Kunstig intelligens

- en grøn gamechanger eller sort samvittighed?



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Program

09.30 Velkomst og åbningstale v. Digitaliseringsministeren

09.40 Hvad er omfanget af AI's klimaaftryk?

- What is the carbon footprint of AI? *v. Raghavendra Selvan, Datalogisk Institut, KU*
- Hvordan spiller AI sammen med vores bæredygtighedsmål? *v. Mette Kaagaard, Microsoft Danmark*
- Hvad er klimaperspektiverne på mikrochip-produktionen til AI? *v. Jörg Hübner, DTU Nanolab*
- Rundbordssamtaler

10.40 Pause

11.00 AI's rolle i at indfri vores klimaambitioner

- Sådan hjælper kunstig intelligens 30 danske kommuner med energioptimering af bygningsmassen, *v. Malte Frederiksen, Ento*
- Automatiseret klimaregnskab med AI, *v. Thor W. Larsen, BeWo*
- AI til udvikling af vejrmodeller, *v. Marianne Thyrring, DMI*
- Rundbordssamtaler

12.00 Frokostpause

12.30 Hvordan forholder vi os til AI's klimaudfordringer

- Genbrug af overskudsvarme fra Microsofts datacenter til fjernvarmen i Høje Taastrup Kommune, *v. Lars Christensen, Høje Taastrup Kommune*
- Klimavenlig datalagring, *v. Pierre Bennorth, CopenCloud*
- Rundbordssamtaler

13.35 Paneldebat: Hvordan kan vi gøre brugen af AI mere grøn?

13.50 Afrunding



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Velkommen

Lisbeth Knudsen, strategidirektør i Tænketanken Mandag Morgen



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Åbningstale

Digitaliseringsminister Caroline Stage Olsen (M)



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Hvad er omfanget af AI’s klimaaftryk?



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What is the carbon footprint of AI?

Hvad er omfanget af AI's klimaaftryk?

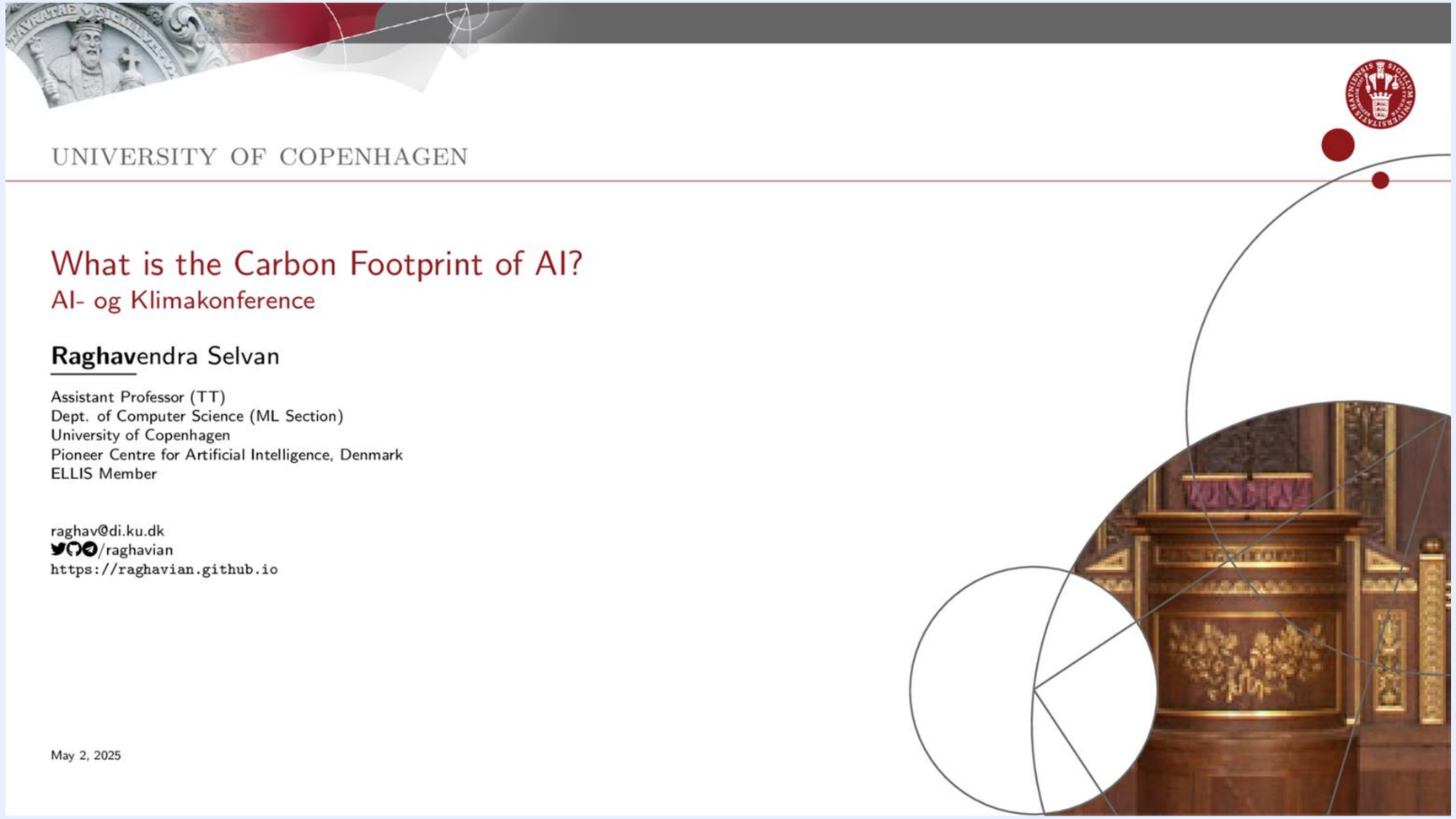
v. Raghavendra Selvan, adjunkt ved Datalogisk Institut, KU



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UNIVERSITY OF COPENHAGEN

What is the Carbon Footprint of AI?

AI- og Klimakonference

Raghavendra Selvan

Assistant Professor (TT)
Dept. of Computer Science (ML Section)
University of Copenhagen
Pioneer Centre for Artificial Intelligence, Denmark
ELLIS Member

raghav@di.ku.dk
/raghavian
https://raghavian.github.io

May 2, 2025

AI for Sustainability

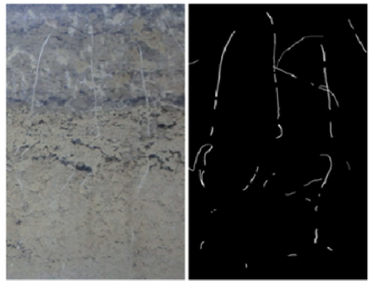
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AI for Sustainability

Plant Root Measurement



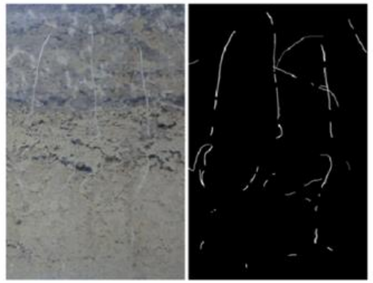


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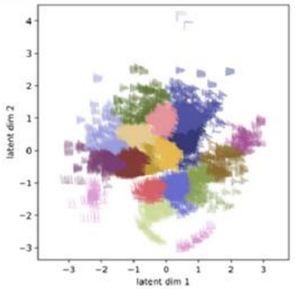
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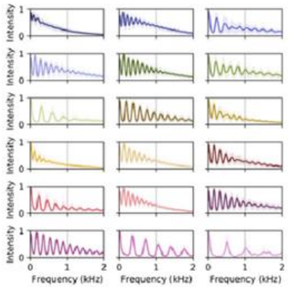
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Biodiversity Quantification



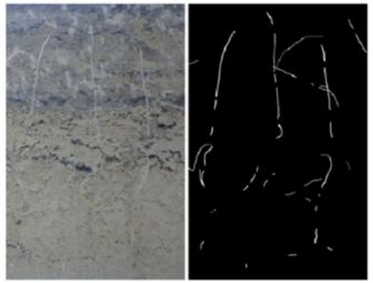


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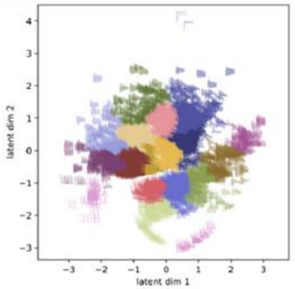
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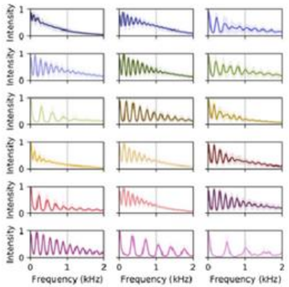
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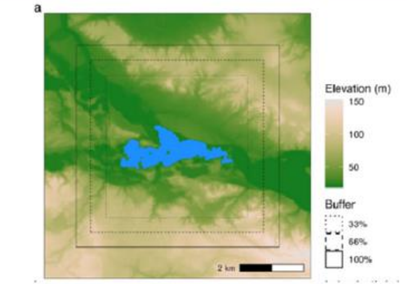


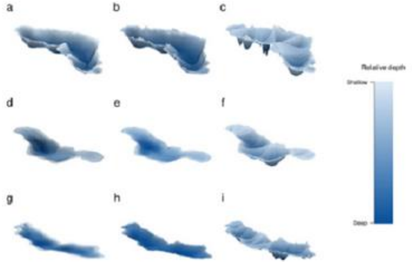
Biodiversity Quantification





Estimating Lake Depth





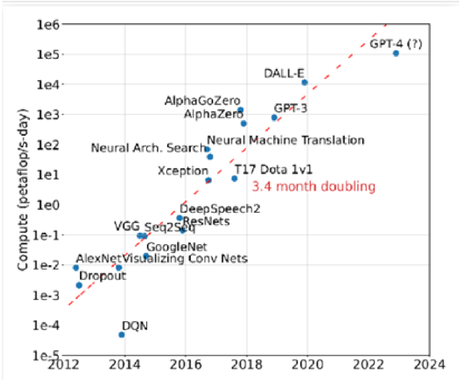
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Progress in AI → Large Models & Large Datasets → Large Compute

Figure adapted from https://openai.com/blog/ai-and-compute/
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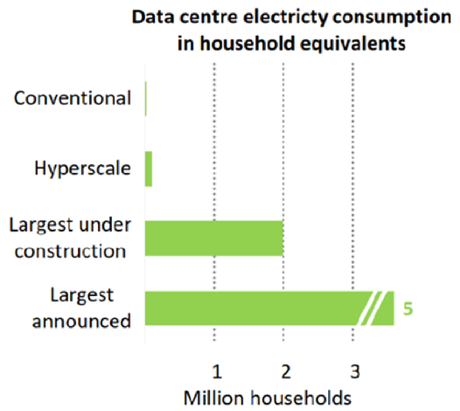
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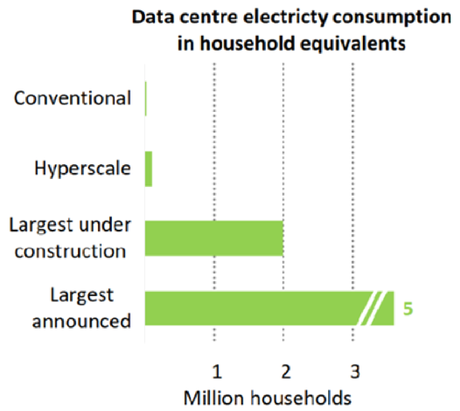


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- No precise numbers for AI as a sector, yet

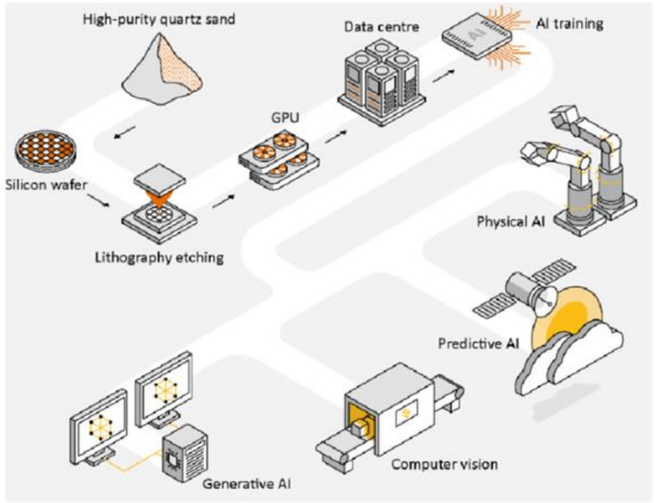
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Some Estimations of Energy Consumption of AI

AI Supply Chain figure adapted from Energy and AI. IEA. 2025
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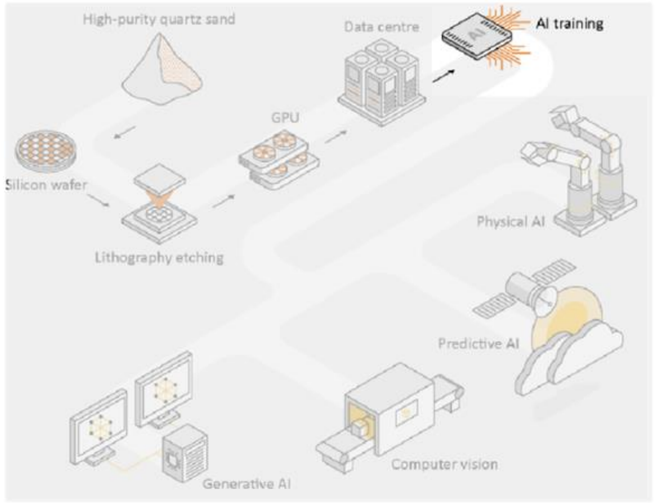


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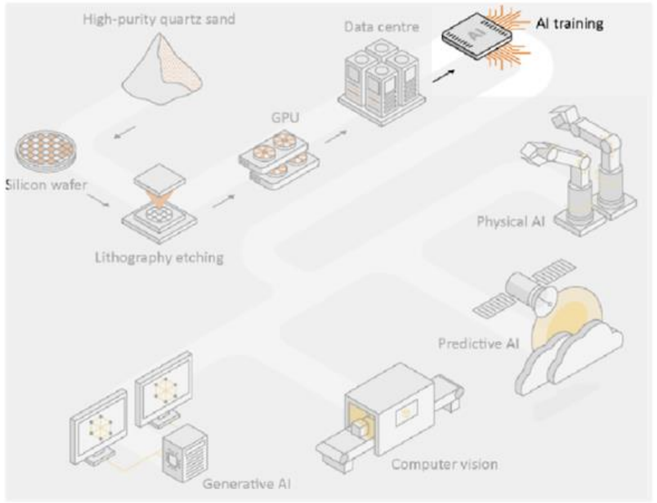


Let's look at LLaMA-3 training

(Kudos to Meta for publishing this information)

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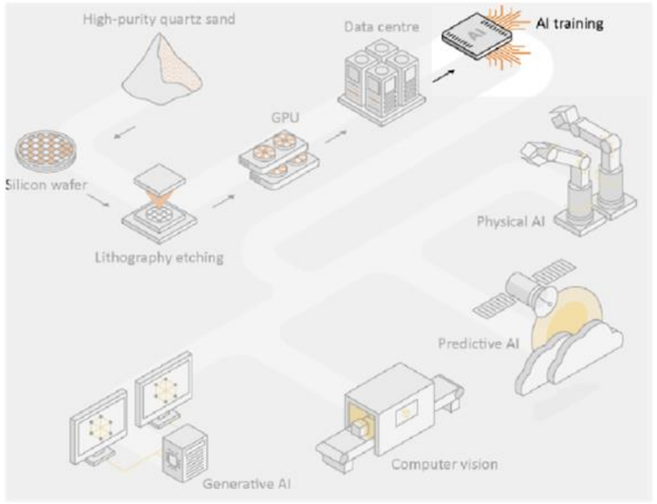
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Carbon Footprint	CO2e: 8,930 tons
Energy Consumption	Energy used: 21.5 GWh
Training Time	GPU hours: 30.84 M
Model Complexity	Parameters: 405 B Training data/tokens: 15 T

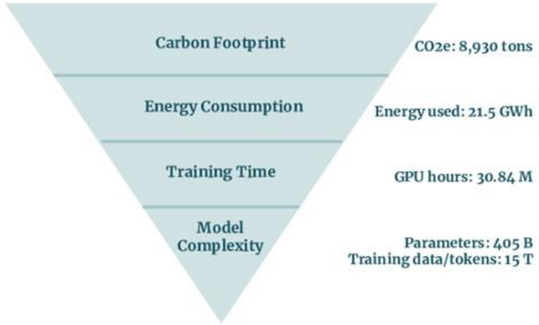
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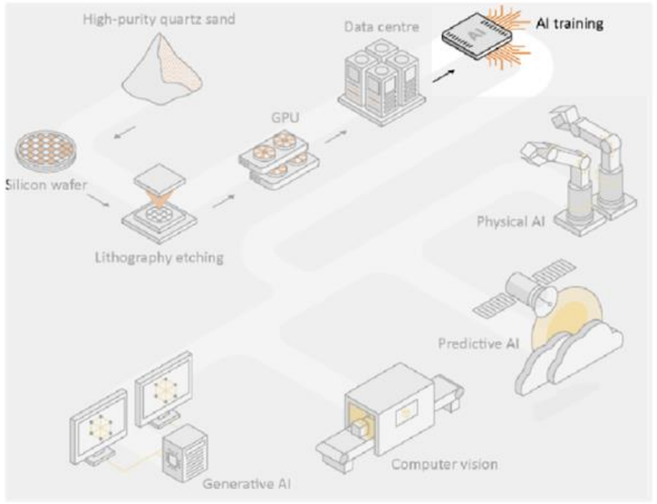
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Model name	Number of parameters	Power consumption	CO_2eq emissions	CO_2eq emissions × PUE
GPT-3	175B	1,287 MWh	*502 tonnes*	552 tonnes
Gopher	280B	*1,066 MWh*	*352 tonnes*	380 tonnes
OPT	175B	*324 MWh*	70 tonnes	*76.3 tonnes*[3]
BLOOM	176B	433 MWh	25 tonnes	30 tonnes

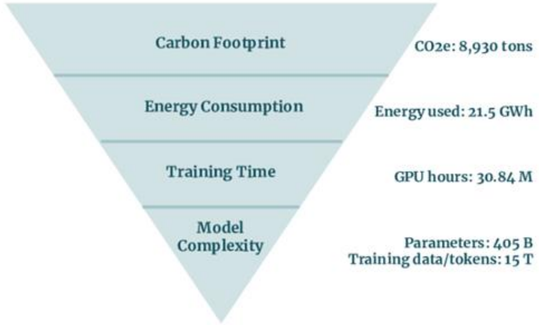
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AI could become a significant contributor to Climate Change due to its large resource footprint.

