



**FROM DATA TO UNDERSTANDING: DESIGNING
VISUALIZATIONS FOR YOUR AUDIENCE
EFFECTIVE COMMUNICATION OF SCIENTIFIC DATA**

MARK JONES

CREATIVE DIRECTOR

MJPhD, LLC

5 October 2026



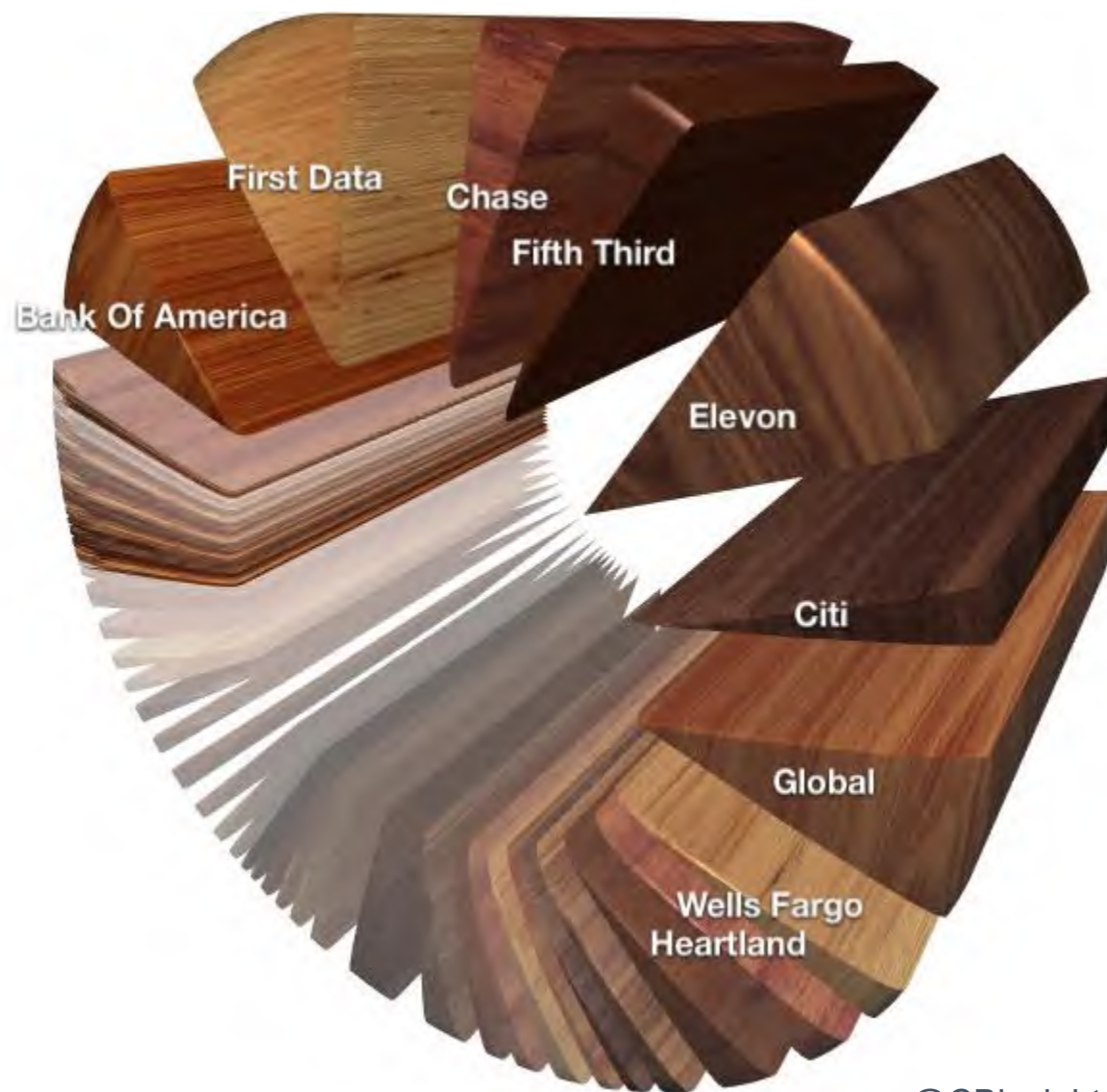


Jump and
a net will
appear



MJPhD

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



curated bad graphics



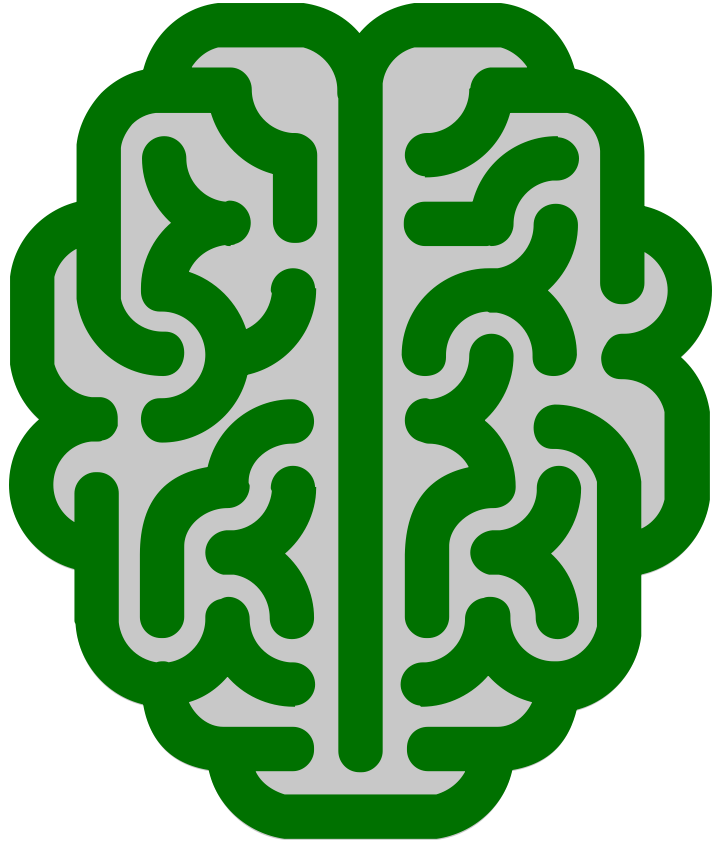
Tools
Tactics
Strategy
Audience
Goal



any communication
Designing a presentation
without an audience in mind
is like writing a love letter
and addressing it 'to whom
it may concern'.

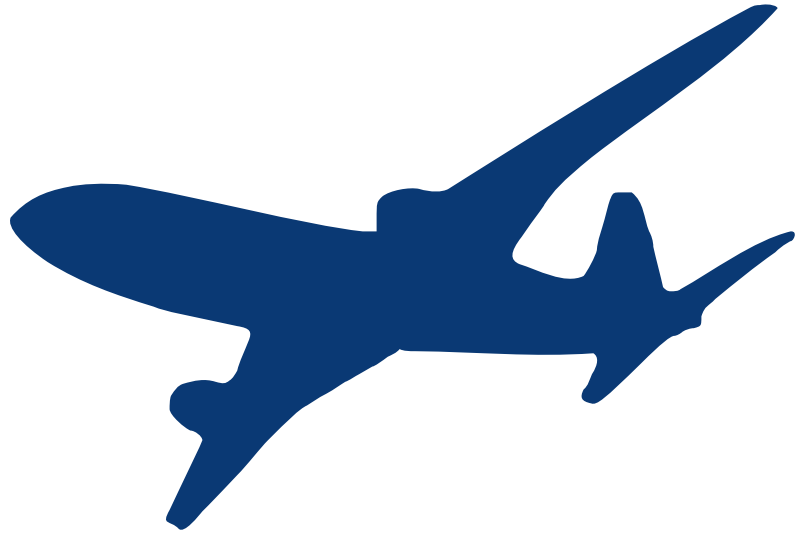


Ken Haemer
Presentation Research Manager,
AT&T

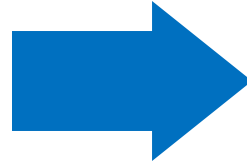


ready

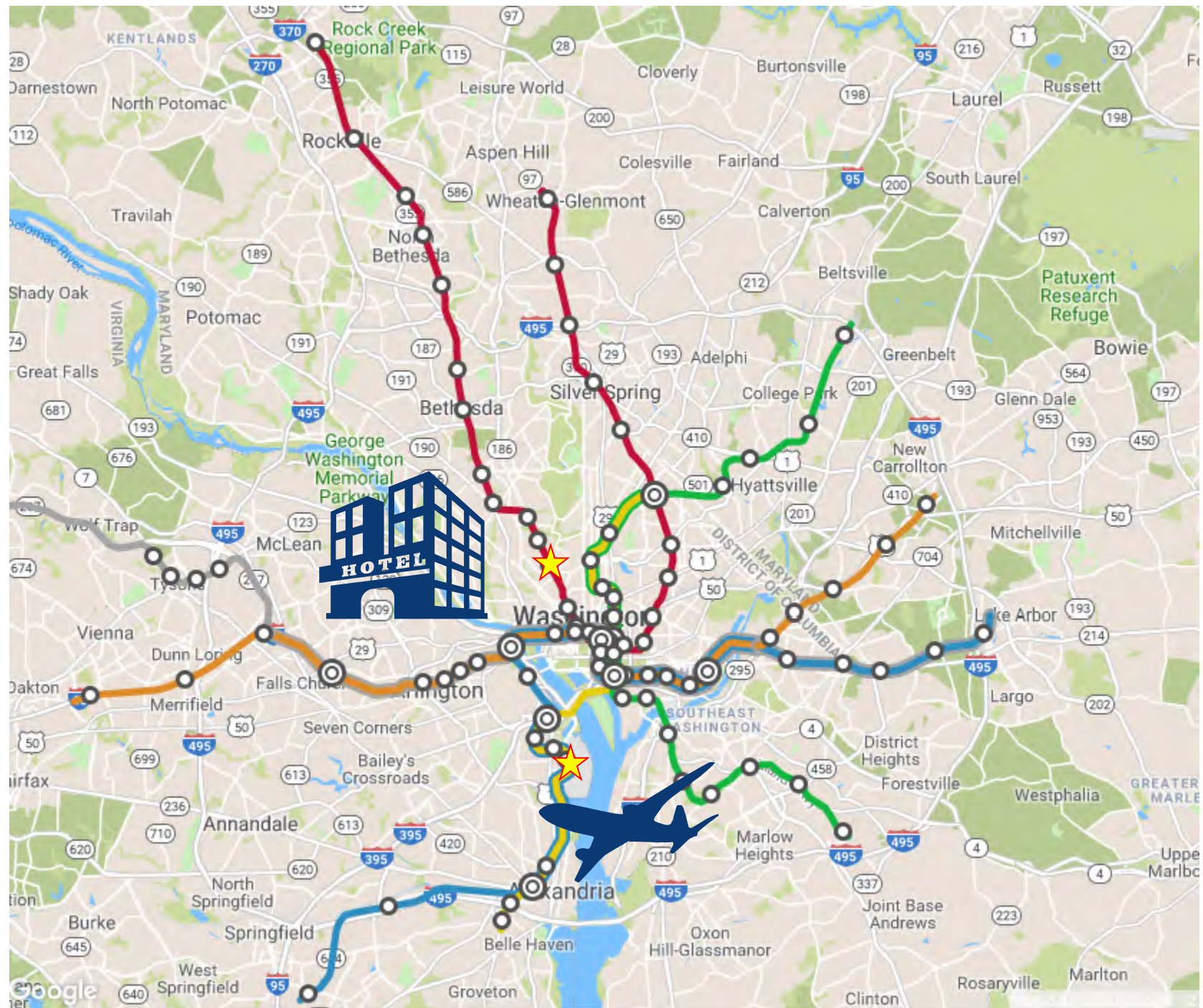
Washington, D.C.



Reagan National Airport



Marriott Woodley Park

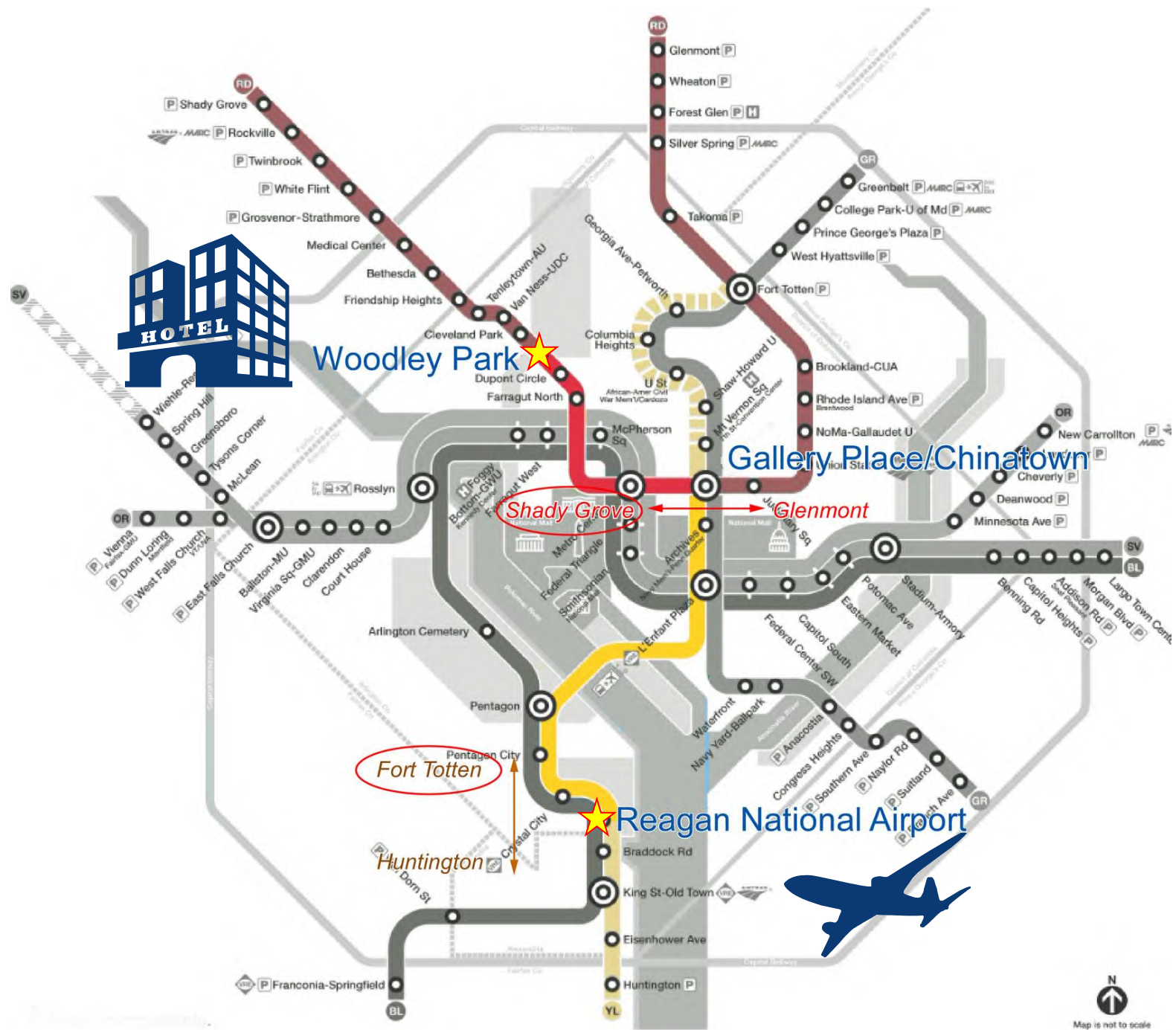






 Metro is accessible.

N
↑
Map is not to scale





Woodley Park ★

Gallery Place/Chinatown

Shady Grove

Glenmont

Fort Totten

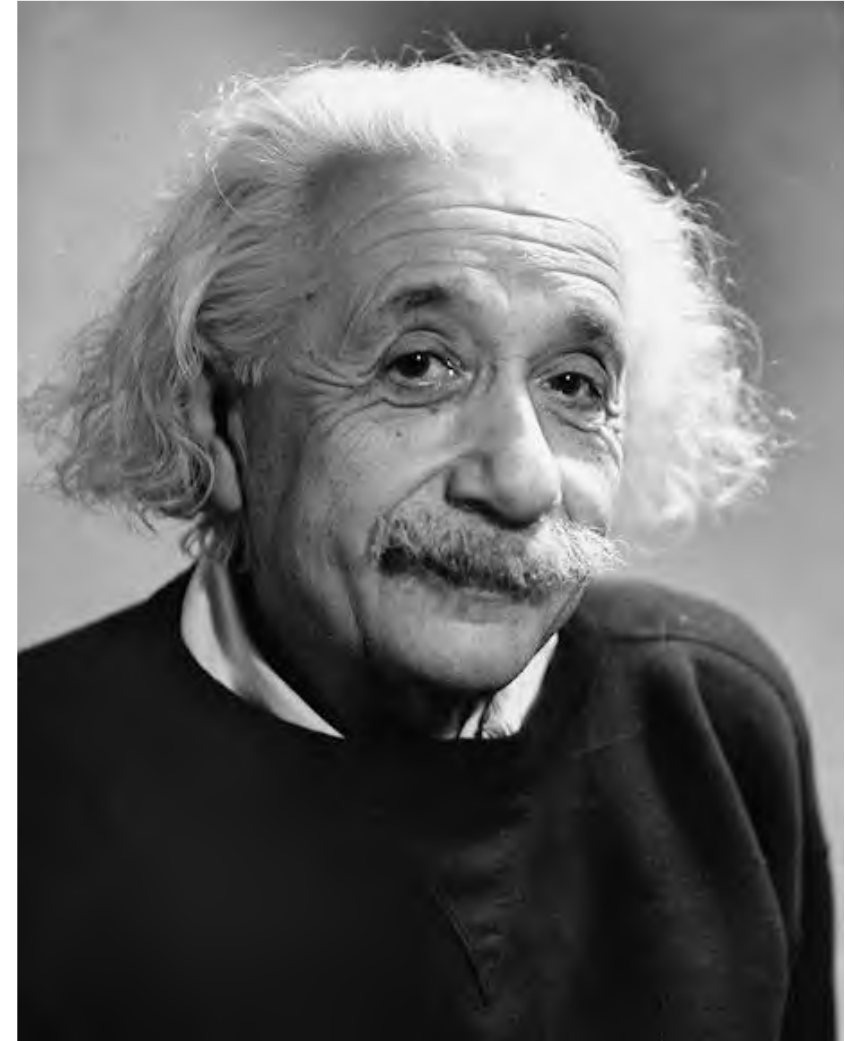
★ Reagan National Airport

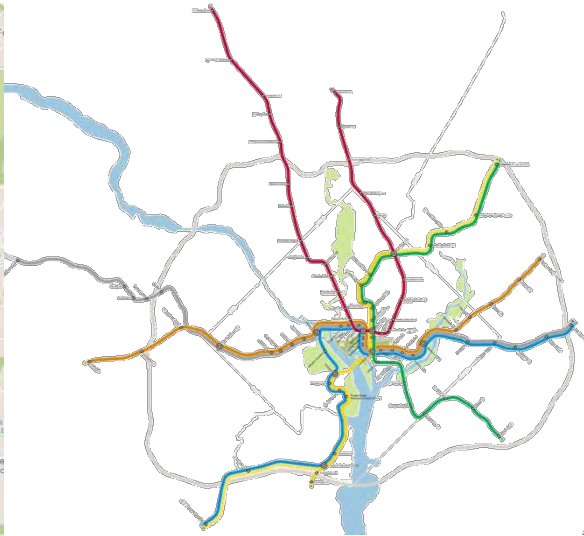
Huntington



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

Albert Einstein





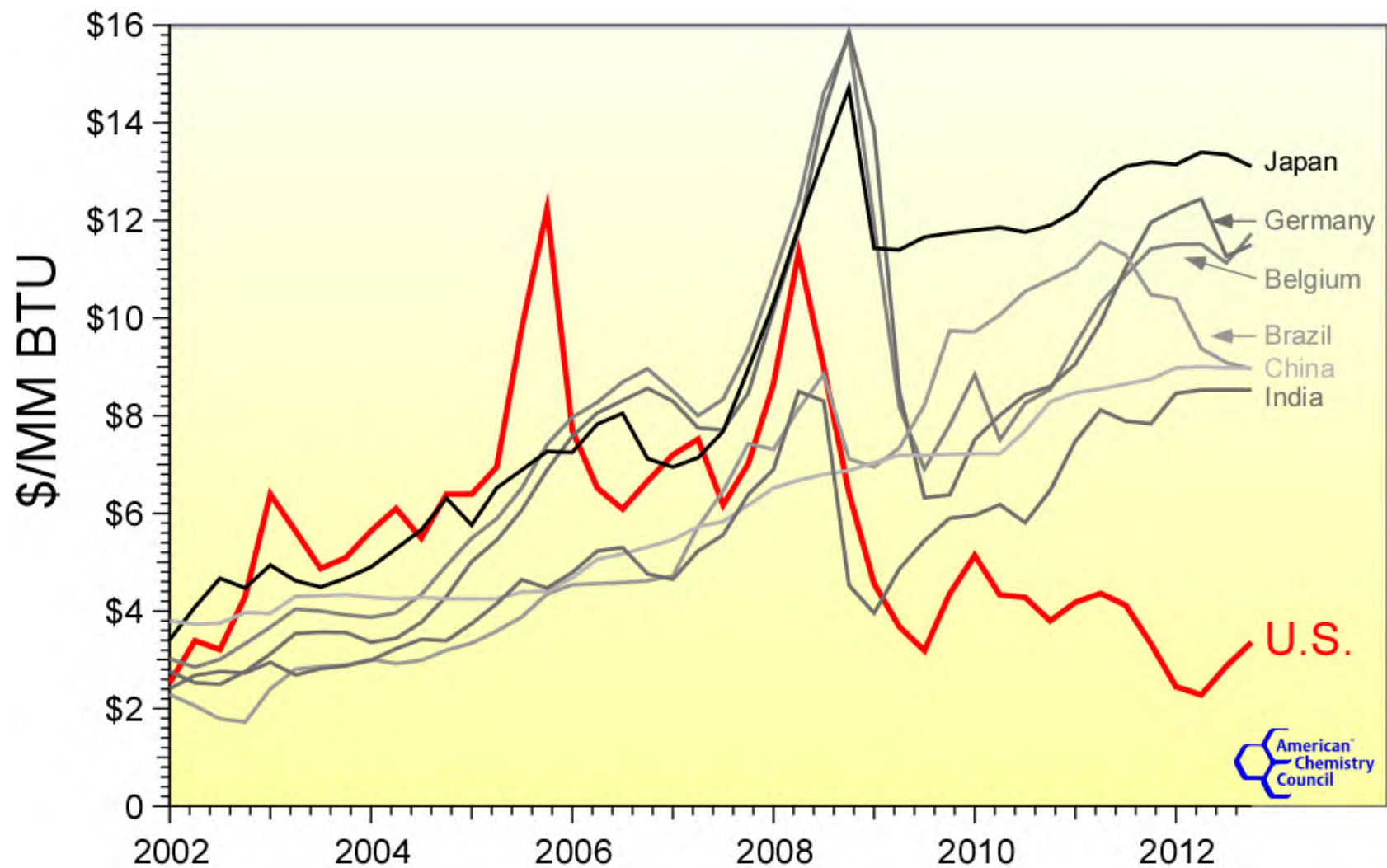
FIVE PRINCIPLES OF DATA PRESENTATION

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

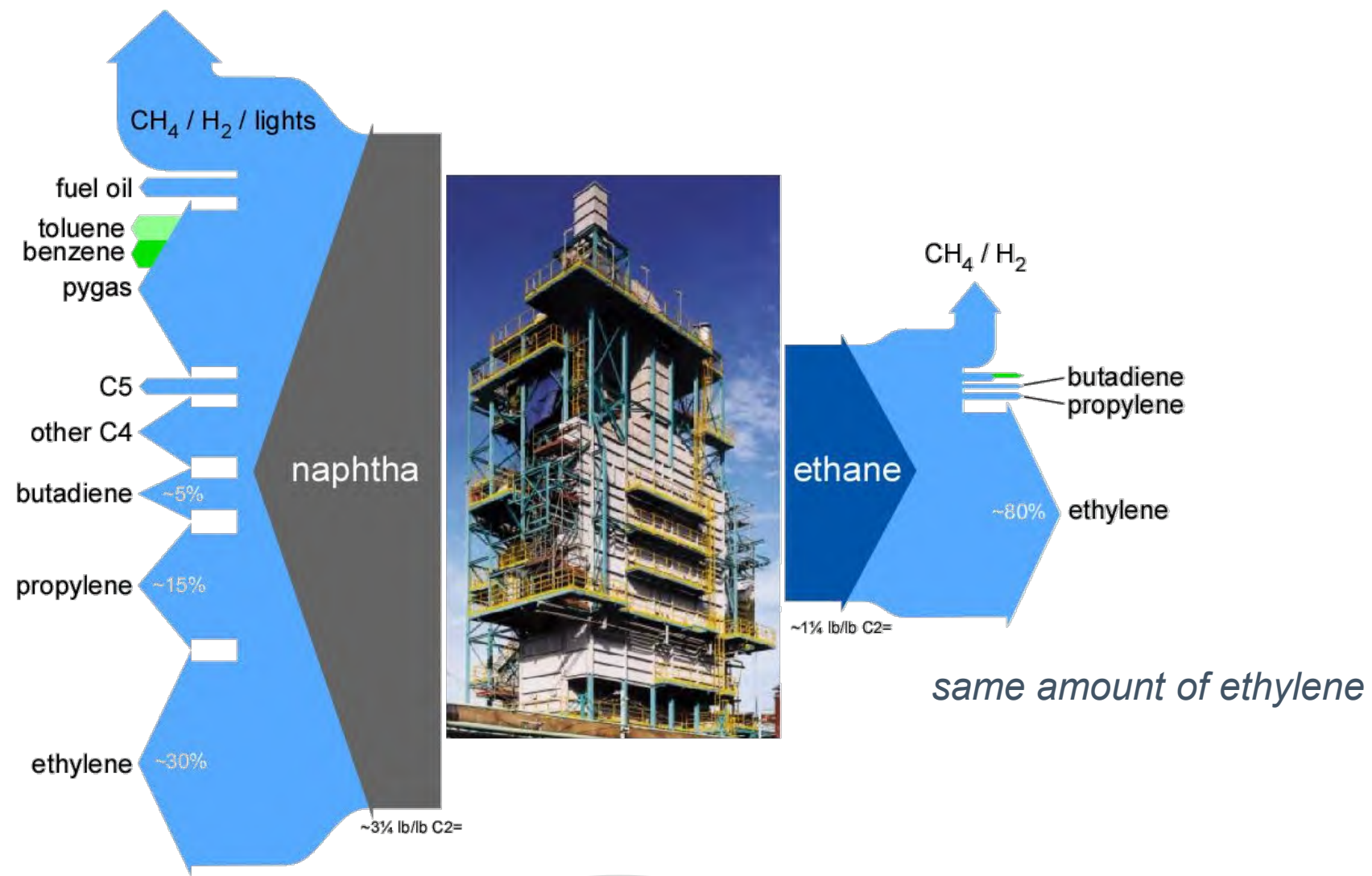
Everything should be made as simple as possible, but not simpler.

