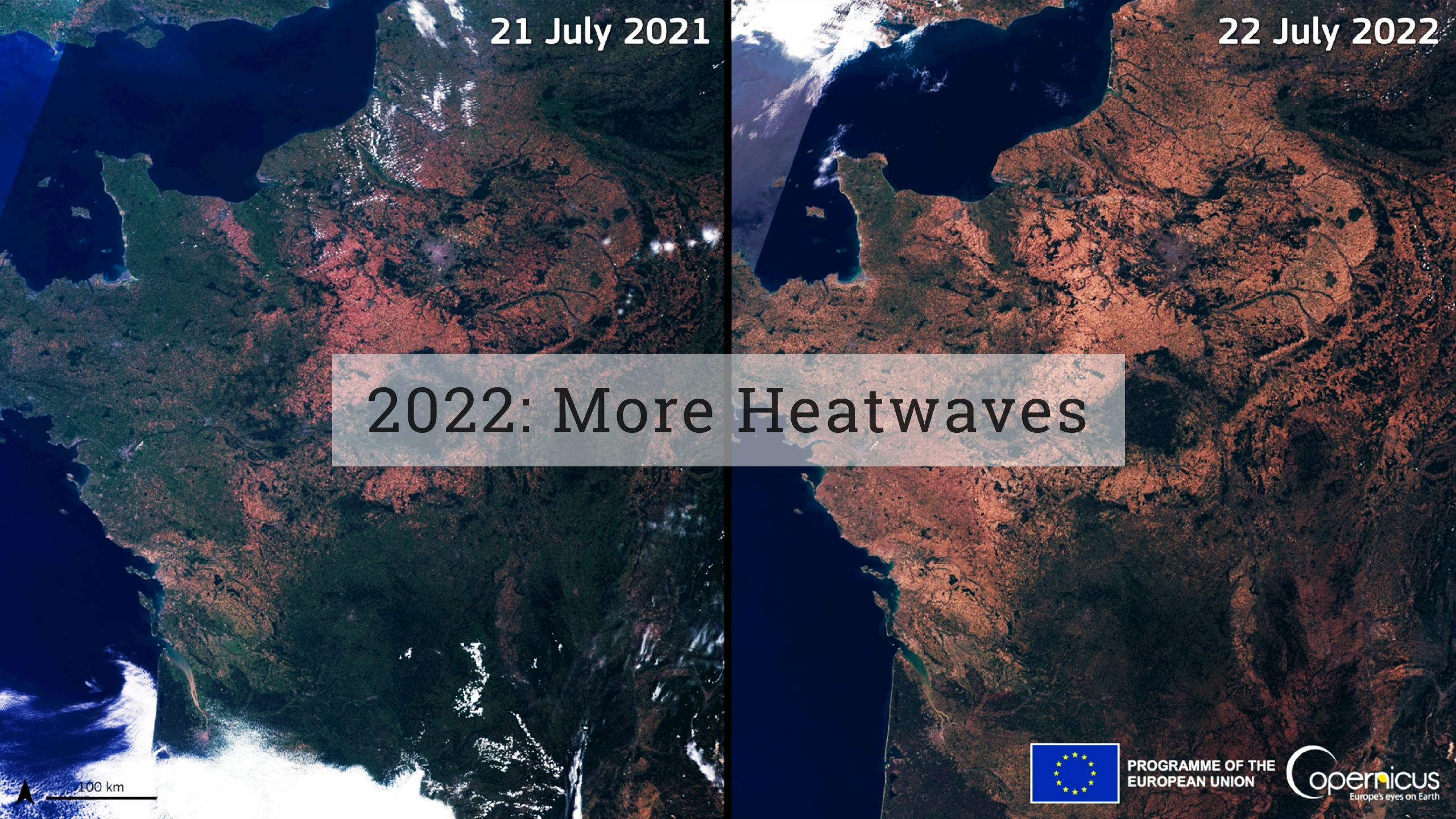
Better than the New Oil

Sustainable IT on the Radar

TOM KENNES

2021: 20% more floods (2000-2020)


21 July 2021
22 July 2022
2022: More Heatwaves
100 km
PROGRAMME OF THE EUROPEAN UNION
Copernicus
Europe's eyes on Earth

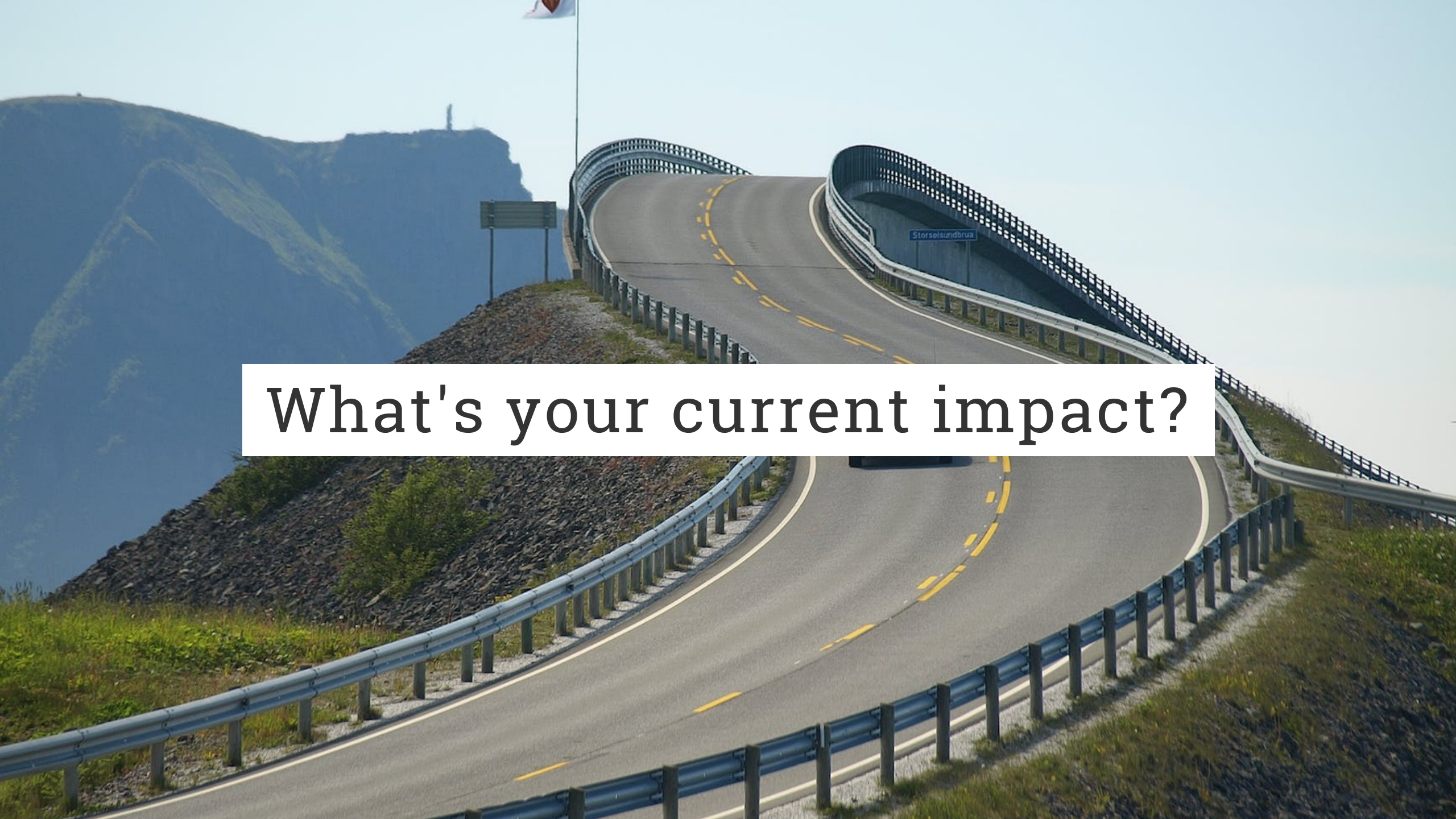
2022: China 70-day Heatwave

BETTER THAN THE NEW OIL

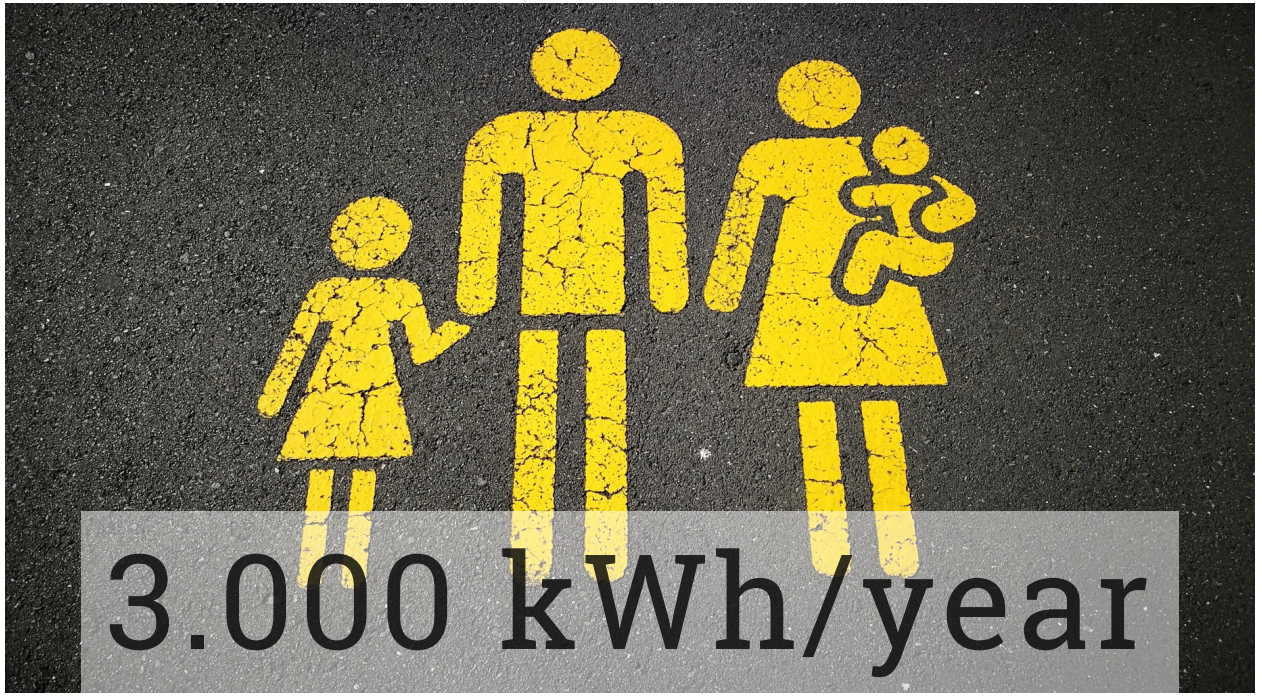
SDIA

skyworkz


How Did I End Up Here?