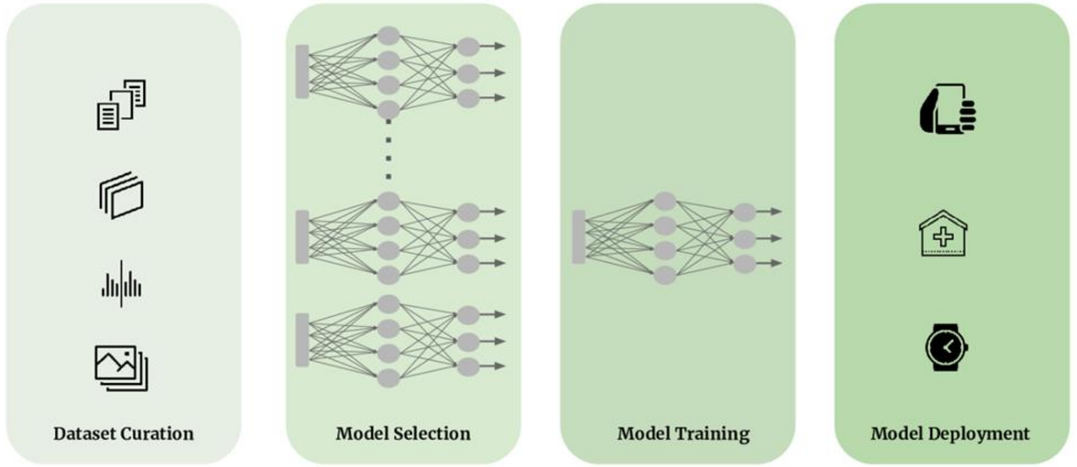
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Current Research Focus: Improving Sustainability Across Life-Cycle of AI Models

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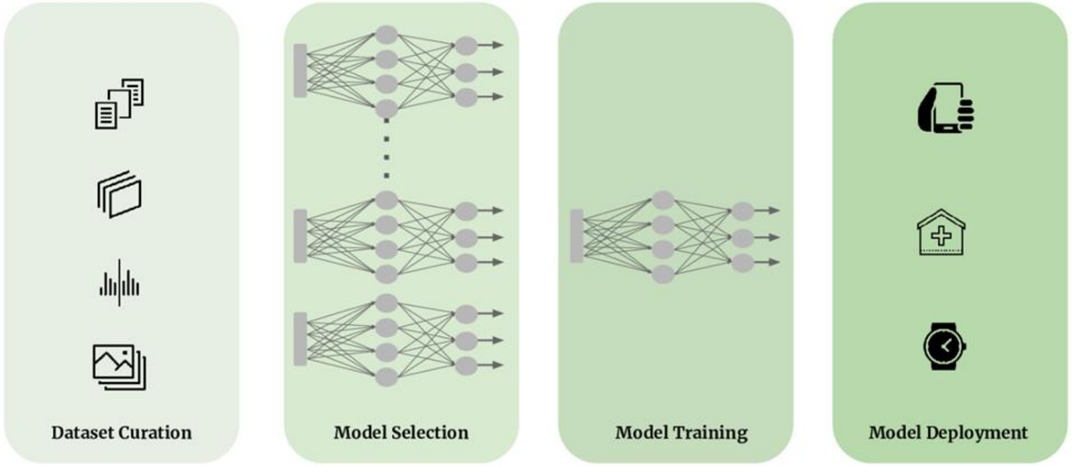


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Transition from *Abundance* mindset and operate with resource constraints.

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Joint Optimisation of Performance and Energy Consumption

Bakhtiarifard, Igel, Selvan. "EC-NAS: Energy Consumption Aware NAS" (2024)

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- Main objective of model selection is performance (accuracy)

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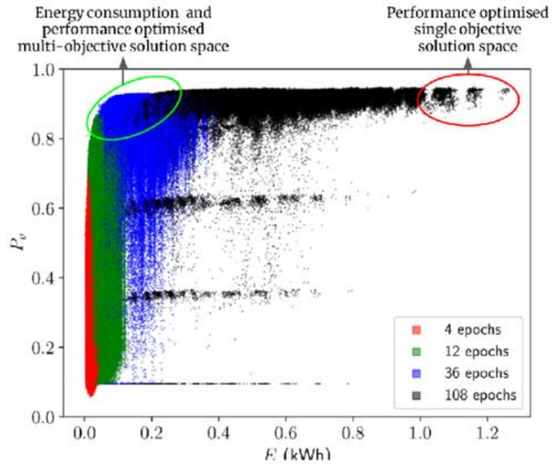
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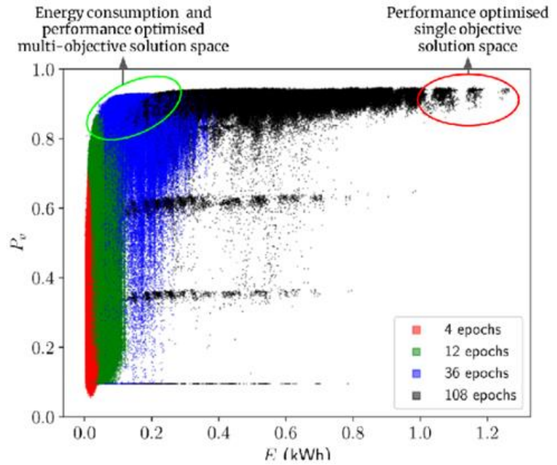


On average, 1% reduction in performance for 70% reduction in energy!

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Similar observations with DeepSeek; achieved comparable performance with a fraction (10%) of resources.

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What Can We Do?

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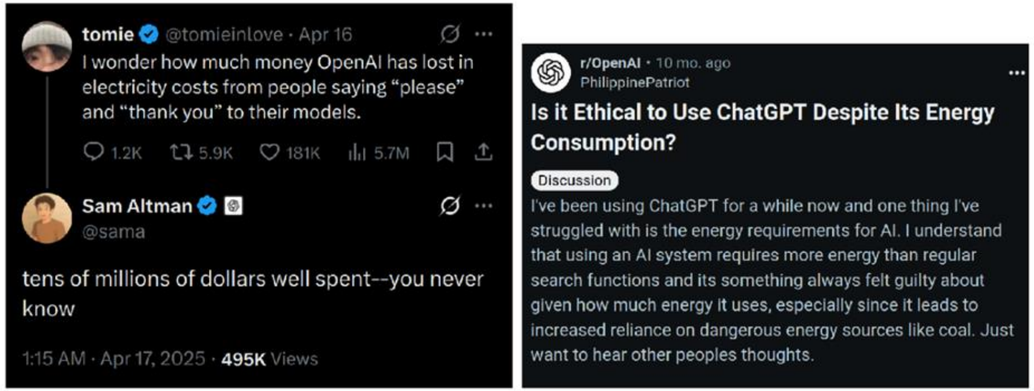


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What Can We Do?



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What Can We Do?





Resist Individualization of Responsibility

Individual actions matter; Collective action is imperative; Systemic transformations are more effective.

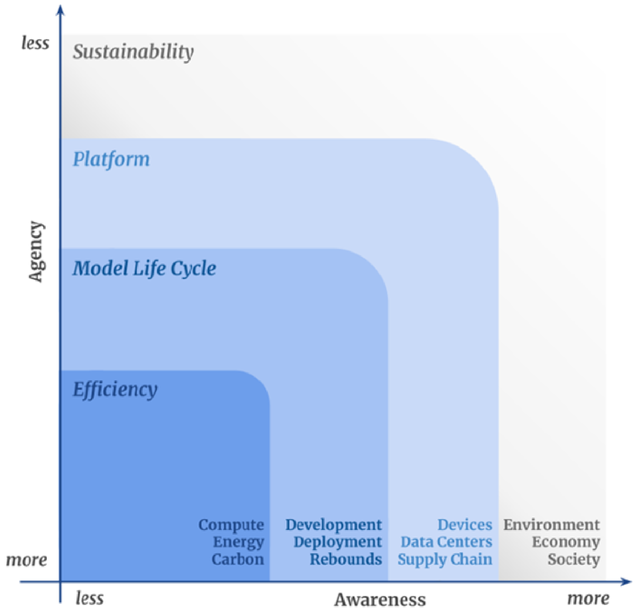
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Efficiency is Necessary. But, not a Sufficient Condition



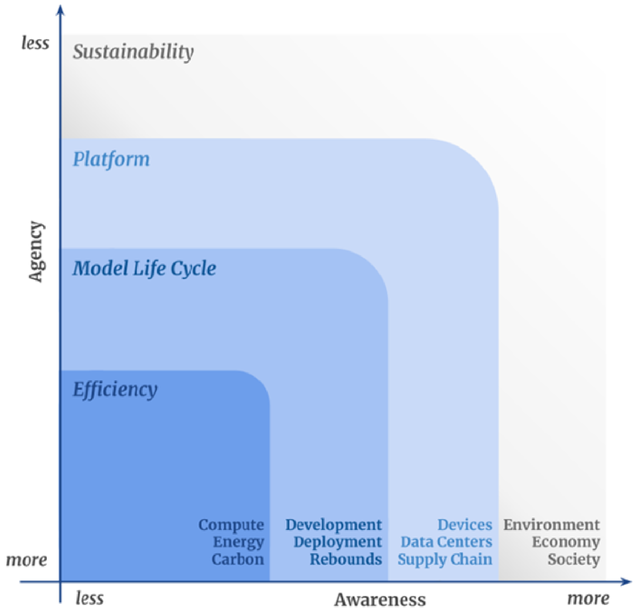
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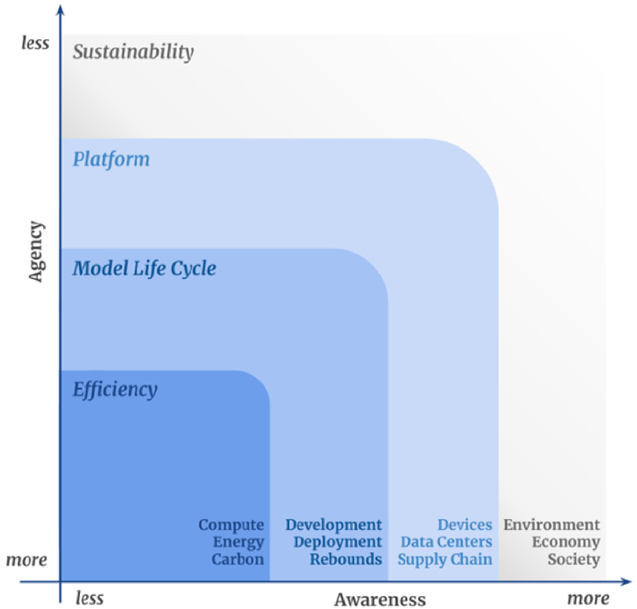
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Climate and Resource Aware Machine Learning (CARAML) Framework

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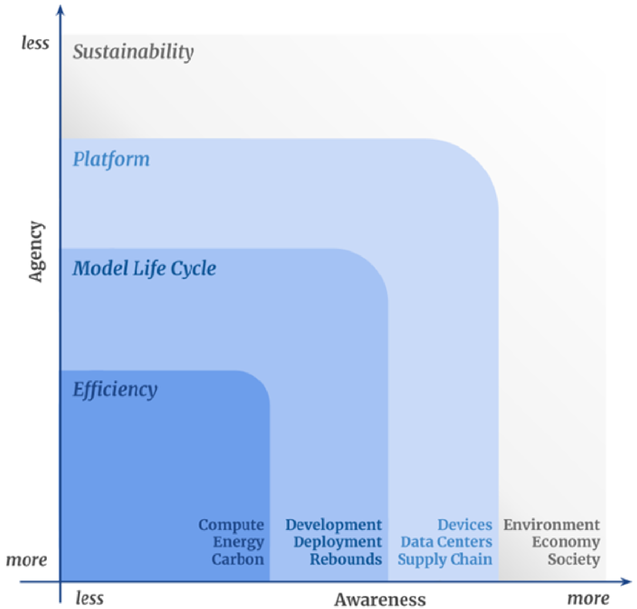


Climate and Resource Aware Machine Learning (CARAML) Framework

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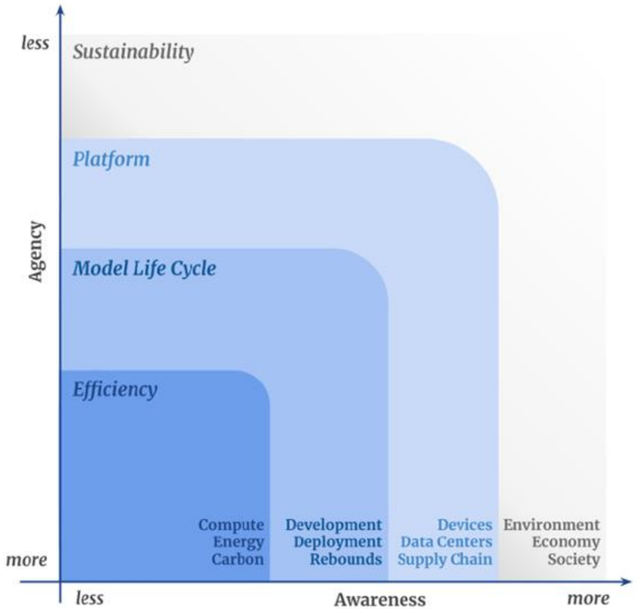


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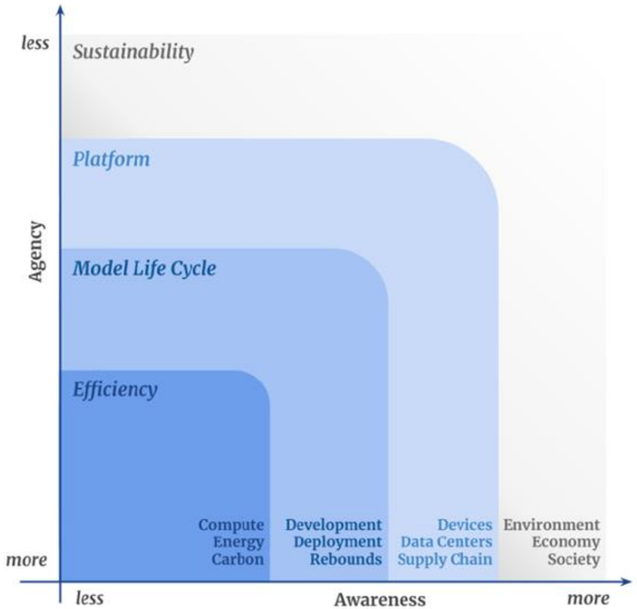


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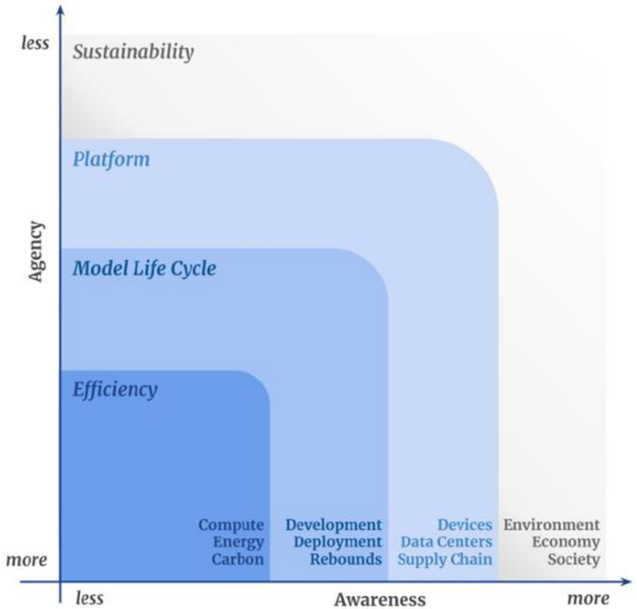


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- **Global Action**
  - Coordinated global standards
  - Address digital divide through global access
  - Coordinated research on global challenges

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Conclusions



Selvan, Pepin, Igel, Samuel, Dam. Equity through Access: A Case for Small-scale Deep Learning. 2024.

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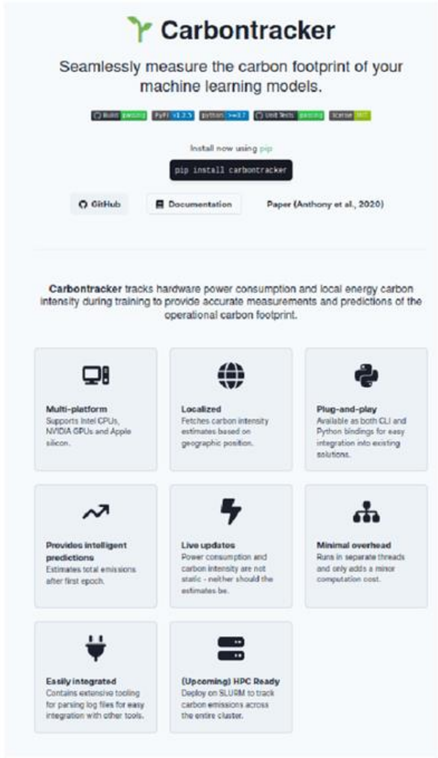




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Thank you



Thank you

Reach out

raghav@di.ku.dk
/raghavian

Questions?



Thank you

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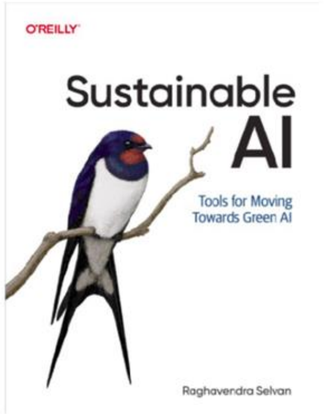
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Thank you

For more on Sustainable AI, check out my upcoming book...



https://www.oreilly.com/library/view/sustainable-ai/9781098155506/

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Questions?

Funding received under European Union's Horizon Europe Research and Innovation programme under grant agreements No. 101070284, No. 10107040 and No. 101189771

Funding received under Independent Research Fund Denmark (DFF) under grant 430700143B,

Hvordan spiller AI sammen med vores bæredygtighedsmål?

Hvad er omfanget af AI's klimaaftryk?

v. Mette Kaagaard, CEO, Microsoft Denmark & Iceland



ADD algoritmer data & demokrati

DI Digital

mandagmorgen TÆNKETANKEN

AI – SORT SAMVITTIGHED ELLER BÆREDYGTIG FREMTID?

Mette Louise Kaagaard
CEO Microsoft Denmark & Iceland
https://www.linkedin.com/in/mette-louise-kaagaard-367518/



Generativ AI og Bæredygtighed

Gen AI bruger mere strøm og vand

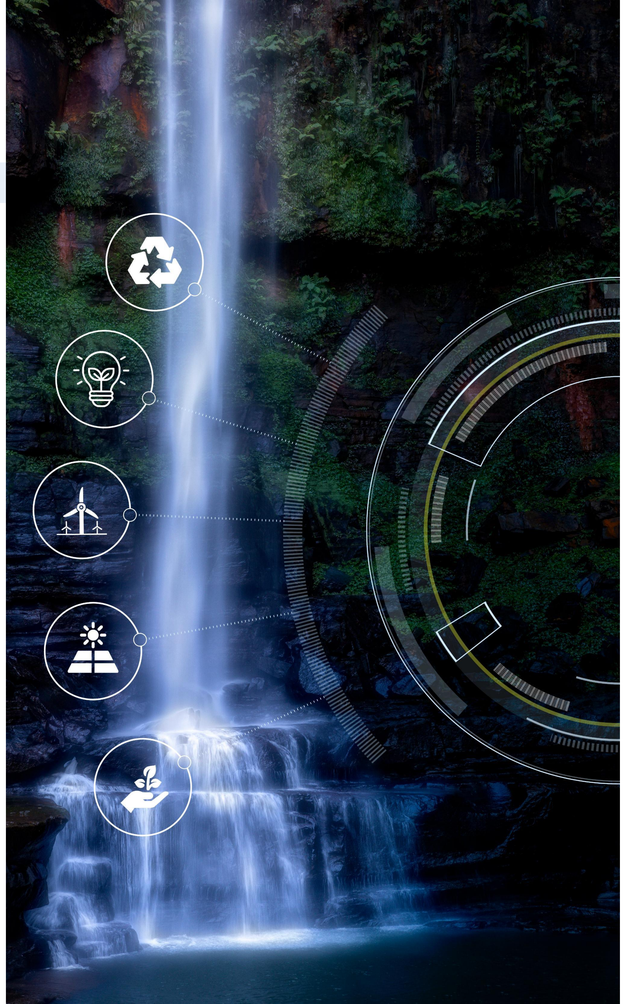
AI udgør kun en lille del af det globale energiforbrug