Nancy Duarte in Slideology

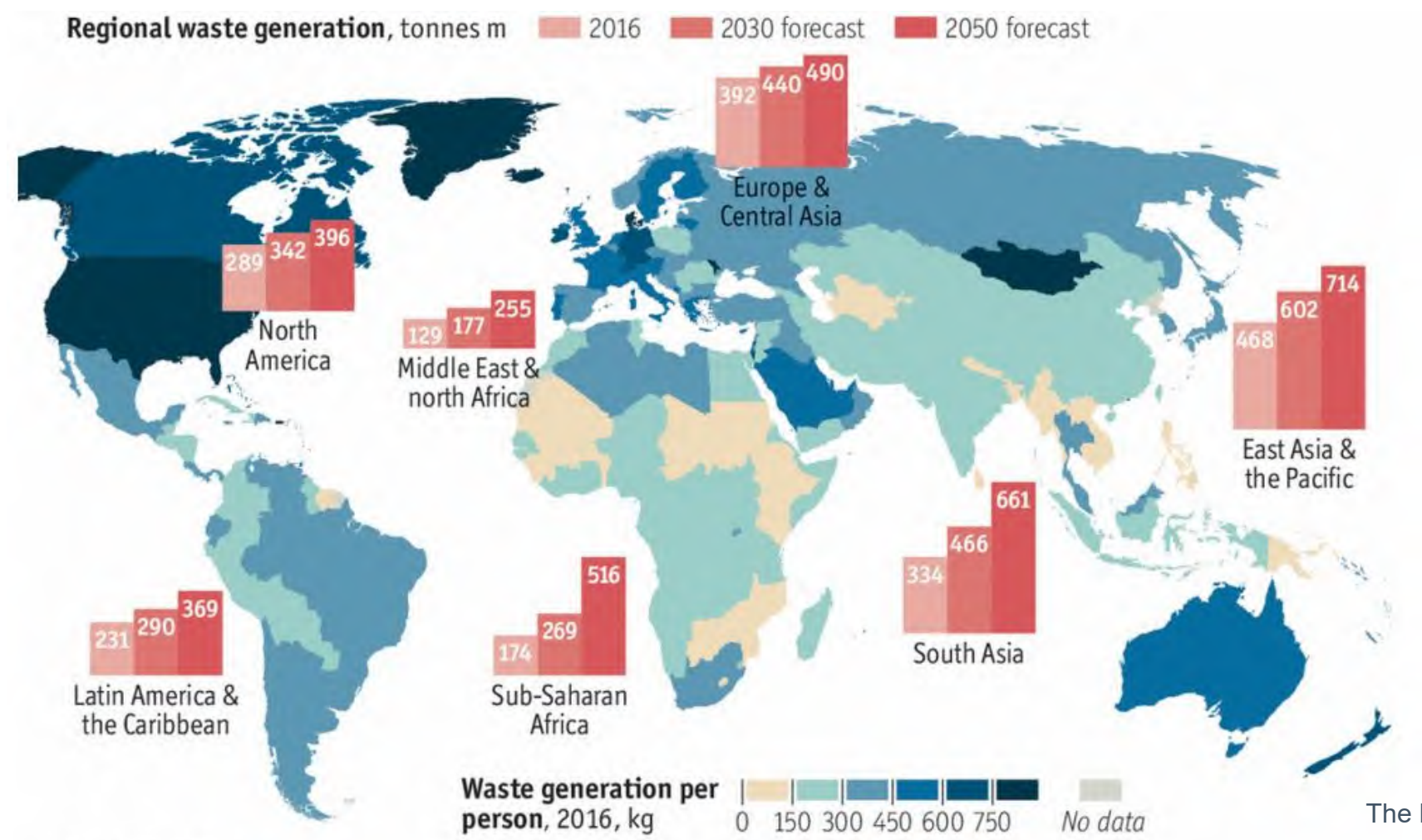
WORLD NATURAL GAS PRICES



NAPHTHA VS ETHANE CRACKING COMPARISON



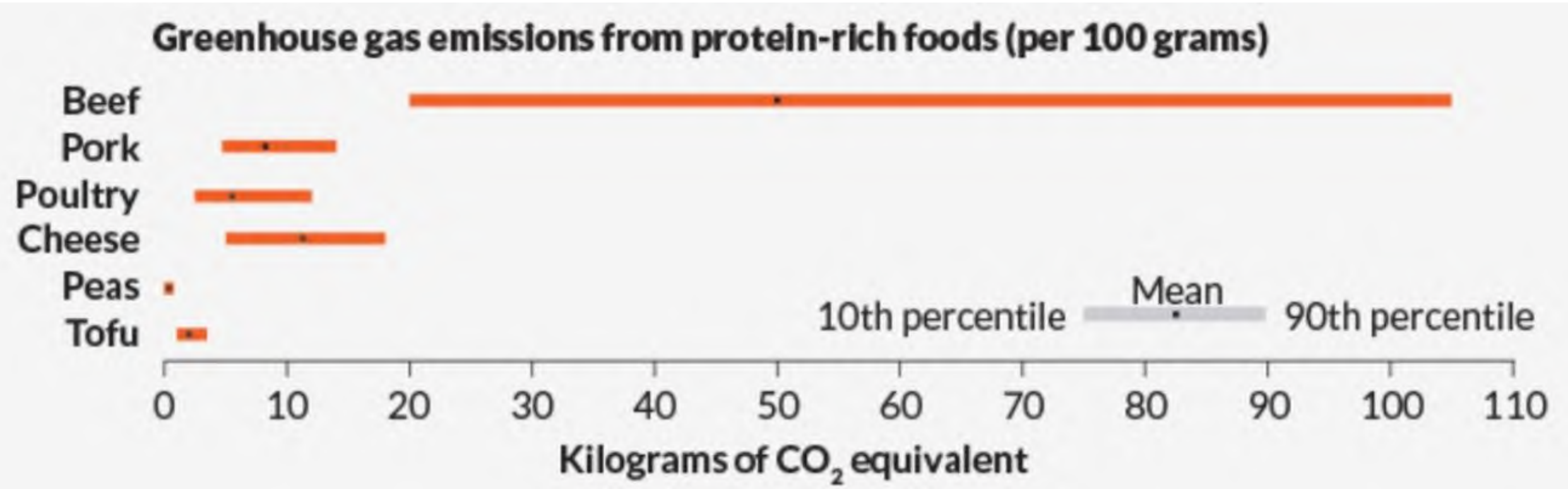
LOTS OF INFORMATION – THROWAWAY WORLD



Source: World Bank

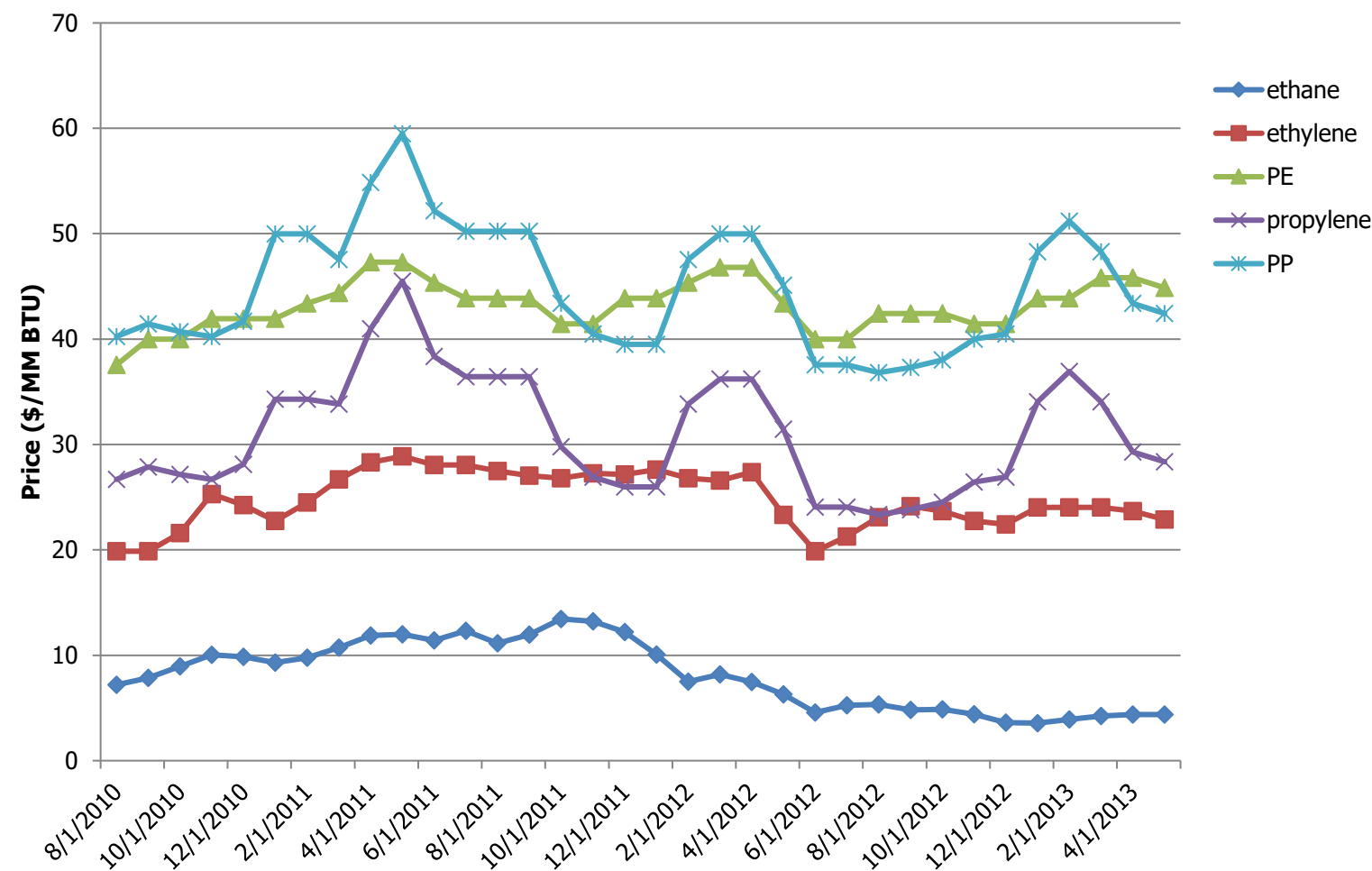
The Economist; 2 Oct 2018

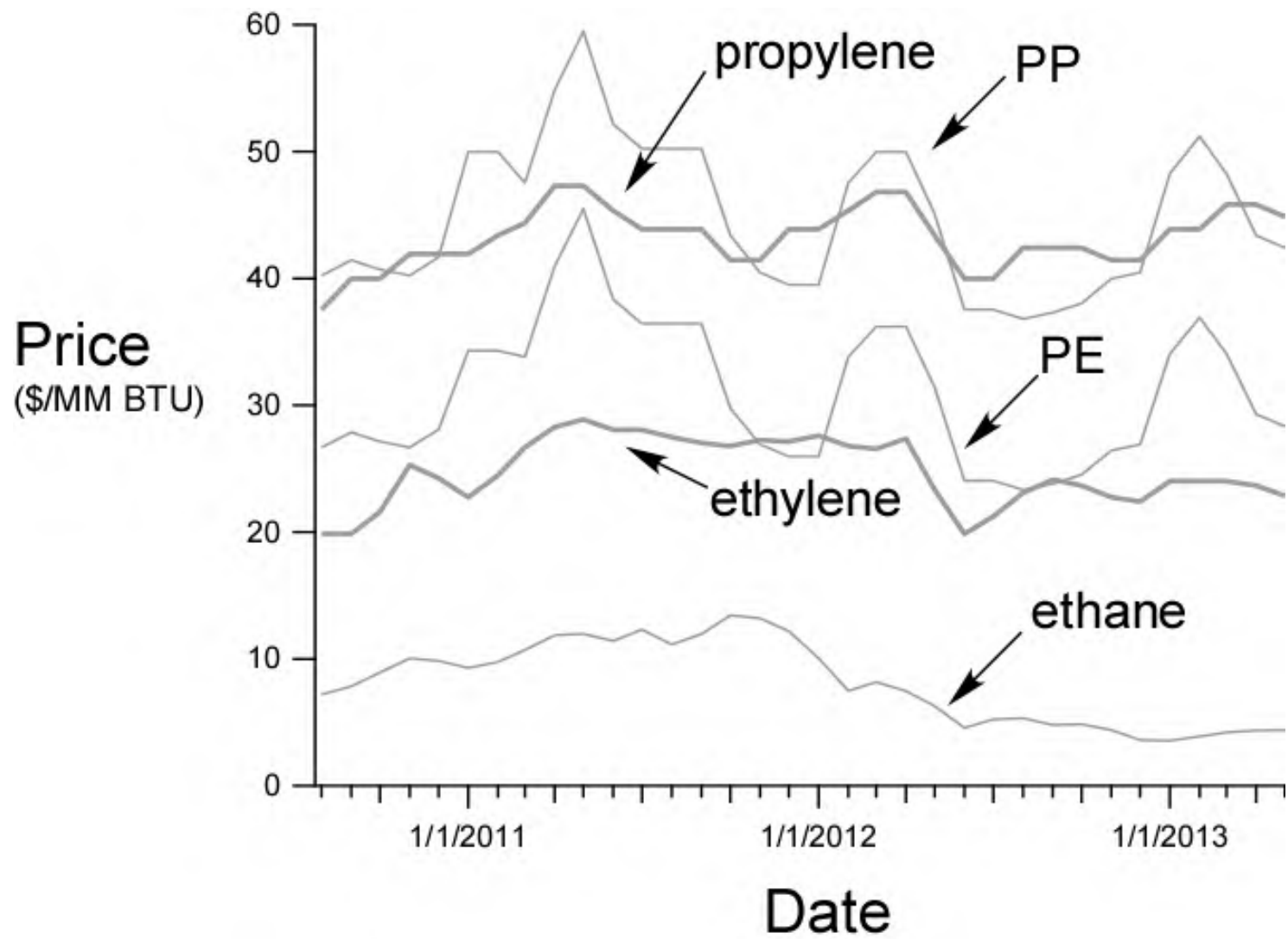
FARM TO TABLE

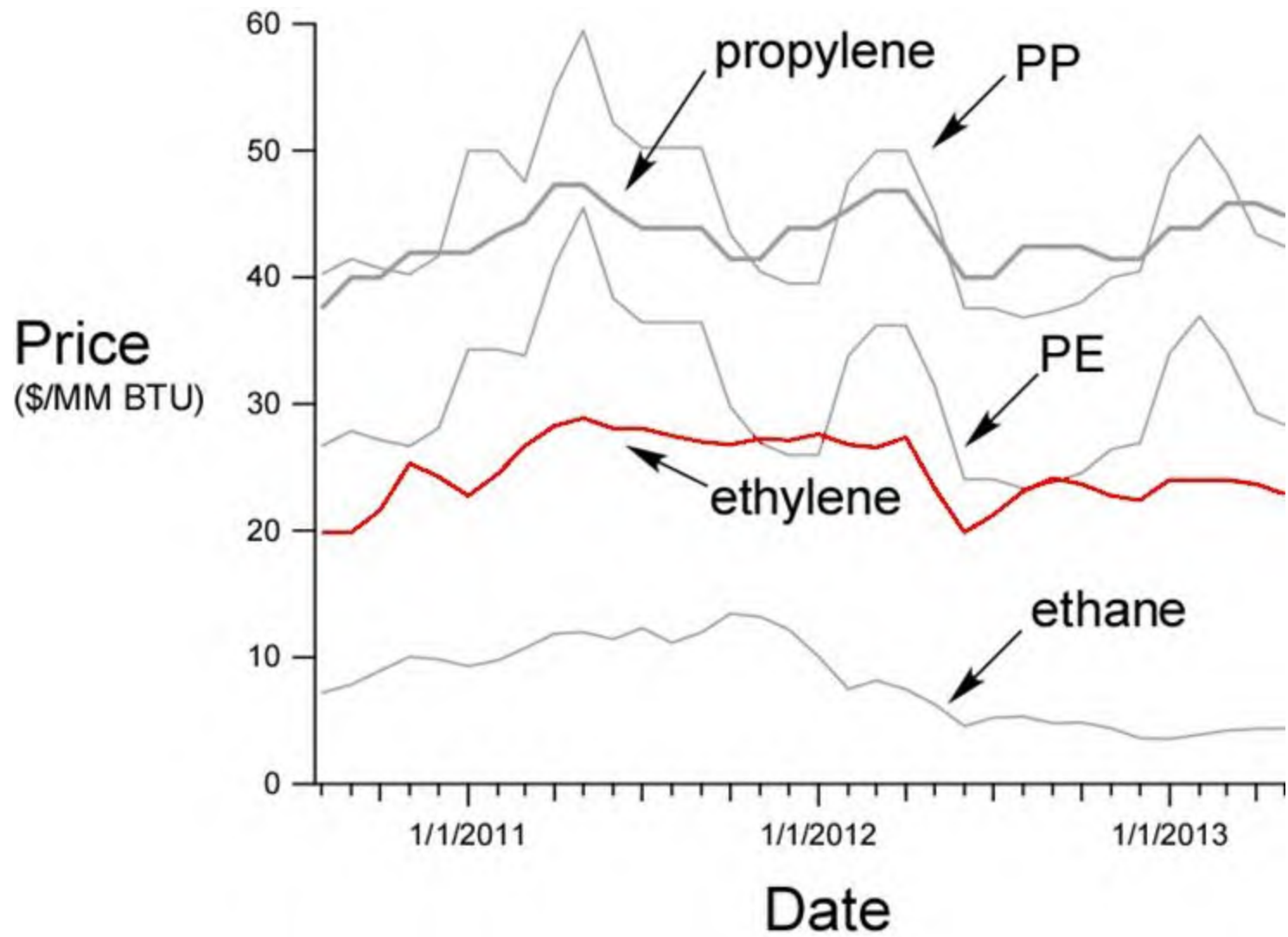


graphic by C. Chang in Milius, Susan; "Can science build a better burger?", *Science News*, September 20, 2018 downloaded from [sciencenews.org/article/can-science-build-better-burger](https://www.sciencenews.org/article/can-science-build-better-burger) on 2 November 2018.

