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Eco-conscious Cloud Computing

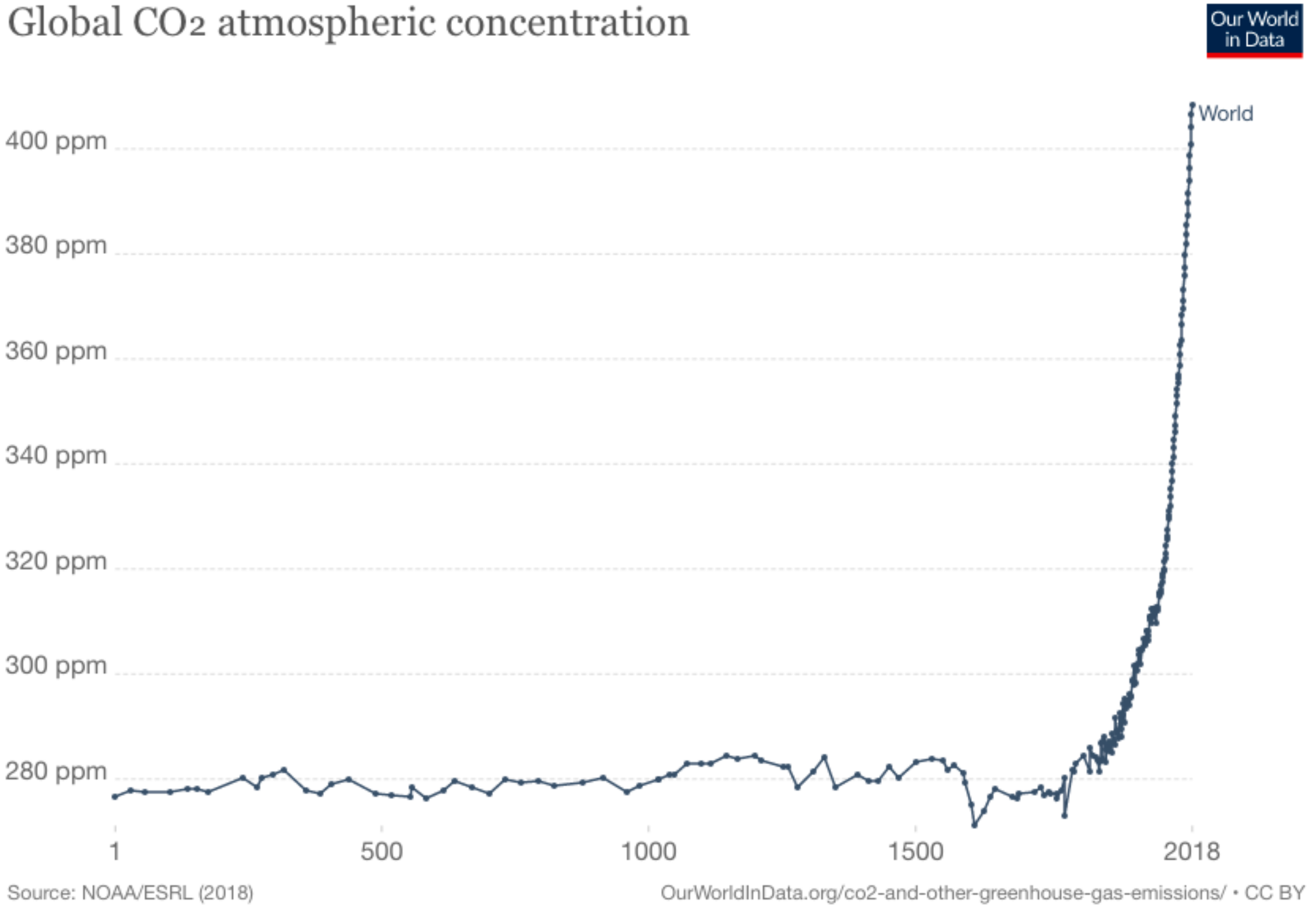
From Concept to Action

Hugh Walcott | 6 September 2023

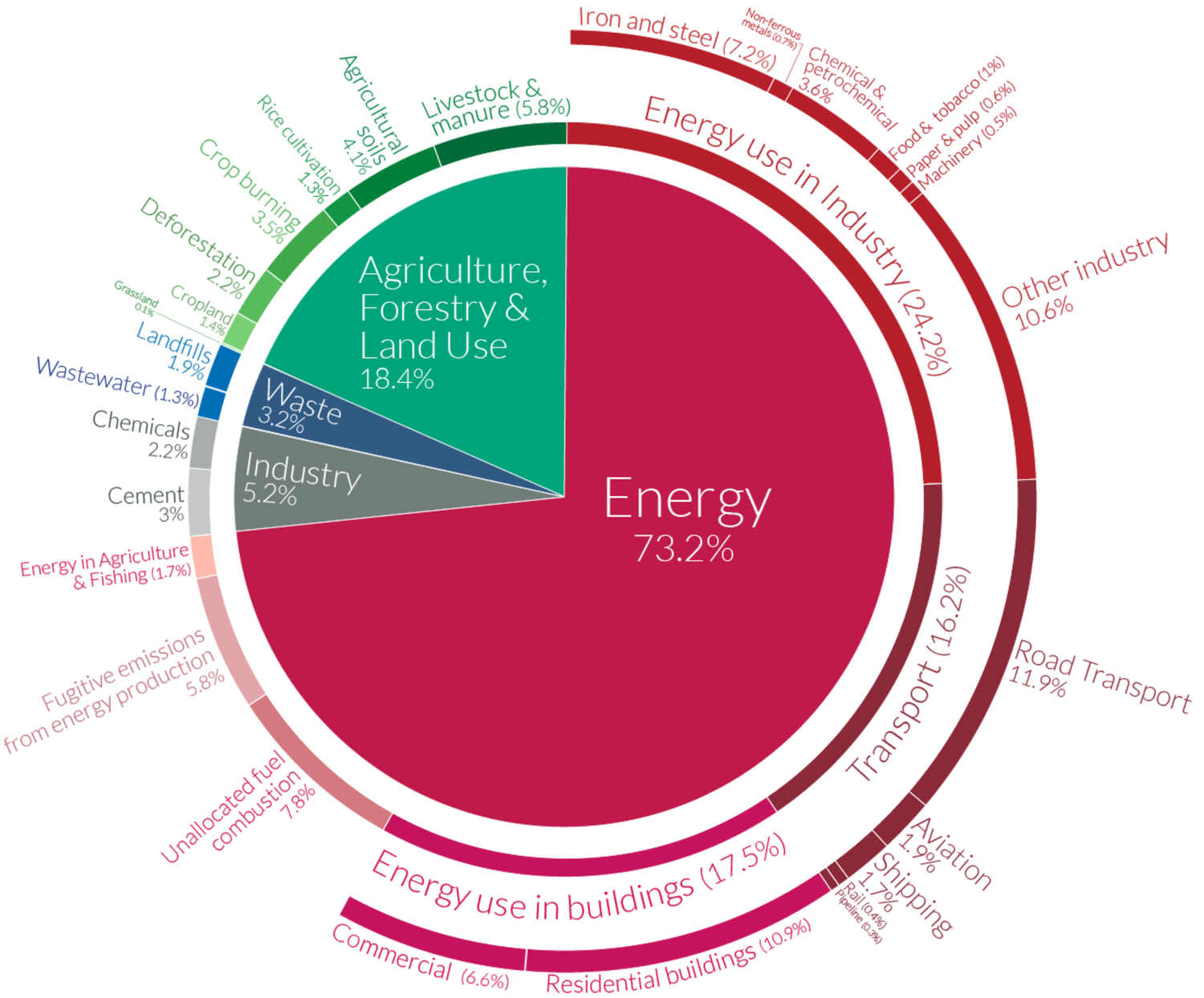
The Future?

