

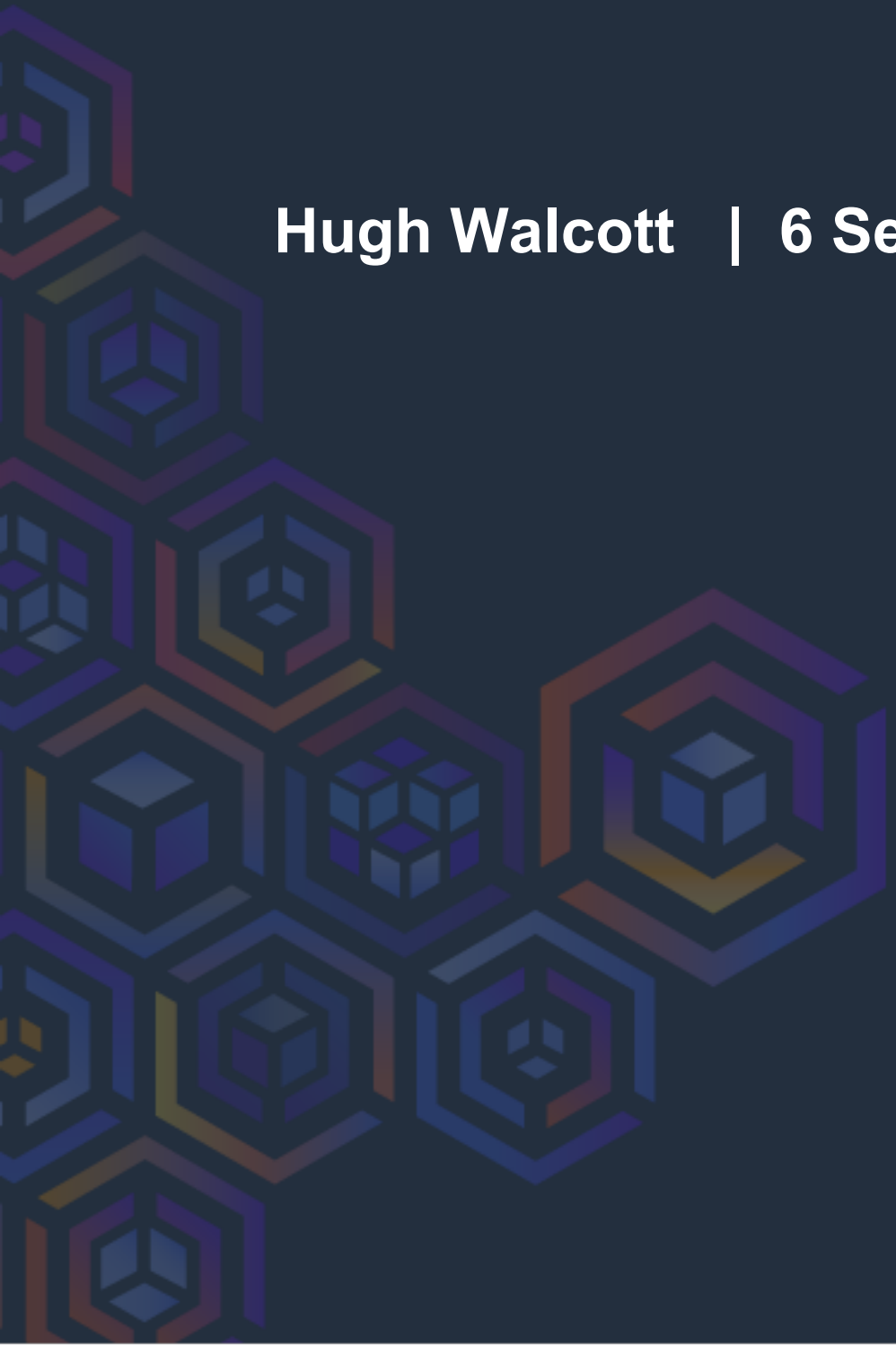


COMMUNITY DAY

Eco-conscious Cloud Computing

From Concept to Action

Hugh Walcott | 6 September 2023

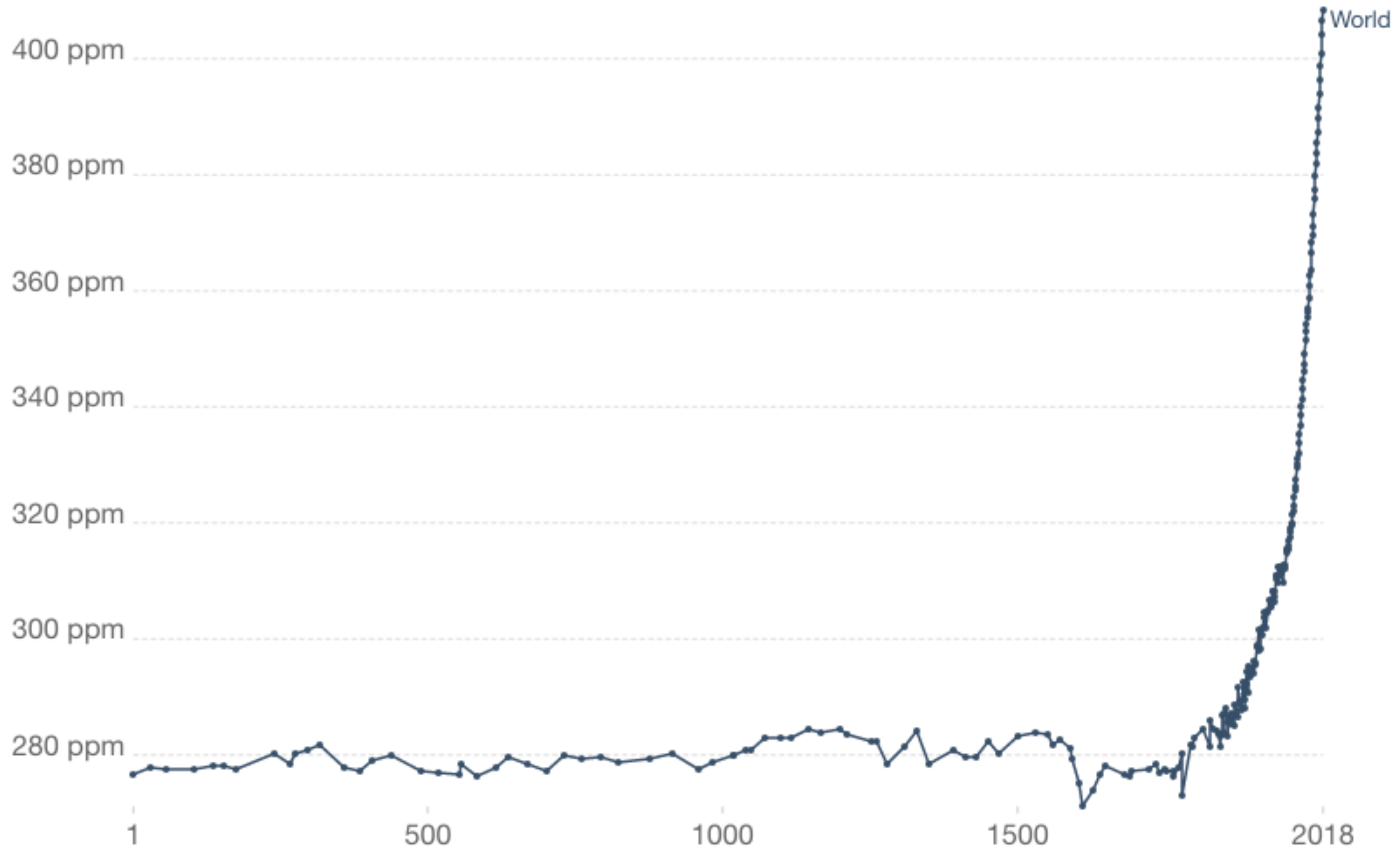




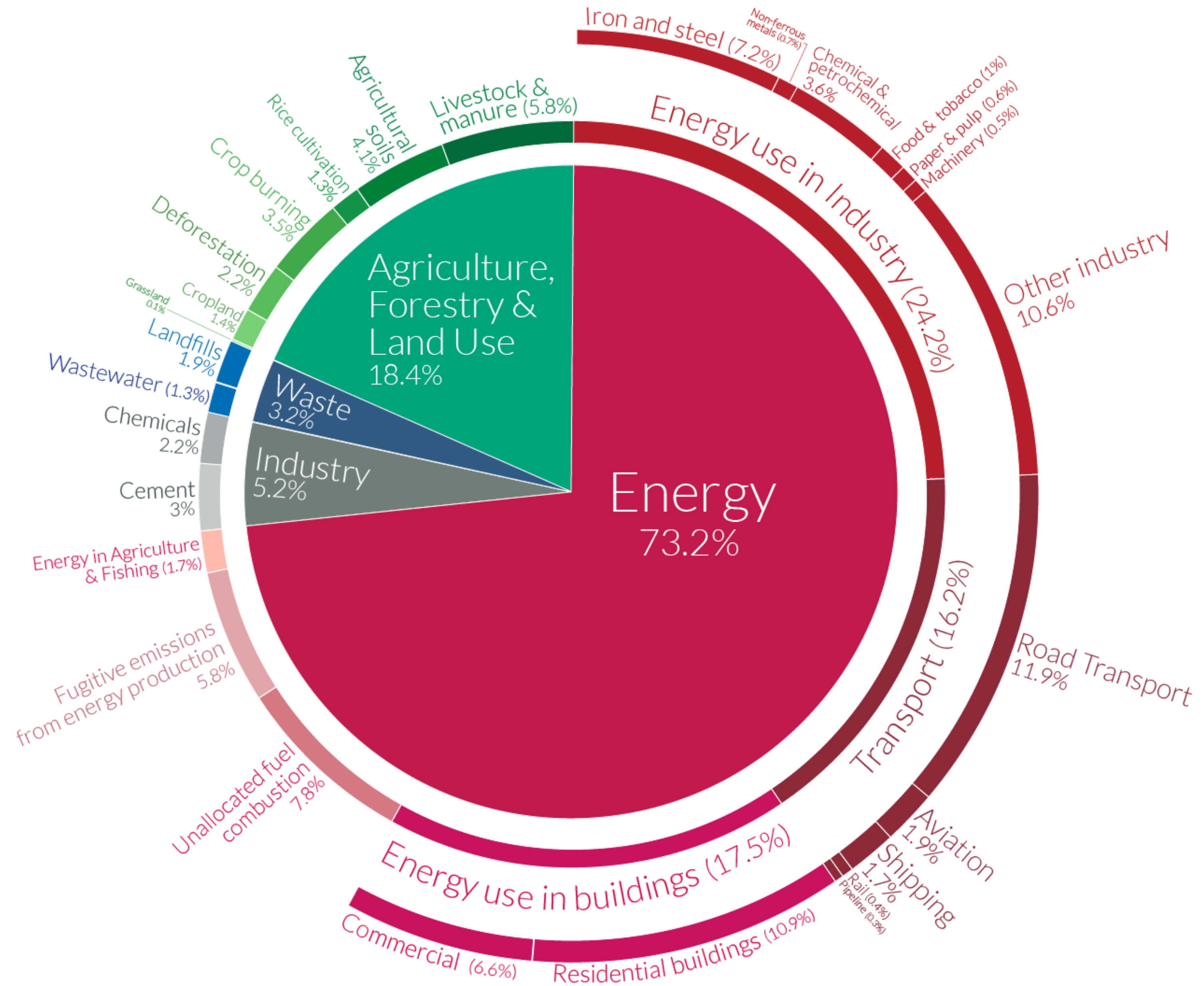
The Future?

