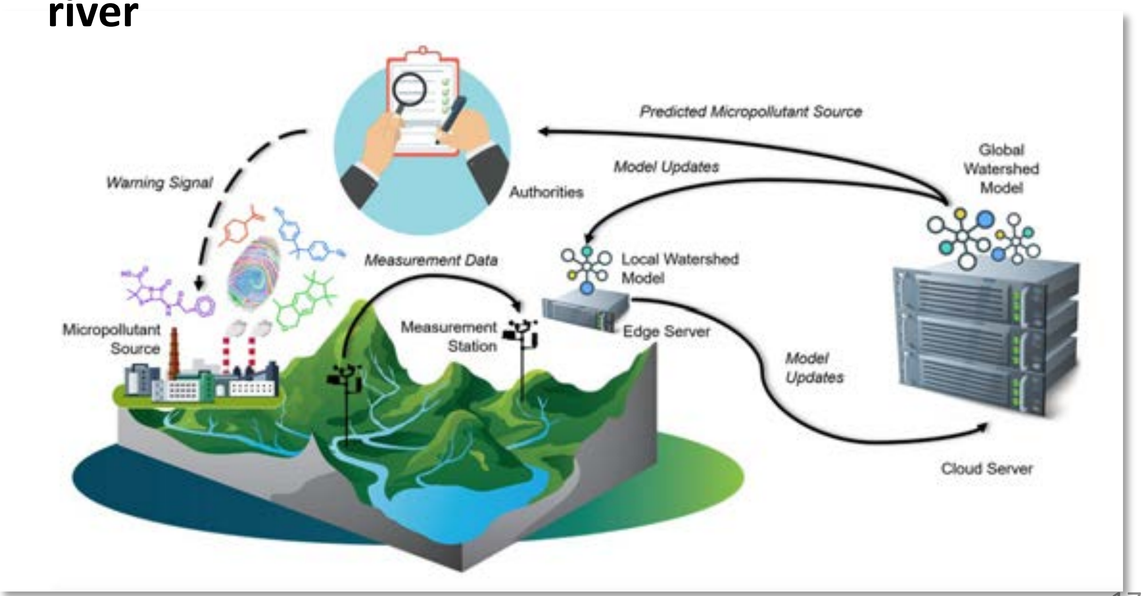
Batagaika crater

Ambarnaya river, Norilsk, Siberia

Source: https://www.brusselstimes.com/news/115566/u-s-offers-to-help-russia-following-arctic-oil-spill/

SWAIN - Sustainable Watershed Management Through IoT-Driven Artificial Intelligence

- In-silico digital representation of the river
- viscoelasticity
- **Data from IoT sources + expert knowledge = digital model of the river**



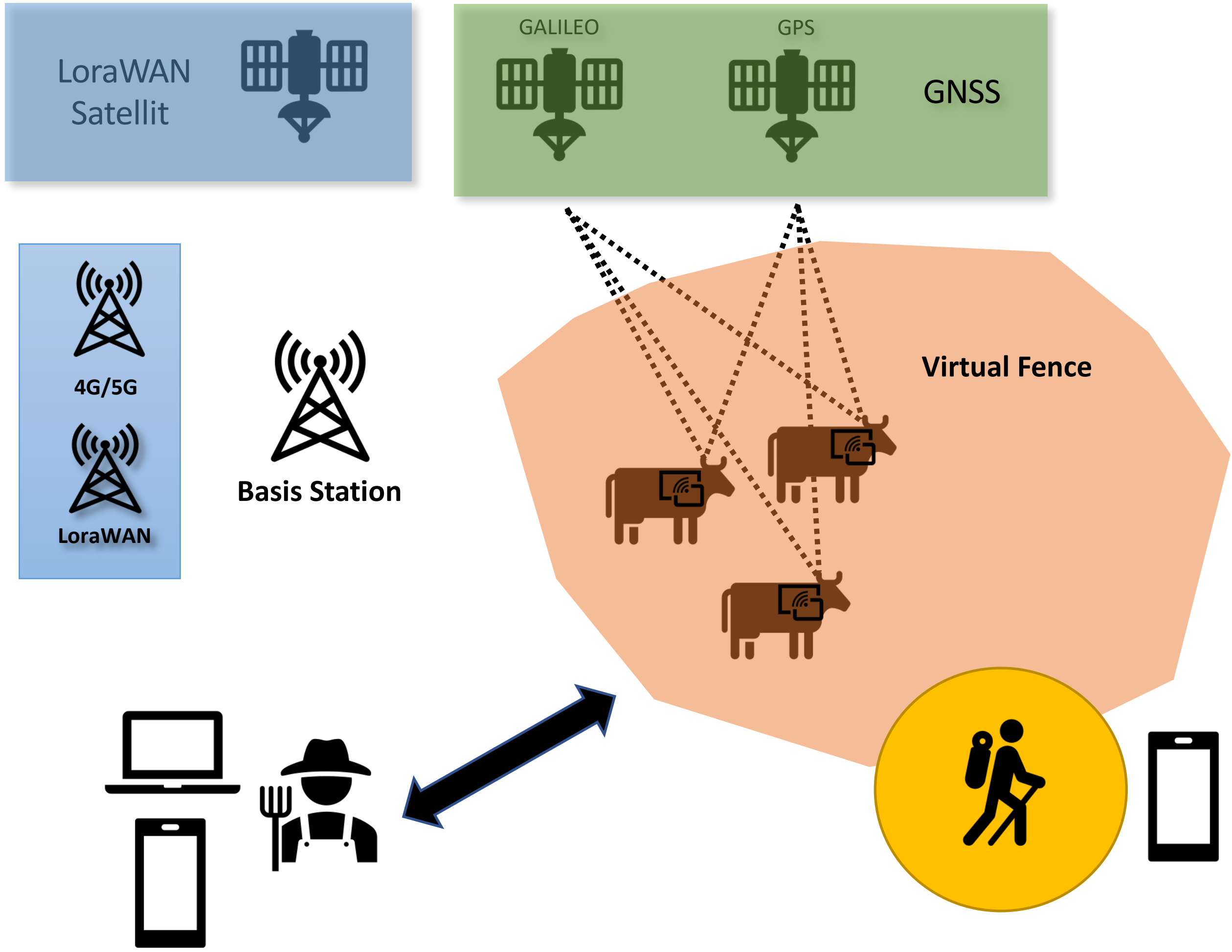
TU WIEN · BOĞAZİÇİ ÜNİVERSİTESİ 1863 · universität wien · SYKE Finnish Environment Institute · chist-era

Source: S. Ahmad, H. Uyanık, T. Ovatman, M. T. Sandıkkaya, V. De Maio, I. Brandic, A. Aral. Sustainable Environmental Monitoring via Energy and Information Efficient Multi-Node Placement. IEEE Internet of Things Journal

FFG Forschung wirkt

Virtual Shepherd

VIEHFINDER



MOVING LAYERS

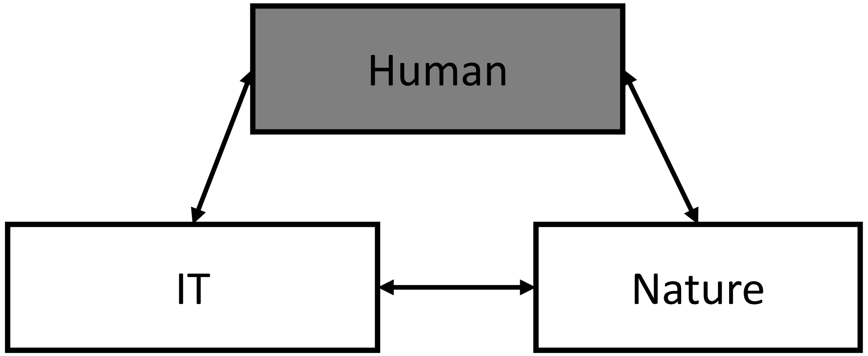
TECHNISCHE UNIVERSITÄT WIEN

TU Graz

PARIS LODRON UNIVERSITÄT SALZBURG

Computational Sustainability

Actors:



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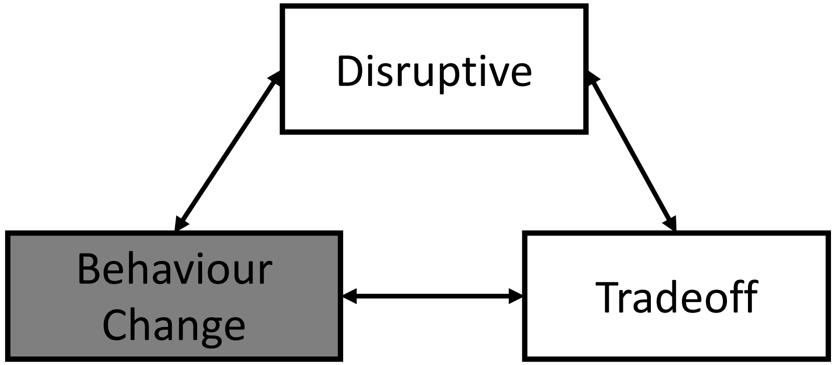


NETZPOLITIK

30 Minuten Netflix wie sechs Kilometer Autofahrt: Kritik an "Klimakiller" Videostreaming

Onlinevideos sollen mittlerweile so viele CO2-Emissionen erzeugen wie ganz Spanien

30. Oktober 2019, 12:22 419 Postings

Weil man sich die Fahrt ins Kino oder das Geschäft spart und weder Verpackung noch Transport von Datenträgern erforderlich ist, hat Videostreaming den Ruf, gut für das Klima zu sein. Dem ist aber nicht so, sagt ein Experte der eigentlich auf Menschenrechte spezialisierten Non-Profit-Organisation Shift, wie "Bigthink" schreibt.

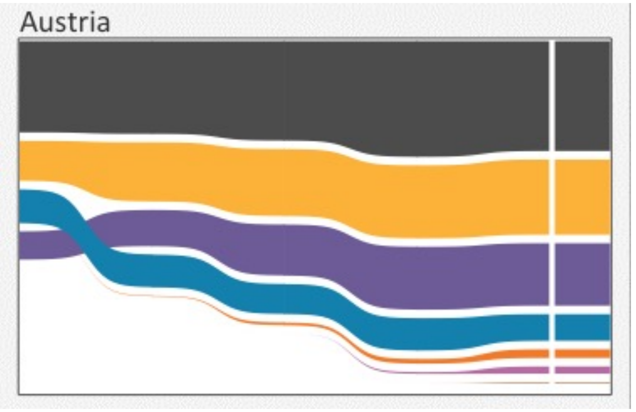
Videostreaming wird offenbar zunehmend zum Klimaproblem.

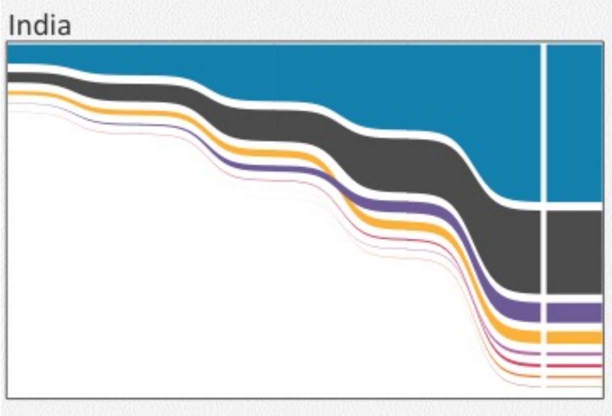
Foto: AFP

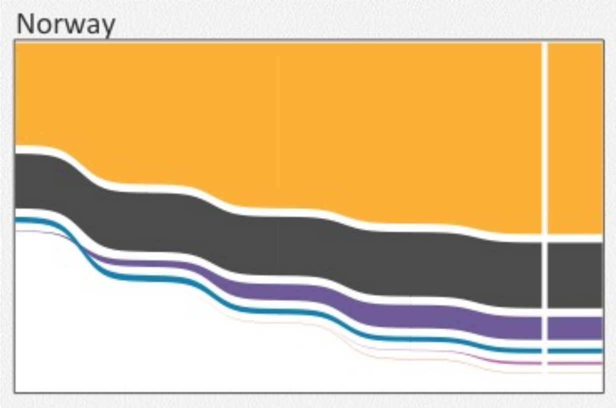
Netflix und Co sollen laut Berechnungen den Treibhausgasausstoß ankurbeln. Eine halbe Stunde Unterhaltung soll das Äquivalent von 1,6 Kilogramm CO2-Emissionen verursachen, was einer Autofahrt über 6,3 Kilometer entspricht. Im vergangenen Jahr sollen die Emissionen der Streamingdienste in Summe ungefähr jenen von Spanien entsprochen haben. Aufgrund der wachsenden Popularität der Dienste rechnet man künftig mit einer Verdoppelung

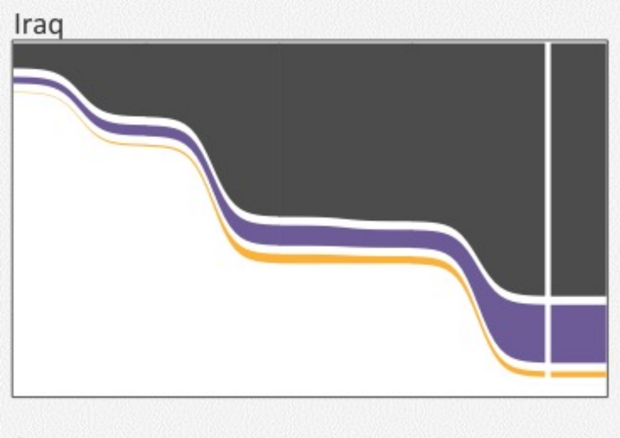
Source: https://www.derstandard.at/story/2000110497282/30-minuten-netflix-wie-6-km-autofahrt-kritik-an-klimakiller

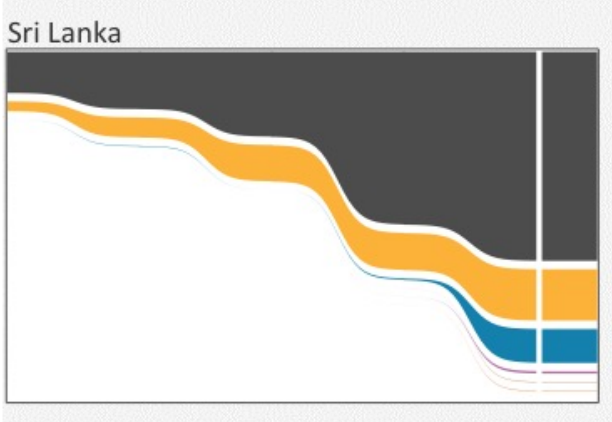
Energy Consumption by Country 1969-2018











Fossil Fuels

Total	Oil	Coal	Gas
86.2%	34.3%	29.2%	22.8%
1,283.4K TWh	509.8K TWh	434.3K TWh	339.3K TWh

Alternative Energies

Total	Hydropower	Nuclear	Other
13.8%	6.7%	4.6%	0.9%
205.2K TWh	99.2K TWh	68.8K TWh	12.7K TWh

Wind	Solar
1.3%	0.4%
18.7K TWh	5.7K TWh

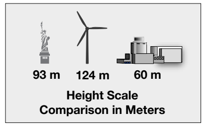
Click on a Source to sort countries and highlight selected source(s)

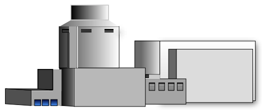
Note: Electricity is the only power source for the IT.

Source: https://www.visualcapitalist.com/wp-content/uploads/2020/09/energy-consumption-interactive.html

2077 2-Megawatt Wind Generators:
9,098,136 Megawatt Hours of electricity per year.

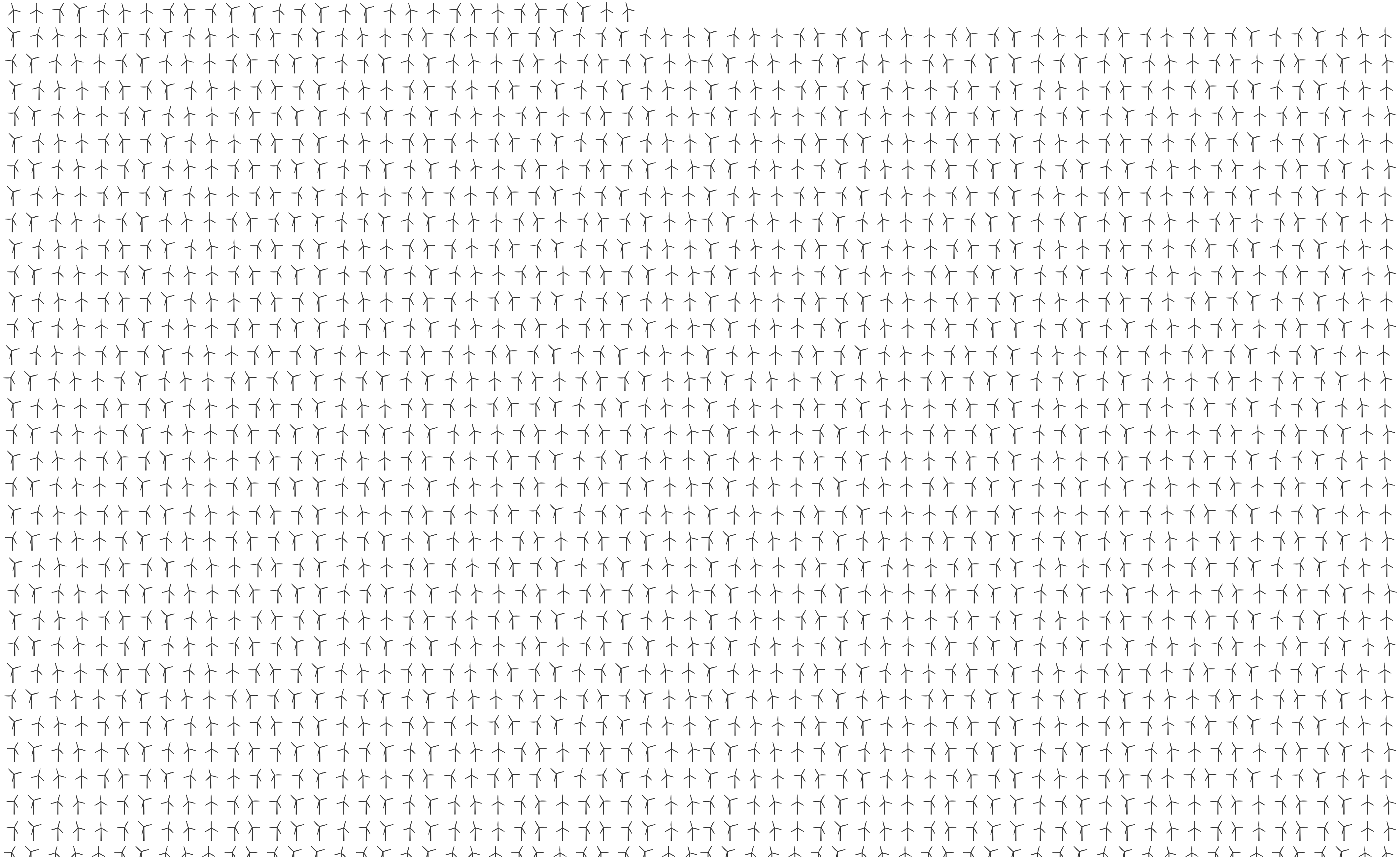
25% Capacity factor, variable output based on weather conditions.
20 year life span.





One 1154-Megawatt Nuclear Power Plant:
9,098,136 Megawatt Hours of electricity per year.

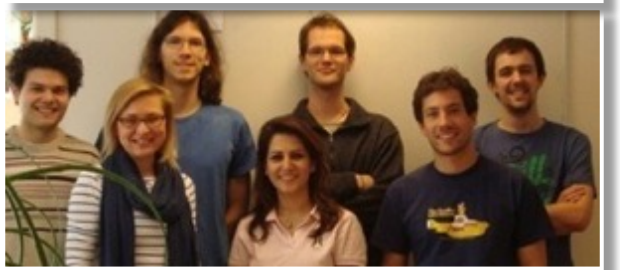
90% Capacity factor, constant output, offline for refueling, maintenance.
60 Year life span.



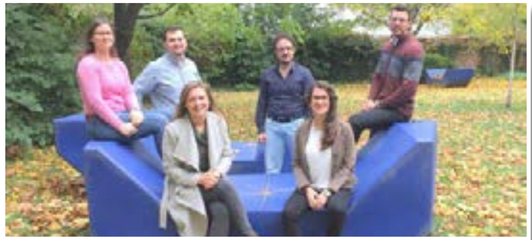
Created by Jason Correia, Feb. 2012

Thanks to funding agencies and my team

2010



2013



2017

2021

2023

European Commission | Horizon 2020 European Union funding for Research & Innovation

cost EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

chist-era

QUANTUM AUSTRIA

W|W|T|F

Stadt Wien

MARIE CURIE ACTIONS

FWF

FFG Forschung wirkt

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Vorstellung

Neue FZÖ-Fördermöglichkeiten mit Fokus auf AI for Green

Gerit Oberraufner, FWF

Markus Proske, FFG

Hannes Schwetz, aws

AIM AT 2030
Artificial Intelligence Mission Austria

AI Mission Austria –
AI for Green

Wien, 11. Oktober 2023

Gerit Oberraufner

FWF Österreichischer Wissenschaftsfonds

AI Mission Austria – AI for Green

FWF Österreichischer Wissenschaftsfonds

- **Zielsetzung**: exzellente wissenschaftliche Grundlagenforschung im Bereich AI Green. Verwendung von AI Technologien um
  - den Umweltschutz voranzutreiben
  - den Arten- und Naturschutz zu gewährleisten
  - dem Klimawandel entgegenzuwirken
  - den Ressourceneinsatz zu verringern
- **Ausschreibungsstart**: 15. November 2023, laufende Einreichung
- **Abwicklung**: über bestehendes, gut etabliertes Förderportfolio
  - Einzelprojekte, ESPRIT, PEEK, 1000-Ideen

WIR FÖRDERN ZUKUNFT.

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ARTIFICIAL INTELLIGENCE MISSION AUSTRIA (AIM AT)

Markus Proske
11.12.2023 | Wien

AI MISSION AUSTRIA (AIM AT)

Gemeinsame Initiative von FWF, FFG und AWS, finanziert durch den Fonds Zukunft Österreich

- FWF: AI-Grundlagenforschung
- FFG: anwendungsorientierte AI-Forschung
- AWS: unternehmerische Umsetzung

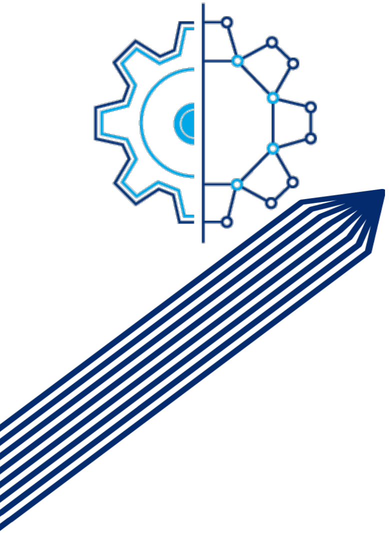
Web: ffg.at/aim

Rückblick auf 2023:

- Standortübergreifendes Leitprojekt zur vertrauenswürdigen und menschenzentrierten Nutzung von AI
- Stiftungsprofessur „Edge AI“

Ausblick auf 2024 mit Fokus auf „AI for Green“:

- Stiftungsprofessur „AI in Green Energy Systems“
- Auf- und Ausbau von „AI for Green“ Kompetenz
    - 10 industrienahe Dissertationen
    - Forschungspraktika für Schüler:innen
- AI zum Schutz von Ökosystemen und Förderung nachhaltiger Landnutzung



aws AI-Förderungen im Überblick

www.aws.at/aimissionaustria

AI-Start
Jetzt Antrag stellen!
Nur noch bis **04. Dezember 2023** möglich!

