see www.mjphd.net/Workshop/forFun.html if you want to try your hand at improving some questionable graphics.

EFFECTIVE COMMUNICATION OF SCIENTIFIC DATA

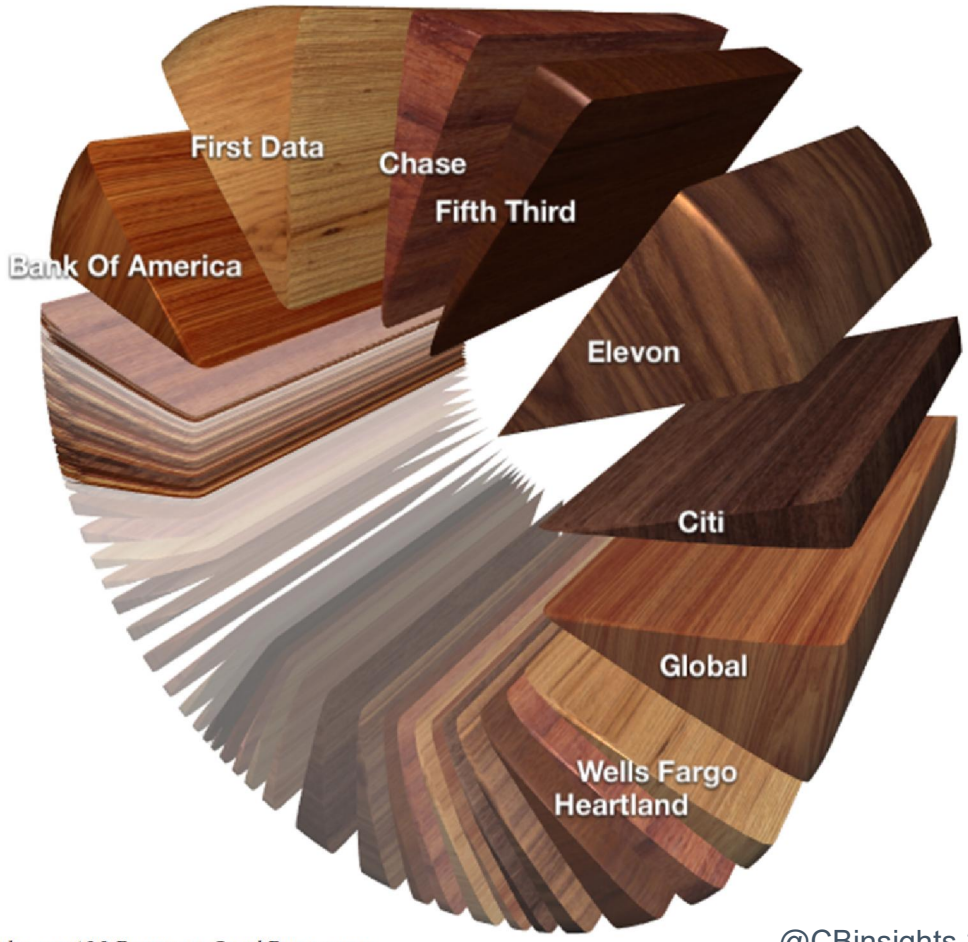
MARK JONES

EXECUTIVE EXTERNAL STRATEGY AND COMMUNICATIONS FELLOW

THE DOW CHEMICAL COMPANY

25 March 2021

The top 10 Payment Card Processors account for 57% of the total number of Merchant Outlets in 2010.



curated bad graphics

CB INSIGHTS

Distribution of the top 100 Payment Card Processors

@CBinsights 28 Jun 2017

COMMUNICATION HIERARCHY

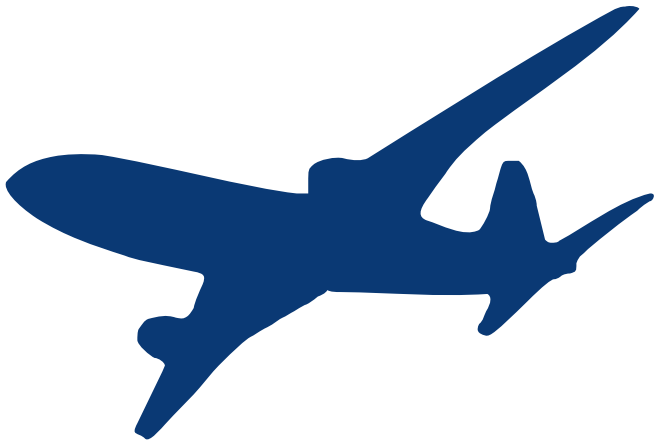
“Designing any communication ~~a presentation~~ without an audience in mind is like writing a love letter and addressing it ‘to whom it may concern’.”

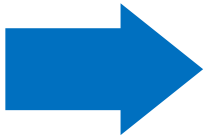
Ken Haemer
Presentation Research Manager,
AT&T

in HBR Guide to Persuasive Presentations

MIND READY

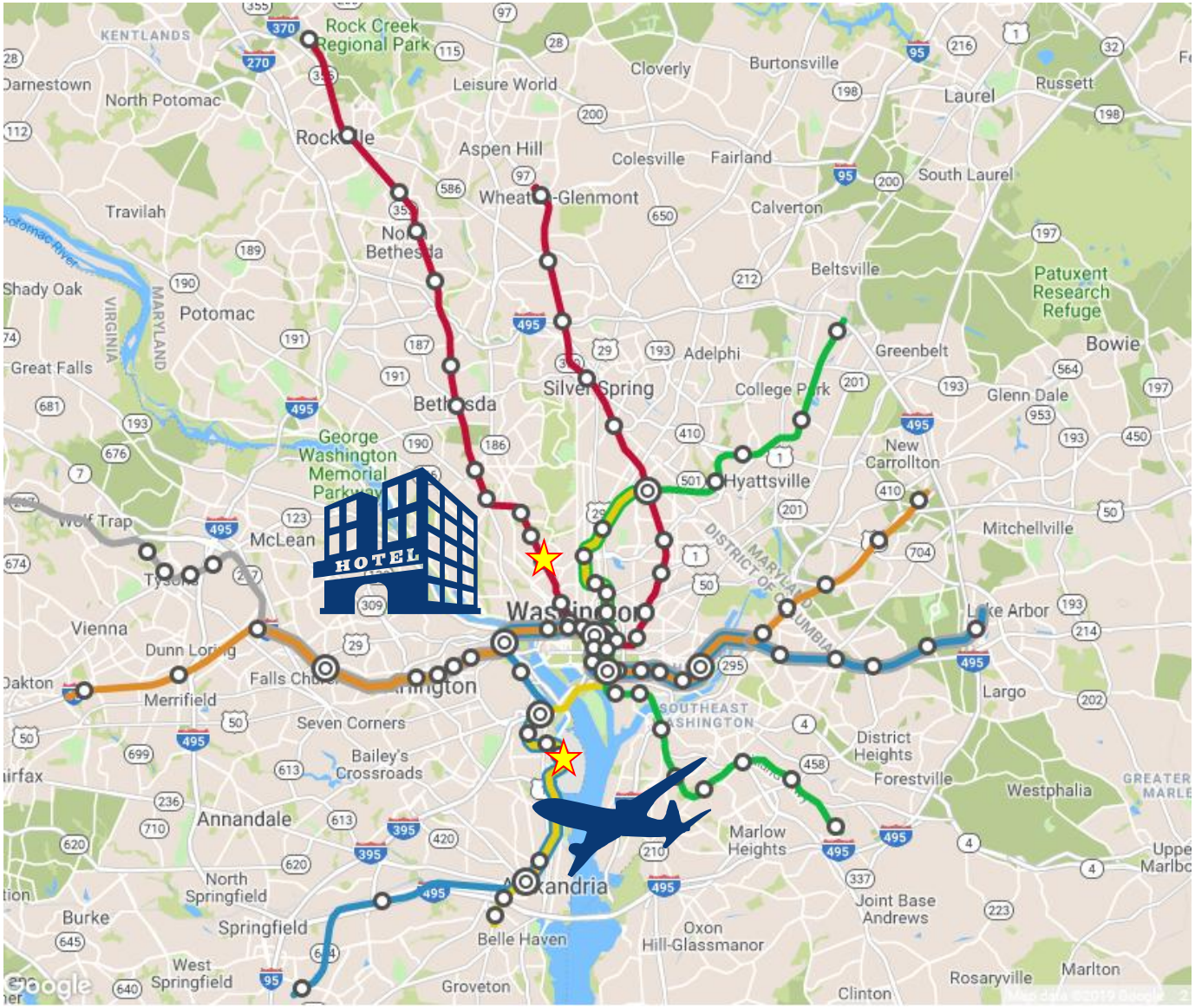
Washington, D.C.





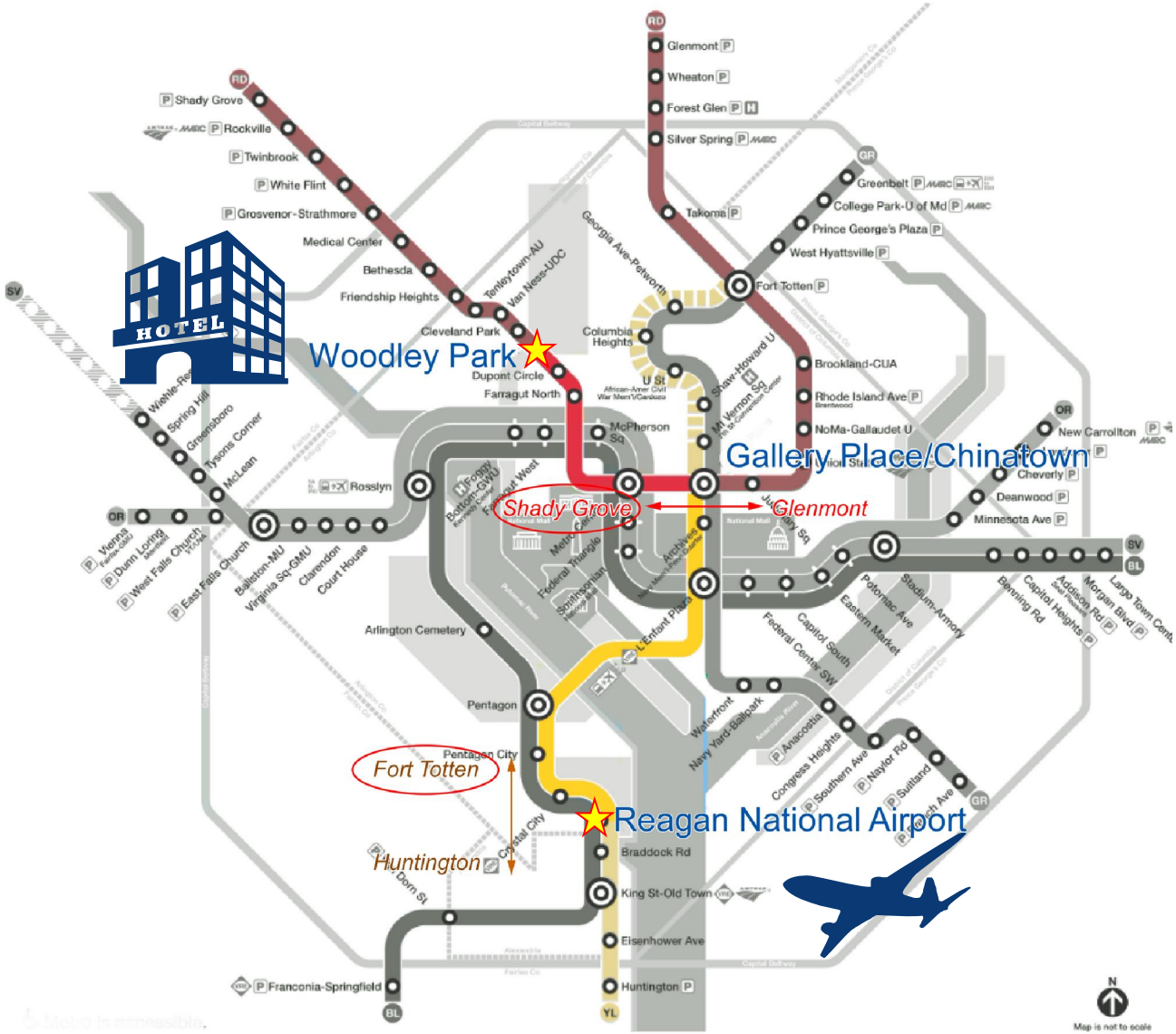
Reagan National Airport

Marriott Woodley Park


HOTEL
Rock Creek Regional Park
Leisure World
Cloverly
Burtonsville
Laurel
Russett
North Potomac
Rockville
Aspen Hill
Colesville
Fairland
South Laurel
Wheaton-Glenmont
Calverton
Travilah
Beltsville
Patuxent Research Refuge
Bowie
Shady Oak
Potomac
Great Falls
Adelphi
Greenbelt
Silver Spring
College Park
Glenn Dale
Bethesda
George Washington Memorial Parkway
New Carrollton
Hyattsville
Wolf Trap
McLean
Mitchellville
Vienna
Dunn Loring
Merrifield
Falls Church
Seven Corners
Lake Arbor
Largo
Bailey's Crossroads
District Heights
Forestville
Westphalia
Annandale
Marlow Heights
North Springfield
Springfield
Burke
Belle Haven
Oxon Hill-Glassmanor
Joint Base Andrews
West Springfield
Groveton
Rosaryville
Marlton
Clinton

HOTEL

HOTEL
RD
Glenmont
Wheaton
Forest Glen
Silver Spring
Takoma
Fort Totten
Brookland-CUA
Rhode Island Ave
NoMa-Gallaudet U
Union Station
Shady Grove
Rockville
Twinbrook
White Flint
Grosvenor-Strathmore
Medical Center
Bethesda
Friendship Heights
Tenleytown-AU
Van Ness-UDC
Cleveland Park
Woodley Park
Dupont Circle
Farragut North
McPherson Sq
Metro Center
Gallery Place
Judiciary Sq
Archives
L'Enfant Plaza
Federal Center SW
Capitol South
Eastern Market
Potomac Ave
Stadium-Armory
Benning Rd
Capitol Heights
Addison Rd
Morgan Blvd
Largo Town Center
Georgia Ave-Petworth
Columbia Heights
U St
Shaw-Howard U
Mt Vernon Sq
GR
Greenbelt
College Park-U of Md
Prince George's Plaza
West Hyattsville
OR
New Carrollton
Landover
Cheverly
Deanwood
Minnesota Ave
SV
BL
Wiehle-Reston E
Spring Hill
Greensboro
Tysons Corner
McLean
Rosslyn
Foggy Bottom-GWU
Farragut West
Vienna
Dunn Loring
West Falls Church
East Falls Church
Ballston-MU
Virginia Sq-GMU
Clarendon
Court House
Arlington Cemetery
Pentagon
Pentagon City
Crystal City
Ronald Reagan Washington National Airport
Braddock Rd
King St-Old Town
Eisenhower Ave
Huntington
YL
Van Dorn St
Franconia-Springfield
Waterfront
Navy Yard-Ballpark
Anacostia
Congress Heights
Southern Ave
Naylor Rd
Suitland
Branch Ave
Metro is accessible.
N
Map is not to scale


HOTEL
Woodley Park
Gallery Place/Chinatown
Reagan National Airport
Shady Grove
Glenmont
Fort Totten
Huntington
Shady Grove
Rockville
Twinbrook
White Flint
Grosvenor-Strathmore
Medical Center
Bethesda
Friendship Heights
Tenleytown-AU
Van Ness-UDC
Cleveland Park
Columbia Heights
Georgia Ave-Petworth
Dupont Circle
Farragut North
U St
Shaw-Howard U
Glenmont
Wheaton
Forest Glen
Silver Spring
Takoma
Fort Totten
Greenbelt
College Park-U of Md
Prince George's Plaza
West Hyattsville
Brookland-CUA
Rhode Island Ave
NoMa-Gallaudet U
New Carrollton
Cheverly
Deanwood
Minnesota Ave
Largo Town Cente
Morgan Blvd
Addison Rd
Capitol Heights
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L'Enfant Plaza
Arlington Cemetery
Pentagon
Pentagon City
Crystal City
Braddock Rd
King St-Old Town
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Franconia-Springfield
Vienna
Dunn Loring
West Falls Church
East Falls Church
Ballston-MU
Virginia Sq-GMU
Clarendon
Court House
Wiehle-Reston East
Spring Hill
Greensboro
Tysons Corner
McLean
Map is not to scale

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Cheverly
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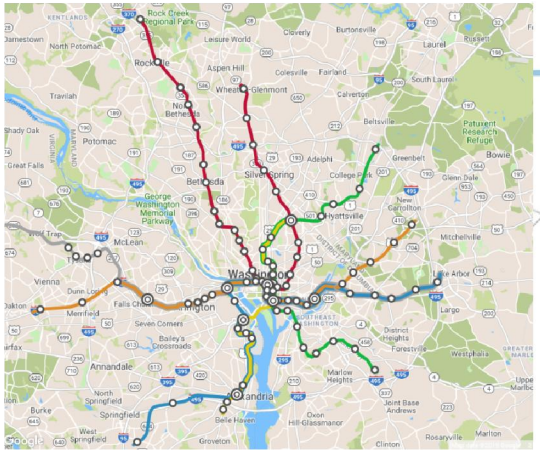
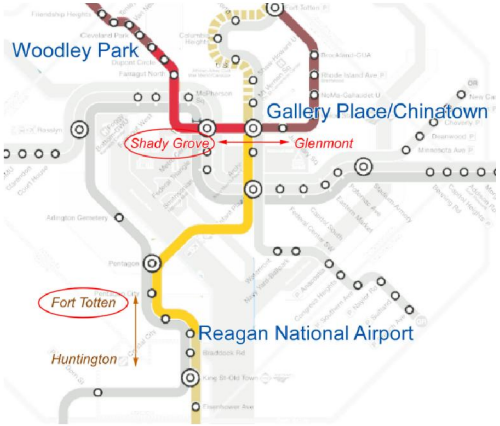
Minnesota Ave
Arlington Cemetery
Pentagon
Pentagon City
Braddock Rd
King St-Old Town
Eisenhower Ave

SIMPLICITY

Everything should be made as simple as possible, but not simpler.

Albert Einstein




Woodley Park
Gallery Place/Chinatown
Shady Grove
Glenmont
Fort Totten
Reagan National Airport
Huntington

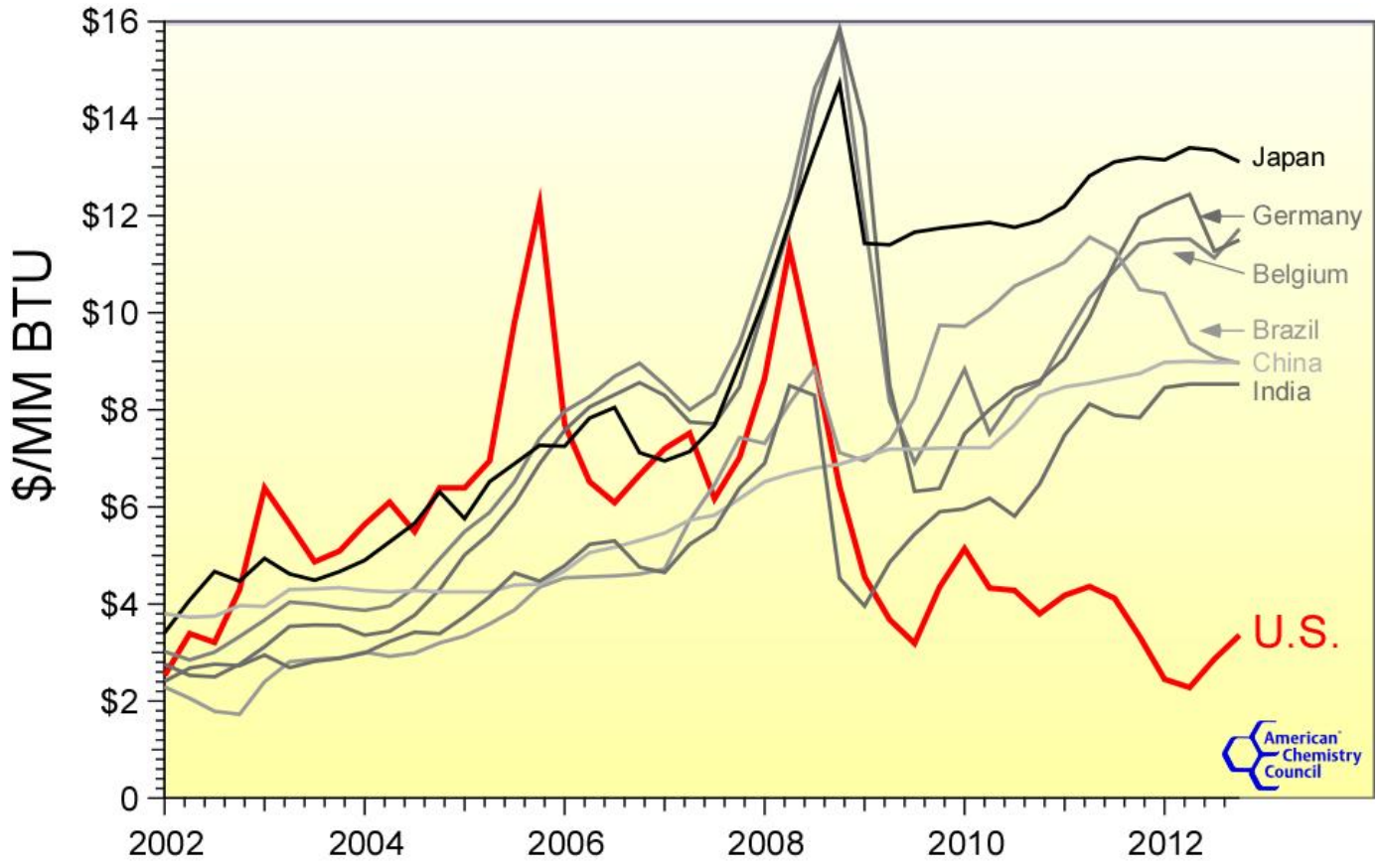
Five Principles of Data Presentation

- Tell the truth
- Get to the point
- Pick the right tool
- Highlight what is important
- Keep it ~~simple~~ **appropriate**

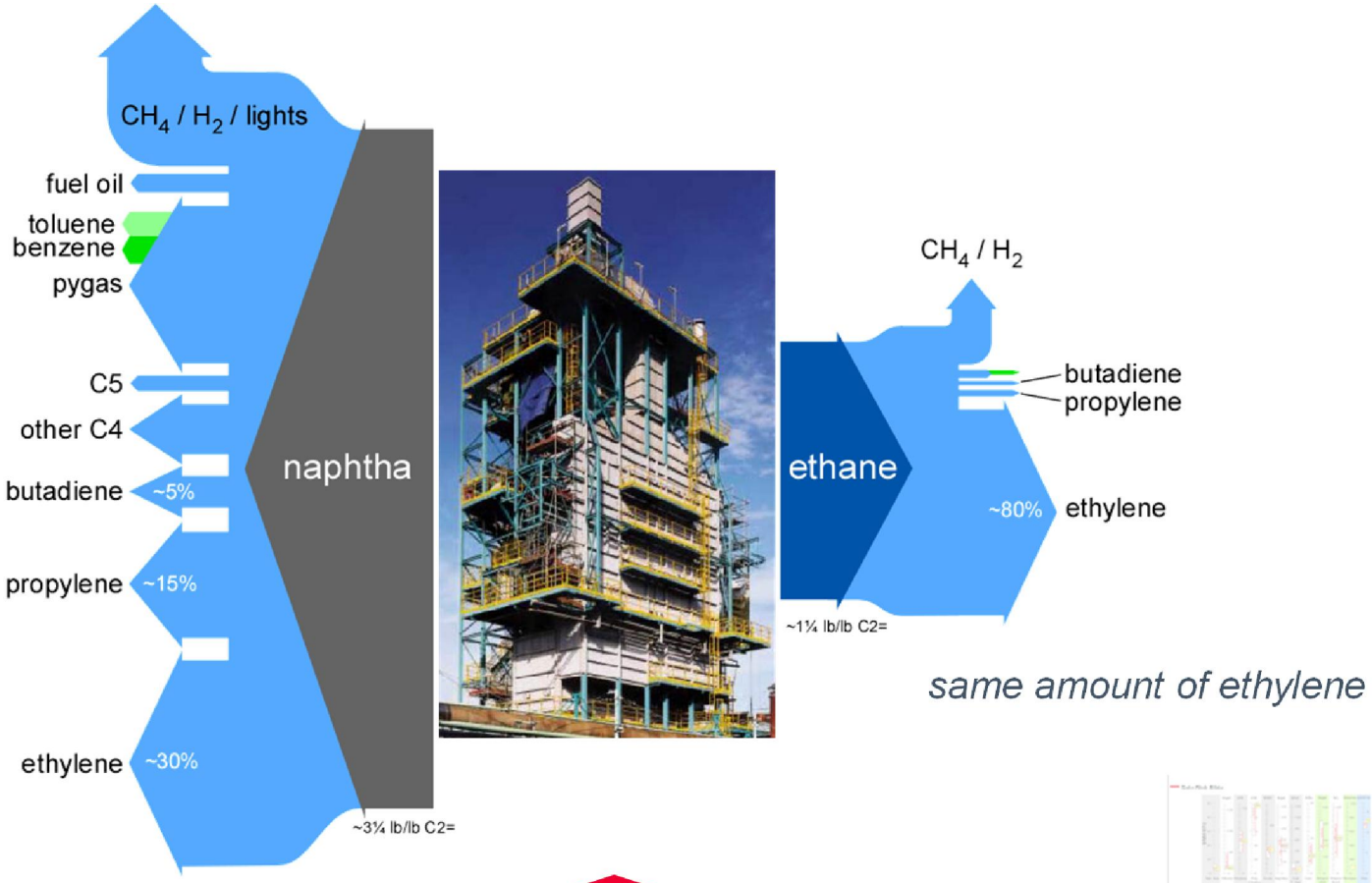
Everything should be made as simple as possible, but not simpler.