Global CO₂ atmospheric concentration

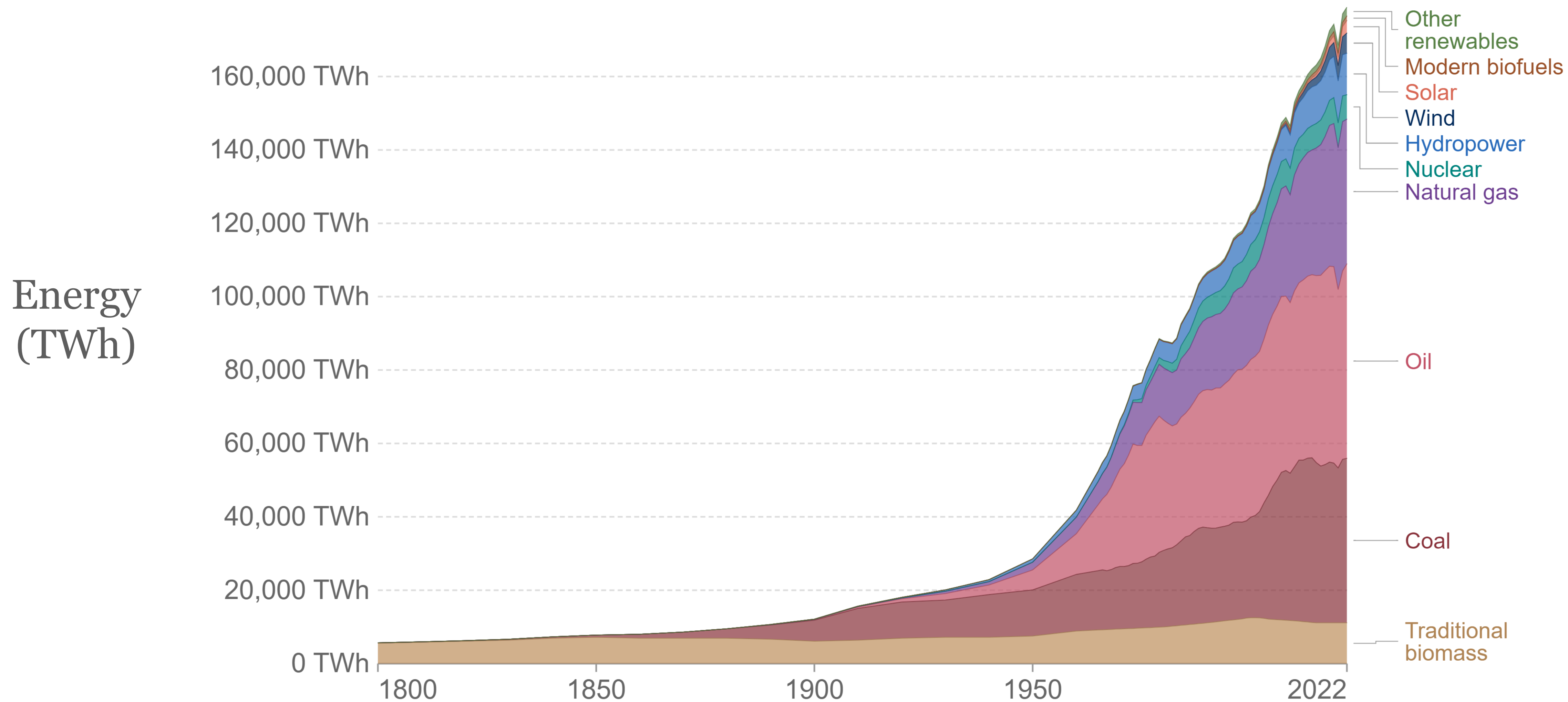
CO₂
Parts
per
million



Greenhouse gas by sector

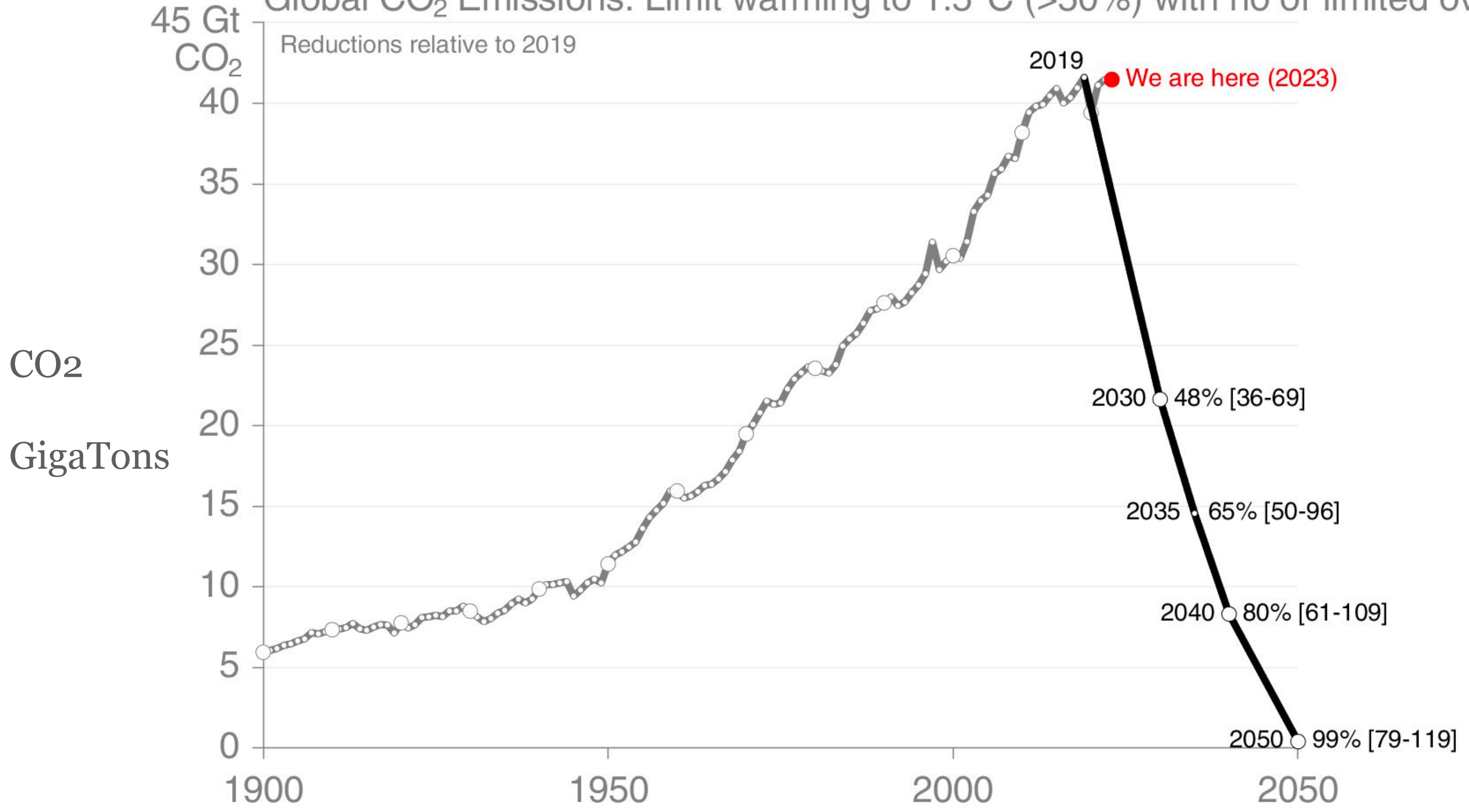


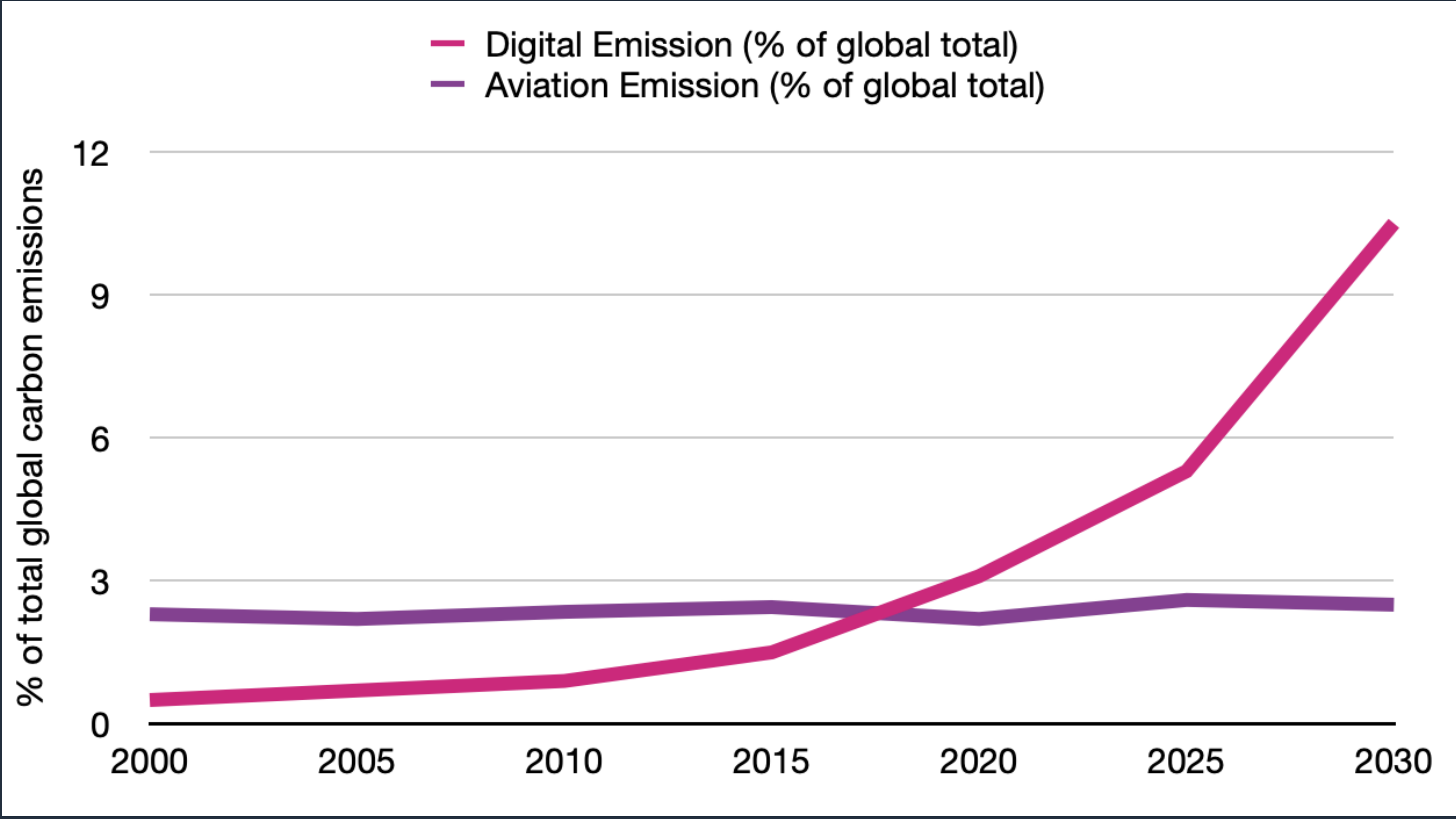
Global primary energy consumption by source



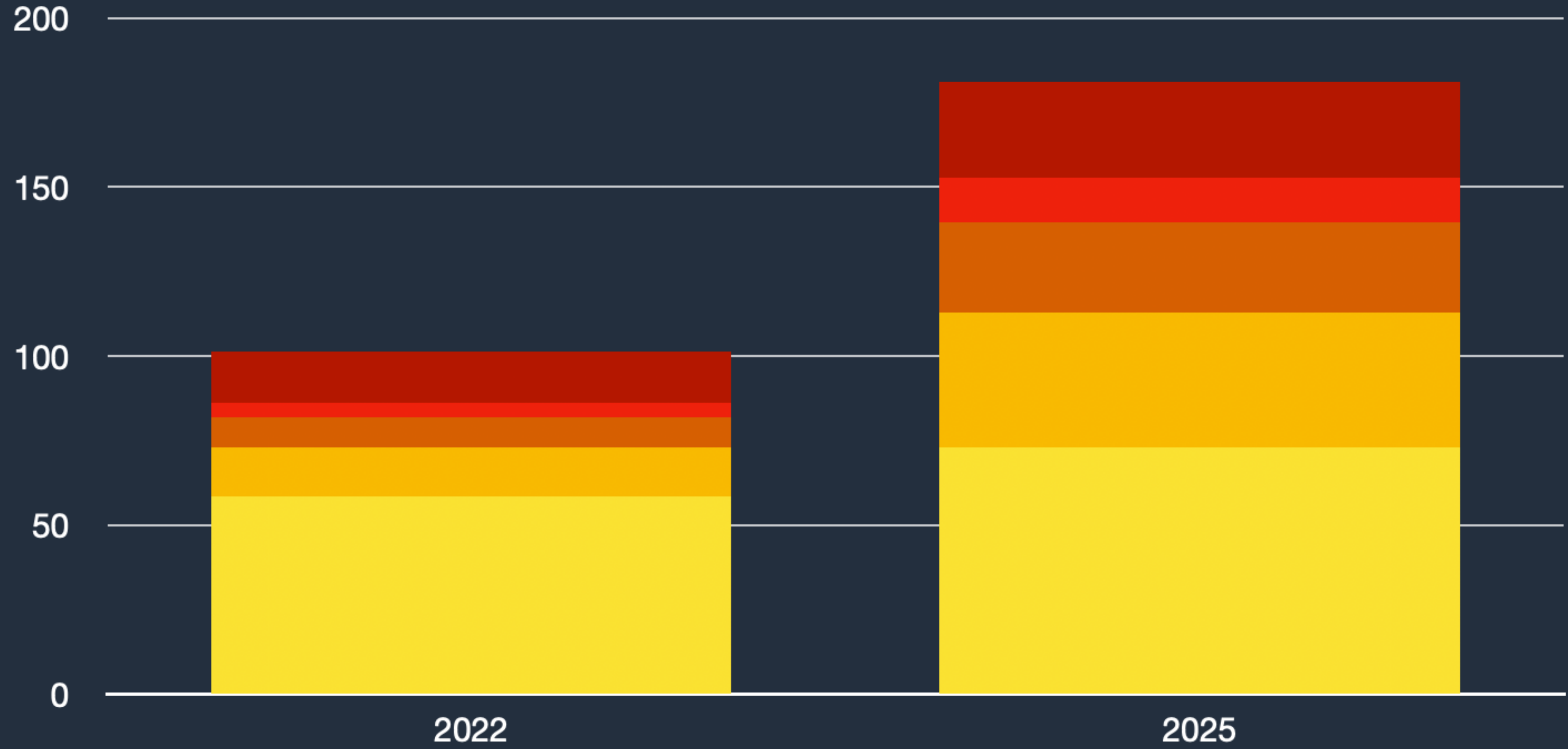
Source: Energy Institute Statistical Review of World Energy (2023); Vaclav Smil (2017)
OurWorldInData.org/energy • CC BY

Global CO₂ Emissions: Limit warming to 1.5°C (>50%) with no or limited overshoot





IoT Devices AWS Azure GCP Others



New data created (ZBytes / year)



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Eco-conscious Cloud Computing

Energy Awareness

+

Systems Thinking

aws

COMMUNITY DAY

1997



aws

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aws

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AWS Nevada - one of 700 hyper scale data centres

Where does the Cloud come from?