Datacentre udgjorde ca. 2 % af energiforbruget i 2024

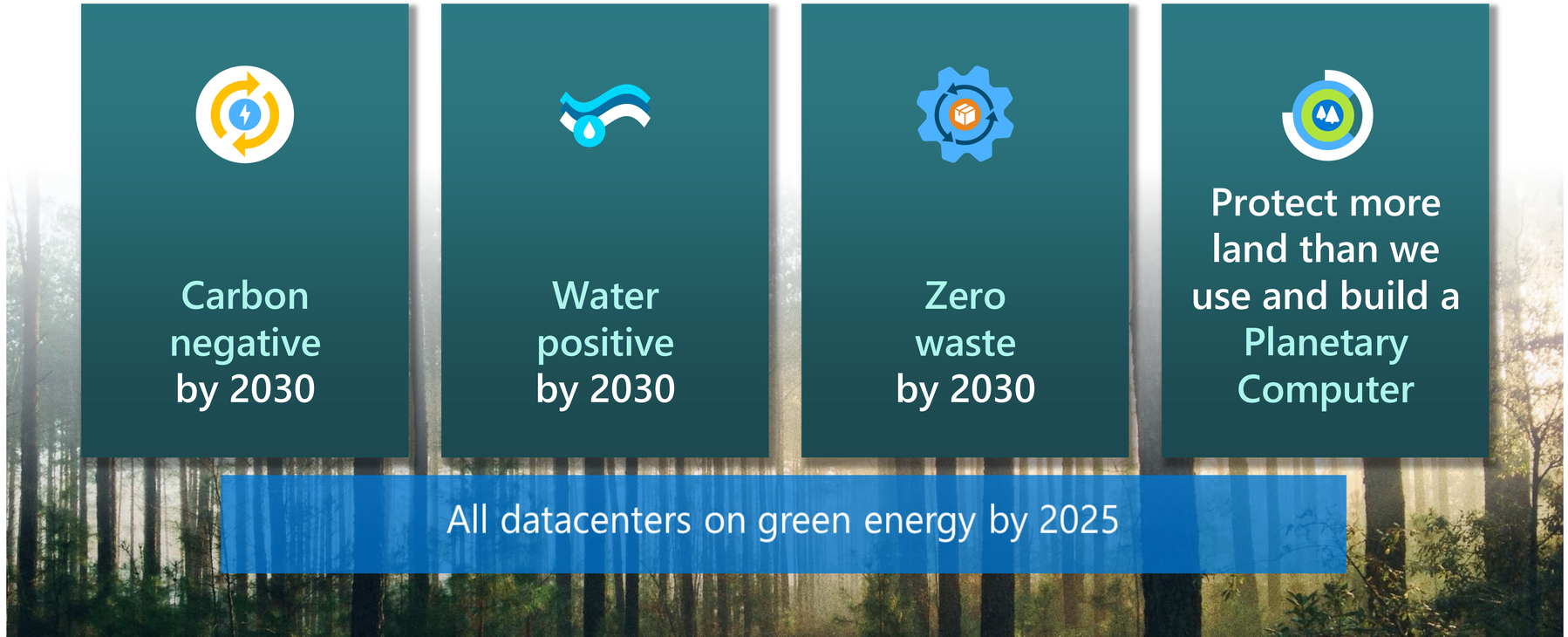
Effektive modeller og hardware er nøglen til energibesparelse

AI forbedrer produktionseffektivitet og reducerer energiforbrug

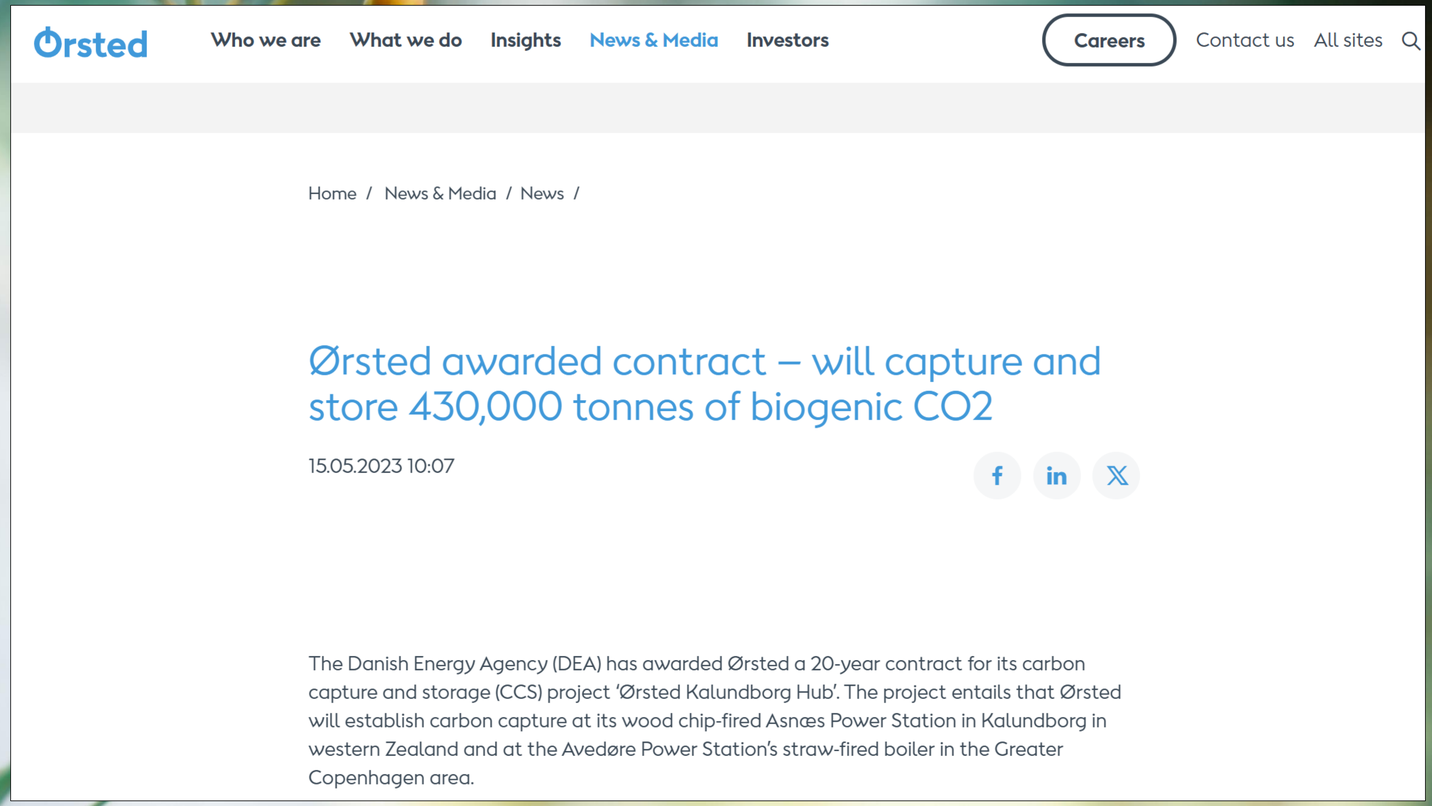
AI driver forskning i bæredygtige materialer og fødevarer



The path to removing all emissions by 2050



Microsoft Climate Innovation Fund: $1 Billion over 4 Years




Thank you

Sustainable Datacentres

Our Sustainability commitments

2025

Operate with 100% renewable energy

Protect more land than Microsoft uses

2030

Become carbon negative

Become zero waste

Become water positive

2050

Remove all historic emissions

Microsoft is procuring **new renewable energy** equivalent to the consumption of the new datacenters in Denmark.

Leadership in Energy and Environmental Design (LEED) is the world's largest green building certification program. The datacenters are designed to be **LEED Gold certified**

Power usage effectiveness (PUE) measures cloud energy efficiency. Datacenters are designed to run at an efficiency rate of **1.16.**

Waste Heat Recovery into the **district heating** system in Høje Tåstrup warming 7.000 houses and planned in Køge.

Almost **no water** usage. Microsoft designed the new Denmark datacenters for a water usage efficiency rate of 0.01 L/kWh.

Zero Waste: 78% of our end-of-life assets and components; the remaining 22% of materials are recycled, by use of Microsoft Circular Centers.

Hvad er klimaperspektiverne på mikrochip-produktionen til AI?

Hvad er omfanget af AI's klimaaftryk?

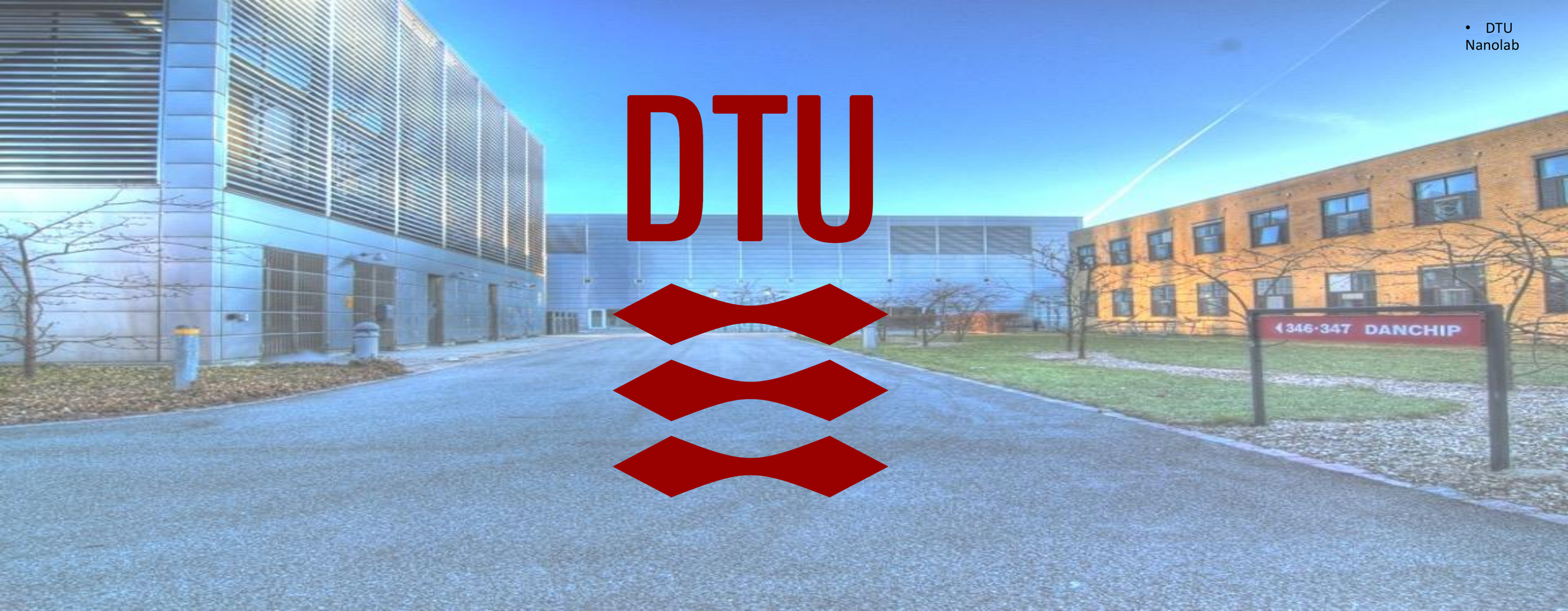
v. Jörg Hübner, direktør i DTU Nanolab



ADD algoritmer data & demokrati

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mandagmorgen TÆNKETANKEN



- DTU Nanolab

DTU Nanolab National center for Nanofabrication and Characterization

open access nanofabrication and characterization

…from basic research to small scale production…

ISO 9001
DNV
CERTIFIED ORGANISATION

Remarks on the environmental footprint of semiconductor fabrication (with a special perspective on AI chips)

Jörg Hübner, Director DTU Nanolab

Illmenau Summerschool 74

Disclaimers:

The semiconductor value chain is complex and solid data for assessing the ecological footprint is not available.*

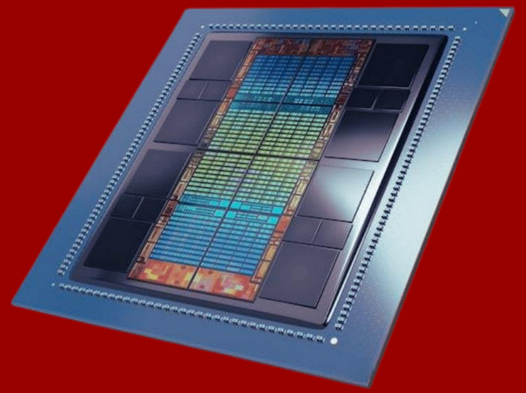
Yours truly is a nanofabrication engineer and not a sustainability impact specialist

**Chip Production's Ecological Footprint ….” Julia Christina Hess June, 2024, Interface - Tech Analysis and Policy Ideas for Europe*

Kongens

Chip fabrication vs Chip usage

In 2030 with 20% chip production share of EU:
electricity consumption of European semiconductor industry 47.4 tWh
European data centers: 98.5 tWh
(total residential power consumption of greater Paris 61 tWh)





Two aspects:

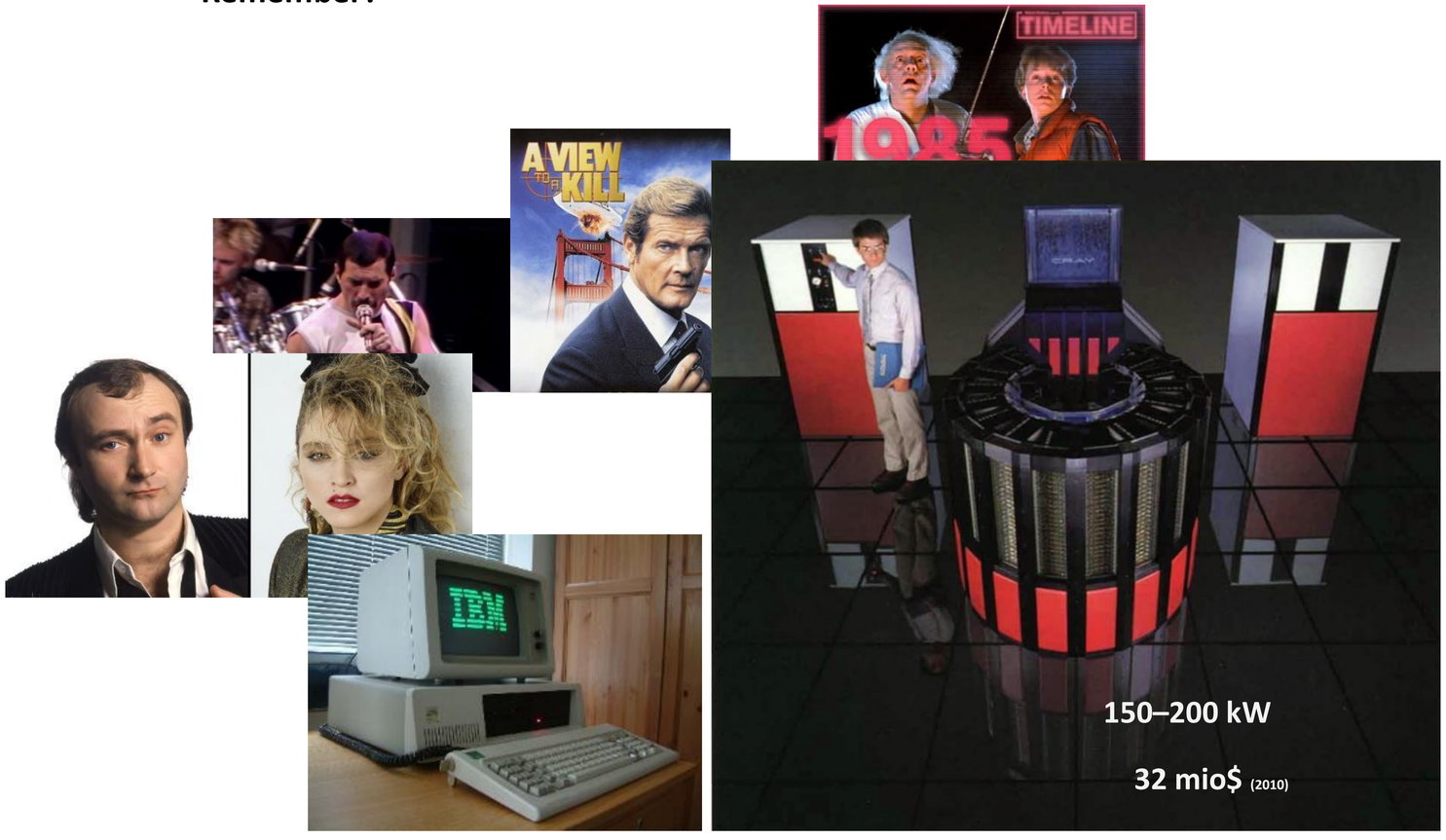
Chip fabrication

Chip usage

” ….making chips is not rocket science ….its much more difficult”

… a historic perspective …..

Remember?



5000 Cray 2 = 1 IPHONE 12







3 Dkk and 20 Mio km/l

…where is the problem?



25

Let’s focus on semiconductor production





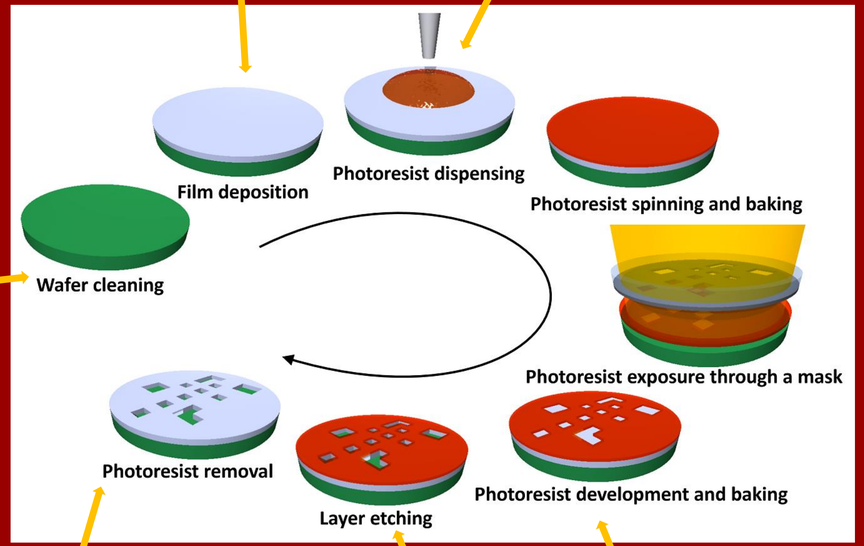
semiconductor industry emits more than 100 mio tons of CO_2e per year - doubled in 2030

(around 10% of the car industry)

Nanofabrication – how chips are made

metals, rare earth oxides

epoxys, pfas

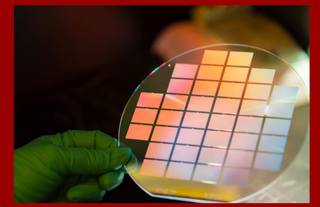


chemicals water

organic solvents

gases

chemicals



the more advanced chips
– the more cycles

a few facts….

chips:



nm



m

-takes about 3 months (500 processes) wafer start to diced wafer
-up to 80 billion transistors per chip - growing
-nanometer size and precision
-1,15 trillion chips shipped in 2021 (80% made in Asia, 92% leading edge logical chips made chips in Taiwan)
-expected to grow from 574 billion US$ in 2022 to 1380 US$ billion in 2030

a few facts….

chip factories:



- around 16 fabs with 10nm and beyond are currently under construction
- price about 10 billion US$ (each)
- power consumption of one plant: 100 - 200 MWh equals a small city
- nanometer size and precision

Contributors to environmental impact:

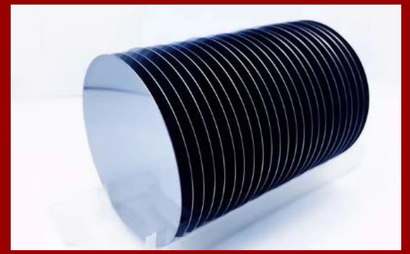
- Raw materials (silicon, chemicals, metals gases)
- Water
- Electricity
- Transport

Water:

A large semiconductor fabrication plant today uses up to 38 mio liters of water per day
about the daily water consumption of 300 000 Germans

Taiwanese Fabs have up to 80% water reuse and recycling
European Fabs can have as low as 10%- to 14%

Electricity:



In 2030 with 20% production share of EU:
electricity consumption of European semiconductor industry 47.4 tWh
European data centers: 98.5 tWh
(total residential power consumption of greater Paris 61 tWh)

or estimated 100-150 KWh per square centimeter of wafer produced
(6MWh per year per capita in Dk – buys you around 40 cm^2)

Transport:

Highly specialized, consolidated industry:

- *few world wide providers of materials, chemicals and consumables*
- separation of front end and back end

Components in a chip often travel well over 50 000 km and cross international borders up to 70 times before end customer

All in all:

Production of a single high-end chip can easily generate more than 30 kg CO_2e emissions…. ***(6t CO_2e for producing a car)***

problematic if not handled with care:



Flourinated Gases



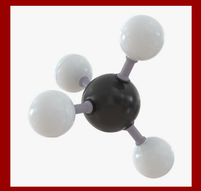
Global Warming Potential:

…example SF6 (sulfurhexaflouride):

1 kg SF6 equals 23 t of CO2 a factor of 23000

~1500 t per year used by the semiconductor industry
1500t x 23000= 33.5 MtCO2e abated ~50% still 15 MtCO2e SF6 alone
same amount of C4F8 is used, GWP around 12000





1 kg CH4 equals 0.012 t of CO2

Methane (CH4): 12 years

Inconsistent numbers – CO2e difficult to assess:

example fluorinated gases:



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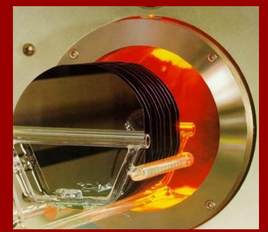
same amount of C4F8 is used GWP around 12000 contributing to ~8MtCO2e

Adding NF3 and others we are at
more than half the total semiconductor CO2e emission
originating from flourinated process gasses????