Nancy Duarte in Slideology

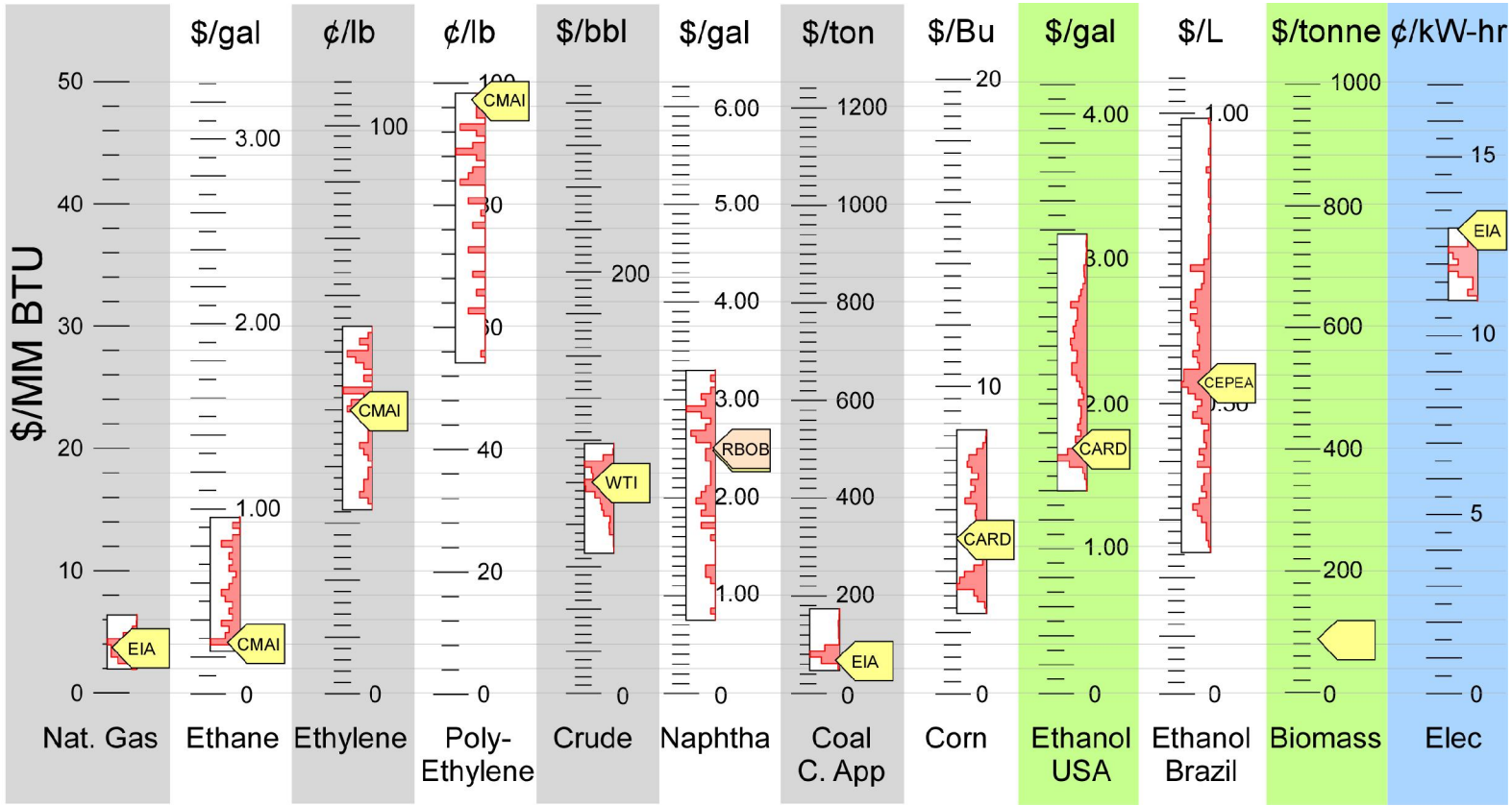
World Natural Gas Prices



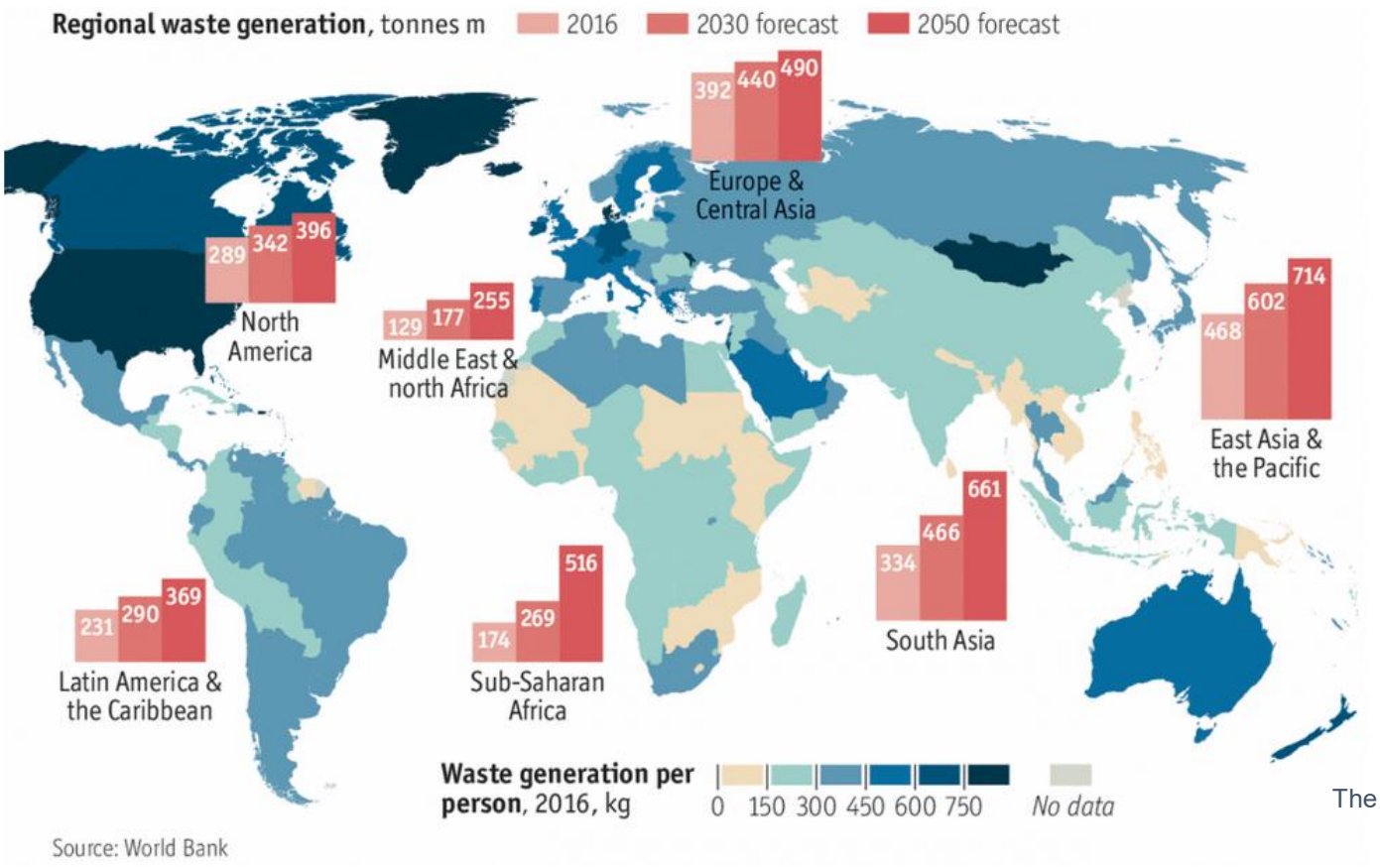
NAPHTHA VS ETHANE CRACKING COMPARISON



DATA RICH SLIDE

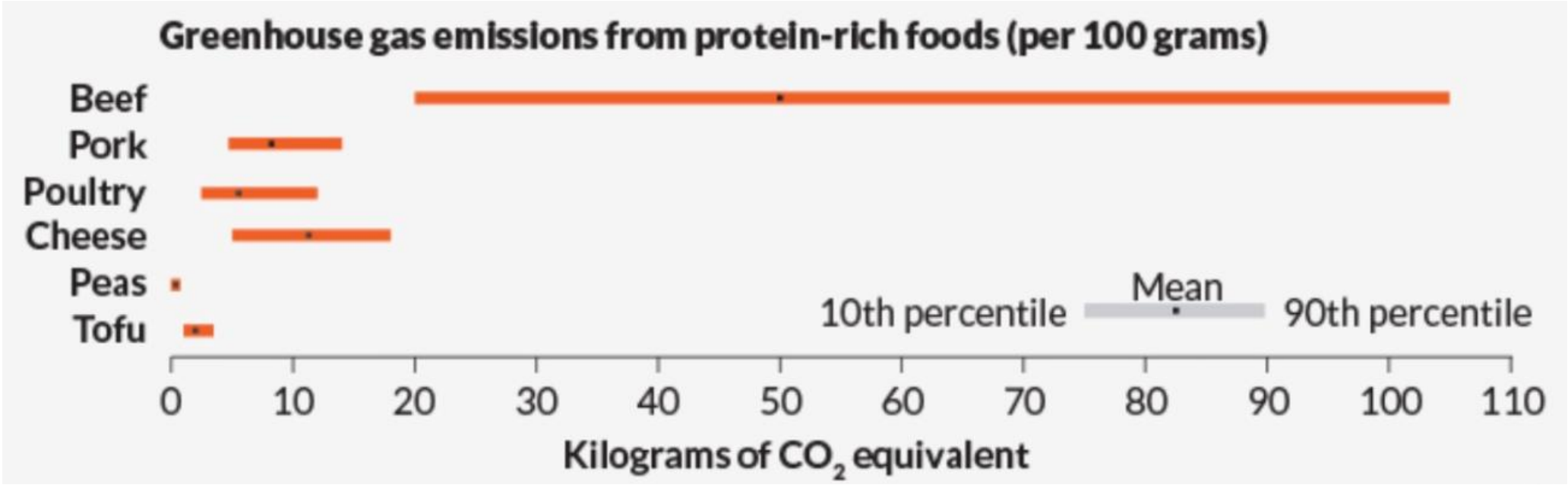


LOTS OF INFORMATION – THROWAWAY WORLD



The Economist; 2 Oct 2018

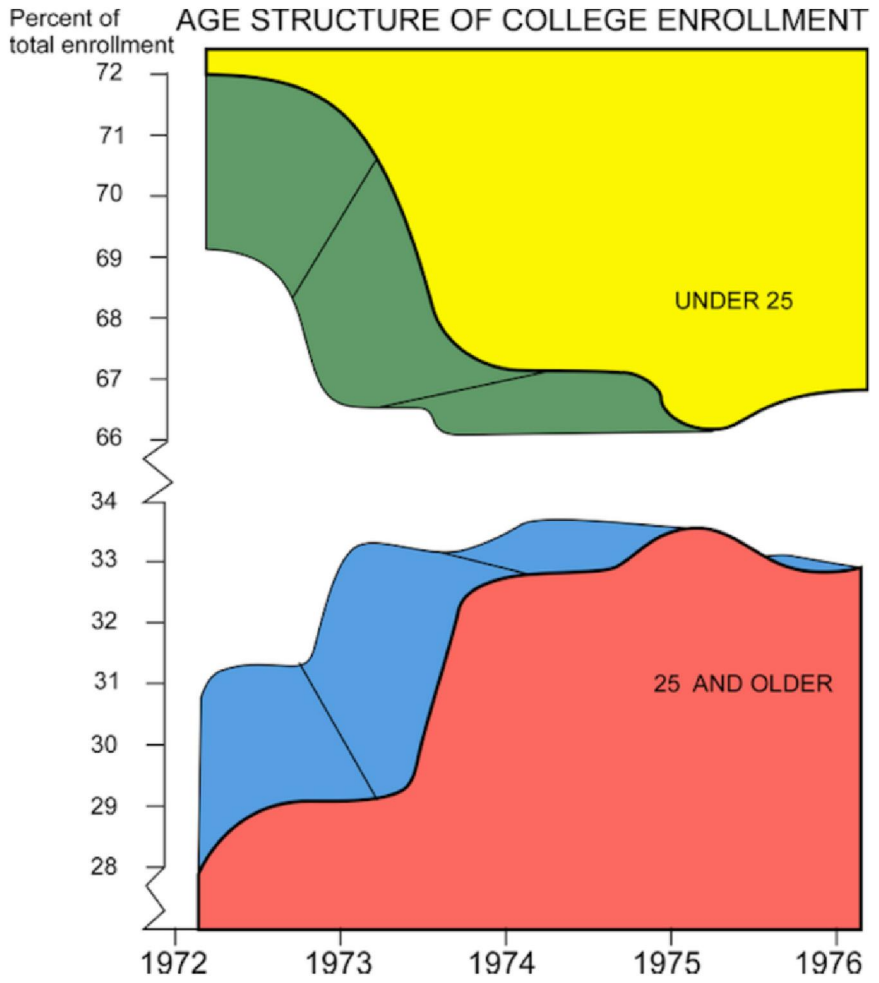
FARM TO TABLE



graphic by C. Chang in Milius, Susan; "Can science build a better burger?", *Science News*, September 20, 2018 downloaded from sciencenews.org/article/can-science-build-better-burger on 2 November 2018.

Edward Tufte's Five Principles of Data Presentation

1. Above all else show the data
2. Maximize the data-ink ratio
3. Erase non-data ink
4. Erase redundant data
5. Revise and Edit.



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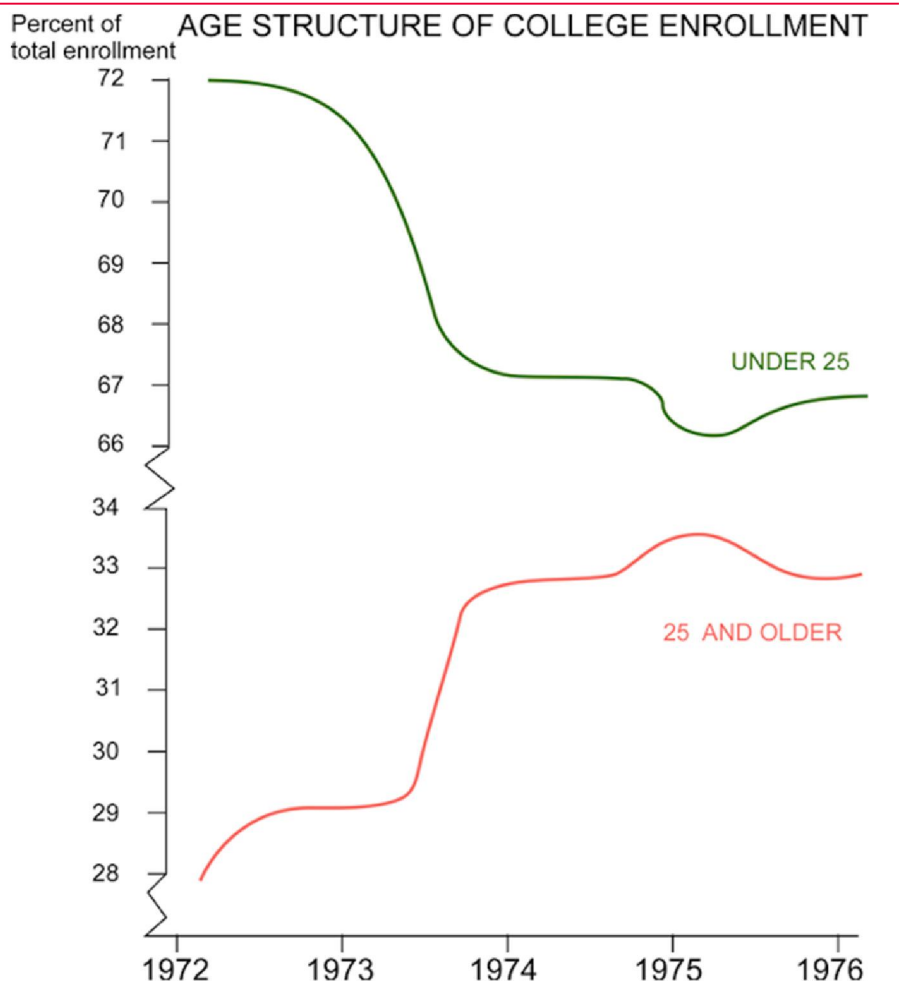

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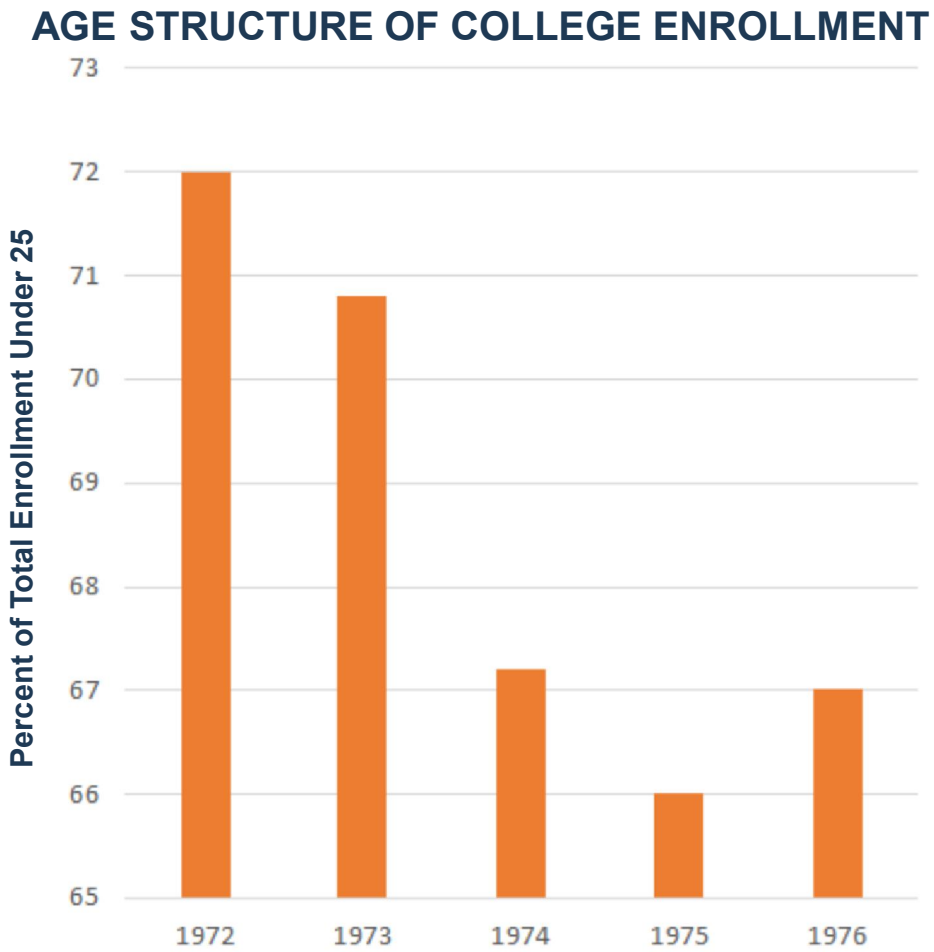


Edward Tufte's Five Principles of Data Presentation

Pick the right tool

1. Above all else show the data

Tell the truth

2. Maximize the data-ink ratio

Get to the point

3. Erase non-data ink

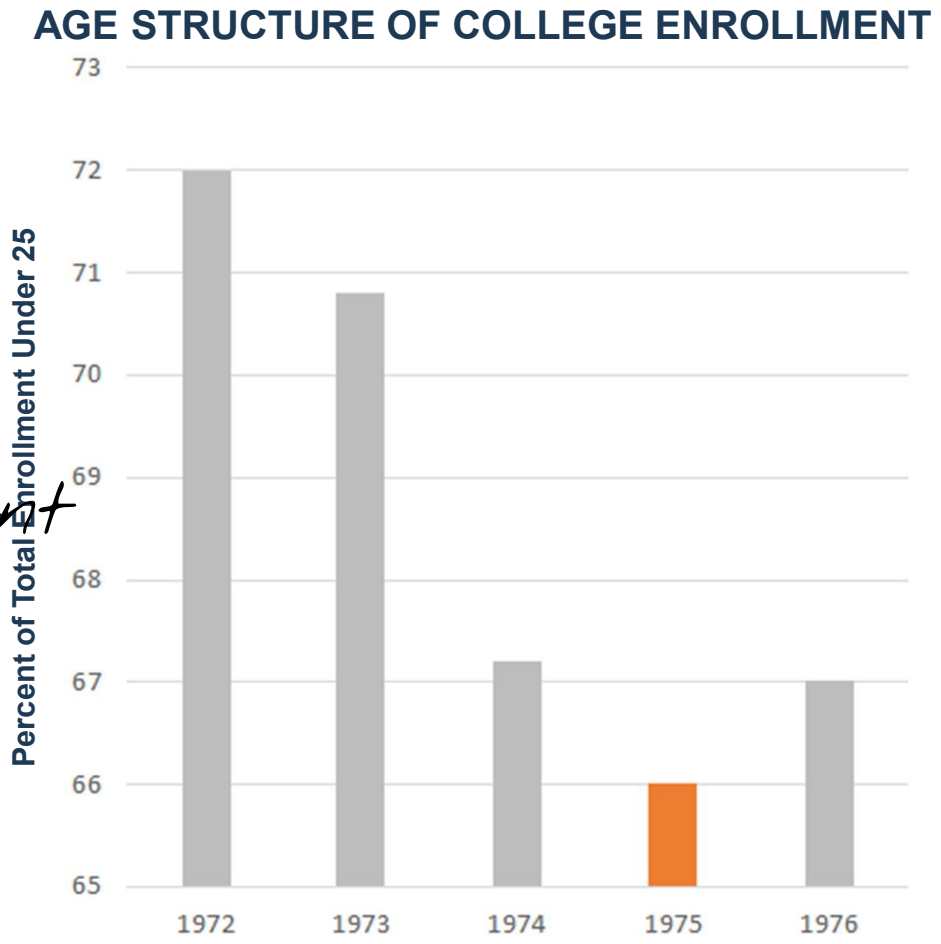
Highlight what is important

4. Erase redundant data

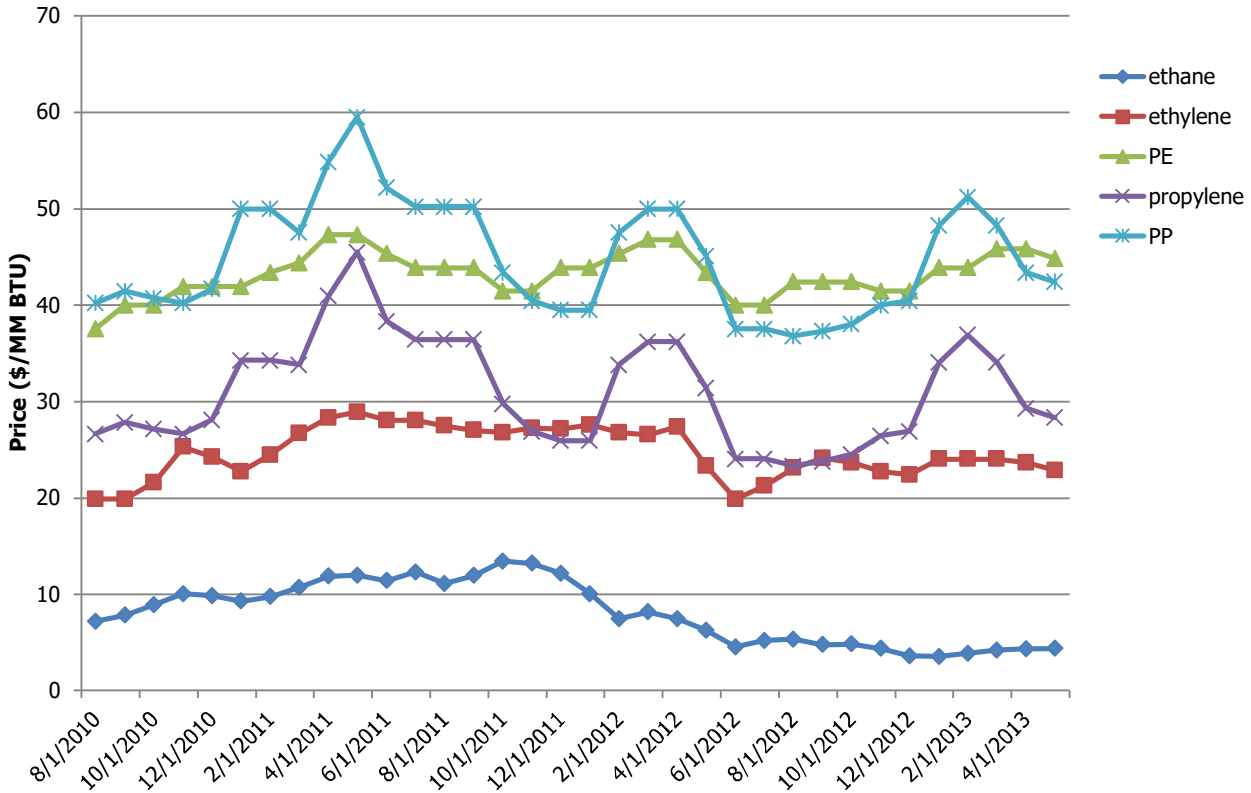
Get to the point

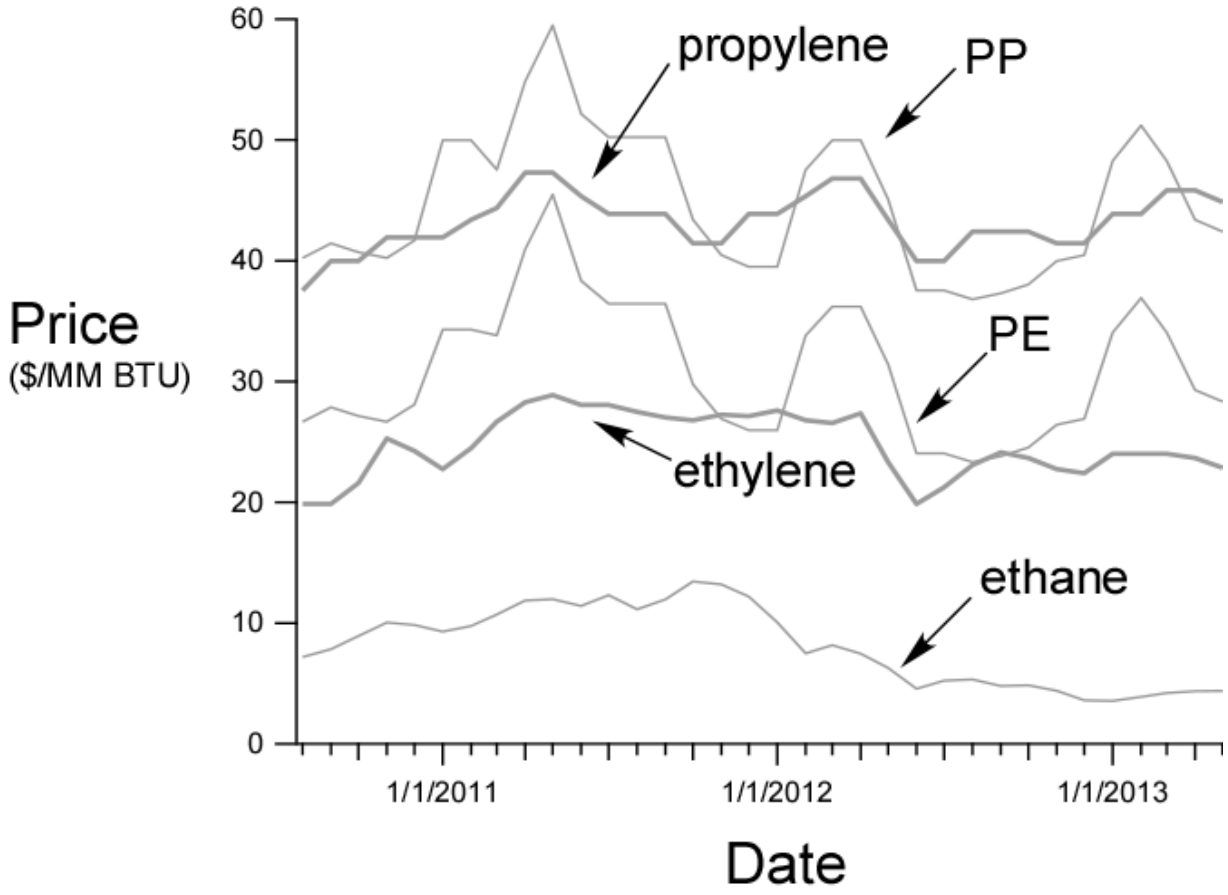
5. Revise and Edit.

