

# Do websites contribute to global warming

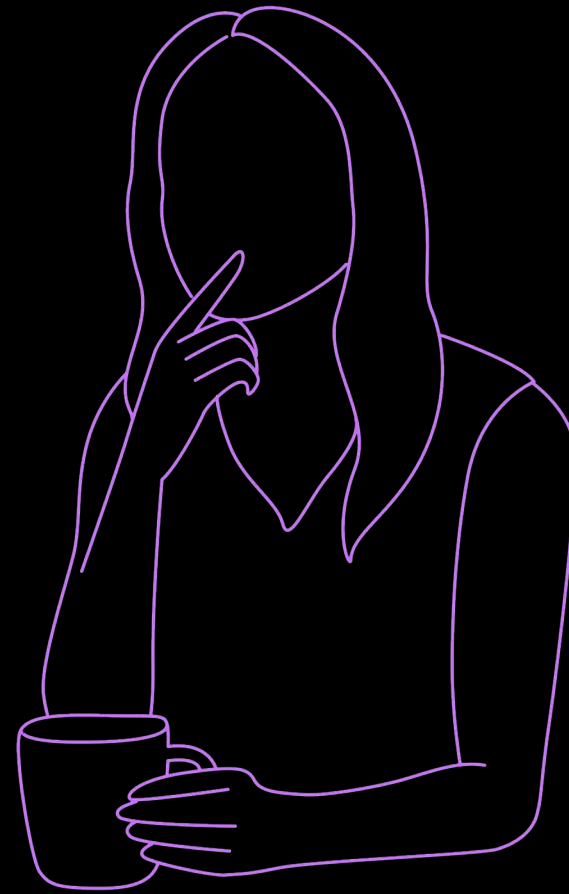
Julia Ziębińska

## **Digital ecology is...**

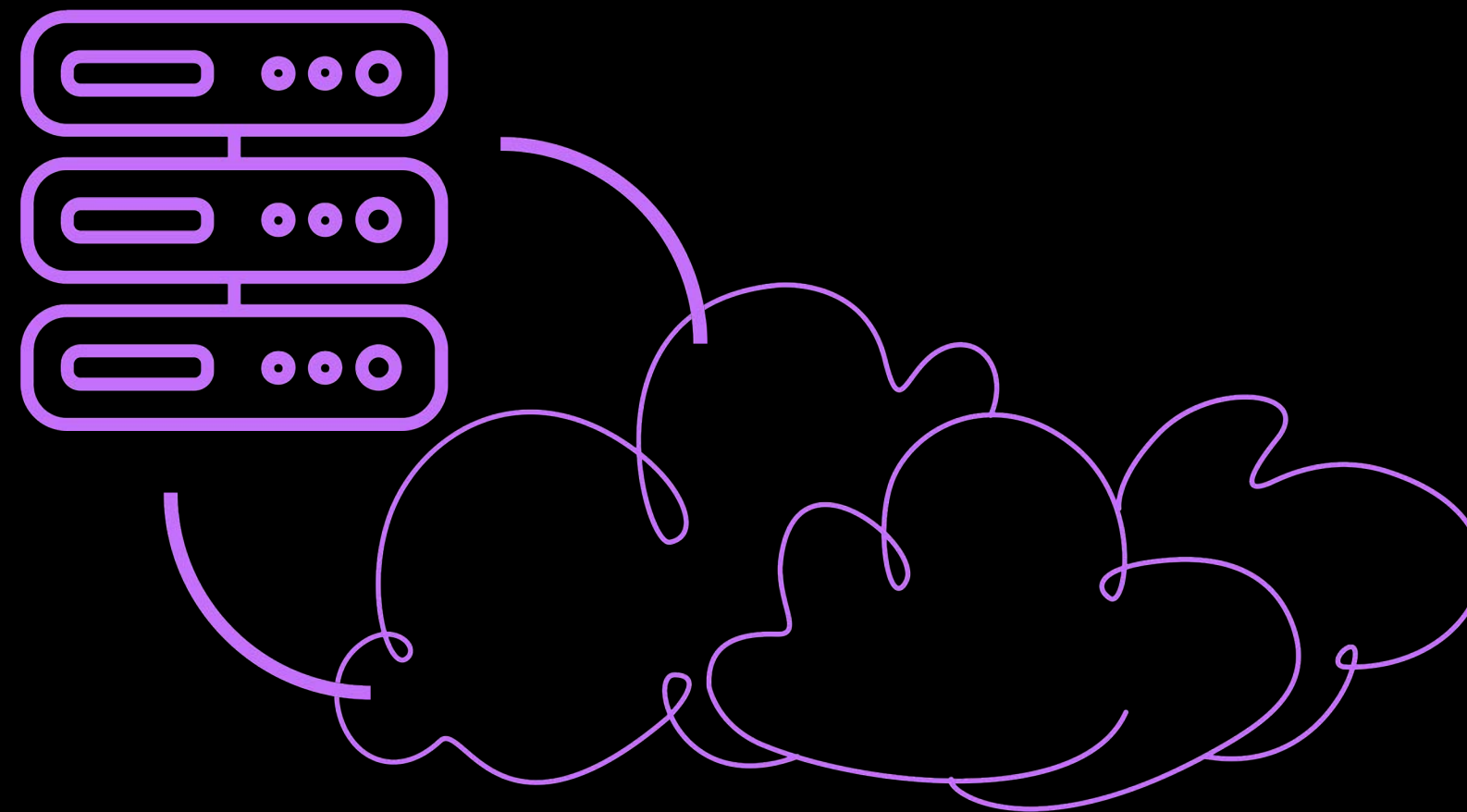
a field of study about the interdependence of digital systems and the natural environment