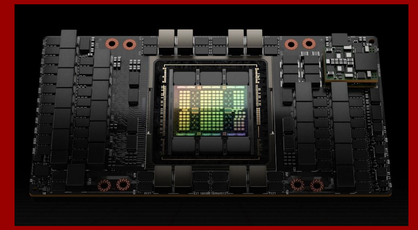
Difficult !

"Estimating fluorinated GHG emissions from semiconductor manufacture is complicated and has required a significant and coordinated effort by the industry and governments. It was historically assumed that the majority of these chemicals were consumed or transformed in the manufacturing process. It is now known that under normal operating conditions, anywhere between 10 to 80 percent of the fluorinated GHGs pass through the manufacturing tool chambers unreacted and are released into the air."

https://www.epa.gov/eps-partnership/semiconductor-industry



Nvidia H100 …an example



Caution CO2e numbers on production can be up to a factor 10 off (too low))

It is estimated that a 300mm wafer yields 65 chips

A 300mm wafer at 5nm node has a CO2e of around 1200kg

Around 20kg CO2e per chip plus 30% of packaging, testing

production:

30kg CO2e*

Peak power consumption of 1 H100 is 700W, annual avarage 61% 3740 kWh/year
Lifetime 5 years so 18,700kWh
In Europe 0.233 kg CO2e per kWh
lifespan operation:

4.5t CO2e

somewhere around 1%

*buys you less than 10min of flying in a commercial airliner

Gefion…an example



Around 1500 H100 chips

30kg CO2e x 1500 = 45t CO2e*

4.5t CO2e x 1500 = 6750t CO2e**

*buys you less than 200h of flying in a commercial airliner
equals 10 times Europe –Westcoast US and back

** it is claimed that Gefion runs entirely on renewable energy so the official number is zero CO2e

Conclusions:



Environment impact of chip production is substantial

Take numbers with care - difficult to asses



A lot can be done and has to be done toward greener chip production especially on flourinated gases and chemicals

Nearly all large chip producers promise CO2 neutral chip fabrication by latest 2050

Lifetime electricity consumption CO2e is estimated to be dominant over fabrication CO2e by up to a factor 100

A Danish perspective:

chip production industry in Dk:

Photonic chips

Sensor chips

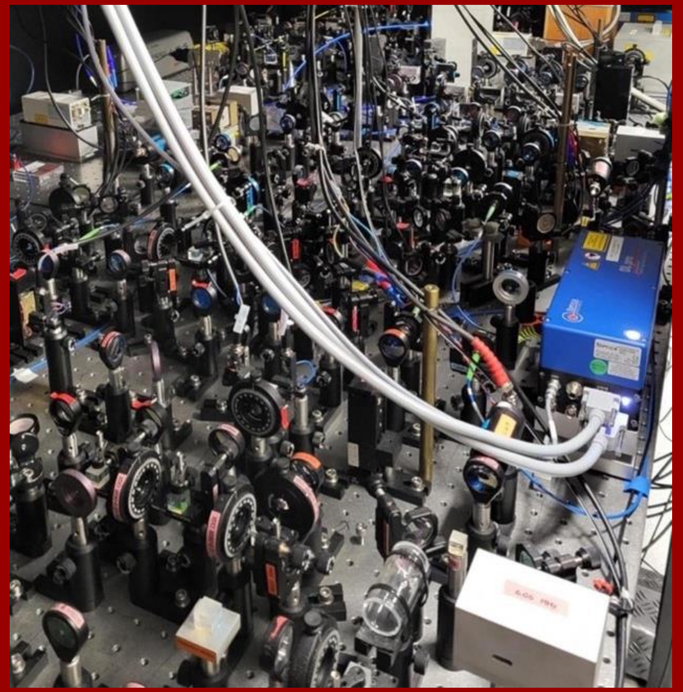
MEMS chips

Quantum Chips

estimated more than
a billion Dkk total turnover

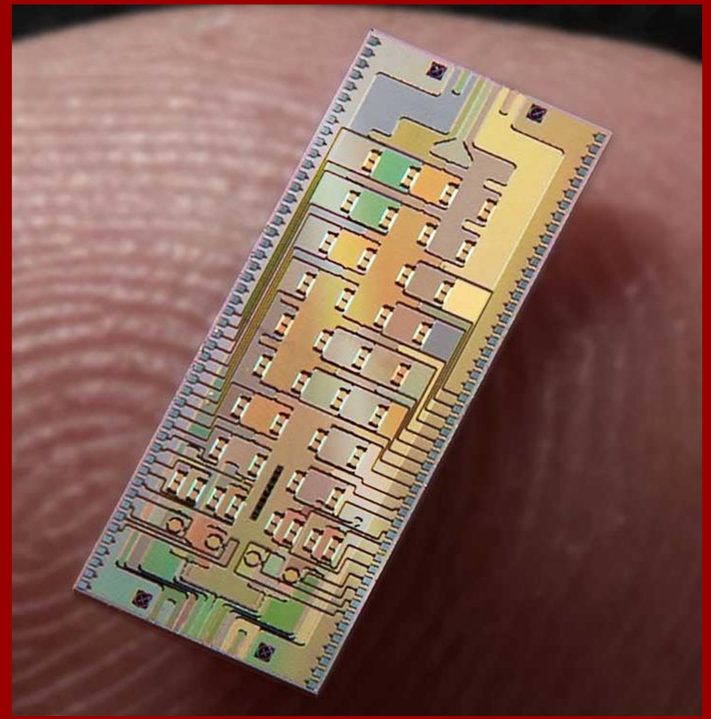
example from BigQ center for macroscopic quantum states – Ulrik Lund Andersen - DTU Physics

Ambition: Denmark will be a future key player in quantum chip production



example from BigQ center for macroscopic quantum states – Ulrik Lund Andersen - DTU Physics

→



Kongens Lyngby


"Let everyone sweep
his own frontdoor
and the whole world
will be clean."
-Goethe

DTU Nanolab

- 1,350 m^2 (14,500 sq ft) ISO 4 & 5
- 1/3 ducted HEPAs
- 2/3 Fan Filter Units (FFUs)
- 291 FFUs
- FFUs up to 18 years old
- Unable to control (Bus stopped working)
- Energy saving mode not possible
- Some units failed in recent years



Power savings on ducted HEPA

- Reduce air recirculation 18:00 to 06:00 and weekends
- Before: 26 000 kWh/month
- After: 15 000 kWh/month
- Total saving: 42%







Power savings on LED

- Change from fluorescent to LED light
- Switch off light when no one inside
- Intelligent section-wise power-up
  - Access card
  - PIR sensors
- Before: Ca. 15 600 kWh/month
- After: 3 900 kWh/month
- Total saving: 75%





Total power savings

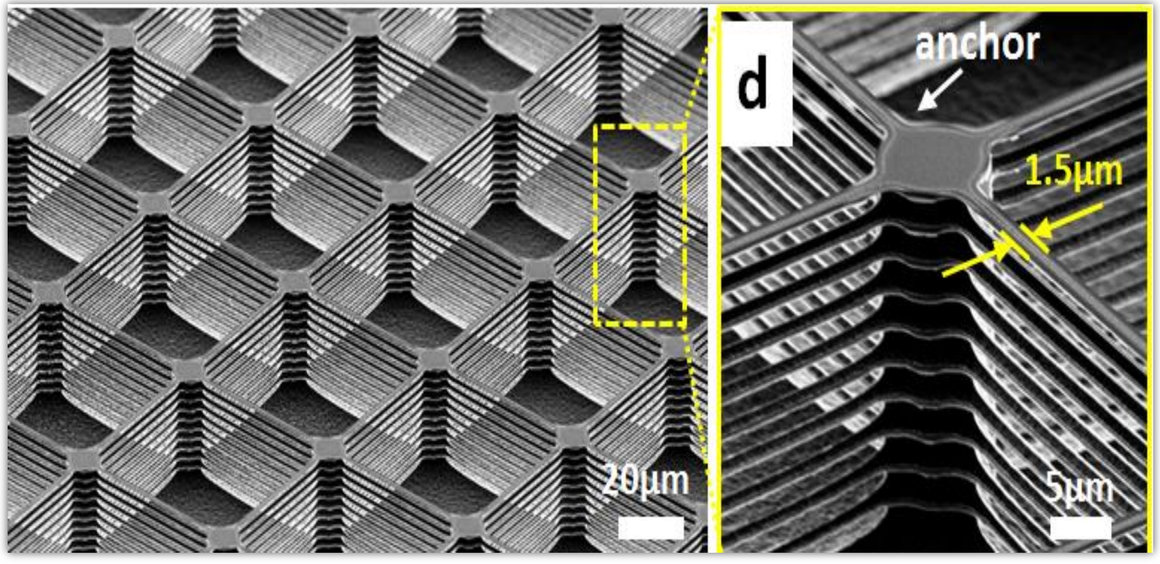
Item	Power before [kW/mth]	Power after [kW/mth]	Saving
FFU	11 500	5 800	50%
Ducted HEPA	26 000	15 000	42%
LED	15 594	3 900	75%
Total	**53 094**	**24 700**	**53%**

Total electrical power consumption for facility: Ca. 350 000 kWh/month
(NB: Excluding most power for chilled water – Not metered at DTU Nanolab)
I.e. ca. 8% saving of total electricity consumption

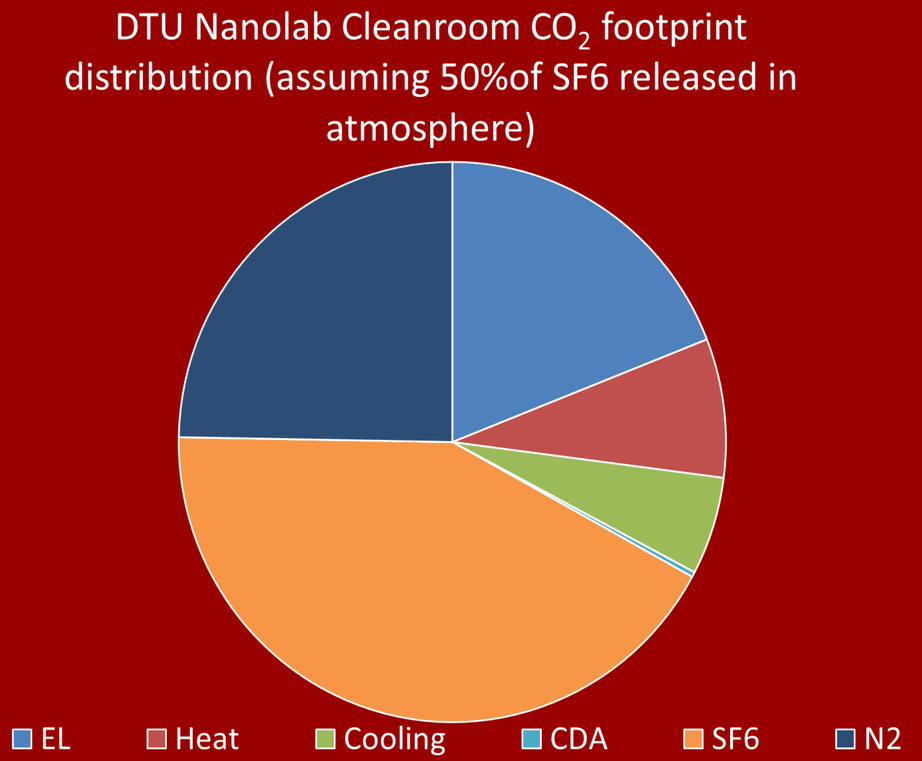

BIGGER FISH TO FRY

Dry etching silicon and oxides…..





Case DTU Nanolab



3 mitigation options:



ISO 9001
DNV
CERTIFIED ORGANISATION

Process improvements

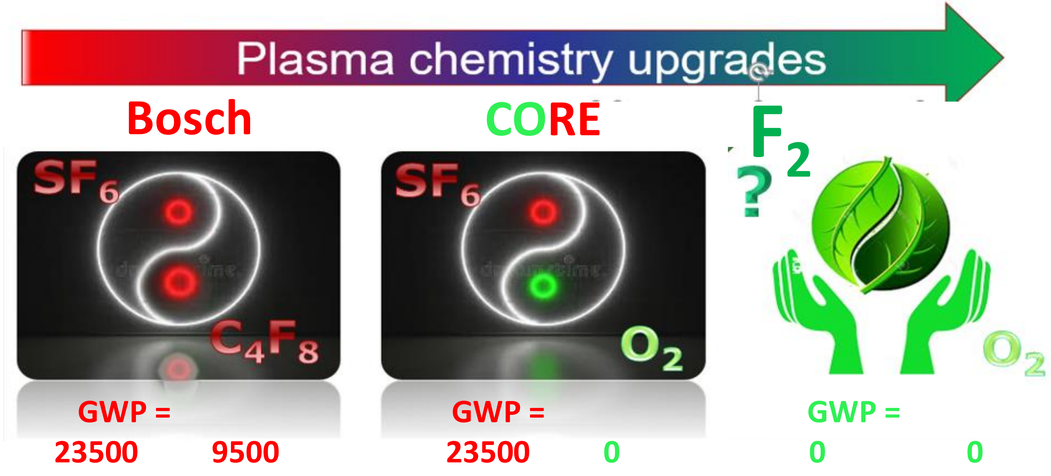
Alternative chemicals

Destruction technologies (abatement)



Replacing the bad boys

But the most important sustainability goal is to replace the gases having a high Global Warming Potential.
A well-known procedure to etch high aspect ratio features in silicon material is based on the so-called Bosch process. This cyclic process uses two potent global warming gases: SF_6 and C_4F_8.
In a first step to reduce the environmental impact, Nanolab has found and implemented an alternative cycle called CORE in which the C_4F_8 gas is replaced by O_2.
A further step is currently being investigated and is based on replacing the SF_6 with fluorine or HF



1
1
1

Conclusions DTU Nanolab:



Biggest concern flourinated gases with high GWP

active research topics at DTU Nanolab

Process improvements – *flow of SF6, (C4F8)*

Alternative chemicals – *F2 instead of SF6, O2 instead of C4F8?*

Destruction technologies (abatement) – *under investigation difficult for R&D*

ISO 9001 DNV CERTIFIED ORGANISATION


DTU



Rundbordssamtaler



ADD algoritmer data & demokrati

DI Digital

mandagmorgen TÆNKETANKEN

Do not edit
How to change the design

Hvad ser du som den største udfordring ift. AI's klimaaftryk?



The Slido app must be installed on every computer you're presenting from

slido

AI’s rolle i at indfri vores klimaambitioner



ADD algoritmer data & demokrati

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mandagmorgen TÆNKETANKEN

Sådan hjælper kunstig intelligens 30 danske kommuner med energioptimering af bygningsmassen

AI's rolle i at indfri vores klimaambitioner

v. Malte Frederiksen, Founder & CCO i Ento



ADD algoritmer data & demokrati

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ENTO

Energioptimering med
kunstig intelligens

Erfaringer fra 30 danske kommuner,
danmarks største detailkæder og
pensionsselskaber



Kan vi tillade os at bruge mere energi
på at bruge mindre energi?

Water > Baseload

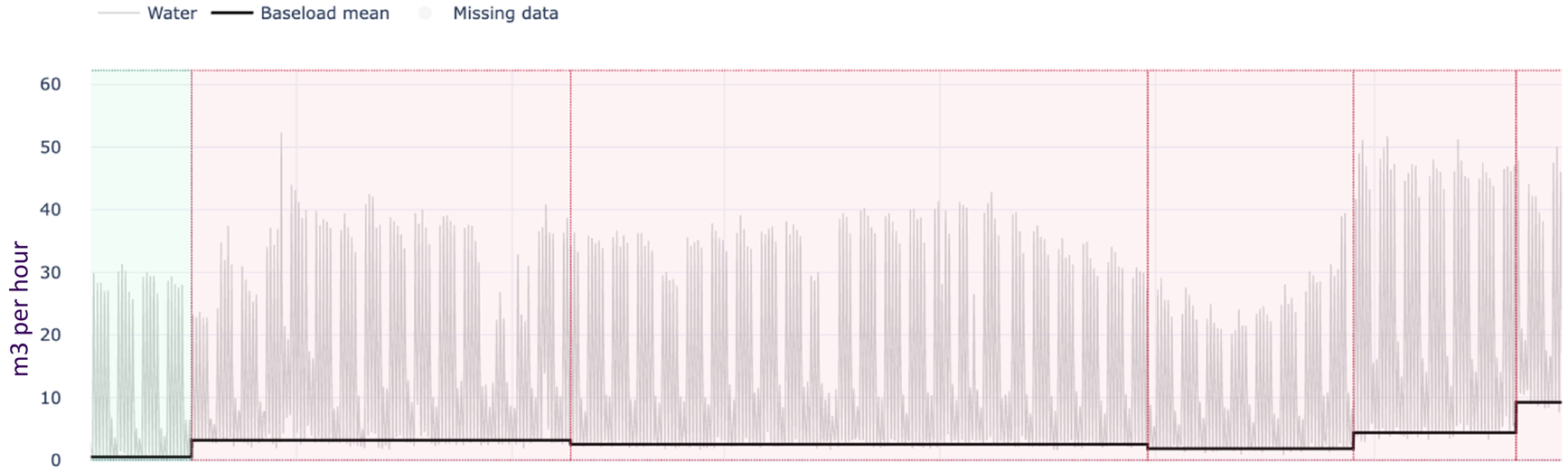
Prioritize | Investigate | Ignore | Register | Plan Action | Email

Estimated Savings

147,578 m³ | 6,198,272 DKK | 76%

Pipe burst pattern detected! Water leak since: 17-08-2024. Water leak acceleration is: 35.987 liter per day!

This figure illustrates the **baseload** (daily minimum) level of water consumption.



Kan vi tillade os at lade være…?

Agenda de næste 15 minutter

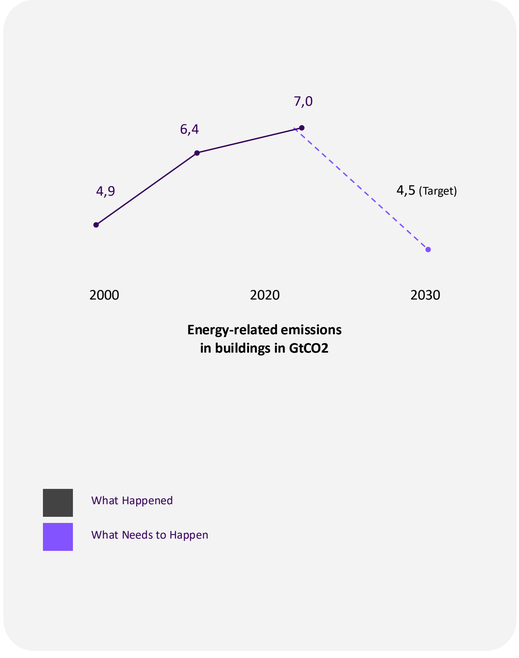
Hvad er problemet - hvor stort er det?

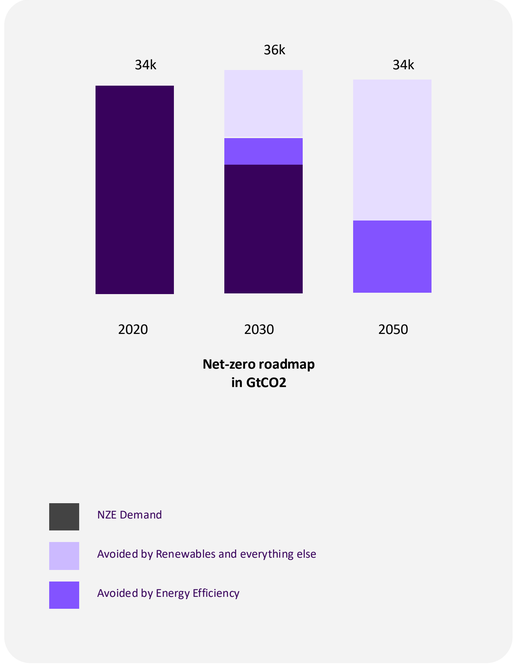
Hvad er Ento - hvordan virker teknologien?