Energy + Minerals

Life Cycle Assessment of Dell R740



On behalf of Dell

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

Life Cycle Assessment of

Dell R740



On behalf of Dell

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)

Why is the Cloud here?

Why is the Cloud here?

Compute + Storage + Networking

Cost + Convenience + Control



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Why is the Cloud here?



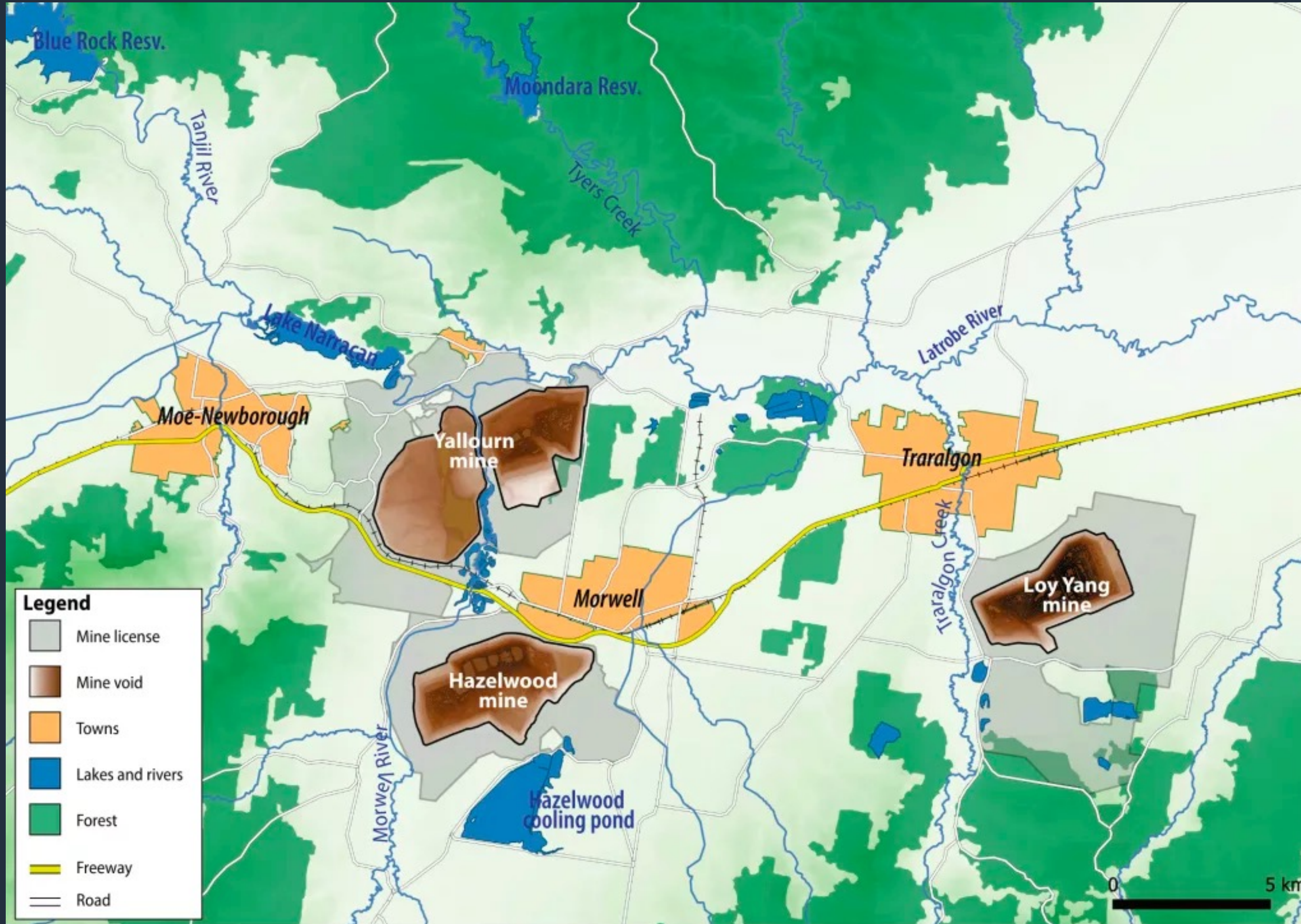
Melbourne region
(ap-southeast-4)

- 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

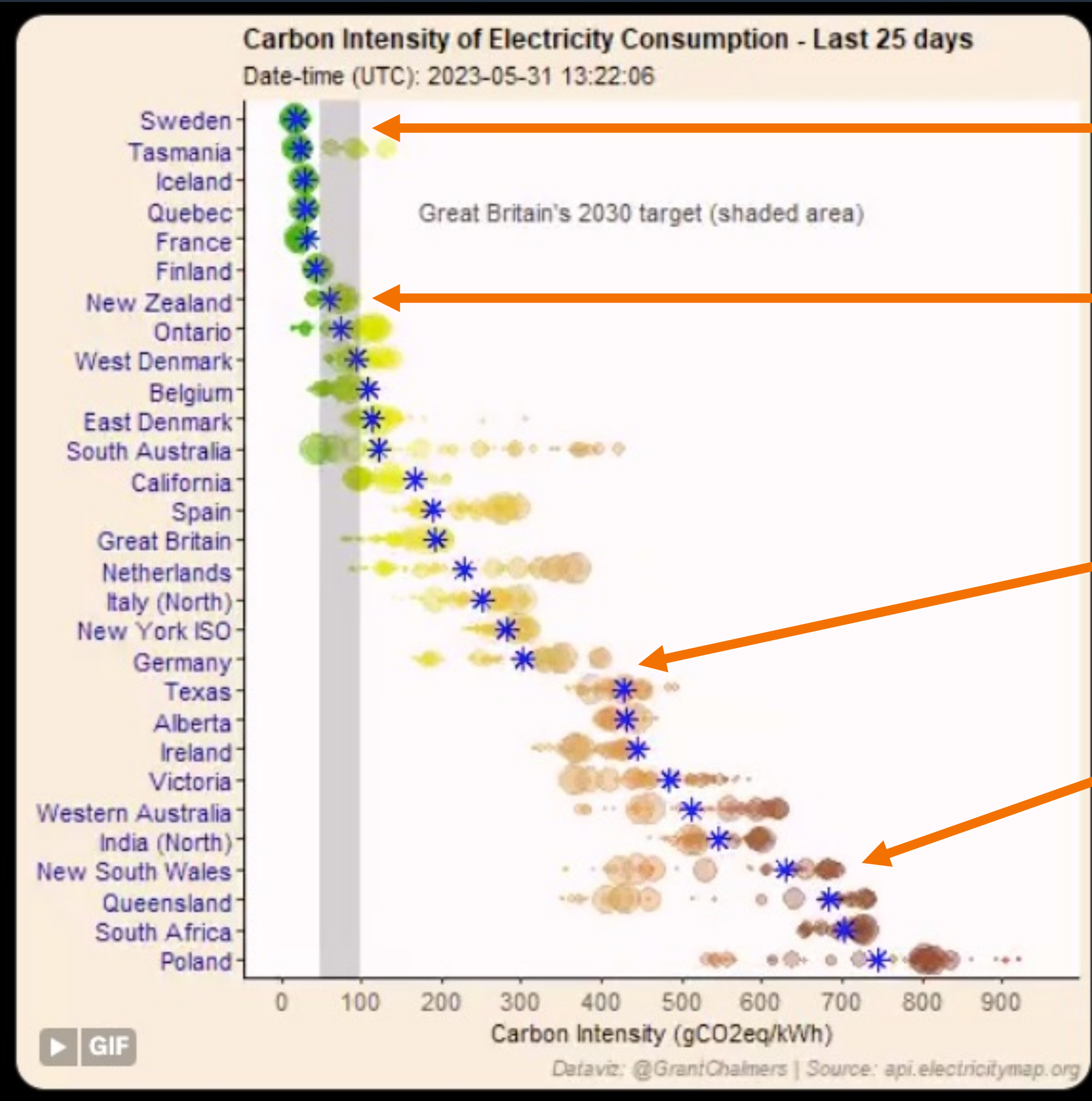


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Why is the Cloud here?