What's your current impact?

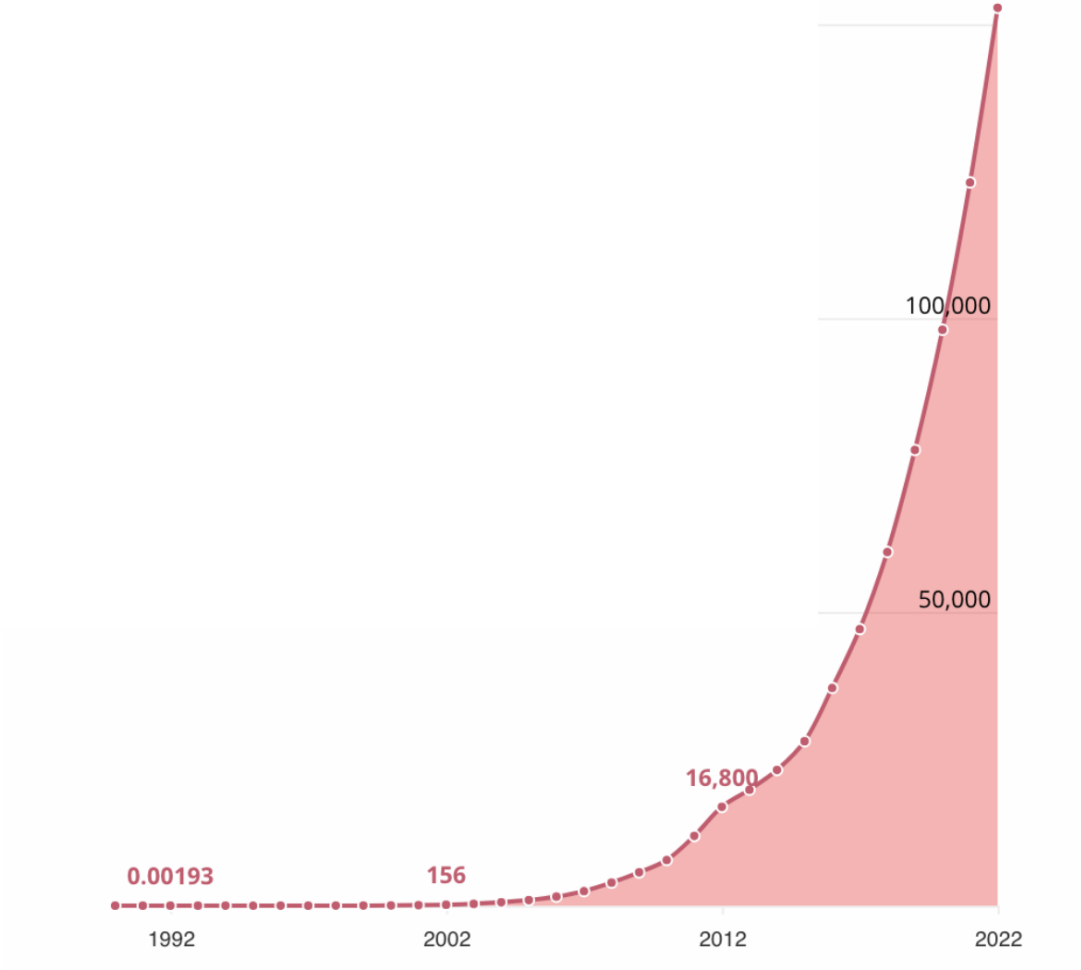

3.000 kWh/year


8.5t CO2/year

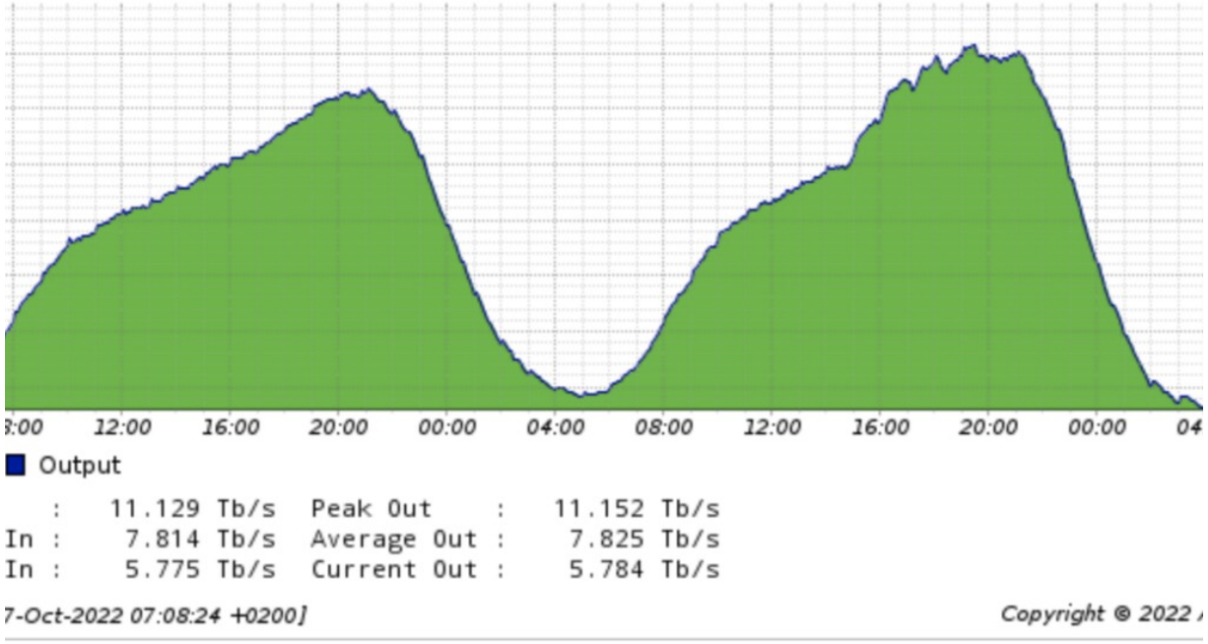

0.15-0.2 kWh/km for EVs,
3000 g CO2/l for gasoline


500 g CO2eq/kWh

Estimating CO2 is tough!