AI-Start — 15.000 EUR Zuschuss bis zu 50% Förderquote
Erste Schritte zur Umsetzung vertrauenswürdiger AI-Vorhaben

AI-Start: Green — = **AI-Start** + **Schwerpunkt auf Green**
Initiative zur Erreichung von Klima- und Nachhaltigkeitszielen, Einreichung ab 02/2024

AI-Adoption — 150.000 EUR Zuschuss bis zu 80% Förderquote
Innovative vertrauenswürdige AI-Projekte und Vorbereitung auf Regulierung, Standards, Normen und Zertifizierungen, Einreichung ab 01/2024

AI-Adoption: Green — **= AI-Adoption** + **Schwerpunkt auf Green**
Maßnahmen zum Klima- und Umweltschutz als auch zur Anpassung an die Folgen des Klimawandels, Einreichung ab 01/2024

AI-Wissen — AWS-Coaching und bis zu 40.000 € Zuschuss bis zu 80% Förderquote
20.000 € Zuschuss und Beratung für die Implementierung von Daten-strategien AI-Geschäfts- und Innovationsschutzstrategien
20.000 € Zuschuss für AI-Weiterbildungen und AI-Zertifizierungen, ab Anfang 2024

Vorstellung

Good Practices im Bereich künstliche Intelligenz und Klimaneutralität

Je 3 Minuten Vorstellung

Folgend Möglichkeit zum individuellen Kennenlernen

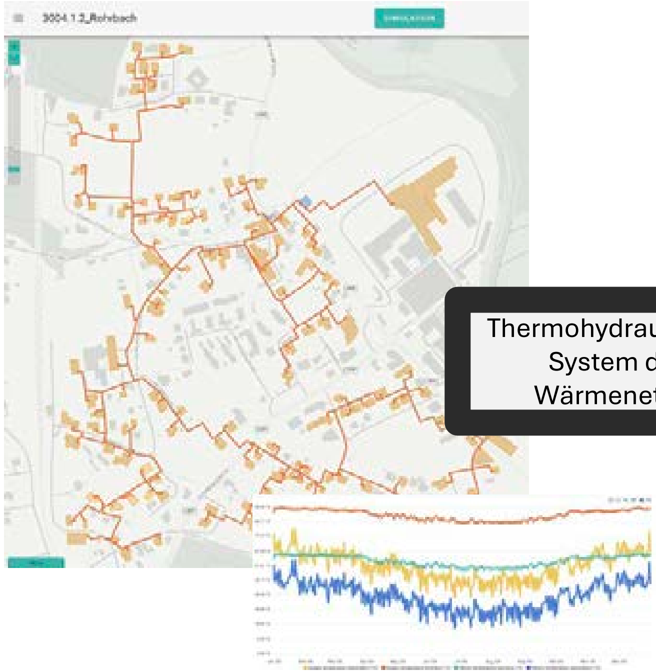
Vorstellung

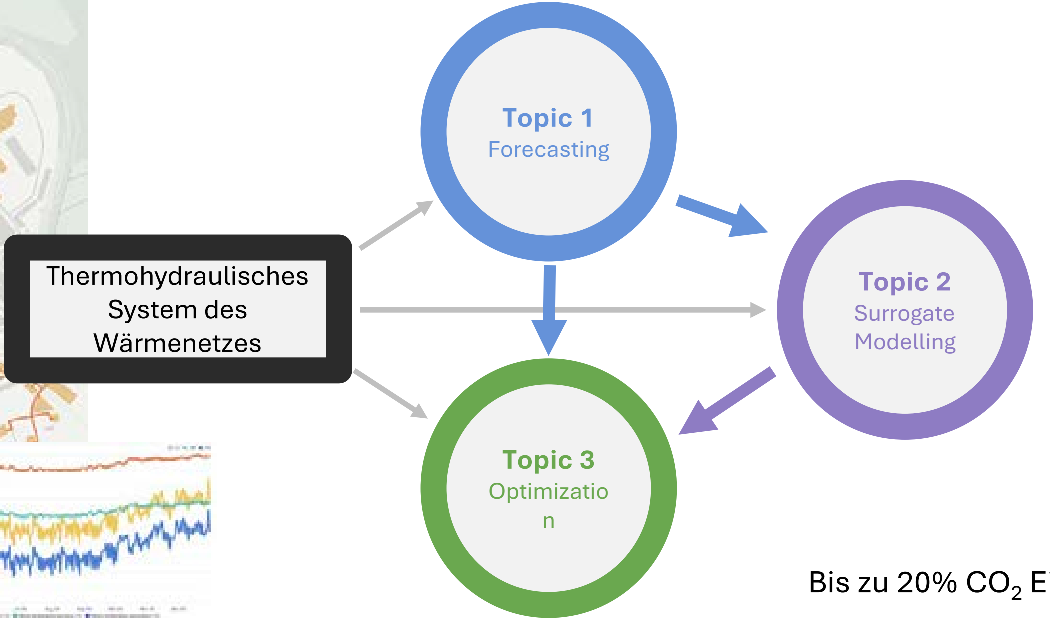
AI4GreenHeatingGrids

Sebastian Haid, Arteria Technologies

AI4GreenHeatingGrids

Einsatz von KI zur optimierten Regelung großer, komplexer Wärmenetze





Bis zu 20% CO_2 Einsparung

Sebastian Haid
sebastian.haid@arteria.at

Vorstellung

DrSOLAR

Alex Fräss-Ehrfeld, Elle Zadina, Kaegan Schiff, AIR6Systems

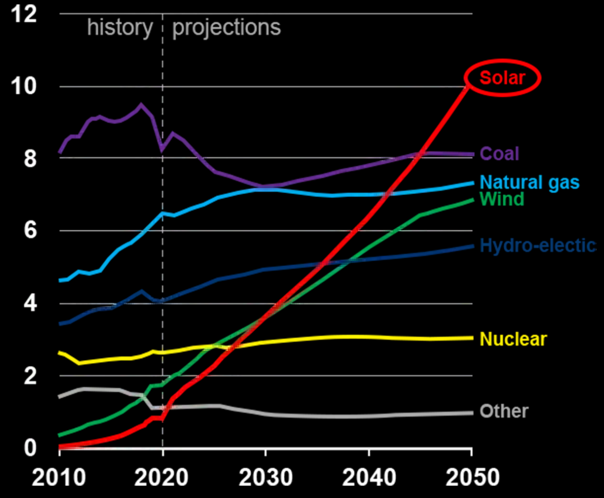
DrSOLAR

DROHNEN-BASIERTE PV-ANLAGEN INSPEKTION MIT KI

AIR6 SYSTEMS

SOLAR ENERGIE[1]

Weltweite Stromerzeugung nach Quelle
(netto, Billionen kWh)



LÖSUNG ZUR EFFIZIENZSTEIGERUNG (BETRIEB & WARTUNG)

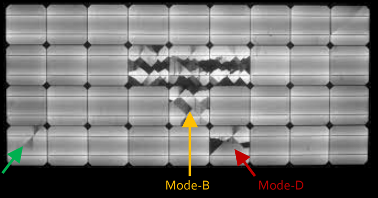
Identifikation von fehlerhaften Modulen
aus der Luft

1 **DROHNENAUTONOMIE**
AIR4 Drohne von AIR6 Systems

2 **ZUVERLÄSSIGE ERKENNUNG**
SWIR Sensor + Elektrolumineszenz

SWIR SENSOR

EL VERFAHREN [2]



3 **AI – KLASSIFIKATION**
Software / KI

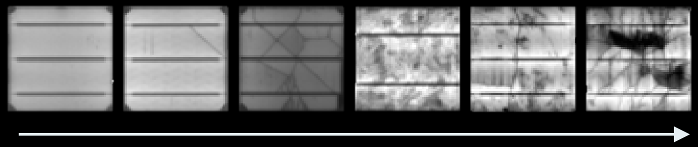


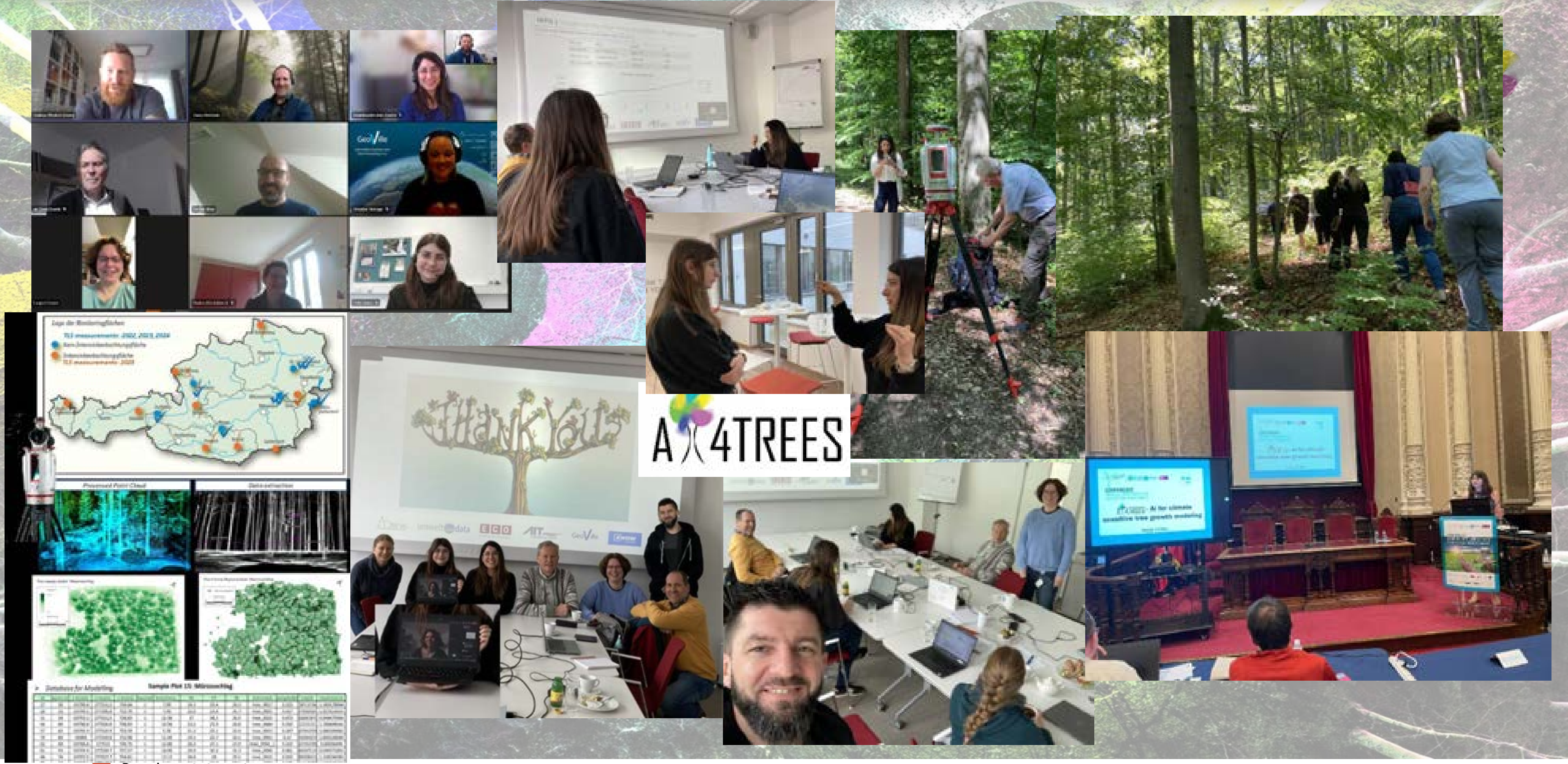
Image Credits:

(1) www.earth.org
(2) DTU FOTONIK
(3) www.researchgate.net/publication/359273663_CNN-based_Deep_Learning_Approach_for_Micro-crack_Detection_of_Solar_Panels

Vorstellung

AI4Trees

Anahid Jalali AIT



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Innovation und Technologie

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The developments described are carried out within the AI4Trees research project funded by the Austrian Research Promotion Agency (FFG) in the frame of the Research, Technology & Innovation (RTI) initiative “AI for Green”.

https://www.linkedin.com/company/ai4trees/

Vorstellung

AI RoboSens

Markus Loinig, Senzoro GmbH

Vision "AI RoboSens"

Produktionsstätten
mit 0 "Zero"
Energieverschwendung

Ziele

Automatische Detektion von Energieverlusten in Fabriken mittels Künstlicher Intelligenz, Inspektionsroboter und Sensor-Fusioning

Aktivitäten / Waste Scenarios

1.) Detektion von Leckagen (z.B. Druckluft)

2.) Detektion von Wärmeverlusten (z.B. defekte Isolierungen)

3.) Detektion von nicht voll funktionsfähiger Bauteile (z.B. defekte Ventile, defekte Wälzlager)

4.) Detektion von Anomalien (z.B. Geräusche, Gerüche/Gase, Vibrationsverhalten)

5.) … weitere

Sensoren

1) Gas-/Geruchssensor
2) Wärmebildkamera
3) Luftultraschallsensor
4) Visuelle Kamera
5) Vibrationssensor
6) Körperschallsensor
7) … weitere

Konsortium

senzoro
Senzoro GmbH

Spezialisiert auf die Auswertung von Sensordaten mittels Künstlicher Intelligenz

smart inspection
Smart Inspection GmbH

Spezialisiert auf autonome Inspektionssysteme für Industrieanlagen

Universität für Weiterbildung Krems
DONAU UNIVERSITÄT KREMS
Department für integrierte Sensorsysteme

Spezialisiert auf Sensor Fusioning und Analyse von Sensordaten mittels Künstlicher Intelligenz

Industriepartner & Zielgruppe

WIEN ENERGIE

Was fehlt ?

Wir sind auf der Suche nach weiteren Industriepartnern, um möglichst realistische Szenarien zu definieren

(Bei Interesse: info@senzoro.com)

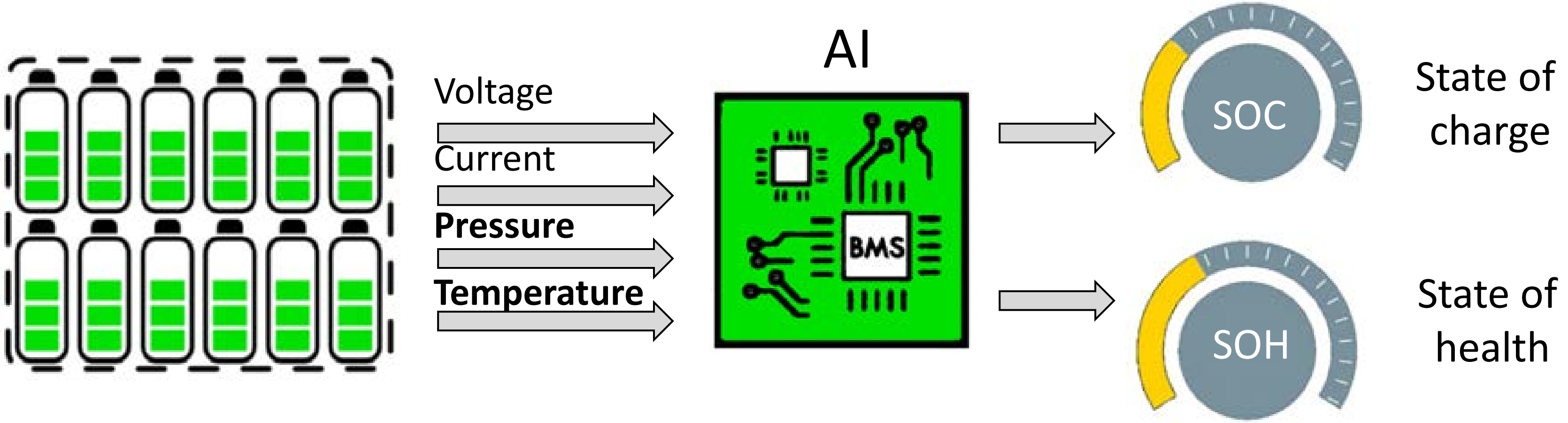
Vorstellung

DurAIcell

Florian Krebs, JOANNEUM RESEARCH Forschungsgesellschaft mbH

DurAIcell

Multi-sensory AI for long duration battery management



Main goal: Increase battery efficiency to save valuable ressources

Vorstellung

Rebottle: KI-Implementierung in 48 Stunden

Lilia Gerber

Rebottle

KI Implementierung in 48 Stunden

Vorstellung

REWAI und RecAIcle

Michael Haslgrübler, Pro2Future

REWAI - Reducing Energy and Waste using AI

Project Duration: 01.04.2022 – 31.3.2025

DI Dr. Michael Haslgrübler, Pro²Future, michael.haslgruebler@pro2future.at

Consortium:

Pro2Future GmbH
Johannes Kepler University Linz - Institute of Pervasive Computing (JKU-IPC)
Graz University of Technology - Institute of Interactive Systems and Data Science (TUG-ISDS)
Lenzing AG

This work was supported by REWAI (FFG, Contract No. 892233)

Shareholders of Pro2Future GmbH:

Public funding of Pro²Future:

recAIcle - Recycling-oriented collaborative waste sorting by continual learning

Project Duration: 01.07.2022 – 30.6.2025

DI Dr. Michael Haslgrübler, Pro²Future, michael.haslgruebler@pro2future.at

Consortium:

Pro2Future GmbH

Siemens AG Österreich

Montanuniversität Leoben, Lehrstuhl für Abfallverwertung und Abfallwirtschaft

This work was supported by recAIcle (FFG, Contract No. 892220)

Shareholders of Pro2Future GmbH:

Public funding of Pro²Future:

Vorstellung

ESCADE

Jia Lei Du, Salzburg Research

ESCADE

Energy-Efficient Large-Scale Artificial Intelligence for Sustainable Data Centers

Weltweit nachhaltigstes KI-Rechenzentrum

Dr.-Ing. Jia Lei Du, Salzburg Research

AI Policy Forum, Technisches Museum, Wien

11. Oktober 2023

Deutsches Forschungszentrum für Künstliche Intelligenz GmbH · NT.AG · SHS - STAHL-HOLDING-SAAR · SEITEC · RUB · Technische Universität Dresden · salzburgresearch · eco2050 · SpiNNcloud · elevait · ALEPH ALPHA · DLR Projektträger · FFG · Bundesministerium für Wirtschaft und Klimaschutz · Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

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Innovation und Technologie

Bundesministerium
Finanzen

Vorstellung

Fledged

Stefan Übermasser, AIT

AIM AT 2030
Artificial Intelligence Mission Austria

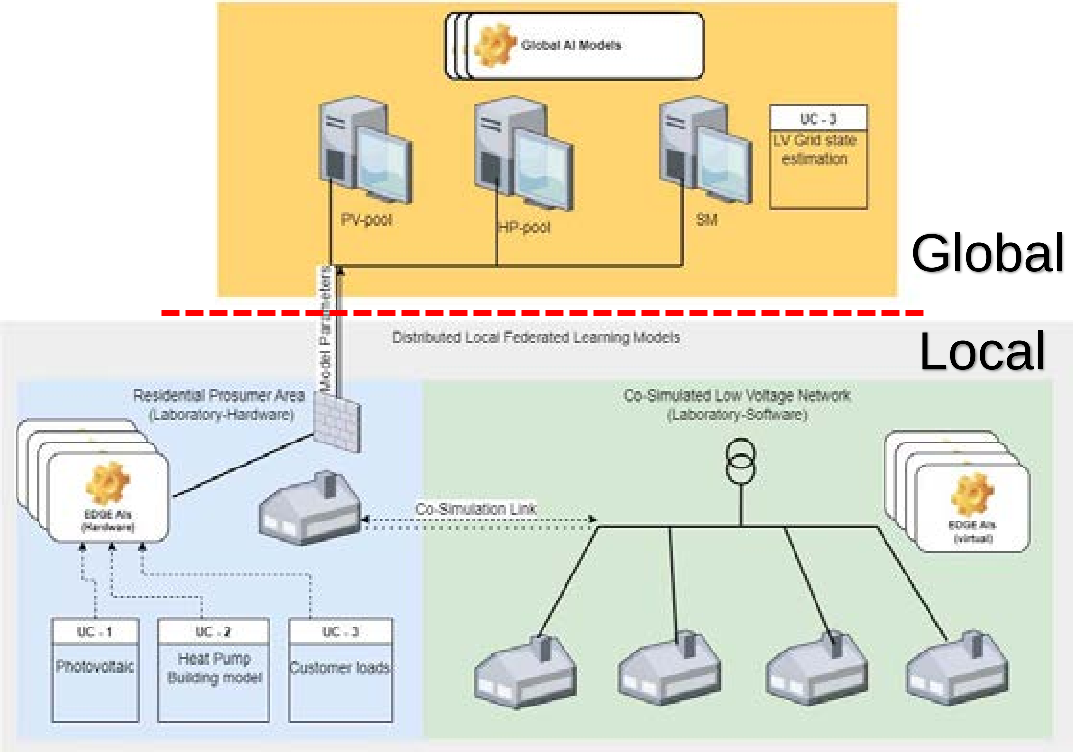
FLEDGED

Federated Learning in the LV Grid for Edge AI Applications

FLEDGED Goals: Develop, test, and evaluate federated learning for defined LV applications in the distribution system (including end users) to achieve the following:

- Improve services through **on-site use of local high-resolution data** and situation-dependent machine learning algorithms
- **Ensuring data privacy and increased security** by avoiding data transfers
- **Enabling new services** that were not feasible due to privacy issues and/or the problem of transferring large data sets
- With a focus on services that **increase hosting capacity and the use of local renewable energy generation** by better supporting planning and decision-making processes
- Services to forecast flexibility, **promote optimal energy market decisions**, avoid costly grid reinforcements, and increase grid stability

Federated Learning Architecture



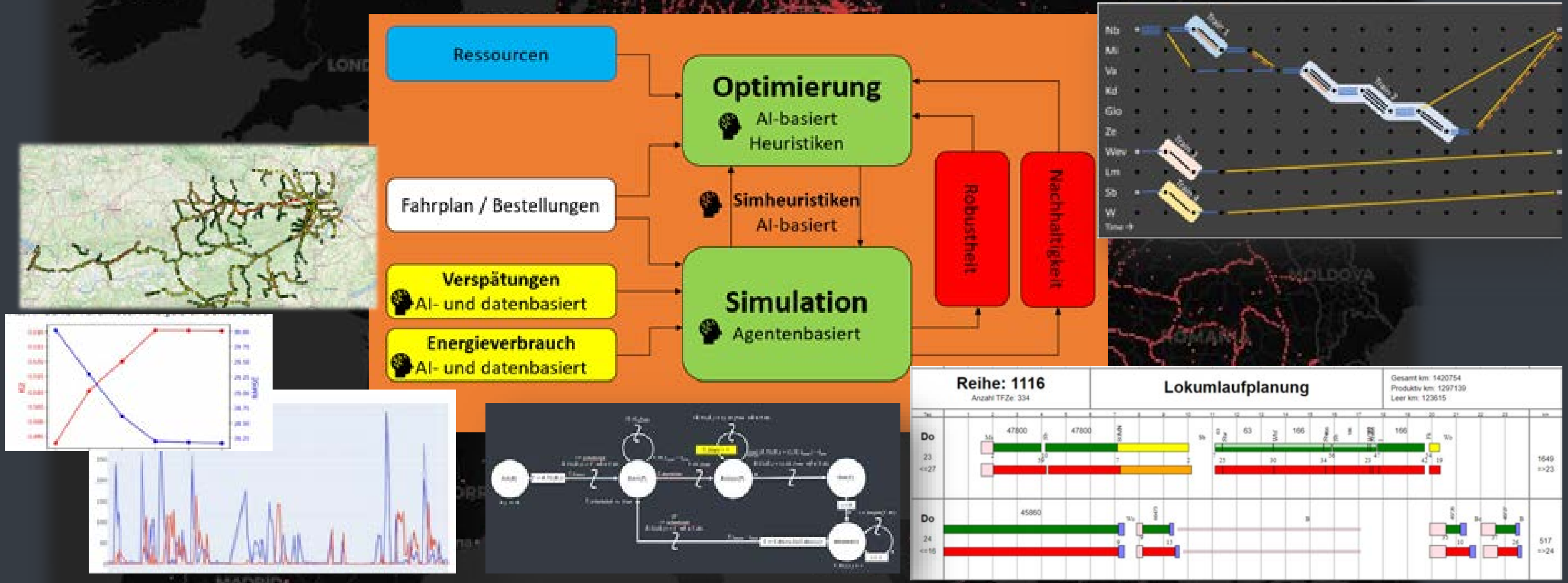
Dieses Projekt wird aus Mitteln der FFG gefördert. www.ffg.at

Vorstellung

GreenTrAInPlan

Matthias Rößler, dwh GmbH

Green-TrAIn-Plan



dwh
simulation services
technical solutions

universität wien

TU WIEN
TECHNISCHE UNIVERSITÄT WIEN

ÖBB

Vorstellung

BAMBI

Gabriele Traugott, FH Hagenberg


BAMBI
Biodiversity Airborne Monitoring
Based on Intelligent UAV sampling
FFG
Forschung wirkt.

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Willkommensworte

Alexander Banfield-Mumb-Mühlhaim

Bundesministerium für Finanzen

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Artificial Intelligence Mission Austria

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Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Eine Vision für KI und Klimaneutralität in Österreich

Gertraud Leimüller

winnovation consulting gmbh

AIM AT 2030
Artificial Intelligence Mission Austria

Keynote

Vom Traum zur Realität – Das Lösungspotenzial von AI in der Praxis

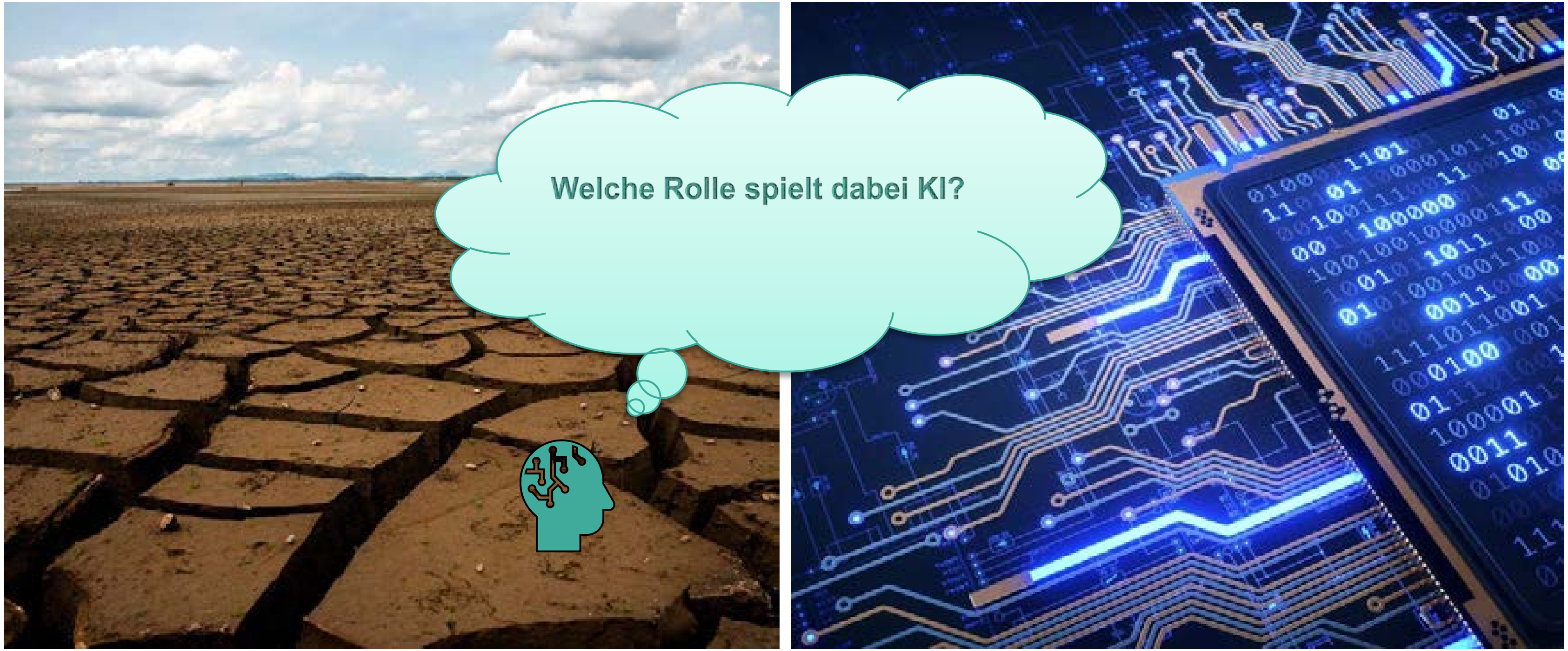
Jasmin Lampert, AIT

AUSTRIAN INSTITUTE OF TECHNOLOGY
TOMORROW TODAY

VOM TRAUM ZUR REALITÄT – DAS LÖSUNGSPOTENZIAL VON AI IN DER PRAXIS

Jasmin Lampert (AIT) AI Policy Forum, 11. Oktober 2023

WICHTIGE THEMEN IM 21. JAHRHUNDERT



KANN KI HELFEN KLIMANEUTRAL ZU WERDEN?