Hvilken værdi skaber det - hvem kan bruge det?

Spørgsmål

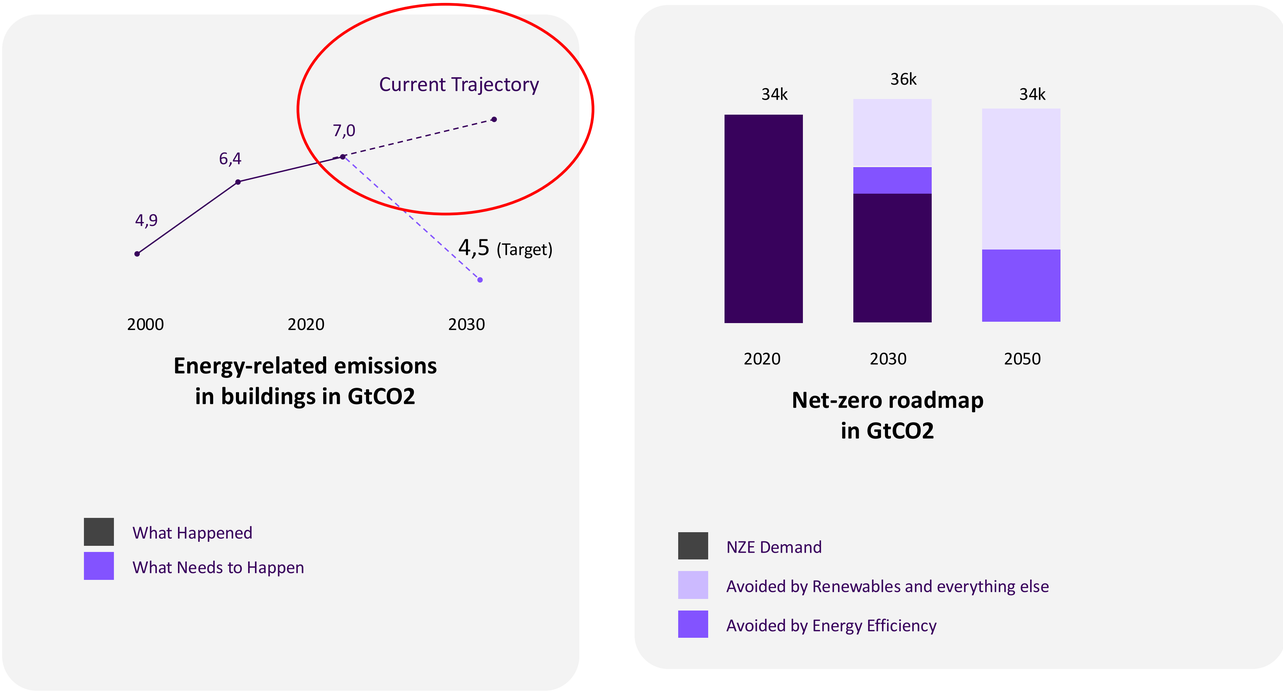
Drift af bygninger udleder 28% af globale CO2 udledninger. Energieffektivitet skal være største enkeltstående bidragsyder til at nå klimamål





Sources: International Energy Agency, Energy Cities, NYC.gov

… men bygninger bruger fortsat mere og mere energi..



Sources: International Energy Agency, Energy Cities, NYC.gov

Fordi det er “svært” at energioptimere...

Dyrt og tidskrævende
at samle og analysere data fra mange kilder

Besværligt at identificere og planlægge optimeringsprojekter

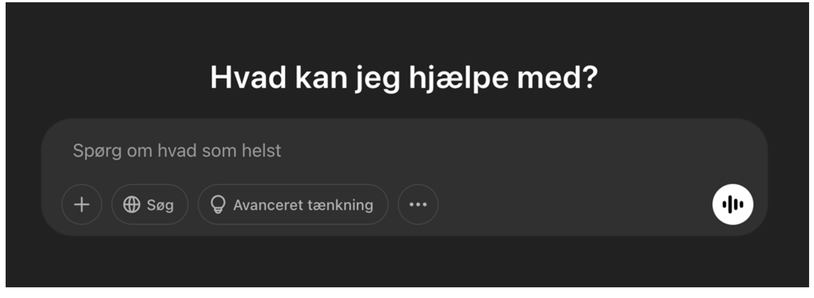
Mangel på resourcer
til at drifte og optimere bygninger ift målsætning

Begrænset opfølgning
og dokumentation af resultater



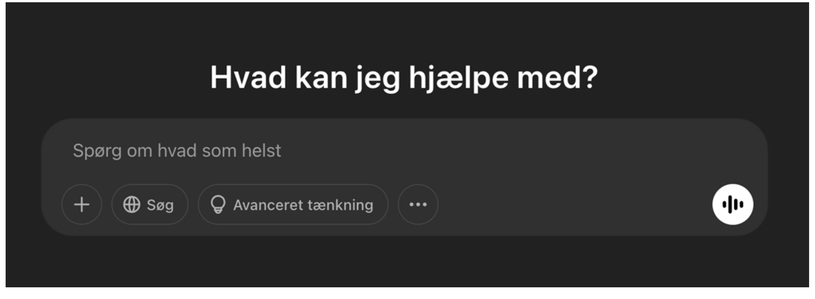
Lav optimeringshastighed og stort uudnyttet potentiale!

Men vi lever jo i en forunderlig tid…



Generer hyperrealistiske billeder af ting der ikke eksisterer…

Men vi lever jo i en forunderlig tid… ikk?





Hvad er Ento - hvordan virker teknologien?

.. En dansk venture-funded tech virksomhed der arbejder med energioptimering

Founders



Henrik Brink, CEO
Former machine learning specialist at UC Berkeley. Co-founder and lead machine learning engineer at Wise.io, acquired by General Electric to optimise industrial processes with machine learning.



Kasper Bjørn Nielsen, CTO
Experienced software, devops and machine learning developer. Previously at Wise.io, General Electric, and Siemens Gamesa. Has built data infrastructure and machine learning applications that have helped companies with optimisation at scale.



Malte Frederiksen, CCO
Former business development consultant at Innovation Center Denmark in Silicon Valley, where he helped a number of major Danish energy companies with digitalisation and innovation.

Backers

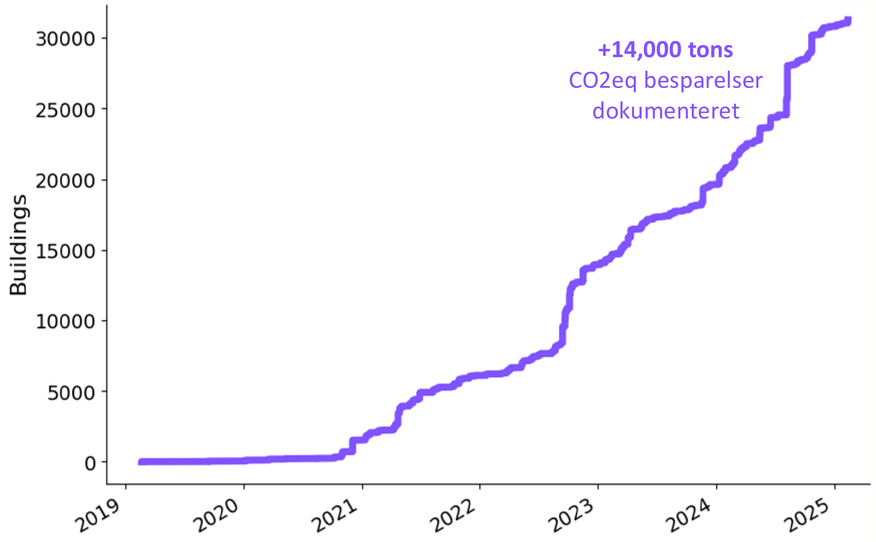
byFounders, Copenhagen - DK
Leading Nordic early-stage venture fund backing globally ambitious teams from the Nordics and Baltics. Partner experience includes founders of Unity, Trustpilot, and Peakon, bringing deep operational and scaling expertise

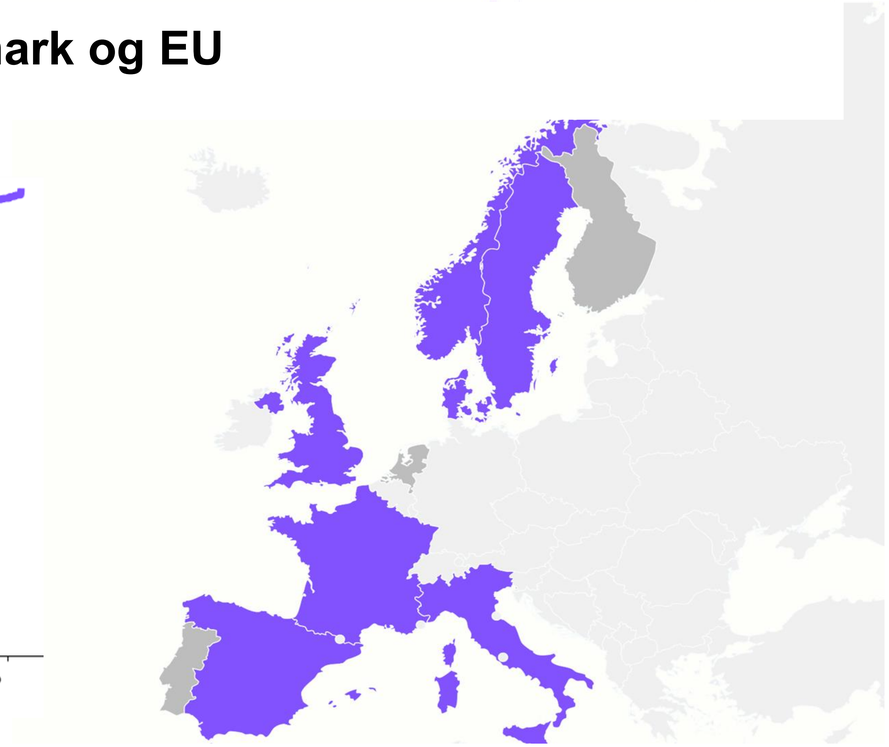
Voyager, San Francisco - US
Voyager Ventures focuses on early-stage climate technology companies, aiming to build a decarbonized global economy and a sustainable future. Partner experience from IEA, Obama White House, energy efficiency renovation and electrification.

With scientists, energy experts and entrepreneurs from…

With institutional and angel investors from…

.. for de største bygningsejere i Danmark og EU





Comune di Narni
deas
Aalborg Kommune
H&M
Velliv
Arbejdernes Landsbank
Bilka
EL:CON
Normal
London Borough of Hounslow
ELGIGANTEN
VIBORG KOMMUNE
NETTO
midt regionmidtjylland
Hjørring Kommune
EUC-SYD
Wihlborgs
FREDERIKSSUND KOMMUNE
HOLSTEBRO KOMMUNE



Vi bliver nødt til at gøre tingene lidt smartere hvis vi skal lykkedes med grøn omstilling af vores bygninger..

Hvordan går vi fra en dum måler til smarte besparelser?

Energiforbrugsdata





Salling Group bruger AI til at spare millioner på energiforbruget

Kun få måneder efter, at de var begyndt at bruge Entos AI-platform, havde de energiansvarlige hos den danske detailgigant Salling Group verificeret besparelser på flere millioner euro.

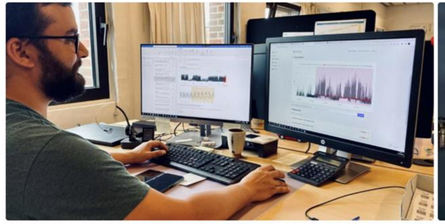
Detailhandel Elektricitet



Detailbank reducerer 20 % af bygningsporteføljens energiforbrug

Entos løsning gør det muligt for Arbejdernes Landsbank at sænke sit energiforbrug og klimaaftryk med mere end 100 tons CO2e om året, svarende til 20 % af bankens samlede forbrug - uden investeringer i ny hardware.

Elektricitet Detailhandel



Holstebro Kommune: Energibesparelser med AI-baseret system

I august 2021 begyndte Holstebro Kommune at bruge Entos digitale energirådgiver - en nem foranstaltning, der resulterede i betydelige besparelser!

Fjernvarme Elektricitet Offentlig Vand



AI hjælper Kolding Kommune med energioptimering

Ved hjælp af kunstig intelligens identificerer den offentlige bygningsejer energispild i kommunens bygninger. Løsningen har reduceret både tid, CO2-udledning og driftsomkostninger.

Elektricitet Fjernvarme Offentlig

Fra målerdata til energibesparelser

Energiforbrugsdata med en adresse

Vejrdata
(Temperatur, solindstråling, vindretning, vindhastighed, fugtighed, …)

Kalenderinformation
(time, ugedag, uge, helligdage, …)

Brugsdata
(Driftstider, indeklima sensorer, …)

Bygningsinformation
(Areal, byggeår, teknisk udstyr, …)

Fra målerdata til energibesparelser

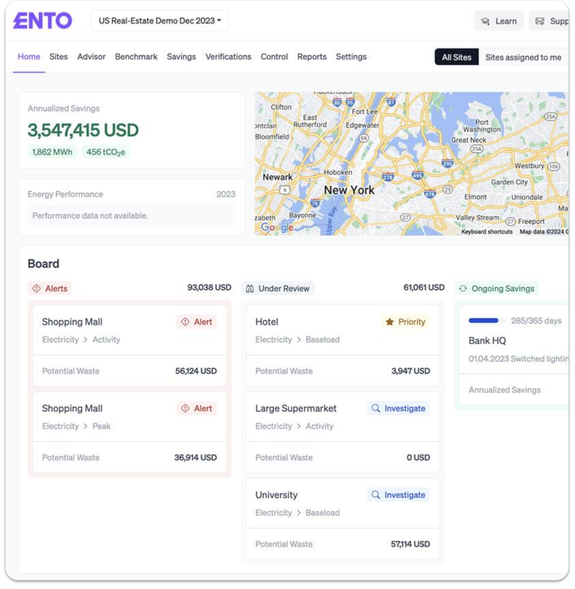
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(Areal, byggeår, teknisk udstyr, …)



Onboardes på få minutter

Fra målerdata til energibesparelser

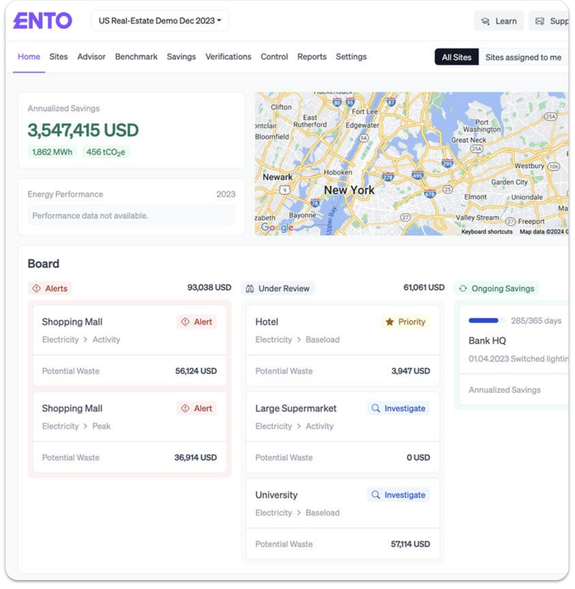
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Brugsdata
(Driftstider, indeklima sensorer, …)

Bygningsinformation
(Areal, byggeår, teknisk udstyr, …)



Onboardes på få minutter

En central platform til..

Finde energispild - uden investeringer
- Optimer varme og ventilationsanlæg
- Lav prædiktiv styring baseret på relle behov i bygningen

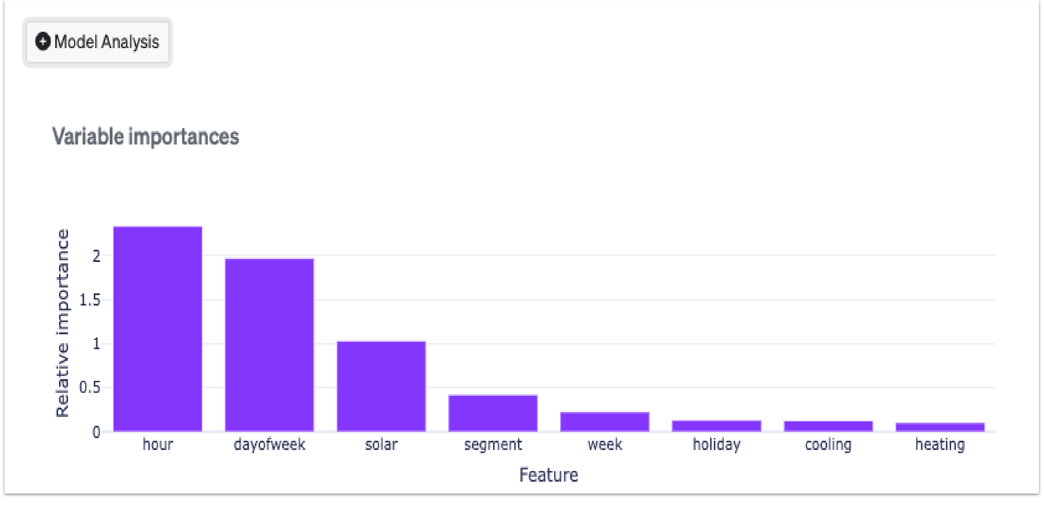
Energieffektivitet
- Skift til LED belysning, nye ventilationsmotorer, køleelementer
- Add doors to refrigerators

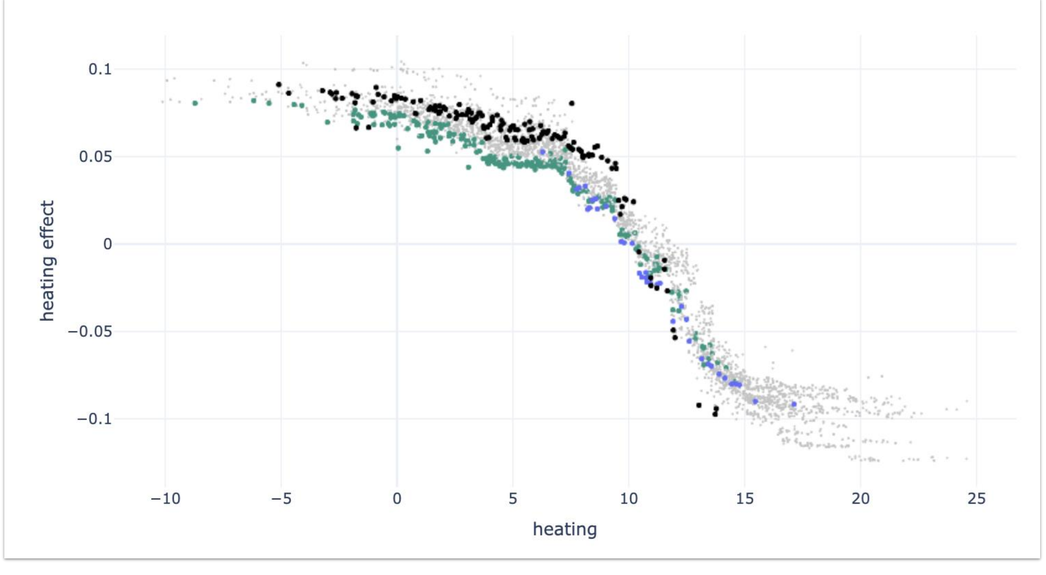
Netto-nul investeringer
- Skift til varmepumper
- Installer solceller

Læg en proaktiv energi strategi
- Dokumenter indsatsen
- Planlæg større investeringer

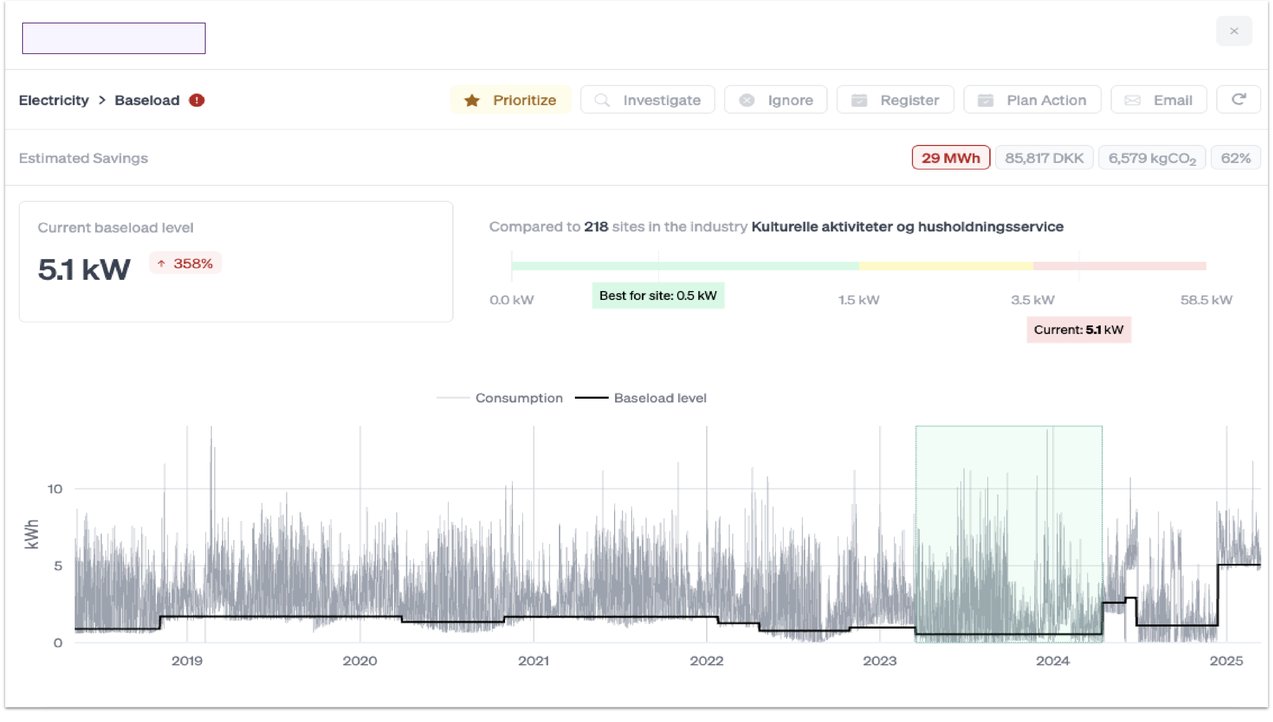
Hvordan virker den kunstige intelligens?

