

Why We Need a Green Perf Metric

Brian Louis Ramirez

Web Perf Engineer @Speed Kit



performance.now()

Harry Roberts
Optimising Largest Contentful Paint

Photo: [Joyce Goverde](#), [Performance.now\(\)](#) 2022

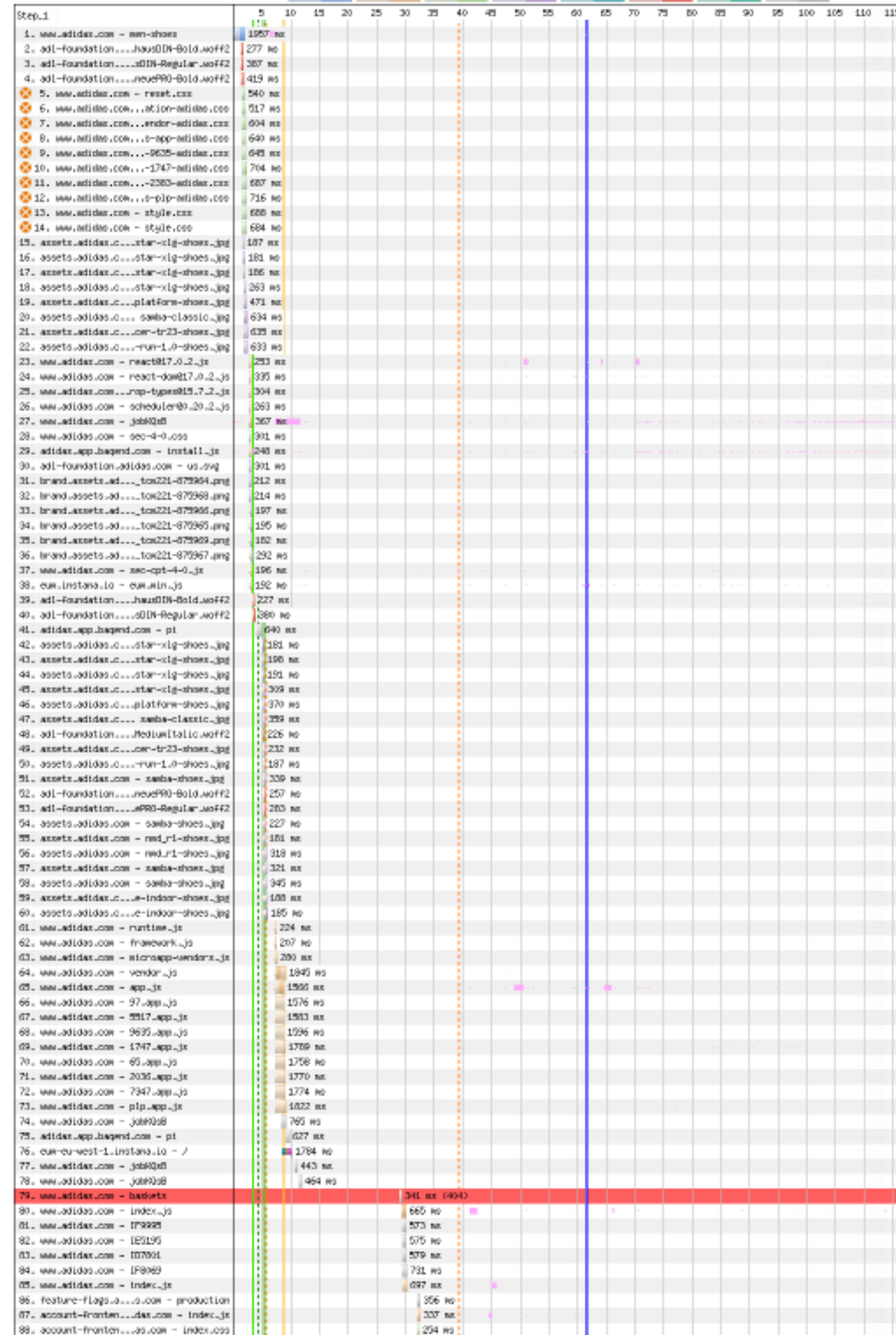


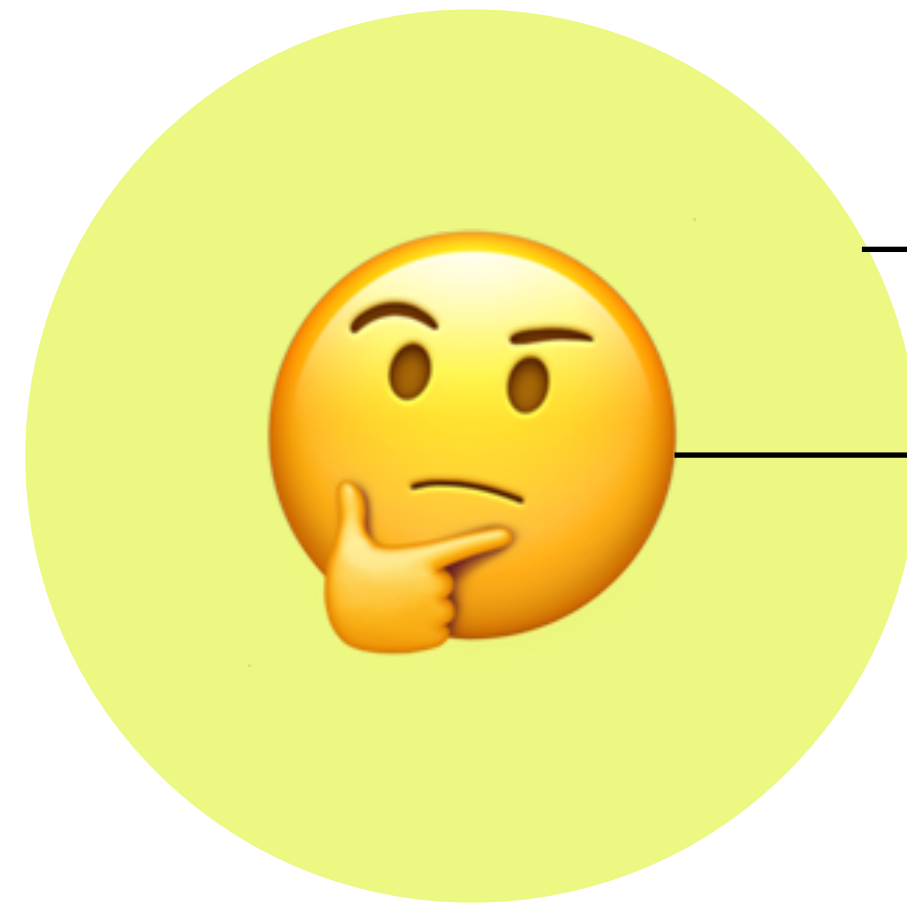
**What do we have
in common?**

Start Render | First Contentful Paint | Largest Contentful Paint | Layout Shift | DOM Interactive | DOM Content Loaded | On Load | Document Complete

Render Blocking Resource | Insecure Request | 3xx response | 4xx response | Doesn't Belong to Main Doc

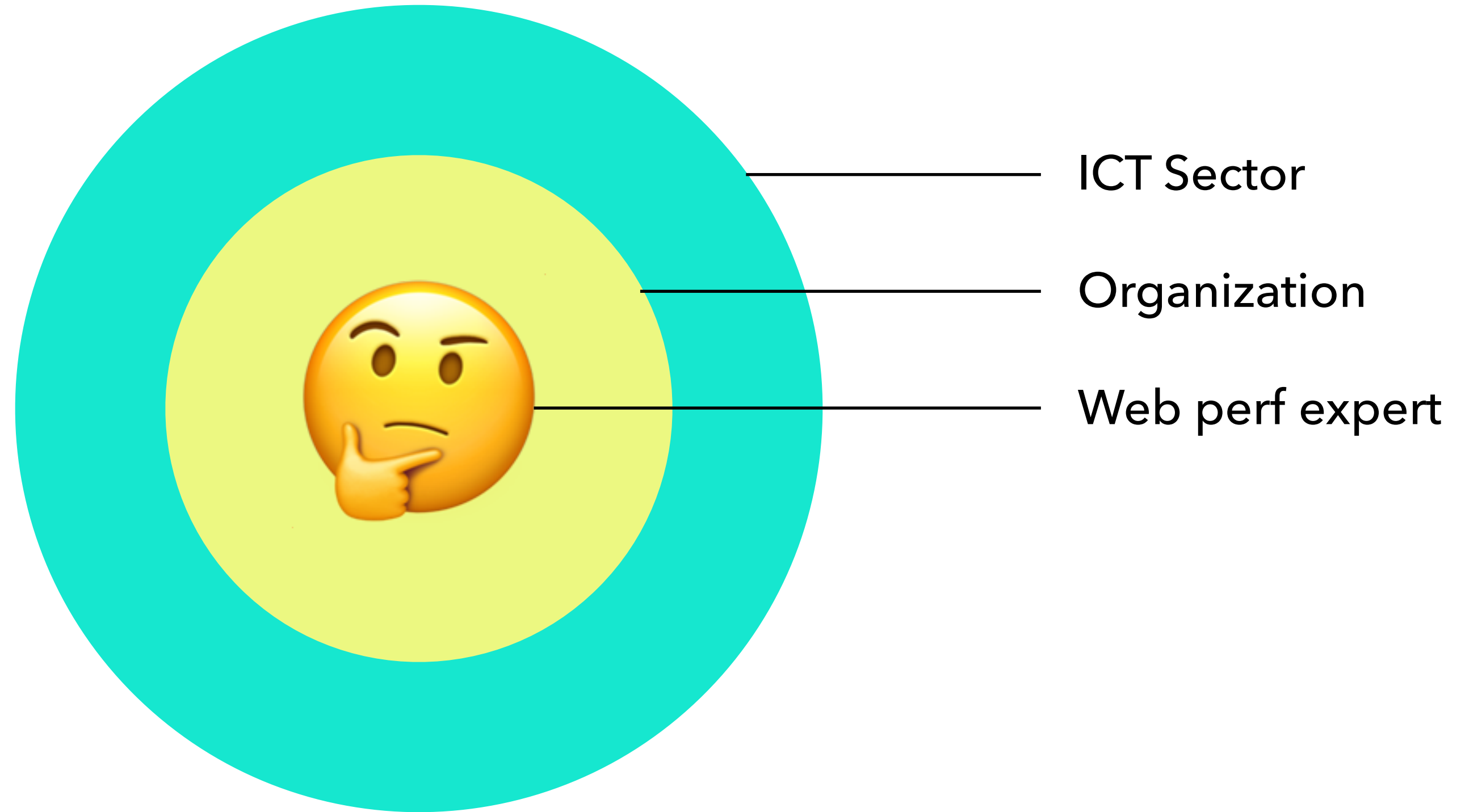
wait dns connect ssl HTML JS CSS Image Flash Font Video Other JS Execution

