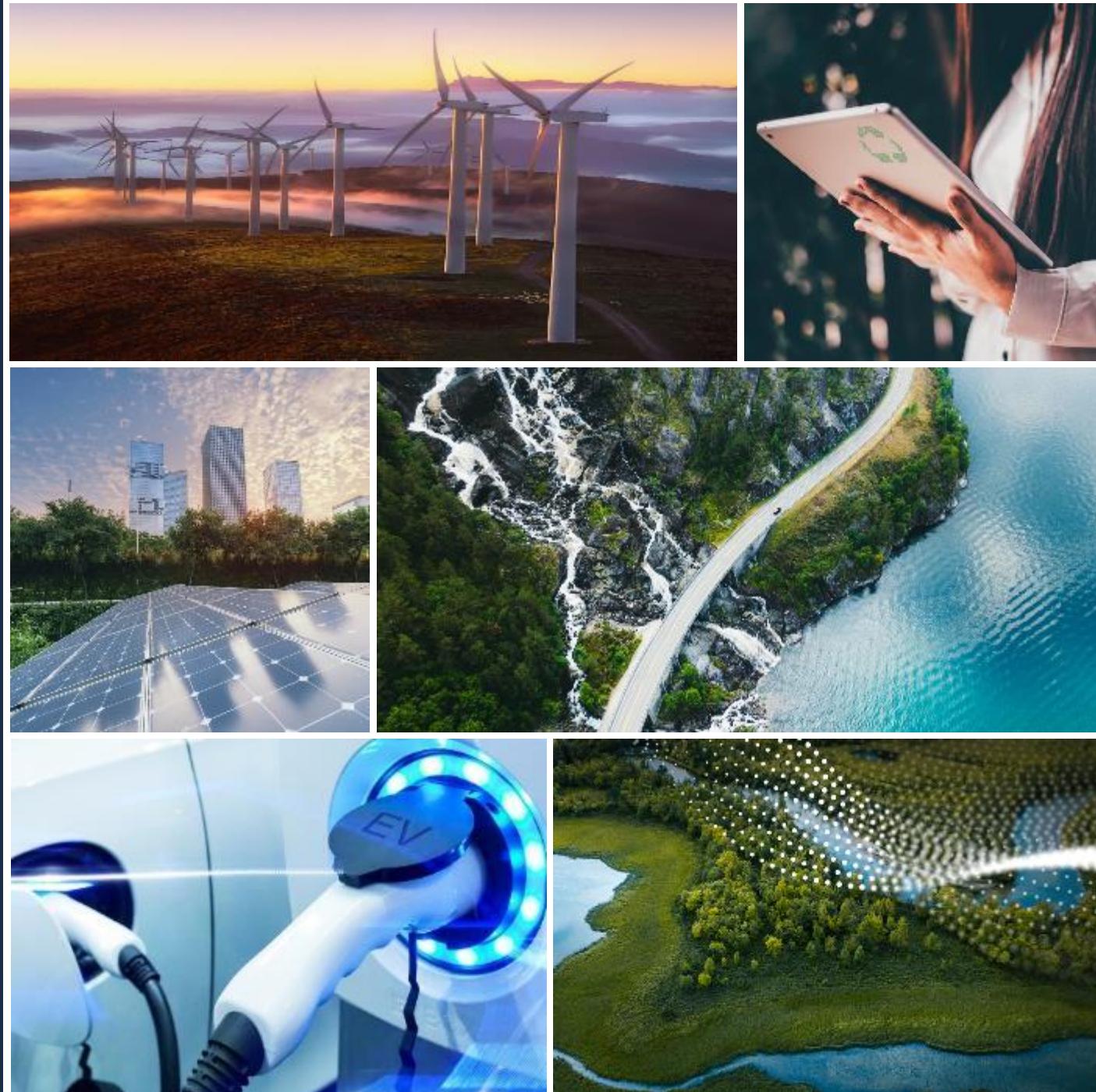




Microsoft Cloud
for Sustainability

Cloud Native Sustainability 101



Agenda

- Sustainability
- Carbon context & concepts
- Microsoft's Sustainability journey
- Microsoft Cloud for Sustainability

The bottom line

**Our way of life is
fundamentally unsustainable.**

But it doesn't have to be!

A planet sized **challenge**



Carbon

We are adding too much carbon dioxide to the atmosphere.



Waste

We are generating too much waste, polluting the land, sea, and air.



Ecosystems

We are overconsuming finite resources, destroying ecosystems, & causing extinctions.



Water

We are polluting oceans and freshwater sources and depleting them.

