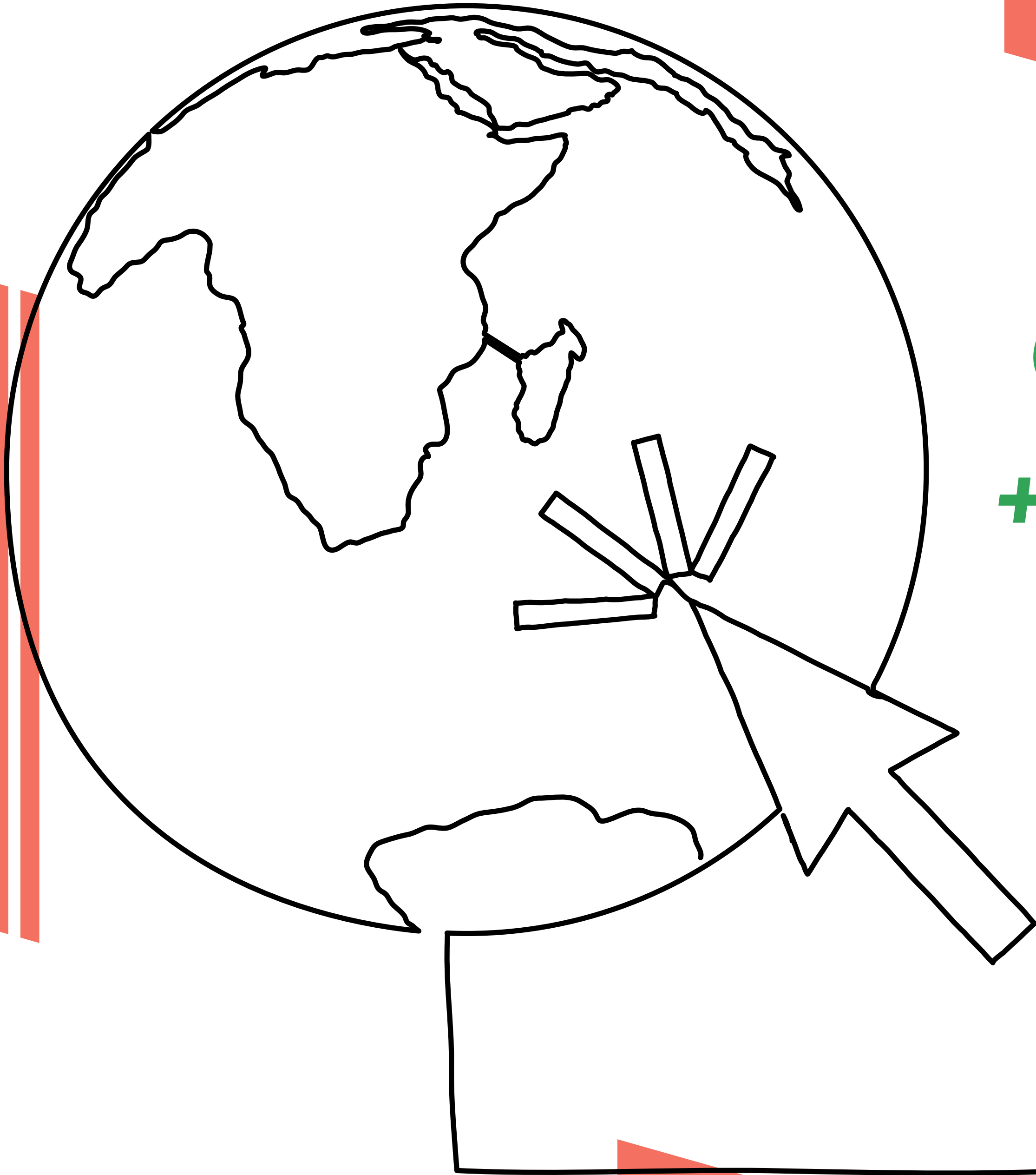


Sustainable Website Design

Construction and Presentation Methods
to Address Climate Change

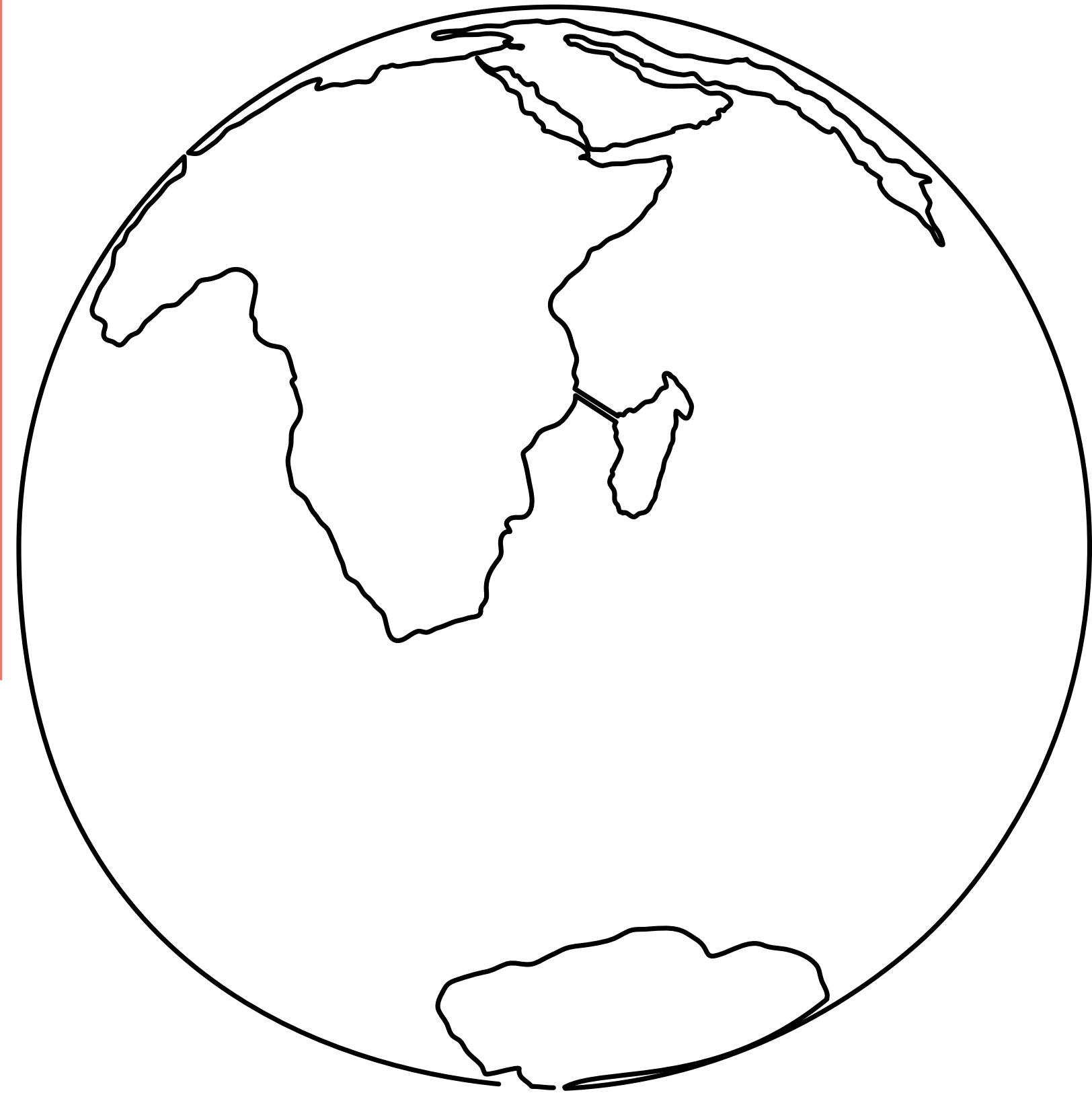
A presentation for
Princeton ACM / IEEE-CS Chapters Joint Meeting
November 2024

By Michael Blank
PMUG Webmaster



Computers / Web + The Environment

Climate Change is Here Now



Extreme Weather & Climate Change

[science.nasa.gov/climate-change/extreme-
weather/](https://science.nasa.gov/climate-change/extreme-weather/)

Climate Change is Here Now



- Health

[Climate Change Indicators: Heat-Related Deaths](#)
EPA, May 2024

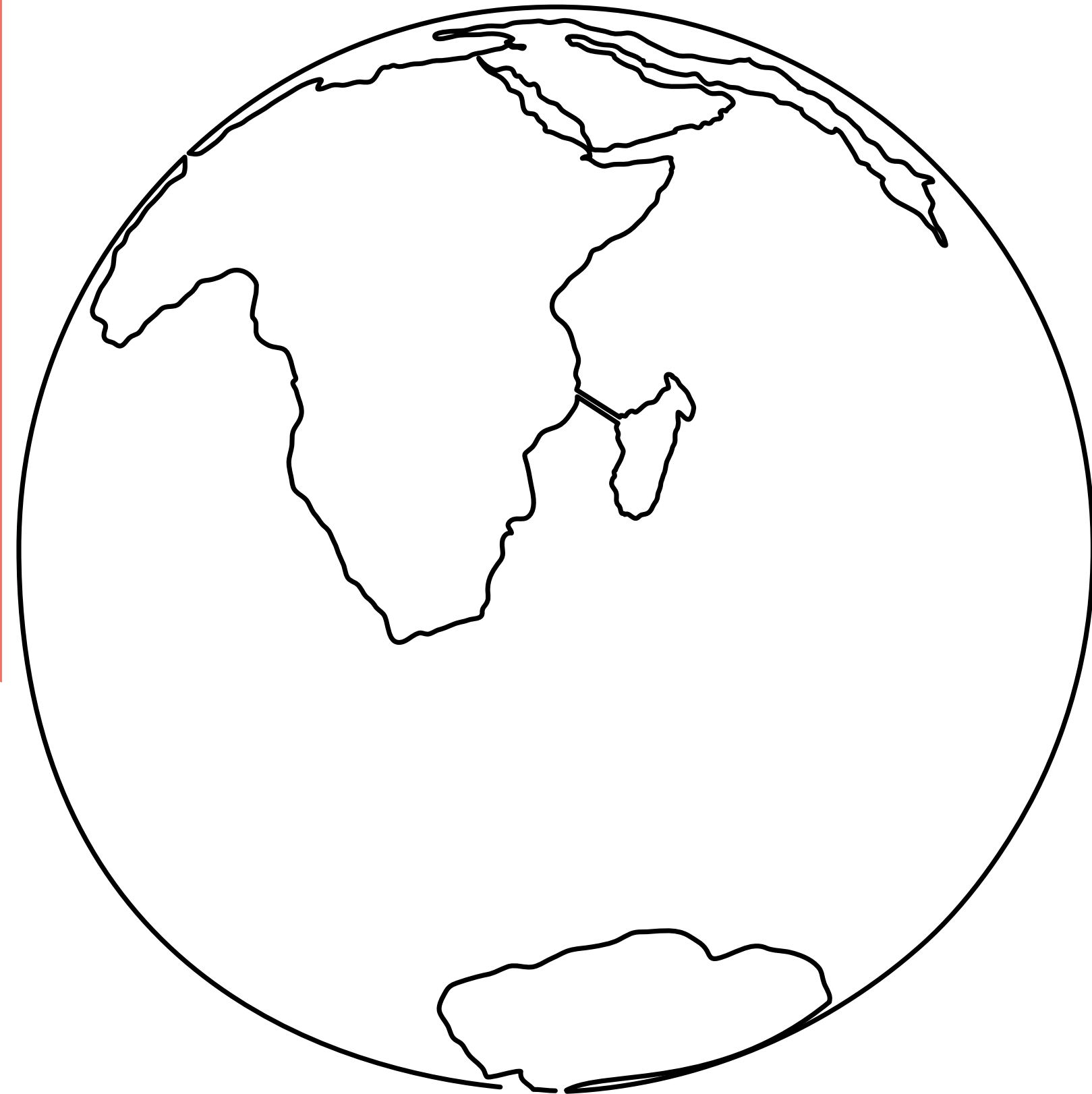
[Heat-Health Action Plans: Guidance](#)
World Health Organization, January 1, 2008

[Climate Change and Respiratory Diseases](#)
European Respiratory Review, June 2014

[As Animals Migrate Because of Climate Change, Thousands of New Viruses Will Hop From Wildlife to Humans—and Mitigation Won't Stop Them](#)
Inside Climate News, June 7, 2022

[Wildfire Smoke Exposure Under Climate Change: Impact On Respiratory Health Of Affected Communities](#)
National Library of Medicine,
March 1, 2020