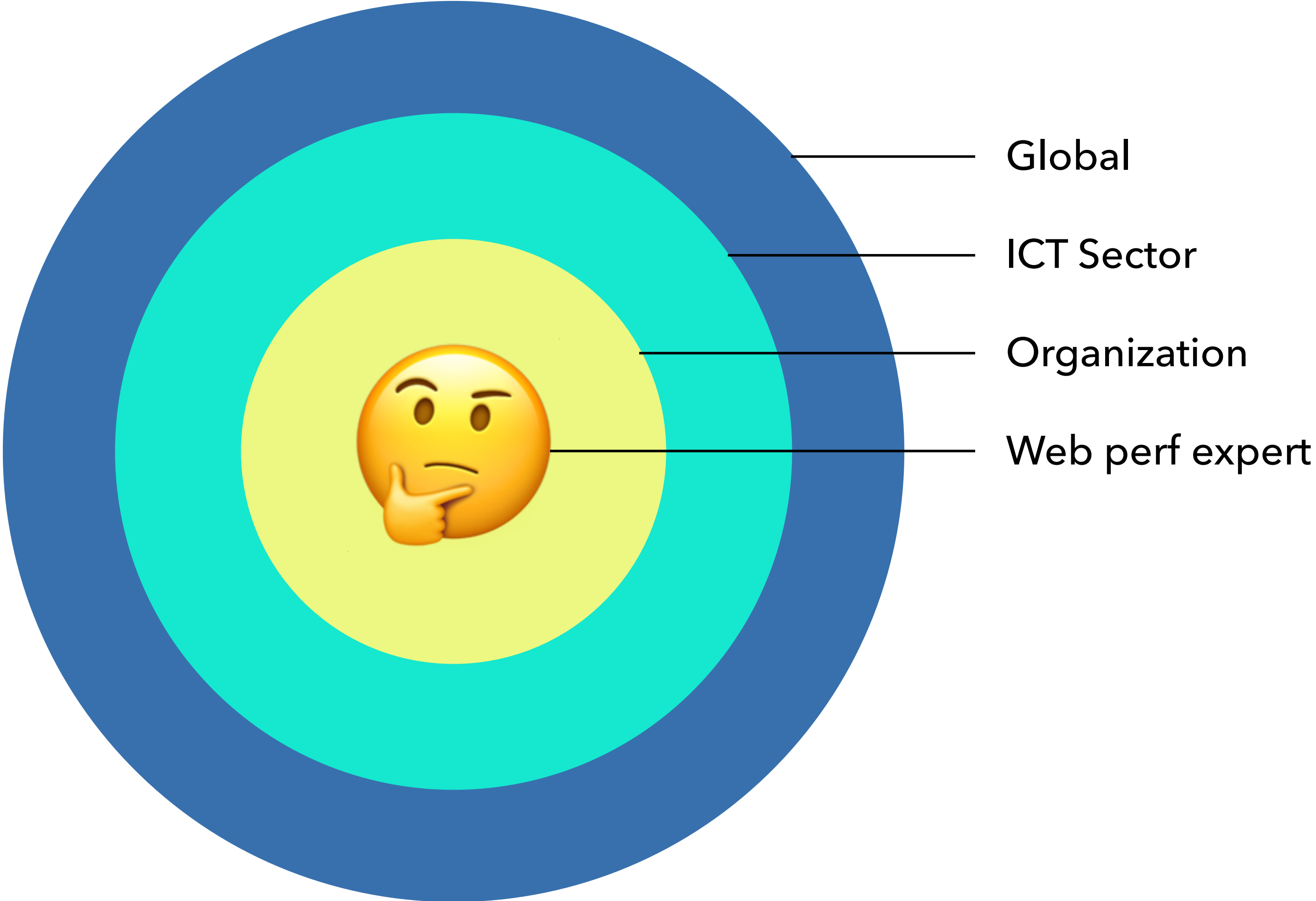




Organization

Web perf expert



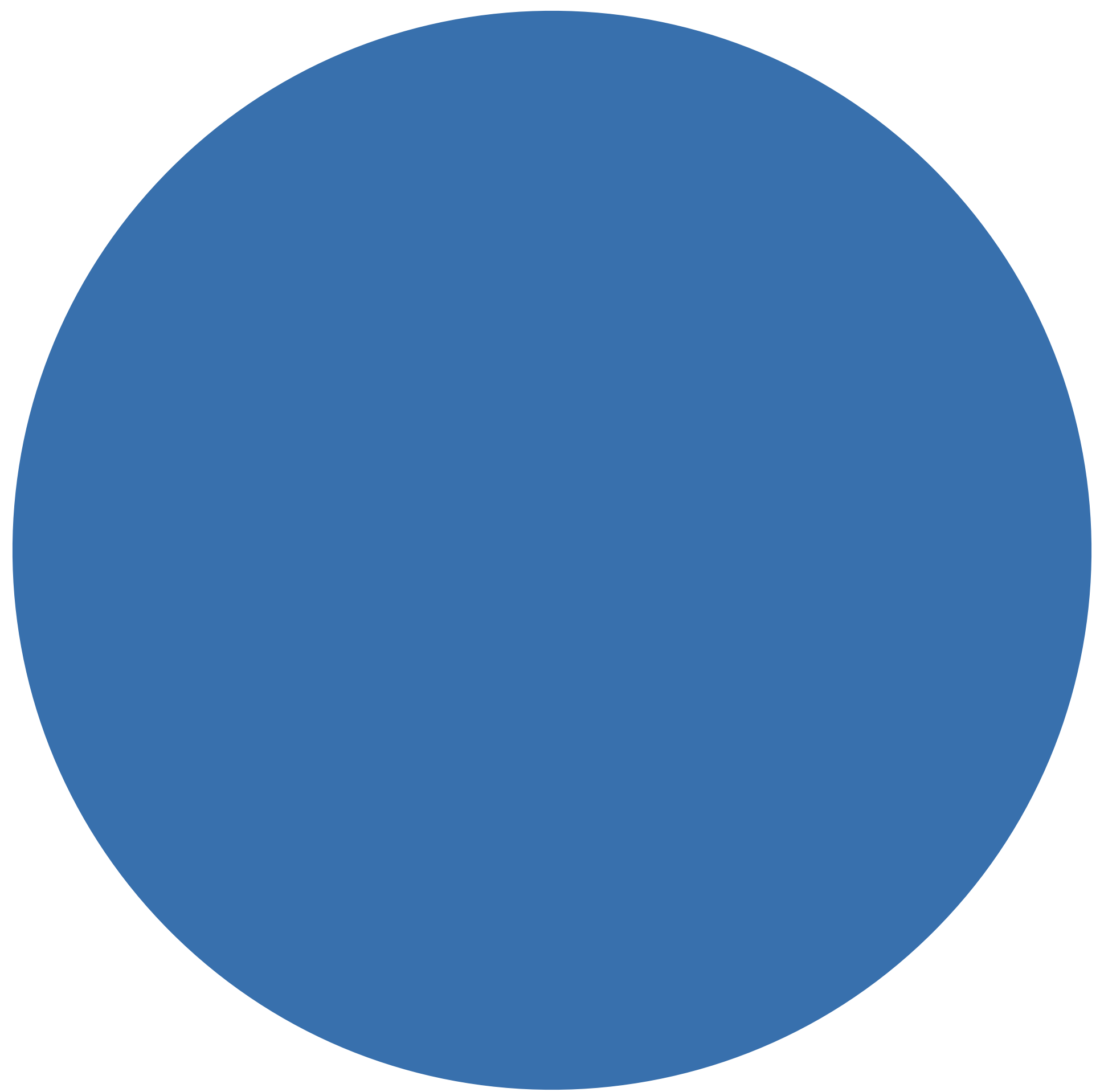



Global

ICT Sector

Organization

Web perf expert





**We all work on the
largest machine
ever built.**

The Internet Machine



Energy,
Land,
Water,
Resources



Data Centers



Networks

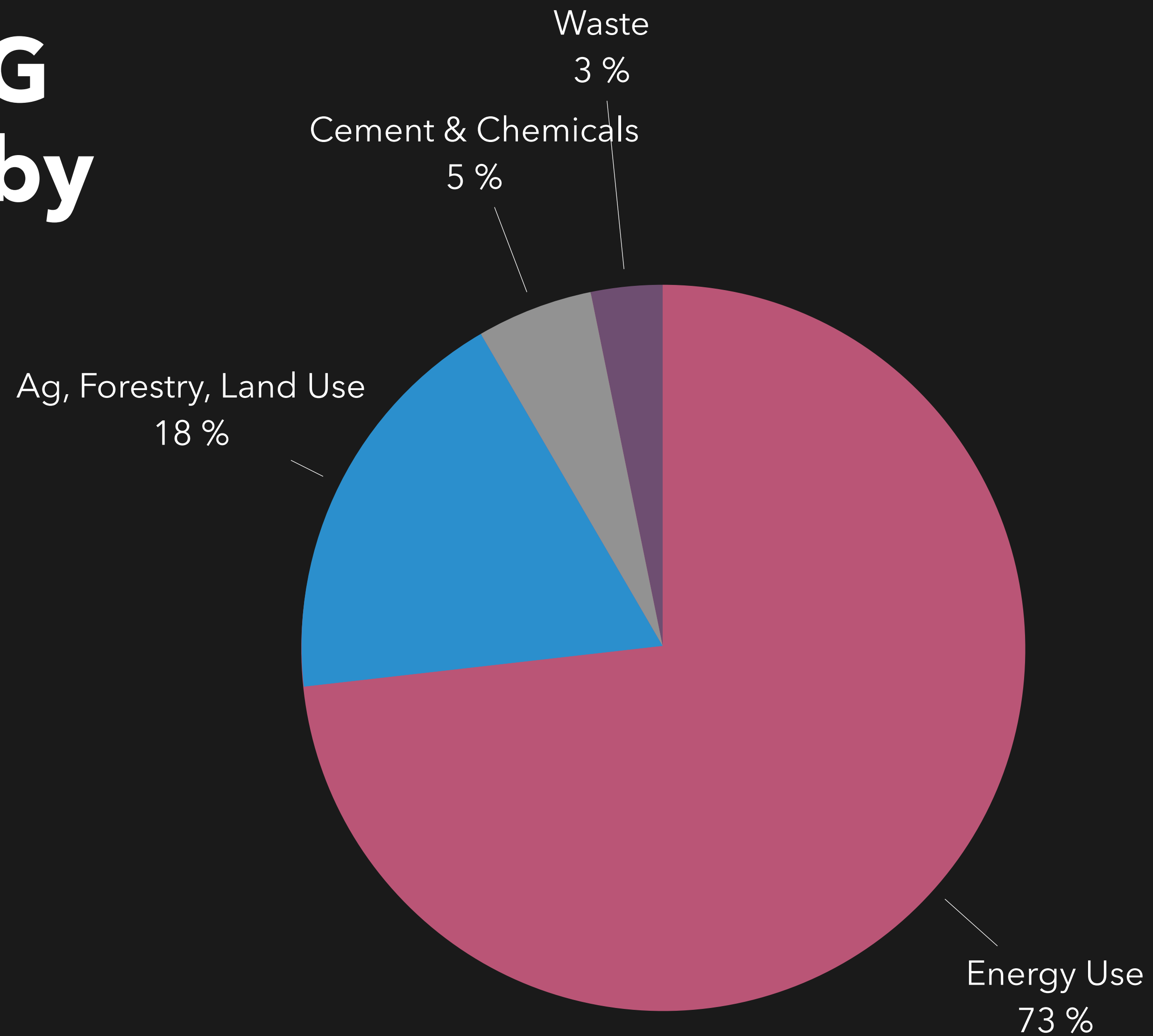


Devices