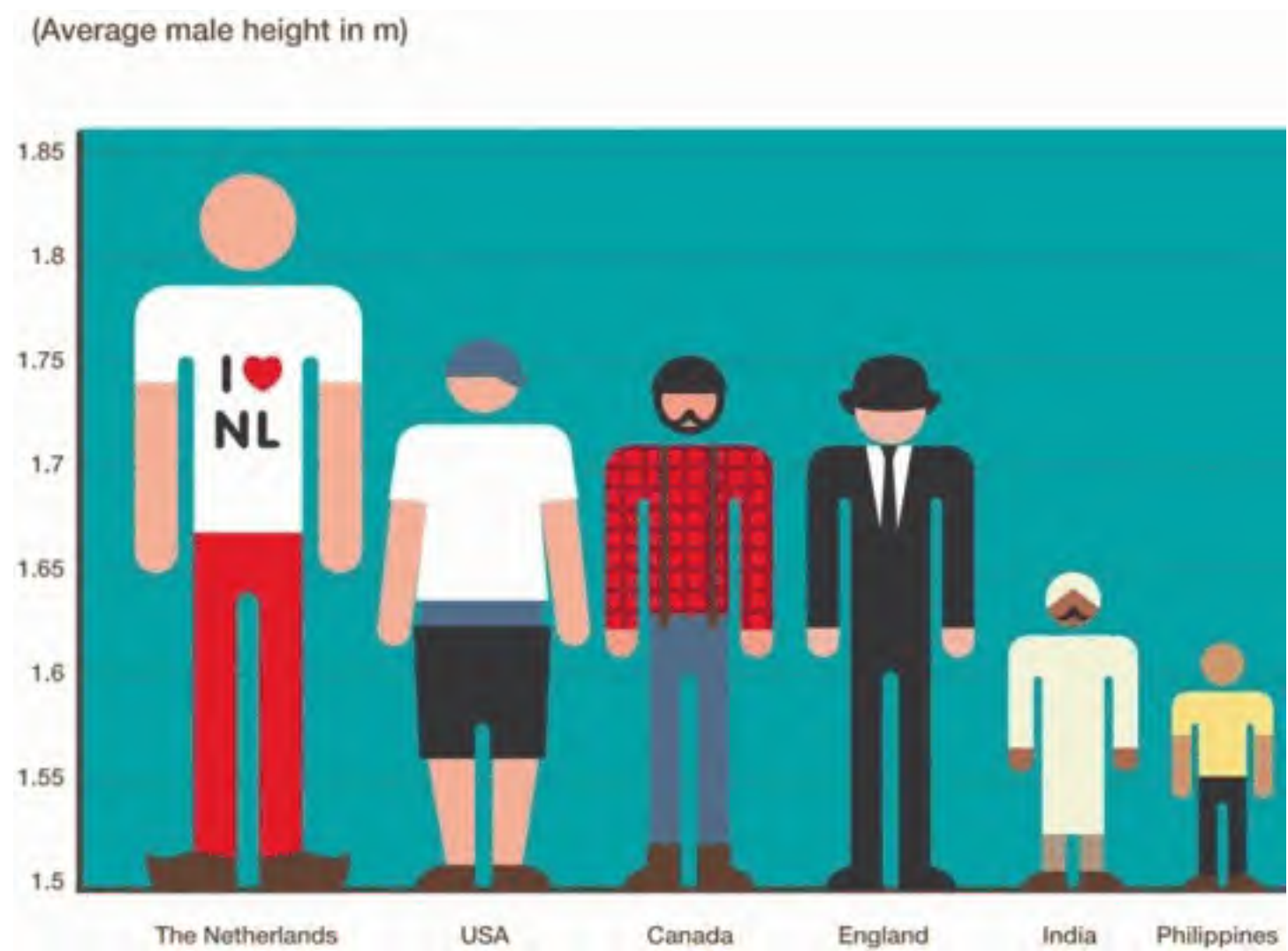
STANDARD EXCEL PLOT





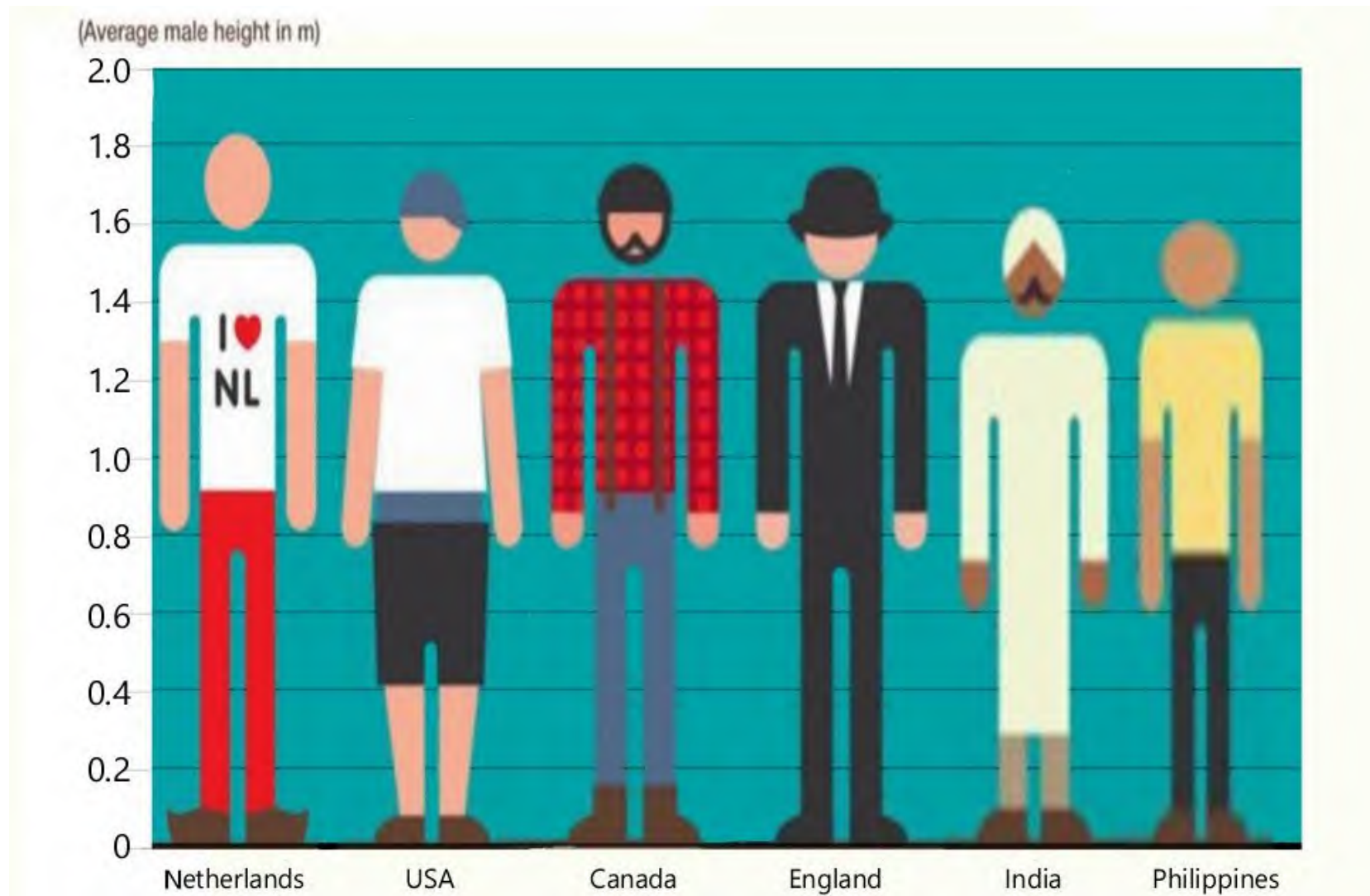


BAD GRAPHS – LOOKING DOWN ON THE REST OF THE WORLD

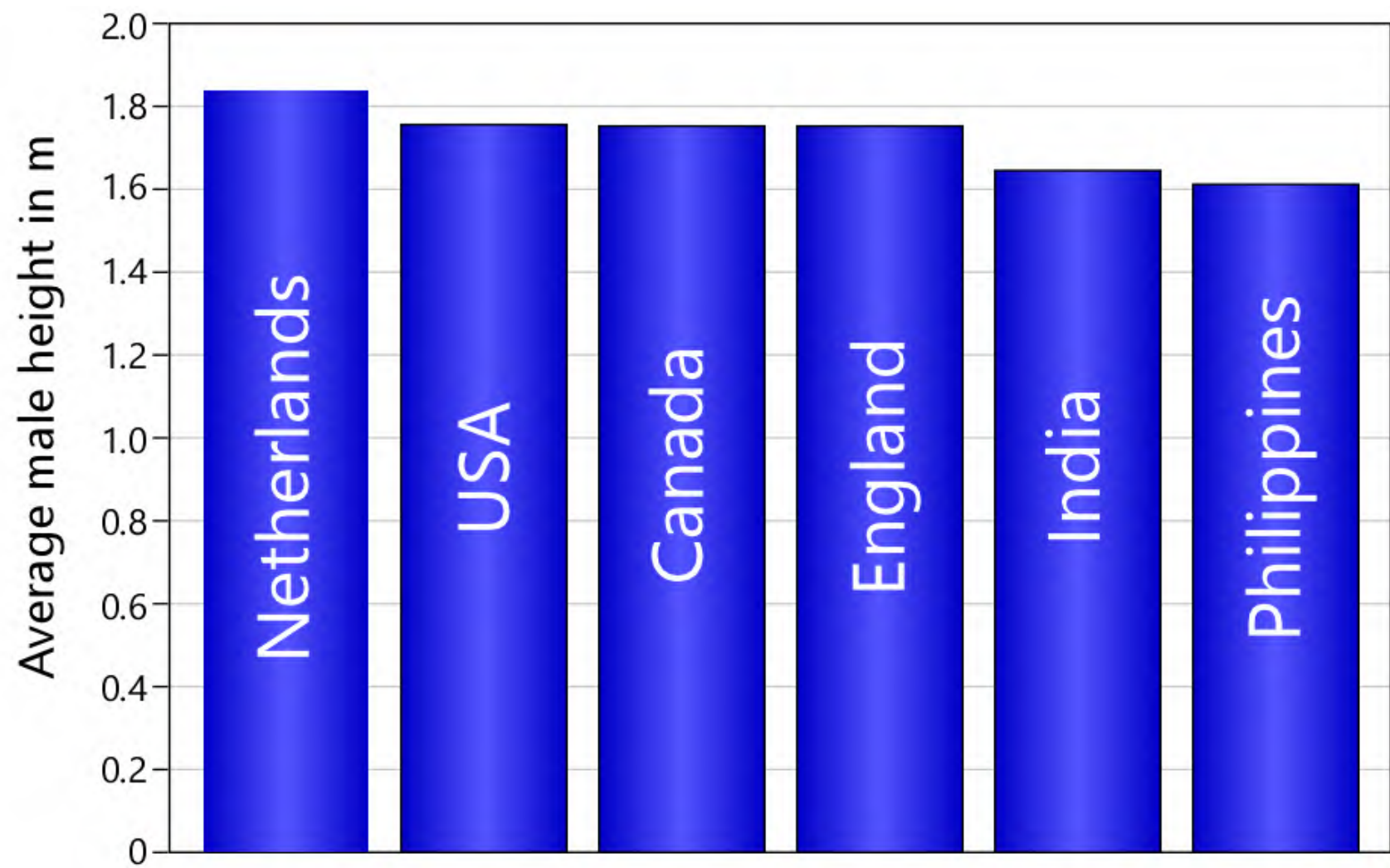


ticktockmaths.co.uk/bad-graphs/

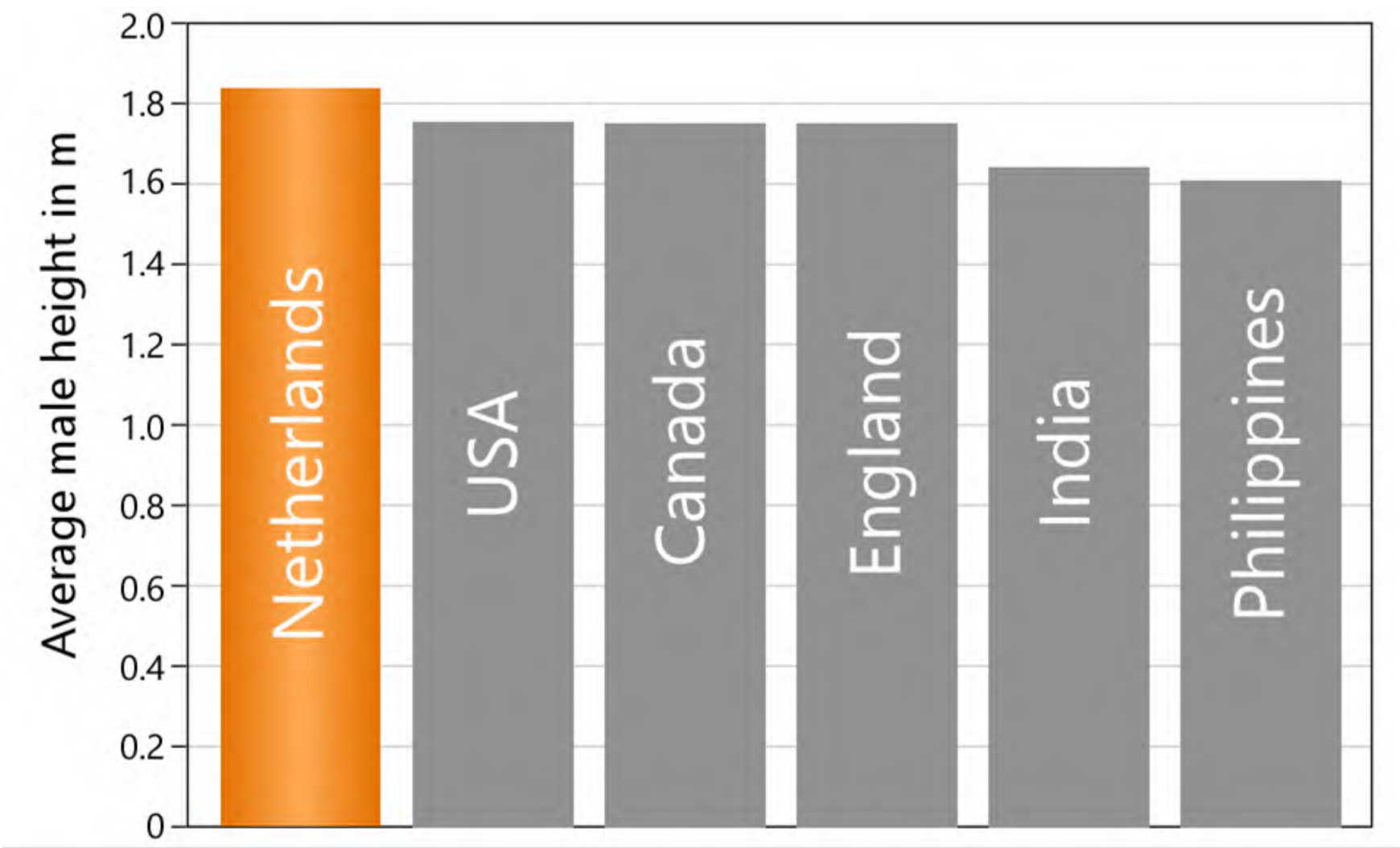
BETTER – BUT NOT GOOD ENOUGH



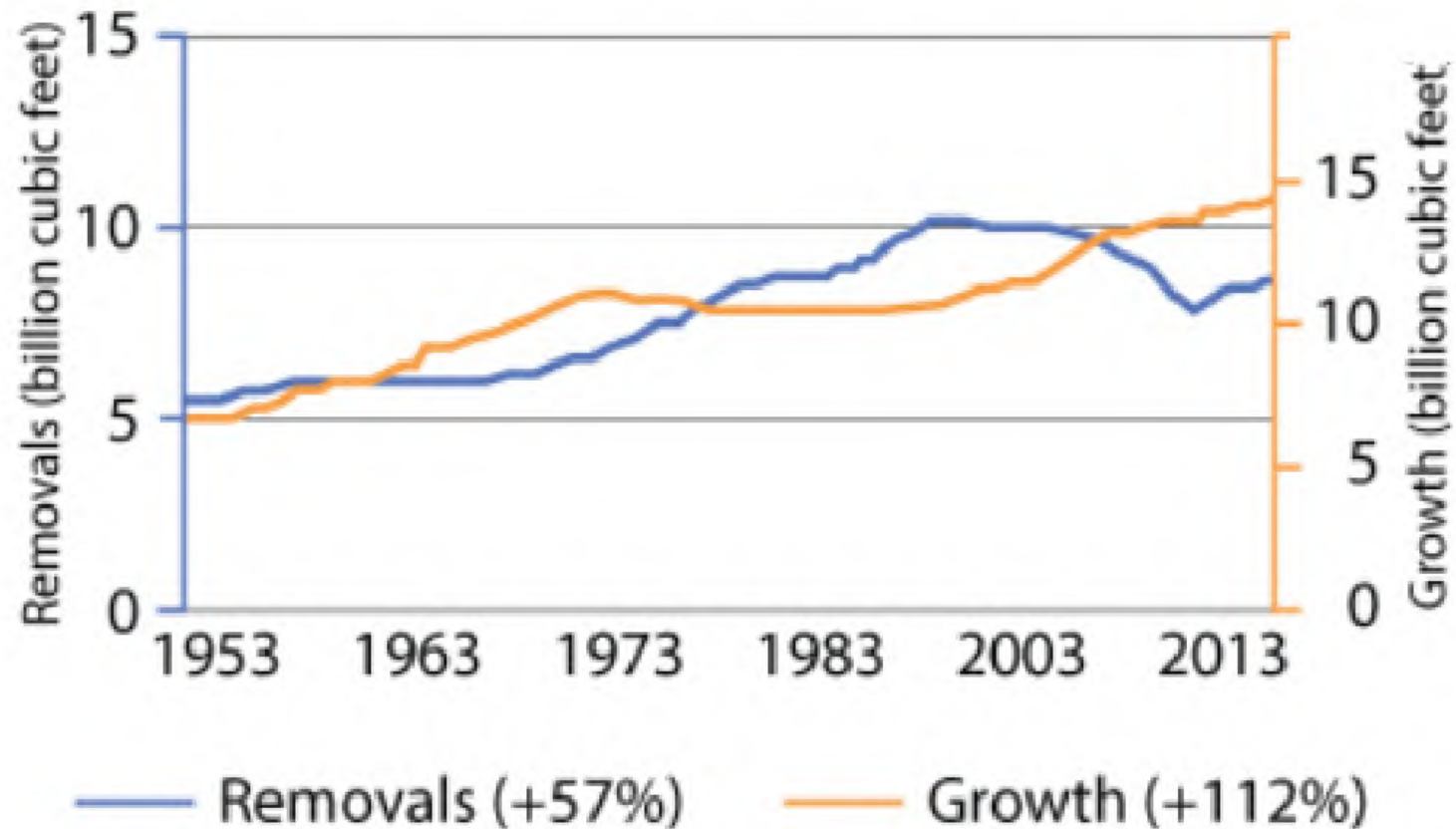
BETTER GRAPH



MAKING THE POINT

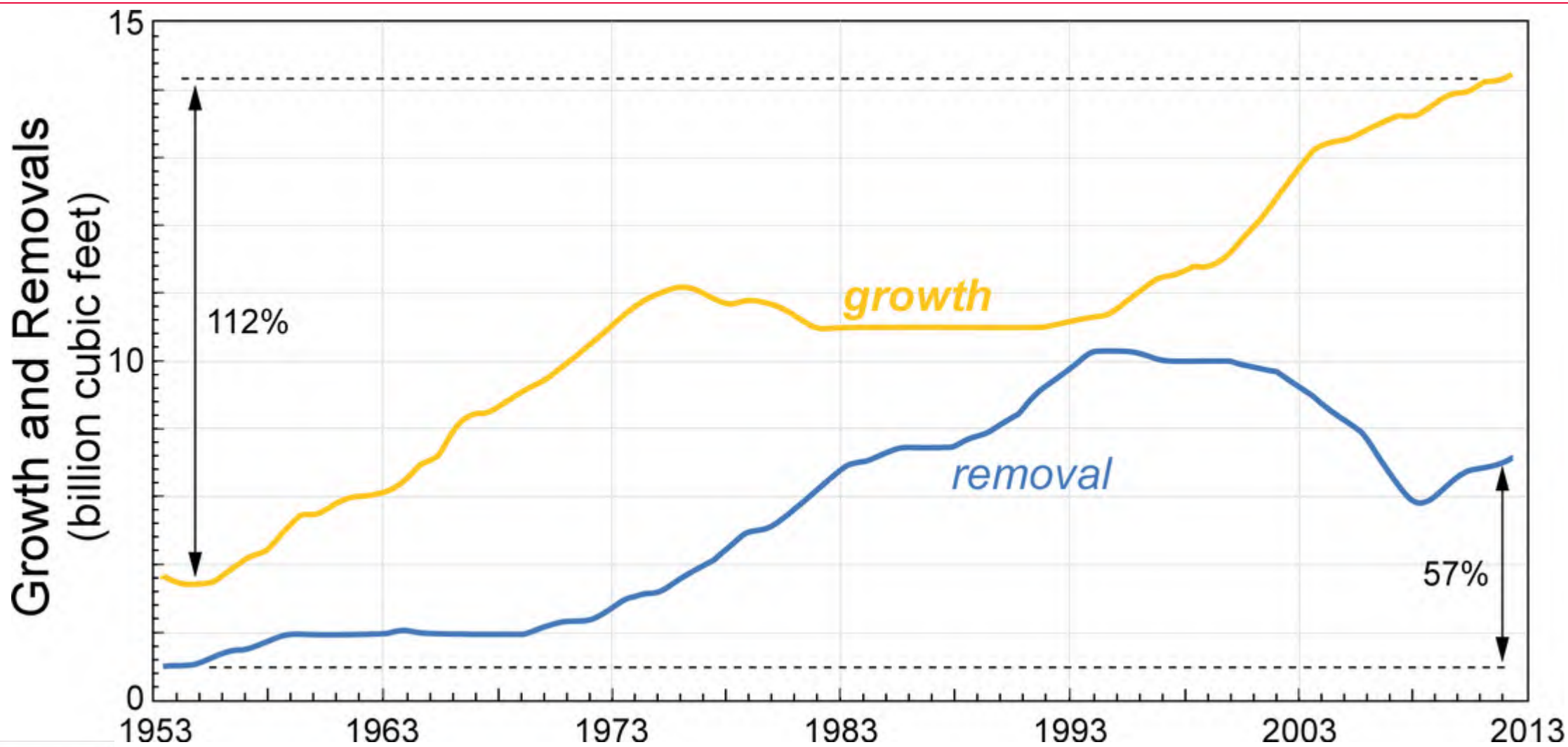


Southern Timber Removals and Growth

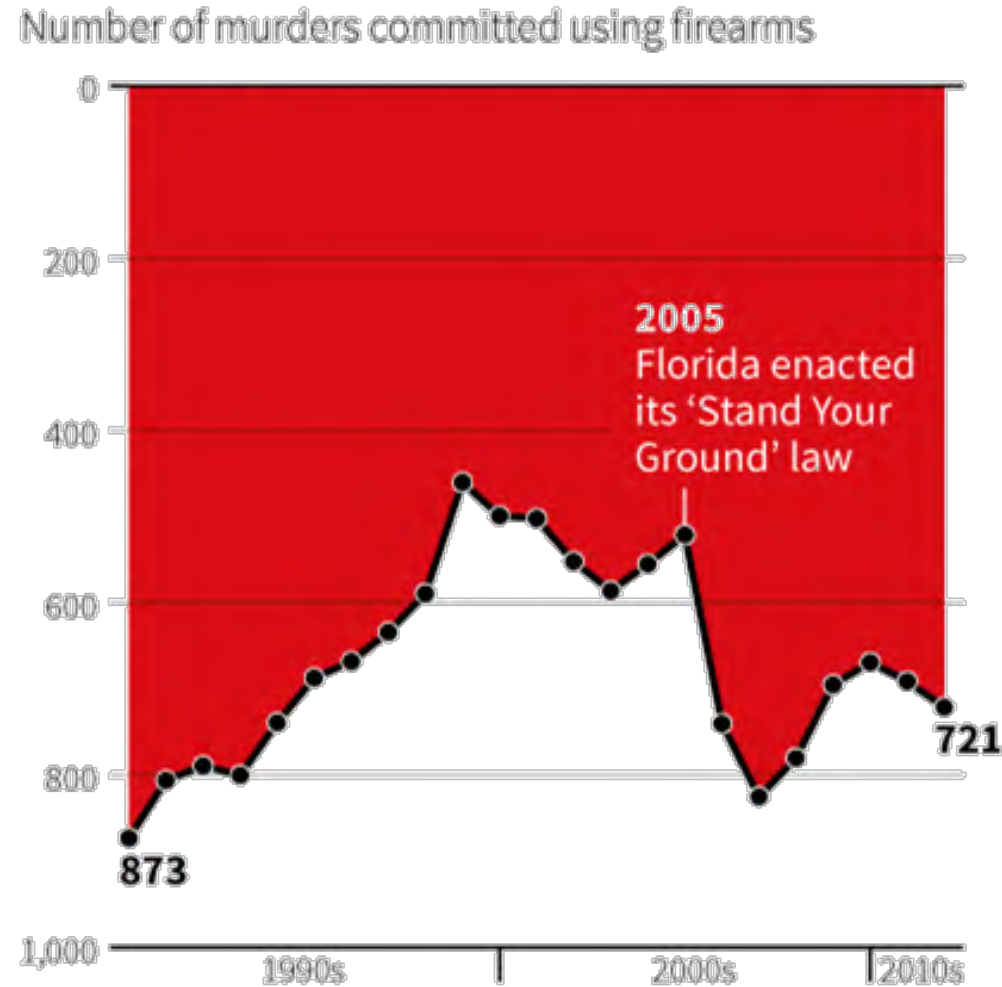


biomassmagazine.com/articles/15210/healthy-demand-for-southern-timber-ensures-forested-lands-remain-forested

SOUTHERN TIMBER



AXIS GAMES - GUN DEATHS IN FLORIDA



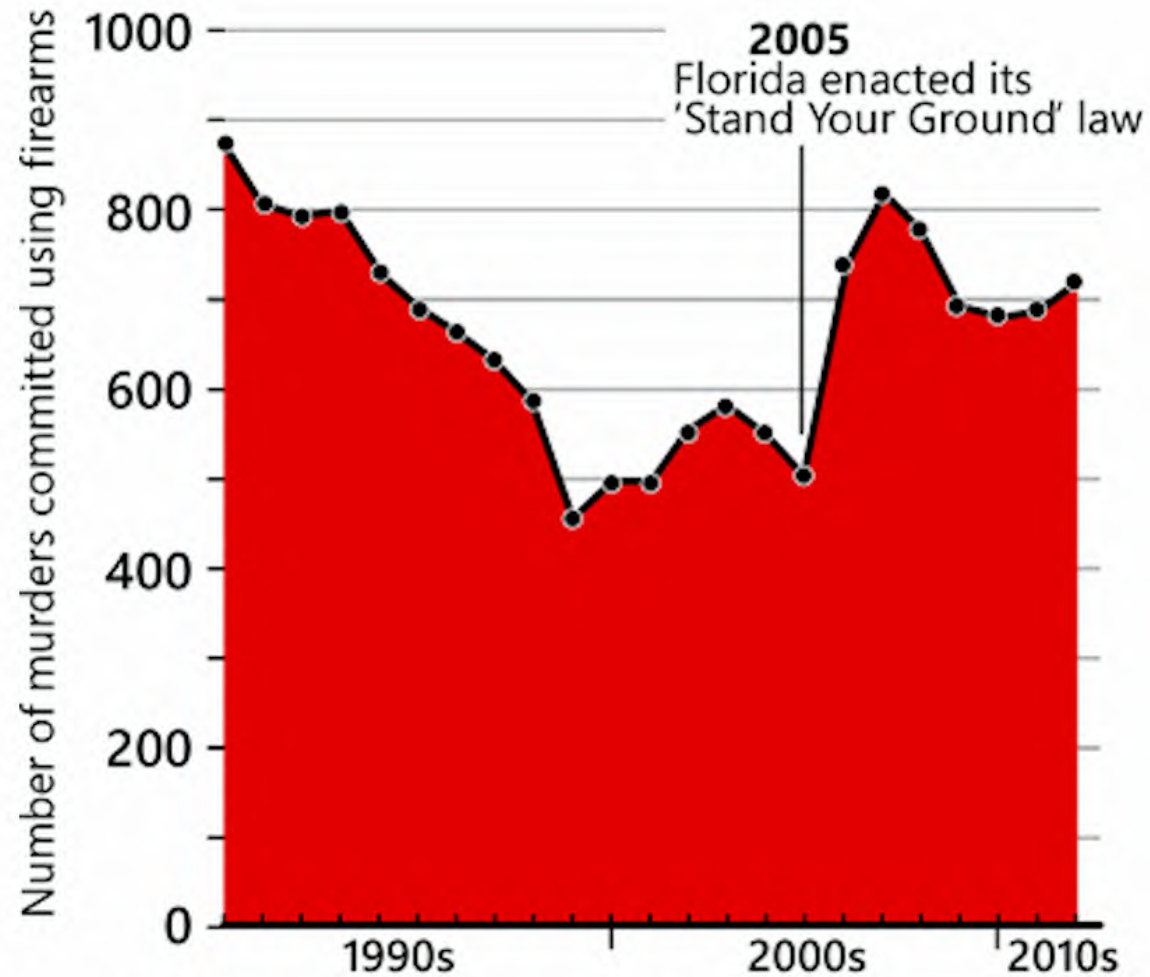
Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