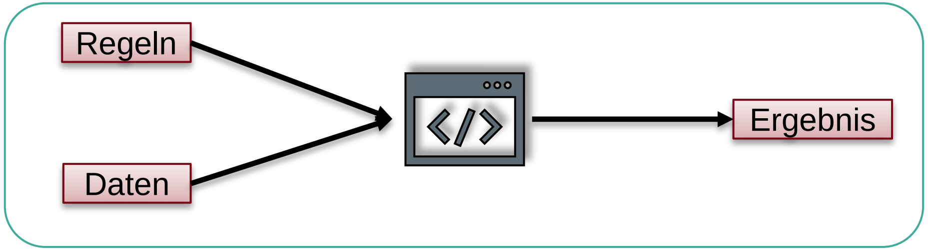
Einerseits

KI-Anwendungen haben eigenen CO_2-Fußabdruck

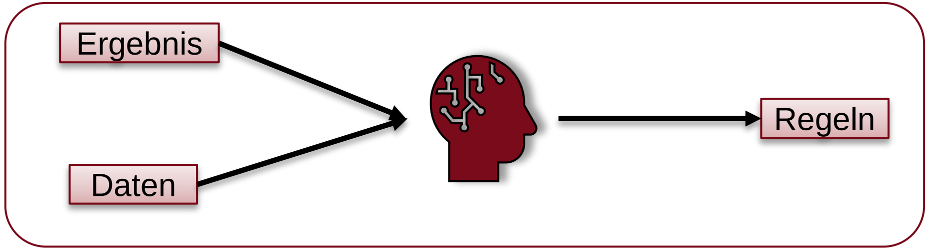
Andererseits

KI-Anwendungen können helfen, um optimale (effiziente) Lösungen zu finden

WAS IST KI?

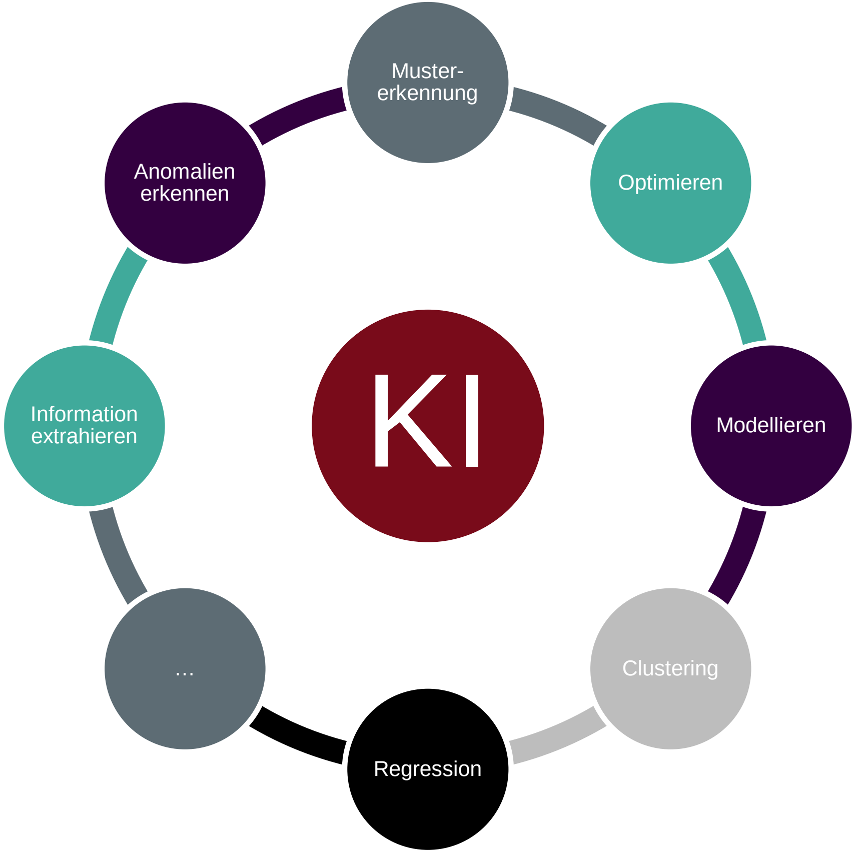


Klassisches Programmieren



Maschinelles Lernen

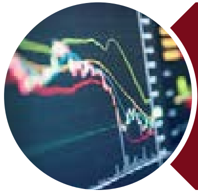
WAS KANN KI?



KI
Muster-
erkennung
Optimieren
Modellieren
Clustering
Regression
…
Information
extrahieren
Anomalien
erkennen

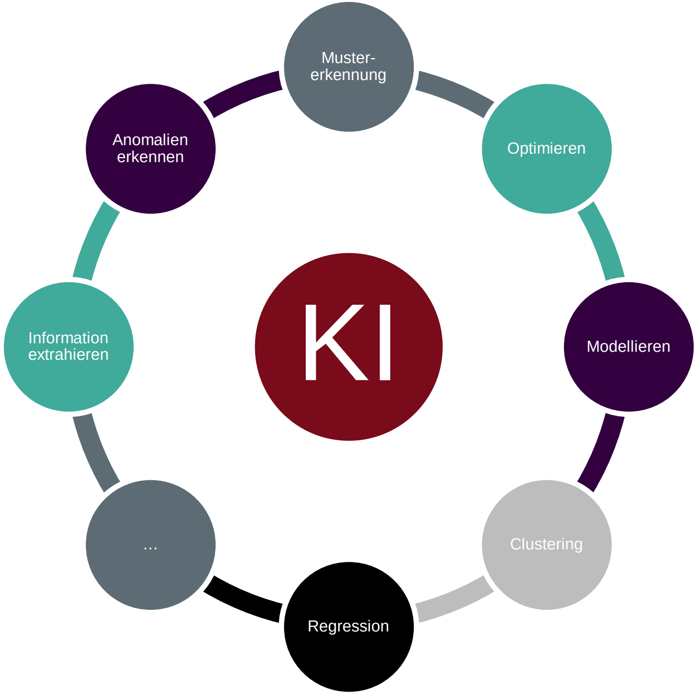
WAS KANN KI BESONDERS GUT?

Bildanalyse

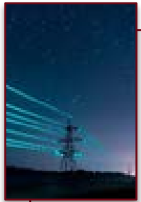


Optimierung komplexer Systeme

Generative KI



WO WIRD KI EINGESETZT, UM KLIMANEUTRAL ZU WERDEN?

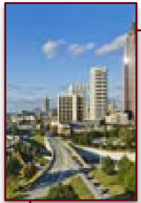


Elektrische Systeme

- Erneuerbare Energiequellen
- Reduzieren des Energiebedarfs
- Globale Effekte erzielen

Transport

- Reduzierung des Verkehrs
- Effizienz von Fahrzeugen verbessern
- Alternative Antriebe
- Modaler Shift

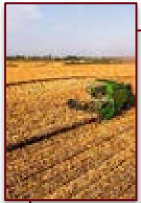


Gebäude und Städte

- Gebäude-Optimierung
- Städteplanung
- Smart Cities

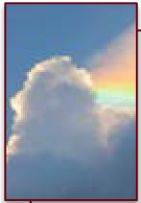
Industrie

- Optimierte Lieferketten
- Verbesserung von Materialien
- Produktion & Energie



Forst- und Landwirtschaft

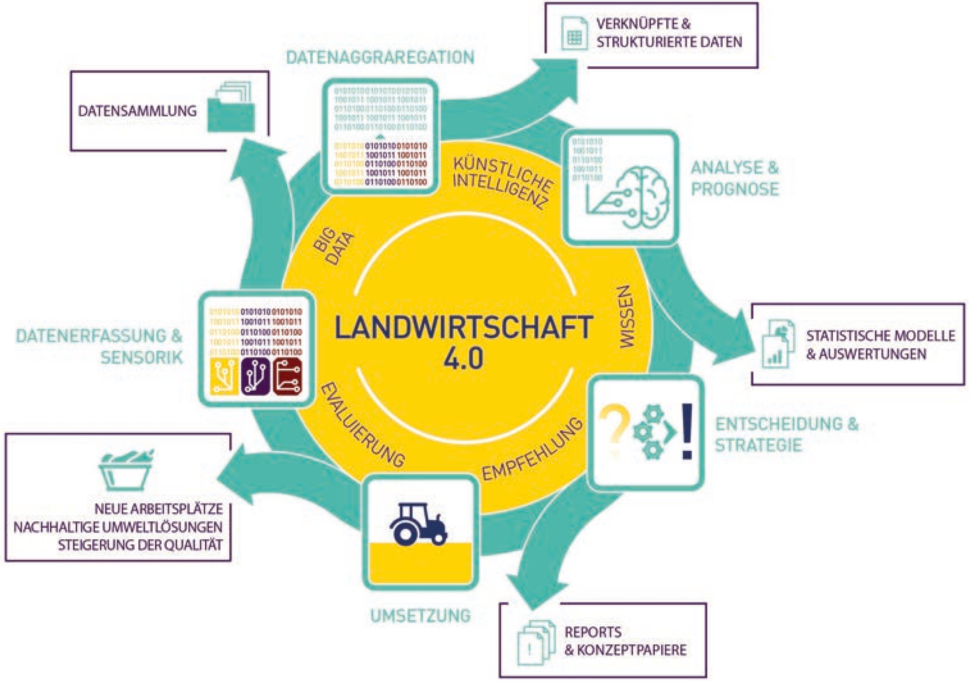
- Monitoring: Emissionen, Biodiversität
- Nachhaltige Landwirtschaft
- Forstmanagement



Klimawissenschaften

- Bessere Modelle und Vorhersagen
- Vorhersage von Extremereignissen

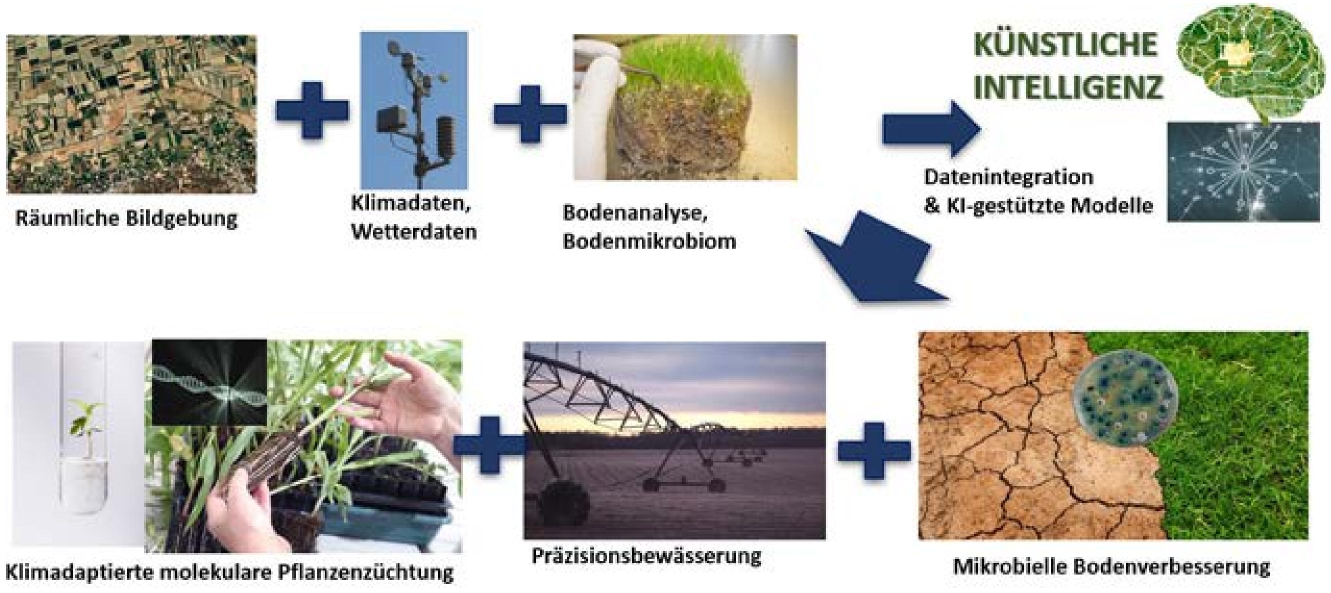
KI IN DER LANDWIRTSCHAFT



KI IN DER LANDWIRTSCHAFT

- Anwendungen:
  - Optimierung der Ernte
  - Geringerer Einsatz von Düngemitteln und Pestiziden
  - Resistentere Pflanzen
  - Automatisierung der Prozesse
  - …

KLIMAFITTE PFLANZEN



Quelle: HBR@AIT

PREDICTBEETWEEVIL

Data- and model-based prediction of sugar beet weevil occurrence

Industrie: AGRANA Research & Innovation Centre

AIT: HBR & DSAI

Dauer: 3 Jahre

PROBLEM: Auftreten des Rübenderbrüsslers verursacht hohen Schaden (Verlust von 4.460 ha in 2020 in Österreich)

ZIEL: Vorhersagemodell für die Ausbreitung des Derbrüsslers

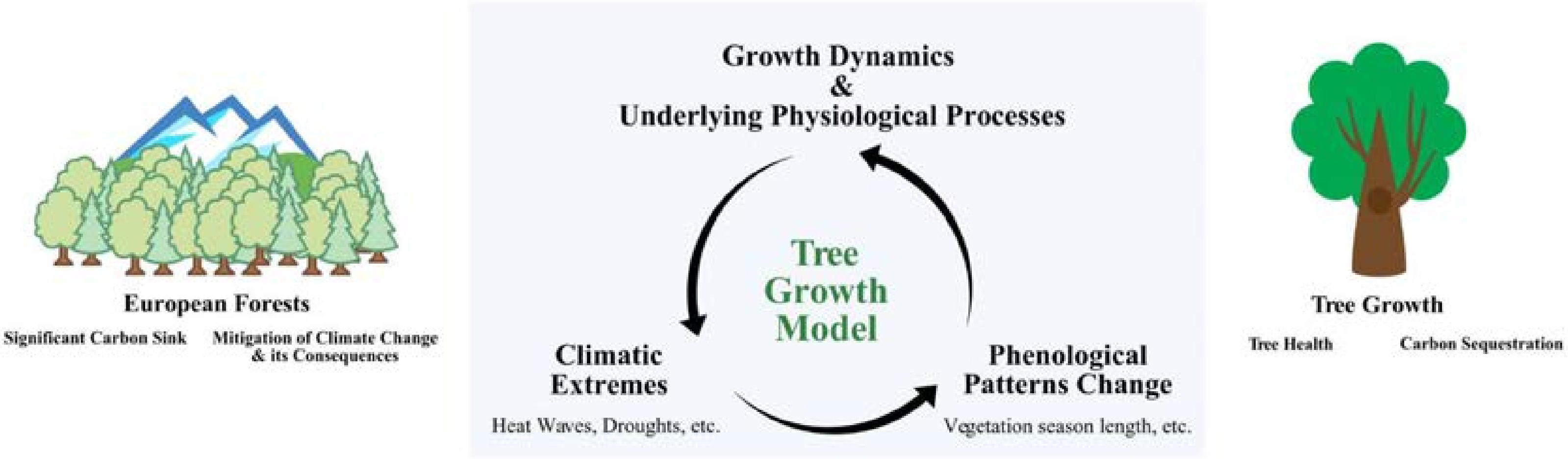
METHODIK: Datensammlung (Klima, Bodenfeuchtigkeit, -typ), Analyse (Bodenmikroben, Biodiversität), Regressionsmodell als Basis, KI-basierte Modelle, um komplexe Zusammenhänge zu erfassen

KI IN DER FORSTWIRTSCHAFT

Anwendungen:

- Monitoring Waldbestand und Biodiversität
- Ausbreitung von Schädlingen und Krankheiten
- Wachstumsmodelle
- Optimale Strategien im Forstmanagement
- Tracking von Holzbeständen
- …

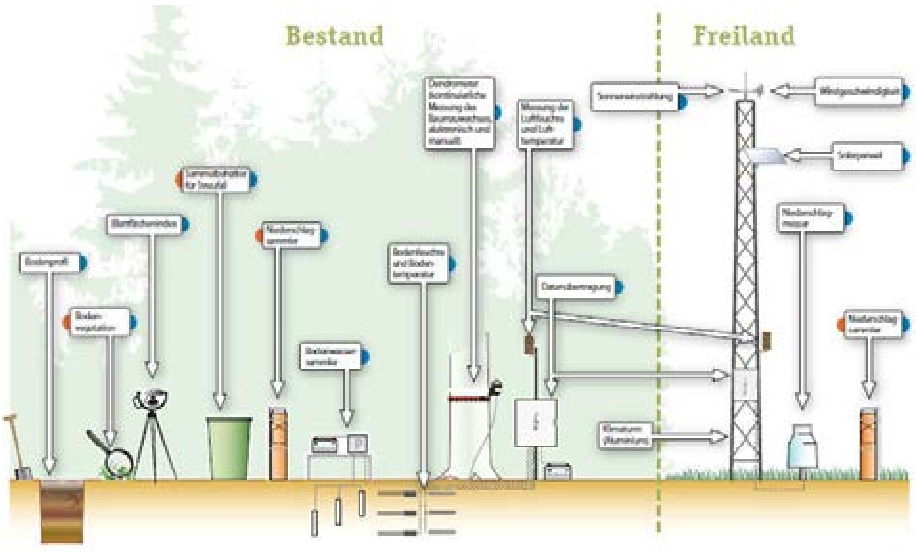
AI4TREES: PROBLEMSTELLUNG



BFW Bundesforschungszentrum für Wald · umweltdata · E.C.O. Institut für Ökologie · AIT Austrian Institute of Technology TOMORROW TODAY · GeoVille · Know Center

AI4TREES: IN A NUTSHELL

- Ziel: Modellierung des Baumwachstums unter Berücksichtigung des veränderten Klimas
- Motivation: Waldbestand bindet Kohlendioxid
- Gefördert durch das BMK im Rahmen des „AI for Green“ Programms
- Herausforderungen:
  - Datengrundlage erfasst nicht die klimatischen Veränderungen
  - Angepasste Modelle für einzelne Baumarten
  - Berücksichtigung unterschiedlicher Daten-Modalitäten



ICP Forest Monitoring Network

DATENGRUNDLAGE

Stündliche Messungen

Dendrometer

Jährliche Messungen

Terrestrial Laser Scanning

2-3 Beobachtungen/Jahr

Fernerkundung

TECHNOLOGISCHER ANSATZ

- Data Science
  - Räumliche Analyse und Vergleich mit Klimadaten
  - Qualitätsanalyse
- KI
  - Erklärbare Algorithmen (XAI)
  - Probabilistischer Ansatz: Gaußsche Prozesse
  - Physics-informed Machine Learning

Baumwachstum als Klassifikation

x_train = tree_df['2010-01-01': '2012-12-30‘]
x_test = tree_df['2013-01-01': '2013-12-30']

KI FÜR ERNEUERBARE ENERGIEN

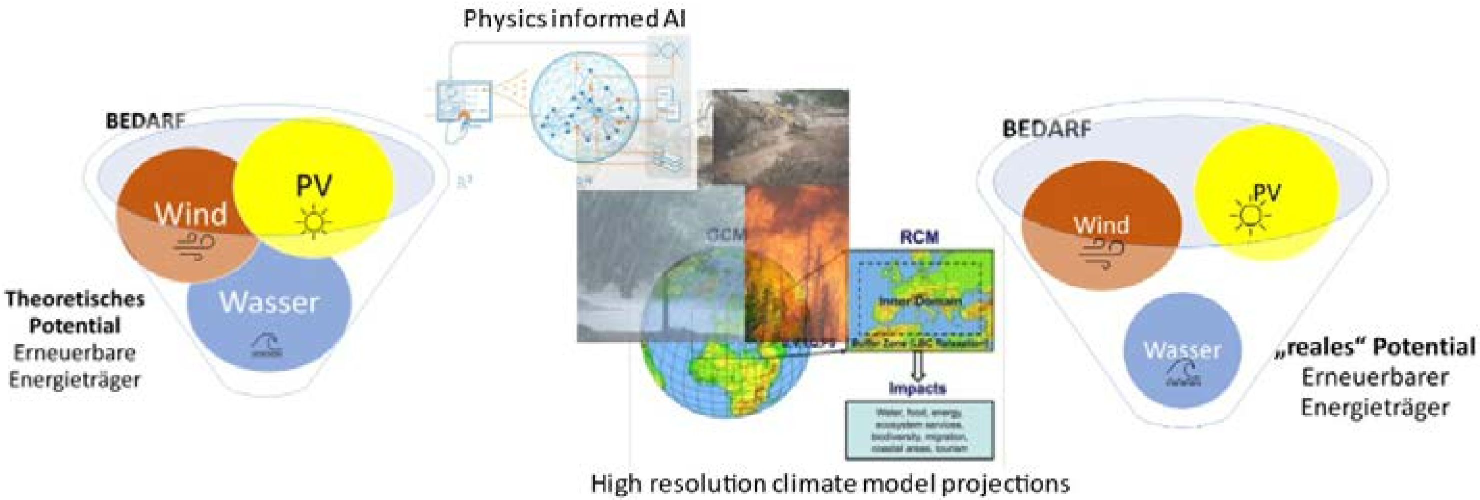
Problemstellung:

- Erneuerbare Energiequellen spielen eine wichtige Rolle zur Erreichung der Klimaziele.
- KI-basierte Prognosemodelle für Wind- und Sonneneinstrahlungen können effiziente Einbindung von erneuerbaren Energien ermöglichen.
- Energieausbeute von Wind-, Wasser- und Solarkraftwerken mithilfe von KI optimieren.

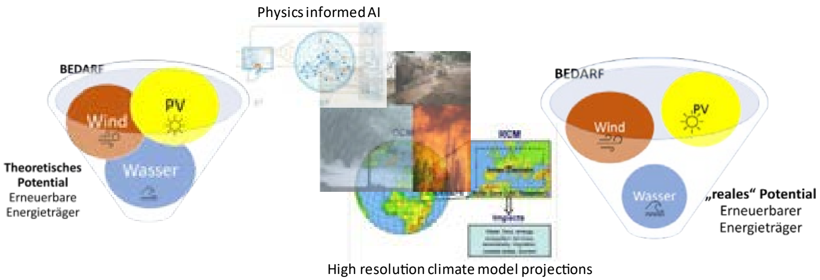
ENERGAIZE

- Um bessere Prognosemodelle für den Energiesektor zu gewinnen, sind langfristige dynamische Wetter- und Klimaprojektionen nötig.
- Diese Projektionen sind sehr zeit- und rechenintensiv
- Physics-informed Machine Learning kann helfen, um effizienter zu höheren Auflösungen zu kommen.
- Sondierung:Gefördert durch das BMK im Rahmen des „AI for Green“ Programms

UNSER ANSATZ

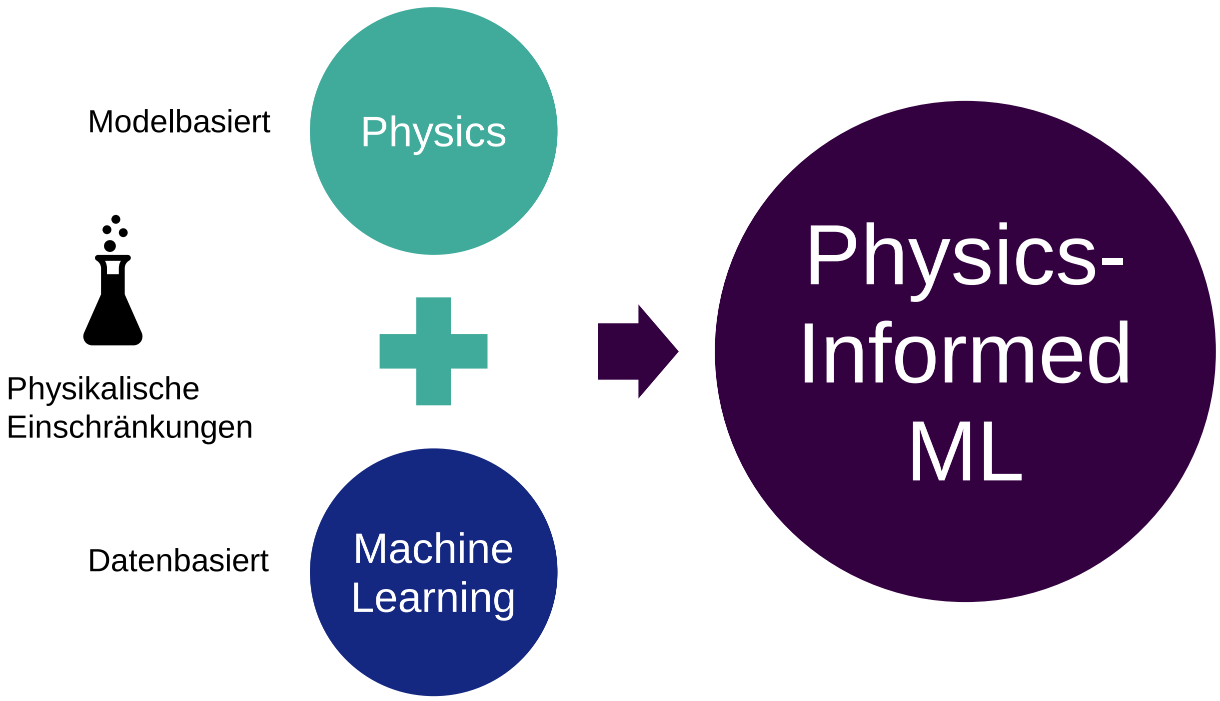


UNSER ANSATZ



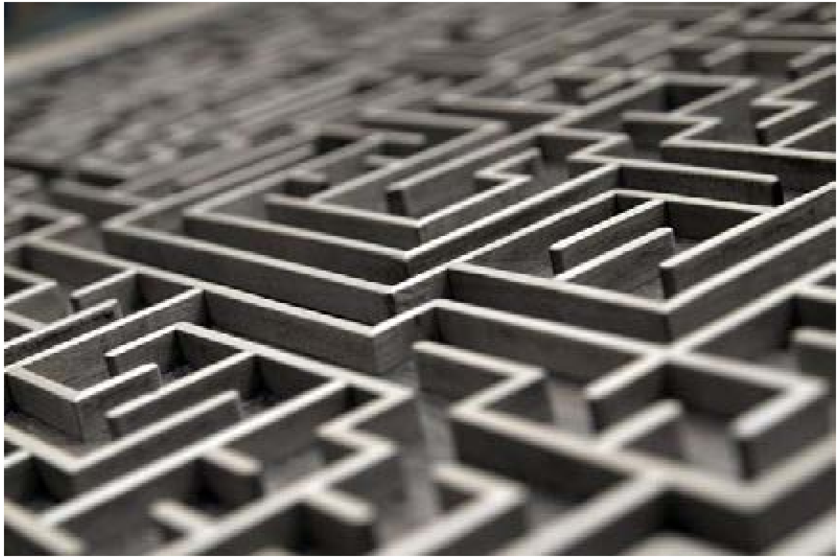
- Anwendung von KI:
  - Beim Downscaling von Klima- und Wettermodellen (Superresolution)
  - Bei der effizienteren Erzeugung von Ensembles
  - Optional: Bei der Erkennung von extremen Wettersituationen (Pattern Recognition)

PHYSICS-INFORMED MACHINE LEARNING



- Weniger Daten nötig
- Verbesserte Recheneffizienz
- Besser verallgemeinerbar
- Besser interpretierbar

HINDERNISSE



- Fehlende oder nicht repräsentative Daten
- Nicht dokumentierte oder inkompatible Datenformate
- Nicht digitalisierte Daten
- Domänenexperten haben wenig KI-Expertise und umgekehrt
- Fehlende Recheninfrastruktur

ZUSAMMENFASSUNG

Klimawandel und Nachhaltigkeit sind die größten Herausforderungen für die Zukunft der Menschheit.