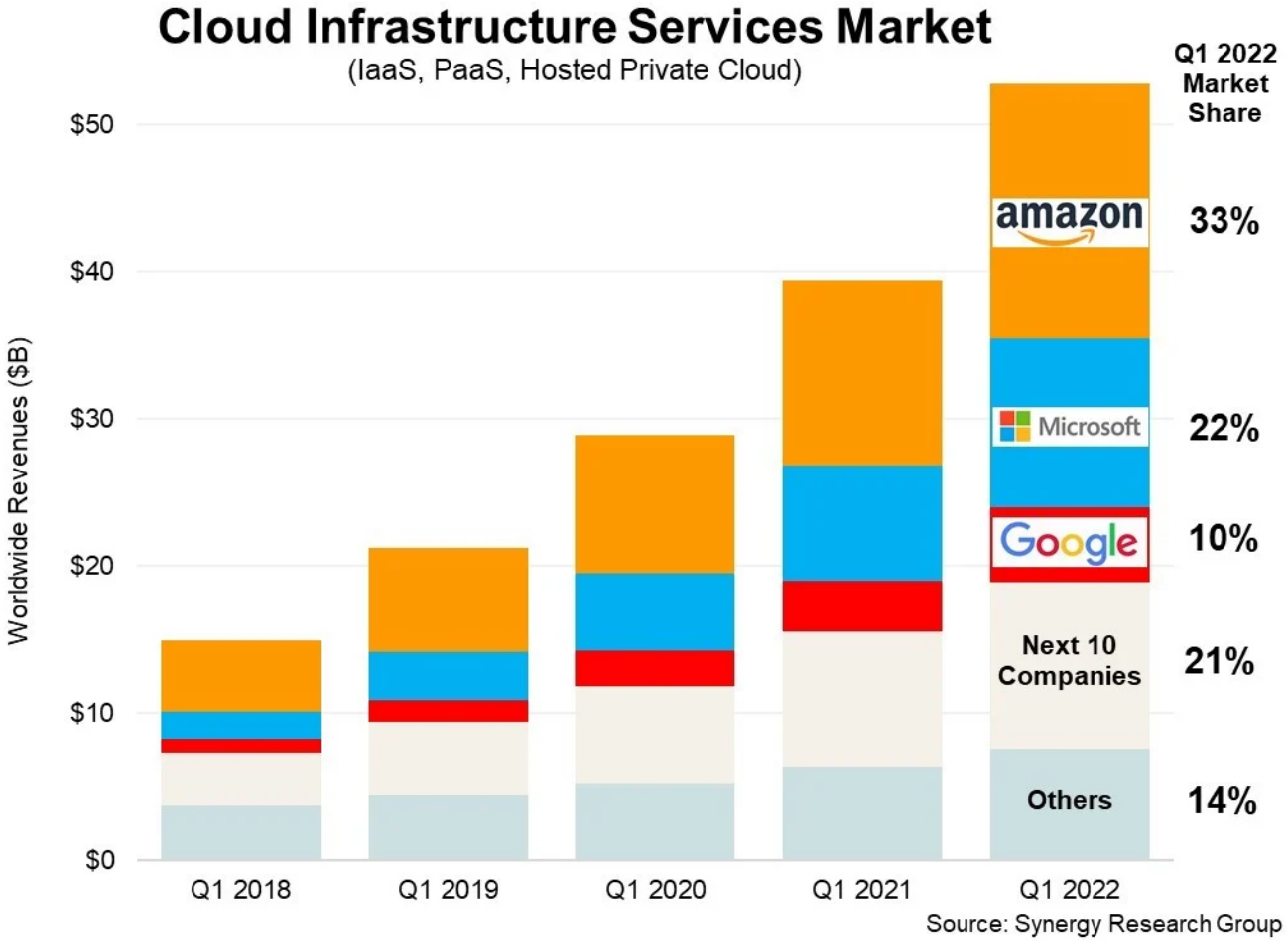


Global Internet traffic



AMS-IX breaking records

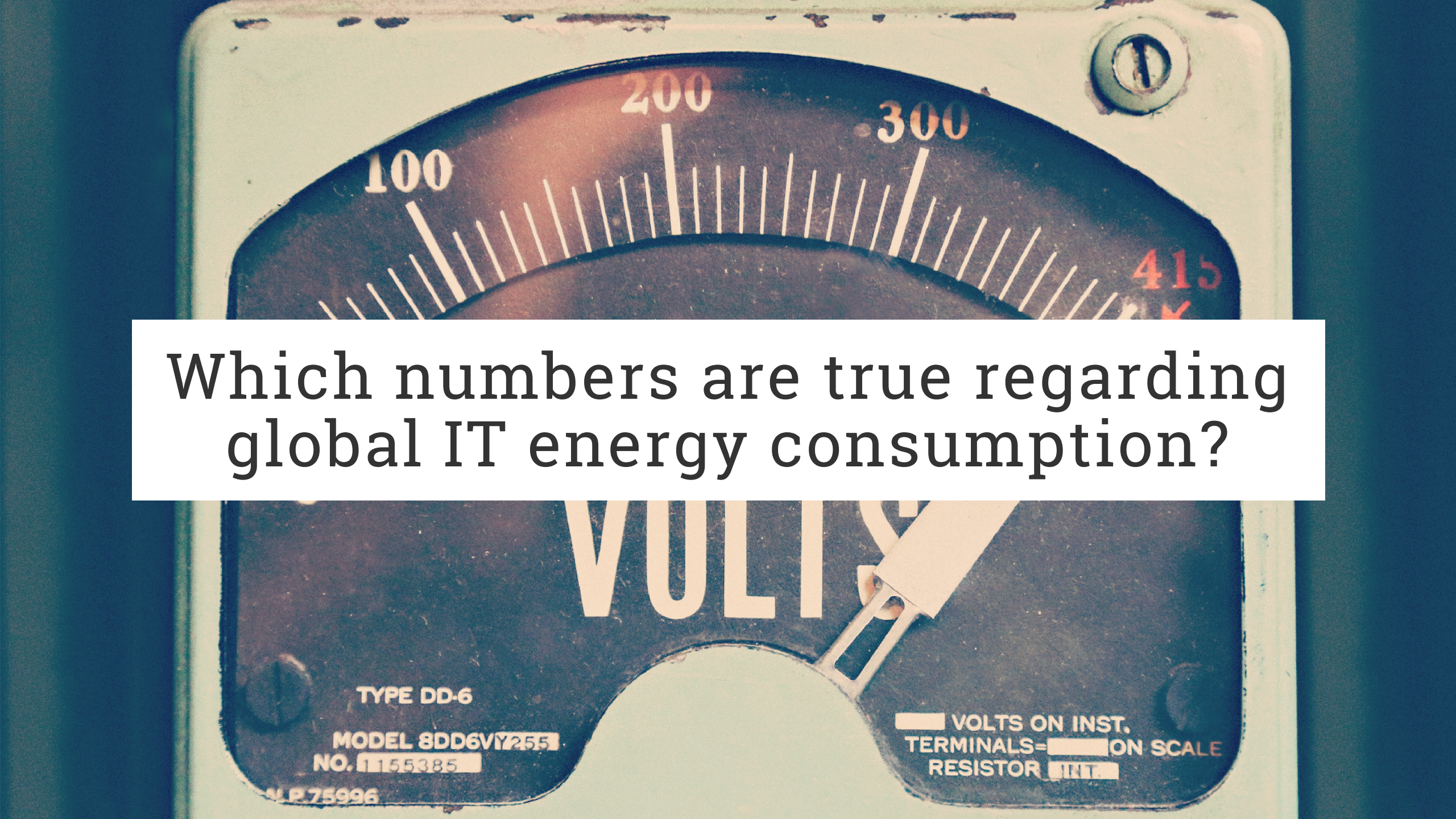
Let's bring it back to IT



Snowflake Gets $479M, Reaches Decacorn Status With $12.4B Valuation

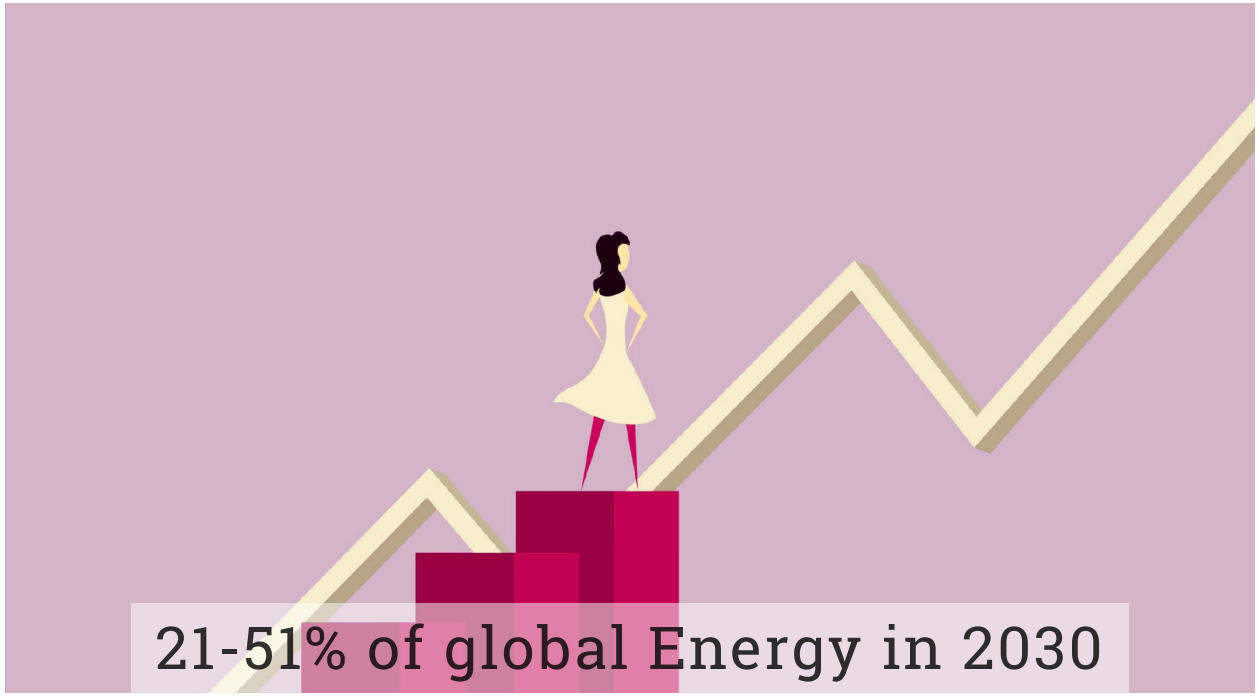
Databricks raises $1.6B at $38B valuation as it blasts past $600M ARR

Meta raises $10 billion in first-ever bond offering

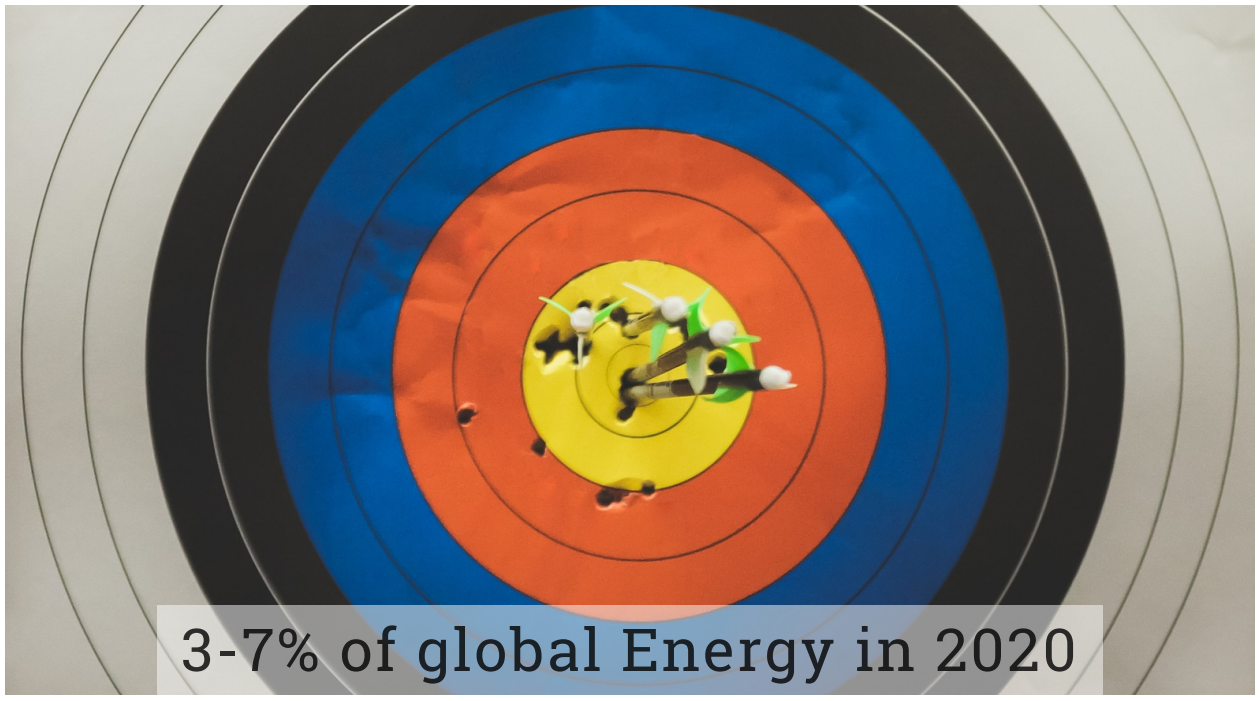


Which numbers are true regarding global IT energy consumption?