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

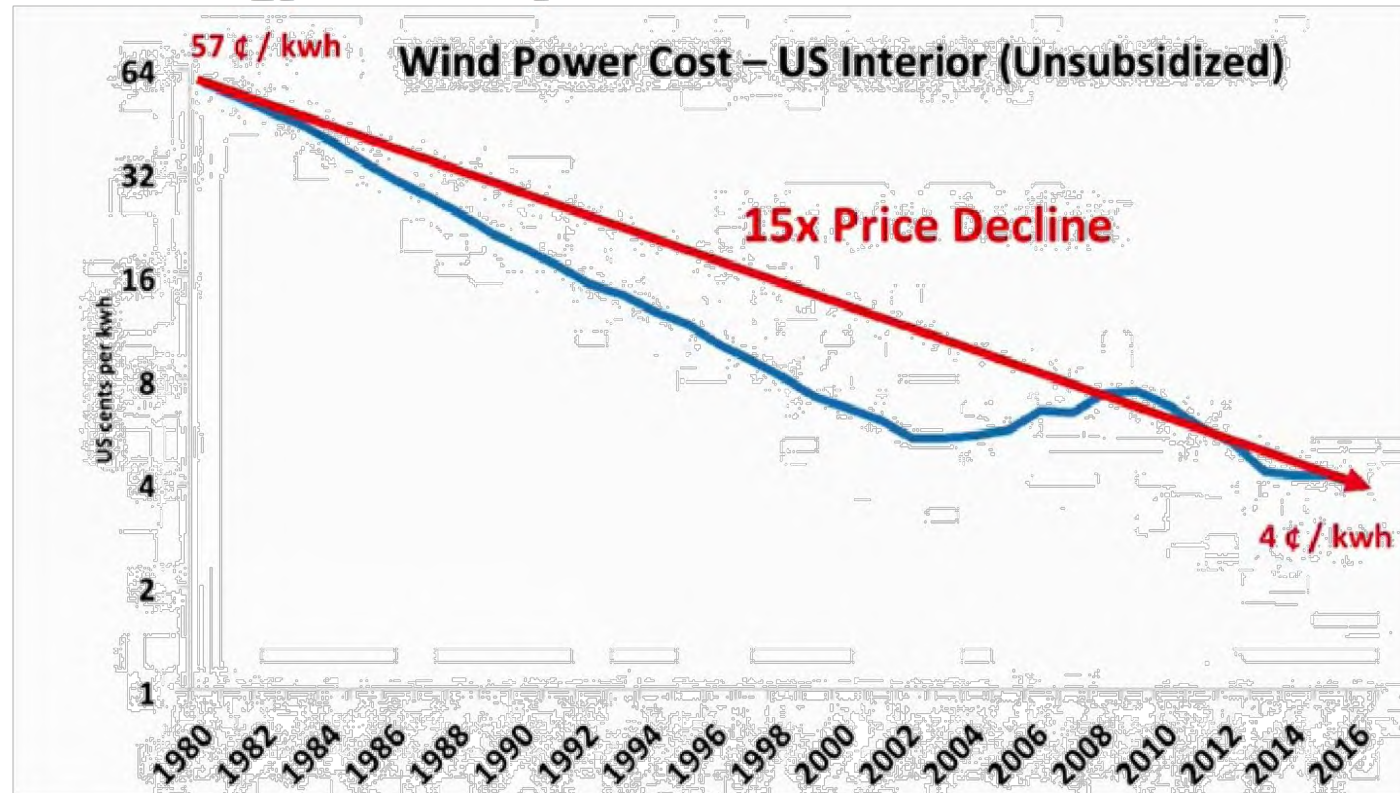
GUN DEATHS IN FLORIDA



Source: Florida Dept of Law Enforcement

AXIS GAMES – HIDDEN LOG AXIS

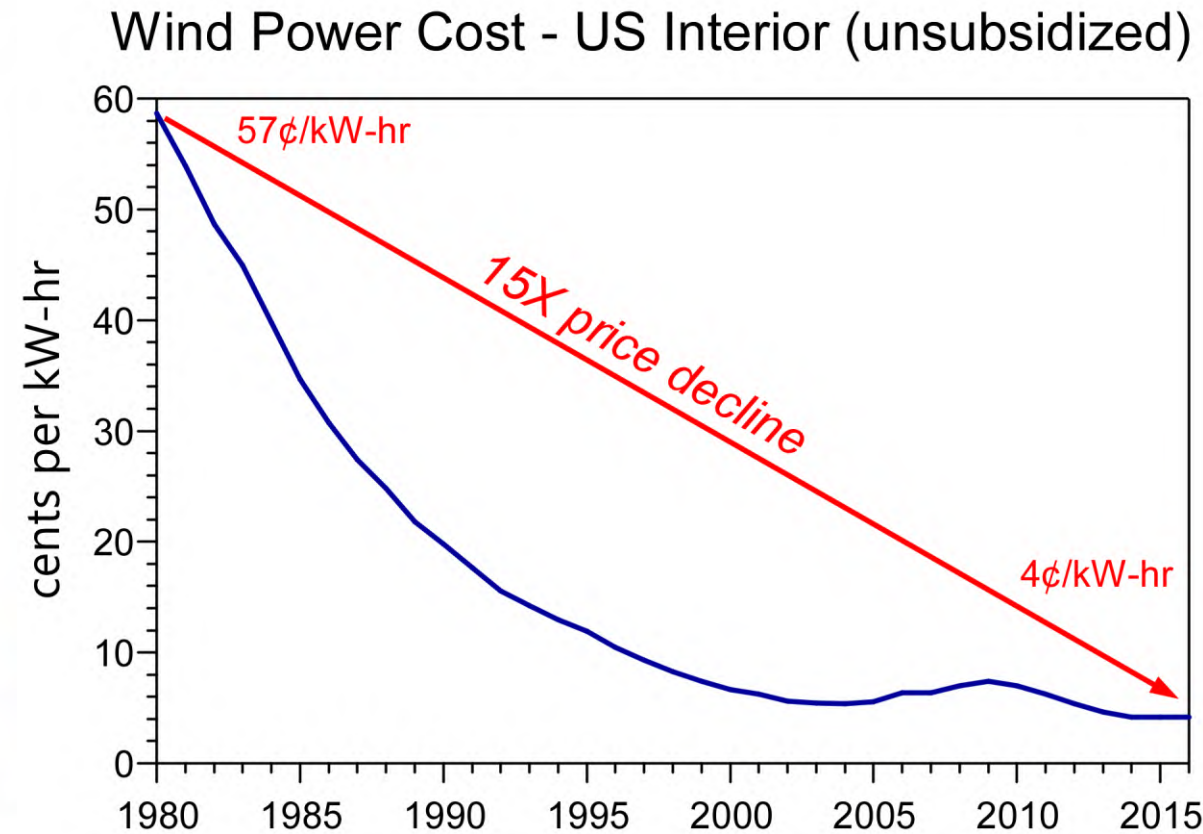
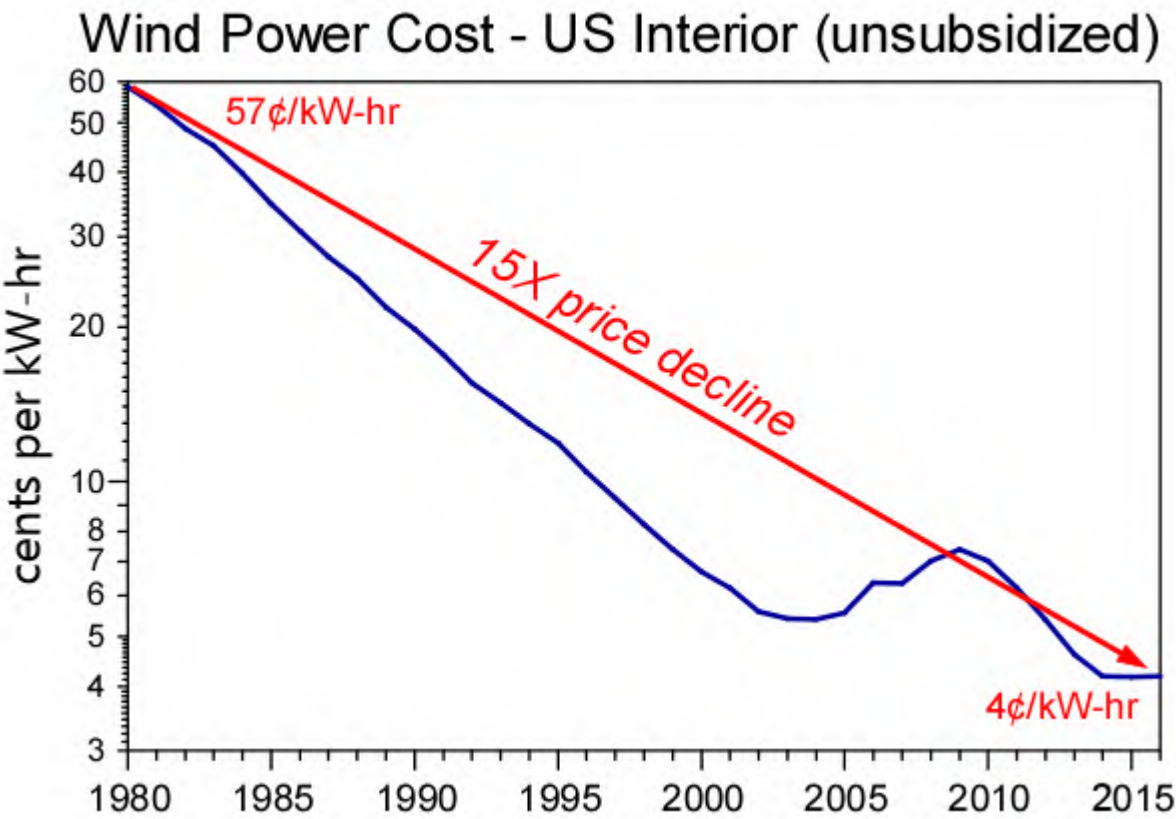
The Clean Energy Revolution – and the Disruption of the Energy Industry



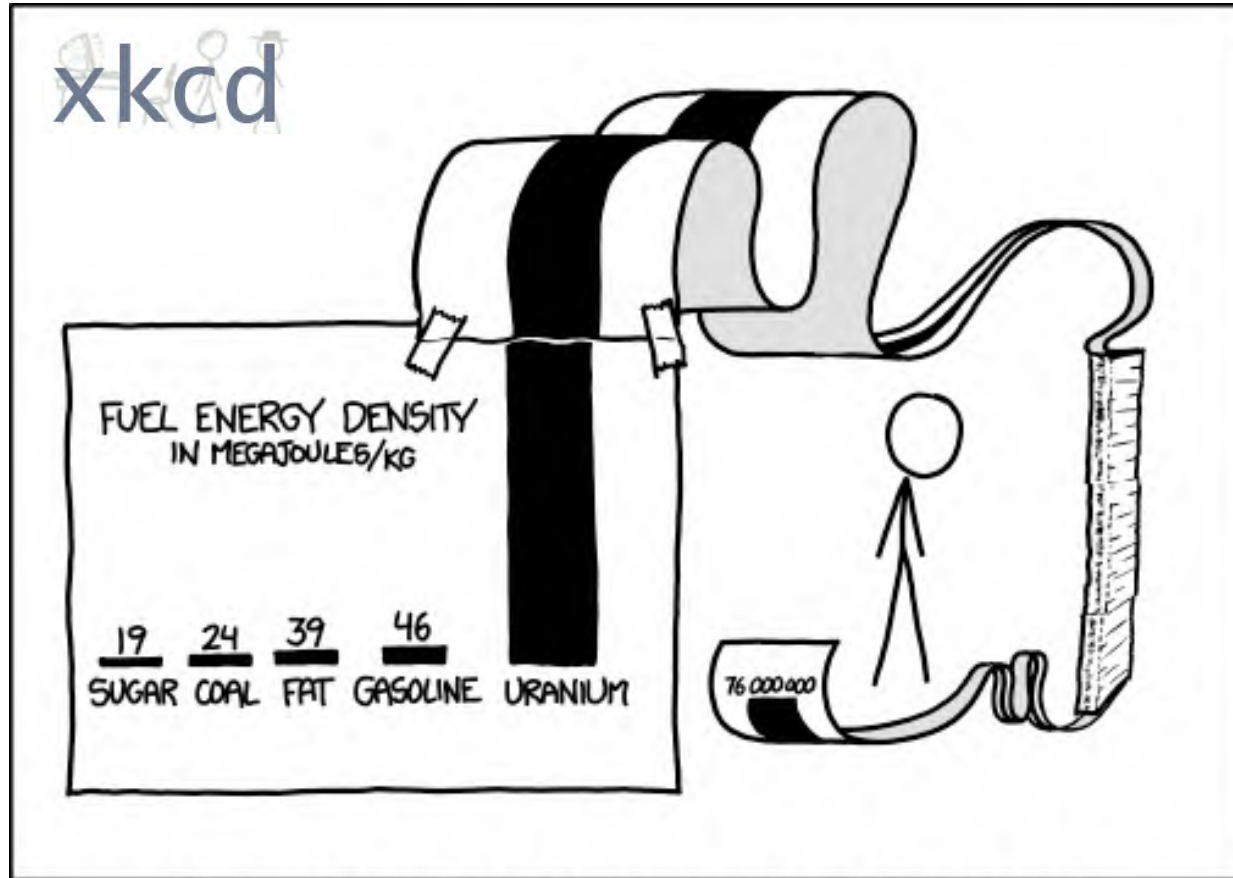
rameznaam.com/ video "The Clean Energy Revolution – and the Disruption of the Energy Industry",

youtu.be/fwSkQa1tNmE

CLEAN ENERGY



PROBLEMS WITH LOG AXES



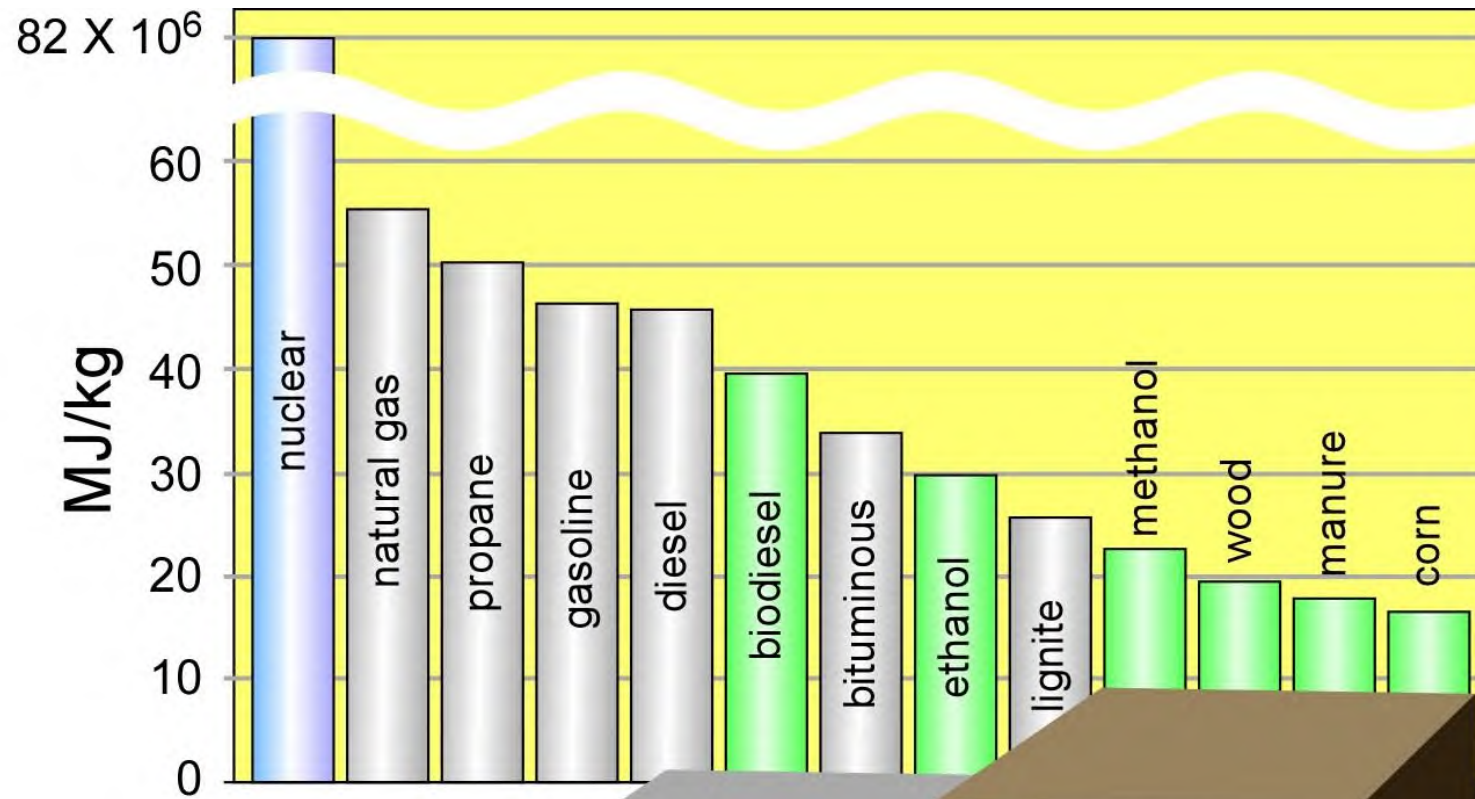
SCIENCE TIP: LOG SCALES ARE FOR QUITTERS WHO CAN'T
FIND ENOUGH PAPER TO MAKE THEIR POINT *PROPERLY*.

Human perception is linear.

Log axes are great for
detailed understanding,
not for instantaneous
recognition.