KI-Anwendungen sind immer wichtiger für wissenschaftliche Entdeckungen und in der Industrie

Der (richtige) Einsatz von KI ist entscheidend, um klimaneutral zu werden.

VIELEN DANK!

- Klimawandel und Nachhaltigkeit sind die größten Herausforderungen für die Zukunft der Menschheit.
- KI-Anwendungen sind immer wichtiger für wissenschaftliche Entdeckungen und in der Industrie
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Dr. Jasmin Lampert

Senior Scientist

Data Science & AI

Center for Digital Safety & Security

jasmin.lampert@ait.ac.at

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Finanzen

Keynote

Wie wird KI eine grüne Technologie? Ein Blick in die Zukunft

Felix Creutzig, Mercator Research Institute on Global Commons and Climate Change

AIM AT 2030
Artificial Intelligence Mission Austria

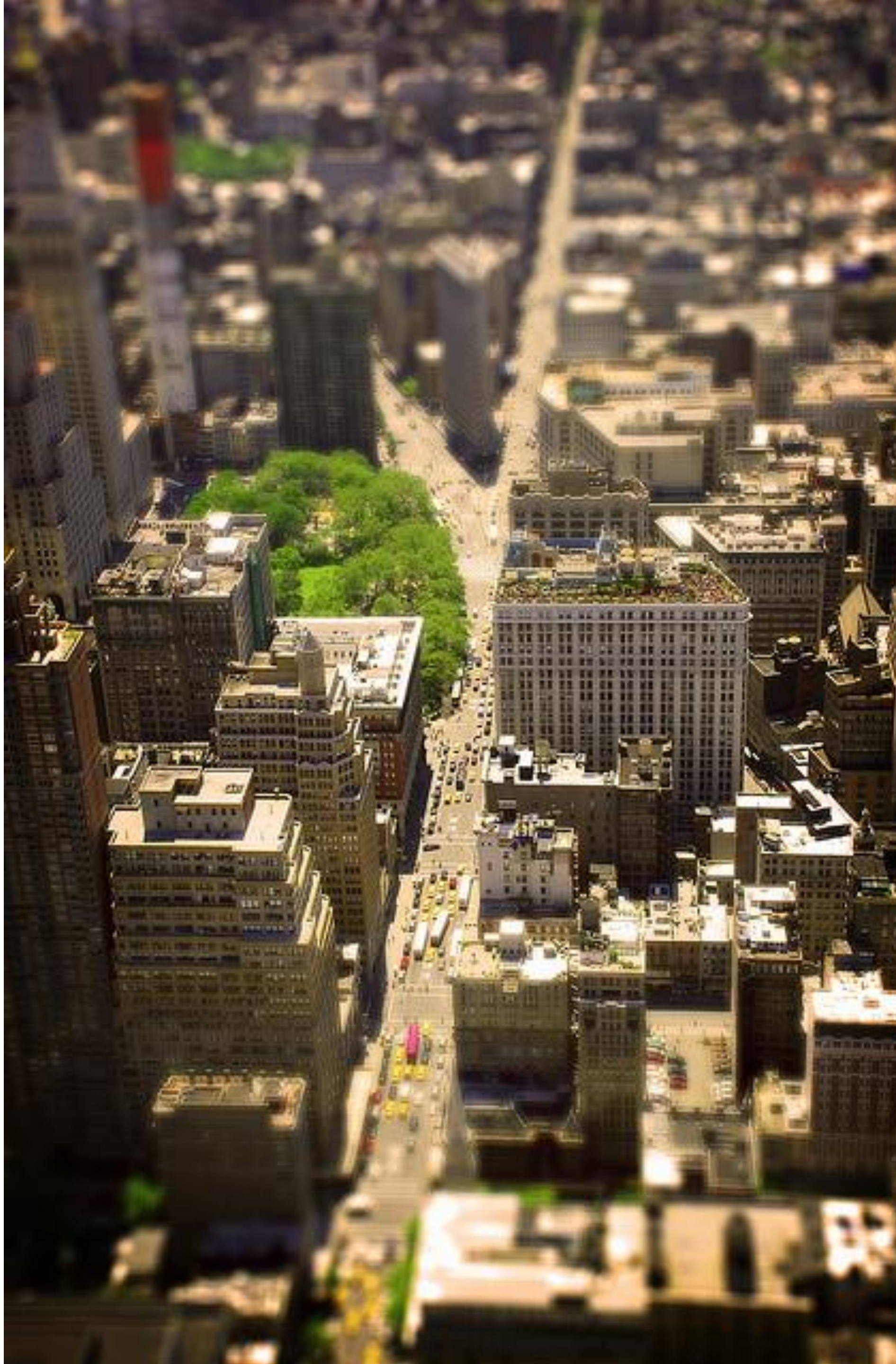
IPCC: insight on climate solutions and the role of AI

Prof. Dr. Felix Creutzig

Chair Sustainability Economics of Human Settlements, TU Berlin

Mercator Research Institute on Global Commons and Climate Change - Berlin

MCC
Mercator Research Institute on Global Commons and Climate Change

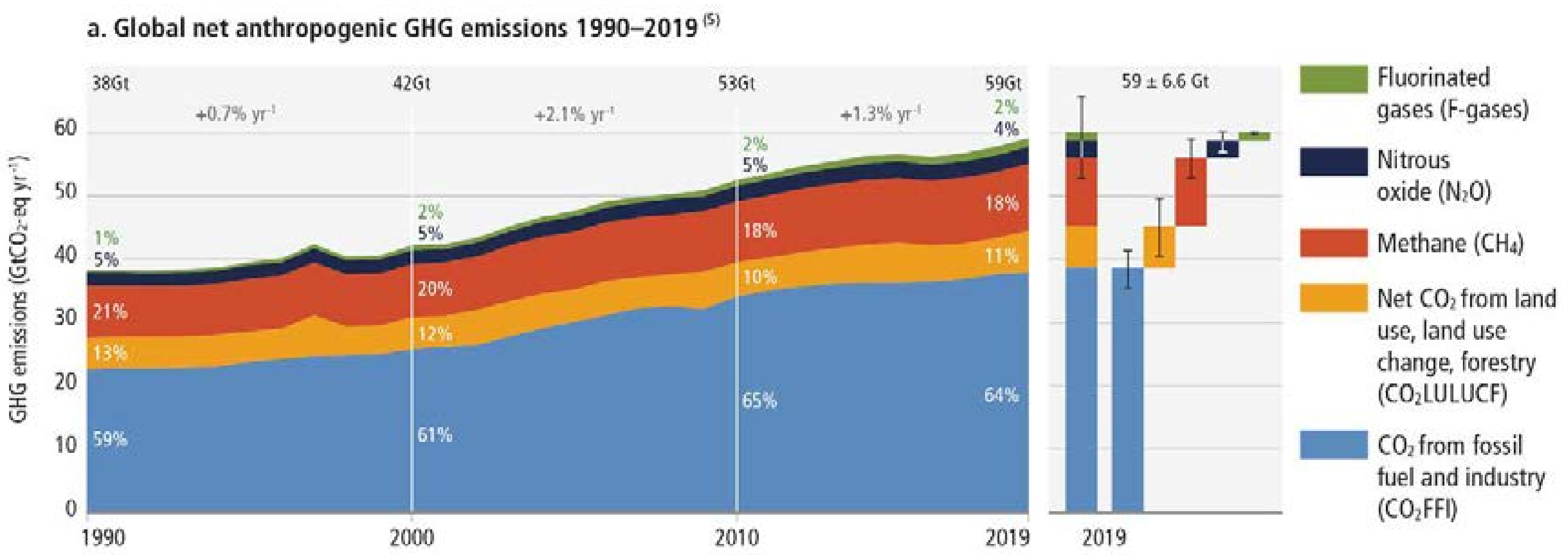



WE ARE STILL STUCK IN
THE FOSSIL AGE

Stuck in the age of fossil fuels

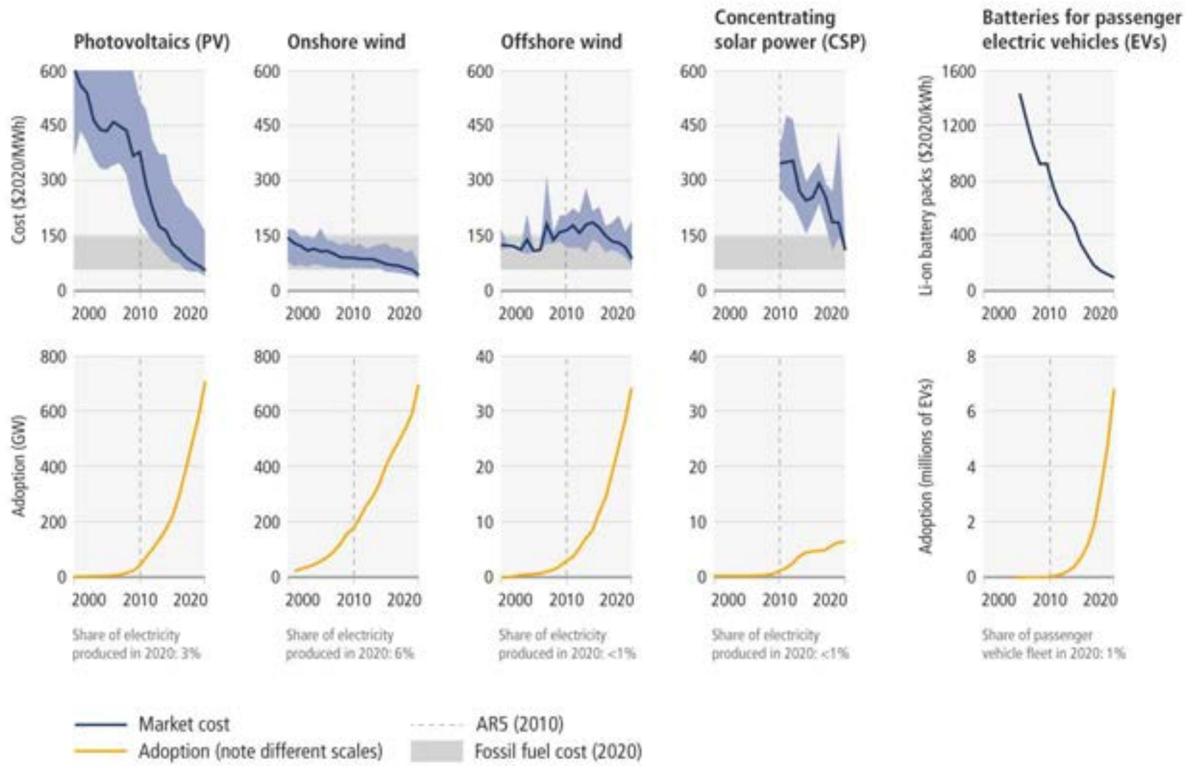
- 2019 emissions 12% higher than in 2010 and 54% higher than in 1990.
- Emissions grwoth slowed from 2.1%/yr for 2000-2009 to 1.3%/yr for 2010-2019.
- Decarbonisation of energy is progressing far too slow at the global scale compared to what we see in 1.5°C and 2°C scenarios.

Global net anthropogenic emissions have continued to rise across all major groups of greenhouse gases.



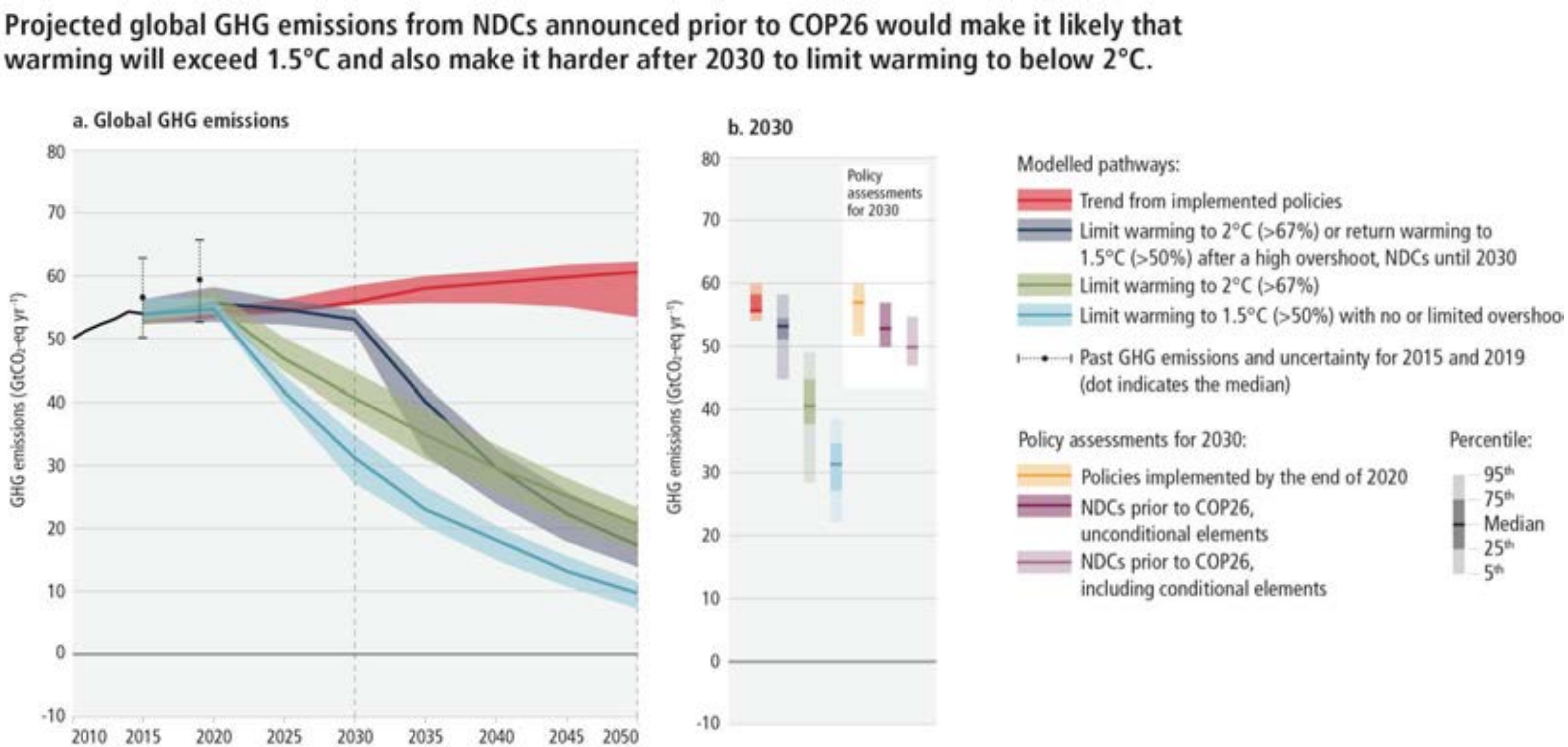
INCREASED EVIDENCE OF CLIMATE ACTION

The unit costs of some forms of renewable energy and of batteries for passenger EVs have fallen, and their use continues to rise.

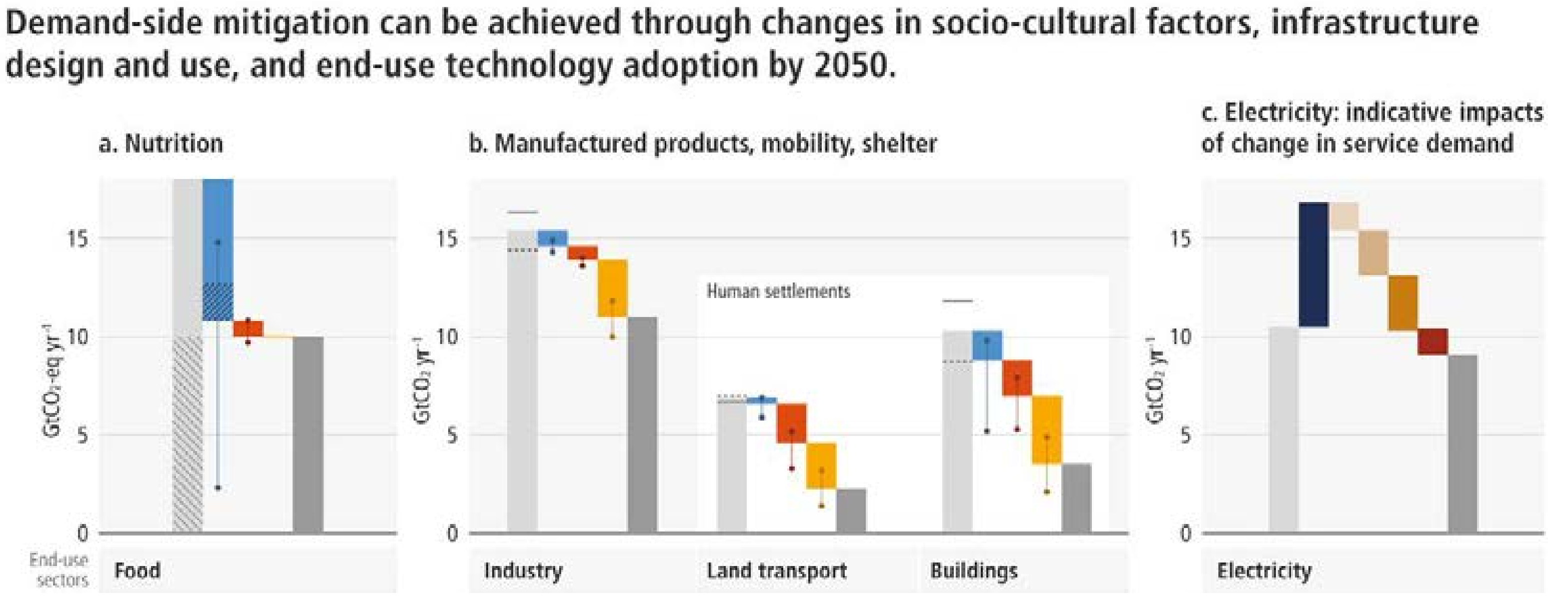


- A growing number of countries have achieved sustained GHG emissions reductions for longer than 10 years.
- Some key technologies have developed much better than planned. Since 2010, up to 85% decreases in the costs of solar and wind energy, and batteries. Large increases in installed capacity.
- An increasing range of policies and laws have enhanced energy efficiency, reduced rates of deforestation and accelerated the deployment of renewable energy.

NDCs are insufficient to keep 1.5°C well within reach



End-use interventions can reduce GHG emissions by 40-70% in 2050

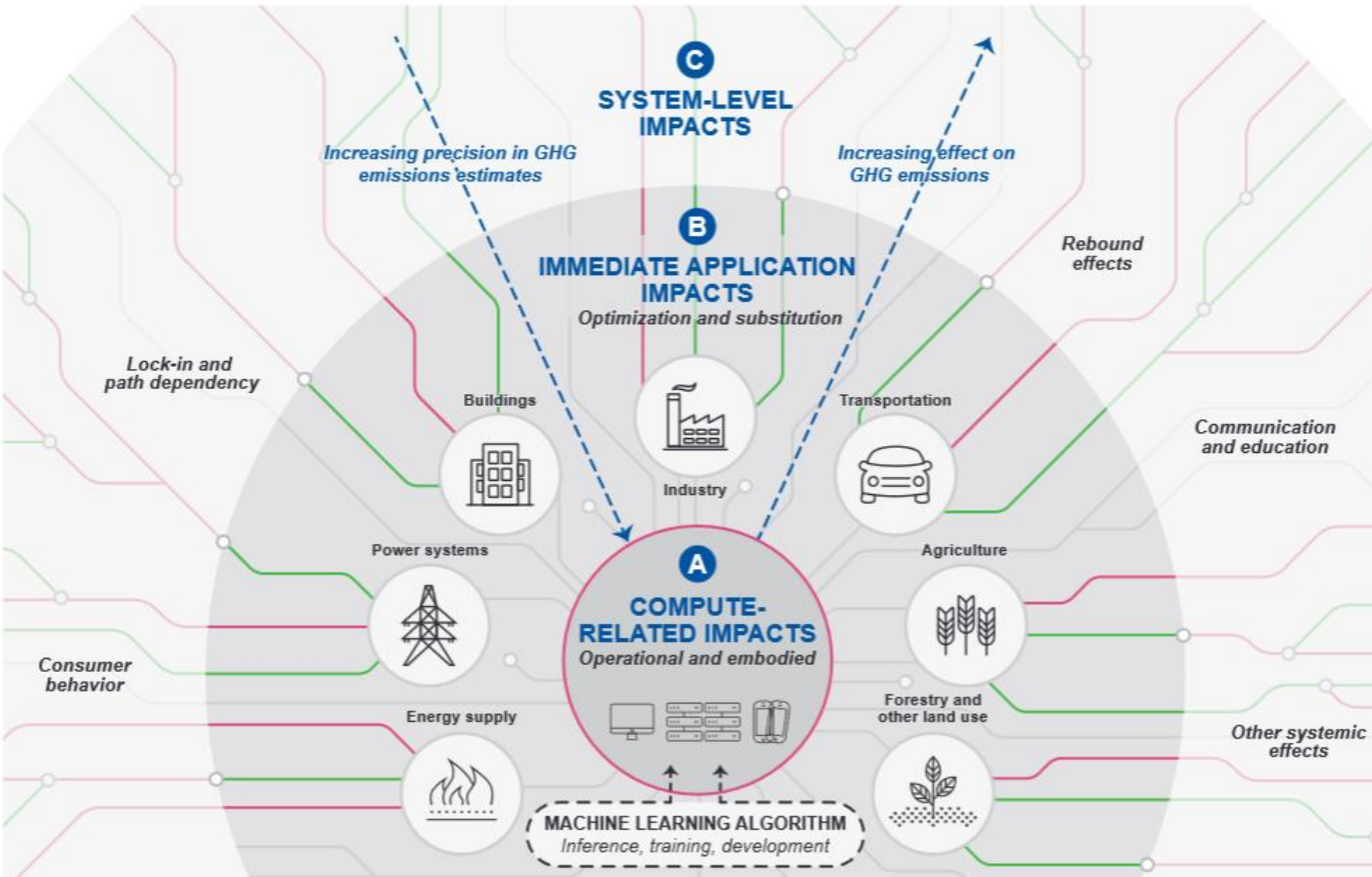


- By 2050 a combination of effective policies, improved infrastructure and technologies leading to behavioural change has the potential to enable reductions in GHG emissions by between 40 and 70%.
- The types of technologies used and what infrastructure is provided can help individuals to lead low-carbon lifestyles (e.g.energy-efficient buildings; make walking & cycling, car-sharing & access to public transport easier).
- The way choices are presented can influence decision-making (e.g. plant-based diets; food waste).