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



Sweden

New Zealand

Singapore

Australia



Why is the Cloud here?

Compute + Storage + Networking

Cost + Convenience + Control + **CLIMATE**



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Conceptual

What happens to my Cloud when it dies?



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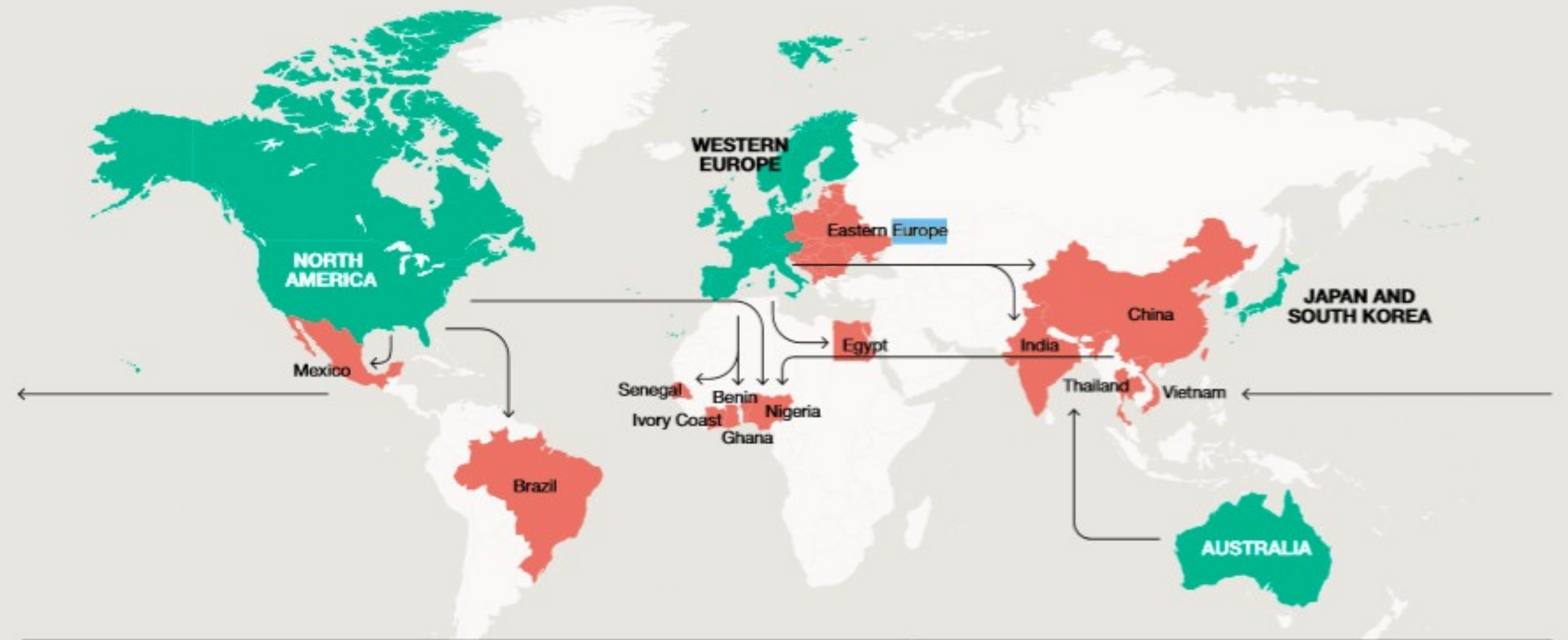
End of life





MAPPING OUT E-WASTE

- ◆ Regions sending e-waste
- ◆ Regions receiving e-waste
- ↪ Common routes for illegal shipments



Some of the highest and lowest e-waste generating nations E-Waste generated (kg per capita), 2016

28.5	24.9	24.8	23.9	23.6	0.4	0.5	0.6	0.6	0.8
Norway	United Kingdom	Denmark	Netherlands	Australia	Niger	Ethiopia	Afganistan	Uganda	Nepal

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

Individuals



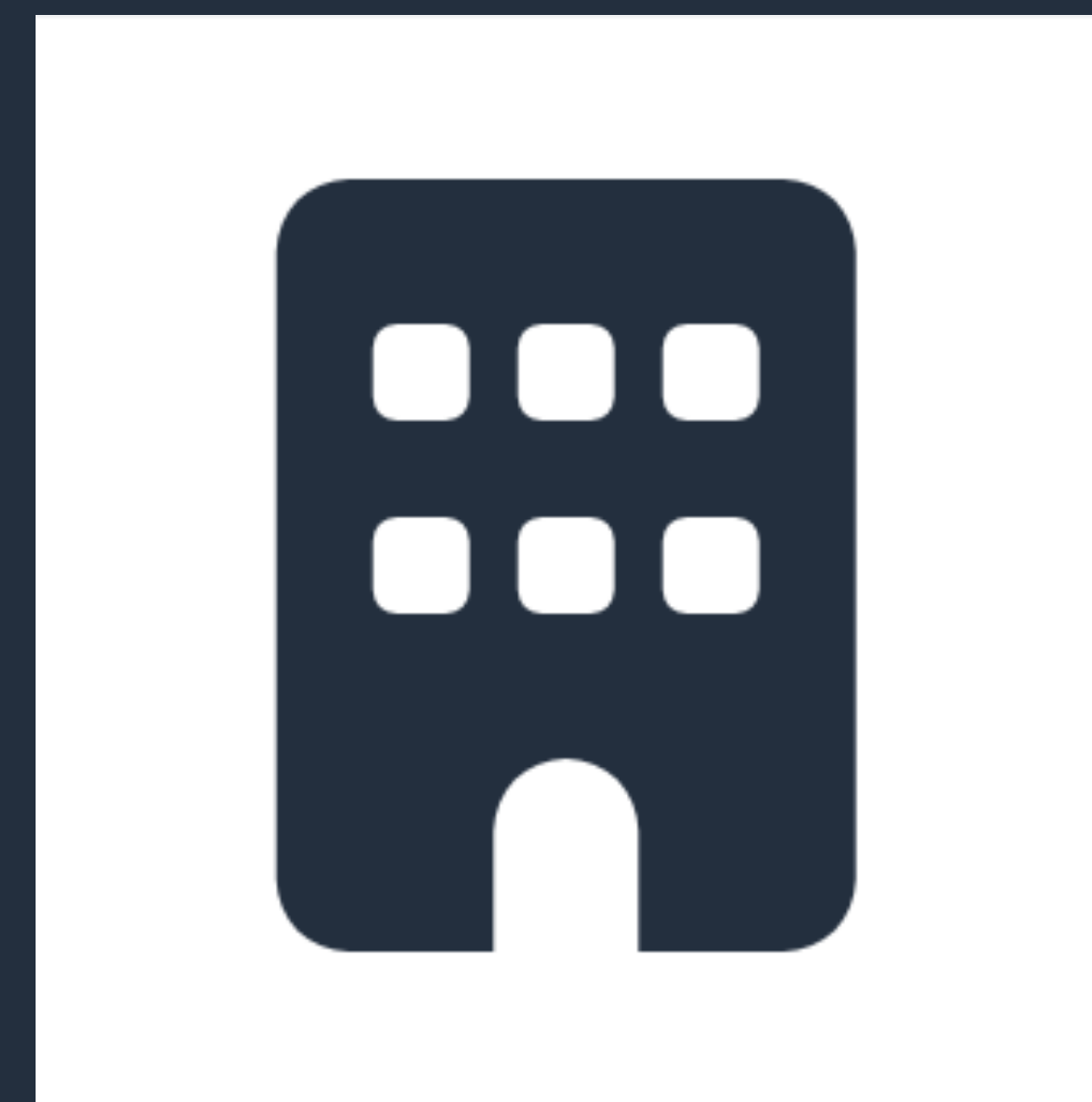
Measure / Report

Teams



Manage / Optimise

Organisations



Reduce / Offset



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Awareness

Tools

Advice

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

AWS Billing > Cost and Usage Reports

Cost and Usage Reports [Info](#)

Cost and Usage Reports (1) Actions Create report

<input type="checkbox"/>	Report name	S3 bucket	Time granularity	Data last refreshed
<input type="checkbox"/>	TestApi	carbon-usage	Daily	August 25, 2023, 03:28 (UTC+12:00)