a branch of ecology that promotes green practices to make digital systems more sustainable.

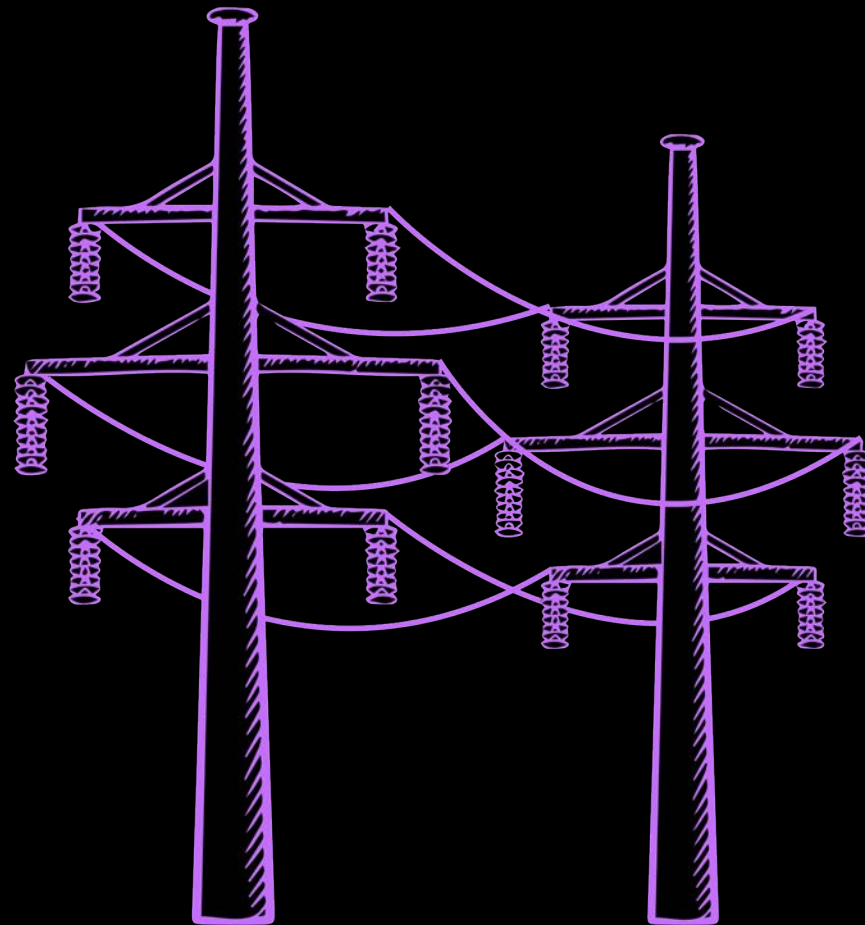
How does the Internet emit CO<sub>2</sub>?



Servers / Data centres / Cloud



# Data transfer and power lines



# End devices



4%

of all greenhouse gases

\*Cloud? 100 zettabytes by 2025 = 200 bln tons CO2/year

What can we do about it?

We can make a **significant** impact with **insignificant**  
changes!



# E-mails

- Deleting emails
- Other messaging tools
- Spam
- Size of e-mails



# Browsing

- Ecosia, Lilo, DuckDuckGo
- Close tabs
- Write addresses directly
- Bookmarks
- Keywords
- Erase old media on social media platforms



# Devices

1. Changing smartphones or computers less often

Replacement every 6th year instead of 4th:  
190 kg of CO2 emissions per person less

2. Deleting mobile apps

3. Disabling mobile notifications

4. Unplugging a router

# Websites

Every day **250 000** web pages are published.

Every view generates **1.8 g CO2**  
what sums up to **216 kg CO2 annually.\***

= driving 900 km by a gasoline car

\*10 000 views monthly

How much CO<sub>2</sub> does **your website**  
produce?

# The original Website Carbon calculator

**Estimate your web page carbon footprint:**

Your web page address

By using this carbon calculator, you agree to the information that you submit being stored and published in our public database.

