2025

frank.computer

Accessibility and Data

As told from my perspective in data visualization.

Frank Elavsky

hcii.cmu.edu, axle-lab.com, dig.cmu.edu

Today

Intro accessibility and models of disability

A “light” walkthrough evaluating a visualization with Chartability

A short highlight of some of my more recent work

CLASS QUESTION

What is accessibility?

CLASS QUESTION

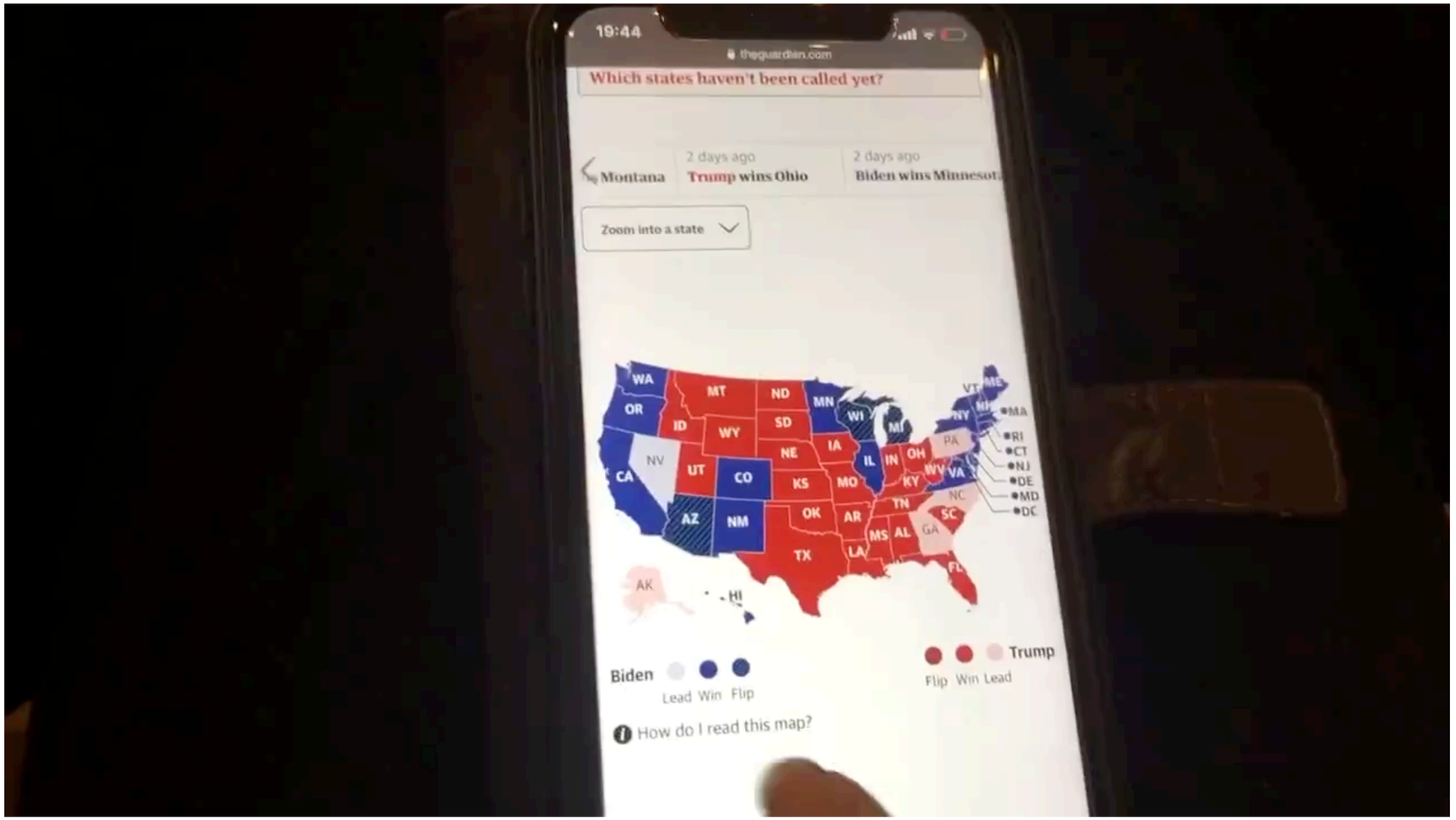
Why does accessibility matter?

CLASS QUESTION

1. What is accessibility?
2. Why does accessibility matter?

What is an inaccessible experience like?

Credit: Sarah Fossheim [on twitter]



Access is a human right

Accessibility for people with disabilities is an internationally recognized human right.

It is the morally and ethically correct thing to do.

UN CRPD Article 9: Accessibility, UN CRPD Article 10: Right to Life

Disability is Widespread

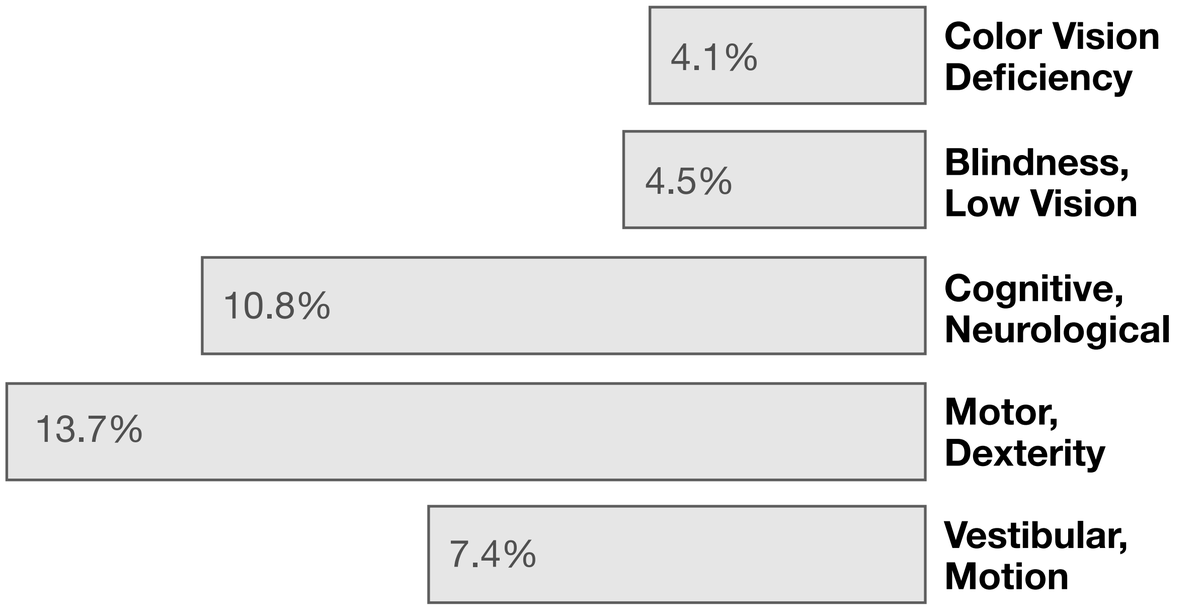
Worldwide **more than 1.3 billion people** (~16%) experience some form of disability [World Health Organization, 2023]

Disability is Widespread

(Roughly) **One in four** Americans has disability of some sort

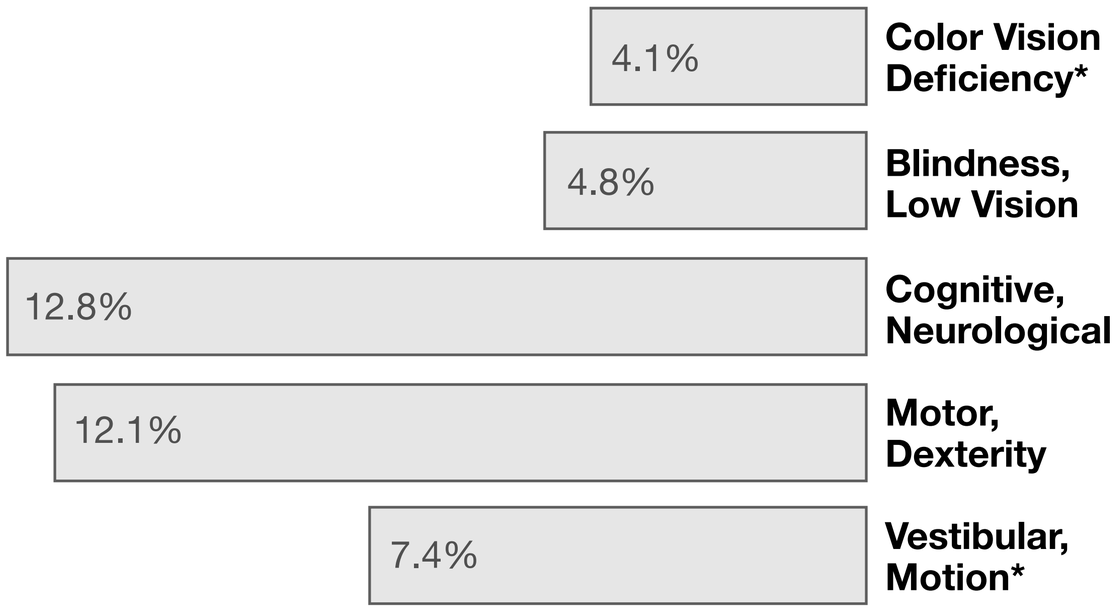
One in ten Americans has a severe disability

- “An impairment that significantly limits one or more major life activities”



Source: Okoro et al. “Prevalence of Disabilities and Health Care Access by Disability Status and Type Among Adults”

~26% of people living in the United States self-report living with a disability that affects their daily life (2017)



Centers for Disease Control and Prevention. Disability and Health Data System (DHDS). 2023. Available from: http://dhds.cdc.gov
*No new data

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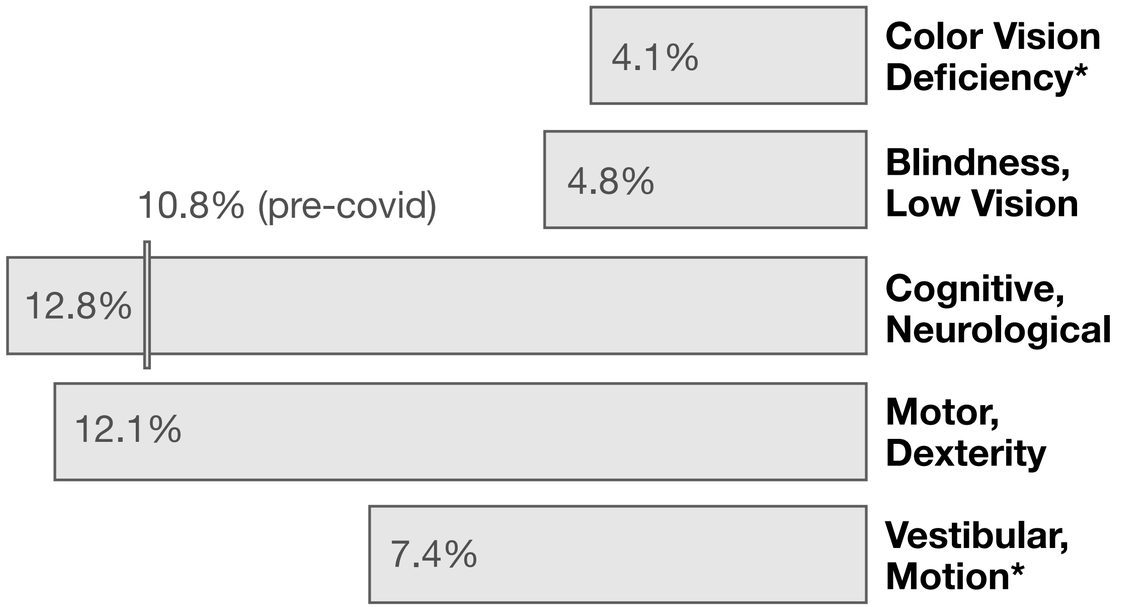
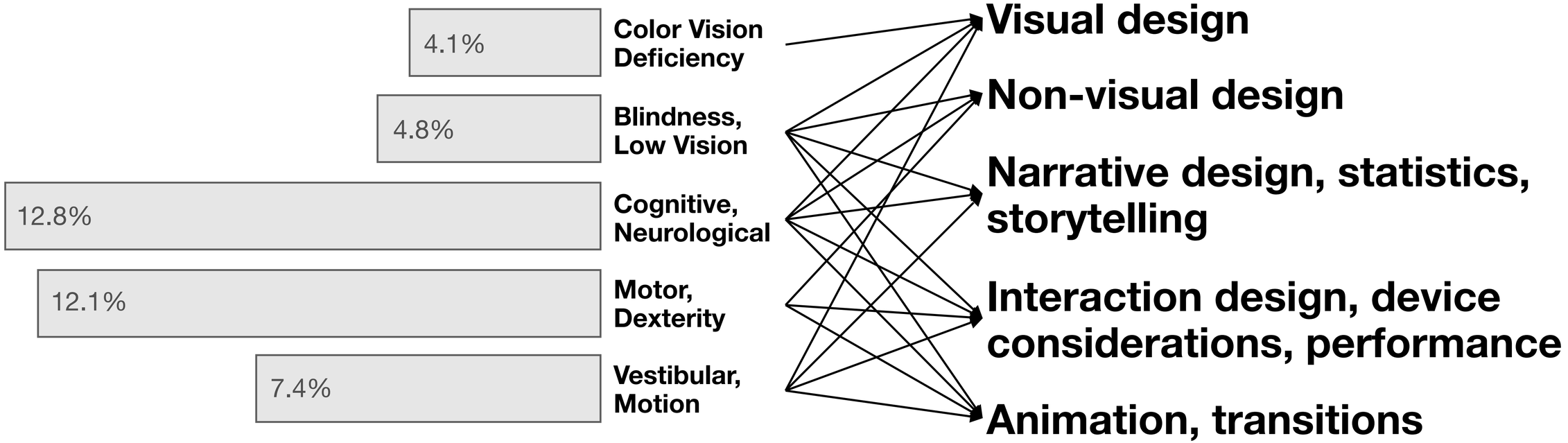
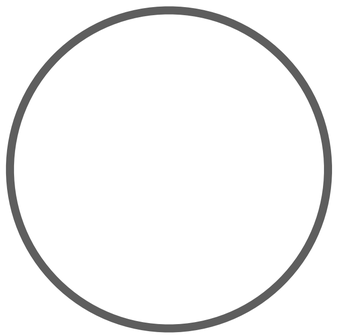


Cognitive disability is on the rise

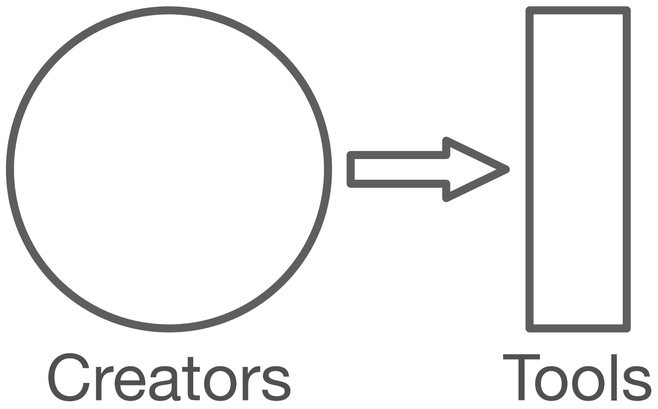
Centers for Disease Control and Prevention. Disability and Health Data System (DHDS). 2023. Available from: http://dhds.cdc.gov
*No new data

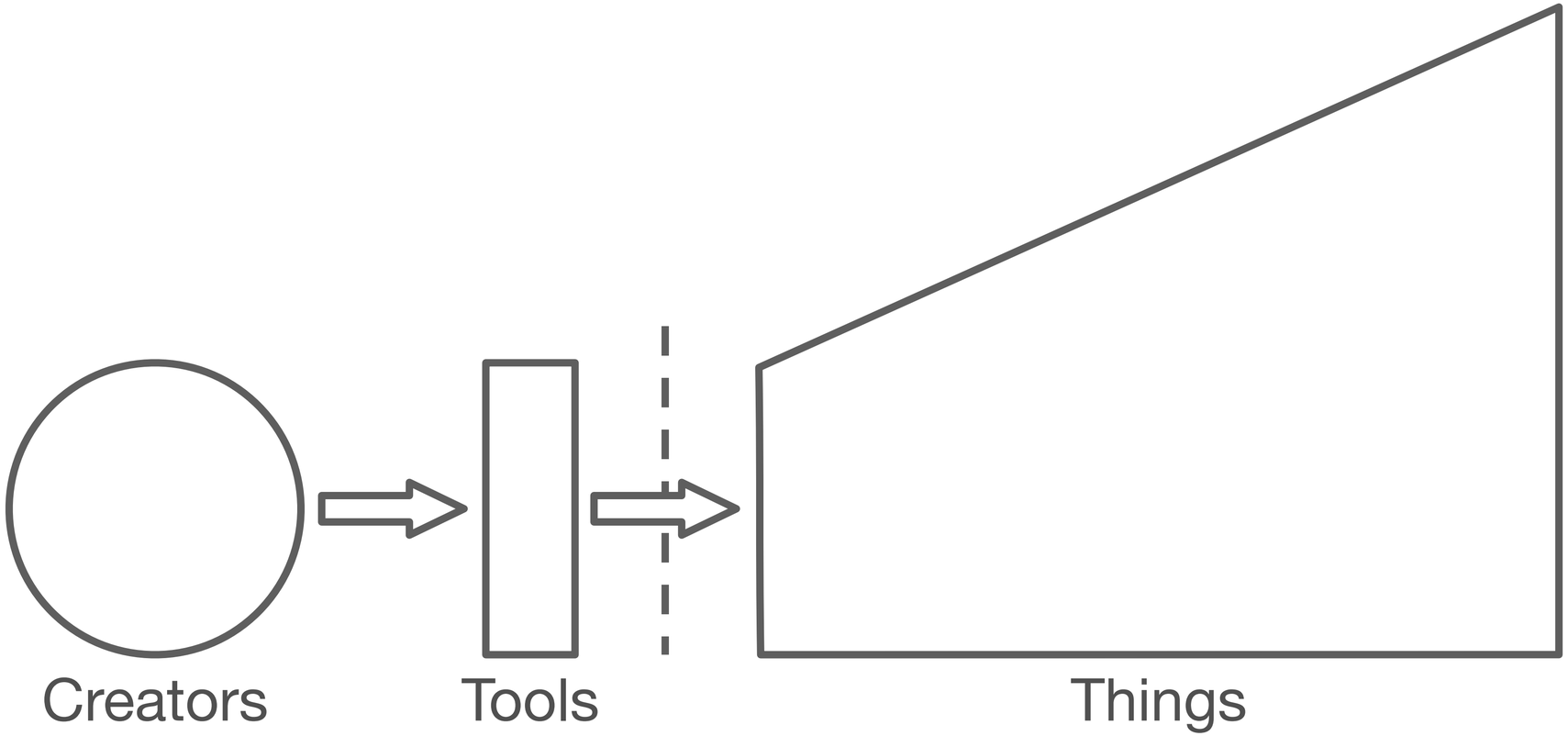
Accessibility affects every aspect of visualization work

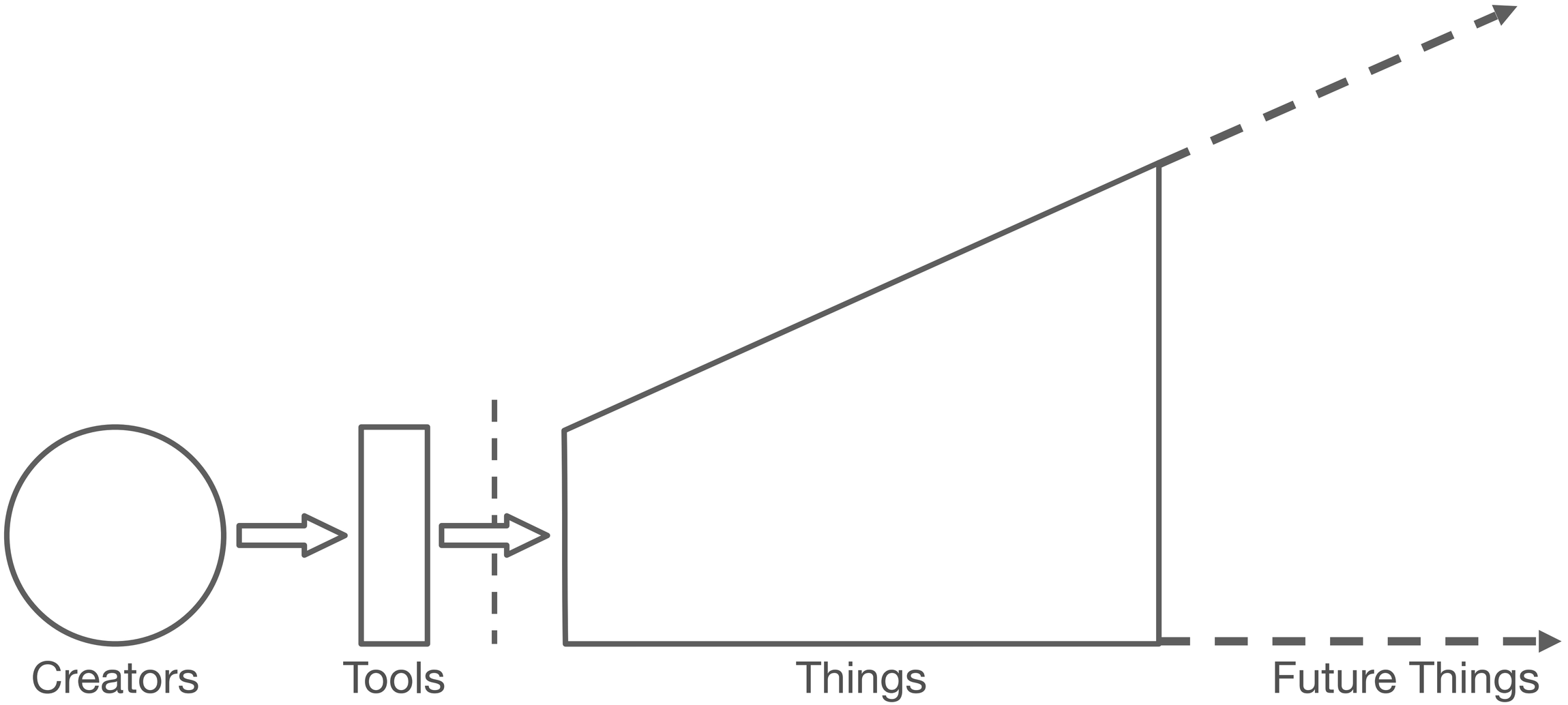




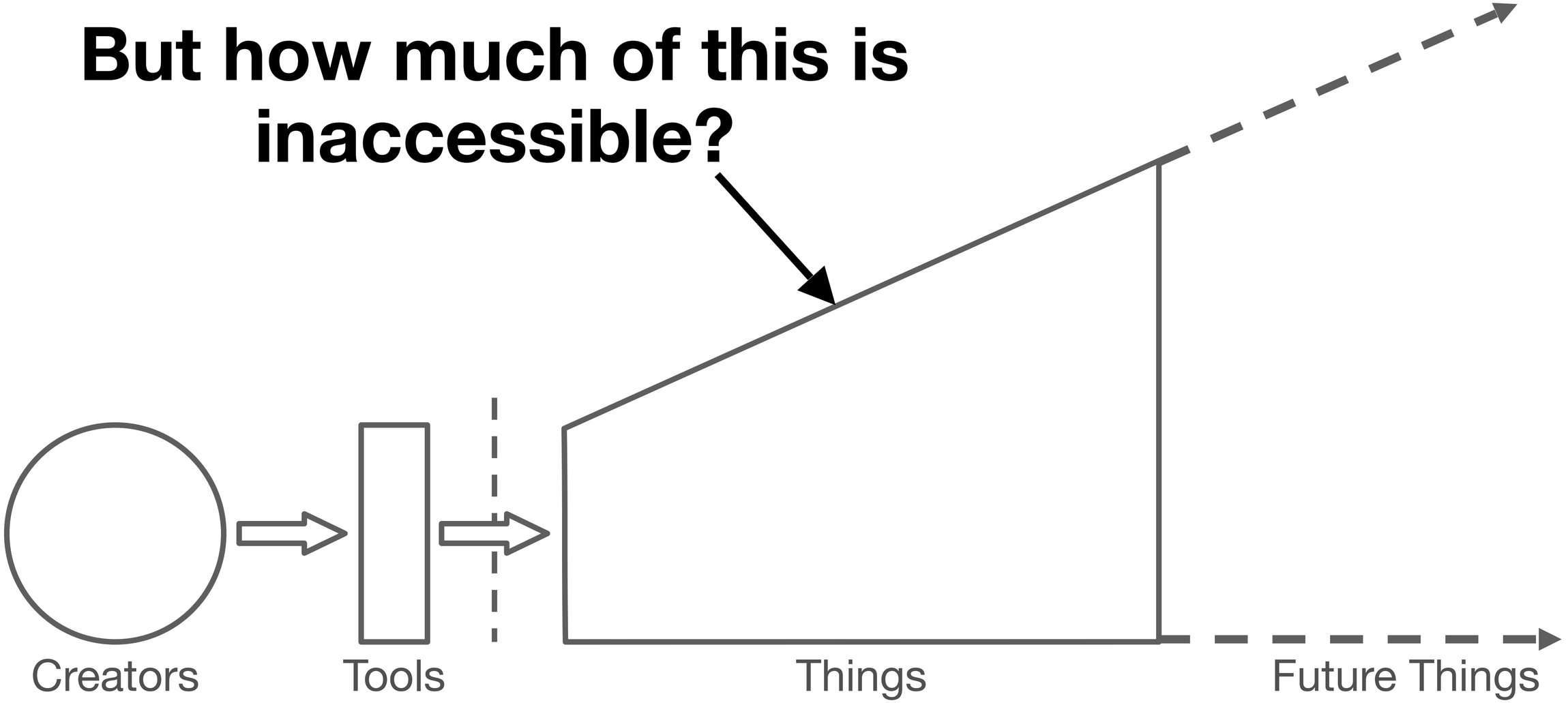
Creators


Creators
Tools


Creators
Tools
Things


Creators
Tools
Things
Future Things

But how much of this is inaccessible?



CLASS QUESTION

What % of existing content out there is *measurably* inaccessible in some way?

CLASS QUESTION

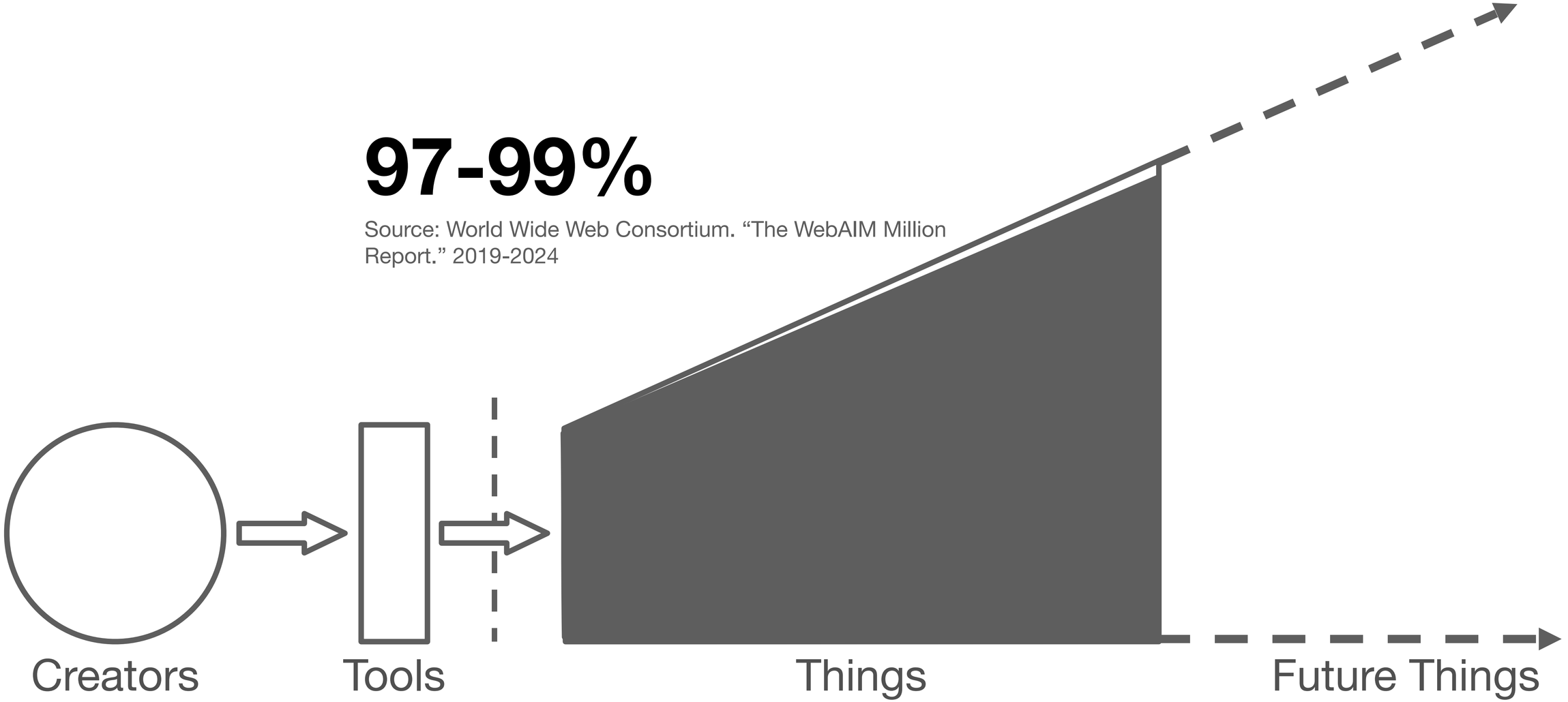
Who is *responsible* for making things accessible?

CLASS QUESTION

1. What % of existing content out there is *measurably* inaccessible in some way?
2. Who is *responsible* for making things accessible?

97-99%

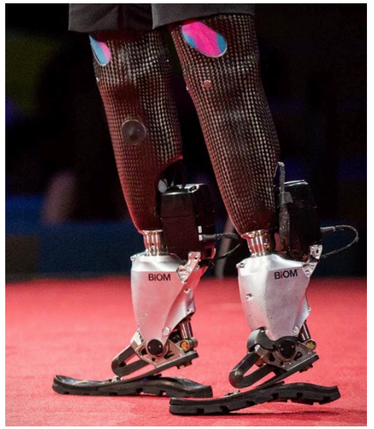
Source: World Wide Web Consortium. “The WebAIM Million Report.” 2019-2024



What about curbs in our cities?

Medicalizing framing: the body is the cause/location of disability (according to normative standards).

Augment or “cure” the body, the person typically bears the cost of access.



Social framing: The *curb* is the source/location where disability is produced (as a “barrier” to access).

We built barriers, so now *we* need to fix them.

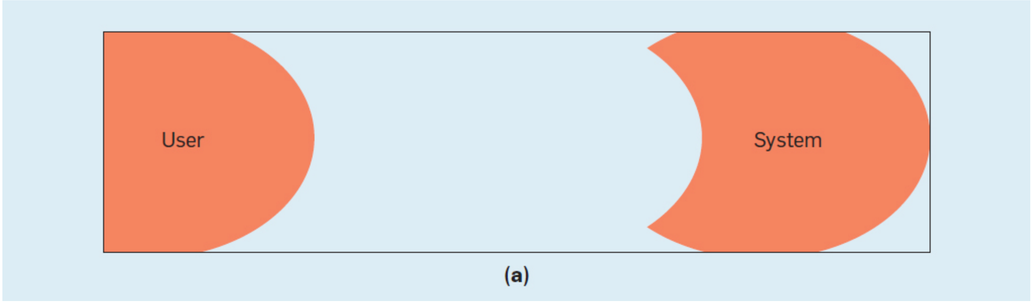
CLASS QUESTION

Question for Frank

Concept: **Ability Assumptions**

Ability Assumptions

(Wobbrock et al) https://cacm.acm.org/magazines/2018/6/228034-ability-based-design/fulltext



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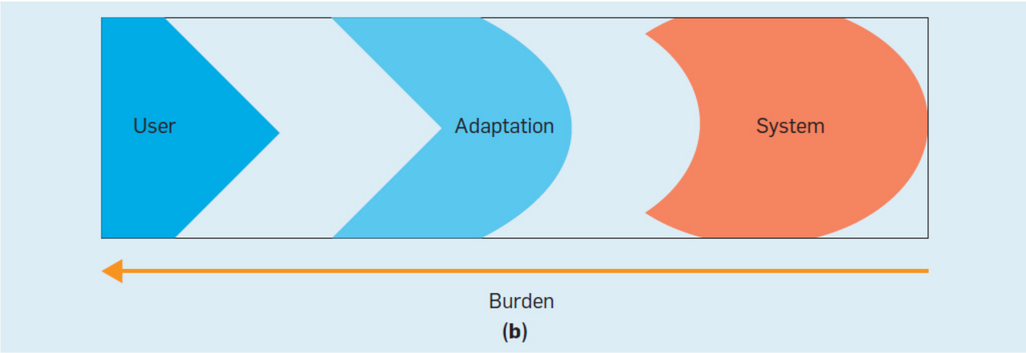

Ability Assumptions

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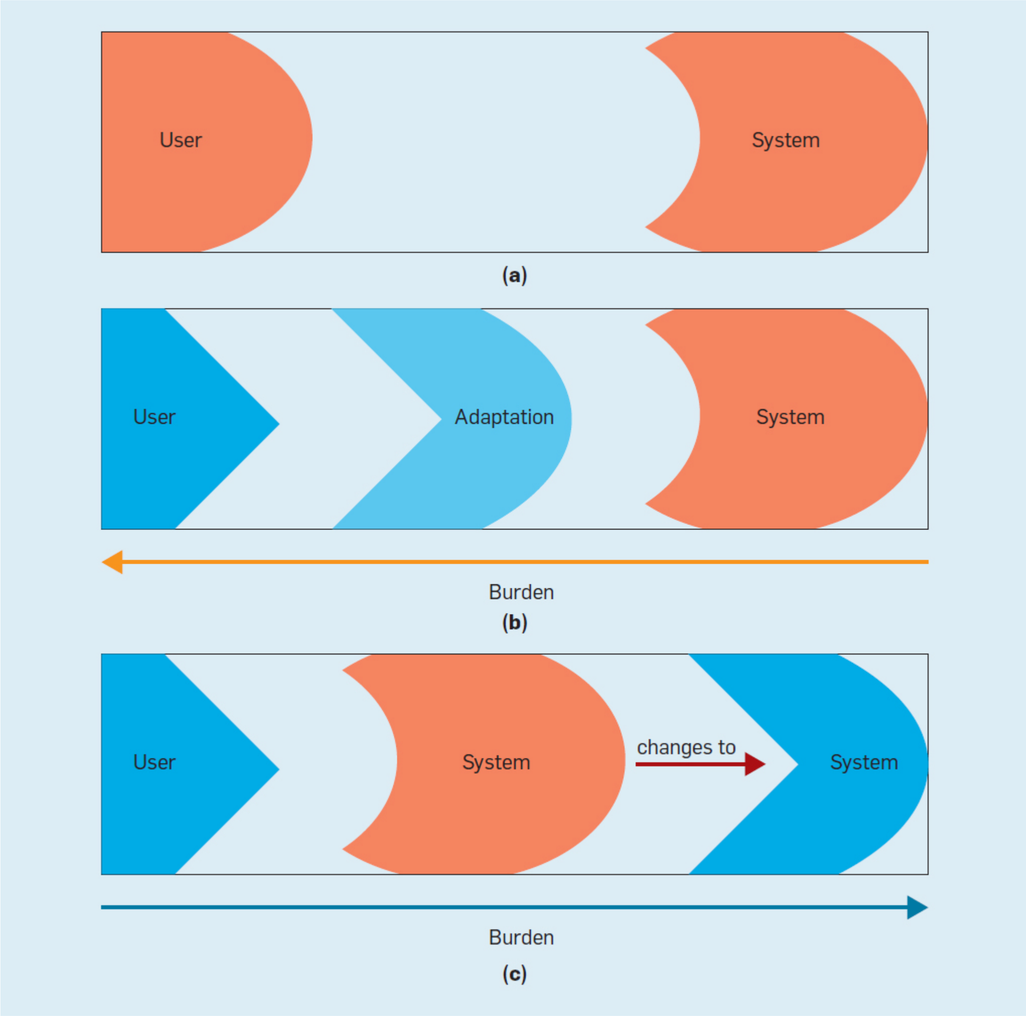


A curb exclusively assumes the ability to step up

A cut curb has fewer *exclusive* ability assumptions

CLASS QUESTION

Question for Frank

Concept: **Situational Impairment**

Permanent

Touch

One arm

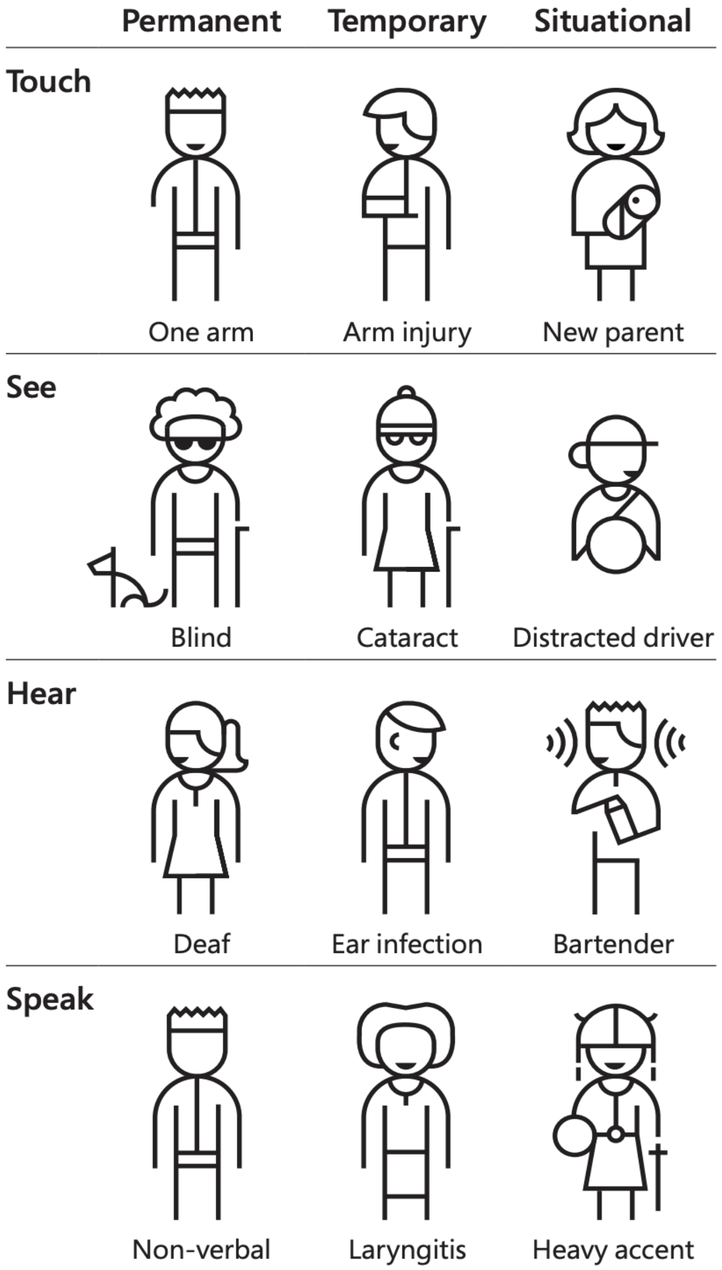
	Permanent	Temporary
Touch		
	One arm	Arm injury

	Permanent	Temporary	Situational
Touch			
	One arm	Arm injury	New parent

We all experience situational impairment in our daily lives. **Accessibility benefits everyone**!

