

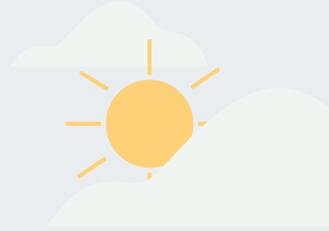


The Environmental Effects of AI

Joshua Cheng, Daisy Deng, Leo Lue,
Arisha Mamedova, Emilia Sloan

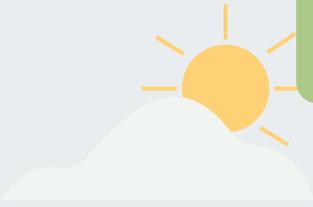
Additional credits to Vivian Lee

What is AI?



- Artificial Intelligence (AI)
- AI learns from data
- Chatbots, self-driving cars, systems
- Possibilities practically endless





Benefits of AI

Electronic Waste

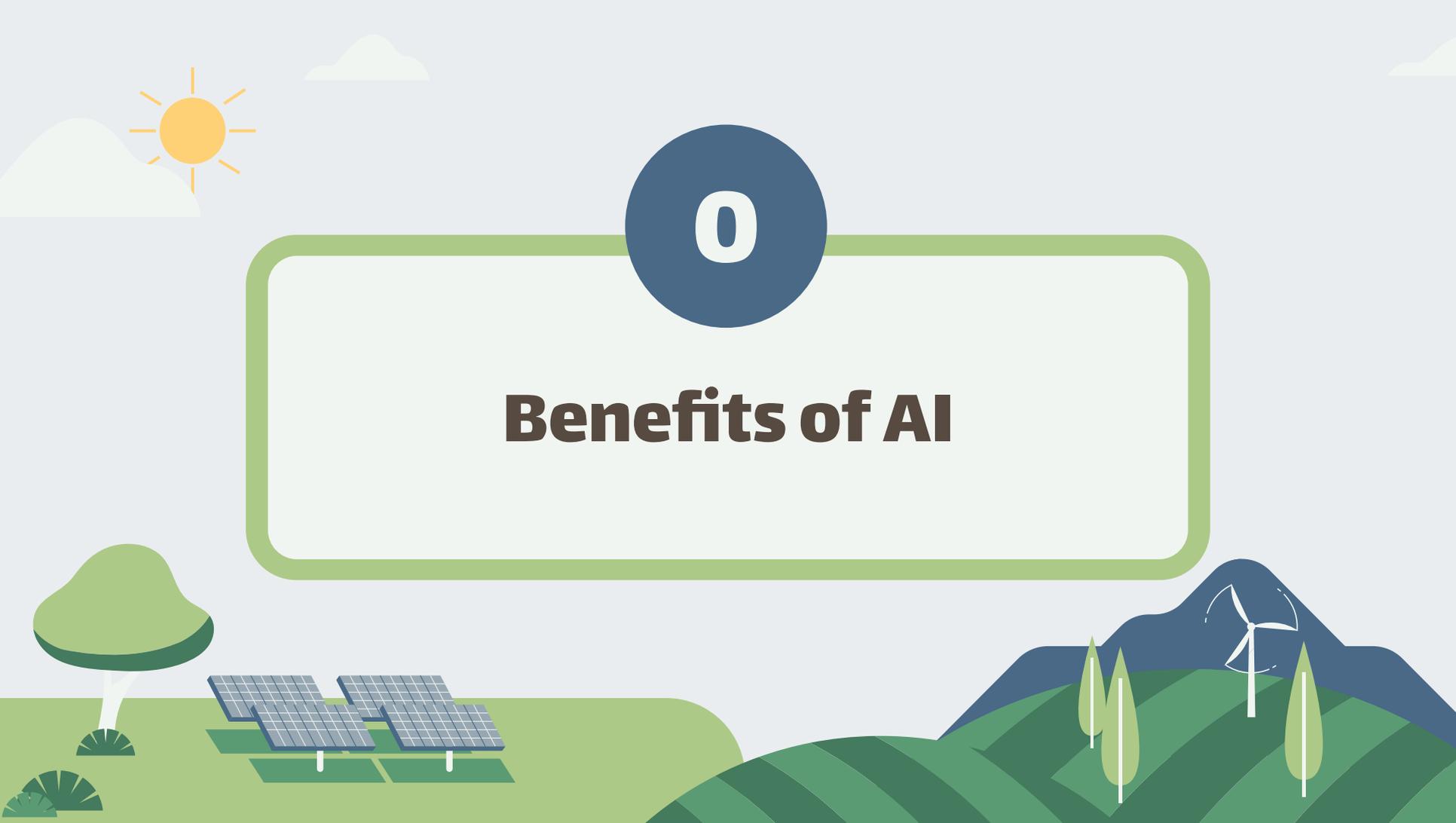
Energy Consumption

Water Consumption

Land Use

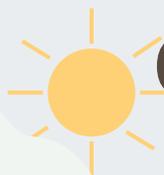
Conclusion





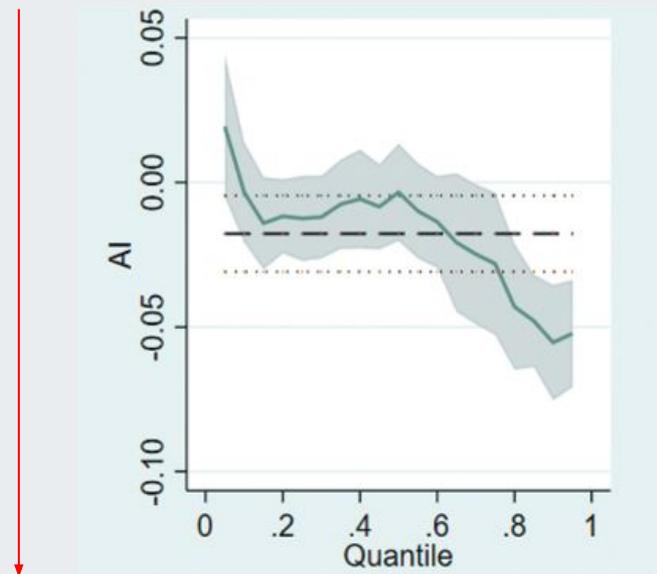
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Benefits of AI



Can AI help the environment?

AI's role is in reducing carbon emissions **increases**



Countries' carbon emissions **increases**

High-emission countries often invest more in AI for sustainability, but this also varies widely

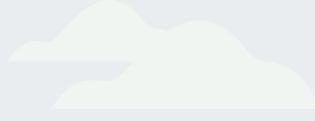
Fig. 1. Relationship between AI's contribution to carbon reduction and carbon emissions (Zhong et al., 2024): X-axis: Total CO₂ emissions (World Bank). Y-axis: AI's role in carbon emissions (robots installed per country, IFR).