CO2

Parts per million



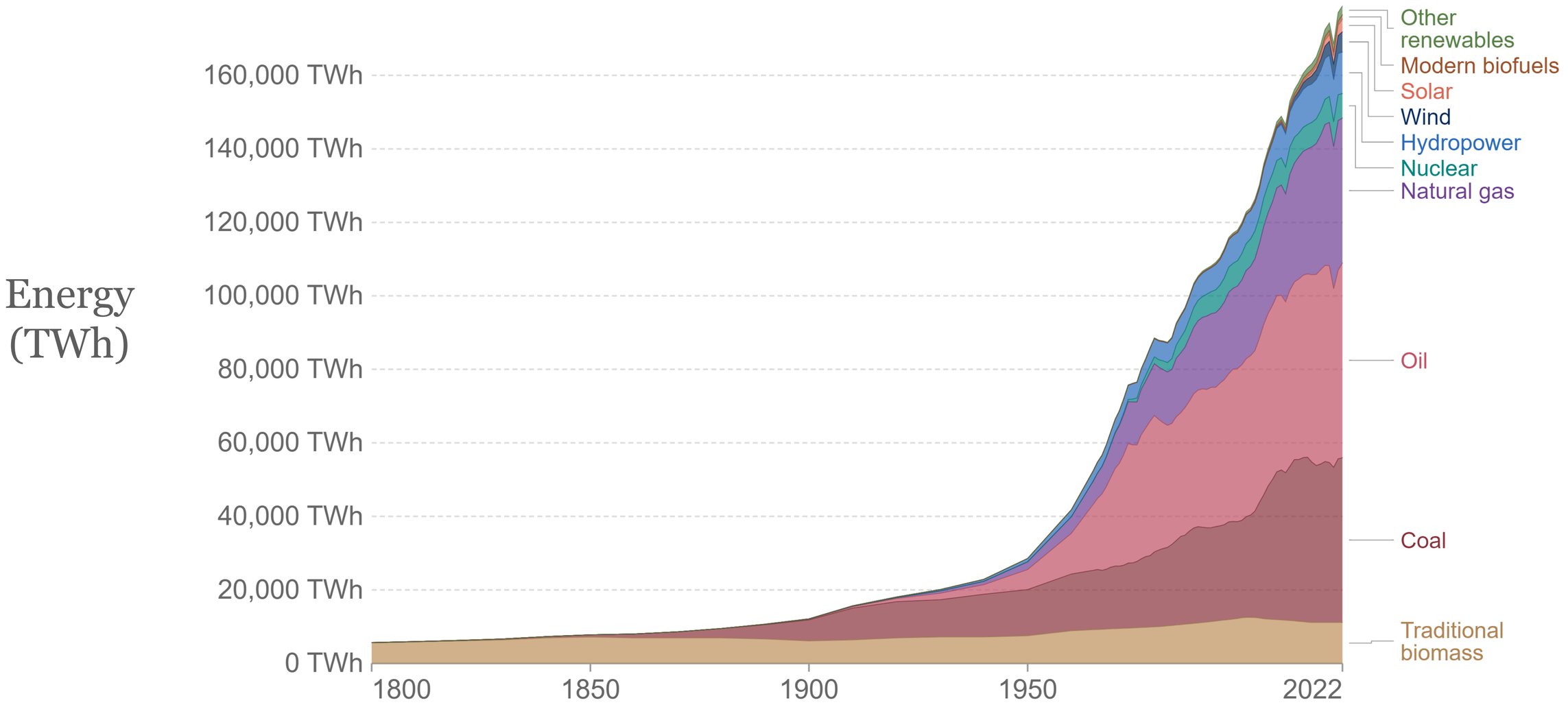
Greenhouse gas by sector



OurWorldinData.org – Research and data to make progress against the world's largest problems.
Source: Climate Watch, the World Resources Institute (2020).