Climate Change is Here Now



- Health
- Economy

[Extreme Weather Is Driving Food Prices Higher. These 5 Crops Are Facing The Biggest Impacts](#)
World Economic Forum, February 2024

[The Economic Impact of Climate Change on Northwest Farms](#)
USDA Climate Hubs

[Global Warming And Heat Extremes To Enhance Inflationary Pressures](#)
Nature Communications, March 21, 2024

[Adapting Food Supply Chains to Climate Change](#)
Food Logistics, September 18, 2023

[Does Climate Change Cause an Upsurge in Food Prices?](#)
National Library of Medicine, January 2, 2024

Climate Change is Here Now



- Health
- Economy
- Insurance

[Climate Change, Disaster Risk, and Homeowner's Insurance](#)

Congressional Budget Office, August 27, 2024

[States beg insurers not to drop climate-threatened homes](#)

Stateline, June 5, 2024

[Homeowners insurance sector slammed by climate impacts](#)

Insurance Business, May 14, 2024

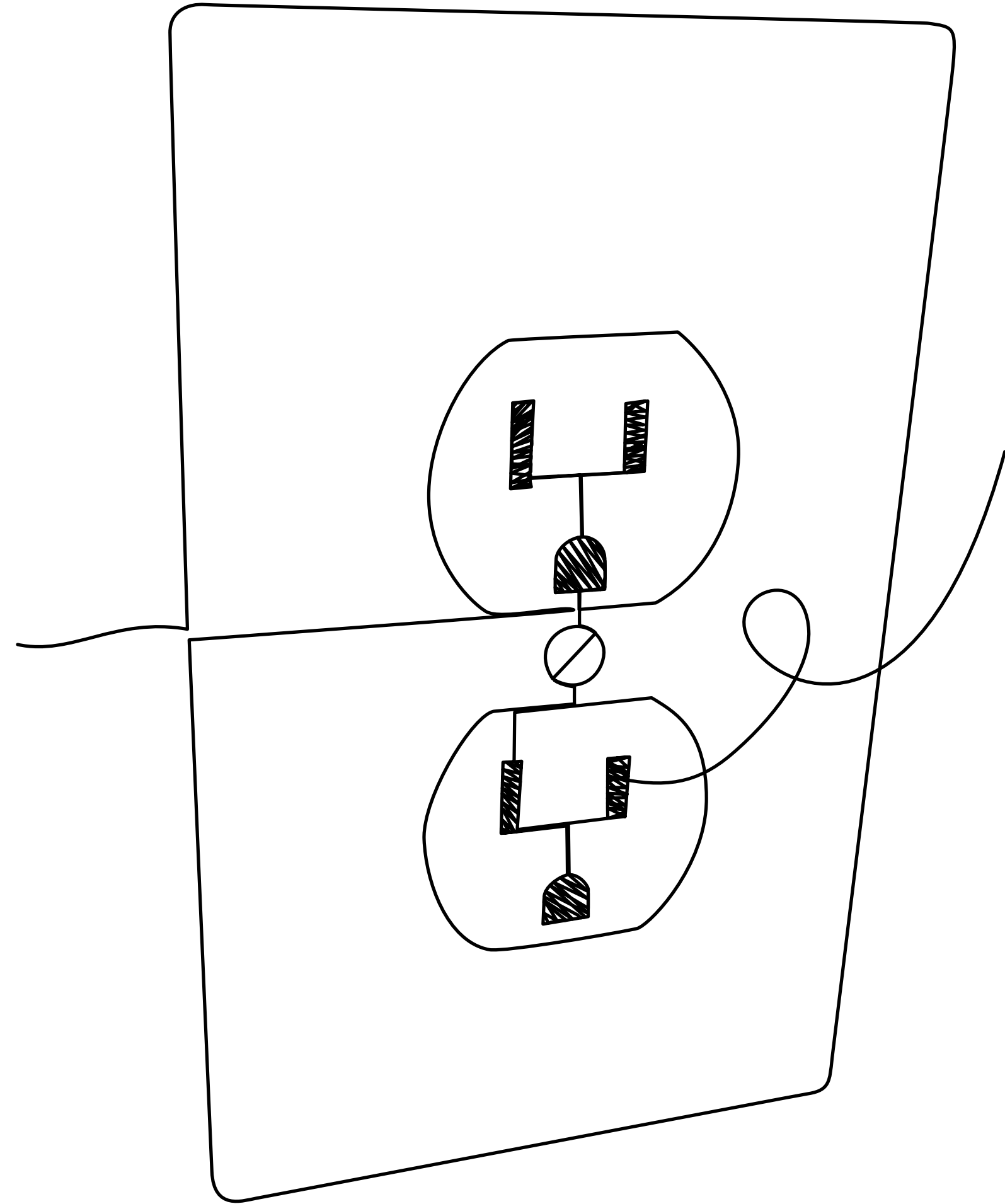
[Florida's homeowner's insurance crisis: How climate change, extreme weather are driving up costs](#)

WBBH-TV NBC 2, August 14, 2024

[Insurers Keep Dropping California Homeowners. Changes Are In The Works To Try To Stop Their Cherry-Picking](#)

KNTV NBC, September 27, 2024

The Web, Electricity, and CO₂

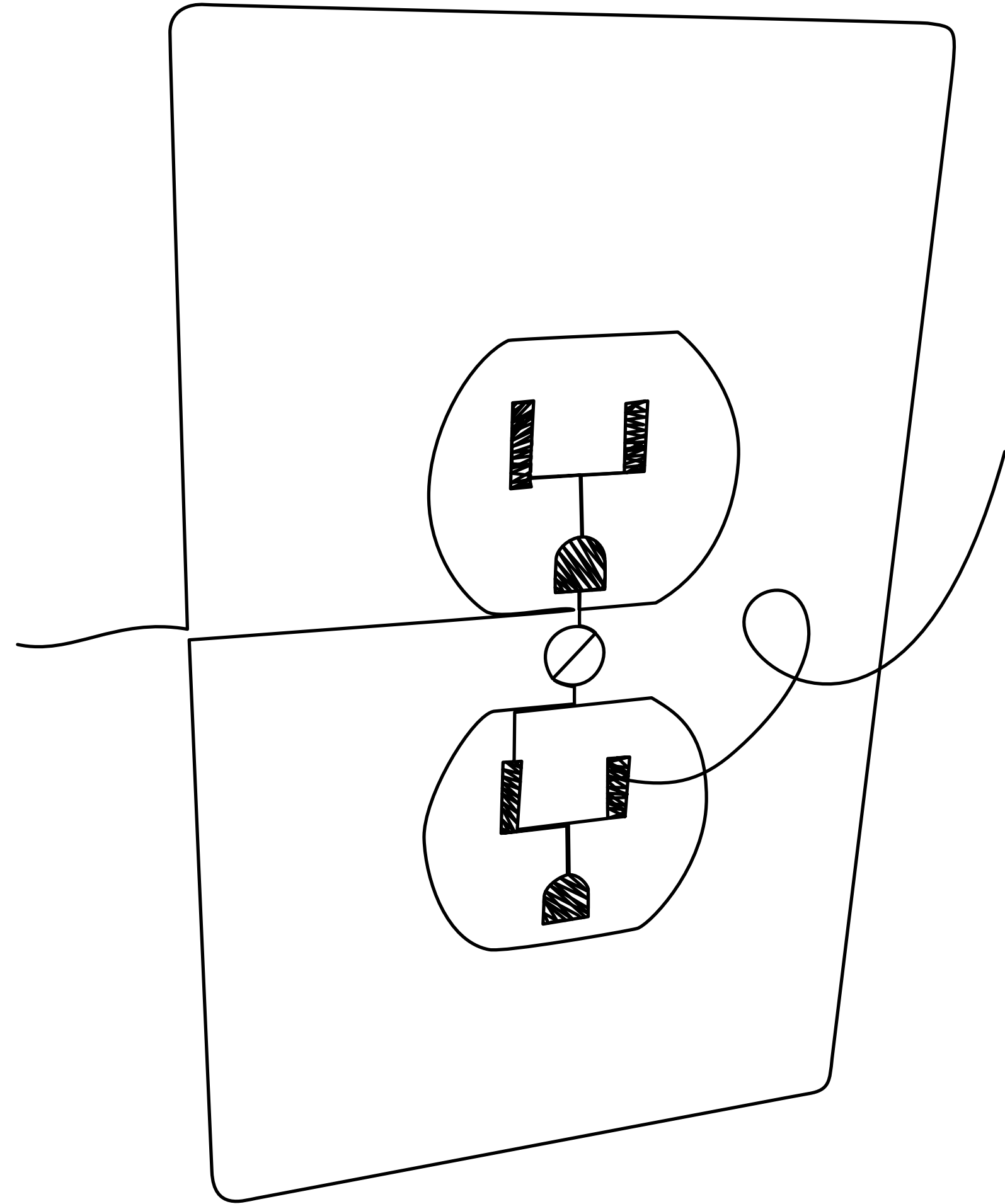


“The **carbon footprint of our gadgets, the internet and the systems supporting them** accounts for 3.7% of global greenhouse emissions, **similar to the airline industry.**”

[The Carbon Footprint of the Internet](#)

Climate Impact Partners - April 22, 2021

The Web, Electricity, and CO₂



“...it was shown that the global ICT sector (i.e., **data centres, data transmission networks, and end-user devices**) emitted **1.0–1.7 Gt CO₂-eq in 2020**, considering both operational and embodied emissions. This is equivalent to 1.8–2.8% of global anthropogenic greenhouse (GHG) emissions, **surpassing the GHG emissions of Australia or France.**”

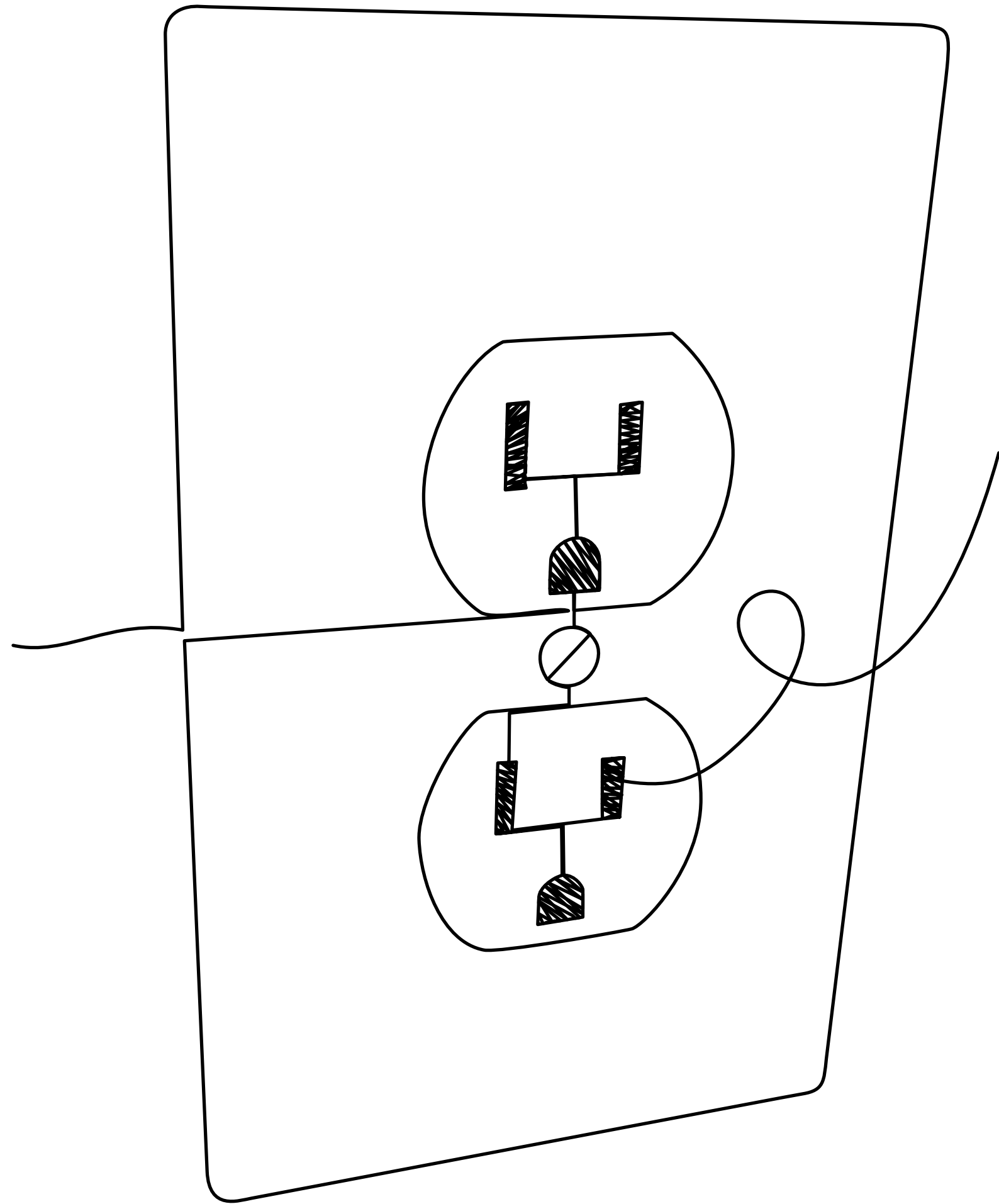
[The Environmental Sustainability Of Digital Content Consumption](#)