Først dannes en forståelse for den driften af den enkelte bygning

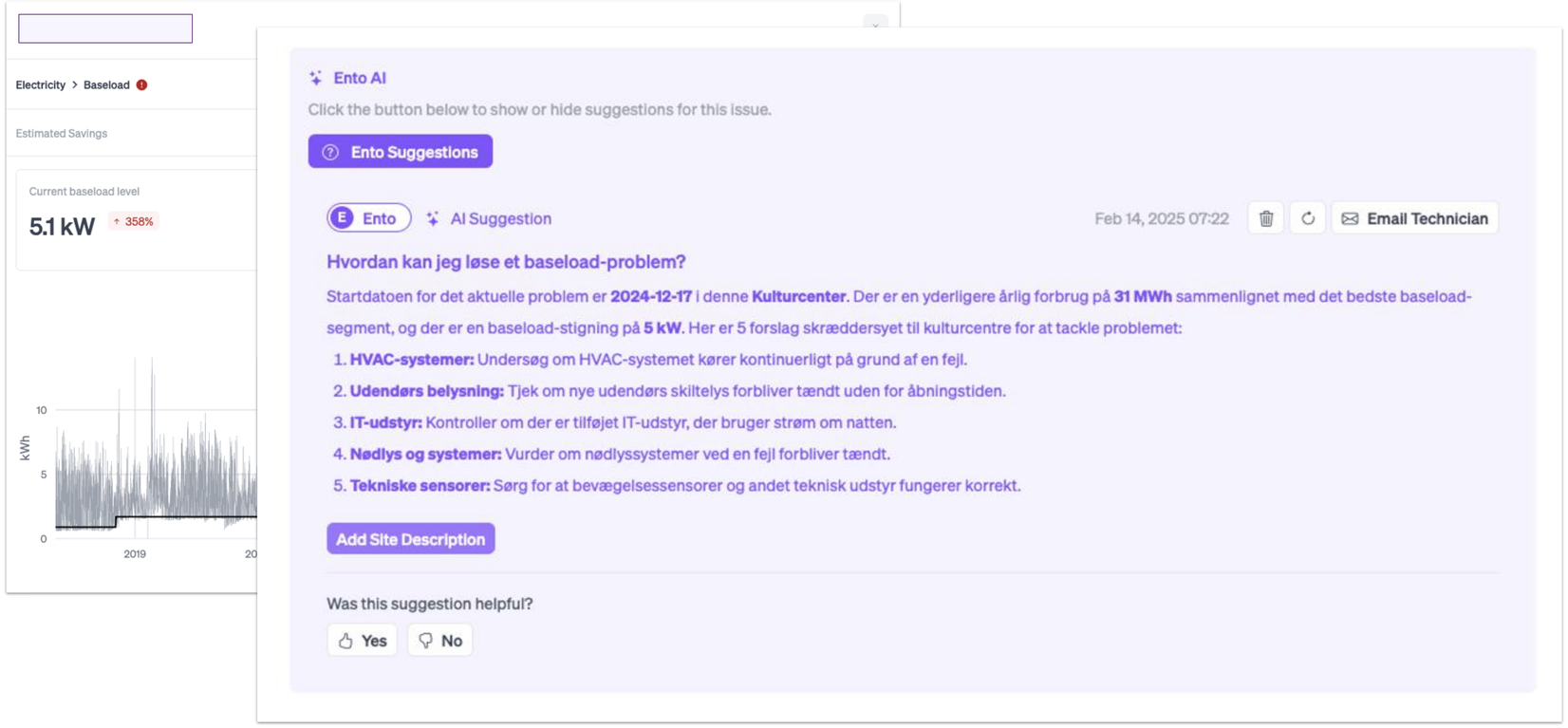




Så findes driftsfejl, beregner omkostningen

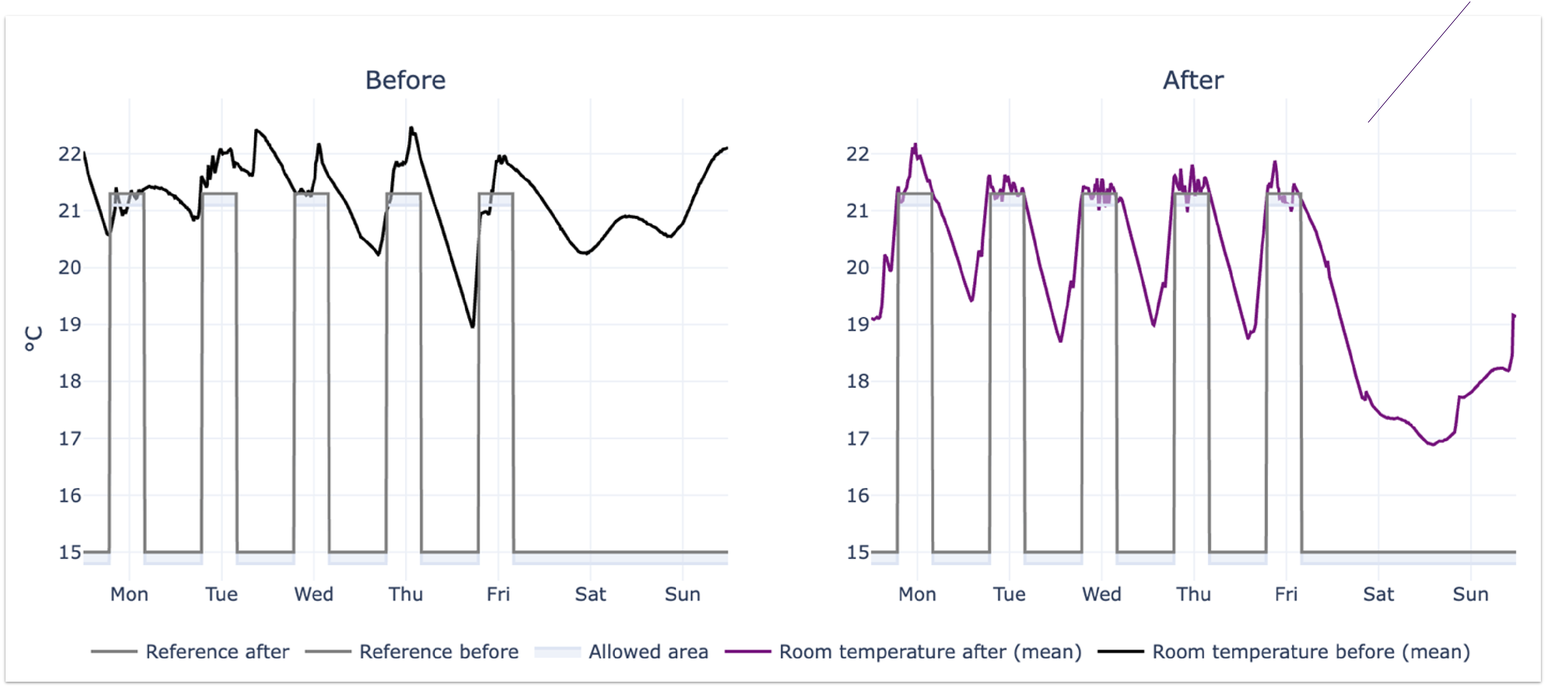


Så findes driftsfejl, beregner omkostningen og giver løsningsforslag

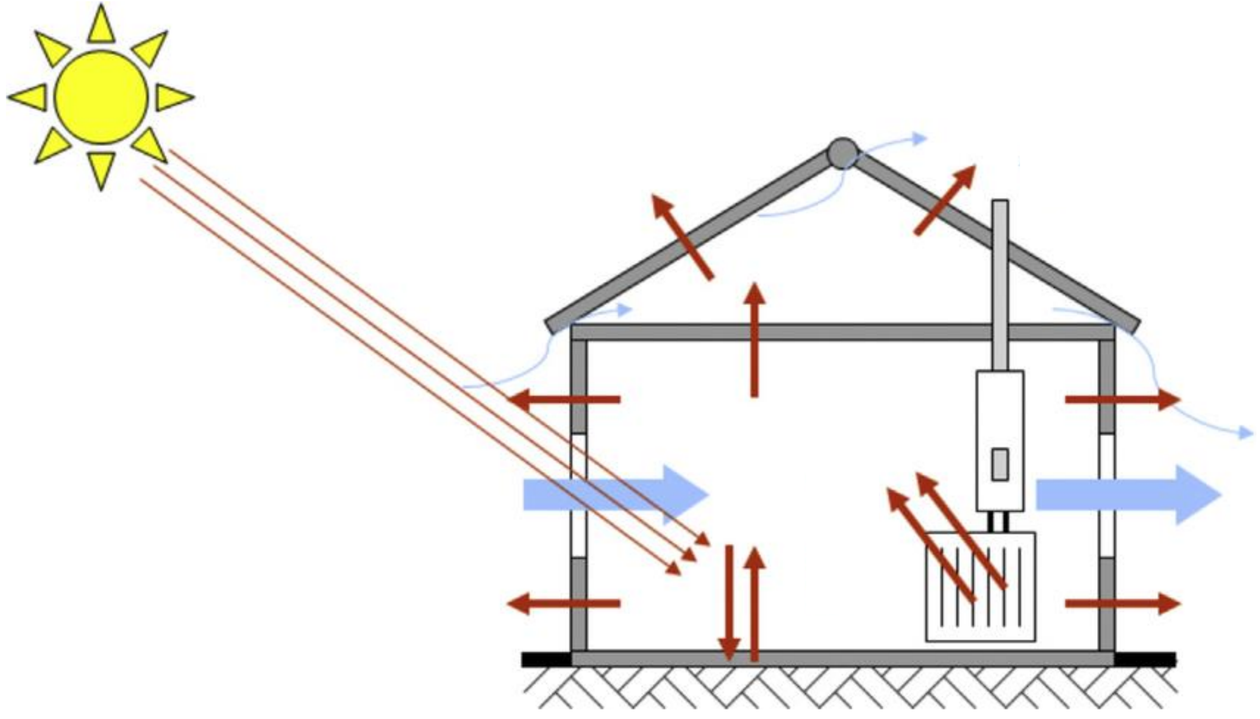


AI kan også styre tekniske anlæg - stort set perfekt
= mindre forbrug og bedre indeklima

Besparelse 28%



Det handler “bare” om at tage en beslutning



Hvordan kommer man (hurtigt) igang?

Integrer data

Eldata

100+ vand og varme forsyninger

Andre energi og sensor data

Online fuldmagt fra bygningsejer eller administrator

→ **Automatisk bygnings- og målerstruktur** → **Automatisk analyse uden opsætning**

Alle bygningsejere kan lave en detaljeret energistrategi, der betaler sig fra dag ét

Spørgsmål?

… Ellers følg med på LinkedIn 👇



Malte Frederiksen

Kommerciel direktør
Medstifter af Ento

malte@ento.ai
81927213



Automatiseret klimaregnskab med AI

AI's rolle i at indfri vores klimaambitioner

v. Thor W. Larsen, Partner Sales Manager, BeWo



ADD algoritmer data & demokrati

DI Digital

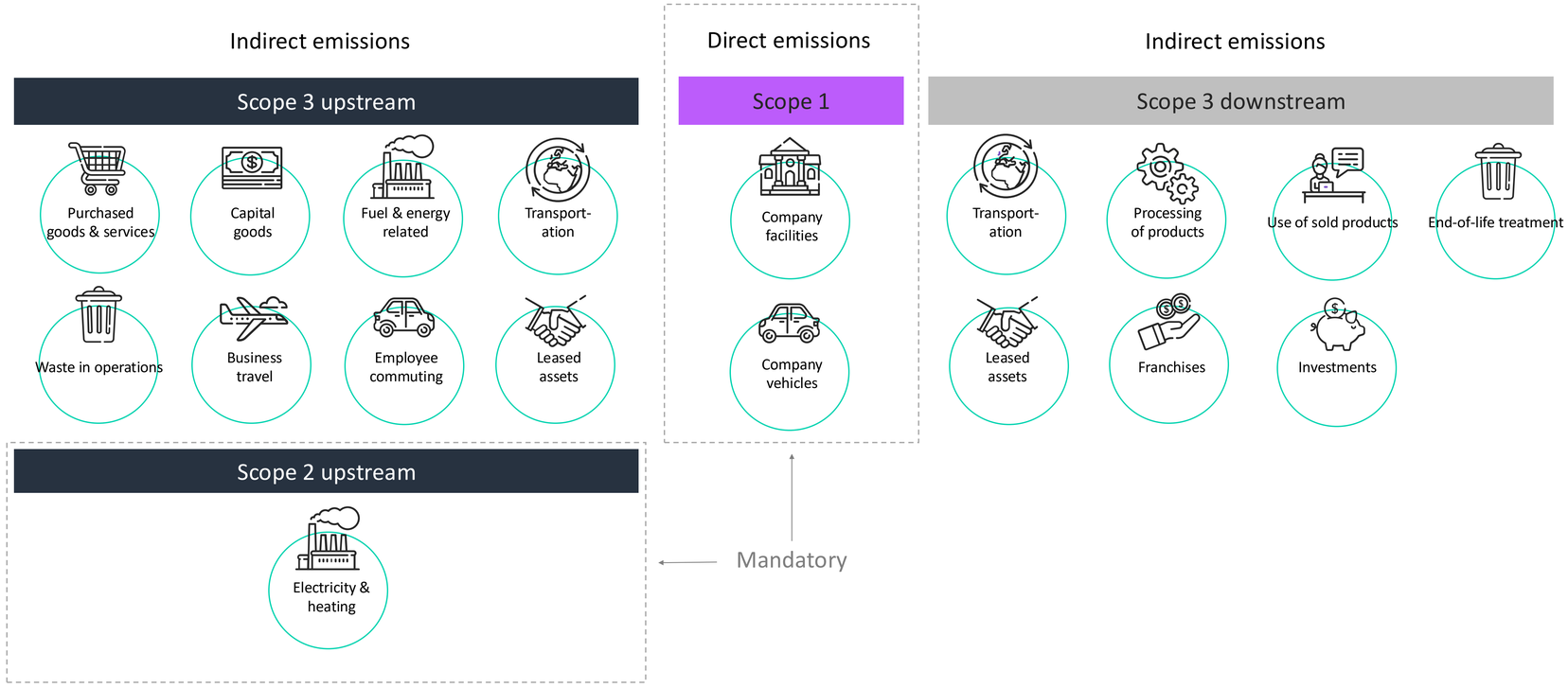
mandagmorgen TÆNKETANKEN

Automating Carbon Accounting with AI

AI- og Klimakonference - May 2nd 2025

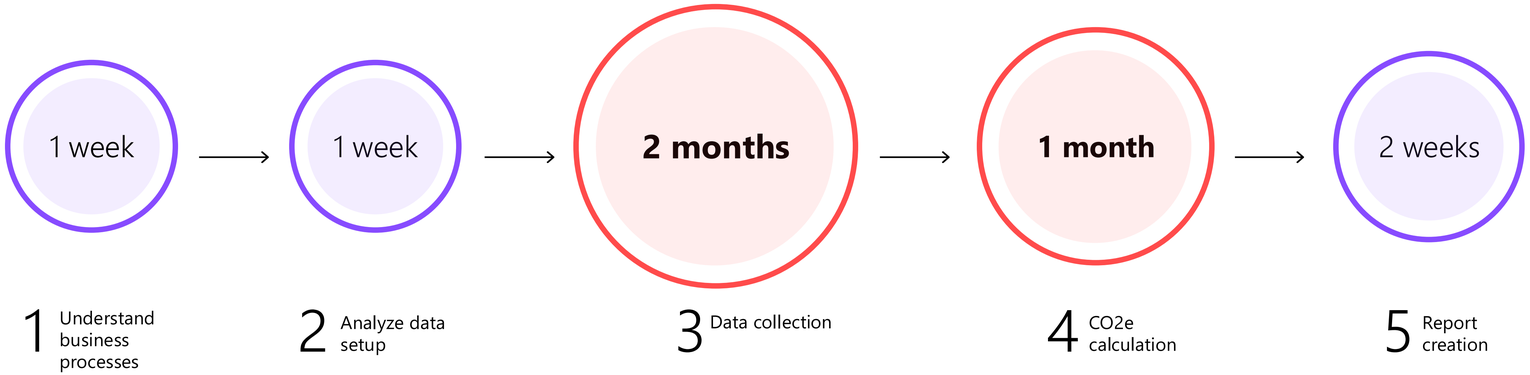

Our mission is to help companies spend
less time collecting data and calculating
CO2 emissions and more time reducing it.