# Website carbon calculator

**All websites have a carbon footprint. What's yours?**

Use the tool below to estimate the digital carbon footprint of any website.

Enter your website address:

Calculate



How green is your website?  
Enter a web address below to find out now!

https://www.yourwebsite.com

Submit

# Conf42: JavaScript 2023

November 16 2023 - premiere 5PM GMT

Thu Nov 16 2023 18:00:00 GMT+0100 (GMT+01:00) in CET

[Subscribe](#)[Sponsors](#)[Add to calendar](#)

12d

4h

53m

15s



Carbon results for

[conf42.com/js2023](https://conf42.com/js2023)

Share     

This page was last tested on 4 Nov, 2023.



Uh oh! This web page is dirtier than **94%** of web pages tested



Oh my, **2.95g of CO2** is produced every time someone visits this web page.



This web page appears to be running on **sustainable energy**

Over a year, with **±10,000**

monthly page views, [conf42.com/js2023](https://conf42.com/js2023) produces



**353.61kg of CO2 equivalent.**

The same weight as 2.36 sumo wrestlers and as much CO2 as boiling water for 47,915 cups of tea



**378 billion bubbles**

Woah, that's a lot of bubbles!



**17 trees**

This web page emits the amount of carbon that 17 trees absorb in a year.

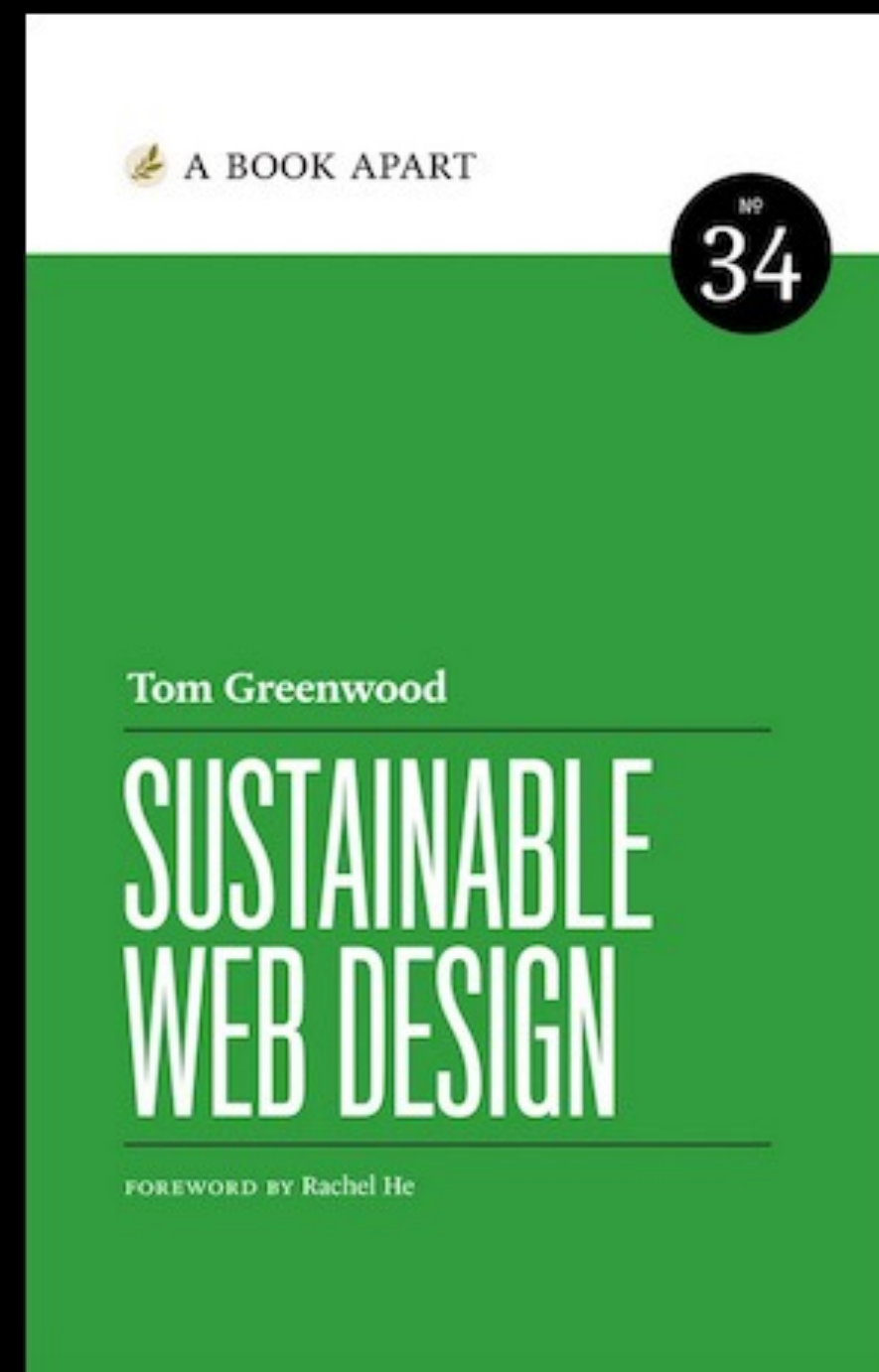


**923kWh of energy**

That's enough electricity to drive an electric car 5,906km.