Global primary energy consumption by source

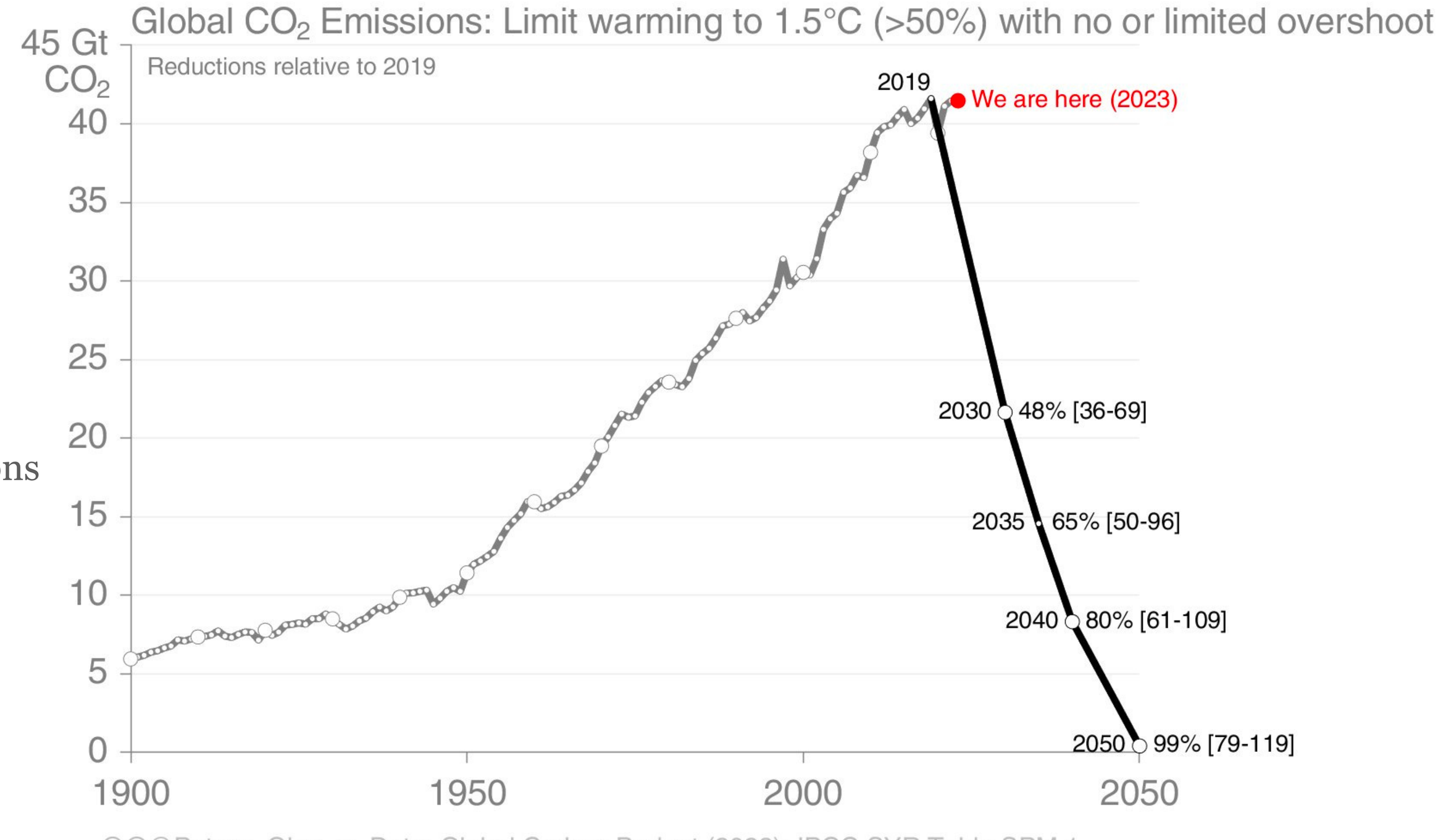
Our World in Data

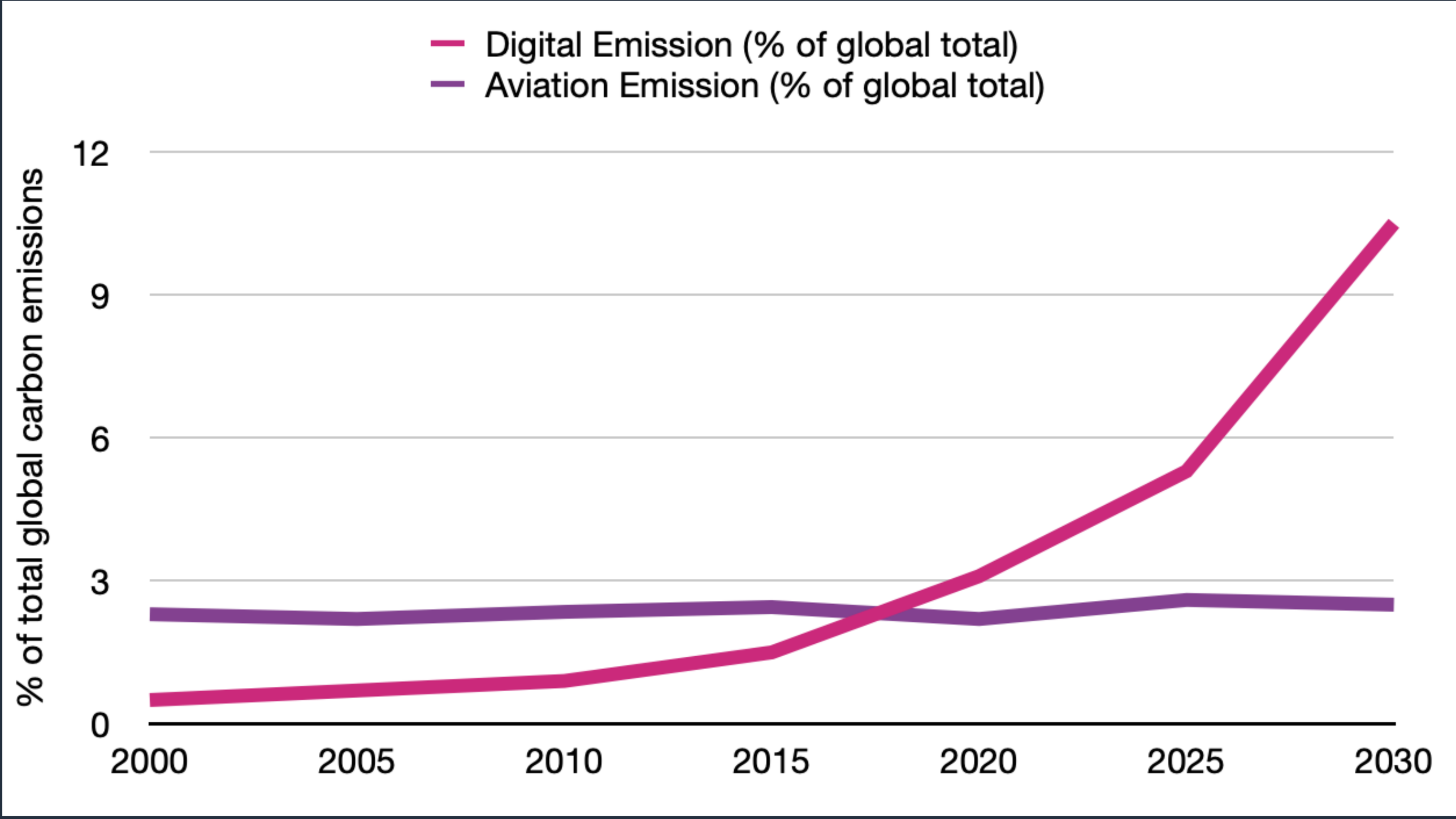


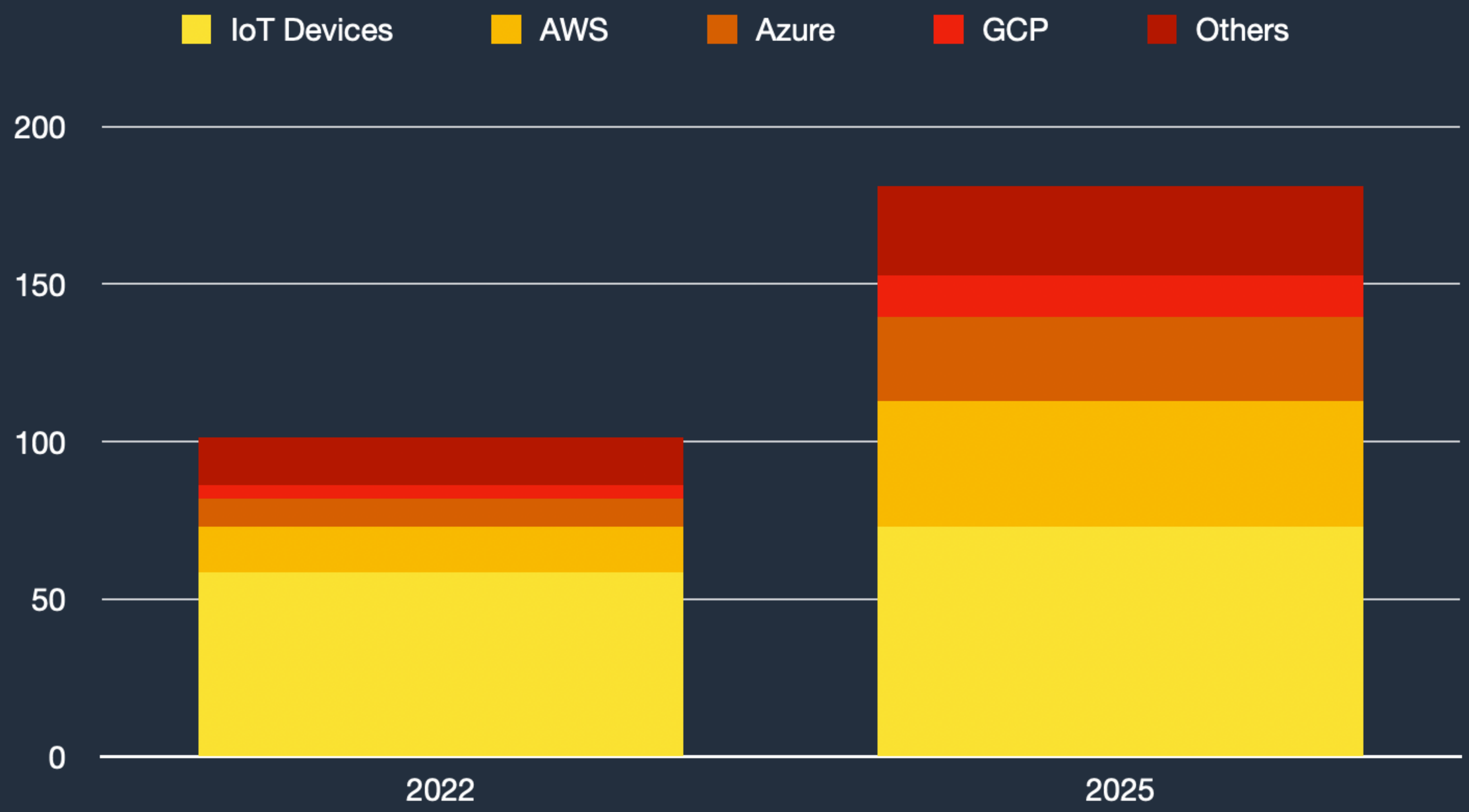
Source: Energy Institute Statistical Review of World Energy (2023); Vaclav Smil (2017)
OurWorldInData.org/energy • CC BY

CO2

GigaTons




Digital Emission (% of global total)
Aviation Emission (% of global total)
% of total global carbon emissions
12
9
6
3
0
2000
2005
2010
2015
2020
2025
2030



New data created (ZBytes / year)

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Eco-conscious Cloud Computing

Energy Awareness
+
Systems Thinking

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1997

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AWS Nevada - one of 700 hyper scale data centres

Eco-conscious computing

Where does the Cloud come from?

Energy + Minerals

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Where does the Cloud come from?

Minerals used in manufacture of servers:

Magnesium, Radium, Barium, Niobium, Osmium, Cobalt, Manganese, Titanium, Hafnium, Tungsten, Germanium, Gold, Silver, Copper, Mercury, Bismeth, Silicon, Gallium, Zinc, Iron, Sulfur, Phosphorus, Cadmium, Palladium, Tantalum, Platinum, Aluminum, Carbon, Lead, Nickel, Boron, Chromium, Potassium, Fancium, Casium, Sodium, Lithium, Calcium, Nitrogen, Oxygen, Arsenic, Neodymium, Selenium, & Tin.

● Toxic ● Rare ● Conflict

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Where does the Cloud come from?

Server: 30 kgs

Embodied Emissions:

- Manufacture = **4,288 kg CO2e**
- Use = 4,525 kgCO2e (EU)
- Use = 14,000 kgCO2e (Aus)

Eco-conscious computing

Why is the Cloud here?

Eco-conscious computing

Why is the Cloud here?

$$\frac{\text{Compute + Storage + Networking}}{\text{Cost + Convenience + Control}}$$

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Why is the Cloud here?