	Permanent	Temporary	Situational
Touch			
	One arm	Arm injury	New parent

“Design for One, Extend to All”



Microsoft’s Inclusive Design 101 Toolkit: https://download.microsoft.com/download/b/0/d/b0d4bf87-09ce-4417-8f28-d60703d672ed/inclusive_toolkit_manual_final.pdf

CLASS QUESTION

What is a situation you've found yourself in where your **hearing**, **sight**, **voice**, or **hands** were impaired?

CLASS QUESTION

Any other questions?

Turns out, a lot of barriers are *shared*!

So how do we *catch* barriers?

Listen to people with disabilities (PWD).

There are a lot of ways to listen:

1. Actually ask them!
2. Find where they are already speaking
3. Find where they have already spoken:
    - Research
    - Blog posts
    - Accessibility standards

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1. Actually ask them!
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    - **Accessibility standards**

An acronym in web standards:

P

O

U

R

An acronym in web standards:

Perceivable
O
U
R

An acronym in web standards:

Perceivable
Operable
U
R

An acronym in web standards:

Perceivable
Operable
Understandable
R

The 4 pillars of accessible design:

Perceivable
Operable
Understandable
Robust

Perceivable
Operable
Understandable
Robust

Chartability's additions:

+
C
A
F

Elavsky et al, "Chartability." (2022)

Perceivable
Operable
Understandable
Robust

Chartability's additions:

+
Compromising
A
F

Elavsky et al, "Chartability." (2022)

Perceivable
Operable
Understandable
Robust

Chartability's additions:

+
Compromising
Assistive
F

Elavsky et al, "Chartability." (2022)

Perceivable
Operable
Understandable
Robust

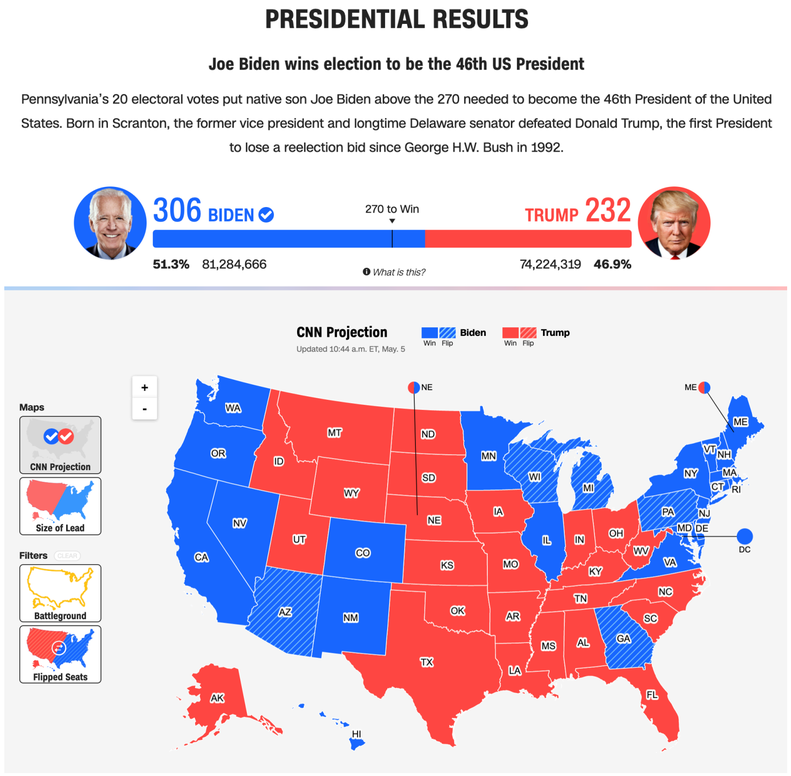
Chartability's additions:

+
Compromising
Assistive
Flexible

Elavsky et al, "Chartability." (2022)

CLASS QUESTION

Question for Frank



Let's evaluate this map from CNN with Chartability.

Elavsky et al, "Chartability." (2022)

POUR+CAF

“I need to **pour a cup of coffee** to help me consider accessible design!”

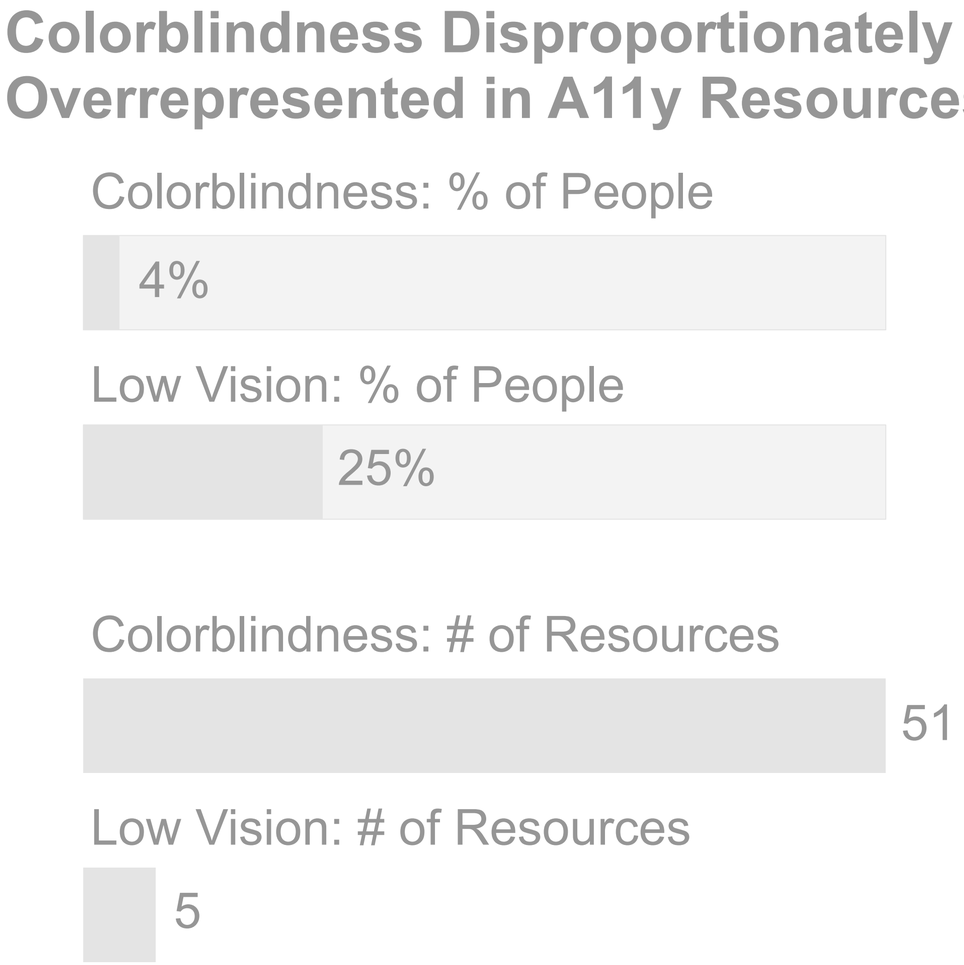
Perceivable

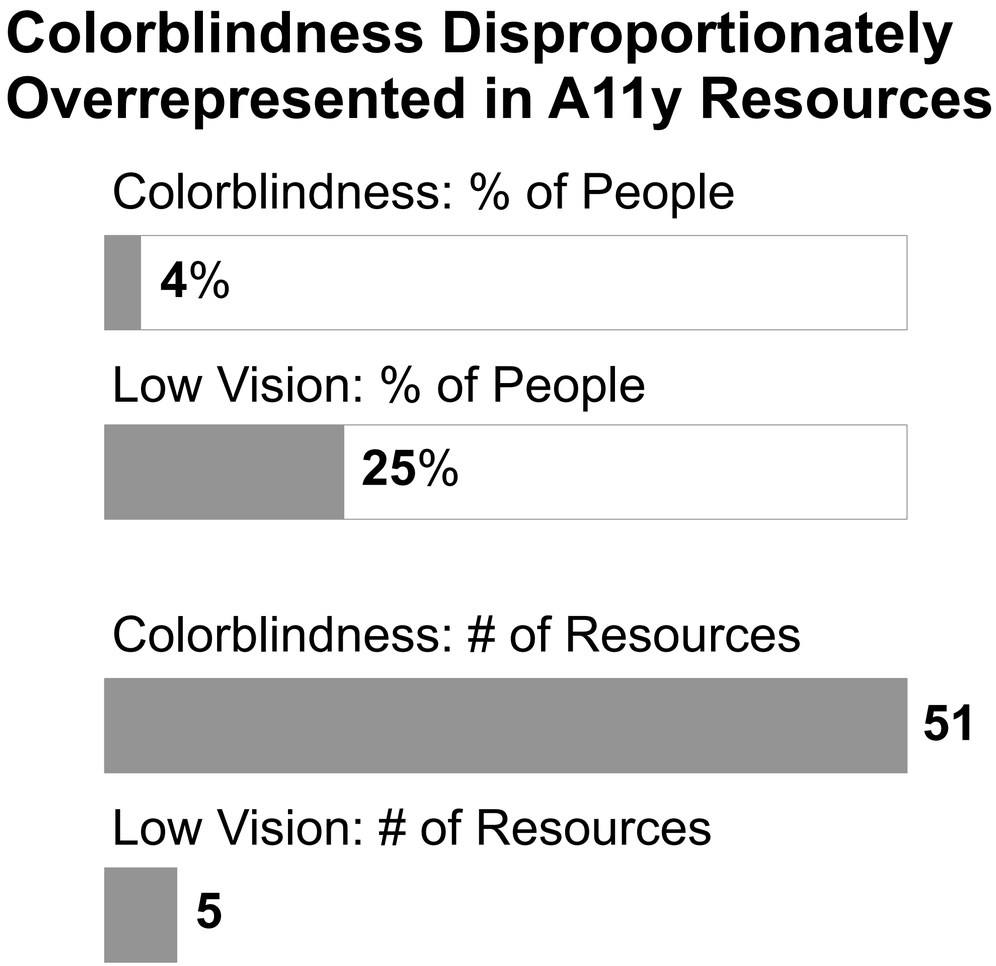
Can someone perceive this in multiple ways? Is each way easy?

Perceivable Checklist:

1. High Contrast
2. Colorblind-Safe + Redundant Encoding
3. Alt Text

Design with high contrast

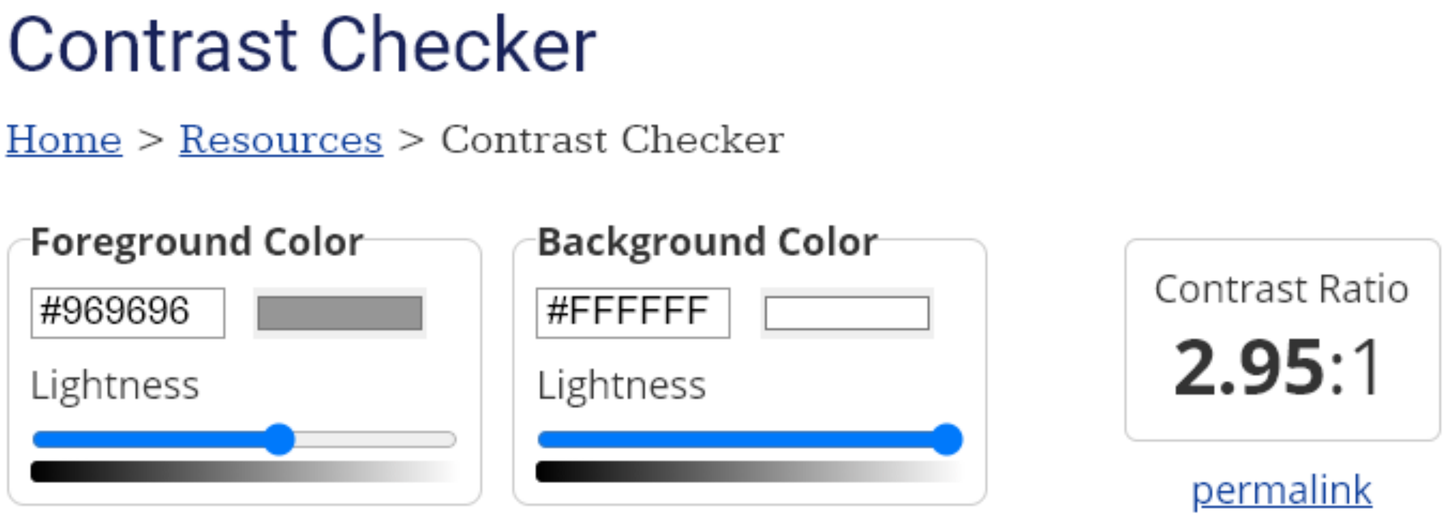




Use High Contrast Text

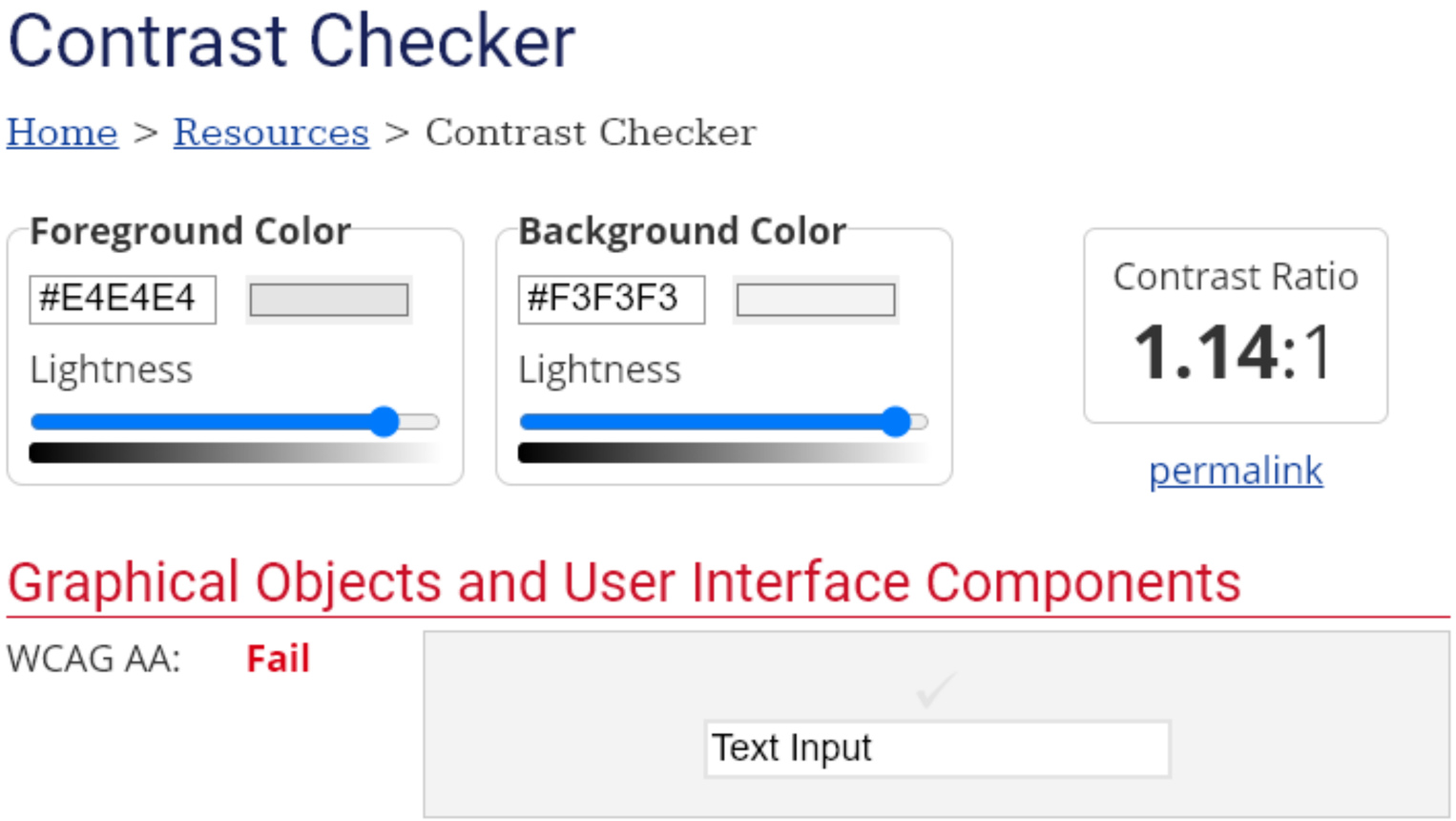
Text needs at least 4.5:1 contrast against its background.

Large text (bold and 16pt or larger) can be 3:1 or higher.



Use High Contrast Geometries

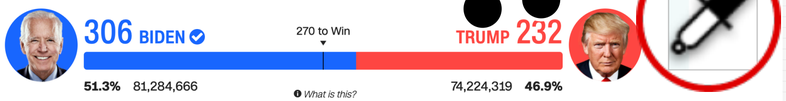
Chart elements need at least 3:1 contrast against their background.

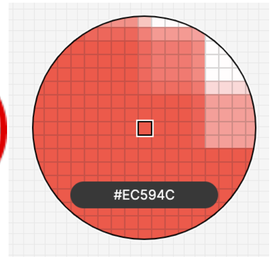


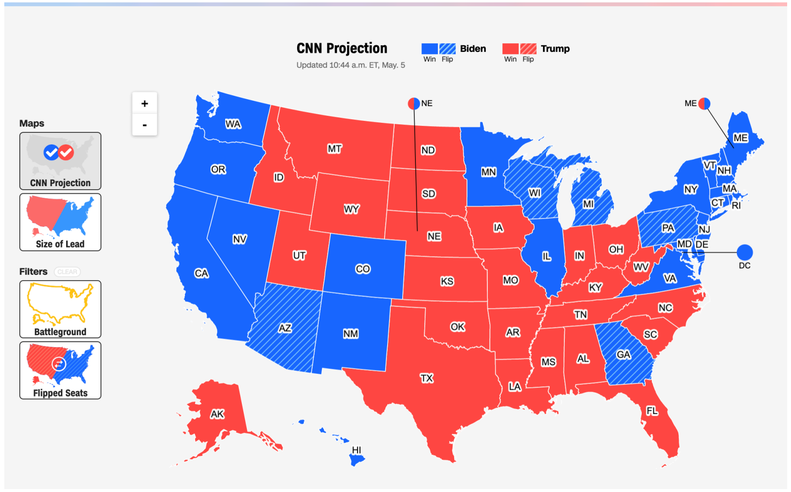
PRESIDENTIAL RESULTS

Joe Biden wins election to be the 46th US President

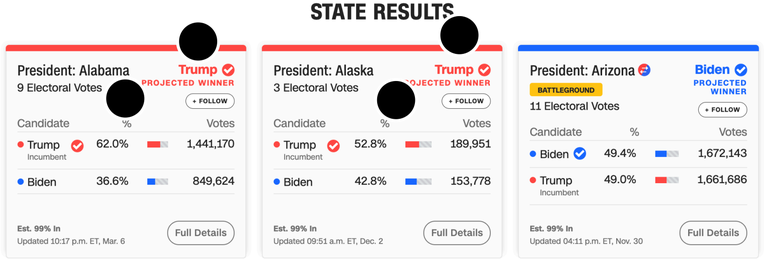
Pennsylvania's 20 electoral votes put native son Joe Biden above the 270 needed to become the 46th President of the United States. Born in Scranton, the former vice president and longtime Delaware senator defeated Donald Trump, the first President to lose a reelection bid since George H.W. Bush in 1992.







STATE RESULTS



Show More States

Contrast Checker

Home > Resources > Contrast Checker

Foreground Color

#EC594C

Lightness

↔

Background Color

#FFFFFF

Lightness

Contrast Ratio

3.44:1

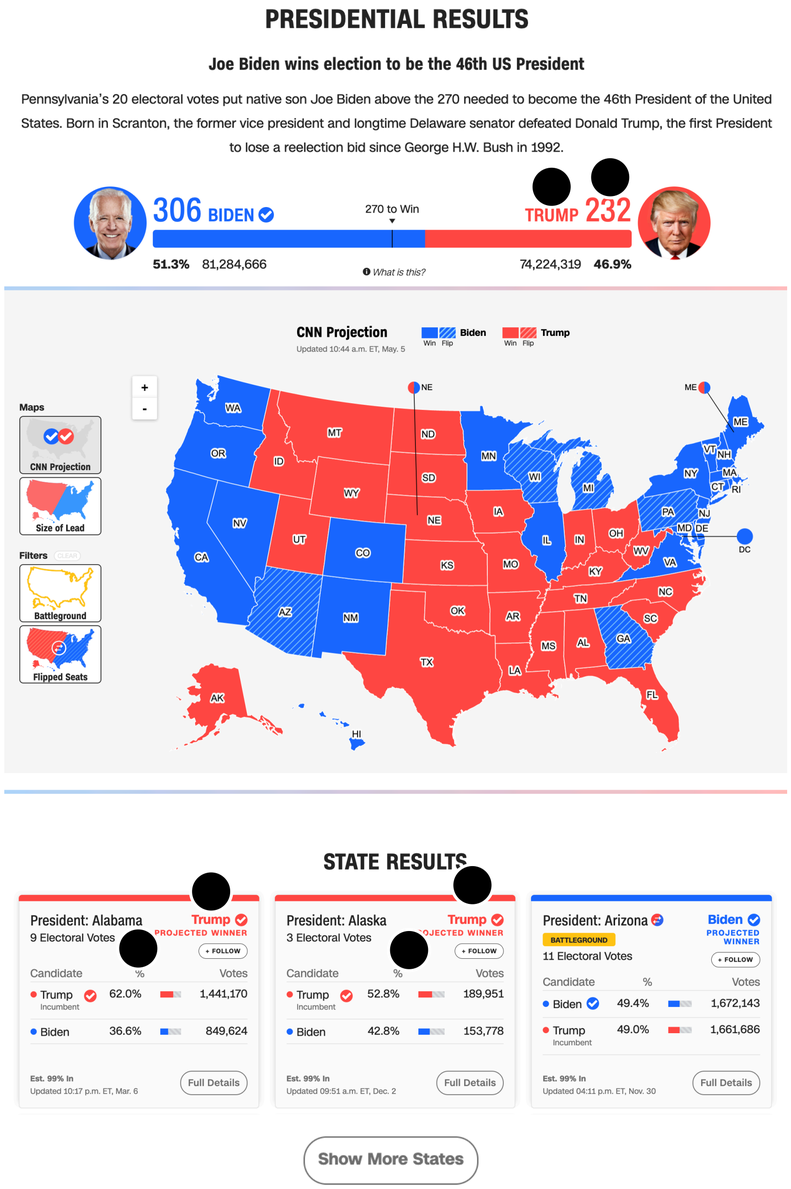
permalink

Normal Text

WCAG AA: **Fail**

WCAG AAA: **Fail**

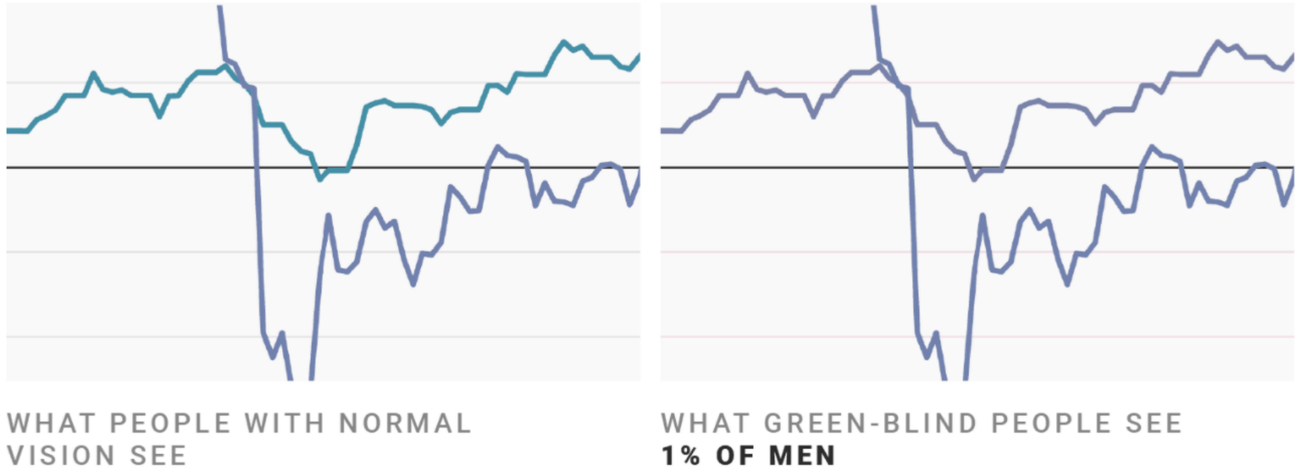
The five boxing wizards jump quickly.



6 instances of low contrast

Don’t rely on color alone!

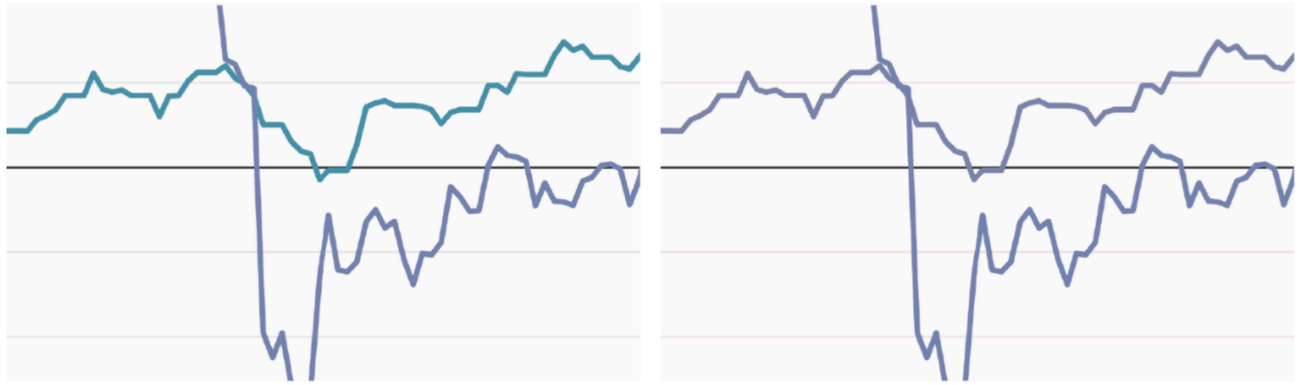
(Muth) https://blog.datawrapper.de/colorblindness-part2/



WHAT PEOPLE WITH NORMAL VISION SEE

WHAT GREEN-BLIND PEOPLE SEE
1% OF MEN

“Redundant encoding” is one strategy



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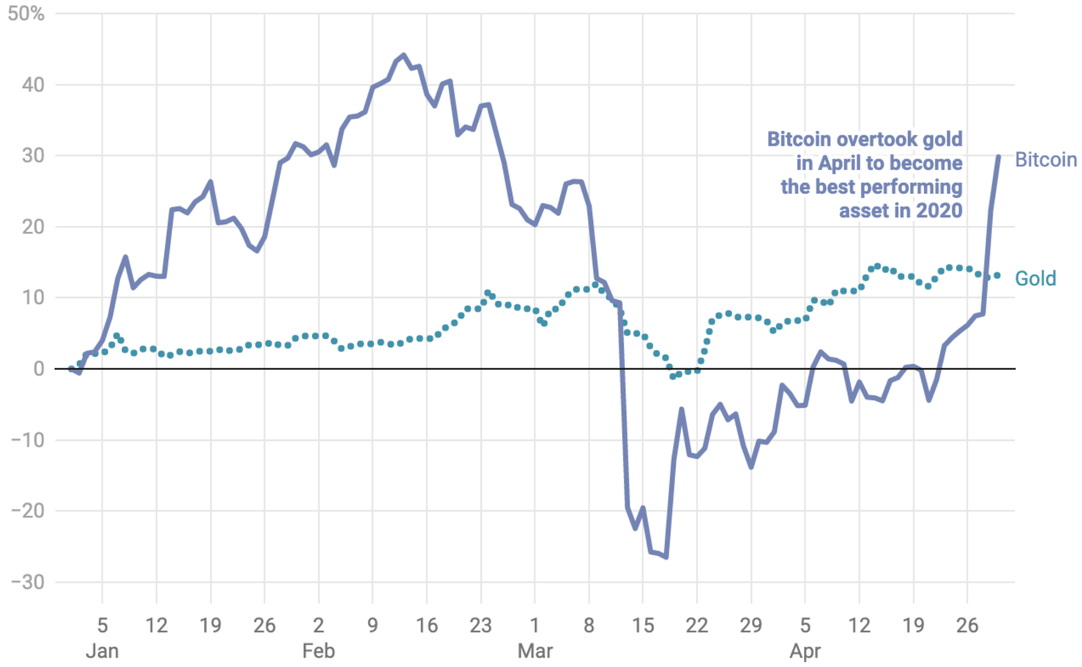
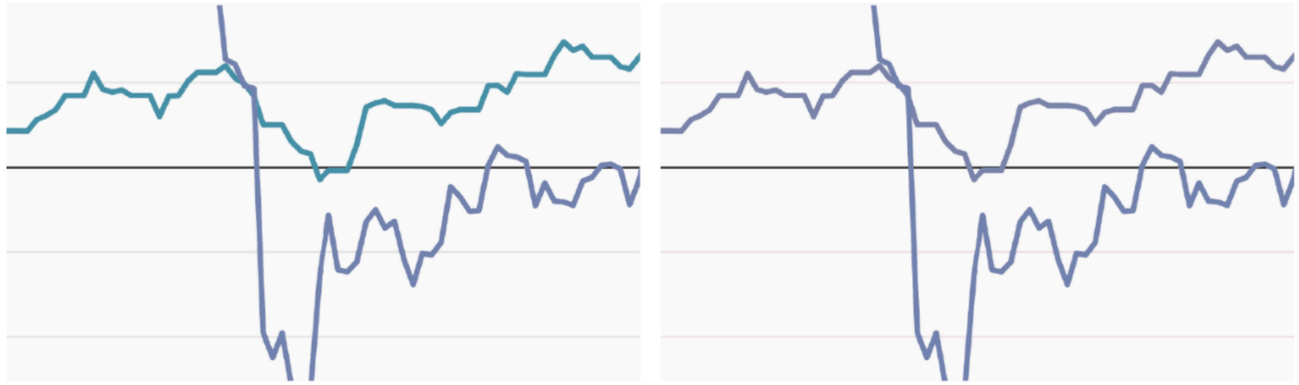


Bitcoin and gold price change (%) between January and May 2020

Chart: Based on Anthony Cuthbertson • Source: CoinMarketCap, Nasdaq, Gold Price • Get the data

A note: **“Color-vision deficiency”** and **“colorblindness”** refer to the same thing, both terms are fine to use.



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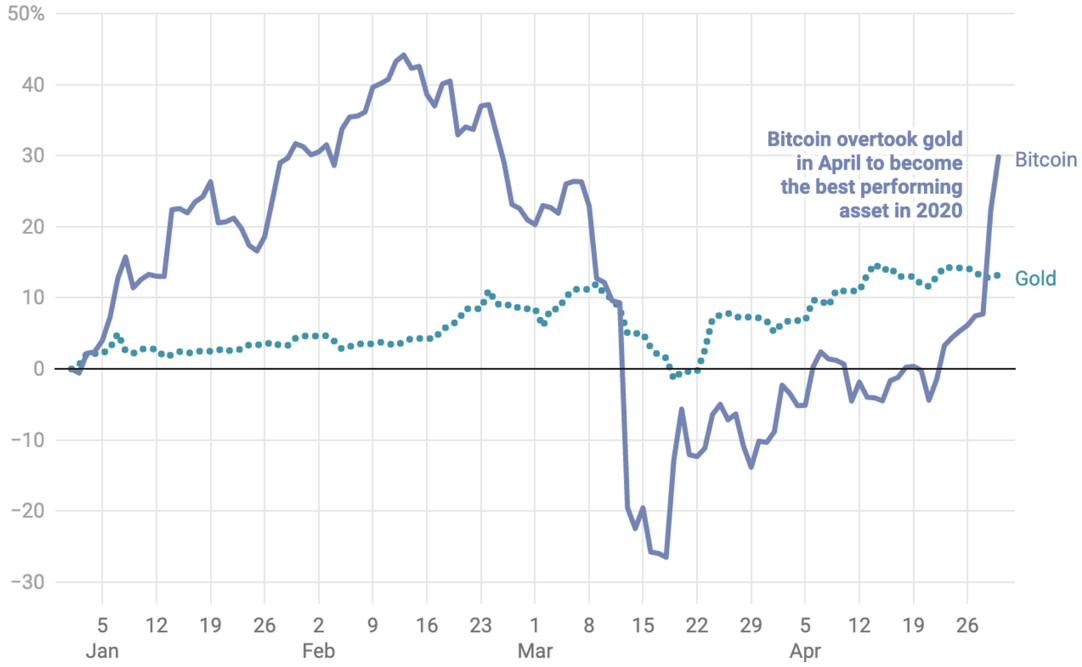

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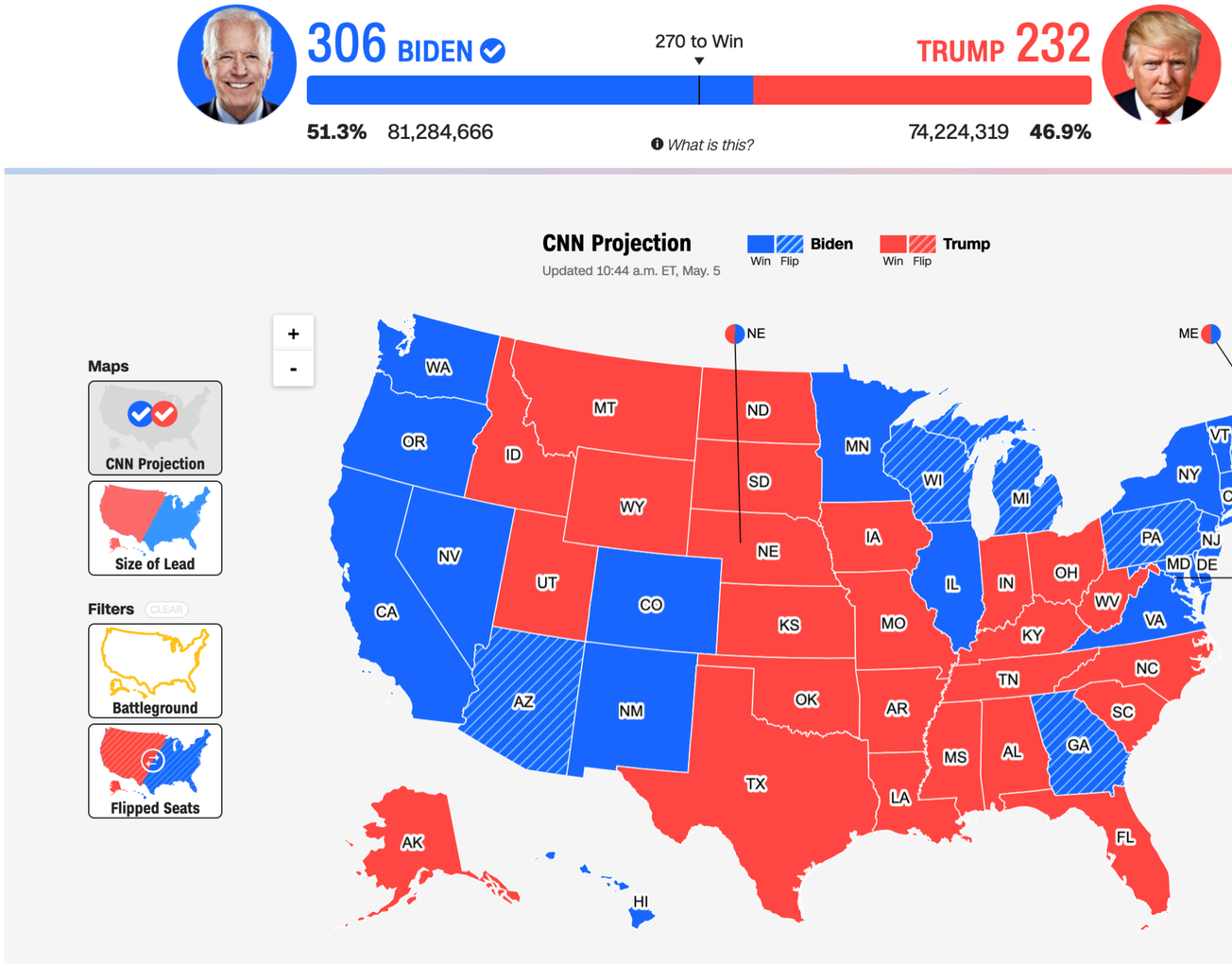
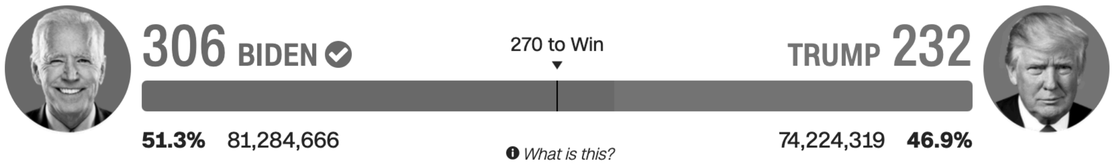
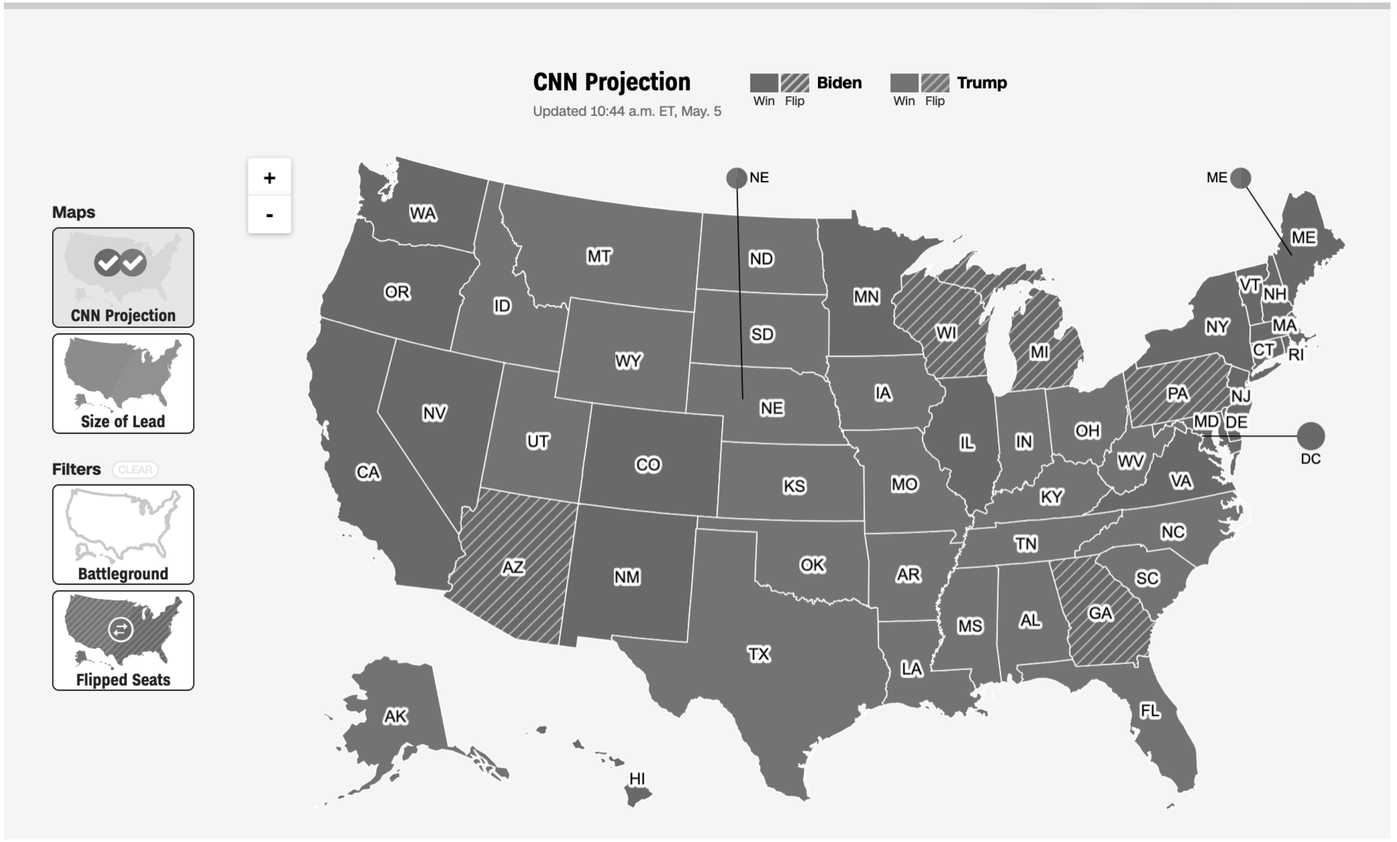
Chart: Based on Anthony Cuthbertson • Source: CoinMarketCap, Nasdaq, Gold Price • Get the data

But sometimes you *can't* redundantly encode!