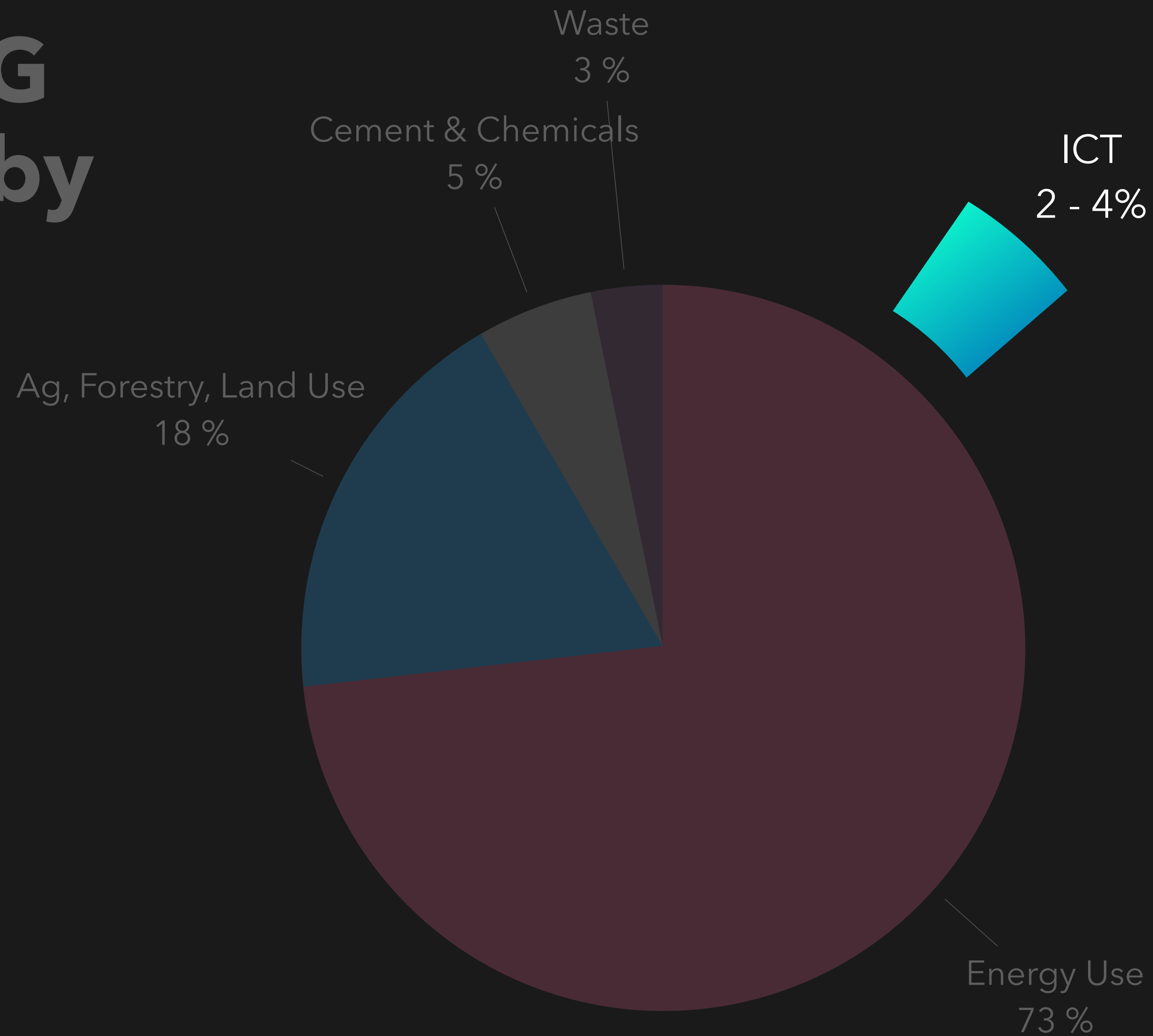


What is our impact?

Global GHG Emissions by Sector

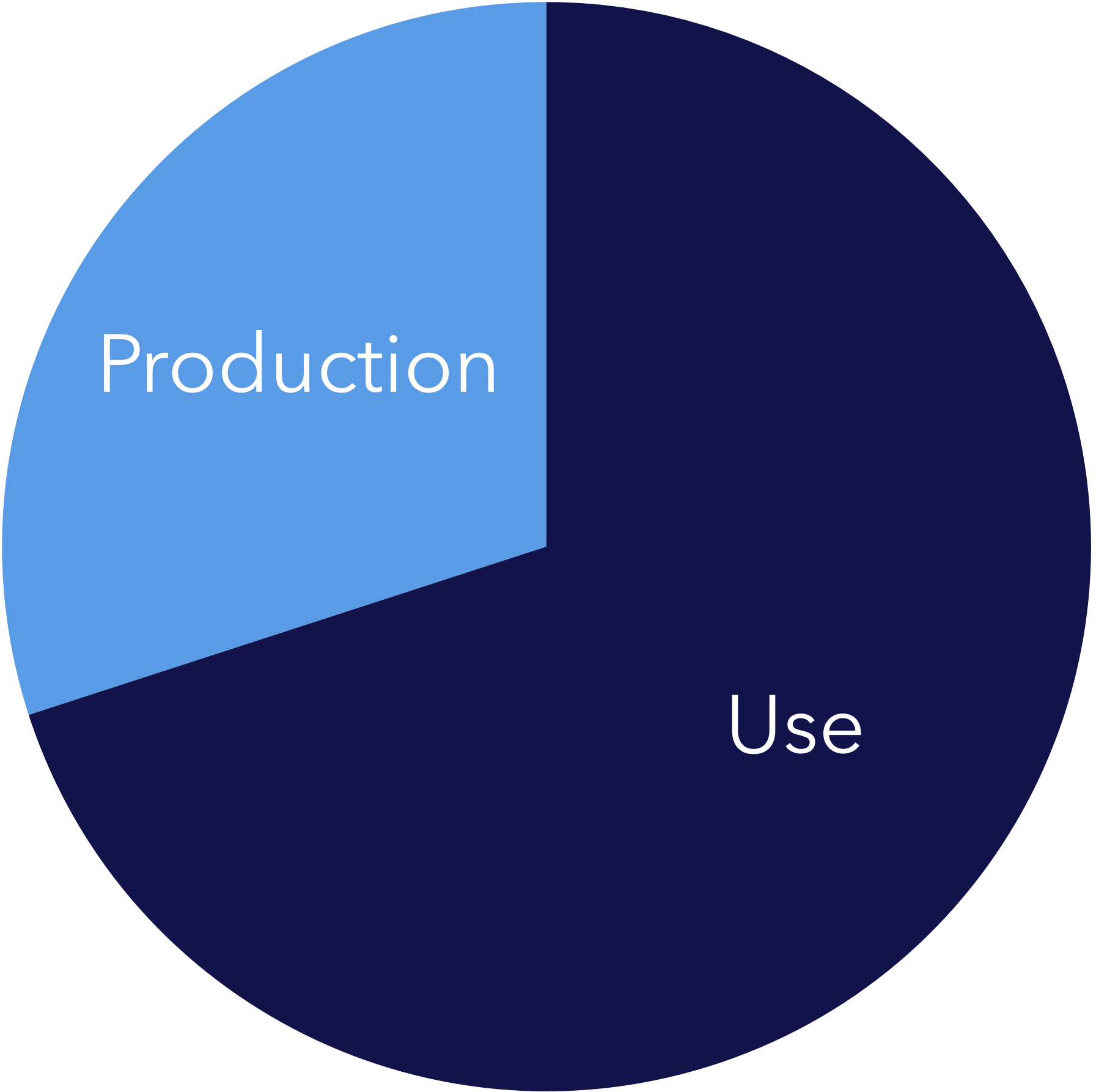


Global GHG Emissions by Sector



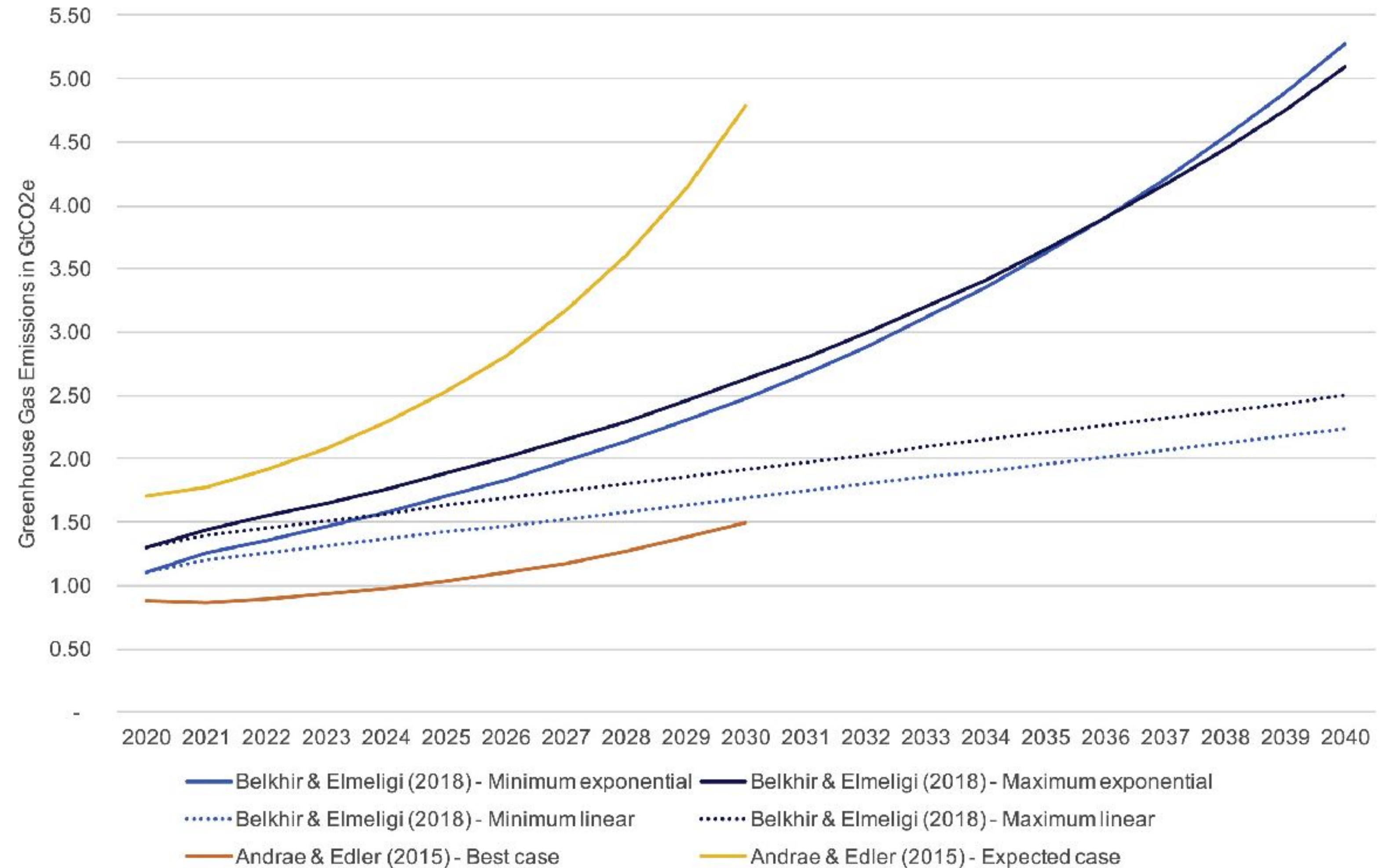
Source: ourworldindata.org/ghg-emissions-by-sector. "The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations" (2021) by Charlotte Freitag, Mike Berners-Lee, et al.