Permanent link to this comic: <https://xkcd.com/1162/>

Image URL (for hotlinking/embedding): https://imgs.xkcd.com/comics/log_scale.png



kg/day
for
1000 MW

²³⁵U

3.3

natural
gas

2.6 million

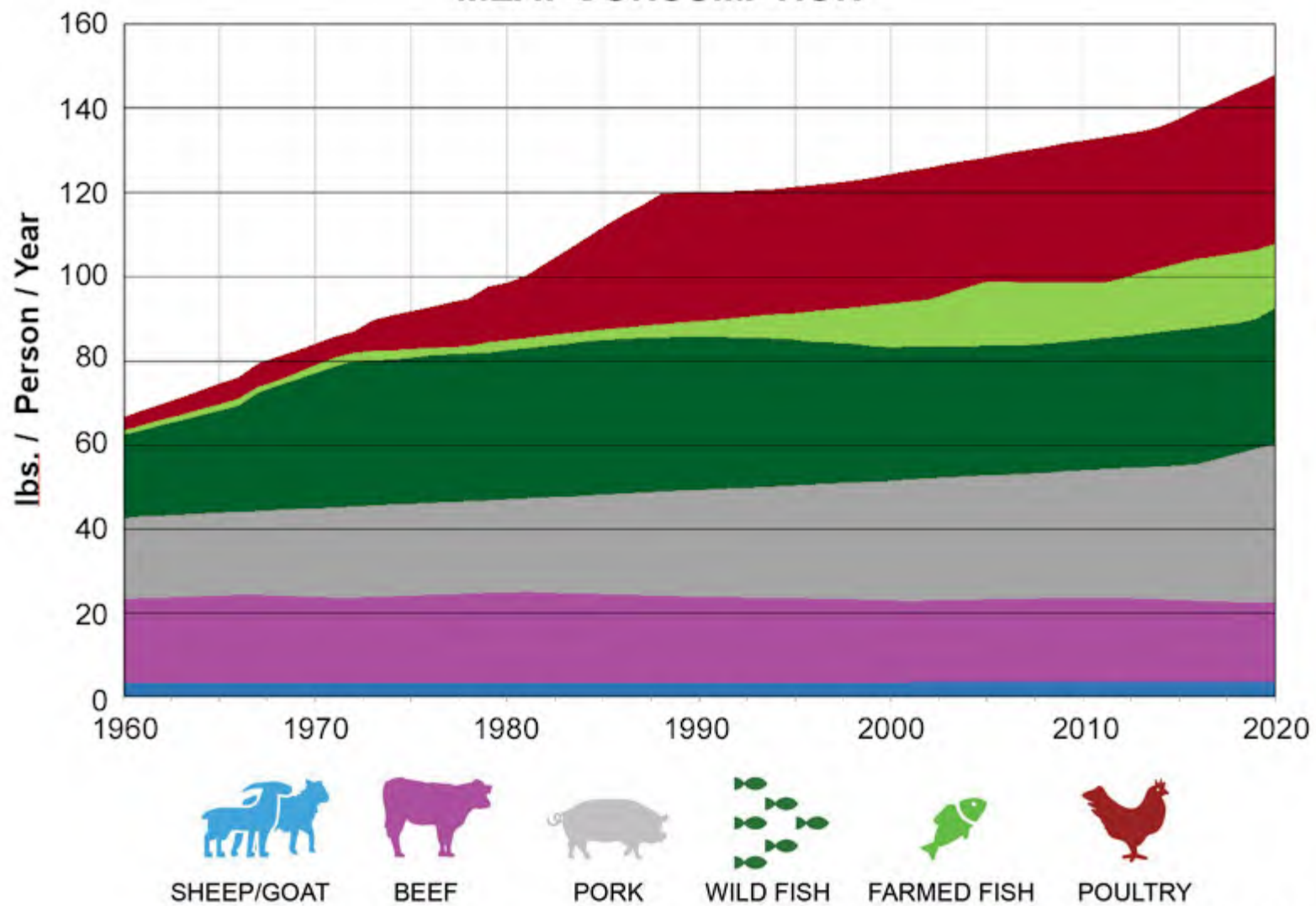
coal

6.9 million

wood

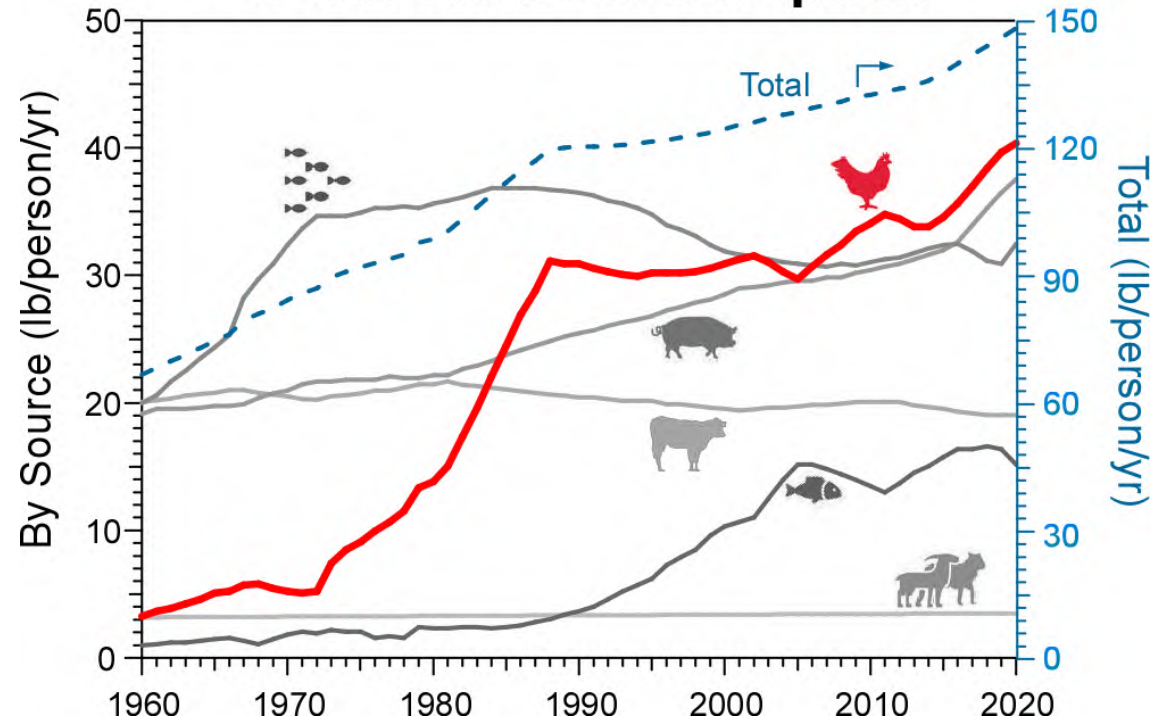
12 million

MEAT CONSUMPTION

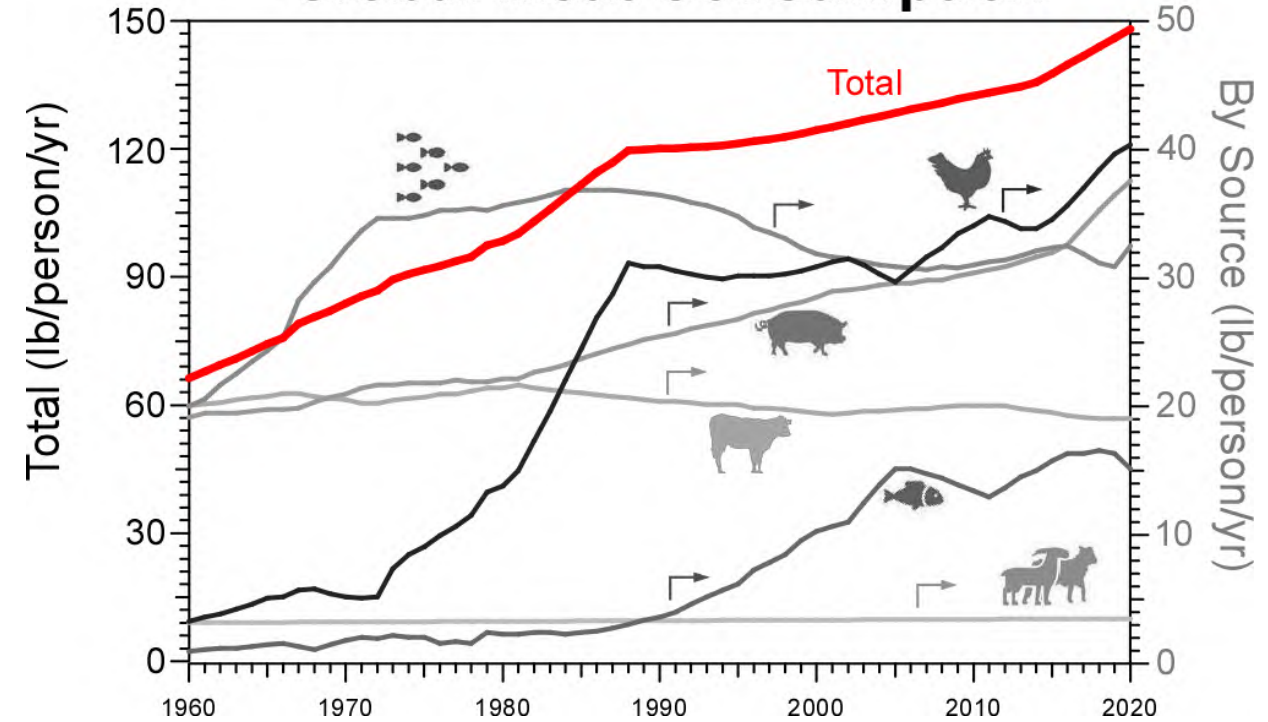


www.ethanolproducer.com/articles/16179/opportunities-in-high-protein-feed

Global Meat Consumption



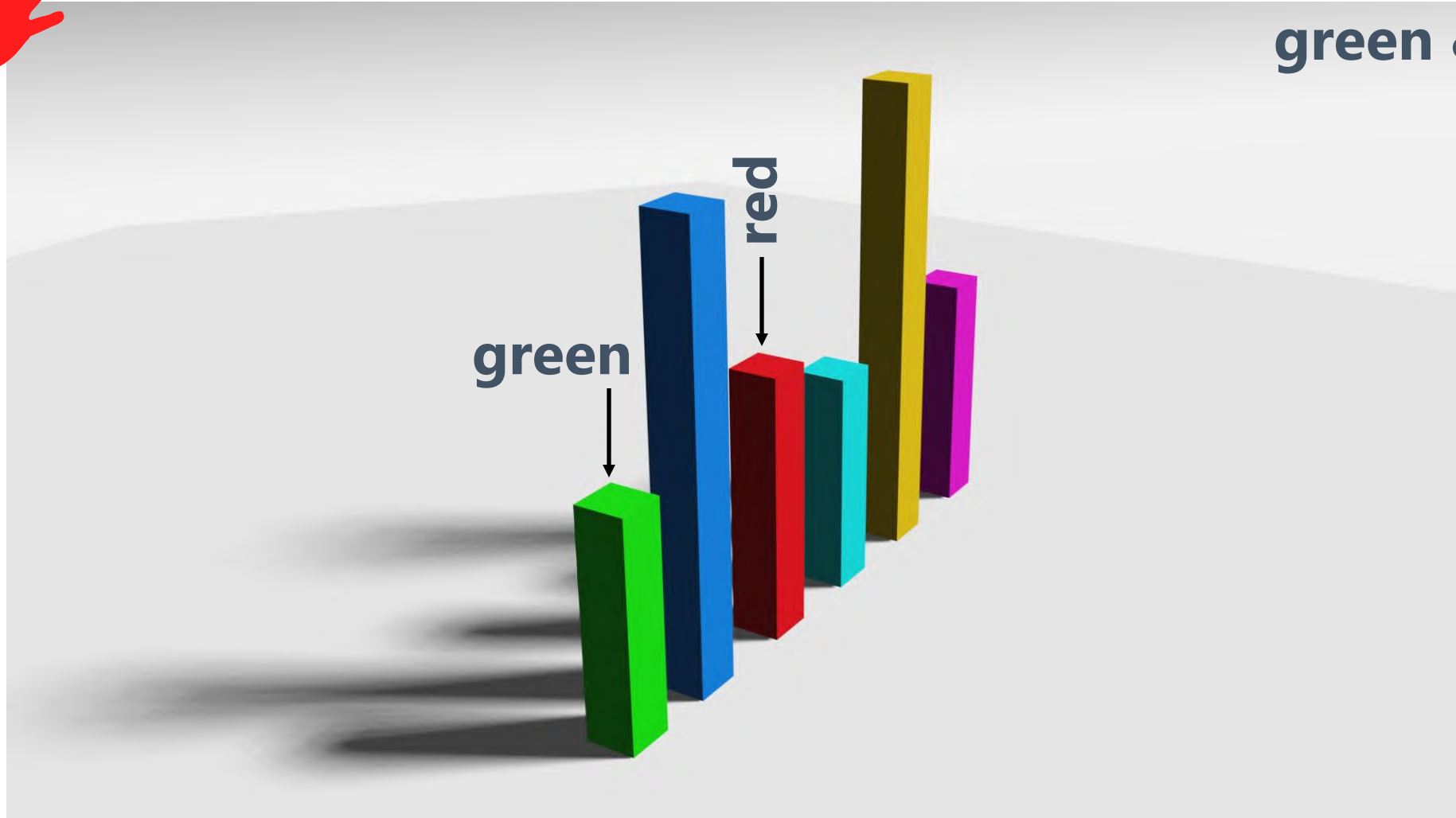
Global Meat Consumption



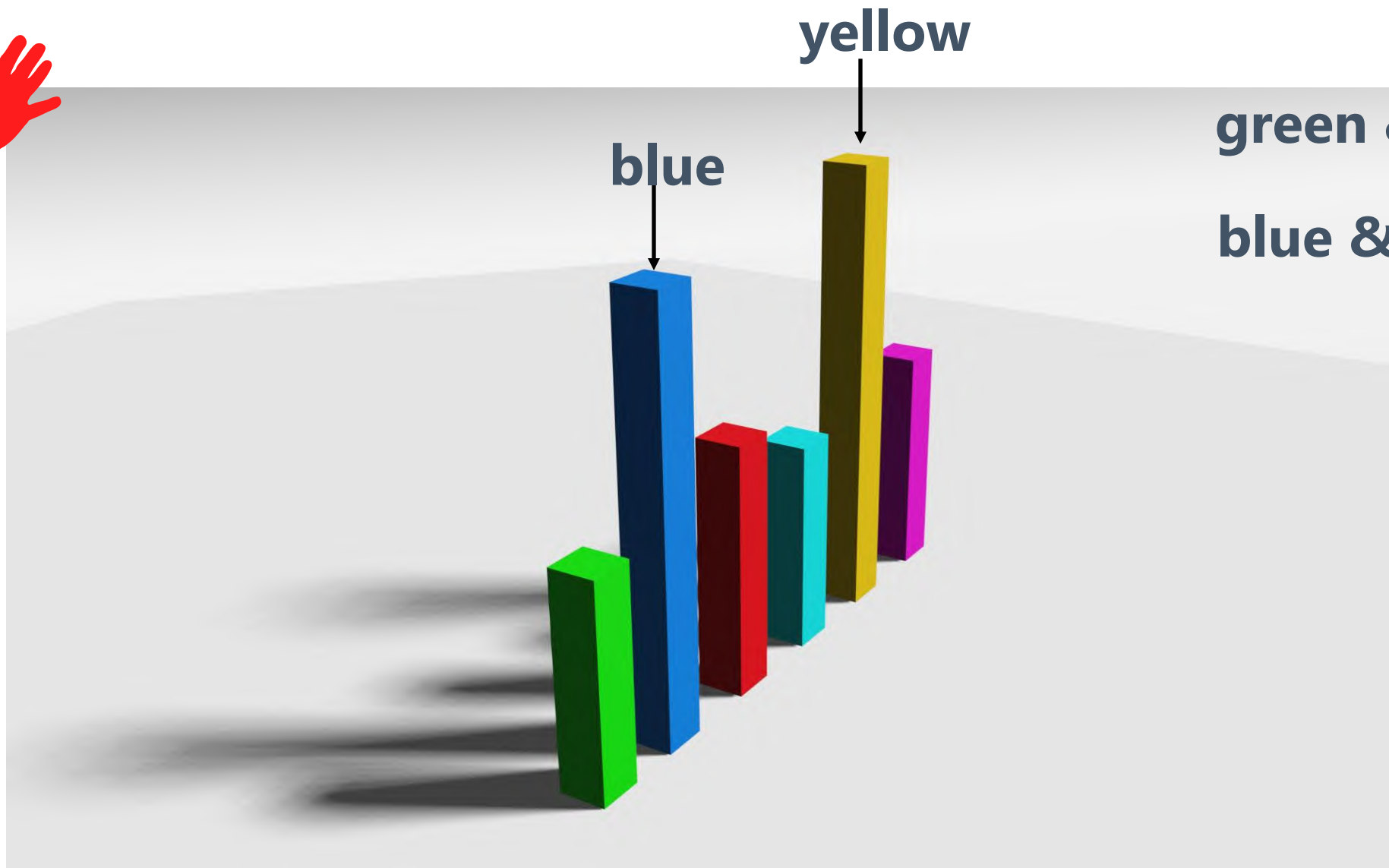


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WHICH BARS ARE THE SAME HEIGHT?

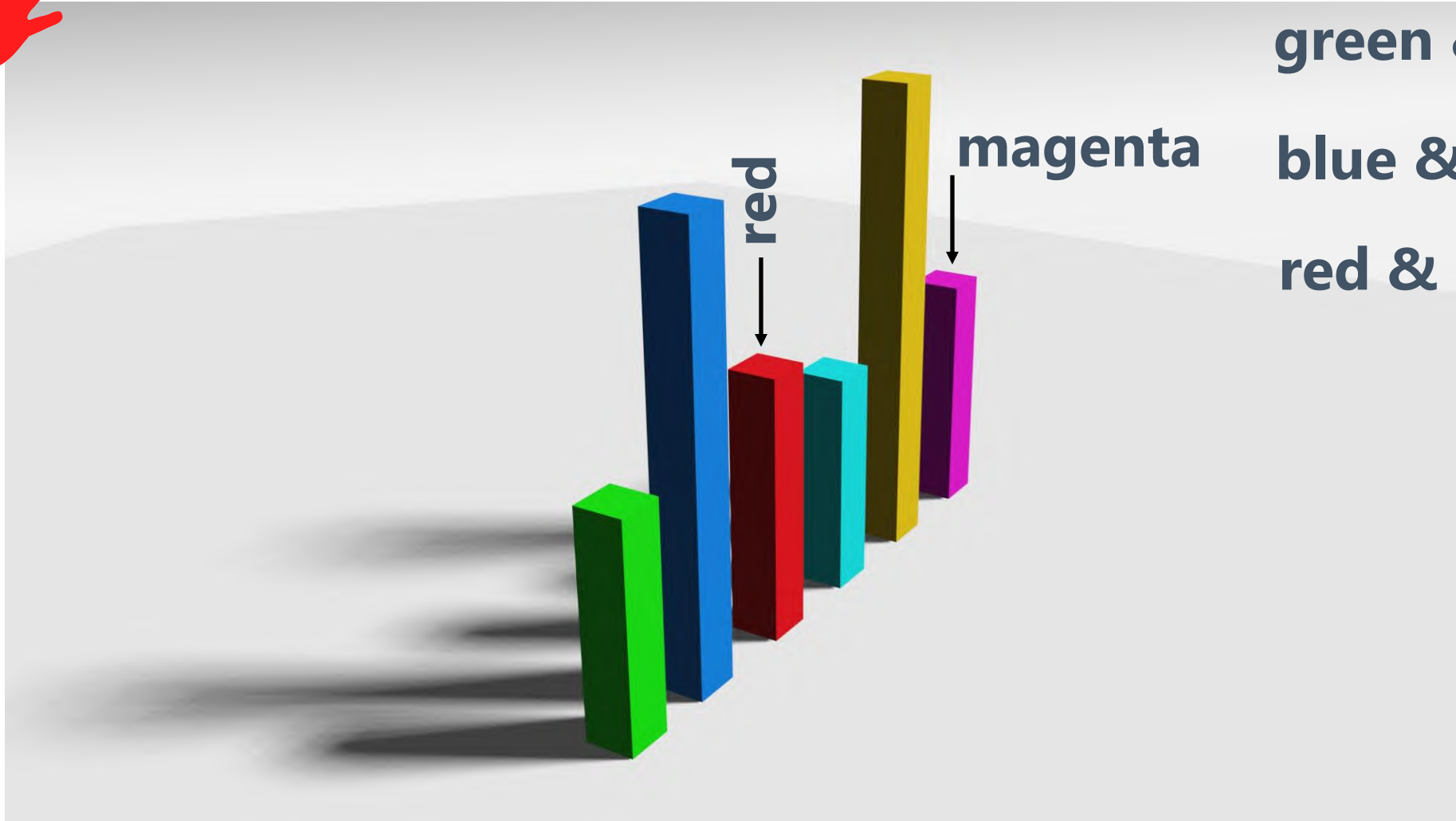


WHICH BARS ARE THE SAME HEIGHT?



MJPhD

WHICH BARS ARE THE SAME HEIGHT?

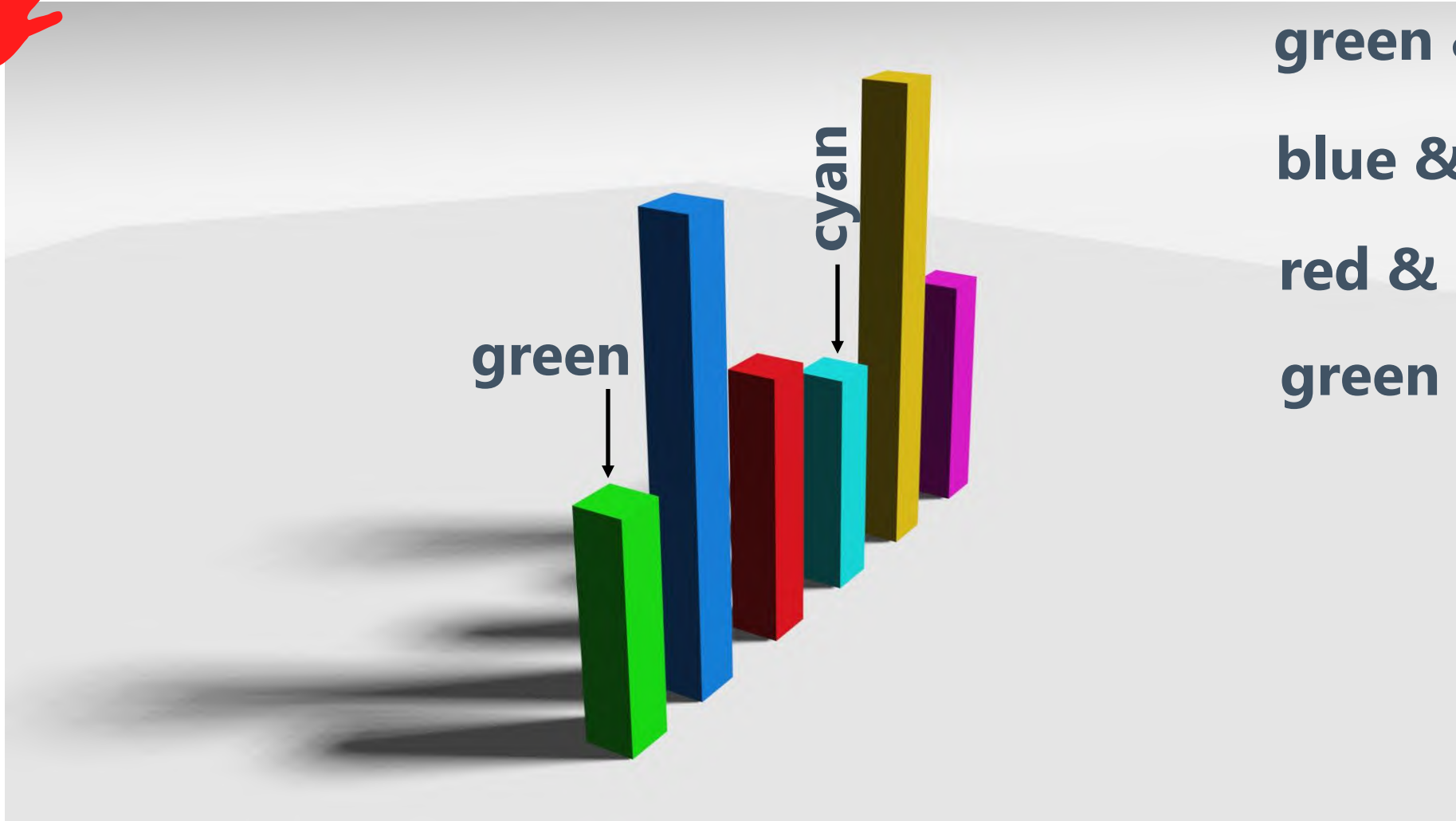


green & red

blue & yellow

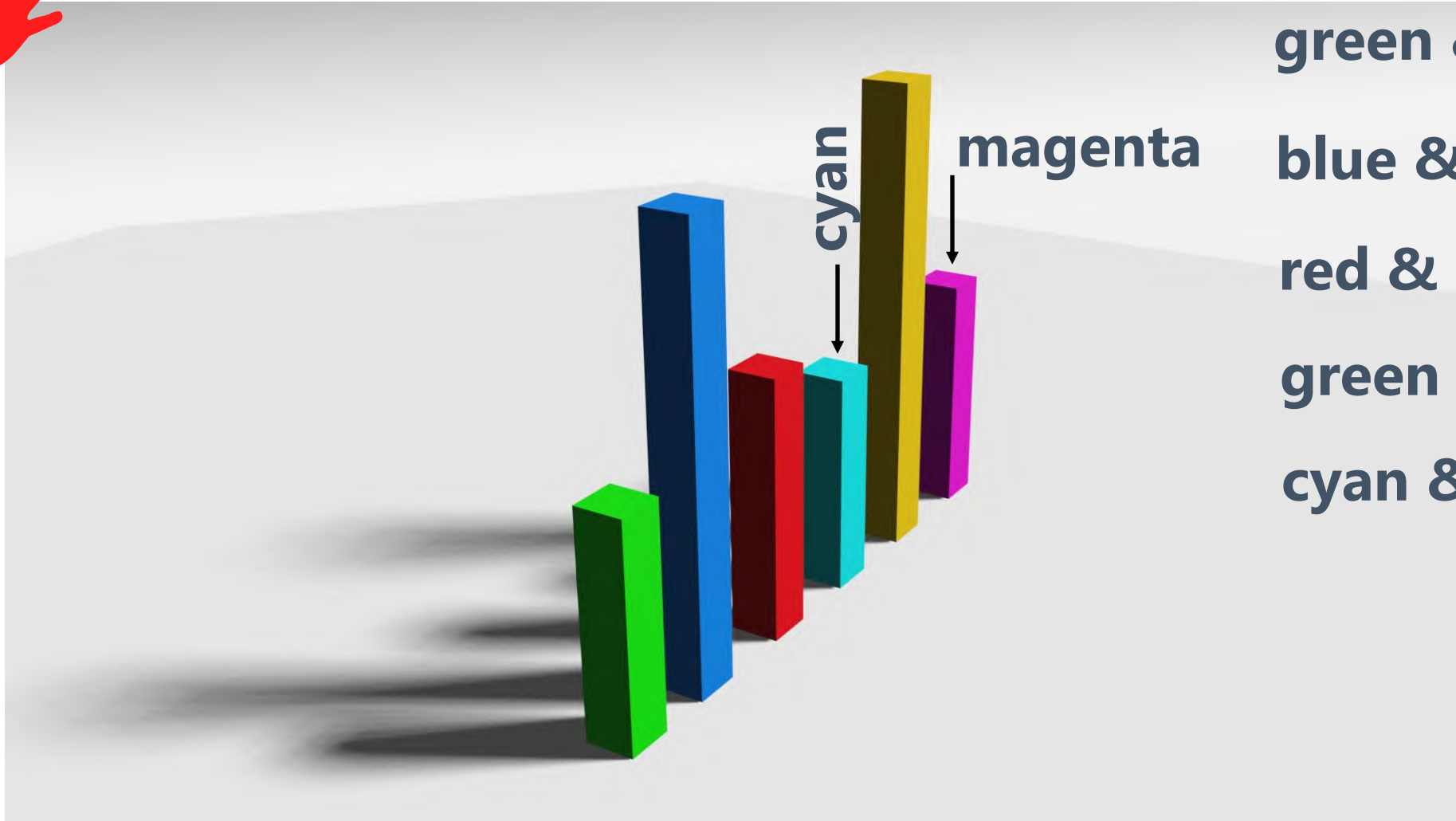
red & magenta

WHICH BARS ARE THE SAME HEIGHT?



green & red
blue & yellow
red & magenta
green & cyan

WHICH BARS ARE THE SAME HEIGHT?



green & red

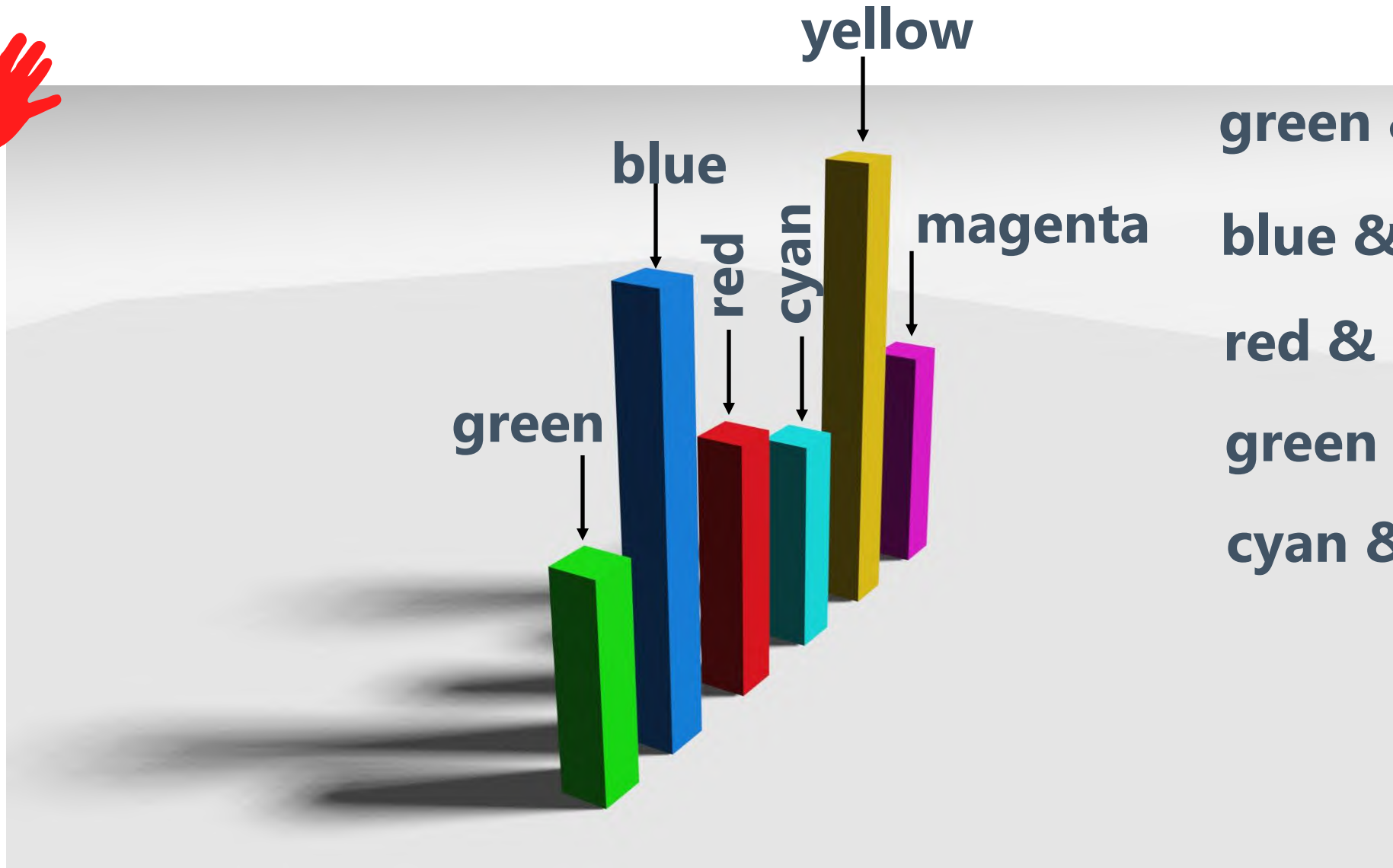
blue & yellow

red & magenta

green & cyan

cyan & magenta

WHICH BARS ARE THE SAME HEIGHT?