Feedback loops



More forest fires
More carbon emissions



More waste
Public health crisis

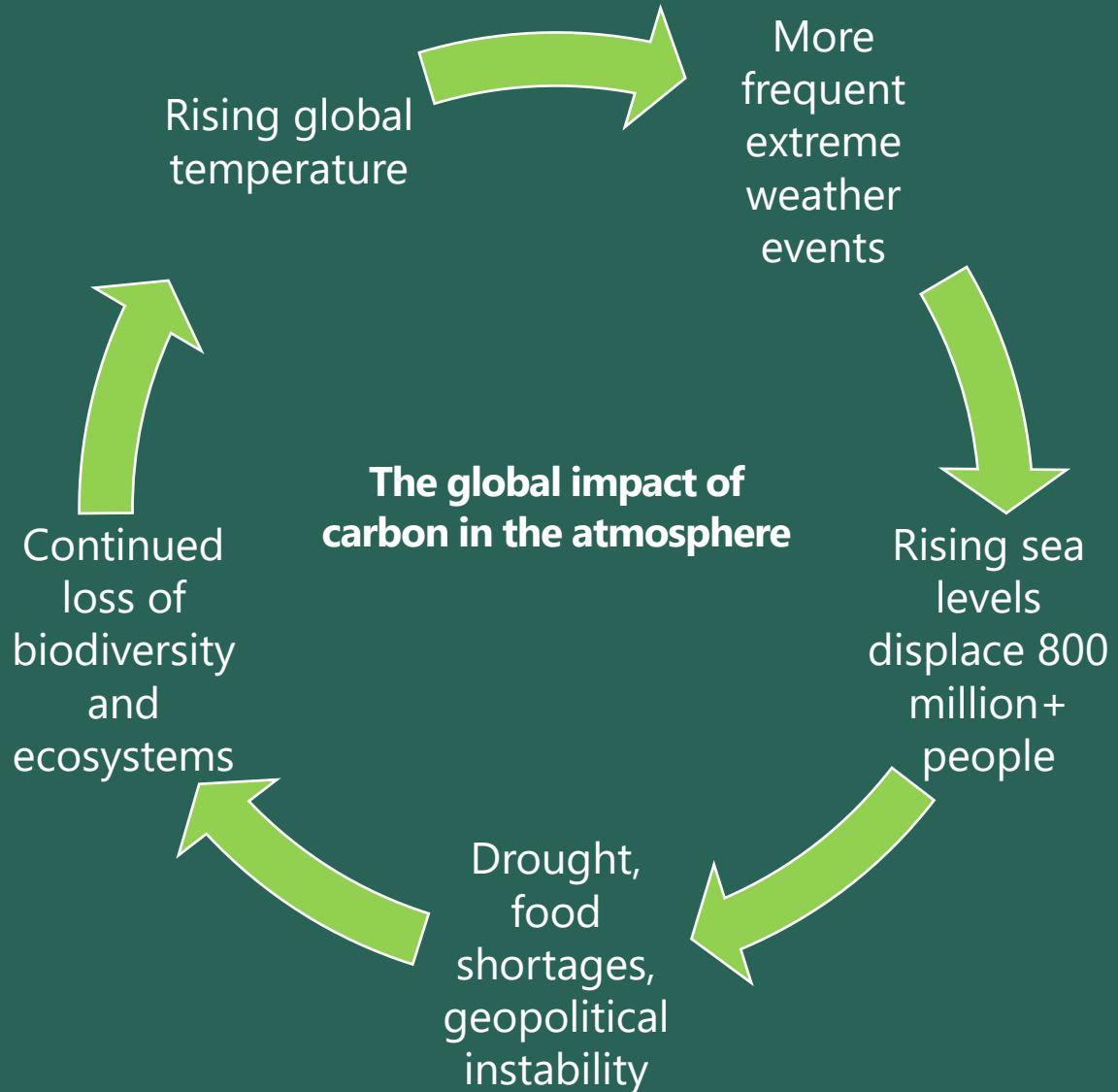


Mass extinctions
Less productive ecosystems



Less water
More instability

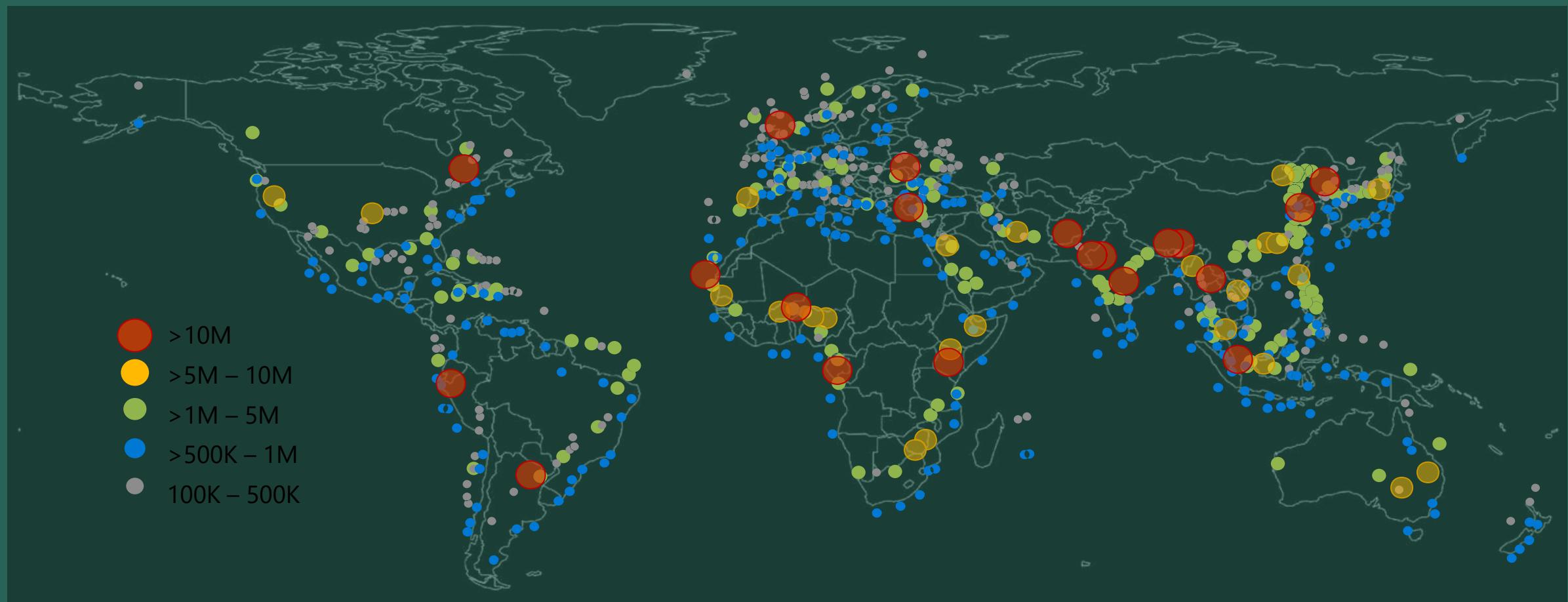
It's all connected



Why it matters

800 million people in 570 cities will be at economic and health risk if sea levels rise by 2 ft (.6 m)

Urban populations at risk, 2050s:



Since 1970

 2x

Doubling of global
carbon emissions

 2x

Doubling of
human population

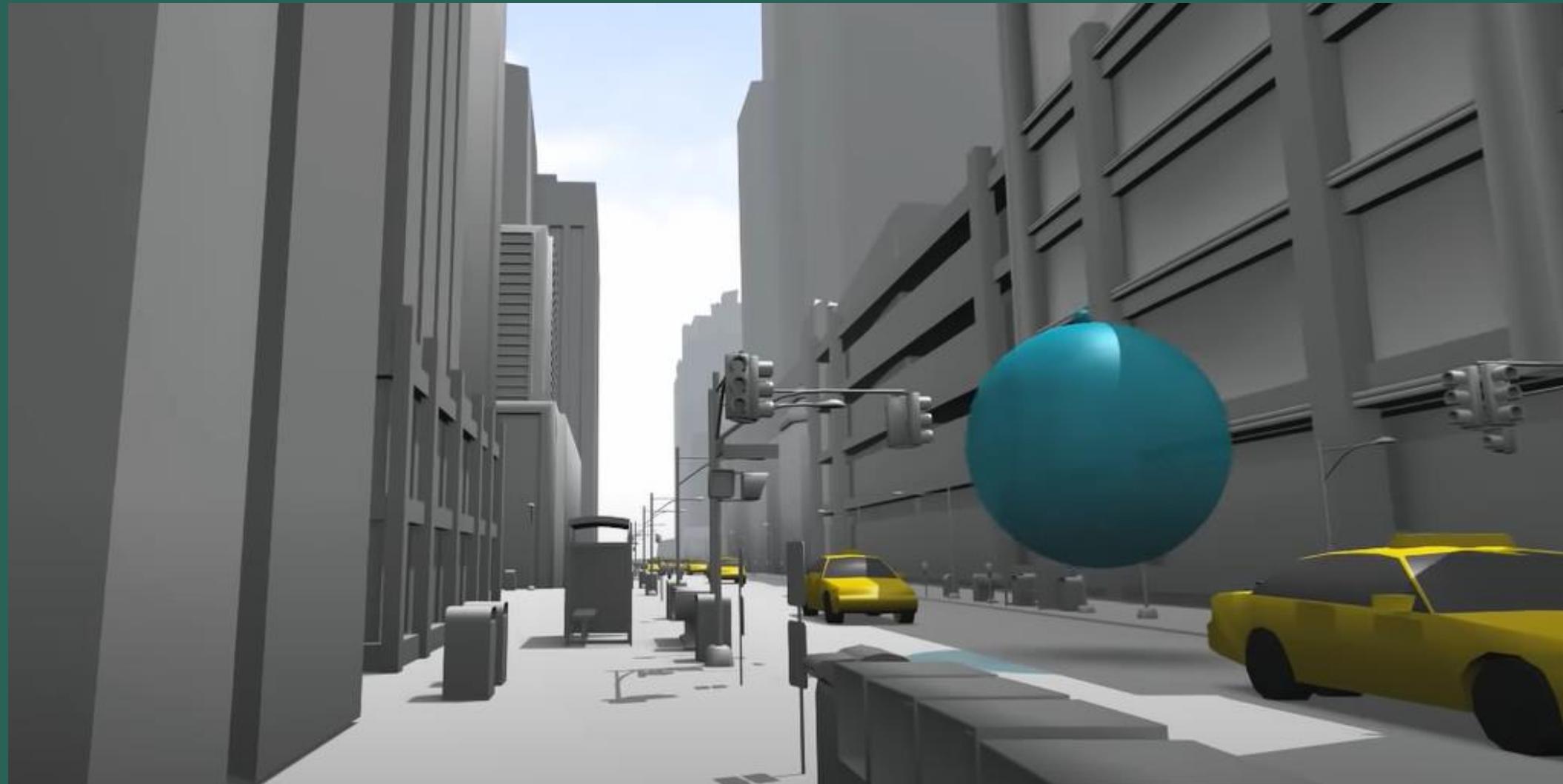
 60%

60% of wildlife
has gone extinct

 50%

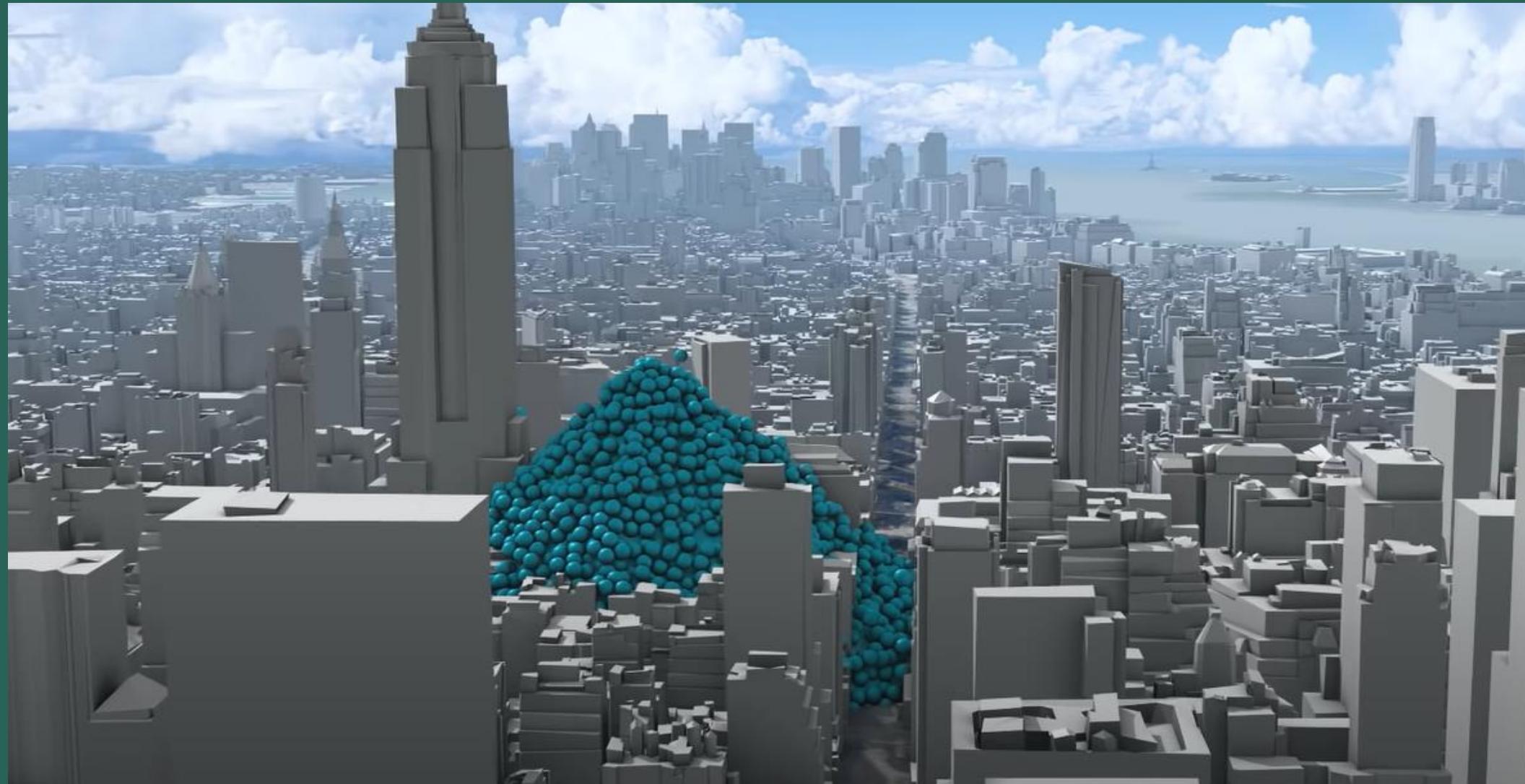
50% of coral
reefs have died

Seeing the invisible

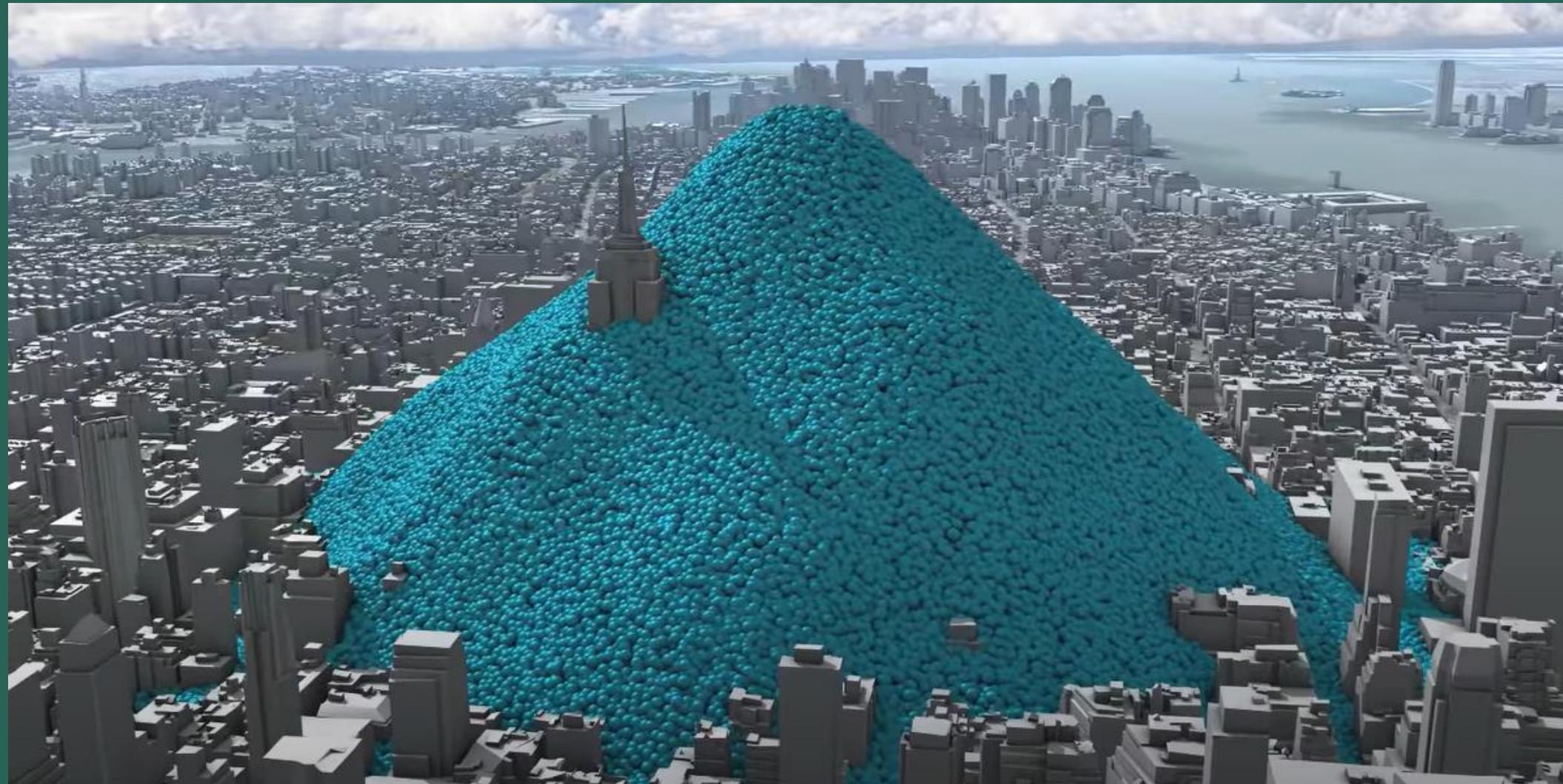


One ton of carbon dioxide would fill a sphere 33 ft (10 m) across

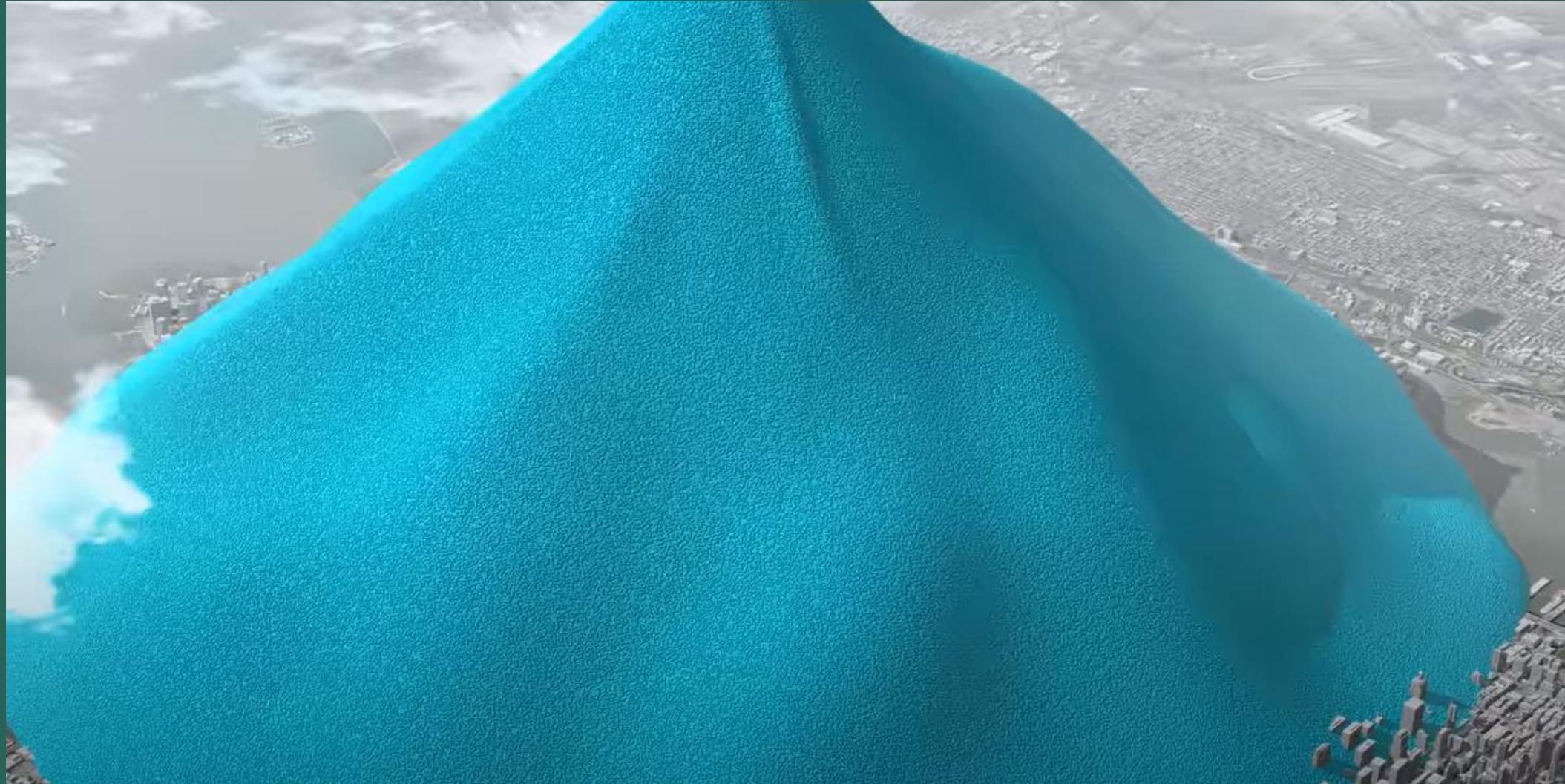
1 hour of emissions



1 day of emissions



1 year of emissions



Our climate, our future



Cloud Computing is adding to the worries

Technological advances have transformed computing into the 5th utility, after water, electricity, gas, and telephony

- As more computation workloads migrate to the cloud, modern cloud computing platforms have become increasingly large-scale and distributed.

Because of the massive growth of cloud computing, data centers are rapidly expanding

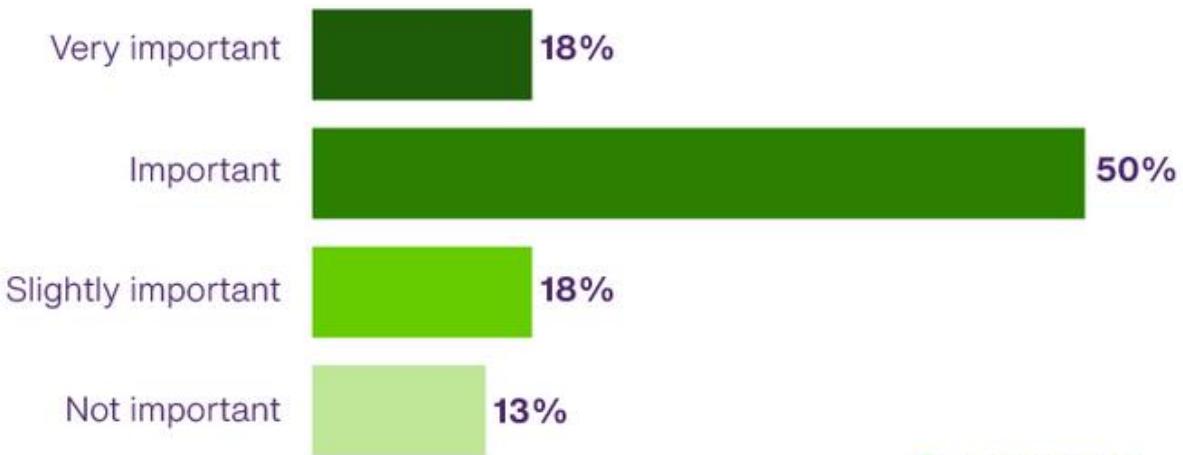
- Although cloud computing has the potential to increase efficiency and reduce technology's toll on the environment, it has also led to an enormous increase in energy consumption by data centers and other infrastructure.
- These data centers have a gigantic appetite for electricity, and not all electricity is generated using renewable resources.
