

Java sustainability on Microsoft Azure

OpenTour 2023

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Topics

- Why do we need to think of IT sustainability
- Java and Sustainability
- Microsoft Azure Sustainability
- Gains from Java Modernisation
- Customer examples
- Where do we go from here?

Azure Red Hat OpenShift

A jointly supported, turnkey application platform native to Azure.



Focus on innovation

Simplify operations so your teams can refocus on innovation, not managing infrastructure.

Accelerate time to value

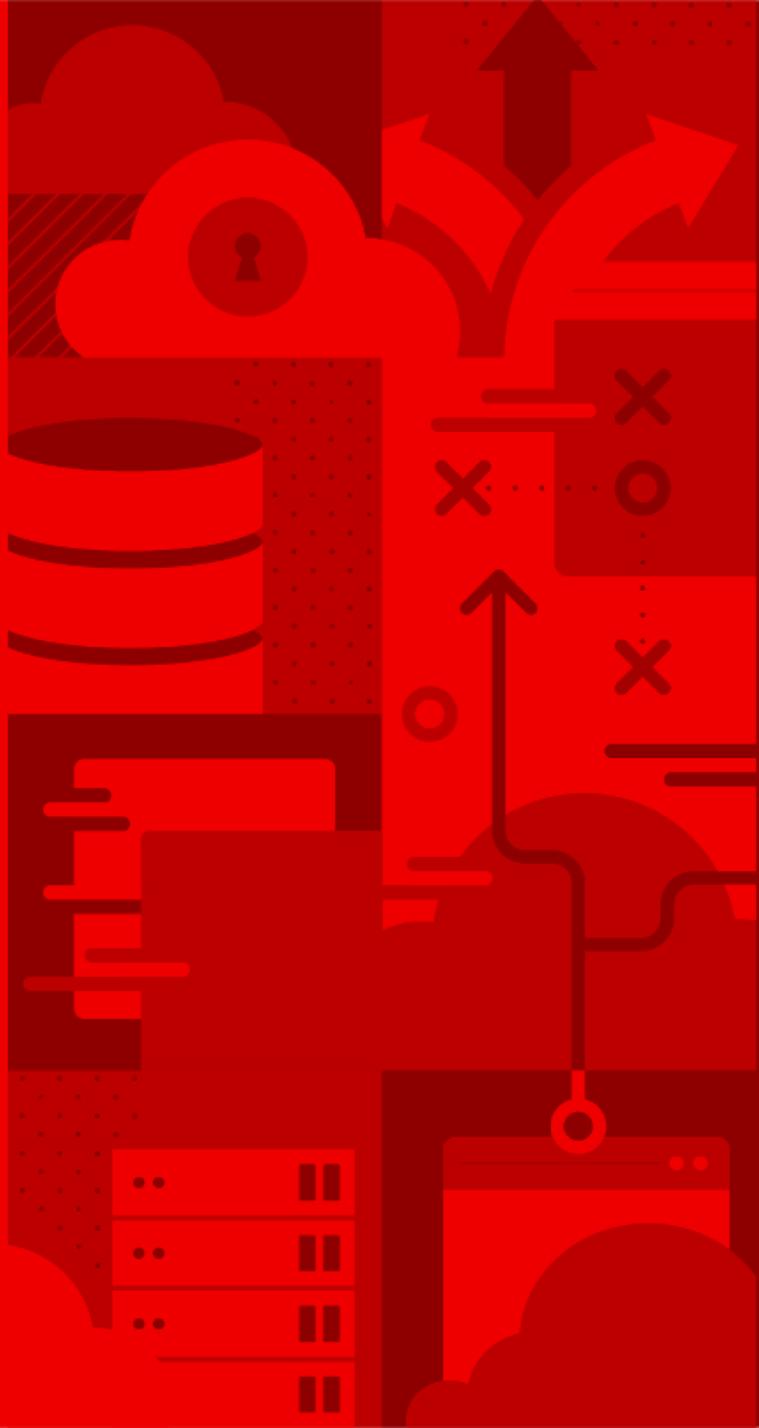
Quickly build, deploy, and manage applications that scale as needed.

Hybrid cloud flexibility

Deliver a consistent experience on premises and in the cloud.

Operational efficiency

Enhance operational consistency, efficiency and security by proactive management and support



Why do we need to think of IT sustainability?

Climate change - Our most significant challenge ahead

What is the risk?

- Climate action failure - is the number 1 risk over the next decade*
- We are on a spiral downwards if we do not do anything now
- Impossible to sustain life as we know it over time on Earth

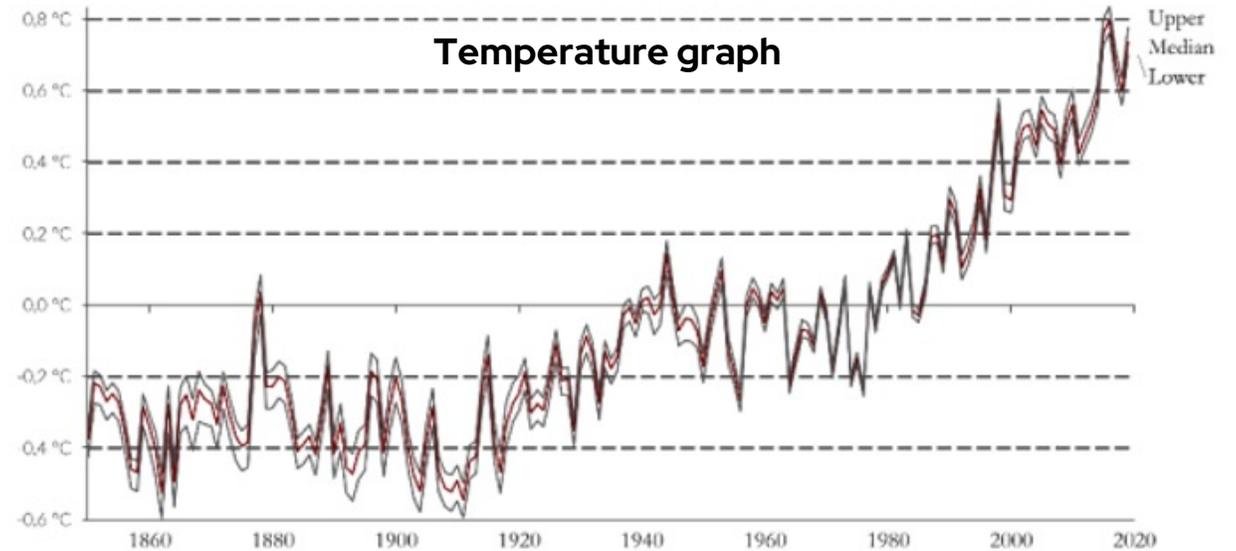
How did we get here?

- 4th Industrial revolution - "The age of Software" (started around 2011)
- Climate change is caused by human emissions of Co2,
 - ◆ GreenHouse Gasses (GHG),
 - ◆ Overpopulation,
 - ◆ Increased loss of biodiversity,
 - ◆ Exploration of earth metals
 - ◆ Increased waste

How are we impacted globally?

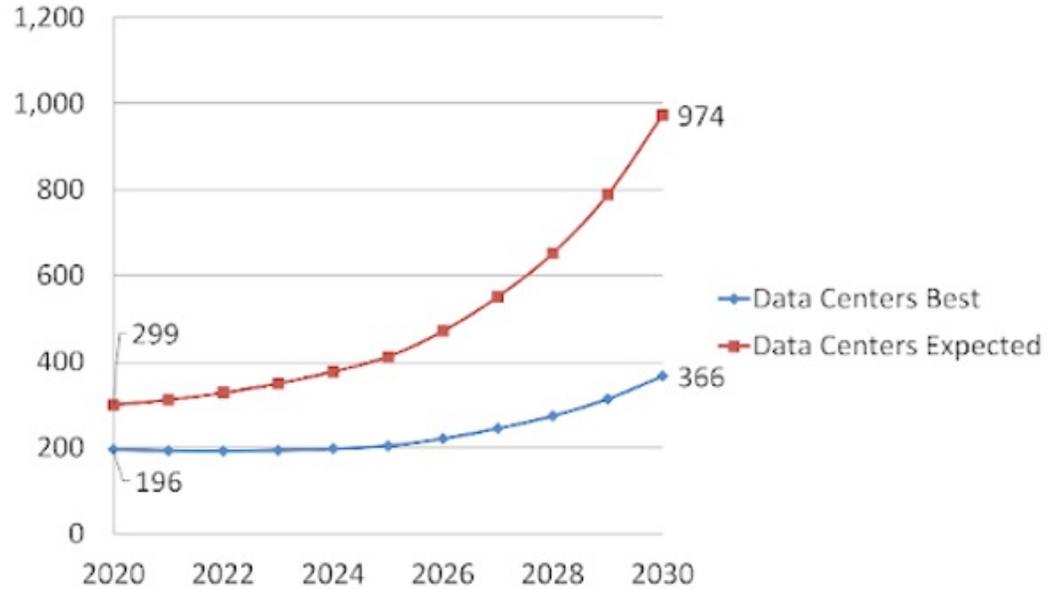
- Extreme heat / heat trapping
- Cold where it was not before
- Massive precipitation (rain)
- Drought
- Wildfires