**Around 70%
of ICT's
footprint is
due to use**



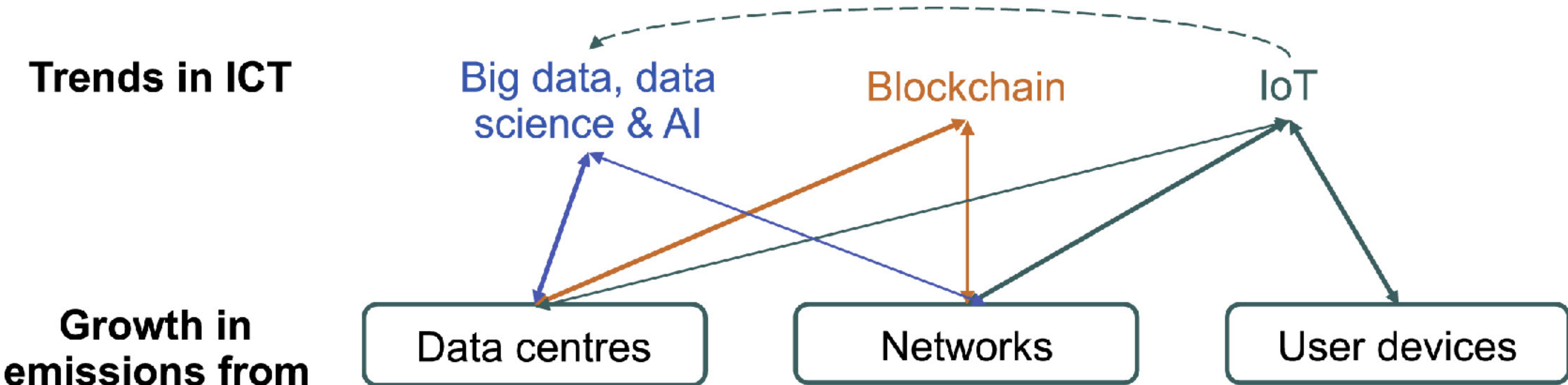
Source: "The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations" (2021) by Charlotte Freitag, Mike Berners-Lee, et al.

Projected GHG emissions from ICT



Source: [“The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations”](#) (2021) by Charlotte Freitag, Mike Berners-Lee, et al.

Trends in ICT



Source: [“The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations”](#) (2021) by Charlotte Freitag, Mike Berners-Lee, et al.



**We need to shift how we consume on
the planet, because we have
exceeded the limits.**

David Obura, Coral Reef Expert

A photograph of a server room with several server racks. The racks have mesh doors, and behind them, a dense network of colorful cables (orange, blue, green) is visible, illuminated by small green and blue lights. The overall scene is dark, with the primary light sources being the server components and the glowing cables.

Digital is physical.

Digital is social.

AMAZON

RESPECT
WORKERS!

RESPECT
COMMUNITIES!

LOCAL
102
UFCW

NEW YORK
CHANGE

ALIGN

LOCAL

A young boy with a shaved head is sitting on a ground covered with small, light-colored rocks and sand. He is wearing a light-colored, long-sleeved shirt and dark trousers. He is looking down at his hands, which are resting on the ground. The background shows more of the rocky terrain and some larger, crumpled pieces of paper or fabric. The overall scene suggests a state of poverty or displacement.

Digital is human.

Our job:

Make the web faster.

Business as usual?

Our biggest challenges

Too much energy use

Too many devices

Our biggest challenges

What we do already

Too much energy use

Reduce page weight

Optimize media

Audit 3P, use façades

Compression,
minification

Caching

Lazy-loading

Remove unused code

Perf budgets

Too many devices

Support legacy,
progressively

Our biggest challenges

What we should avoid

Too much energy use

"Shotgun" preloading

Too many media
formats

Tracking data without
end-of-life

Too many devices

Our biggest challenges

What more we can do

Too much energy use

Measure green metrics

Green hosting / cloud

Carbon awareness

a11y

Environmental
budgets

Too many devices

Cloud/ISP carbon data

Our biggest challenges

What more we can do

Too much energy use

Too many devices

Our biggest challenges

What more we can do

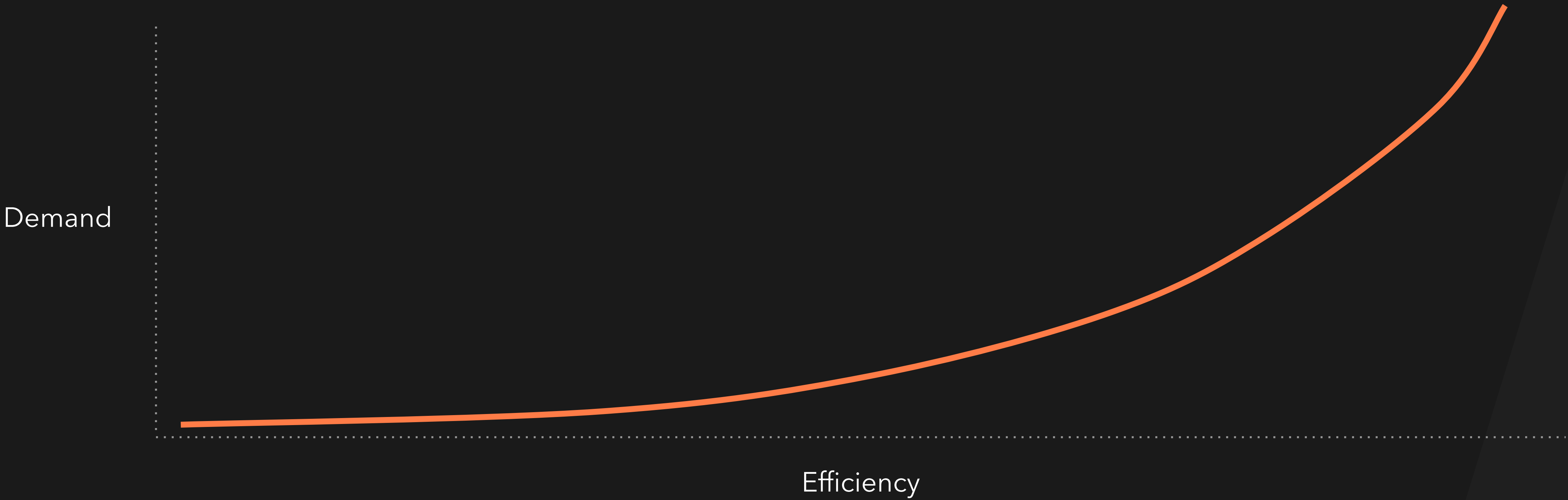
Too much energy use

Too many devices

Human behavior

The Jevons Paradox

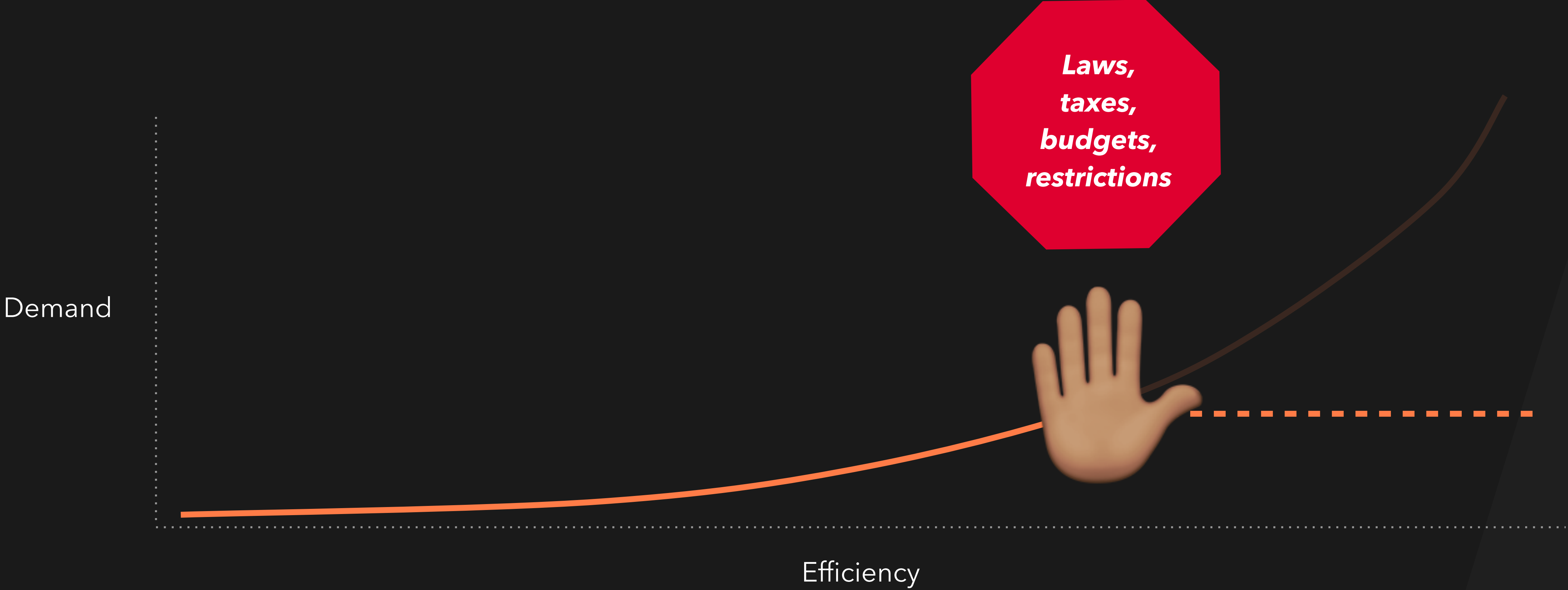
Increasing efficiency enables increased use



Source: [Wikipedia](#)

The Jevons Paradox

Increasing efficiency enables increased use



Source: [Wikipedia](#)

CSRD



The screenshot shows the European Commission website page for Corporate Sustainability Reporting. The page is in English and features a navigation menu with categories like Home, Regulation, Supervision, Financial markets, Banking & insurance, Sustainable finance, Digital finance, Consumer finance, Financial crime, and EU & worldwide. The main content area is titled "Corporate sustainability reporting" and includes a sub-header "What the EU is doing and why". The text explains that EU rules require large companies and listed companies to publish regular reports on social and environmental risks. A "PAGE CONTENTS" section lists "What the EU is doing and why", "Policy making timeline", "Relevant legislation", and "Related links". A "New rules on corporate sustainability reporting: The Corporate Sustainability Reporting Directive" section is also visible.

CCDAA



The screenshot shows the California State Senate Bill No. 253 document. The document is titled "Senate Bill No. 253" and "CHAPTER 382". It is an act to add Section 38532 to the Health and Safety Code, relating to greenhouse gases, and making an appropriation therefor. The document is dated October 7, 2023, and was approved by the Governor and filed with the Secretary of State. The document is a Legislative Counsel's Digest and includes the following text:

SB 253, Wiener. Climate Corporate Data Accountability Act.
The California Global Warming Solutions Act of 2006 requires the State Air Resources Board to adopt regulations to require the reporting and verification of statewide greenhouse gas emissions and to monitor and enforce compliance with the act. The act requires the state board to make available, and update at least annually, on its internet website the emissions of greenhouse gases, criteria pollutants, and toxic air contaminants for each facility that reports to the state board, as provided.