green & red

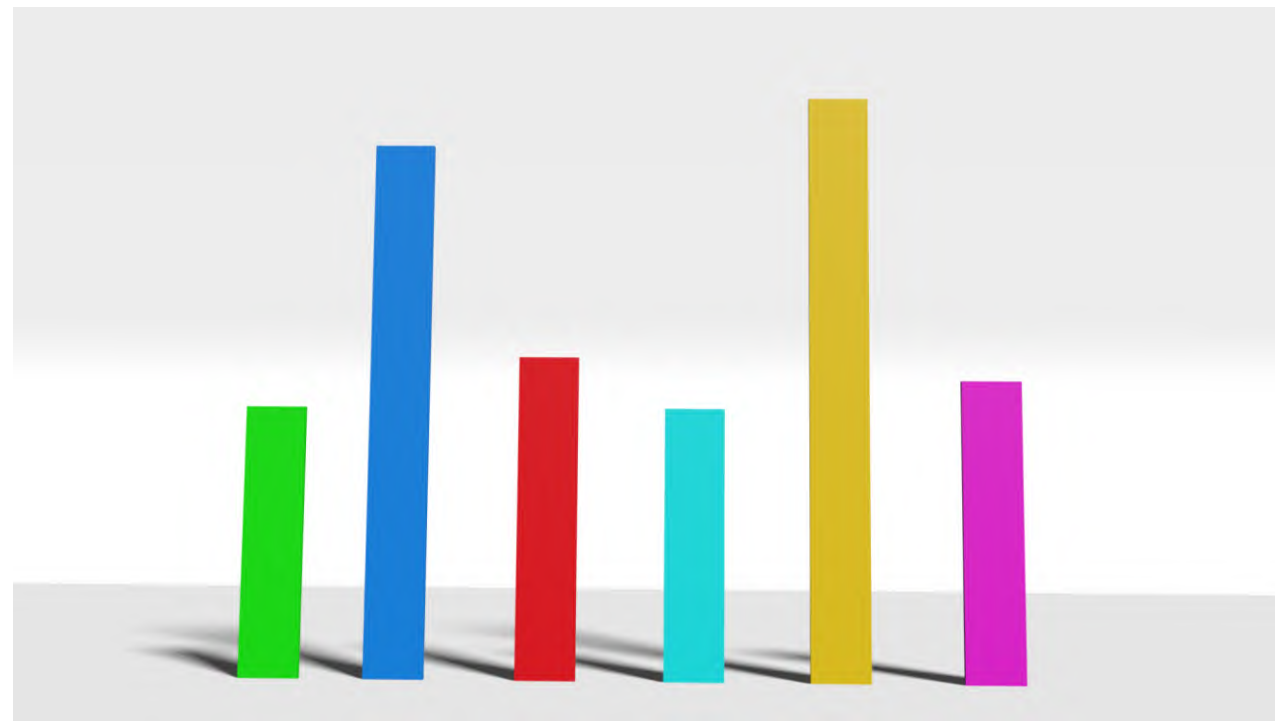
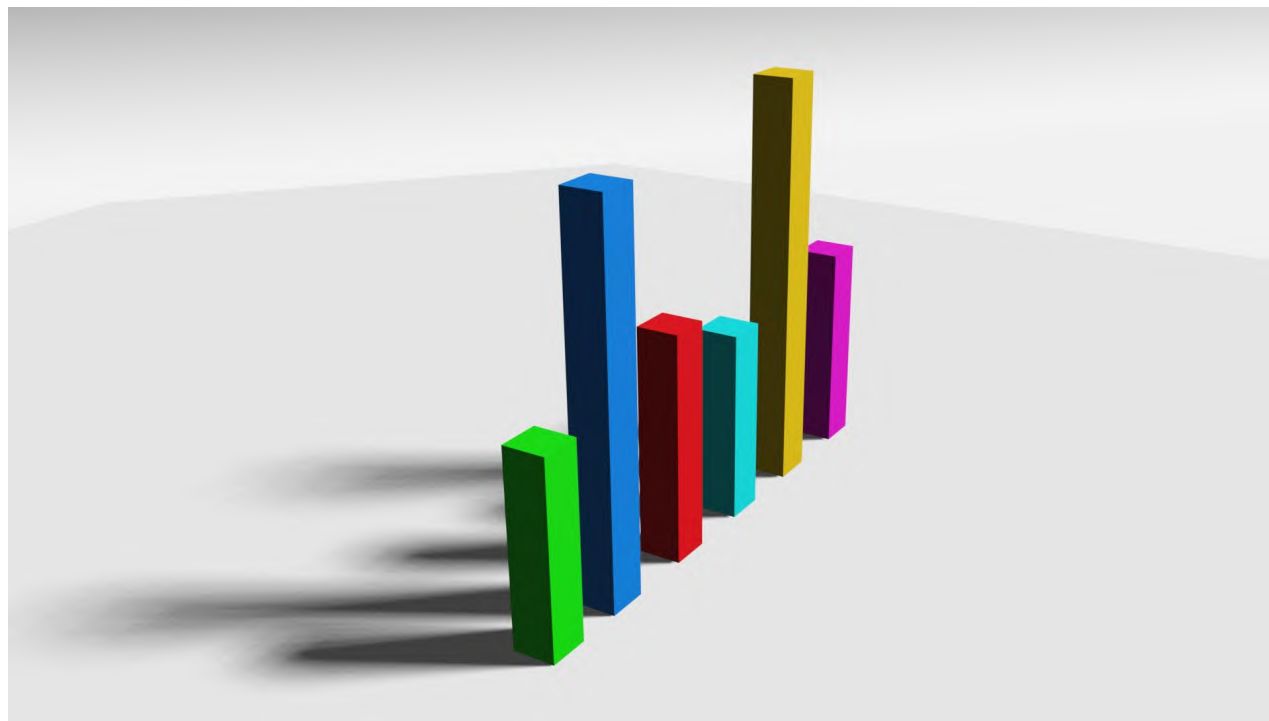
blue & yellow

red & magenta

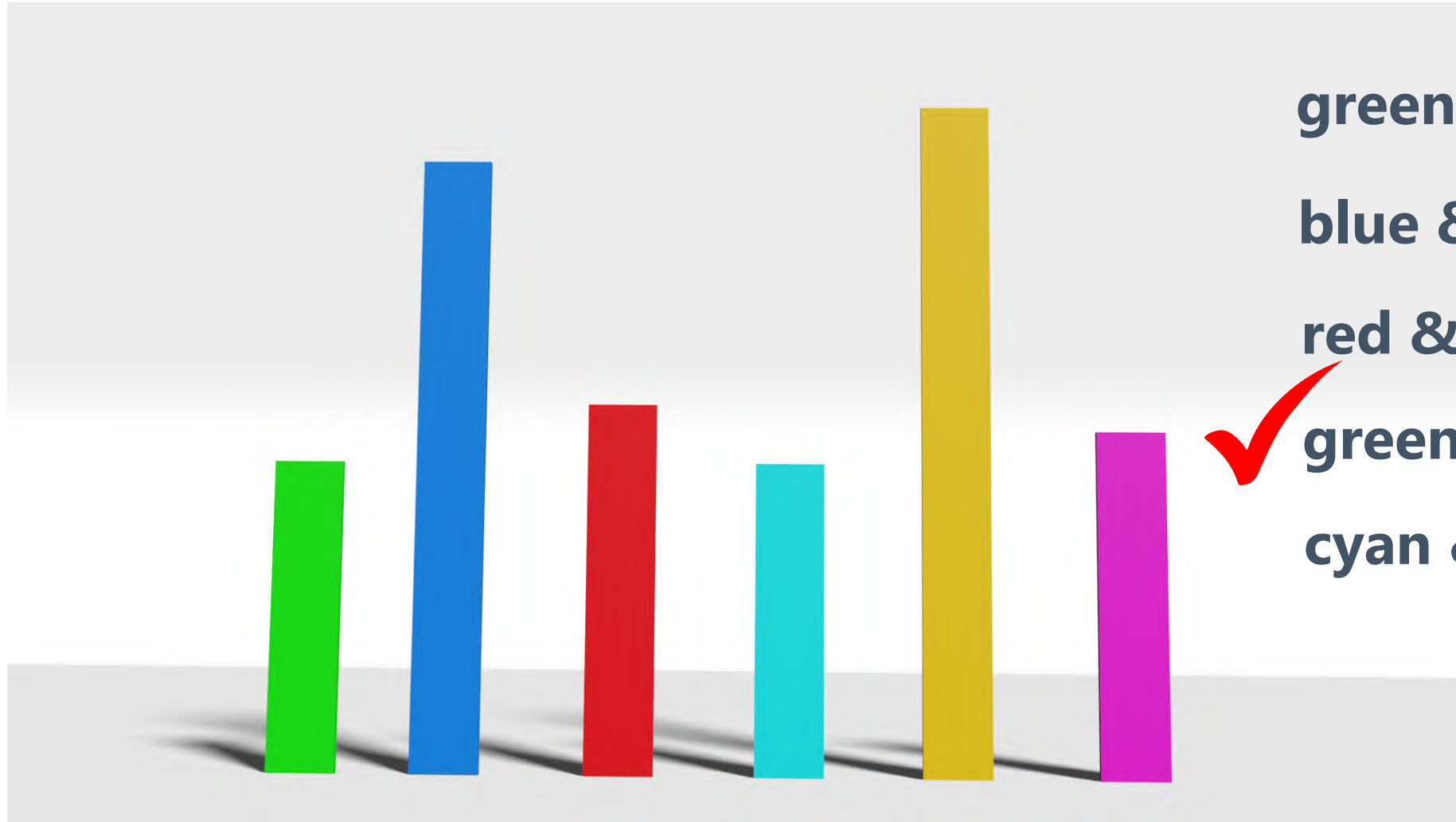
green & cyan

cyan & magenta

WHICH BARS ARE THE SAME HEIGHT?



WHICH BARS ARE THE SAME HEIGHT?



green & red

blue & yellow

red & magenta

✓ green & cyan

cyan & magenta

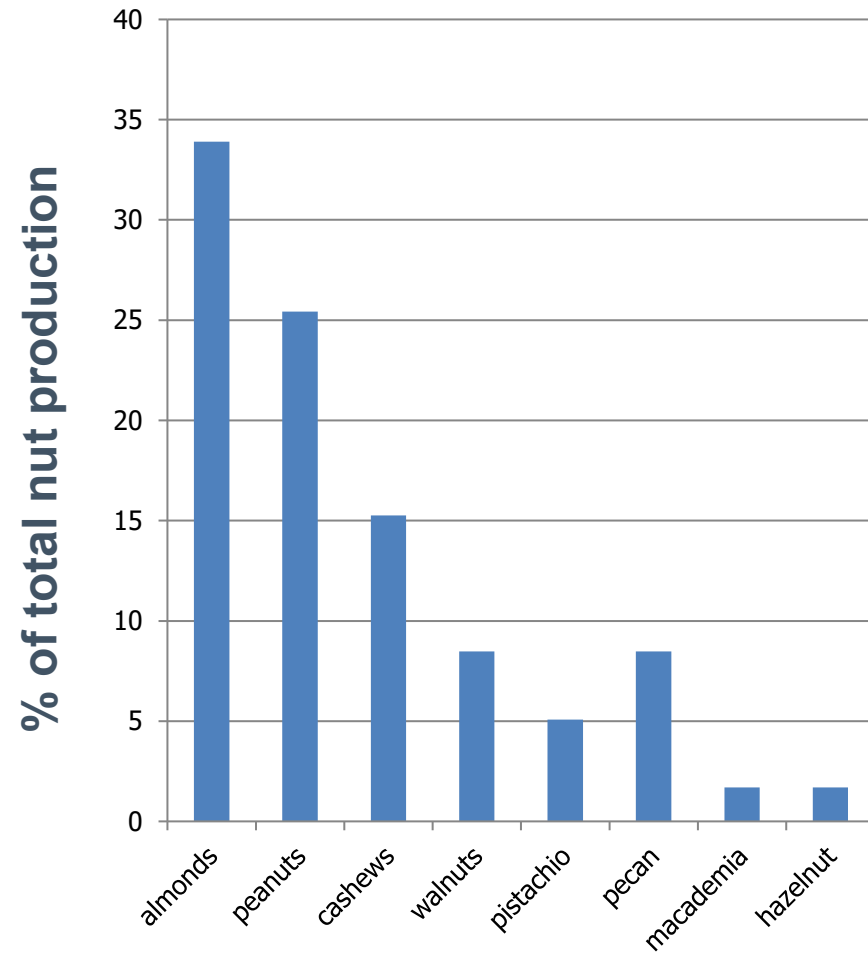
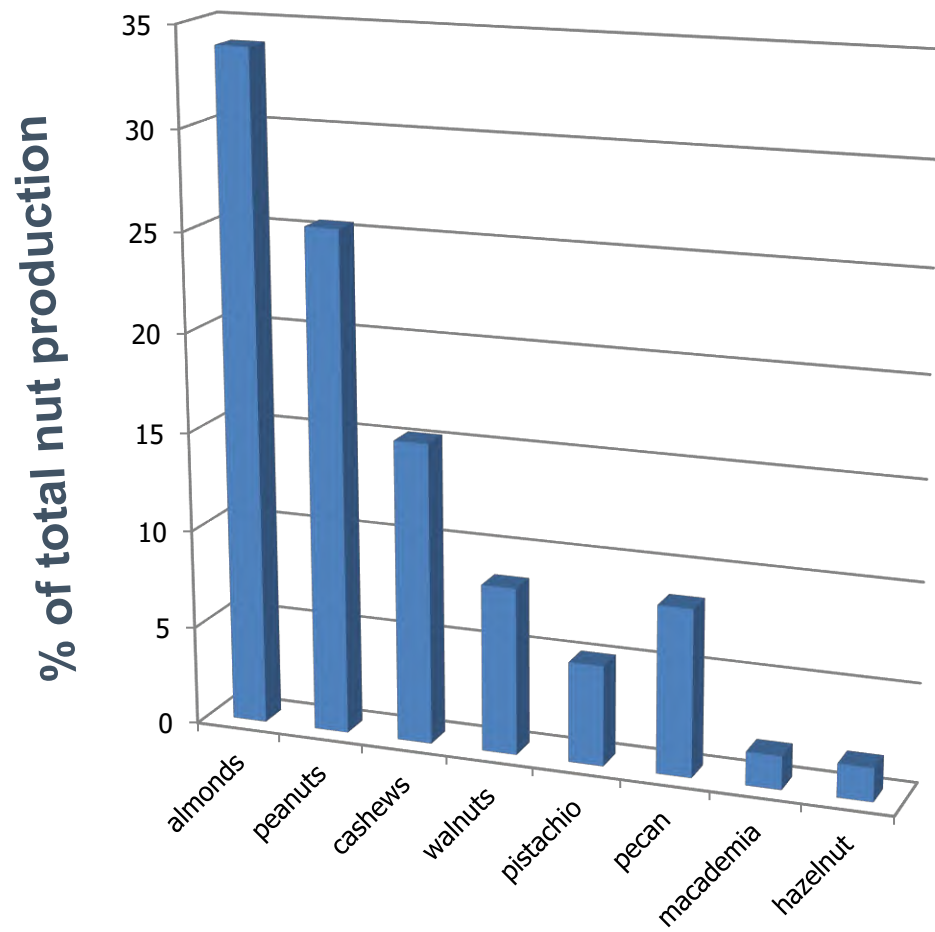


CHART JUNK

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

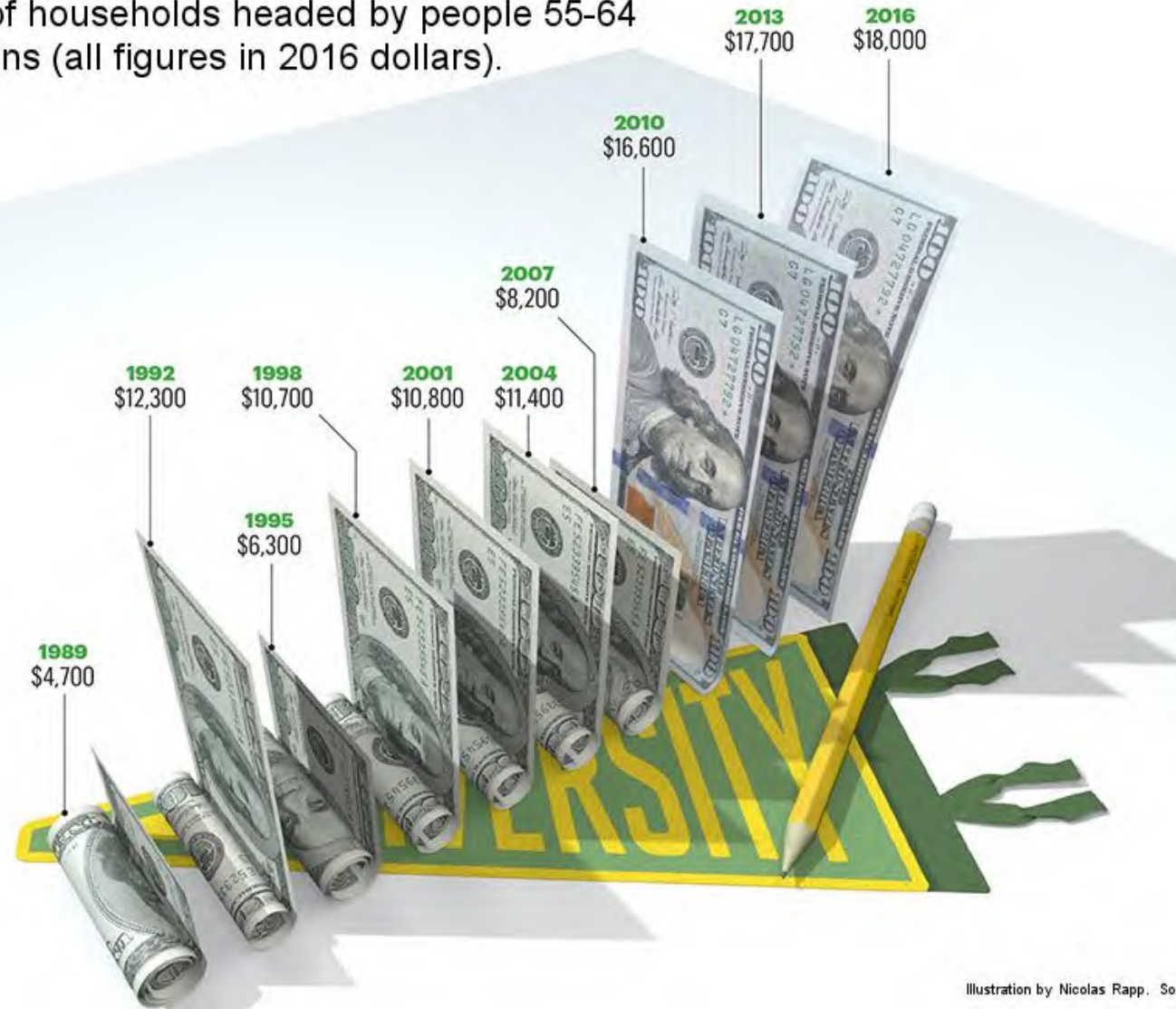
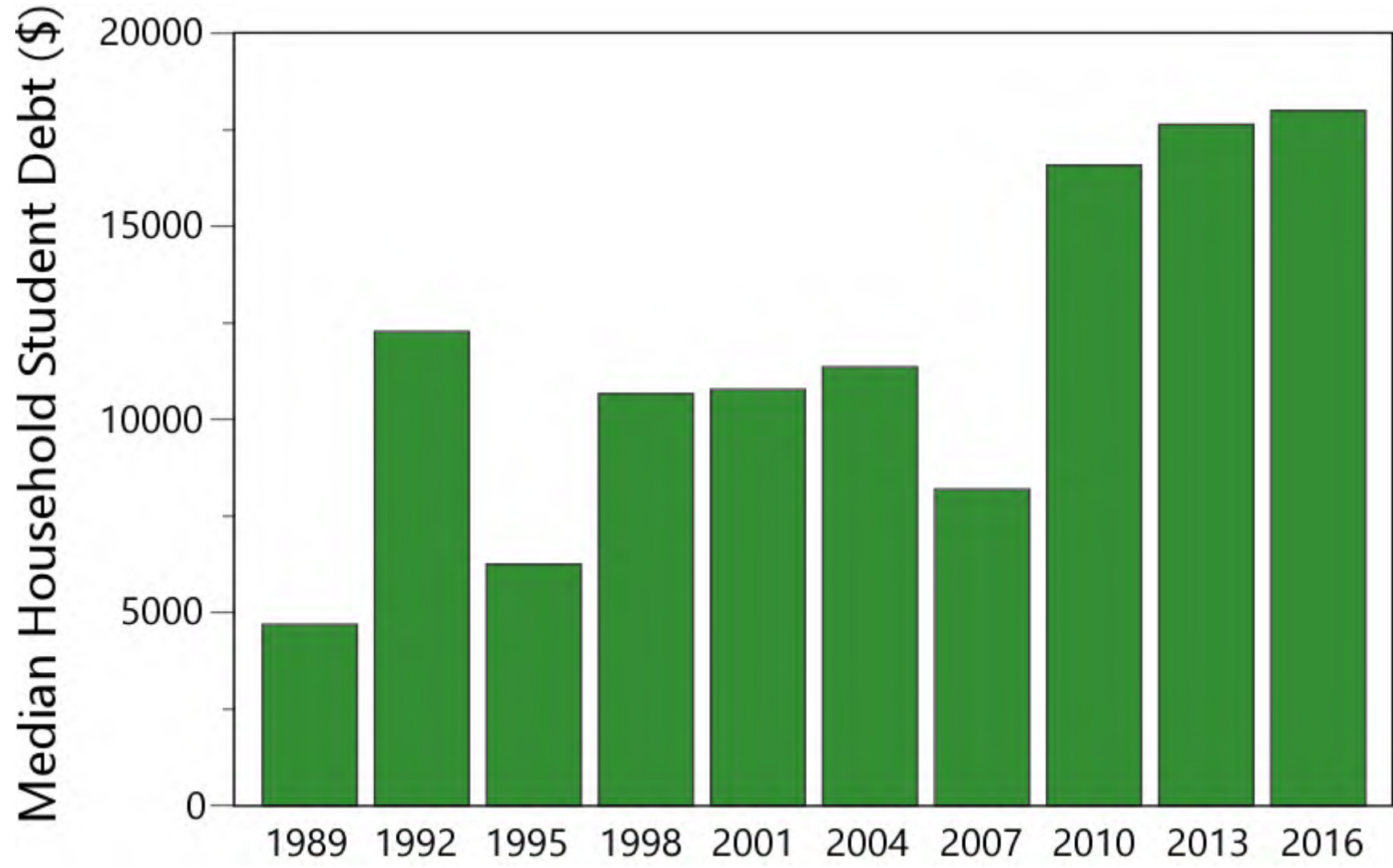


Illustration by Nicolas Rapp. Source: Federal Reserve Board

REMOVE THE JUNK



REMOVE THE JUNK



HOW MANY TIMES BIGGER?