Nature Communications - May 2, 2024

The Web, Electricity, and CO₂

Web Infrastructure & Electricity

- Data Centers
- Wired & Wireless Network Transmission
- Consumer Devices
- From Design to End of Life

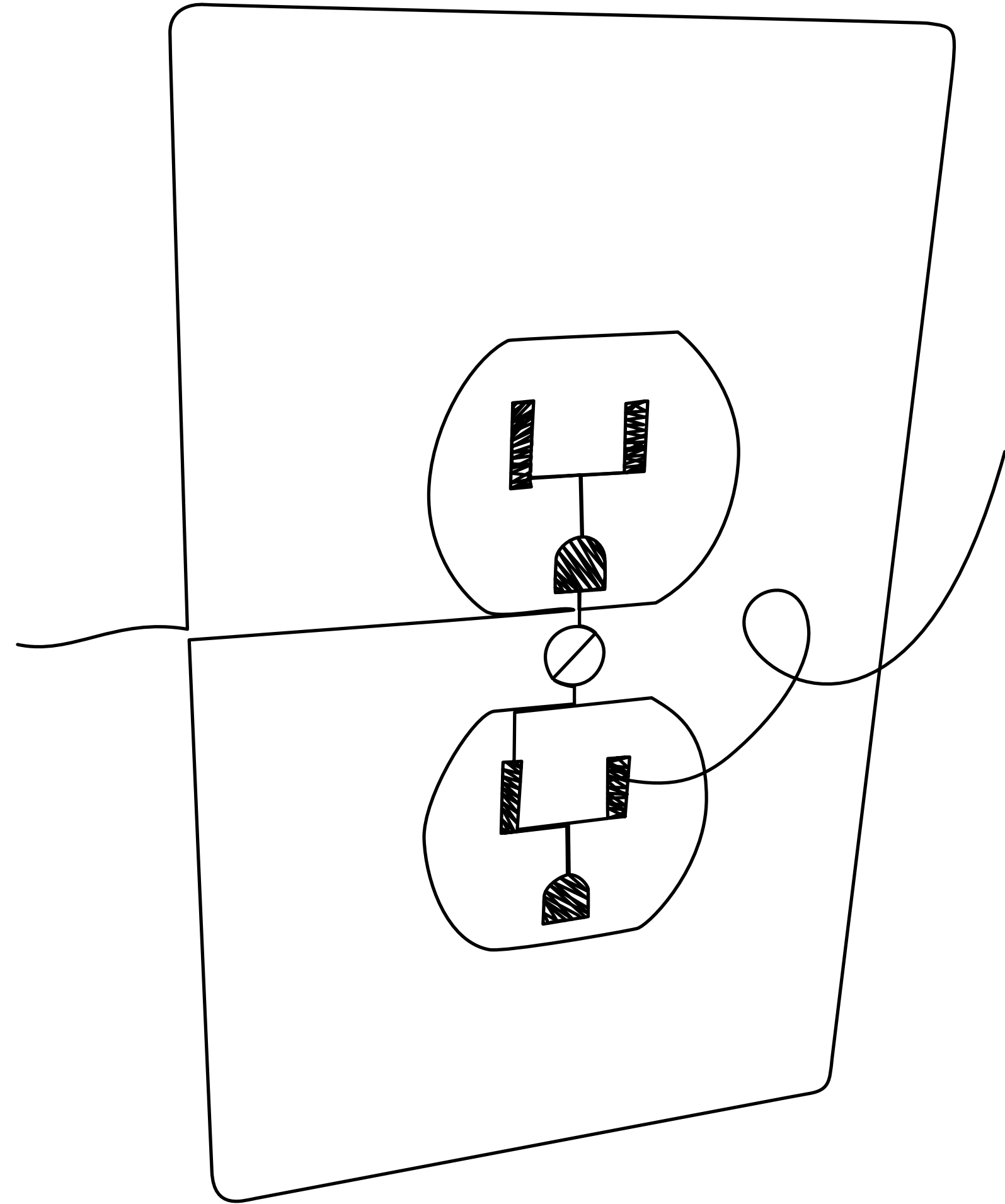


The Web, Electricity, and CO₂

Not All Electricity is “Green”

Electricity Maps

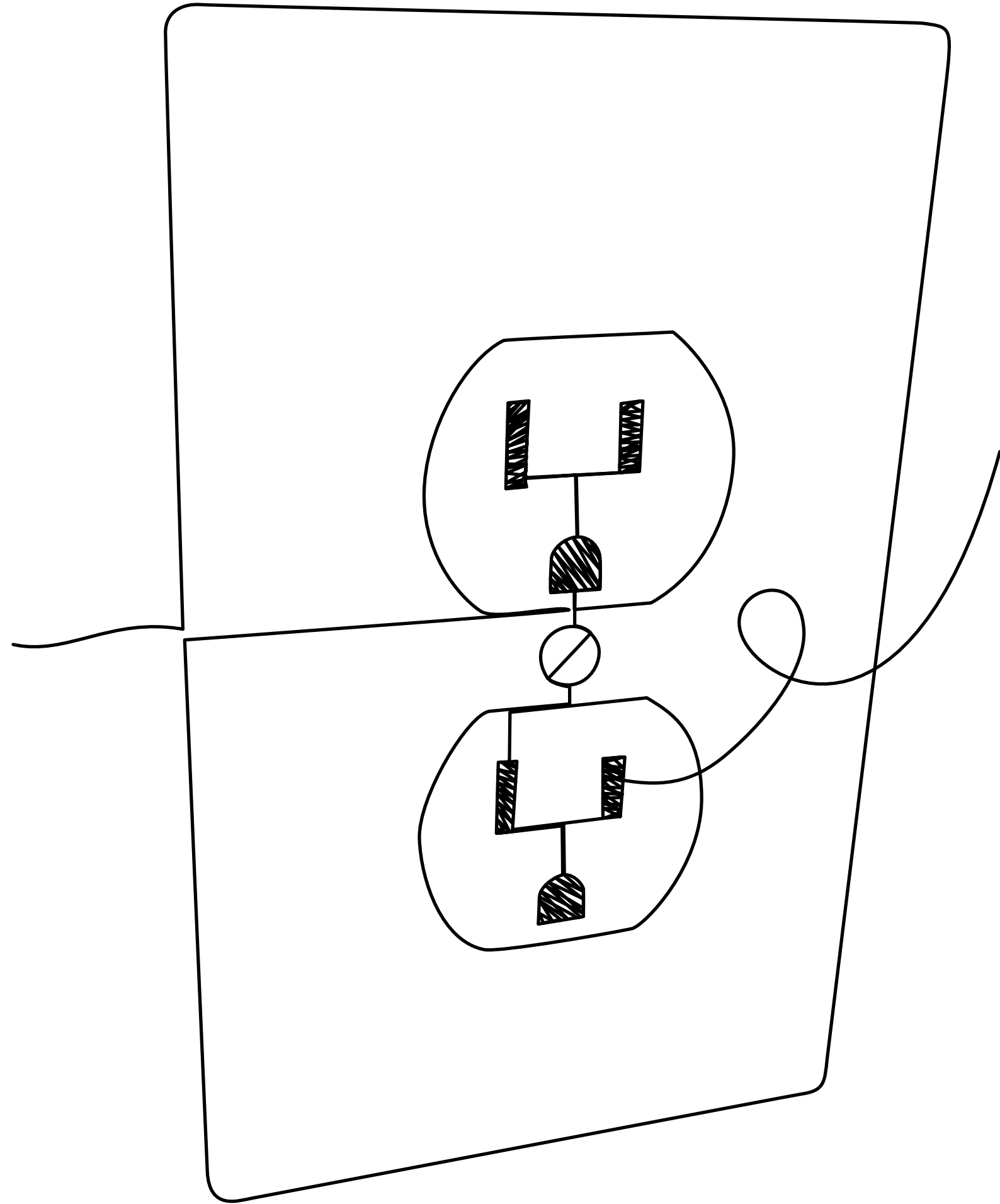
app.electricitymaps.com

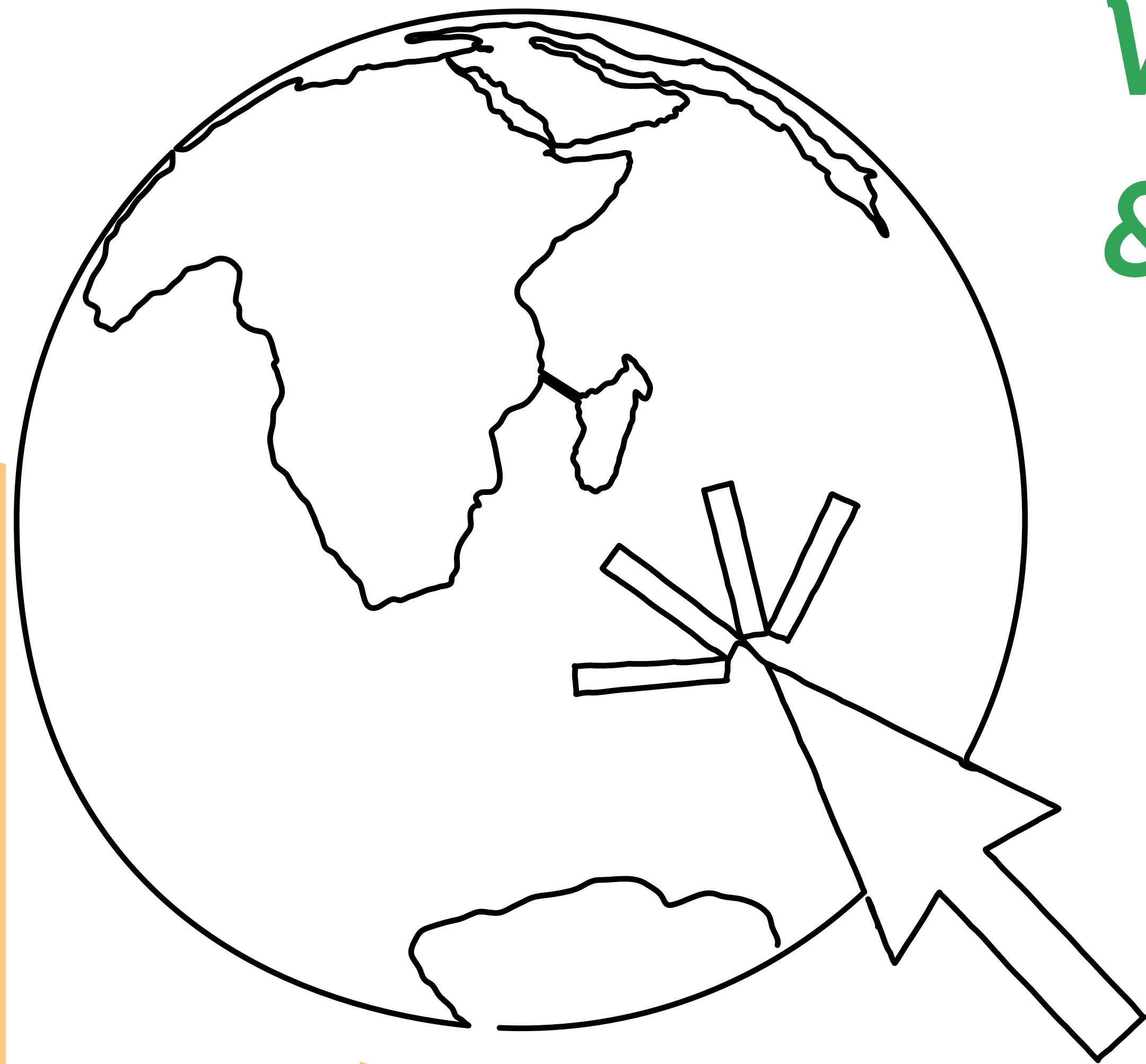


The Web, Electricity, and CO₂

Takeaways:

- A mix of renewable + non-renewable
- Non-renewable = more CO₂
- “Low Carbon Website” =
makes less CO₂ by using less electricity
(less non-renewables from gen. mix)





Website Validation & Side Benefits

- SWD is Relatively New

- Website Validation

websitecarbon.com

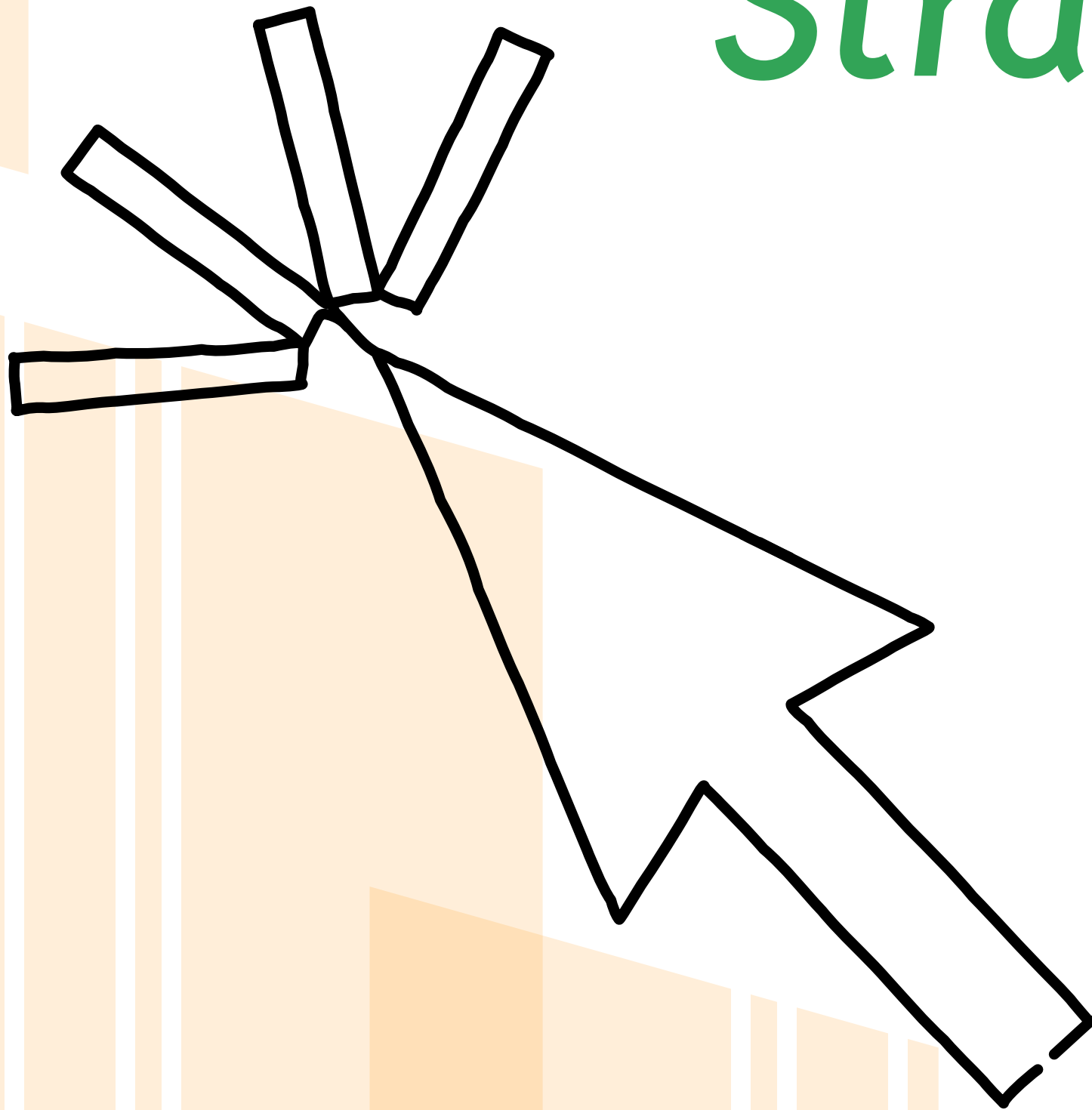
ecograder.com

Website Validation & Side Benefits



- SWD is Relatively New
- Website Validation
- Side Benefits

Sustainable Website Design Strategies



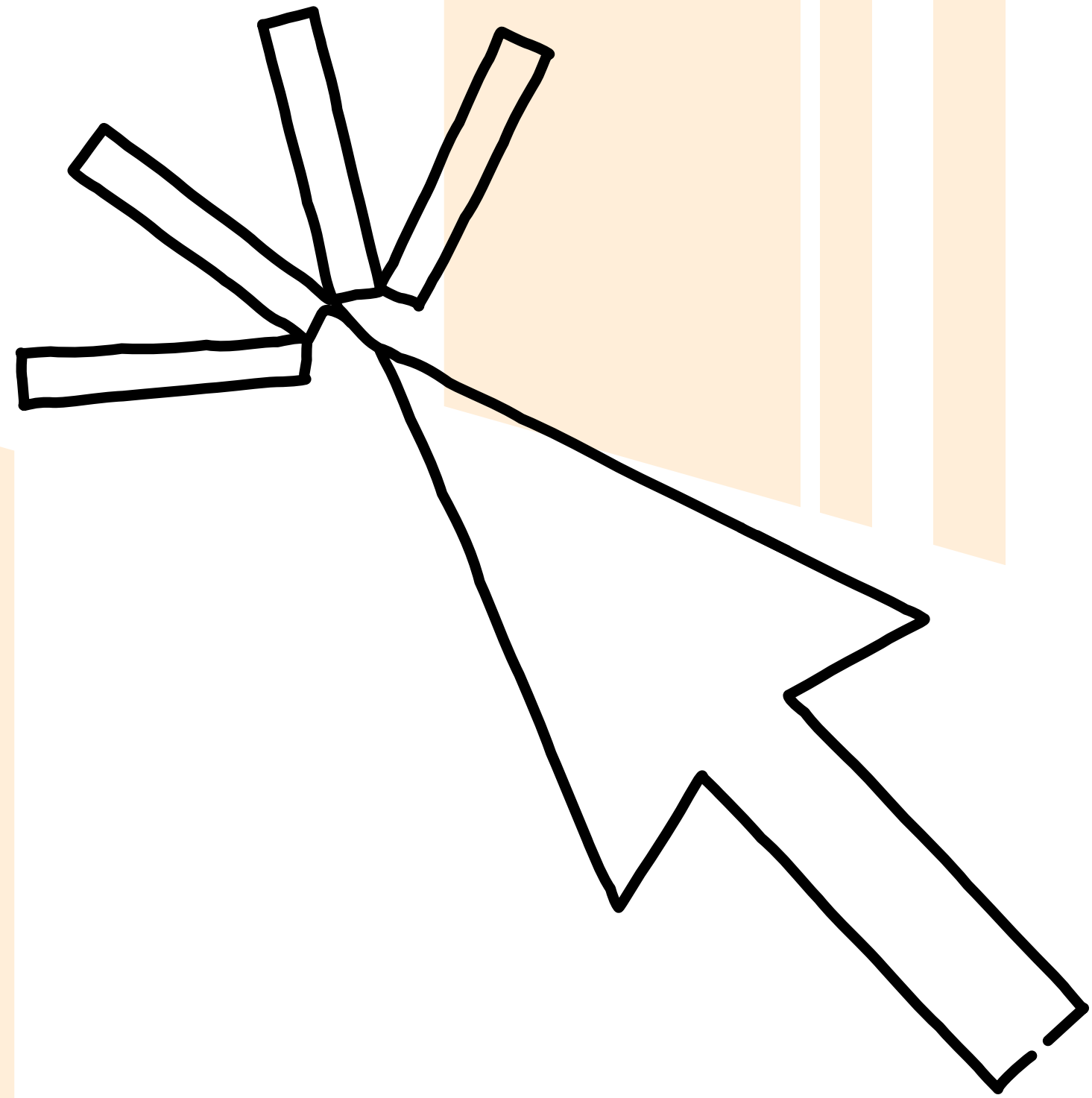
Reduce Data

- Smaller image file size

Graphics programs like:

[Photoshop](#), [Affinity Photo](#)