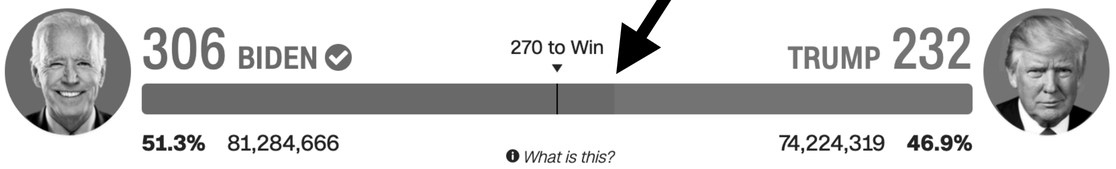


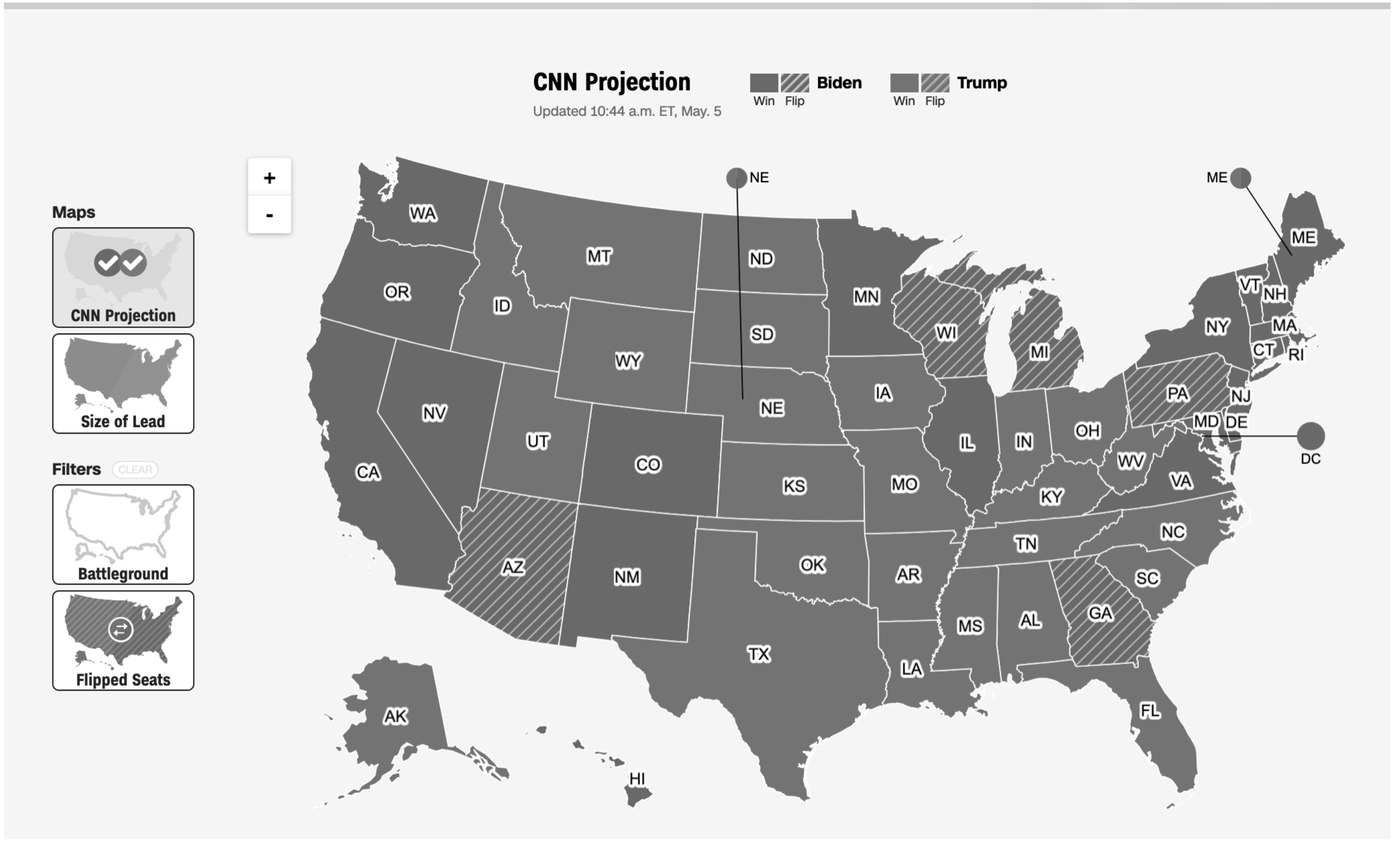
This map is trouble in greyscale



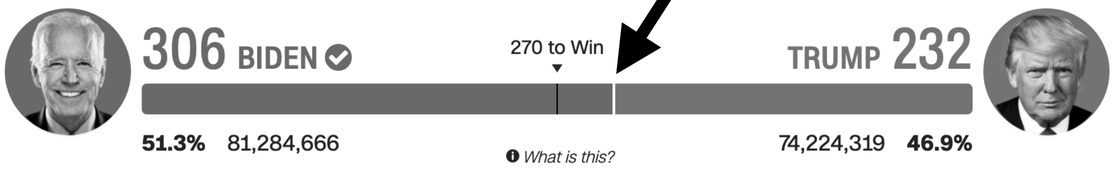


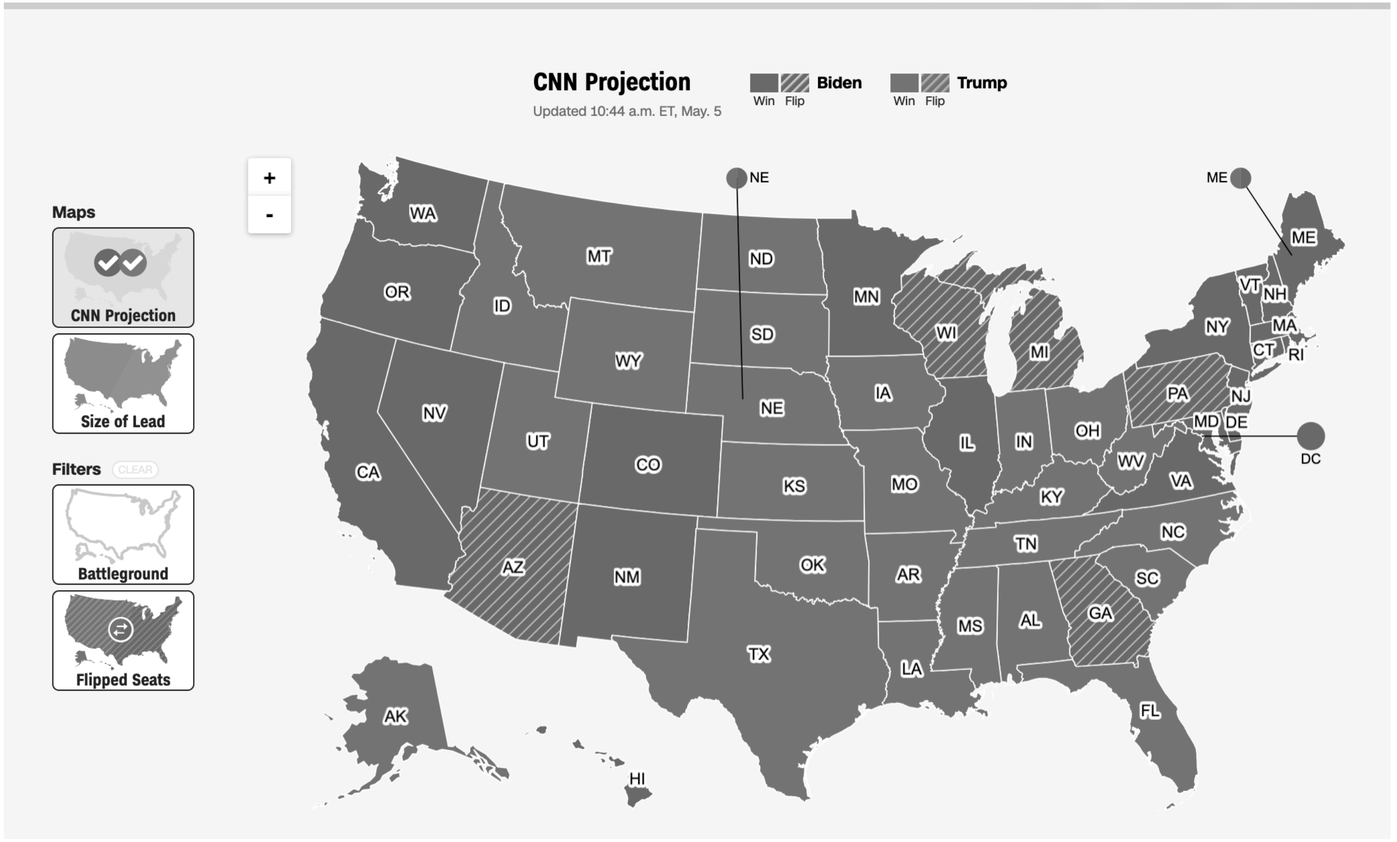
The division here matters!



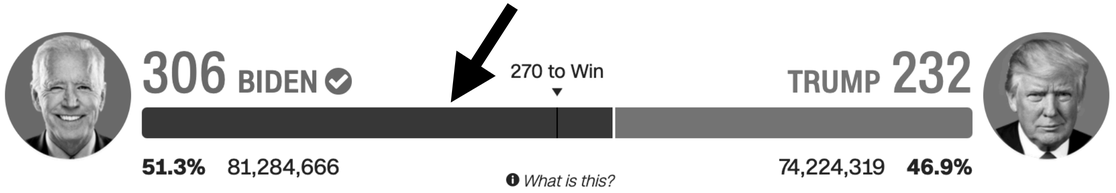


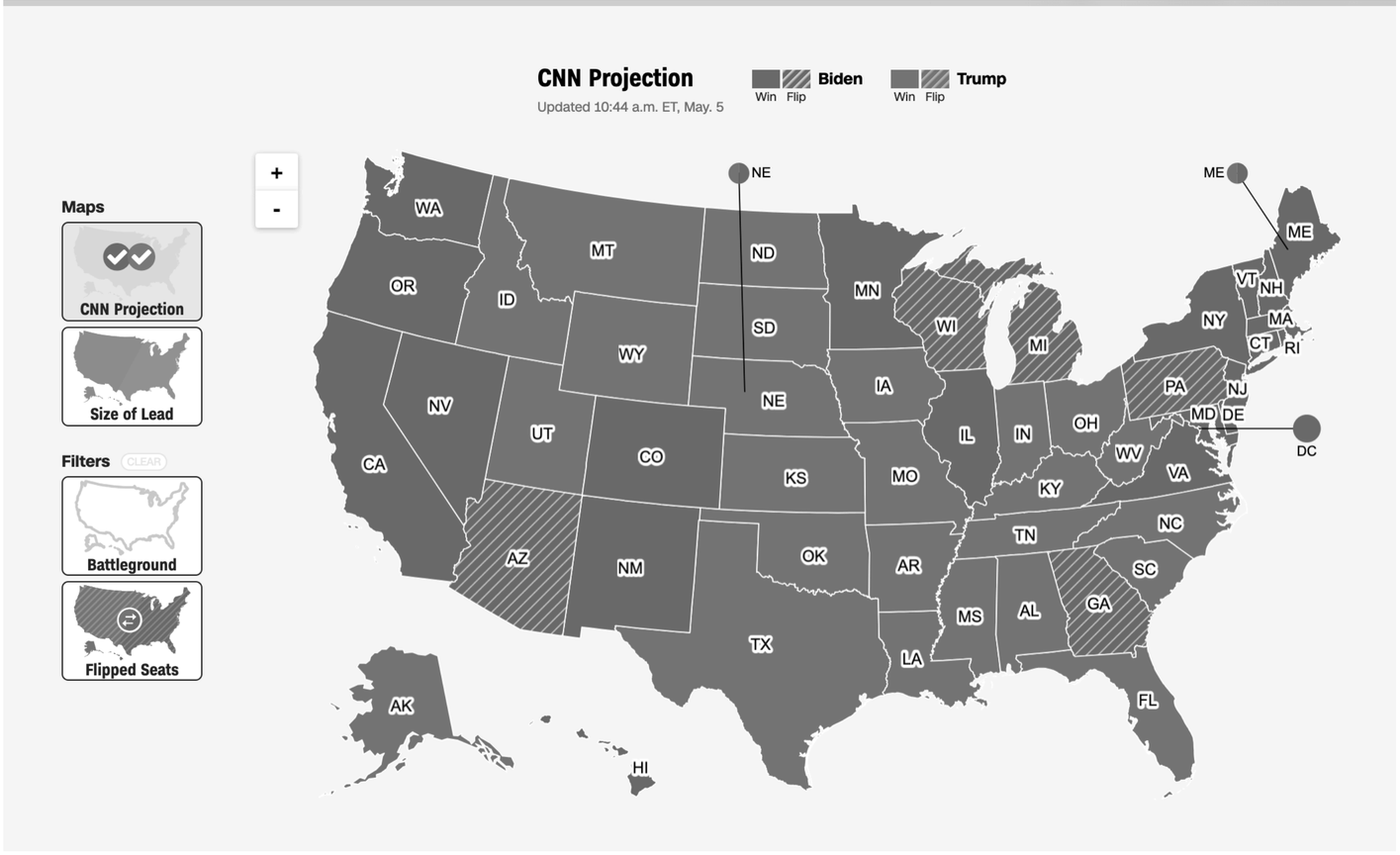
Maybe a small white divider, like the states?



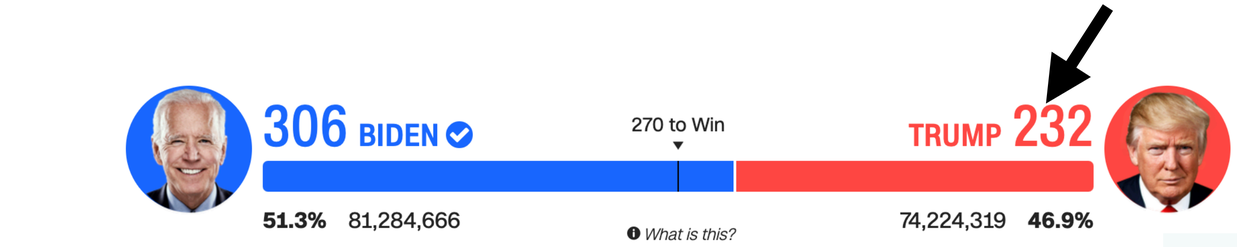


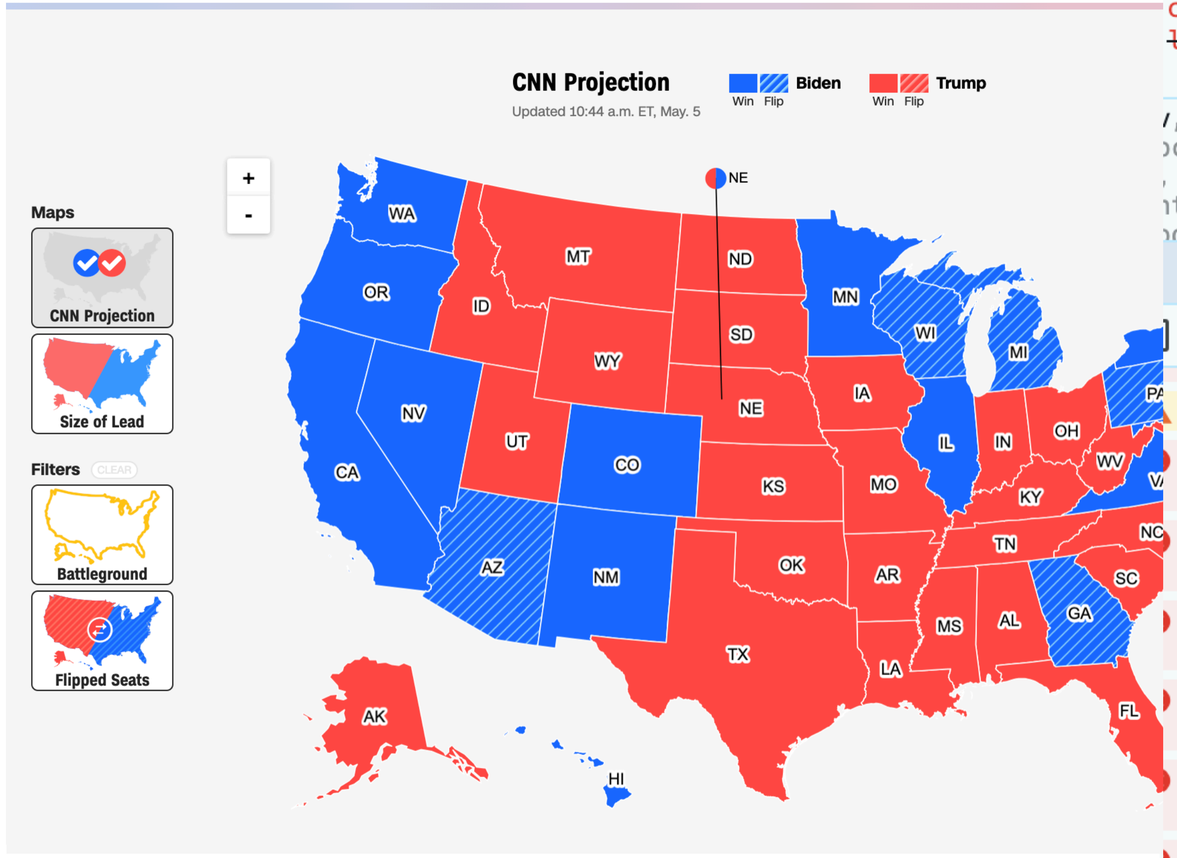
Perhaps test a darker blue too?

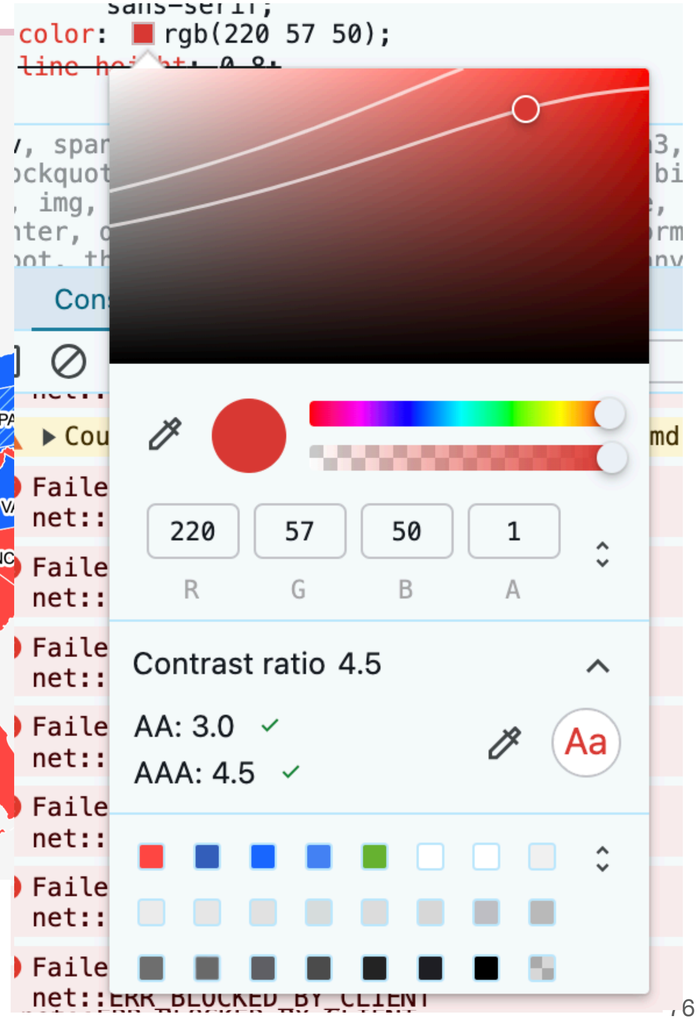




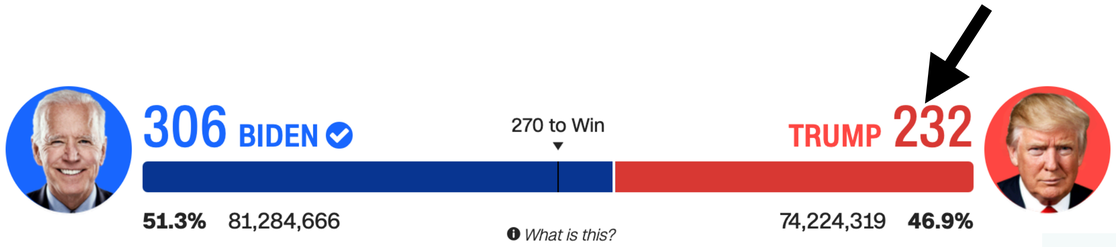
What if we fix the contrast failures at the same time?

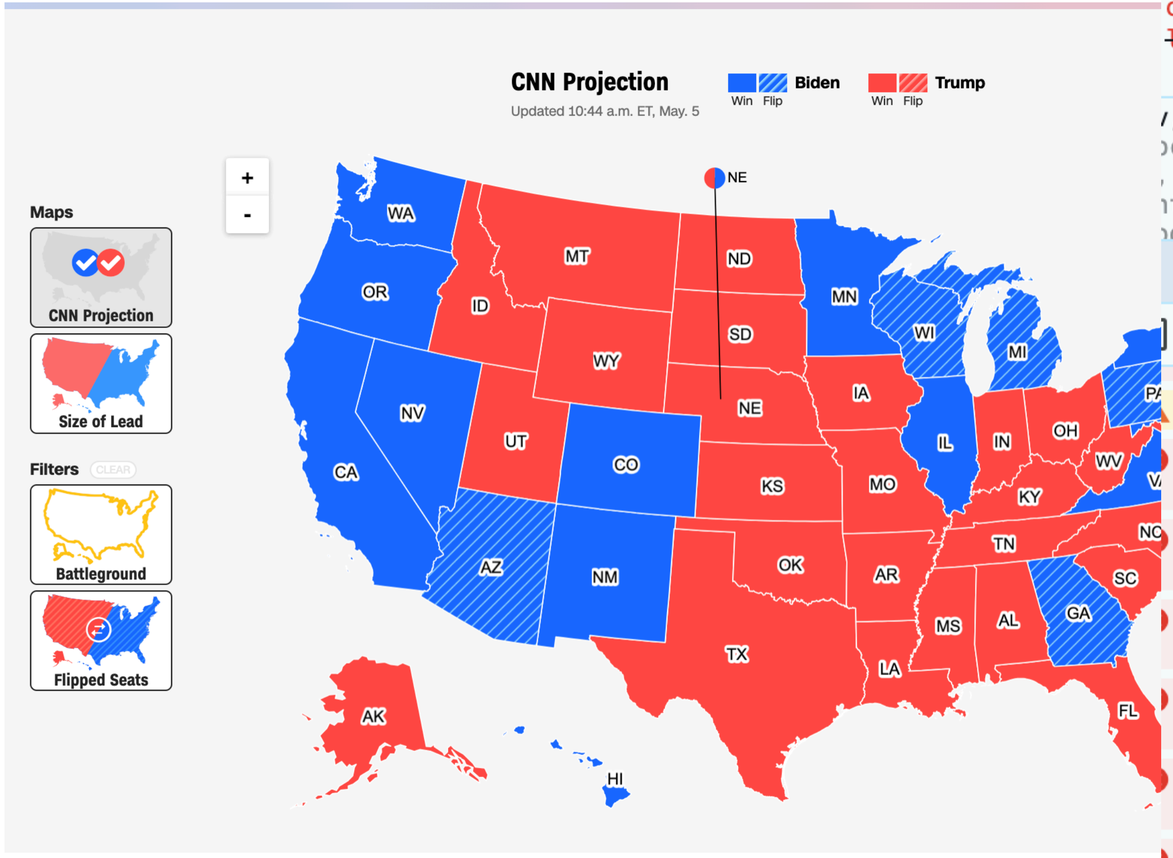


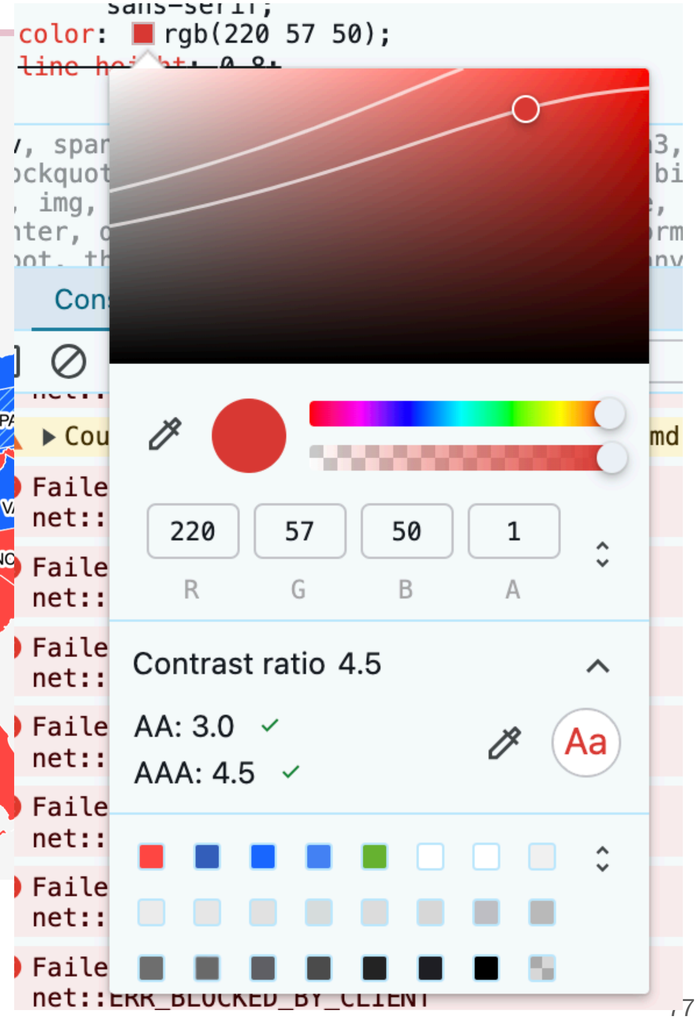




This text now passes!

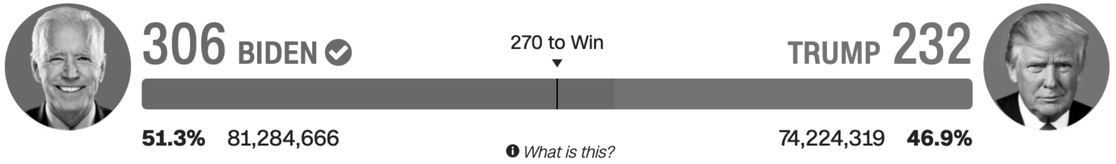


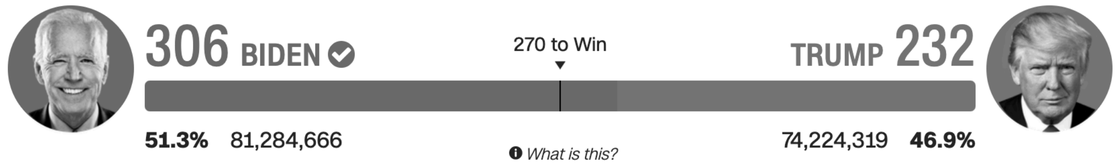




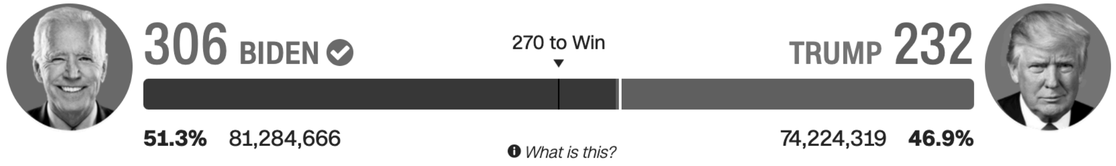
Let’s check that greyscale again…

Before

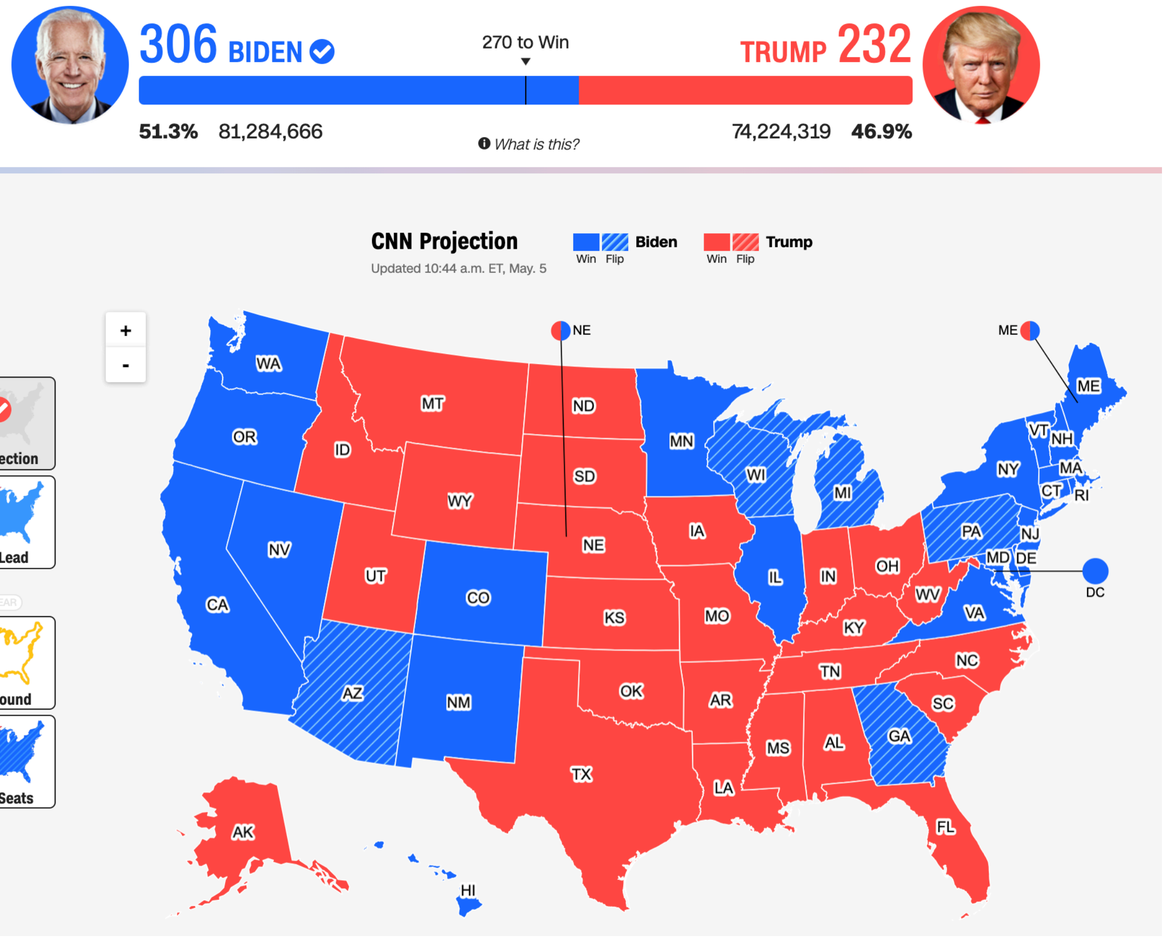

306 BIDEN
270 to Win
TRUMP 232
51.3% 81,284,666
What is this?
74,224,319 46.9%

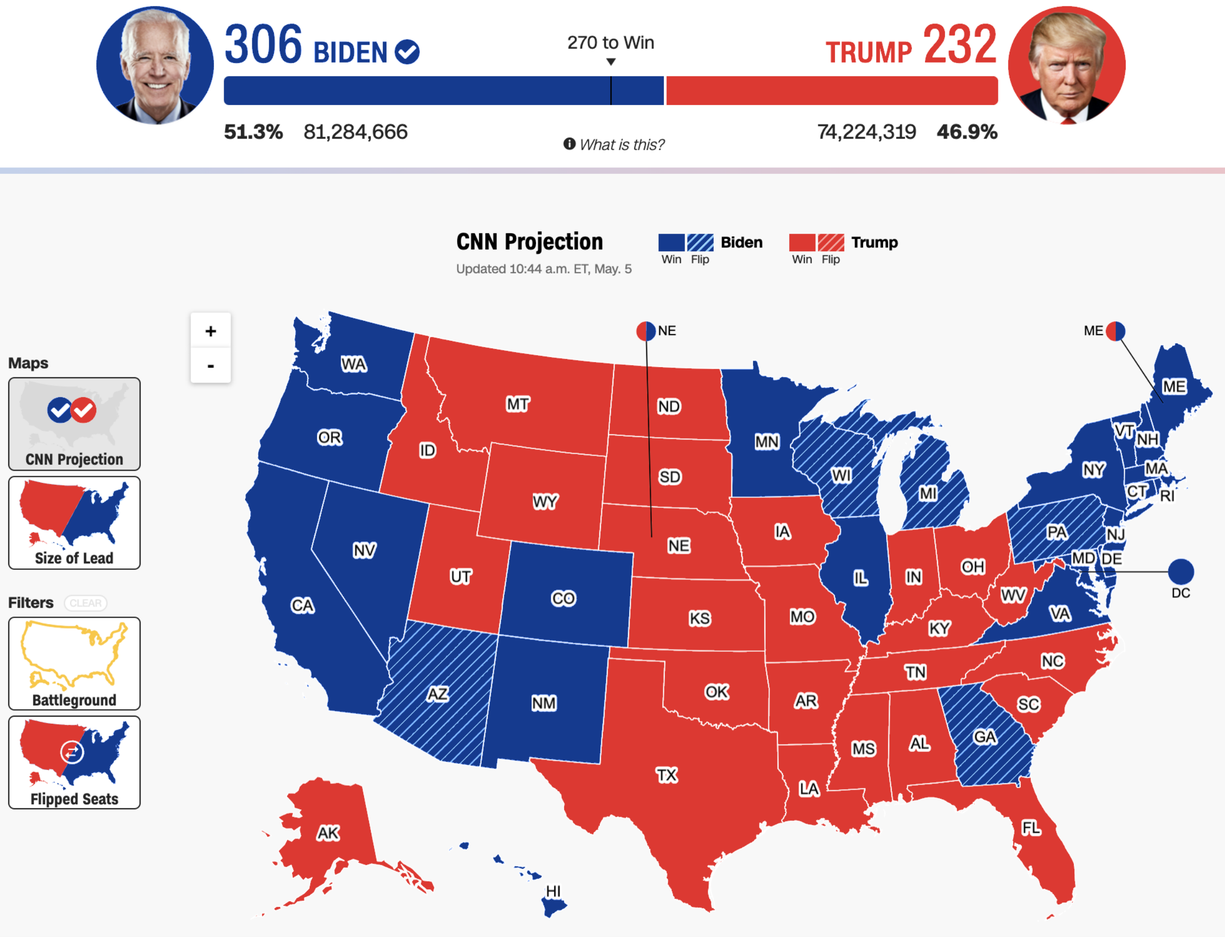

306 BIDEN
270 to Win
TRUMP 232
51.3% 81,284,666
What is this?
74,224,319 46.9%

And after!