Analyze your cost and usage

AWS Cost Explorer lets you dive deeper into your cost and usage data to identify trends, pinpoint cost drivers, and detect anomalies. [View in Cost Explorer](#)

Monitor your Reserved Instance (RI)

This report allows you to visualize your RI utilization, providing insight into increasing your RI usage efficiency. [View in Utilization Report](#)

AWS Usage Report

You can download dynamically generated AWS usage reports that cover a single service. [Create a Usage Report](#)

Customer Carbon Footprint Tool [Info](#)

Start month: May 2022 | End month: May 2023 | Download

Your carbon emissions summary

Compares your carbon emissions with on-premises computing equivalents

0.389 MTCO_{2e} Your estimated AWS emissions | **0.525** MTCO_{2e} Your emissions saved on AWS

Your emissions by geography

■ AMER ■ APAC ■ EMEA

Your emissions by services

Service	Carbon emissions	%
EC2	0.128 MTCO _{2e}	32.9%
S3	0.0 MTCO _{2e}	0%
Other	0.261 MTCO _{2e}	67.1%
Total	0.389 MTCO _{2e}	100%

Your emission savings

0.243 MTCO_{2e} Saved from AWS renewable energy purchases | **0.282** MTCO_{2e} Saved by using AWS computing services

Your AWS carbon emission statistics

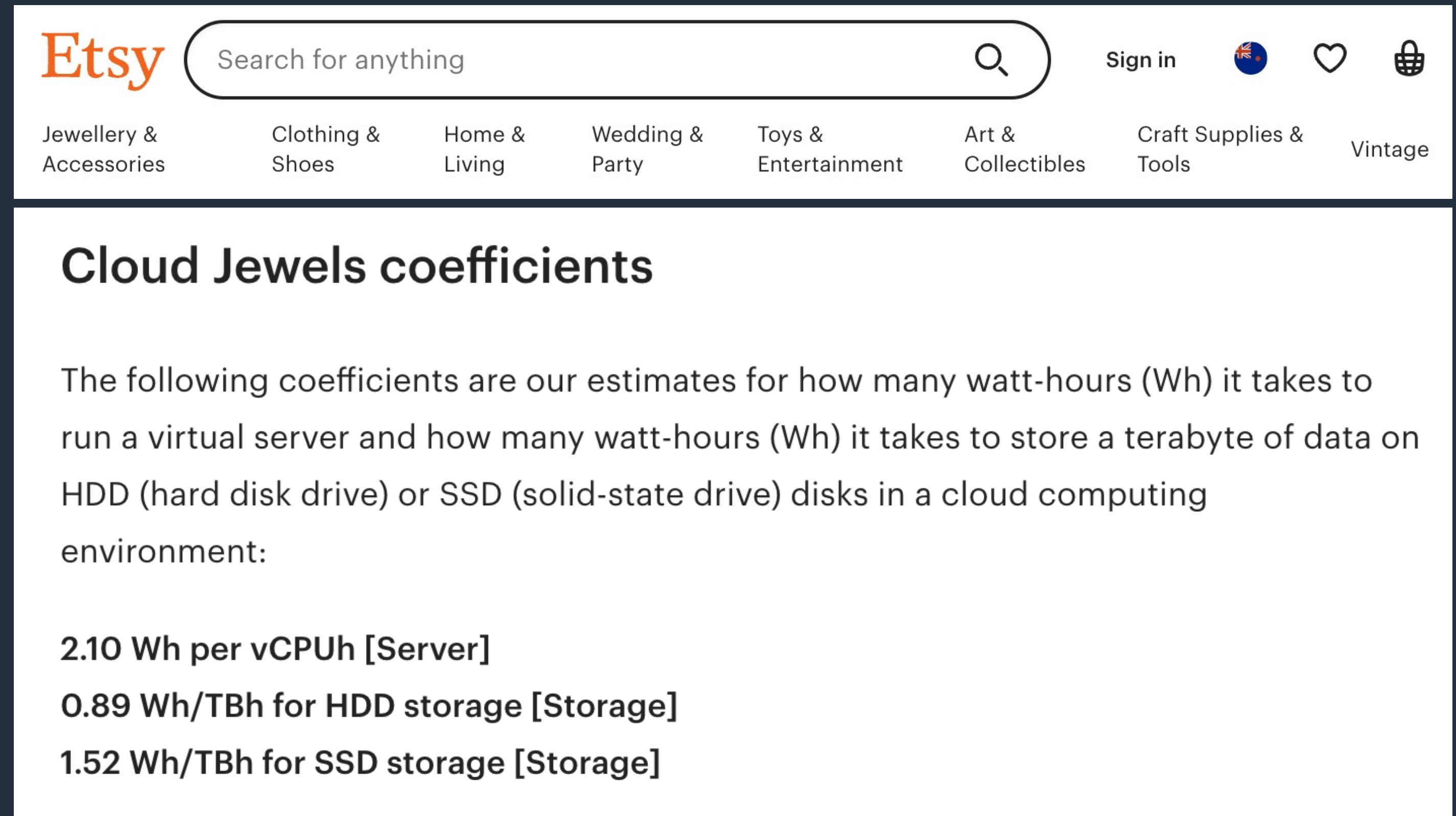
Month Quarter Year

Carbon emissions (MTCO_{2e})

Timeline: Sep 2020, Dec 2020, Mar 2021, Jun 2021, Sep 2021, Dec 2021, Mar 2022, Jun 2022, Sep 2022, Dec 2022, Mar 2023

2. Etsy (yes, the online marketplace)

- Simple
- Energy Estimate
- EY Verified



The image shows a screenshot of the Etsy website. At the top, the Etsy logo is on the left, followed by a search bar with the text "Search for anything" and a magnifying glass icon. To the right of the search bar are links for "Sign in", a globe icon, a heart icon, and a shopping cart icon. Below the search bar, there are several category links: "Jewellery & Accessories", "Clothing & Shoes", "Home & Living", "Wedding & Party", "Toys & Entertainment", "Art & Collectibles", "Craft Supplies & Tools", and "Vintage".