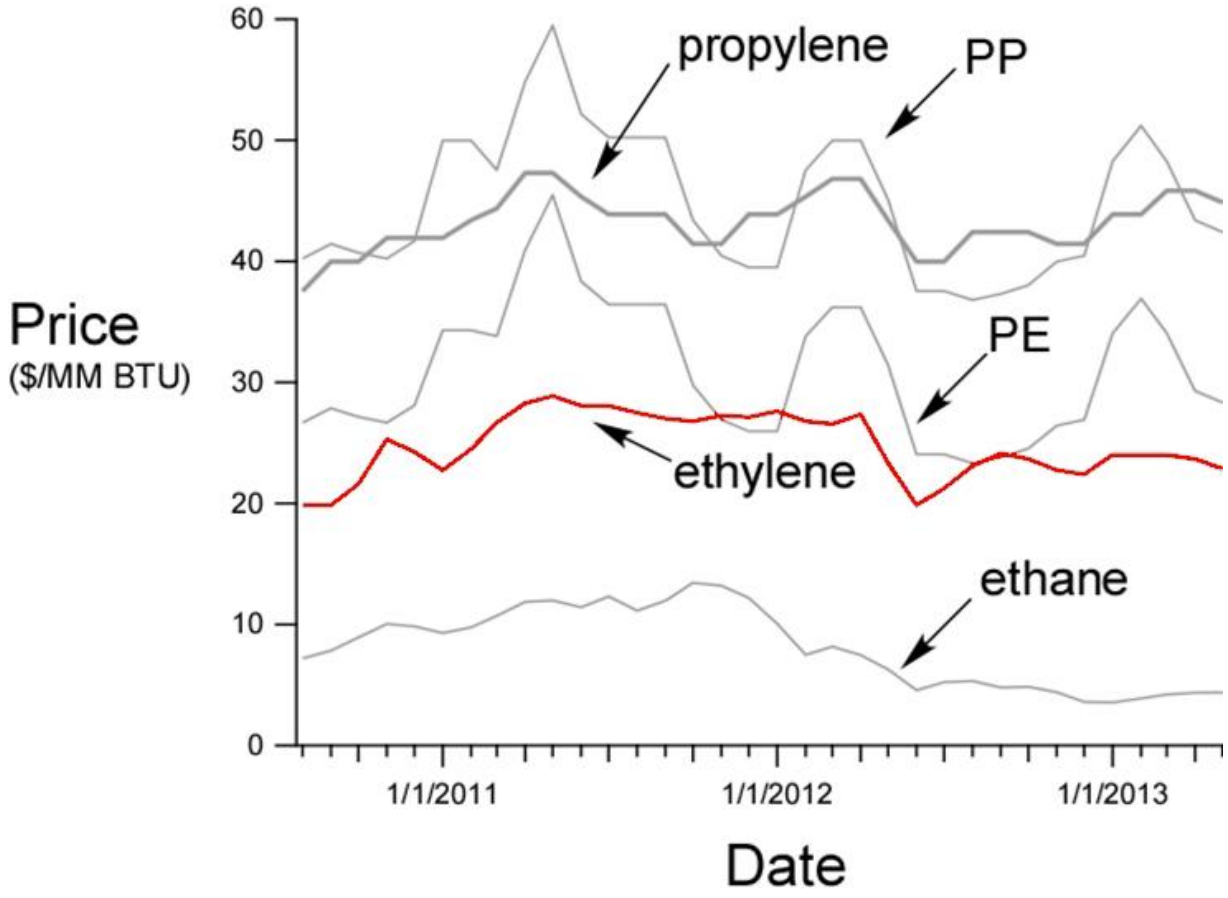
Keep it appropriate



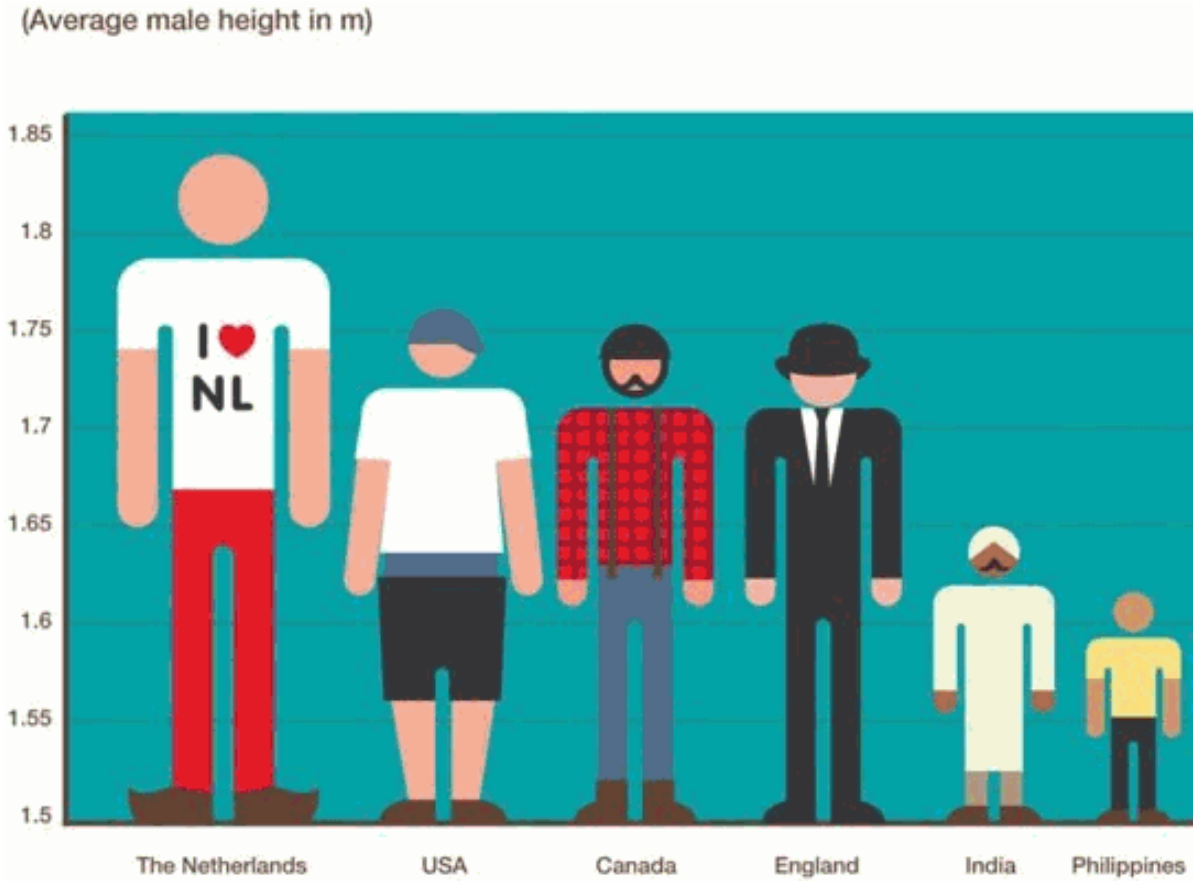
STANDARD EXCEL PLOT




Price
($/MM BTU)
60
50
40
30
20
10
0
propylene
PP
PE
ethylene
ethane
1/1/2011
1/1/2012
1/1/2013
Date

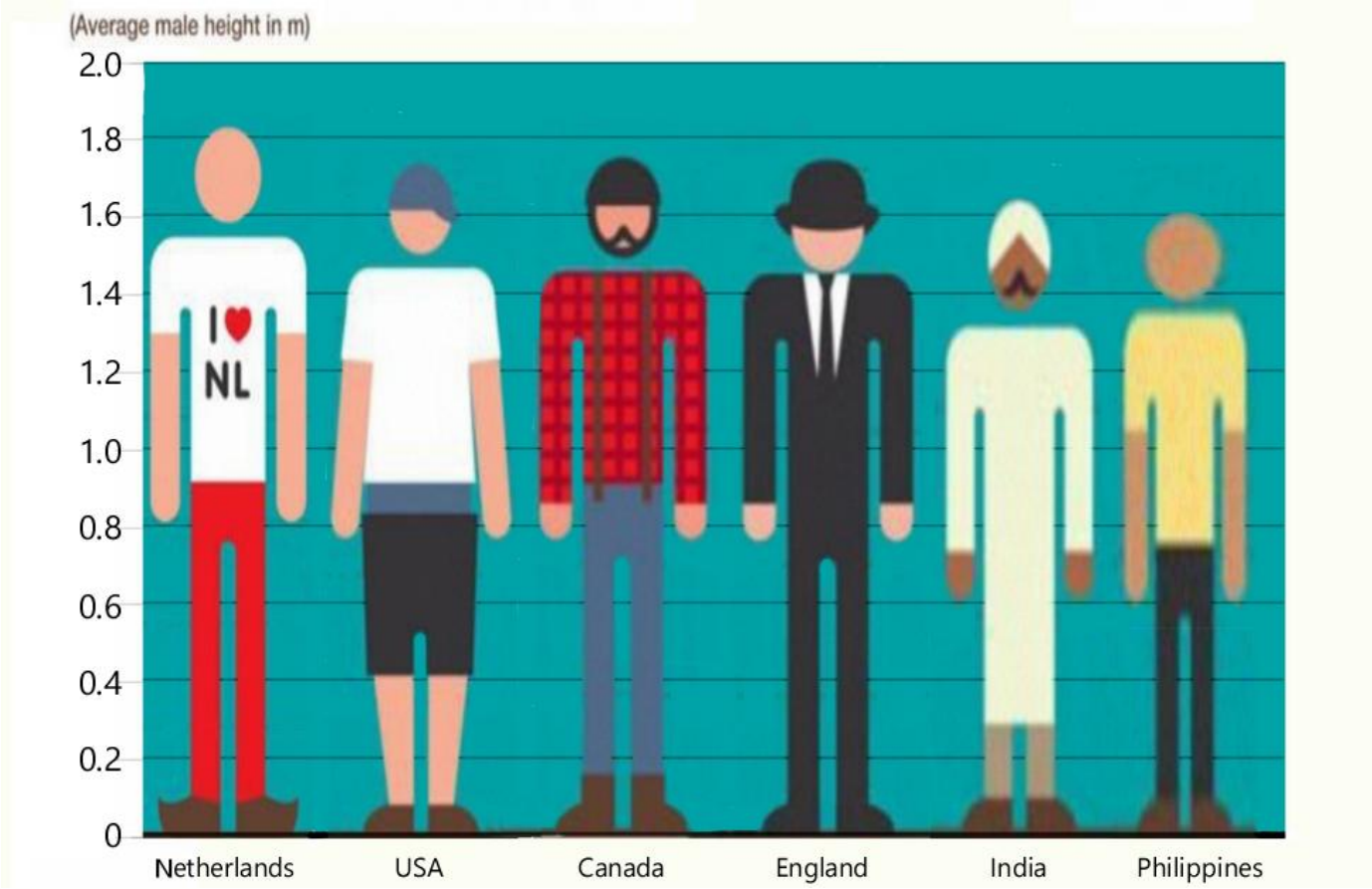

Price
($/MM BTU)
60
50
40
30
20
10
0
propylene
PP
PE
ethylene
ethane
1/1/2011
1/1/2012
1/1/2013
Date

Bad Graphs – Looking Down on the Rest of the World

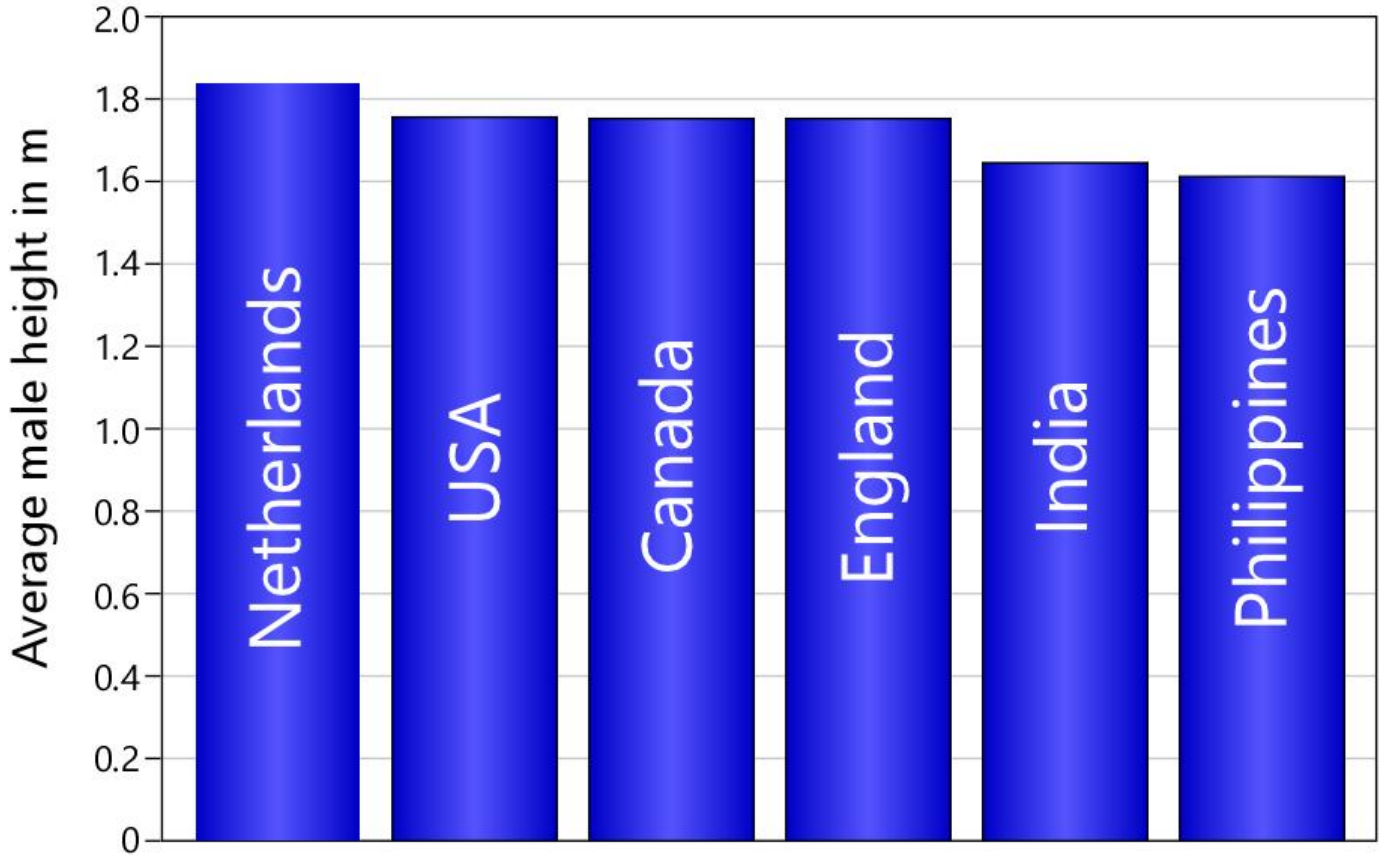


ticktockmaths.co.uk/bad-graphs/

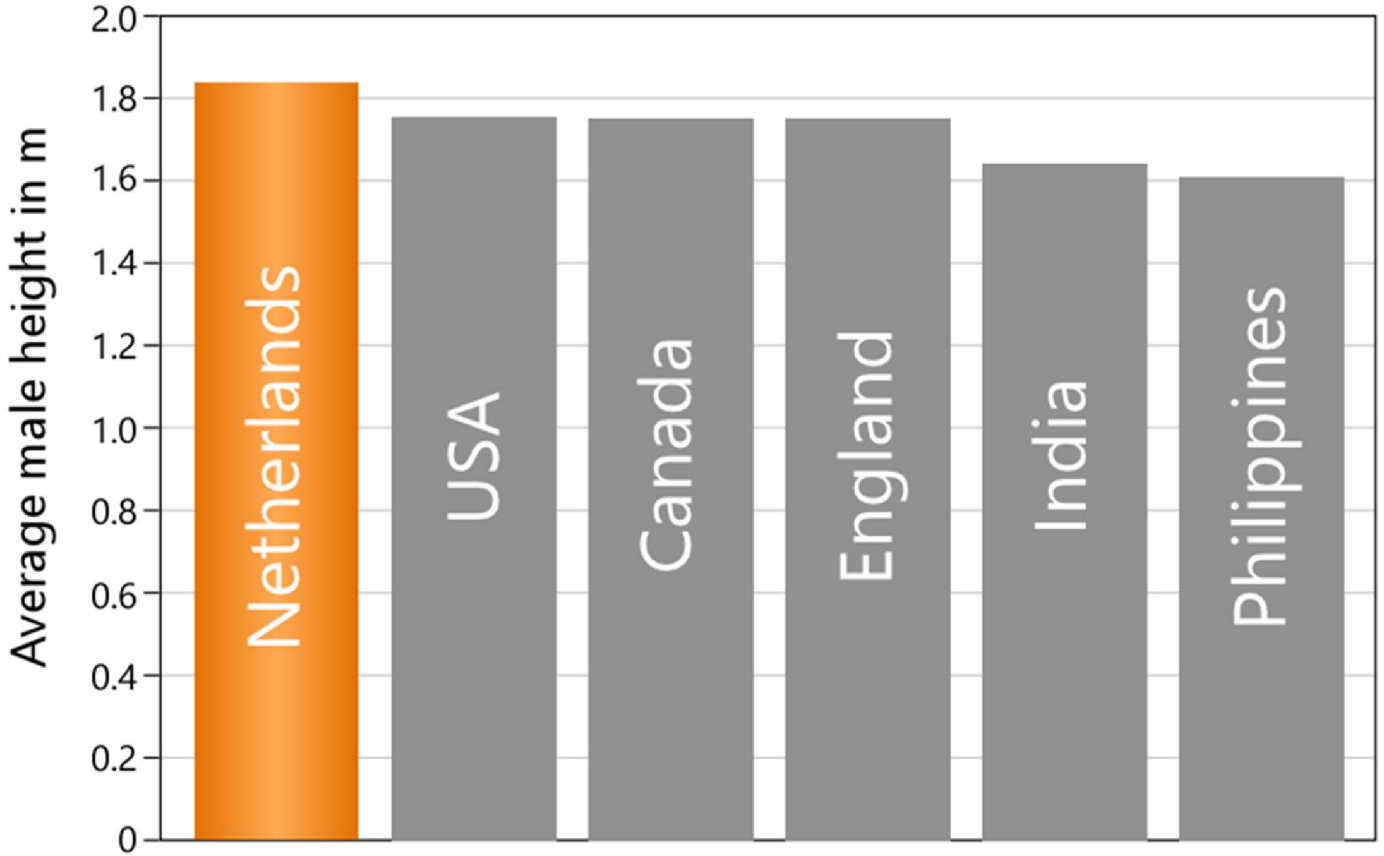
BETTER – BUT NOT GOOD ENOUGH



BETTER GRAPH

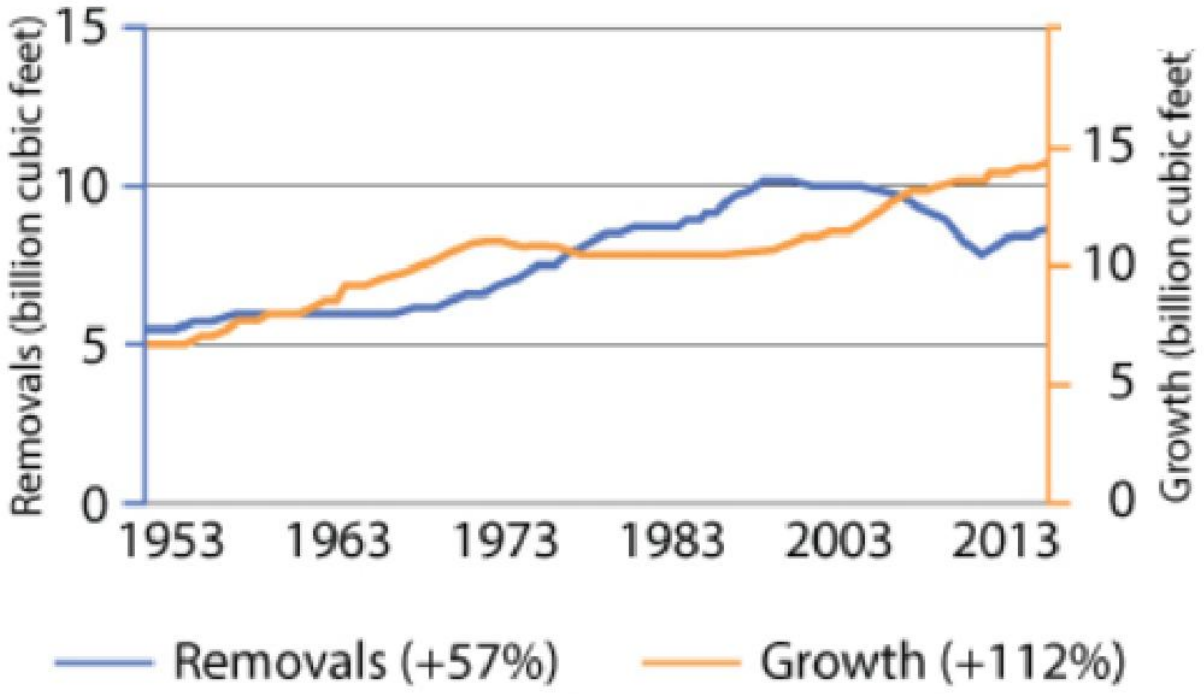


MAKING THE POINT



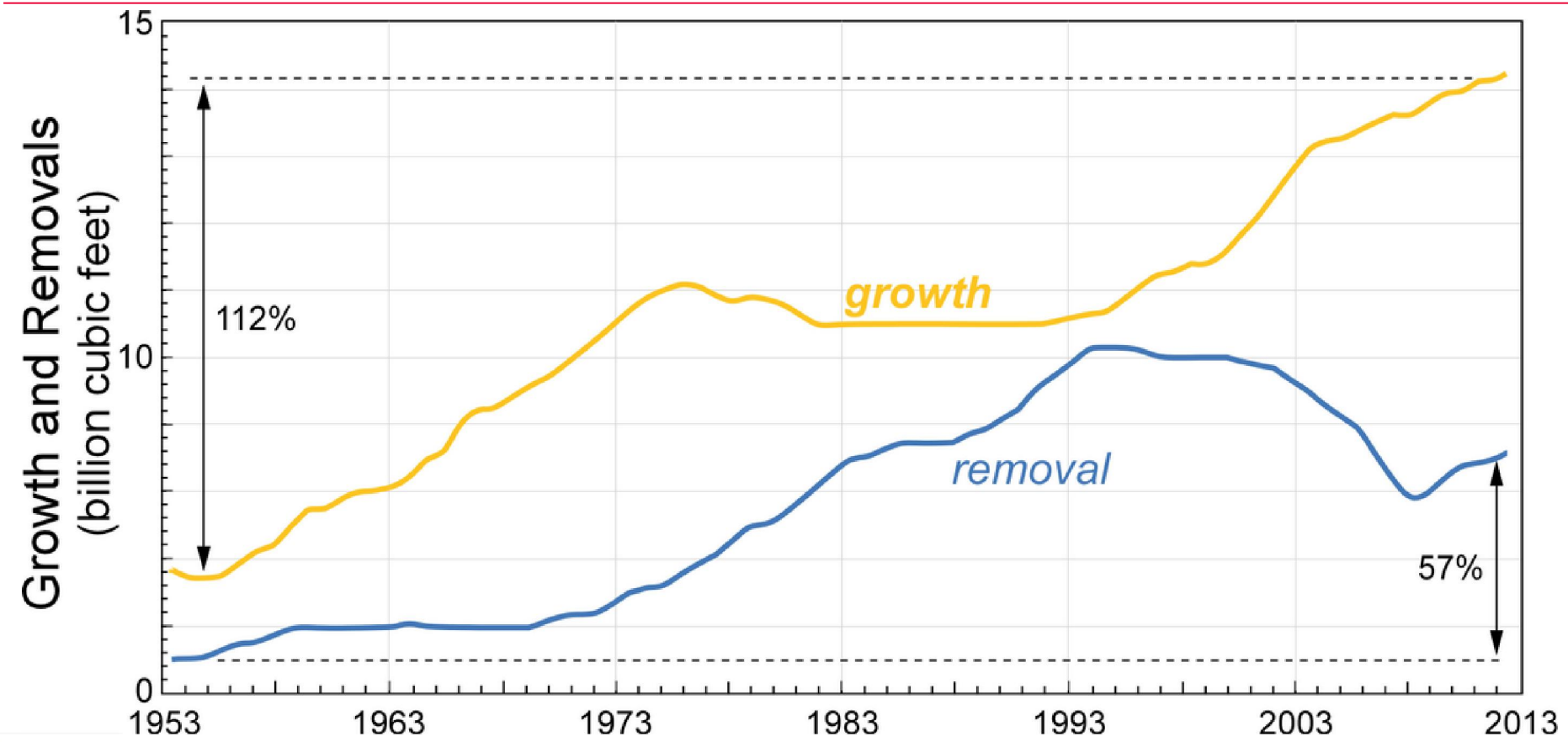
AXIS GAMES

Southern Timber Removals and Growth

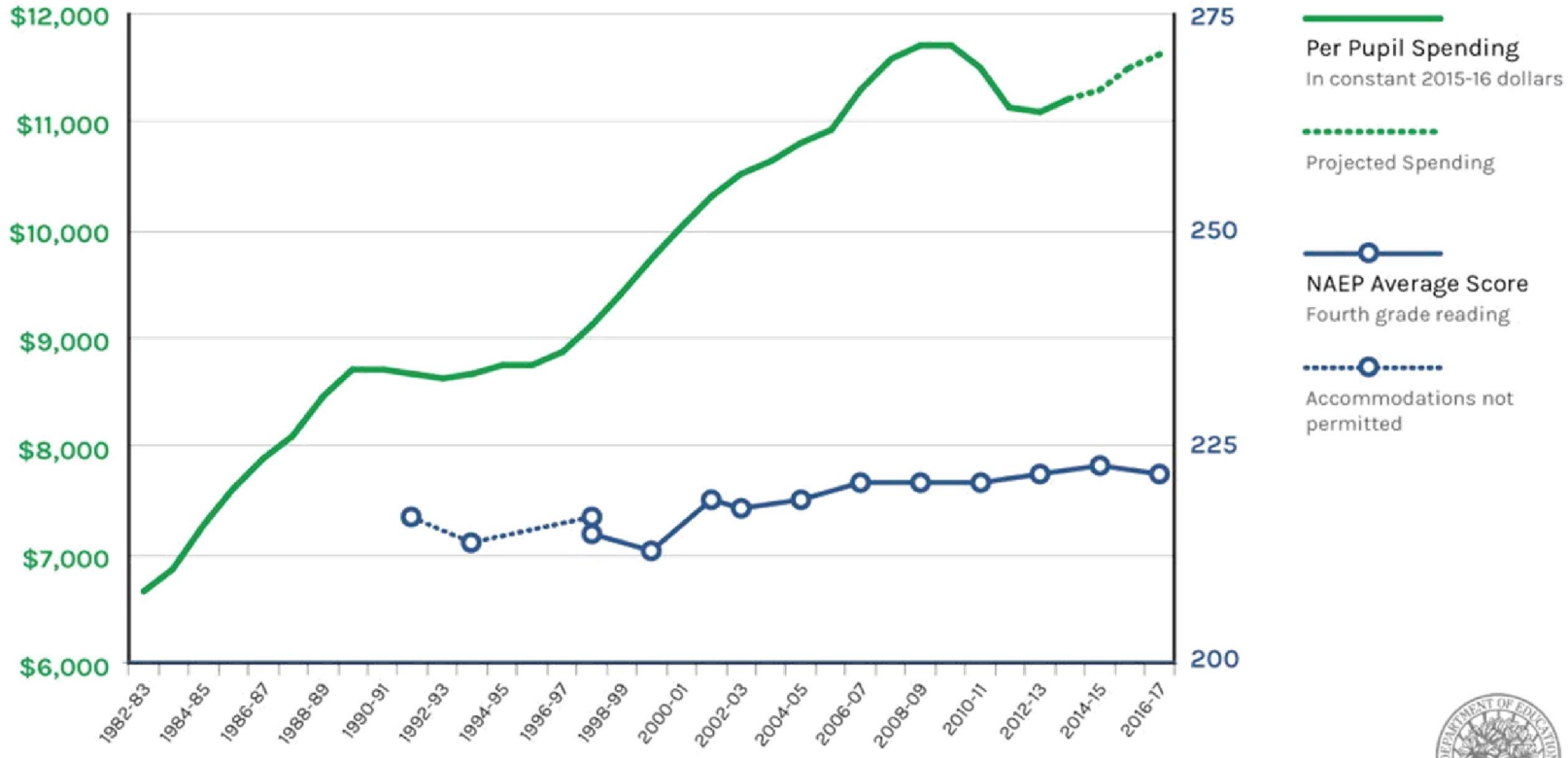


biomassmagazine.com/articles/15210/healthy-demand-for-southern-timber-ensures-forested-lands-remain-forested

SOUTHERN TIMBER



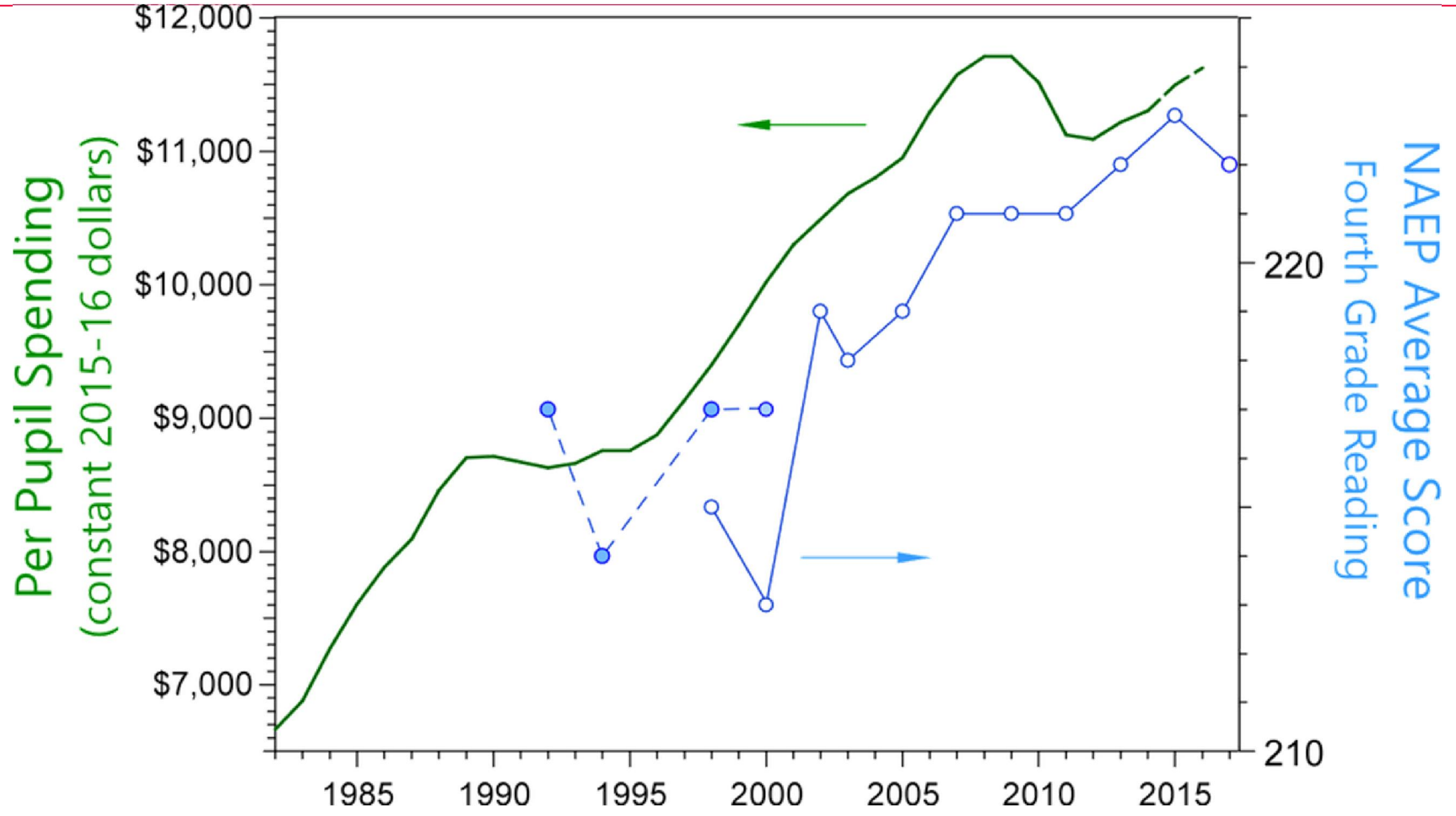
GAMES WITH 2 AXES



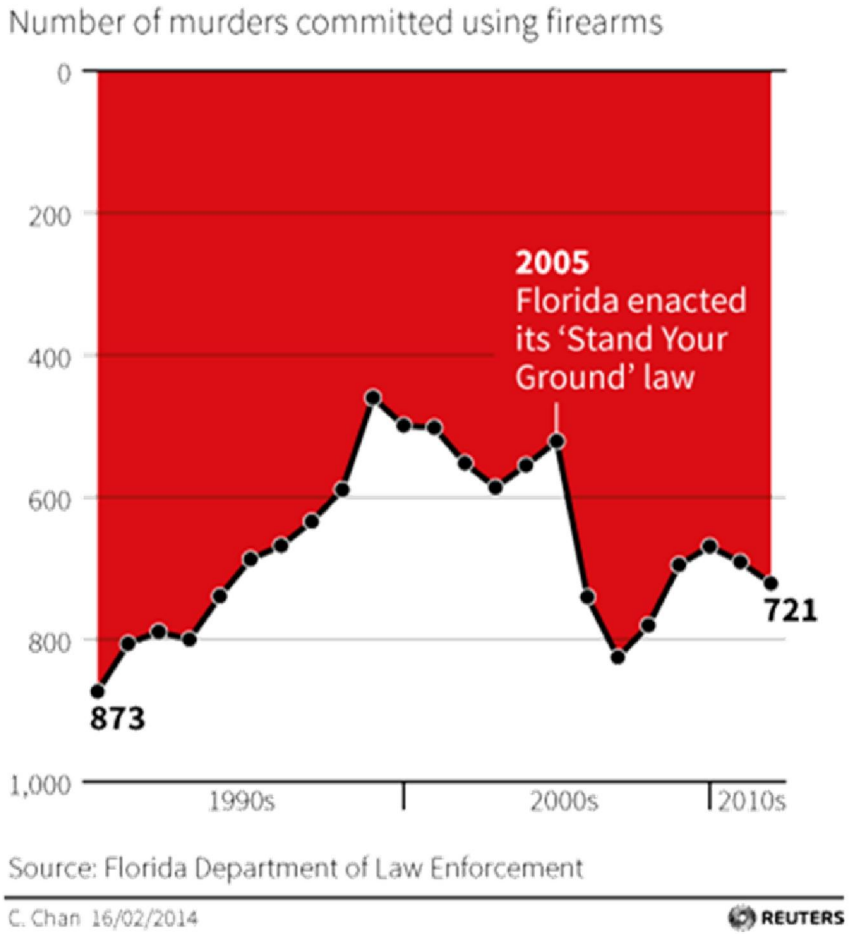
Source: U.S. Department of Education, National Center for Education Statistics, Revenues and Expenditures for Public Elementary and Secondary Education, 1970–71 through 1986–87; Common Core of Data (CCD), "National Public Education Financial Survey," 1987–88 through 2013–14; National Elementary and Secondary Enrollment Projection Model, 1972 through 2026; Public Elementary and Secondary Education Current Expenditure Projection Model, 1973–74 through 2026–27; and National Assessment of Educational Progress, Reading Report Card, 2017

http://www.shankerinstitute.org/blog/we-cant-graph-our-way-out-research-education-spending