306 BIDEN
270 to Win
TRUMP 232
51.3% 81,284,666
What is this?
74,224,319 46.9%

Sufficient contrast can help folks differentiate



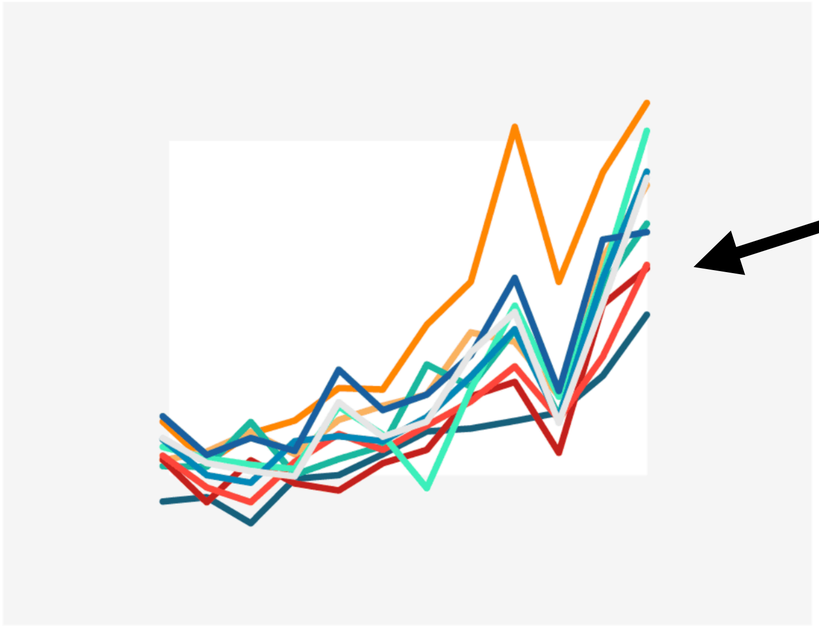


But what about more than 2 colors?

NOT IDEAL

Source: Datawrapper

But what about more than 2 colors?



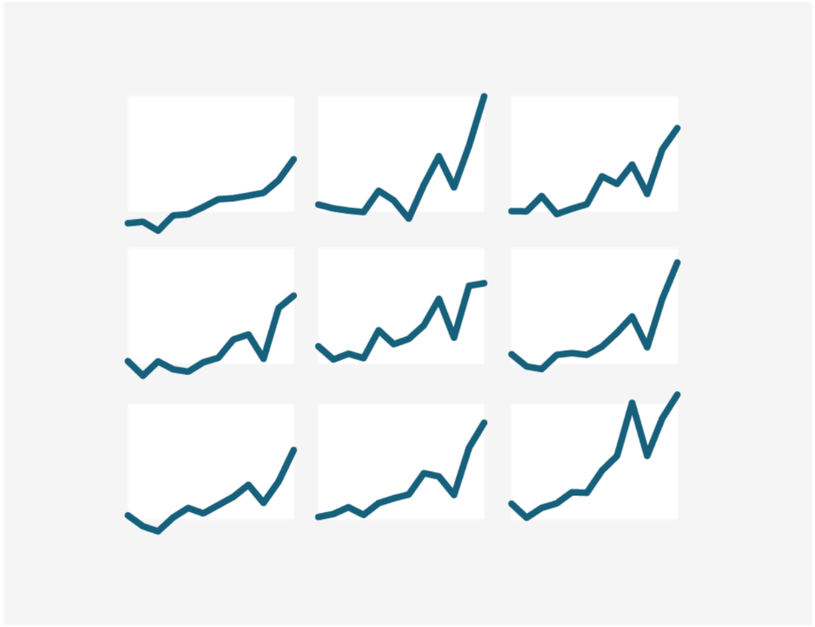
NOT IDEAL

Finding “pair” contrast gets really hard after 3+ colors…

Source: Datawrapper

Reduce your colors and redesign!

NOT IDEAL



BETTER

Source: Datawrapper

Reduce your colors and redesign!

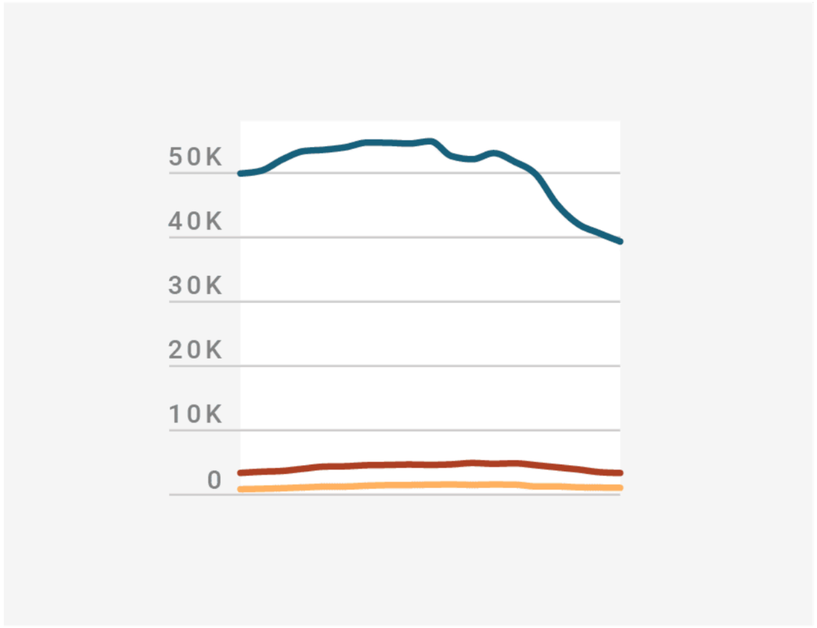
Using “small multiples” is an easy, powerful technique

NOT IDEAL

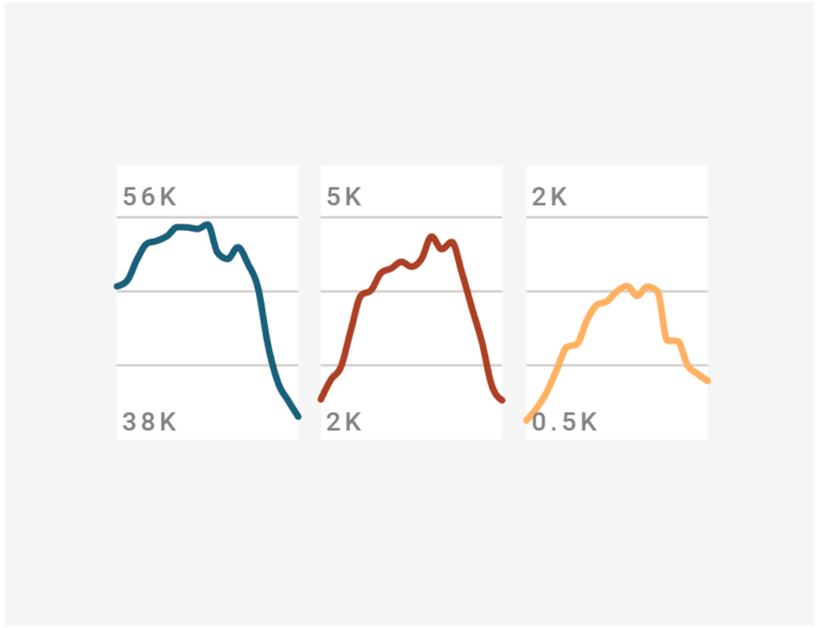
BETTER

Source: Datawrapper

Or simply separate your colors, if they matter



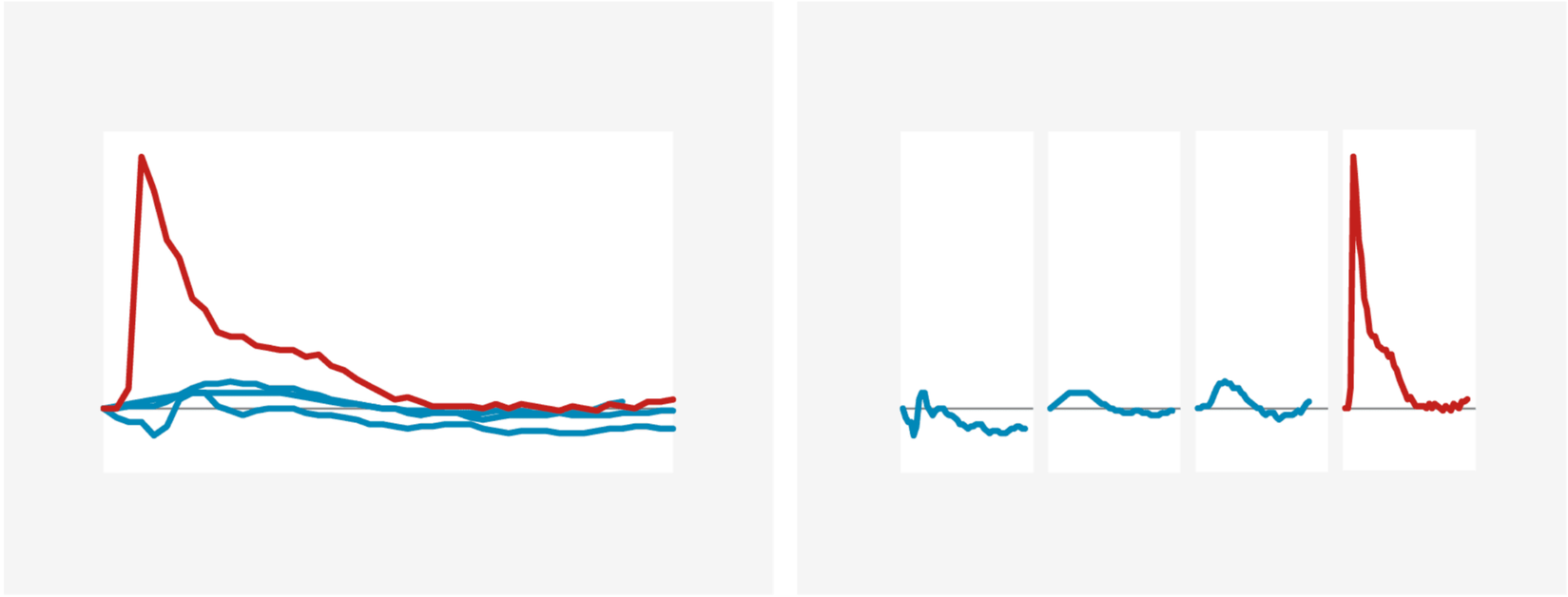
GOOD



ALSO GOOD

Source: Datawrapper

My favorite use of color is to pick just one for *emphasis*



GOOD BETTER

Source: Datawrapper

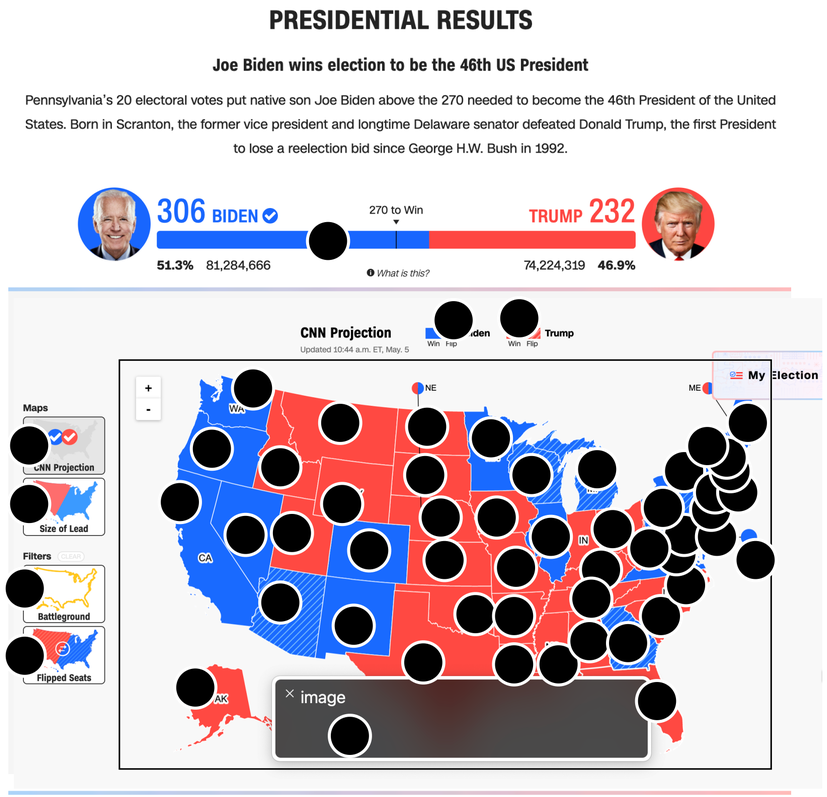
Add alt text

There is great research on alt text, but the most important thing to know is that you should add it to every image you post online (including twitter), in a document, or presentation.

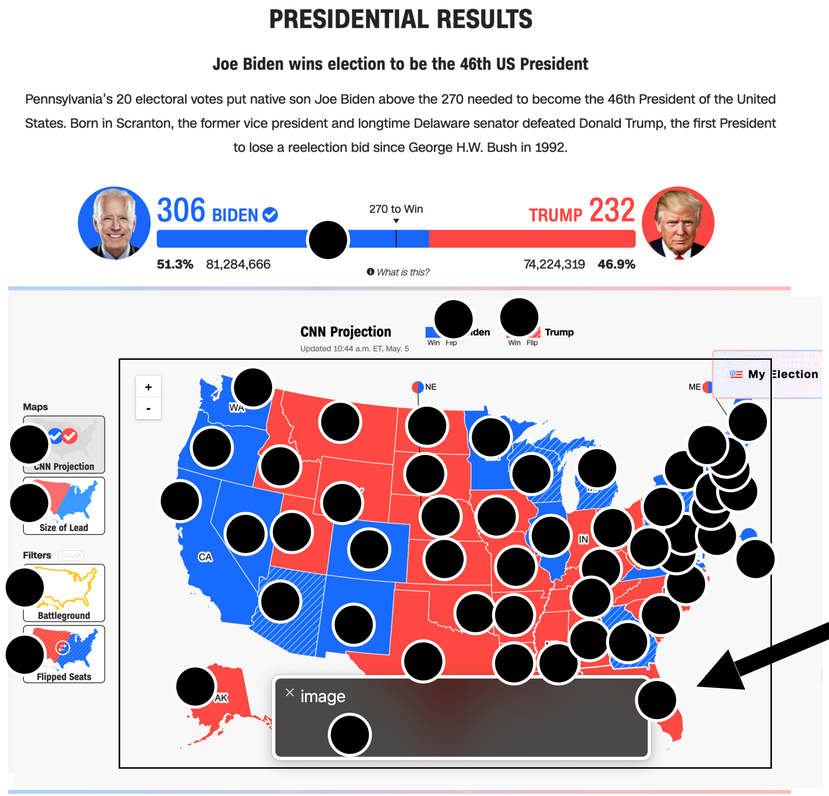
Guidance: https://medium.com/nightingale/writing-alt-text-for-data-visualization-2a218ef43f81

alt= “**Chart type** of **type of data** where **reason for including chart**”

Include a **link to data source** somewhere in the text



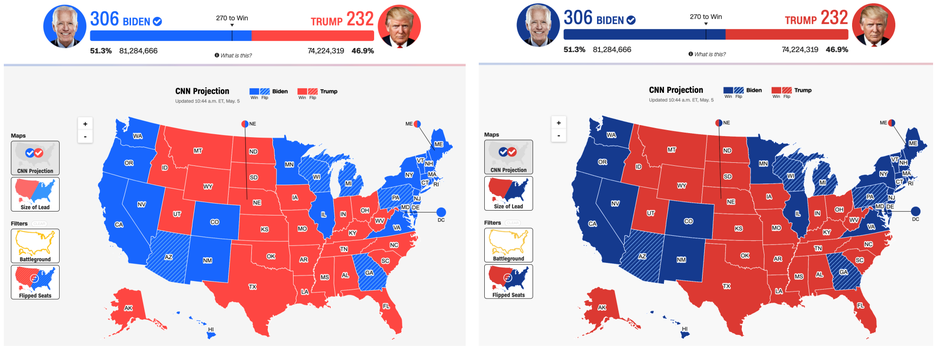
57 instances of “Content is only visual”



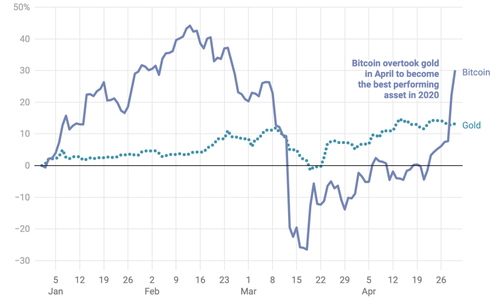
Each state should announce to screen readers what state it is and who won it, not "image!"

Recap: Perceivability

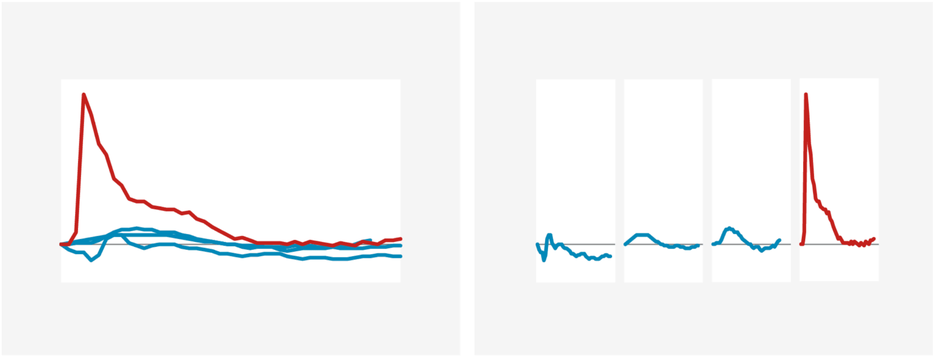
Use high contrast



Use redundant encoding



Reduce colors and crowding



Add alt text

alt= “**Chart type** of **type of data** where **reason for including chart**”

Include a **link to data source** somewhere in the text

Perceivable Evaluation Toolkit:

1. Contrast Checker
2. Safe color design
   a. CVD Checker
   b. Redundant encoding design ideas
   c. Small multiples design ideas
3. Alt Text

CLASS QUESTION

Question for Frank

Operable

Can someone operate this in multiple ways? Is each way easy?

Operable Checklist:

1. Mouse
2. Keyboard-only
3. Screen Reader

Many assistive input technologies “navigate”

A person in a wheelchair operating an old computer using a desk-mounted sip and puff device called the POSSUM.

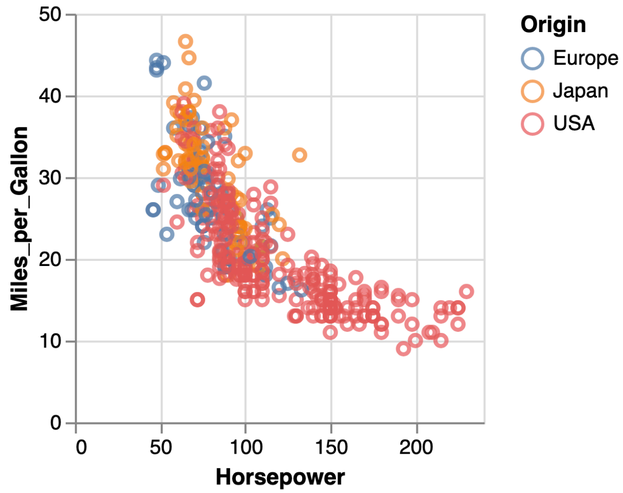
Image credit: Wikipedia, Public Domain, 1960. Photographer: Possum Ltd.

Why “keyboard-only?”

Some things work for screen readers but not for keyboard-only users!

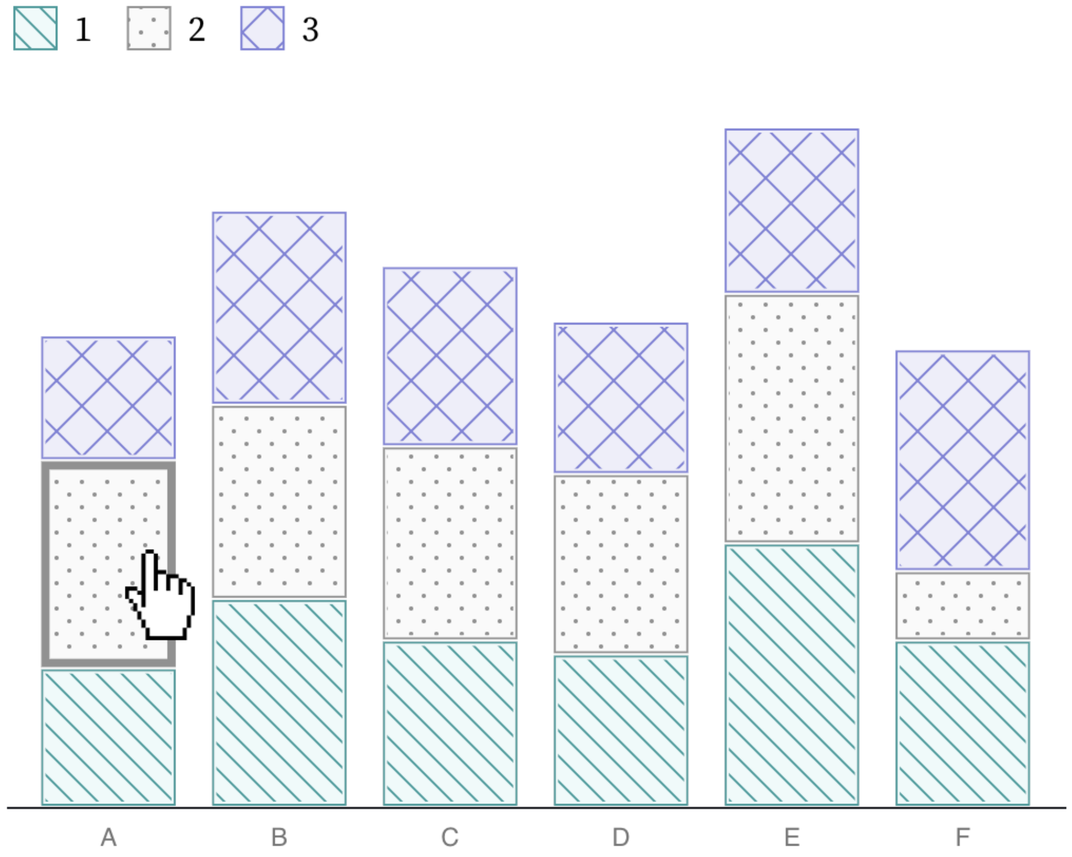
Scatterplot with External Links and Tooltips

A scatterplot showing horsepower and miles per gallons that opens a Google search for the car that you click on.



https://vega.github.io/vega-lite/examples/point_href.html

Ensure Keyboard Access (if interactive)



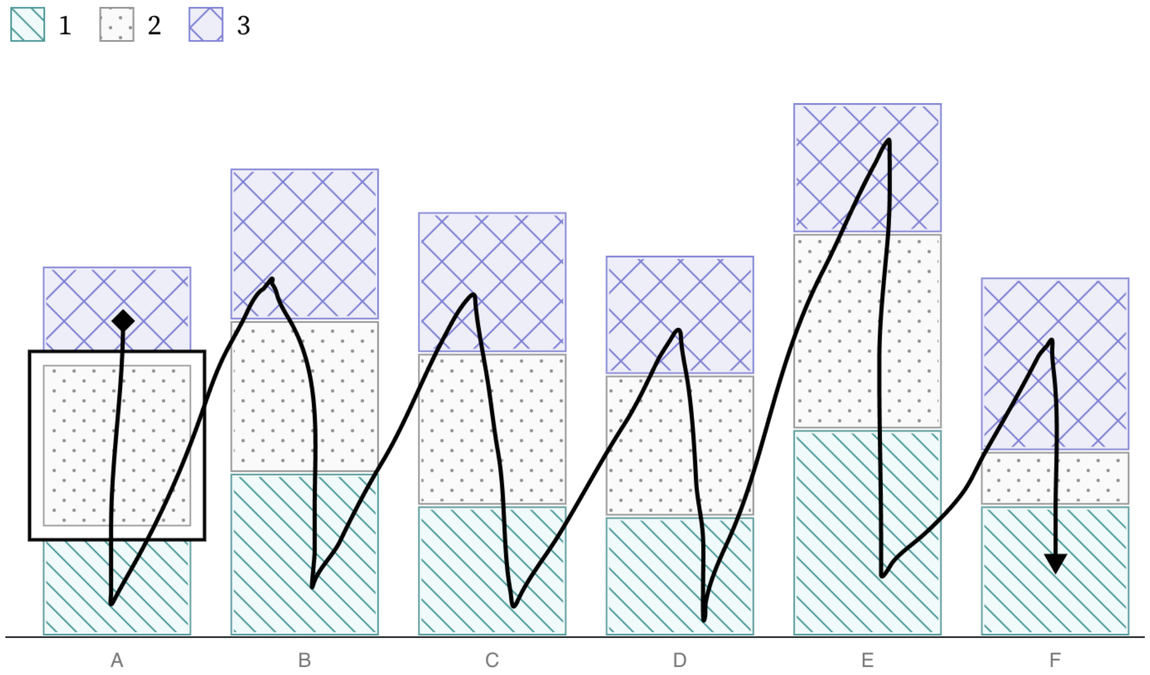
> **Status**: **Category 2** of **Building A** has been selected.

Products In Building A that belong to Category 2*

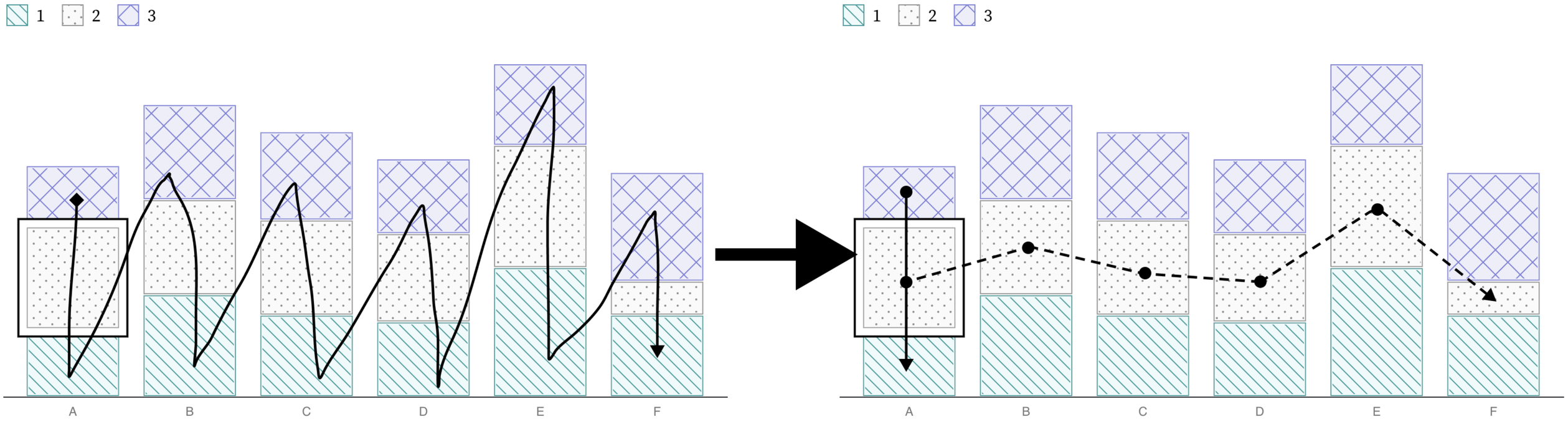
Product Name	Count in Stock
Product A	147
Product C	88
Product M	69

**This table has been populated by the selection in the preceding chart.*

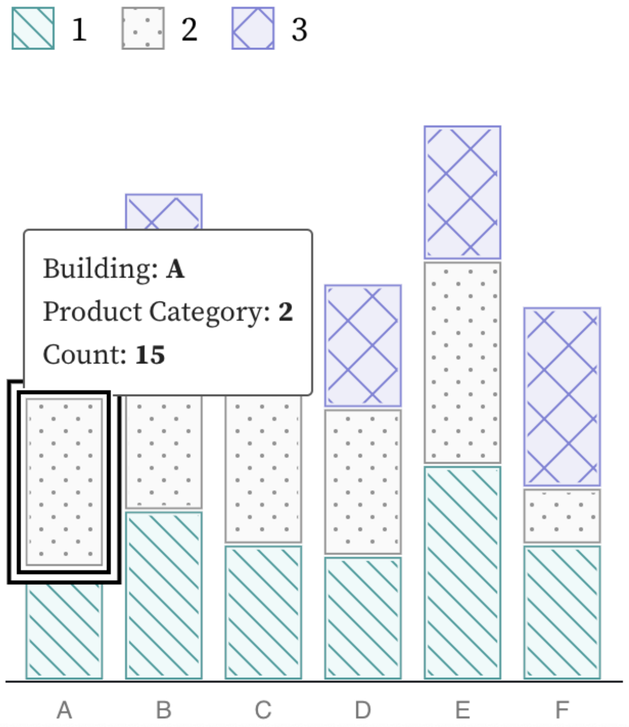
How does someone move around? By default, it is as elements are rendered:



Consider more flexible movement when data *exploration* matters

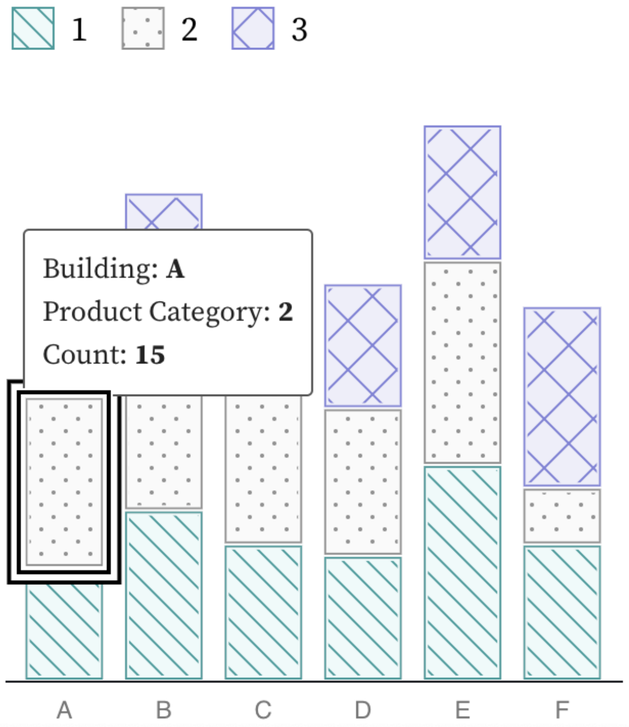


Alt text should communicate operability



Building A. Product Category 2. Count 15. Bar 2 of 3. Image.

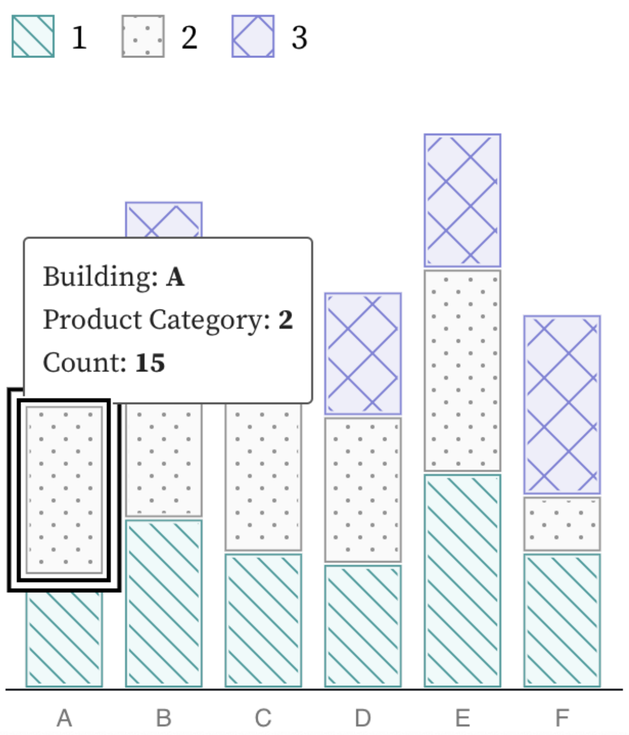
Semantics matter



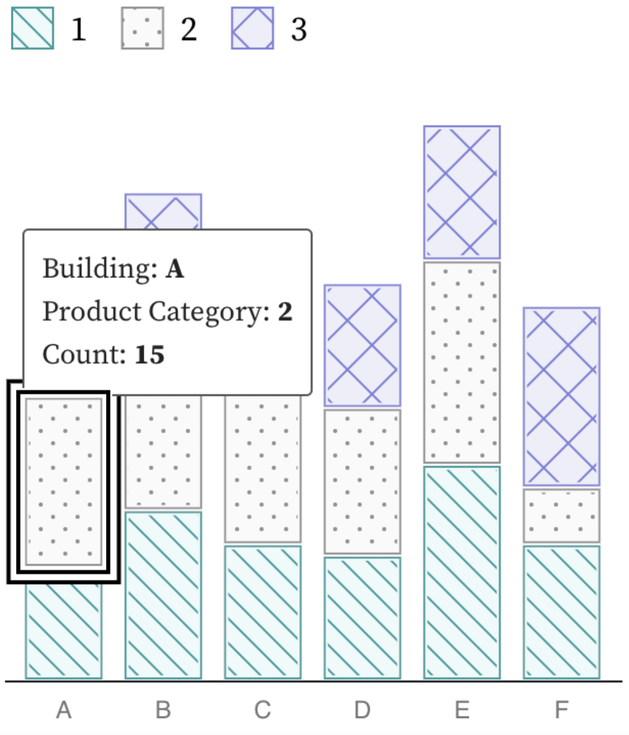
Building A. Product Category 2. Count 15. Bar 2 of 3. Image.

“Image” doesn’t signal interactivity!

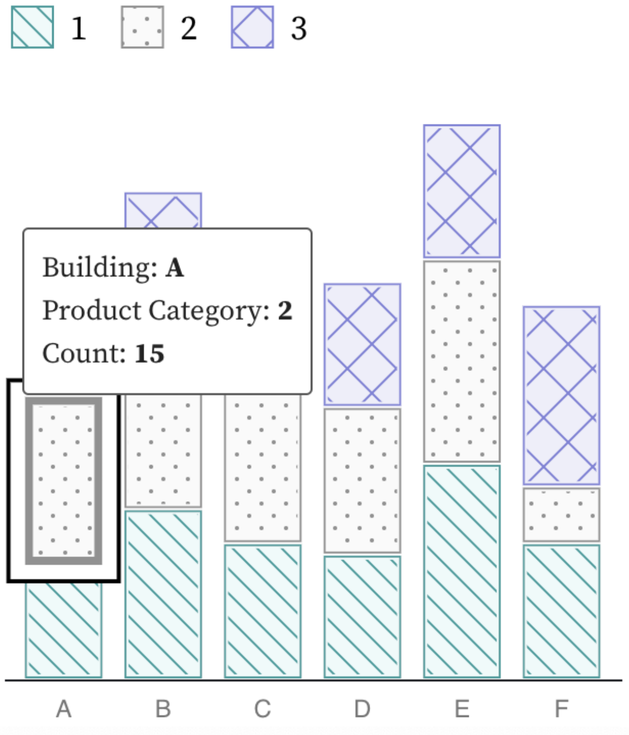
“Aria” states and roles are standardized



× Building A. Product Category 2. Count 15. Bar 2 of 3. Image.