100% Renewable by 2030


21-51% of global Energy in 2030


CO2
Emissions will remain at 2%

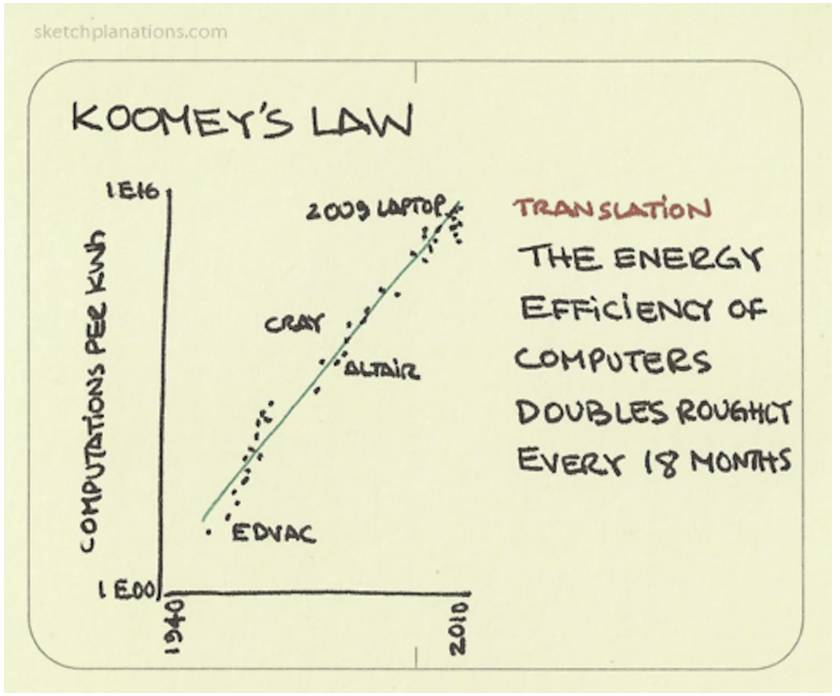

3-7% of global Energy in 2020

21-51% of Global Energy in 2030

(Green) Consultancies

THE SHIFT PROJECT

Specific non-profits



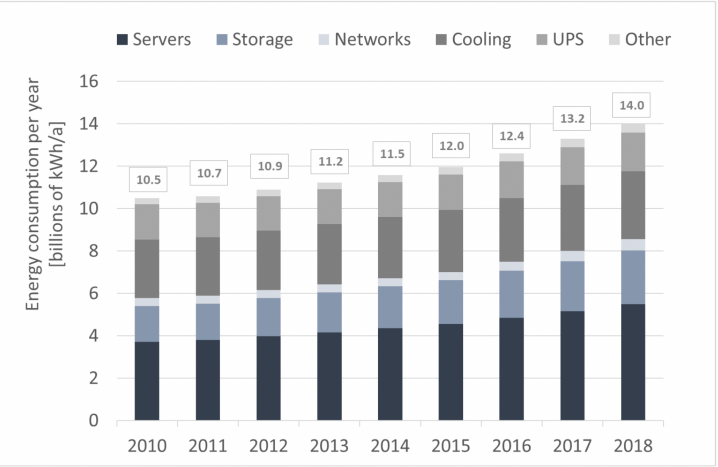
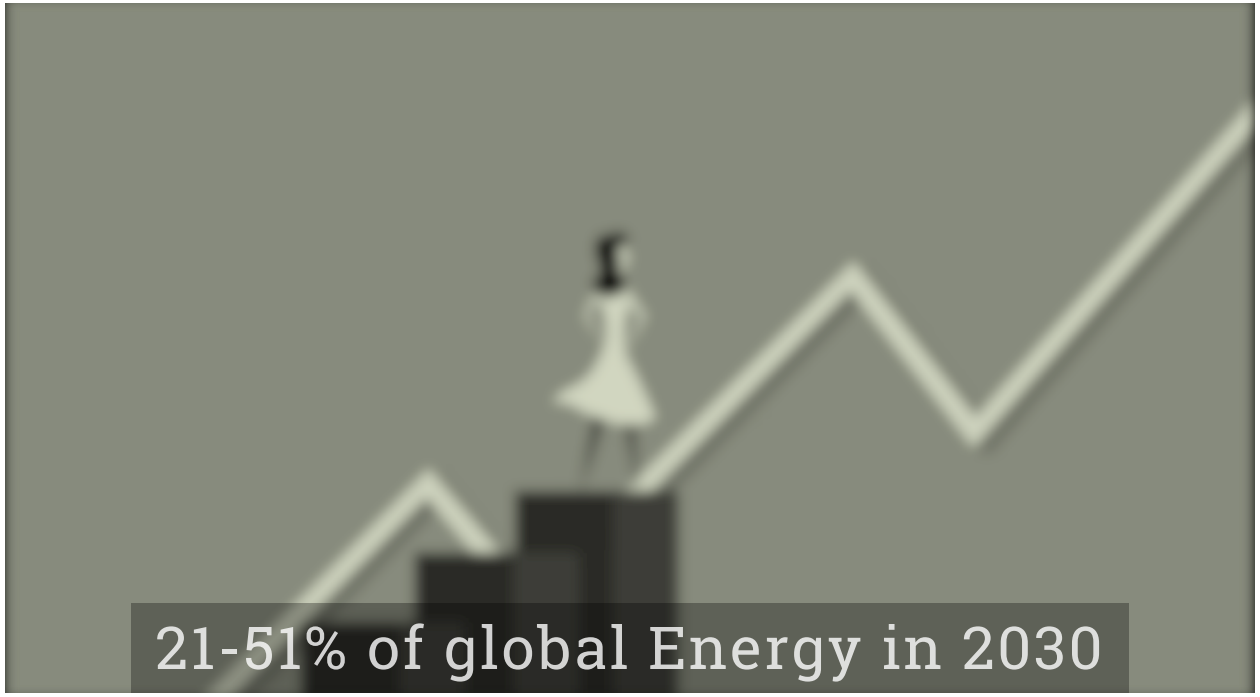


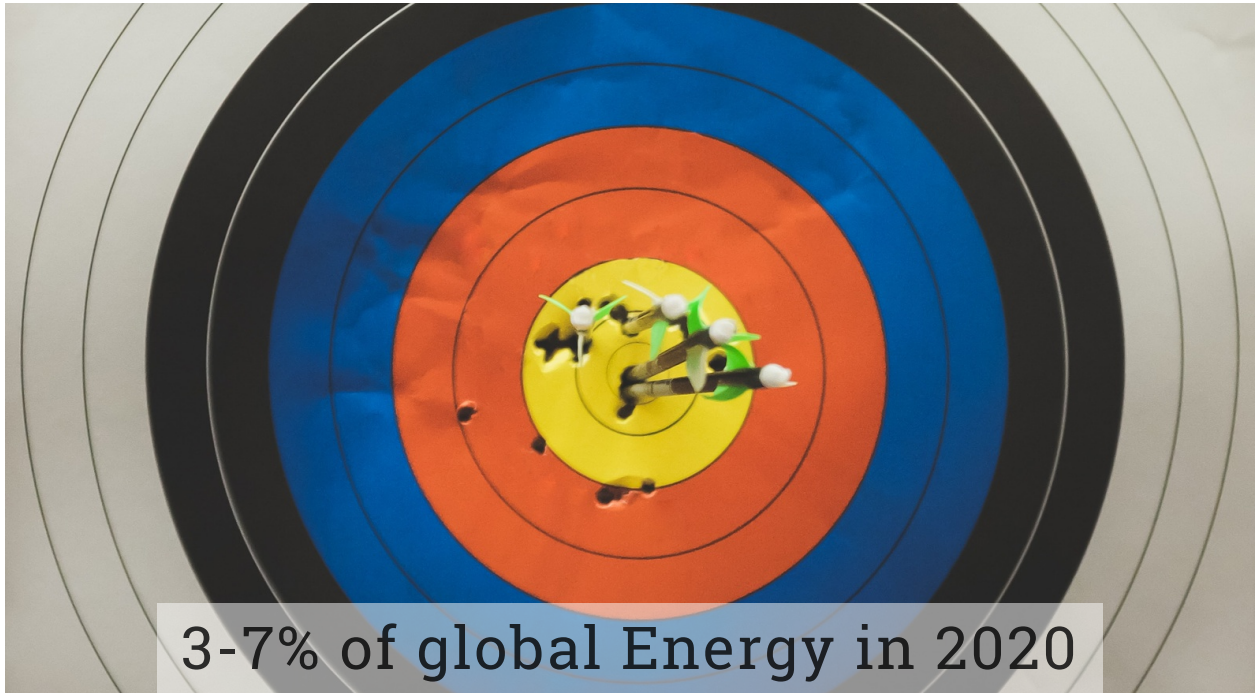
Figure 1: *Energy consumption of servers and data centers in Germany in the years 2010 to 2018 (Source: Borderstep)*