**Resulting in devastated lives,
economic downturns regionally
and more**

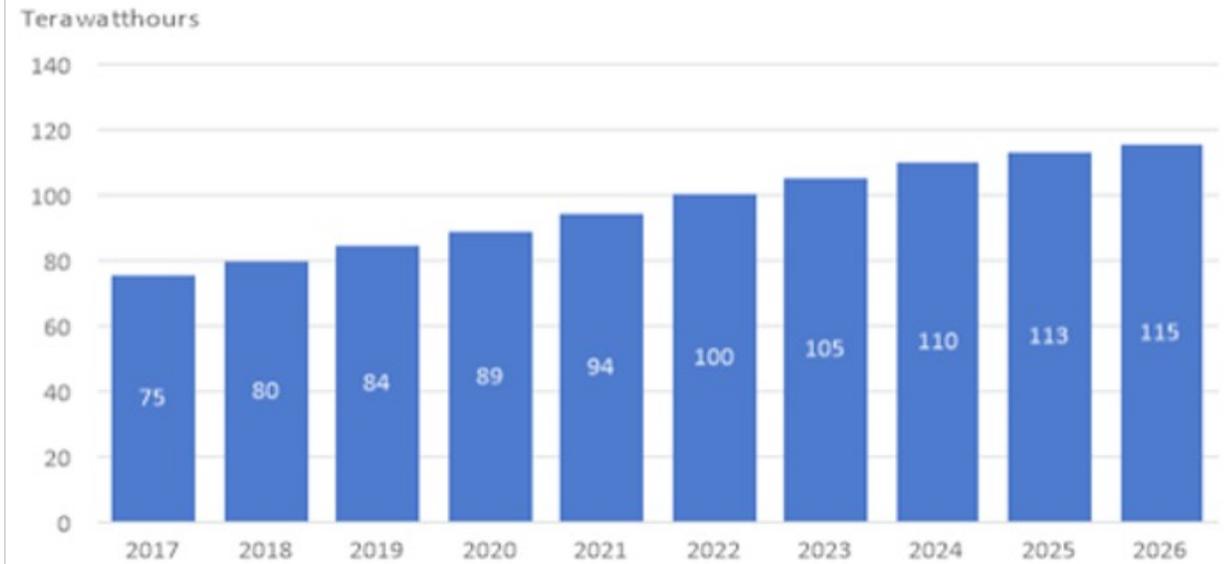


Energy consumption & emissions

Electricity usage (TWh) of Data Centers 2020-2030



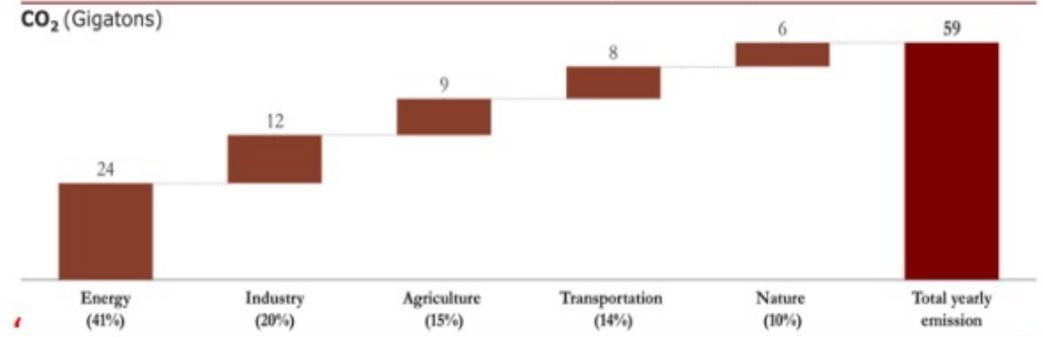
Estimated Power Used by All Types of Datacenters in Europe





1-2% of the world's energy
is consumed by data centers

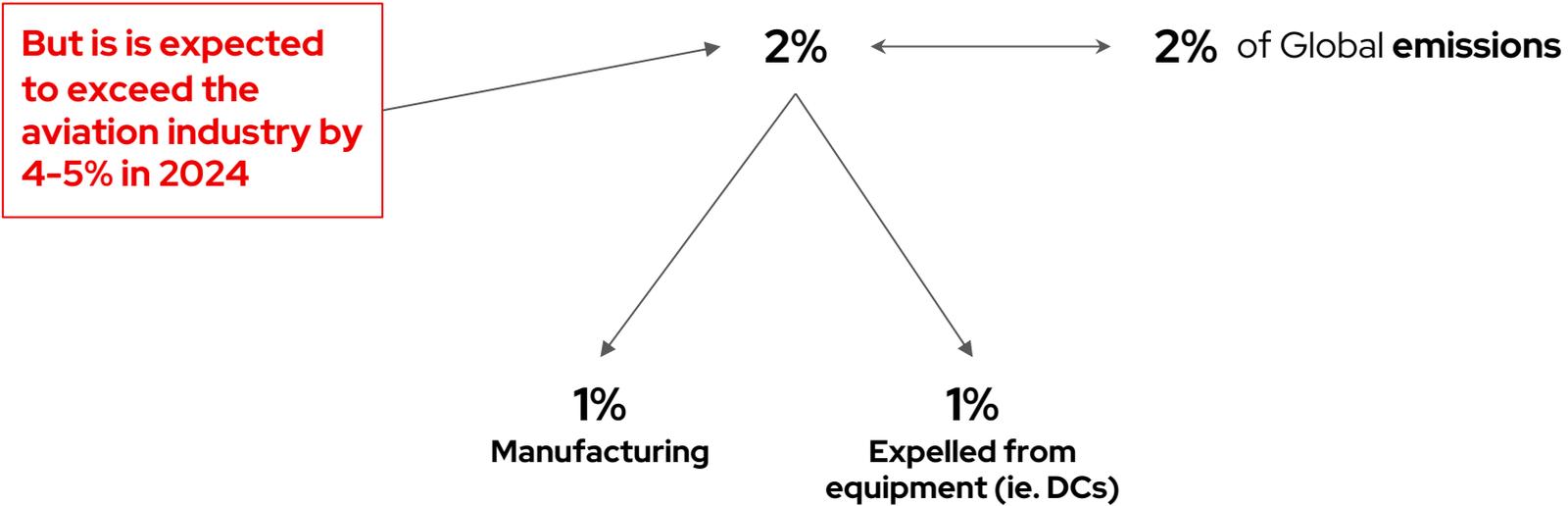
2021 - total CO2 emissions per year globally



Global IT industry emissions

Global IT industry

Global IT industry = Global Aviation industry



Looking ahead

Technologies & Trends predicted to impact our Carbon footprint

- Artificial Intelligence / LLMs (ie Chat4Gpt)
- Online presence / Metaverse
- Robotics / Process automation
- IOT / exponential growth in connected devices
- Hyper connectivity
- Crypto
-

Corporate sustainability

Shift towards a broader spectrum of stakeholders; Employees, Customers, Partners, Ecosystems and communities... in addition to the shareholders

Putting it directly → Companies are faced with the ultimatum; **Innovate or Die**

Four main drivers for Enterprise to invest in Sustainability



Java and Sustainability

What is Java / Why Java

80%

of worldwide enterprises run Java on Desktop, Server, Cloud

3 Billion

Active Java Virtual Machines globally

#1

Developer choice for cloud

12 Million

Developers run Java

May 2023	May 2022	Change	Programming Language	Ratings	Change
1	1		 Python	13.45%	+0.71%
2	2		 C	13.35%	+1.76%
3	3		 Java	12.22%	+1.22%
4	4		 C++	11.96%	+3.13%
5	5		 C#	7.43%	+1.04%

Top 3
programming
language

Traditional Java designed for a different time



Traditional

- ▶ **Throughput** at the expense of **footprint**
- ▶ **Long running** at expense of **startup speed**
- ▶ Rich, dynamic behavior for mutable systems



Cloud Native

- ▶ **Throughput** solved by horizontal scaling
- ▶ Ephemeral, immutable systems
- ▶ Footprint and performance matter

What is the consequence?

“**Tumble dryer**”-effect (not fit / too big for purpose)

+



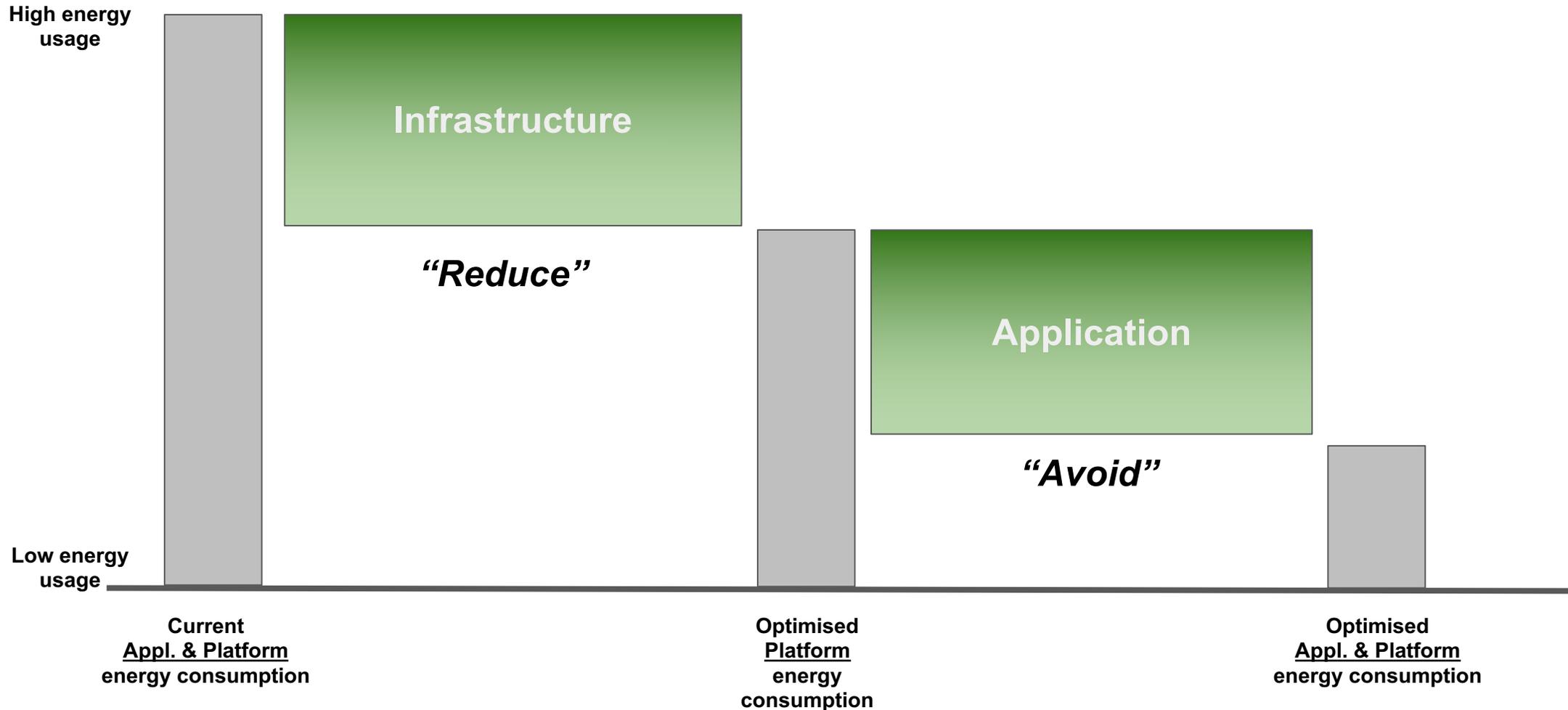
“**Light bulb**”-effect (always on)