Melbourne region
(ap-southeast-4)

- Loy Yang Power Station
- 3,280 MW

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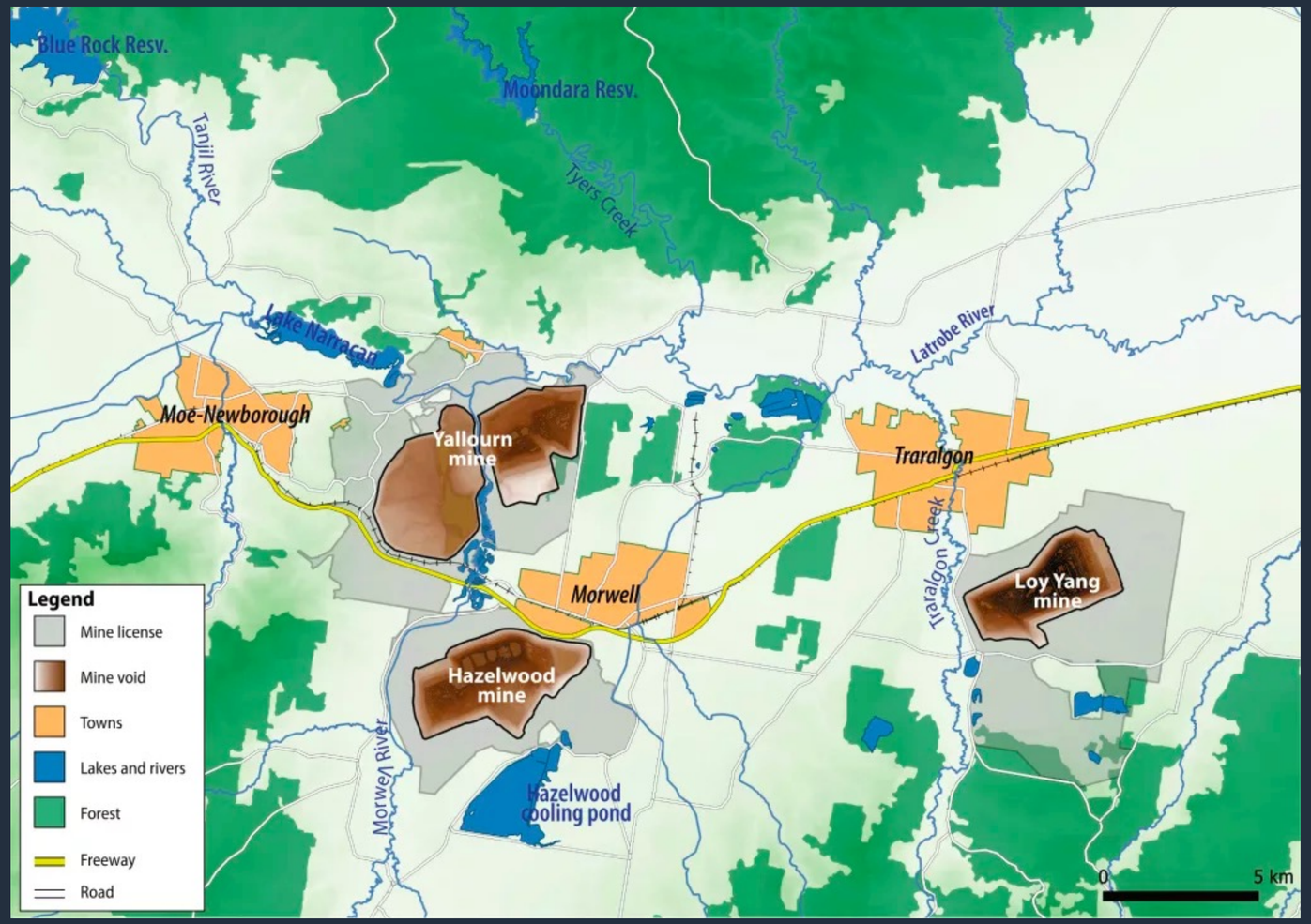
Why is the Cloud here?



- Loy Yang
- Australia’s largest coal mine
- 20.83 million tonnes of coal each year

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Why is the Cloud here?

- Loy Yang
- One of 127 open cast mines in Australia

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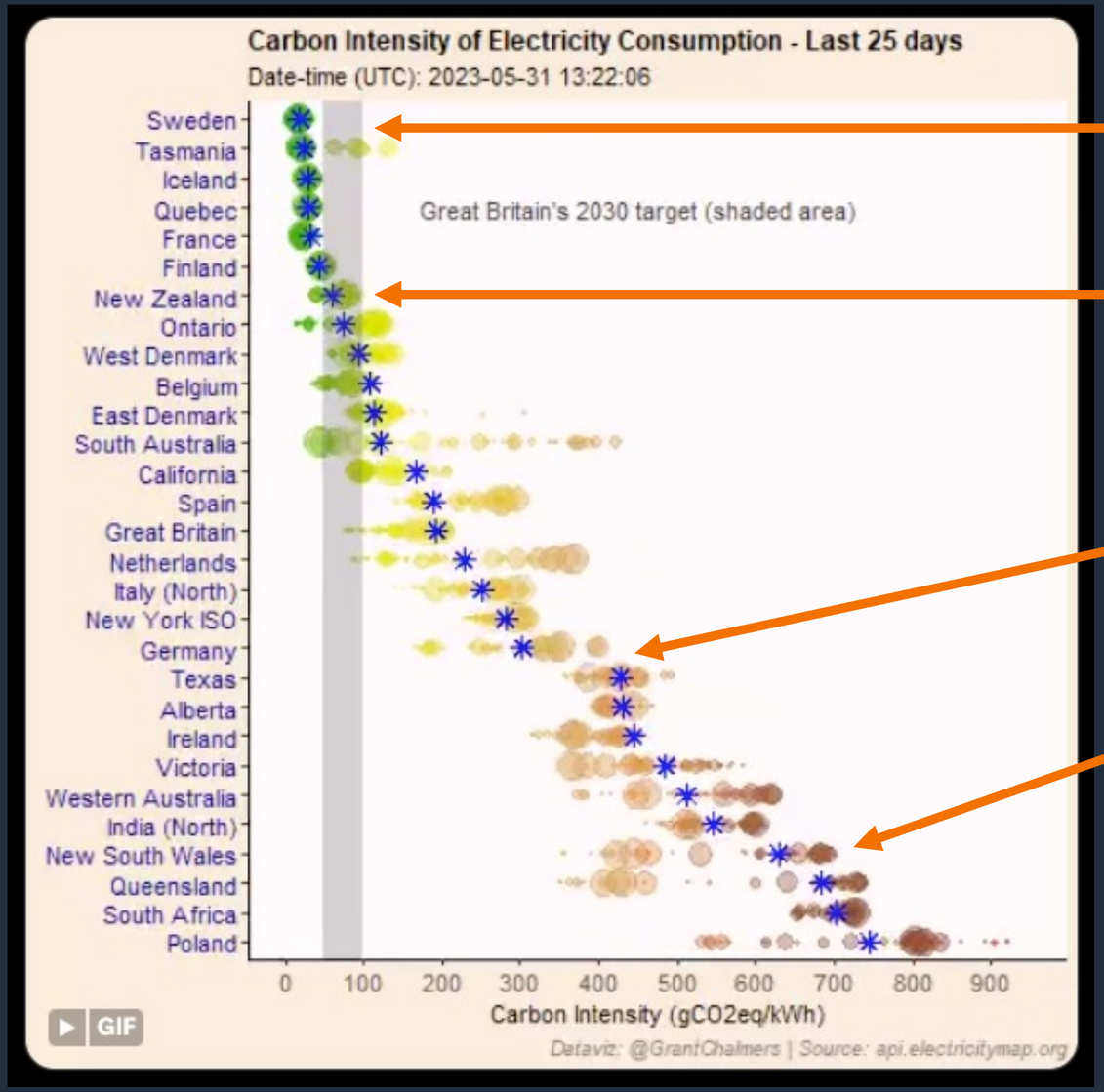
Region matters



Sweden

New Zealand

Singapore

Australia

Why is the Cloud here?

$$\frac{\text{Compute + Storage + Networking}}{\text{Cost + Convenience + Control + CLIMATE}}$$

Conceptual

What happens to my Cloud when it dies?