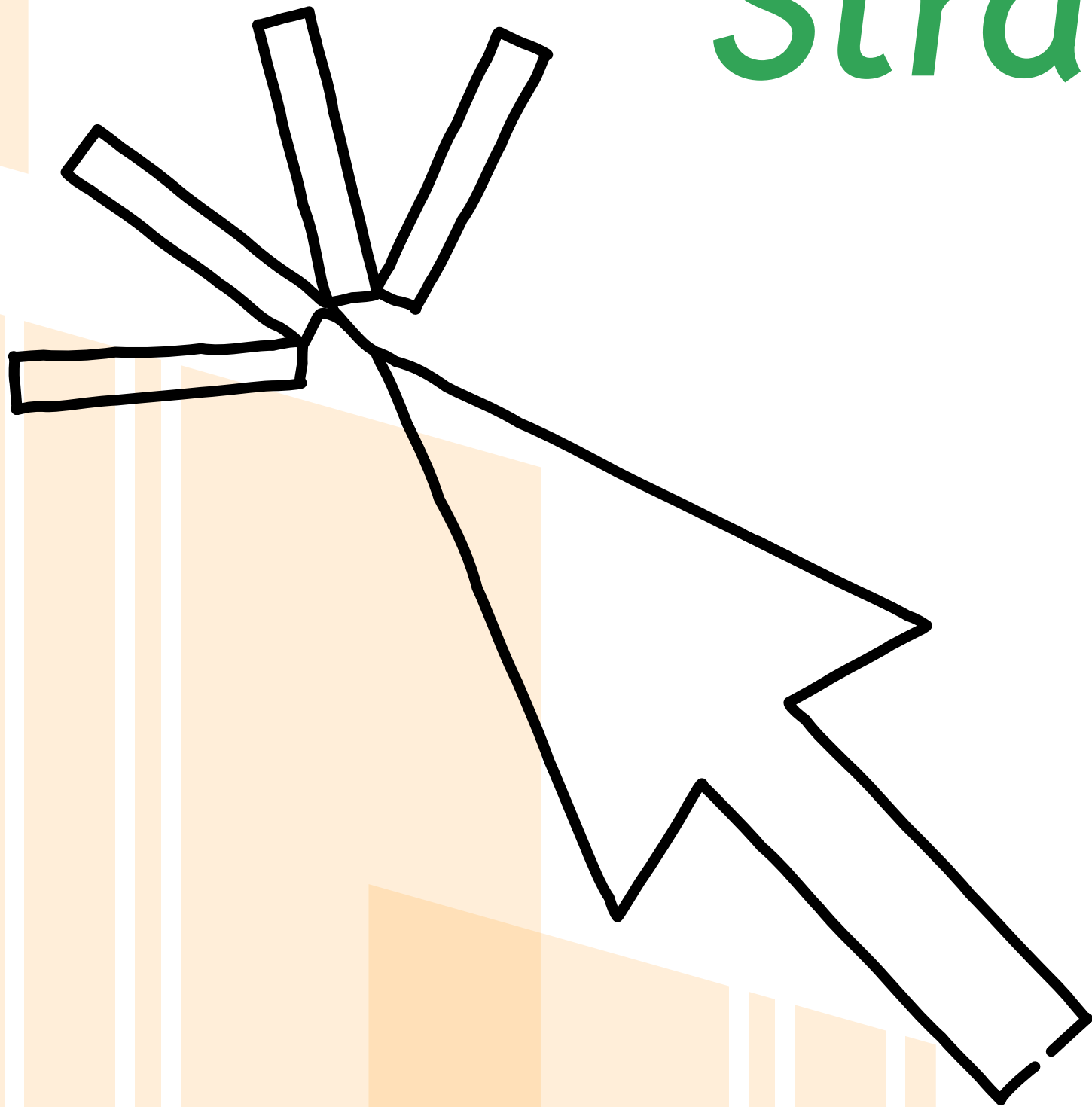
Online at shortpixel.com



Reduce Data

- Smaller image physical size

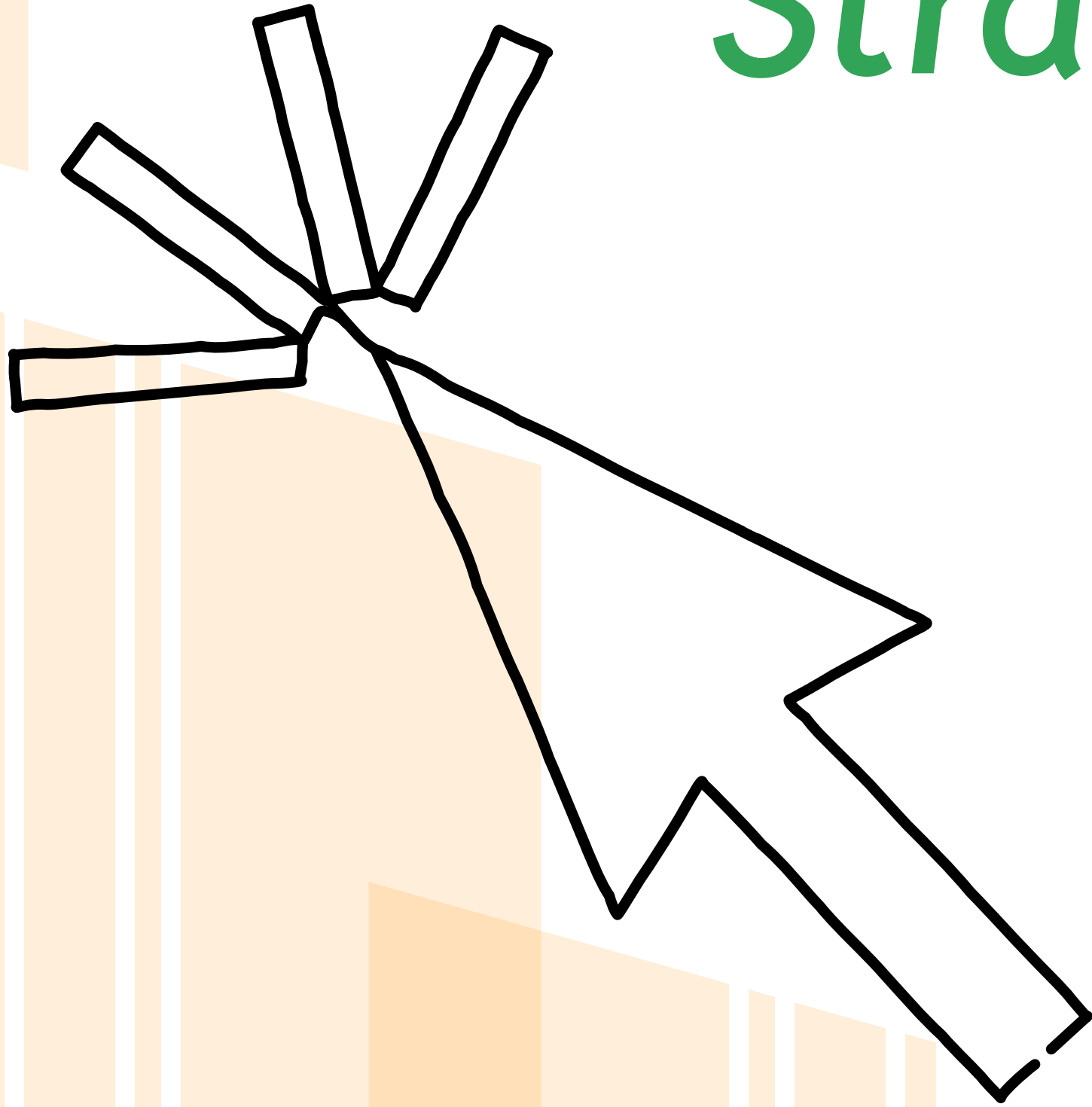
Sustainable Website Design Strategies



Reduce Data

- Compress non-images:
HTML & Javascript minimization
plugins

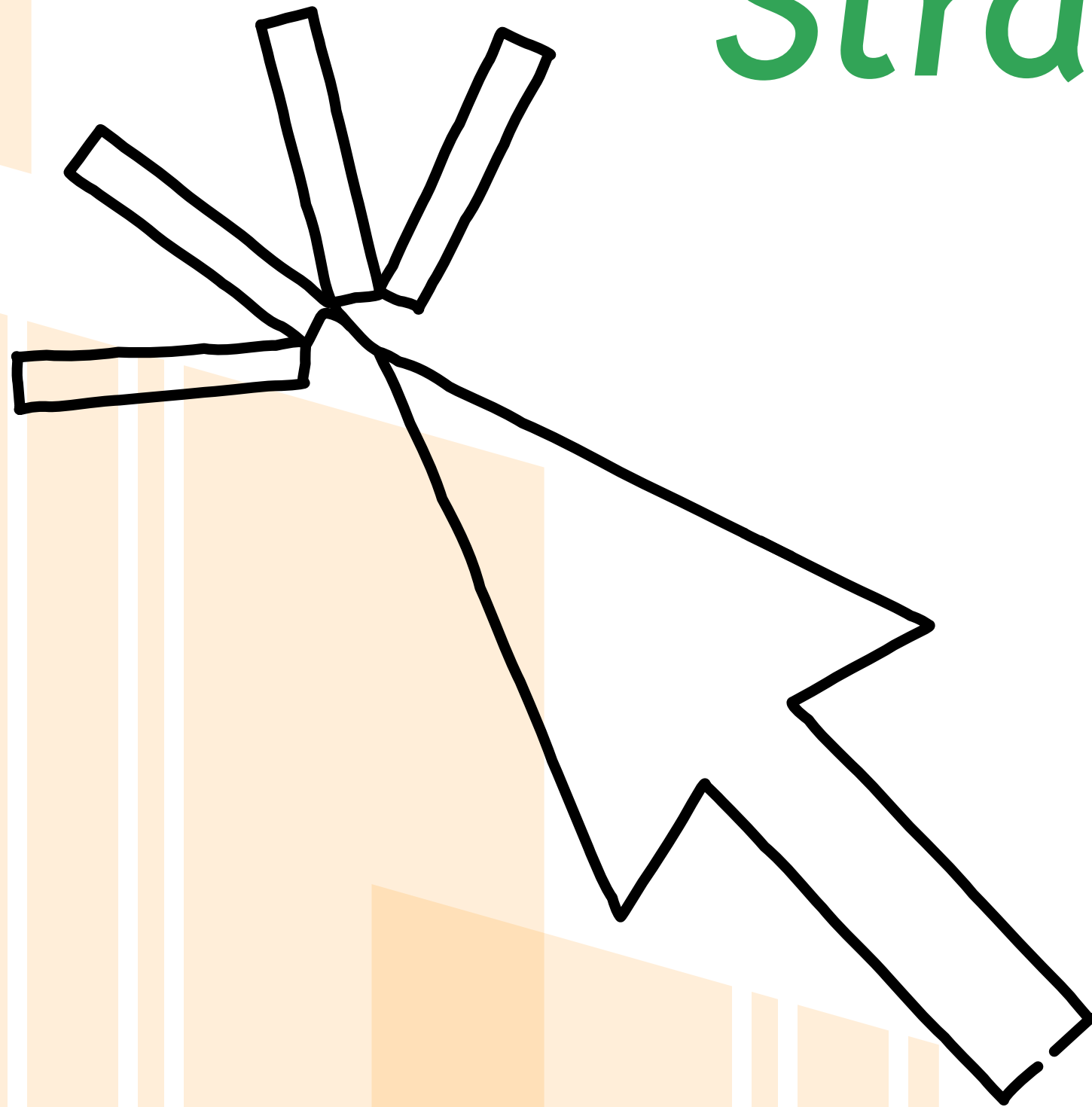
Sustainable Website Design Strategies



More Efficient Formats

- jpg vs webp vs avif

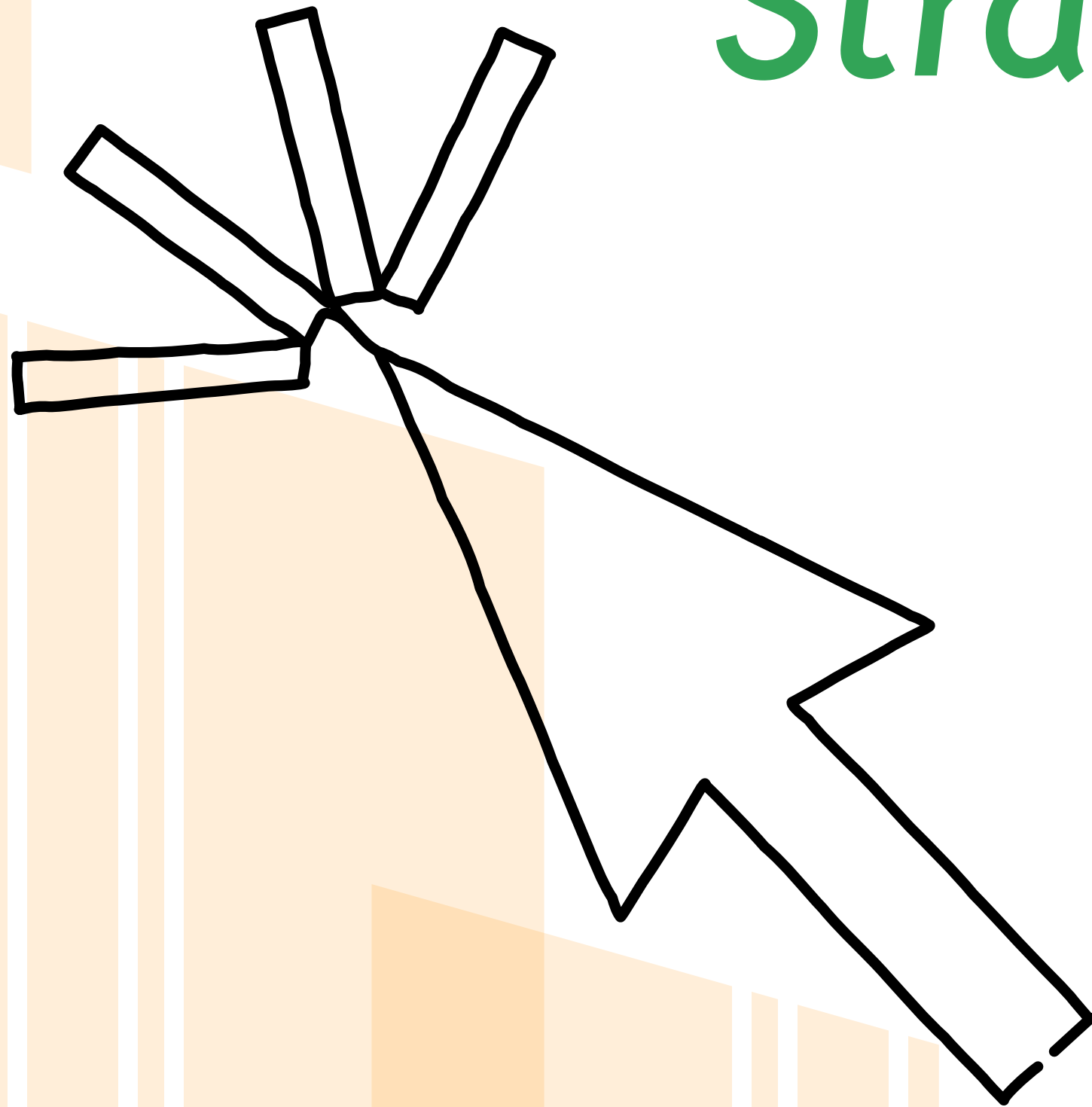
Sustainable Website Design Strategies



Basic HTML Structure to use (avif, webp, jpg fallback)

```
<picture>  
  <source srcset="images/picture.avif" type="image/avif"  
alt="ALT text goes here."/>  
  
  <source srcset="images/picture.webp" type="image/webp"  
alt="ALT text goes here."/>  
  
    
</picture>
```

Sustainable Website Design Strategies



Lighter Analytics

Google Analytics (analytics.google.com)

VS

Cabin Analytics (withcabin.com)