= unnecessary
economical cost, sustainability cost, people
cost

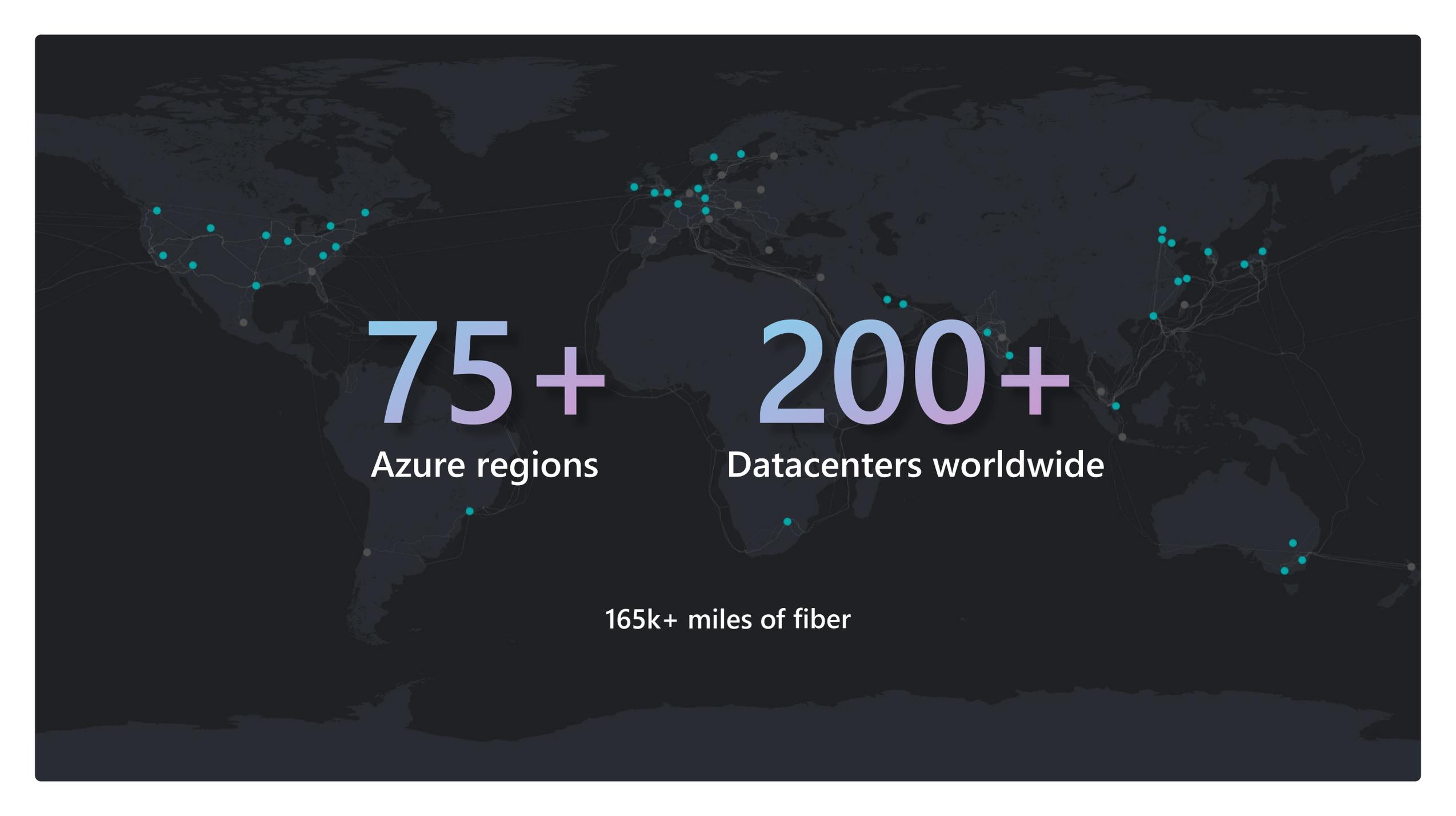


→ **We need to look our own IT set up, have simple mental pictures and start calculating the consequences**

Efficiency Gains from Infrastructure and Application Optimization



Microsoft Azure sustainability

A dark-themed world map showing a network of data centers. The map is overlaid with a network of light blue and white lines representing fiber optic connections. Numerous small dots, some in light blue and some in light purple, are scattered across the map, indicating the locations of data centers. The text is centered over the map.

75+

Azure regions

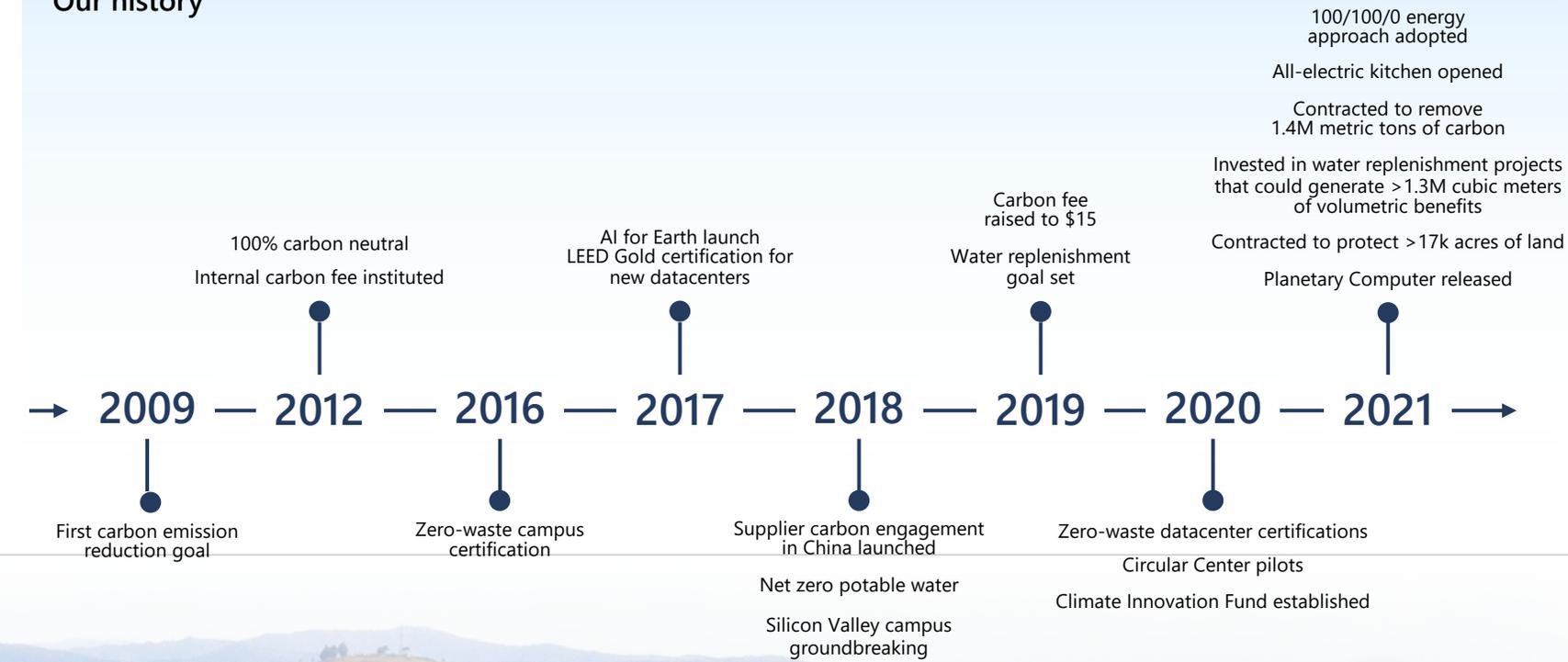
200+

Datacenters worldwide

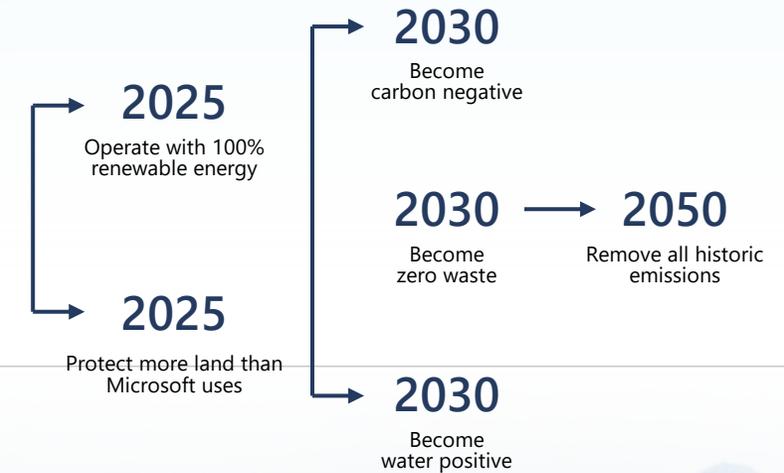
165k+ miles of fiber

Decades of action

Our history



Our commitments



Tool sets

Solutions

Internal systems

Our FY21 emissions

SCOPE 1

Direct emissions
(campus fleet emissions, on-site fossil fuel usage, etc.)

0.1M mtCO₂e

SCOPE 2

Indirect emissions (purchased electricity, heat, etc.)

0.2M mtCO₂e

SCOPE 3

All other emissions
Under Microsoft's influence
(supplier electricity usage, construction materials, shipping waste, campus and datacenter waste, etc.)

