Making the Web Green

Using the web to make the web green

Chris Adams, The Green Web Foundation

Hello!

I'm Chris.

Green Web Foundation - tracking and accelerating the transition of the web to green energy

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Stats for 2019 compared to 2010:

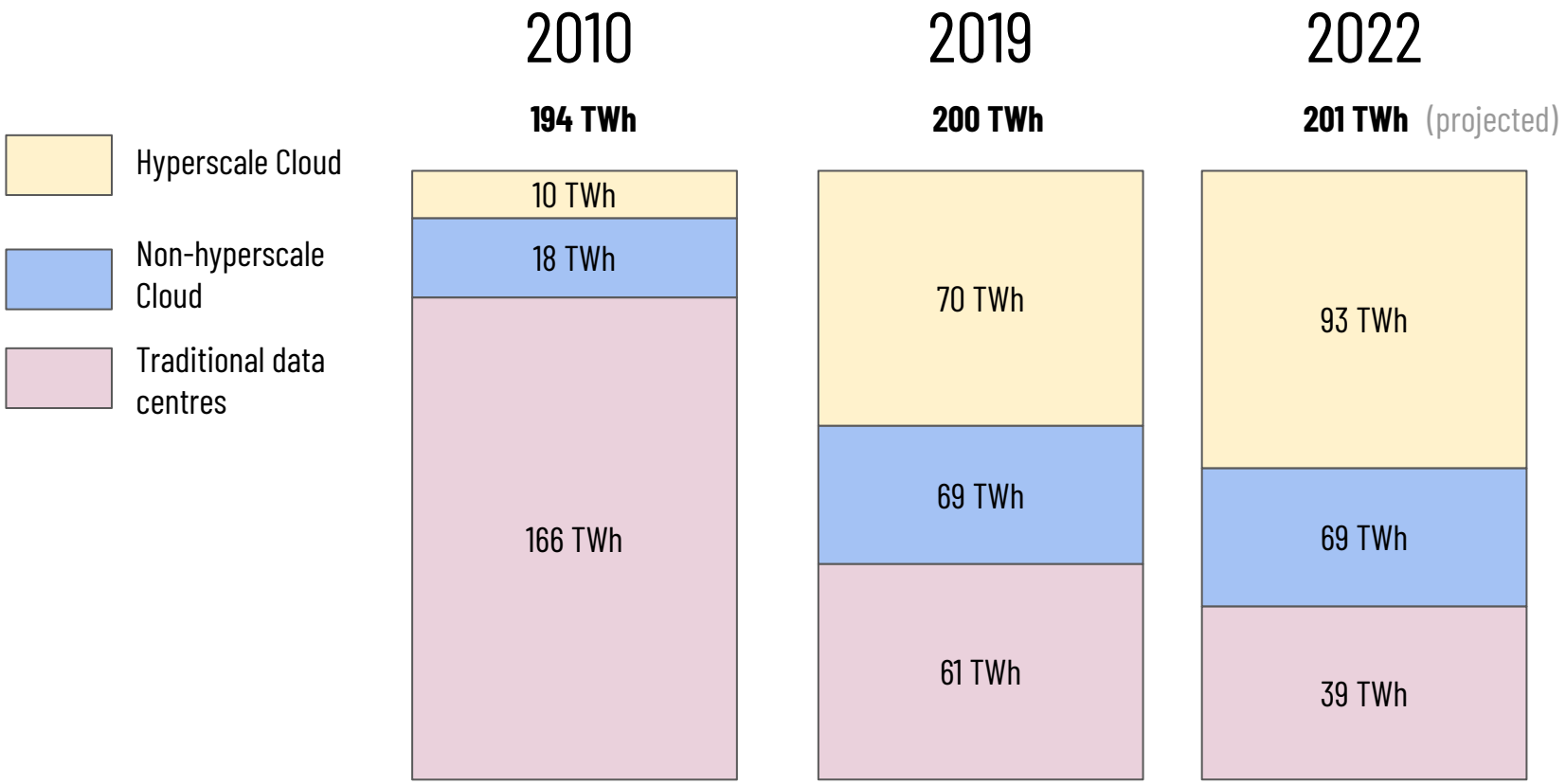
12x as much traffic

7.5x the workloads

~1x the energy usage

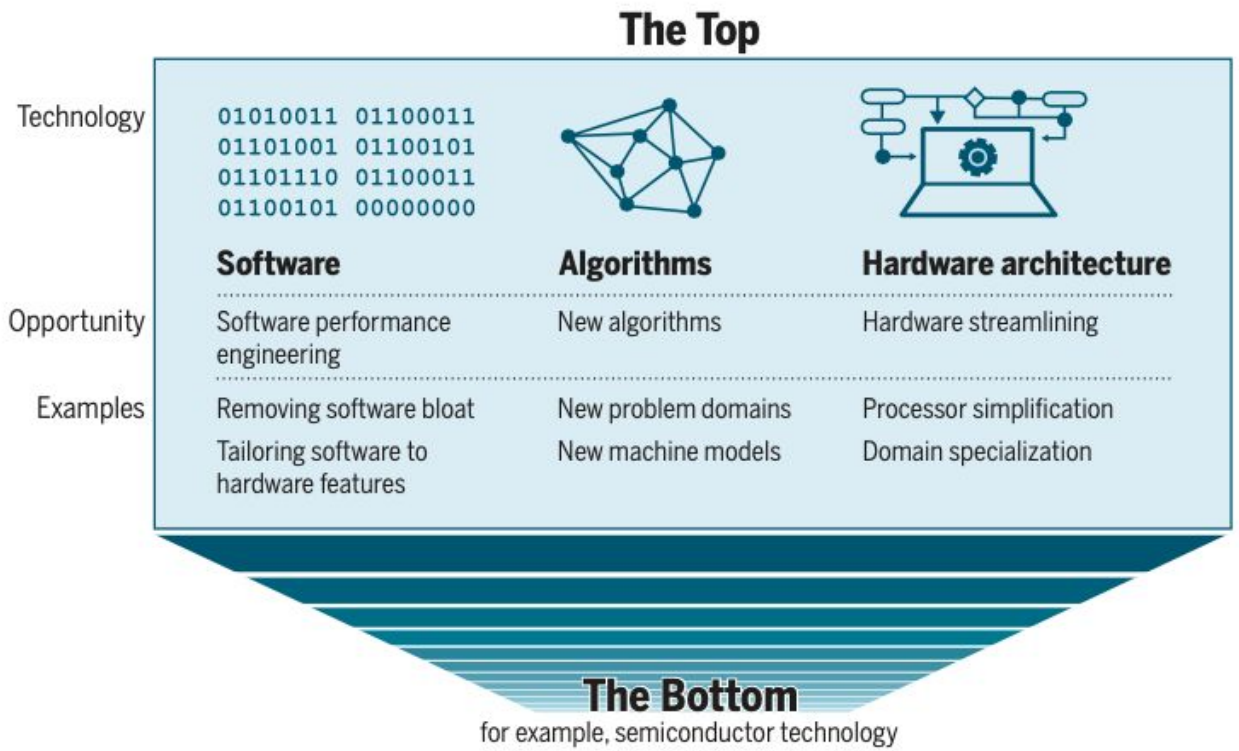
Source - IEA, Global data centre energy demand by data centre type, 2010-2022, IEA, Paris (link)

We might think the carbon footprint has increased. It's likely that it has *reduced* slightly over the last 10 years (Malmodin 2018)



Source - IEA, Global data centre energy demand by data centre type, 2010-2022, IEA, Paris (link)