Creutzig et al, Nature Climate Change 2022 and Chapter 5, IPCC 2022

3 WAY HOW AI AND CLIMATE CHANGE INTERACT

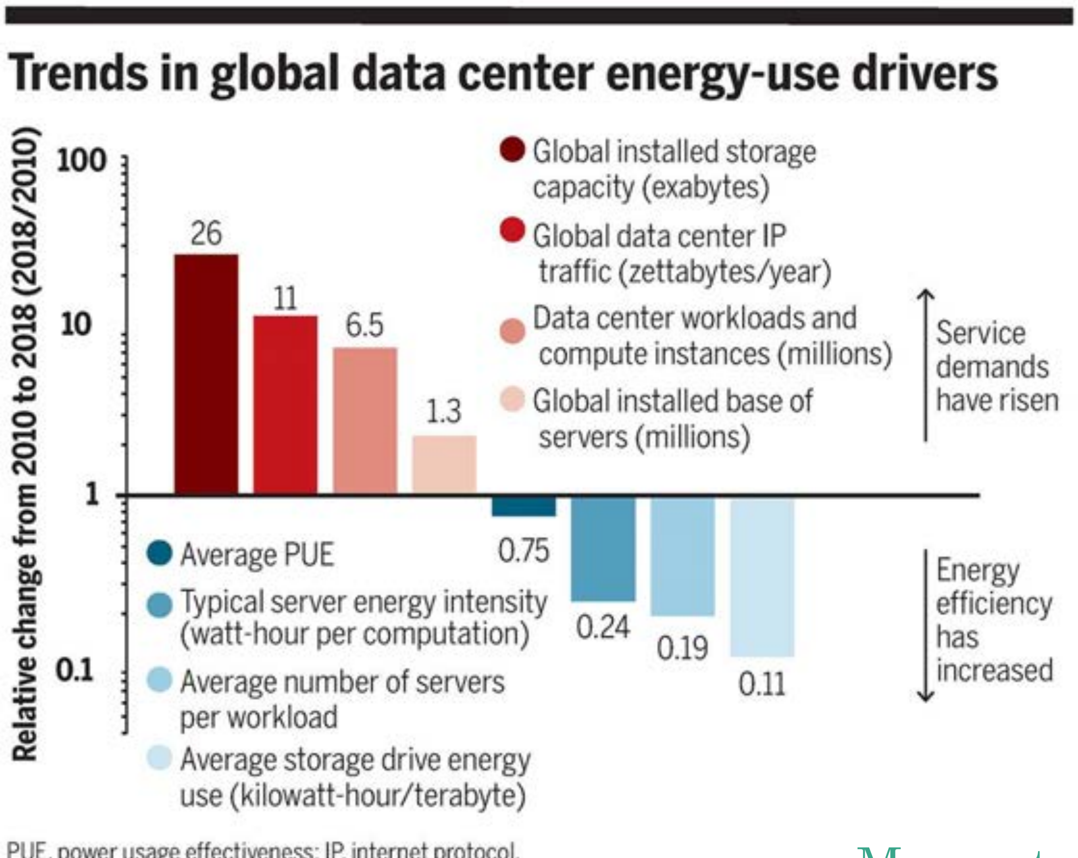
Accounting framework: system level effects dominate but are highly uncertain



Kaack, Creutzig et al (2022) Nature Climate Change

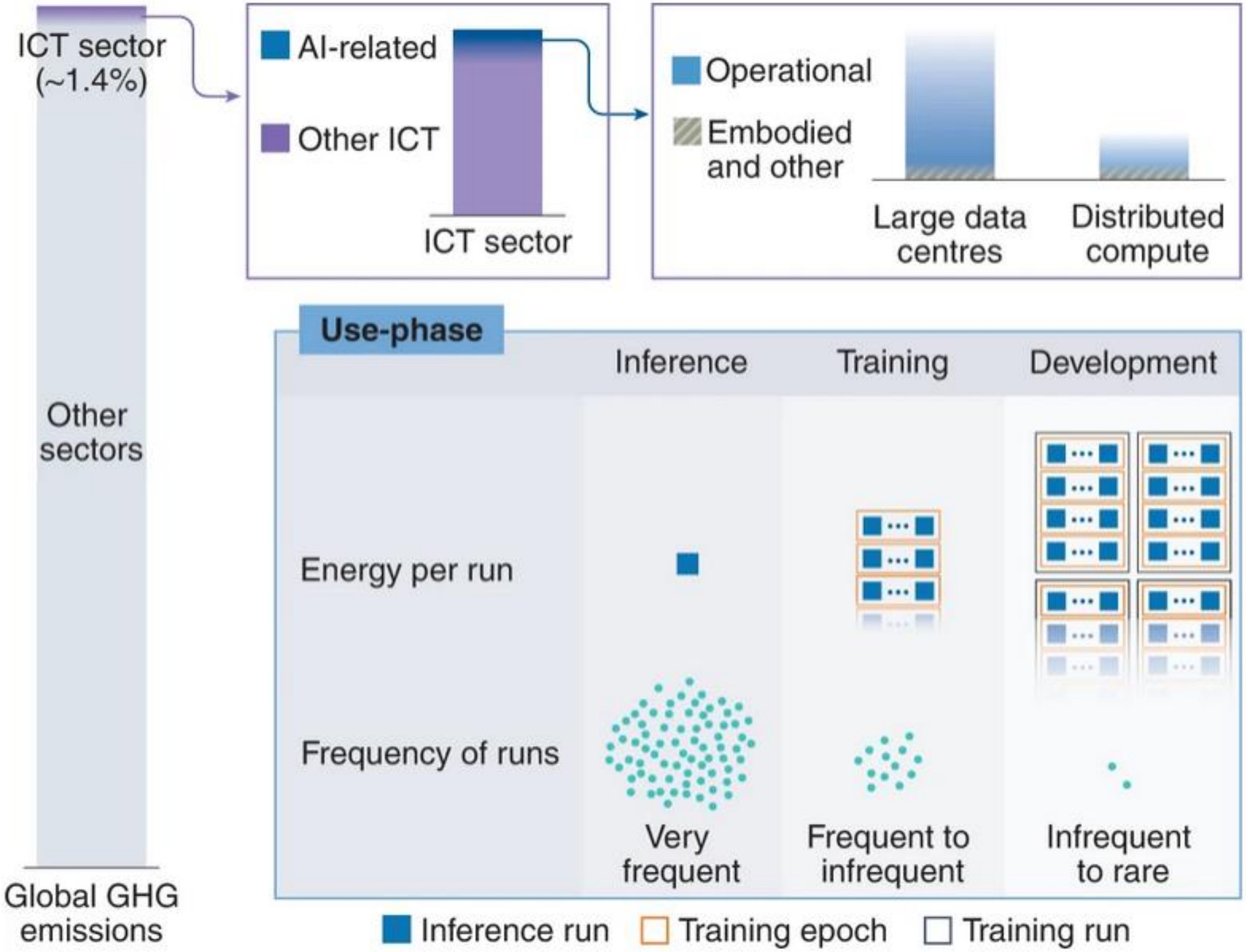
LIFE-CYCLE ASSESSMENT

Energy demand of data center is huge – 1% of global electricity consumption -and growing but efficiency gains mostly compensate



Masanet et al (2020) Science

AI contribution can be high (training) but overall energy demand unknown



Kaack, Creutzig et al (2022) Nature Climate Change

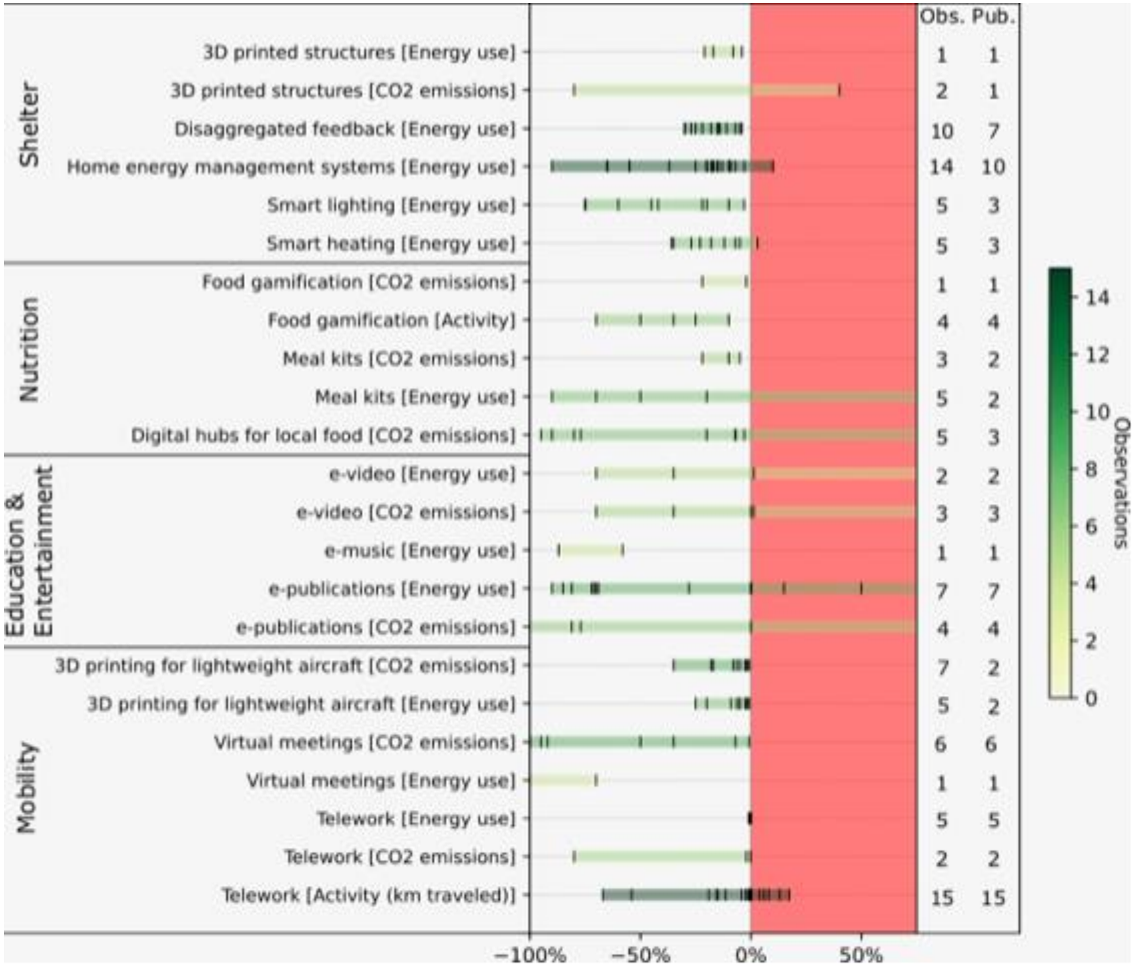
TECHNOLOGICAL OPPORTUNITIES

IPCC for the first time assesses potential and risks of digital technologies to climate change mitigation

End use sector	Quantitative evidence	Contribution of digitalization	Systems perspective, risks, and societal impacts
Residential energy use (e.g. Nudges, feedback, information)	2-4% reduction in global household energy use possible	Effective in combination with monetary incentives, non-digital information	New appliances increase consumption
Smart mobility (Shared mobility and digital feedback for ecodriving)	Reduction for shared cycling, shared pooled mobility, and ecodriving; Increase for ride hailing, ride sourcing	Apps together with big data and machine learning as preconditions for new shared mobility	Ride hailing increases GHG emissions, especially due to deadheading, as well as scale effects
Smart cities (Using digital devices and big data to make urban transport and building use more efficient)	30% reduction in a "smart city" scenario due to targeted climate-mitigation interventions, including AI-based low-carbon urban planning, shared pooled mobility, etc.	Big data analysis necessary for optimization of service provisioning systems	Efficiency gains offset by rebound effects; Privacy concerns linked with digital devices in homes

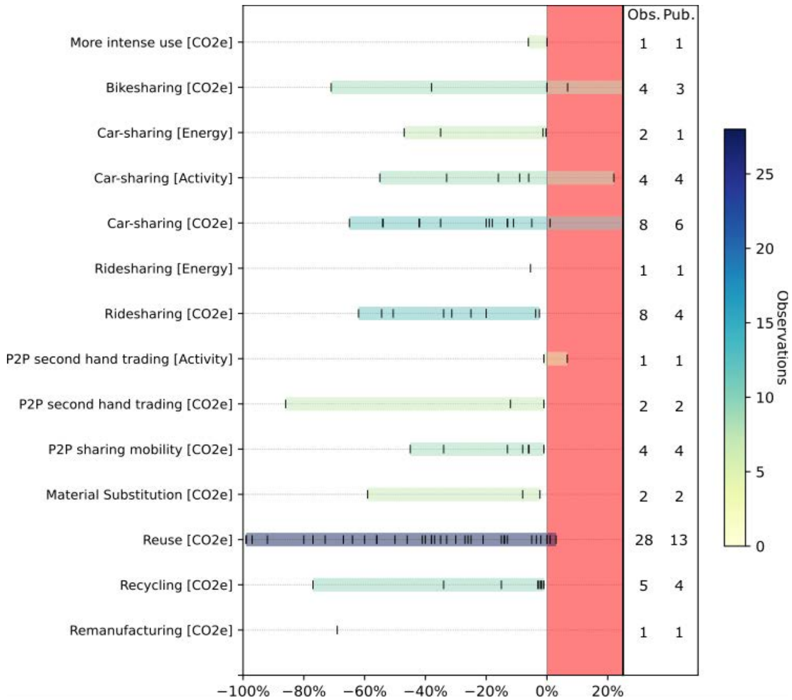
Chapter 16, WGIII, IPCC (2022)

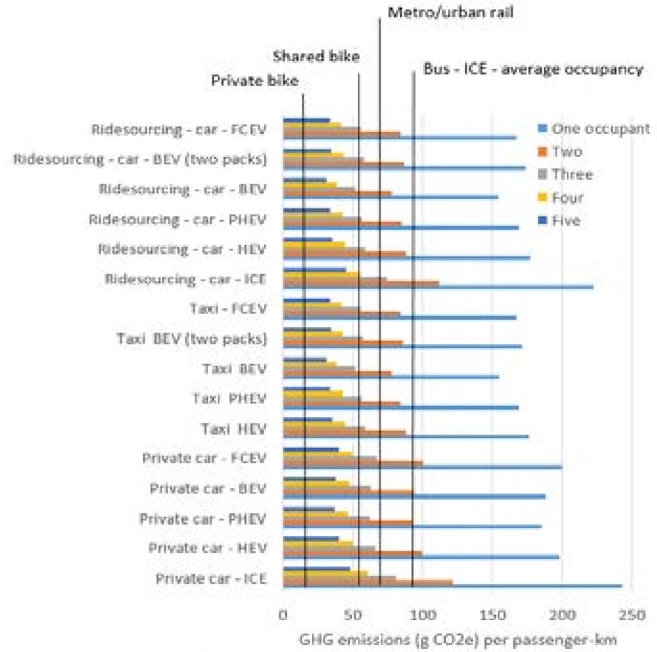
Digitalisation, if steered by standards and pricing, offers new opportunities for GHG emission savings



Synthesis by Nico Heeren, Eric Masanet and Alessandro Sanchez Pereira; mostly based on Wilson et al 2020

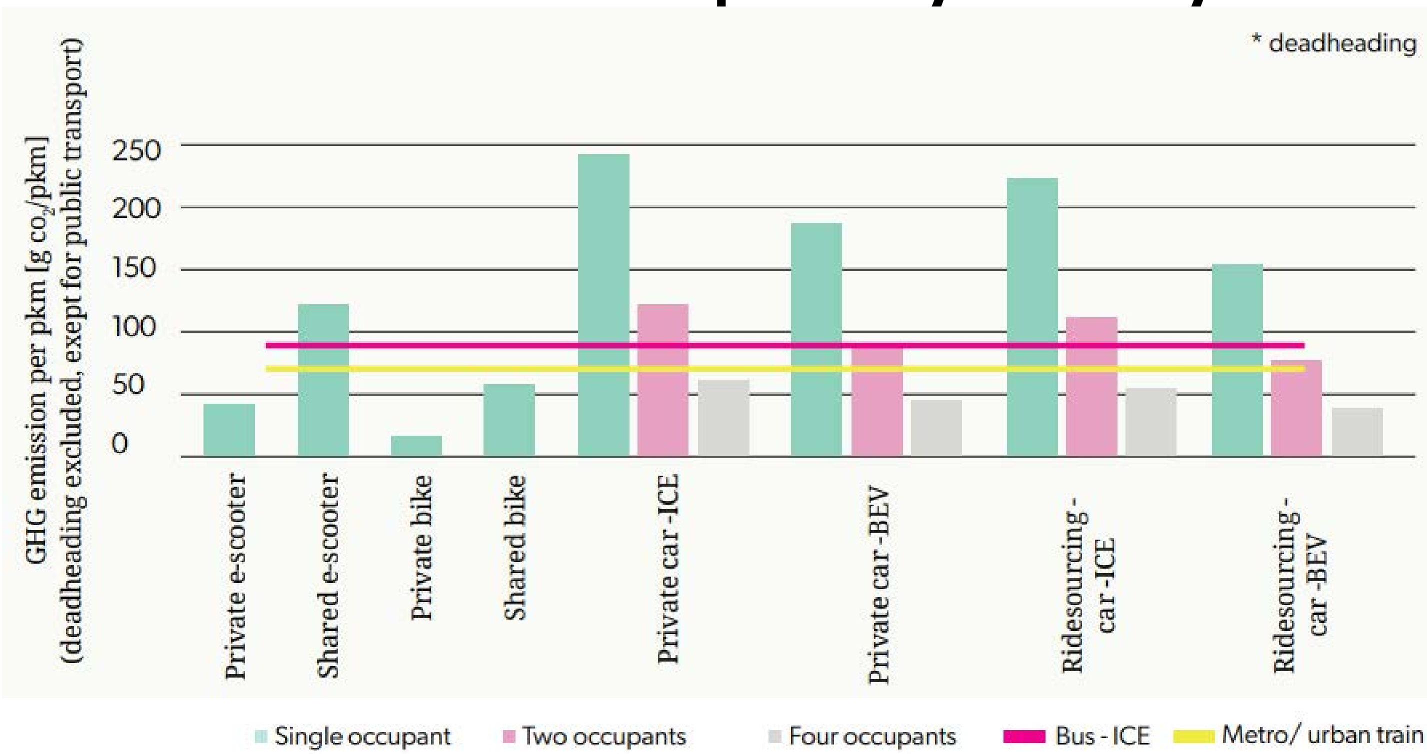
In particular by sharing material stock and vehicles (occupancy)





Synthesis by Nico Heeren, Eric Masanet and Alessandro Sanchez Pereira; right panel based on ITF, 2020

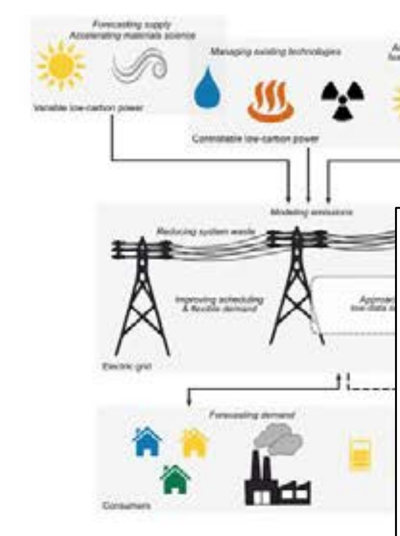
Shared urban mobility systems: occupancy is key



ITF (2020)
Creutzig (2020)

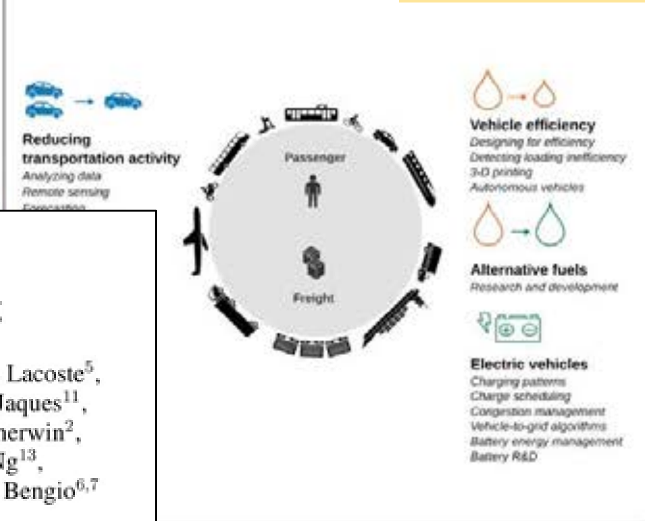
- Smaller vehicles better than larger ones
- Lifetime of e-scooters matters
- Private bike better than shared bike
- Private motorized transport better than public transport with 4 passengers
- Ridesourcing (Uber) unacceptable choice due to deadheading (=cruising of vehicles in search for passengers)

Electricity systems



Buildings

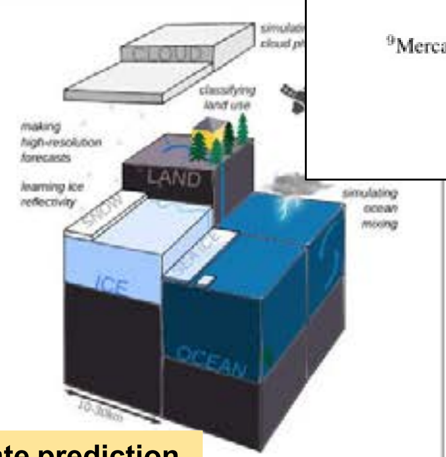
Transportation



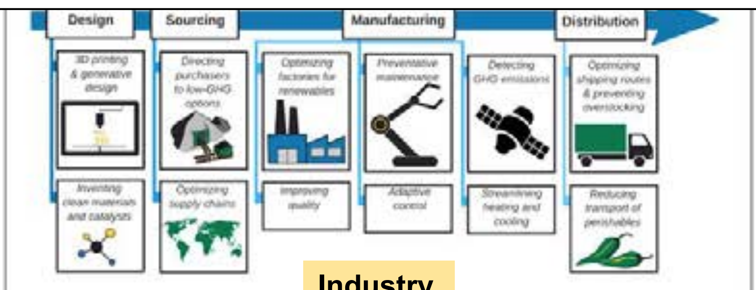
Tackling Climate Change with Machine Learning

David Rolnick[1*], Priya L. Donti[2], Lynn H. Kaack[3], Kelly Kochanski[4], Alexandre Lacoste[5], Kris Sankaran[6,7], Andrew Slavin Ross[8], Nikola Milojevic-Dupont[9,10], Natasha Jaques[11], Anna Waldman-Brown[11], Alexandra Luccioni[6,7], Tegan Maharaj[6,7], Evan D. Sherwin[2], S. Karthik Mukkavilli[6,7], Konrad P. Kording[1], Carla Gomes[12], Andrew Y. Ng[13], Demis Hassabis[14], John C. Platt[15], Felix Creutzig[9,10], Jennifer Chayes[16], Yoshua Bengio[6,7]

[1]University of Pennsylvania, [2]Carnegie Mellon University, [3]ETH Zürich, [4]University of Colorado Boulder, [5]Element AI, [6]Mila, [7]Université de Montréal, [8]Harvard University, [9]Mercator Research Institute on Global Commons and Climate Change, [10]Technische Universität Berlin, [11]Massachusetts Institute of Technology, [12]Cornell University, [13]Stanford University, [14]DeepMind, [15]Google AI, [16]Microsoft Research



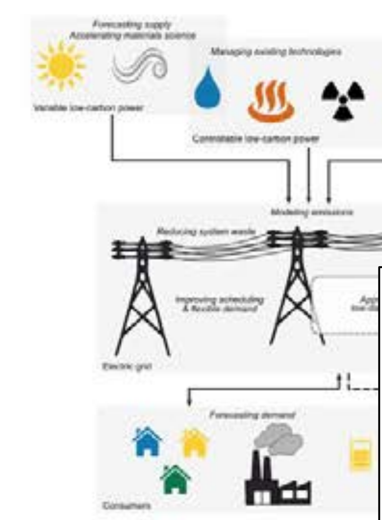
Climate prediction



Industry

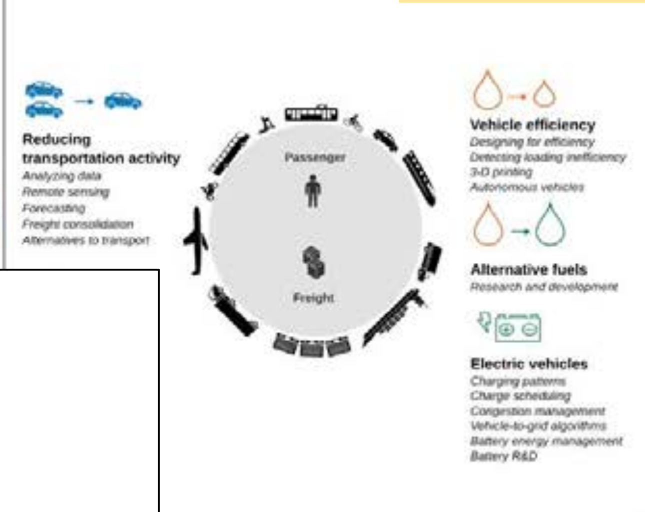
Societal adaptation

Electricity systems



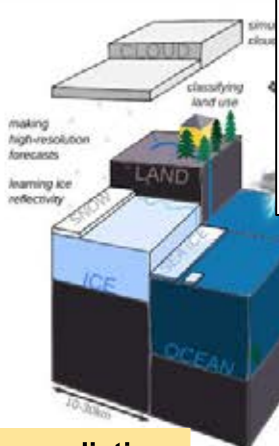
Buildings

Transportation



Key roles of AI:

1. Distilling raw data into actionable information
2. Approximating time-intensive simulations
3. Improving predictions
4. Accelerating scientific discovery
5. Optimizing complex systems
6. Supporting (urban) climate governance