AI Optimization Examples

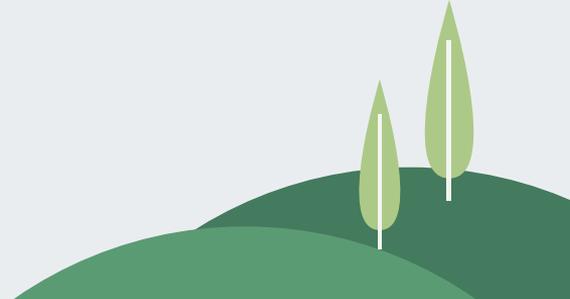
- Smart gardening
- Enhanced wind farm systems
- UNEP's World Environment Situation Room (WESR)





“While data and AI are necessary for enhanced environmental monitoring, there is an environmental cost to processing this data that we must also take into account.”

-David Jensen, coordinator of the United Nations Environment Program's (UNEP's) Digital Transformation sub-programme.





01

Electronic Waste

Unsustainable Ways of E-Waste Disposal



Landfilling

Dumping waste into
a giant hole in the
ground

Acid Bath

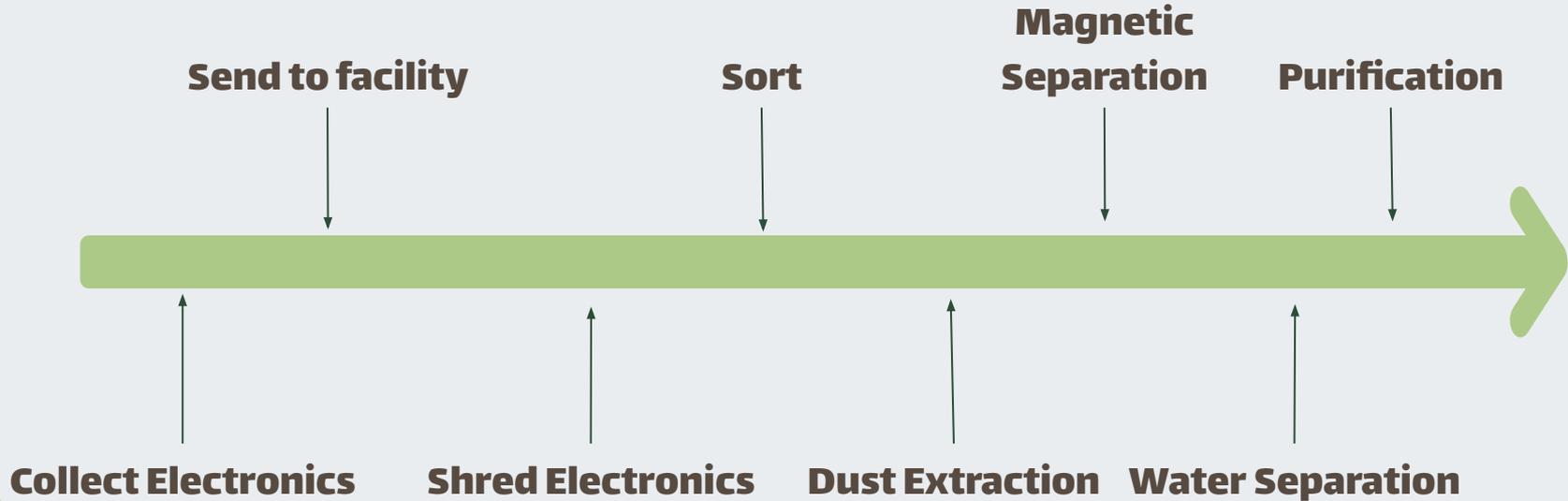
Soak waste in an
acid bath



Incinerating

Burning waste

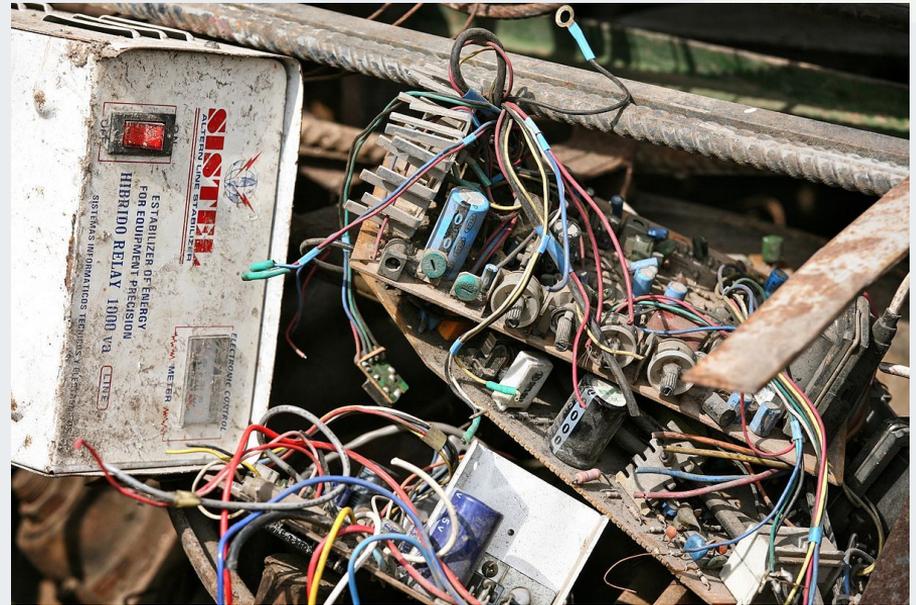
The Process of E-Waste Recycling



Recycling, Continued



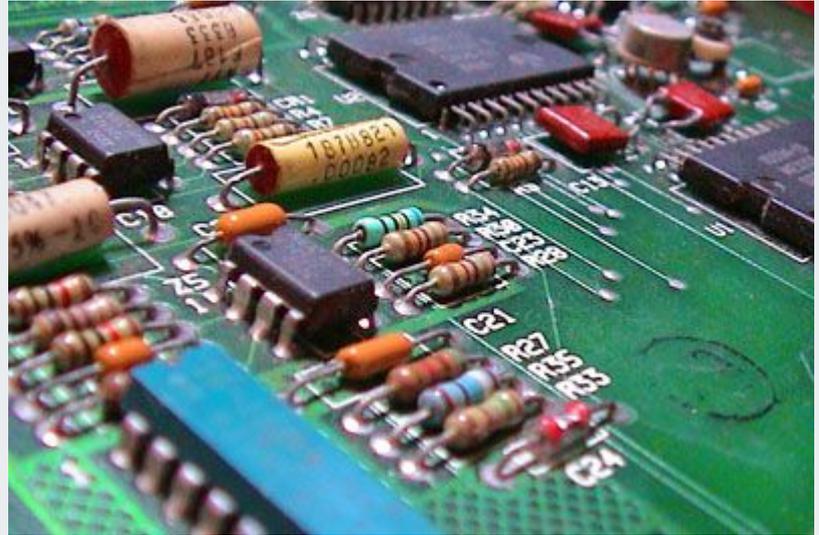
- Pros: nothing is wasted
- Cons: Complex, costly
- 22% of e-waste is recycled
- Informal recycling -> no safe disposal of hazardous materials,
 - Still poses an environmental hazard
- Therefore, reuse is still the best option