*aligned with
axis is easiest to
accurately quantify.*



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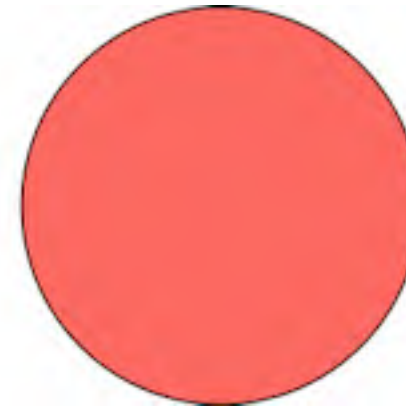
4x

5x

6x

7x

HOW MANY TIMES BIGGER?



3x

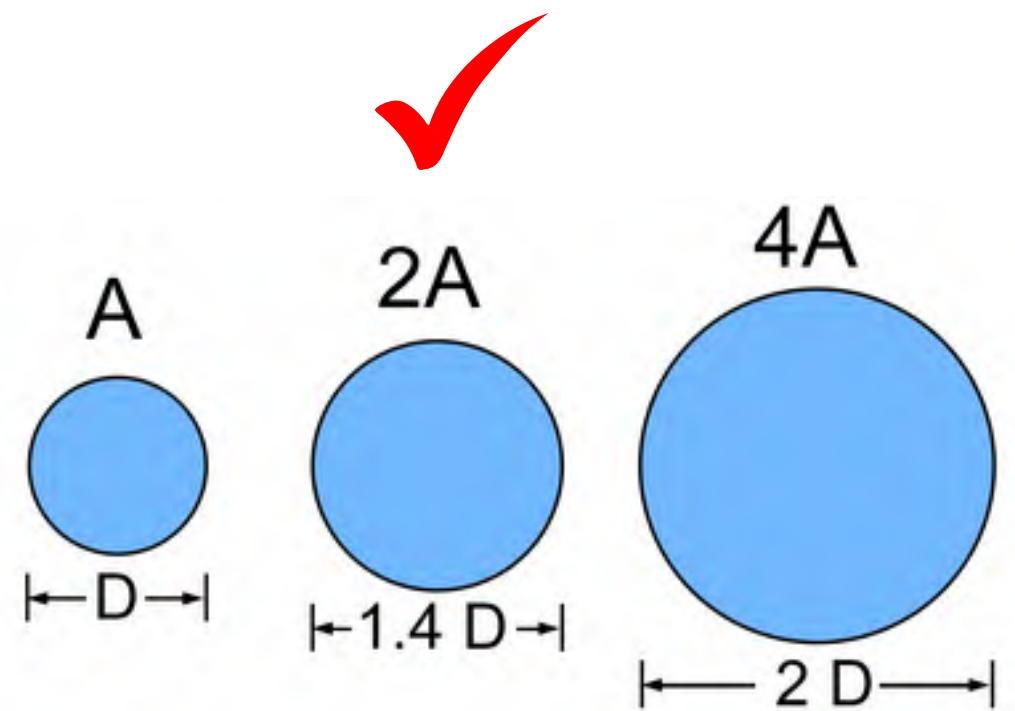
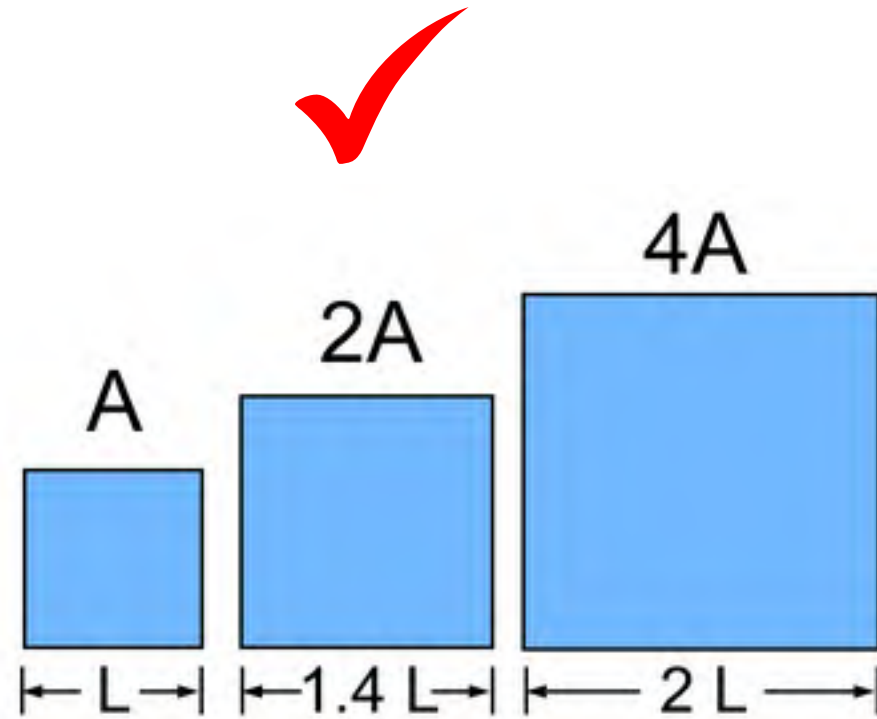
4x

5x

6x

area is hard to judge

AREA CONFUSION



WHICH IS LARGEST?



left
rectangle



triangle



square



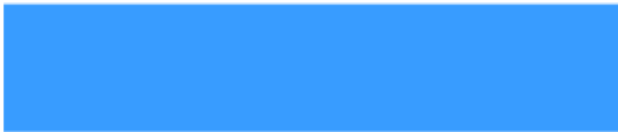
circle



right
rectangle



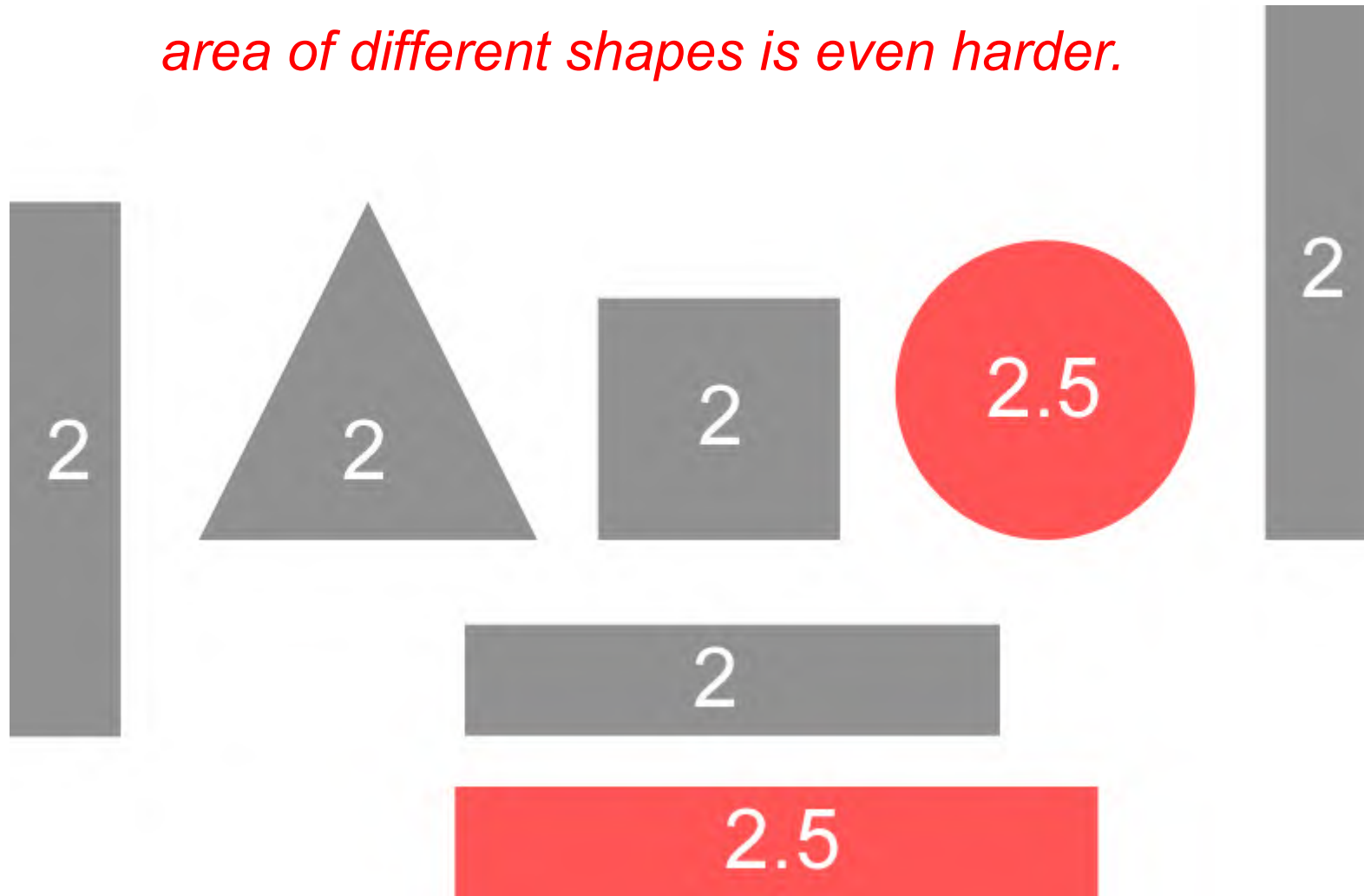
top
bar



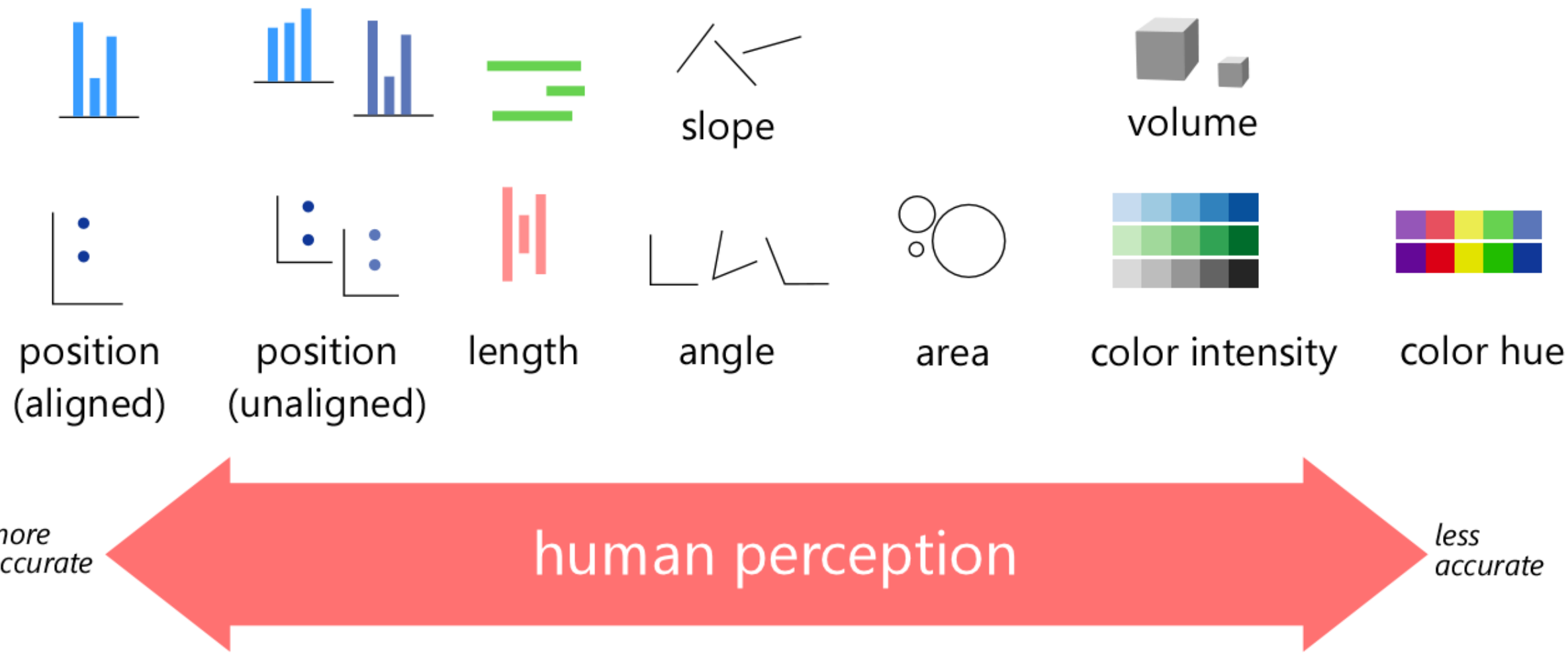
bottom
bar



area of different shapes is even harder.

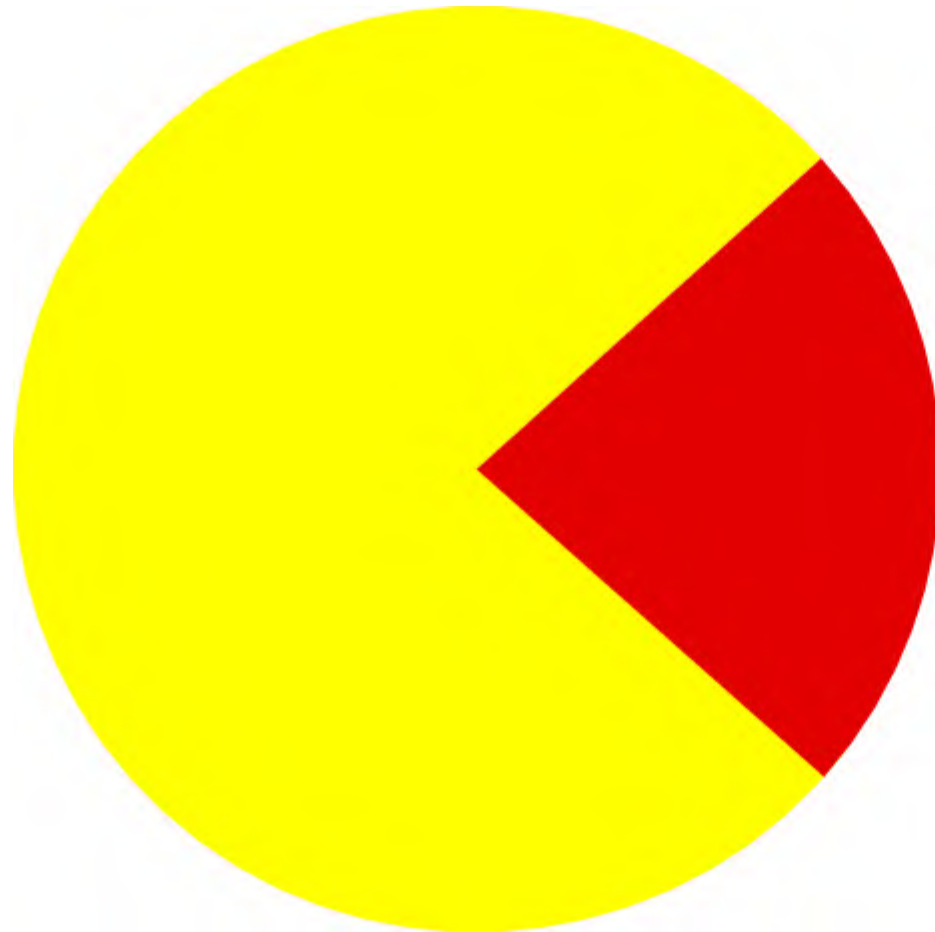


HUMAN PERCEPTION



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.

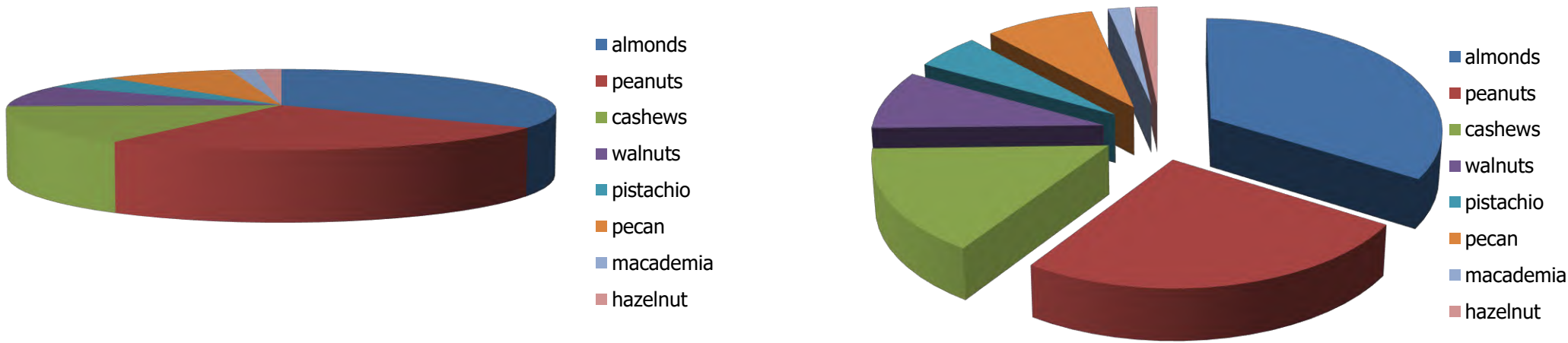
PIE CHARTS



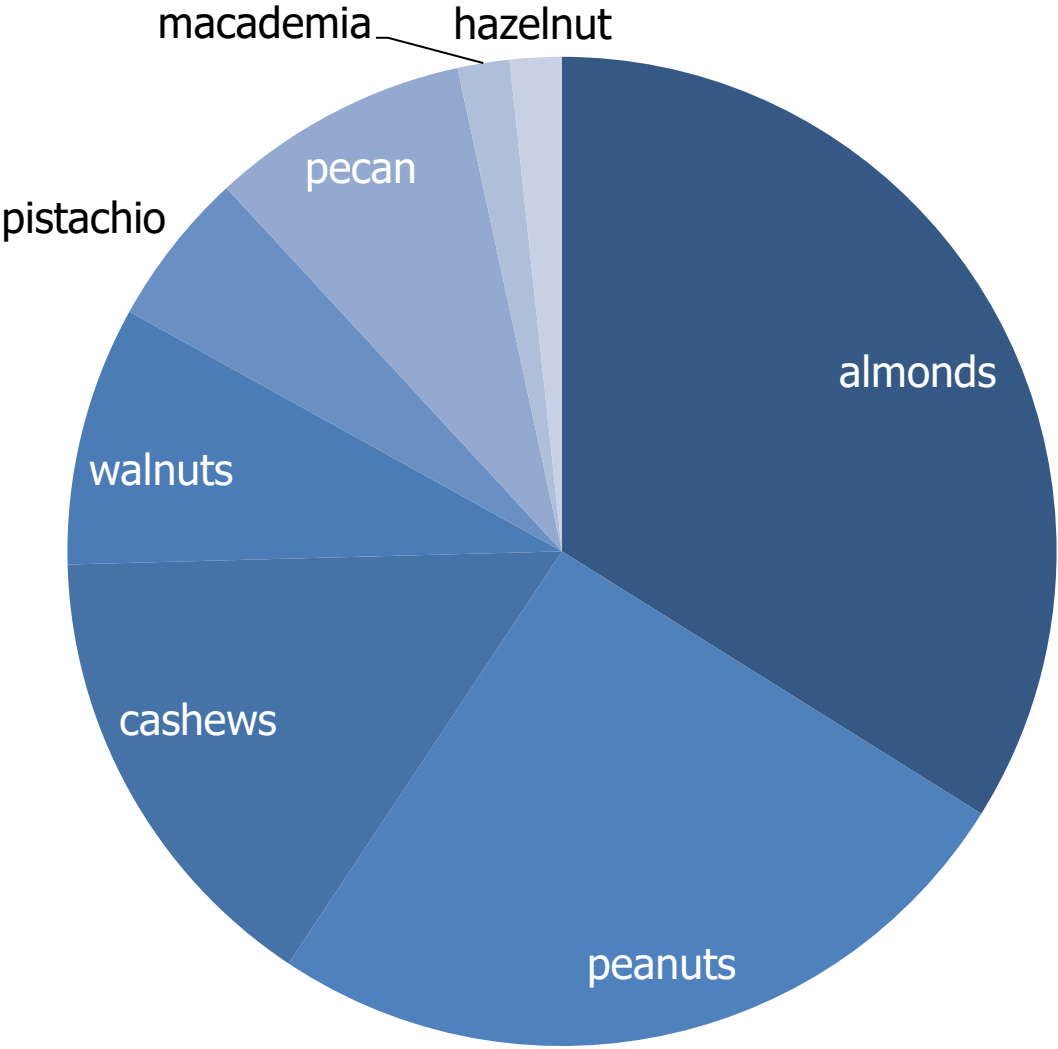
 doesn't look like Pacman

 looks like Pacman

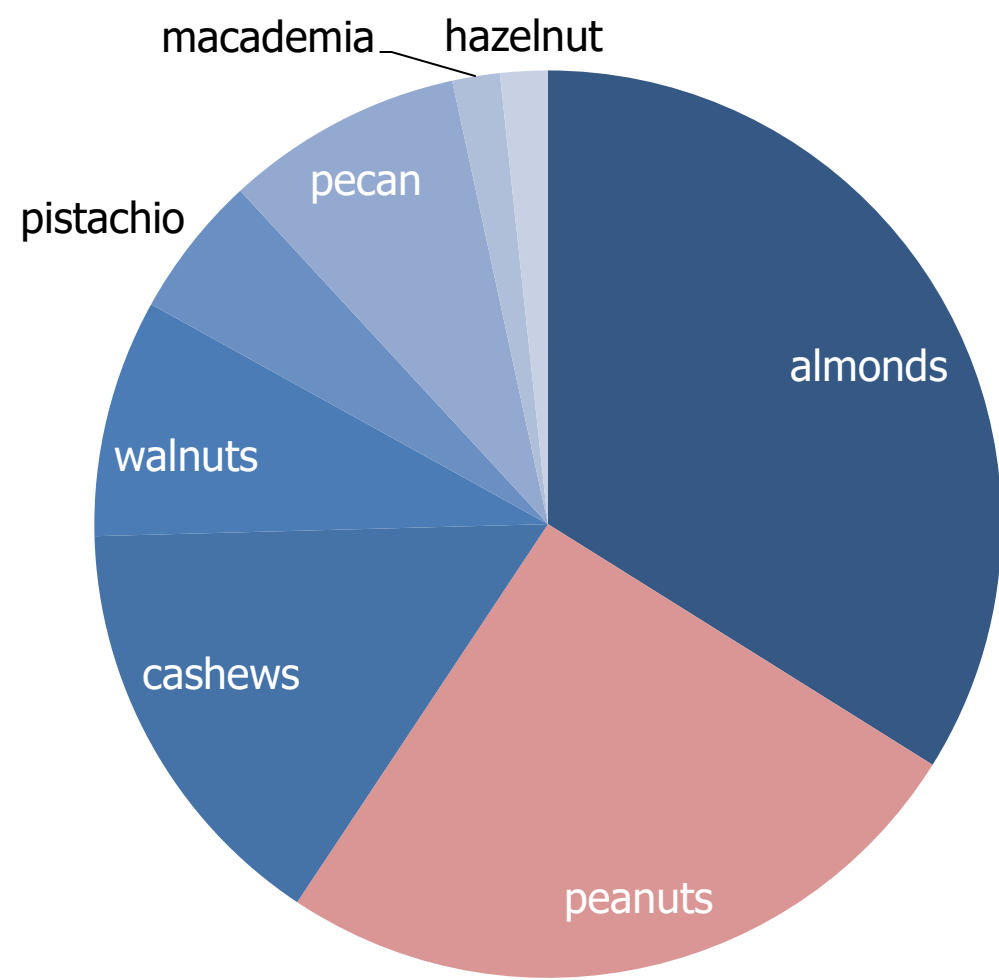
U.S. NUT PRODUCTION



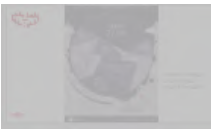
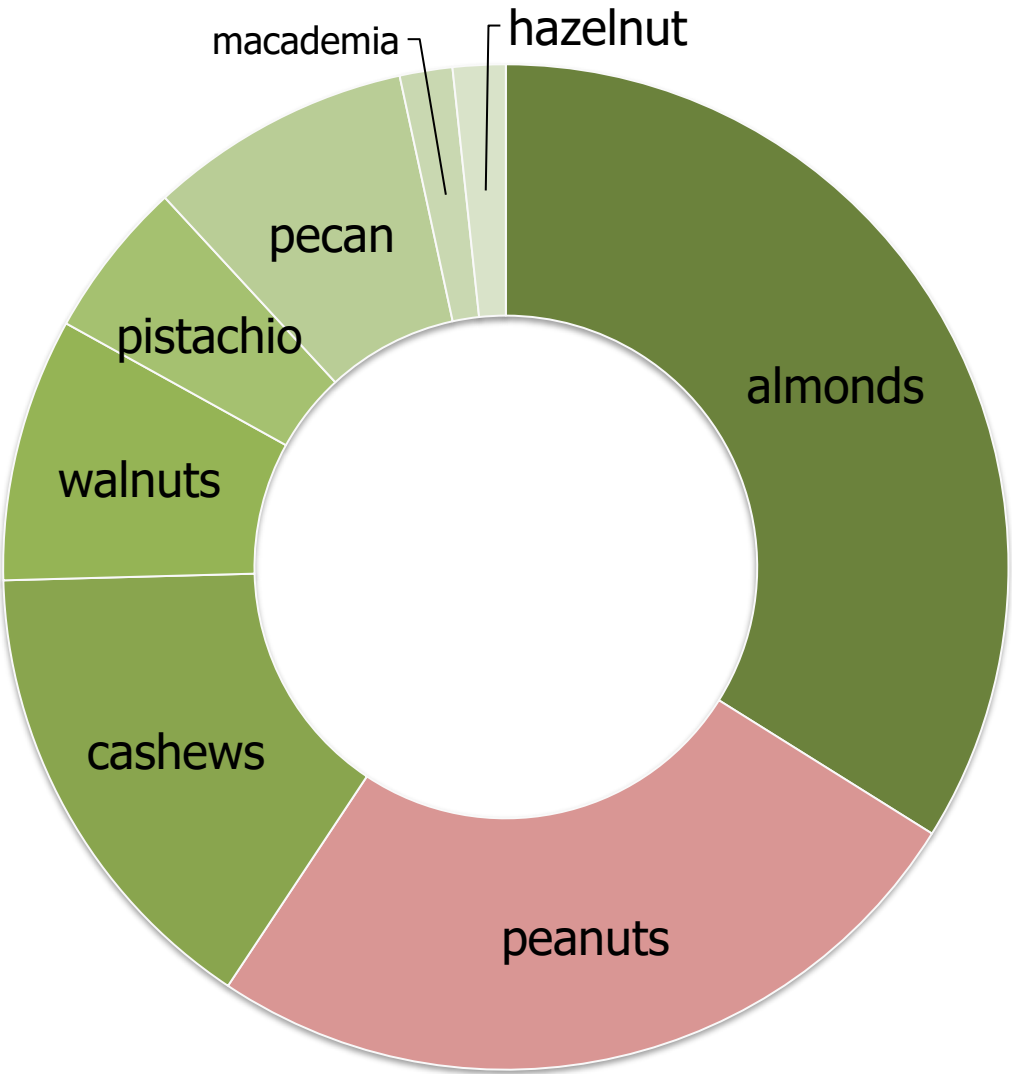
U.S. NUT PRODUCTION