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End of life

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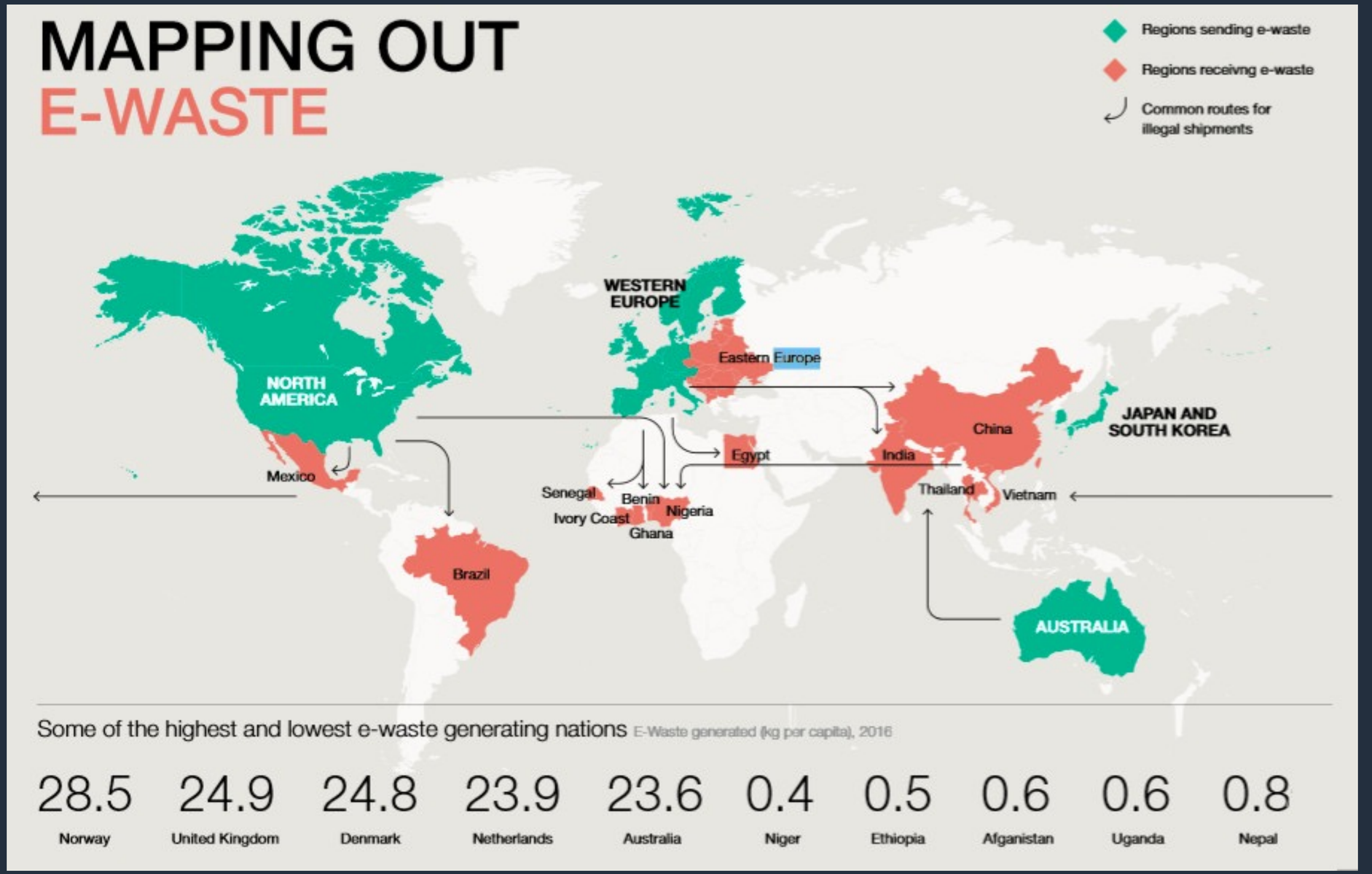
End of life

2% of all waste

12.5% recycled

70% of all toxic waste in landfill

Fastest growing municipal waste stream



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Ways to take action

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Practical

Individuals

Measure / Report

Teams

Manage / Optimise

Organisations

Reduce / Offset

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SilverLining

Awareness Tools Advice

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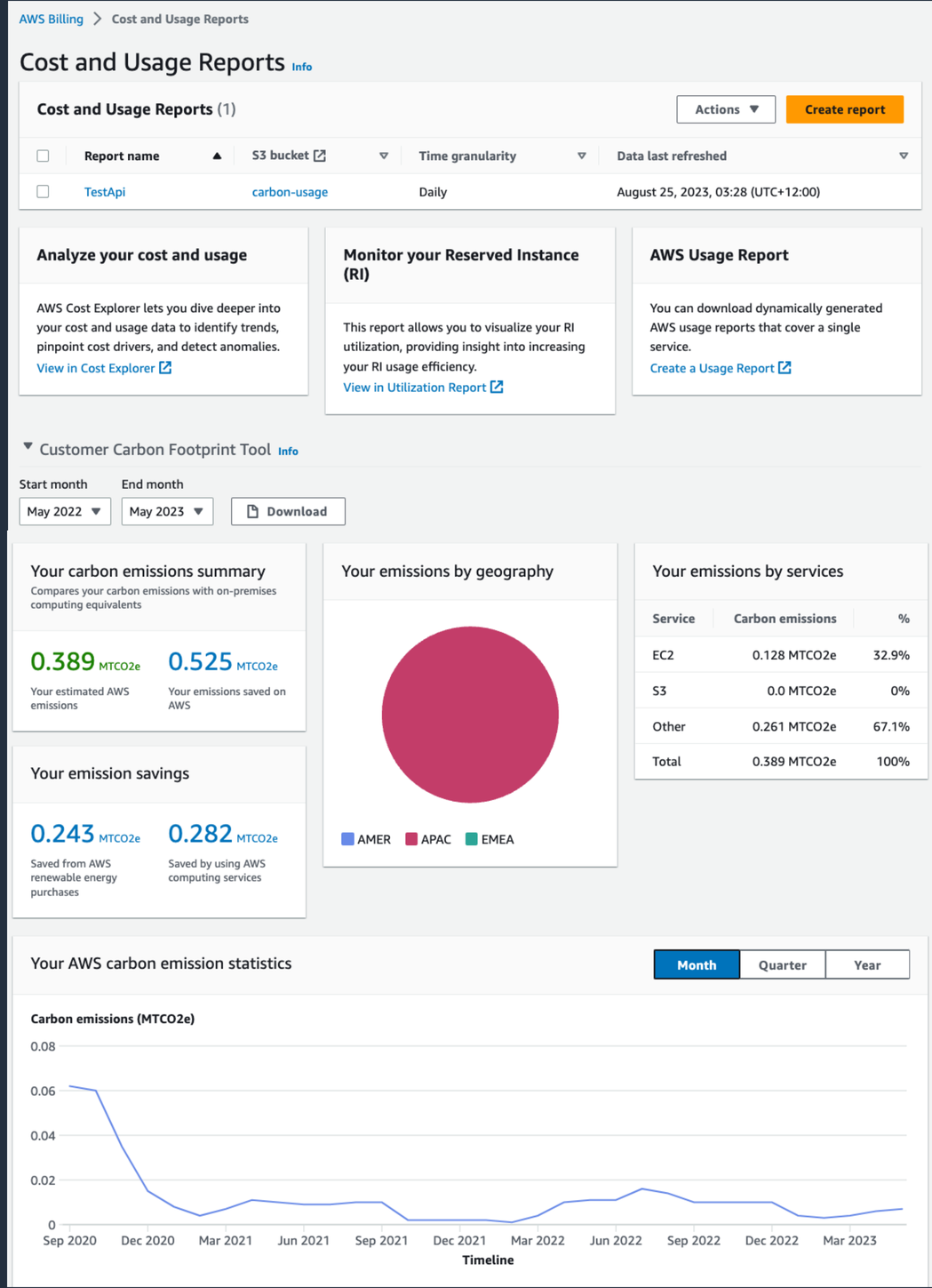
1. AWS Carbon Footprint Tool

Quick estimate

- By service type
- By time
- By geography

But…

- More detail is needed to identify:
  - Opportunities to save energy
  - Opportunities to reduce emissions