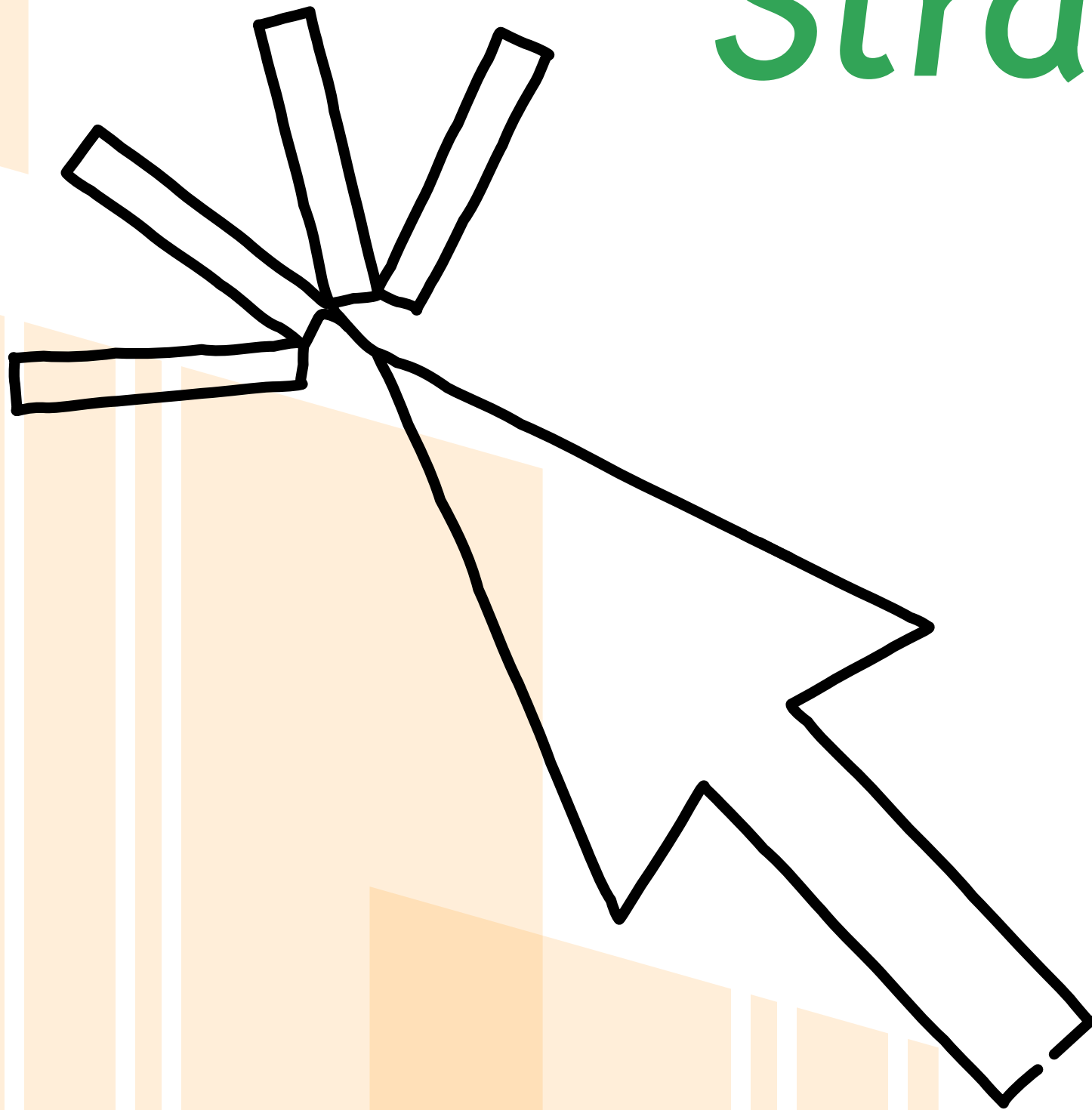
Sustainable Website Design Strategies

Lighter Plugins

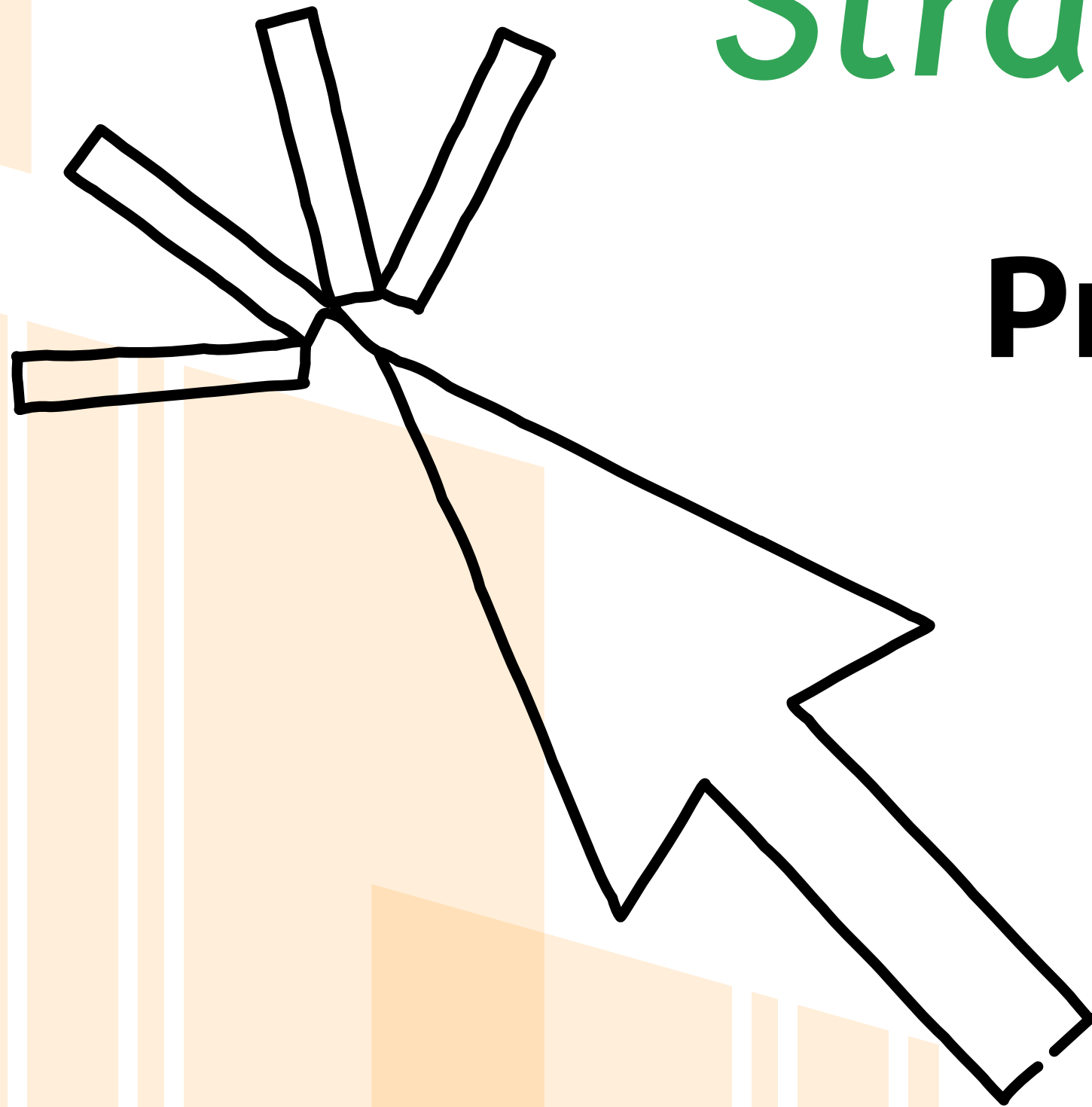
[Yoast SEO](#)

VS

[Slim SEO](#)