More Honest Axes

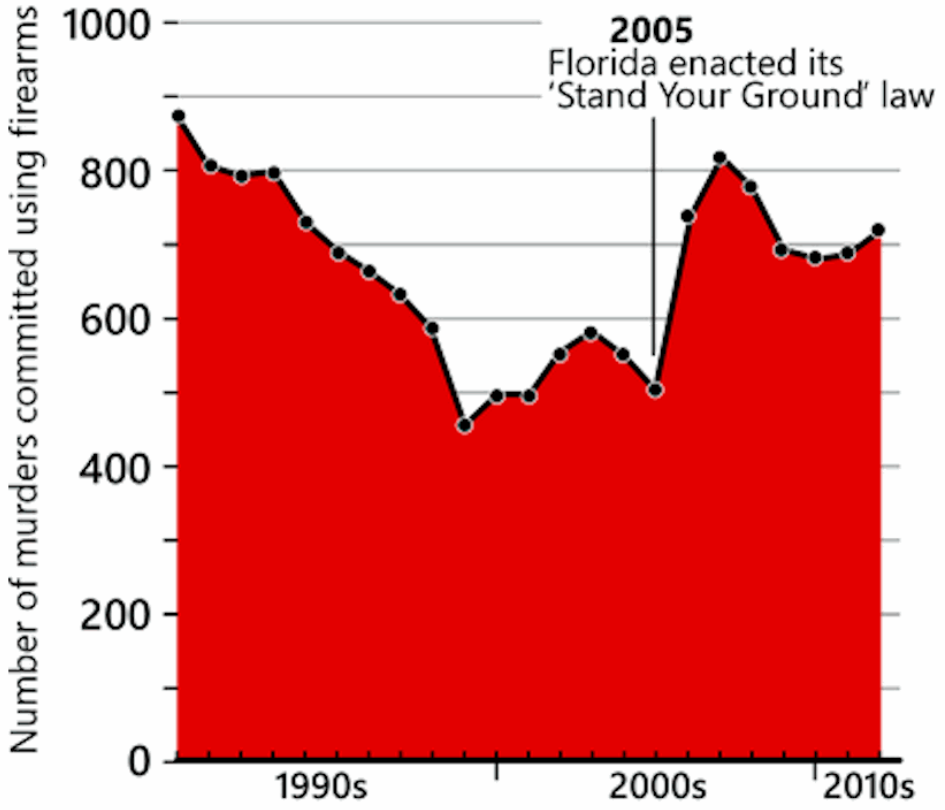


Axis Games - Gun deaths in Florida



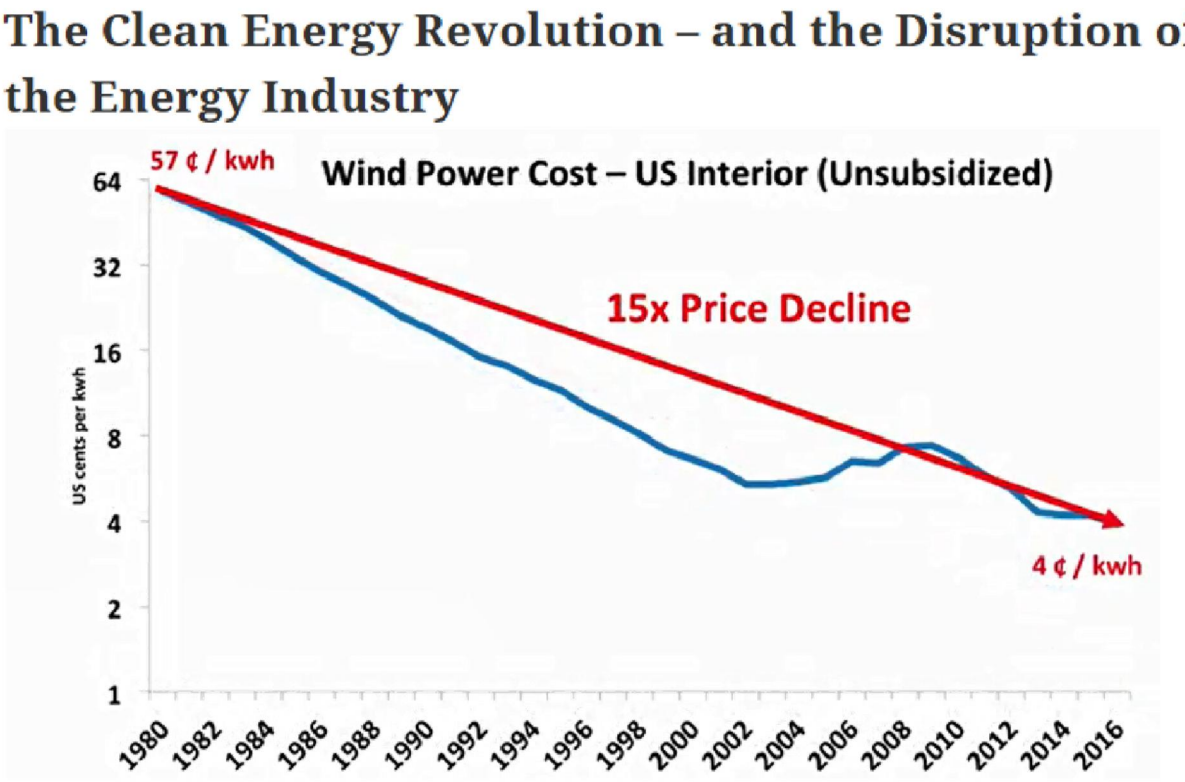
methodsavvy.com/good-data-bad-graphs/

Gun deaths in Florida



Source: Florida Dept of Law Enforcement

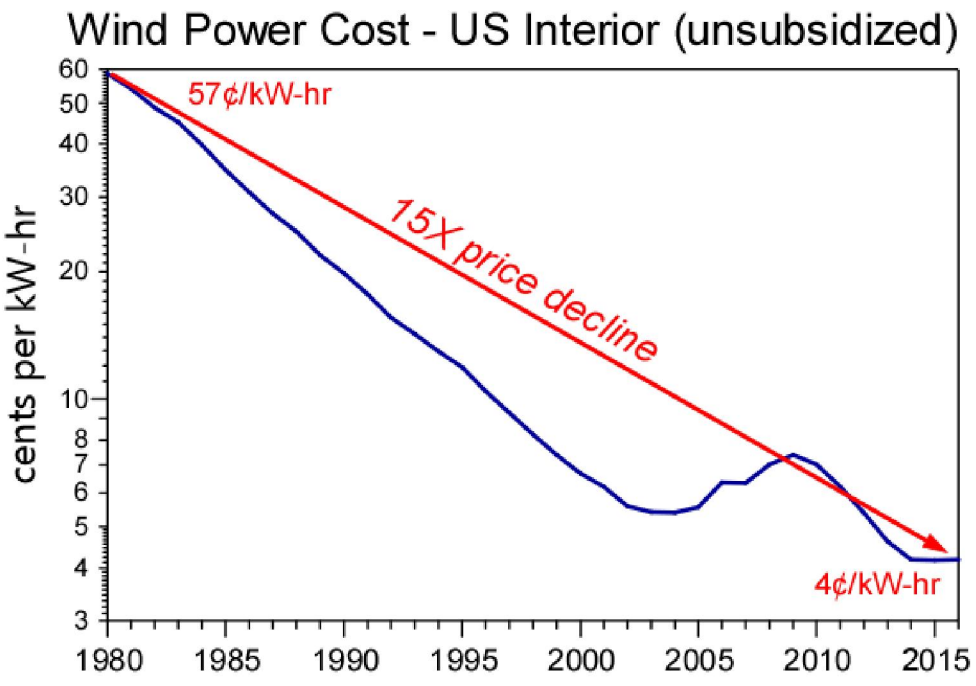
Axis Games – Hidden Log Axis

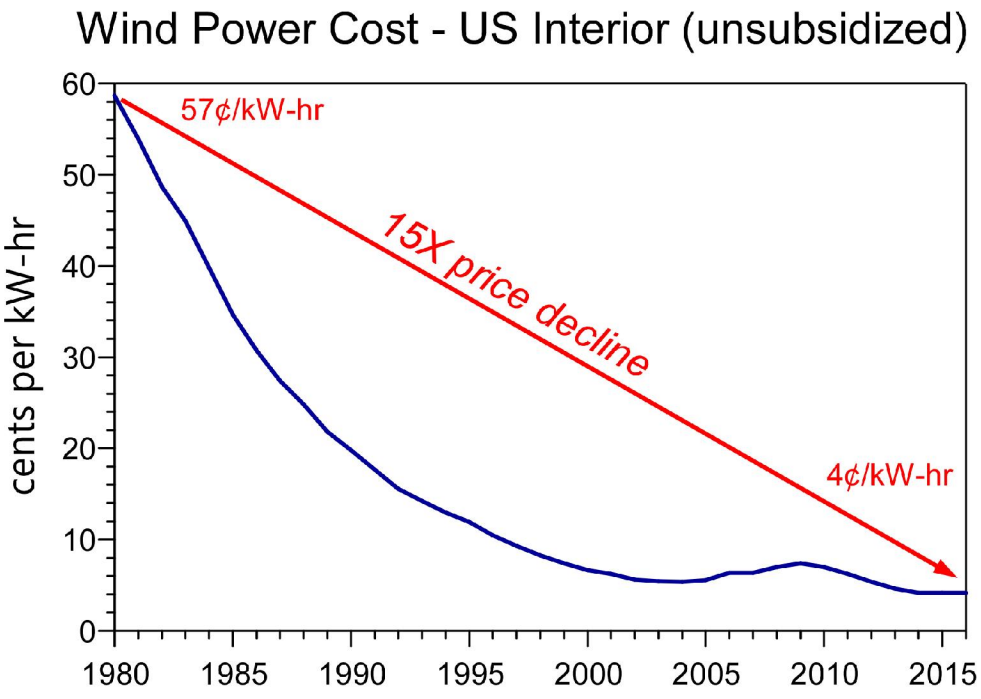


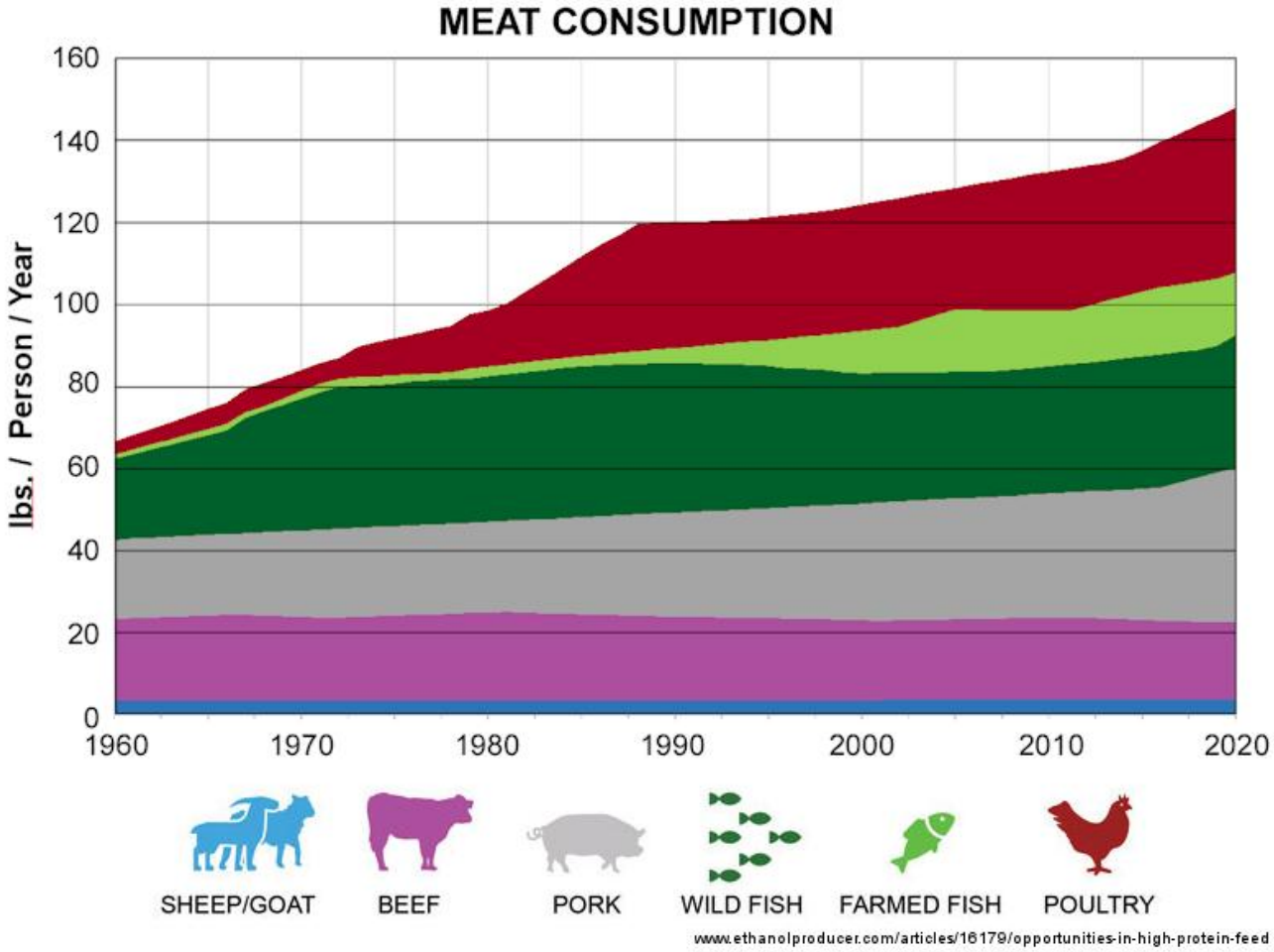
rameznaam.com/ video "The Clean Energy Revolution – and the Disruption of the Energy Industry",

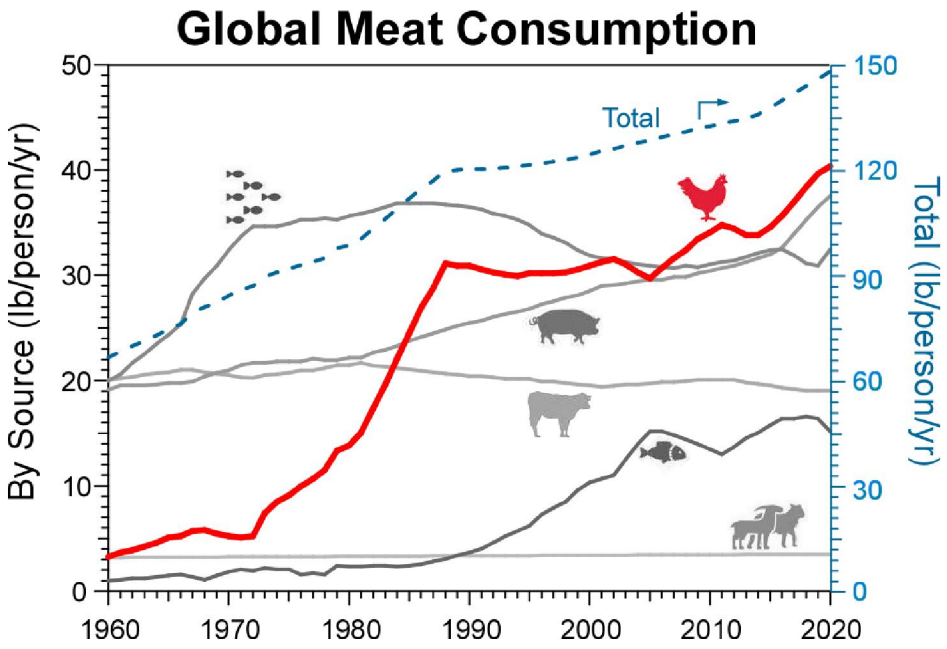
youtu.be/fwSkQa1tNmE

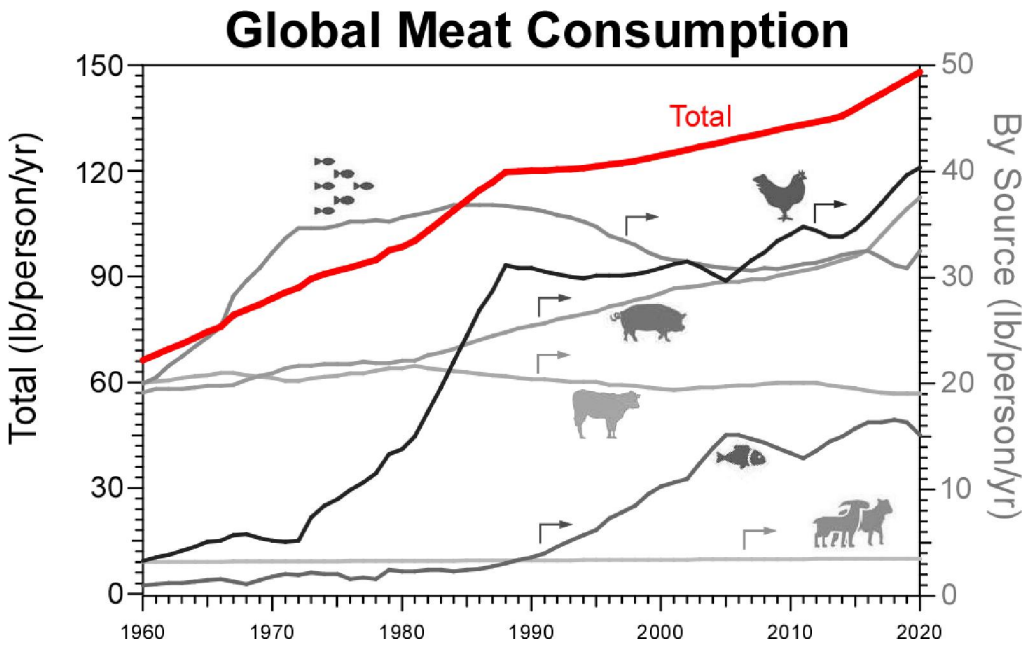
CLEAN ENERGY






MEAT CONSUMPTION
lbs. / Person / Year
160
140
120
100
80
60
40
20
0
1960
1970
1980
1990
2000
2010
2020
SHEEP/GOAT
BEEF
PORK
WILD FISH
FARMED FISH
POULTRY
www.ethanolproducer.com/articles/16179/opportunities-in-high-protein-feed


Global Meat Consumption
By Source (lb/person/yr)
Total (lb/person/yr)
Total
0
10
20
30
40
50
0
30
60
90
120
150
1960
1970
1980
1990
2000
2010
2020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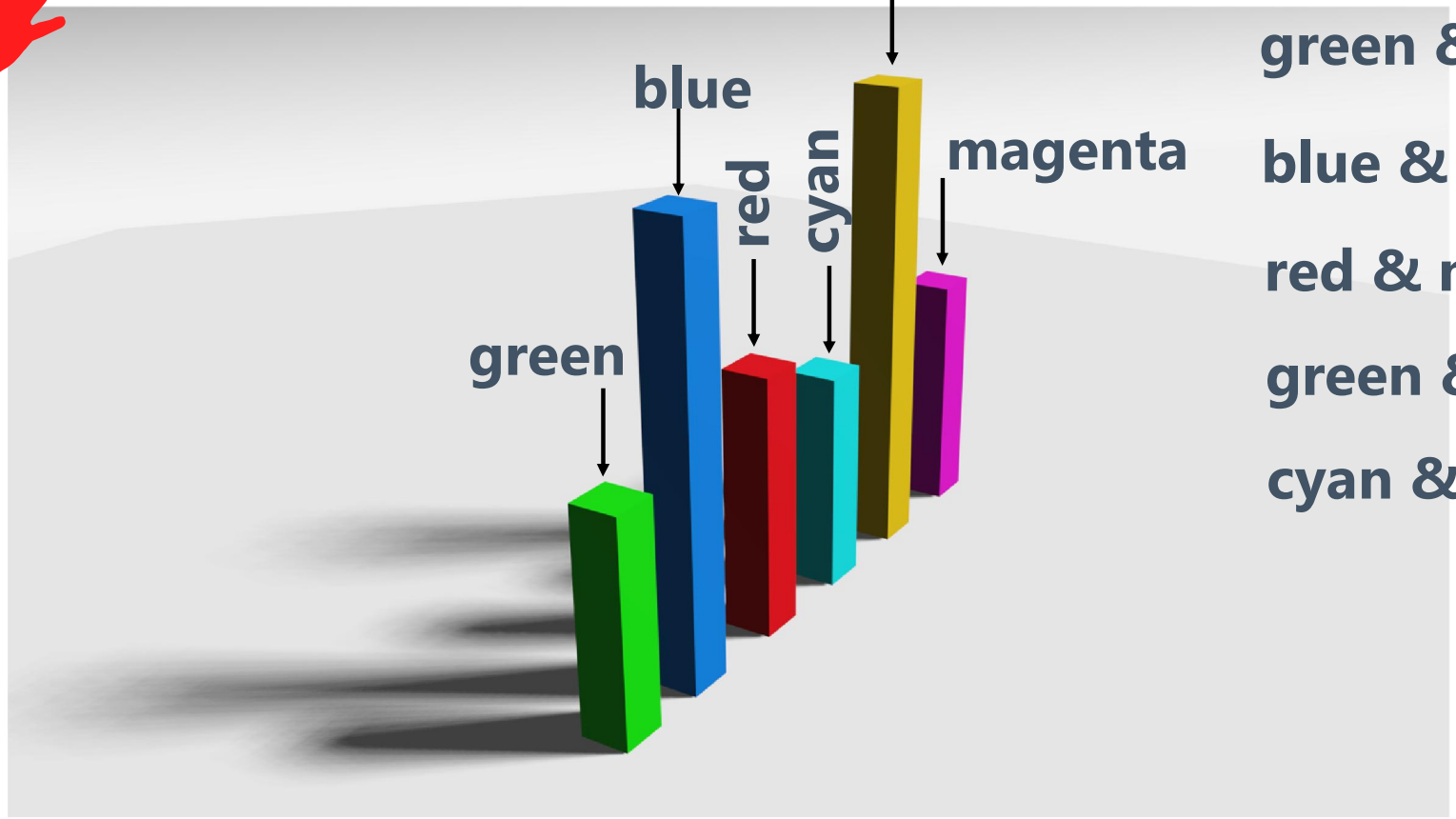
Total (lb/person/yr)
By Source (lb/person/yr)
Total
0
30
60
90
120
150
0
10
20
30
40
50
1960
1970
1980
1990
2000
2010
2020

Which Bars Are the Same Height?



green & red

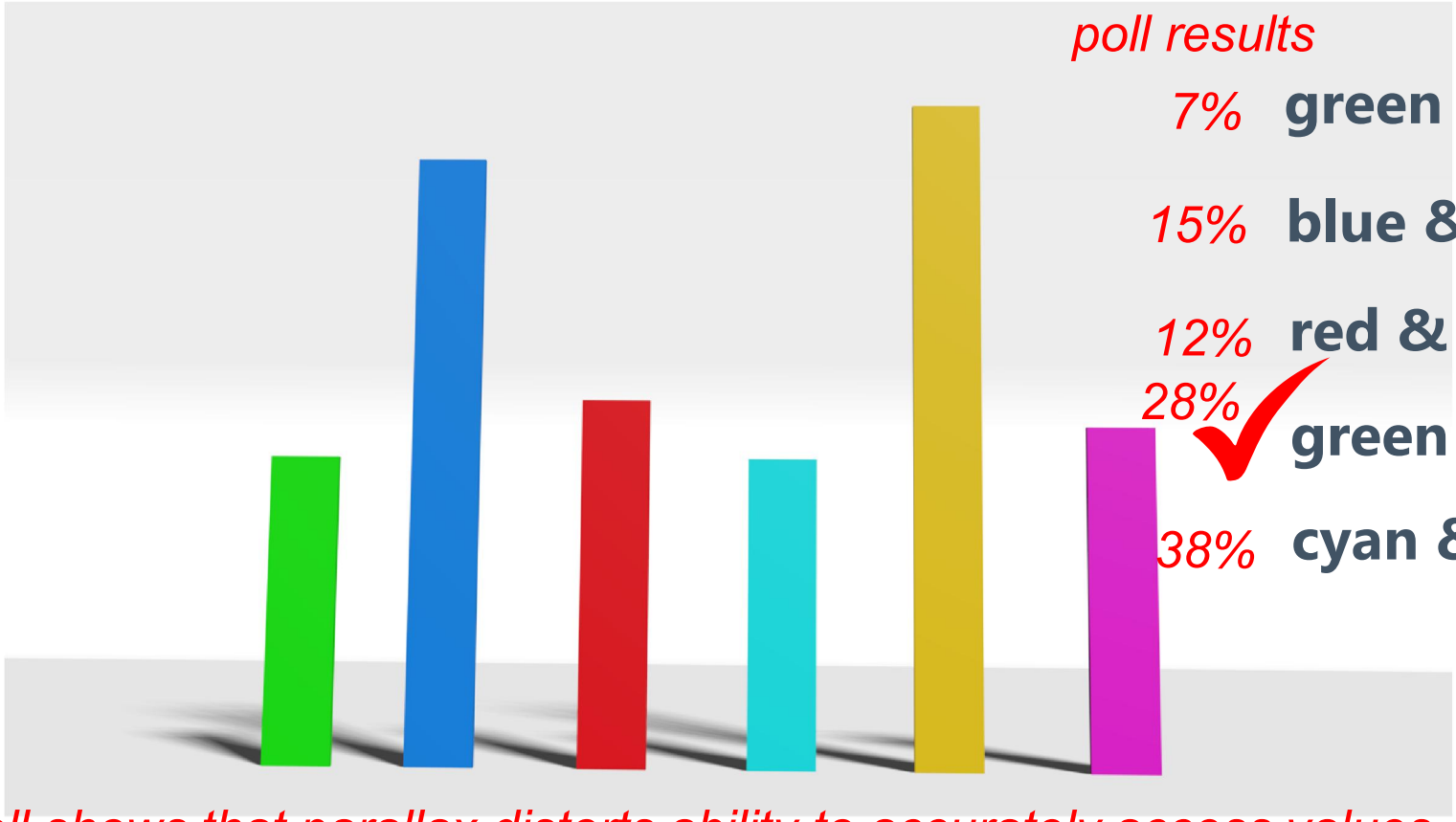
blue & yellow

red & magenta

green & cyan

cyan & magenta

WHICH BARS ARE THE SAME HEIGHT?



poll results

7% **green & red**

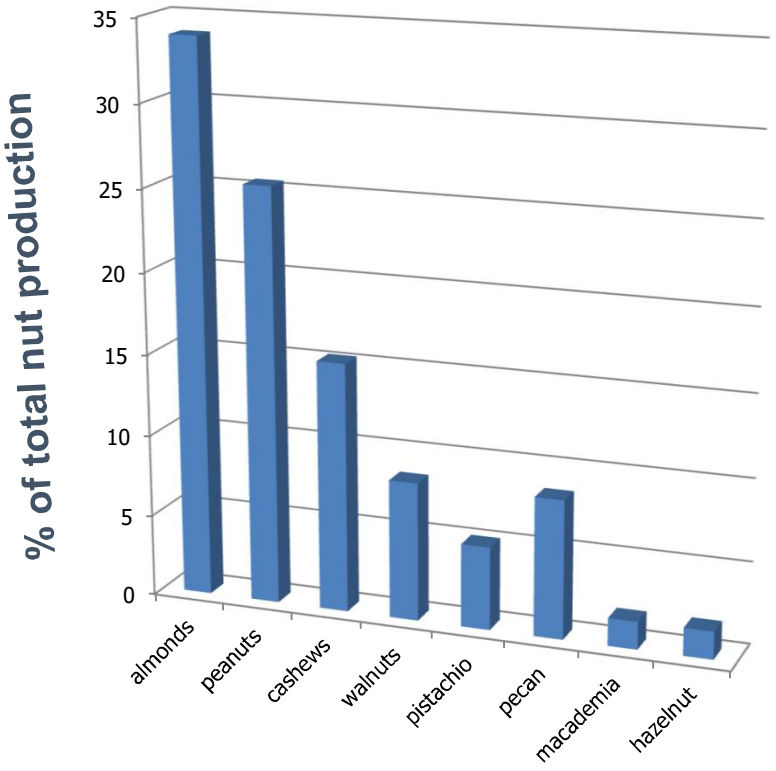
15% **blue & yellow**

12% **red & magenta**

28% ✓ **green & cyan**

38% **cyan & magenta**

poll shows that parallax distorts ability to accurately access values.