Climate prediction

Industry

Societal adaptation

Deep dive: The role of AI in urban governance and solutions

Prof. Dr. Felix Creutzig

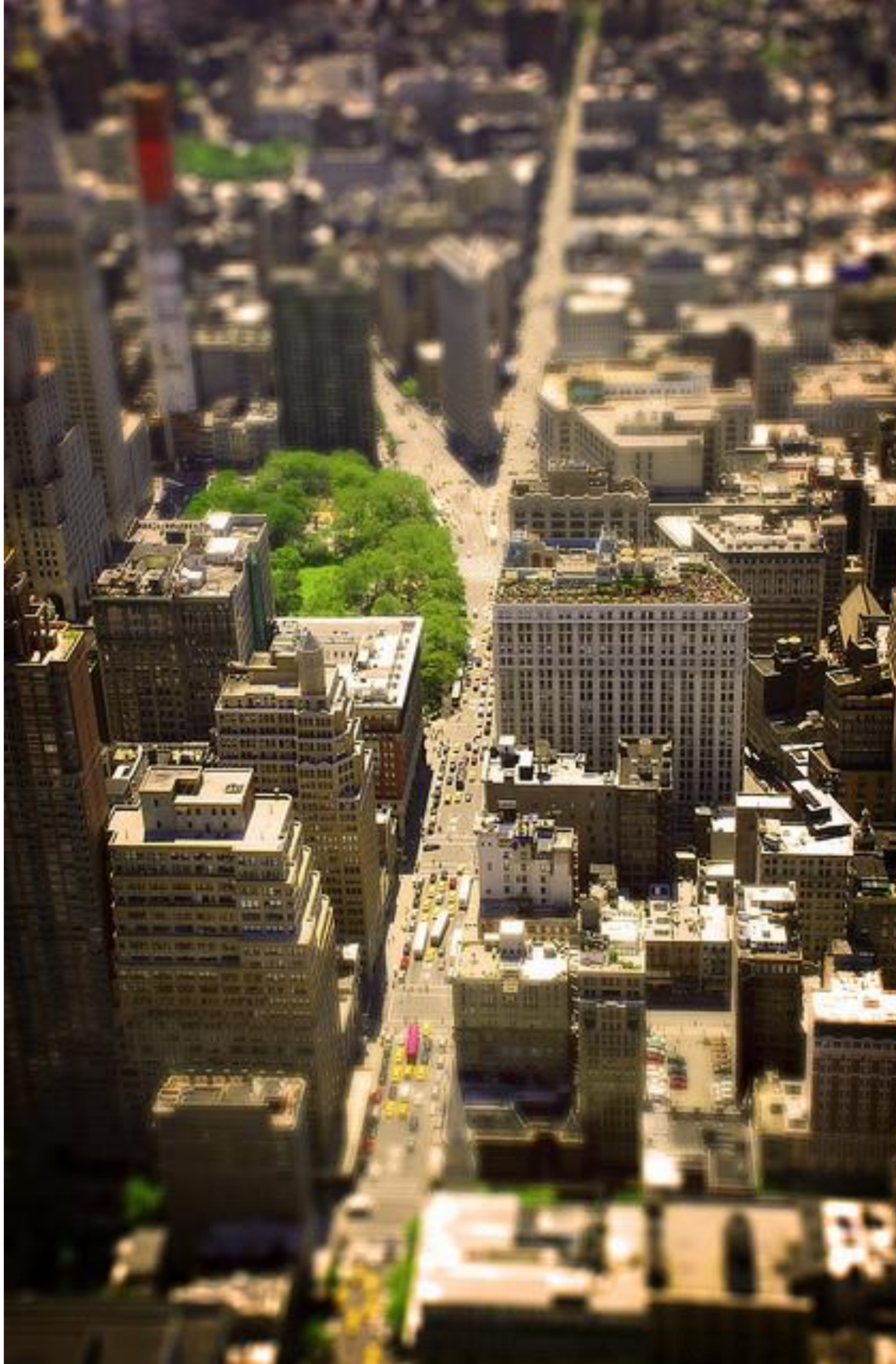
Chair Sustainability Economics of Human Settlements, TU Berlin

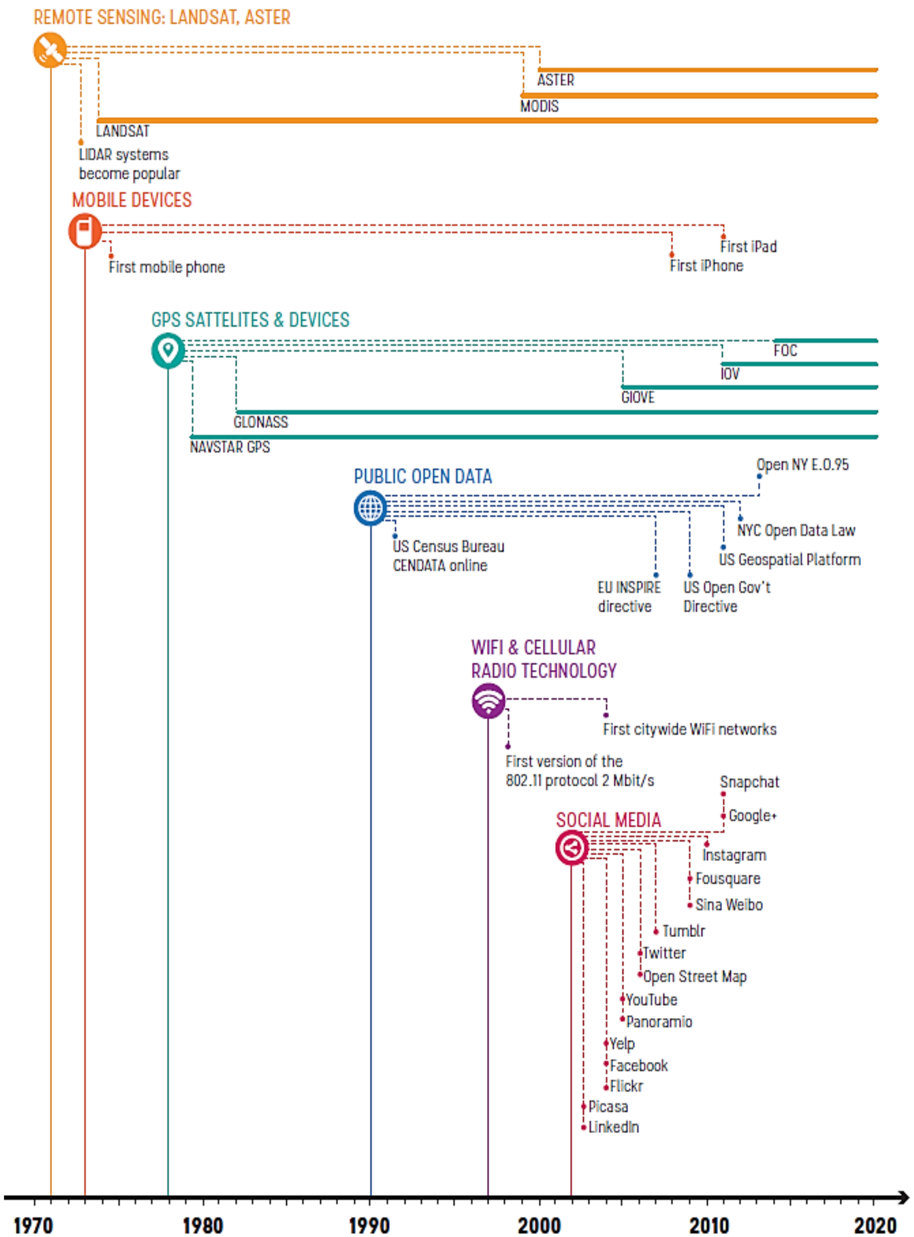
Scientific Coordinator Einstein Center Climate Change

Mercator Research Institute on Global Commons and Climate Change - Berlin

MCC

Mercator Research Institute on Global Commons and Climate Change





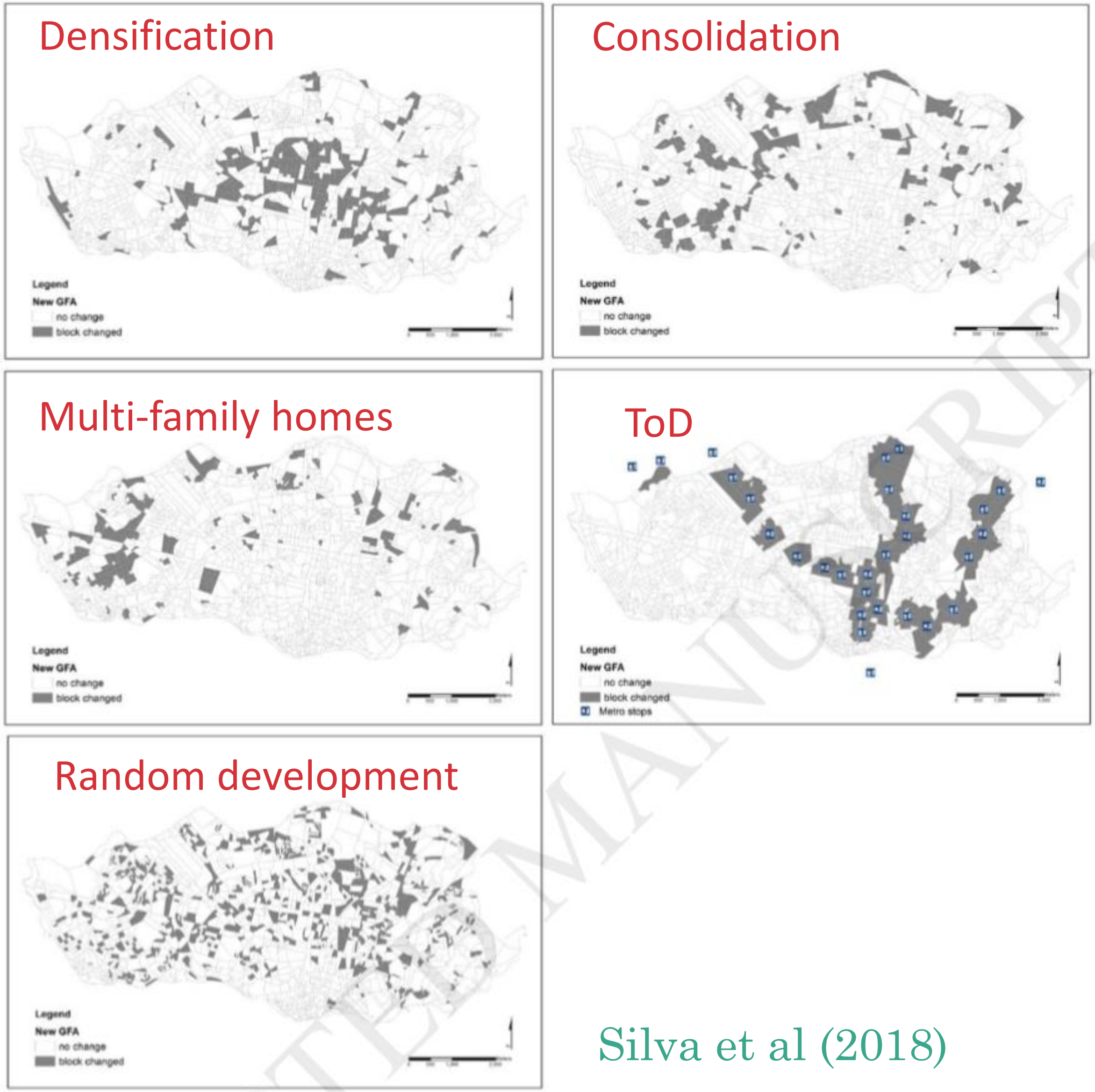
Big data in urban sciences

Evolution of key "Big Data" sources and technologies and the rise of Social Media Data (SMD).

- increasing availability of location-based social, infrastructural, and landscape/biophysical data.
- SMD represents major new phase in ability to understand links between human behavior, values, and preferences and infrastructural, climatological, or other core components of urban, peri-urban, and rural systems that are important for driving transformative change for improving sustainability

Ilieva and McPhearson (2018)
Nature Sustainability

Creutzig et al (2019a)
Global Sustainability



Silva et al (2018)

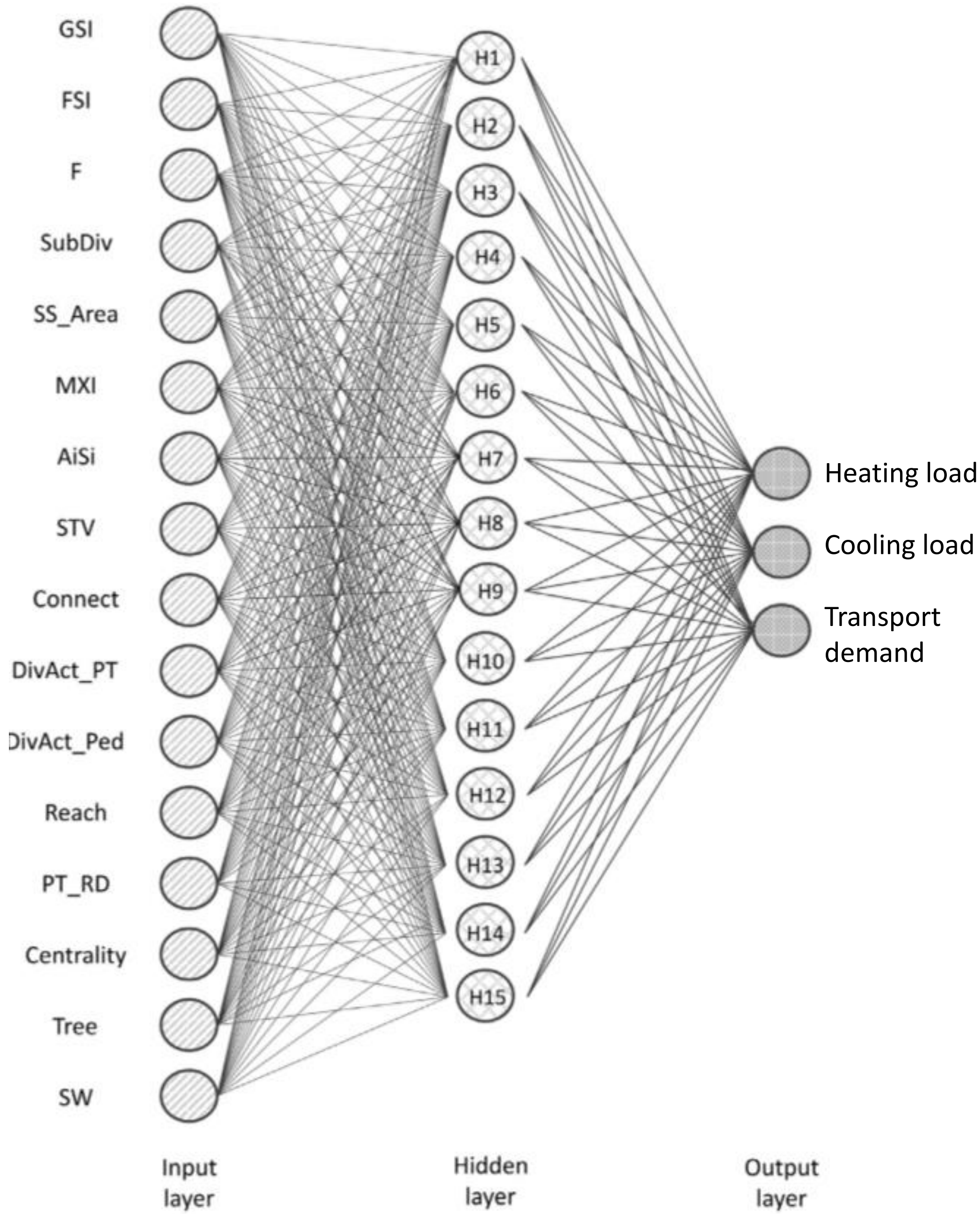
Porto: scenarios

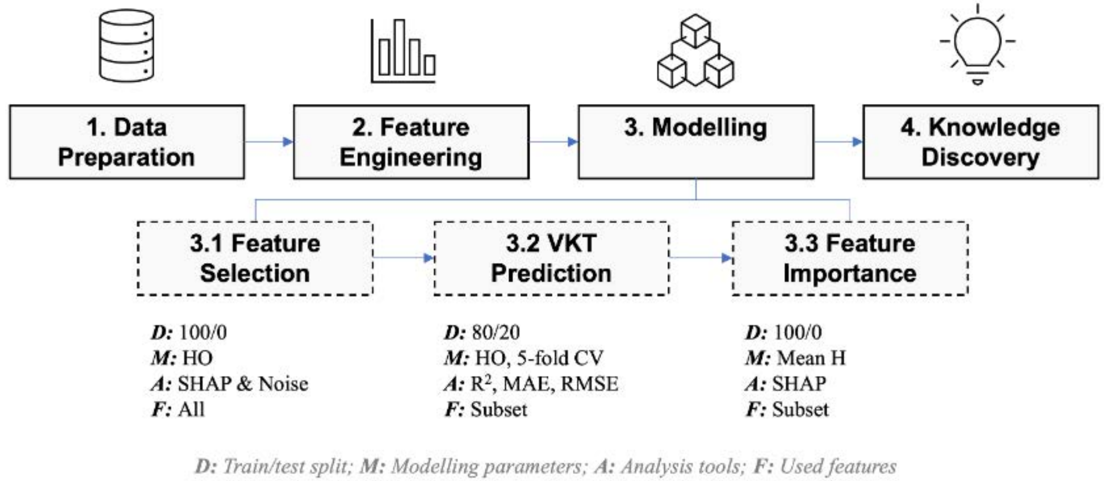
- Design scenarios with 10% additional residential space
- Apply ANN on new scenarios
- Predict change in energy use
- Marginally it is best to compactify, larger changes go along well with ToD

Predict energy use with urban structure data

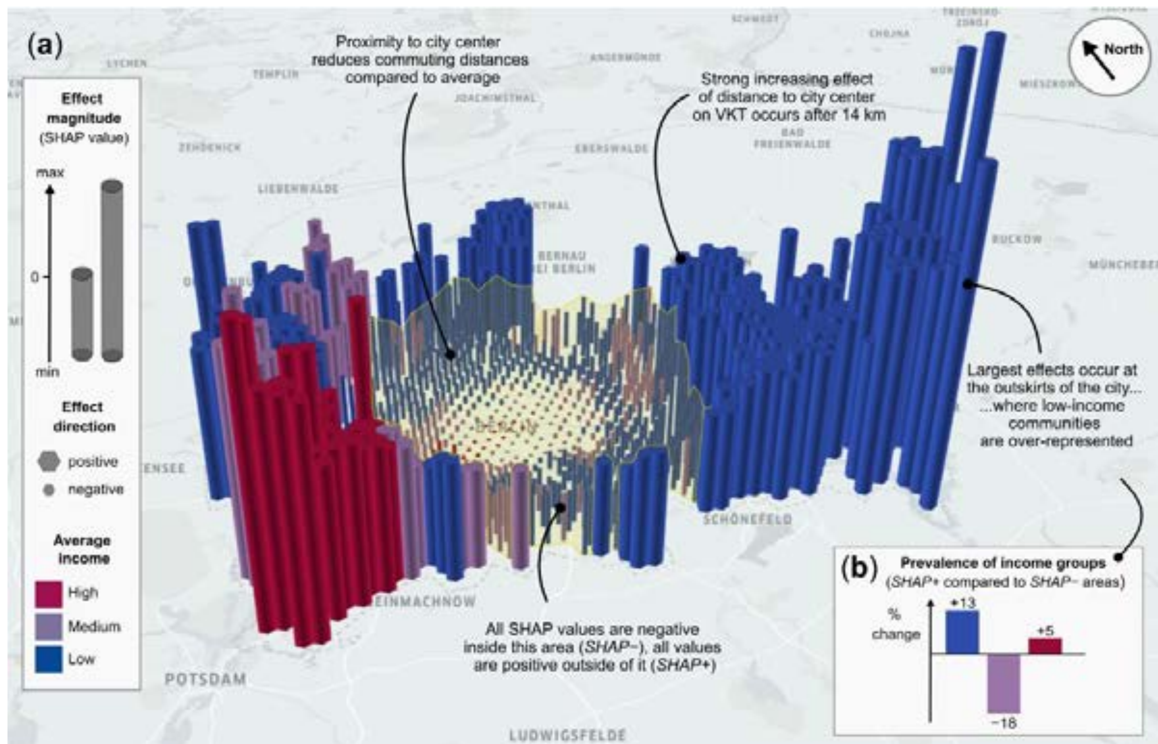
- 16 urban properties, such as compactness, accessibility, centrality, etc.
- Train ANN with data for heating, cooling, and transport demand
- Predict energy use at block-scale

Silva et al (2017)



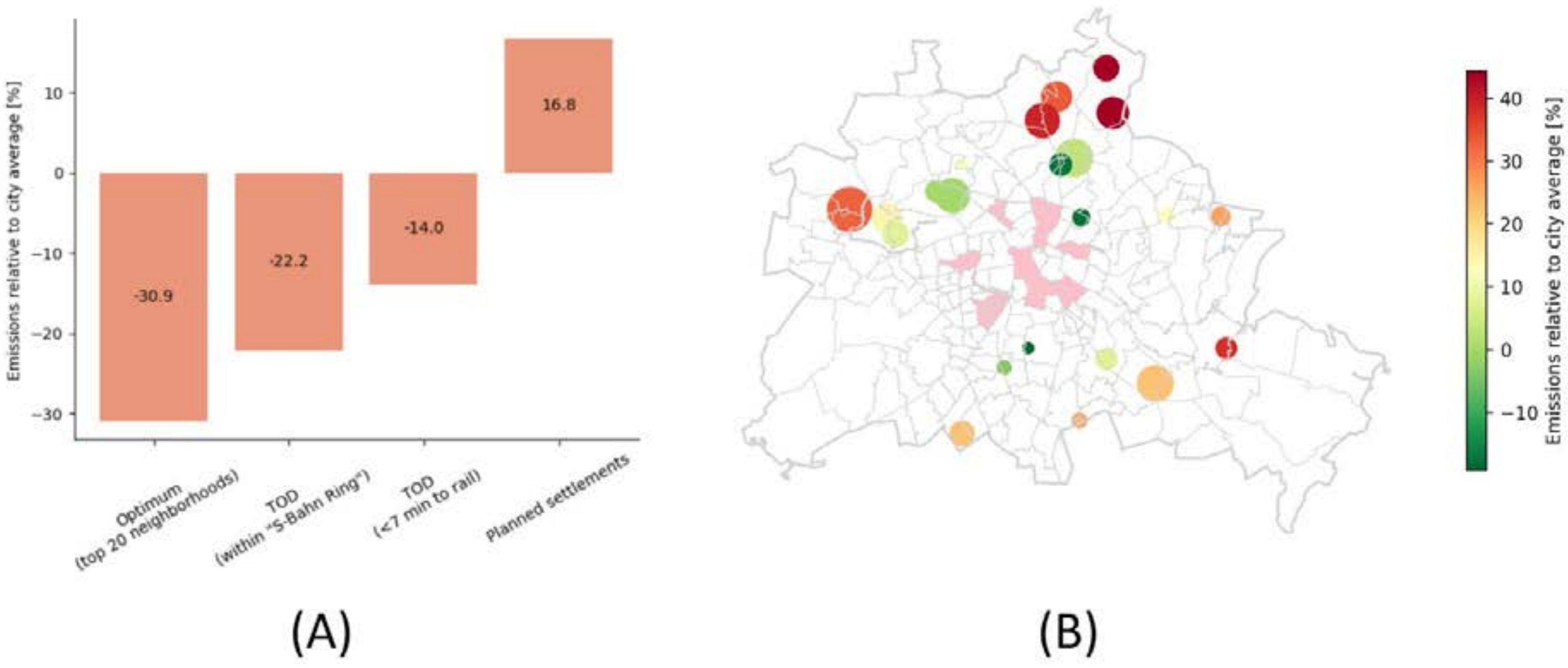


New AI platform to compute urban form metrics relevant to inducing GHG emissions at street and building level



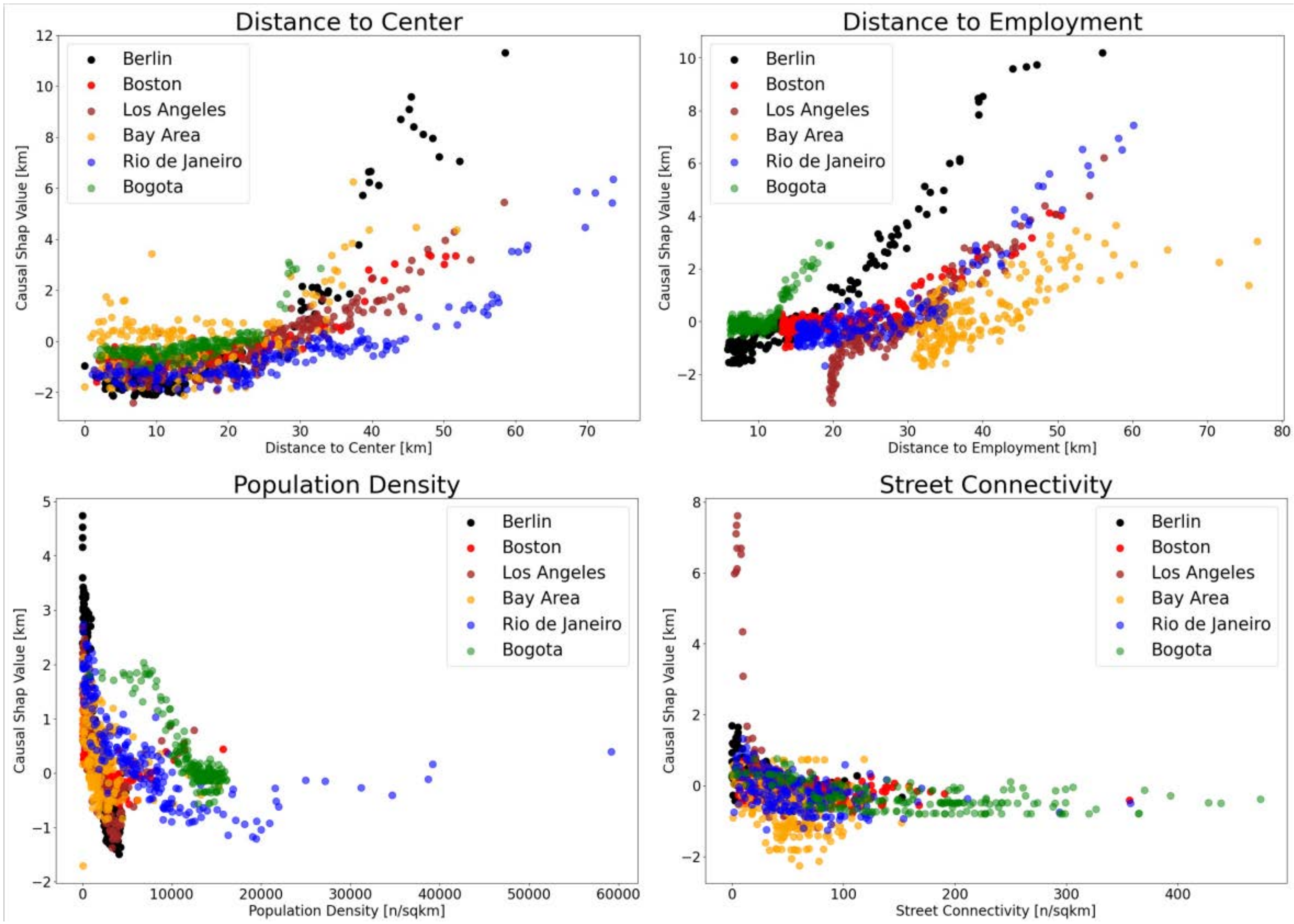
Wagner, Creutzig et al, TRD (2022)

High-resolution AI methods can support urban planning – as demonstrated in evaluating new settlements in Berlin



Nachtigall, Creutzig et al, in preparation

Identifying urban form causal influence at neighborhoodlevel across cities



Wagner, Creutzig et al, in prepration

Joint governance of data, AI and physical infrastructure

Digital infrastructure

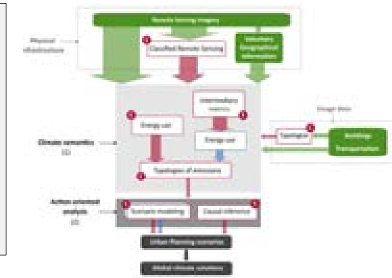
Telework. Confinement dramatically increased telework levels and demand for videoconferencing tools.