NO! Because Rebound Effects


100% Renewable by 2030


21-51% of global Energy in 2030


Emissions will remain at 2%


3-7% of global Energy in 2020

Cloud 100% renewable

2025

2025

Cloud 100% renewable

2025

2025

2007 (!) *

*Carbon-free datacenters by 2030

Purchasing Renewable Energy

Renewable Energy Offset Certificates

Carbon Accounting Dashboards

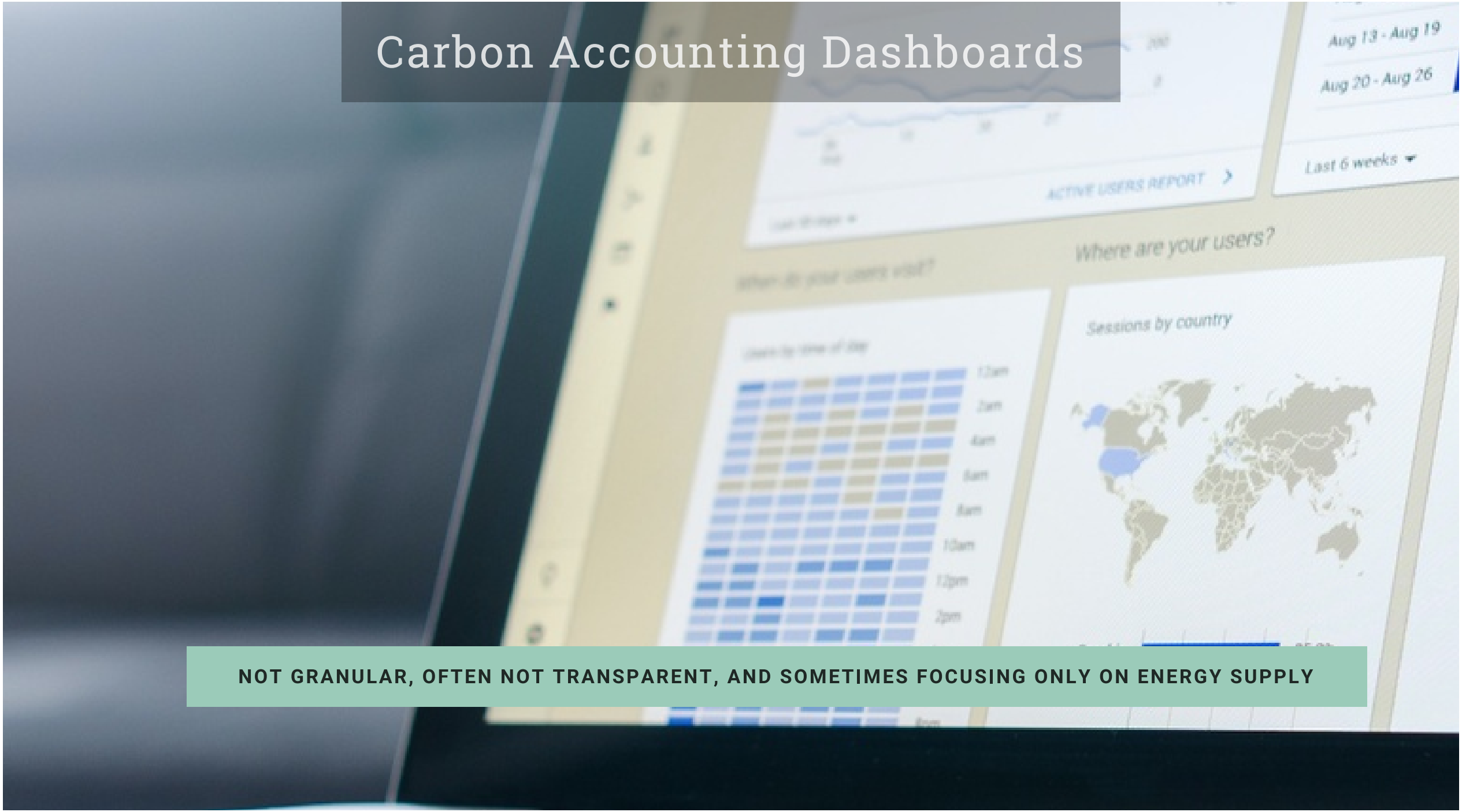
Purchasing Renewable Energy

HOLISTICALLY, WE ARE NOT GREENER

Renewable Energy Certificates

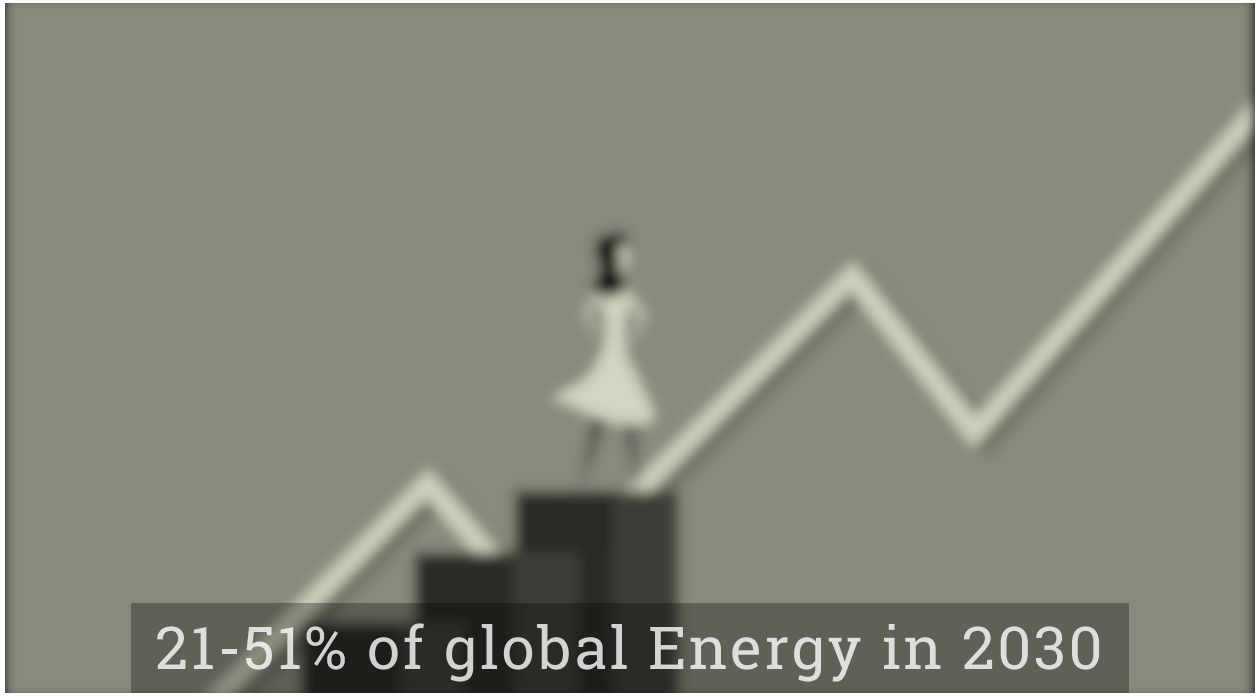
REMAIN HEAVILY CRITICIZED AND HARD TO AUDIT PROPERLY

Carbon Accounting Dashboards



NOT GRANULAR, OFTEN NOT TRANSPARENT, AND SOMETIMES FOCUSING ONLY ON ENERGY SUPPLY


100% Renewable by 2030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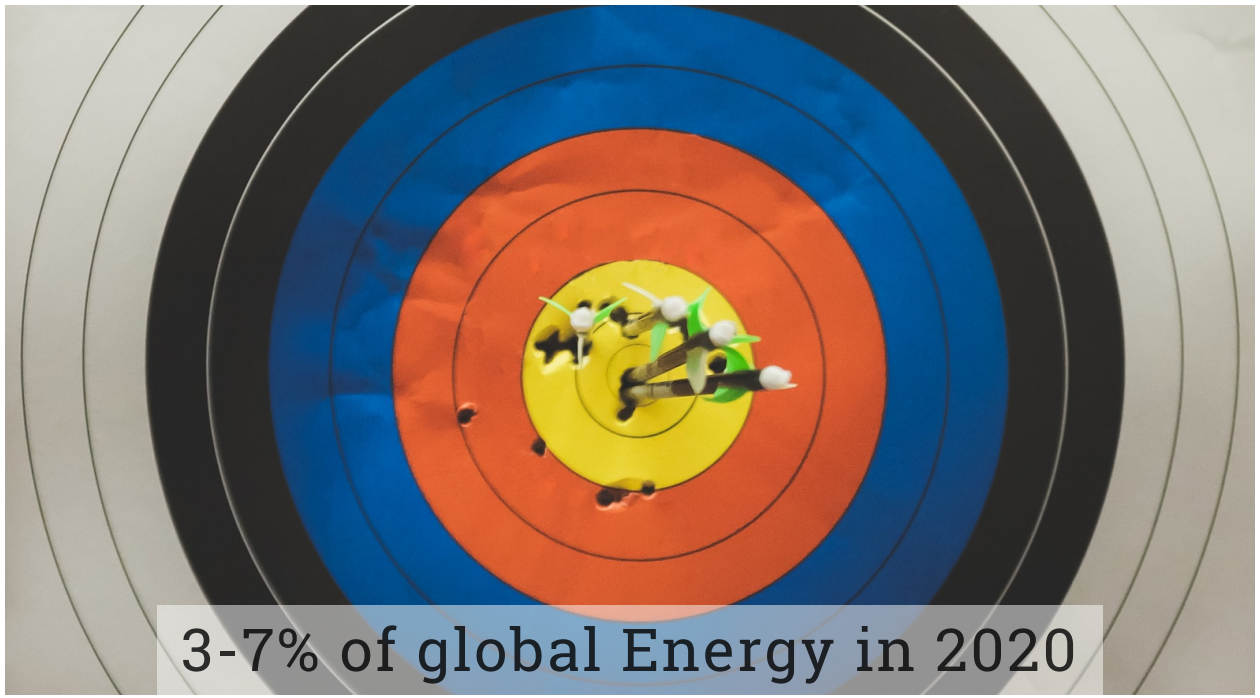