% of total nut production
35
30
25
20
15
10
5
0
almonds
peanuts
cashews
walnuts
pistachio
pecan
macademia
hazelnut

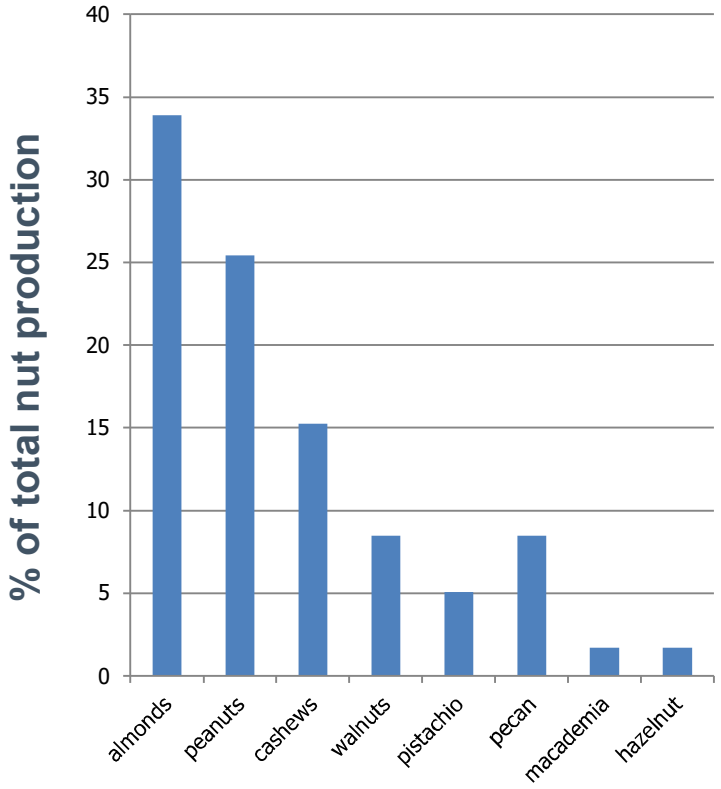

% of total nut production
40
35
30
25
20
15
10
5
0
almonds
peanuts
cashews
walnuts
pistachio
pecan
macademia
hazelnut

CHART JUNK

Median student debt of households headed by people 55-64 and owing student loans (all figures in 2016 dollars).

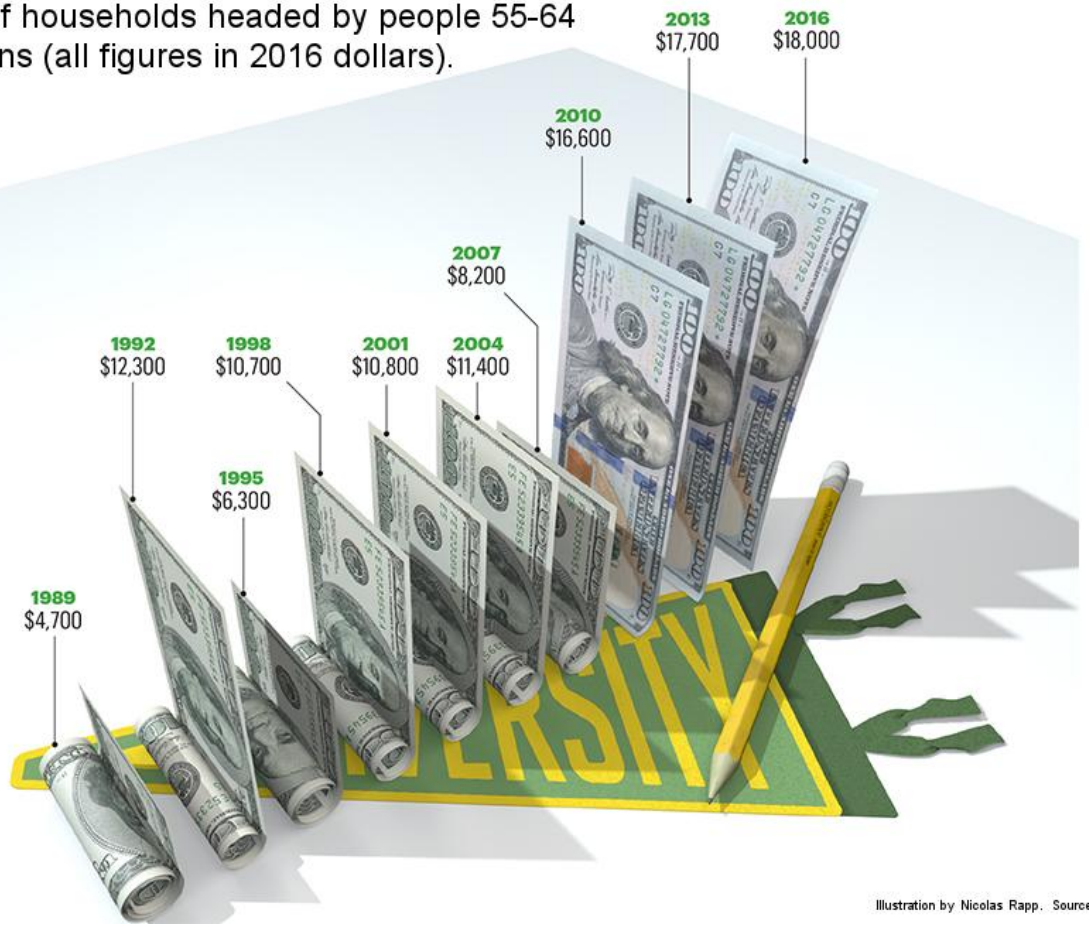
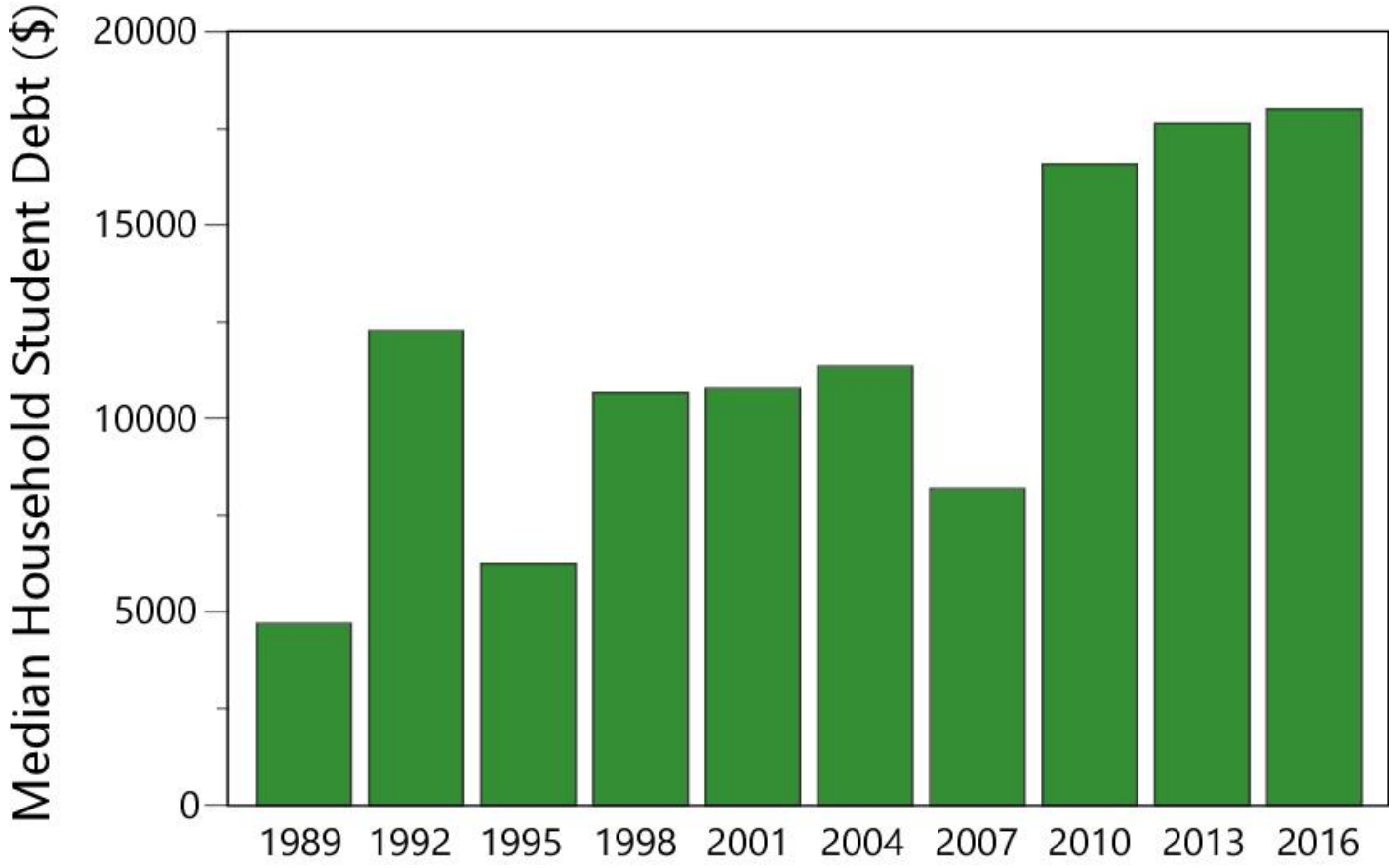


Illustration by Nicolas Rapp. Source: Federal Reserve Board

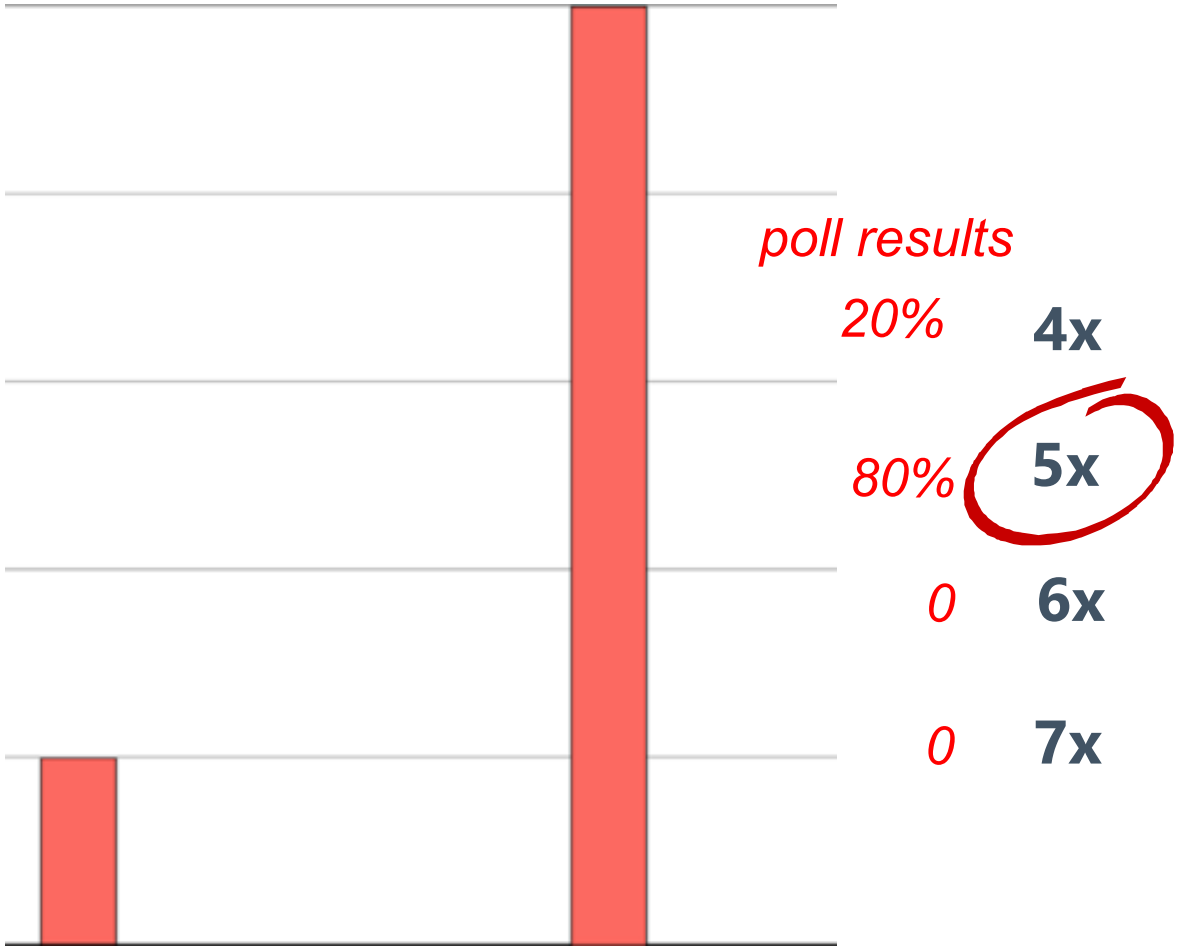
REMOVE THE JUNK

REMOVE THE JUNK

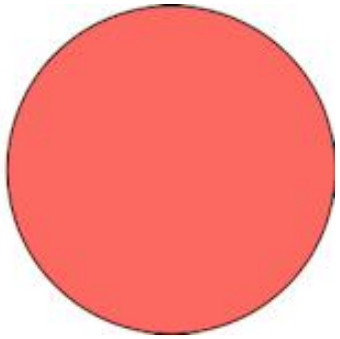


How many times bigger?

aligned with axis is easiest to accurately quantify.



How many times bigger?

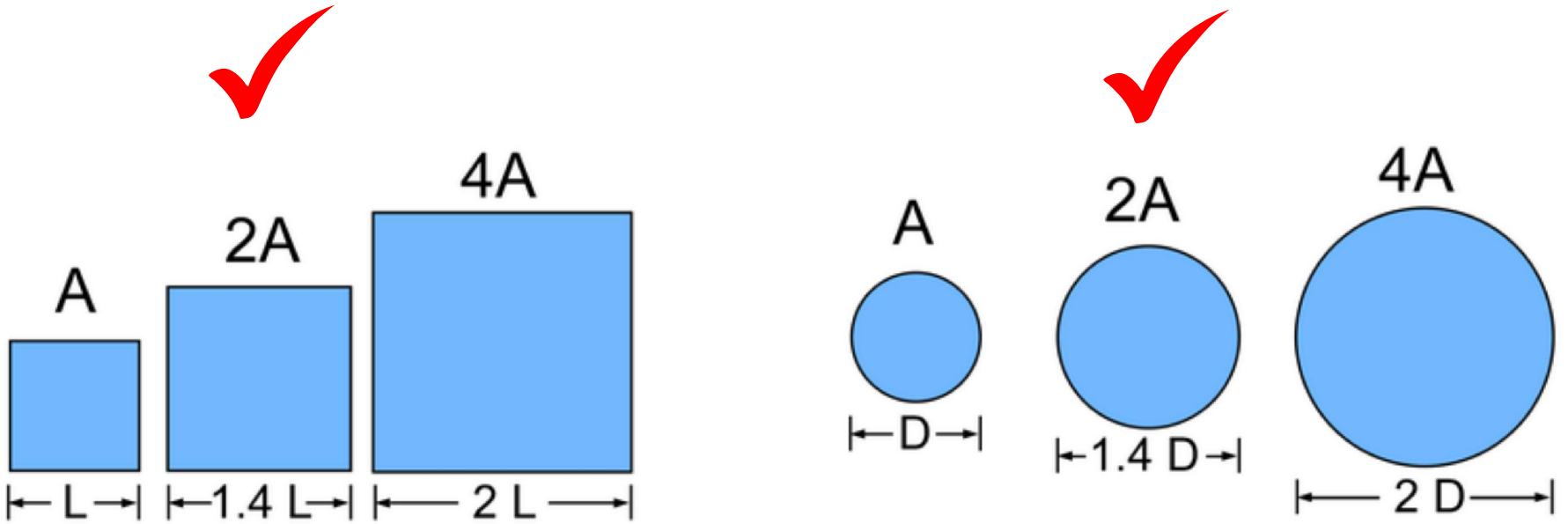


poll results

3x	*25%*
4x	*34%*
5x	*18%*
6x	*23%*

area is hard to judge

Area Confusion



WHICH IS LARGEST?

left rectangle

triangle

square

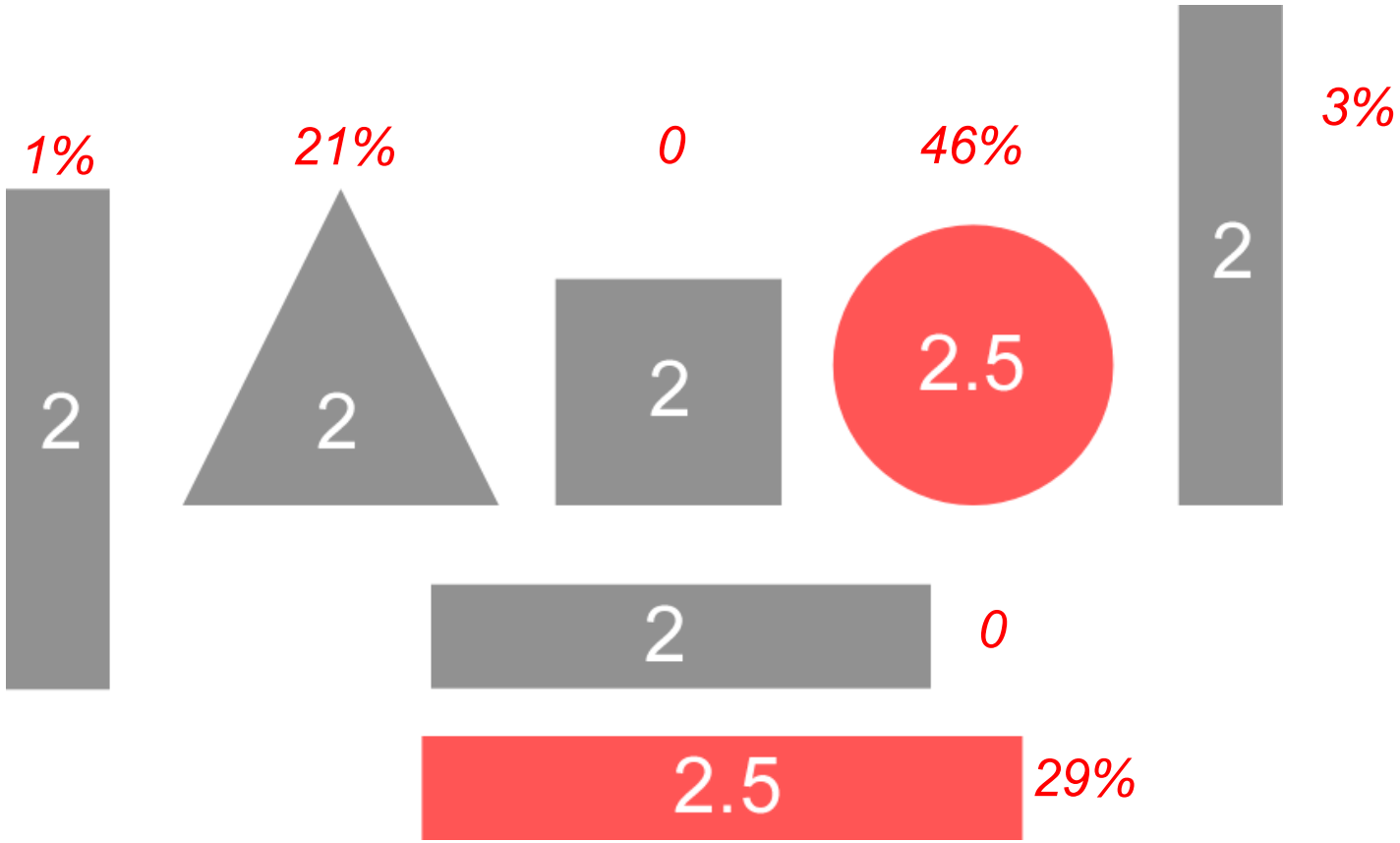
circle

right rectangle

top bar

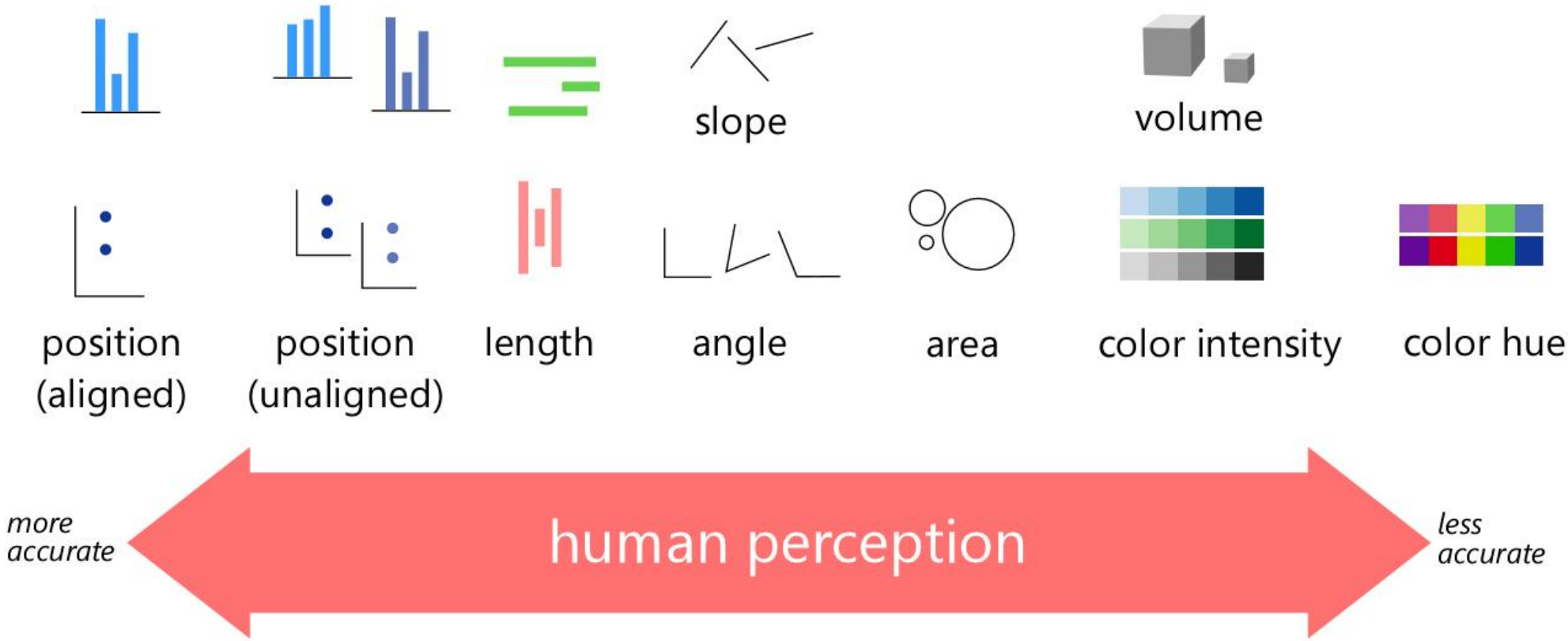
bottom bar

poll results



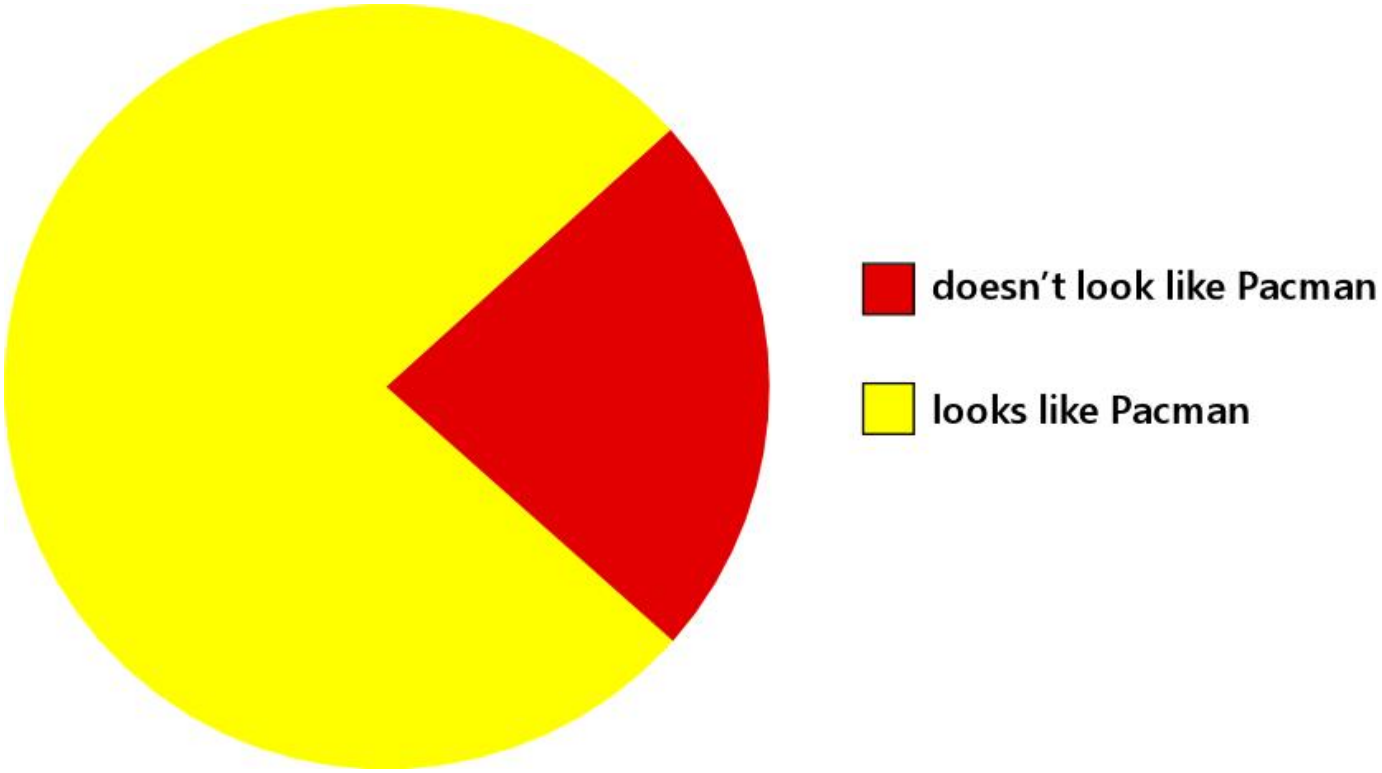
area of different shapes is even harder.