The cost of this efficiency is a less diverse ecosystem (Recalibrating global data center energy-use estimates, Koomey et al)

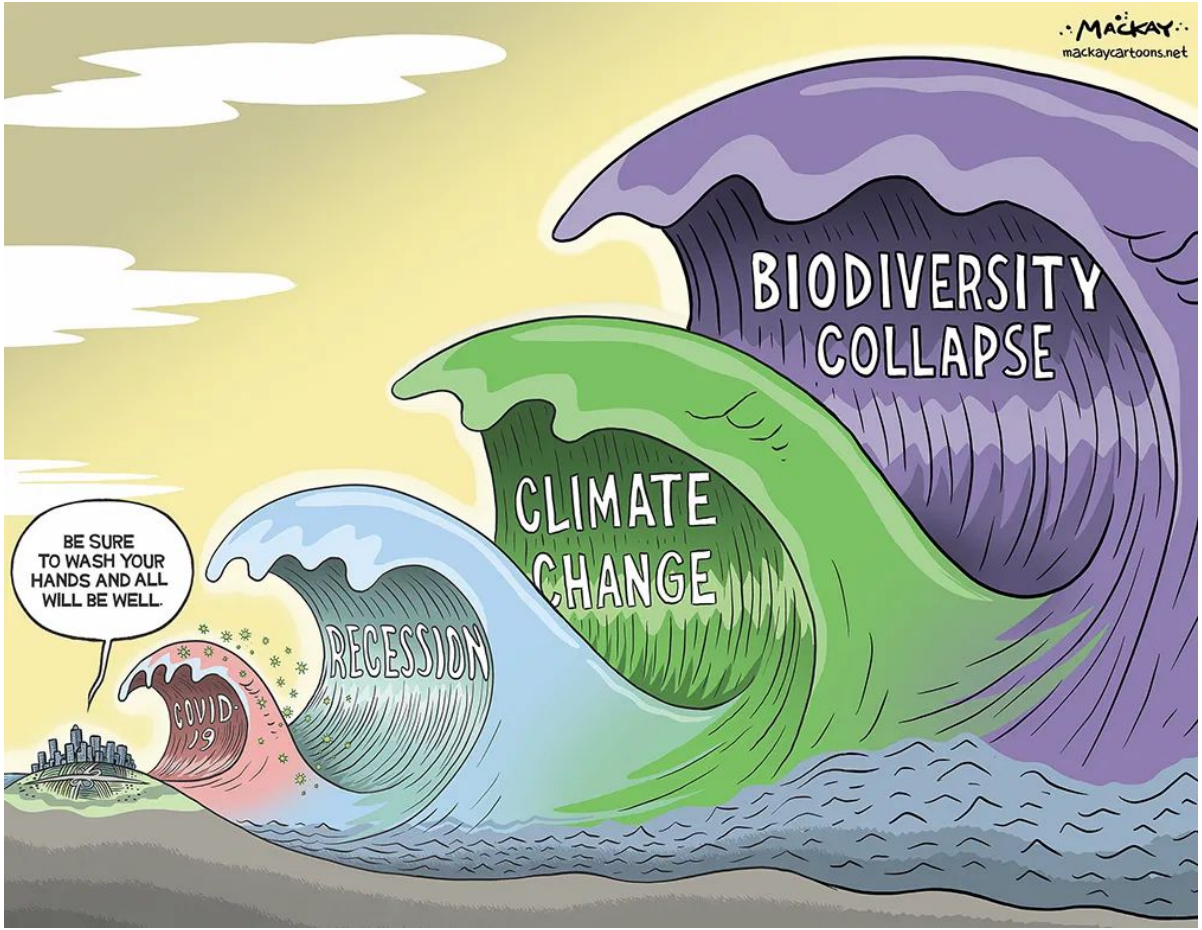


Performance gains after Moore's law ends. In the post-Moore era, improvements in computing power will increasingly come from technologies at the "Top" of the computing stack, not from those at the "Bottom", reversing the historical trend.

As gains from hardware alone diminish, there is a greater need to work at the software layer too (link)

Rapid.
Far Reaching.
Unprecedented.

Word for word guidance for policy makers from IPCC on the scale of changes needed (link)



More on the origins of the waves cartoons - (link)

The internet is the biggest machine in the world and it mostly runs on fossil fuels.

We are in a climate crisis

largely because we keep burning fossil fuels, instead of finding a path off them

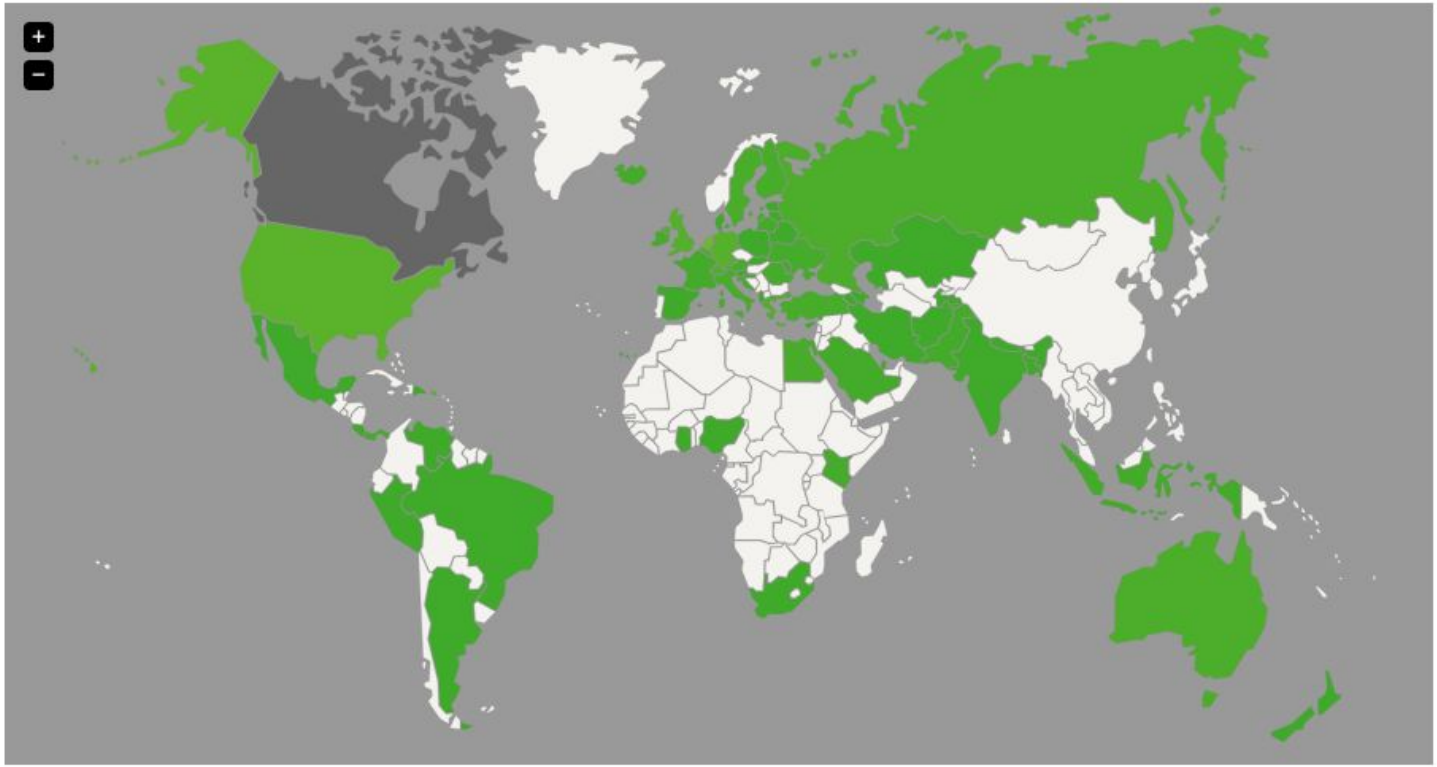
Green

Open

Lean

Distributed

A way to think about greening digital infrastructure. See also, principles.green (link)