Tom Greenwood



# The formulas

## Data transfer of an average visit

- Data transfer of the first visit (25%) = energy of the website
- Data transfer of the returning visit (75%) = energy of the website x 2%

## Energy of the website

- Energy of the website = website size x end-user traffic
- End-user traffic = 0.81 kWh/GB



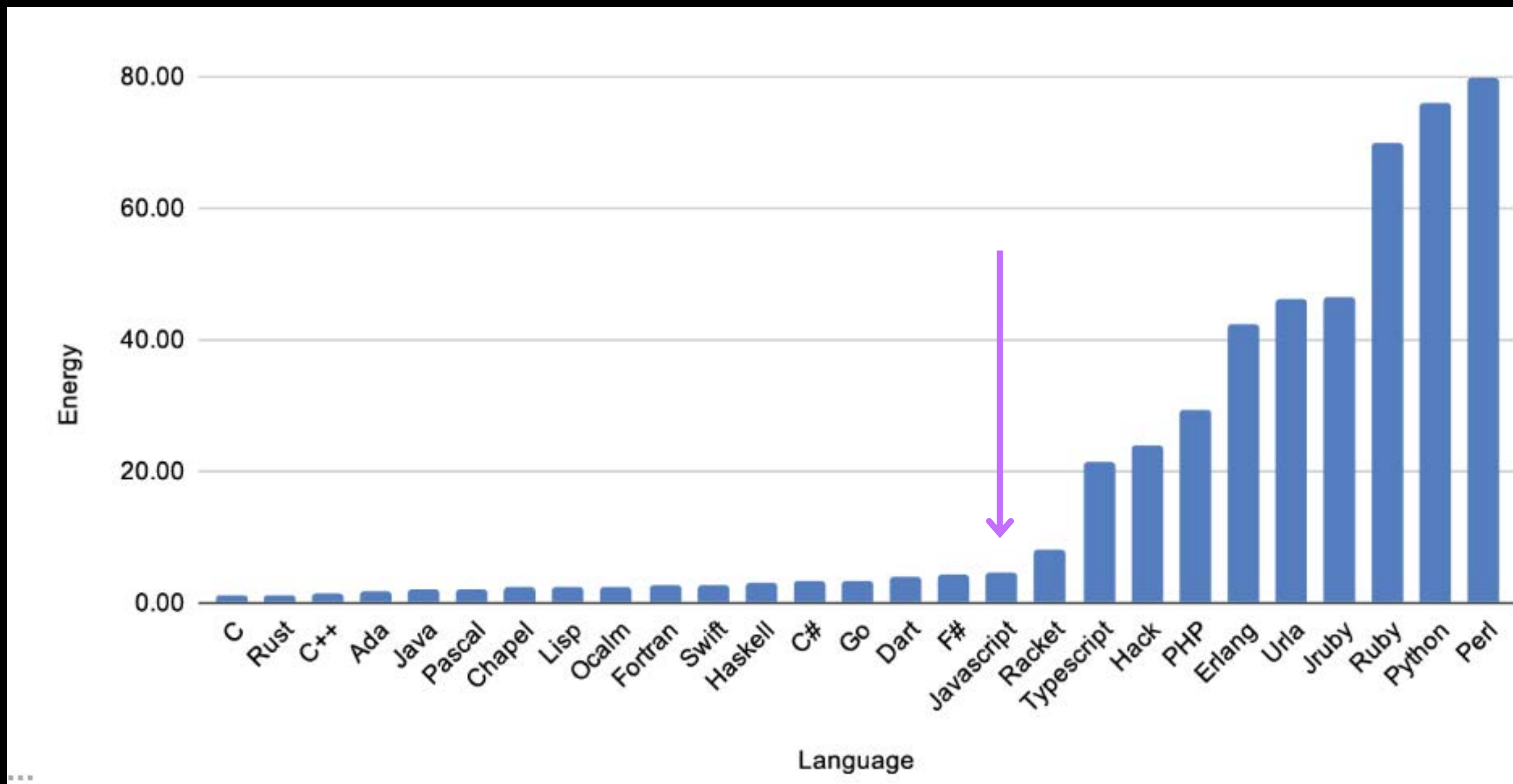
## Emissions of CO2 per one visit

- Emissions of CO2 per one visit = data transfer of an average visit \* energy emissions
- Energy emissions = 442 g/kWh

Emissions of CO2 per one visit = (75% \* website size + 25% \* 2% \* website size) \* end-user traffic \* energy emissions

How can we create **more sustainable**  
websites?