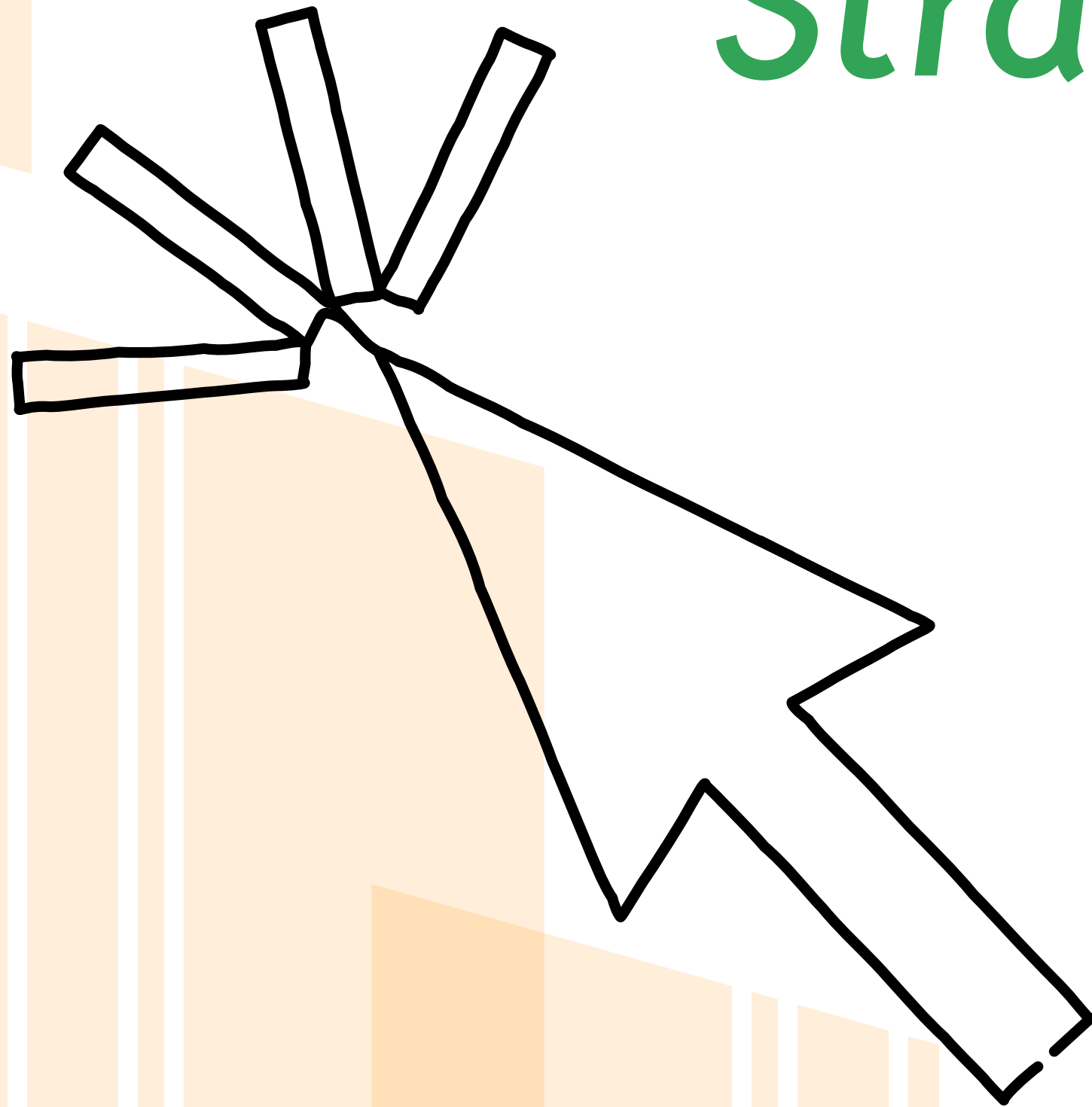
Sustainable Website Design Strategies



Processor Intensive Page Elements

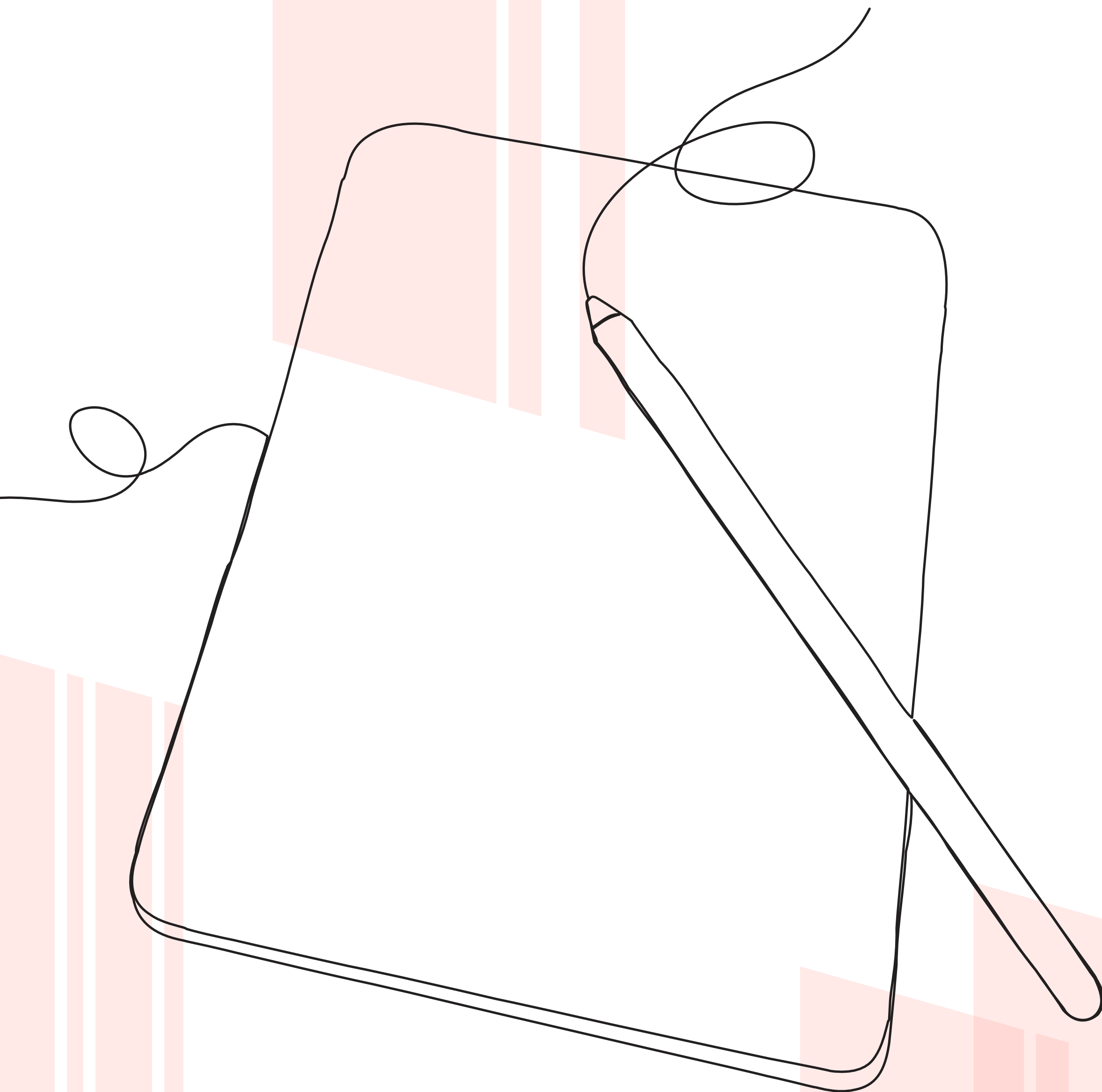
- Slideshows and Carousels
- Autoplay & Background Video
- Endless Scrolling

Sustainable Website Design Strategies



Other Strategies

- Lazy loading
- Caching



PMUG and Sustainable Web Design

pmug-nj.org

The PMUG Website on the Website Carbon Calculator

Before Redesign (2/18/23)


After Redesign (2/19/23)

October 2024


Website Carbon Calculator [How does it work?](#) [FAQ](#) [Get the badge!](#) [API](#) [Consultancy](#)

Carbon results for **pmug-nj.org** [Share](#) [f](#) [t](#) [in](#) [v](#) [e](#)

This page was last tested on 18 Feb, 2023.

 Hurrah! This web page is cleaner than **78%** of web pages tested

 Only **0.21g of CO2** is produced every time someone visits this web page.


 Oh no, it looks like this web page uses **bog standard energy** If this site used green hosting, then it would emit 9% less CO2


Over a year, with **±10,000** monthly page views.


Website Carbon Calculator [How does it work?](#) [FAQ](#) [Get the badge!](#) [API](#) [Consultancy](#)

Carbon results for **pmug-nj.org** [Share](#) [f](#) [t](#) [in](#) [v](#) [e](#)

This page was last tested on 19 Feb, 2023.

 Hurrah! This web page is cleaner than **89%** of web pages tested

 Only **0.12g of CO2** is produced every time someone visits this web page.

 Oh no, it looks like this web page uses **bog standard energy** If this site used green hosting, then it would emit 9% less CO2


Over a year, with **±10,000** monthly page views.

Website Carbon Calculator [How does it work?](#) [FAQ](#) [Get the badge!](#) [API](#) [Consultancy](#)

Website carbon results for: [pmug-nj.org](#)


A+ Hurrah! This web page achieves a carbon rating of **A+**

This is cleaner than **92%** of all web pages globally




[Learn about our rating system](#)

This page was last tested on 30 Oct, 2024. [Copy URL](#)

 Only **0.09g of CO2** is produced every time someone visits this web page.

[How do we calculate this?](#)

 Oh no, it looks like this web page uses **bog standard energy** If this site used green hosting, then it would emit 9% less CO2

[How do we find this out?](#)

This result is an approximation

You can get a comprehensive view of a website's emissions and potential improvements by carrying out a [Website Carbon Audit](#).

The PMUG Website on Ecograder

Before Redesign (2/18/23)

After Redesign (2/19/23)

October 2024

Ecograder Scoring <https://pmug-nj.org/>
Scanned 2/18/2023, 1:05:11 PM EST

70 out of 100

OVERALL SCORE
This page scores **70** out of a possible 100 points.

Not bad, though there's room to improve this page. Ecograder prioritizes a holistic approach to digital sustainability reporting. Each report includes quantifiable metrics to help you reduce emissions and improve performance. We also share best-in-class web design practices that aren't as easy to quantify from an ecological perspective. Read on to learn specific action items you can take to improve this page and your website overall.

Share your score

ESTIMATED EMISSIONS
This page emits an estimated **0.297g** of carbon dioxide equivalent (CO₂e) every time someone views it.

Pages visits per month: < 1k, 1k-10k, 10k-100k, 100k-1m, 1m+

With the traffic numbers you selected, this page could create between 2.97 kilograms and 29.74 kilograms of CO₂e per month.

That's roughly equivalent to:

- between 0.378 and 3.777 gallons of gas consumed
- between 7.435 and 74.352 miles driven by an average gasoline-powered passenger vehicle
- between 0.137 and 1.369 days of home energy use
- between 362.837 and 3,628.365 smartphones charged

And that's just a single page on your site.

25% OF SCORE
1 Improve User Experience
Creating an accessible user experience that is free from barriers or intrusions helps people find what they need and accomplish tasks quickly. This is important because end consumer device use can potentially account for up to 52% of a digital product or service's overall emissions. Here are a few recommendations for providing your users with a better experience.

93 out of 100

Ecograder Scoring <https://pmug-nj.org/>
Scanned 2/19/2023, 11:53:57 AM EST

74 out of 100

OVERALL SCORE
This page scores **74** out of a possible 100 points.

Not bad, though there's room to improve this page. Ecograder prioritizes a holistic approach to digital sustainability reporting. Each report includes quantifiable metrics to help you reduce emissions and improve performance. We also share best-in-class web design practices that aren't as easy to quantify from an ecological perspective. Read on to learn specific action items you can take to improve this page and your website overall.

Share your score

ESTIMATED EMISSIONS
This page emits an estimated **0.166g** of carbon dioxide equivalent (CO₂e) every time someone views it.

Pages visits per month: < 1k, 1k-10k, 10k-100k, 100k-1m, 1m+

With the traffic numbers you selected, this page could create between 1.66 kilograms and 16.55 kilograms of CO₂e per month.

That's roughly equivalent to:

- between 0.21 and 2.102 gallons of gas consumed
- between 4.138 and 41.382 miles driven by an average gasoline-powered passenger vehicle
- between 0.076 and 0.762 days of home energy use
- between 201.945 and 2,019.454 smartphones charged

And that's just a single page on your site.

25% OF SCORE
1 Improve User Experience
Creating an accessible user experience that is free from barriers or intrusions helps people find what they need and accomplish tasks quickly. This is important because end consumer device use can potentially account for up to 52% of a digital product or service's overall emissions. Here are a few recommendations for providing your users with a better experience.

100 out of 100

Ecograder Scanned 10/30/2024, 12:02:03 PM EDT
RESCAN PAGE TRY ANOTHER PAGE

Your Impact Report

Report for: <https://pmug-nj.org/>

Performance Impact

Ecograder Score **75** Out of 100
Emissions per Pageload **0.13** grams of carbon dioxide

Page Weight **91**
UX Design **88**
Green Hosting **0**

This page scores better than 57% of all URLs crawled by Ecograder

Climate Impact

Digital Carbon Rating **A**
Ecograder's digital carbon rating system gives this URL an "A" on a scale of A to E.

Page Emissions **0.13 g**
Assuming your page gets 100C pageviews, you're emitting **130.00** grams of carbon dioxide.

Page Weight **339.92 KB**
This page is 146.47% smaller than the average web page.

Scripts and media assets contribute to your page's emissions estimate but they aren't the only factor. The chart below breaks down estimated emissions impact per page view of individual asset types at this URL.