HUMAN PERCEPTION

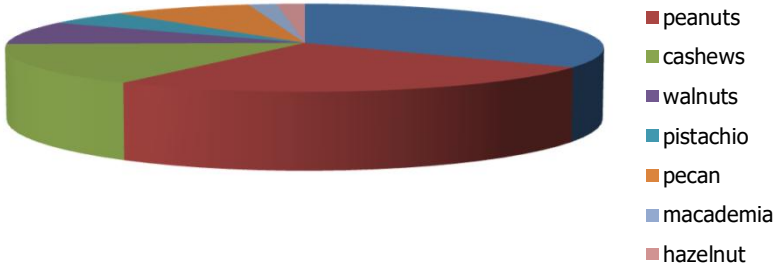


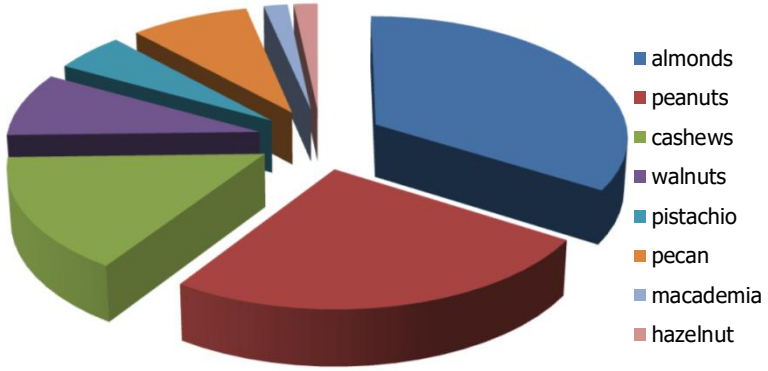
Cleveland, W.S. and McGill, R., 1984. Graphical perception: Theory, experimentation, and application to the development of graphical methods. *Journal of the American statistical association*, *79*(387), pp.531-554.