- Ready to go
- Institutional alignment

Use digitalization to optimize public transit. Contactless payment and time-specific ticketing to optimize capacity consistent with physical distancing.

- Vision
- Political stamina

Sustainable urban planning. Use big data and machine learning tools to optimize transport and urban planning. Build up urban data governance.



Physical infrastructure

Desolation. High level of confinement emptied streets, especially in cities with high exposure to COVID-19, such as Wuhan, Milan, and New York.

- Ready to go
- Institutional alignment

PUI. Municipalities providing pop-up infrastructure to incentivize more walking and cycling.

- Vision
- Political stamina

Consolidation. PUI made permanent and safe. Continuous network provided.

Confinement | Smart physical distancing | Post-COVID-19

Creutzig et al, ERIS (2022)


SYSTEMIC CONSEQUENCES

Digitalization, AI and the Anthropocene – Past, Present, Future

Prof. Dr. Felix Creutzig

Chair Sustainability Economics of Human Settlements, TU Berlin

Scientific Coordinator Einstein Center Climate Change

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MCC
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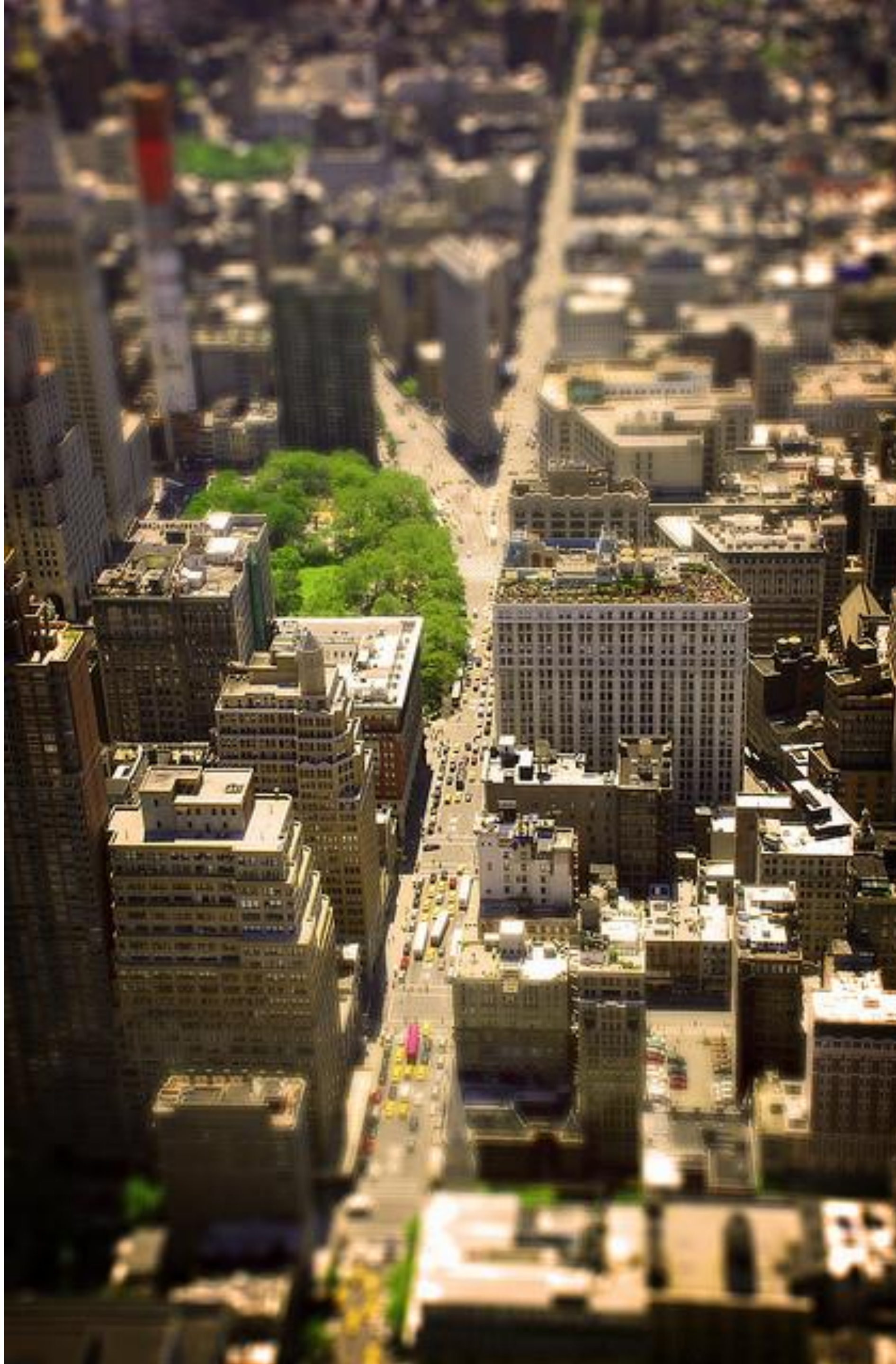


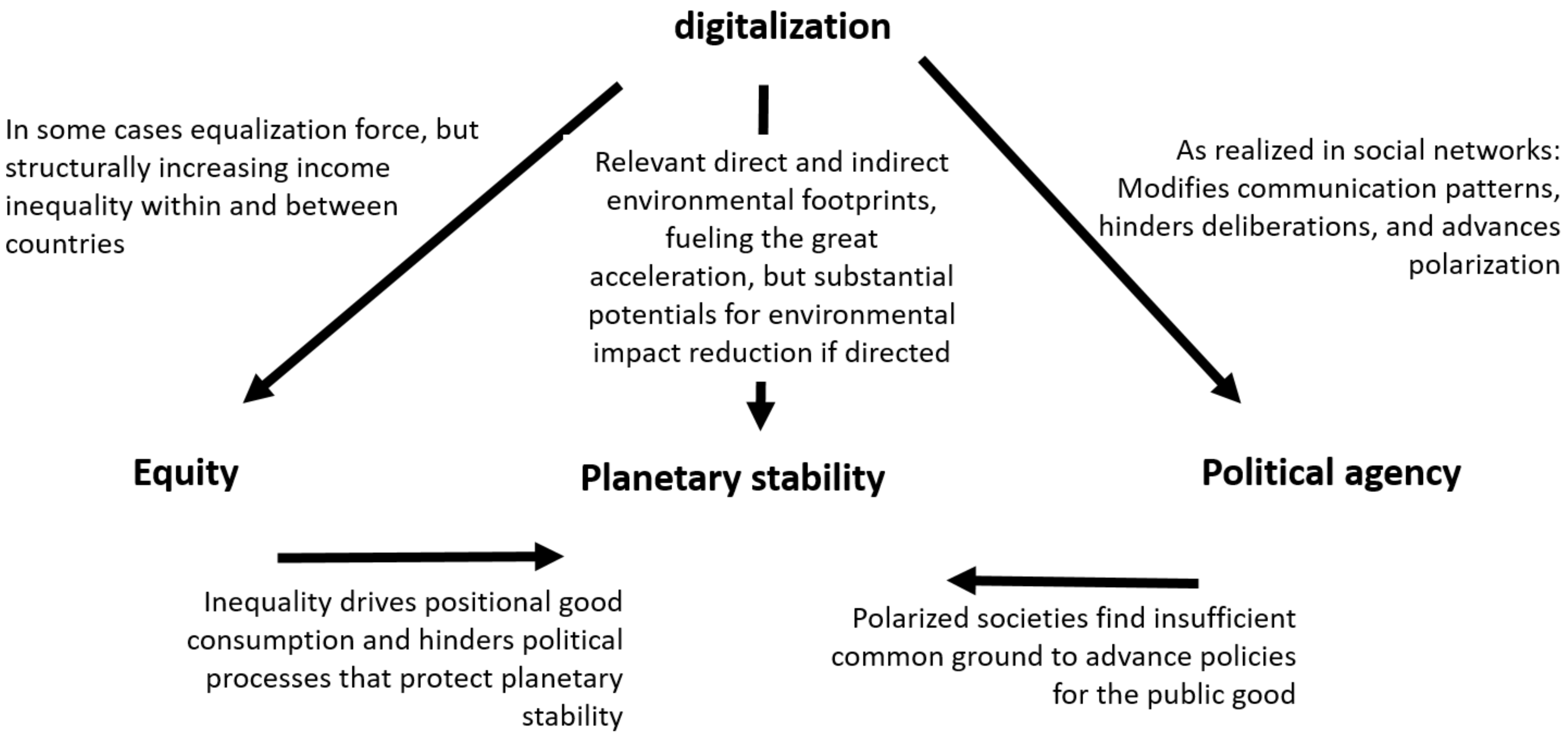
Planetary stability: Accelerating forces trump efficiency gains

- Digitalization force of great acceleration
- Enables both accelerated resource consumption and accelerated efficiency deployment
- Ressource demand long-tailed: proportional shift from few fossils to many minerals

Rapid integration of renewable energy
Vehicle-to-grid technologies
Shared pooled mobility

Energy use in data centers
AI use for oil field exploration
Unlimited deployment of autonomous vehicles

Digitalization, society and planetary stability



Creutzig et al, Digitalization and the Anthropocene, Ann. Rev. Env. Res. 2022

In balance, digitalization increases inequality

Global

- More opportunities for developing countries to contribute to global markets in the service sector (flat world)
- ICT-based rationalizations substitute for labor-intensive processes and thus erode the competitive advantage of developing countries (74% of all robot installations in USA, China, Germany, South Korea, Japan)

National

- Results in polarization of income, substituting middle-class jobs

Supply side

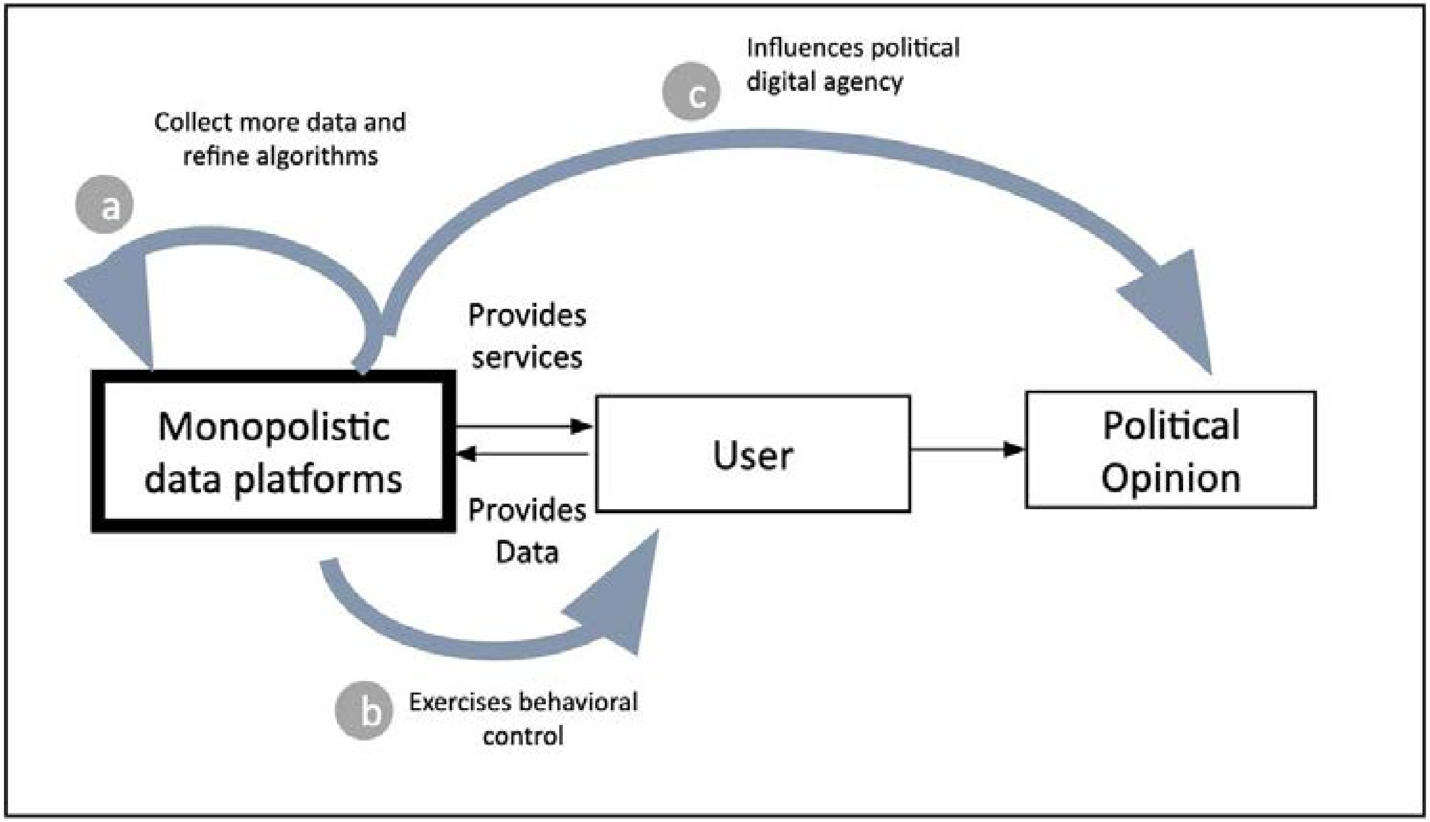
- Mining operations servicing the ICT sector are associated with forced labor, including child labor, excessive working hours, low wages, lack of social protection, discrimination against migrant workers, humiliating disciplinary actions and (sexual) violence

Consumption

- In developed world 87% have access to internet, in developing world 19%

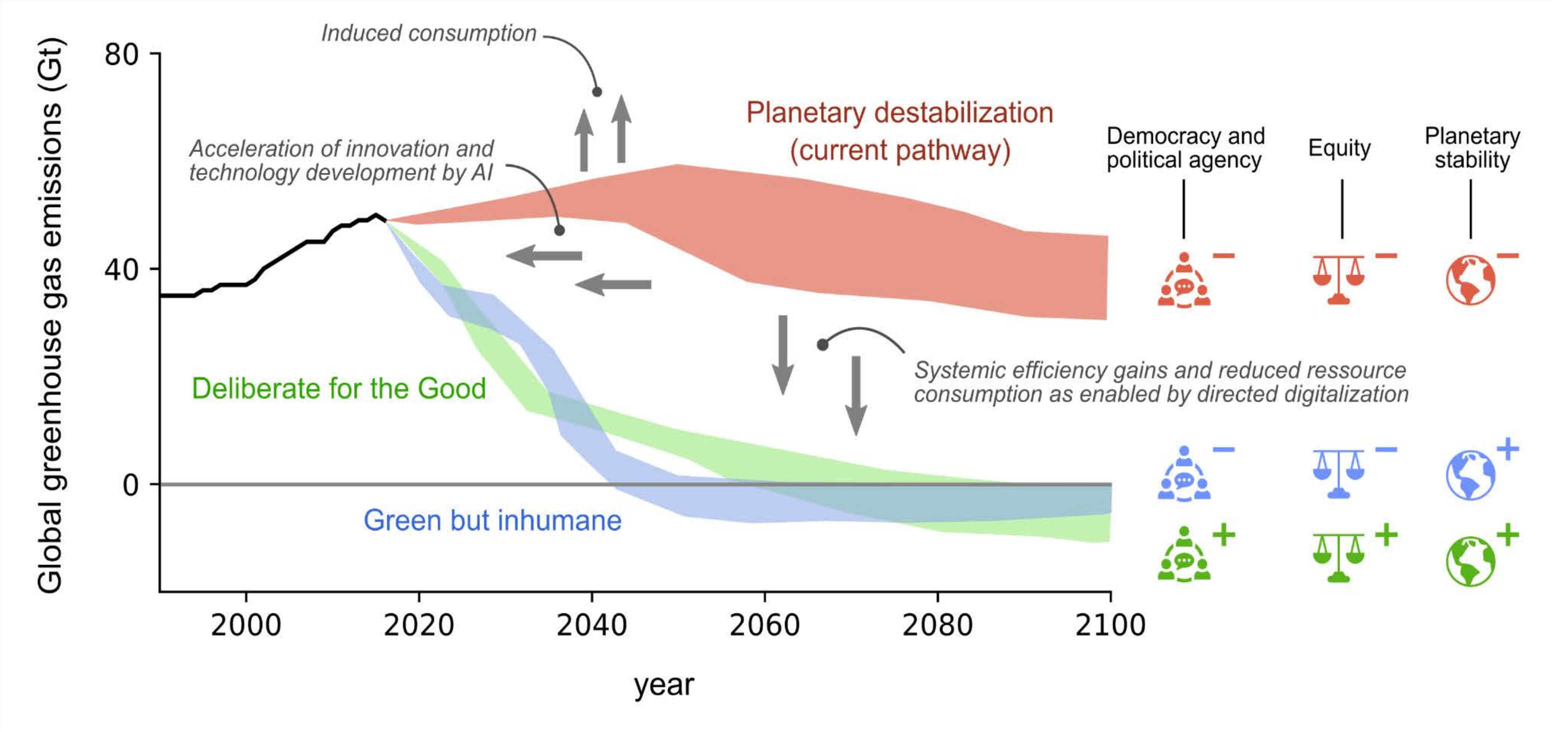
Creutzig et al, Digitalization and the Anthropocene, Ann. Rev. Env. Res. 2022

Political agency: substantial potential but economics of attention and emotion destabilize democracies



Creutzig et al, Digitalization and the Anthropocene, Ann. Rev. Env. Res. 2022

Three pathways of digitalization in the Anthropocene

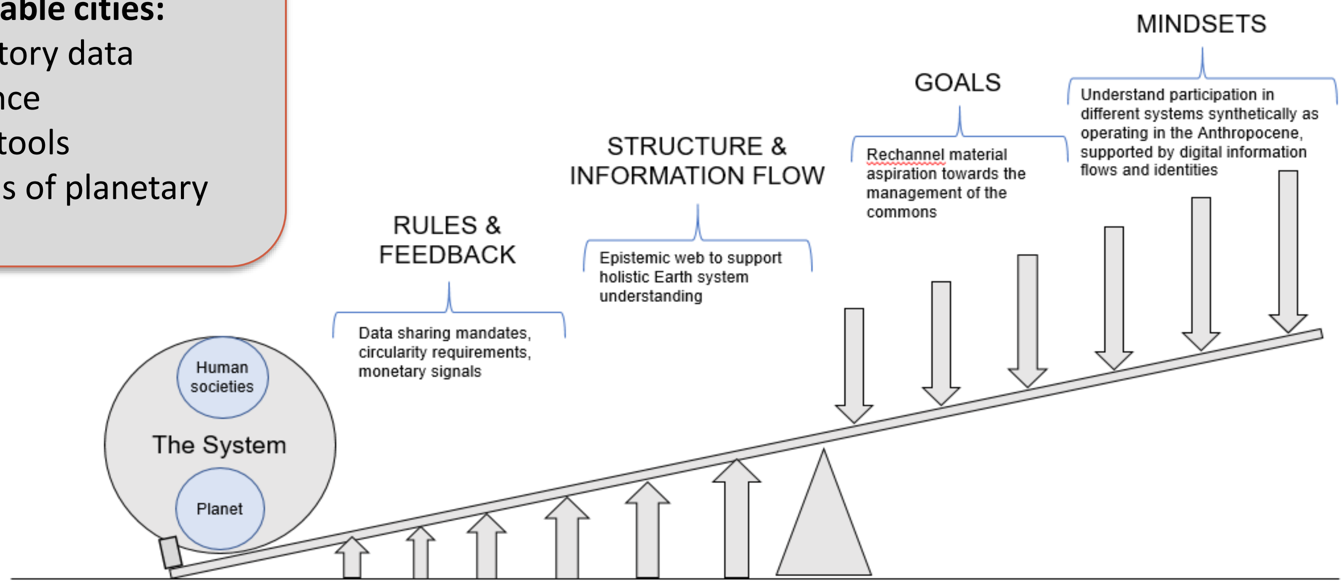


Creutzig et al, Digitalization and the Anthropocene, Ann. Rev. Env. Res. 2022

Key leverage points

Apply to smart conscious sustainable cities:

- Participatory data governance
- Big data tools
- Conscious of planetary stability



Summary:

- Digitalization part of planetary dynamics of the Anthropocene, operation via environmental, social and political channels
- Set appropriate goals, developing balanced epistemic web, and apply new rules via public policy

Three-tiered architecture of AI for climate change mitigation

Governance

Avoid run-away consumption pathways
Direct **improved** energy technologies
Direct enabling tools to **shift** & accelerate mitigation

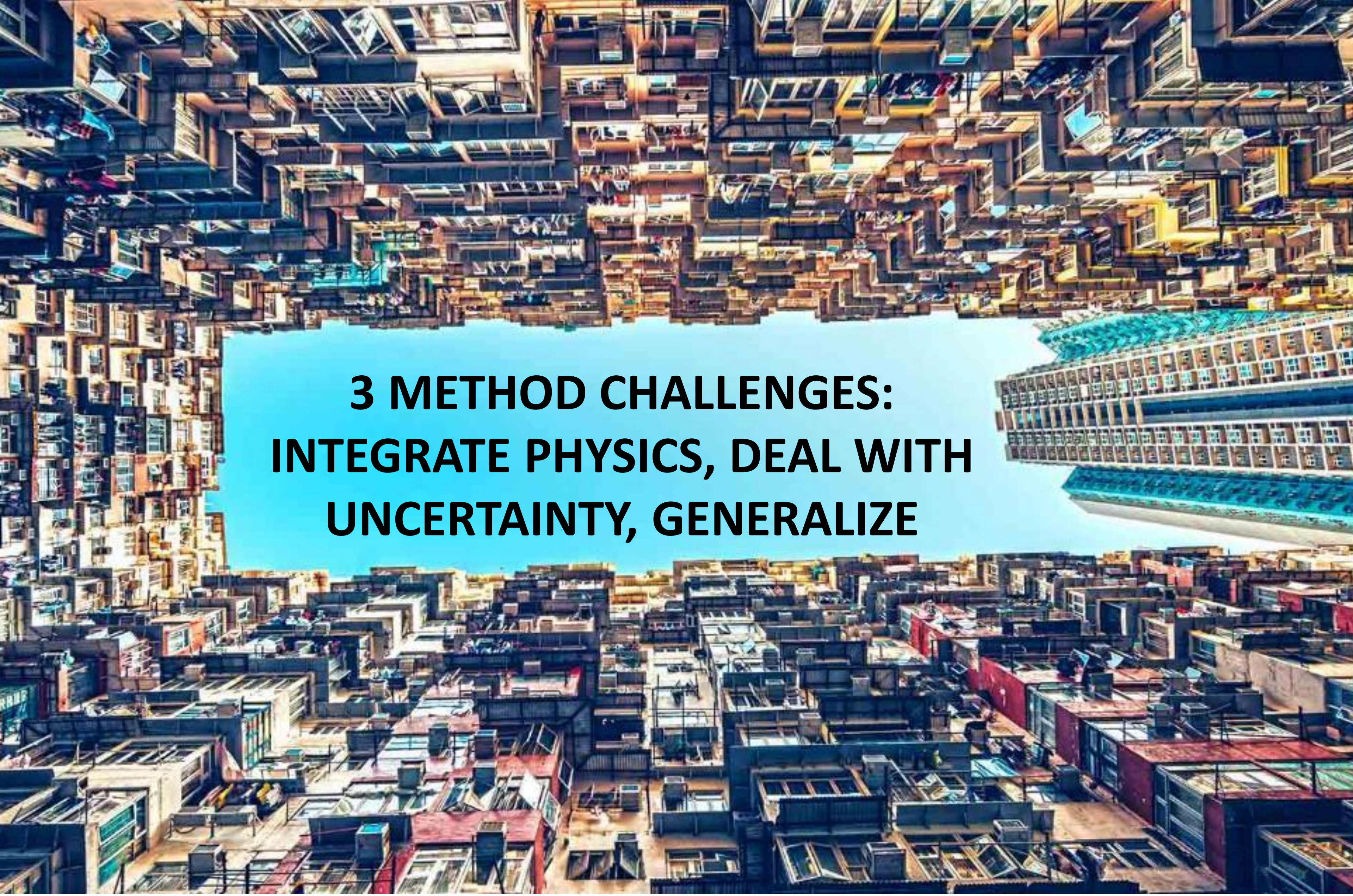
Pathways

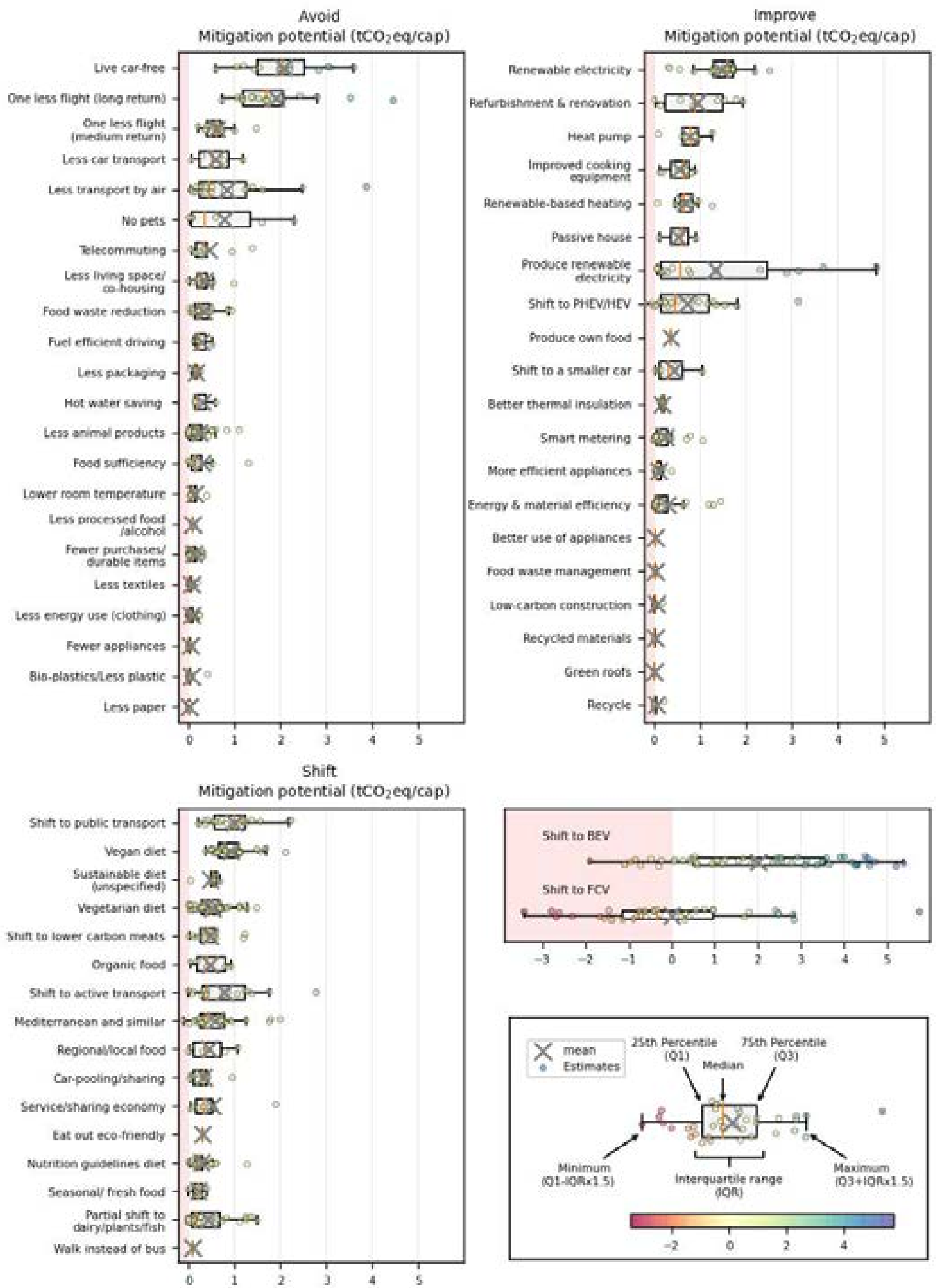
Implement efficient energy end use technologies, such as shared mobility systems, highly accessible cities, and renewable energy grid integration