This bill would require the state board, on or before January 1, 2025, to develop and adopt regulations requiring specified partnerships, corporations, limited liability companies, and other business entities with total annual revenues in excess of \$1,000,000,000 and that do business in California, defined as "reporting entities," to publicly disclose to the emissions reporting organization, as defined, and obtain an assurance engagement on, starting in 2026 on a date to be determined by the state board, and annually thereafter, their scope 1 and scope 2 greenhouse gas emissions, as defined, and, starting in 2027 and annually thereafter, their scope 3 greenhouse gas emissions, as defined, from the reporting entity's prior fiscal year, as provided. The bill would require the state board to review during 2029, and update as necessary on or before January 1, 2030, these deadlines to evaluate trends in scope 3 emissions reporting and to consider changes to the deadlines, as provided. The bill would require a reporting entity to obtain an assurance engagement, performed by an independent third-party assurance provider, of the entity's public disclosure as provided. The bill would require the state board, in developing these regulations, to consult with the Attorney General, other government stakeholders, investors, stakeholders representing consumer and environmental justice interests, and reporting entities that have demonstrated leadership in full-scope greenhouse gas emissions accounting and public disclosure and greenhouse gas emissions reductions. The bill would also require the state board to ensure that the assurance process minimizes the need for reporting entities to engage multiple assurance providers and ensures sufficient assurance provider capacity, as well as timely reporting implementation, as required. The bill would further require the state board to contract with an emissions reporting organization to

92

The EU's Corporate Sustainability Reporting Directive (CSRD); California's SB 253, the Climate Corporate Data Accountability Act (CCDAA)

W3C Community Group
Draft Report

Web Sustainability Guidelines (WSG) 1.0

Draft Community Group Report 10 October 2023

Latest published version:
<https://w3c.github.io/sustyweb/>

Latest editor's draft:
<https://w3c.github.io/sustyweb/>

Editors:
[Alexander Dawson](#)
[Tim Frick](#) (Mightybytes)

Feedback:
[GitHub w3c/sustyweb](#) (pull requests, new issue, open issues)

Implementation:
[Sustainable Web Design](#)

Supplements:
[At A Glance](#)
[Quick Reference](#)

Copyright © 2023 the Contributors to the Web Sustainability Guidelines (WSG) 1.0 Specification, published by the [Sustainable Web Design Community Group](#) under the [W3C Community Contributor License Agreement \(CLA\)](#). A human-readable [summary](#) is available.

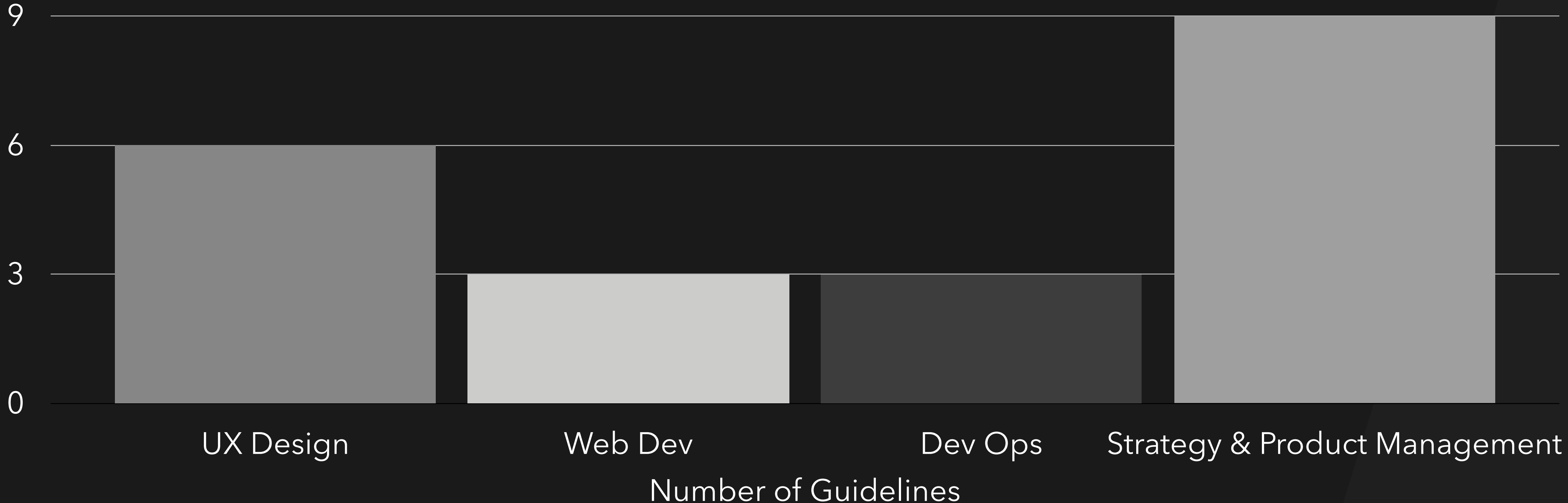
Abstract

Web Sustainability Guidelines (WSG) 1.0 covers a wide range of recommendations for making websites and products more sustainable. Following these guidelines which utilize environment, social, and governance (ESG) principles throughout the decision-making processes, you can minimize your environmental impact through a mixture of user-centered design, performant web development, renewable infrastructure, sustainable business strategy, and (with metrics) various combinations of those mentioned. It should be noted that these guidelines will not address every possible mechanism or strategy to become sustainable, as such, these guidelines (which are notably Web orientated and focused) should be seen as a starting point in a sustainability journey (coverage does not extend for example to manufacturing or shipping of physical products). Following these guidelines will often make Web content more accessible, usable, and performant as a by-product.

UNOFFICIAL

Web sustainability guidelines

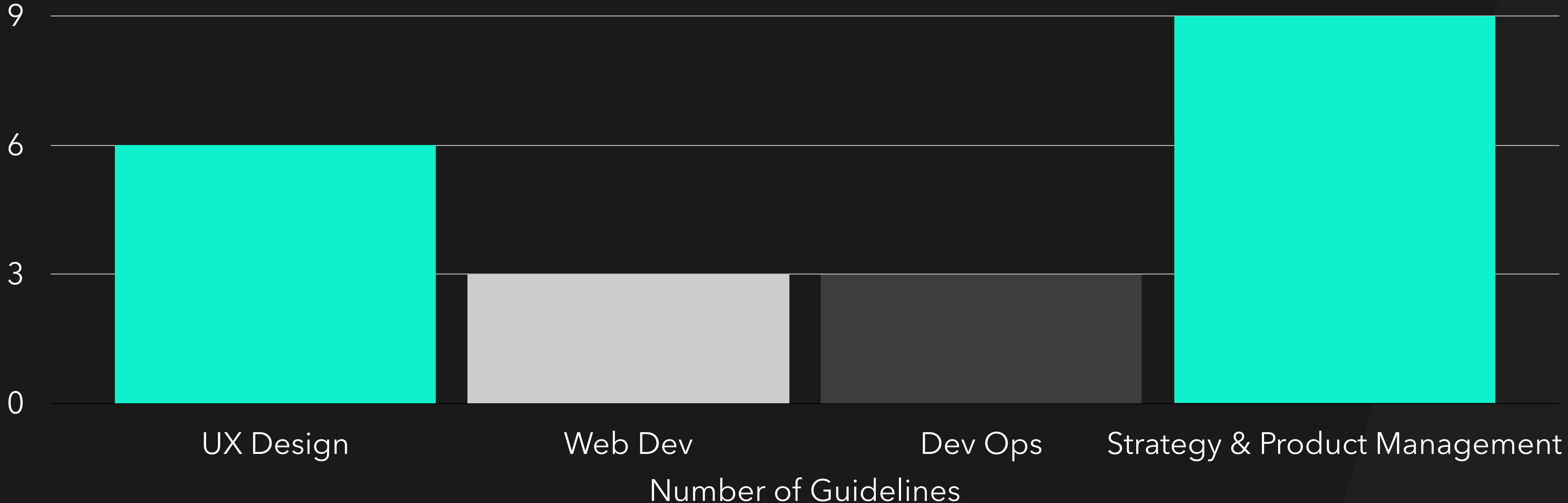
High Impact, Low-/Medium Effort



Source: [“Web Sustainability Guidelines: Getting Started”](#) by Brian Louis Ramirez, based on Web Sustainability Guidelines, v1, 2023

Web sustainability guidelines

High Impact, Low-/Medium Effort



Source: [“Web Sustainability Guidelines: Getting Started”](#) by Brian Louis Ramirez, based on Web Sustainability Guidelines, v1, 2023

The biggest problems

What more we can do

Too much energy use

Too many devices

Human behavior

Green Software
Training

Inform what not to
build / what to delete

Raise awareness

Help devise
sustainability strategy

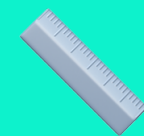
Activism

Our job:

Make the web faster.

Our job:

Make the web faster *and* greener.



Measure



Investigate

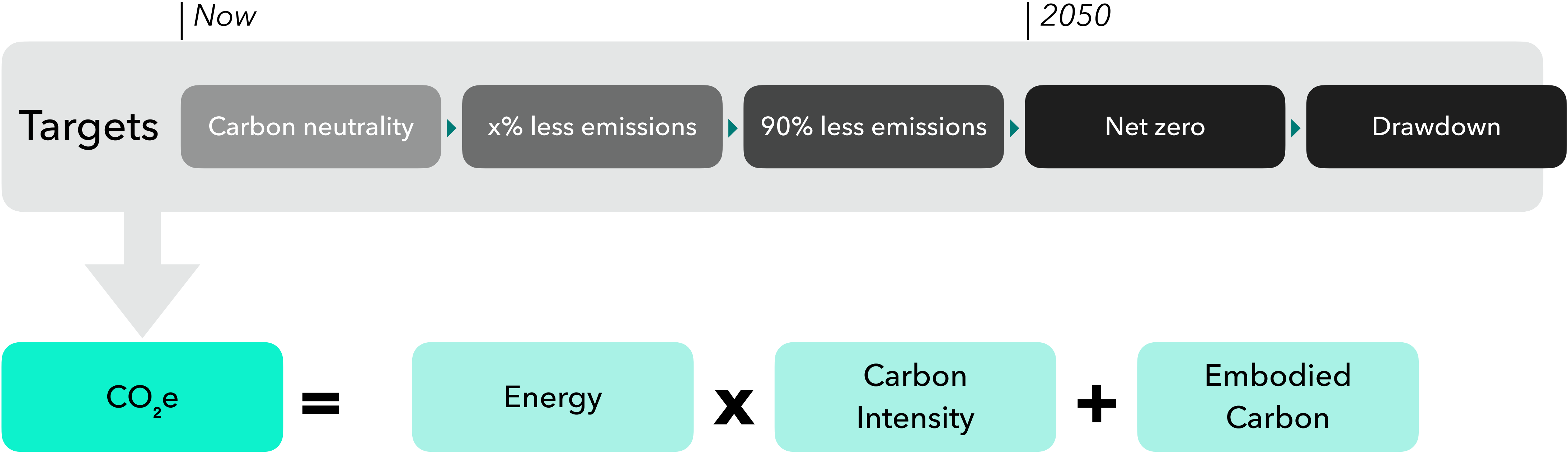


Optimize



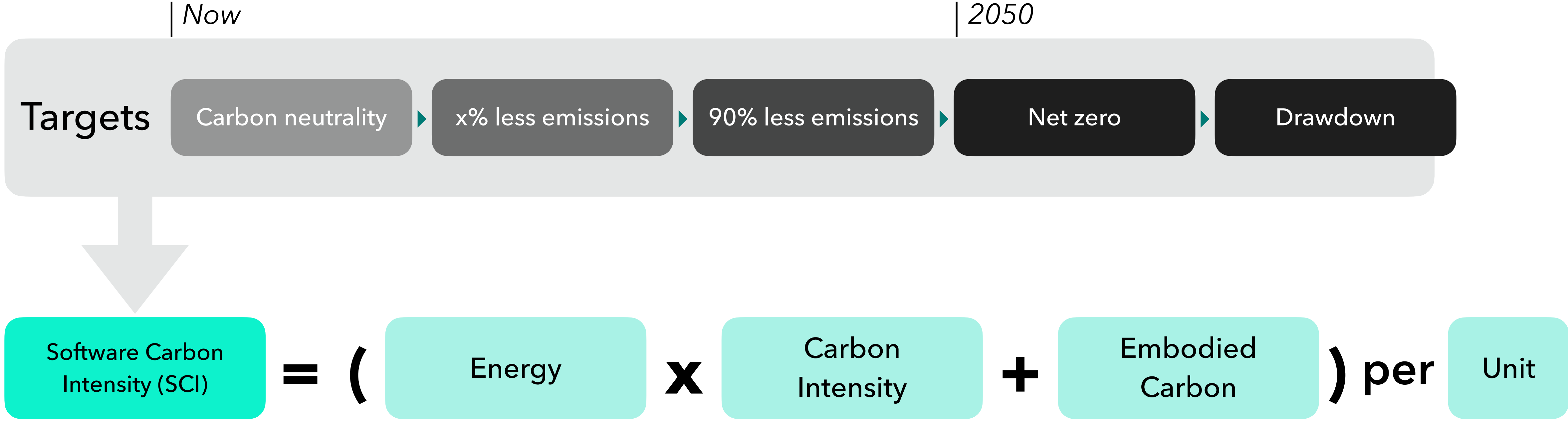
References: [Building Green Software](#) (2024, preview) by Anne Currie, Sarah Hsu, Sara Bergman. “[Why do estimates for internet energy consumption vary so drastically?](#)” by Tom Greenwood. [Green Software Practitioner](#) by the Green Software Foundation. “[Calculating Digital Emissions](#)” on [sustainablewebdesign.org](#).