THE DIRECTORY COMPRISES 501 GREEN HOSTING COMPANIES IN 62 COUNTRIES

As gains from hardware alone diminish, there is a greater need to work at the software layer too (link)

Green

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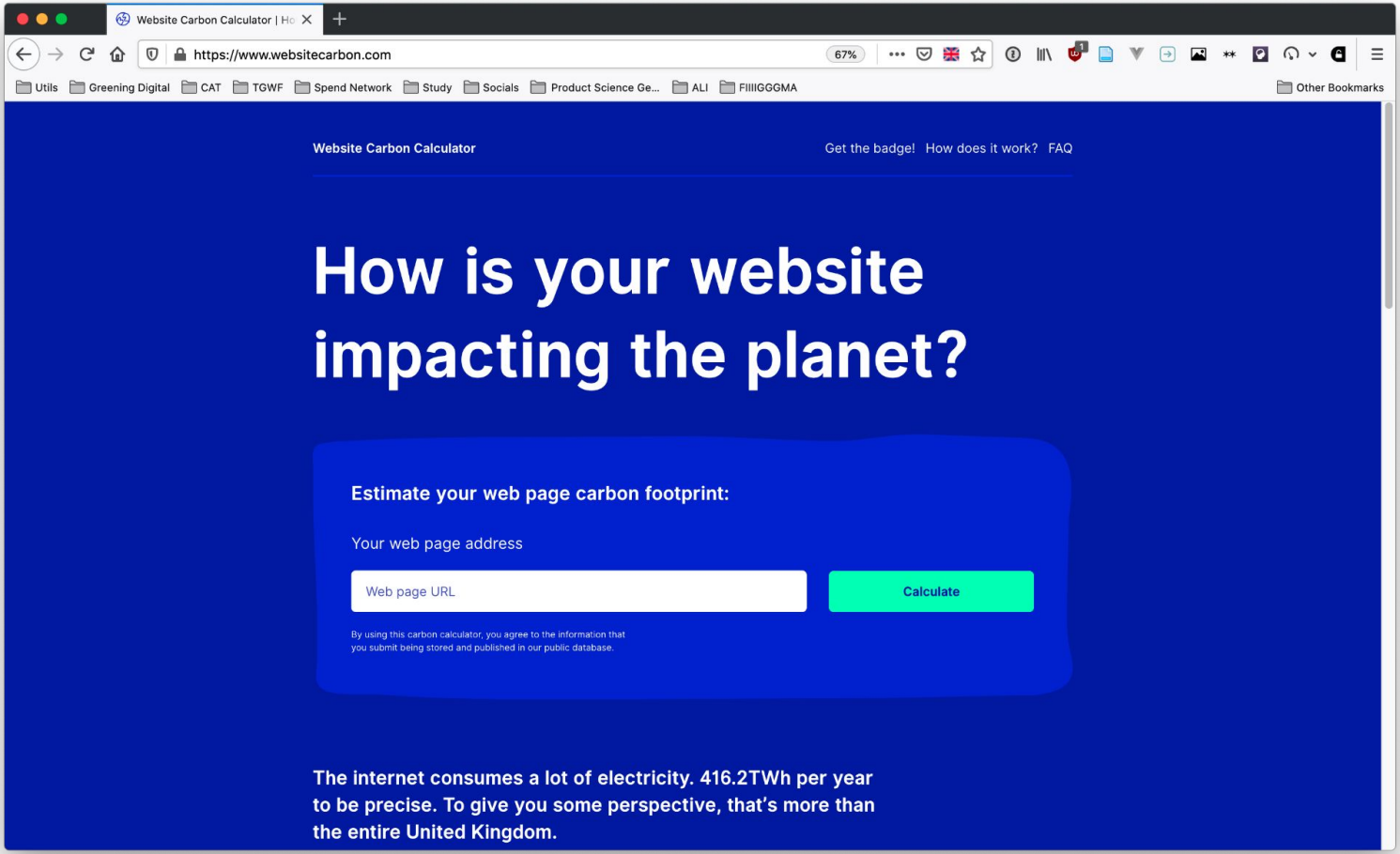
Lean

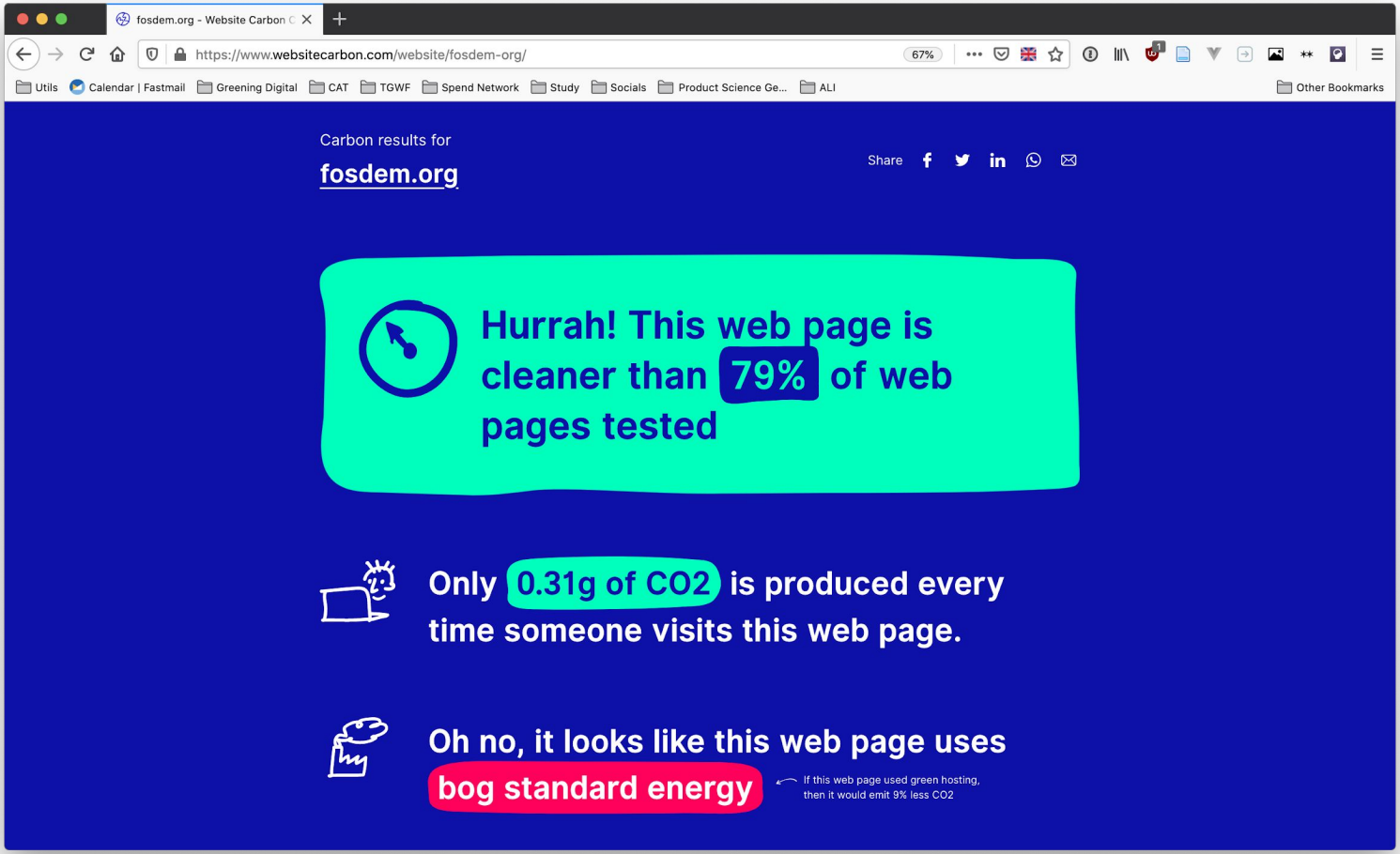
Distributed

as in green energy, and
greener material inputs.