 - NASDAQ notes that a medium-to-large-sized data center uses power densities 100x greater than a typical office building.
 - The International Energy Agency (IEA) reports that data centers (excluding energy used for cryptocurrency mining) represent 1% of global electricity demand, and that figure is expected to rise to between 3–8% in the next decade.

Organizations realize its important

Organizations are acknowledging this environmental impact

- Companies have historically driven financial, security, and agility benefits through cloud, but sustainability is becoming an imperative.
- In a TELUS International survey of tech leaders, 68% believe a Green Cloud Computing solution is important for their organization.
- Energy demands will only expand as the world gains more usage of data-heavy technologies, like virtual reality, video collaboration, and crypto mining.
- The next big cloud competition is the race to zero emissions, the World Economic Forum (WEF) reports.

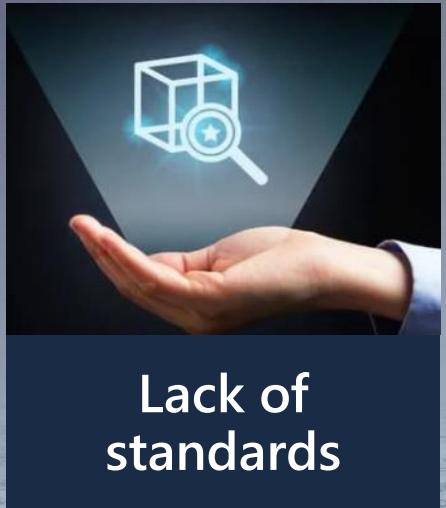
How important is having a sustainable/green cloud computing solution for your organization?



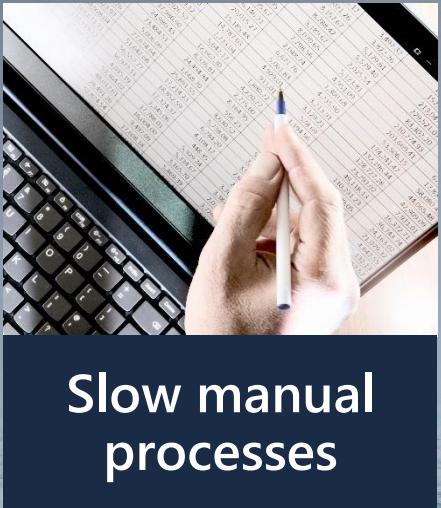
N = 82 technology leaders | Powered by www.pulse.qa