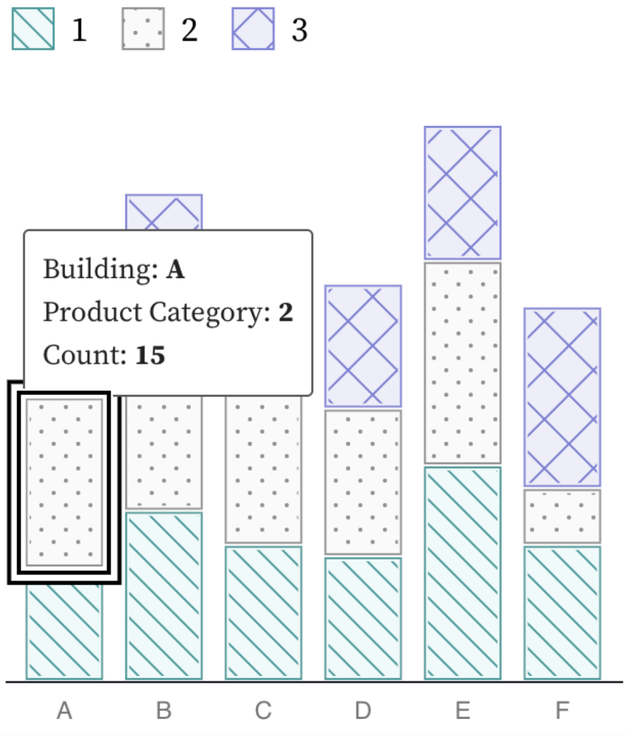
× Building A. Product Category 2. Count 15. Bar 2 of 3., toggle button



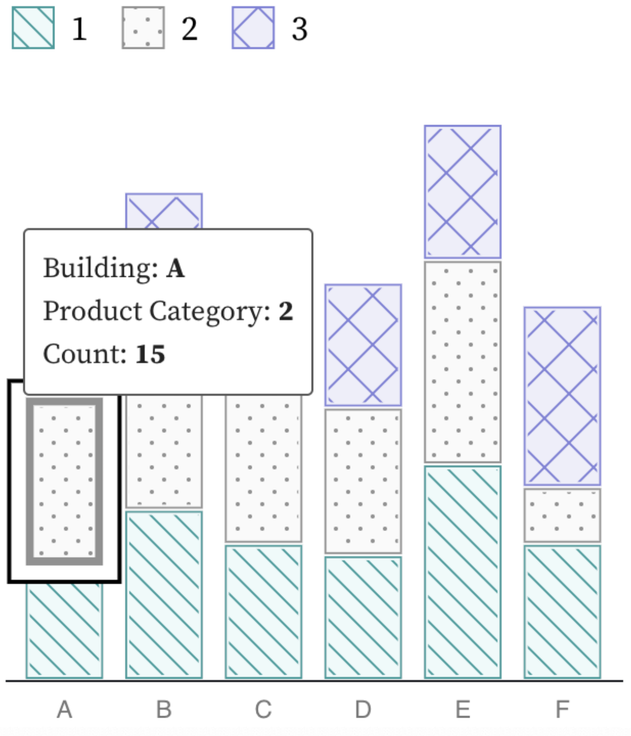
× selected, Building A. Product Category 2. Count 15. Bar 2 of 3., toggle button

Communicating operability should be visual too

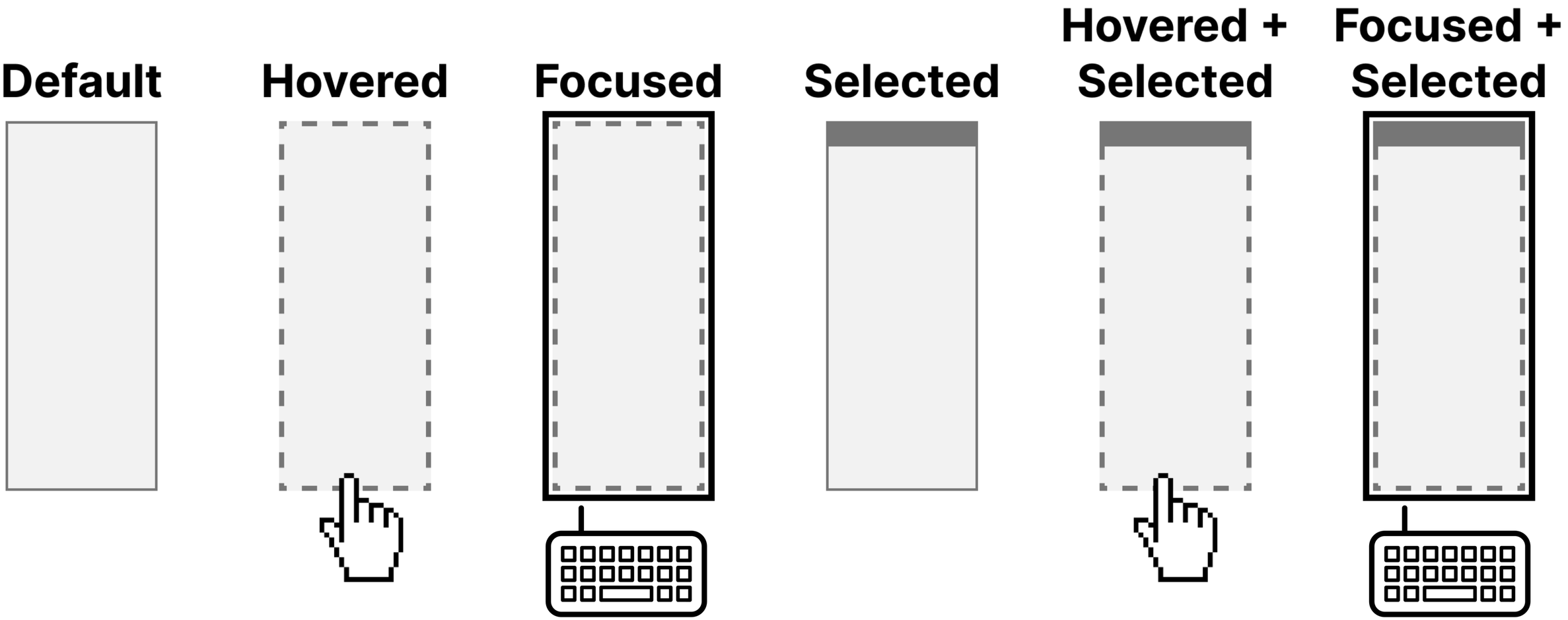
Hovered/focused

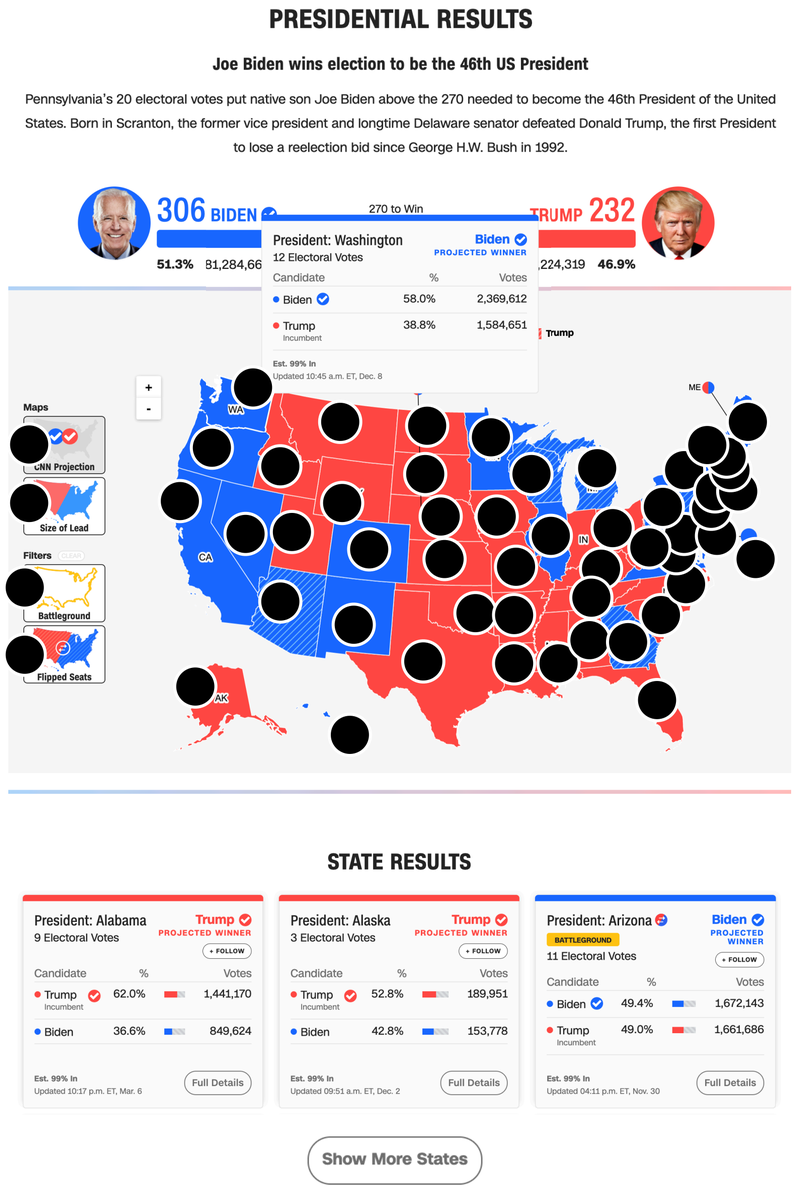


Selected



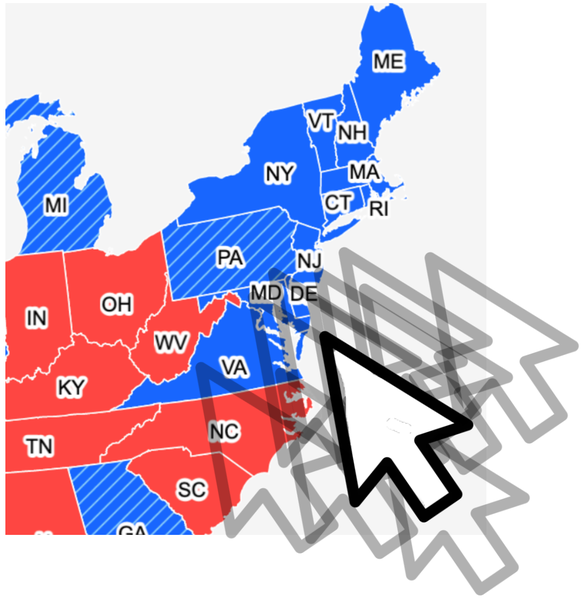
Design your own interaction styling

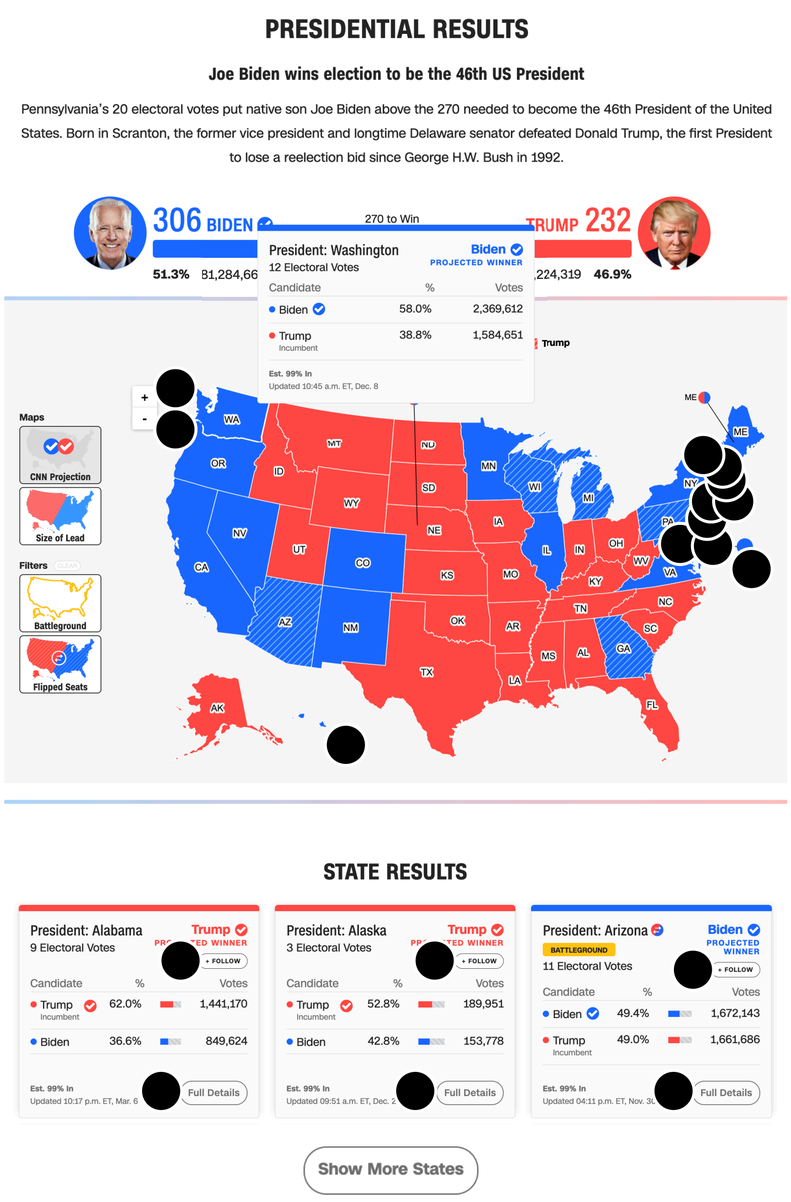




54 instances of “only one input type”

Expecting users to hover on something tiny is an accessibility design failure

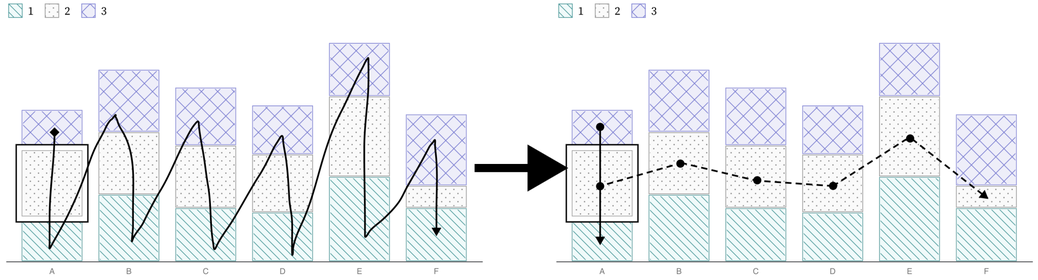




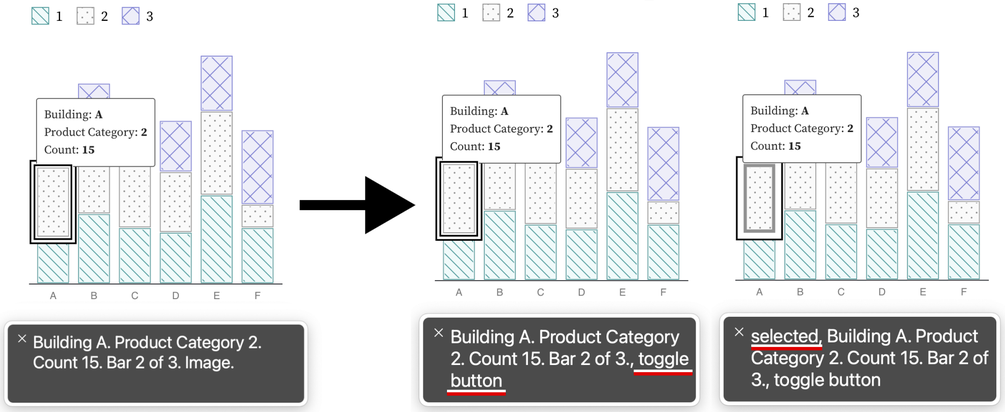
18 instances of “target pointer size is too small”

Recap: Operability

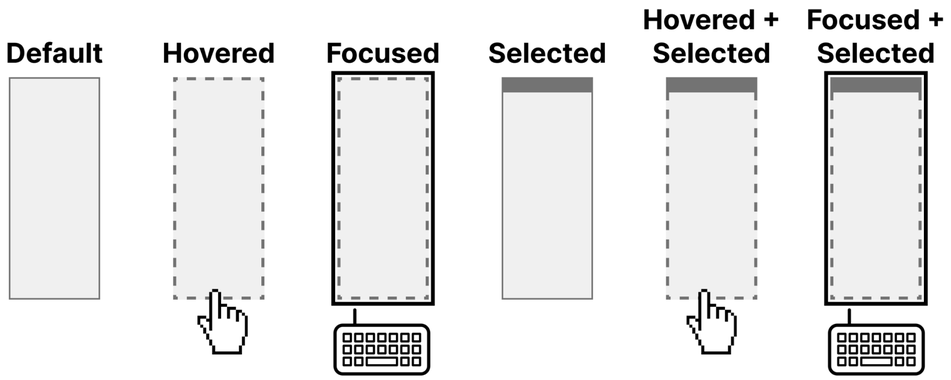
Consider how someone navigates



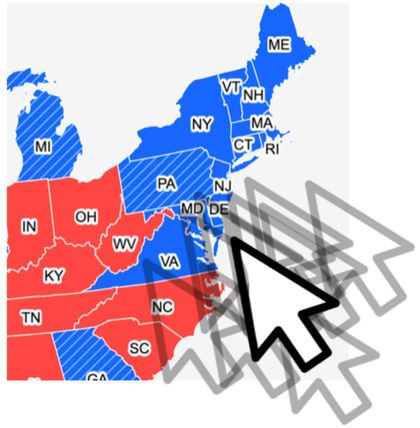
Describe the functionality of elements



Communicate interaction state visually



Improve the size of interaction areas



Operable Evaluation Toolkit:

1. **Use your mouse**: can it do something meaningful? (tooltip, click event, etc) If so:
   a. Test using a **keyboard-only**: can you navigate *and* use keyboard activation (spacebar/enter) on the visualization?
   b. Test using a **screen reader**: Can you use a screen reader to navigate and use keyboard activation on the visualization?
2. **Check sizes:** can a mouse *easily* interact with this?

CLASS QUESTION

Question for Frank

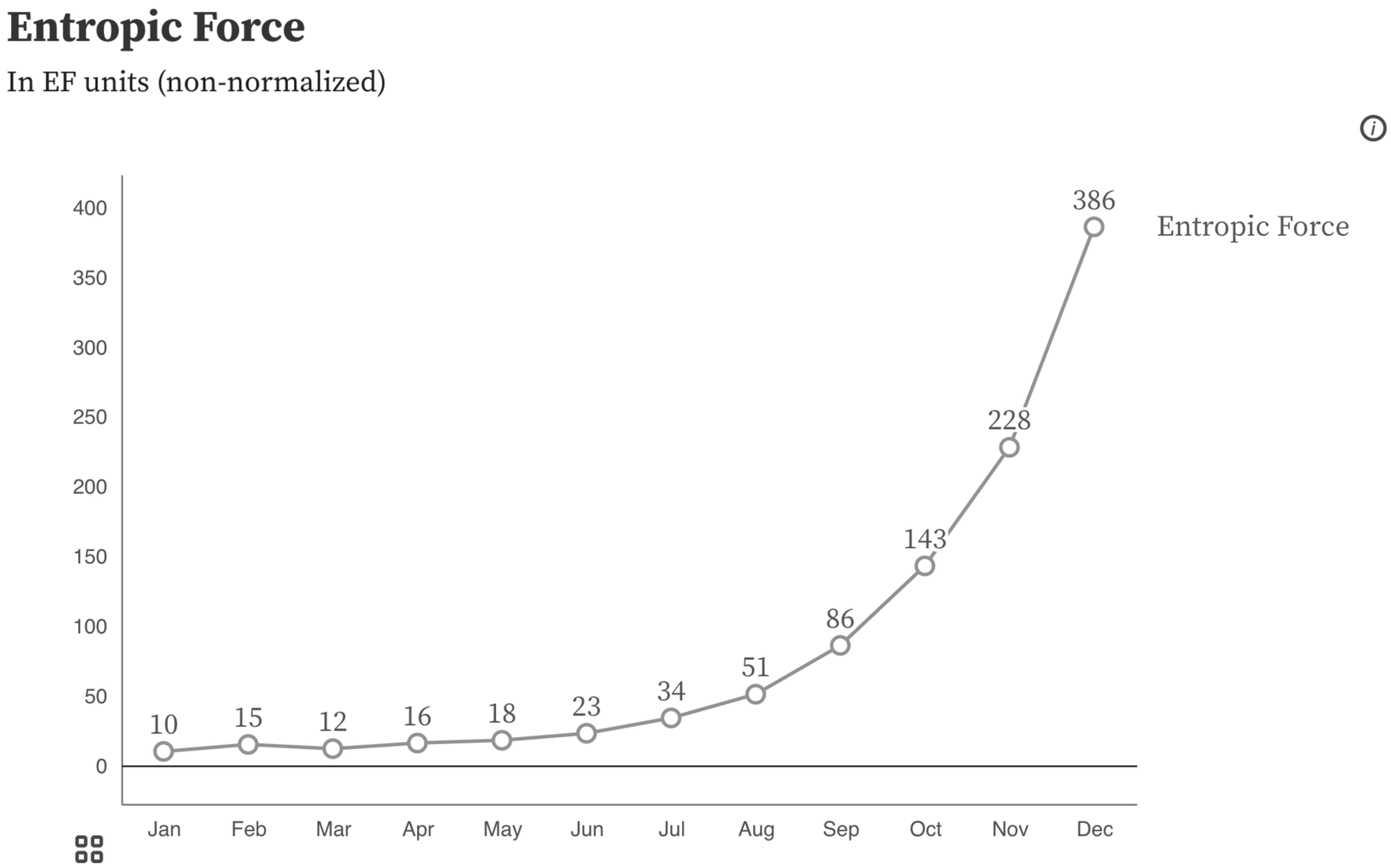
Understandable

Can someone understand this in multiple ways? Is each way easy?

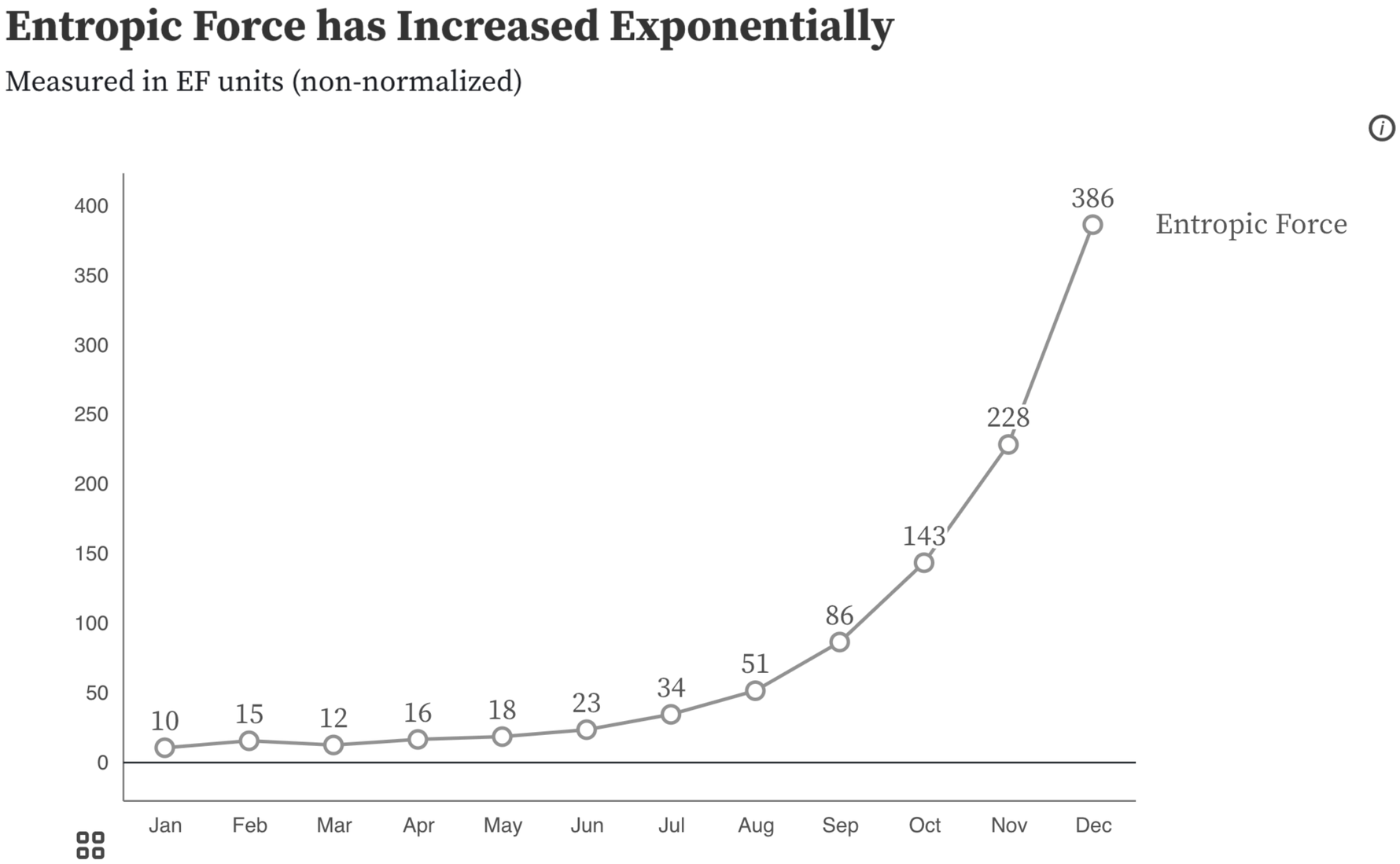
Understandable Checklist:

1. Descriptive title, summary, or caption
2. Data table or data download
3. Reading level

Non-descriptive titles are inaccessible



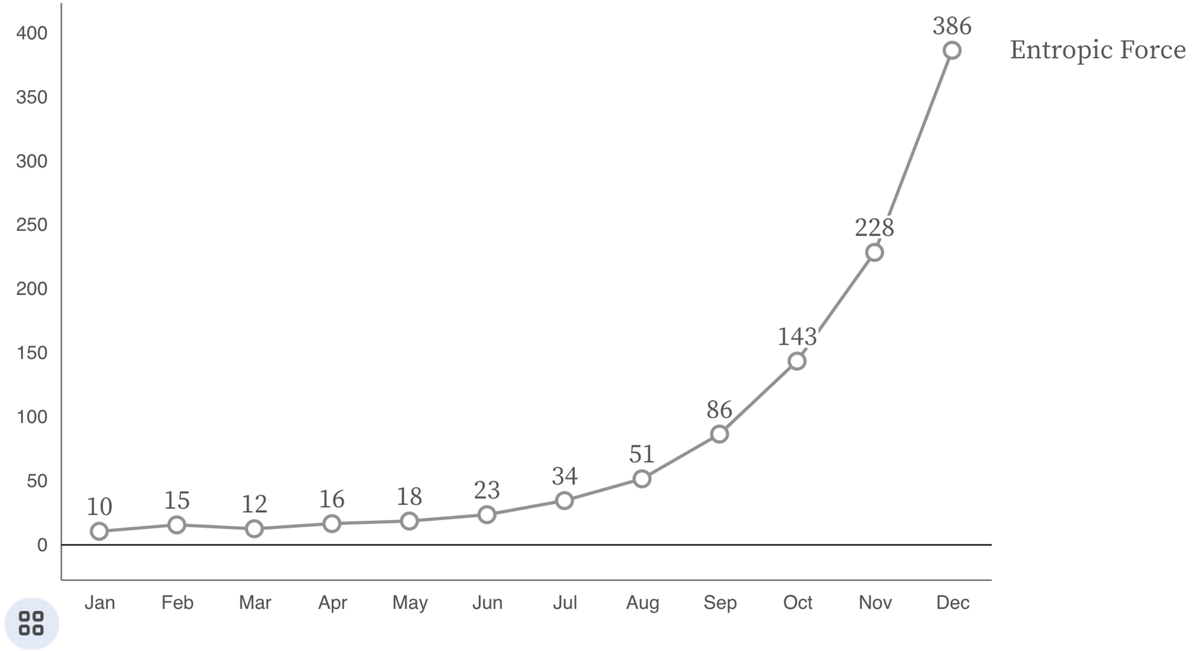
Descriptive titles have summaries/takeaways

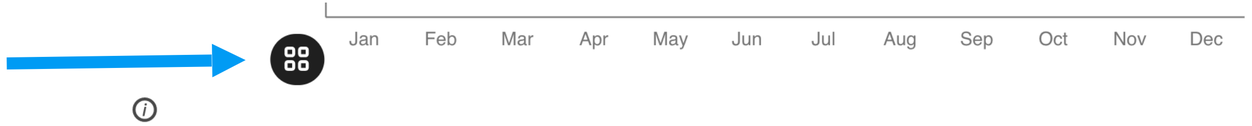


All charts should have data available!

Entropic Force has Increased Exponentially

Measured in EF units (non-normalized)





Line	Date	Value	Note
Entropic Force	Jan	10	Lowest Value
Entropic Force	Feb	15	
Entropic Force	Mar	12	
Entropic Force	Apr	16	
Entropic Force	May	18	
Entropic Force	Jun	23	
Entropic Force	Jul	34	
Entropic Force	Aug	51	
Entropic Force	Sep	86	
Entropic Force	Oct	143	
Entropic Force	Nov	228	
Entropic Force	Dec	386	Highest Value

Technical language is often overkill

Measured in EF units (non-normalized). EF units are valuable for catching egregious over-simulation in models that use randomized data decimation techniques. This particular evaluation findings demonstrate that the randomization models are significantly over-producing entropy in our latest force simulations.

Hemingway Editor

Readability

Post-graduate

Poor. Aim for 14.

Words: **39**

Show More

1 adverb. Aim for 0 or fewer.

0 uses of passive voice. Nice work.

1 phrase has a simpler alternative.

0 of 3 sentences are hard to read.

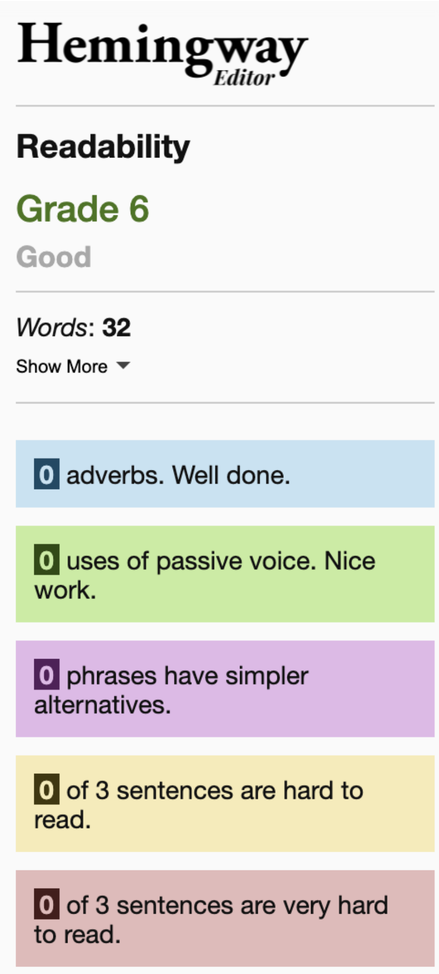
2 of 3 sentences are very hard to read.

Keep summaries as non-technical as possible

If the topic is technical, provide a “plain language” summary somewhere close by that is easy to find (either in the same location or with by providing a link).

Measured in EF units (non-normalized). EF units are valuable for catching egregious over-simulation in models that use randomized data decimation techniques. This particular evaluation findings demonstrate that the randomization models are significantly over-producing entropy in our latest force simulations.

Measured in EF units (non-normalized). These units are helpful for catching bad data loss when we remove our data at random. We are producing too much entropic force in our latest models.



Recap: Understandability

Use concise, descriptive titles

Entropic Force

In EF units (non-normalized)

→

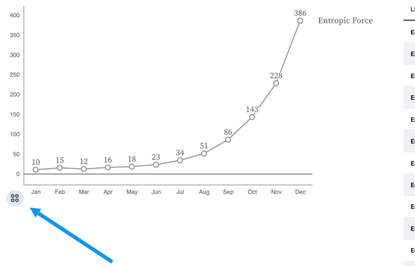
Entropic Force has Increased Exponentially

Measured in EF units (non-normalized)

Add easy-to-access data or tables

Entropic Force has Increased Exponentially

Measured in EF units (non-normalized)



Line	Date	Value	Note
Entropic Force	Jan	10	Lowest Value
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Entropic Force	Mar	12	
Entropic Force	Apr	16	
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Entropic Force	Jun	23	
Entropic Force	Jul	34	
Entropic Force	Aug	51	
Entropic Force	Sep	86	
Entropic Force	Oct	143	
Entropic Force	Nov	228	
Entropic Force	Dec	386	Highest Value

Simplify your language

Measured in EF units (non-normalized). EF units are valuable for catching egregious over-simulation in models that use randomized data decimation techniques. This particular evaluation findings demonstrate that the randomization models are significantly over-producing entropy in our latest force simulations.

Hemingway Editor

Readability

Post-graduate

Poor. Aim for 14.

Words: **39**

Show More

1 adverb. Aim for 0 or fewer.

0 uses of passive voice. Nice work.

1 phrase has a simpler alternative.

0 of 3 sentences are hard to read.

2 of 3 sentences are very hard to read.

Measured in EF units (non-normalized). These units are helpful for catching bad data loss when we remove our data at random. We are producing too much entropic force in our latest models.

Hemingway Editor

Readability

Grade 6

Good

Words: **32**

Show More

0 adverbs. Well done.

0 uses of passive voice. Nice work.

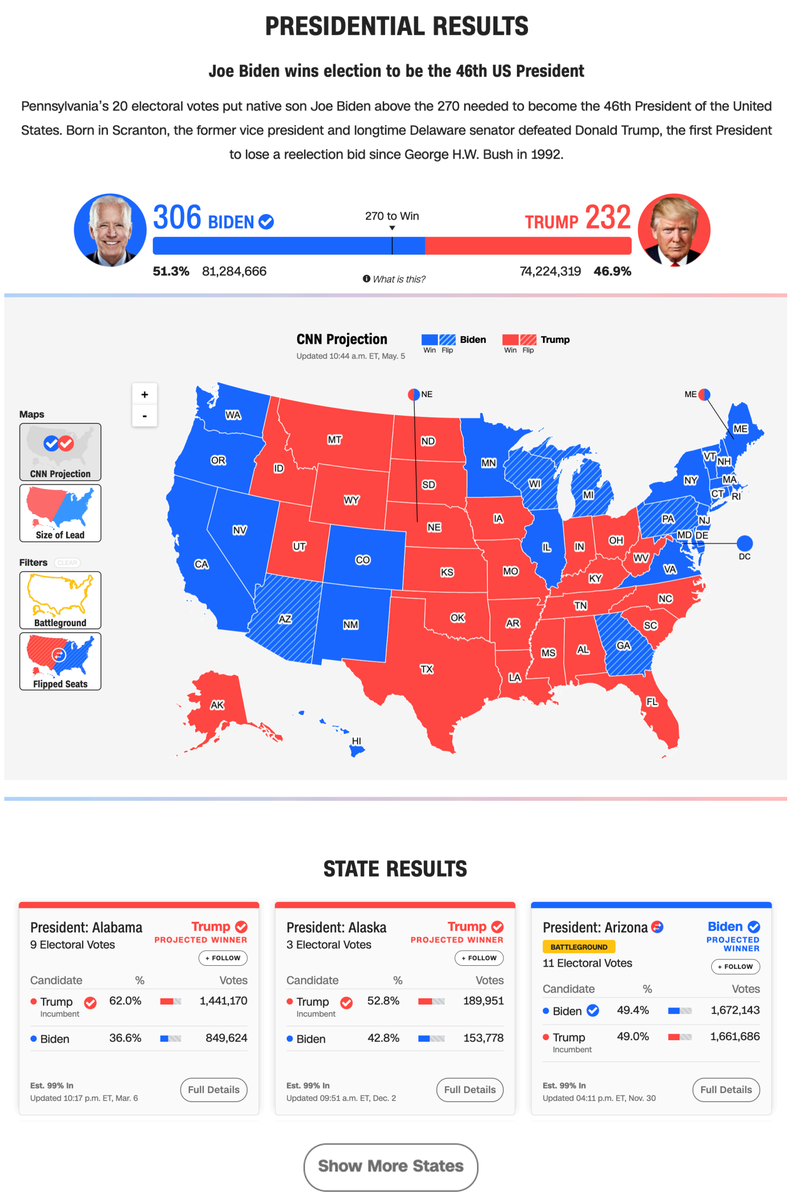
0 phrases have simpler alternatives.

0 of 3 sentences are hard to read.

0 of 3 sentences are very hard to read.

Understandable Evaluation Toolkit:

1. Is there a descriptive title, summary, or caption?
2. Is there an accessible table or downloadable data file provided?
3. Is the descriptive text supporting the visualization presented at a reading level at grade 9 or below?



Continue this for:

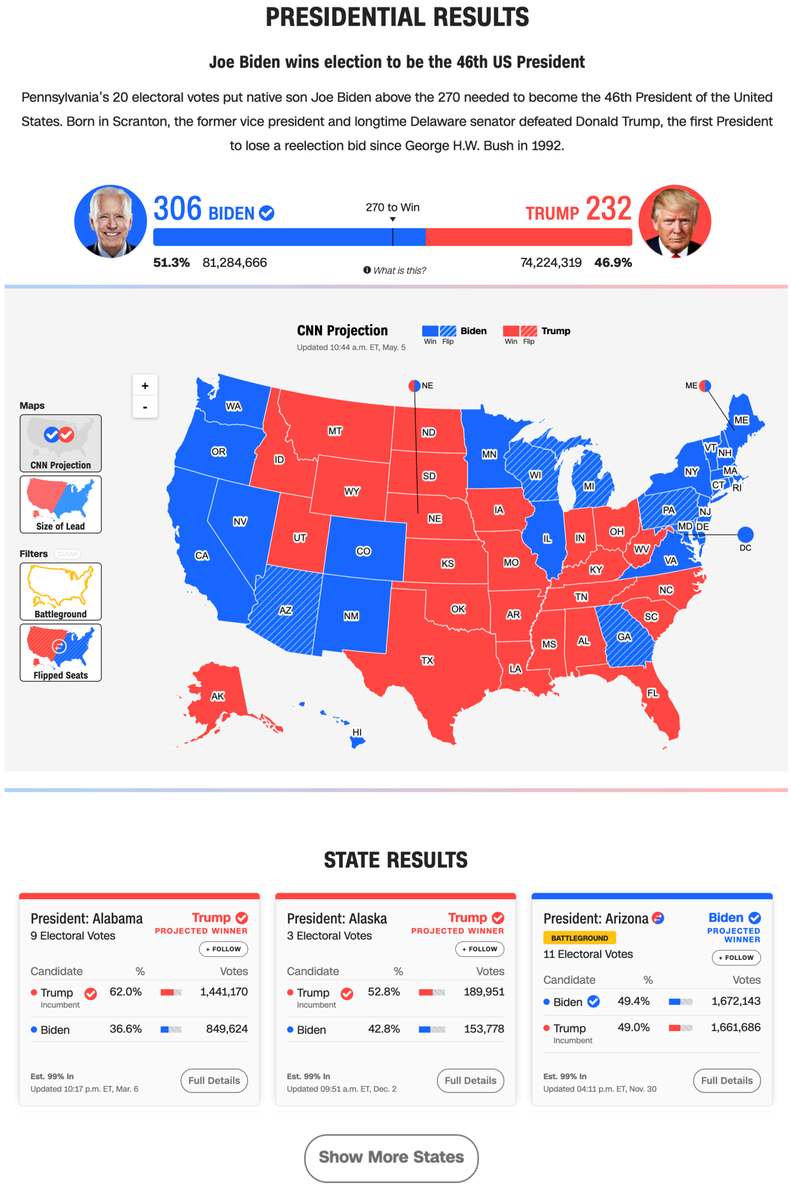
Robust,
Compromising,
Assistive,
and Flexible

978 access failures found in ~60 minutes.