# Programming language





# Libraries

|                   |                |                   |
|-------------------|----------------|-------------------|
| <b>moment-js</b>  | <b>4.23 MB</b> | <b>1.48 g CO2</b> |
| <b>lodash</b>     | <b>1.41 MB</b> | <b>0.5 g CO2</b>  |
| <b>jQuery</b>     | <b>1.32 MB</b> | <b>0.47 g CO2</b> |
| <b>superagent</b> | <b>0.58 MB</b> | <b>0.21 g CO2</b> |
| <b>axios</b>      | <b>0.44 MB</b> | <b>0.16 g CO2</b> |

Also: `needle`, `got`, `request`, `make-fetch-happen`,  
`simple-get`

# Calls to external APIs

- Reduce the number of calls
- Cache data
- Plain JS
- Lighter libraries

| <u>Name</u>       | <u>Size</u> | <u>CO2 reduction</u> |
|-------------------|-------------|----------------------|
| simple-get        | 0.01 MB     | 0.003 g              |
| make-fetch-happen | 0.06 MB     | 0.02 g               |
| request           | 0.2 MB      | 0.07 g               |
| got               | 0.24 MB     | 0.08 g               |
| needle            | 0.26 MB     | 0.09 g               |
| axios             | 0.44 MB     | 0.16 g               |
| superagent        | 0.58 MB     | 0.21 g               |

# Resources / Images

SVG, WebP



| File format | File size | CO2 emission |
|-------------|-----------|--------------|
| SVG         | 126 KB    | 0.26 g       |
| WebP        | 200 KB    | 0.57 g       |
| JPG         | 503 KB    | 1.44 g       |
| GIF         | 913 KB    | 2.61 g       |
| PNG         | 2 111 KB  | 6.05 g       |
| TIFF        | 6 329 KB  | 18.13 g      |
| PSD         | 12 657 KB | 36.25 g      |
| PS          | 12 825 KB | 36.73 g      |

# Resources / Videos

WebM



| <u>File format</u> | <u>File size</u> | <u>CO2 emission</u> |
|--------------------|------------------|---------------------|
| WebM               | 2.6 MB           | 0.91 g              |
| MP4                | 5.9 MB           | 2.06 g              |