13.8M mtCO₂e



Business travel
0.02M mtCO₂e



Use of sold products
4.0M mtCO₂e

Purchased goods/services
4.9M mtCO₂e



Employee commuting
0.08M mtCO₂e



Transportation
0.3M mtCO₂e



Capital Goods
4.1M mtCO₂e



Decarbonizing our supply chain requires increased transparency

Microsoft suppliers are required to report scope 1, 2, and 3 greenhouse gas emissions

We're providing support for recording and reporting their impact, increasing efficiencies, and switching to renewable energy sources



Our **Supplier Code of Conduct** was updated to require emissions disclosures, now part of procurement processes

87 percent of Microsoft in-scope suppliers reported emissions to CDP in July 2021

We're delivering **tools and training** for supplier reporting and building new forms of financing for suppliers



Microsoft's vision is to be the leading platform provider of technology solutions to environmental challenges



Our progress



**1.4 million
metric tons
of carbon removal**



**12,159
metric tons
of waste diverted
from landfills**



**1 million
people reached
with clean water and
sanitation**



**12,270
acres of land
of biodiversity hotspot
protected**



**>600 MUSD
allocated
of impact investment in
Climate innovation fund**



2022 Environmental Sustainability Report

Enabling sustainability for our company,
our customers, and the world

[2022 Environmental Sustainability Report
\(microsoft.com\)](https://microsoft.com)

Microsoft carbon removal

Lessons from an early
corporate purchase

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[Microsoft Carbon Removal - Lessons
From an Early Corporate Purchase](#)

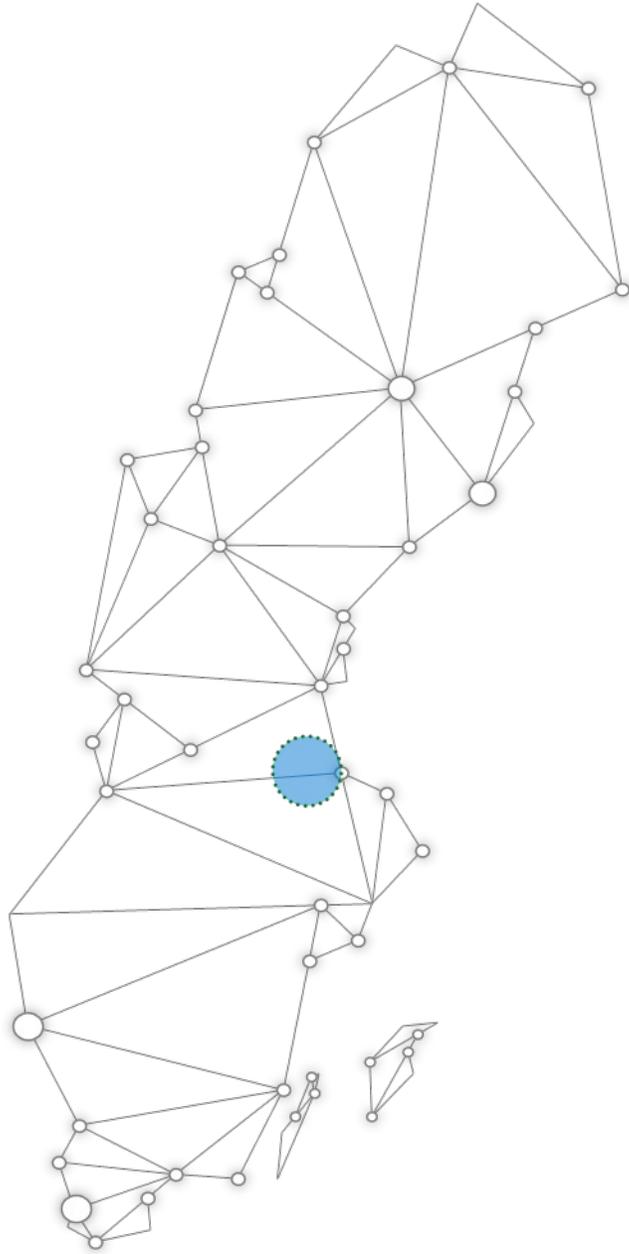
Microsoft Azure is more energy efficient



Up to 93%
more energy efficient



Up to 98%
more carbon efficient

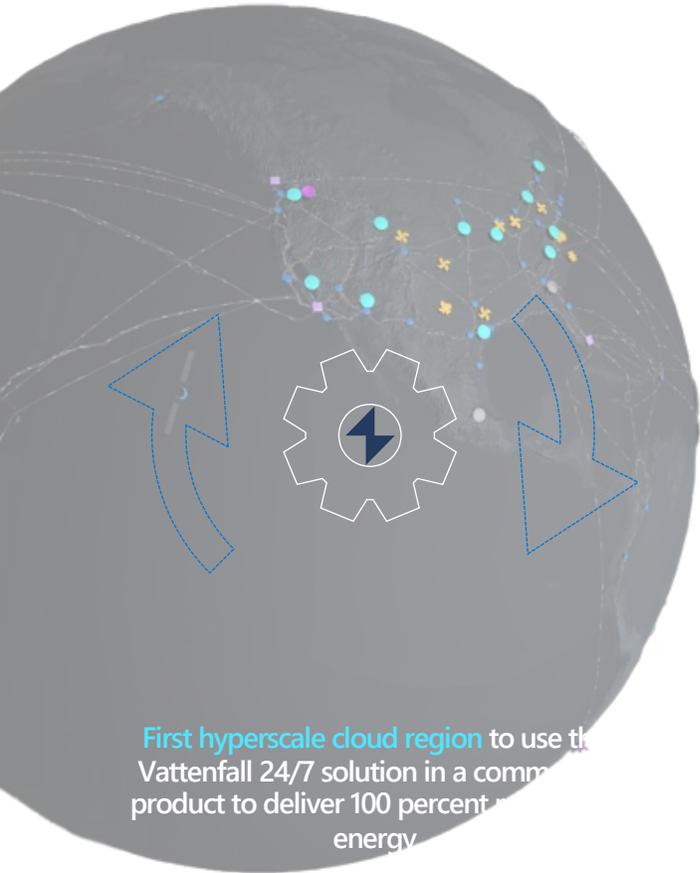


Sweden Central Datacenter Region

Regionen drivs med **100% förnybar energi** – Genom partnerskapet med Vattenfalls 24/7 lösning spårar och matchar vi energiförbrukningen, timme för timme. Genom ökad transparens och noggrannhet möjliggörs matchning av förnybar energi.

Sweden Central är den första regionen som ansökt om **zero-waste** certifikat. Det har möjliggjorts bl.a. på grund av våra Microsoft Circular Center, utformad för att förlänga servernas livscykel genom återanvändning och stödja en cirkulär ekonomi för Microsoft Cloud.

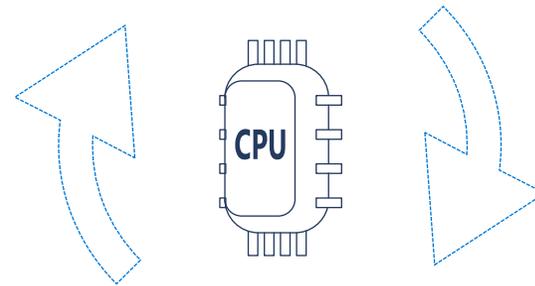
Microsoft's sustainability in Sweden



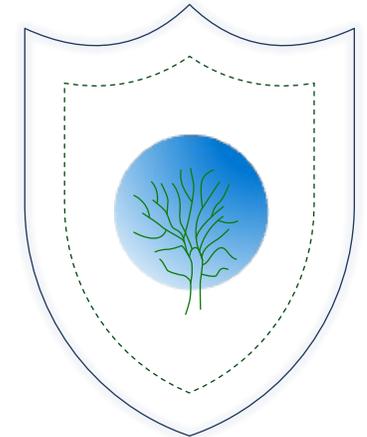
First hyperscale cloud region to use the Vattenfall 24/7 solution in a commercial product to deliver 100 percent renewable energy



Uses rainwater harvesting methods



12,000 servers per month
zero-waste certificate



a range of community projects

Uses free air cooling methods,

Using Preem's Evolution Diesel Plus for backup power,

percent reuse

83

#SkillUpSweden

Rainwater harvesting



Our datacenters in Gävle and Sandviken captures and reuses rainwater for cooling/humidification purposes

40%

Microsoft is committed to reducing water intensity by 40 percent by 2030, as measured in million gallons per year/megawatt (MGY/MW).



Learn more about Microsoft water conservation goals in our 2021 environmental sustainability report.

The three phases of water conservation and reuse in practice

01 Where water is captured or recycled at the datacenter:

Water discharged from cooling systems

Rainwater from the roof

Water from the air through atmospheric water generation

Water runoff from parking lots

02 How collected water is diverted and treated:

Filtered and treated at the onsite treatment plant for later use

Redirected via downspouts or other conduit to onsite storage tanks

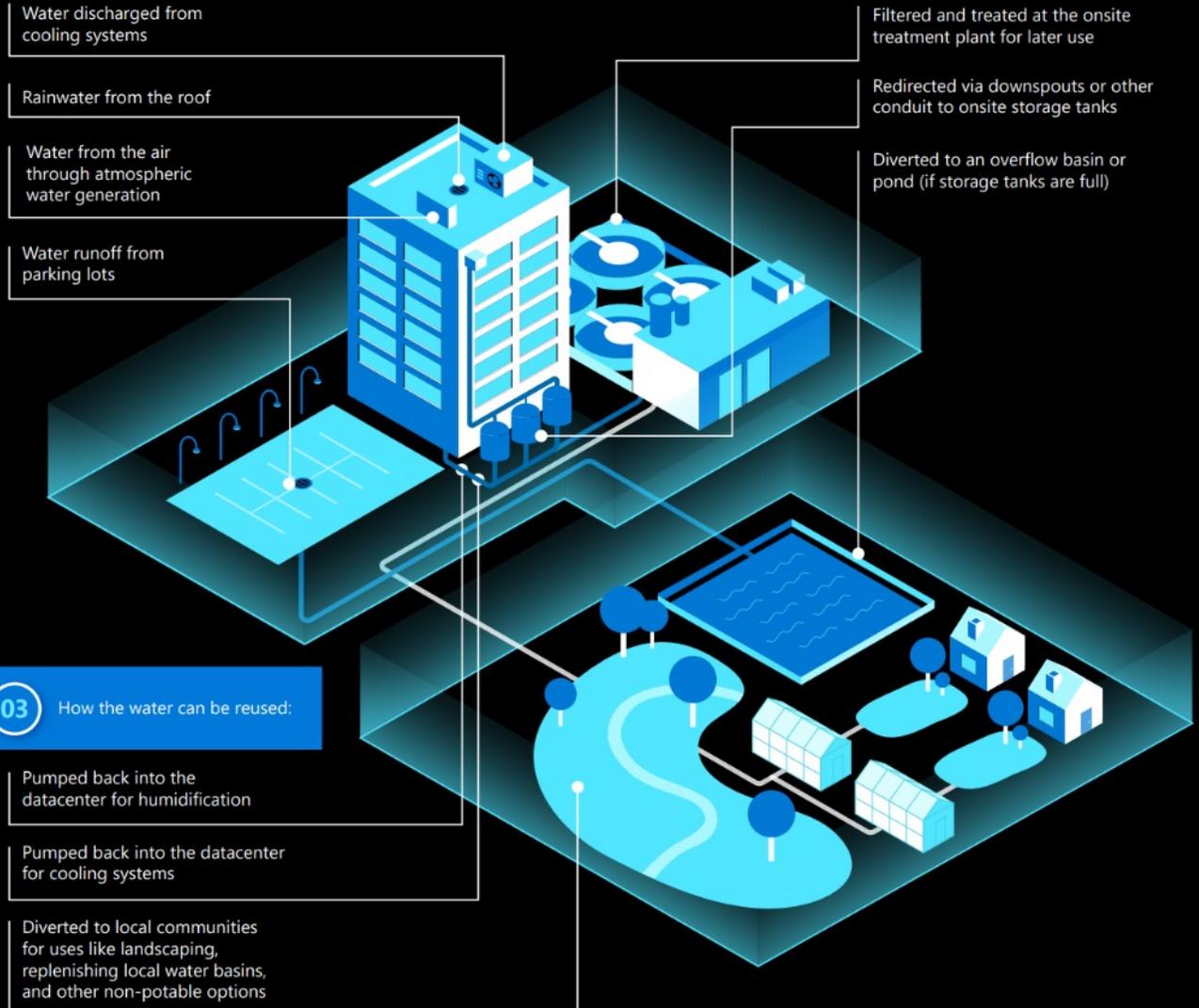
Diverted to an overflow basin or pond (if storage tanks are full)