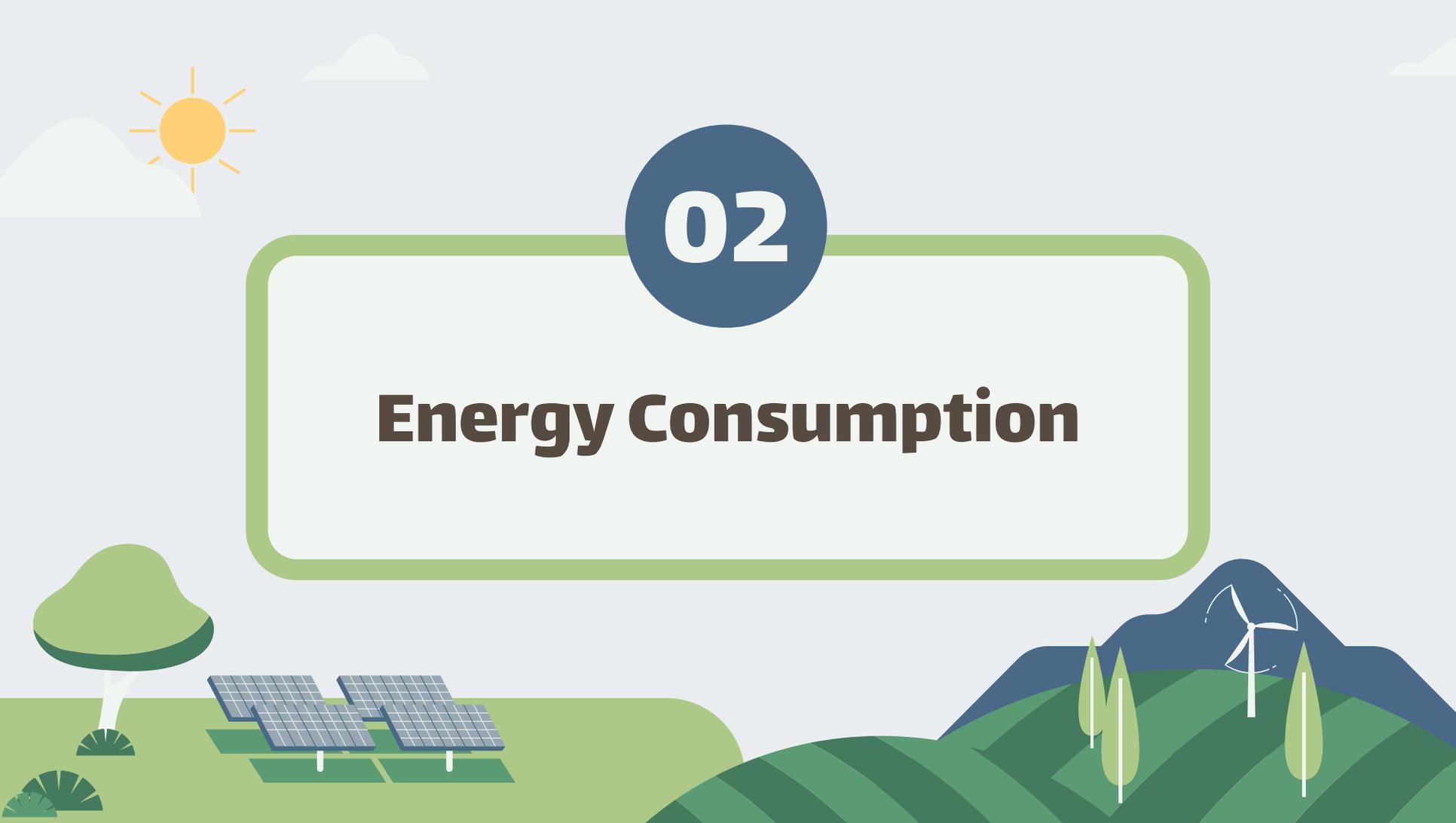


Why does this all matter to AI?



- Electronics have a lifespan of 2-5 years
- Could add 1.2 million to 5 million metric tons of e-waste
- Mostly in the form of CPUs, GPUs, etc.
- Could impact already struggling informal recycling systems
- Solutions





02

Energy Consumption

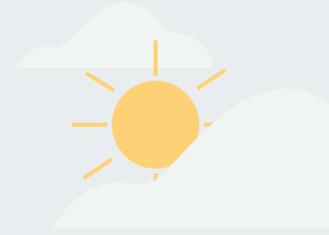
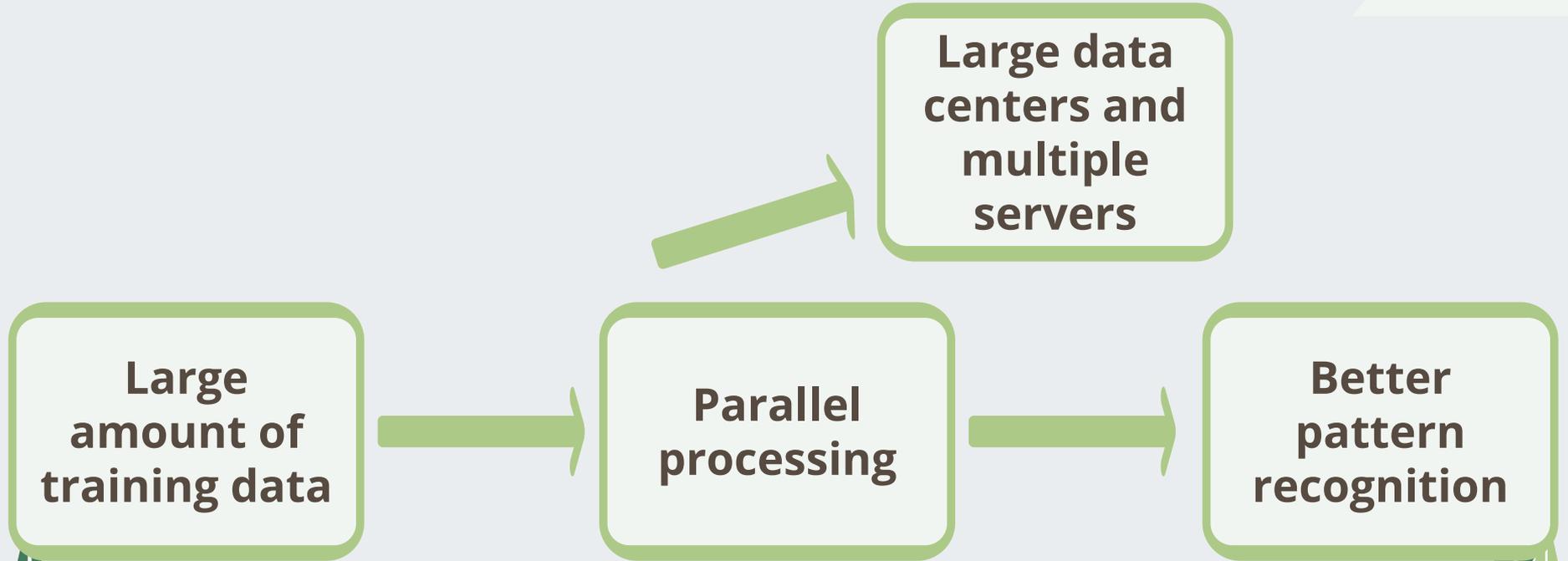