A perfect green metric



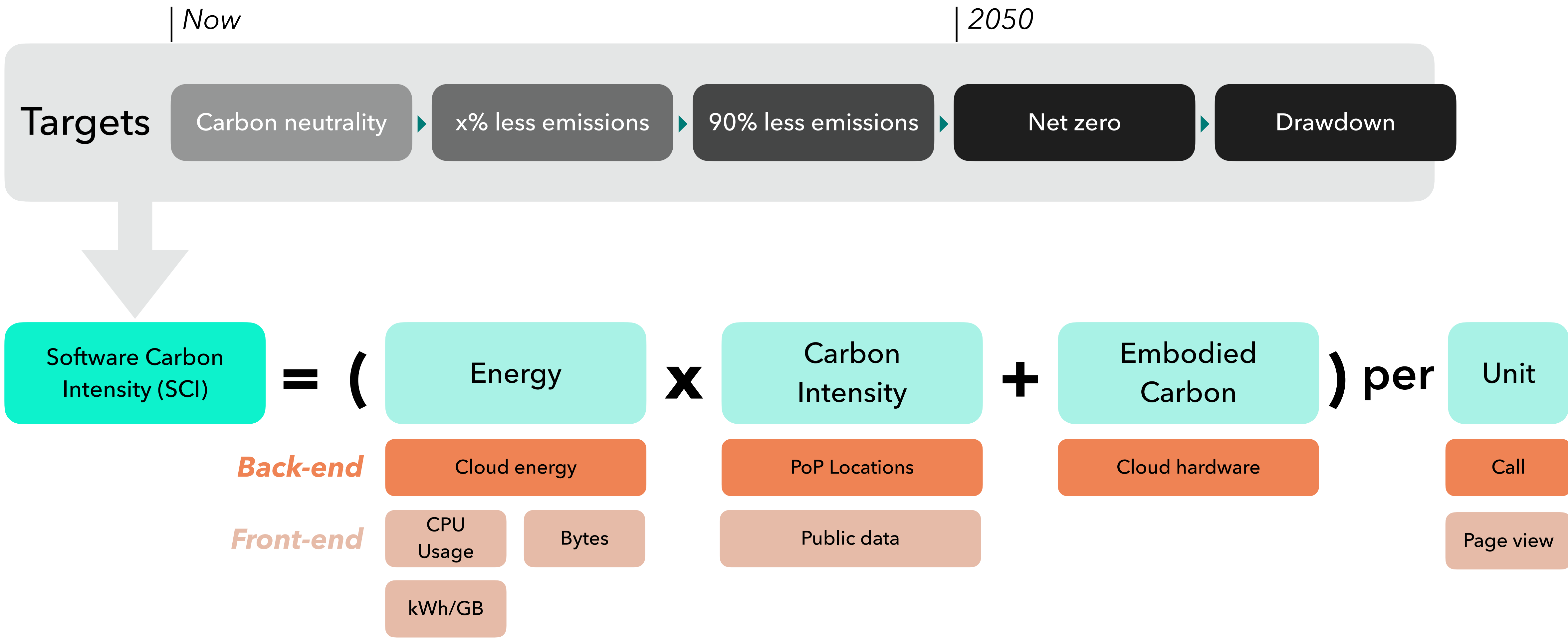
References: [Building Green Software](#) (2024, preview) by Anne Currie, Sarah Hsu, Sara Bergman. “[Why do estimates for internet energy consumption vary so drastically?](#)” by Tom Greenwood. [Green Software Practitioner](#) by the Green Software Foundation. “[Calculating Digital Emissions](#)” on [sustainablewebdesign.org](#).

A good-enough green metric



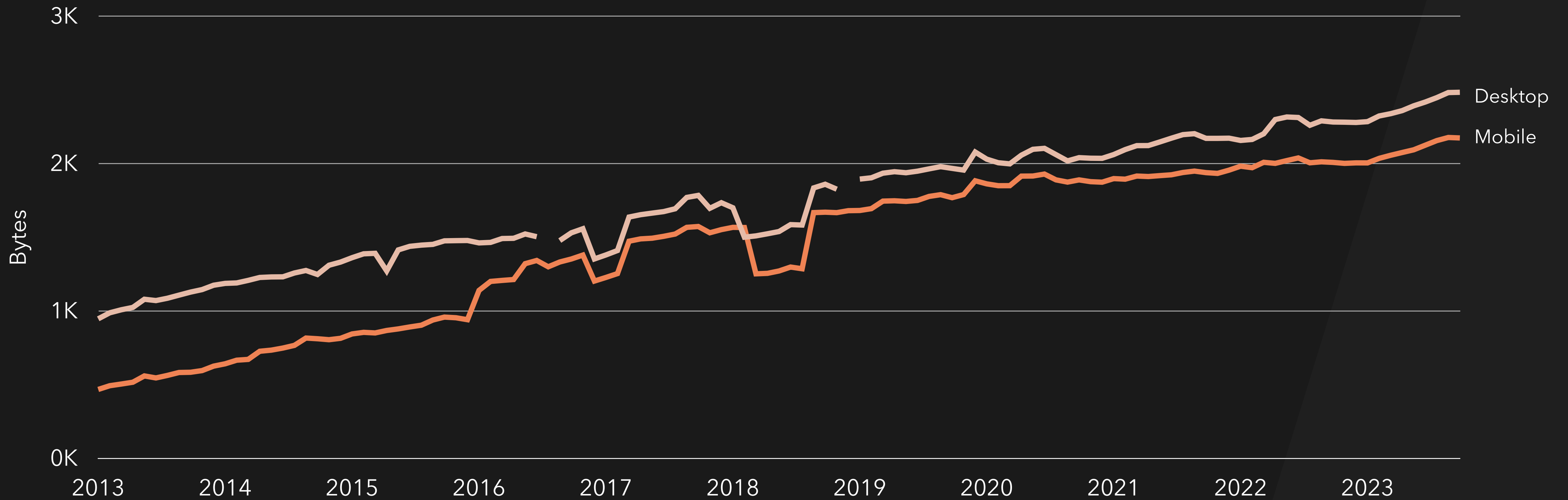
References: [Building Green Software](#) (2024, preview) by Anne Currie, Sarah Hsu, Sara Bergman. “[Why do estimates for internet energy consumption vary so drastically?](#)” by Tom Greenwood. [Green Software Practitioner](#) by the Green Software Foundation. “[Calculating Digital Emissions](#)” on [sustainablewebdesign.org](#).

A good-enough green metric



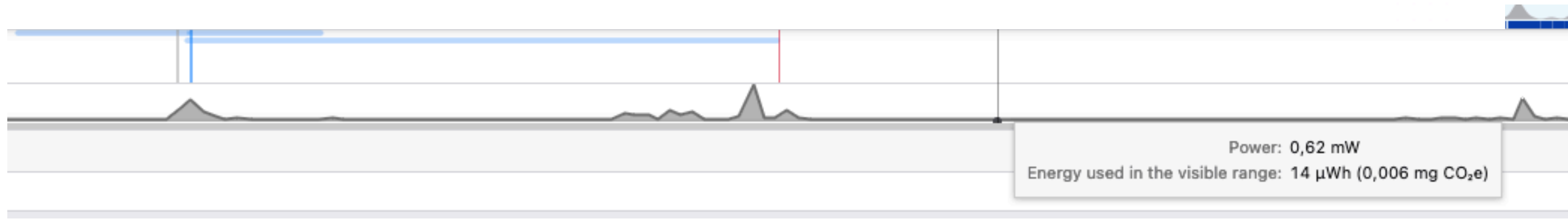
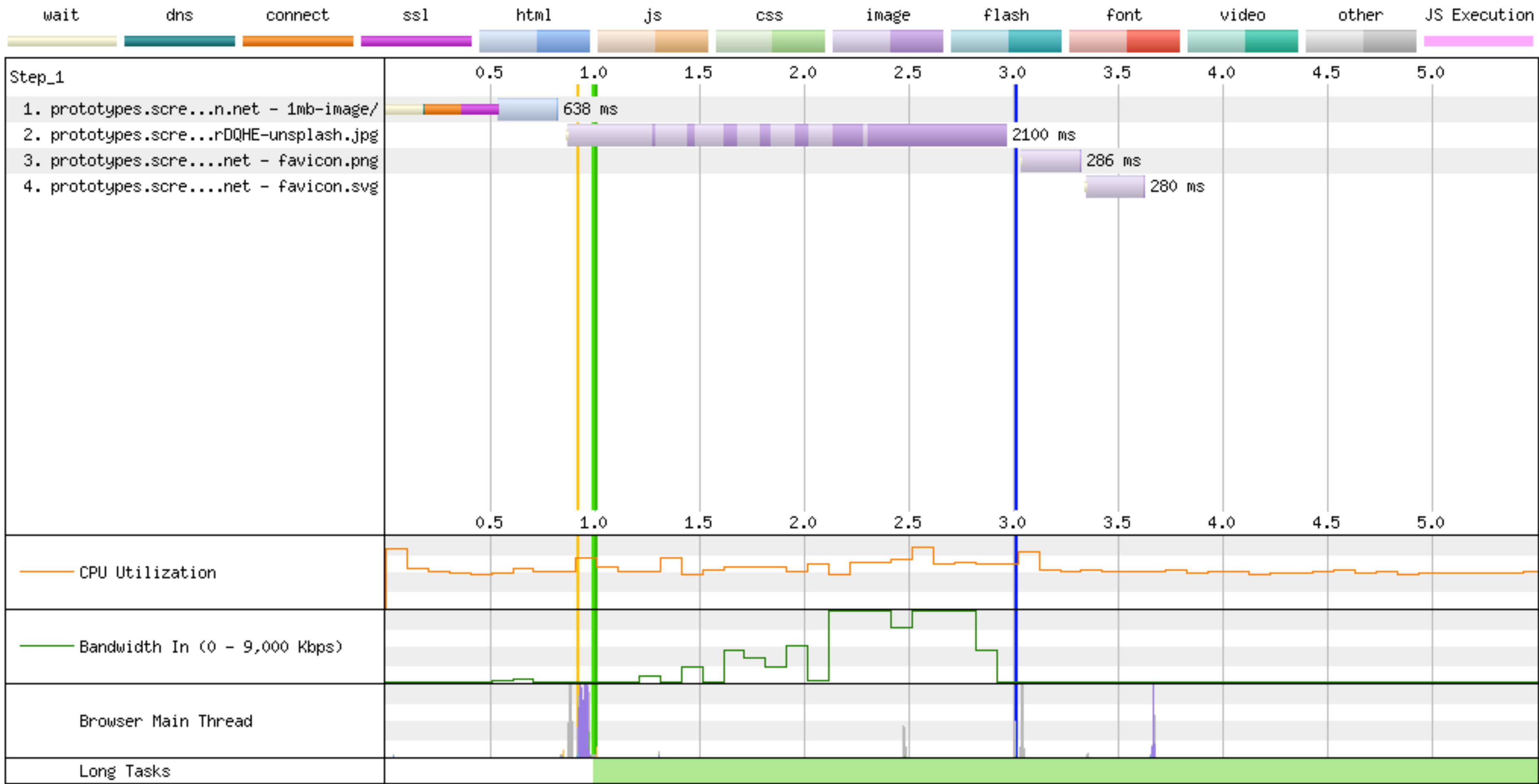
References: [Building Green Software](#) (2024, preview) by Anne Currie, Sarah Hsu, Sara Bergman. “[Why do estimates for internet energy consumption vary so drastically?](#)” by Tom Greenwood. [Green Software Practitioner](#) by the Green Software Foundation. “[Calculating Digital Emissions](#)” on [sustainablewebdesign.org](#).