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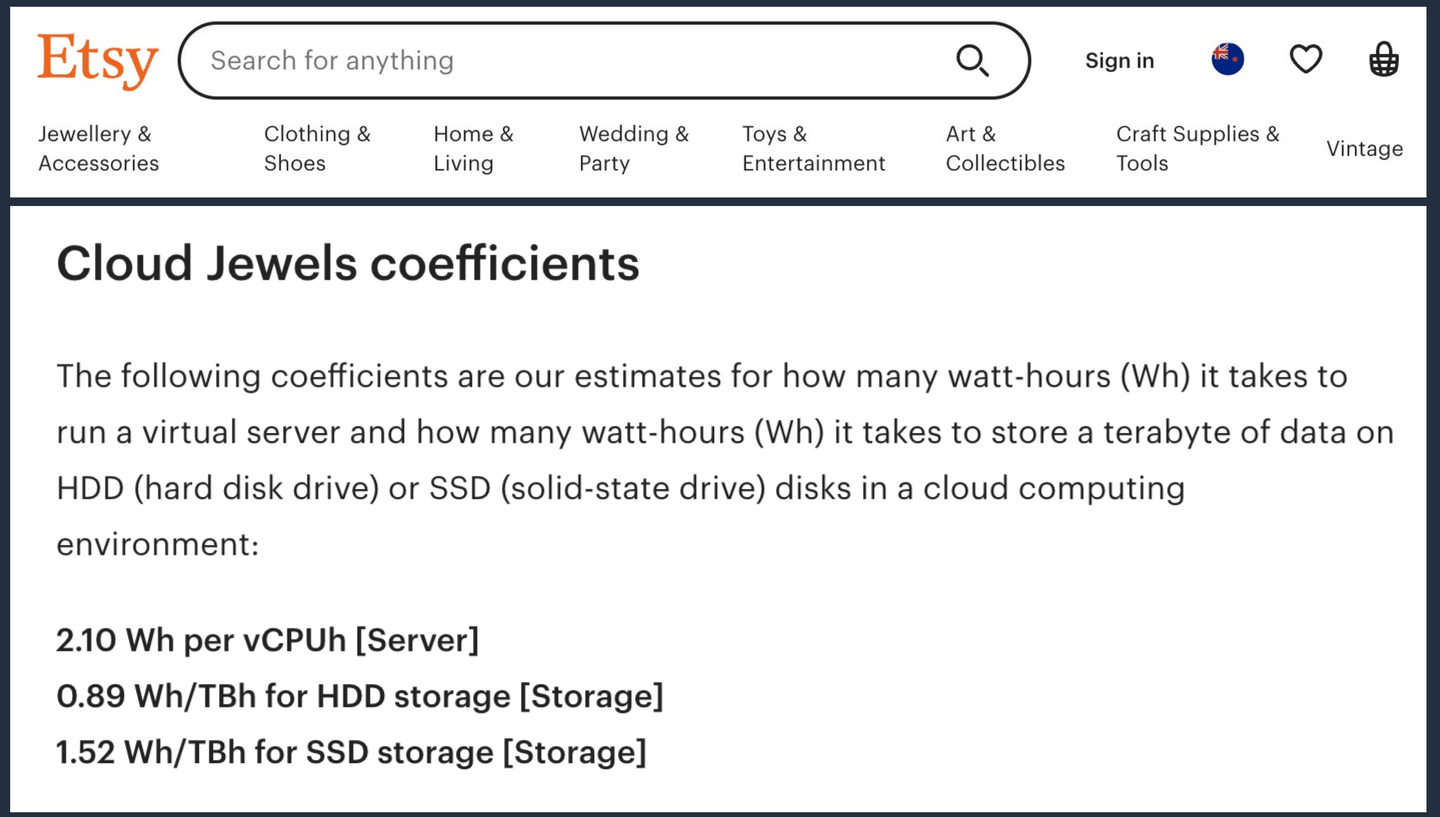
2. Etsy (yes, the online marketplace)

- Simple
- Energy Estimate
- EY Verified



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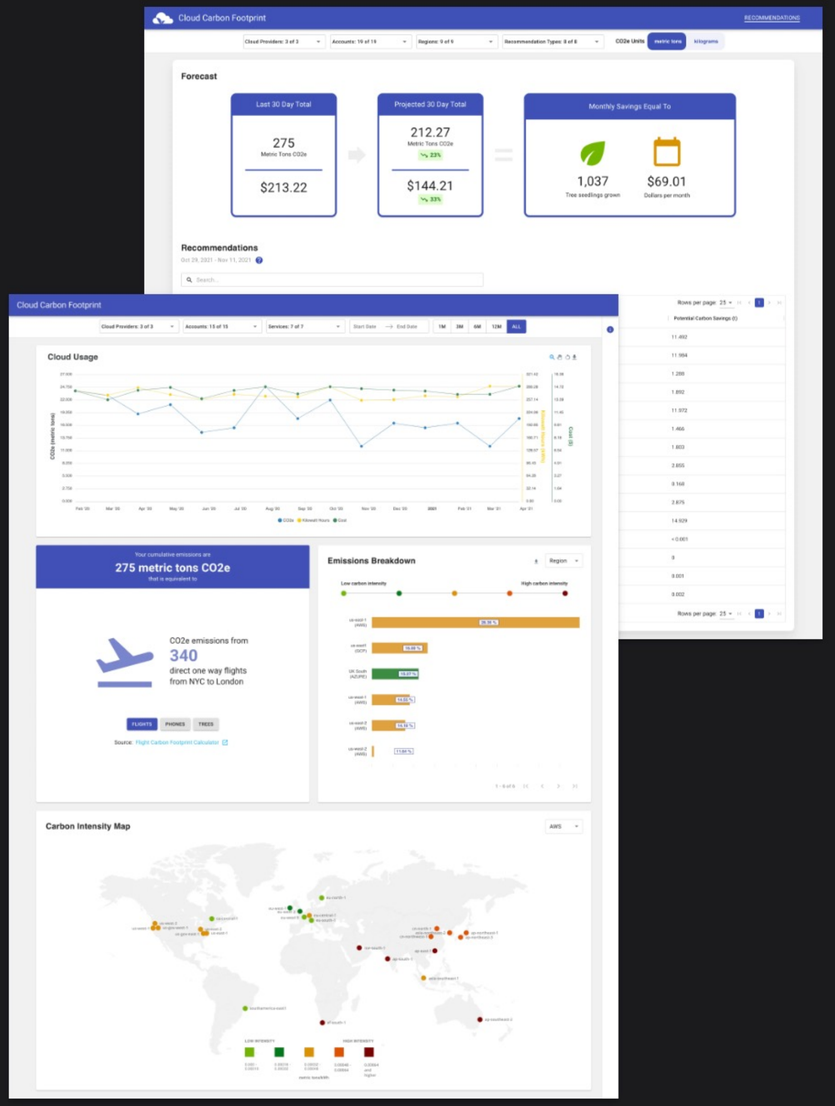
3. Cloud Carbon

- Open source methodology
- Embodied emissions
- API integration

Cloud Carbon Footprint



Get to know the carbon footprint of your cloud usage - and reduce it

Cloud Carbon Footprint is an open source tool that provides visibility and tooling to measure, monitor and reduce your cloud carbon emissions. We use best practice methodologies to convert cloud utilization into estimated energy usage and carbon emissions, producing metrics and carbon savings estimates that can be shared with employees, investors, and other stakeholders.