2%
of global electricity demand

3%
of global CO₂ emissions



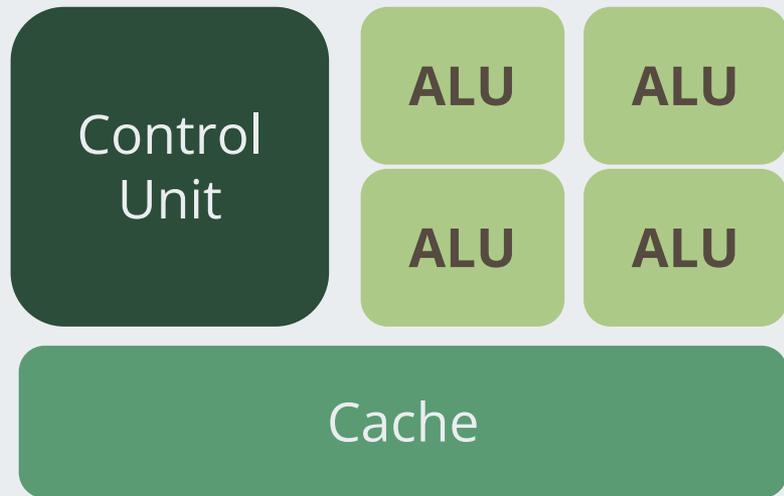
Training and Data Usage



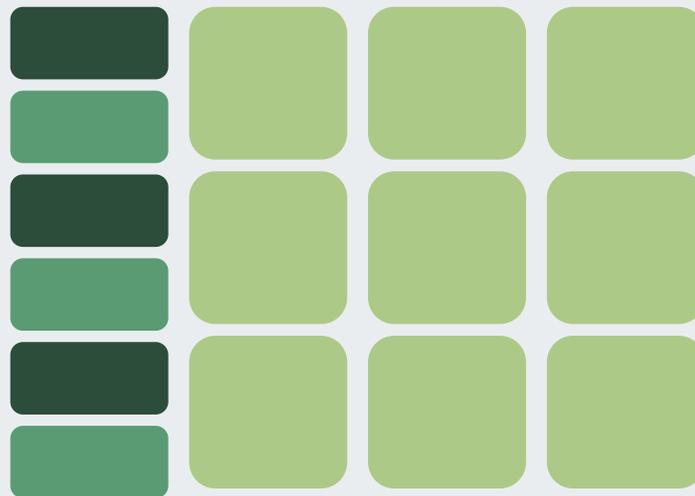
CPU v. GPU



175 Watts



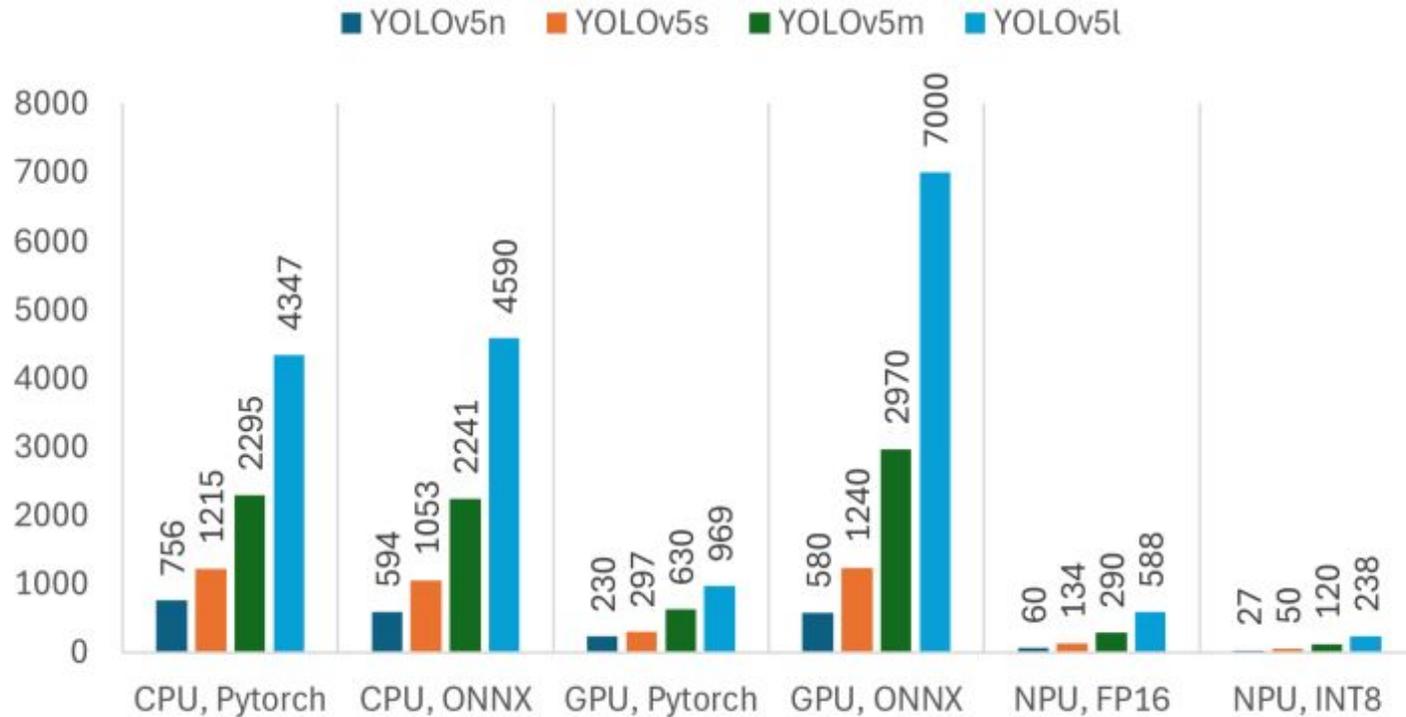
400 - 700 Watts



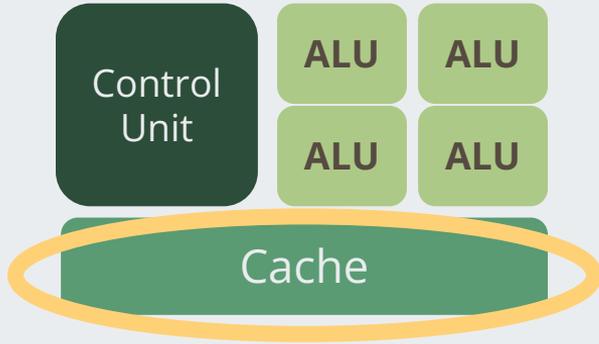
CPU v. GPU v. NPU



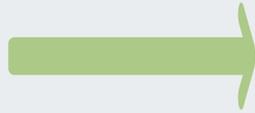
Energy Consumption [Wms]



Memory



Limited
memory
storage in