Webpages keep getting heavier



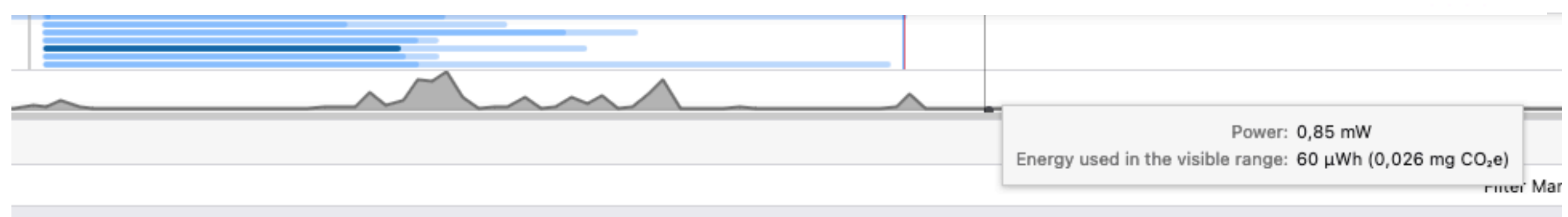
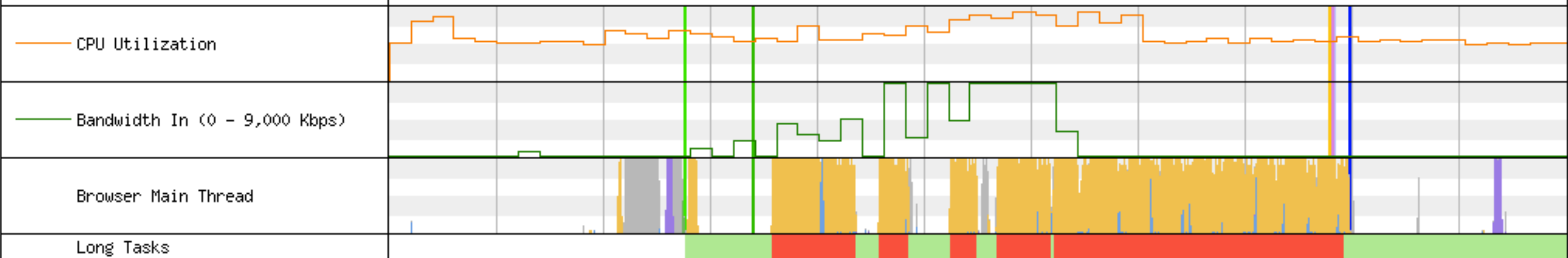
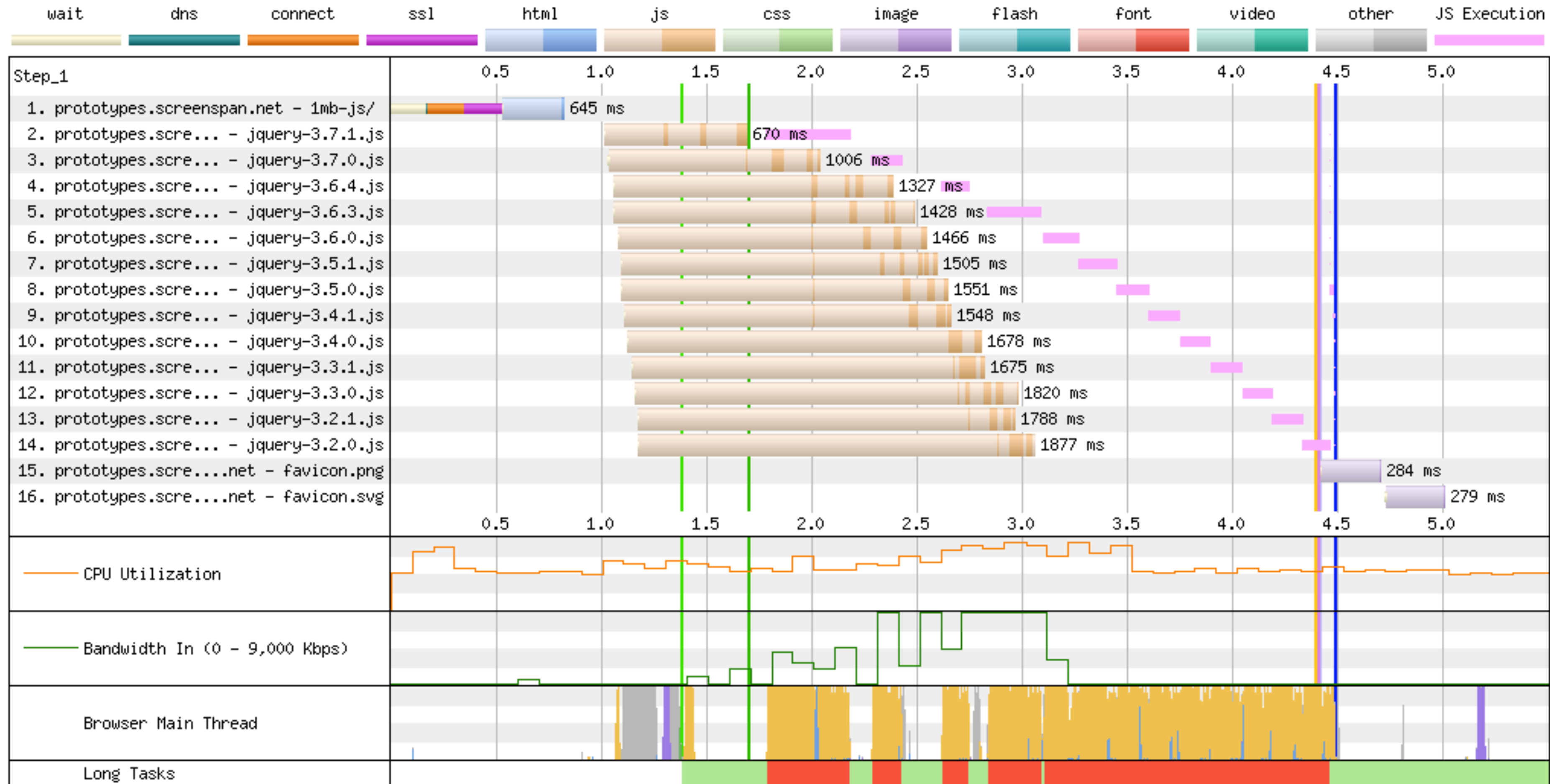
Source: [HTTP Archive](#), Aug 2013 - Sept 2023, no lens

1 MB image file



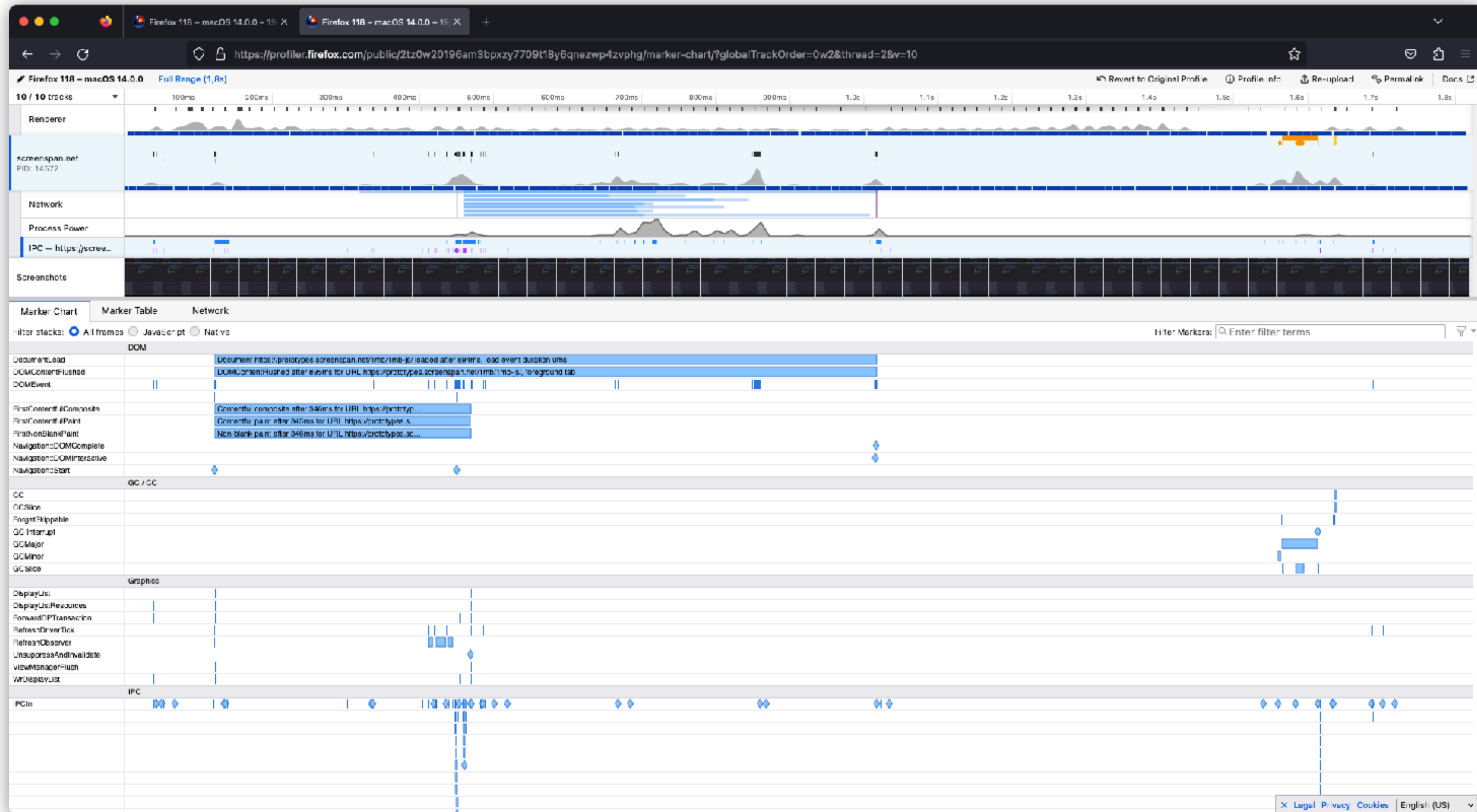
Source: [WebPageTest](#), [Firefox Power Profiler](#)