Perceivable:
6 – Low contrast
57 - Content is only visual
50 - Color alone is used
3 - Meaningful elements can be distinguished

Operable:
54 - Interaction modality only has one input type
58 - No interaction cues or instructions
5 - Low contrast on interactive elements
4 - Keyboard focus indicator missing
4 - Complex actions have no alternative
18 - Target pointer interaction is too small

Understandable:
4 - Interactive context is not clear
6 - Metrics or variables are undefined



Robust:
275 - Does not conform to standards
82 - Semantically invalid
12 - Fragile technology support

Compromising:
54 - Information can only be reached through single process
61 - Information cannot be navigated according to narrative or structure

Assistive:
101 - Navigation and interaction is tedious

Flexible:
2 - User style change not respected
121 - User text adjustments are not respected
1 - Scrolling experiences cannot be adjusted or opted out of
Contrast and textures cannot be adjusted

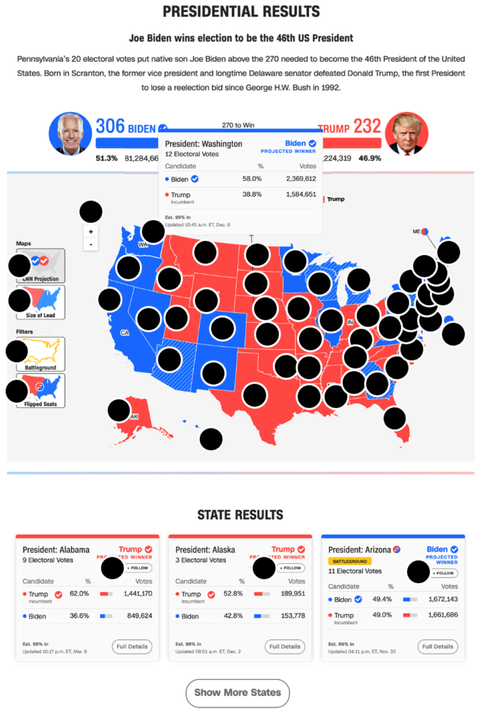
CLASS QUESTION

Question for Frank

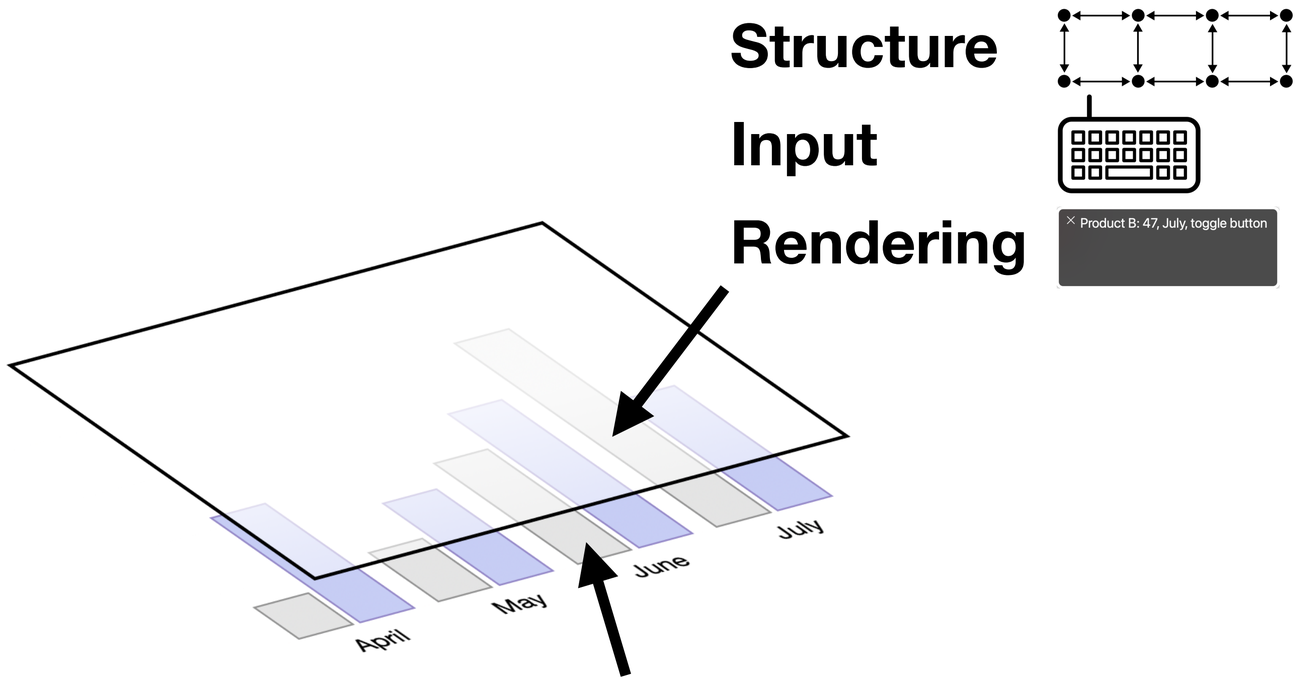
What and how of visualization accessibility

(My recent research)

Chartability:
What are accessibility barriers?



Data Navigator:
How do we build accessible visualizations?



To any visualization toolkit

Past problems:

Problem 1: **Do people who build stuff know what is or isn’t accessible?**

Problem 2: **What do we do with all these pixels?**

Why are pixels so much trouble?

Product AC is trending up, Product AB is tanking

Product AC initiated its launch with 12 clients and our internal marketing personnel cultivated 27 new acquisitions by the close of the calendar year. Product AB started with 42 clients and after a controversy in June, dropped to 4 by December.

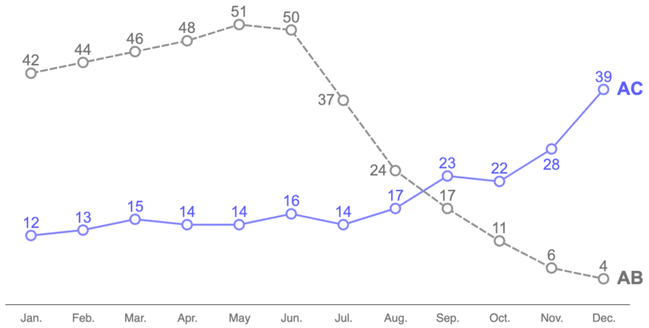
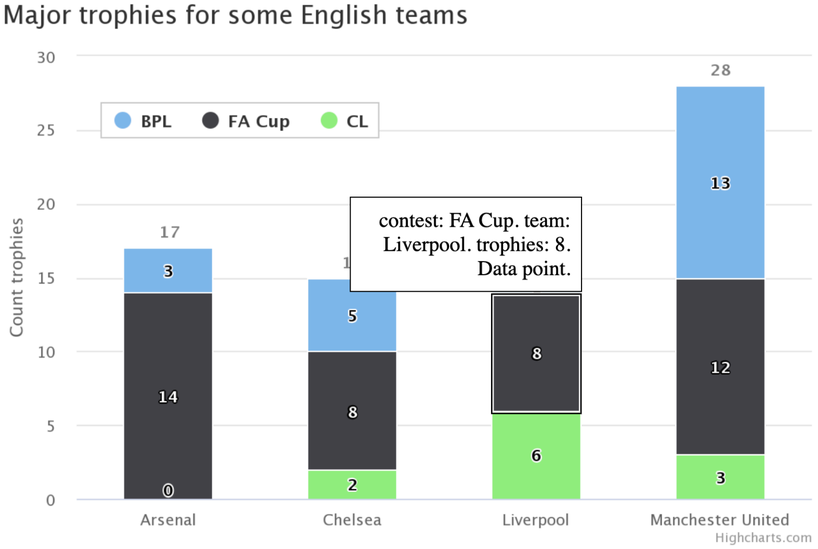


Figure 1: Last year's performance of Products AC and AB. Data is made possible by Sam Smith on the marketing data team.

First demo link

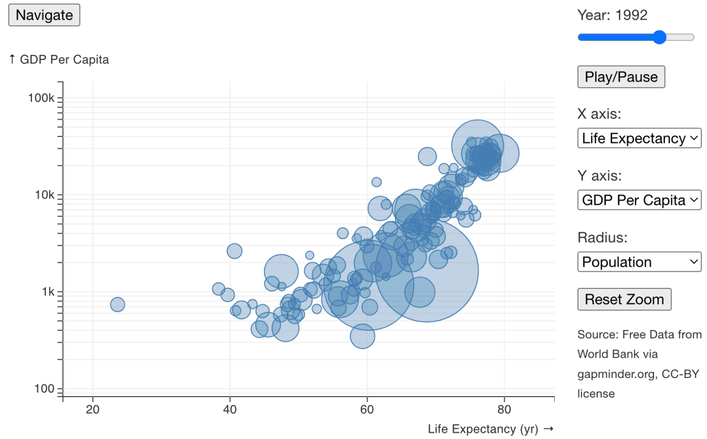
Enter navigation area



Second demo link

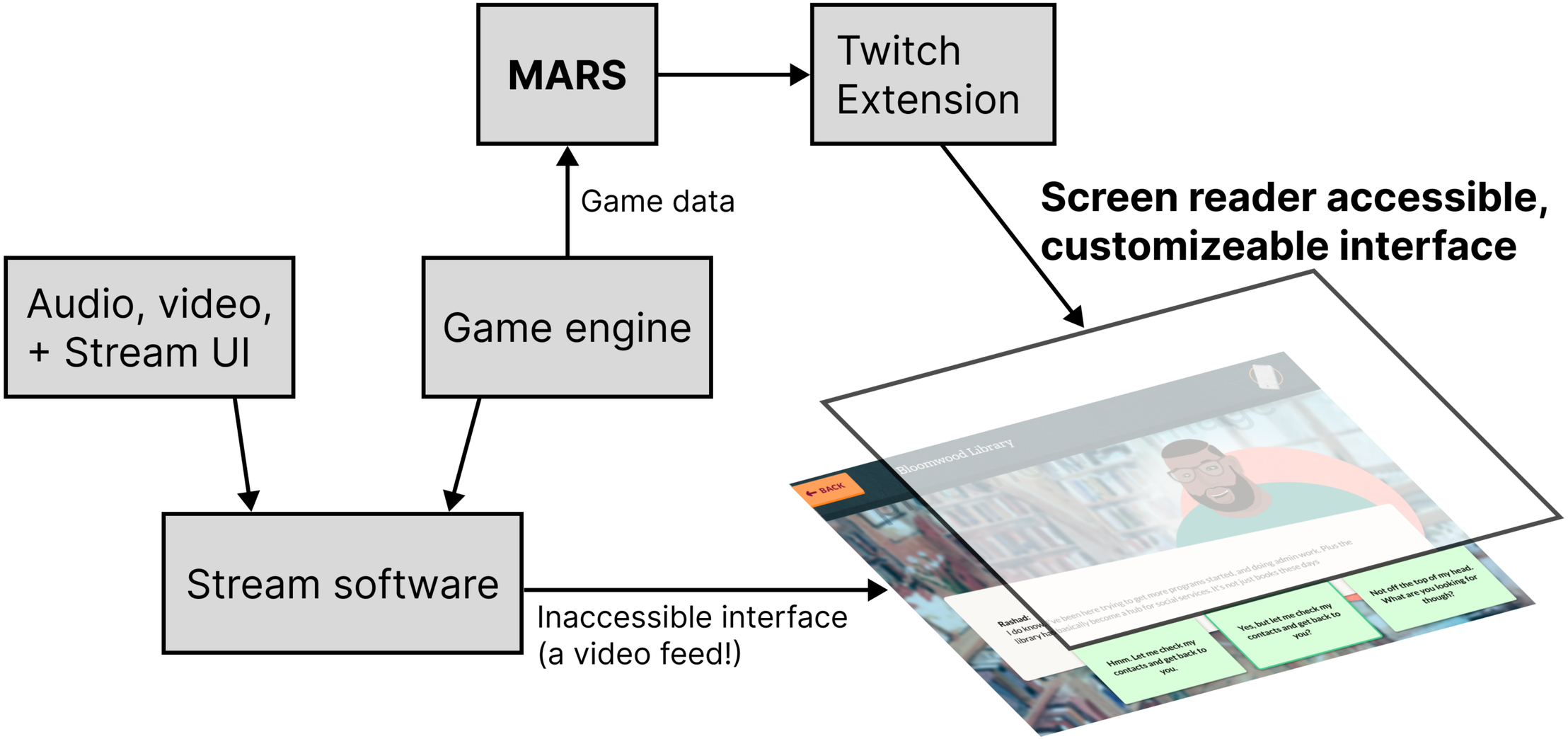
Example: Accessible Gapminder Chart

Below is a responsive, screen-reader-navigable version of the chart shown on the homepage. Press Navigate to enter keyboard navigation. Or, change your “prefers reduced motion” system setting to see fade animations instead of motion.

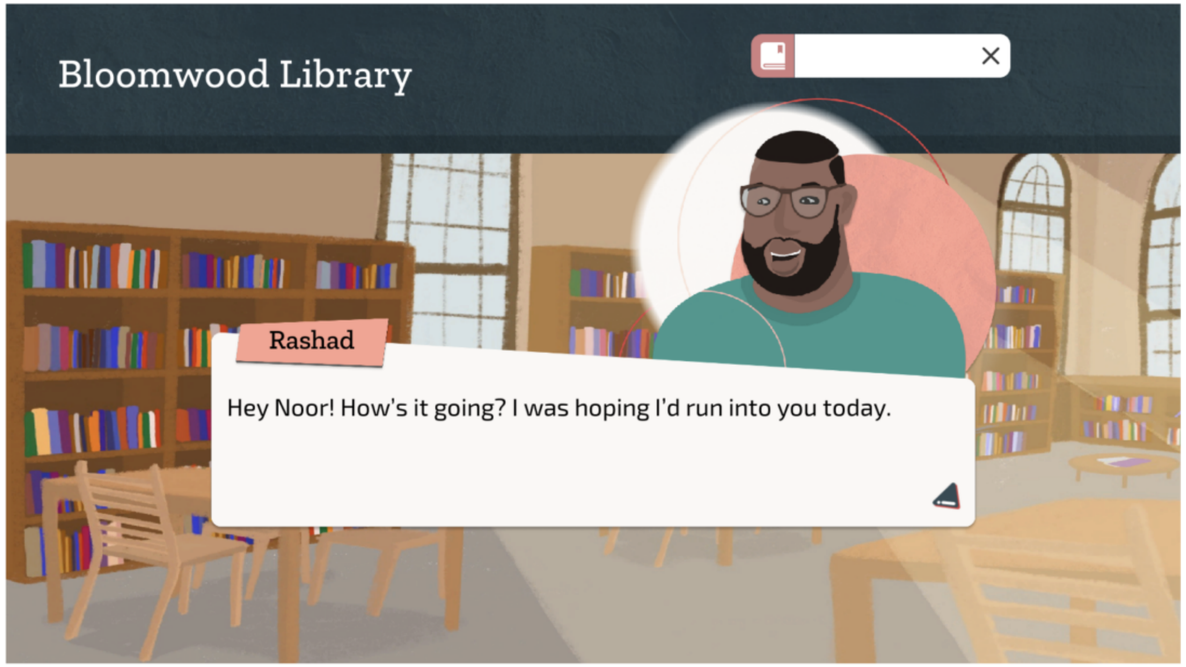


Third demo link

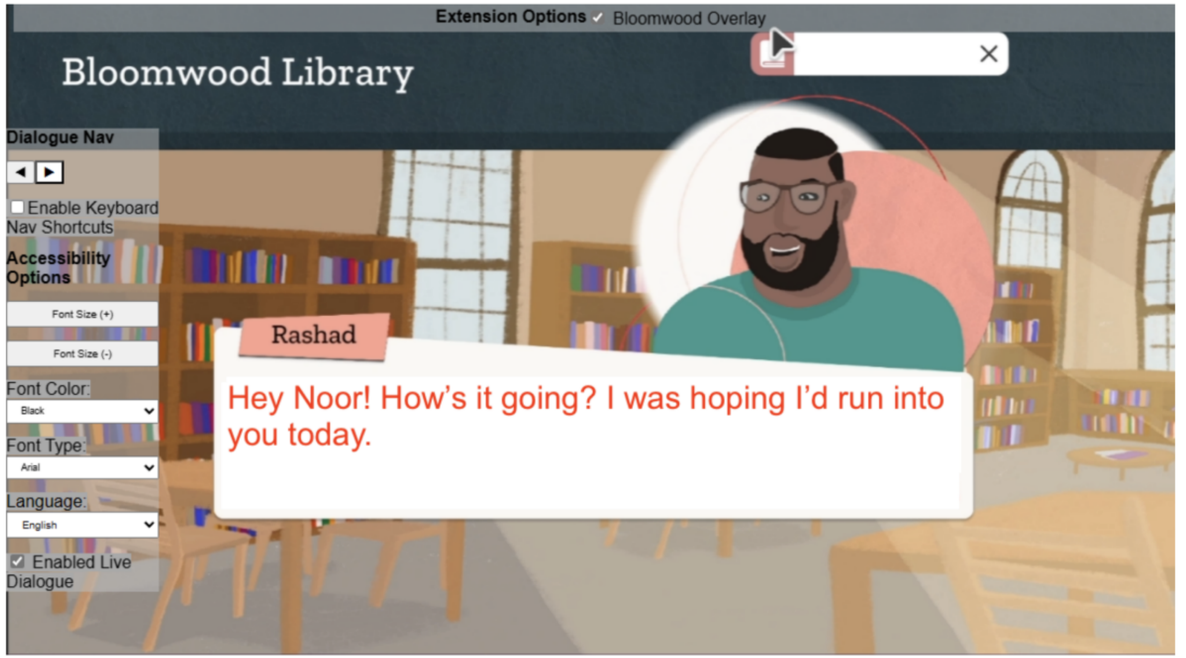
Accessible Streaming Software Infrastructure



Game-aware interfaces for streaming



Gamer interface, to gamer



Stream interface, to viewers

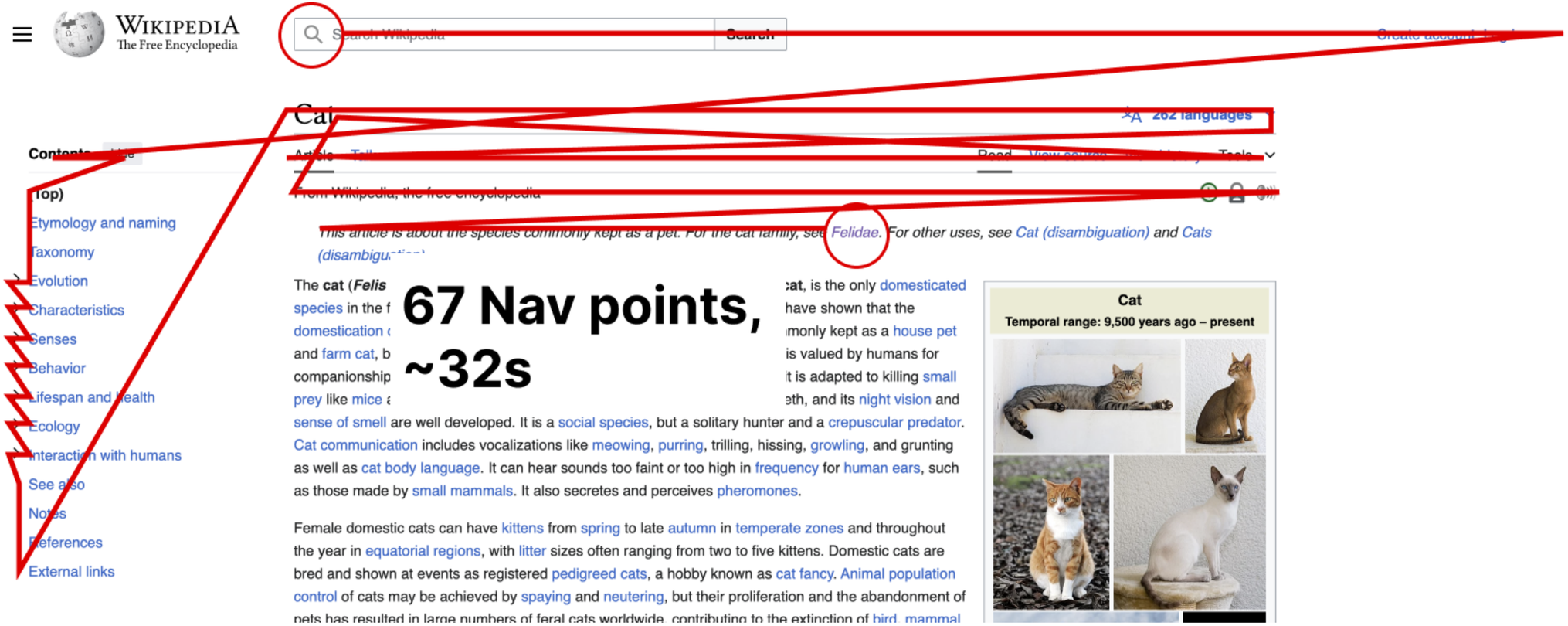
CLASS QUESTION

Question for Frank

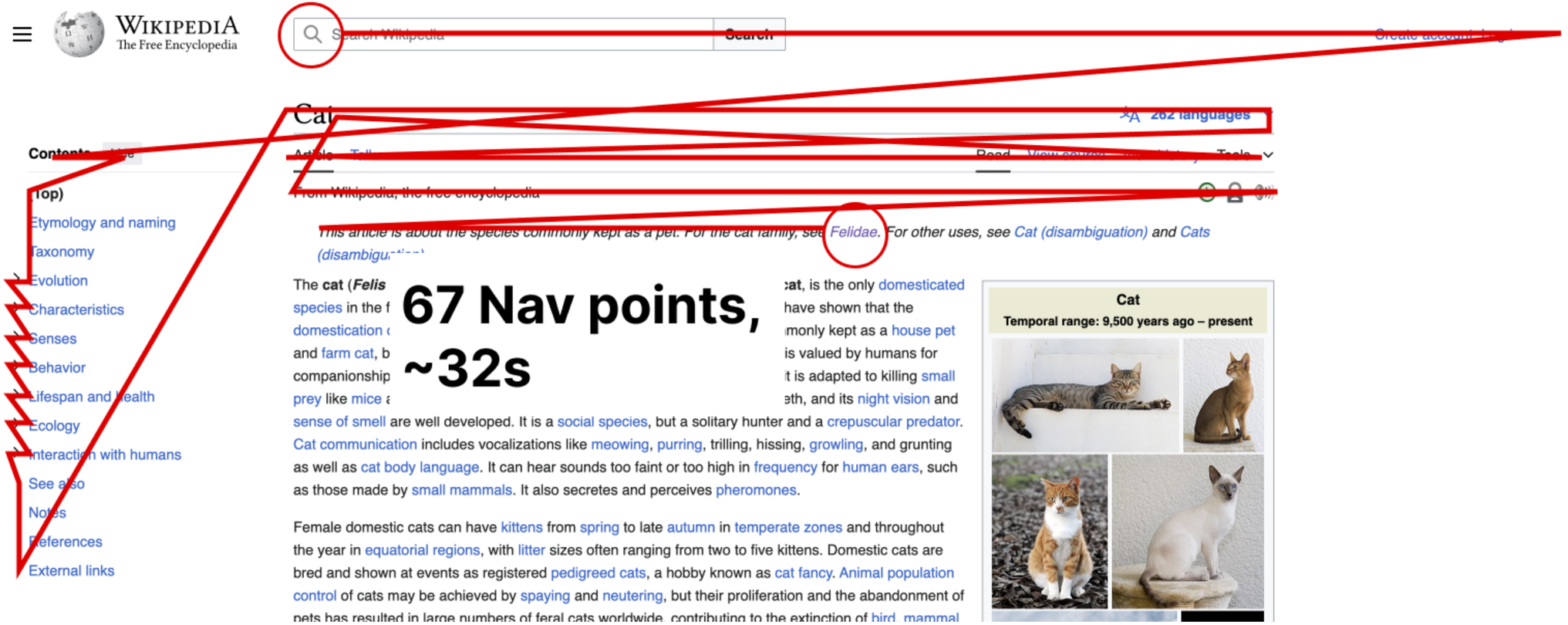
What are some “big-P” Problems in accessibility and visualization?

Problem 1: **Centering research** and development on screen readers (not blind people) limits what we can do

Screen readers processes 1 input at a time



Movement between tasks becomes cognitively expensive



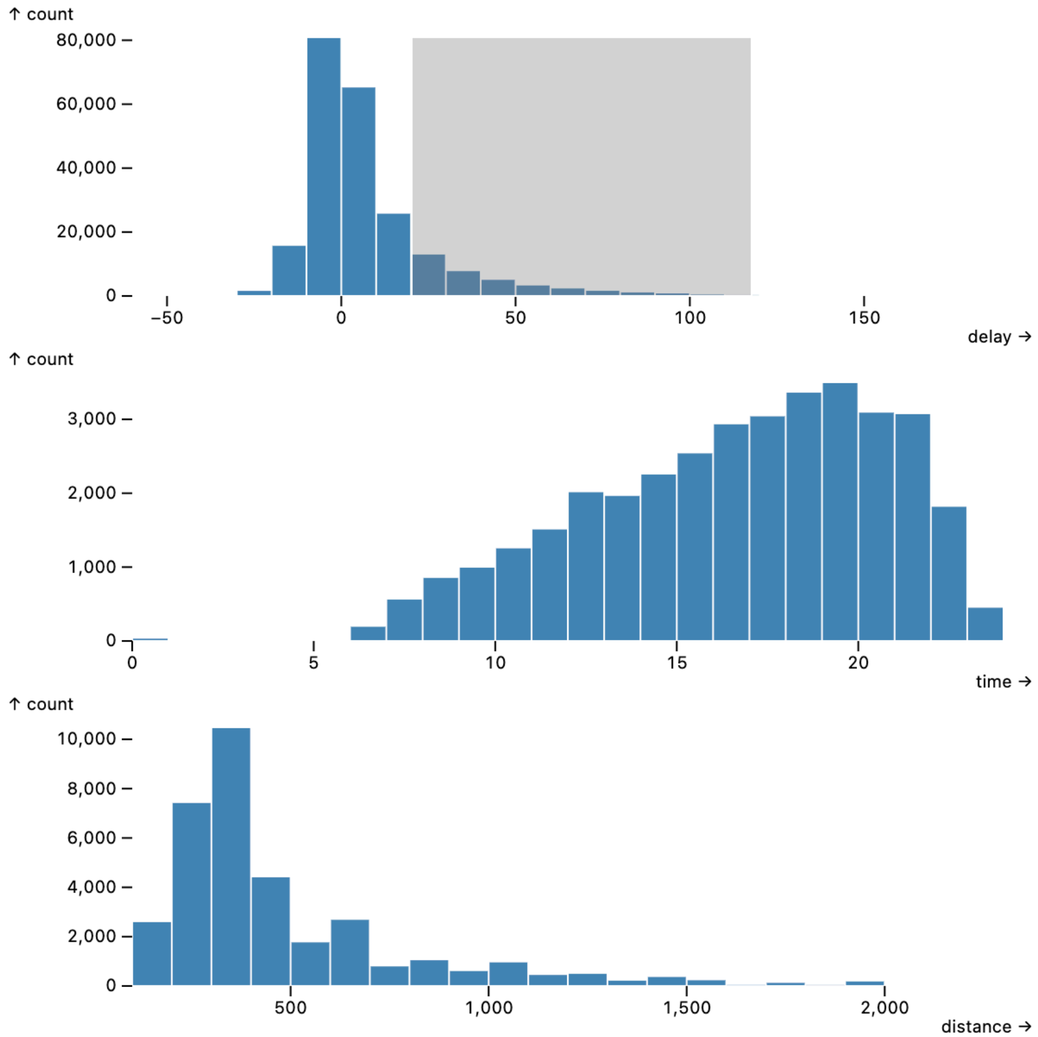
Auditory processing struggles with *dual-task* paradigms*

*Citation

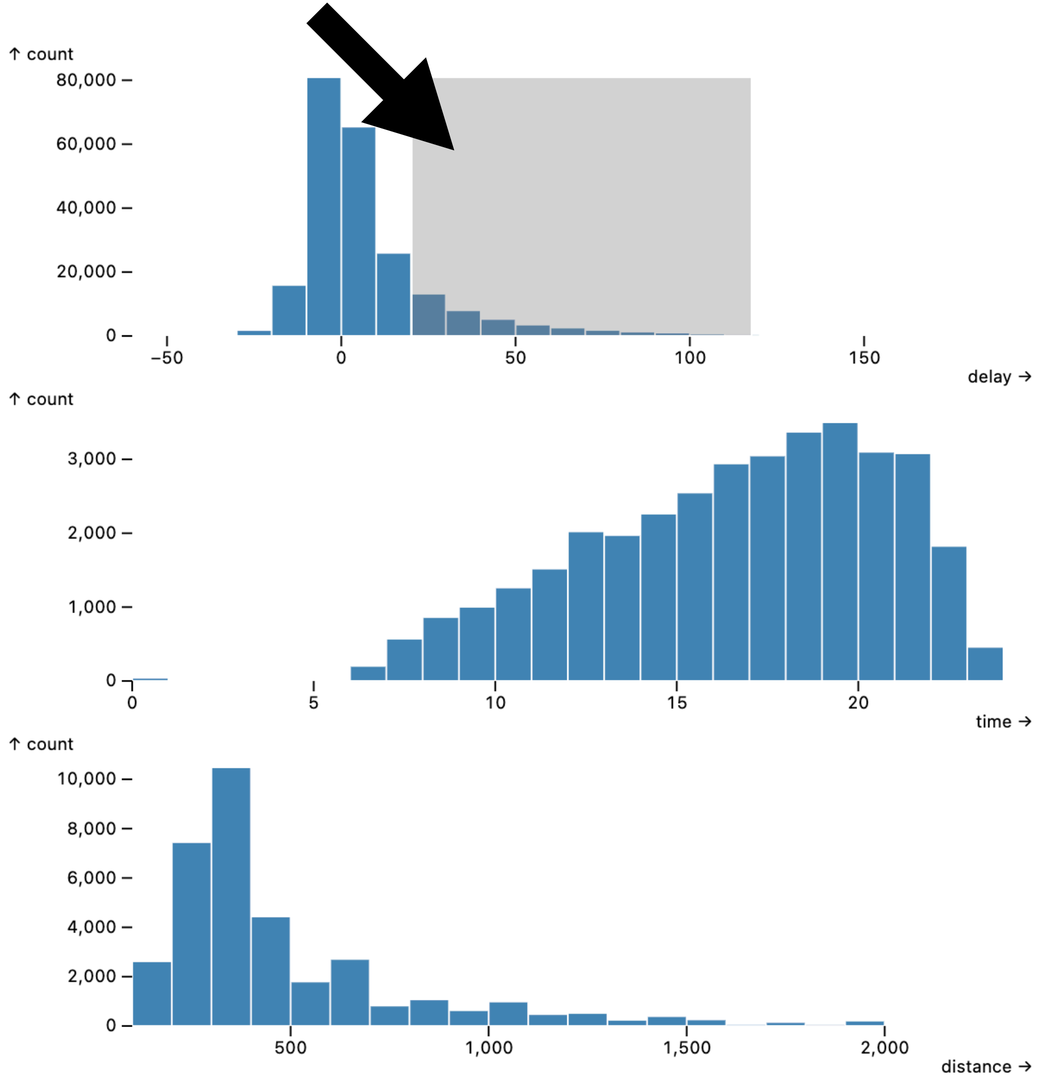
So what about cross-filtering?

Interactive link

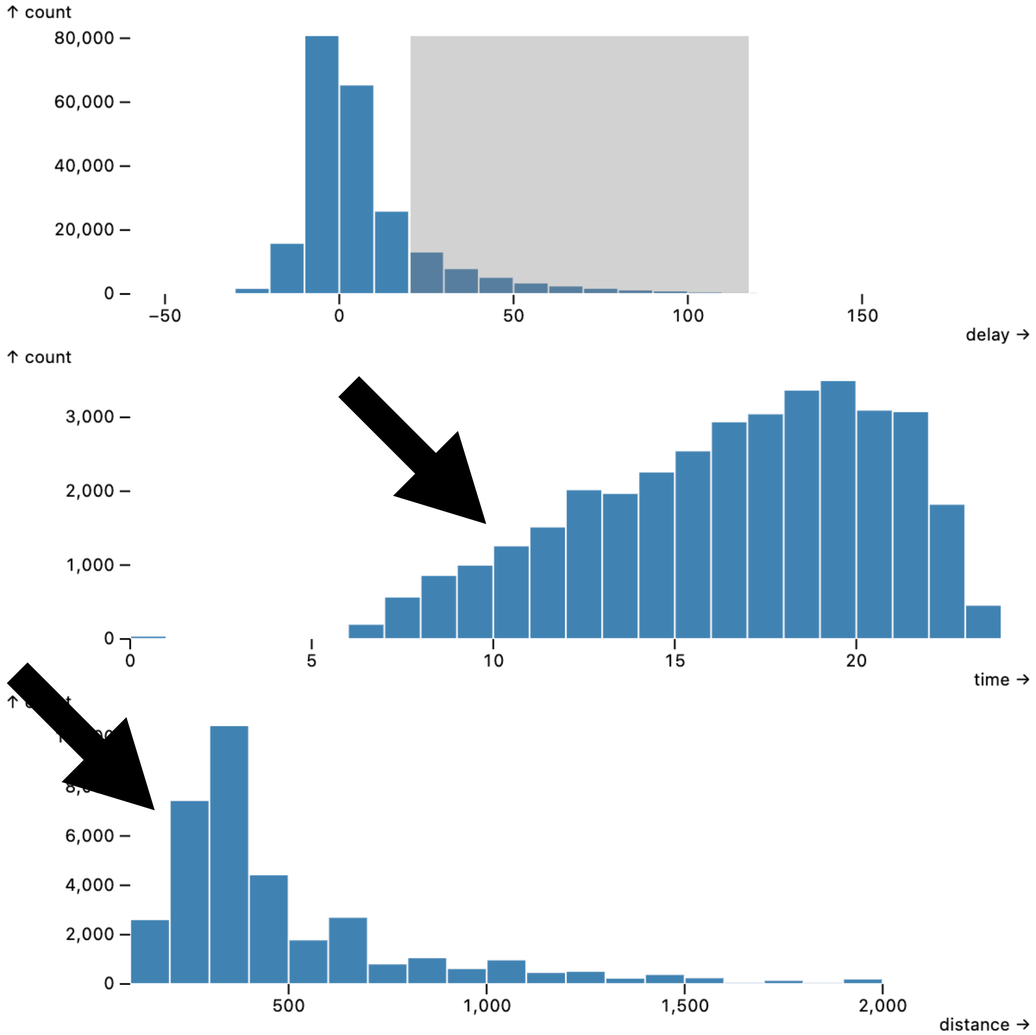
So what about cross-filtering?



Interaction in one space…



Produces simultaneous, coordinated change in another.



For blind users, descriptions, structural navigation, and sonifications will likely *not* solve this challenge.

Preliminary research question:

How do blind people interact with *multiple* tactile media simultaneously?

Observing: Embossed braille in a research context

Image source

Observation 1: Spatial memory storage

My friend didn’t remember the details of a math equation exactly, but he knew *where* that equation was located in his stack of braille pages and *where* on the page the equation was.