03 How the water can be reused:

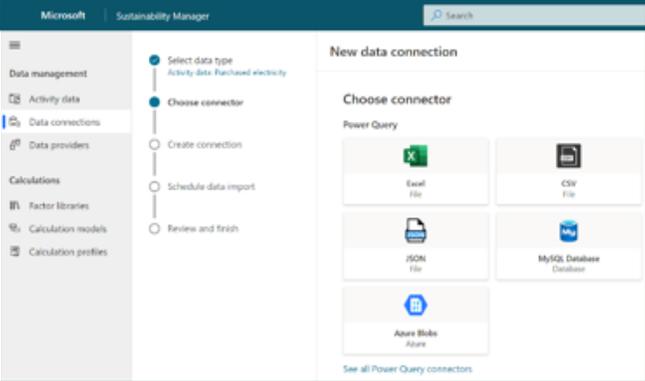
Pumped back into the datacenter for humidification

Pumped back into the datacenter for cooling systems

Diverted to local communities for uses like landscaping, replenishing local water basins, and other non-potable options

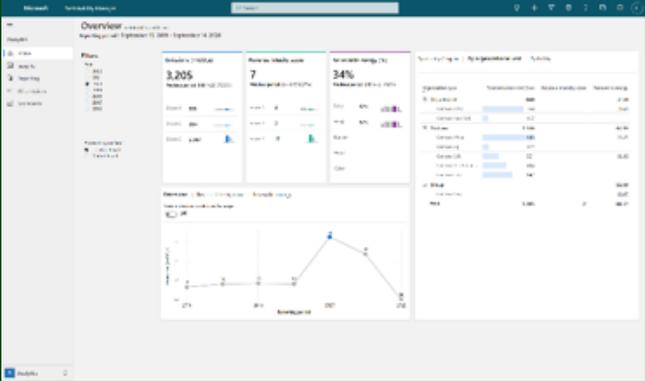


One platform for integrating and accelerating your journey



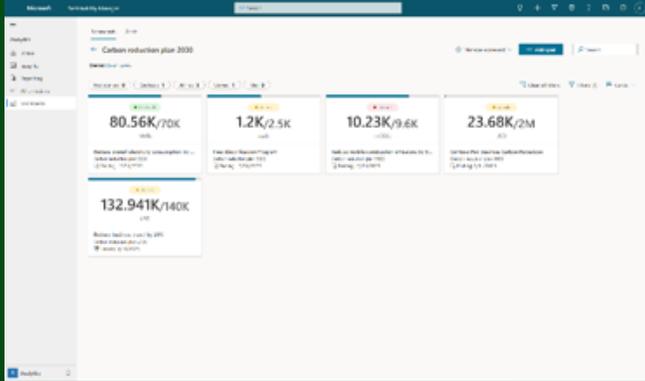
Connect your **data** and calculate your impact