CPU/GPU cache



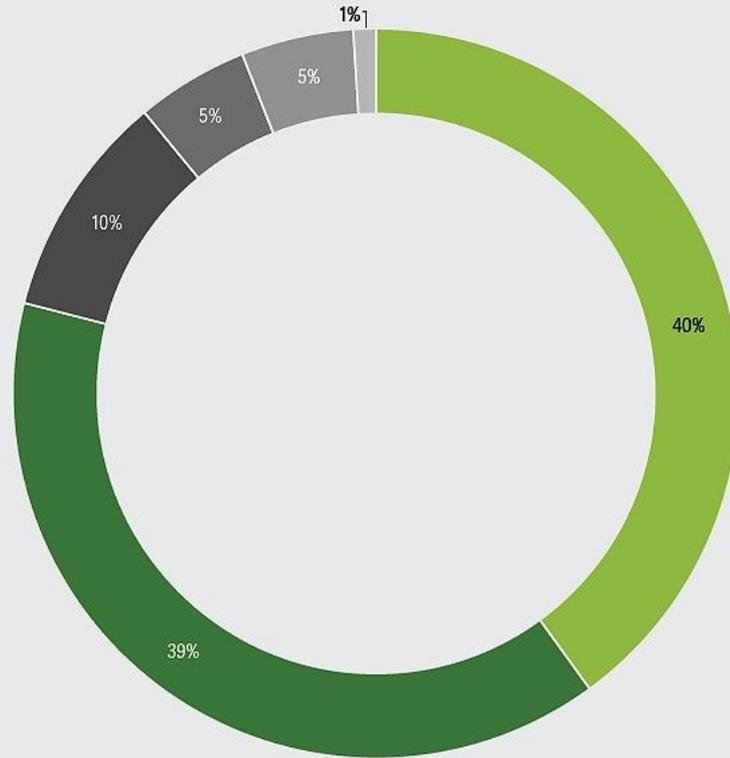
Random
Access
Memory
(RAM)



Long-term
memory

Computing power and cooling systems drive much of the energy consumption in AI data centers

- Computing power and server resources
- Cooling systems
- Internal power conditioning systems
- Network equipment
- Storage systems
- Lighting



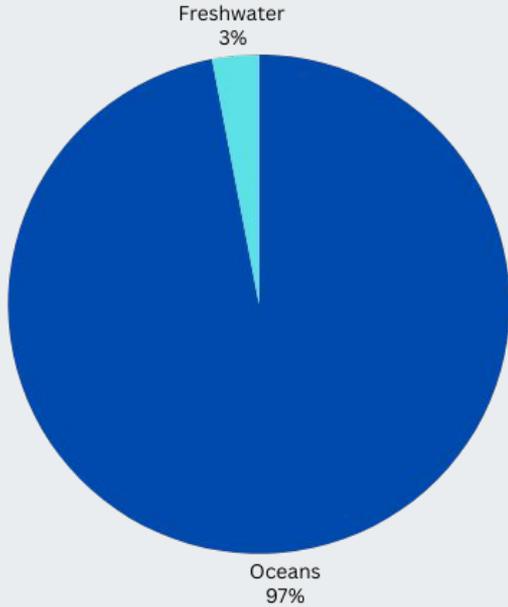
Source: Deloitte analysis.