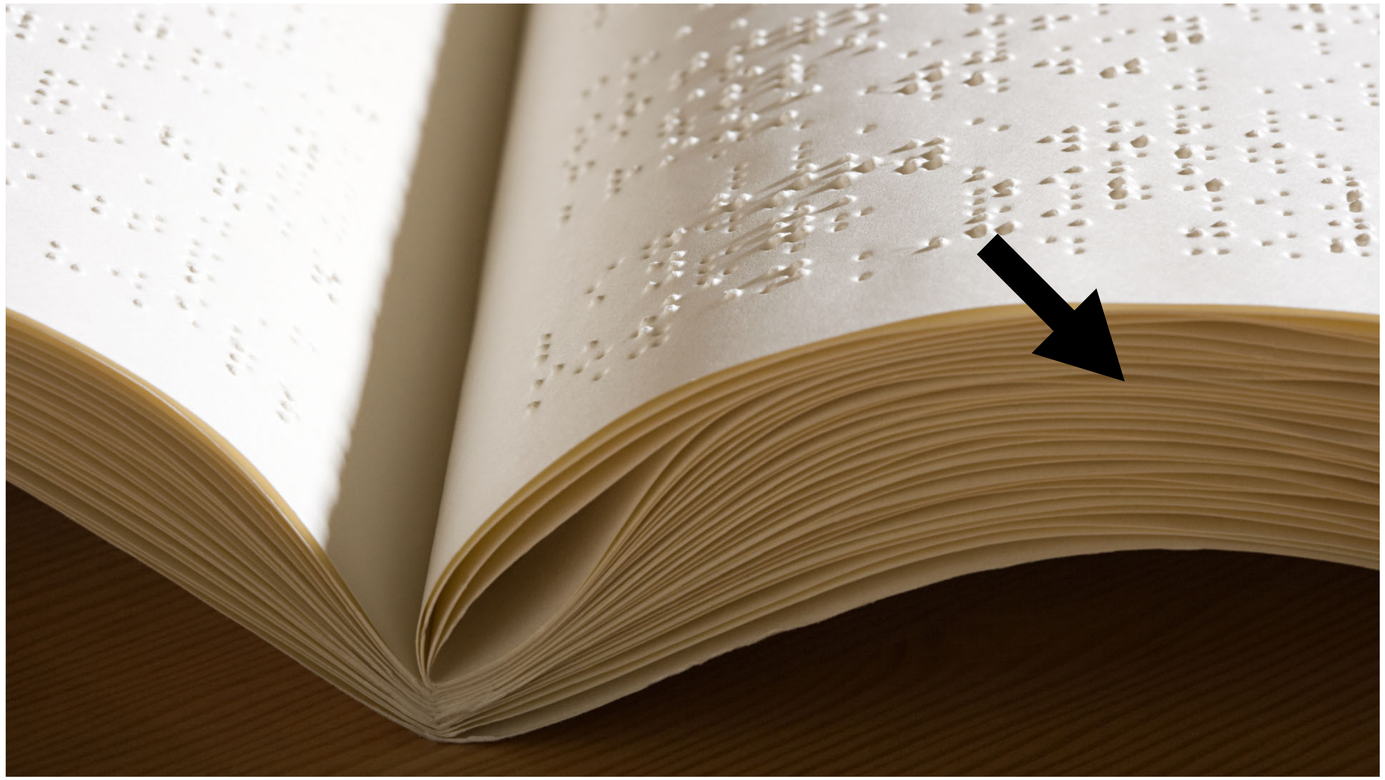
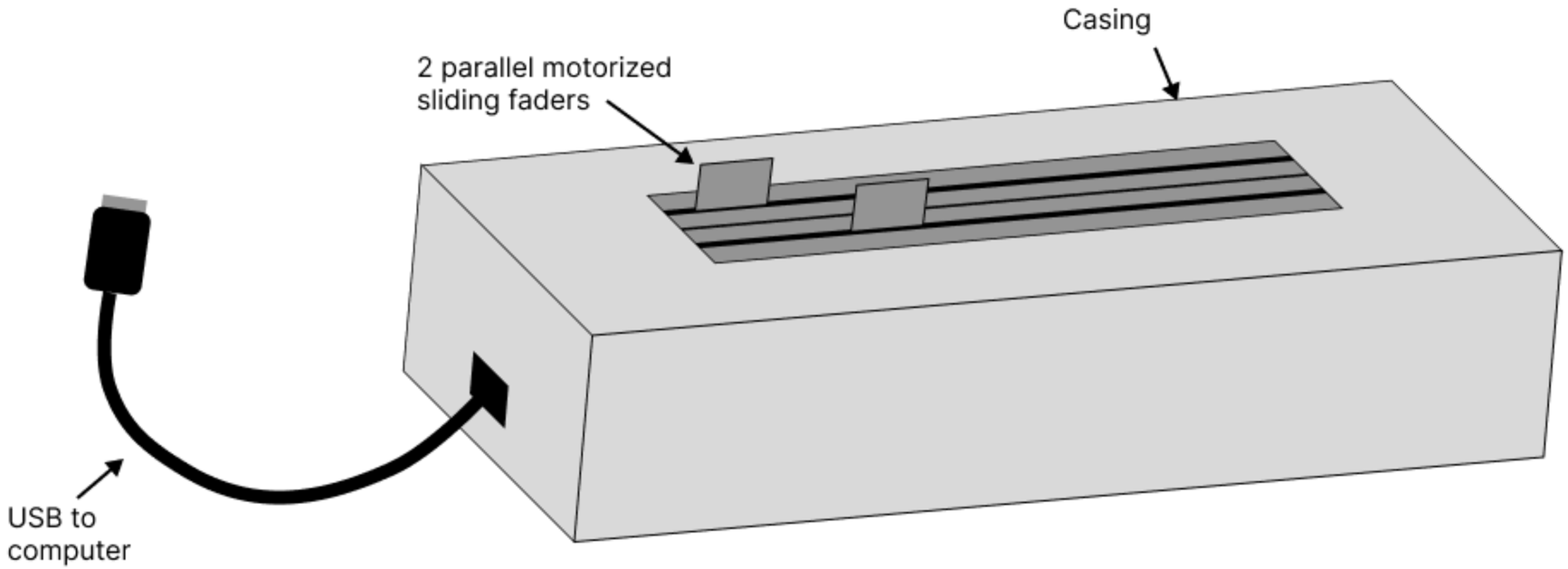


Image source

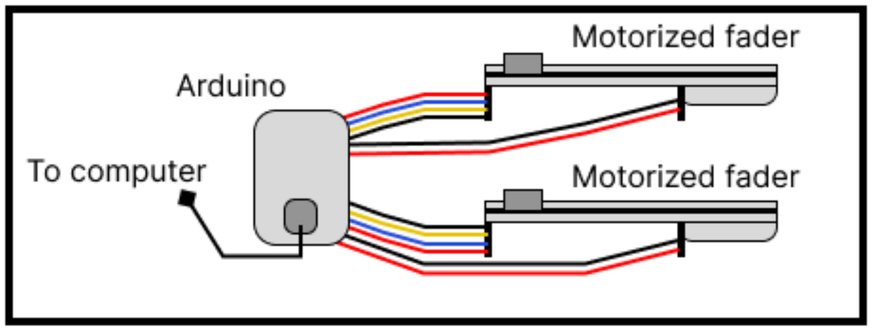
Observation 2: Coordinating perception and comparison

He then compared 2 equations at once. The details of each weren’t important. He was *feeling* for differences simultaneously.

Prototype 2: the *cross-feelter*, 2 motorized faders



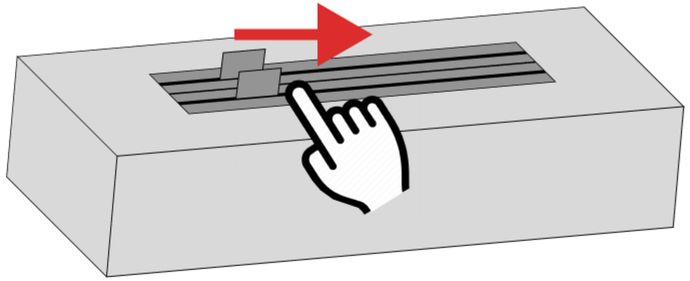
Schematic



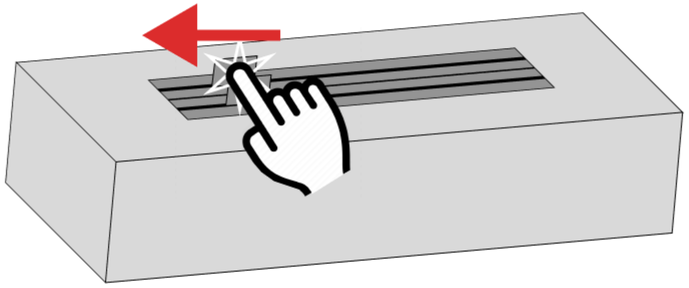
One slider can work with video

1. Video plays with progress slider moving

2. Slider follows, can be felt



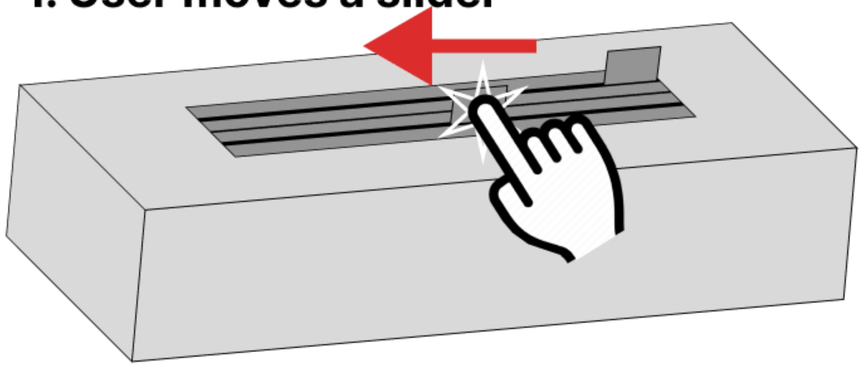
3. User can move slider



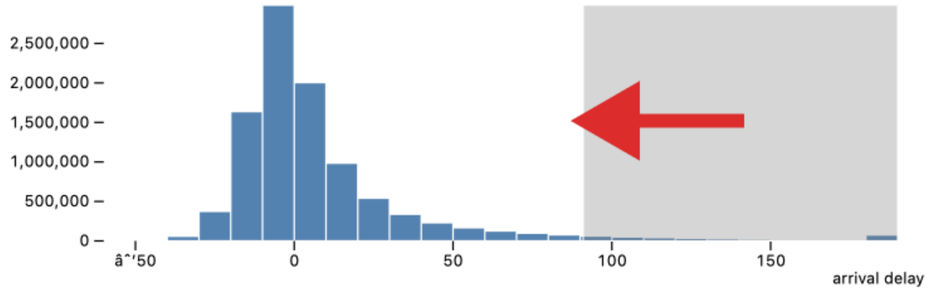
4. Video slider will move with slider change

While 2 sliders works for cross-filtering

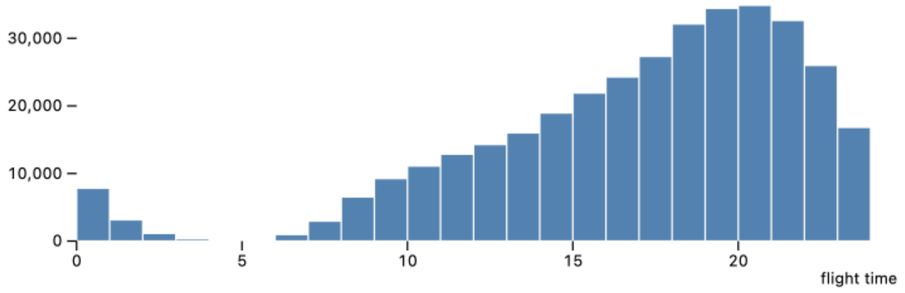
1. User moves a slider



2. Corresponding filter edge moves with

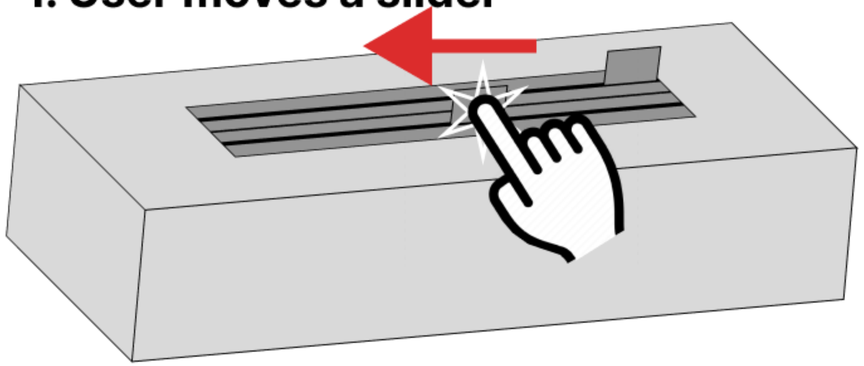


3. Secondary visualization updates

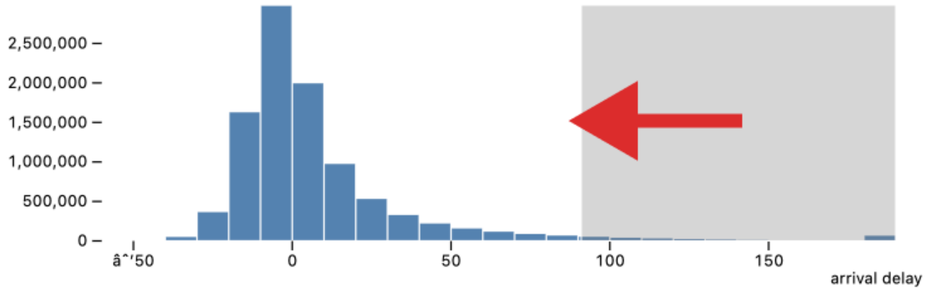


A tactile display can render the input *or* output chart

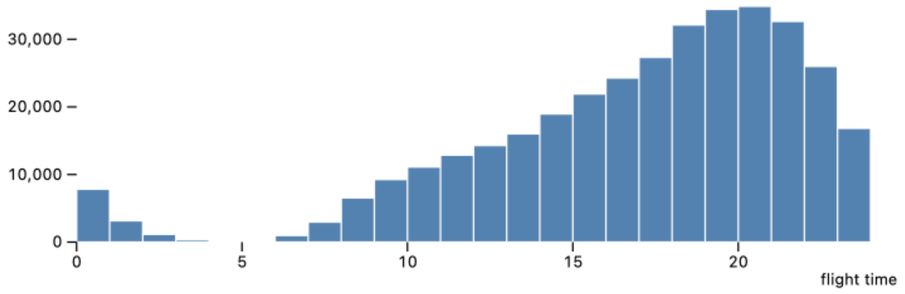
1. User moves a slider



2. Corresponding filter edge moves with



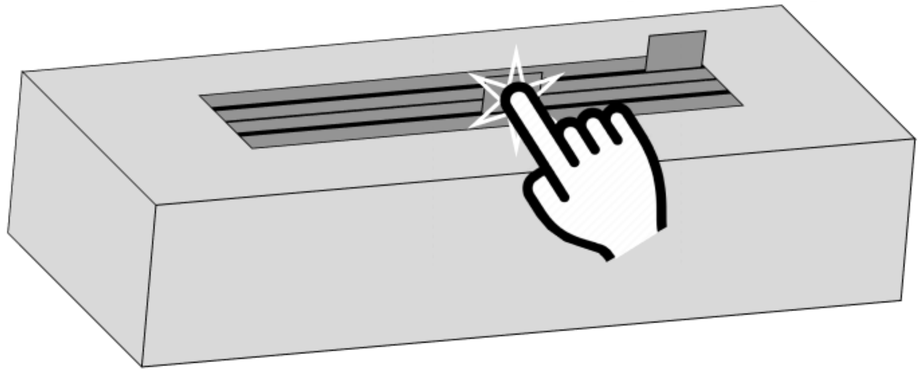
3. Secondary visualization updates



4. Tactile display renders

Cross-coordination! A tactile, dual-task paradigm.

User can interact with a space separate from their current focus!

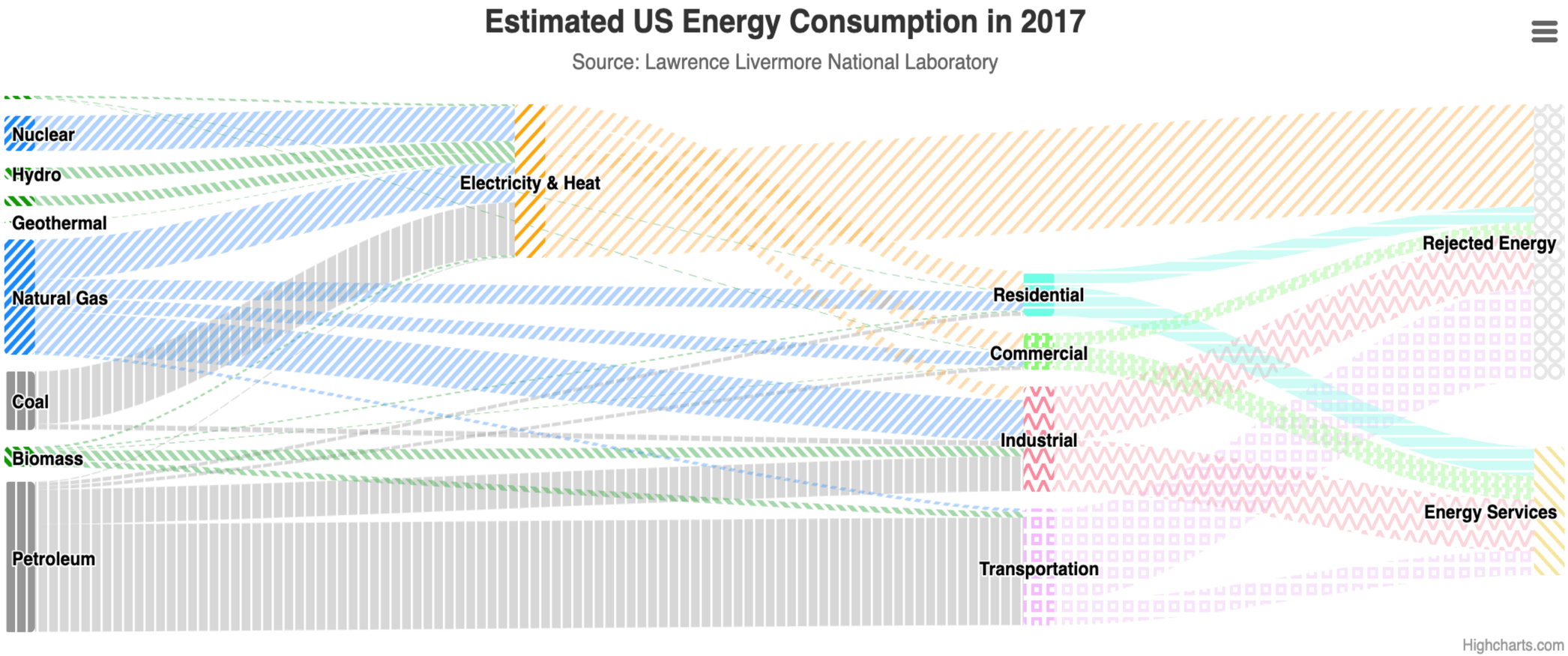


CLASS QUESTION

Question for Frank

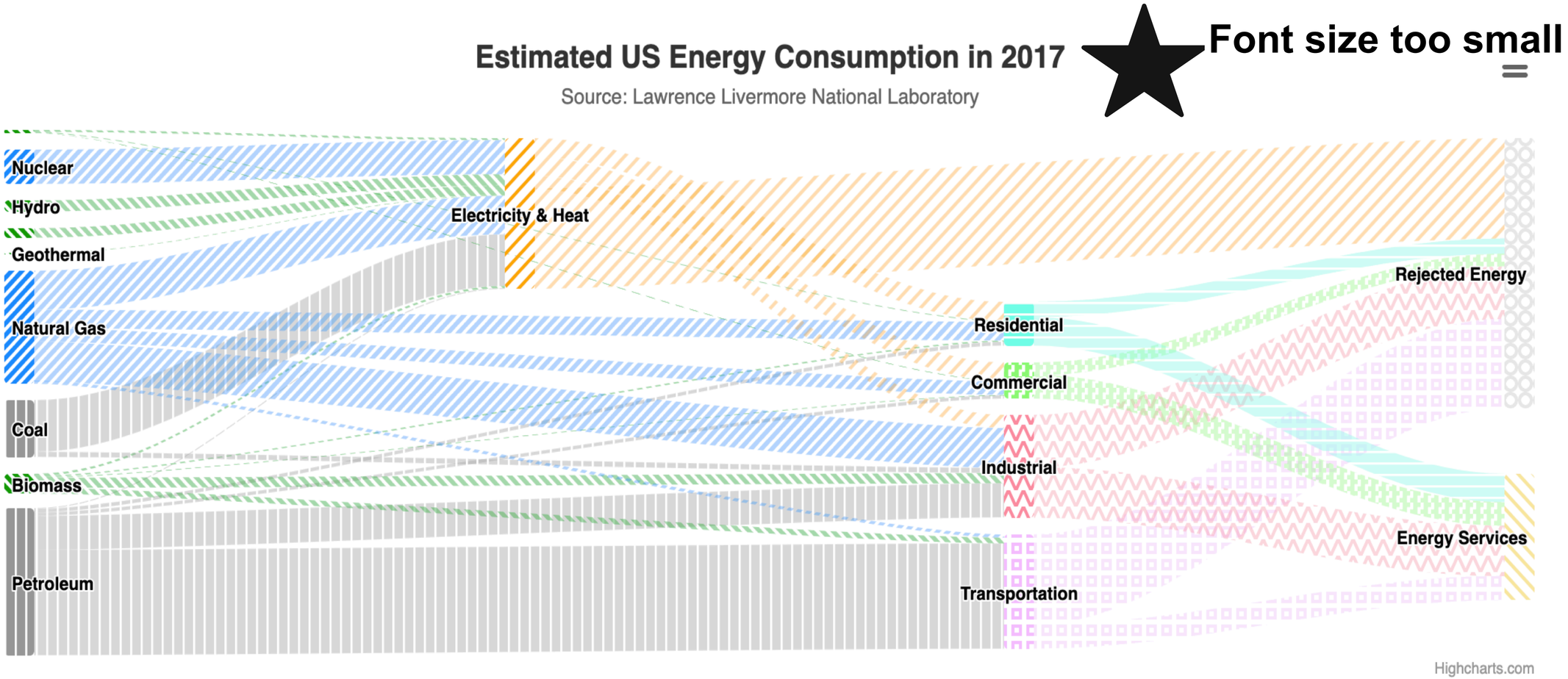
Problem 2: **Access Friction** is when accessibility for someone produces a barrier for others

What about this visualization might be a barrier?



Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

What about this visualization might be a barrier?



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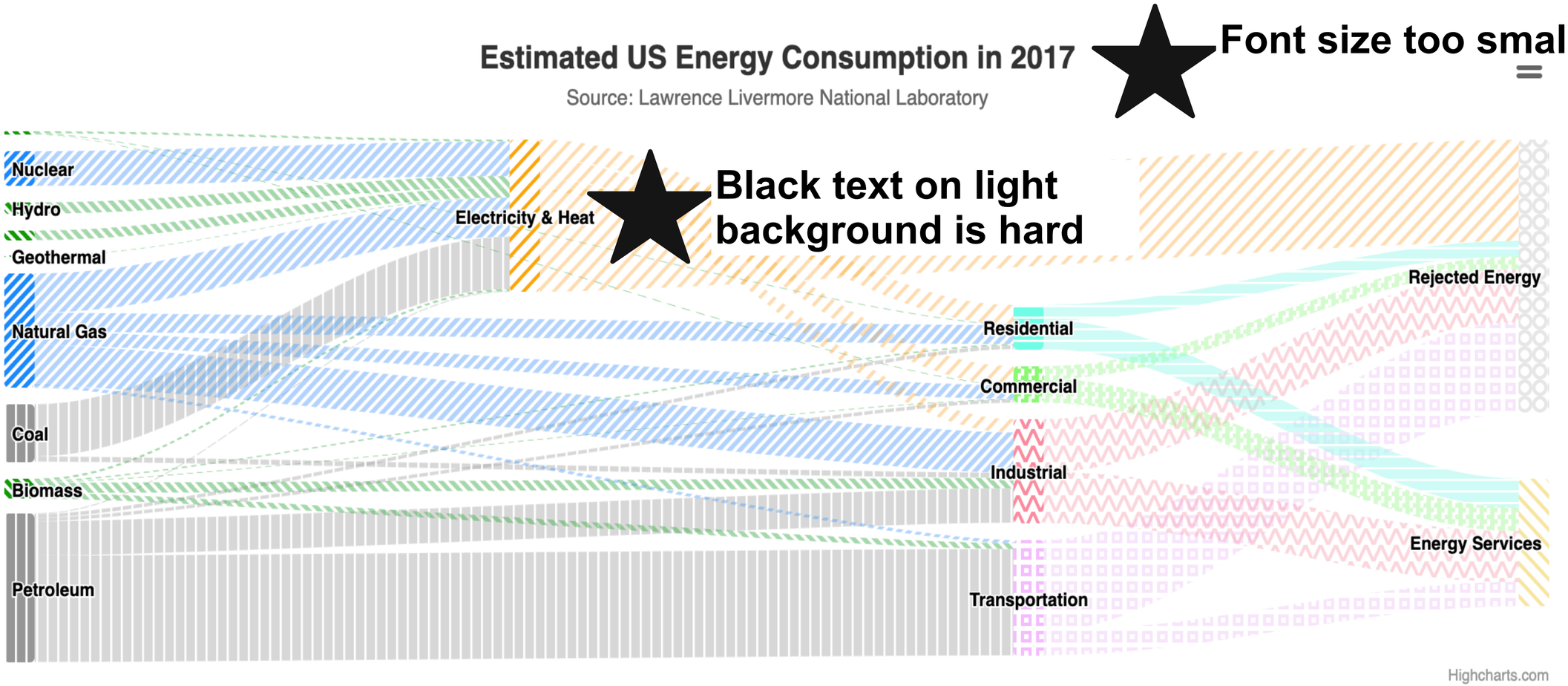

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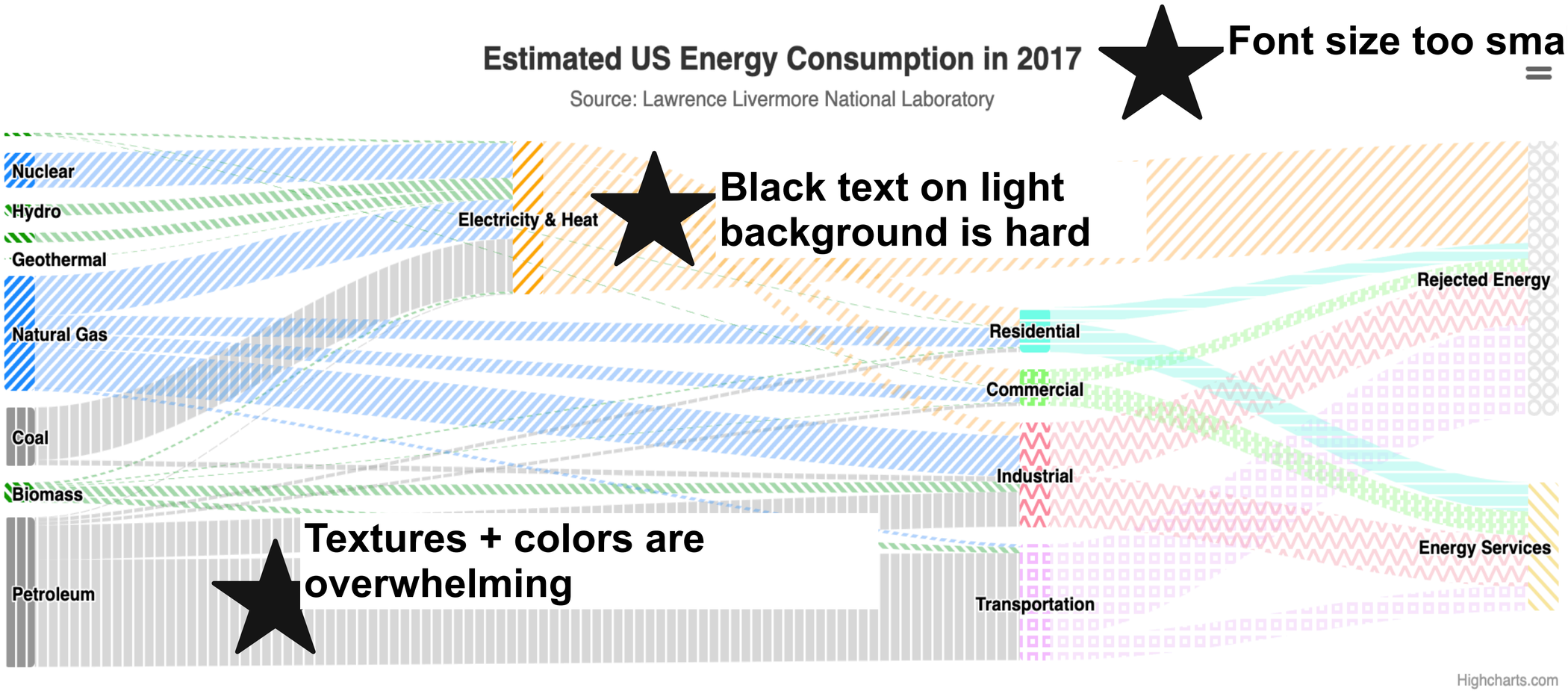

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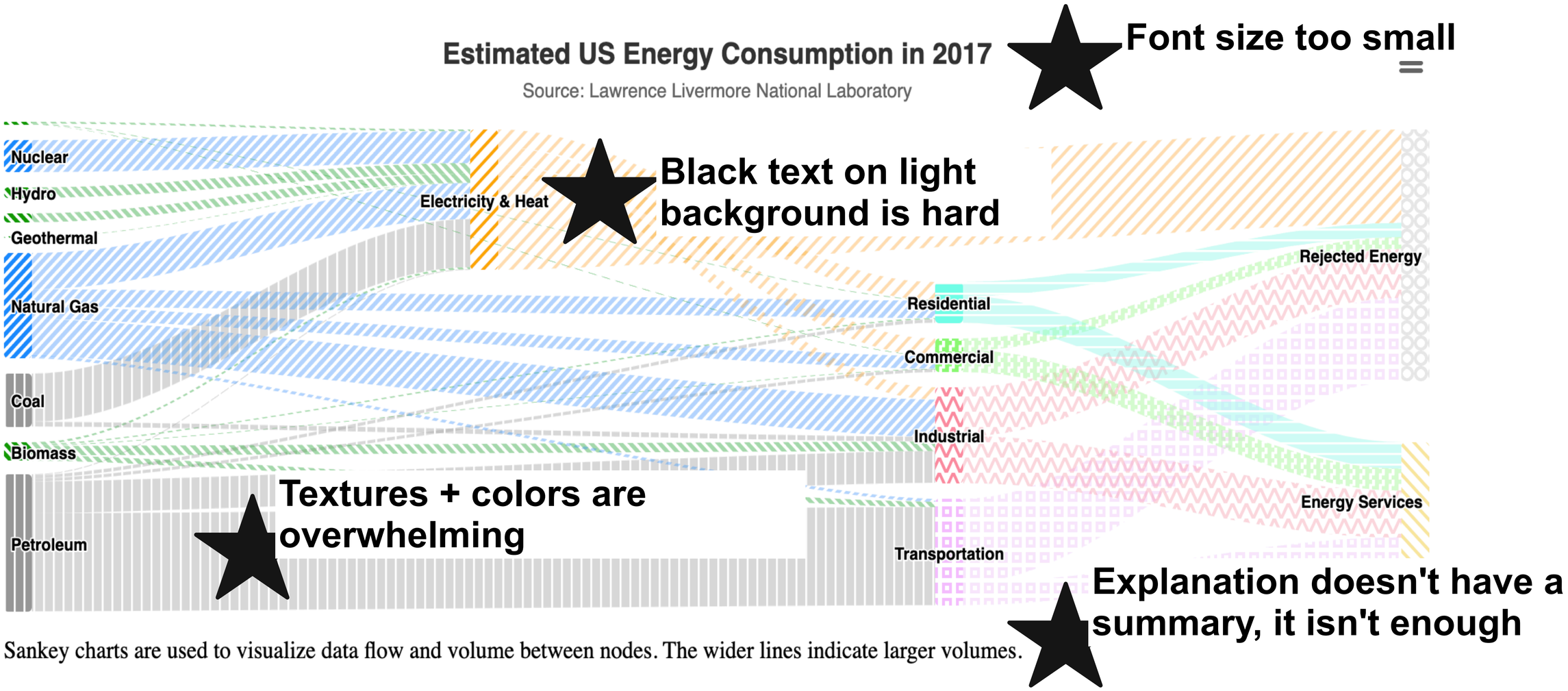
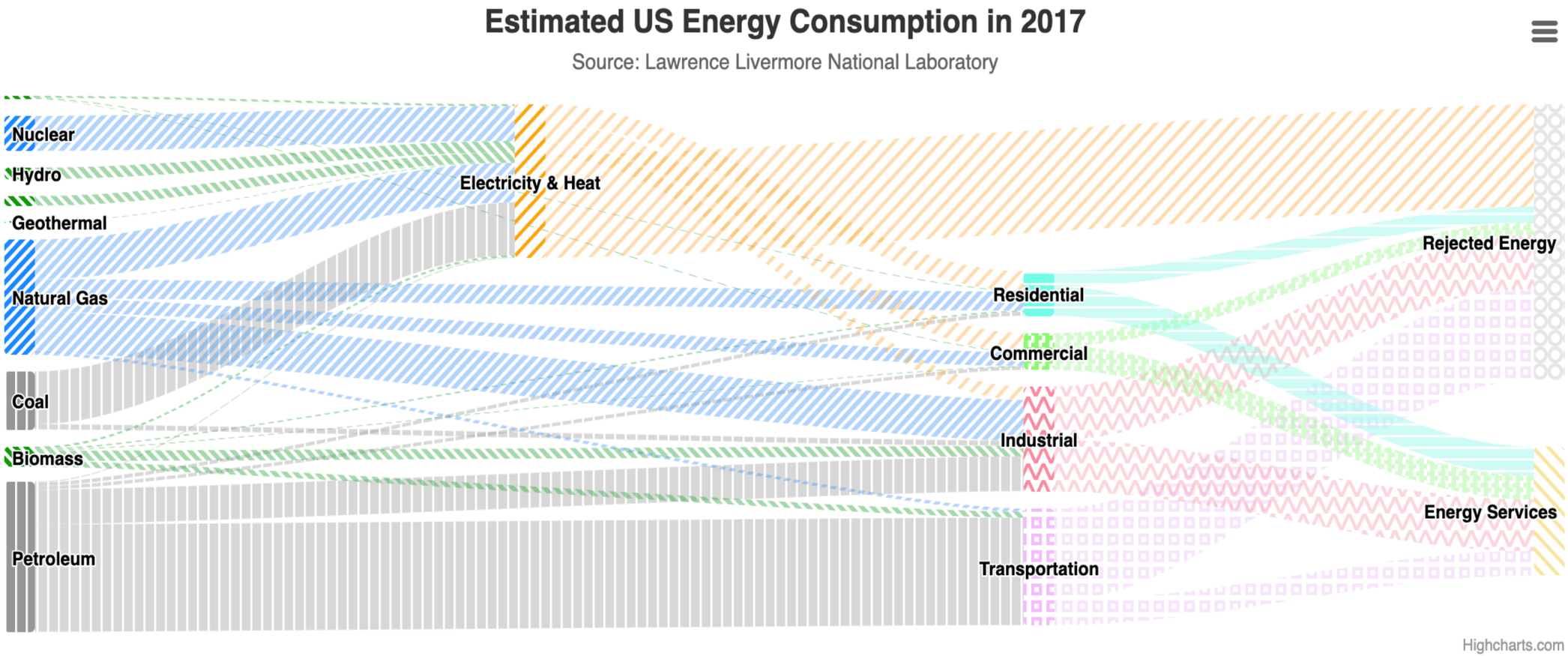


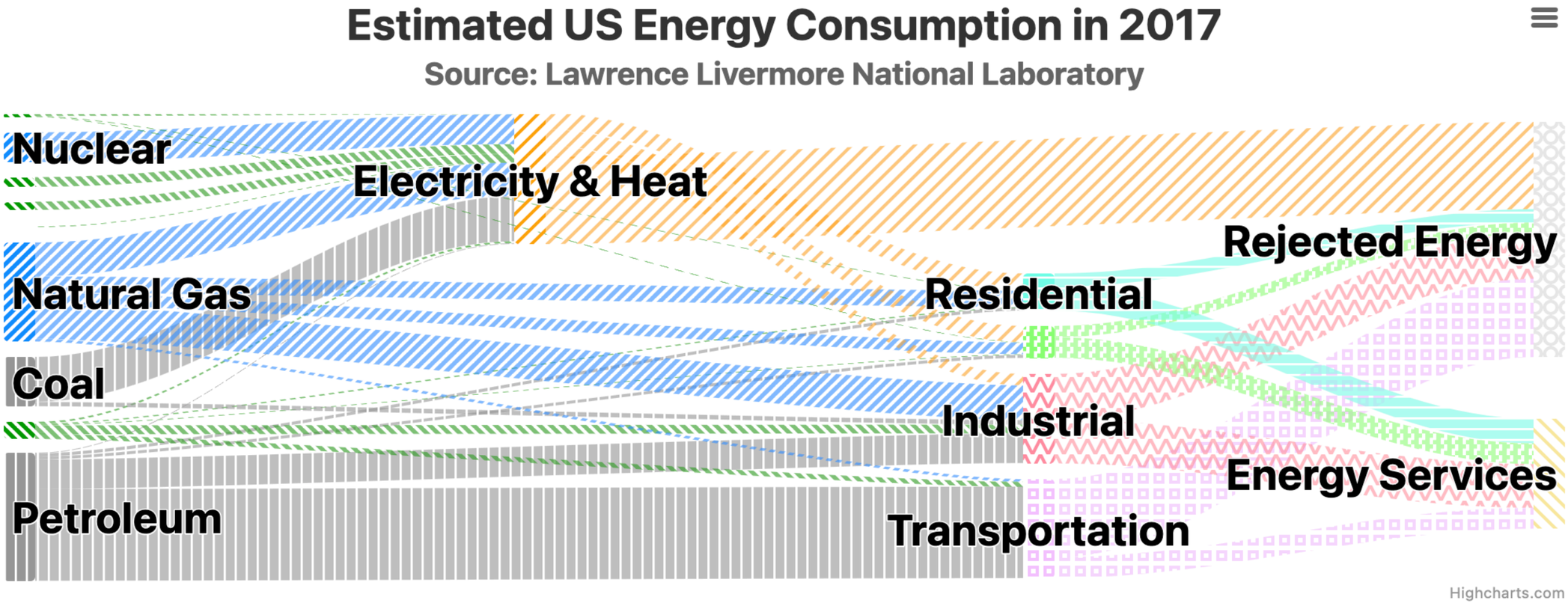
Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

Can we fix this?