RECORD



View data analysis and **insights**

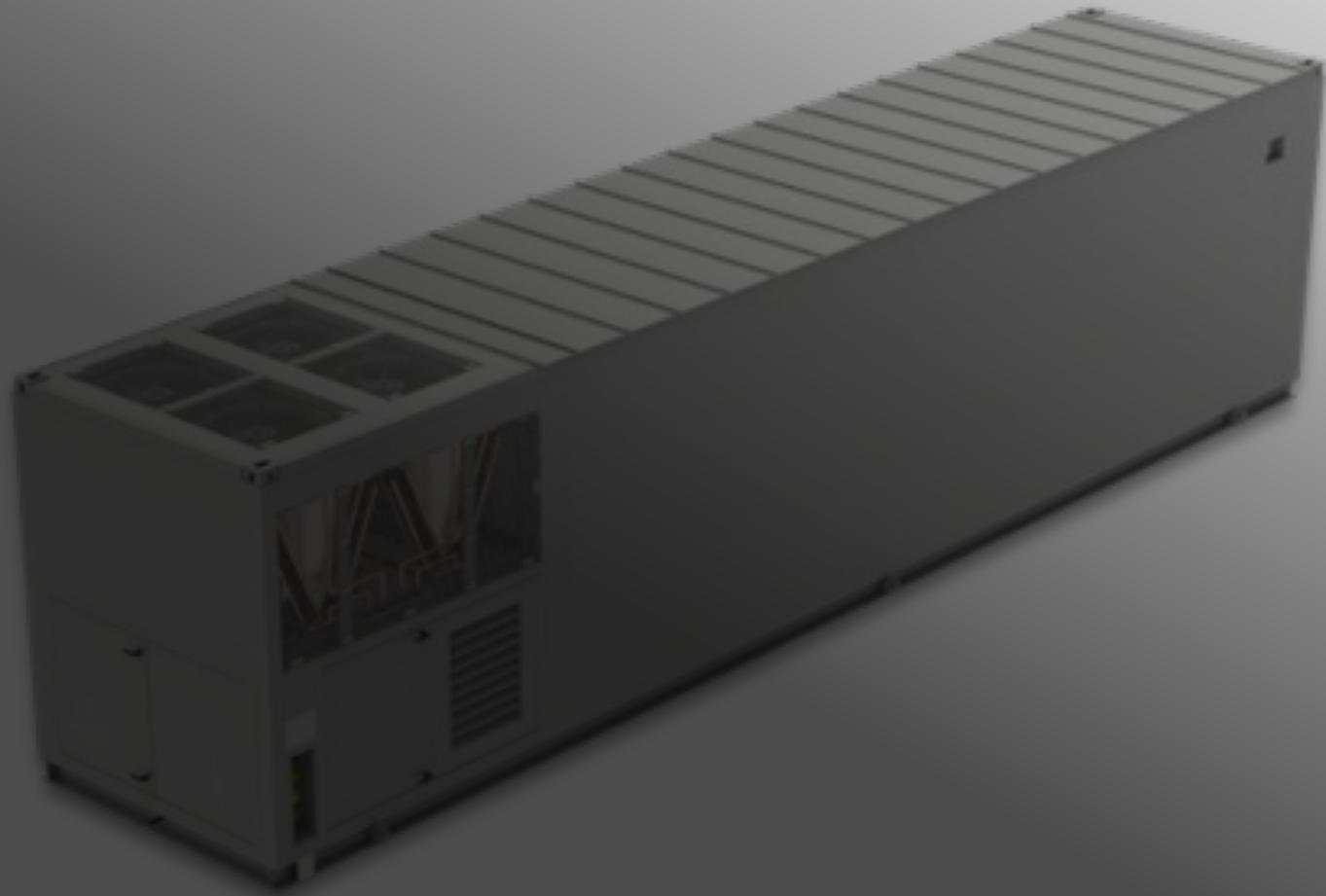
REPORT



Take **action** to accelerate your sustainability journey

REDUCE

Azure Modular Data Center

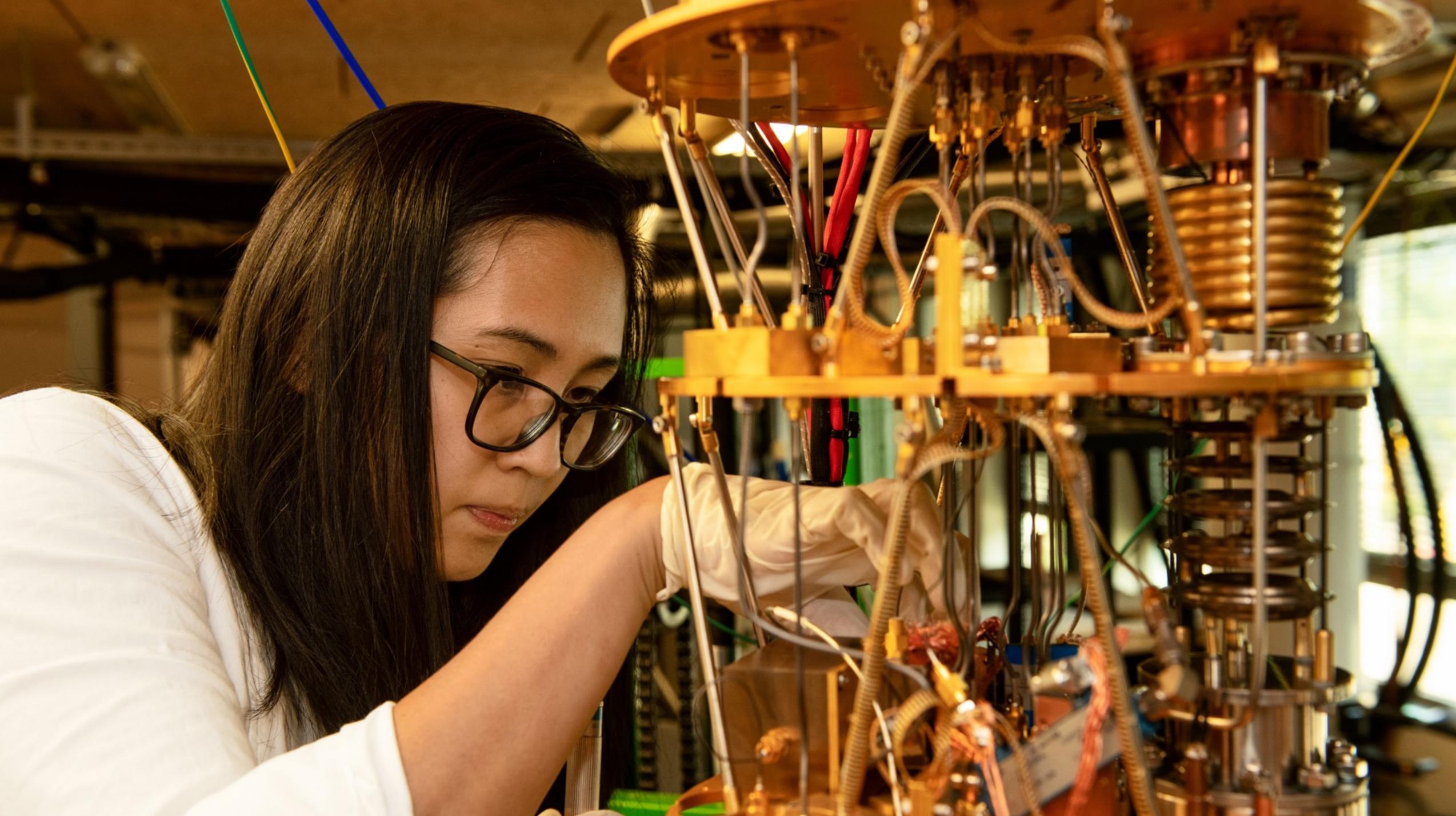


Liquid Cooling



Project Natick

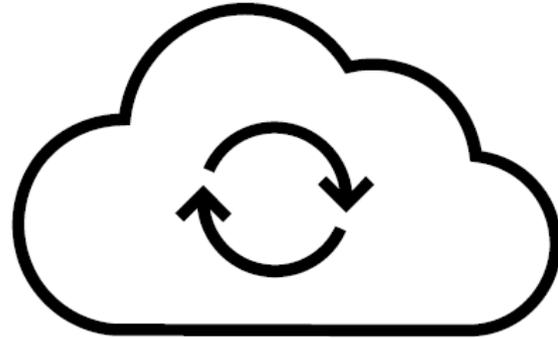




Sustainability is a Shared Responsibility

- Operate sustainably
- Deliver products and services that help customers operate sustainably

Vendor is responsible for offering sustainable products and services



Consumer is responsible for using technologies sustainably

- Select sustainable vendors
- Use products and services to achieve their own sustainability outcomes



Sustainability guidance

Plan your path forward, improve your sustainability posture, and create new business value while reducing your operational footprint.

[Azure Well-Architected Framework sustainability guidance](#)

[Azure Well-Architected Framework sustainability self-assessment](#)

[Azure Kubernetes sustainability guidance](#)

An underwater photograph showing a vibrant coral reef. In the foreground, there is a large, branching piece of yellowish-brown coral. The water is clear and blue, with sunlight filtering down from the surface, creating a bright, shimmering effect. A school of small, dark fish is swimming in the middle ground. The background shows more coral structures and the surface of the water with ripples.

Skilling initiatives

Build cloud skills and cultivate a culture of learning to help your teams navigate evolving sustainability requirements.

[Cloud Skills Challenge for Azure sustainability topics](#)

[Microsoft Learn Collection for Azure sustainability topics](#)

[Principles of Sustainable Software Engineering course](#)

SUPPORTING OUR CUSTOMERS ON THE PATH TO NET ZERO



Datacenters are the compute engine of the cloud

Microsoft Cloud for Sustainability

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

7.8 gigawatt renewable energy procured globally to date

renewable energy around the globe

reduce CO₂

remove CO₂

100/100/0 commitment

Emissions Impact Dashboard

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

RECORD
REPORT
REDUCE
↳ carbon emissions

Protect more land than we use

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 45,000 metric tons CO₂ equivalent

Provide more renewable, reliable energy to the grid

grid-interactive uninterruptible power supply

revitalize Circular Centers

renew

resources

restore

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 2024

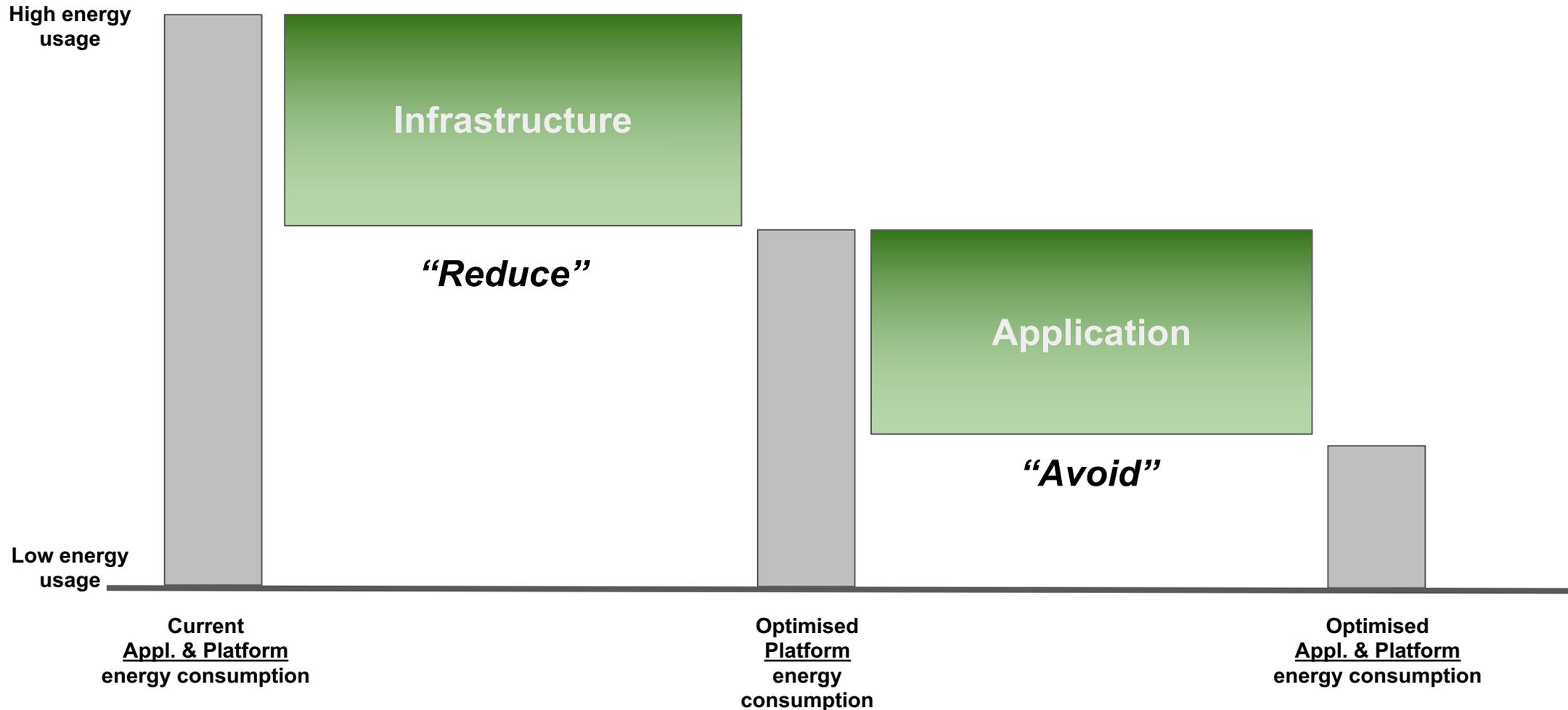
The SDGs address issues consistent with our mission to empower everyone

Our sustainable development focus areas



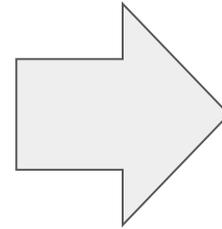
Gains from Java Modernization

Efficiency Gains from Infrastructure and Application Optimization



How do we solve it and get the benefits of modernisation?

“Tumble dryer”



“Light bulb”

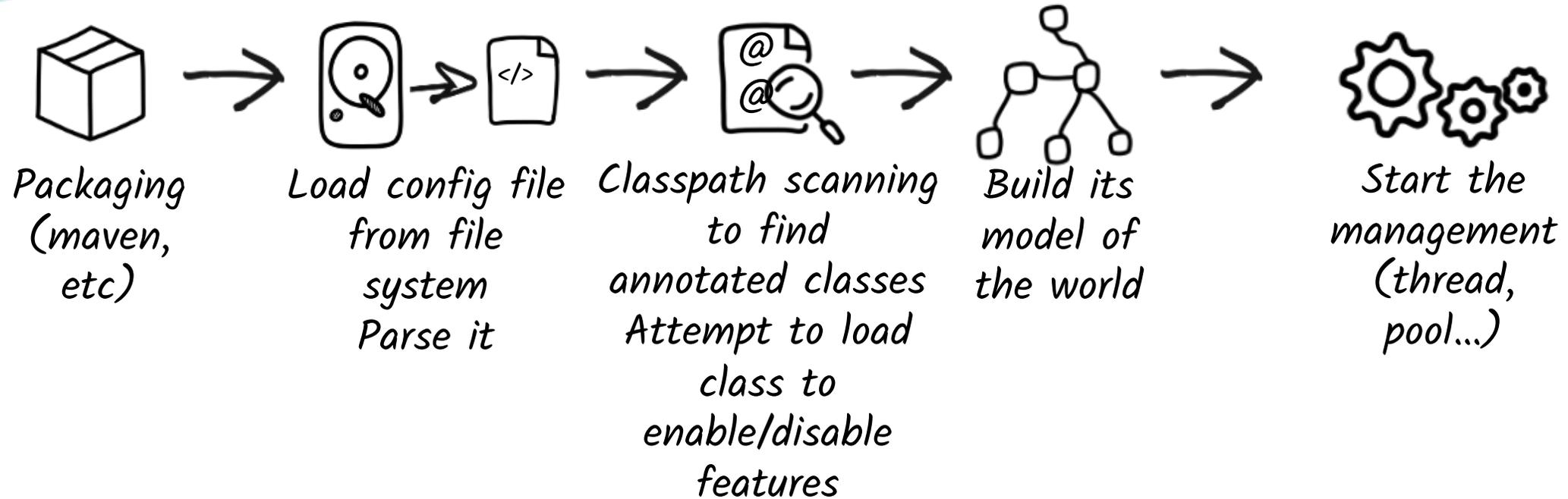


Let's focus on Java....

How does a traditional Java framework start?

Build Time

Runtime



How a Quarkus framework starts

Build Time

Runtime



Build Time

Runtime

What is Quarkus - A Java framework tailored for Kubernetes
deployments.