# Resources / Fonts

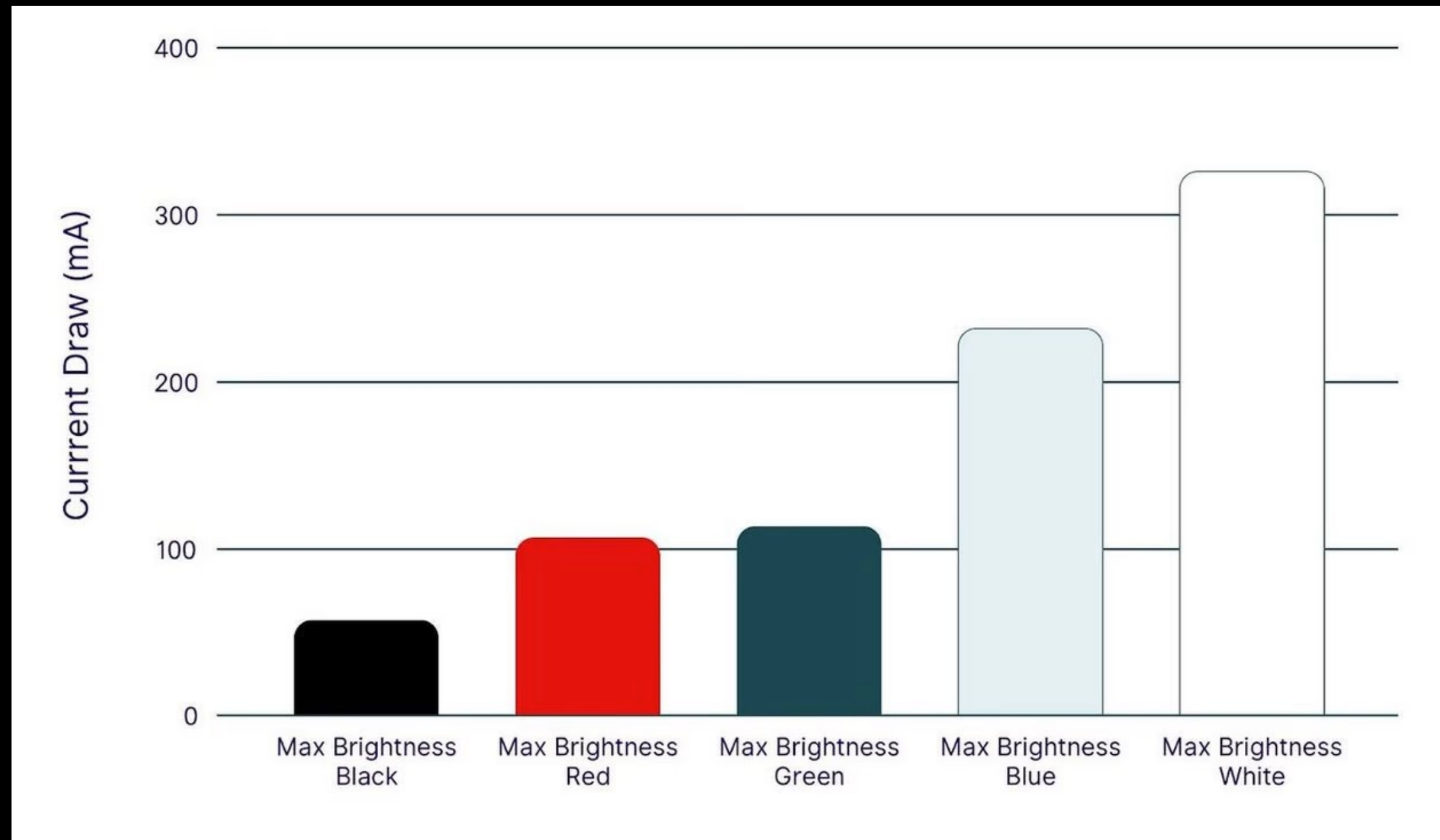
WOFF2 > WOFF > TTF

| <u>Font</u>      | <u>TTF</u> | <u>WOFF</u>   | <u>WOFF2</u>  |
|------------------|------------|---------------|---------------|
| Helvetica        | 0.89 g     | 0.54 g (-39%) | 0.35 g (-61%) |
| Tisa             | 0.61 g     | 0.29 g (-52%) | 0.24 g (-61%) |
| Montserrat       | 0.55 g     | 0.27 g (-51%) | 0.17 g (-69%) |
| Playfair Display | 0.54 g     | 0.26 g (-52%) | 0.17 g (-69%) |
| Roboto           | 0.47 g     | 0.26 g (-45%) | 0.18 g (-62%) |
| Poppins          | 0.44 g     | 0.21 g (-52%) | 0.14 g (-68%) |

local fonts > hosted online

| <u>Name</u> | <u>Size</u> | <u>CO2 reduction</u> |
|-------------|-------------|----------------------|
| Arimo       | 0.061 MB    | 0.021 g              |
| Roboto      | 0.14 MB     | 0.049 g              |
| Open Sans   | 0.516 MB    | 0.18 g               |

# Colors



# Hosting

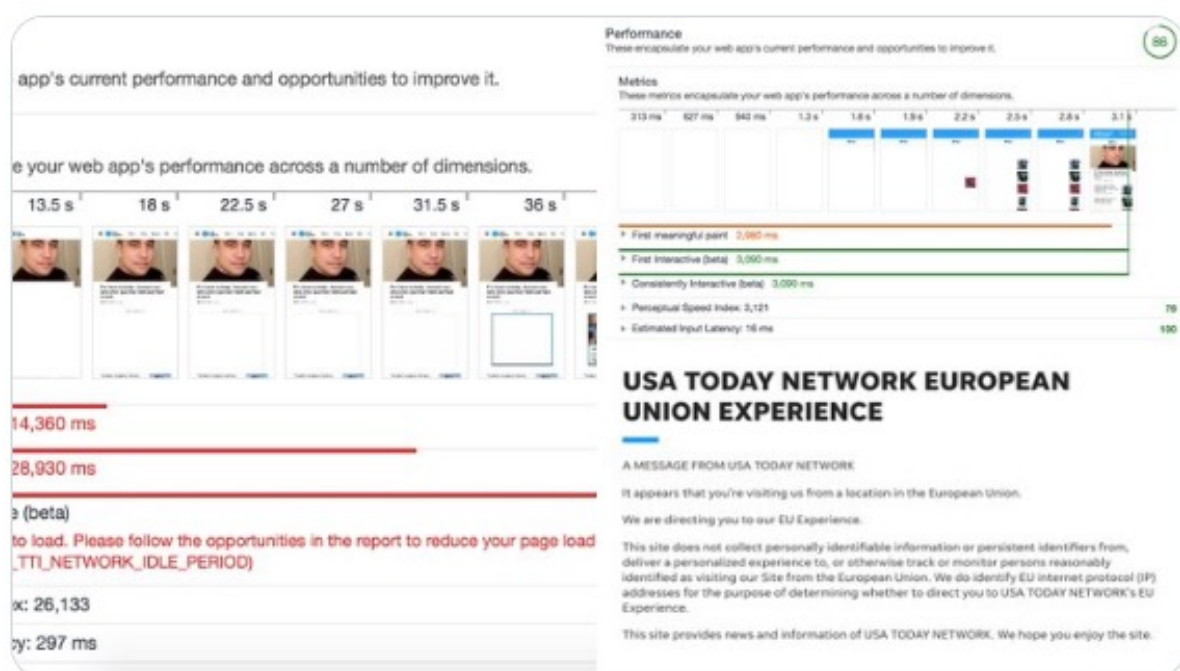
- Power usage effectiveness (PUE)
- Renewable energy
- Planting trees, green employee behaviour policy
- The Green Web Foundation
- Seravo from Finland, S4 Hosting from Lithuania, Strato from Germany, Krystal Hosting from the UK