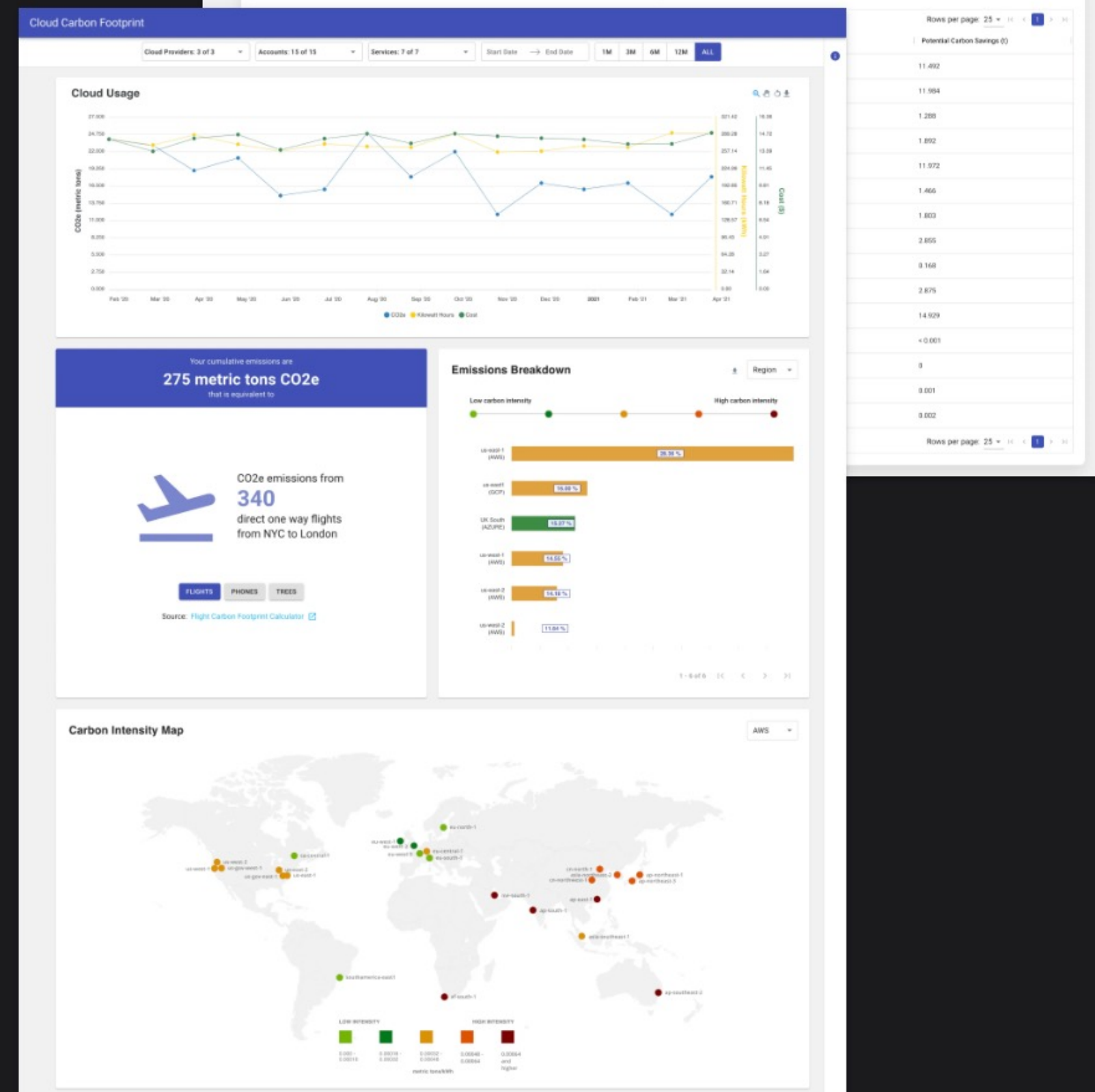
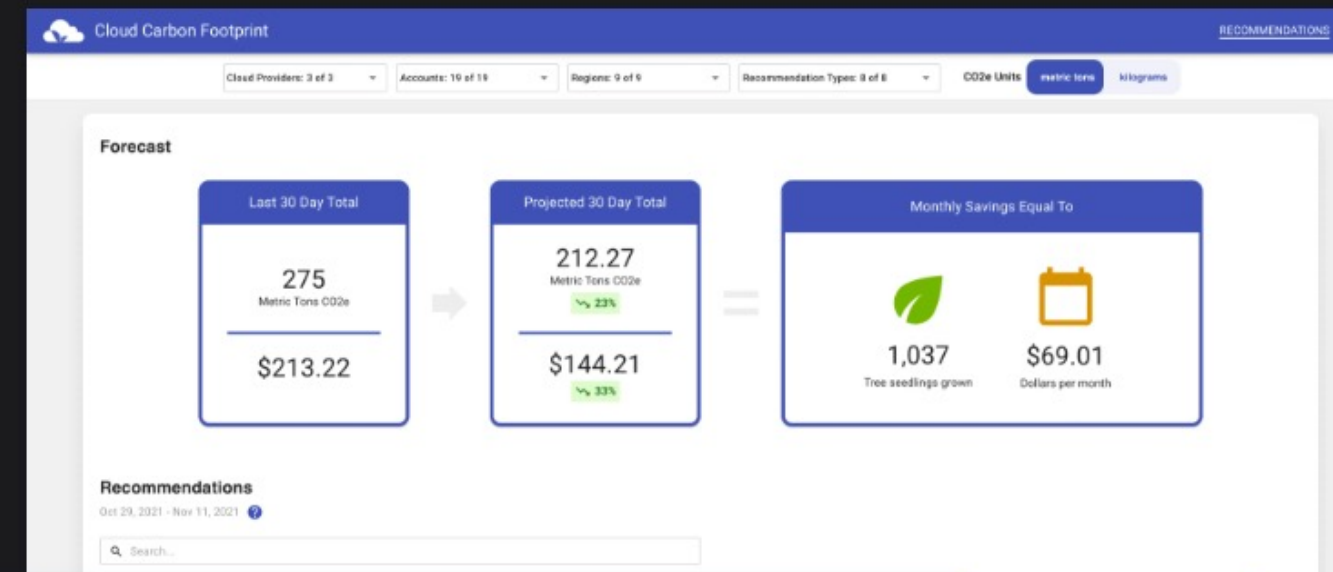
Cloud Jewels coefficients

The following coefficients are our estimates for how many watt-hours (Wh) it takes to run a virtual server and how many watt-hours (Wh) it takes to store a terabyte of data on HDD (hard disk drive) or SSD (solid-state drive) disks in a cloud computing environment:

- 2.10 Wh per vCPUh [Server]
- 0.89 Wh/TBh for HDD storage [Storage]
- 1.52 Wh/TBh for SSD storage [Storage]

3. Cloud Carbon

- Open source methodology
- Embodied emissions
- API integration



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

4. Teads Engineering EC2 calculator

- Open source dataset
- Web calculator
- Simple UX

Select your workload

Instance Type *

db.m2.4xlarge

AWS Region *

us-west-2 | US West (Oregon)

Computing hours

1 Hour(s)

Estimate

Your Estimation

Detailed calculation for:

Instance: **db.m2.4xlarge** [More info](#)

Region: **US West (Oregon)** [More info](#)




Just estimated the carbon footprint of my EC2 workload: for 720 hour(s) of db.m2.4xlarge in us-west-2 the result is **31762.3 gCO₂eq** (24130.3 gCO₂eq for running the Instance and 7632 gCO₂eq for its manufacturing). Give it a try too!


by Teads Engineering

Share on Twitter

Check the full methodology

5. SilverLining portal





🏠 /
👤 Test Org 1 /
📄 TEst account

1 Aug 2022 - 1 Jul 2023
☰

💰
Spend

⚡
Energy

☁️
Carbon

♻️
Waste

Total **636.6 kWh**

The total energy related to the usage of cloud resources for the given account. By comparison, a family home would consume about 500kwh per month.

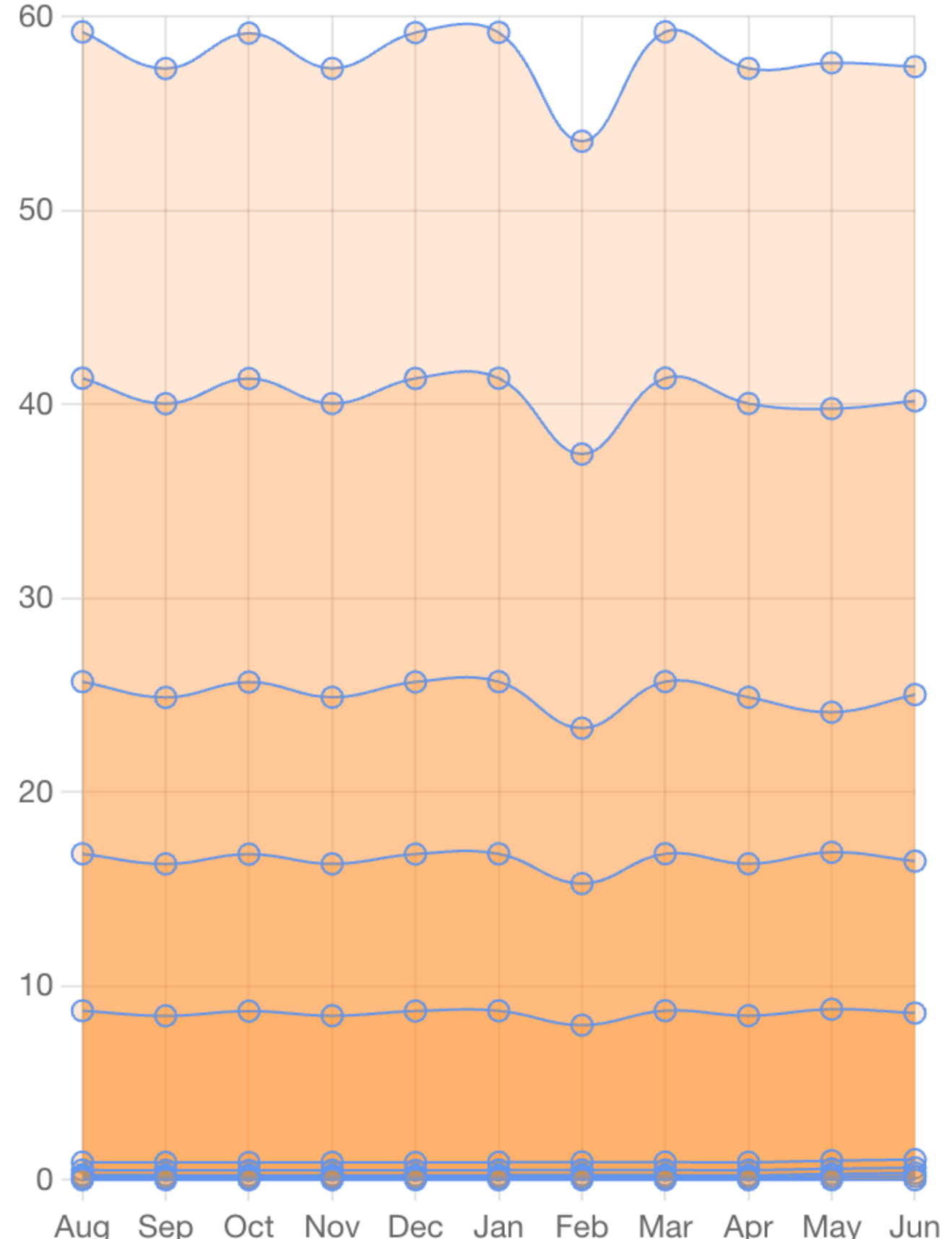
Energy consumed by region:

APS2	100.00%
------	---------

Your next recommended action is to define your cloud compute decarbonizing strategy.