Supersonic, Subatomic **Java**

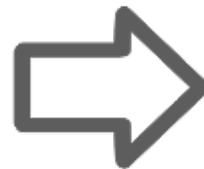
Fast.

Blazing fast to start.

Millisecond fast!

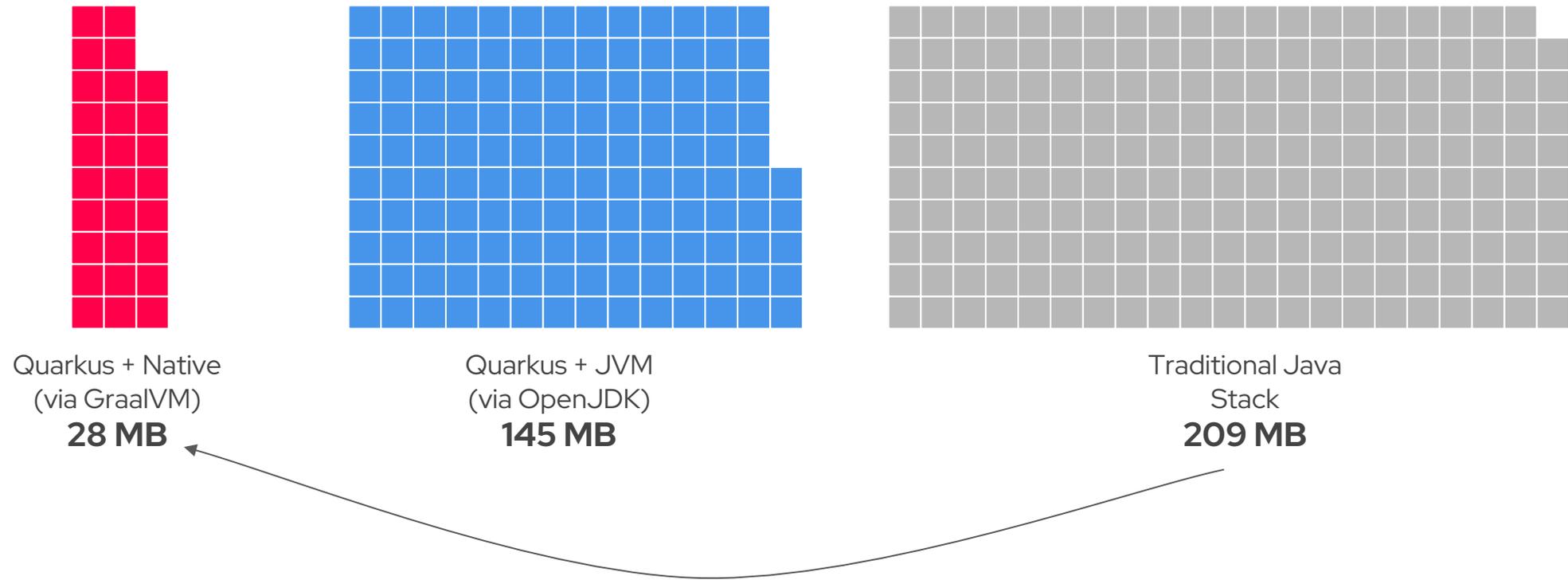
Improve memory consumption.

Increase deployment density.



What is the difference → smaller footprint to do the same or more

In Operation → when running REST (Integrations / APIs)
+ CRUD (Create, Read, Update and Delete) *



*Memory (RSS) in Megabytes, tested on a single-core machine

How does Quarkus help reduce carbon?

'free'

direct
passive
easy to measure

lower memory usage
higher throughput for same resources



energy
usage

'enabled behaviours'

harder to measure real world impact
depends on people taking advantage



machine
selection
(provisioning)



running the same workload on a smaller
machine
saves energy
saves embodied carbon

elasticity

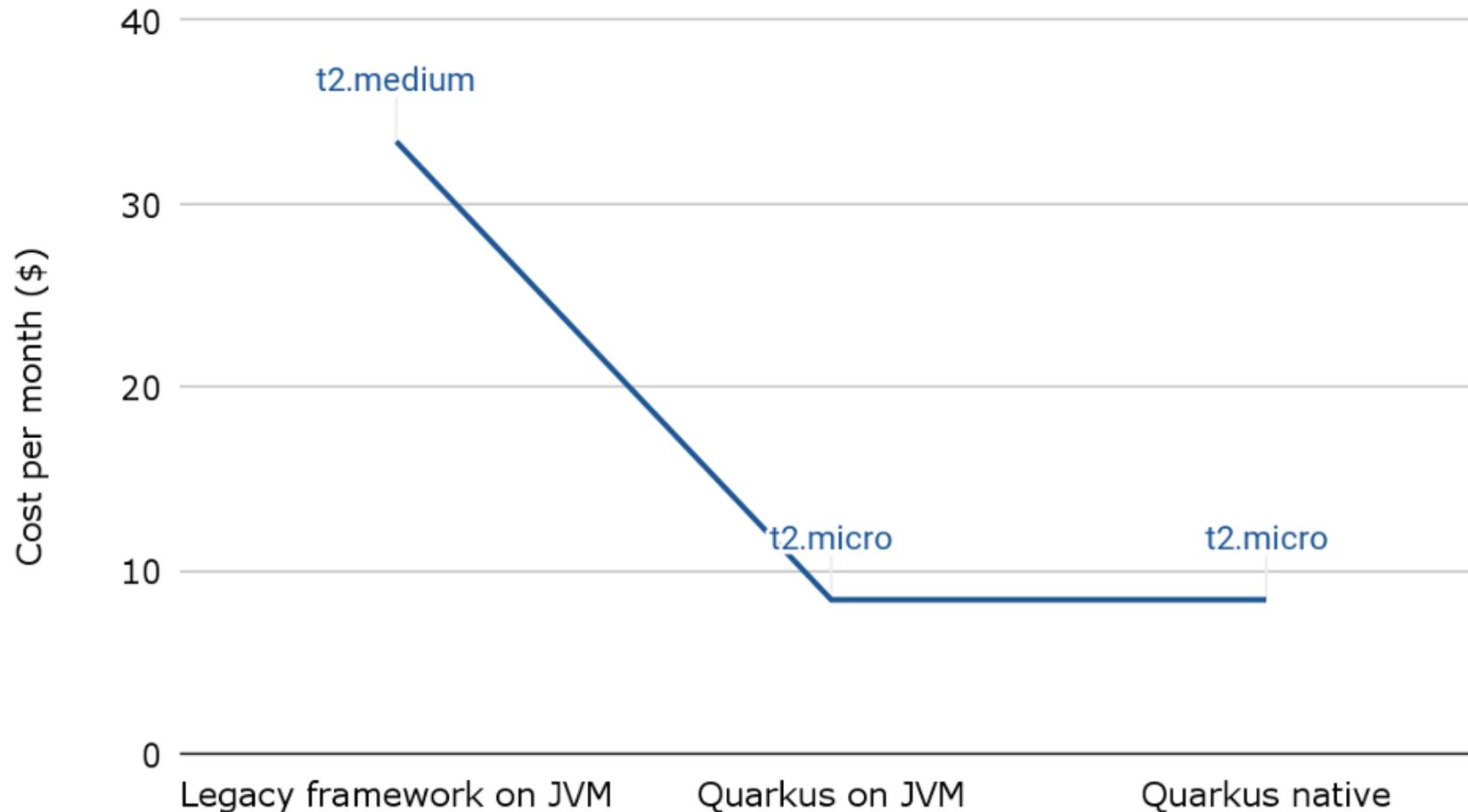


scaling workloads down (ideally to 0)
serverless a good example (but not the only one)

Customer Examples & Economical view

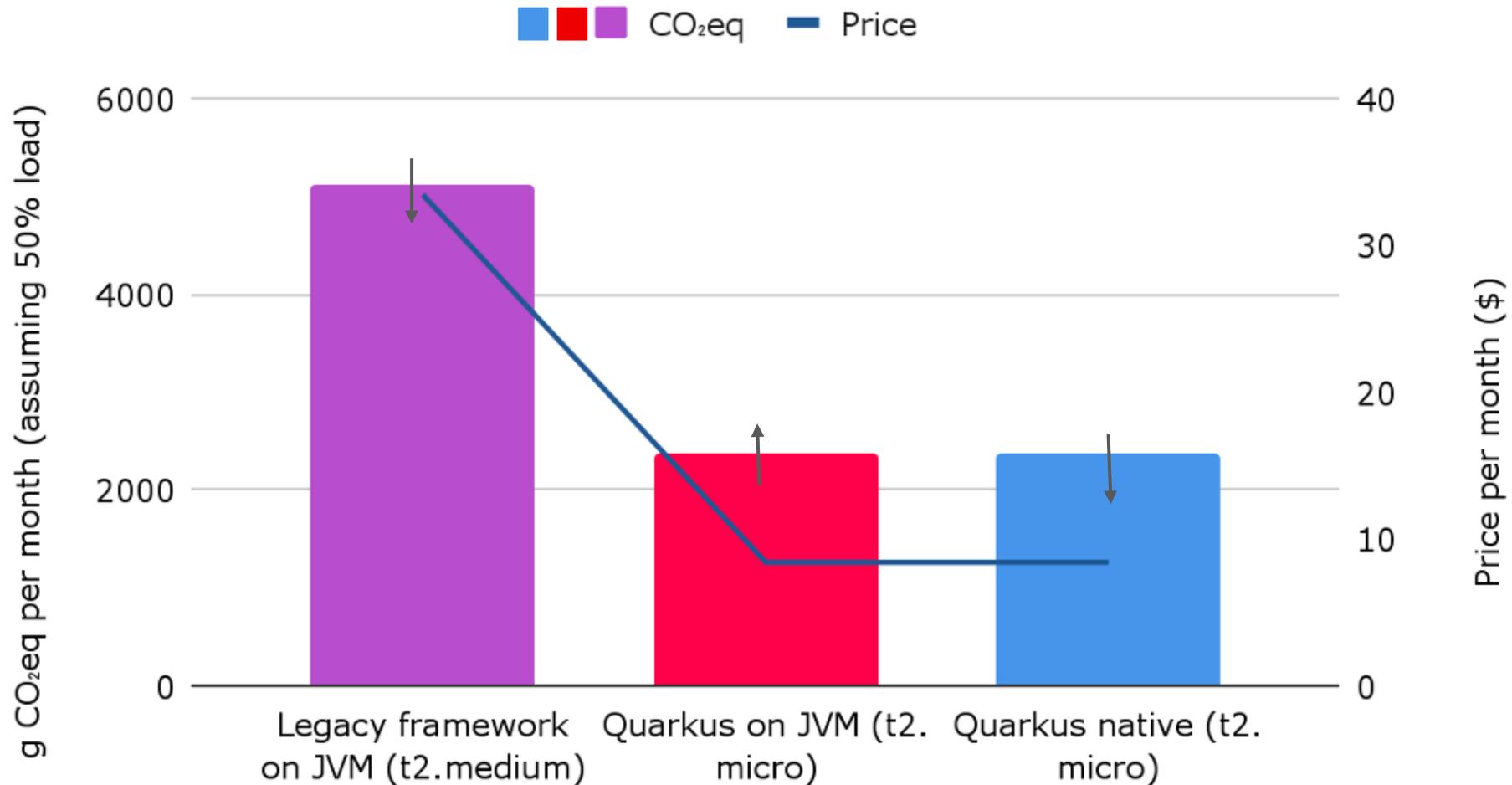
Calculation example based on real applications using Quarkus