Sustainability challenges



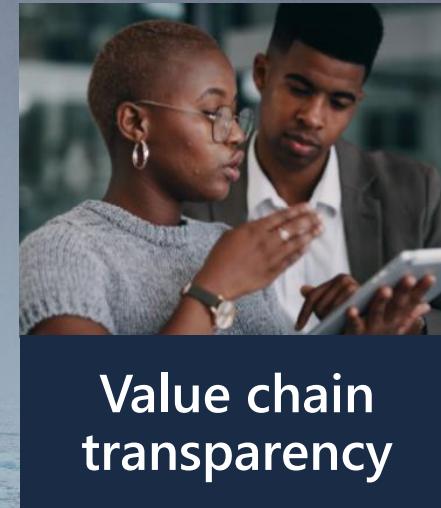
Lack of
standards



Slow manual
processes



Siloed data



Value chain
transparency

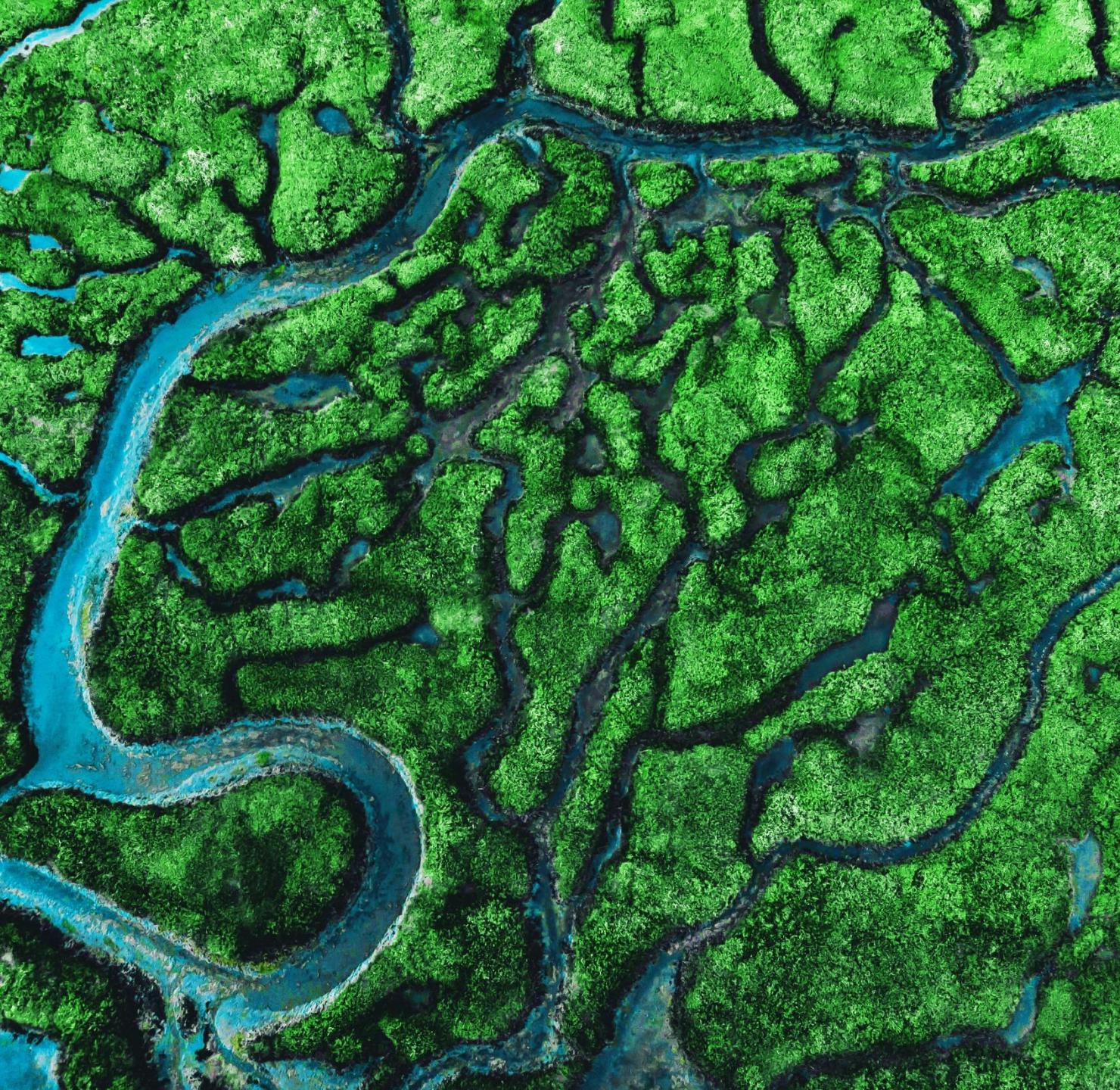


Transformation requires a data-first approach



Achieve data integrity and visibility
across Scope 1, 2, and 3 emissions

Definitions and concepts

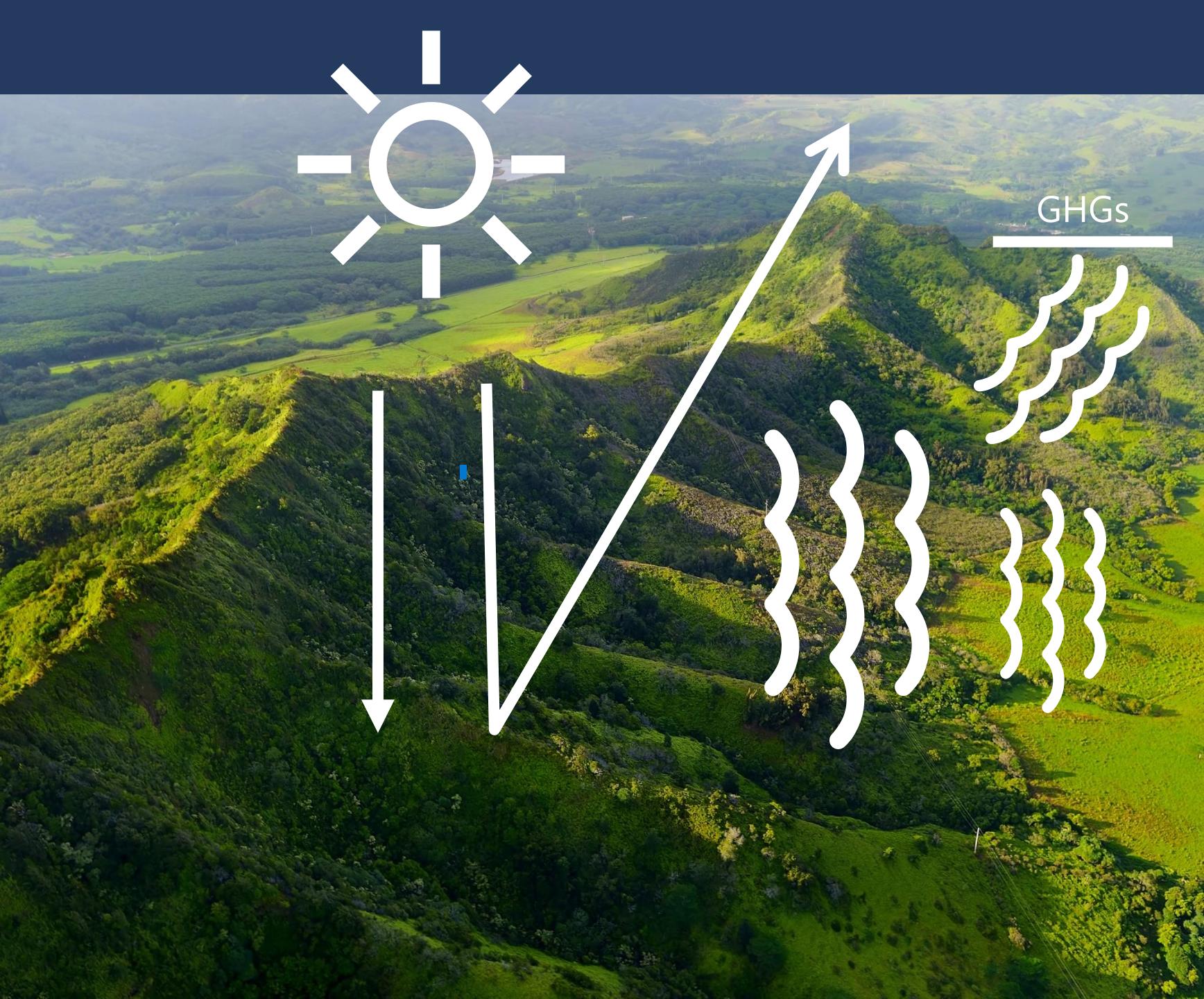


The greenhouse effect

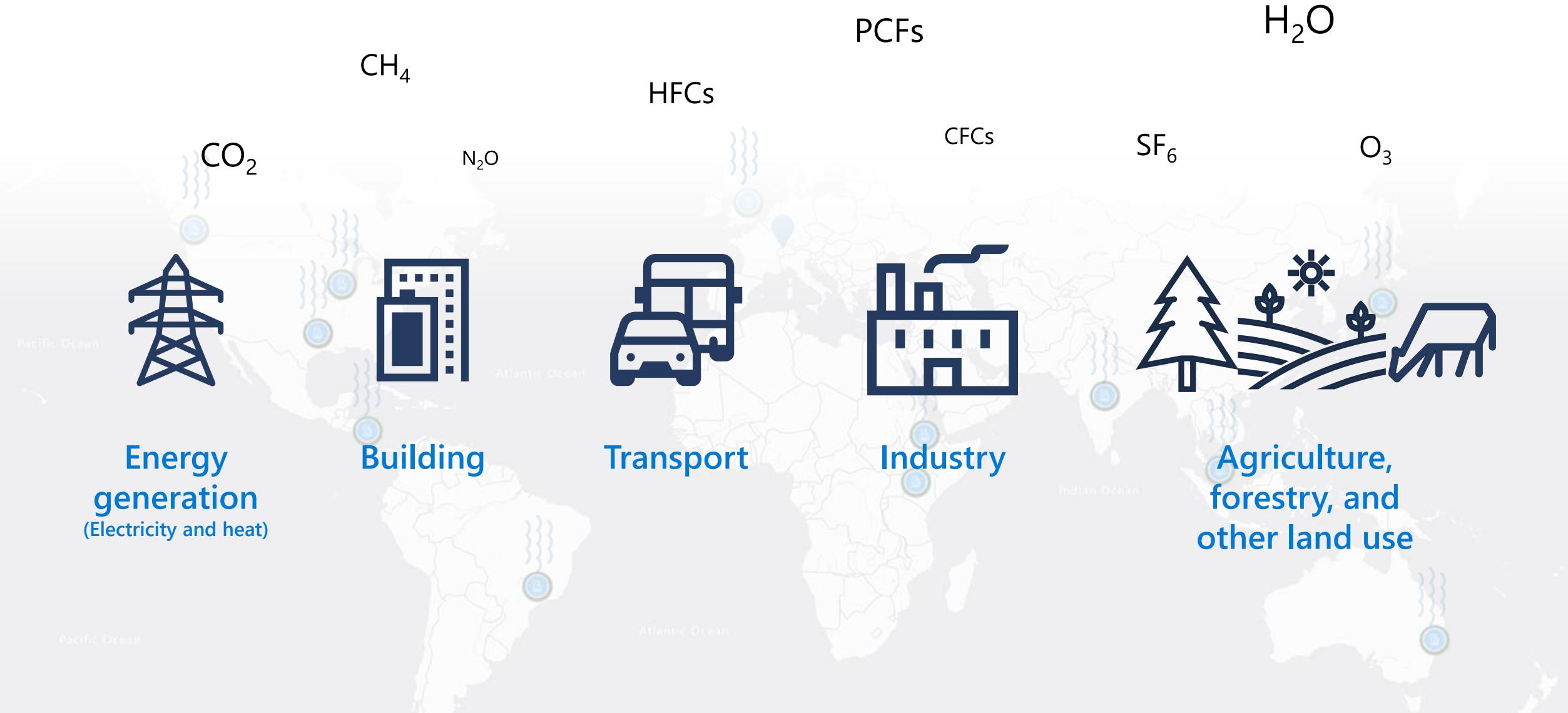
Greenhouse gases (GHGs) trap heat from the sun inside Earth's atmosphere