Scope 1, 2 & 3 (GHG Protocol)



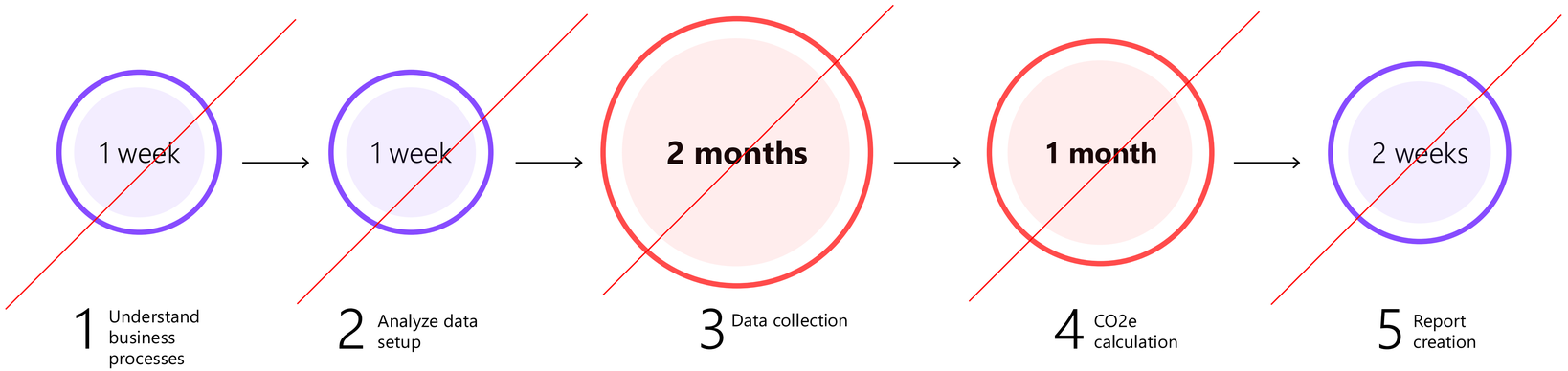
Problem

It takes an average SME **4 months** to calculate Scope 1, 2 & 3 using existing software solutions, and over **200 hours** of work



Problem

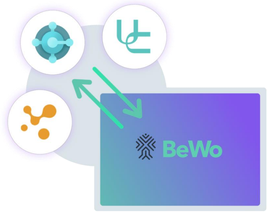
It takes an average SME **4 months** to calculate Scope 1, 2 & 3 using existing software solutions, and over **200 hours** of work



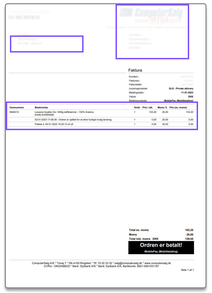
Solution

4 Steps to Achieving World-Class CO2e Reporting

1. Connect to ERP



2. Extraction of purchase data



15/11/2024

Vendor A

Lavazza

Qualita

1 kg Coffee

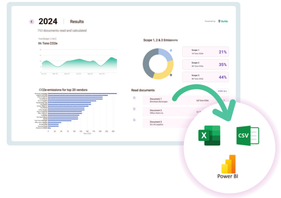
100,2 DKK

3. AI Processing



Process all invoices with AI and extract line-level data

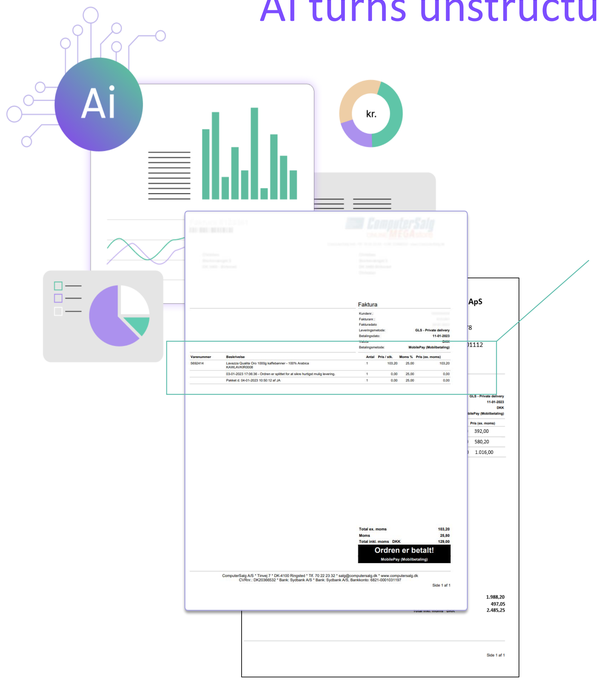
4. Intelligent reporting & monitoring



- Simple controlling and reporting
- Automated carbon tracking
- Monitor updated developments
- Turn data insights into action

Solution

AI turns unstructured data into precise CO2e calculations



Description	Units	Price	
Lavazza Qualita Oro 1000g kaffebønner - 100% Arabica	1	100,2 DKK	1000g x 1 = 1 kg Coffee

Emission factor	Database Authority	Database version	
Coffee bean, roasted, ground	Concito	2023	Link

Solution

The system always prioritizes the available data that gives the highest possible accuracy

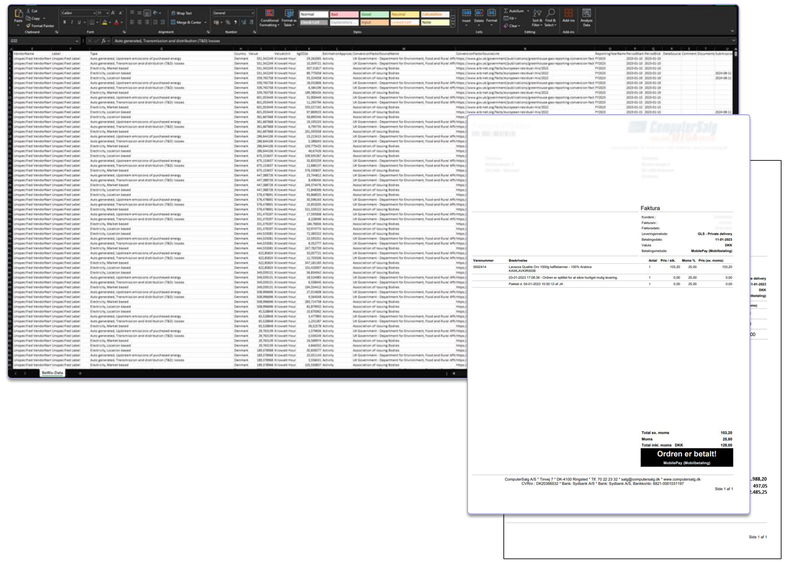
Priority	Estimation approach	Accuracy	Example	Source
1	Supplier-based		2 bags of Duracrete Cement = 49,5 kg CO2e	Supplier calculation on invoice
2	Product-based		50 kg of Cement (Duracrete Cement) = 49,5 kg CO2e	Invoice line + EPD/Product-lookup
3	Activity-based		50 kg of Cement (Average Cement) = 54 kg CO2e	Invoice line + average activity (kg)
4	Spend-based		€ 18,4 (Cement products) = 88,8 kg CO2e	Invoice line or Financial transaction

Solution

Full transparency and auditability is the foundation for CSRD compliant reporting

Each calculation should be traced back to

- **A document attachment**
- **A trusted emission factor source**
- **An applicable estimation approach**



Customers

Construction

Skou Gruppen

FALK TAG & FACADE

CHBYG as

ENTREPRENØRSELSKABET - Tillid under jorden

HV HEINO VISTISEN A/S ANLÆGSGARTNER & AUT. KLOAKMESTER

Børge Jakobsen & Søn A/S TØMRER-MURER-OG ENTREPRENØRFIRMA

MINALTAN

Wholesale & production

XL BYG

ROSENDAHL DESIGN GROUP

BY APPOINTMENT TO THE ROYAL DANISH COURT
OLE LYNGGAARD
SINCE 1963

LAGUR Made in Denmark

ØNSK

FabricAir
Innovating the HVAC industry since 1973

LIFEBRANDS
RESPONSIBLE ENJOYMENT

A.C. PERCH'S THEHANDEL 1835

Services & others

Billund Airport

Aspire mobility group

Erhvervshus HOVEDSTADEN

BRUUN & HJEJLE

ChangeGroup

CABINN .com

stensdal group

DAI

ODENSE HAVN
ODENSE PORT

JUNKBUSTERS
Junk made Easy

Bone's

AALBORG RECYCLING

AAGE OG JOHANNE LOUIS-HANSENS FOND

SERWIZ

CHARLOTTENLUND PRIVATHOSPITAL

Cases



"We want sustainability to be an integrated part of everything we do, and for our decisions to be based on reliable data."

- Stephanie Kirketerp, CFO at Changegroup

ChangeGroup

SME • IT Consultancy • B2B • Danish

Changegroup are providing their customers CO2 data on consultancy projects & actively identify CO2 reduction options

"We have saved a lot of time and resources by using BeWo's platform, which has made us better equipped to focus on sustainable initiatives"

- Lea Meta Larsen, Financial Manager at Changegroup



Cases

SME • Construction • B2B • Danish

CH BYG identified which materials emitted the most in their construction and implemented a procurement policy to reduce emissions



"BeWo has enabled us to focus specifically on our largest sources of emissions, which we have been able to identify accurately through their platform."

- Liam Donaldson, Sustainability Manager at CH BYG

Cases

Enterprise • Hospitality • B2C • Danish

Bone’s Restaurants are leveraging their BeWo data to guide their sustainability strategy towards carbon neutrality



“I believe that the reality we are looking into will be a **‘license to operate’**. If you do not actively and positively address sustainability, you will eventually be left behind.”

- Steffen Larsen, CFO & Sustainability Manager at Bone’s Restaurants



Thor W. Larsen

Partner Sales Manager

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www.bewo.io

AI til udvikling af vejrmodeller

AI's rolle i at indfri vores klimaambitioner

v. Marianne Thyrring, direktør i DMI



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Hvordan kan AI styrke fremtidens vejrmodeller og klimatilpasning?

Marianne Thyrring, direktør

5/1/2025

Danmarks Meteorologiske Institut

Det her vil jeg tale om:

1. DMI’s arbejde med ny teknologi

2. Ambition for DMI’s AI-vejrmodel

3. Potentialer for samfundet

DMI’s arbejde med ny teknologi

- To afgørende tendenser i verdensudviklingen: **klimaforandringer** og **teknologisk udvikling**
- AI/ML og ny teknologi kan spille en voksende rolle i arbejdet for et robust, sikkert og bæredygtigt samfund
- Indsigt, videnskab og tæt samarbejde er afgørende forudsætninger for succes
- Et par eksempler fra DMI:
  - **United Weather Centres West:** Fælles supercomputer med Irland, Island og Nederlandene
  - **Udvikling af AI-vejrmodel:** Træning af en AI-vejrmodel på Danmarks første GPU-accelererede supercomputer Gefion - lanceret i et samarbejde mellem Novo Nordisk Fonden og Danmarks Eksport- og Investeringsfond







Ambition med DMI's AI-vejrmodel - Øget samfundsværdi gennem:

- Levere hyppigere vejrudsigter
- Accelerere hele vejrudsigtsprocessen
- Understøtte den grønne omstilling

Potentialer for samfundet

- **Styrket beredskab og samfundssikkerhed**
  Brug af en AI-vejrmodel vil potentielt kunne give beredskaber nogle ekstra timer at reagere på, når vi varsler farligt vejr, for vi vil spare tid på produktion af vejrprognoser – fra timer til blot minutter

- **Grøn omstilling**
  En AI-baseret vejrmodel kan styrke den grønne omstilling ved hurtigere og mere præcist at forudsige f.eks. sol- og vindforhold til optimering af brug af vedvarende energikilder

- **Fremme af dansk AI-innovation**
  Samarbejdet mellem eksempelvis DMI og Danish Centre for AI Innovation (DCAI) styrker Danmarks position inden for AI-drevet meteorologi





Tak

Rundbordssamtaler



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Hvor ser du det største potentiale for AI i at indfri vores grønne ambitioner?



The Slido app must be installed on every computer you're presenting from

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Frokostpause



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Hvordan forholder vi os til AI's klimaudfordringer?



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Genbrug af overskudsvarme fra Microsofts datacenter til fjernvarmen i Høje Taastrup Kommune

Hvordan forholder vi os til AI's klimaudfordringer?

v. Lars Christensen, chef for By- og Miljøcenteret, Høje Taastrup Kommune



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Høje-Taastrup Kommune

Overskudsvarme fra Datacentre

Høje-Taastrup Kommune

V/ Lars Christensen

By- og miljøchef



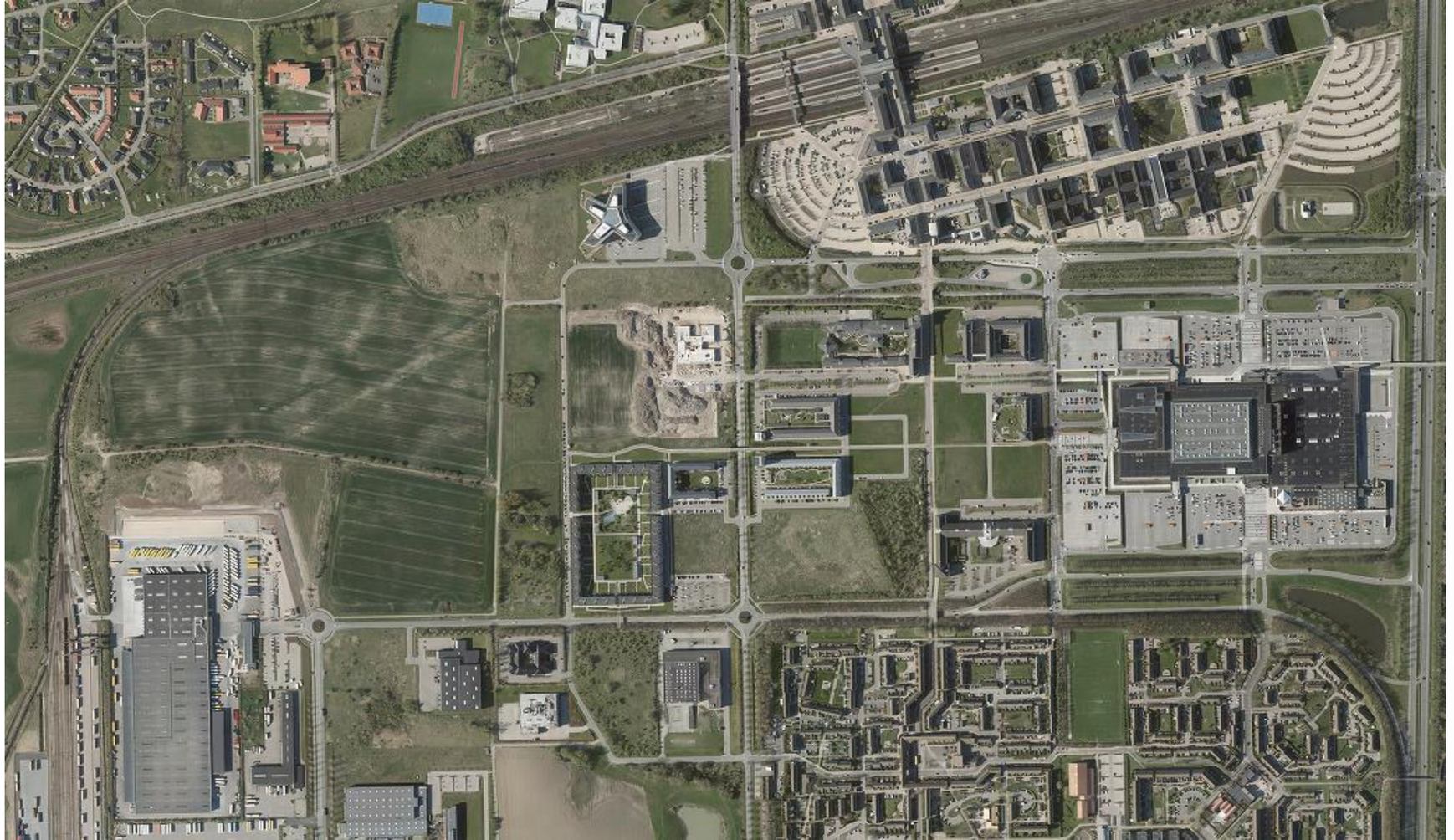
Høje-Taastrup Kommune

Høje-Taastrup Kommune

- 59.500 borgere
- Forventet 68.000 borgere i 2036
- Trafikalt knudepunkt
- 20 min. til CPH lufthavn
- 2720 virksomheder
- 40.390 arbejdspladser
- 32.000 pendler ind hver dag




Bæredygtighedsstrategi
2025-2030
Danmarks grønneste vækstkommune
2030 MÅL: 50% CO2-REDUKTION
2050 MÅL: NETTO-NUL
UDVIKLINGSSTRATEGI
2024-2036
Fælles om fremtiden
VERDENSMÅL





Høje-Taastrup Kommune

Kommunen er myndighed

- Ingen pligt til planlægning
- Hvordan understøtter et projekt kommunens interesser?
- Kan der skabes en merværdi for kommunen?



"OFFICEPARKEN"



Høje-Taastrup Kommune

Energi og varme

Effekt: 50 MW

Elforbrug:

- 440.000 MWh
- 110.000 husstande

Forventeligt 105.000 MWh ved indvinding af overskudsvarme:

- 7.500 husstandes varmeforbrug



Høje-Taastrup Kommune

Datacenter



Varmeværk



Overvejelser ved udnyttelse af overskudsvarme:

- Metode for afkøling af datacenter
- Ombygning / tilbygning

- Distribution / Transmission
- Temperatur
- Varmebehov vinter / kølebehov sommer
- Varmepumper (store vs mange)
- Businesscase
- Kontrakt og forpligtelser

Høje-Taastrup Kommune

Tak for opmærksomheden



Klimavenlig datalagring

Hvordan forholder vi os til AI's klimaudfordringer?

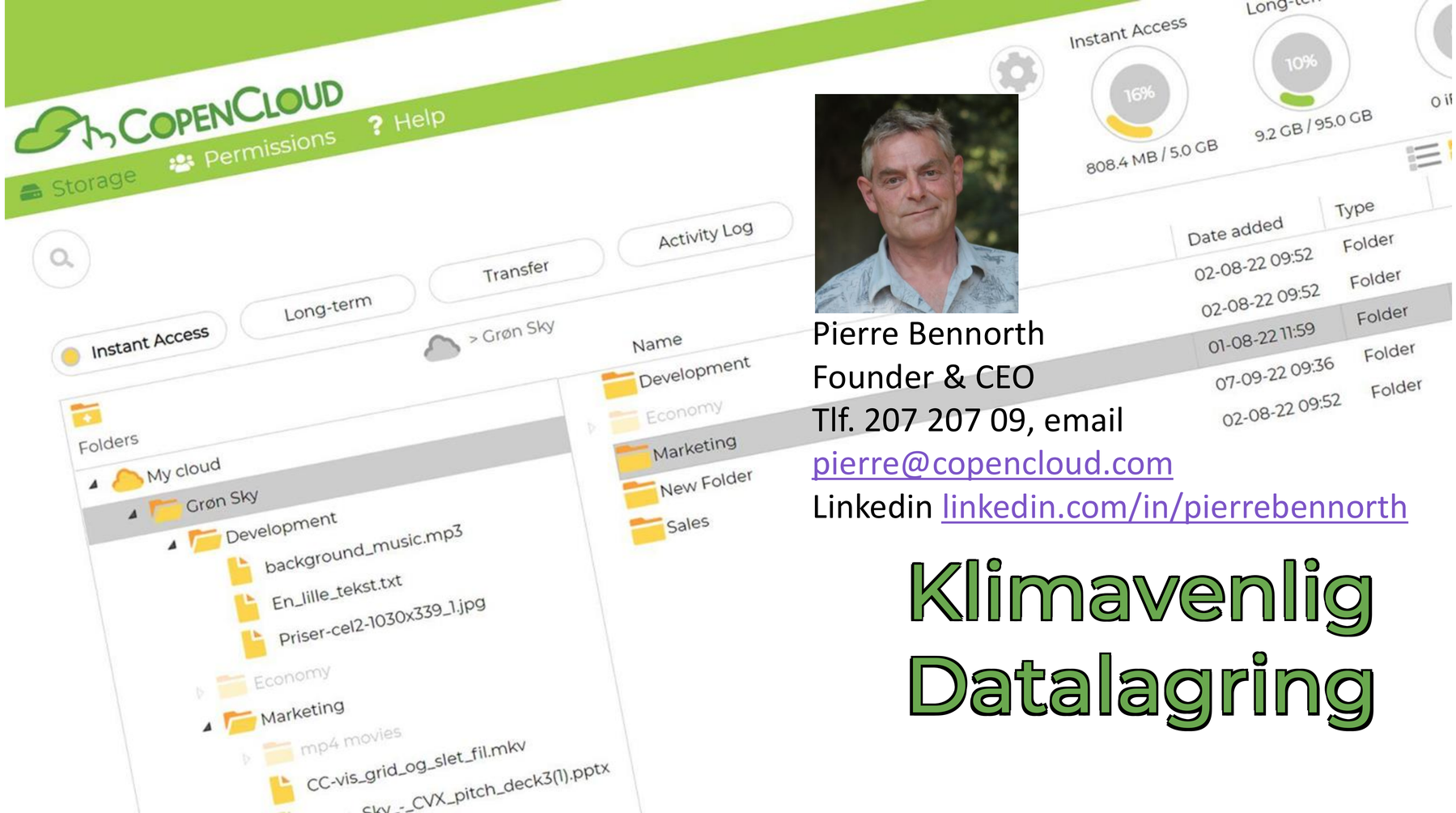
v. Pierre Bennorth, CEO i CopenCloud



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Pierre Bennorth
Founder & CEO
Tlf. 207 207 09, email
pierre@copencloud.com
Linkedin linkedin.com/in/pierrebennorth

Klimavenlig Datalagring



https://sustainablechangemakers.dk/

Brug af data udleder mere CO2 end flytrafikken



– Freitag, C. & et al. (2020). *The climate impact of ICT : A review of estimates , trends and regulations*. *December*.