# User data collection



Marcel Freinbichler  
@fr3ino

Because of #GDPR, USA Today decided to run a separate version of their website for EU users, which has all the tracking scripts and ads removed. The site seemed very fast, so I did a performance audit. How fast the internet could be without all the junk! 😞  
5.2MB → 500KB

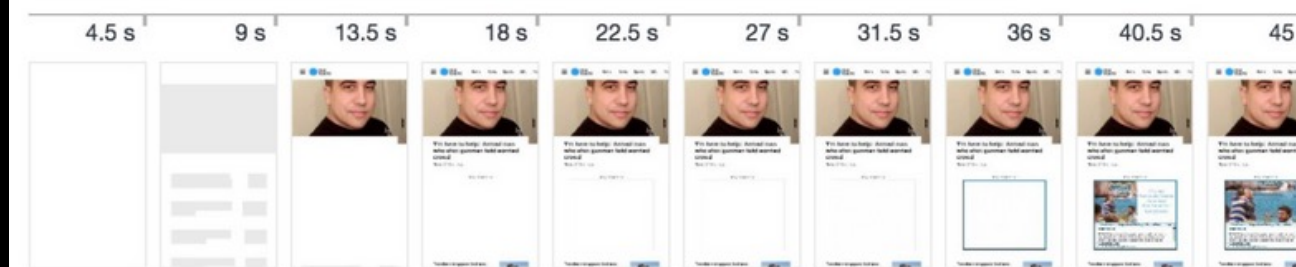


2:05 AM · May 26, 2018 · Twitter Web Client

21.9K Retweets 1,901 Quote Tweets 32.9K Likes

## Metrics

These metrics encapsulate your web app's performance across a number of dimensions.



- First meaningful paint 14,360 ms
- First Interactive (beta) 28,930 ms
- Consistently Interactive (beta)  
Your page took too long to load. Please follow the opportunities in the report to reduce your page load time, and then try re-running Lighthouse. (NO\_TTI\_NETWORK\_IDLE\_PERIOD)
- Perceptual Speed Index: 26,133



- First meaningful paint 2,980 ms
- First Interactive (beta) 3,090 ms
- Consistently Interactive (beta) 3,090 ms
- Perceptual Speed Index: 3,121



# Why?

1

carbon footprint  
mitigation

2

electrical energy  
savings

3

shorter loading  
time

# 53%

of users can be lost if a website  
loads longer than in 3 s

# Why?

1

carbon footprint  
mitigation

2

electrical energy  
savings

3

shorter loading  
time

4

better SEO

# ec0lint

- Linter
- Proposes possible code improvements to mitigate the carbon footprint of websites and make them more sustainable
- ec0lint (eslint) + ecolint-style (stylelint)

PROBLEMS

3

OUTPUT

DEBUG CONSOLE

TERMINAL

```
⊗ juliaziebinska@MacbookJulia frontend % npx ec0lint .
```

```
/Users/juliaziebinska/Desktop/TI_Projekt_22/frontend/src/app/test.js
```

```
1:15 error axios can be removed from your code and replaced by fetch (you can find examples  
on http://ec0lint.com/features/lighter-http). C02 Reduction: up to 0.21 g lighter-http
```

```
* 1 problem (1 error, 0 warnings)
```

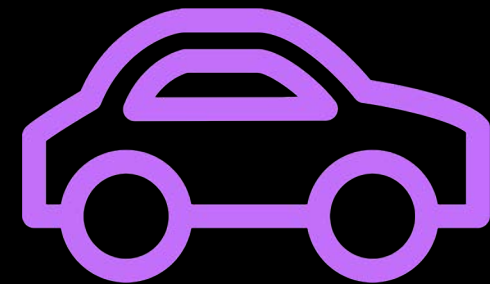
# Features

- Heavy libraries
- Font format
- Font source
- Require font display
- Image format
- Video format
- Number of videos
- Images resolution
- Video autoplay
- Lazy loading
- Background color
- Dark mode
- CO2 module
- CI/CD report
- Angular plugin
- React plugin
- TypeScript plugin
- VSCode plugins
- IntelliJ plugins