3-7% of global Energy in 2020

We need more trustworthy
lower-level energy measurements

IN ORDER TO REALLY TAKE INDIVIDUAL, CORPORATE RESPONSIBILITY

SDIA

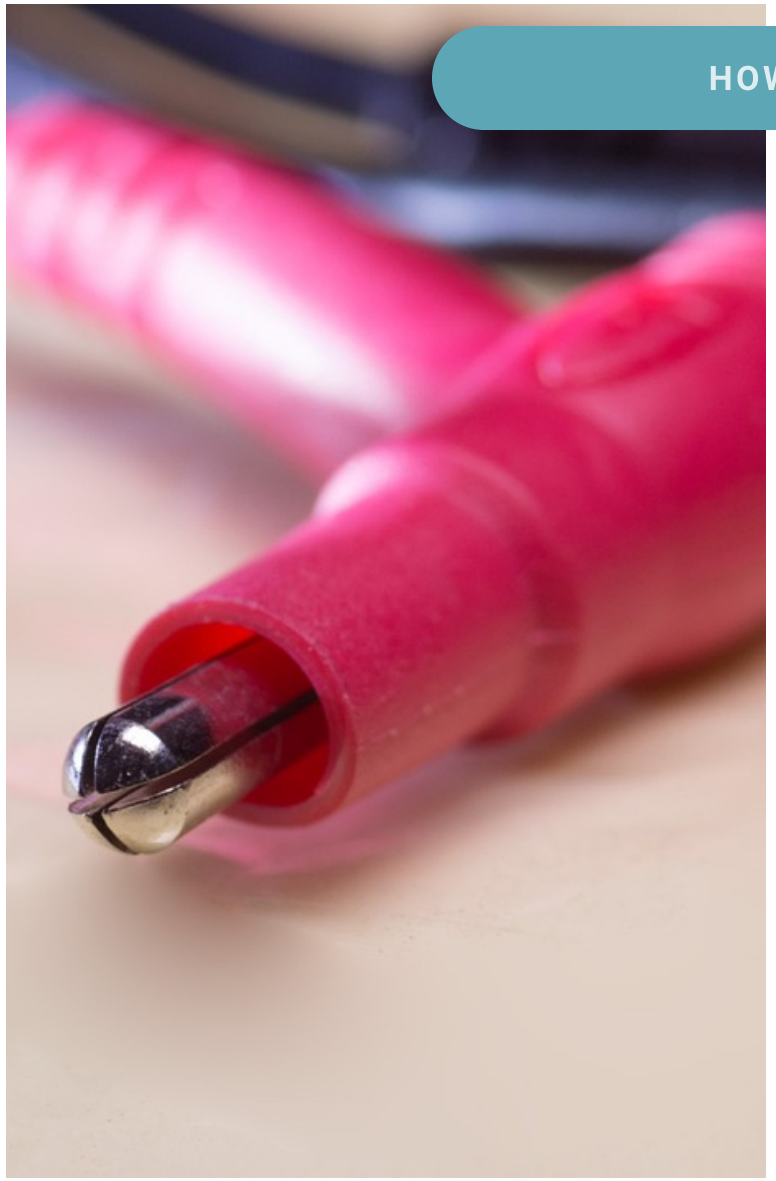
Deloitte.

EY Building a better working world

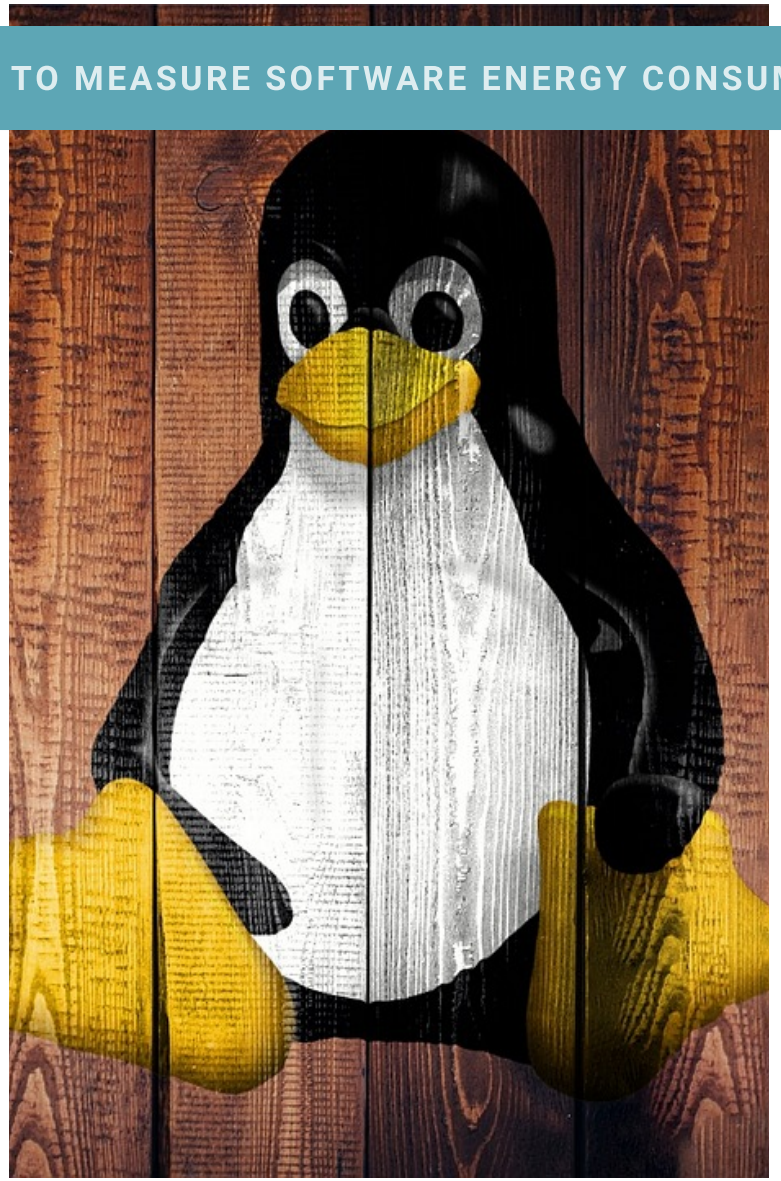
KPMG

pwc

HOW TO MEASURE SOFTWARE ENERGY CONSUMPTION?

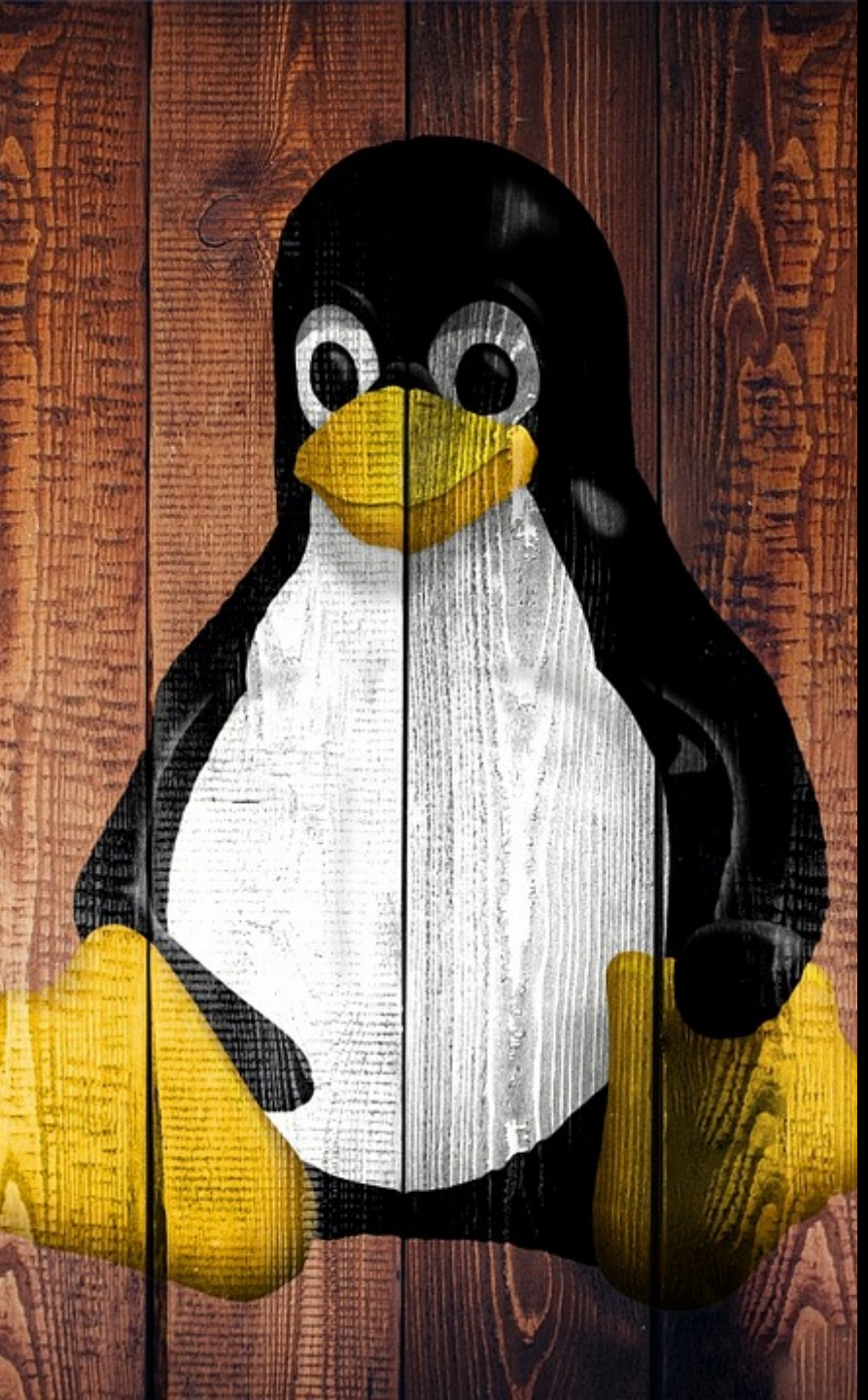


PHYSICAL METERS



RAPL

BEST-EFFORT ESTIMATIONS



Running Average Power Limit (RAPL)

- **DEVELOPED BY INTEL, FOR THERMAL MANAGEMENT PURPOSES**
- **SOFTWARE POWER MODEL BASED ON HARDWARE PERFORMANCE COUNTERS AND I/O MODELS**
- **MEASUREMENTS CPU-LEVEL, PROCESS-LEVEL**
- **LIMITATIONS**
  - Only works with specific chips
  - Root access required

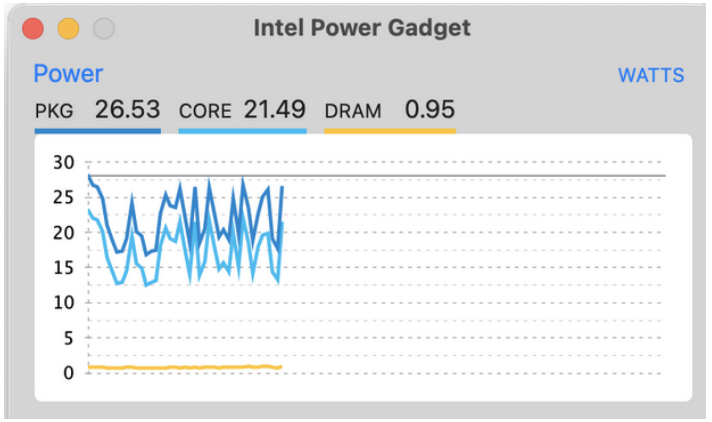
Ad-hoc tools

Example Output for a 5 second sleep command:

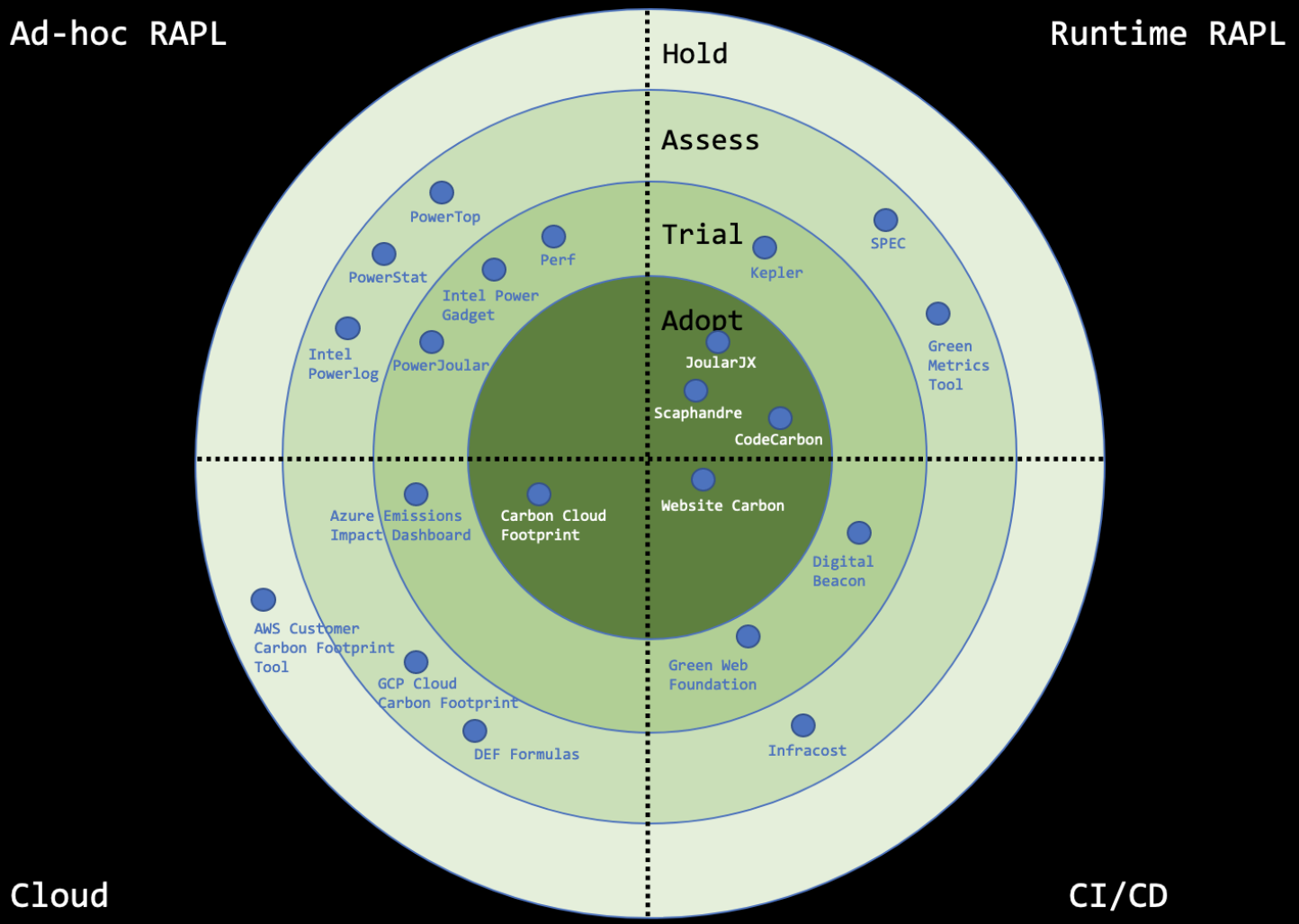
```
Performance counter stats for 'system wide':

             3.59 Joules power/energy-cores/
             8.18 Joules power/energy-ram/
             1.63 Joules power/energy-gpu/
            12.74 Joules power/energy-pkg/
            51.10 Joules power/energy-psys/

      5.001965465 seconds time elapsed
```



And Measure! Introducing the first Sustainable Tech Radar!



RAPL-based Tools

SCAPHANDRE

Developed by Hubble.io, part of Boavizta

Works on Kubernetes and integrates with Prometheus/Grafana

BOAVIZTA

Embedded Carbon calculations using LCA

Live Demo

GREEN METRICS TOOL

Being developed by Green Coding Berlin

Focus mostly on singular runs

Work in progress

Live Demo

Estimations: when RAPL is not available

CLOUD PROVIDERS DASHBOARDS

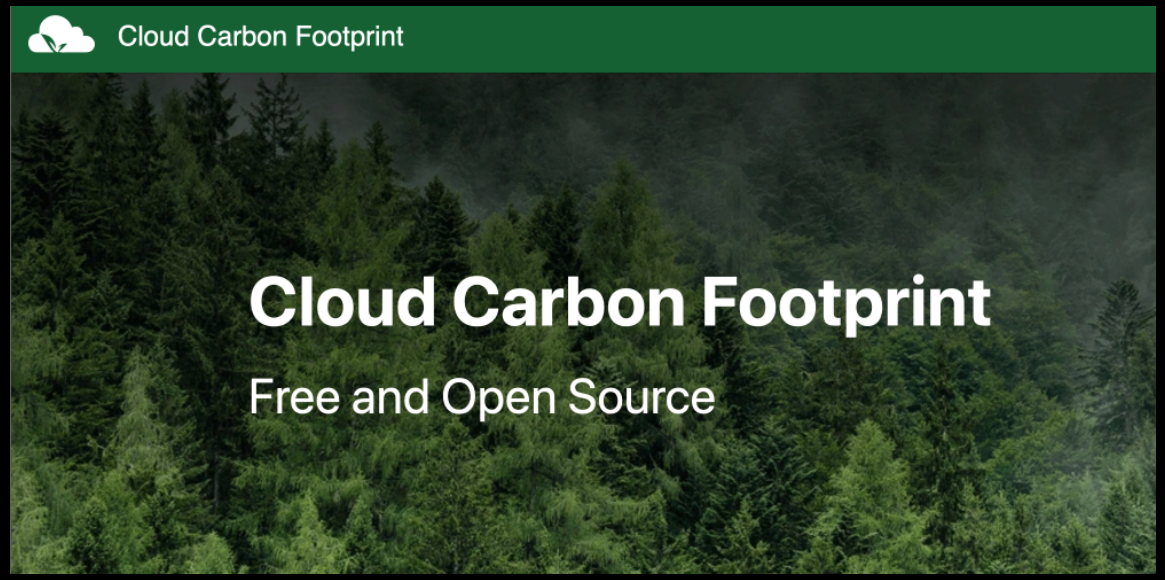
CLOUD CARBON FOOTPRINT

Open Source

SDIA

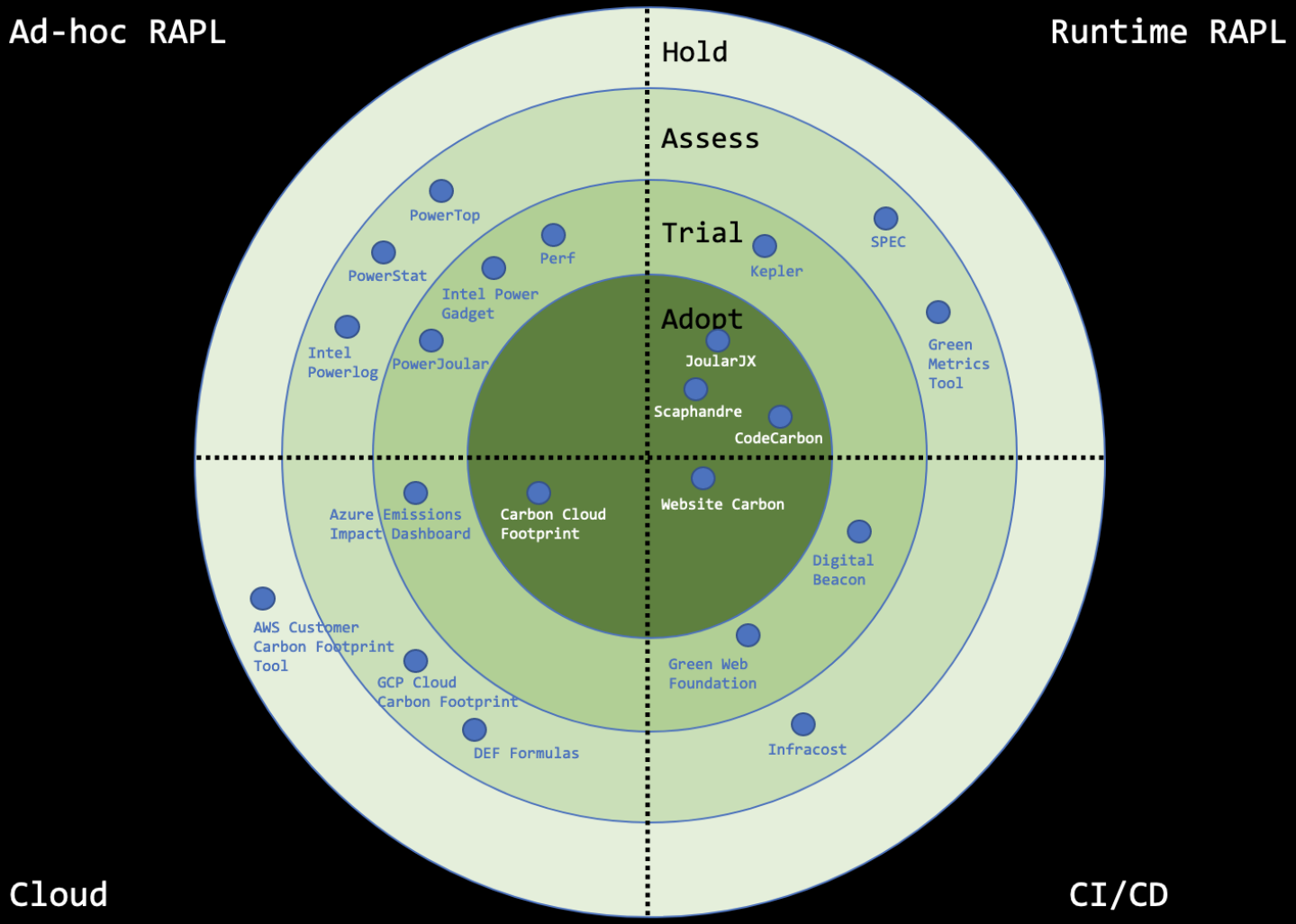
DEF Formulas

Cloud Carbon Footprint



- BASED ON RESEARCH BY THOUGHWORKS AND TEADS ENGINEERING (BENJAMIN DAVY)
- EMPIRICAL ESTIMATIONS WHERE POSSIBLE (BARE METAL)
- METHODOLOGY AND ASSUMPTIONS ARE WELL DOCUMENTED
- INCLUDES SCOPE 3