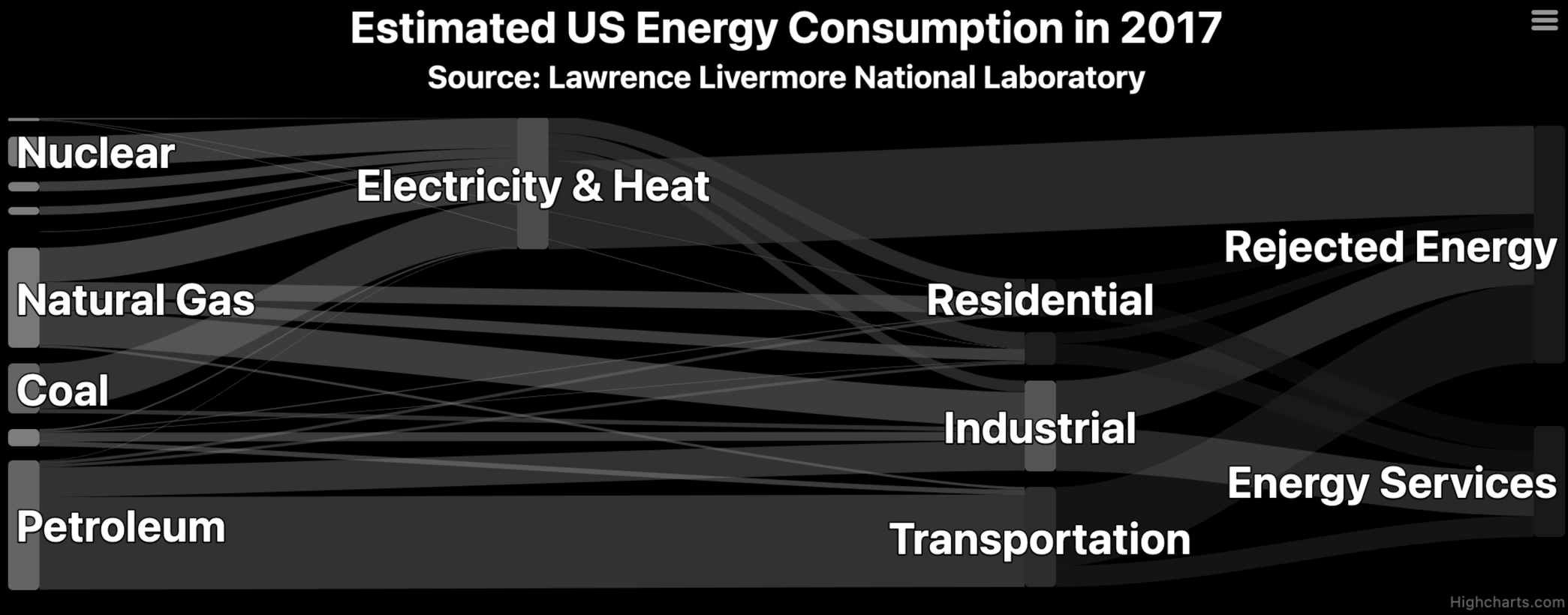
Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

Maybe we can bump up the text size



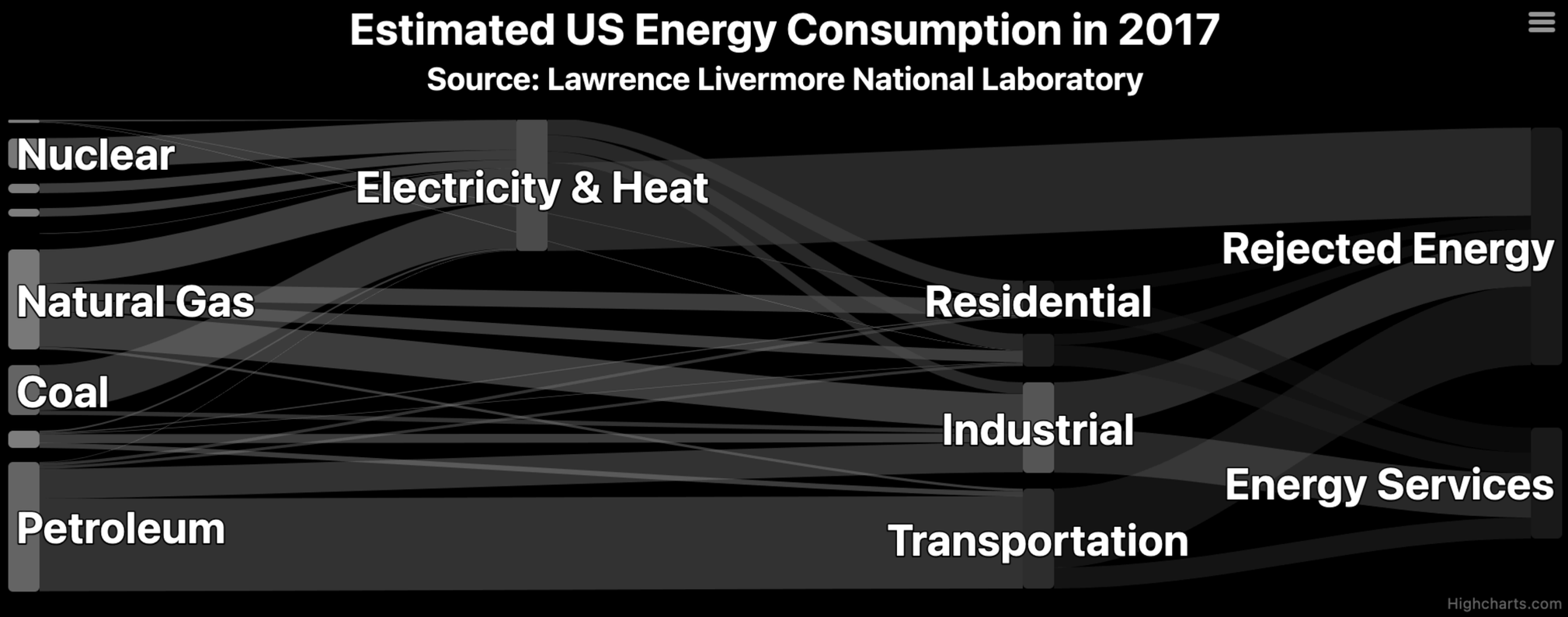
Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

We can reduce visual complexity too



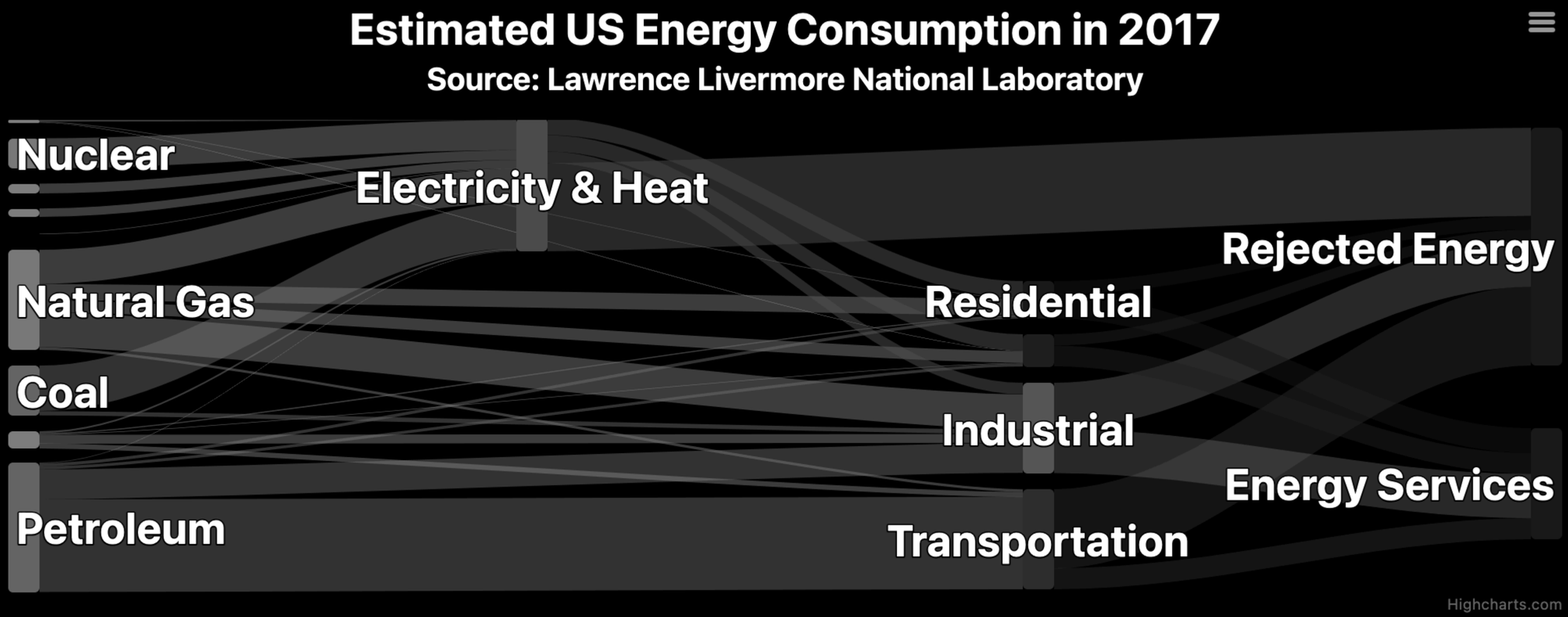
Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

We can add a more descriptive explanation



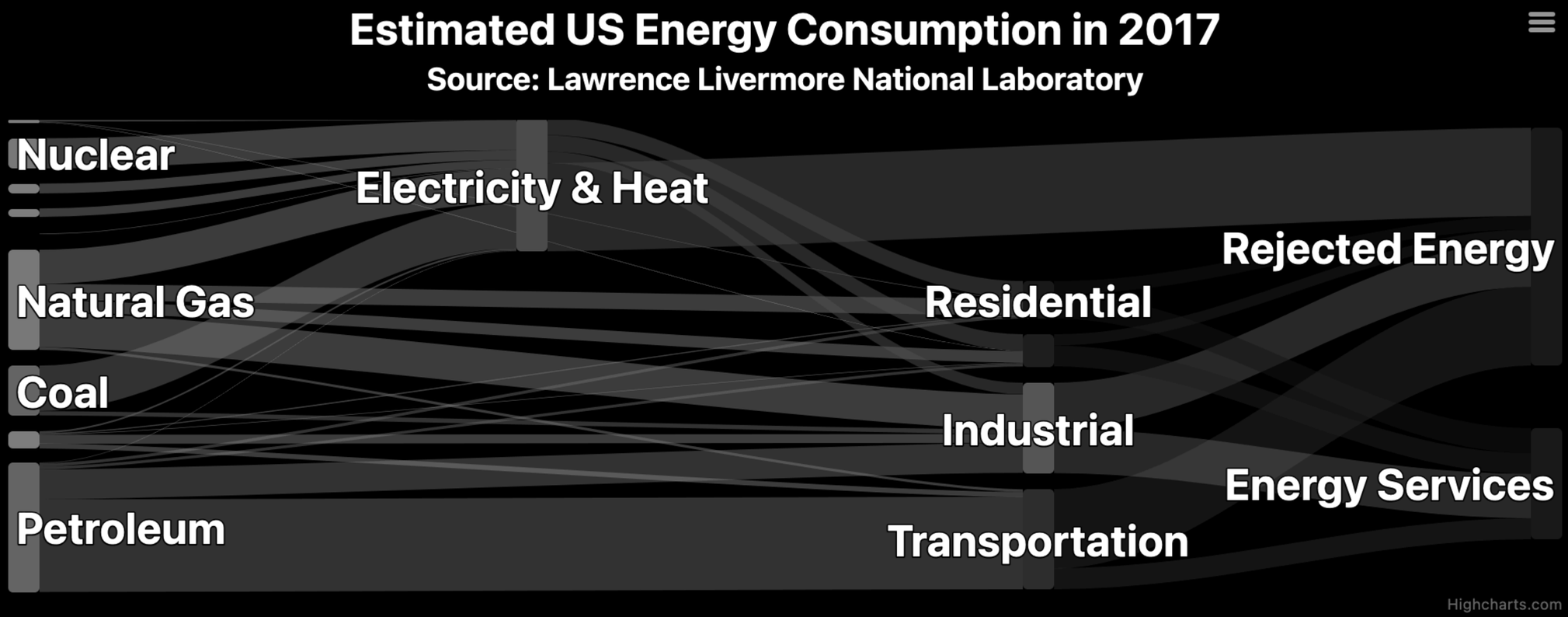
Sankey charts are used to visualize data flow and volume between nodes. Visually wider lines indicate larger volumes. This chart is showing energy consumption and types. Interacting with this chart by selecting a node or flow (such as with a click) will update the stacked bar chart below.

Is this the *perfect*, most accessible design?



Sankey charts are used to visualize data flow and volume between nodes. Visually wider lines indicate larger volumes. This chart is showing energy consumption and types. Interacting with this chart by selecting a node or flow (such as with a click) will update the stacked bar chart below.

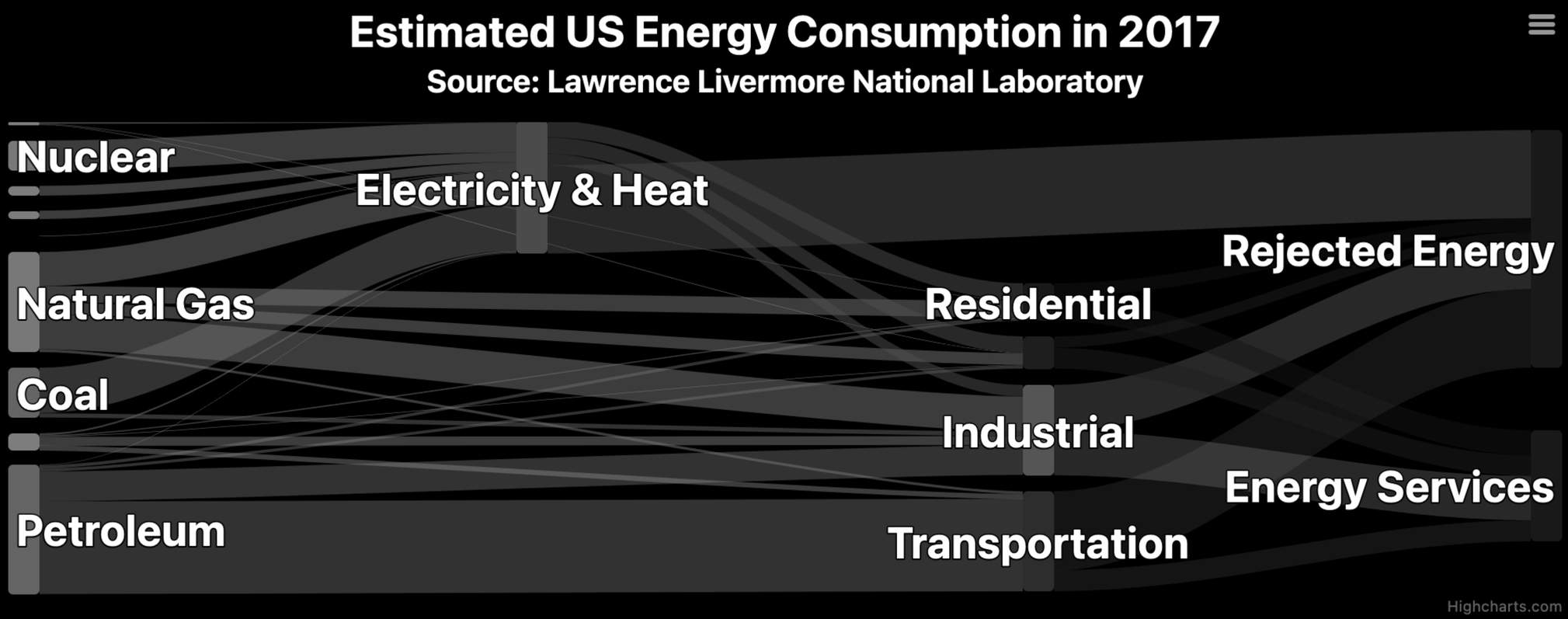
Bad news...



Sankey charts are used to visualize data flow and volume between nodes. Visually wider lines indicate larger volumes. This chart is showing energy consumption and types. Interacting with this chart by selecting a node or flow (such as with a click) will update the stacked bar chart below.

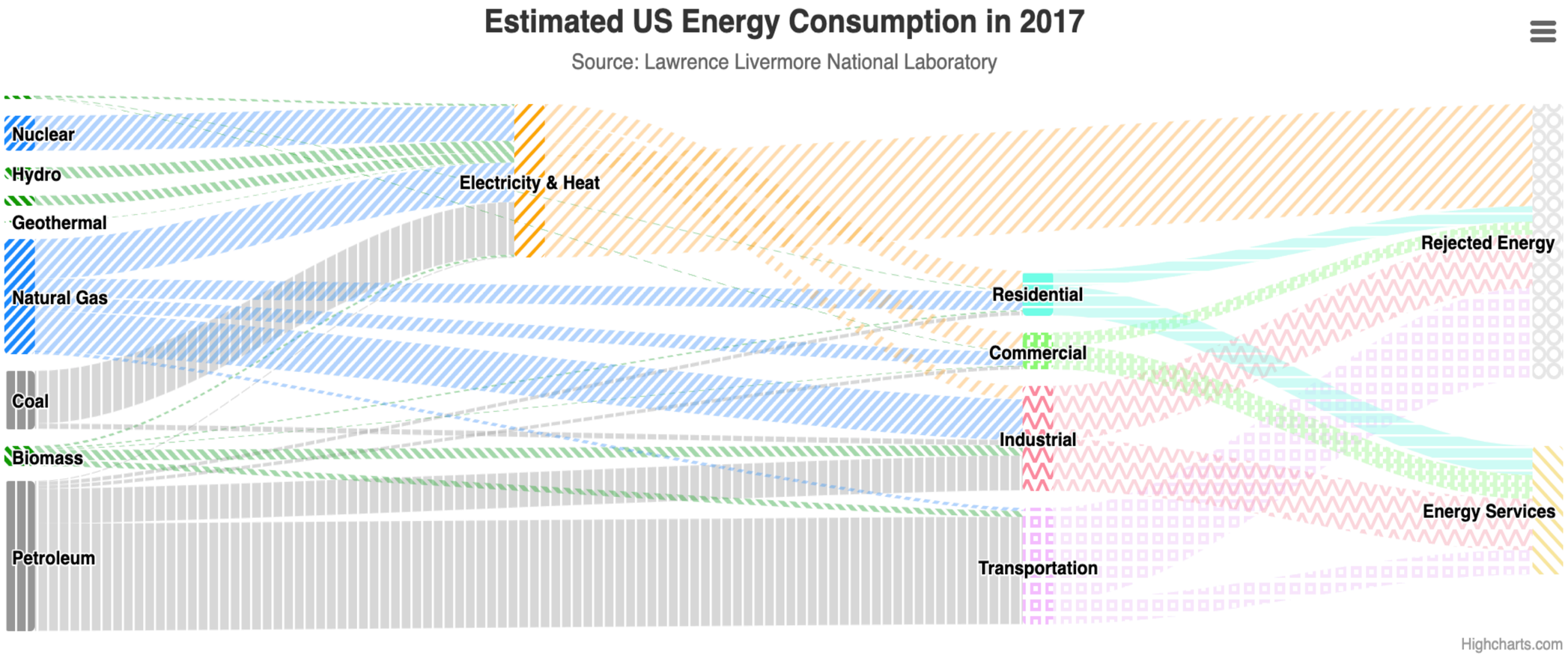
Bad news...

This design has accessibility issues too



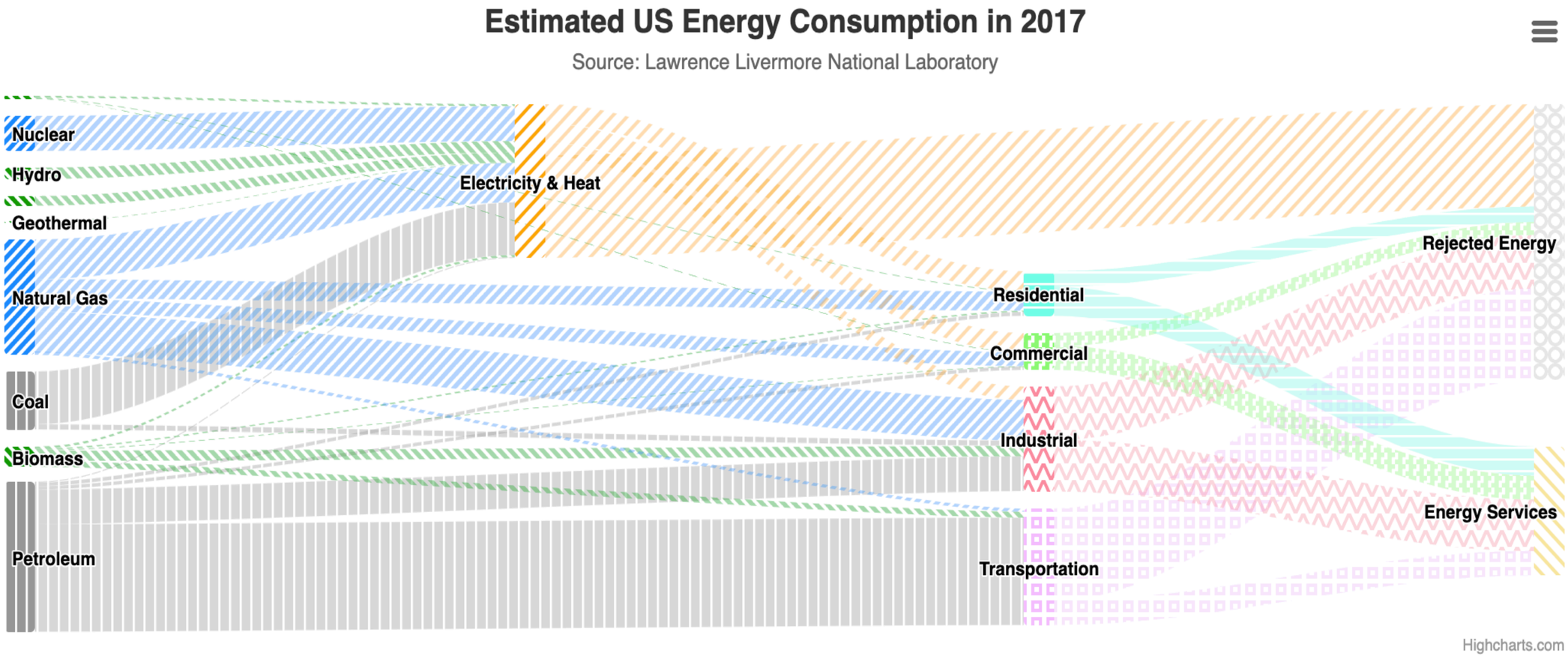
Sankey charts are used to visualize data flow and volume between nodes. Visually wider lines indicate larger volumes. This chart is showing energy consumption and types. Interacting with this chart by selecting a node or flow (such as with a click) will update the stacked bar chart below.

There is no such thing as a single, perfect visualization



Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

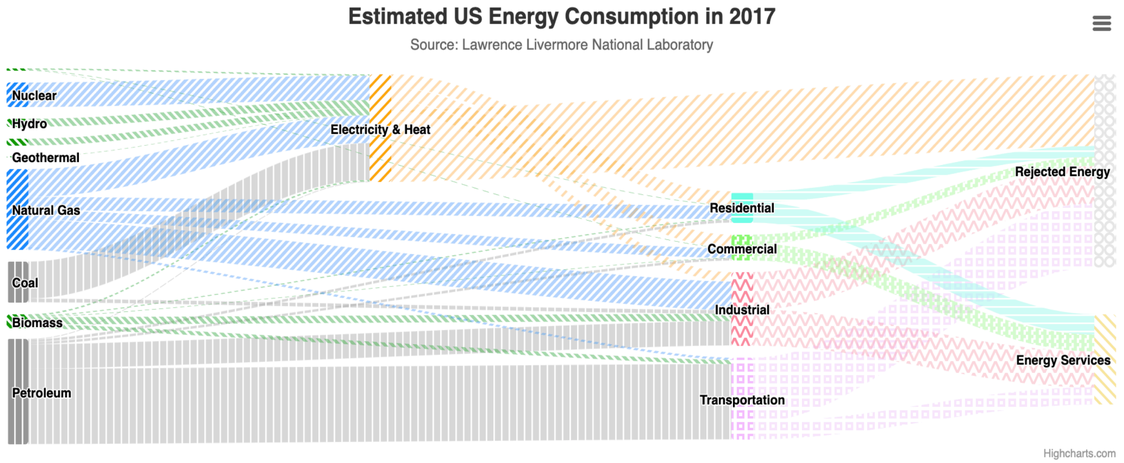
One design *cannot* fit all



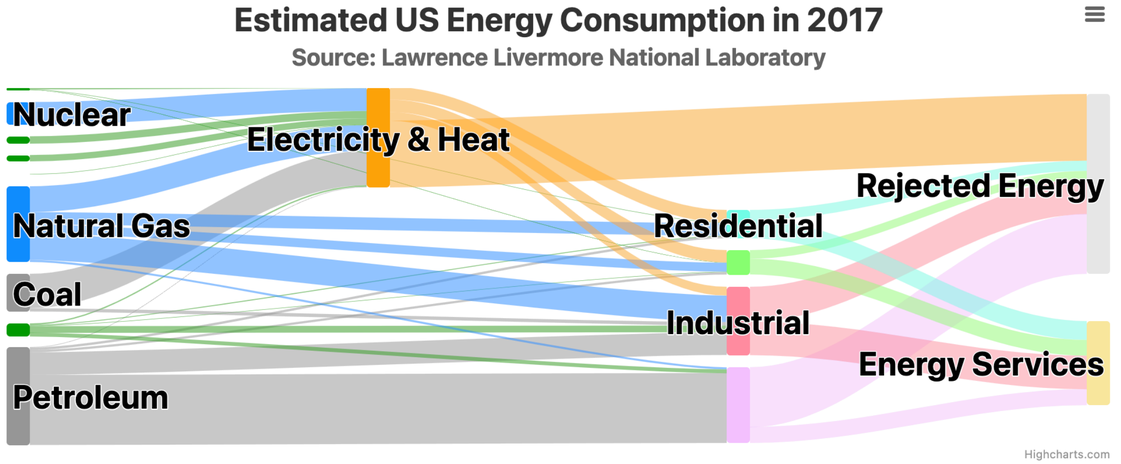
Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.

Why should our chart designs be one-size-fits-all?

Good design enables *personalization*



Sankey charts are used to visualize data flow and volume between nodes. The wider lines indicate larger volumes.



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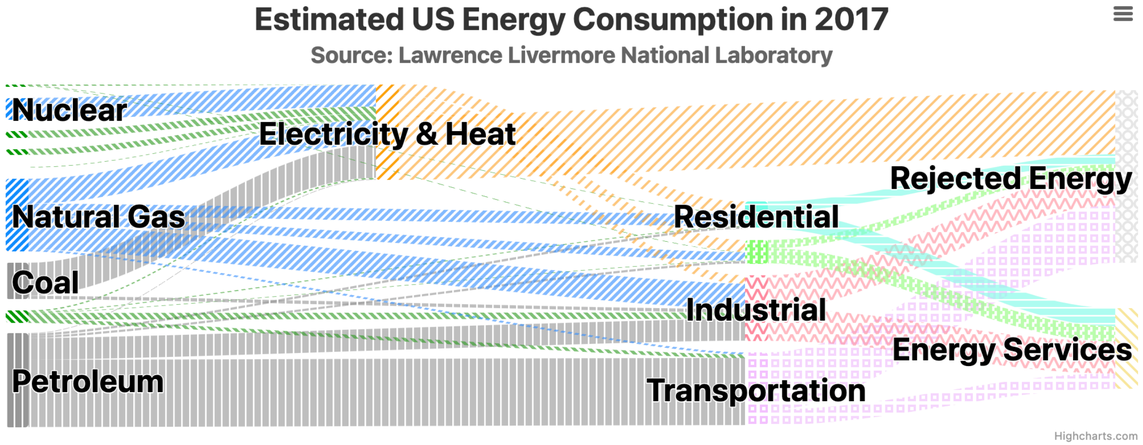

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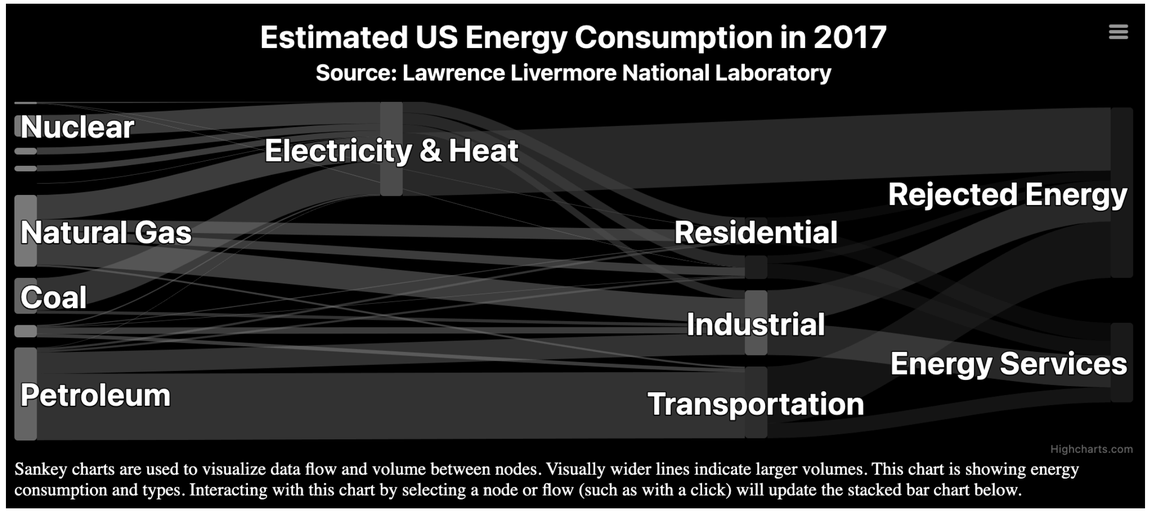


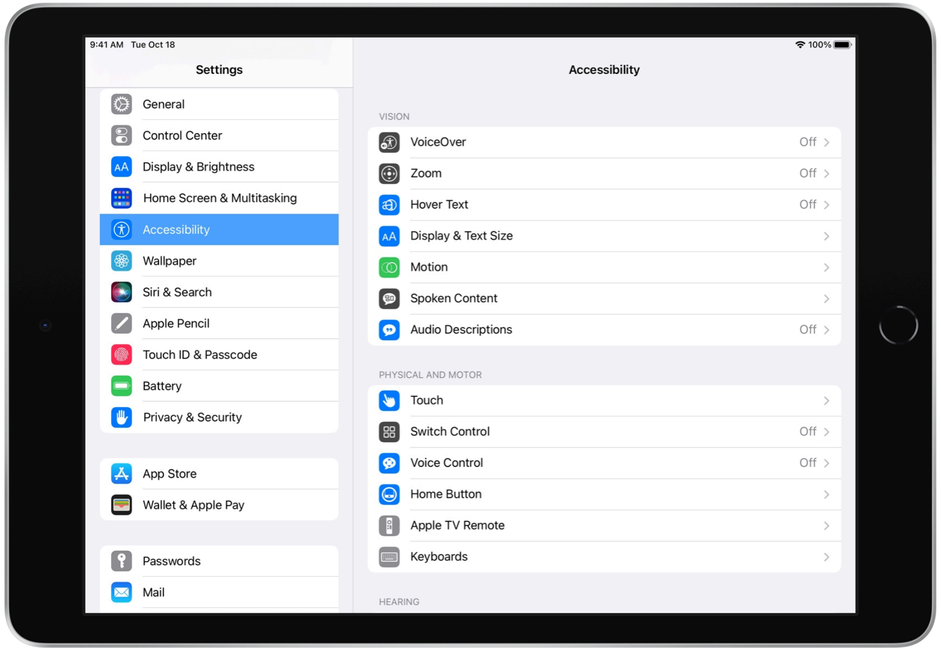
Sankey charts are used to visualize data flow and volume between nodes. Visually wider lines indicate larger volumes. This chart is showing energy consumption and types. Interacting with this chart by selecting a node or flow (such as with a click) will update the stacked bar chart below.

We have been enabling personalization for years

Video games

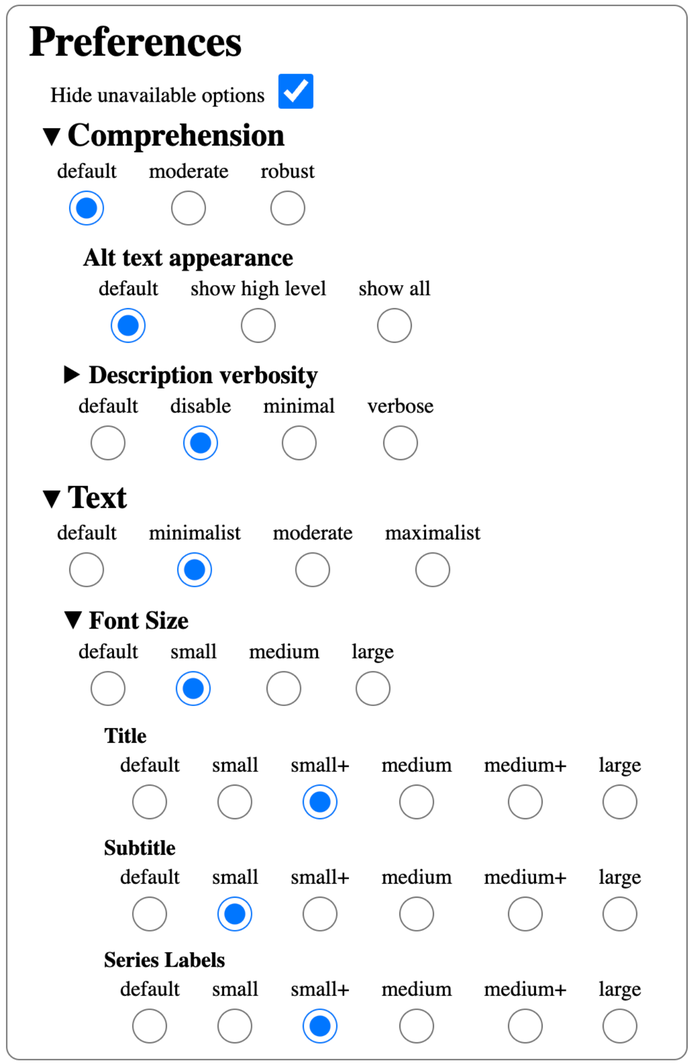
[The Last of Us 2 has more than 60 settings]

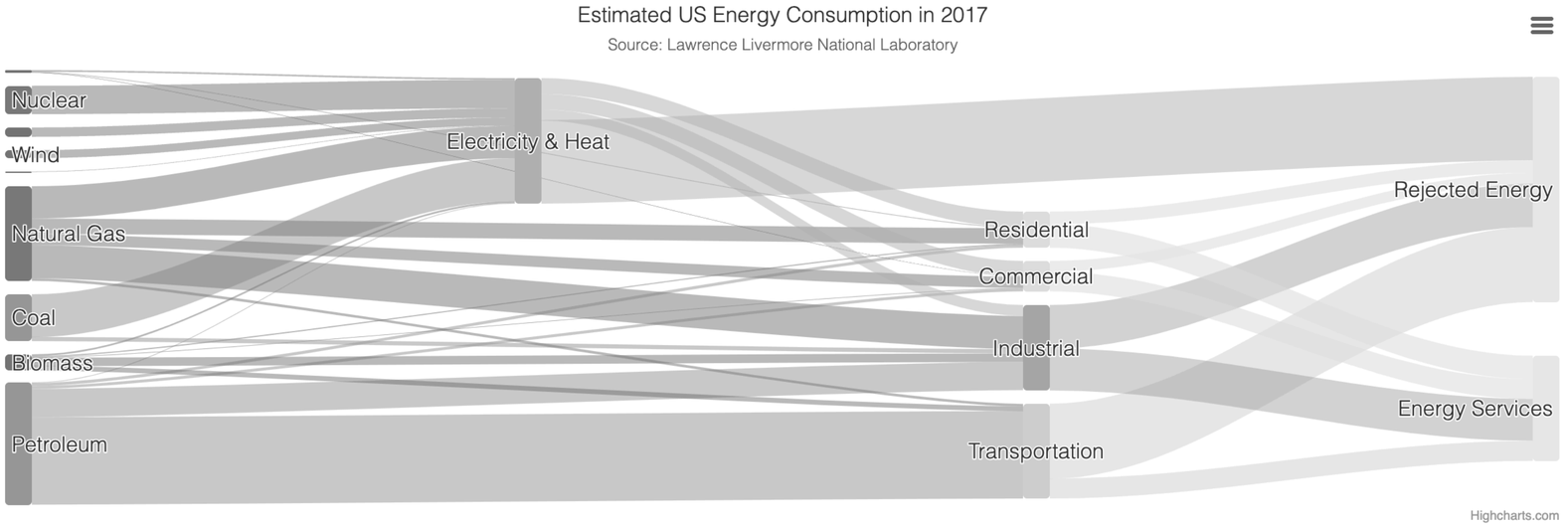
Devices and operating systems

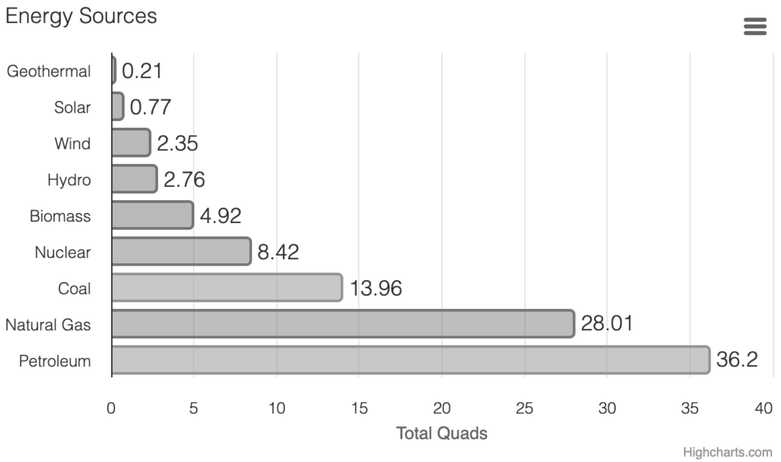


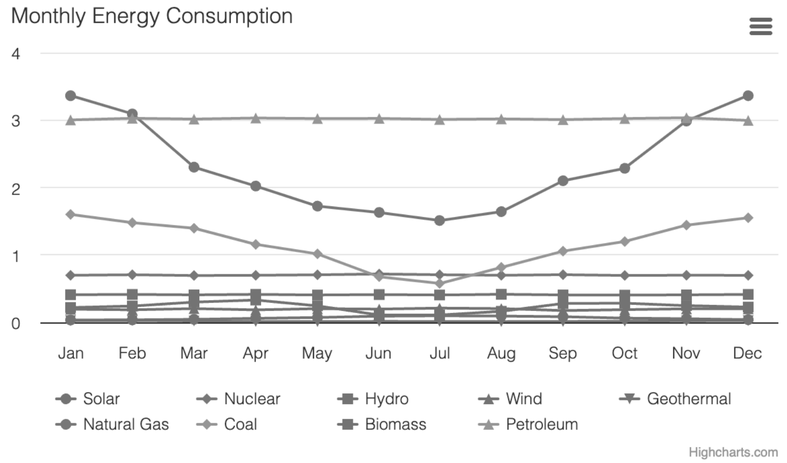
"[Make it yours]" is the motto for Apple's accessibility personalization

What if we *let* users personalize visualizations?









Interactive demo link

Resources

Chartability workbook
Chartability paper
Chartability super audit

Data Navigator demo
Data Navigator paper

Softerware demo
Softerware paper (pre-print)

Our repo of visualization + accessibility resources