Human activities release more carbon dioxide (CO_2) into the atmosphere than ecosystems can recycle

Trapped heat causes climate change



Sources of emissions



Carbon dioxide equivalent (CO₂e)

A unified metric for multiple greenhouse gases

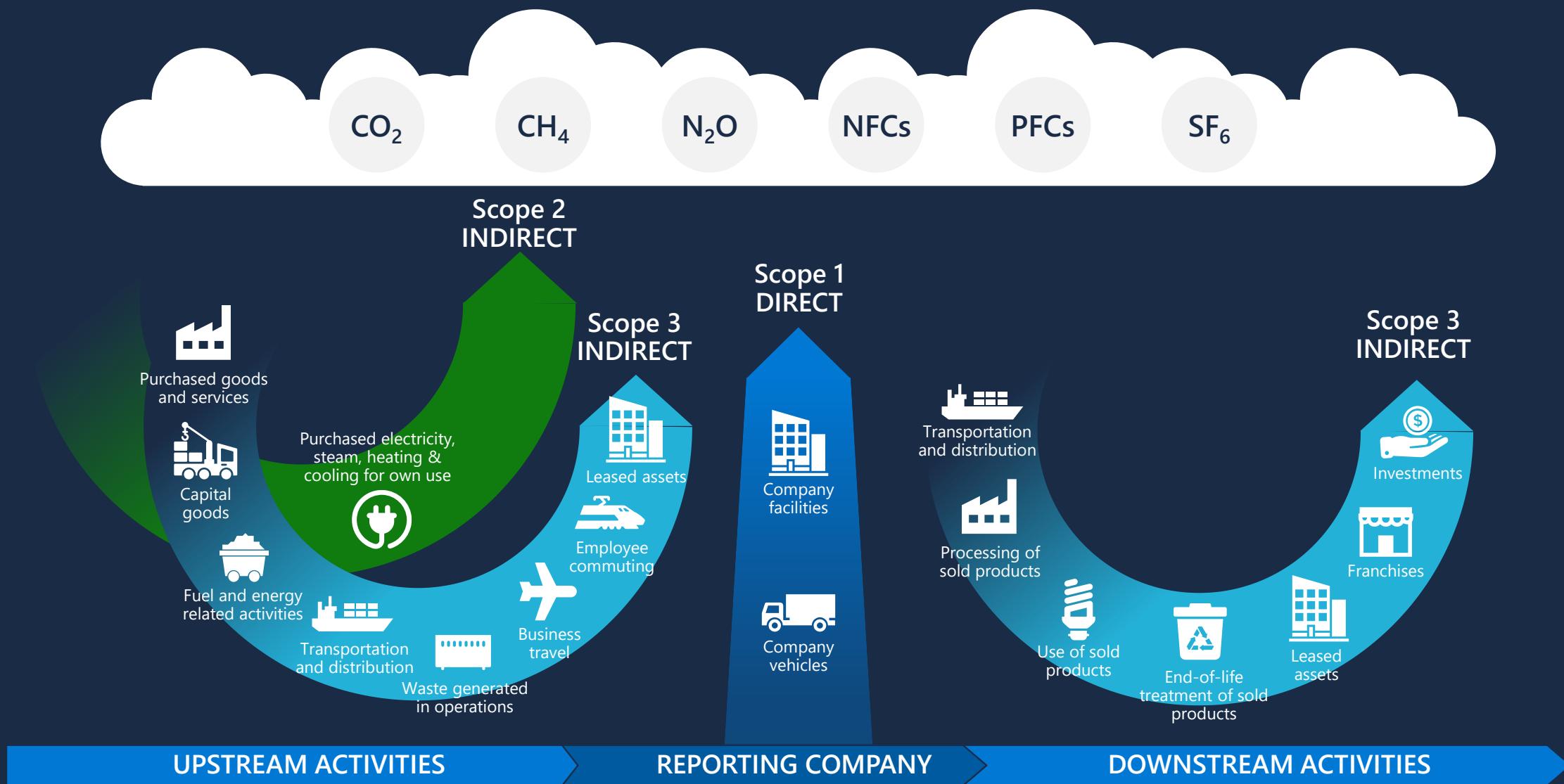
Different human-emitted gases cause global warming at varying intensities and timescales

- Carbon Dioxide (CO₂)
- Methane (CH₄)
- Nitrous Oxide (N₂O)
- Refrigerant Gases (HFCs, PCFs and CFCs)
- Sulphur Hexafluoride (SF₆)
- Water Vapor (H₂O)
- Ozone (O₃)

Global warming potential (GWP) is the potency with which each gas traps heat from the sun

Sustainability Manager uses GWP to convert an organization's multifaceted emissions into carbon dioxide equivalent (CO₂e)

Scopes and emissions across the value chain



Sustainability definitions

Greenhouse Gas Emissions (GHG) measurement

Scope

1



Direct emissions created by your activities, like exhaust from company vehicles or diesel generators

Scope

2



Indirect emissions from the production of electricity or heat you use to power buildings or processes

Scope

3



Indirect value chain emissions from all other activities in which you're engaged, including all parts of your supply chain, from materials in buildings, business travel, and product lifecycle to the electricity your customers consume

Carbon targets

Carbon neutral: A company becomes carbon neutral by reducing their emissions and/or paying others to not emit an equivalent to their remaining emissions.

Carbon net zero: An organization is considered net zero carbon when it removes as much carbon as it emits.

Carbon negative: A company is carbon negative when it removes more carbon than it emits each year.

For more information, visit ghgprotocol.org or watch the Microsoft [carbon math video](#)

What is Green Cloud Computing?