For *running* computers.
And *making* computers.



Website carbon - quick figures for the carbon footprint of a website (link)



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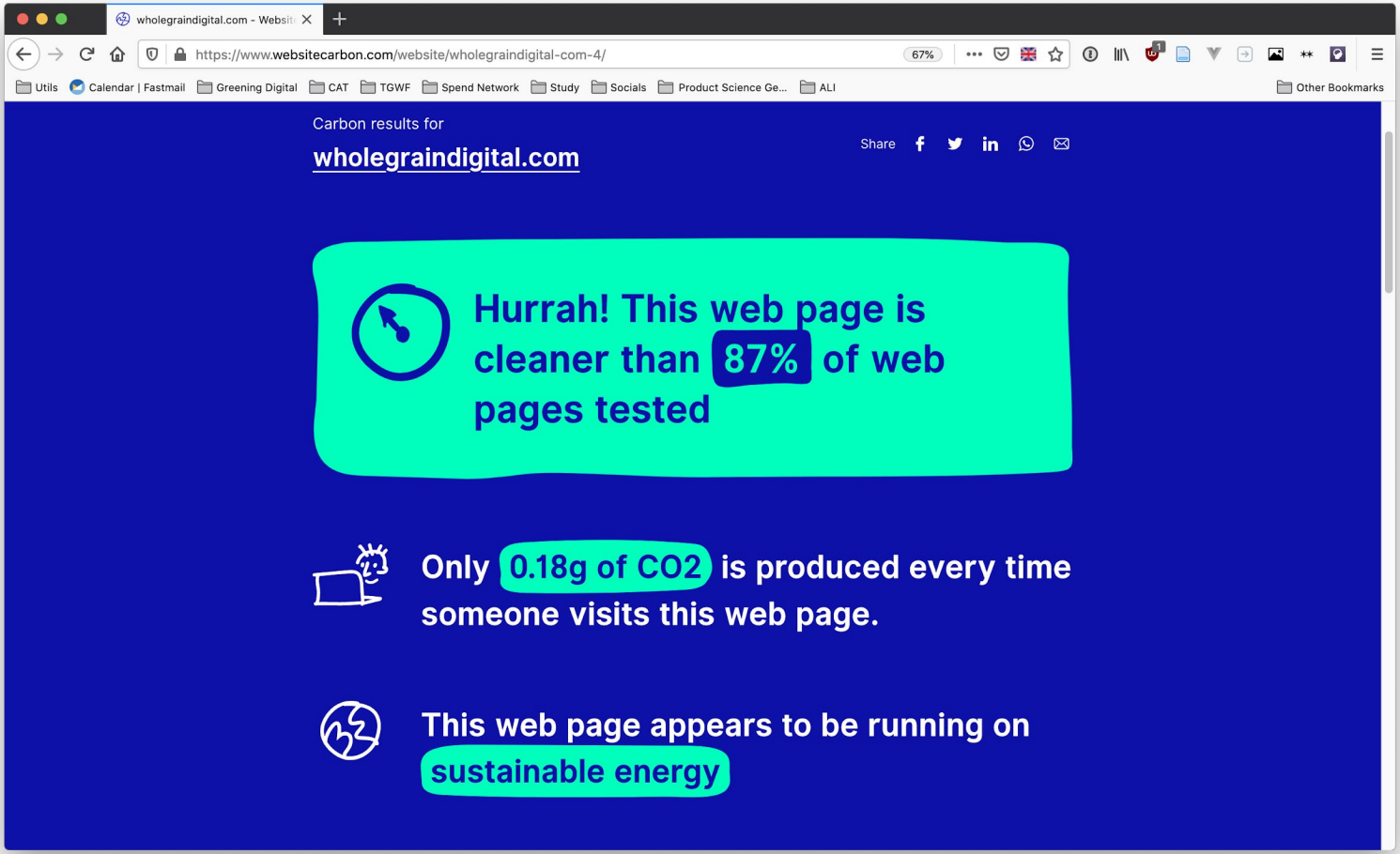

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open data, open source & transparency.

The coach helps you find performance problems on your web page using web performance best practice rules. And gives you advice on accessibility, privacy and best practices.

Coach score

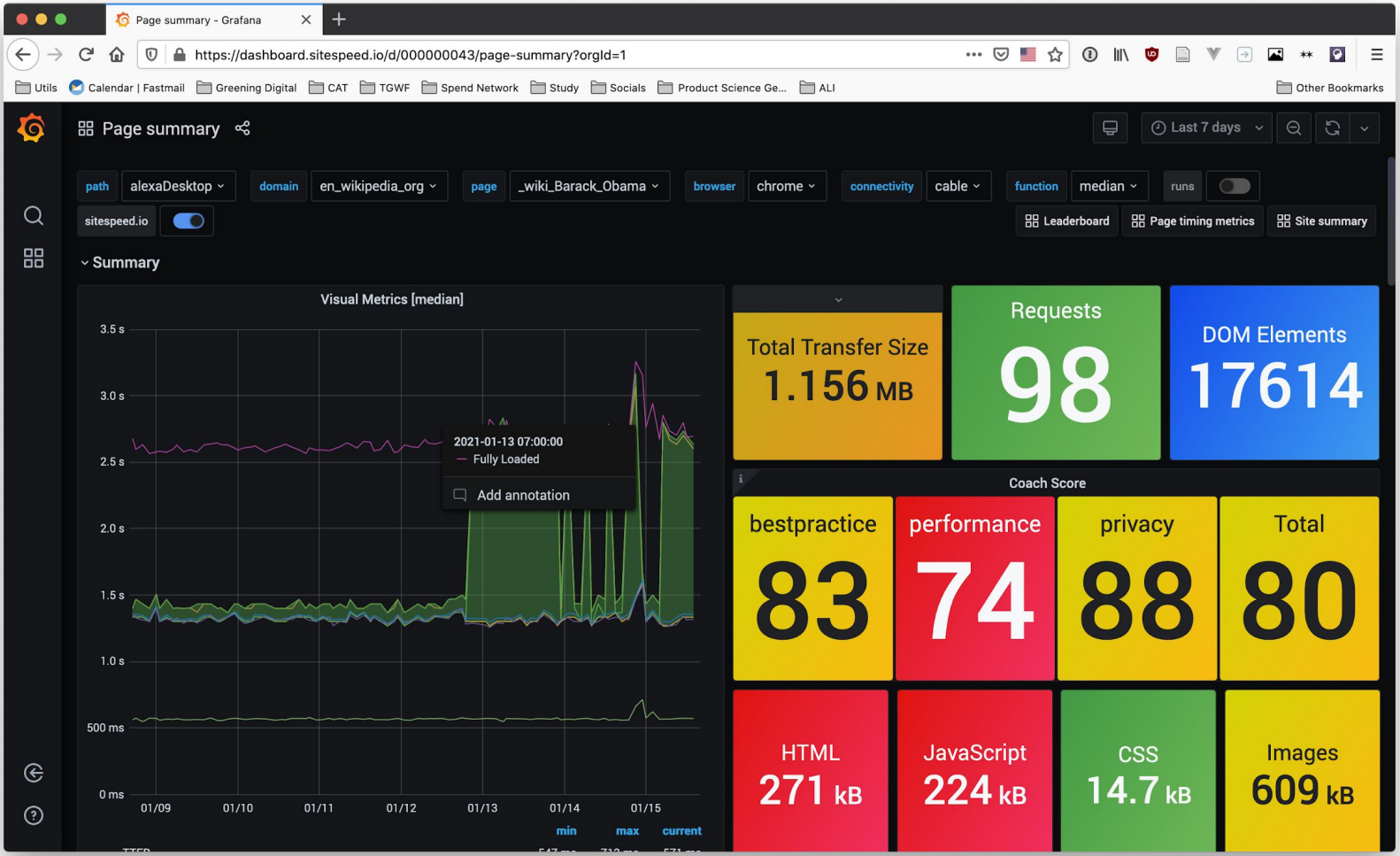
Total score	76
Performance score	71
Privacy score	80
Accessibility score	80
Best practice score	81