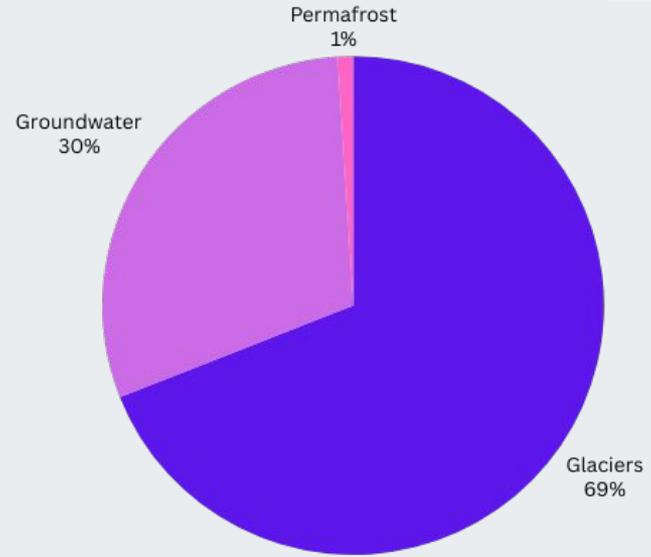
03

Water Consumption

Our limited water supply

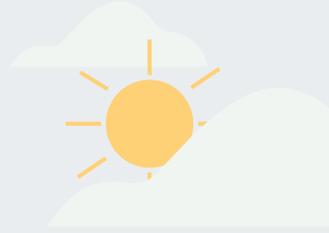


Total water distribution



Freshwater distribution

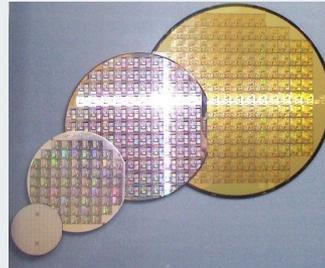
How AI is involved with water



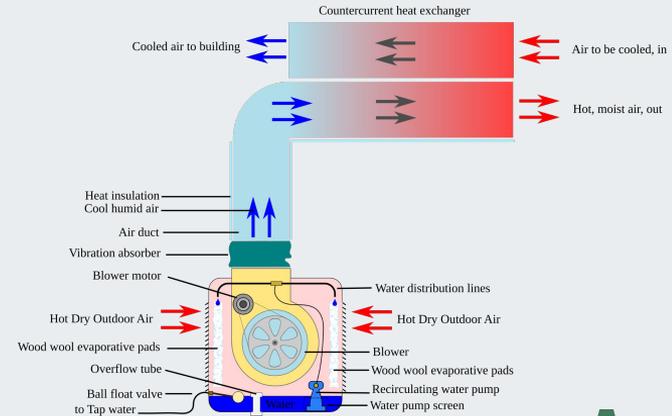
Generating electricity

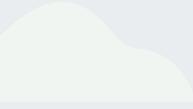


Producing hardware



Cooling servers



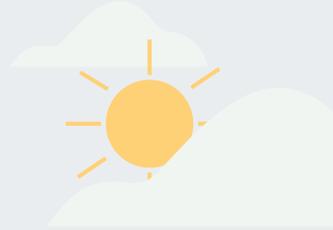


Negative effects on water



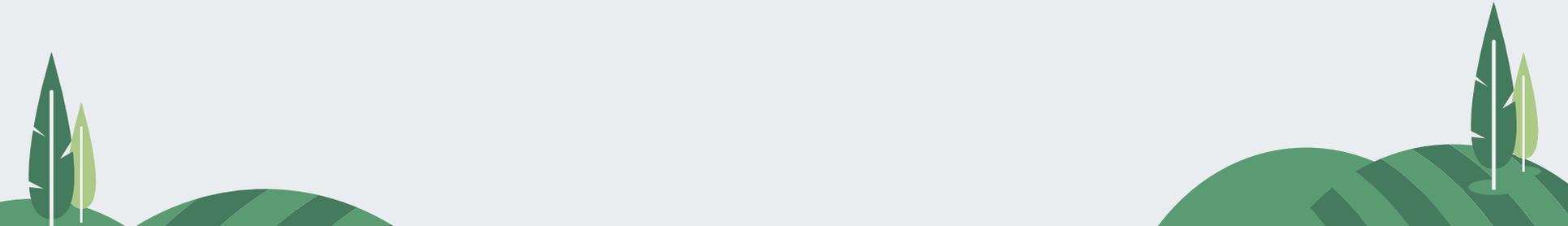
- Drain freshwater resources
 - Especially in drier areas
 - Water pollution:
 - Harm aquatic ecosystems
 - Soil erosion
- 
- 

Possible Improvements

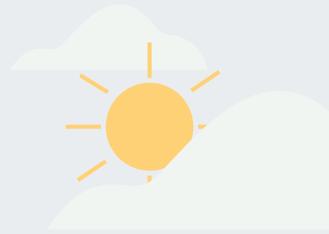


Meta, Google, and Microsoft are striving to replenish more water than they consume by 2030. Some proposed solutions include:

- Water usage data reports
- Water recycling
- Improving wastewater management
- Alternative cooling techniques



Alternative cooling options



Direct-to-chip cooling

A cold plate containing coolant is mounted onto microchips and other hardware components

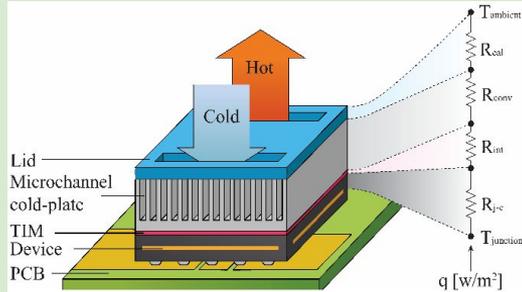
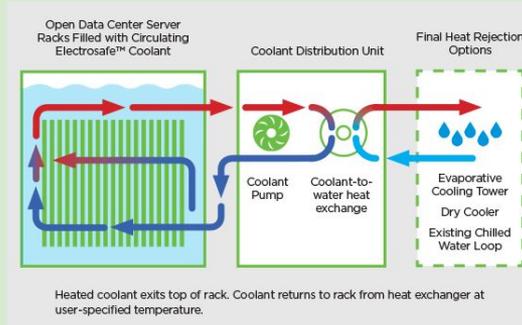


Fig. 1. Schematic cross section of a transistor, cooled by a microchannel cold-plate, and an equivalent thermal resistance model