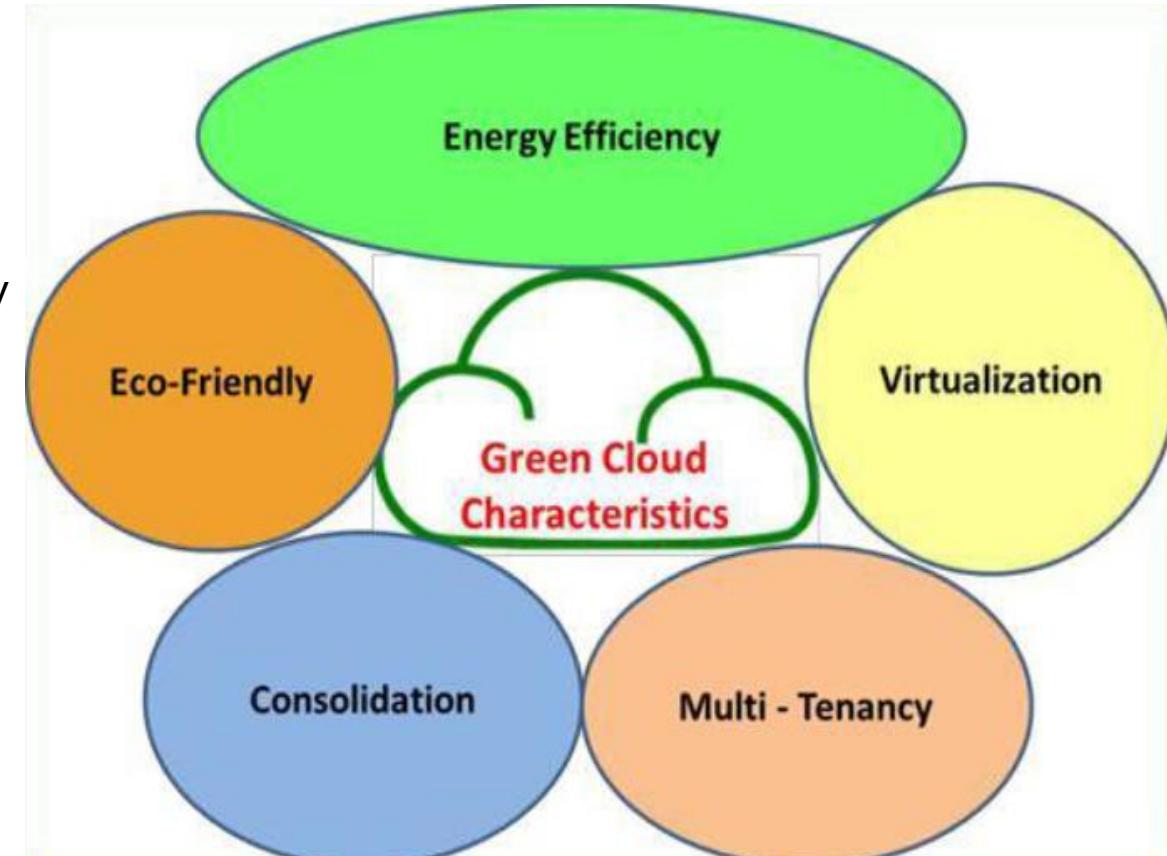
Enter Green Cloud Computing....

- Green Cloud Computing is a sustainable form of cloud computing that aims to reduce the energy consumption and cut down carbon emissions accordingly, reducing the negative consequences on the environment.
- Green Cloud Computing aims to
 - Encourage the recycling or biodegradability of outmoded items and industry waste by decreasing the usage of hazardous compounds and enhancing energy efficiency throughout the product life cycle.
 - A key goal is to lower the data center's power consumption. This means using fewer resources to do the same level of computation and spending more energy on running the IT equipment than cooling the environment where the equipment resides.
- Green Cloud Computing not only provides effective processing and infrastructure usage but also saves energy.
- This concept ensures that the future growth of cloud computing doesn't affect the environment on a large scale.

Techniques

How is Green Cloud Computing achieved?

- Green Cloud Computing has features like online monitoring, virtual machine migration, and visibility placement.
- Green Cloud Computing techniques can be used for many purposes such as allocating resources and improving the performance of communication protocols.
- Common approaches include generating electricity using renewable sources, managing power consumption, and cluster computing.
- When counting cloud emissions, all aspects must be taken into account, like instance type, chip brand, cloud provider, and geographic region.



Techniques

Common Green Cloud Computing practices:

Virtualization

- Improves machine management and energy efficiency through sharing a single physical instance of a resource/application with multiple customers or organizations at the same time.
- It not only allows for better monitoring and resource allocation but also protects the environment by maximizing the number of accessible resources in an environmentally responsible manner.
- Deployment of virtual technologies is a key Green Cloud Computing approach.

Dynamic Voltage Frequency Scaling (DVFS)

- A strategy for lowering processor power and energy usage that's combined with frequency scaling, a technique where dynamic control of the voltage and frequency is adopted.
- DVFS minimizes data center energy usage and maximizes resource use.

Nano Data Centers (NaDa)

- A computing platform that uses internet service providers (ISP)-controlled home gateways to offer computing and storage services.
- More energy-efficient than conventional data centers, NaDAs help reduce the cost of heat dissipation, have high service proximity, and the capacity for self-adaptation or self-scalability.

Techniques

Other sustainable options include:

Alternative cooling methods/
recycling heat

- The servers inside of data centers generate a lot of heat and that heat is typically not recycled. Solutions to improve power consumption include:
 - Locating data centers in places with free cooling (cold air, sea water, etc.).
 - Reusing the heat in areas with heating needs, such as nearby offices or residences.
 - Supplementing the center's power with solar panels, to reduce grid demand.

Carbon-aware job/workload scheduling

- The amount of carbon dioxide (CO₂) emitted by electricity grids varies by time of day and location.
- Job scheduling during less carbon-intensive times is a key way to lower grid emissions.

Reducing CPU Power Dissipation

- Multi-core technology enables the processing of higher loads using less power.
- Most CPUs have power-management features that optimize power consumption by dynamically switching among multiple performance states based on utilization.

Challenges

But Green Cloud Computing is not without challenges



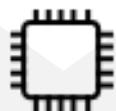
- While cloud computing brings a number of benefits, traditional data centers must be reinvented for zero waste and greater efficiency in order to achieve this.



- Until a few years ago, very few cloud customers had the means of measuring, understanding, or managing their true contributions.
- It takes time for results and benefits of Green Cloud Computing to be visible.



- A principal limitation is the high cost of the components required to make cloud computing more efficient.
- Maintenance of the devices included in the data center is another limitation.



- Additional disadvantages include:
 - Challenges adapting to evolving technology
 - Green computers may be considered underpowered

Industry Efforts - Microsoft



- In 2022, Microsoft was the fourth biggest buyer of renewable energy globally, totaling 1.3GW.
- Microsoft has outlined a vision to run its Azure Planetary Computer, a research effort that allows monitoring of ecosystems by providing computing capabilities and expert advice to NGOs and academics, and its 4 million servers using entirely zero-carbon sources, including hourly matching of renewable energy. It will work with utilities and industry partners to “lay the groundwork for a decarbonized grid.”
- The company also outlined plans to deploy “circular centers” to boost the recycling and reuse of IT components and create zero-waste data center campuses.
- Microsoft uses machine learning to improve the efficiency of its data center infrastructure. It also runs a grant program that provides cloud computing credits for researchers working on climate-related issues.
- The company is leading the way on transparency for its cloud customers. An Emissions Impact Dashboard has been introduced to reduce the environmental impact of businesses by simplifying its reporting and introducing sustainable processes.
- The Microsoft Cloud for Sustainability, launched in 2021, is an offering aimed at enabling companies to more easily and effectively record, report, reduce, and replace their emissions.
- By 2030, Microsoft will have 100% of its electricity consumption, 100% of the time, matched by zero carbon energy purchases, which may also encompass nuclear and carbon-capture, expanding on its previous goal of buying enough renewable energy to match its needs by 2025.¹

SUPPORTING OUR CUSTOMERS ON THE PATH TO NET ZERO

Datacenters are the compute engine of the cloud

7.8 gigawatt
renewable energy
procured globally to date

renewable energy
around the globe



remove CO₂
100/100/0
commitment



We are building
strategies, solutions, and
partnerships that put the
power of our technology
to work on the planet

Microsoft Cloud
for
Sustainability

RECORD
REPORT
REDUCE
carbon emissions

We can truly
make an outsized
impact on climate
change leveraging
the power of
technology!



carbon
negative
incredibly
Herculean task

Become

zero
waste
achieve and renew Zero
Waste certifications

water
positive

We will reduce water use in
our evaporative cooled
datacenters globally by 95%
by 2027*

Innovate how we build and operate
datacenters



two-phase liquid
immersion cooling



Advance waterless
cooling technologies

Reduce reliance on
diesel backup power

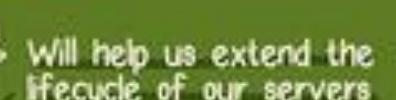


hydrogen fuel cell
backup power

Reduce embodied carbon
in construction



explore carbon-storing materials
such as algae and mycelium
(mushroom)



Will help us extend the
lifecycle of our servers.
83% reuse and 17% recycle of critical
parts while reducing carbon emissions
by 145,000 metric tons CO₂ equivalent

Provide more renewable,
reliable energy to the grid
grid-interactive uninterrupted
power supply