1 MB of JavaScript



Source: [WebPageTest](#), [Firefox Power Profiler](#)

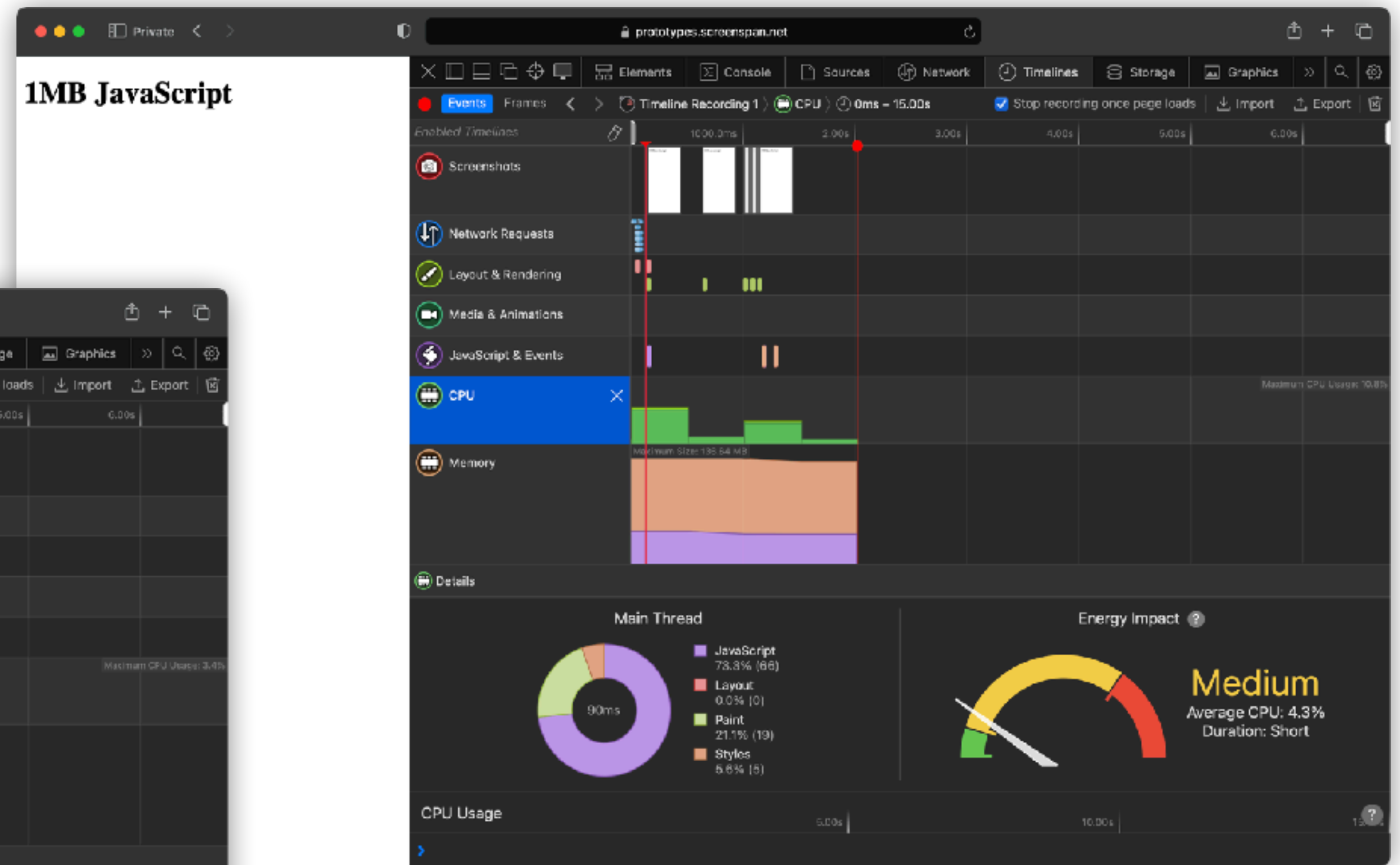
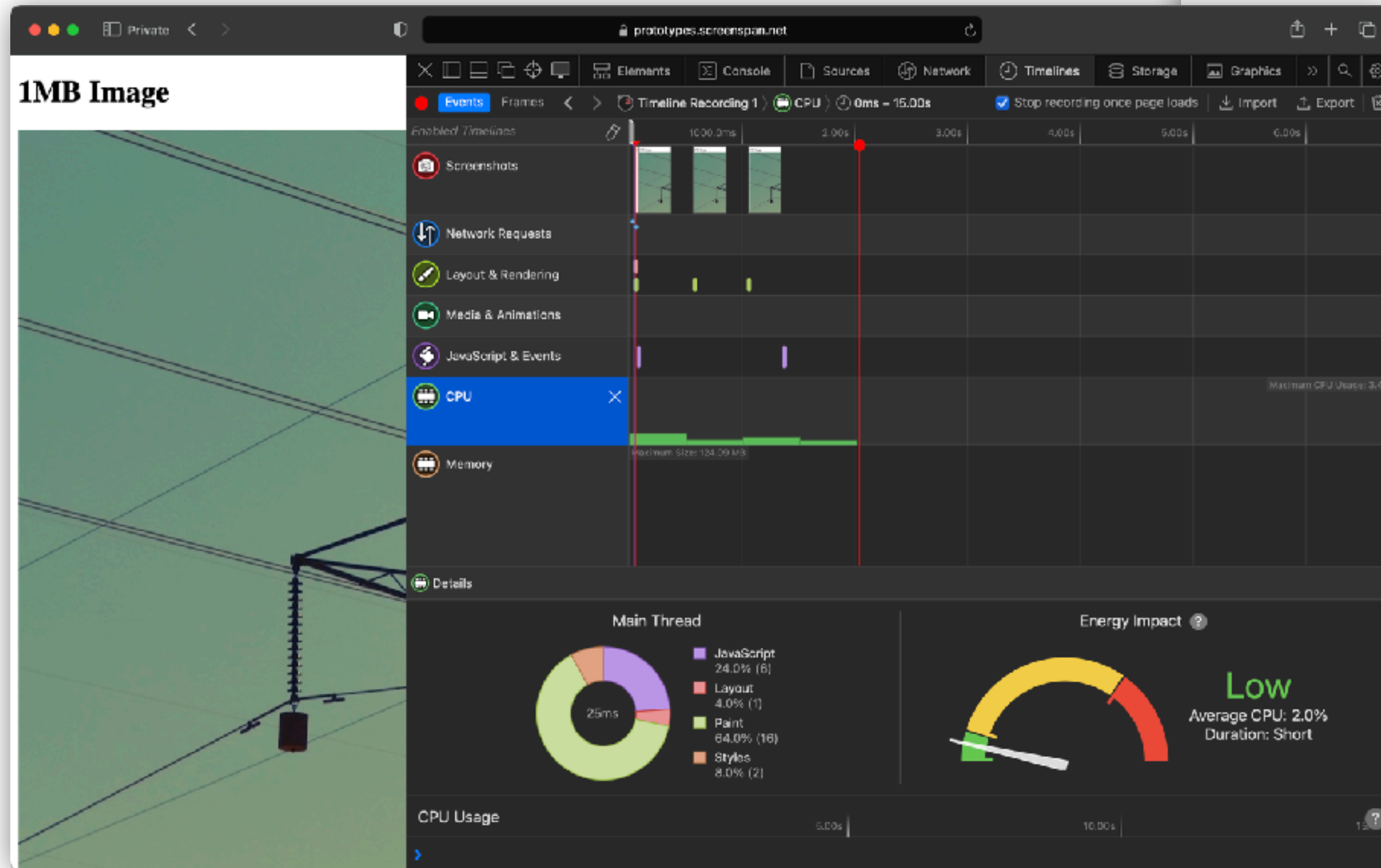
Firefox Power Profiler



Firefox Power Profiler



Safari Inspector



Front-end testing and monitoring

websitecarbon.com

Website Carbon Calculator

Carbon results for unfccc.int/cop28

This page was last tested on 10 Apr, 2023. Test again

Hurrah! This web page is cleaner than 66% of web pages tested

ecograder.com

Ecograder

Your Impact Report

Performance Impact

Ecograder Score: 81 (Out of 100)

Emissions per PageLoad: 0.75 (grams of carbon dioxide)

Page Weight: 94 (25% of score)

UX Design: 74 (17% of score)

Green Hosting: 100 (13% of score)

Carbon Score: 63 (25% of score)

sitespeed.io

Per domain (first run)

Domain	Estimated CO2 emissions	Transfer Size
images.svc.se	0.00009 grams (02.40 %)	729.9 KB
www.aftonbladet.se	0.57624 grams (21.54 %)	725.0 KB
cdn.bannerflow.com	0.47785 grams (17.86 %)	601.2 KB
gfx.aftonbladet-cdn.se	0.19511 grams (7.33 %)	246.8 KB
ib.adrxs.com	0.15065 grams (5.63 %)	126.5 KB
securepubads.g.doubleclick.net	0.08270 grams (3.00 %)	104.0 KB
s3/2.mxcdn.net	0.05839 grams (2.18 %)	49.1 KB
www.klar.se	0.04385 grams (1.64 %)	56.2 KB
cdn.adrxs.com	0.03455 grams (1.29 %)	29.0 KB
accn.adrxs.com	0.03289 grams (1.23 %)	27.6 KB
pp.p4.io	0.03161 grams (1.10 %)	39.0 KB
s3-eu-central-1.amazonaws.com	0.02440 grams (0.91 %)	20.5 KB
cogwheel.inventory.schibsted.io	0.01699 grams (0.64 %)	14.3 KB
static.svd.se	0.01612 grams (0.60 %)	13.5 KB

CO2.js

THE GREEN WEB FOUNDATION

CO2.js - Overview

One day, the internet will be powered by renewable energy. Until that day comes, there'll be a CO2 cost that comes with every byte of data that's uploaded or downloaded.

In a hurry? Check out our [quickstart guide](#). Start calculating digital carbon emissions in 5 minutes with CO2.js

What is CO2.js? CO2.js is a JavaScript library that allows developers to estimate the emissions associated with their apps, websites and software.

Why use it? Being able to estimate the carbon emissions associated with digital activities can be of benefit to both development teams and end users.

WebPageTest Carbon Control

Carbon Control

WebPageTest evaluates a website's carbon usage through the use of services such as the Green Web Foundation's Green Web Dataset and CO2.js

Green Hosting Check

Estimated Carbon Footprint

Page Weight: 1.4 MB

CO2 per new visit: 0.52g

Your Footprint, in Context...

The average passenger vehicle emits 404 grams of CO2 per mile. This website emits that amount of CO2 every 777 visits.

The median CO2 footprint of the top 1000 websites is 0.6 grams per visitor. This website emits 13% less than that per visit.

A site's carbon footprint can vary by device and location, particularly if it relies on 3rd party ads.

Speetals

Aymen Loukil - 1st

International SEO and Webperf Consultant

I'm thrilled to introduce a new feature in Speetals that will help you monitor and improve your website's carbon footprint!

Track Carbon Footprint Evolution...

Monitor your website's carbon emissions - Speetals

Missing APIs?

```
Navigator = {
  deviceAge: 2,
  embodiedCarbon: 8,
  // ...
}

PerformanceSessionTiming = {
  totalTransferSize: 2220, // including request and response headers
  totalTransferredJS: 750,
  // ...
}

PerformanceMeasure = {
  detail: {
    cpuTime: 2342,
    gpuTime: 366,
    energyImpact: .66,
    watts: 0.00014
  }
}
```

Let's make the web
faster and greener .



Thanks!
@SCREENSPAN