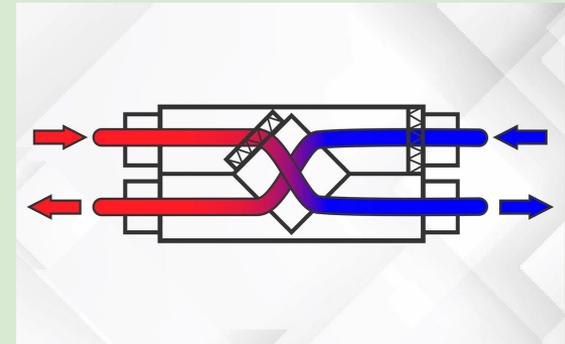
Immersion cooling

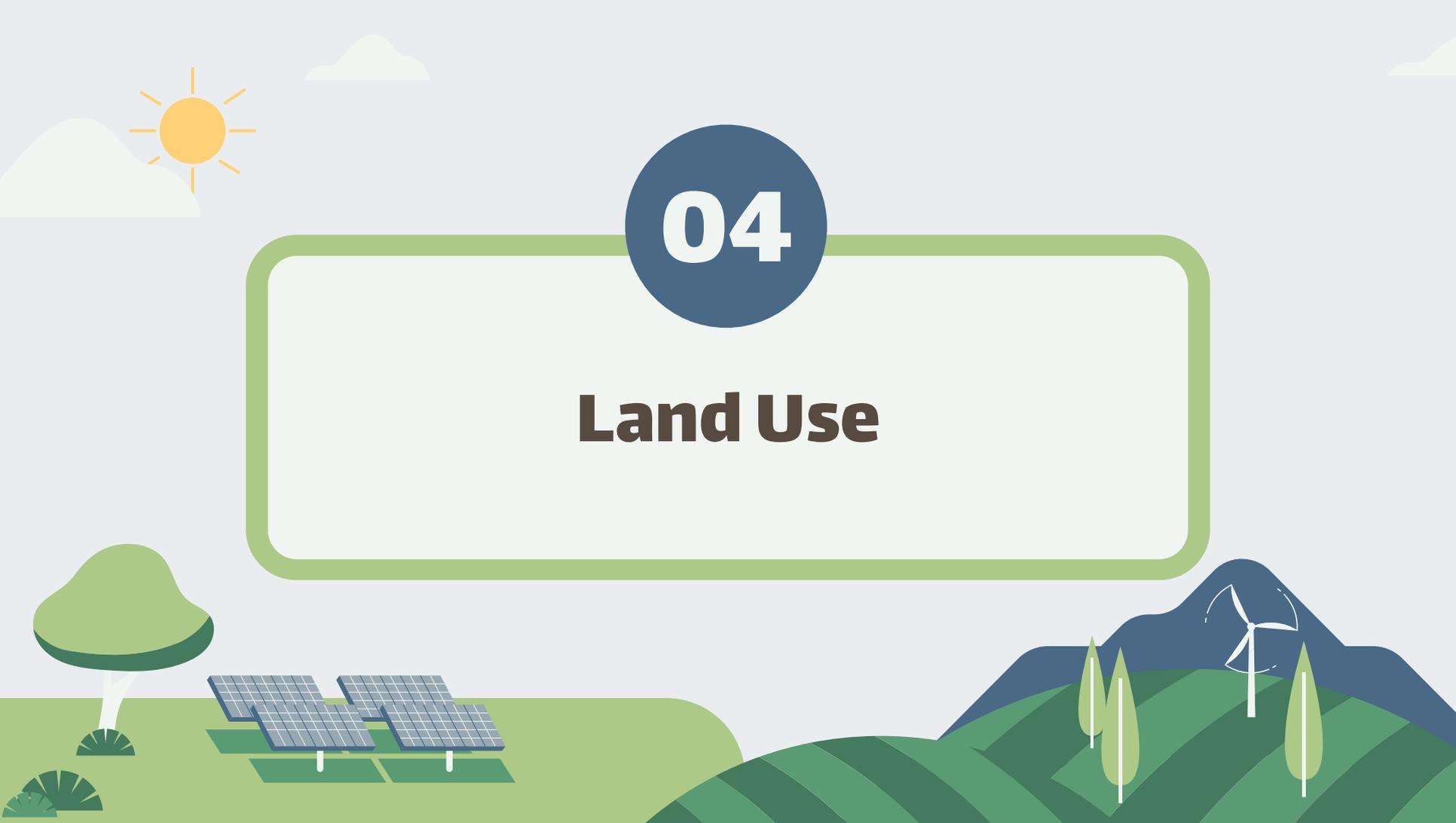
Hardware components are submerged in tanks containing non-conductive dielectric fluids



Free cooling

Hardware components are cooled with outside air from the natural environment



The background features a stylized landscape with a sun in the top left, clouds, solar panels on a green field, a tree, rolling green hills, and a wind turbine on a blue mountain peak. A large green rounded rectangle is centered on the page.

04

Land Use

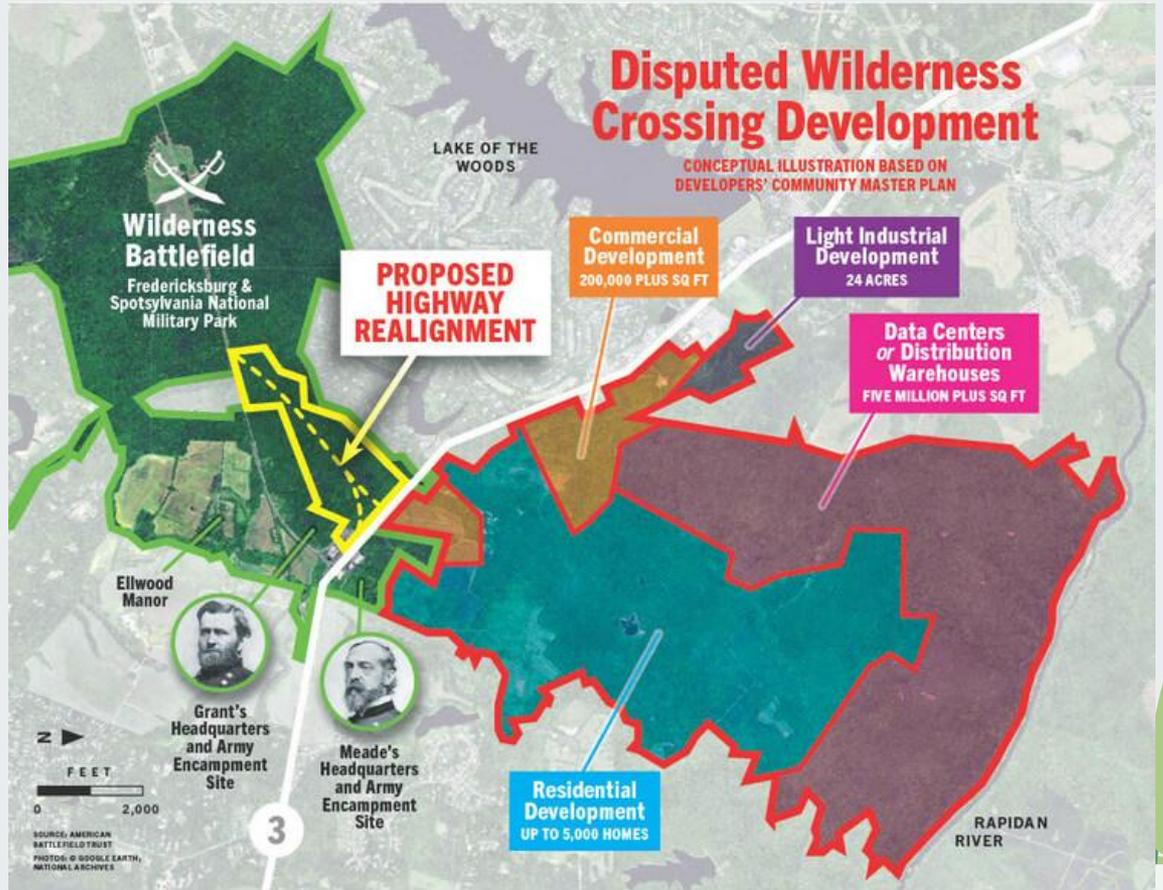


Data centers in Ashburn. (Photo by Getty Images)





Battle of the Wilderness (ThoughCo)



Wilderness Crossing Development (PRNewsWire)



What does this mean for the environment?