Coach - like lighthouse, but for a web that's good for more than just google (sitespeed.io)

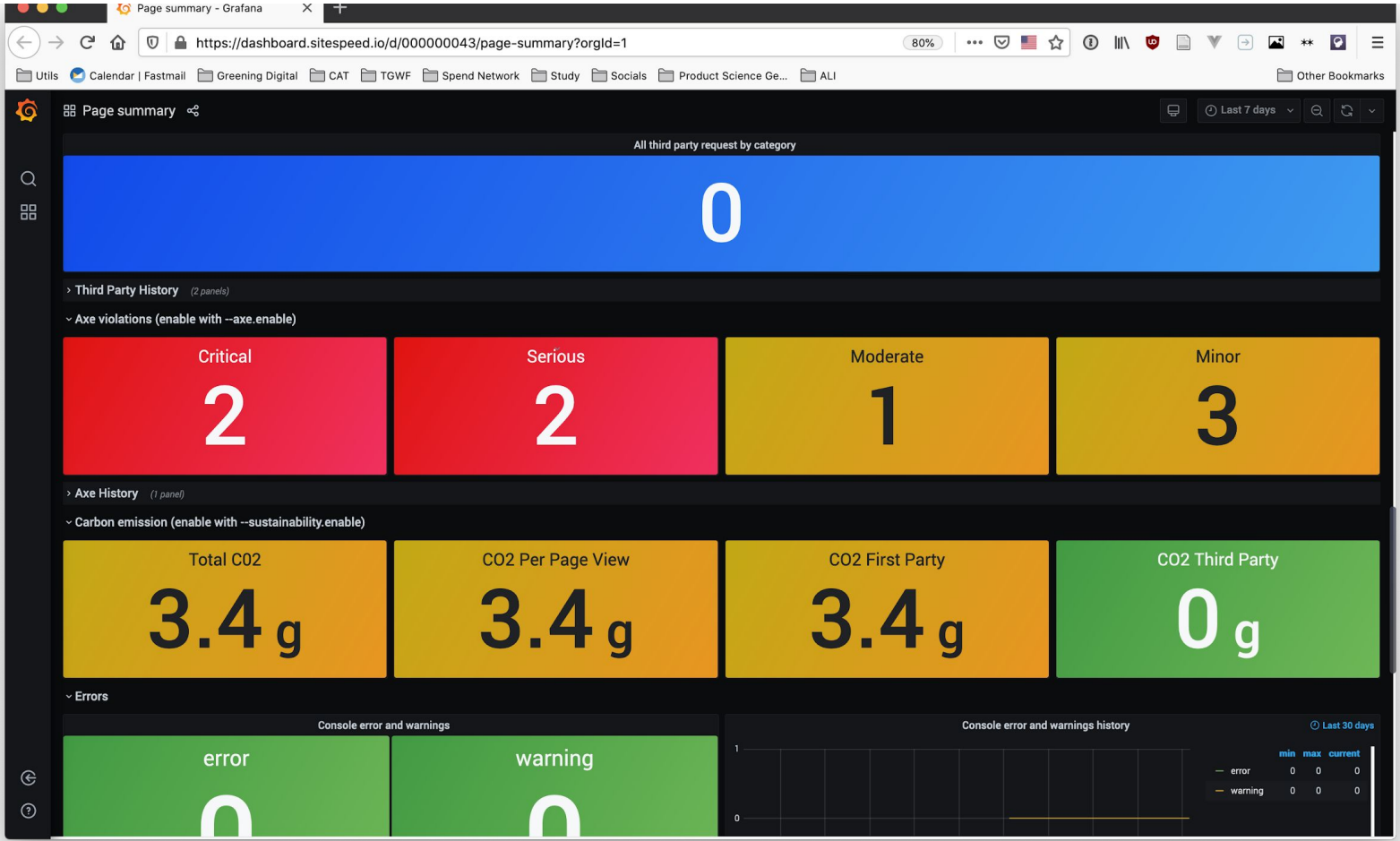
The sustainable web plugin

We know using the internet means using electricity to power servers. And because most of that electricity comes from burning fossil fuels, it means every byte sent has a cost in carbon as well as power. The sustainable web plugin combines the latest in peer reviewed science and open data from the Green Web Foundation to help you build greener, more sustainable websites and applications!

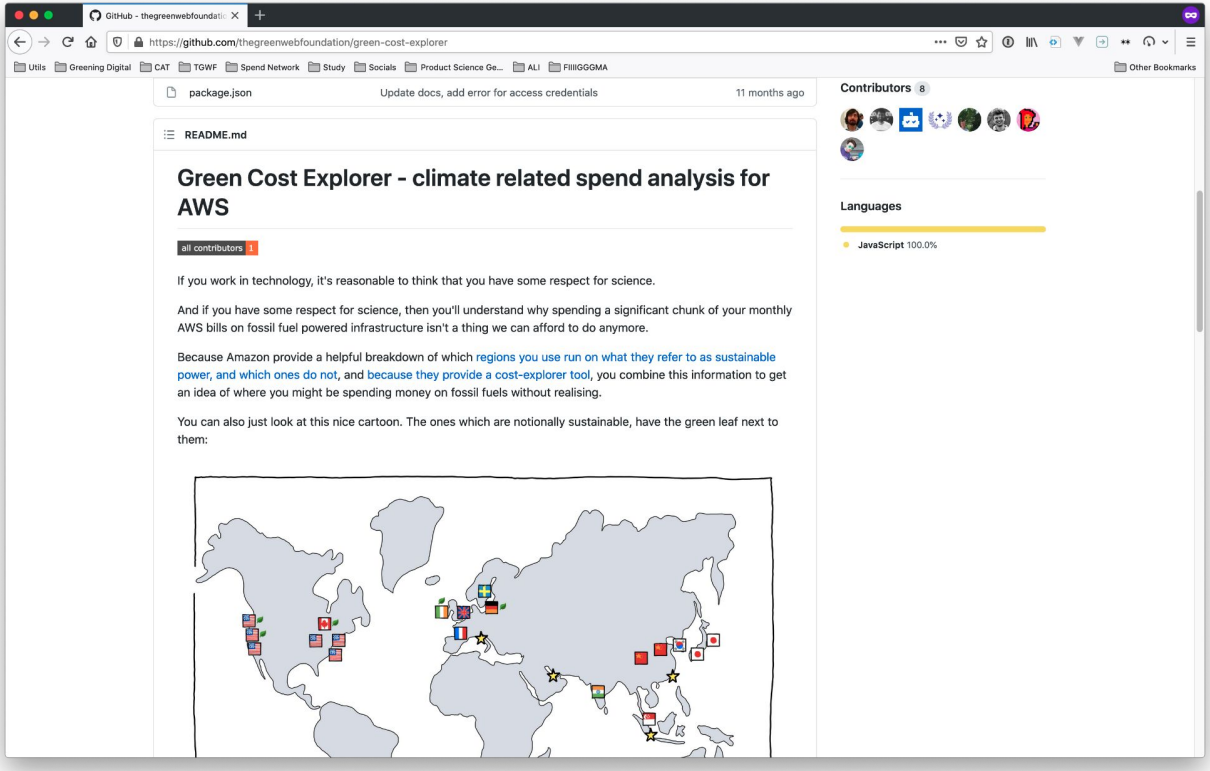
We work out how much energy it takes to serve a site, then work out how much CO2 is emitted to generate the power needed that electricity, based on what information we have about where the power comes from.