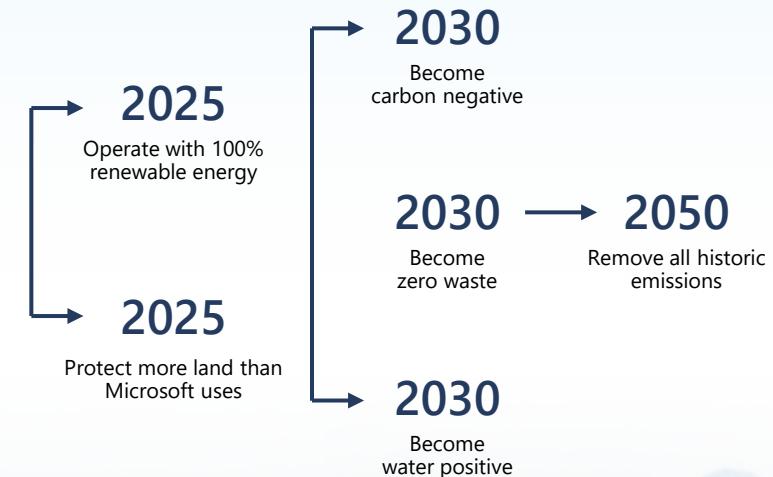


Microsoft's Sustainability Journey - Decades of action

Our history



Our commitments



Tool sets

Solutions

Internal systems

Data intelligence accelerates sustainability progress



Create efficiencies
in your spaces and
processes



Facilitate supply
chain transparency



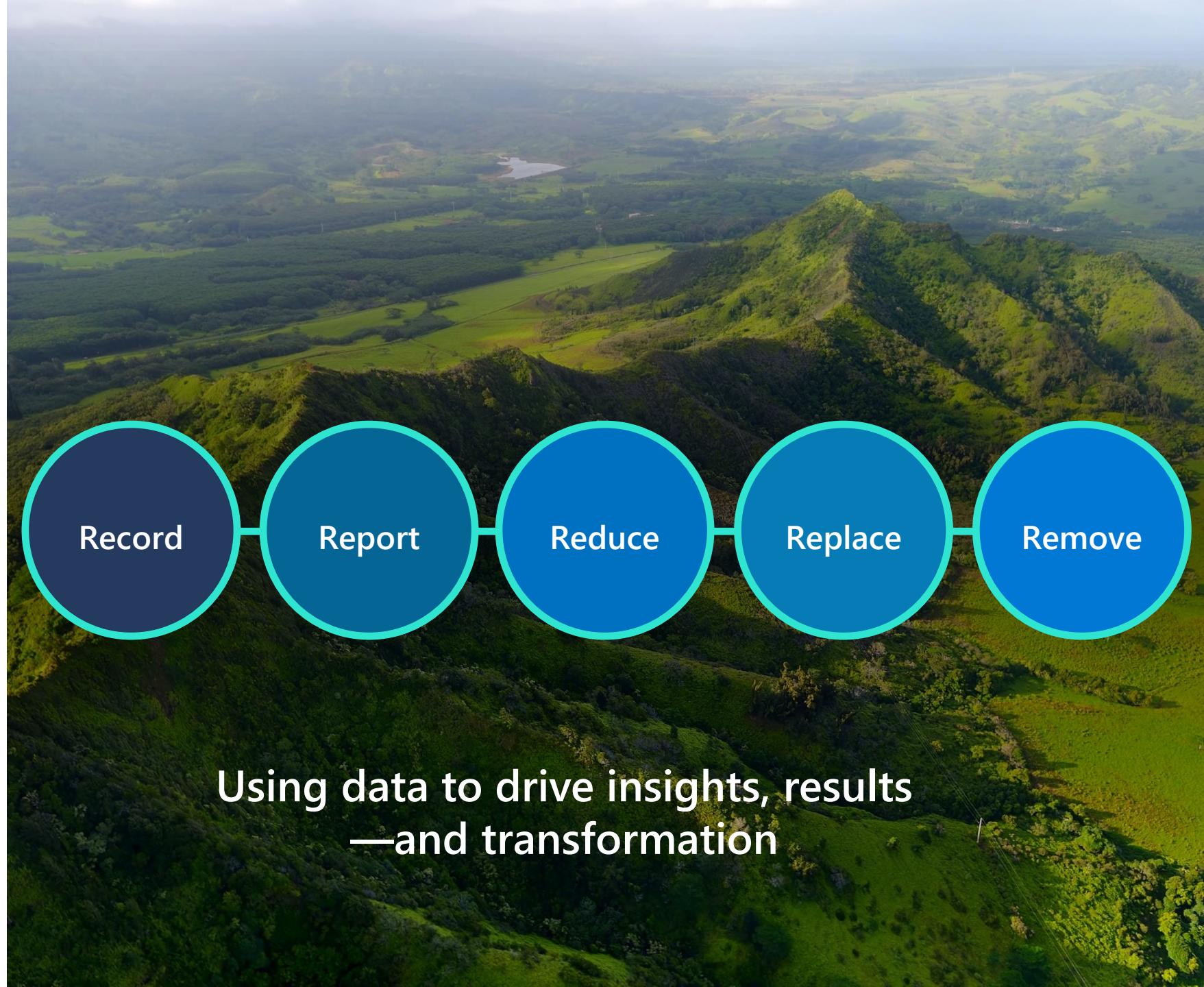
Support reuse and
repurposing of
materials and
products



Shift to
clean energy



connected journey





Record data



Automate data collection



Break down data silos with Common Data Model (CDM)



Calculate emissions across scopes



Generate more accurate results



Report insights



Visualize your impact
in near real time



Track your performance
against goals



Gain actionable insights
to maximize progress



Share results with
stakeholders and agencies



Reduce your footprint



Set and track
sustainability targets



Develop a roadmap
based on data



Use analytics to improve
reduction activities



Reimagine fundamentals
and drive lasting change



Microsoft Cloud
for Financial Services



Microsoft Cloud
for Healthcare



Microsoft Cloud
for Manufacturing



Microsoft Cloud
for Nonprofit



Microsoft Cloud
for Retail



Microsoft Cloud for Sustainability

Microsoft Cloud



Modern
work



Business
applications



Infrastructure



Digital and
app innovation



Data & AI



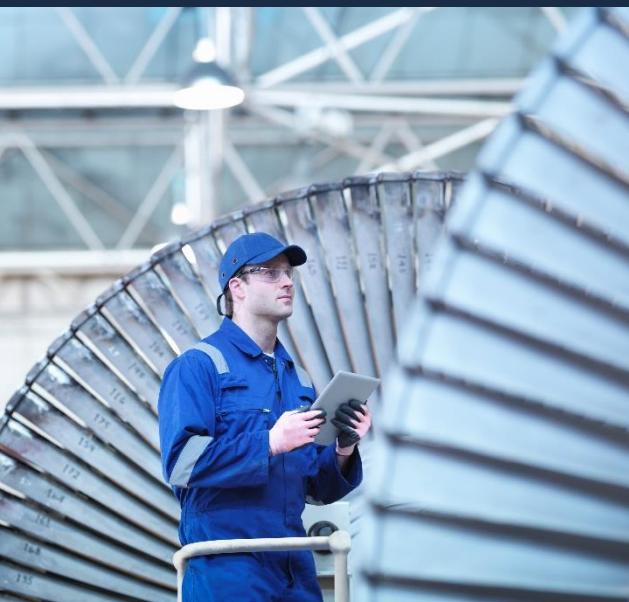
Security

The most trusted and comprehensive cloud

Microsoft Cloud for Sustainability accelerates sustainability progress and business growth



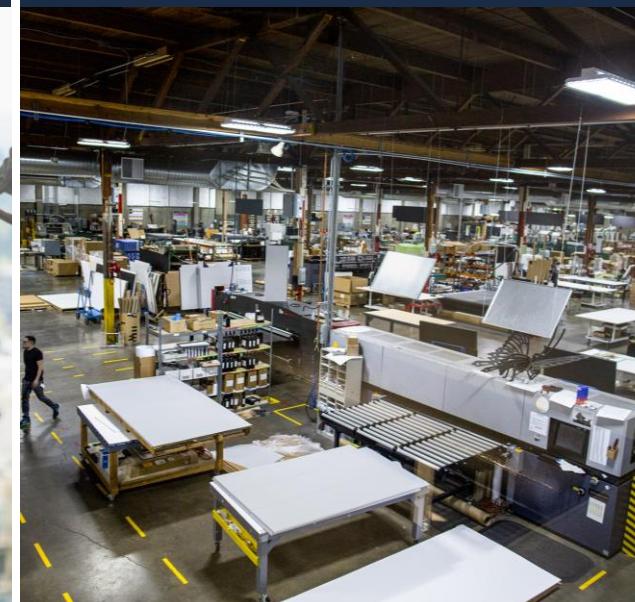
Unify data
intelligence



Build a sustainable
IT infrastructure



Reduce environmental
impact of operations



Create sustainable
value chains



Solution view