GET STARTED

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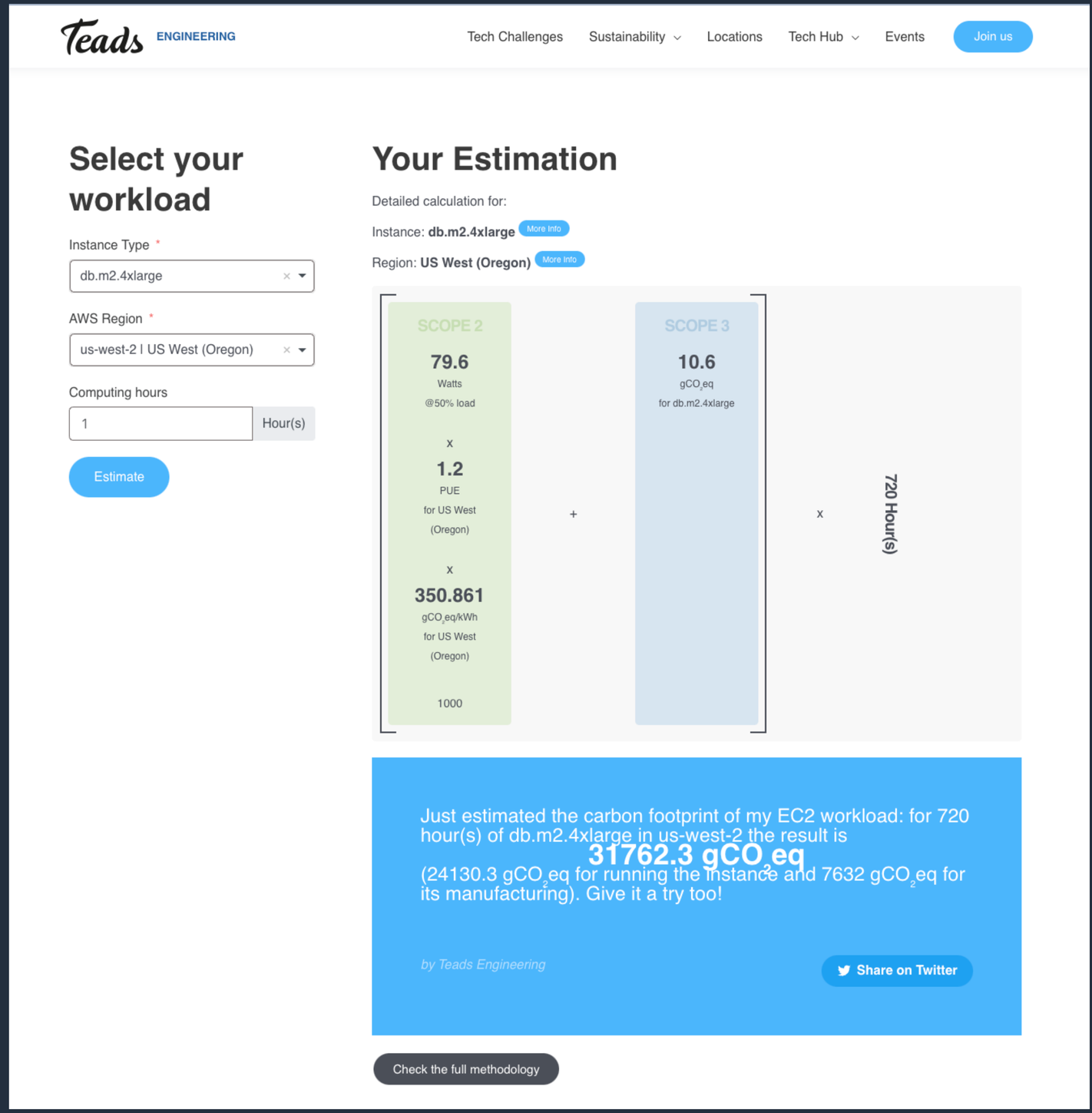
4. Teads Engineering EC2 calculator

- Open source dataset
- Web calculator
- Simple UX



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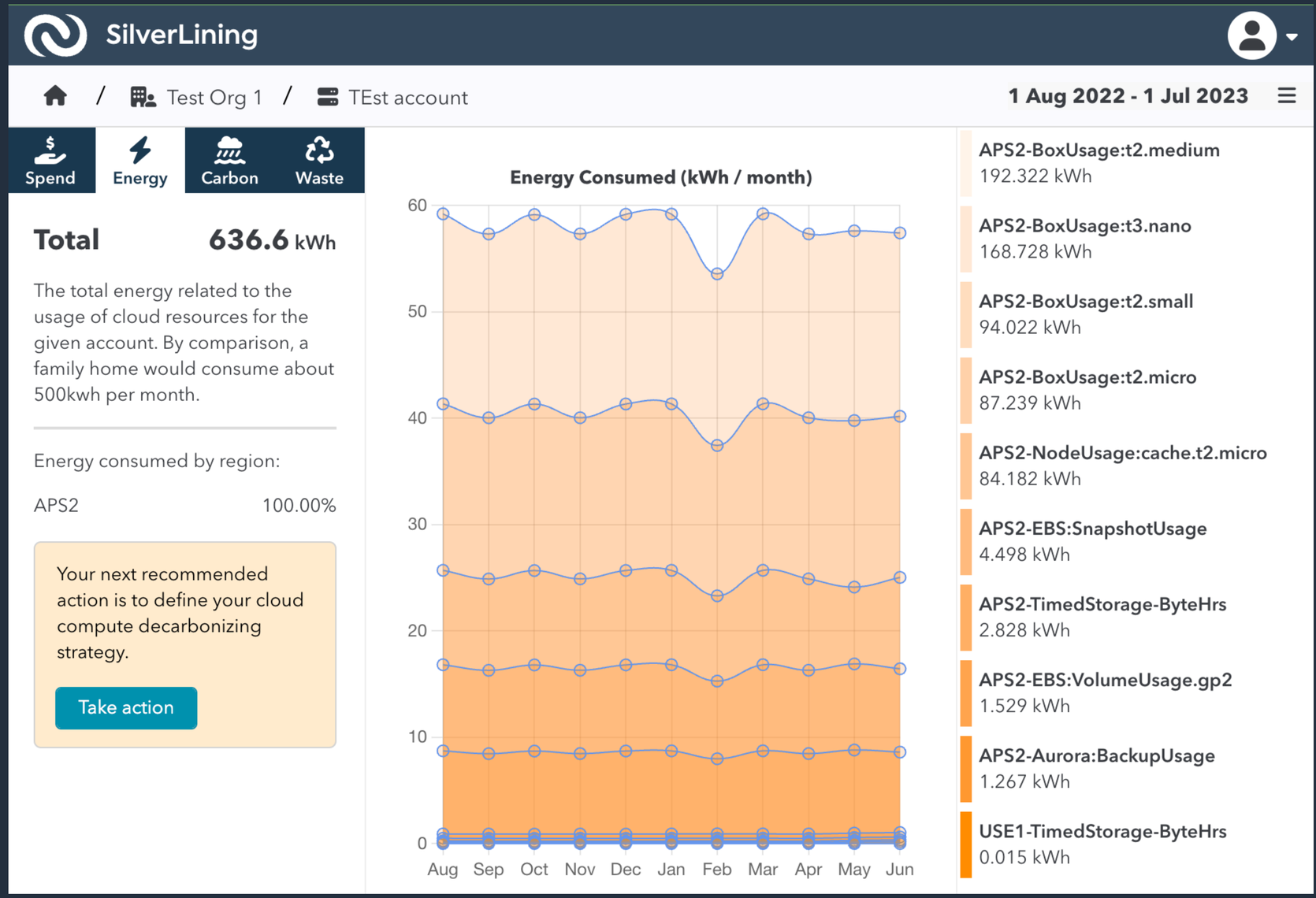
5. SilverLining portal