Pie Charts

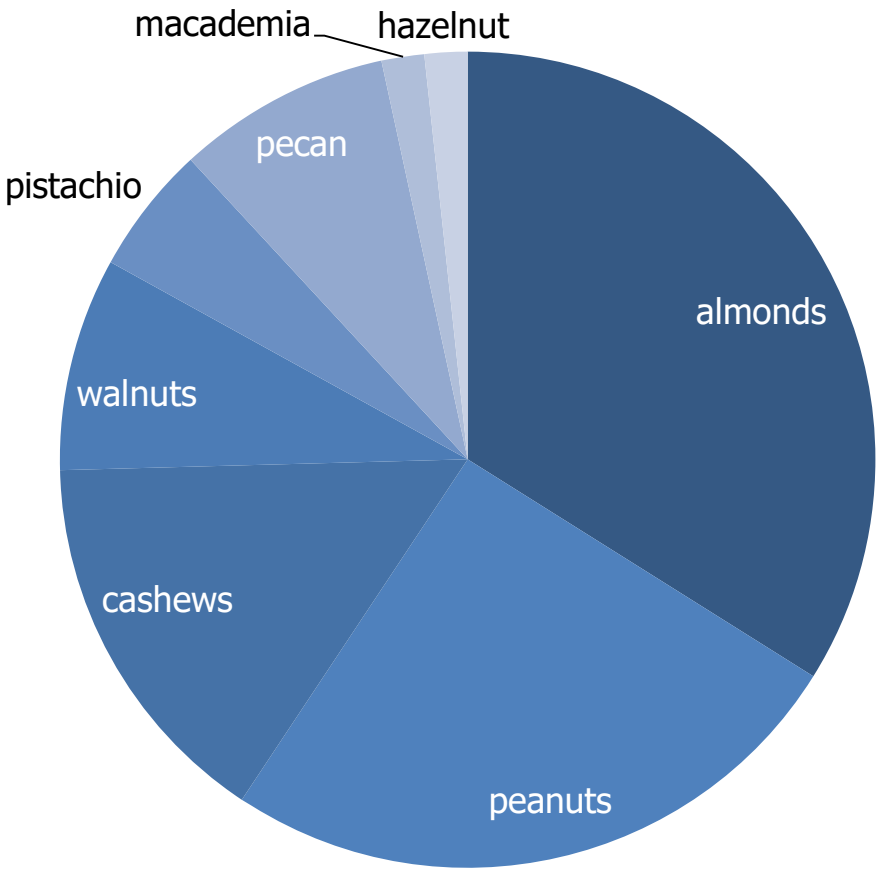


U.S. Nut Production

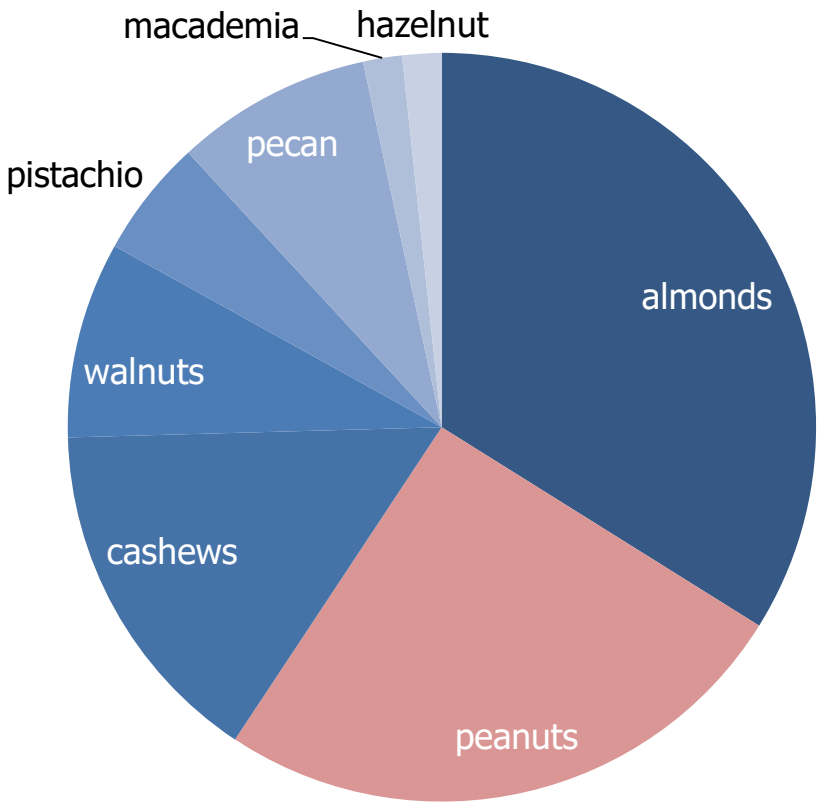




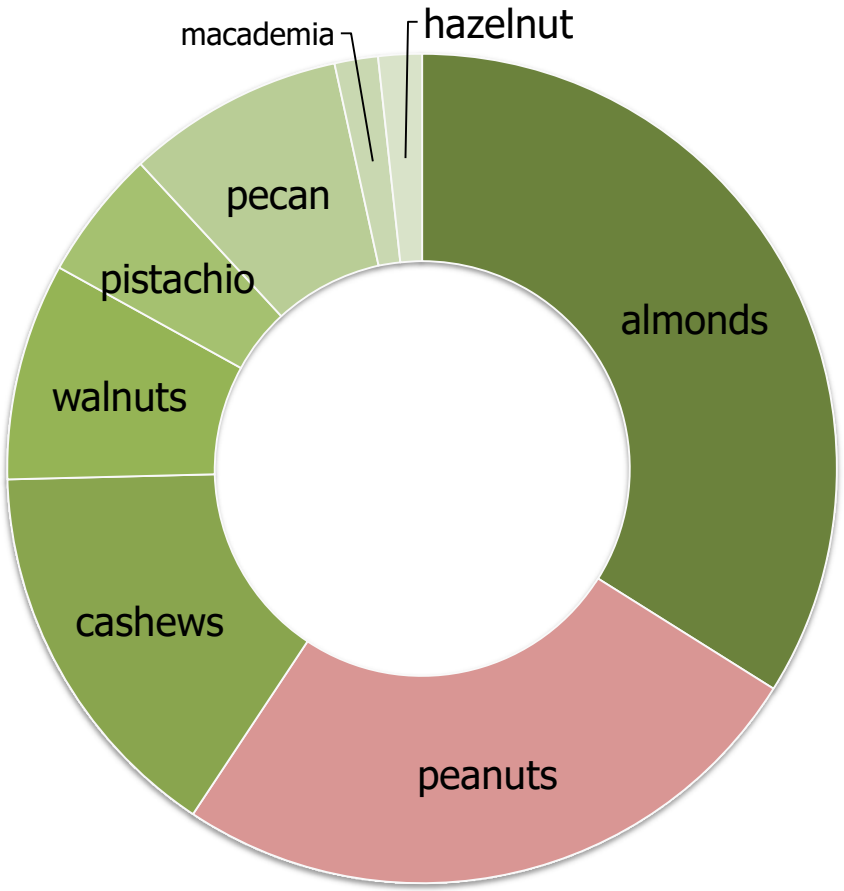
U.S. Nut Production



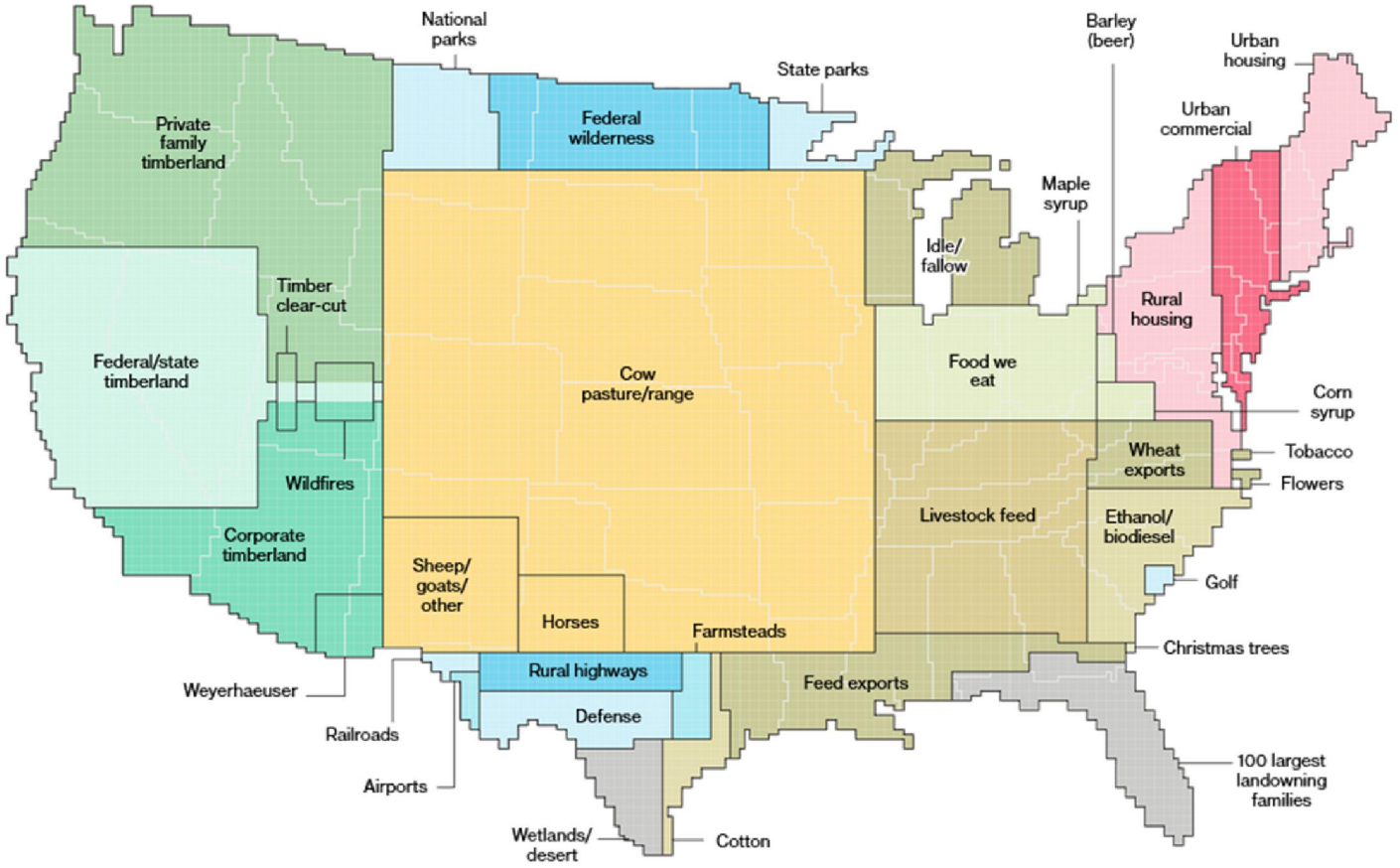
U.S. Nut Production



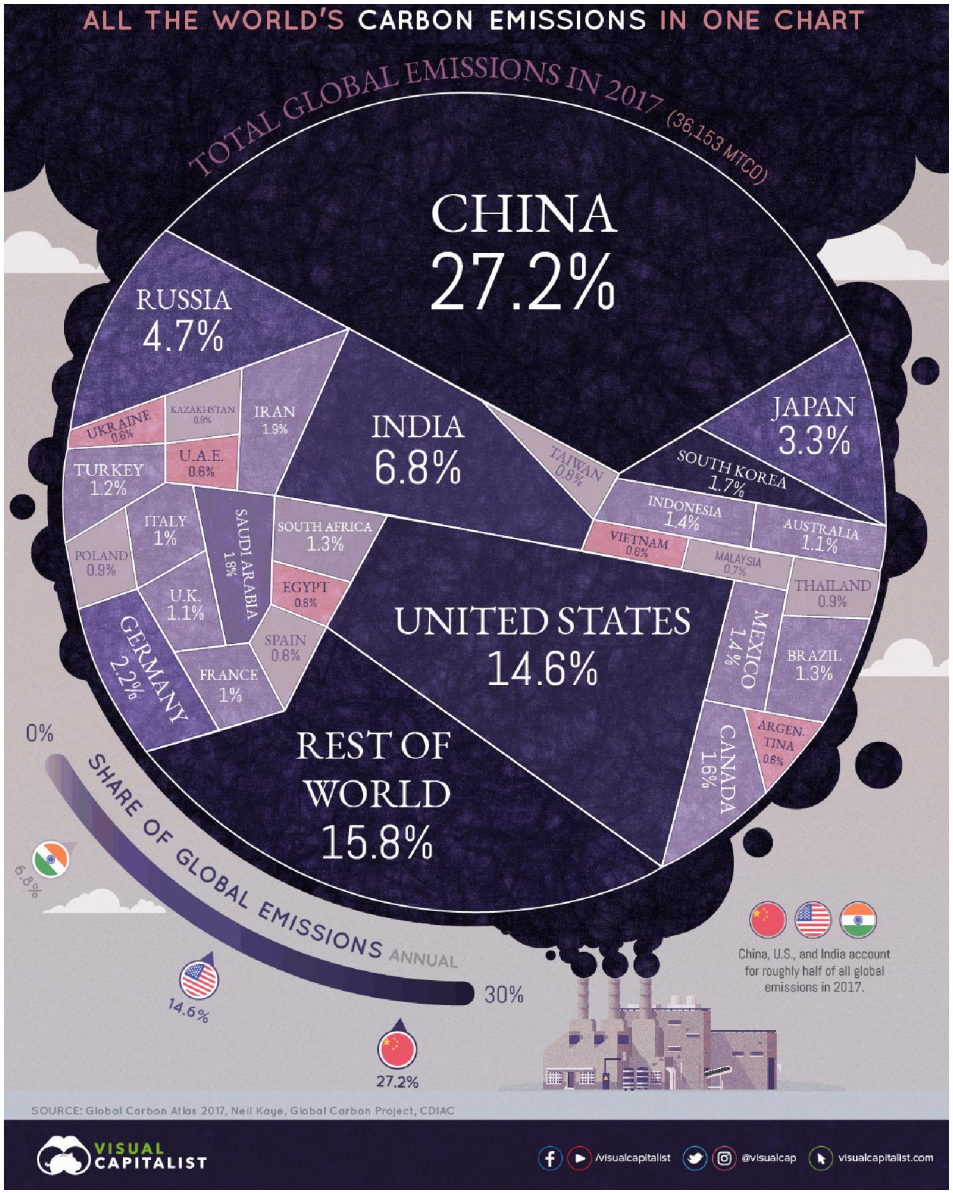
U.S. Nut Production



U.S. Land Use

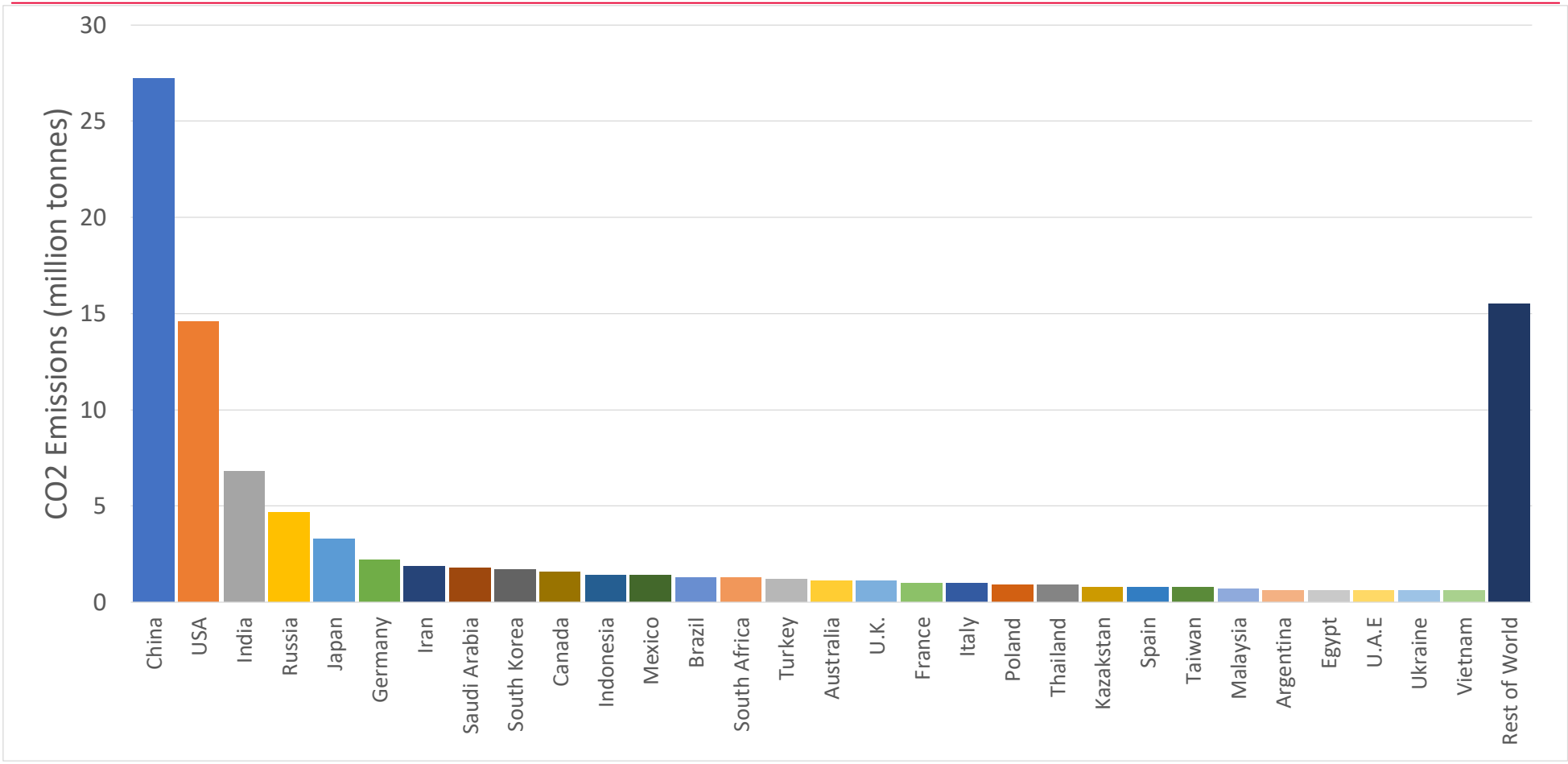


www.bloomberg.com/graphics/2018-us-land-use/

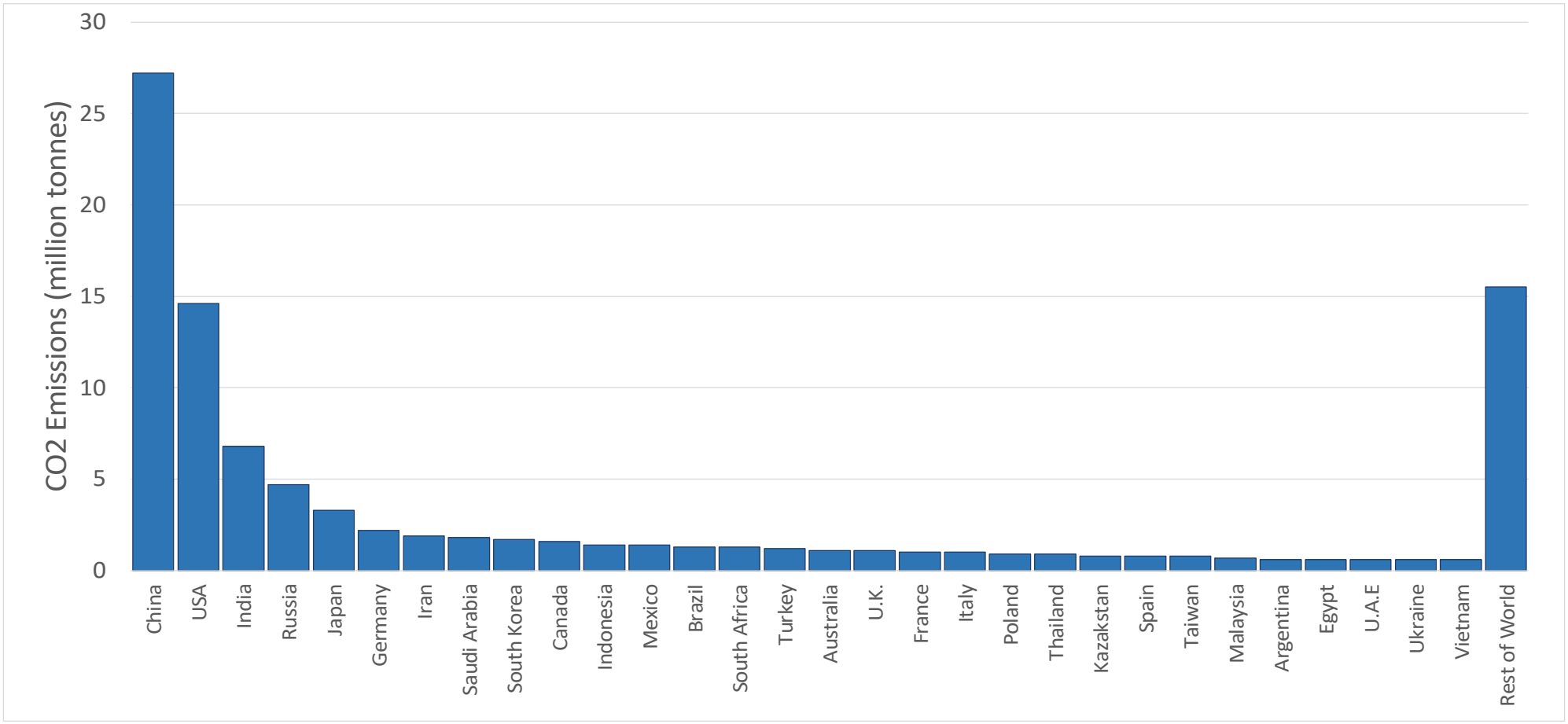


Voronoi Treemap in an irregular shaped container

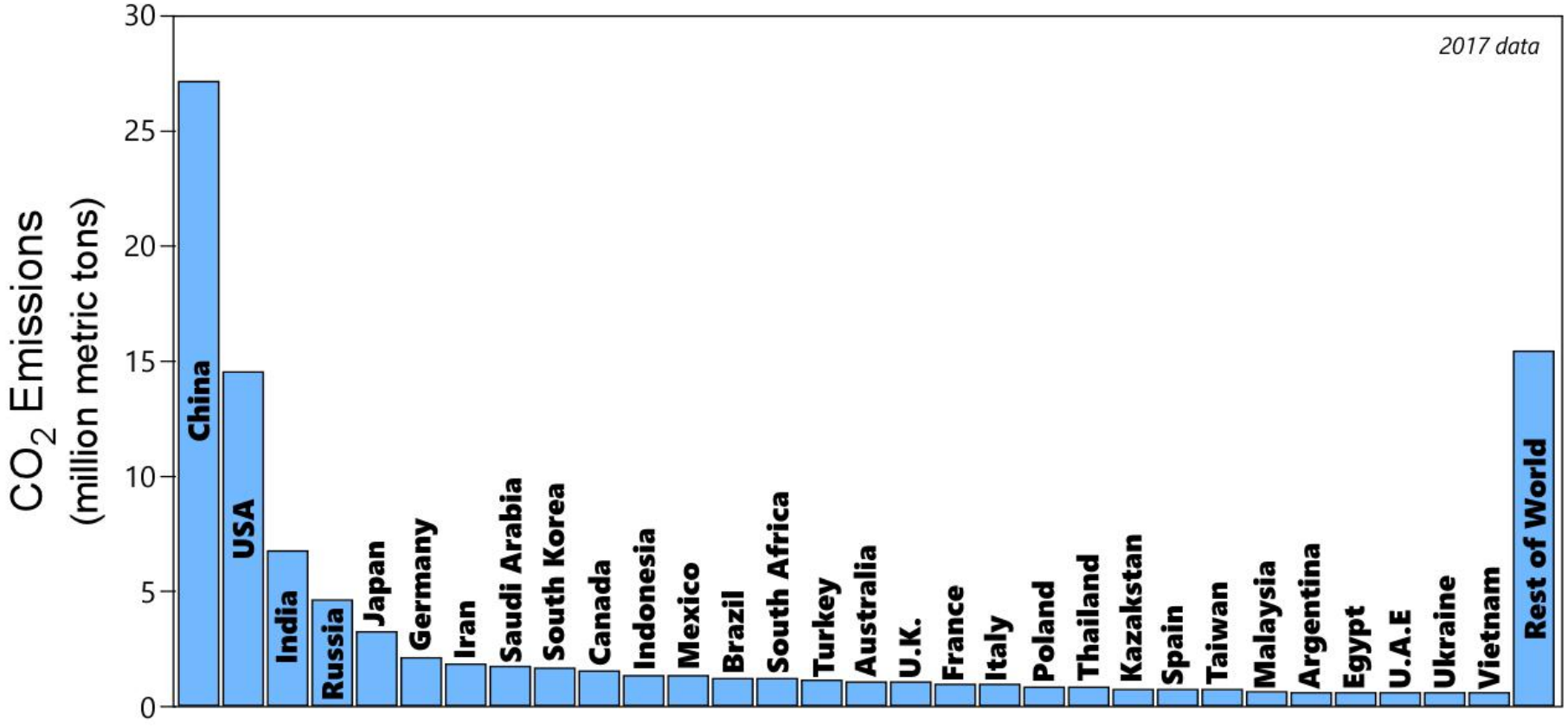
CARBON EMISSIONS



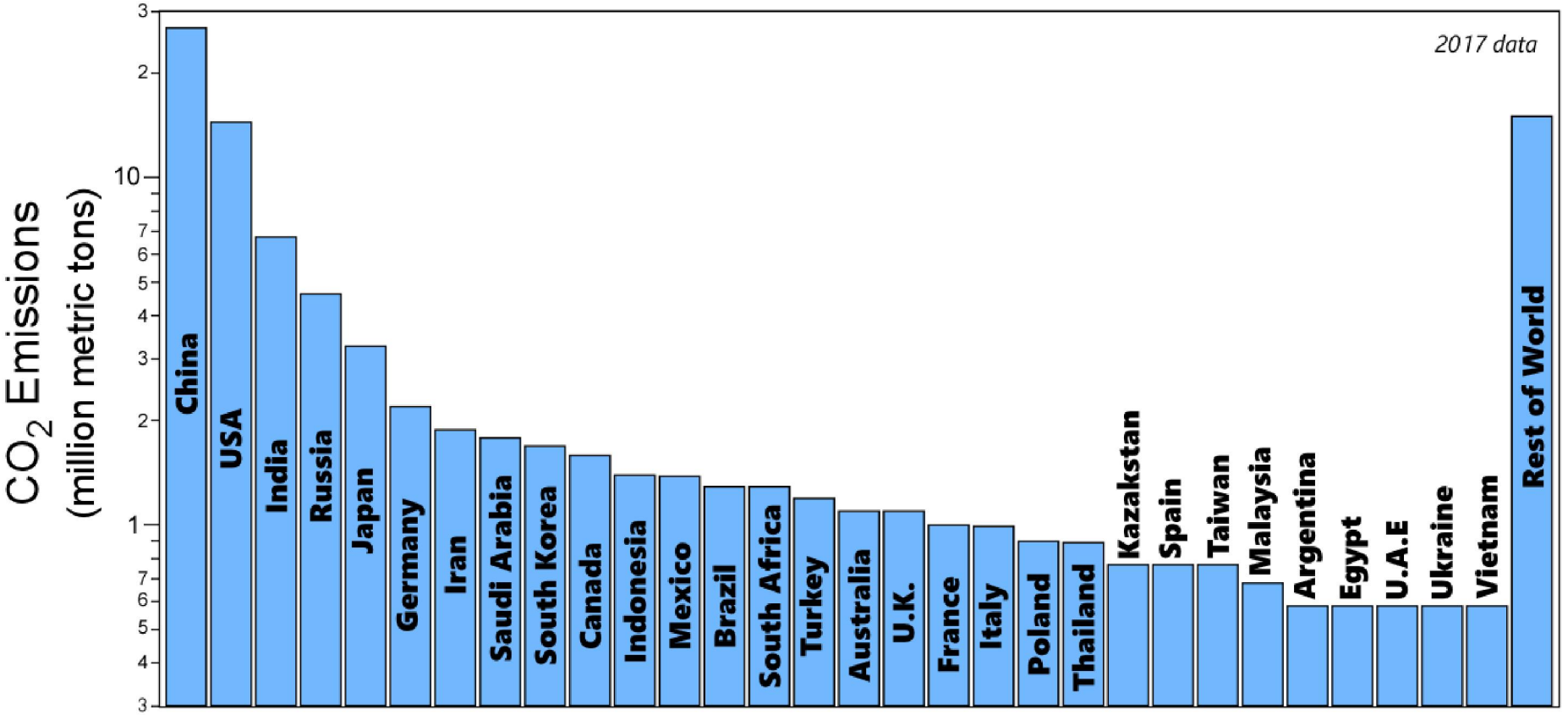
CARBON EMISSIONS



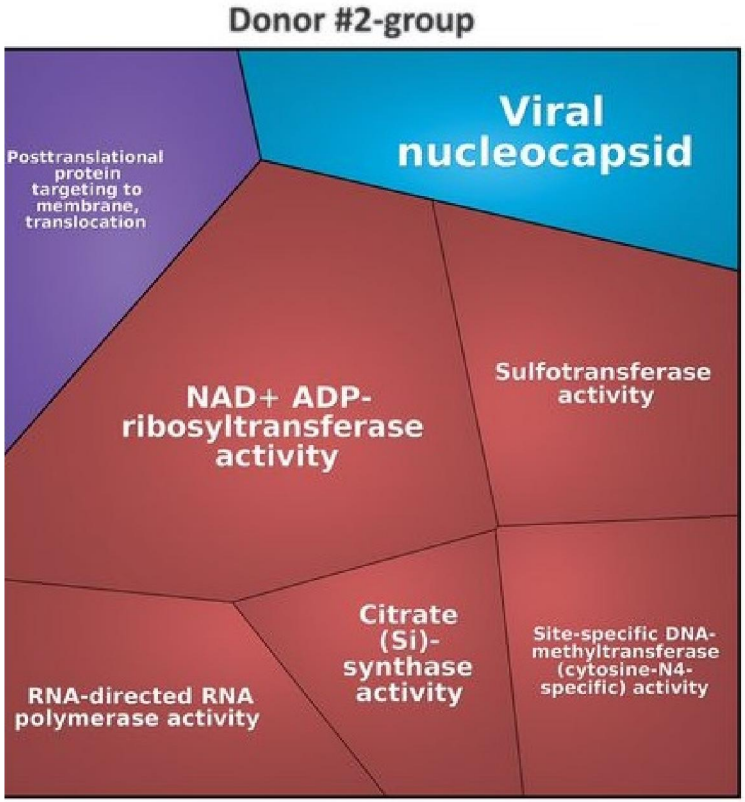
CARBON EMISSIONS



CARBON EMISSIONS

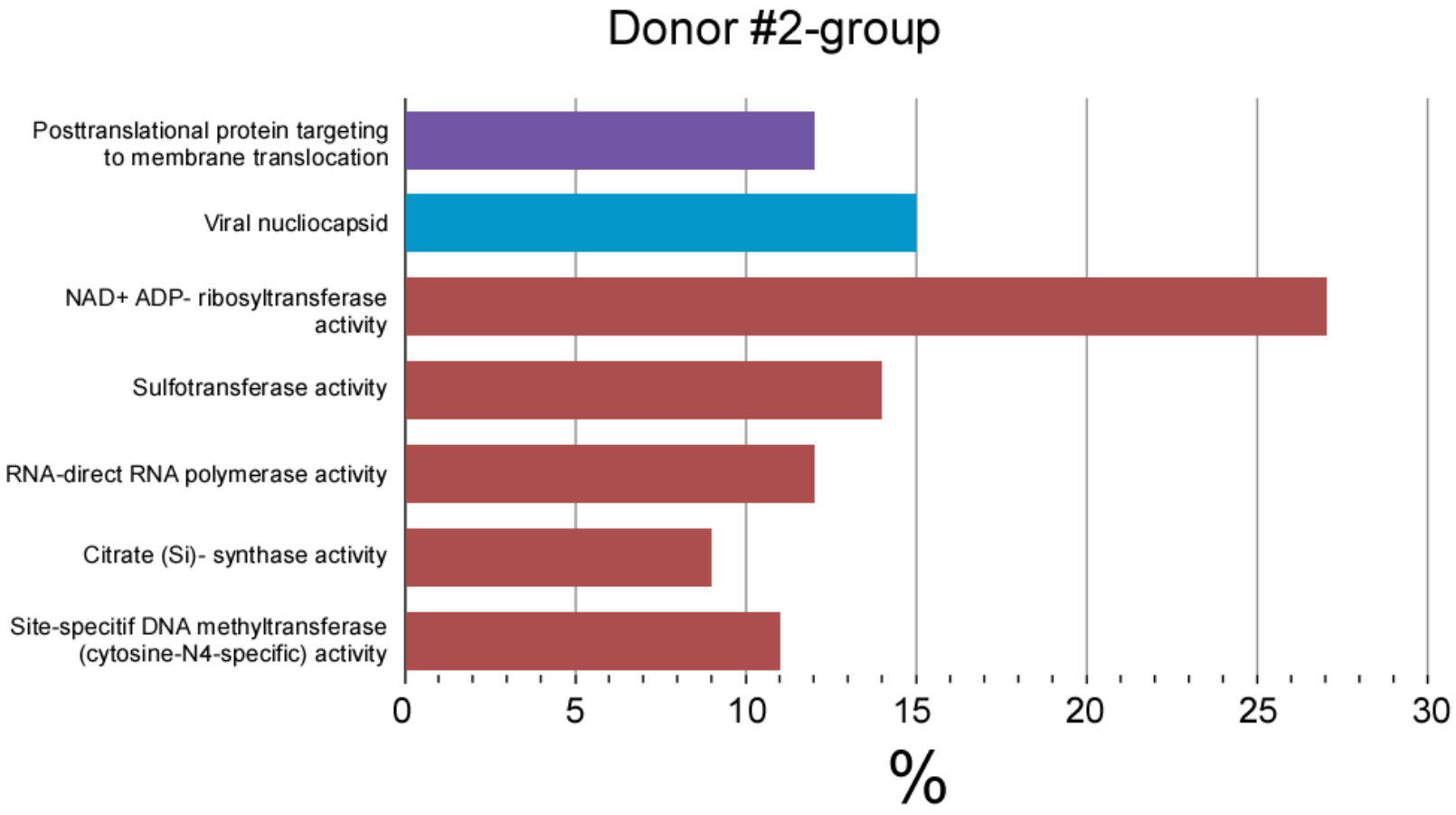


ENRICHED MICROBIOTA IN FECAL TRANSPLANTATION



Baruch et al., "Fecal microbiota transplant promotes response in immunotherapy-refractory melanoma patients", Science 05 Feb 2021, DOI: 10.1126/science.abb5920

ENRICHED MICROBIOTA IN FECAL TRANSPLANTATION



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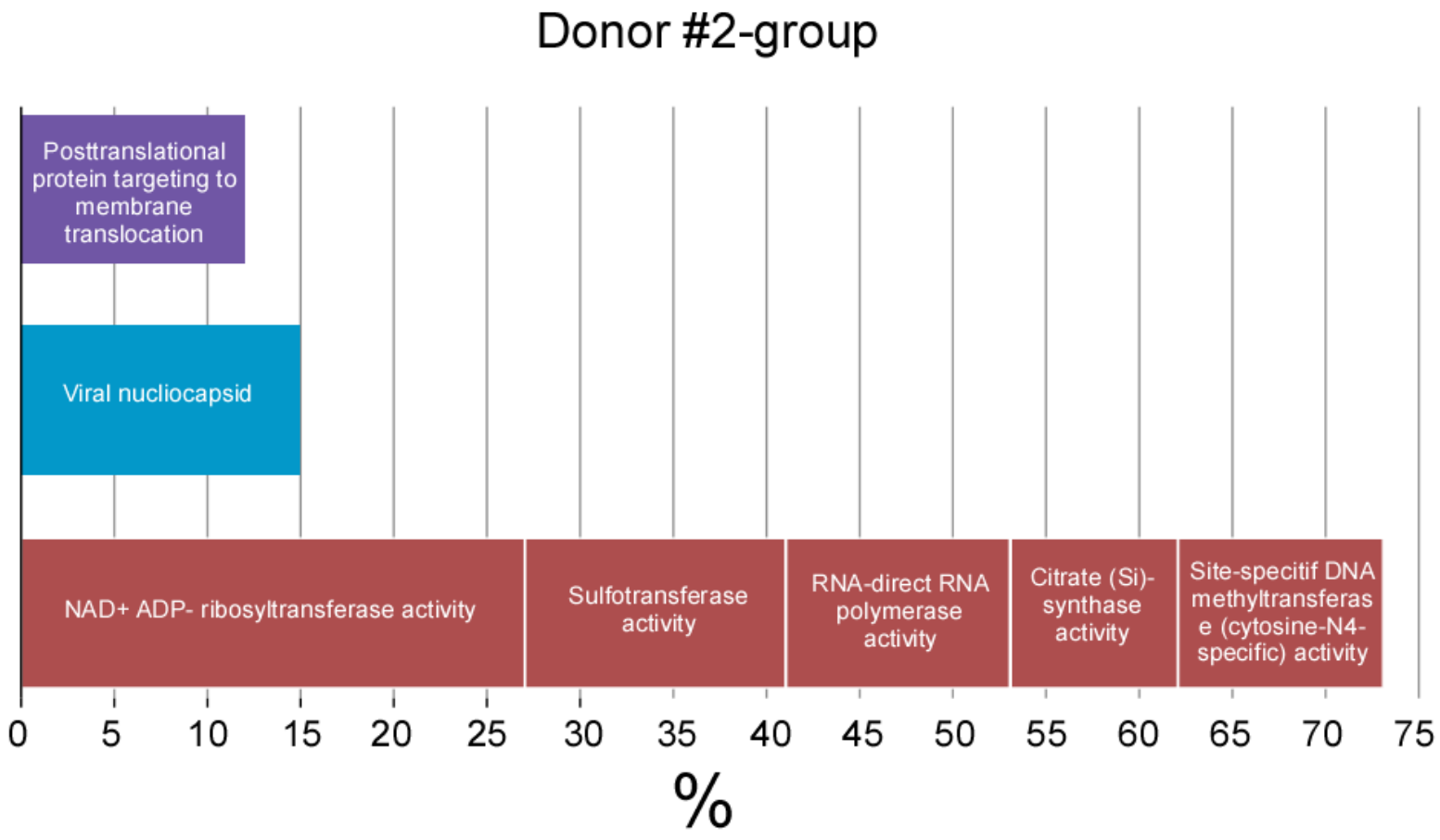
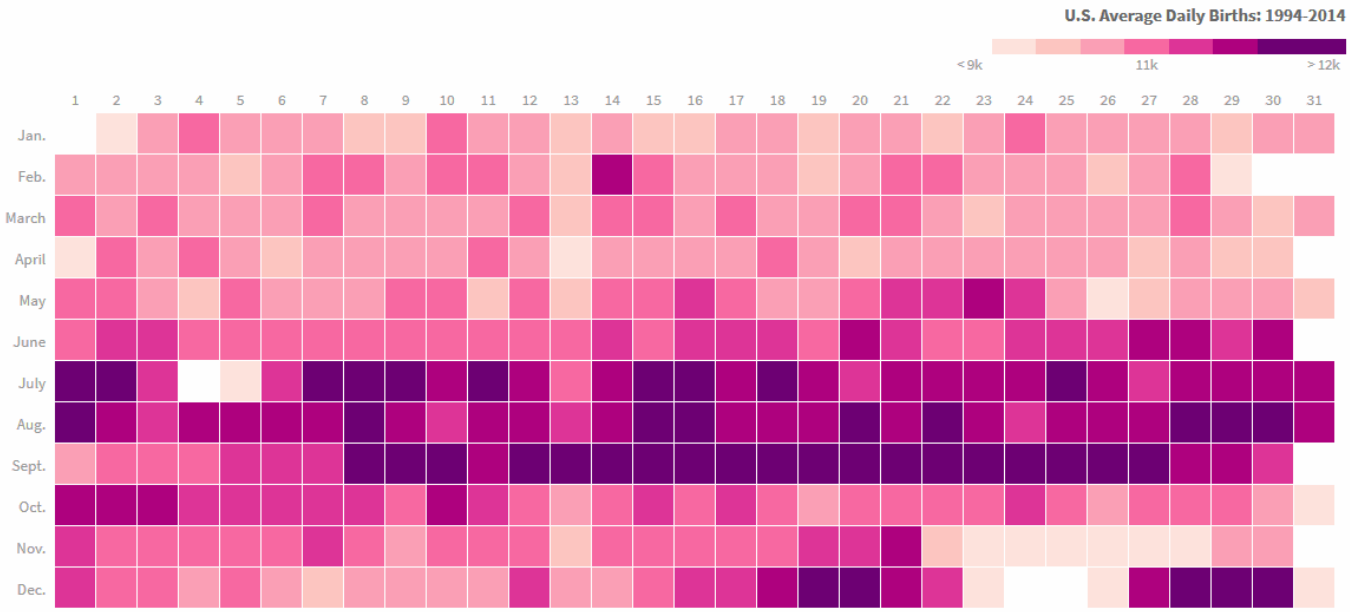


HOW POPULAR IS YOUR BIRTHDAY?

Two decades of American birthdays, averaged by month and day.



Notes: The conception date, purely for illustration, is 266 days prior to birth. It represents a hypothetical "moment of conception" based on the normal gestation period for humans, 280 days, minus the average time for ovulation, two weeks.

Data: U.S. National Center for Health Statistics (1994-2003); U.S. Social Security Administration (2004-2014) — via FiveThirthyEight

Credit: Matt Stiles/The Daily Viz

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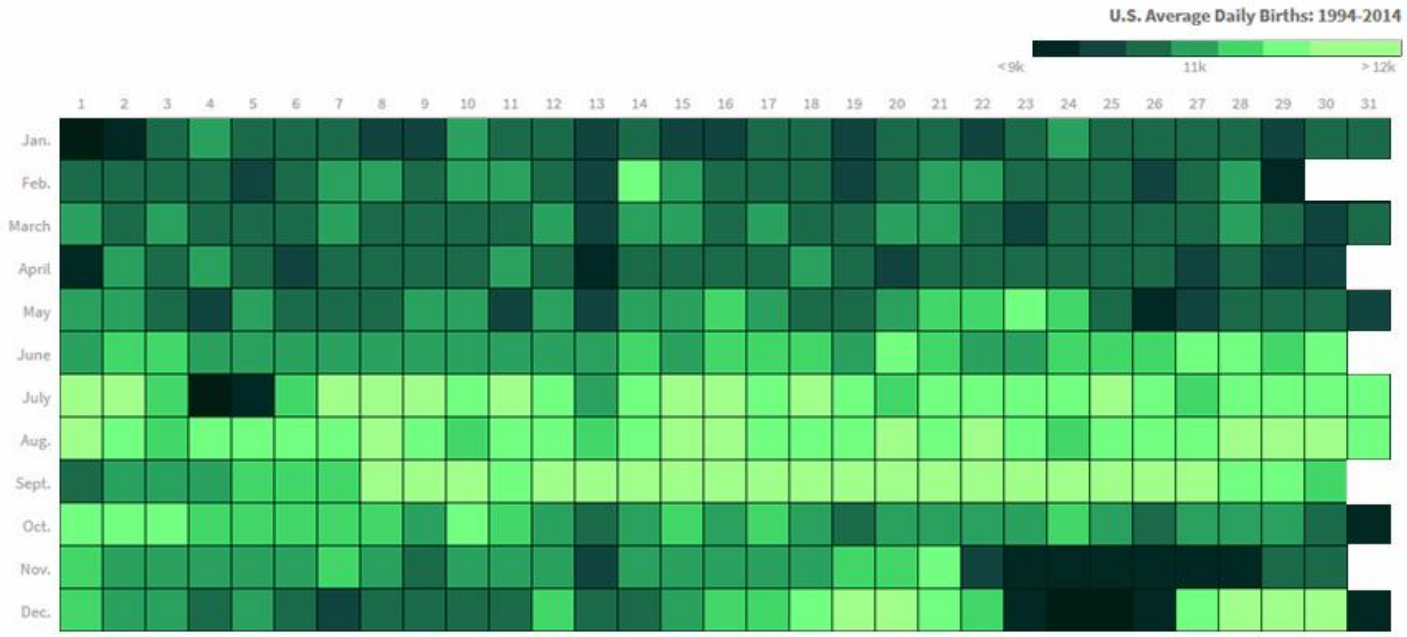

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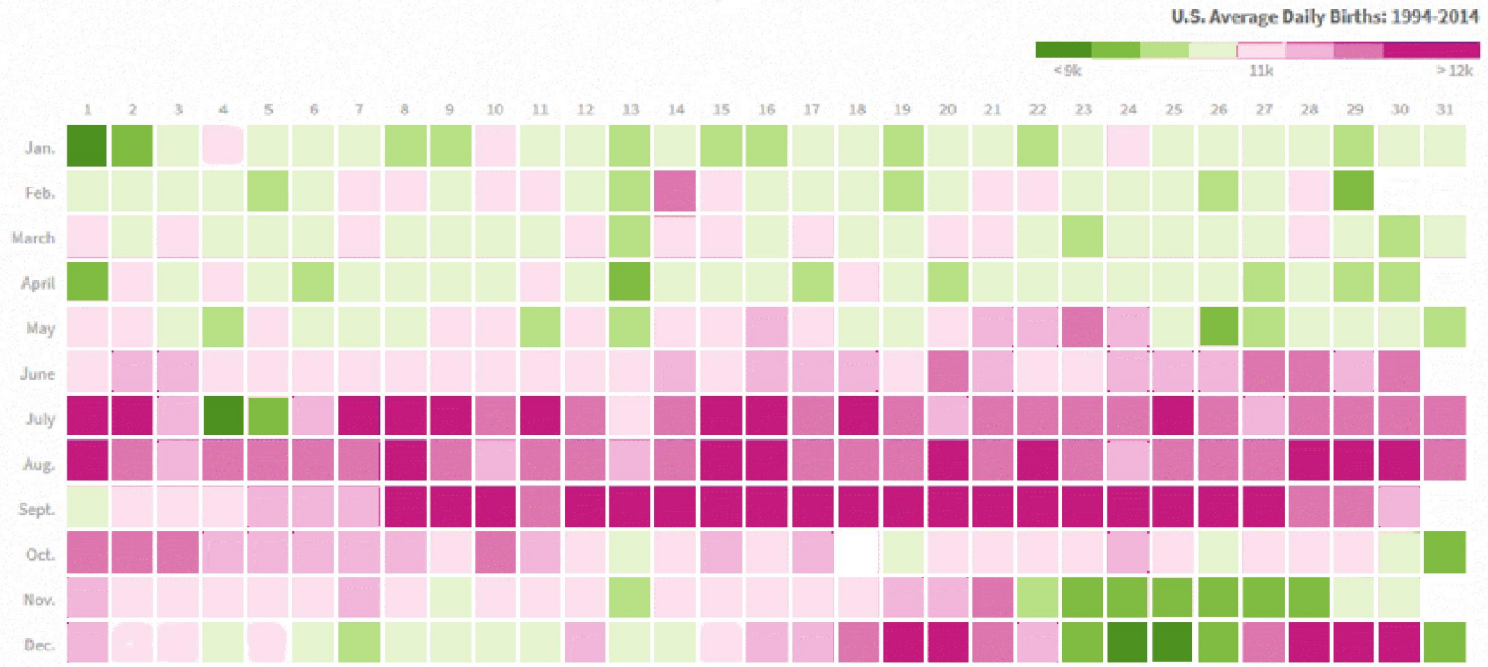

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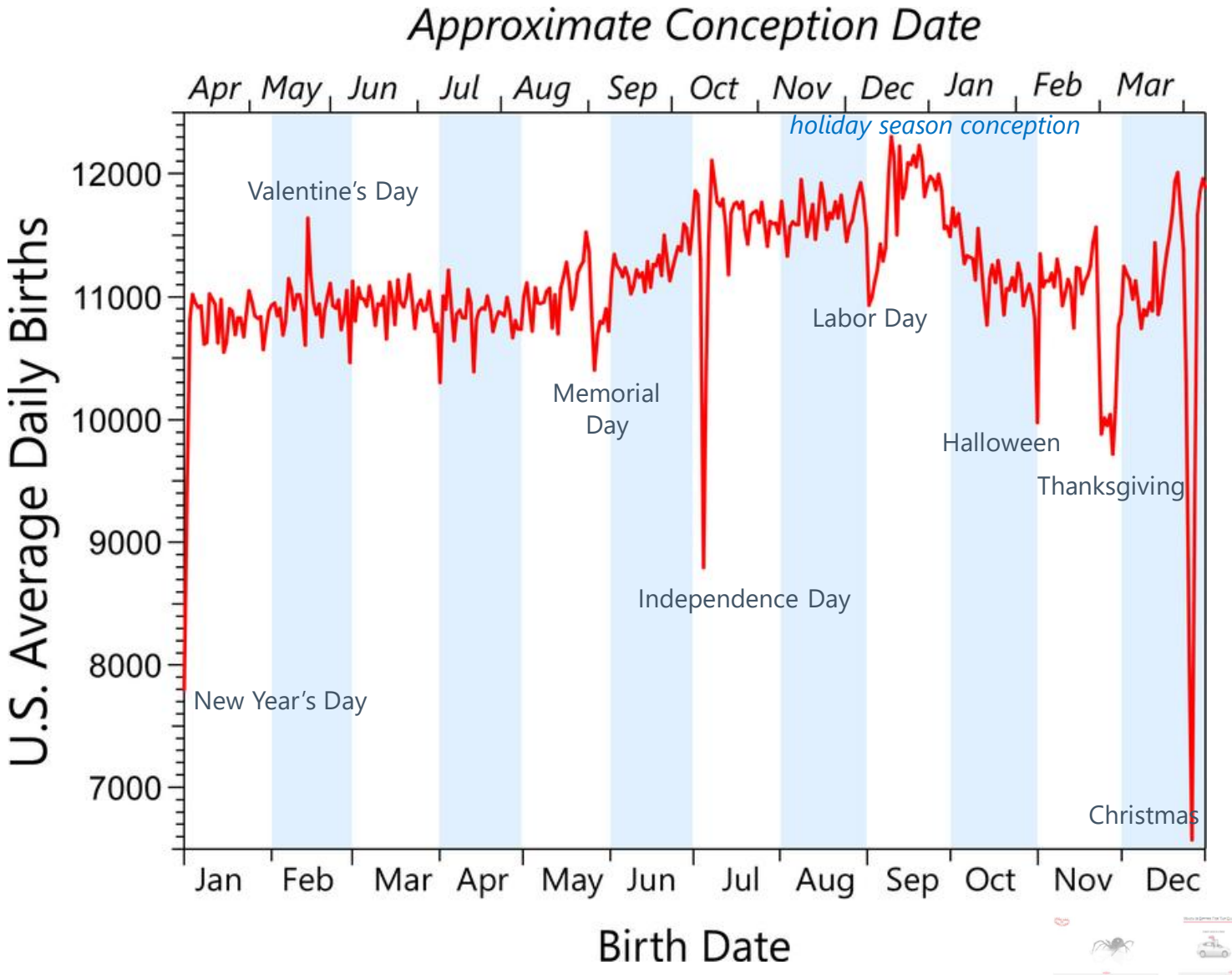
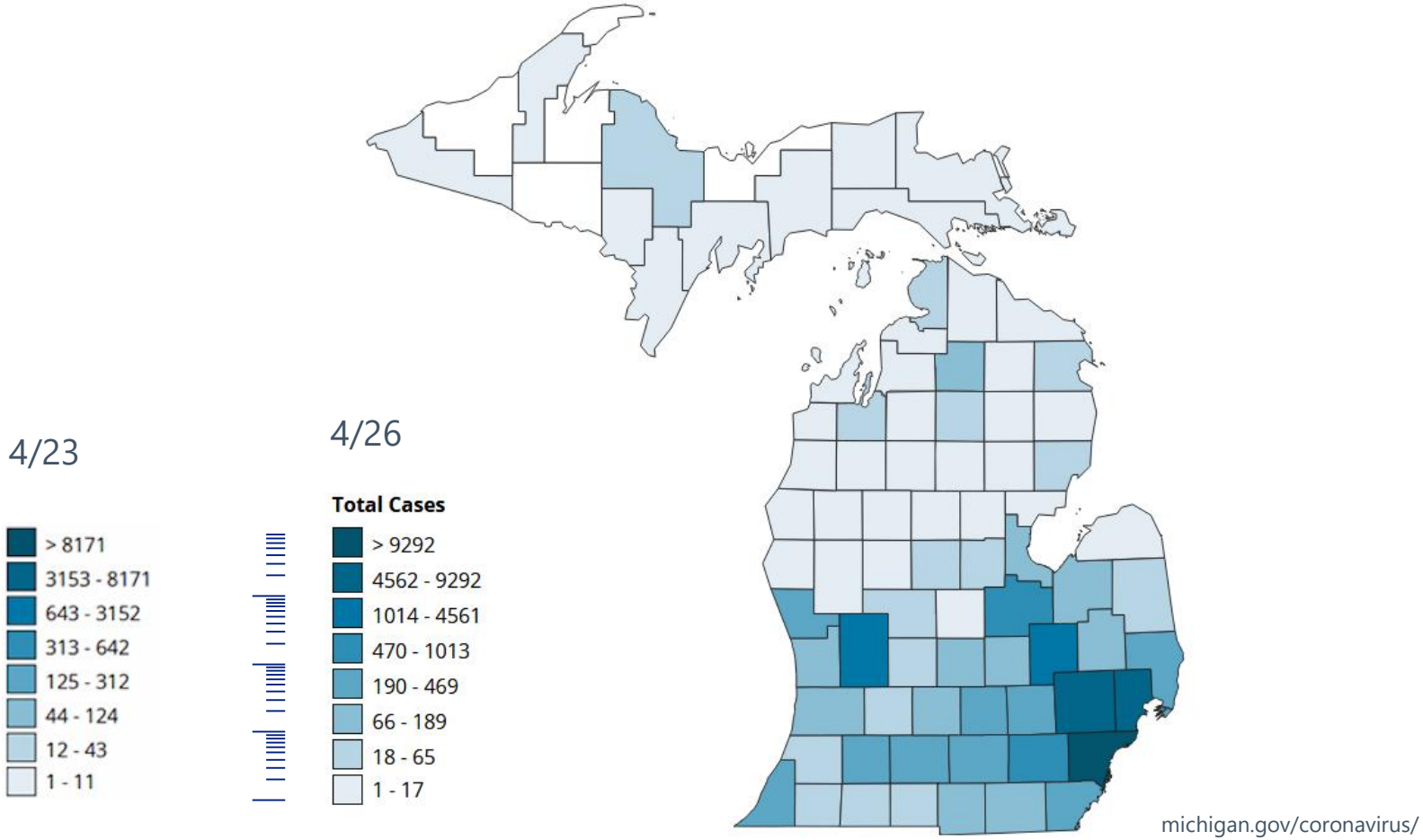

Approximate Conception Date
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
holiday season conception
Valentine's Day
Memorial Day
Independence Day
Labor Day
Halloween
Thanksgiving
Christmas
New Year's Day
U.S. Average Daily Births
12000
11000
10000
9000
8000
7000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Birth Date