Sustainable Tech Radar

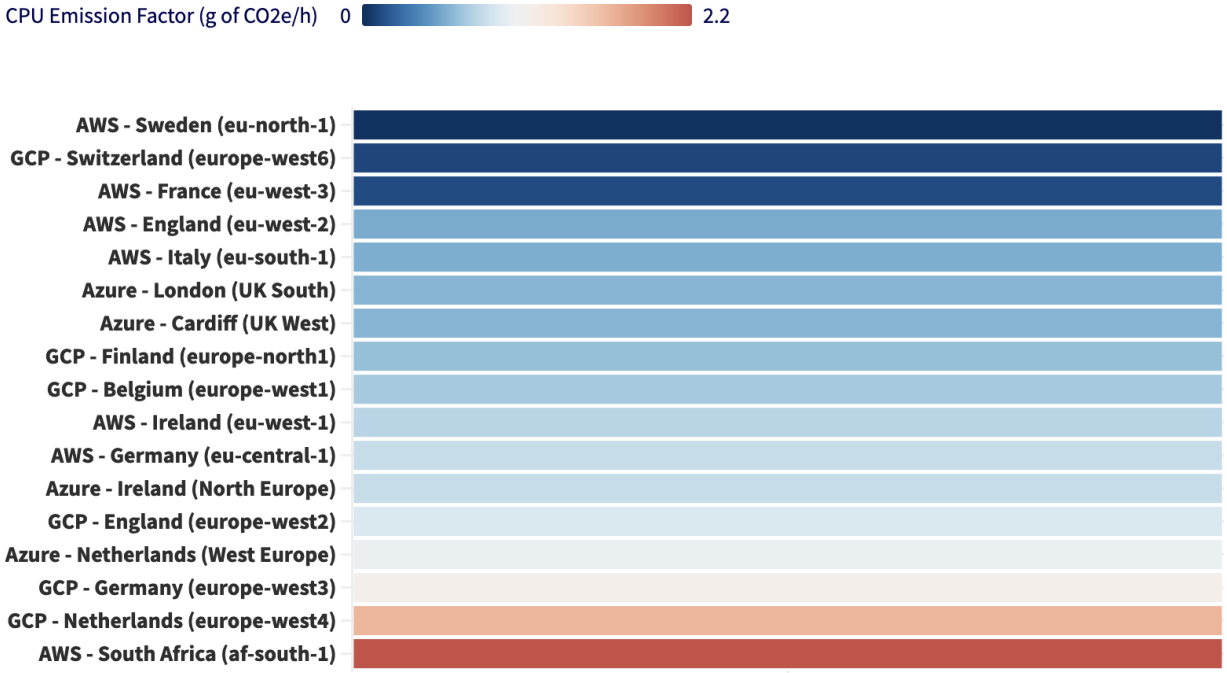


WHAT ELSE CAN YOU DO?

Cloud & Infrastructure

Code

Data



Relocation

Rightsizing

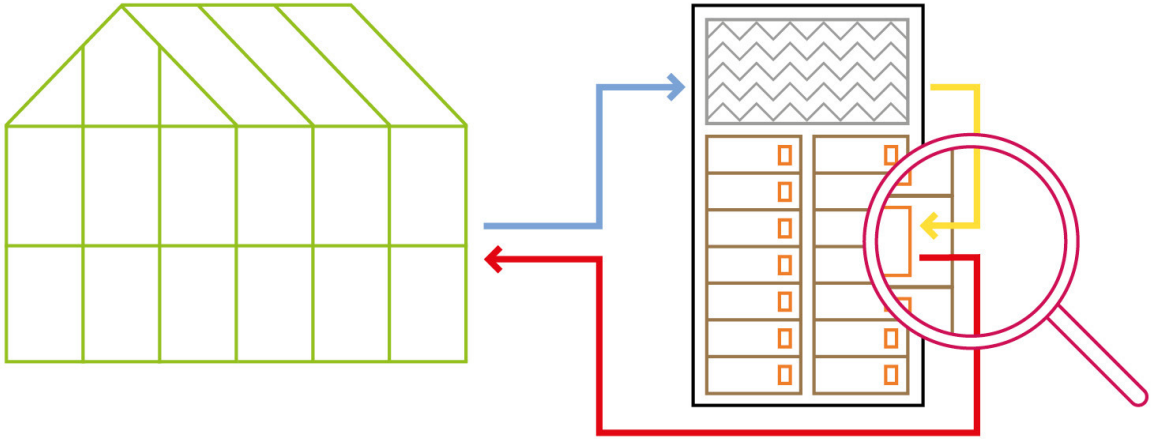
Timing

Innovative Cloud

Much lower PUEs*!

leafcloud

blockheating



*Power Usage Effectiveness

660 KB
February 2012

2159 KB
February 2022

Page/Code Bloat

Performance Testing

Backwards Compatibility

Tiny Updates

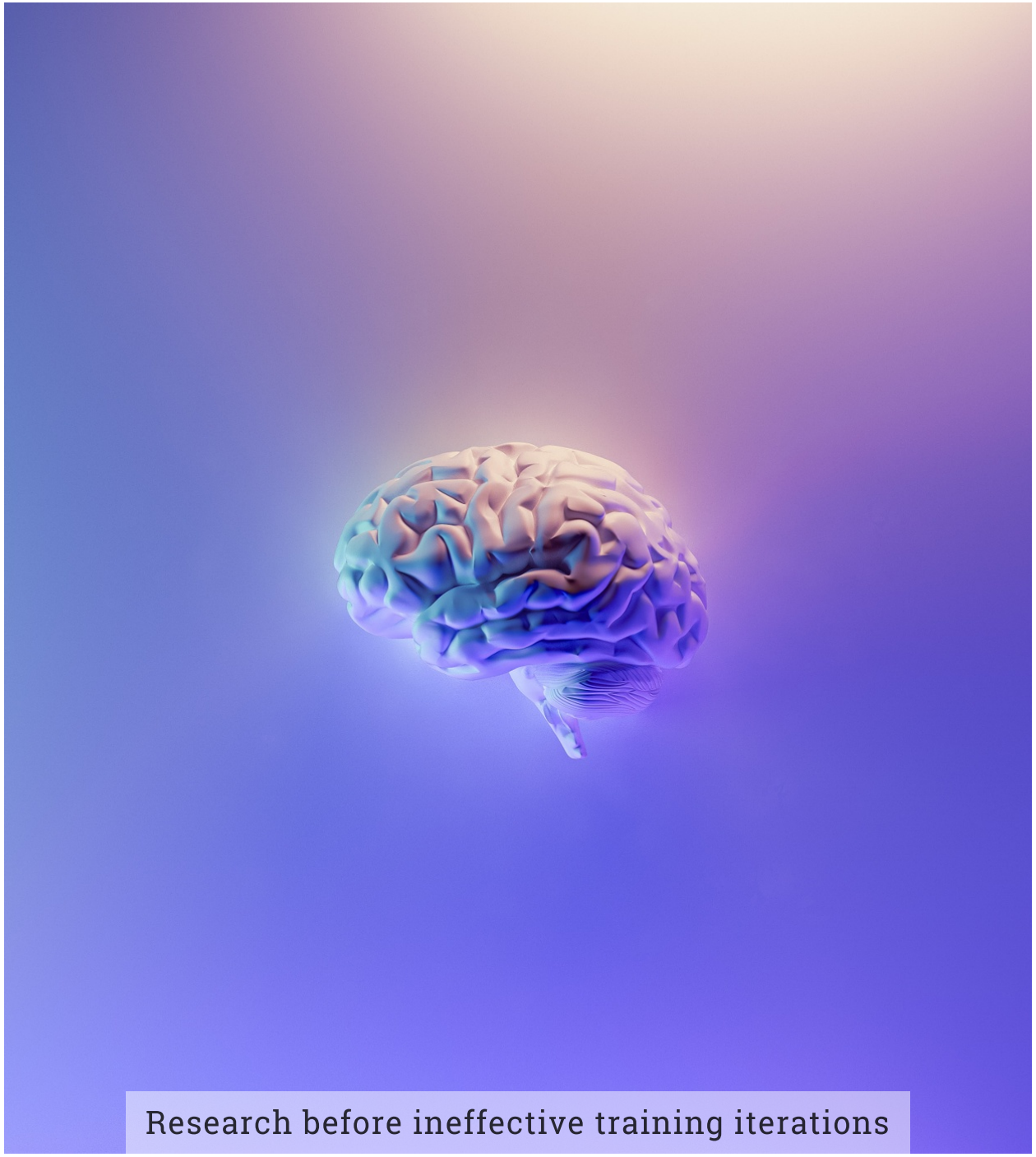
	Energy
(c) C	1.00
(c) Rust	1.03
(c) C++	1.34
(c) Ada	1.70
(v) Java	1.98
(c) Pascal	2.14
(c) Chapel	2.18
(v) Lisp	2.27
(c) Ocaml	2.40
(c) Fortran	2.52
(c) Swift	2.79
(c) Haskell	3.10
(v) C#	3.14
(c) Go	3.23
(i) Dart	3.83
(v) F#	4.13
(i) JavaScript	4.45
(v) Racket	7.91
(i) TypeScript	21.50
(i) Hack	24.02
(i) PHP	29.30
(v) Erlang	42.23
(i) Lua	45.98
(i) Jruby	46.54
(i) Ruby	69.91
(i) Python	75.88
(i) Perl	79.58

Efficient languages

1.7 MB

Is created every second by every person in 2020

Only store what is needed



Research before ineffective training iterations

Thanks! Join Our Community!