Vi lagre alle sammen data, der bruger strøm 24/7

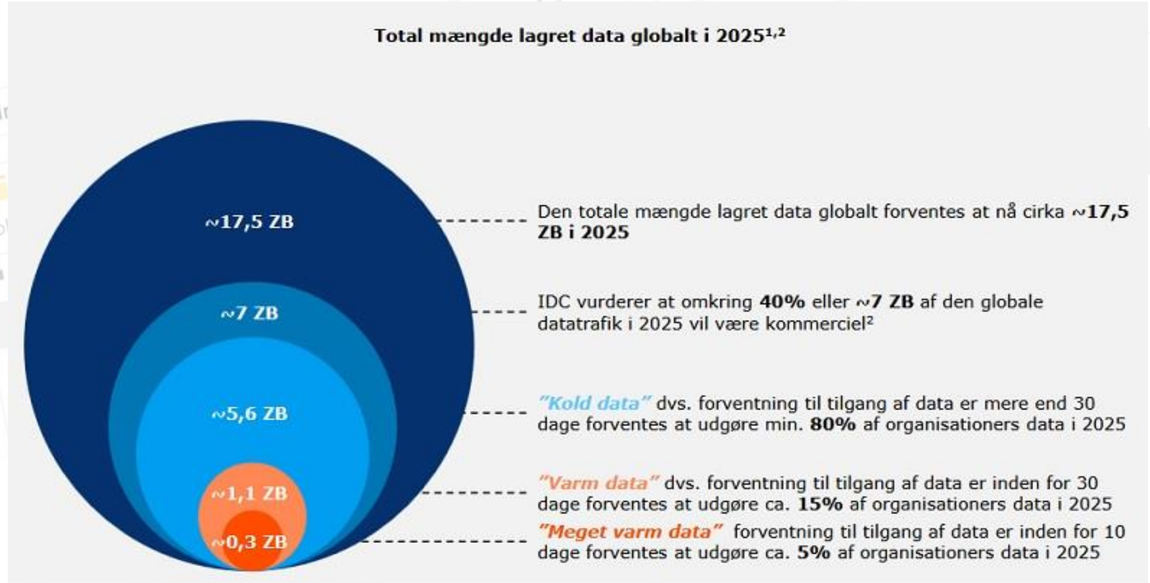
CopenCloud har delt data i to kategorier

Strakslager (hot storage)
Langtidslager (cold storage)



90% CO2-reduktion

RAMBØLL



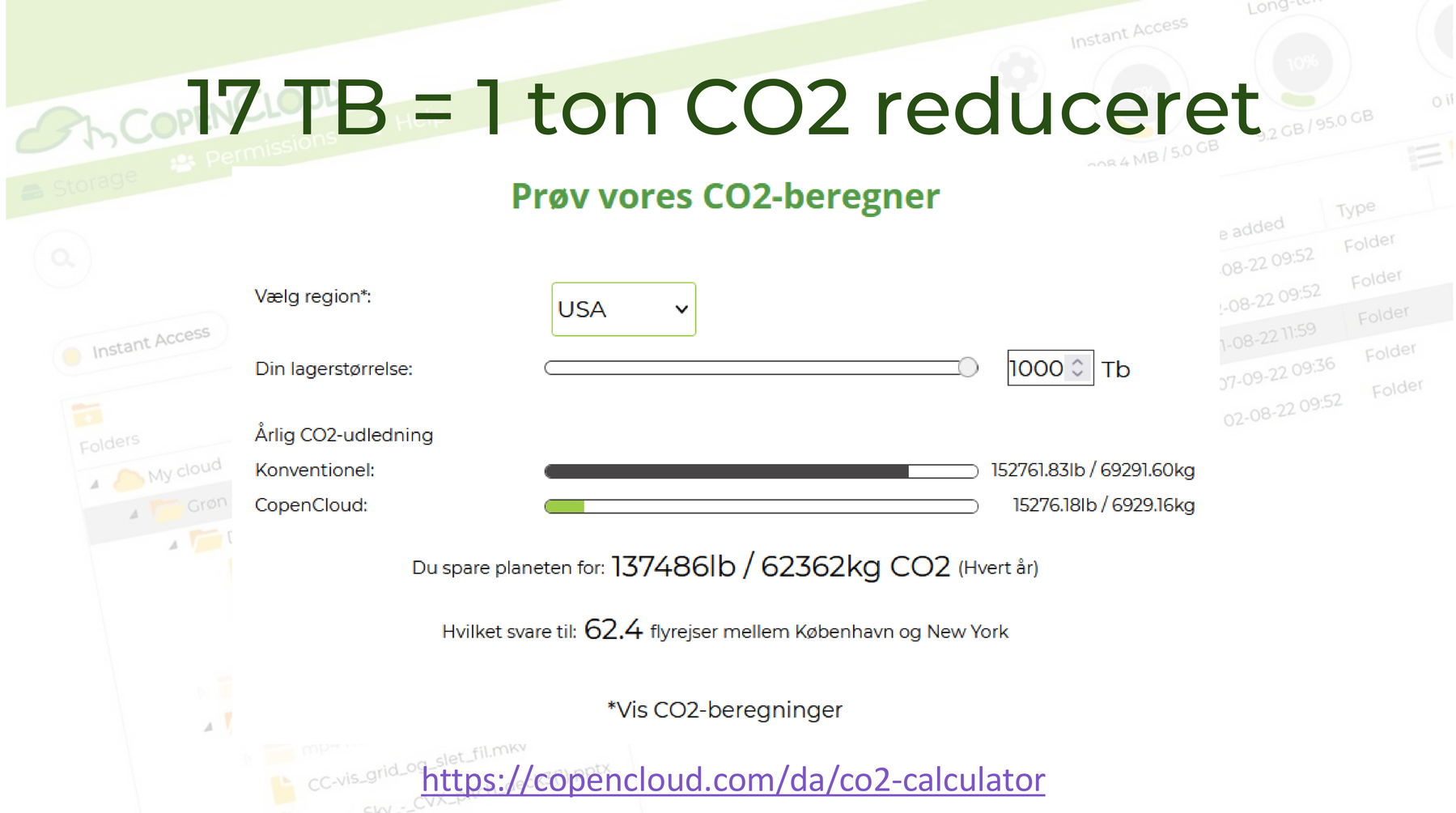
https://copencloud.com/docs/CopenCloud_Rapport.pdf

2023

G+++

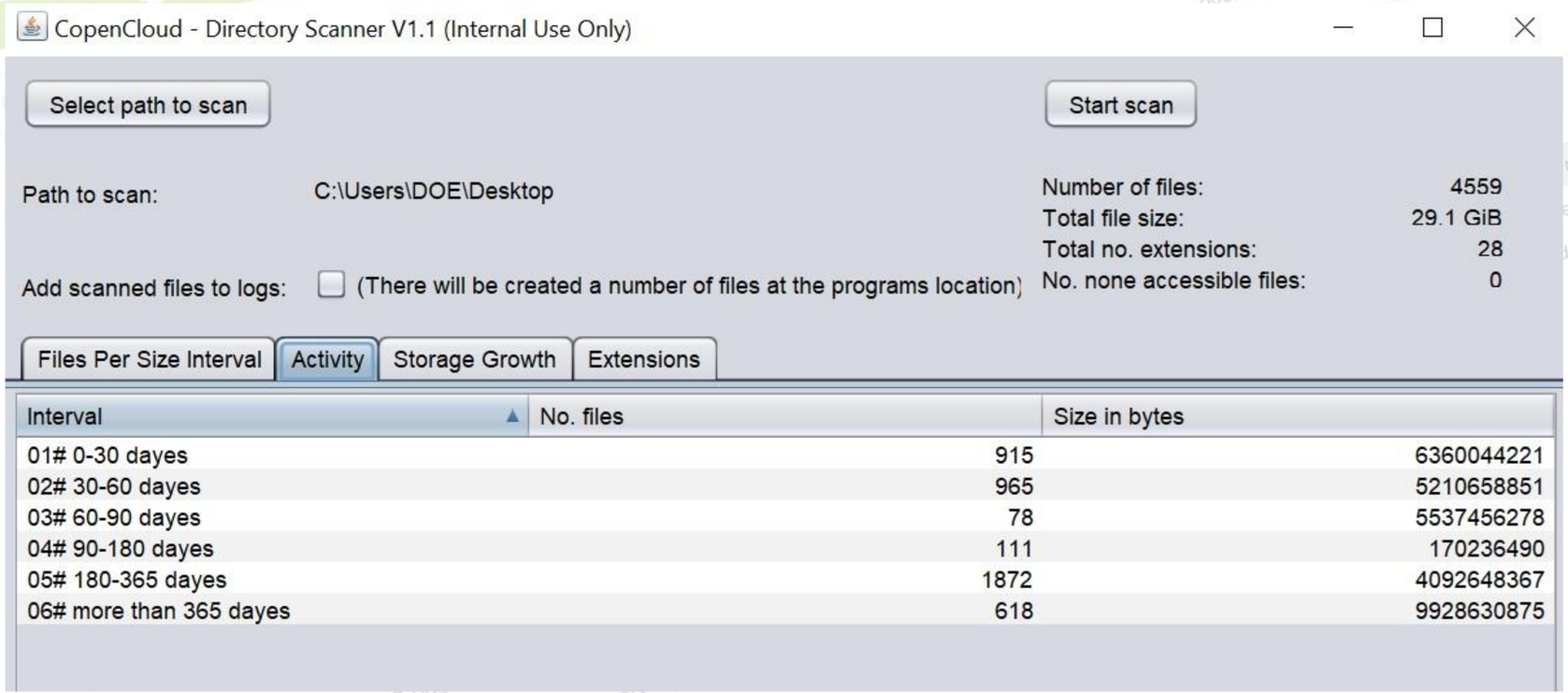
Green Impact
CERTIFIED

17 TB = 1 ton CO2 reduceret



https://copencloud.com/da/co2-calculator

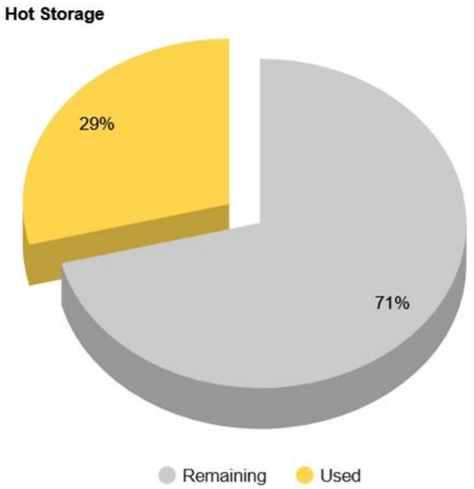
Directory Scanner

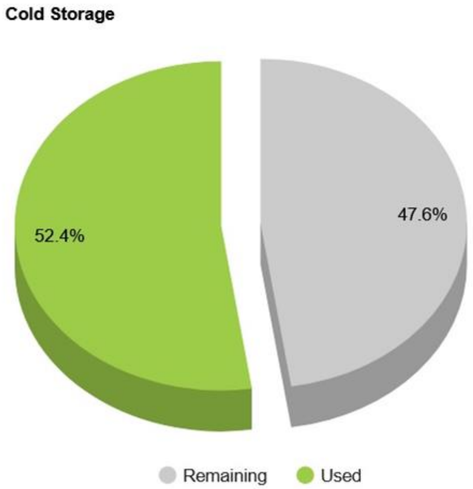


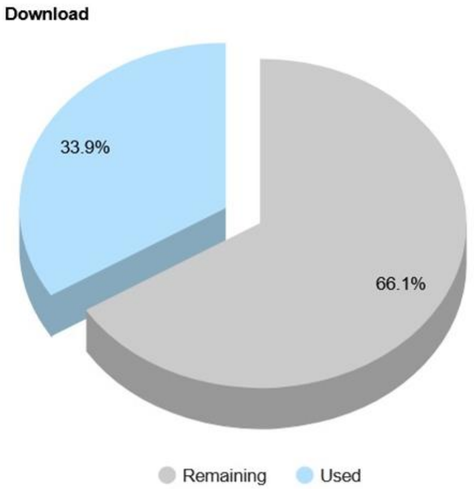
CO2 Rapport til ESG-regnskabet

Total storage space overview for account: Videokonto

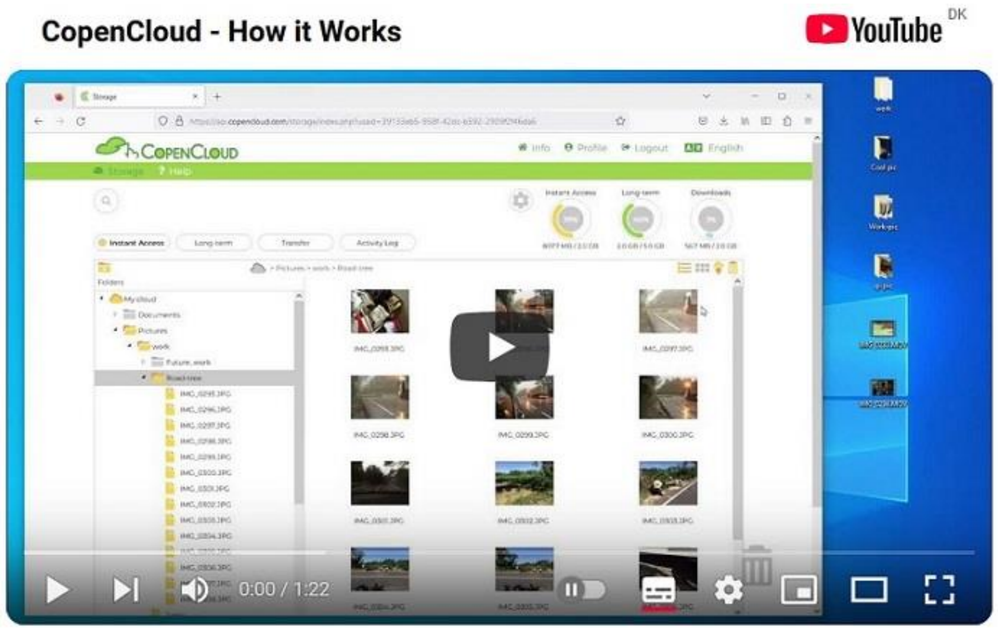
Hot Storage: 890.37 MB / 3.00 GB (28.98327% used)
Cold Storage: 2.62 GB / 5.00 GB (52.38709% used)
Download: 694.03 MB / 2.00 GB (33.88826% used)







Hvor mange bruger DropBox?



https://www.youtube.com/watch?v=1zoBhhHYXh4

Den Grønne Boks

Perfekt til 3. backup



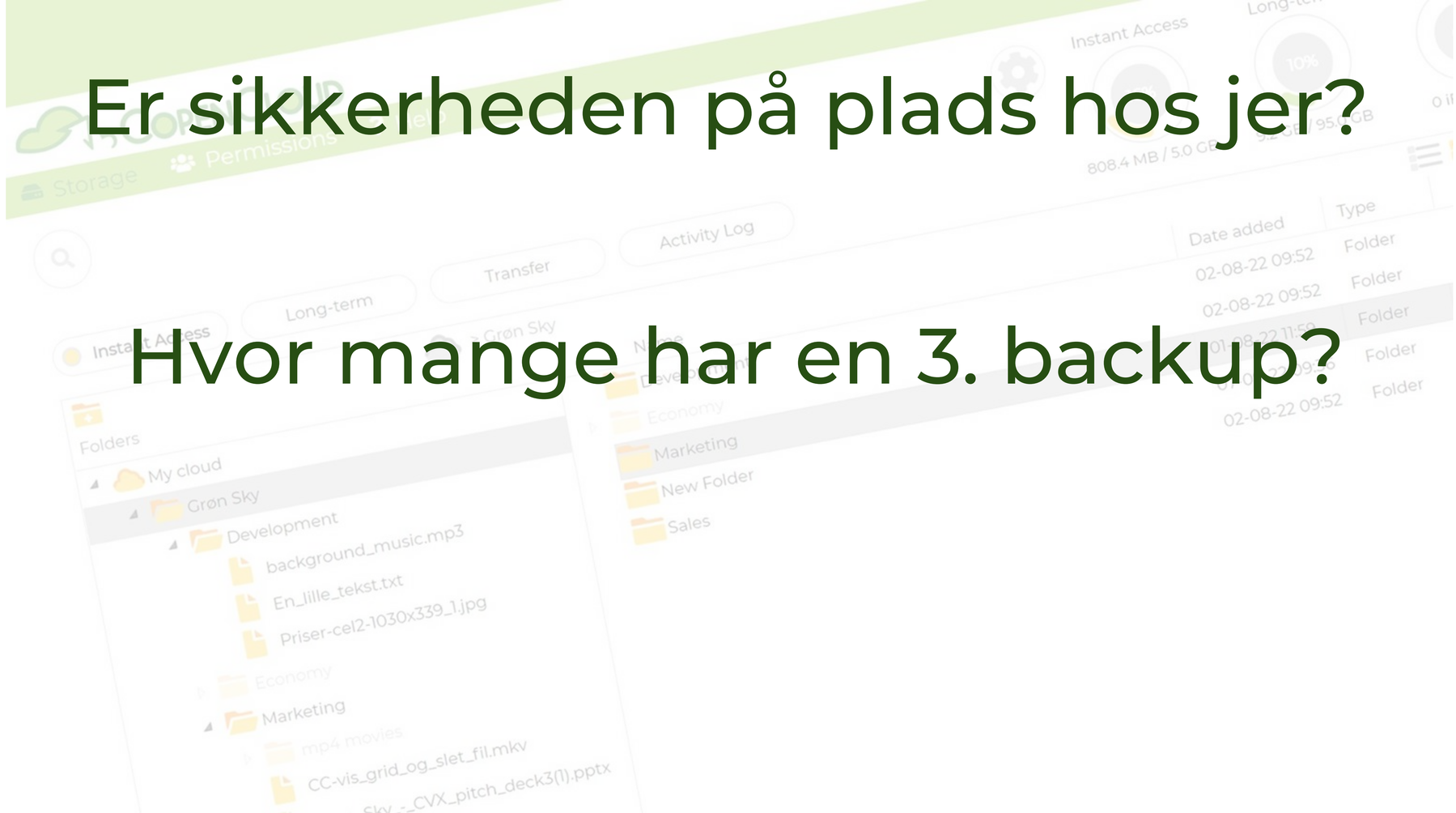
GLADSAXE KOMMUNE

Er sikkerheden på plads hos jer?



Er sikkerheden på plads hos jer?

Hvor mange har en 3. backup?



Er sikkerheden på plads hos jer?

Hvor mange har en 3. backup?

Hvor mange ved det ikke?

Hos os er sikkerhed en topprioritet!

Ingen kan læse, ændre eller hente data fra vores backups.

Den eneste mulige handling er en **kontrolleret restore**, så jeres backup-program kan hente data.

Fri for Ransomware-angreb

Lavere omkostninger med langtidslagring





Klimavenlig Datalagring

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linkedin.com/company/copencloud

Rundbordssamtaler



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Tror du på, at vi kan udvikle grøn AI i fremtiden?



ⓘ The Slido app must be installed on every computer you're presenting from

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Paneldebat: Hvordan kan vi gøre brugen og udviklingen af AI mere grøn?

Andreas Holbak Espersen, branchedirektør, DI Digital
Ulrik Nicolai de Lichtenberg, Director, Scientific Projects, GEFION
Mette Kaagaard, CEO, Microsoft Danmark
Marianne Thyrring, direktør, DMI
Torsten Hasforth, cheføkonom, CONCITO



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Afrunding

Andreas Holbak Espersen, branchedirektør i DI Digital



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QR CODE

Below is the QR code for your survey.

Tak for nu!



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