MICHIGAN CORONAVIRUS CASES

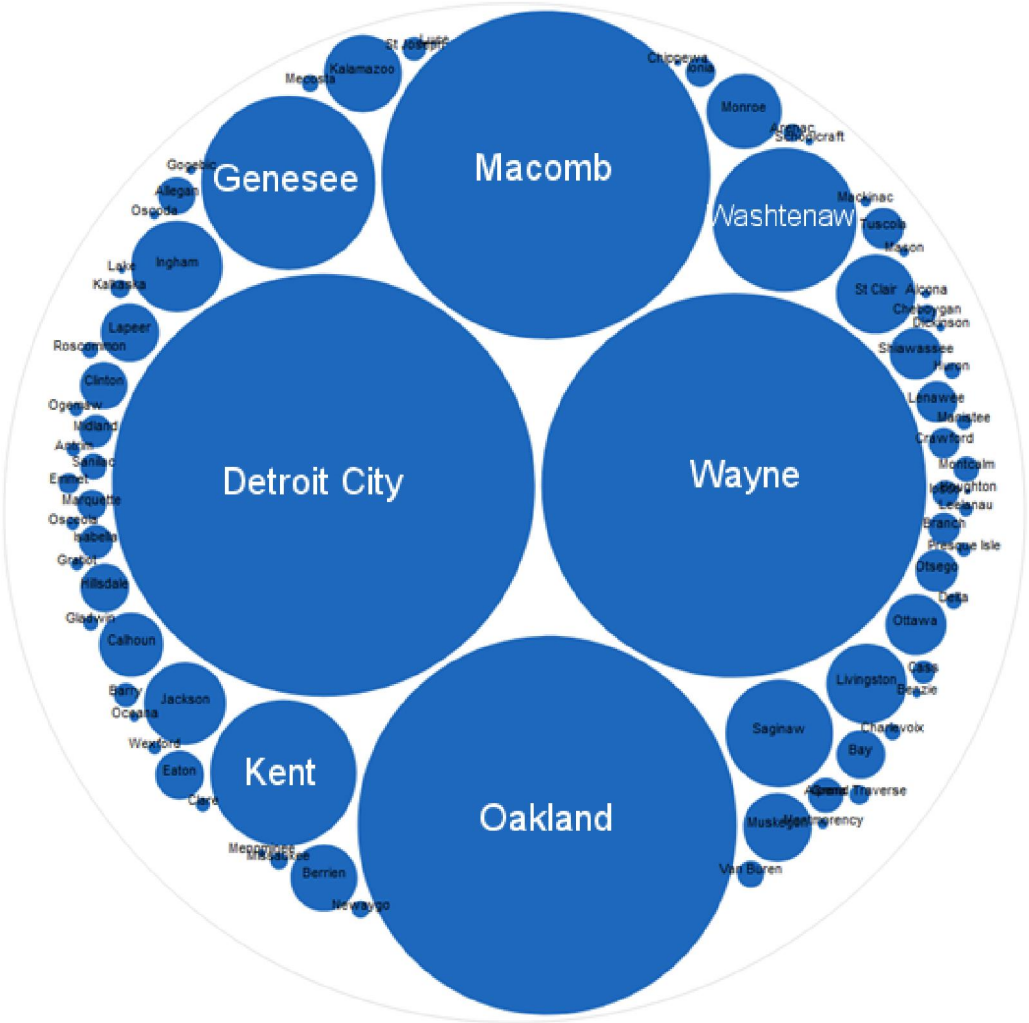


michigan.gov/coronavirus/

MICHIGAN CORONAVIRUS CASES

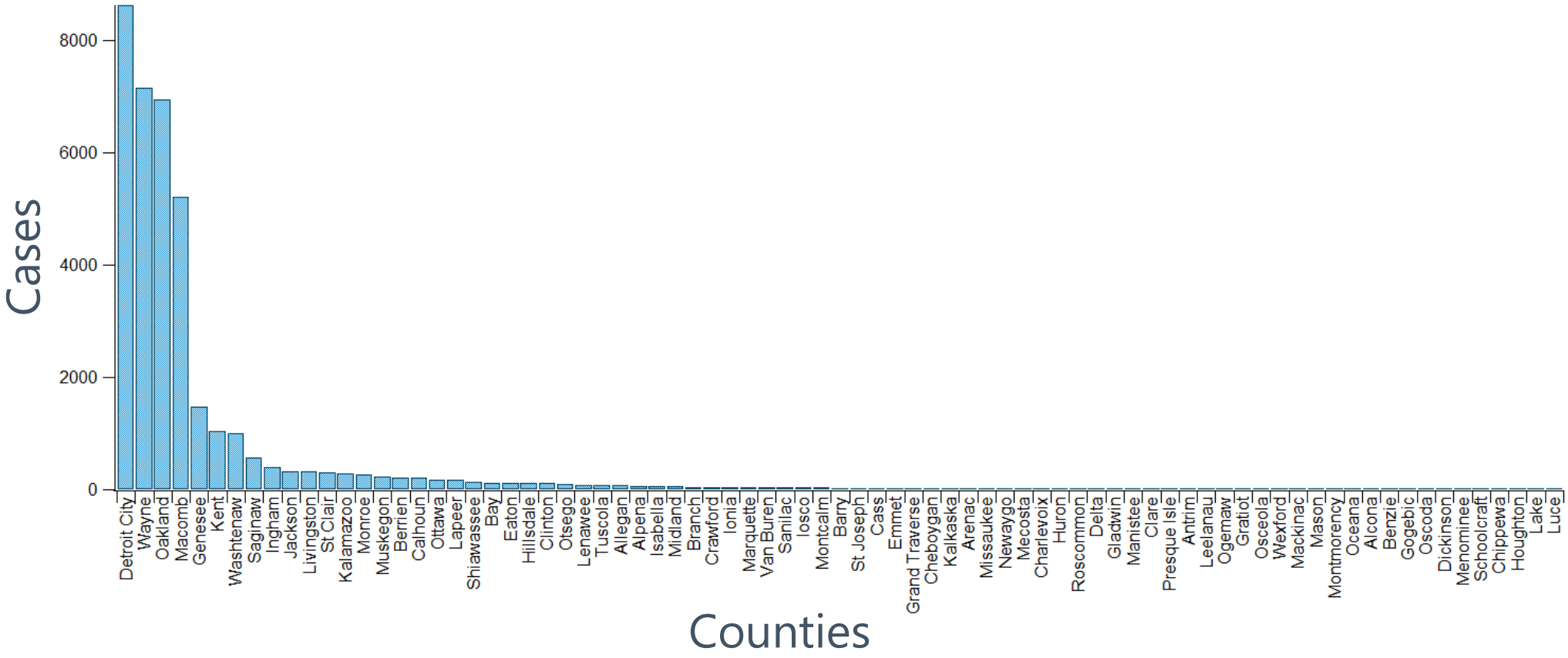
DOW
RAWGraphs

Michigan Coronavirus Cases

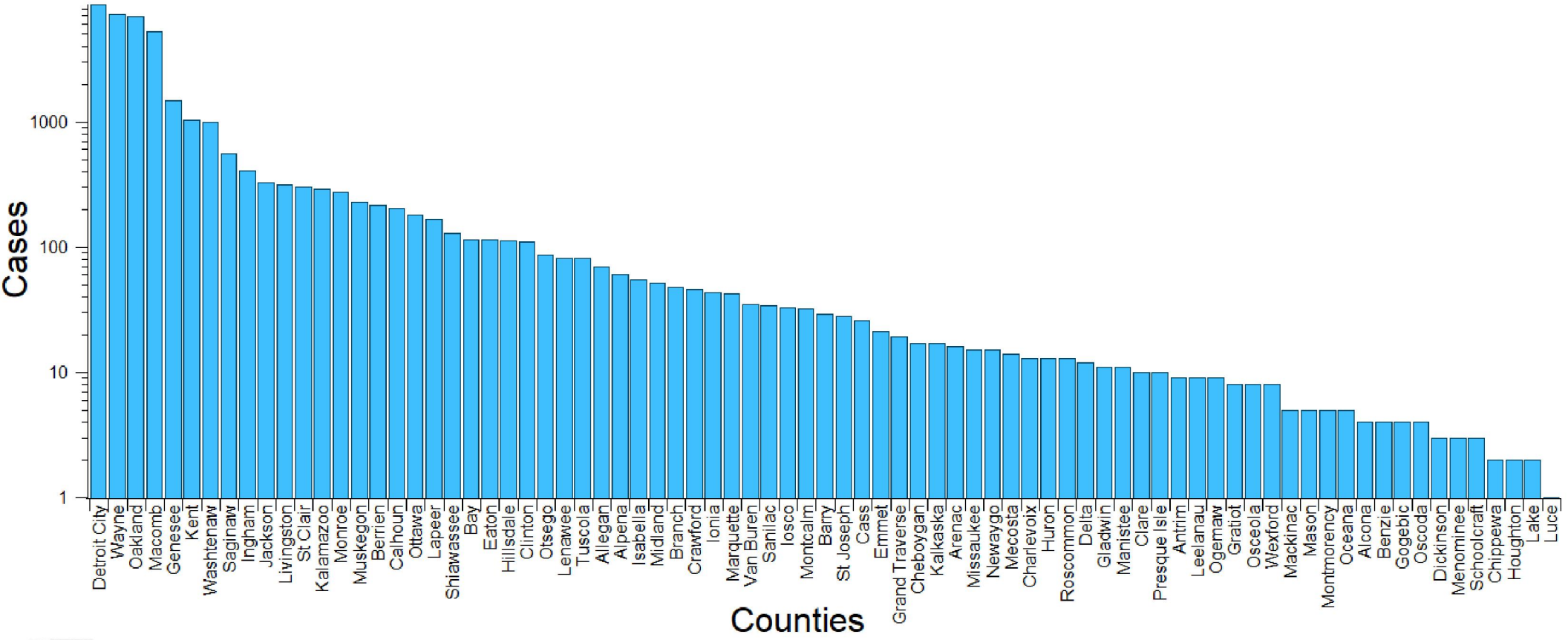


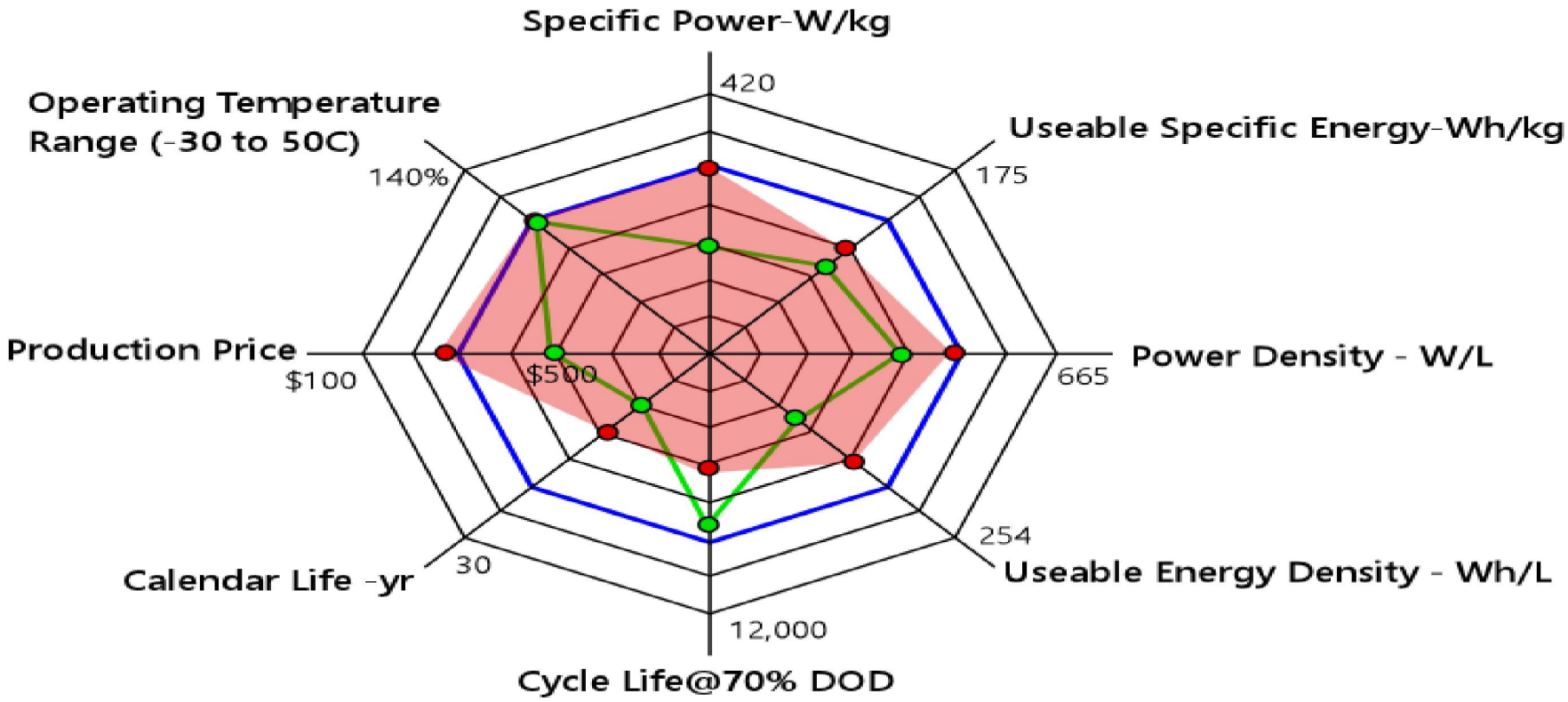
RAWGraphs

MICHIGAN CORONAVIRUS CASES



MICHIGAN CORONAVIRUS CASES




Specific Power-W/kg
420
Useable Specific Energy-Wh/kg
175
Power Density - W/L
665
Useable Energy Density - Wh/L
254
Cycle Life@70% DOD
12,000
Calendar Life -yr
30
Production Price
$100
$500
Operating Temperature Range (-30 to 50C)
140%
Battery A
Battery B

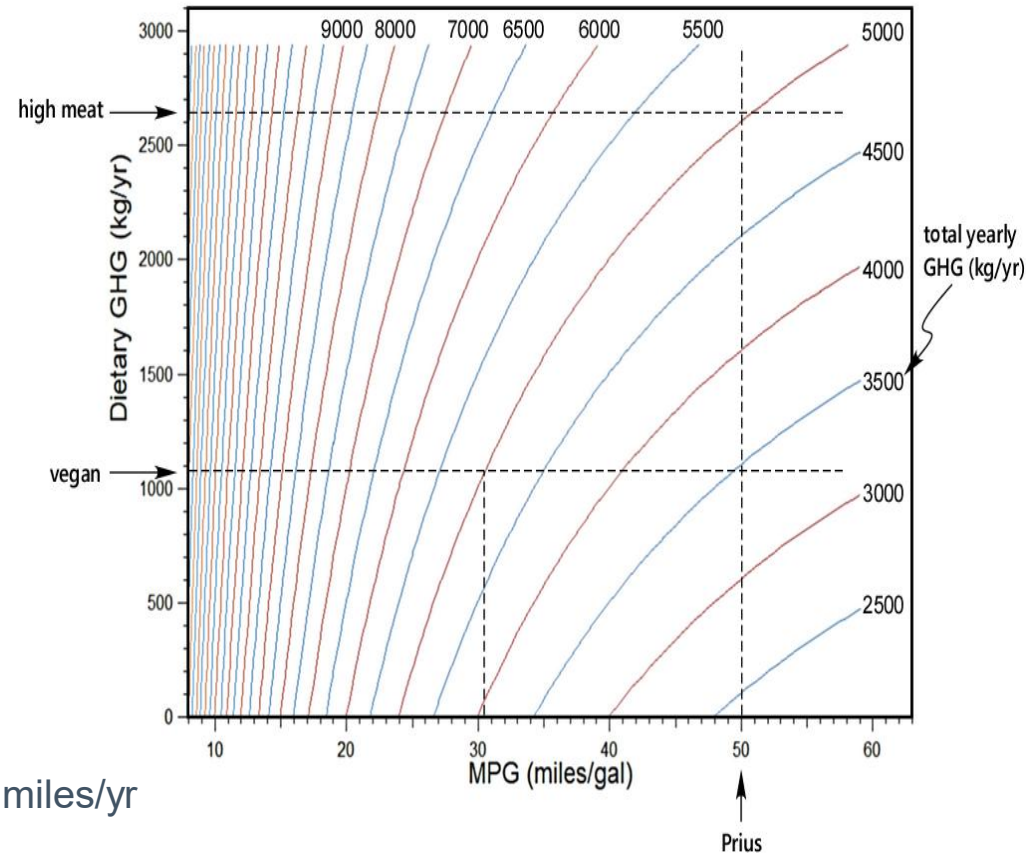
graphs used to gain understanding
are unlikely to be good for explaining

Which Is Better For The Environment?

A MEAT-EATER IN A PRIUS

A VEGAN IN A HUMMER

VEGAN/MEAT-EATER DRIVING COMPARISON

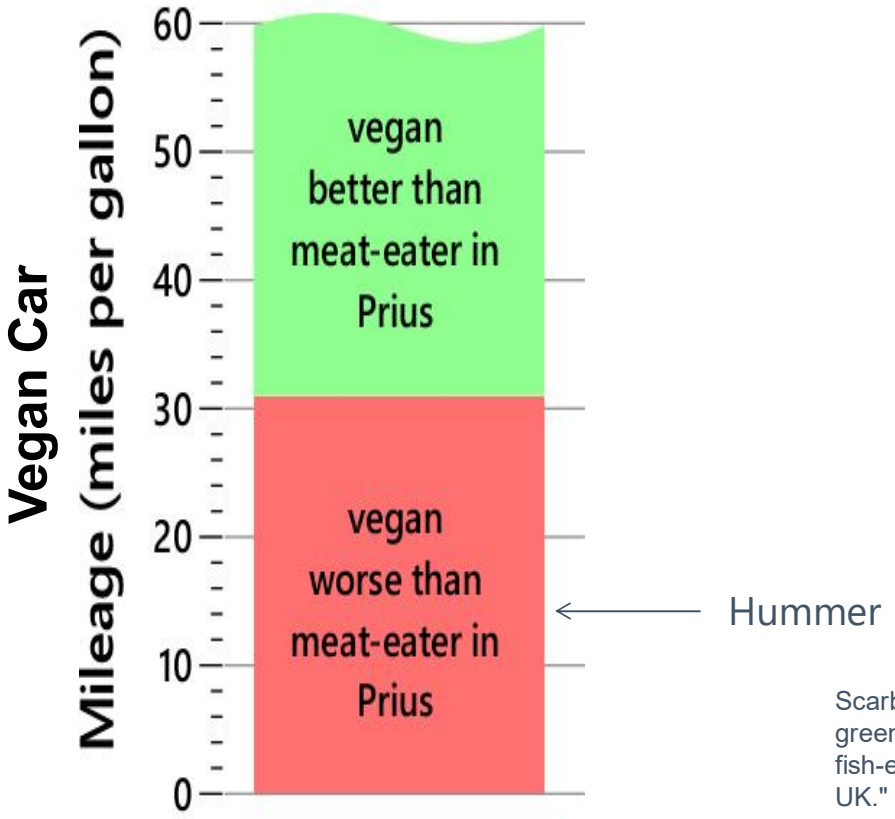


nomograph

assumes 13,476 miles/yr

Scarborough, Peter, et al. "Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK." Climatic Change 125.2 (2014): 179-192.

VEGAN/MEAT-EATER DRIVING COMPARISON



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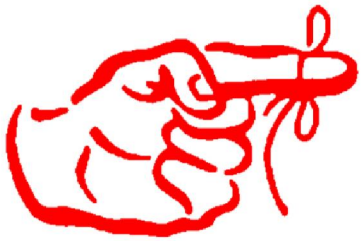
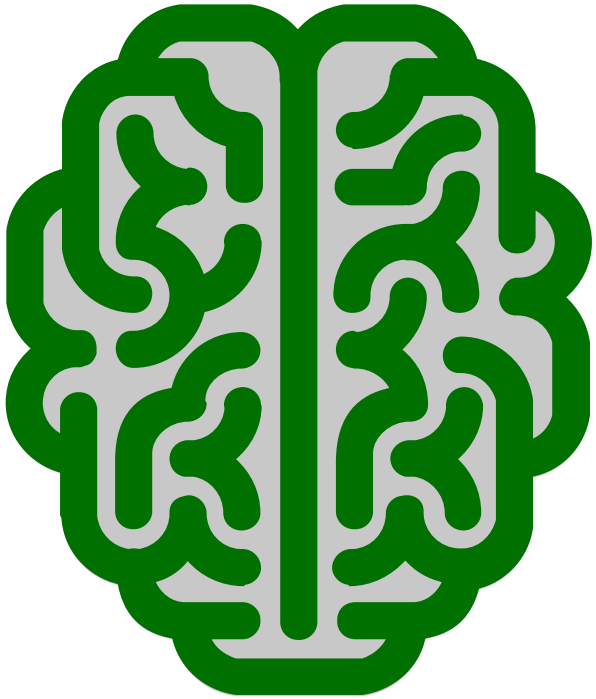


graphs used to gain understanding are unlikely to be good for presentation

Prepare Plot For Your Audience

- Know your audience and craft the presentation for them
  - focus on your key message(s)

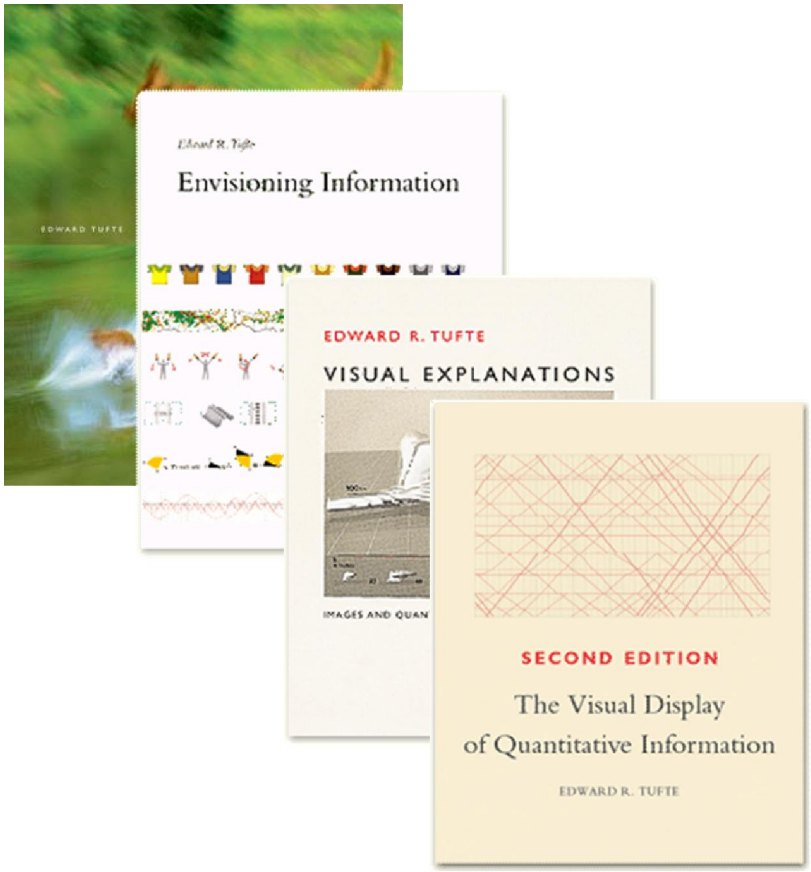


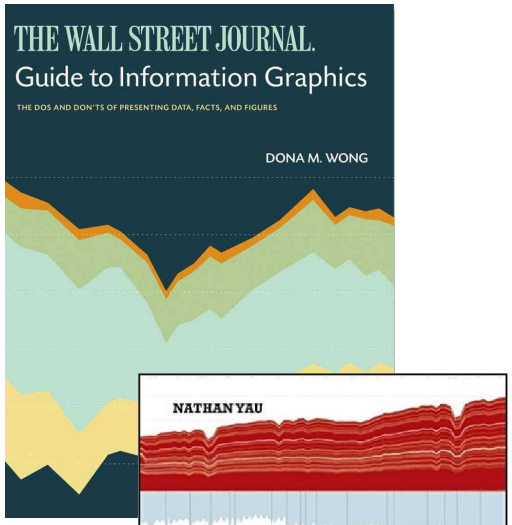
ready

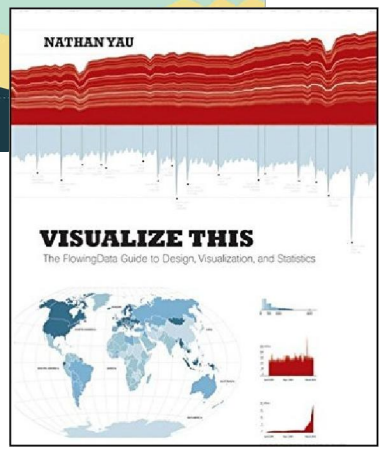
- memorable is better than forgettable (pics memorable)
- make graphics *mind ready*
- info density right for material and audience

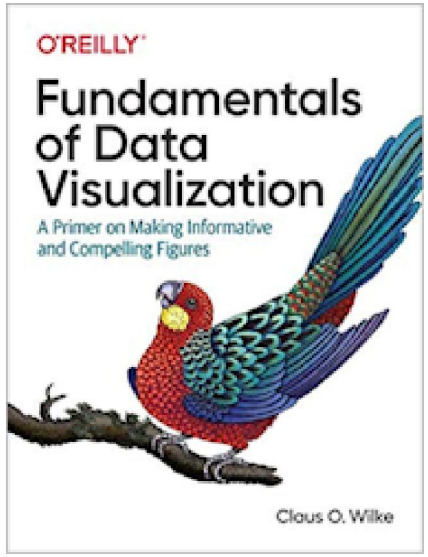
- don't let tools get in the way

Favorite References – Display of Information



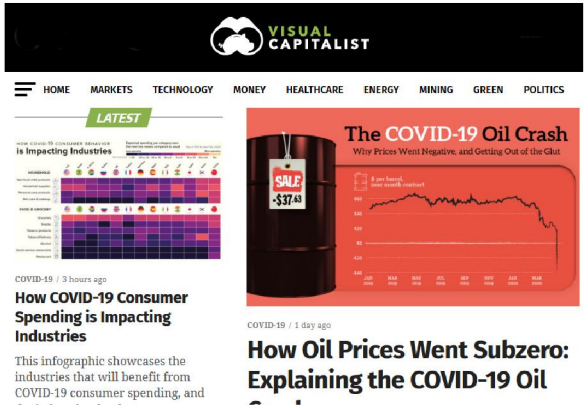




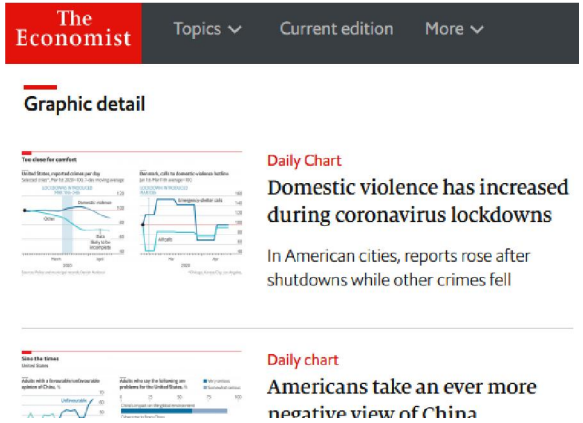


FAVORITE DATA VISUALIZATION WEBSITES - SAMPLES

howmuch.net



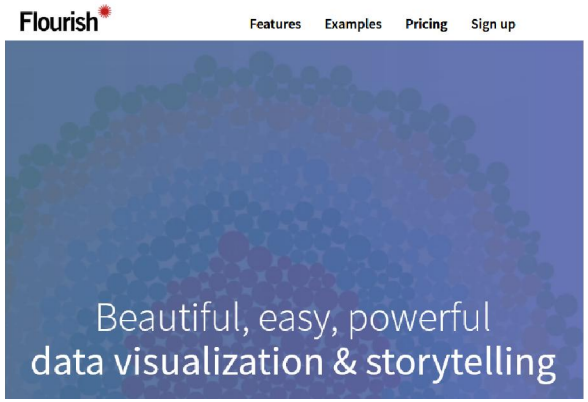
visualcapitalist.com



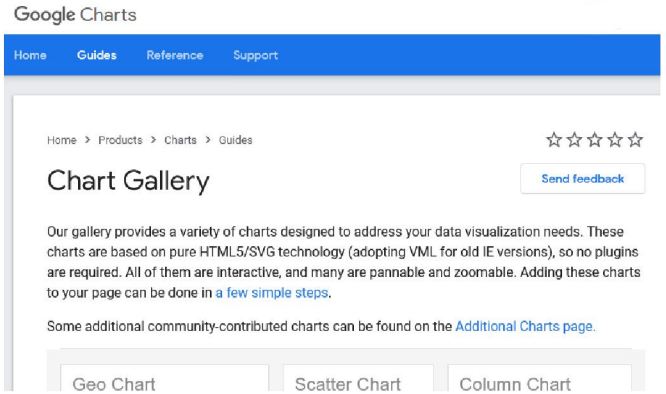
economist.com/graphic-detail/

FAVORITE DATA VISUALIZATION WEBSITES - TOOLS

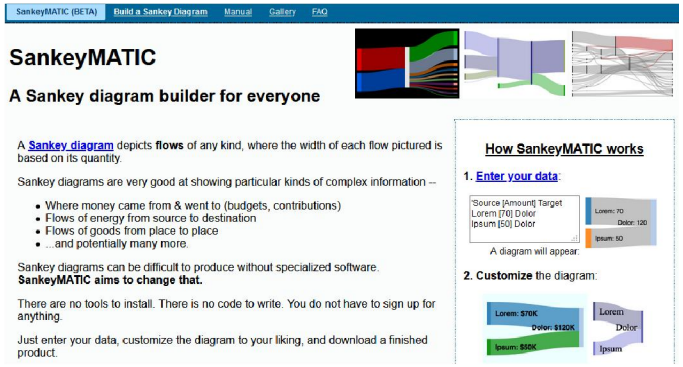
*



flourish.studio



developers.google.com/chart/interactive/docs/gallery



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