Tracking web perf stats with sitespeed and grafana



Tracking carbon stats with grafana and sitespeed



We've contributor and innovation partner for the open source cloud carbon footprint tool (link)

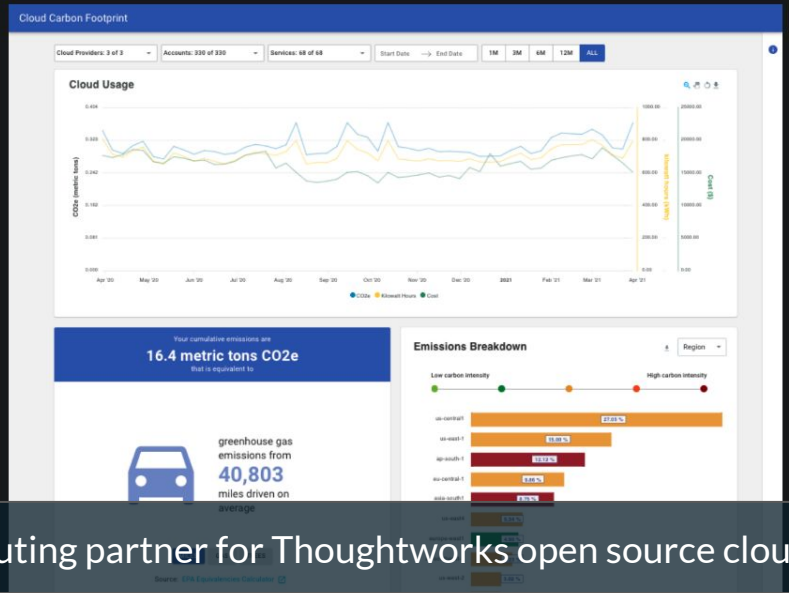
Cloud Carbon Footprint

Try Now Docs Github

Cloud Carbon Emissions Measurement and Analysis Tool

Understand how your cloud usage impacts our environment and what you can do about it

TRY NOW



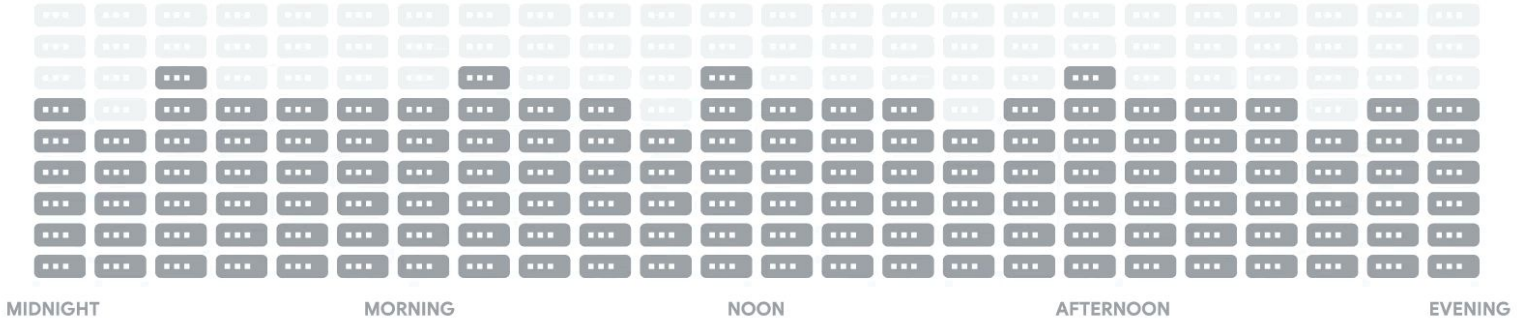
Get to know the carbon footprint of your cloud usage - and reduce it

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 such as Etsy's Cloud Jewels, to convert cloud utilization into estimated energy usage and carbon emissions, producing metrics that can be shared with employees, investors, and other stakeholders.

Contributing partner for Thoughtworks open source cloud carbon footprint tool (link)

Conventional compute load

Execution of compute tasks throughout the day, regardless of carbon impact



How Google move compute loads through ***time*** to when energy is cheap and green (link)

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CONTENTS

Issue #001

An example of an article headline title

Eve Sanchez

WORKS OFFLINE

LOW GRID INTENSITY

Video quality is higher due to lower grid intensity and more renewables

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CONTENTS

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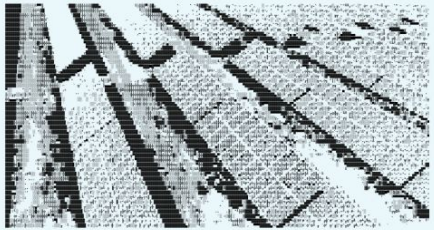
A headlline that sums up what we're all about



WORKS OFFLINE

MEDIUM GRID INTENSITY

Video is being rendered as unicode due to higher grid intensity and fewer renewables

SHOW VIDEO

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CONTENTS

Issue #001

An example of an article headline title

Eve Sanchez

WORKS OFFLINE

A video showing dramatic aerial footage of a solar panel field

SHOW VIDEO

HIGH GRID INTENSITY

Video is being shown as alt text due to higher grid intensity and less renewables