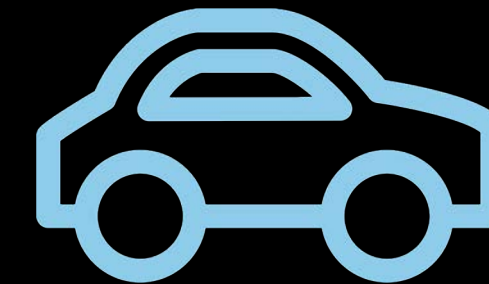
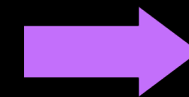
# Environmental impact

for 250 000 websites:  
54 mln kg CO<sub>2</sub>

driving 220 mln km by a  
gasoline car



220 mln  
km

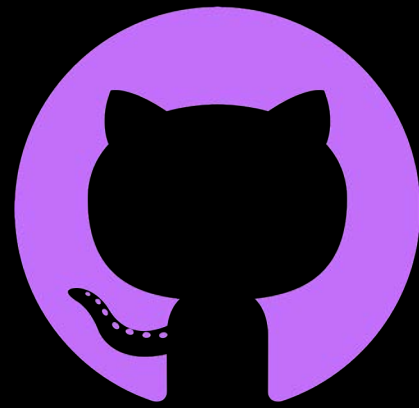


26 mln km

-88%

driving 26 mln km by a  
gasoline car

# Scaling



[github.com/ec0lint](https://github.com/ec0lint)

- Open-source tool
- Development with the help of community
- Everyone can contribute

## References

- [1] <https://www.twaino.com/en/blog/marketing/digital-ecology-the-complete-guide/>
- [2] <https://www.bbc.com/future/article/20200305-why-your-internet-habits-are-not-as-clean-as-you-think>
- [3] <https://www.forbes.com/sites/cognizant/2021/09/21/how-to-be-both-digital-and-green-at-the-same-time/?sh=e80aaf25b5ff>
- [4] <https://medium.com/stanford-magazine/carbon-and-the-cloud-d6f481b79dfe>
- [5] <https://reboxed.co/blogs/outsidethebox/the-carbon-footprint-of-your-phone-and-how-you-can-reduce-it>
- [6] <https://www.carbon60.com/cloud/100-zettabytes-cloud>
- [7] <https://www.weforum.org/agenda/2021/12/digital-carbon-footprint-how-to-lower-electronics/>
- [8] <https://elle.in/article/the-rising-impact-of-digital-pollution-and-how-we-can-reduce-it/>
- [9] <https://www.welcometothejungle.com/en/articles/how-to-reduce-digital-pollution>
- [10] <https://www.eni.com/en-IT/digital-transformation/digital-pollution.html>
- [11] <https://youmatter.world/en/reduce-environmental-impact-internet/>
- [12] <https://earthday.ca/2020/04/07/why-and-how-to-reduce-digital-pollution-in-the-office/>
- [13] <https://climate.selectra.com/en/environment/internet-pollution>
- [14] <https://thanks-in-advance.com/>
- [15] <https://www.wired.co.uk/article/internet-carbon-footprint>
- [16] <https://siteefy.com/how-many-websites-are-there/>
- [17] <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>
- [18] <https://www.websitecarbon.com/>
- [19] <https://sustainablewebdesign.org/>
- [20] Sustainable Web Design by Tom Greenwood
- [21] <https://cloudconvert.com/>
- [22] <https://fonts.google.com/>
- [23] <https://mikeheavers.com/codepen/fonts/helvetica-neue/>
- [24] [www.npmjs.com/package](http://www.npmjs.com/package)
- [25] <https://www.thegreenwebfoundation.org/directory/>
- [26] <https://www.1t.org/pledges/krystals-billion-tree-pledge>
- [27] <https://www.marketingdive.com/news/google-53-of-mobile-users-abandon-sites-that-take-over-3-seconds-to-load/426070/>
- [28] <https://www.ec0lint.com/get-started>
- [29] <https://sustainablewebdesign.org/does-the-website-avoid-tracking-user-behaviour-and-collecting-data-unnecessarily/>

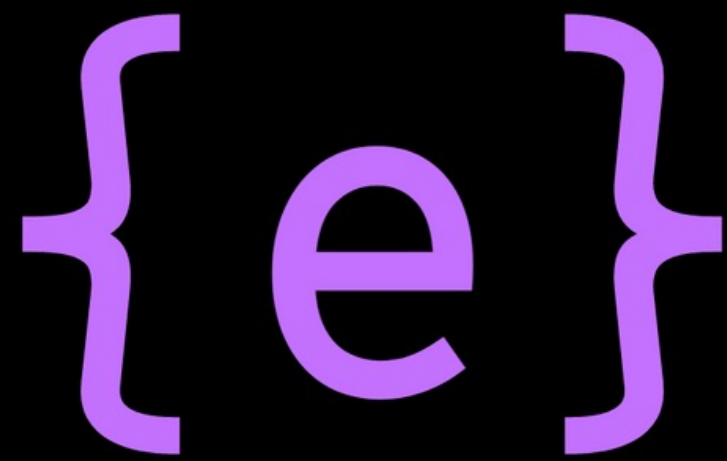




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