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "CostExplorerReadOnly",
      "Effect": "Allow",
      "Action": [
        "account:GetAccountInformation",
        “consolidatedbilling:Get*",
        “consolidatedbilling:List*",
        "ce:GetCostAndUsage"
      ],
      "Resource": [
        "*"
      ]
    }
  ]
}
```



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Ways to reduce climate impacts

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Springload

ZX SECURITY

liquid
security led IT

cogo

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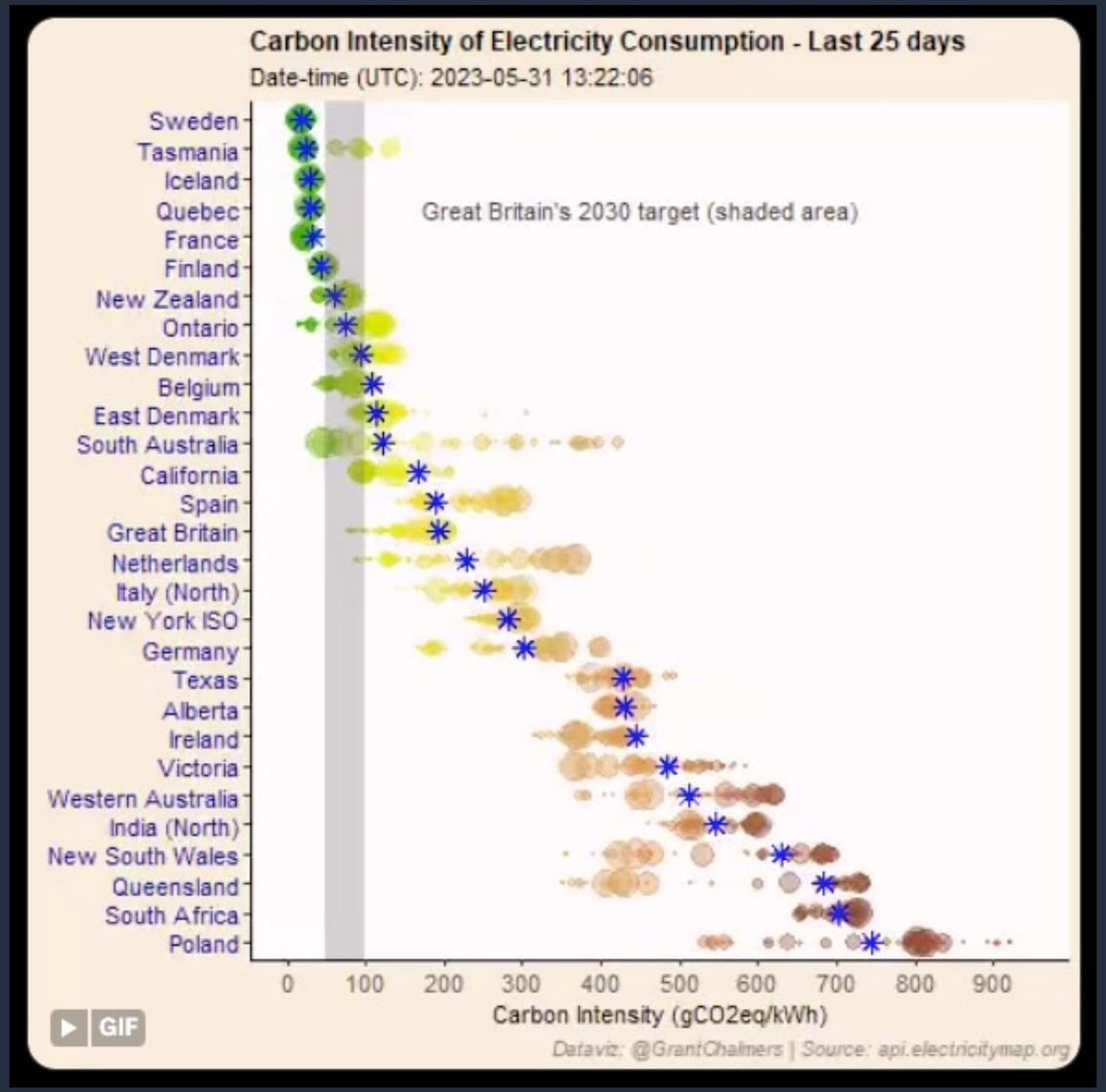
Chose a different region:

```
# Configure the AWS Provider
provider "aws" {
  region = "ap-southeast-4"
}
```



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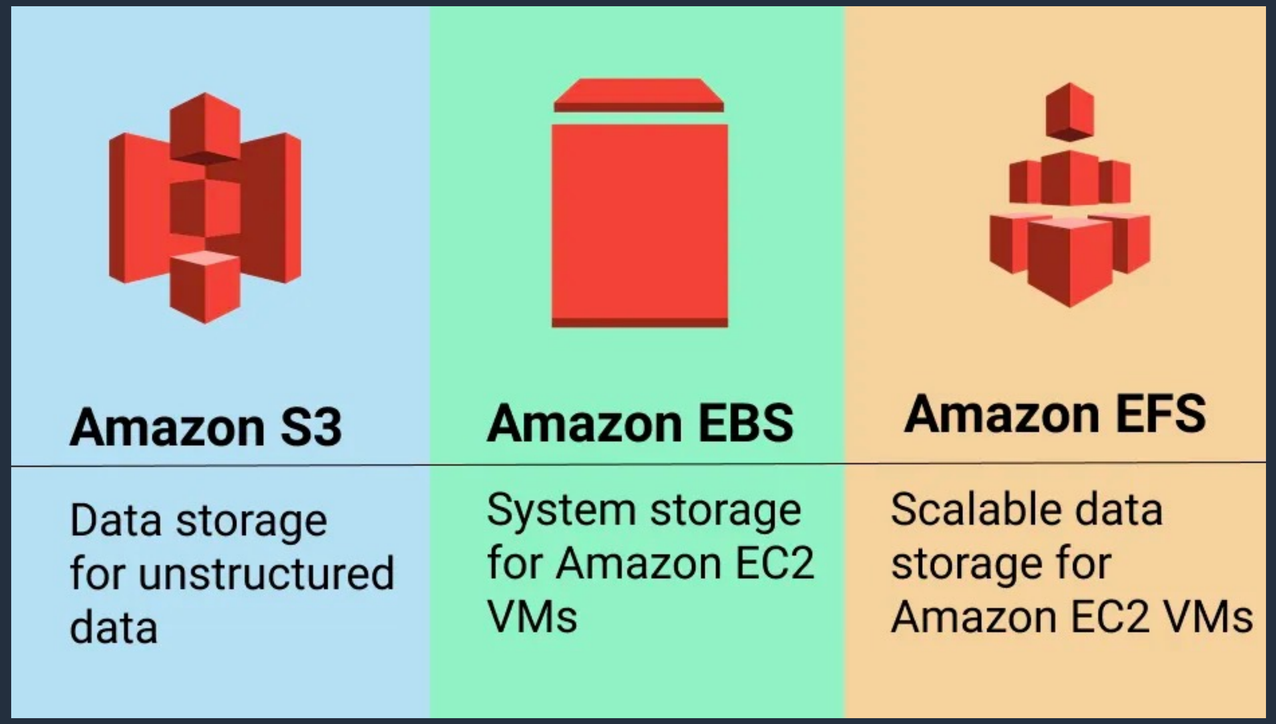
Energy Scenarios (Storage)

Solid State?

Hard Drive?

Replications?

Offline Archive?



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Energy Scenarios (Compute)

Processor: X86 / ARM / Graviton?

Database: RDS / SQLite / NoSQL / Auroa?

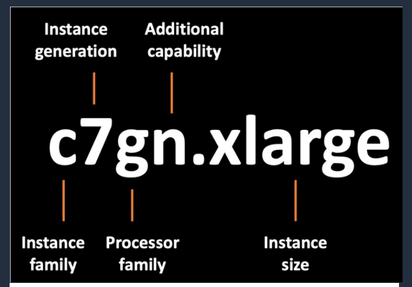
AppServer: ECS / Fargate / Lambda ?

App cluster: (3, 2 or 1 instance)?

Compute size (downsize EC2s)

Test environments: turn off when not in use?

Basian: turn off when not in use?



Processor families

- **a** – AMD processors
- **g** – AWS Graviton processors
- **i** – Intel processors

Instance families

- **C** – Compute optimized
- **D** – Dense storage
- **F** – FPGA
- **G** – Graphics intensive
- **Hpc** – High performance computing
- **I** – Storage optimized
- **Inf** – AWS Inferentia
- **M** – General purpose
- **Mac** – macOS
- **P** – GPU accelerated
- **R** – Memory optimized
- **T** – Burstable performance
- **Trn** – AWS Trainium
- **U** – High memory
- **VT** – Video transcoding
- **X** – Memory intensive

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Energy Scenarios (Compute)	Trade Off	Energy Savings
Processor: X86 / ARM / Graviton?	Time	Medium
Database: RDS / SQLite / NoSQL / Auroa?	Time	High
AppServer: ECS / Fargate / Lambda ?	Time	High
App cluster: (3, 2 or 1 instance)?	Redundancy / availability	Low
Compute size (downsize EC2s)	Time	Medium
Test environments: turn off when not in use?	Wakeup script	Medium
Basian: turn off when not in use?	Wakeup script	Low

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$$\frac{\text{Compute + Storage + Networking}}{\text{COST + Convenience + Control + CLIMATE}}$$

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Thank you… and any questions?

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