Cloud cost impact of framework choice



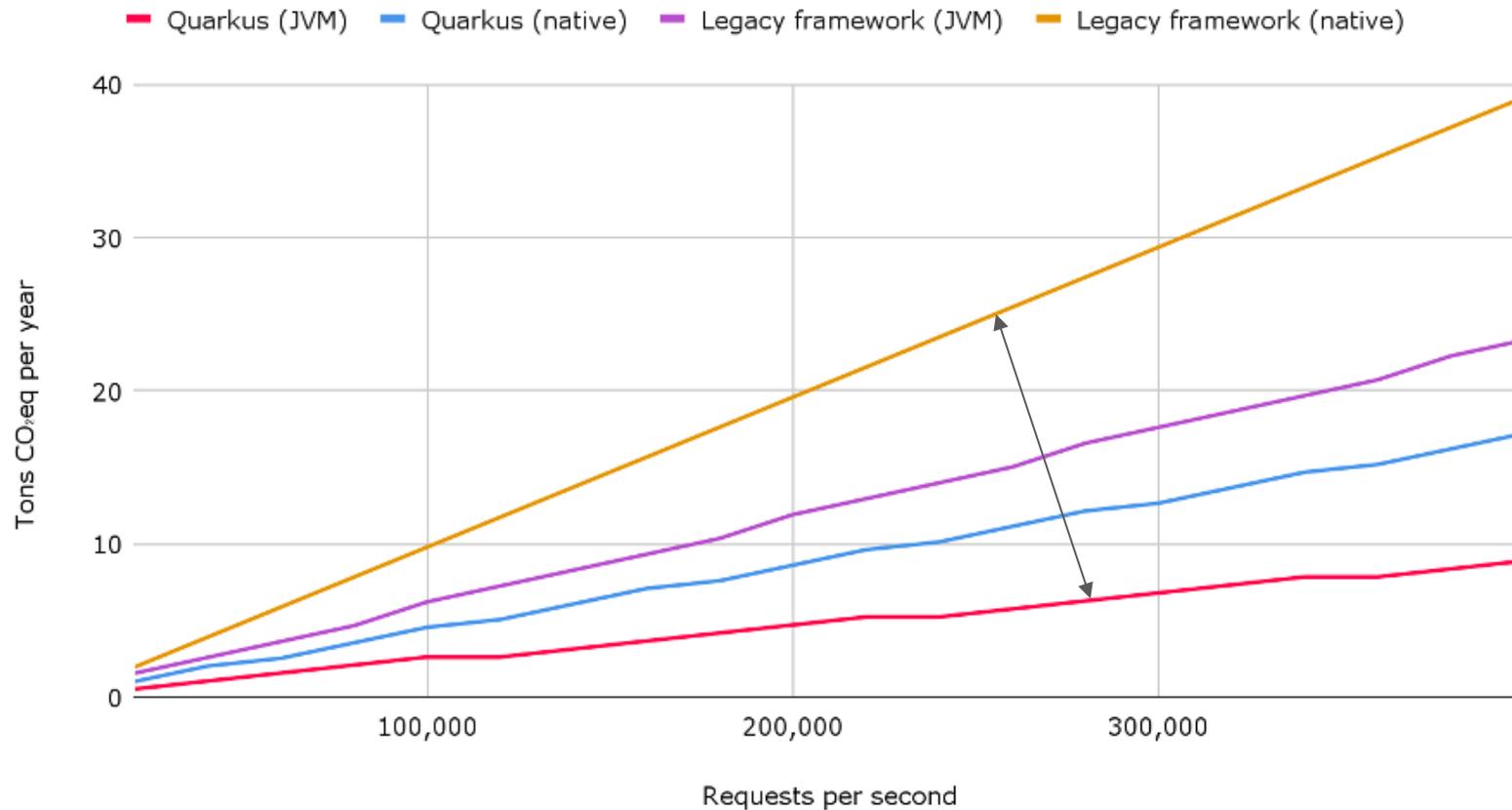
Calculation example - translated to Co2 footprint

Cloud carbon impact of framework choice



Calculation example - translated to Co2 footprint - at Scale

CRUD climate impact at high load (multiple instances)



That is all good, but....

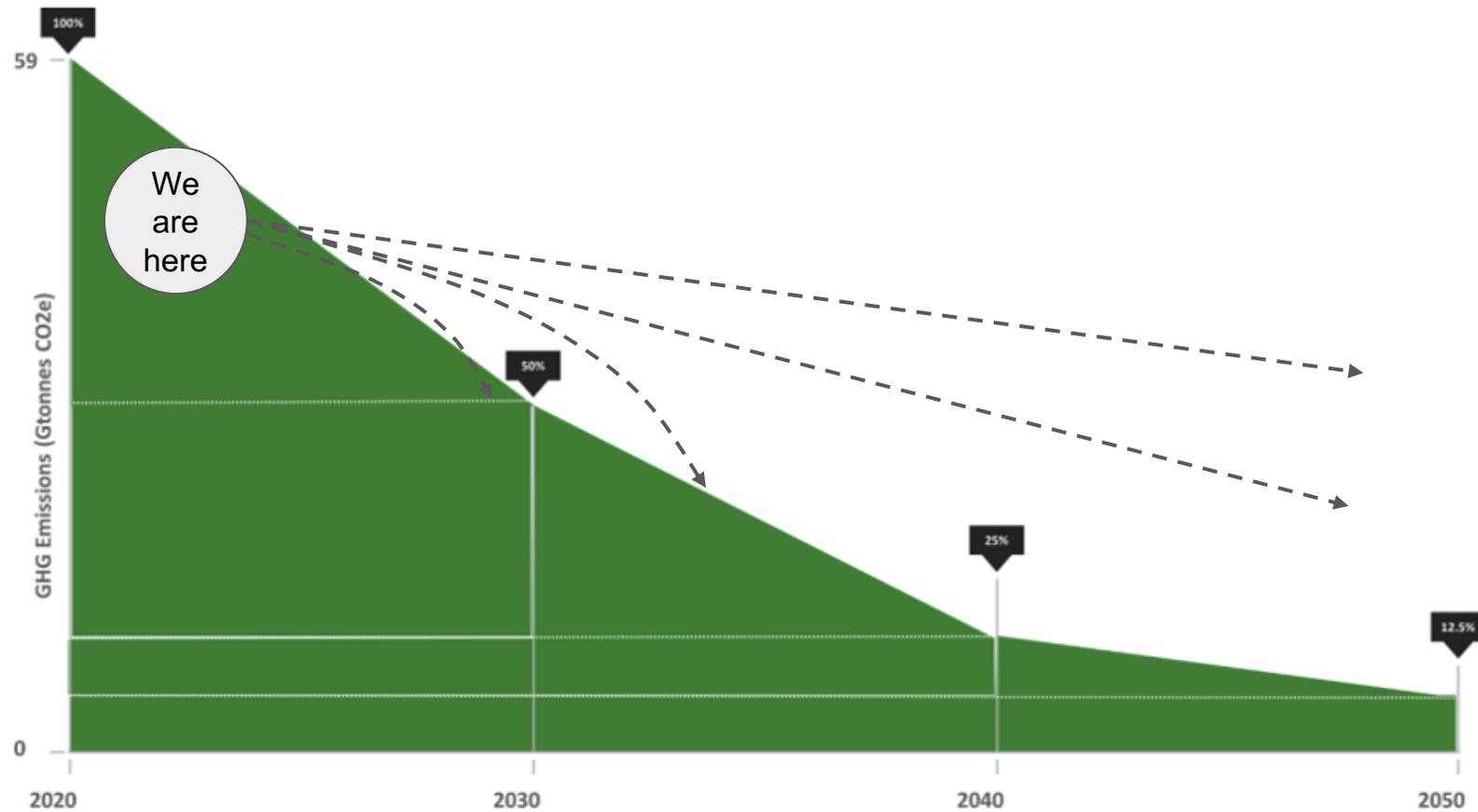
“I’ve never met a customer who wanted to buy software or hardware.
I’ve only met customers who wanted the value they provide”

- Companies are understandably cautious about the current and future state of the economy.
- Red Hat recognizes the need to prioritize projects based on the highest and fastest returns.
- Red Hat offers no-charge Business Value Assessments to pro-actively help you compare cost & business value

Where do we go from here?

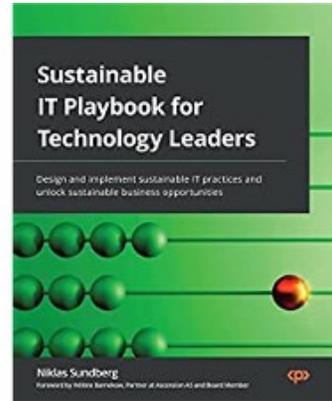
Zooming out

Rebalance / Stabilize -> Bend the curve



Build your awareness

- ▶ Recommended / Useful books



https://www.amazon.de/-/en/dp/1803230347?psc=1&ref=ppx_yo2ov_dt_b_product_details



<https://quarkus.io/blog/quarkus-for-spring-developers/>

- ▶ Red Hat technology

- Whitepaper around Quarkus for sustainability - <https://www.redhat.com/en/resources/greener-java-applications-detail>
- Redmonk interview - <https://redmonk.com/videos/sustainable-software-and-systems-lightswitch-ops-for-the-triple-win-a-redmonk-conversation/>

Summary, where do we go from here?



Your own decision, but...

The future depends on what you do today.

Recap on why companies invest in sustainability



**Come over & discuss with our Azure and Red Hat colleagues today!
We are here during today's event**

Discussion / Questions