Increases in local traffic



**Decrease in walkability
Increase in greenhouse gas release**

Loss of Open Space



**Reduction of wildlife habitat, biodiversity,
and recreational/historic areas**

Pollution



**Damage to environment, clean water
sources, and local area**

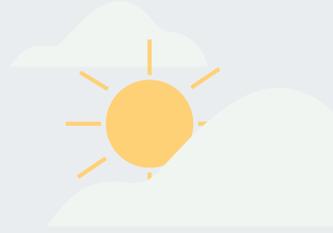
Water Shortage



**Uptick in water demand for locals and toll
on local ecosystem**



Smart Area Selection



- Access to **renewable energy sources**
- Have **proper ways of waste disposal**
- **Natural cooling** → Cooler climates
- **Environmental impact assessments**
- Evaluate **natural disasters** in area (to avoid having to waste resources on rebuilding)
- Avoid **protected habitats**





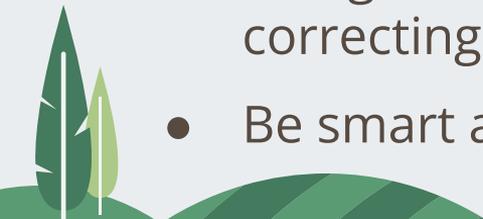
04

Solutions + Activity

General solutions



- Make AI **rely mostly or fully on reusable energy sources** (*like recycling water for energy or recycling components*)
- Make **data centres more green/environmentally friendly**
- Use AI to **focus on advancing environmental technologies**
- Using AI to compile **information** about **climate change** (or other environmental problems) to speed up finding solutions or making current solutions better
- Using AI to **reach out to other countries** that need help with correcting their environment
- Be smart about **where to build data centers**





Your Turn!



We need your help!

You work for a consulting firm that specializes in helping companies be environmentally-friendly.

One of your clients from Virginia would like to implement AI in his company. He wants to create a data center that will follow the best practices.

Your job is to provide a piece of advice he can take to make his environmentally friendly data center.

The more specific and creative, the better!





Questions?

Citations (Benefits)



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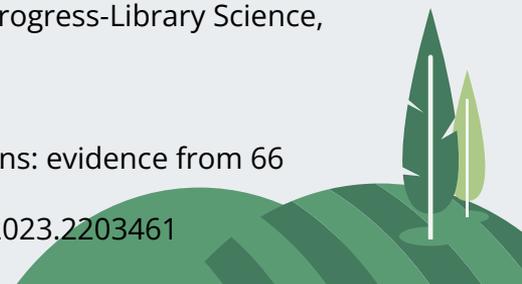
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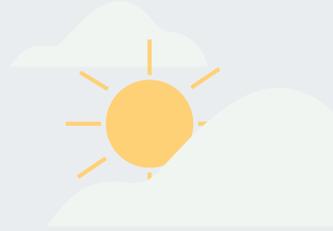
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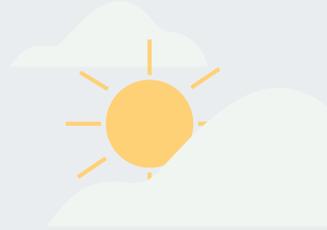
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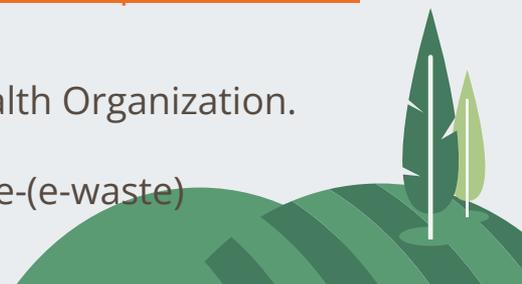
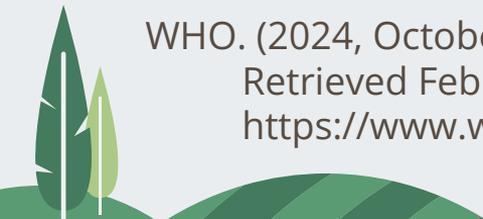
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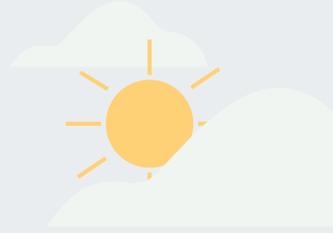
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Citations (Energy)

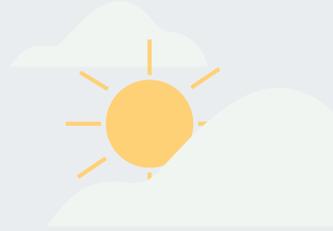


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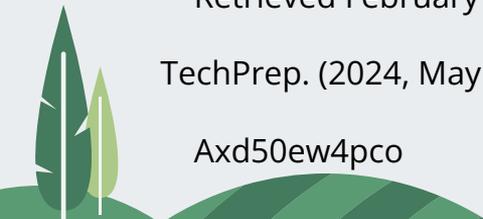


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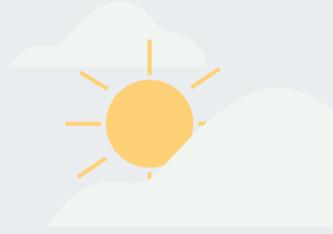
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Axd50ew4pco



Citations (Water)



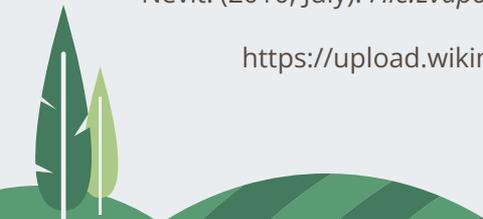
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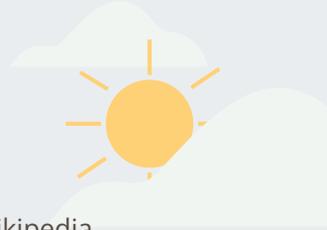
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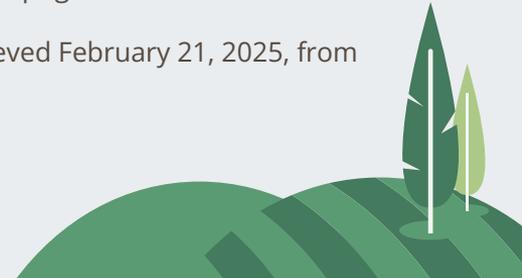
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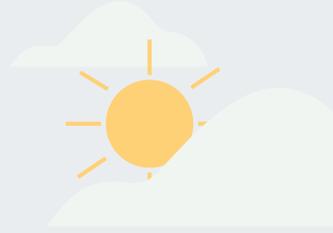
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