Take action

Energy Consumed (kWh / month)



Resource	Usage (kWh)
APS2-BoxUsage:t2.medium	192.322
APS2-BoxUsage:t3.nano	168.728
APS2-BoxUsage:t2.small	94.022
APS2-BoxUsage:t2.micro	87.239
APS2-NodeUsage:cache.t2.micro	84.182
APS2-EBS:SnapshotUsage	4.498
APS2-TimedStorage-ByteHrs	2.828
APS2-EBS:VolumeUsage.gp2	1.529
APS2-Aurora:BackupUsage	1.267
USE1-TimedStorage-ByteHrs	0.015

```

{
  "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

aws

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Springload 

ZX
SECURITY

liquid
security led IT

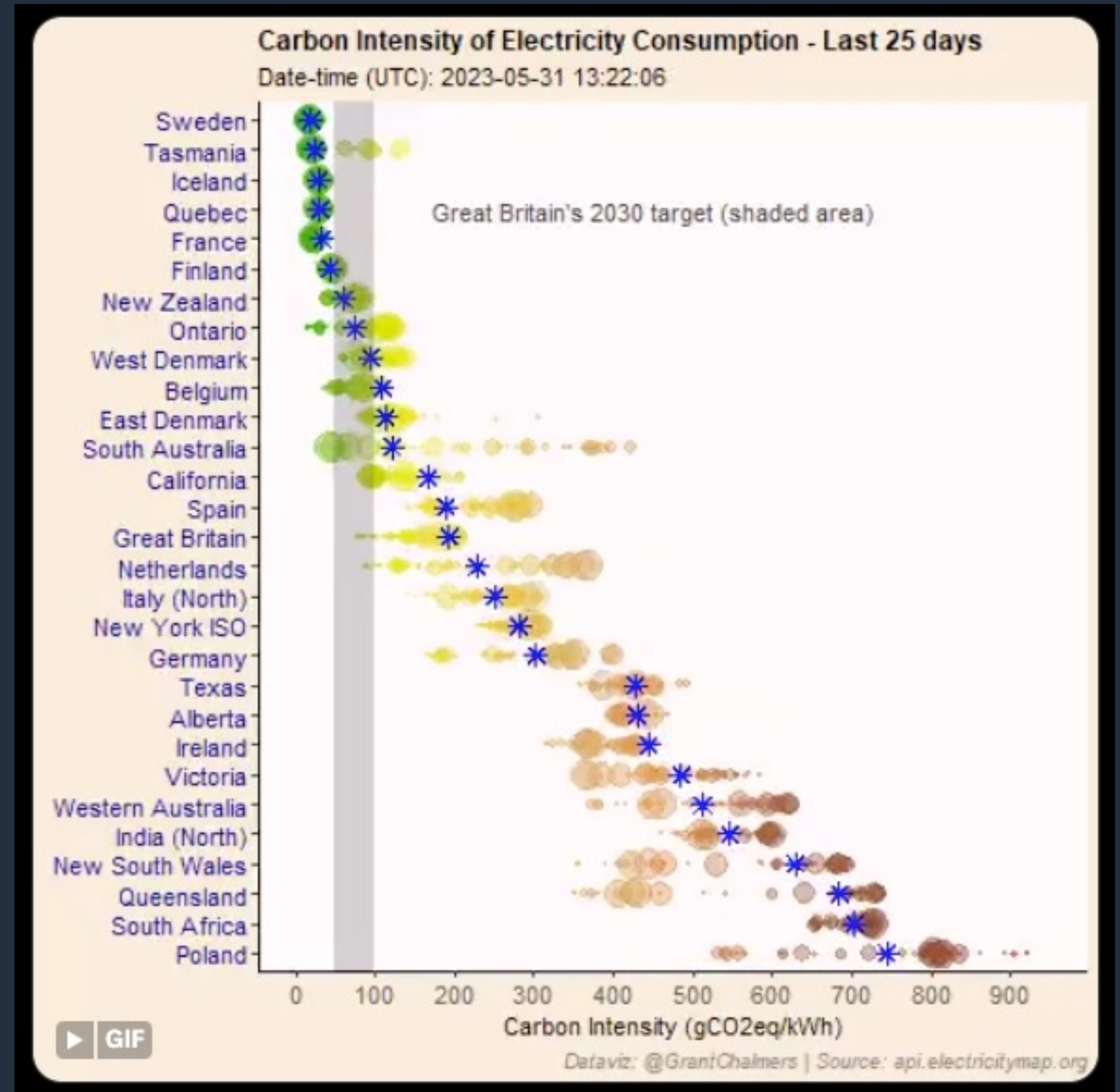
COGO



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Chose a different region:

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



Energy Scenarios (Storage)

Solid State?

Hard Drive?

Replications?

Offline Archive?



Amazon S3

Data storage
for unstructured
data



Amazon EBS

System storage
for Amazon EC2
VMs



Amazon EFS

Scalable data
storage for
Amazon EC2 VMs



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Energy Scenarios (Compute)

Processor: X86 / ARM / Graviton?

Database: RDS / SQLite / NoSQL / Aurora?

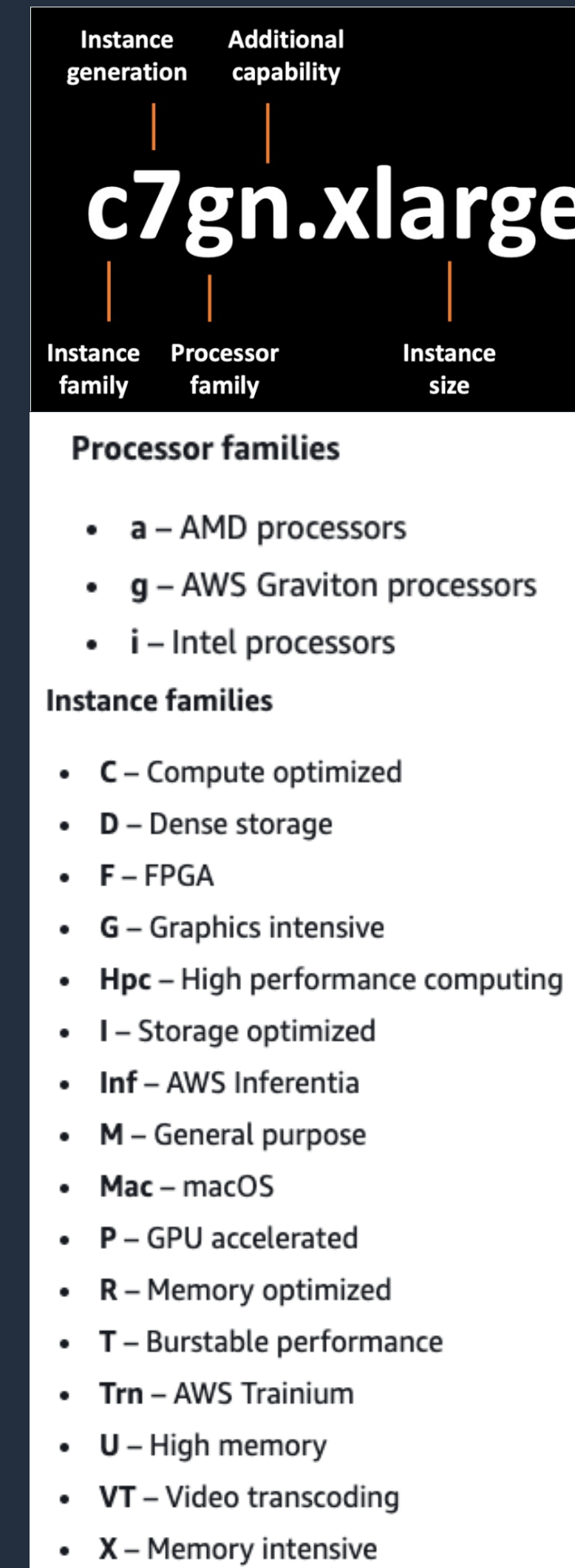
AppServer: ECS / Fargate / Lambda ?

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?





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Energy Scenarios (Compute)

Processor: X86 / ARM / Graviton?

Trade Off

Time

Energy Savings

Medium

Database: RDS / SQLite / NoSQL / Aurora?

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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Compute + Storage + Networking

COST + Convenience + Control + CLIMATE

aws

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Thank you... and any questions?



Hugh @ SilverLining.eco