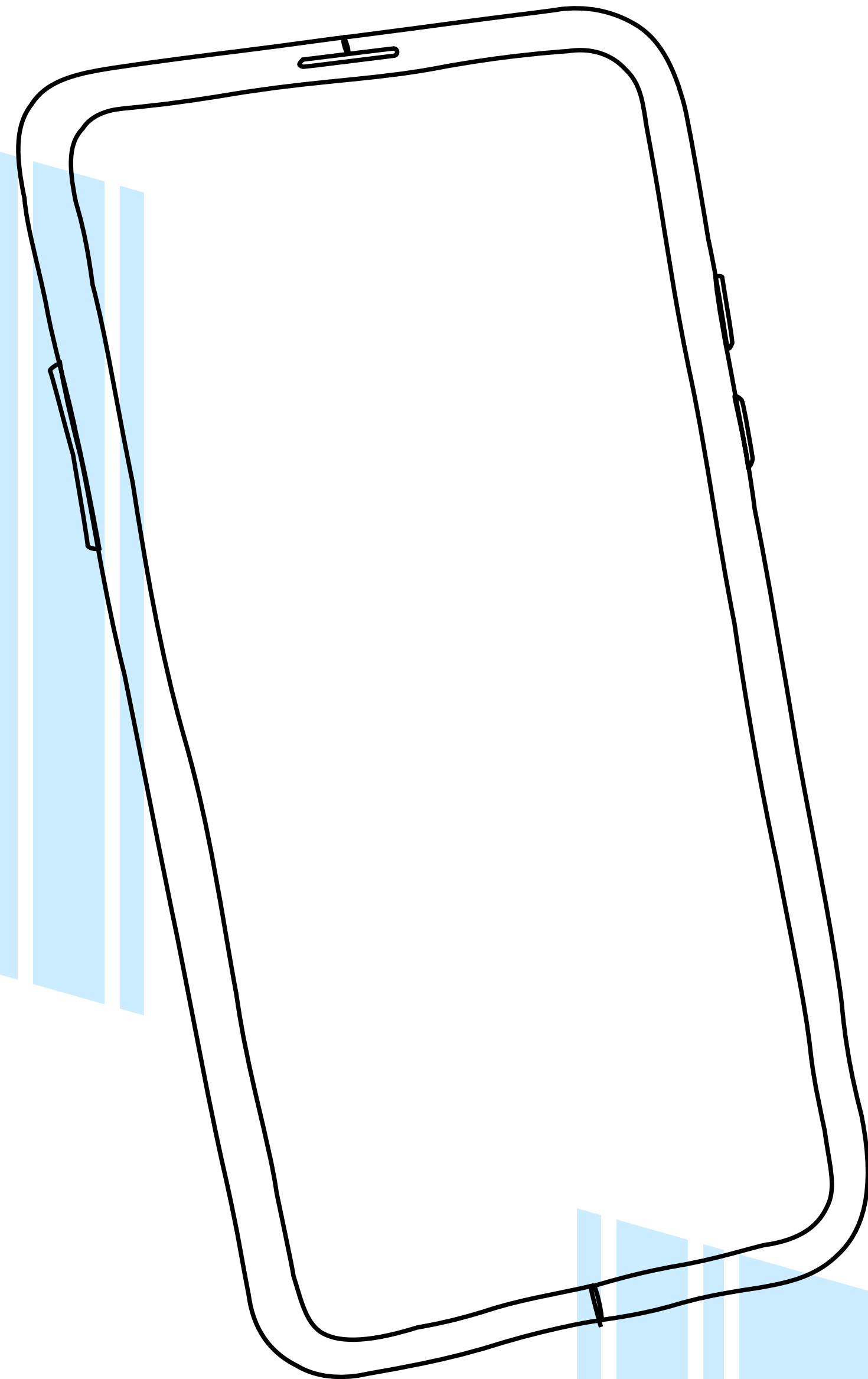
PMUG and Sustainable Web Design

- How PMUG Did It
- Overall Thoughts



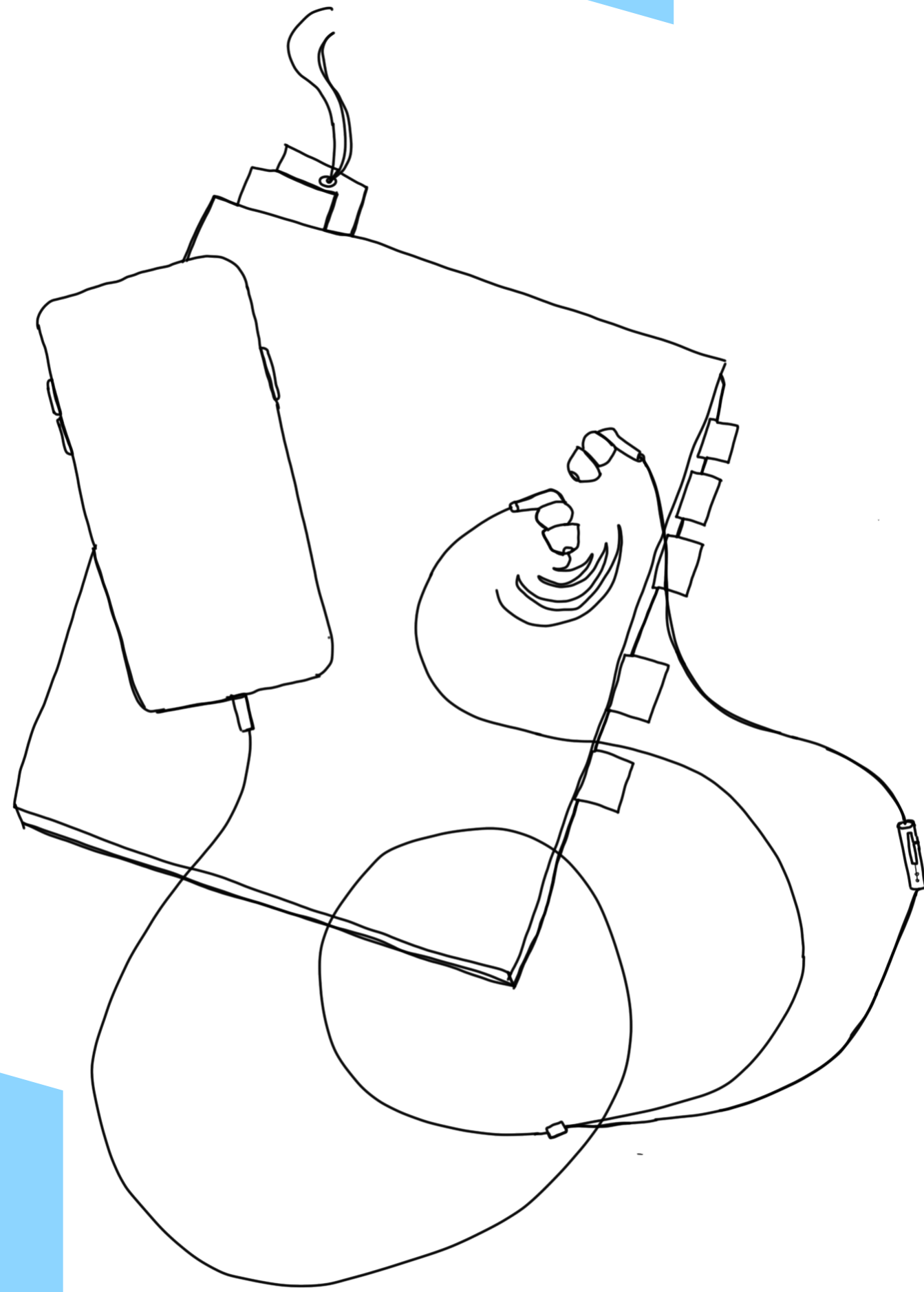
In Closing

- Electricity from a mix of renewable and non-renewable power
- Less energy required for a Website results in less CO₂ from non-renewable energy
- There are strategies and techniques to lower your Website's CO₂ emissions



Additional Resources

Background Material



Books

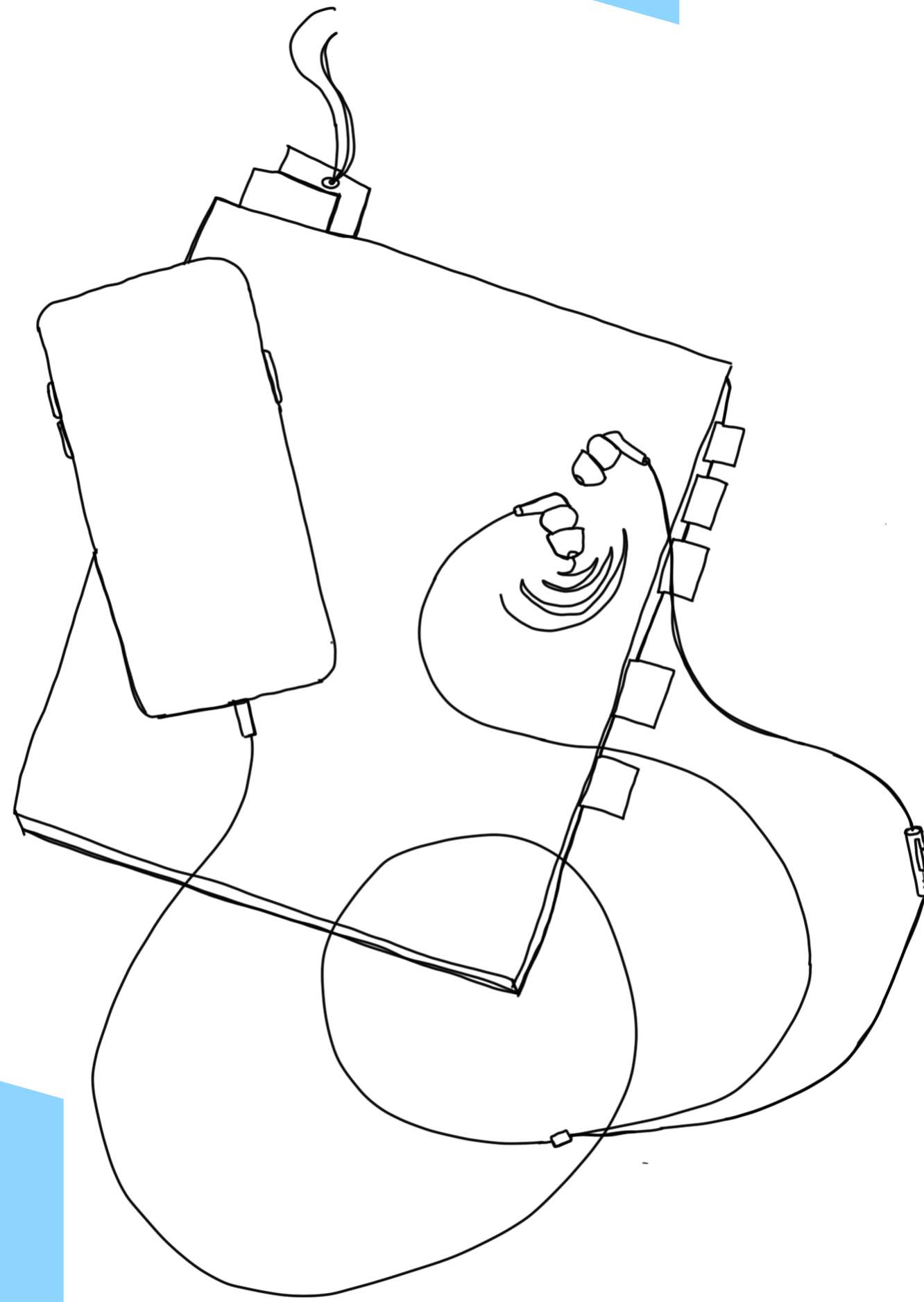
- Tom Greenwood - Sustainable Web Design (August 2024, Revised Version)
- Tim Frick - Designing for Sustainability (September 2016)
- Michael Andersen - Sustainable Web Design In 20 Lessons (March 2023)

Organizations

- [ClimateAction.tech](https://climateaction.tech)
- [Green Web Foundation](https://greenwebfoundation.org)
- [Green Software Foundation](https://greensoftwarefoundation.org)
- [W3C Sustainable Web Design Community Group](https://www.w3.org/community/sustainable-web-design/)

Additional Resources

The Latest



Newsletters and Forums

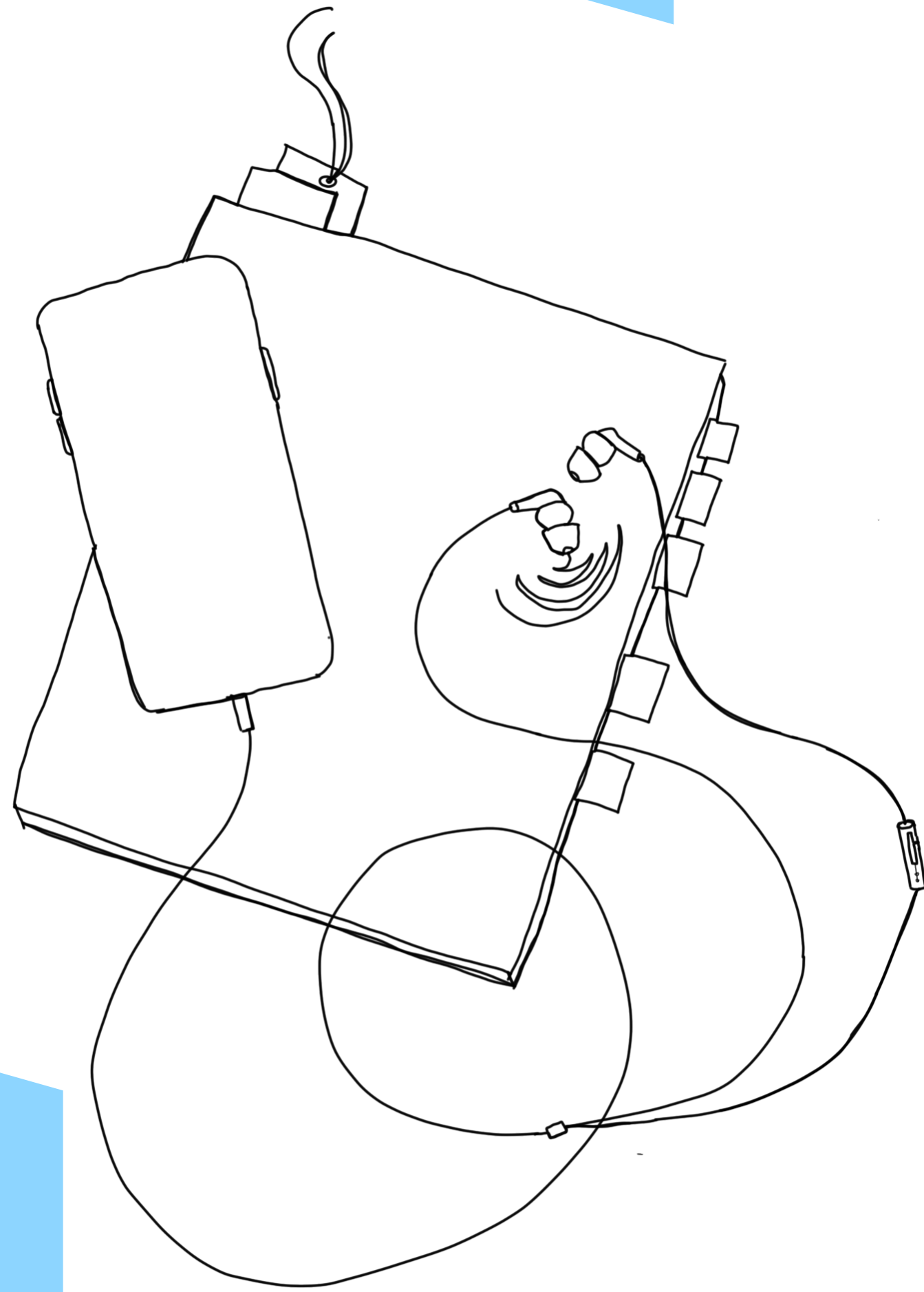
- [Curiously Green Newsletter from Wholegrain Digital](#)
- [ClimateAction.tech Newsletter](#)
- [ClimateAction.tech on Slack](#)
(#greener-design and #greener-webdev)

Blogs

- [Wholegrain Digital posts on Sustainable Websites](#)
- [Mightybytes posts on Sustainable Websites](#)
- [Green the Web posts](#)

Additional Resources

The Latest



Podcasts

- [Environmental Variables](#)
- [Green IO](#)
- [Green the Web](#)

Web Development

- [Website Carbon Calculator](#)
- [Ecograder](#)
- [Are my Third Parties Green?](#)
- [SustainableWebDesign.org](#)



Questions?

e-mail: michaelb.tfm@gmail.com

See princetonacm.acm.org
for presentation slides and links