Tools

Develop AI-based tools for agile climate governance, low-carbon urban planning that accelerate energy conversation and climate mitigation efforts

3 METHOD CHALLENGES: INTEGRATE PHYSICS, DEAL WITH UNCERTAINTY, GENERALIZE





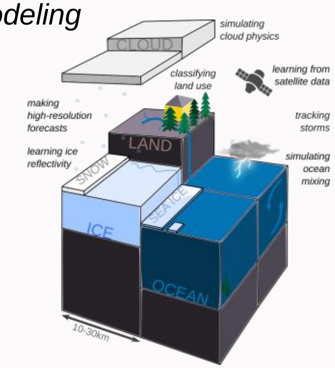
Consumption options categorized into avoid-shift-improve, with major potential in mobility

Based on Ivanova et al 2020; figure design by Max Callaghan

Physics & engineering are central to climate action

Climate prediction

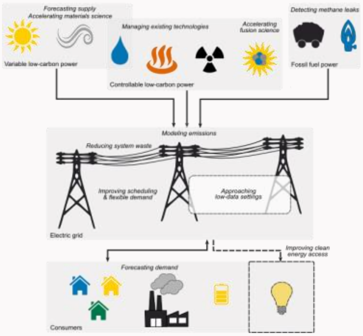
Earth, atmospheric, oceanic modeling



Electricity systems

Wind farm optimization

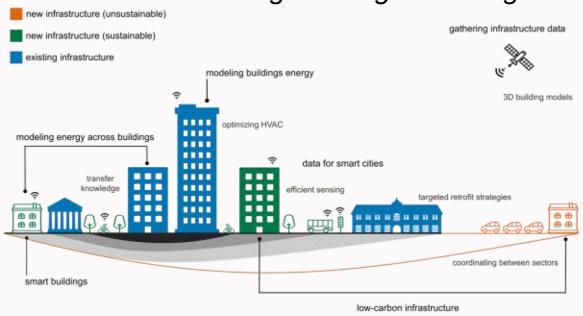
Power system optimization & control



Buildings & cities

Urban environmental simulations

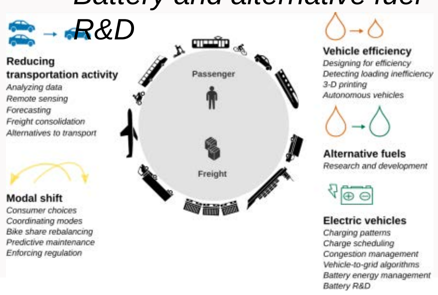
Building heating & cooling control



Transportation

Aerodynamic efficiency modeling

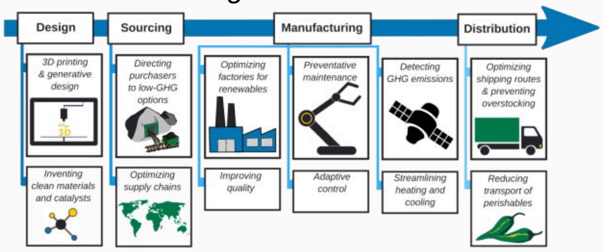
Battery and alternative fuel R&D



Industry

Equipment control & demand response

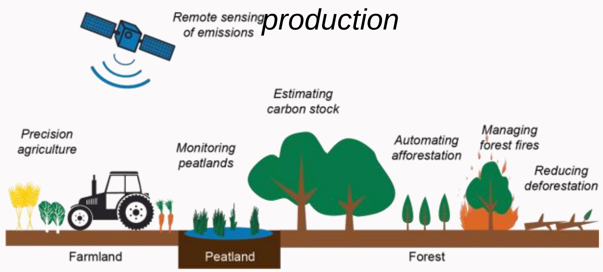
Design of low-materials structures



Land use (agriculture)

Precision agriculture

Cleaner ammonia production



Why physics-informed ML?

	Physics-based approaches	"Pure" ML approaches	Hybrid approaches
Efficiently leverage physical knowledge	✓	✗	✓?
Transparent & robust behavior	✓	✗	✓?
Adaptive, data-driven	✗	✓	✓?
Fast to run	✗	✓	✓?

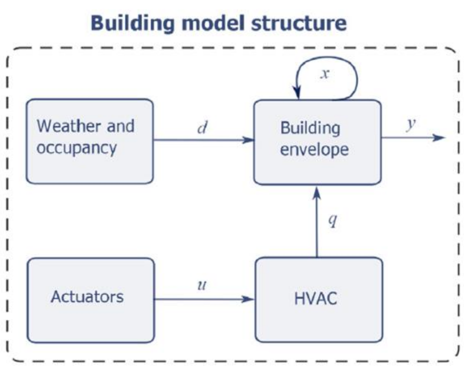
Caveat: This is an oversimplification!

Example: Modeling building dynamics

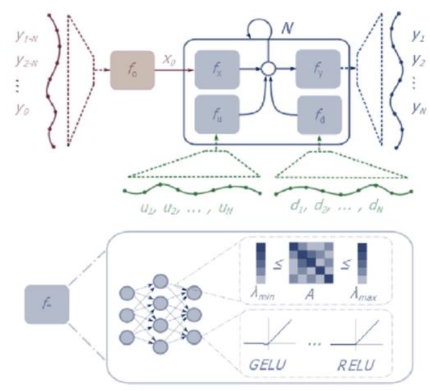
Modeling dynamics of buildings can be difficult & expensive, but is needed for implementing simulators and/or control strategies

Approach: Learn differentiable surrogate using physics-informed ML model

- Can employ within end-to-end “differentiable predictive control” workflow



(a) Structure of physics-based building thermal model.



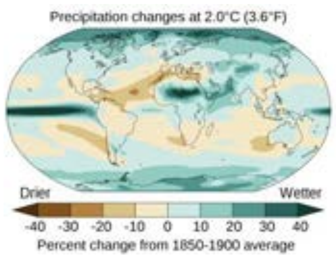
(b) Structured recurrent neural dynamics model.

See related platforms: COBS (building control) and City Learn (city-scale control)

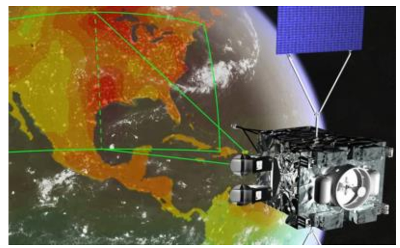
Drgoňa, J., Tuor, A. R., Chandan, V., & Vrabie, D. L. (2021). Physics-constrained deep learning of multi-zone building thermal dynamics. *Energy and Buildings*, *243*, 110992.
Drgoňa, J., Tuor, A., Skomski, E., Vasisht, S., & Vrabie, D. (2021). Deep learning explicit differentiable predictive control laws for buildings. *IFAC-PapersOnLine*, *54*(6), 14-19.

Interpretability and uncertainty in climate change

Climate change mitigation and adaptation require **trust** and **robust decision-making**



Scientific understanding and predictions of climate change



Monitoring, reporting, and verification of emissions and climate change effects

Early warning and emergency response

Policy-making on international, national, and local levels

Planning and operation of critical infrastructure

Innovation and technology assessment

Interpretability and uncertainty in climate change

Interpretability aims:

Oversight	Regulatory oversight and recourse Real-time settings: Intervening & overriding model outputs Domain-informed model debugging
Credibility	Allowing stakeholders to decide whether to trust
Scientific discovery	Working with and expanding domain knowledge

Uncertainty quantification aims:

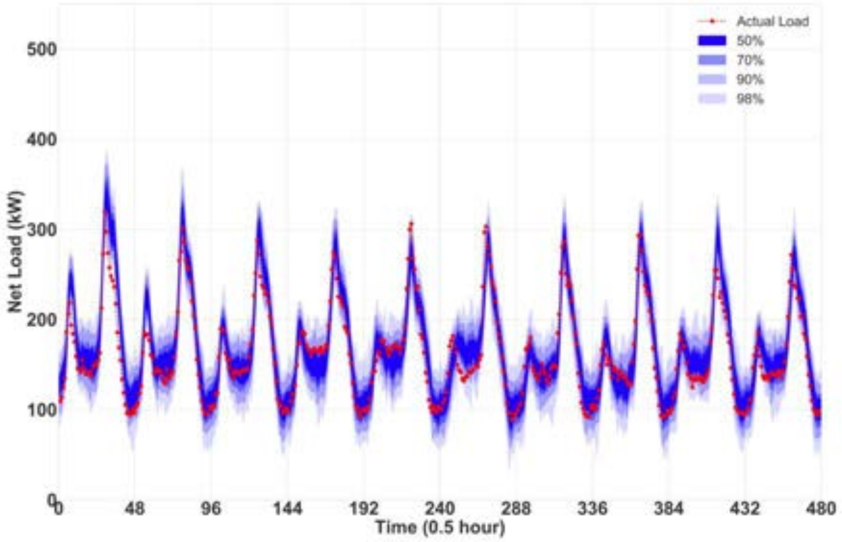
Assessing risks	Input to making robust decisions
Communication	Avoiding overconfidence and increasing credibility

Example: Net load forecasting with Bayesian deep learning

Residential net electricity load is uncertain due to climate variability, variable power generation, and aperiodic human activities

Approach: **Bayesian theory combined with deep LSTM networks** for probabilistic day-ahead net load forecasts

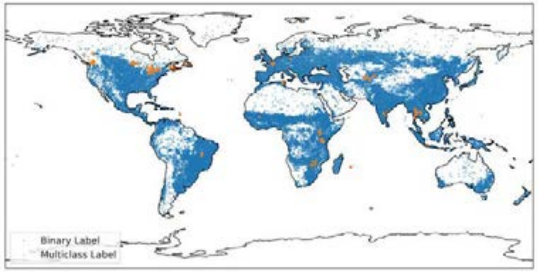
- Using smart meter data and (partially available) PV output data

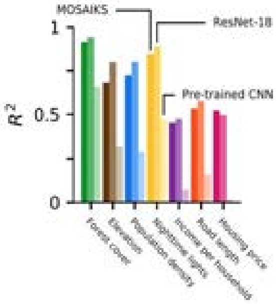


Sun, M., Zhang, T., Wang, Y., Strbac, G., & Kang, C. (2019). Using Bayesian deep learning to capture uncertainty for residential net load forecasting. IEEE Transactions on Power Systems, 35(1), 188-201.

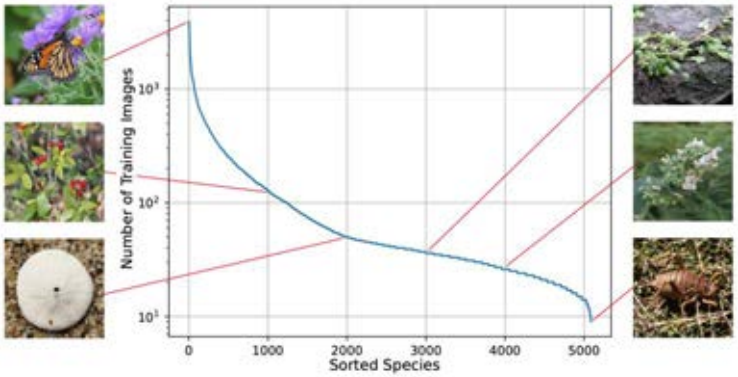
Several notions of generalization

- Generalization across tasks



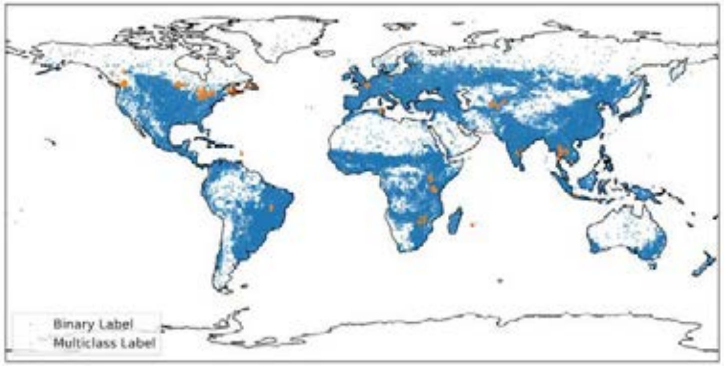


- Generalization under concept drift
- Generalization from limited data



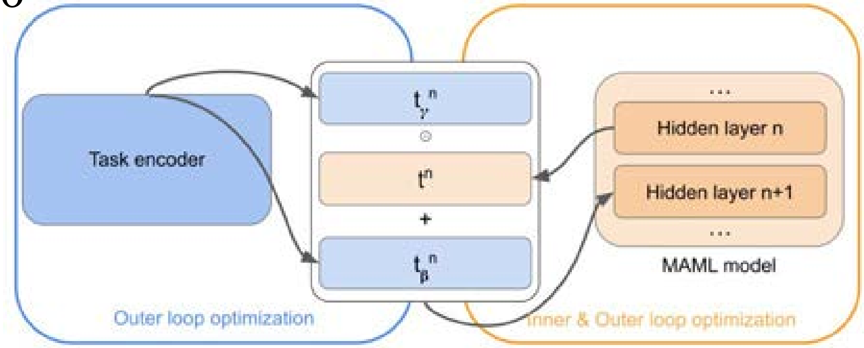
Example: Task-informed meta-learning

Remote sensing to map crops & forecast yield can help avoid food insecurity under climate change, but data are imbalanced by location/crop



TIML builds in location/task metadata to meta-learning via a task encoder

Added to MAML/other meta-learning methods to improve performance on classification & regression tasks



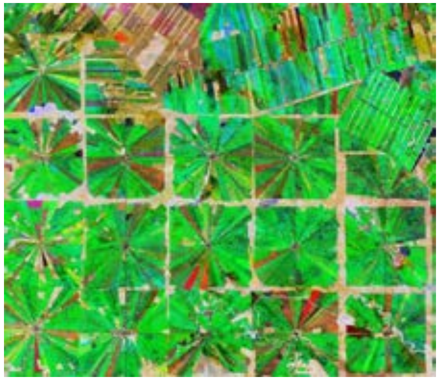
G. Tseng, H. Kerner, D. Rolnick, "TIML: Task-Informed Meta-Learning for agriculture," arXiv 2202.02124, 2022.

G. Tseng, et al., "CropHarvest: A global dataset for crop-type classification," NeurIPS 2021 Datasets and Benchmarks Track.

1. Distilling raw data

Role: Distilling raw data into actionable information

Some relevant ML areas: Computer vision, natural language processing



Examples

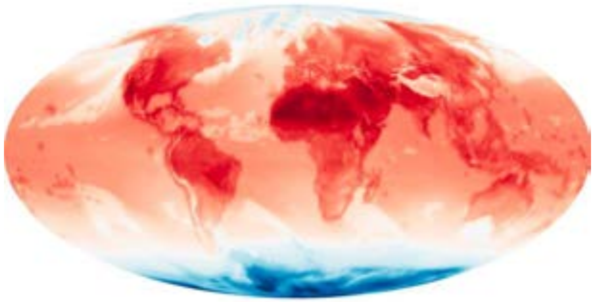
- Mapping deforestation
- Gathering data on building footprints/heights [Mitigation]
- Evaluating coastal flood risk [Adaptation]
- Parsing corporate disclosures for climate-relevant info [Adapation]

2. Approximating simulations

Role: Accelerating time-intensive, often physics-based, simulations

Some relevant ML areas:

Physics-informed ML, computer vision, interpretable ML, causal ML



Examples

- Superresolution of predictions from climate models [A]
- Simulating portions of car aerodynamics [M]
- Speeding up planning models for electrical grids [M]

3. Improving predictions

Role: Forecasts and time series predictions

Some relevant ML areas: Time series analysis, computer vision, Bayesian methods

Examples

- "Nowcasting" for solar/wind power [M]
- Forecasting electricity demand [M]
- Predicting crop yield from remote sensing data [A]

4. Accelerating scientific discovery

Role: Suggesting experiments in order to speed up the design process

Some relevant ML areas: Generative models, active learning, reinforcement learning, graph neural networks

Examples

- Identifying candidate materials for batteries, photovoltaics, and energy-related catalysts [M]
- Algorithms for controlling fusion reactors [M]

5. Optimizing complex systems

Role: Improving efficient operation of complex, automated systems

Some relevant ML areas: Optimization, control, reinforcement learning

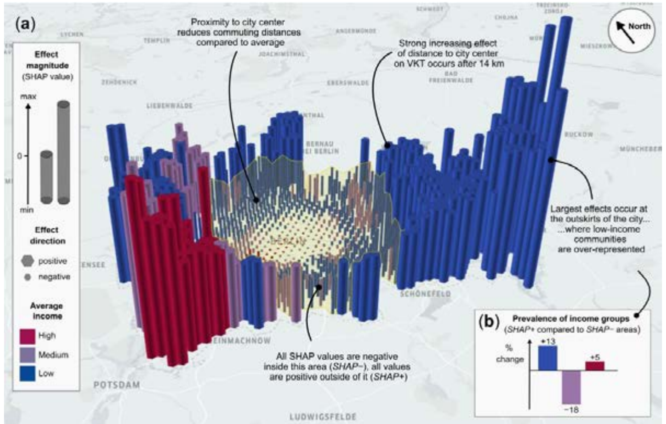
Examples

- Controlling heating/cooling systems efficiently [M]
- Optimizing rail and multimodal transport [M]
- Demand response in electrical grids [M]

Note: Beware of misaligned objectives and rebound effects

6. Enabling and facilitating planning and governance

<u>Role</u>: Providing highly contextualized, decision relevant information



<u>Some relevant ML areas</u>: classification algorithms, predictive learning

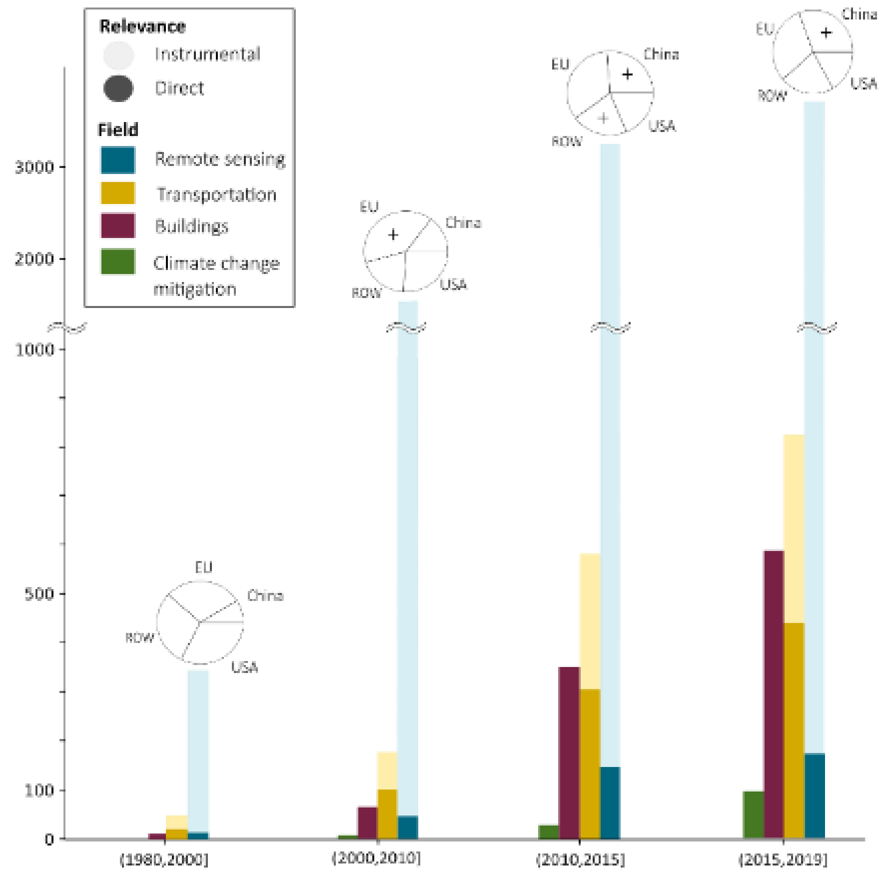
<u>Examples</u>

- Low-carbon urban planning [M]
- Co-optimizing green, blue and built infrastructures for climate resilience [A]

Artificial intelligence for geographically explicit solutions

- Rapid growth in machine learning applications albeit from low base
- Focus on applied issues not intended for climate change mitigation but of indirect relevance
- Substantial expertise in EU, most growth in China

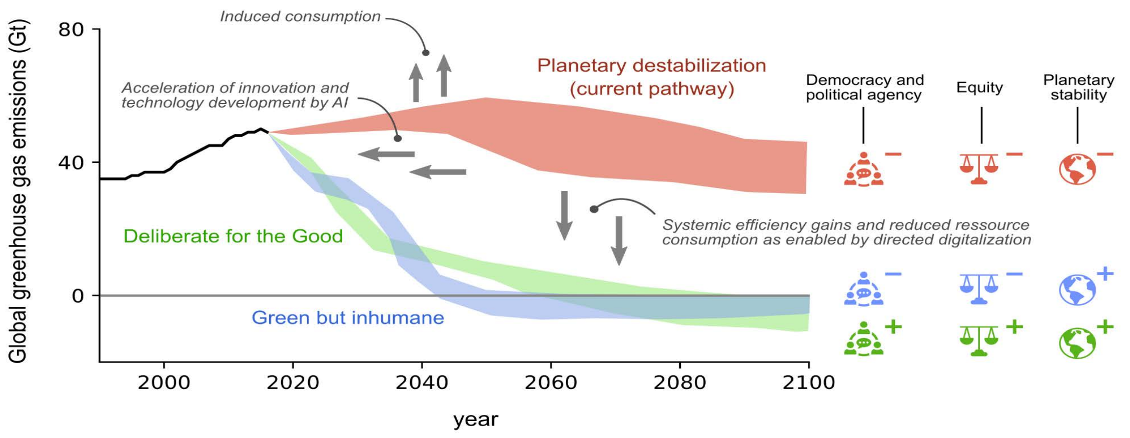
Milojevic-Dupont & Creutzig (2019)



AI governance for climate change mitigation: the urban example

Make use of agile AI-based urban planning systems to:

- Avoid high energy consumption induced by inefficient urban planning and urban sprawl
- Improve energy efficient mobility services and housing use to reduce GHG emissions
- Shift and accelerate mitigation pathways by accelerating planning processes and rapidly adapt (street) infrastructures



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Ivona Brandic, TU Wien

Jasmin Lampert, AIT

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Staatspreis Technologie 2024

„Technologien initiieren Veränderung“

Staatspreis Technologie
„Technologien initiieren Veränderung“

Ausgezeichnet werden Einreichungen in den drei Kategorien

- AI for Green
- Mobilitätstechnologien
- Innovationskultur in Technologieunternehmen

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„Technologien initiieren Veränderung“

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