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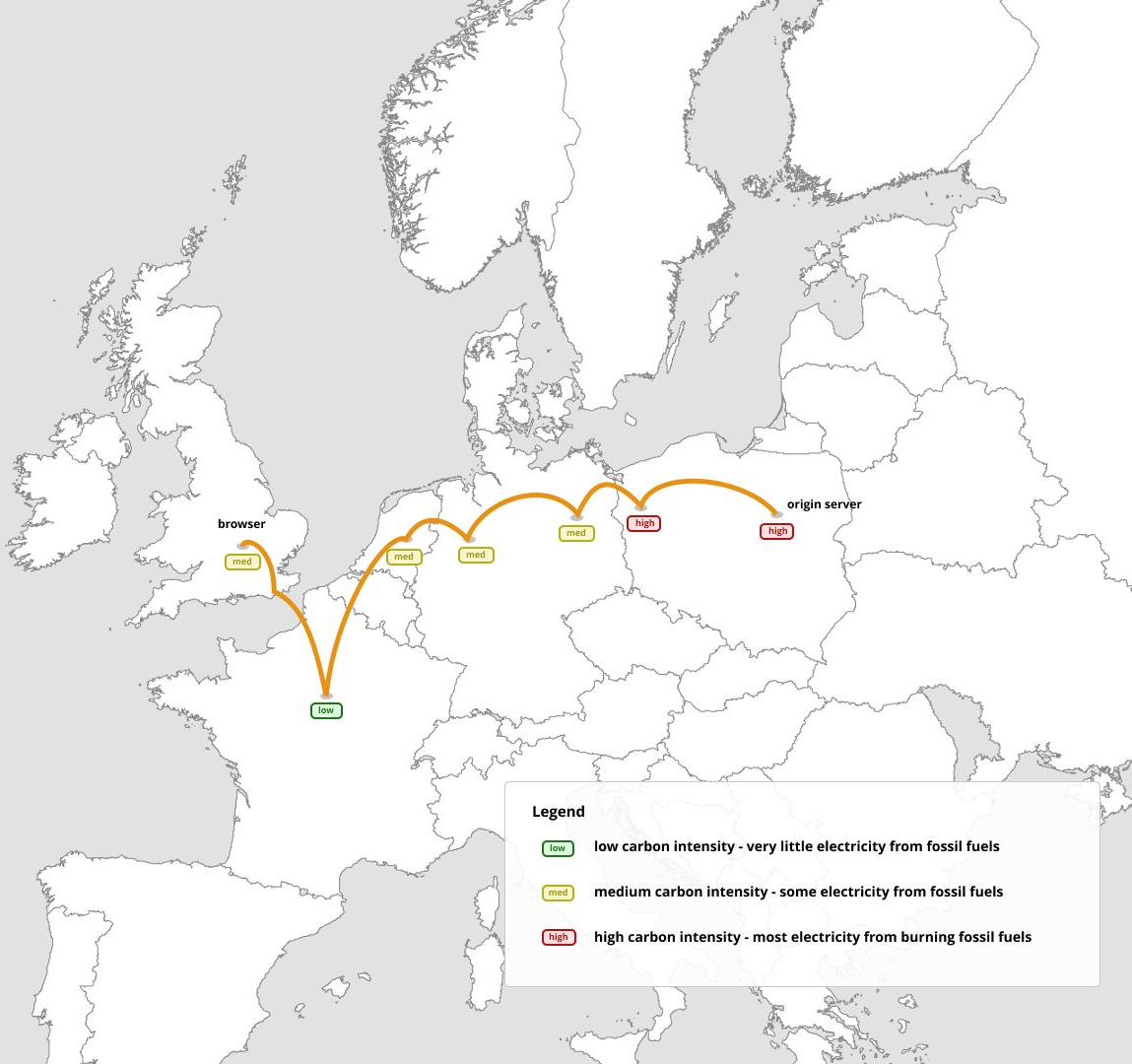
Using grid intensity as a element of designs with Branch Magazine (link)

When we fetch data from servers, we rely on routers to route it to the next ‘hop’ along the way, as well as from the origin server.

This adds up - data transfer for the internet uses around 250 TWh of electricity each year - this is more than Spain uses!

Also when routes pass through areas where electricity mainly comes from burning fossil fuels, we have a higher carbon footprint for this transfer.

Because most electricity globally is still generated by burning fossil fuels, these emissions are hard to avoid with the design of the current internet.

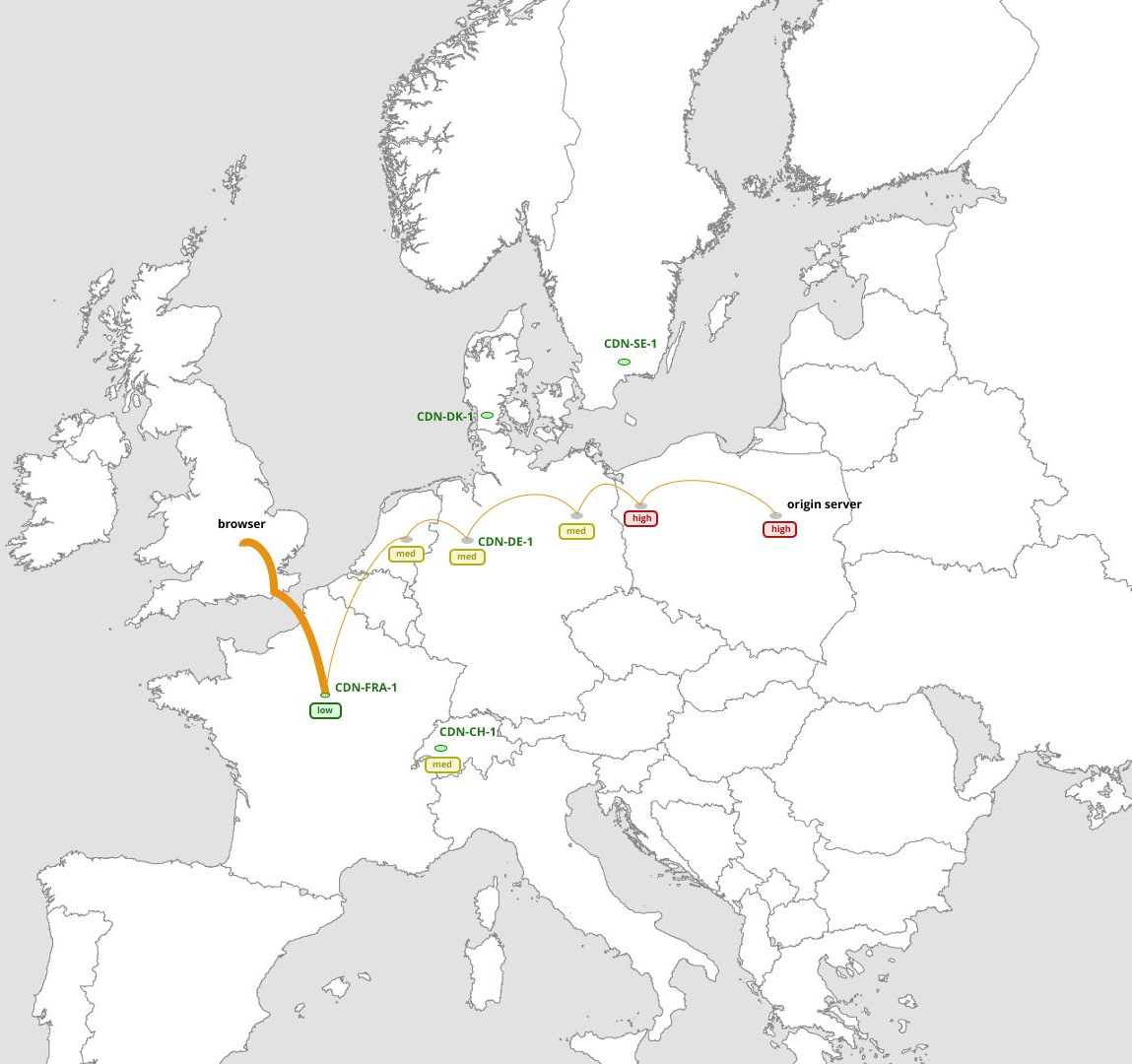


One way to reduce this is to use CDNs to serve the same content from a closer cache instead of fetching it from the origin each time.

This saves hops, and improves the user experience making it feel faster.

If the nodes serving most of the traffic are running where electricity is low carbon, we save carbon here too.

Even if we can't cache everything, we can still serve most of our traffic from greener sources reducing the overall emissions.

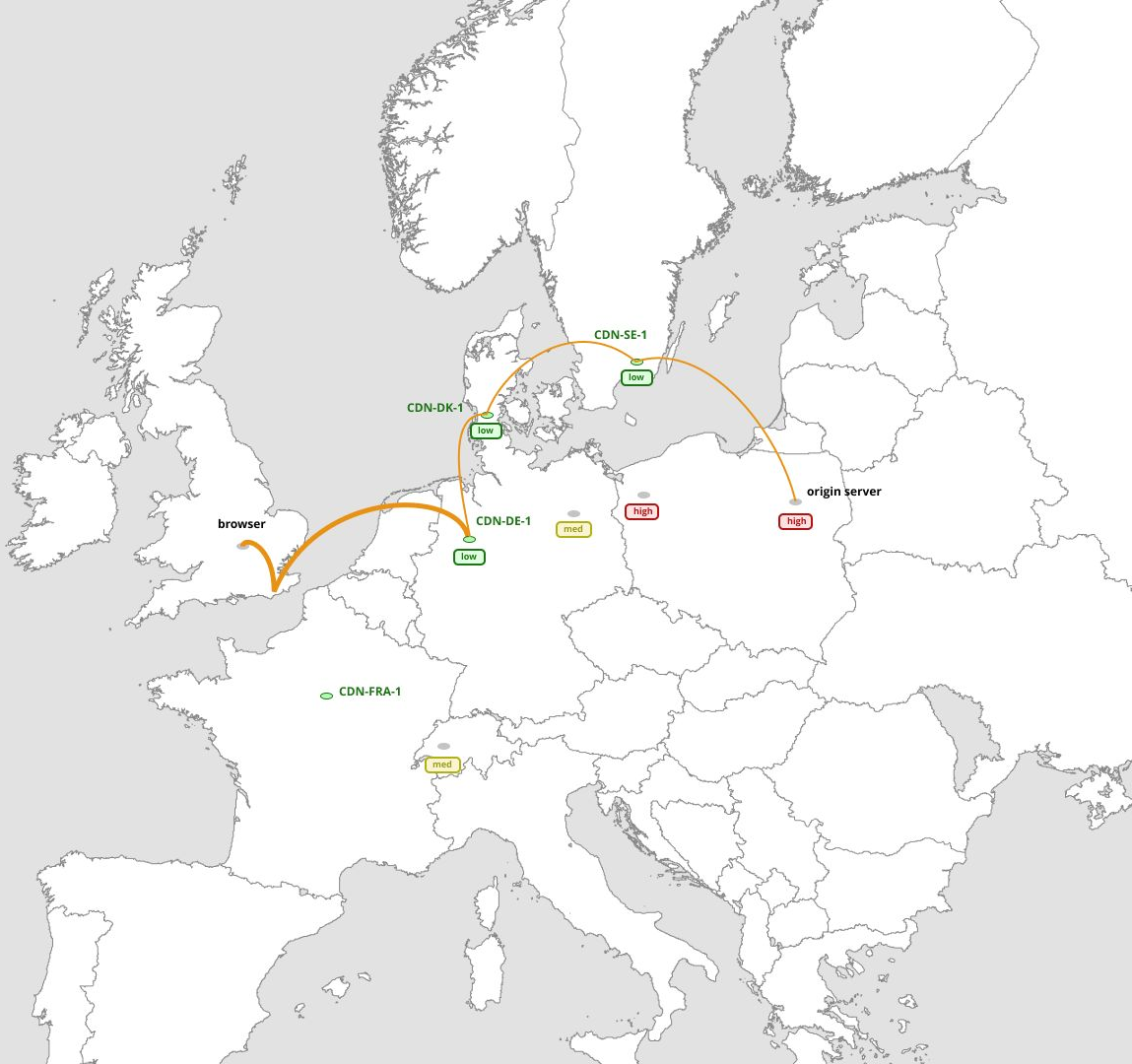


We ***can and should*** go further though.

If we know the carbon intensity of energy on the grid, we can tailor the way we serve traffic to match moments of over-supply on sunny or windy days, when energy is particularly cheap and green.

As long as the nodes are close enough, we can still serve quick responses, and save hops reducing the carbon footprint, but we also help actively balance the grid, making it easier to integrate more renewables into our energy system.

Even when some content can't be cached, we can still optimise for the greenest routes that serves the request in time.

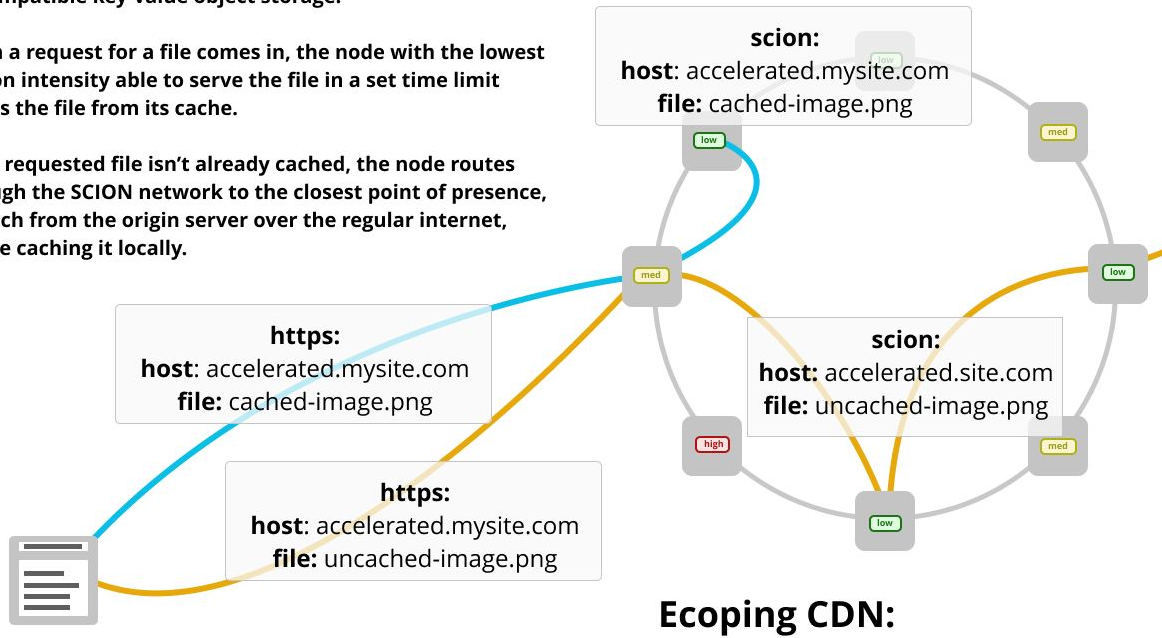


Ecoping CDN

Each node in the CDN is a SCION autonomous system (AS), announcing local carbon intensity every 30 mins to other nodes. Each AS contains a service that implements S3-compatible key-value object storage.

When a request for a file comes in, the node with the lowest carbon intensity able to serve the file in a set time limit serves the file from its cache.

If the requested file isn't already cached, the node routes through the SCION network to the closest point of presence, to fetch from the origin server over the regular internet, before caching it locally.



Origin server:
Accessible over regular internet

Browser:
Requesting page from origin server

Ecoping CDN:
Geographically distributed CDN, connected over carbon aware SCION network

Scenarios :

1. Cache hit: file served from lowest carbon node with requested file

2. Cache miss: file fetched from origin server, routing through SCION network along the greenest path possible to a nearby node, before making final hops over 'regular' internet

Legend

- low — **low carbon intensity - very little electricity from fossil fuels**
- med — **medium carbon intensity - some electricity from fossil fuels**
- high — **high carbon intensity - most electricity from burning fossil fuels**

Thanks!

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