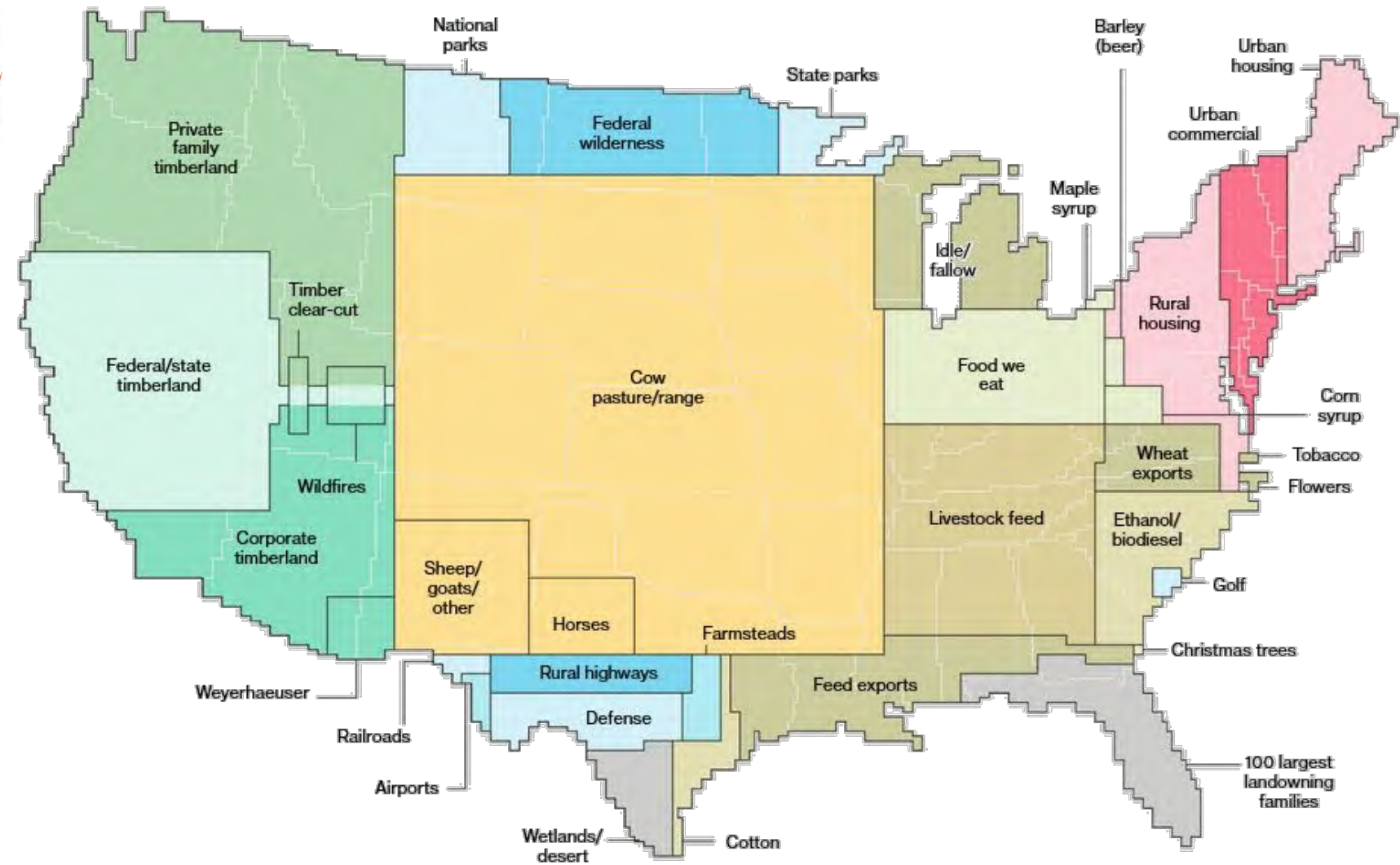
U.S. NUT PRODUCTION



U.S. NUT PRODUCTION



U.S. LAND USE

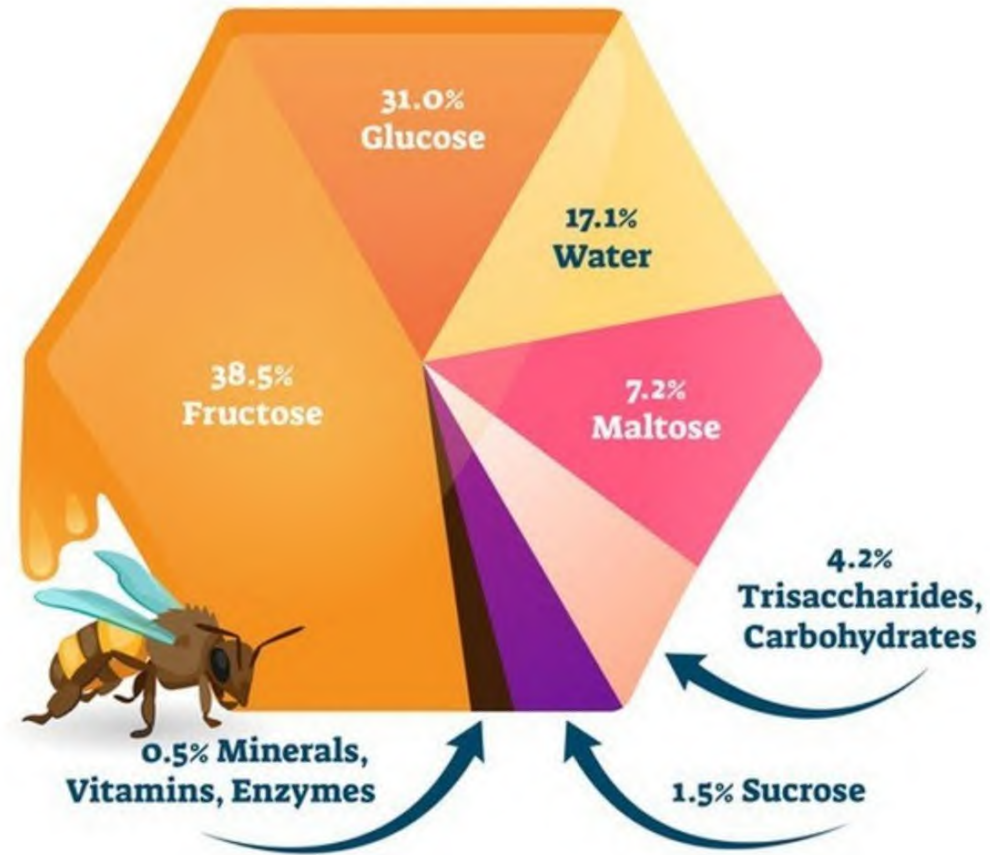


www.bloomberg.com/graphics/2018-us-land-use/

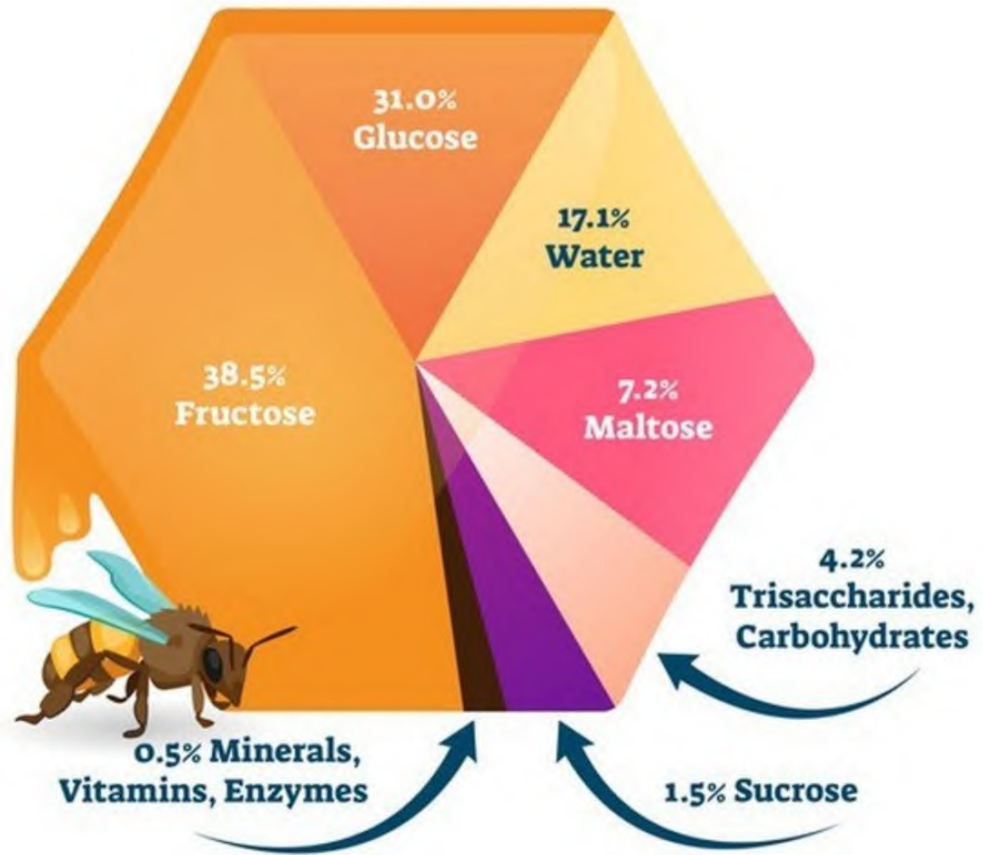
Too CUTE WITH GRAPHICS



COMPOSITION OF HONEY

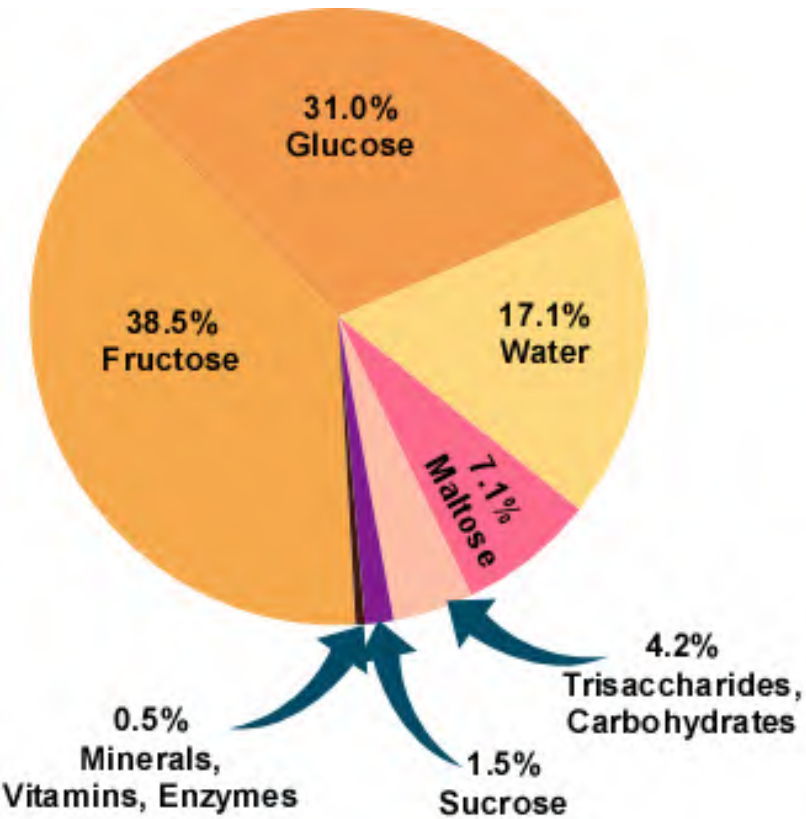


COMPOSITION OF HONEY

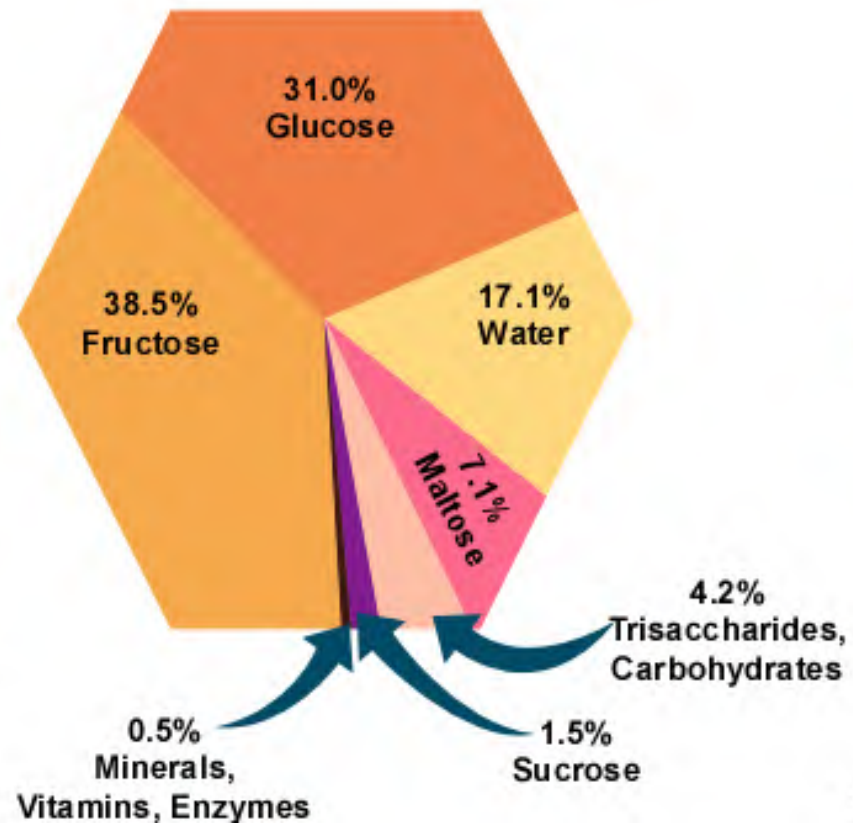


ANGLE OR AREA

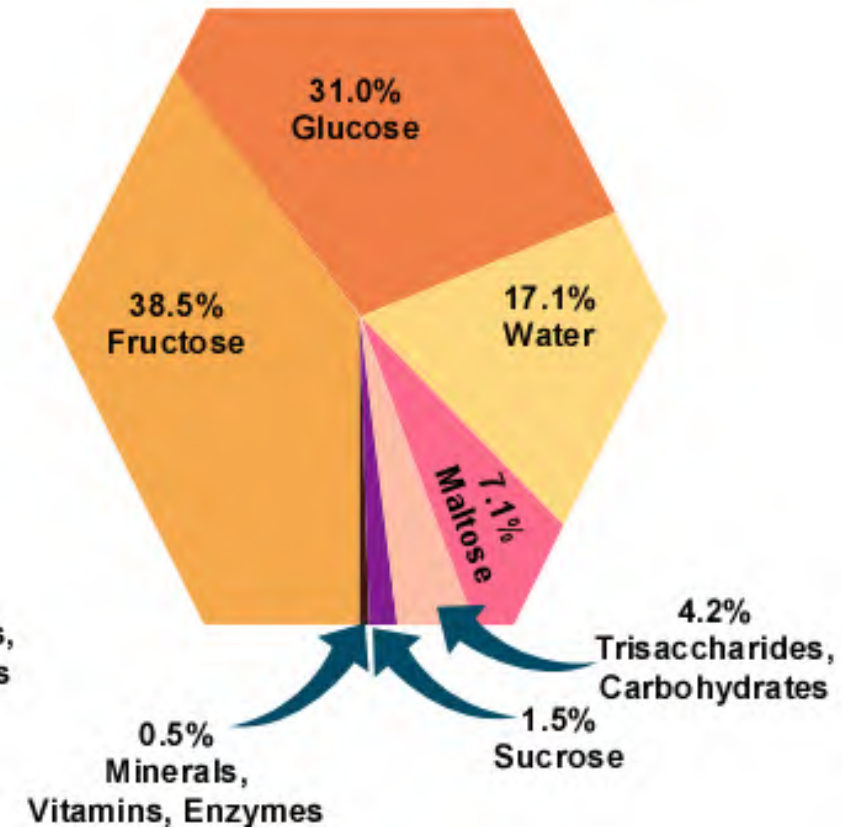
Area and Angle



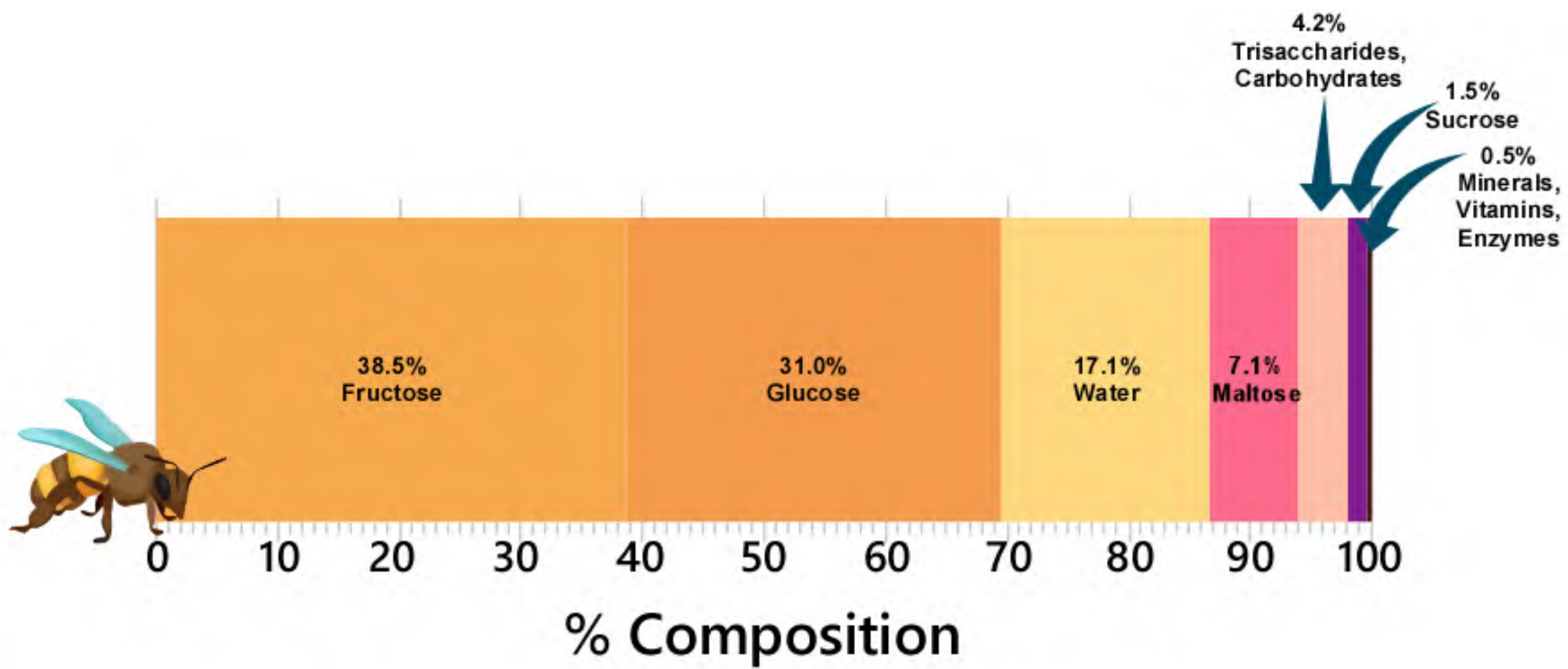
Non-circular Shape Angle



Area



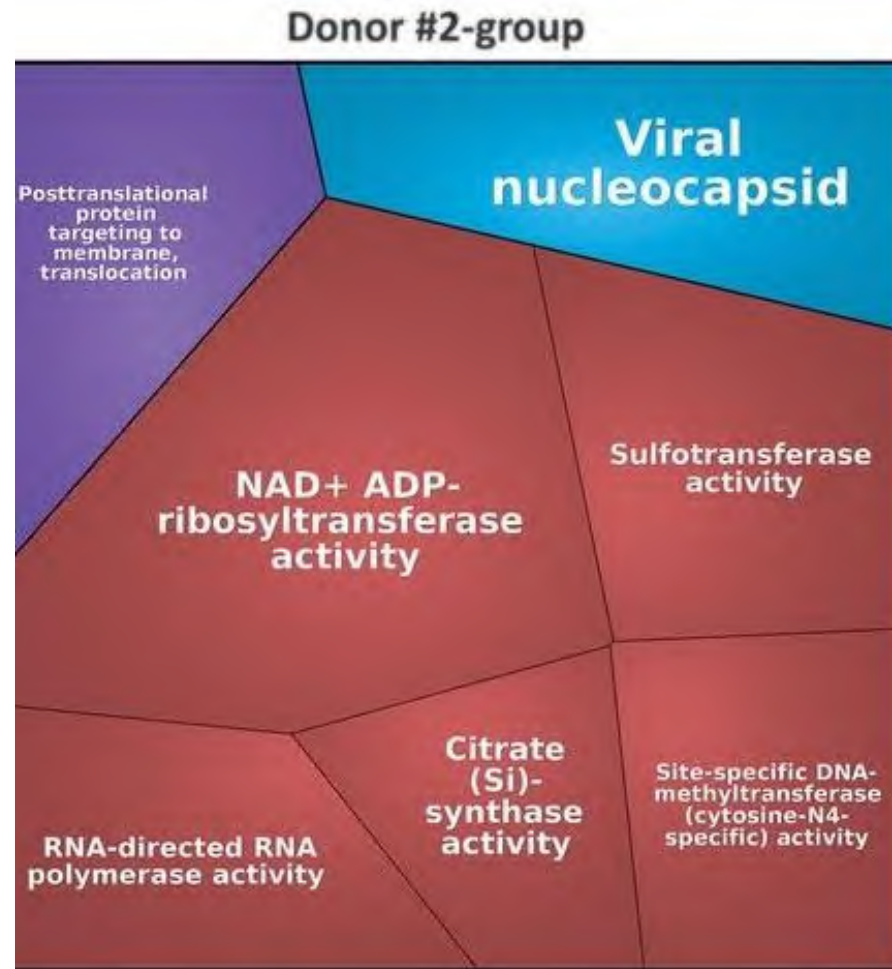
HONEY COMPOSITION



ENRICHED MICROBIOTA IN FECAL TRANSPLANTATION

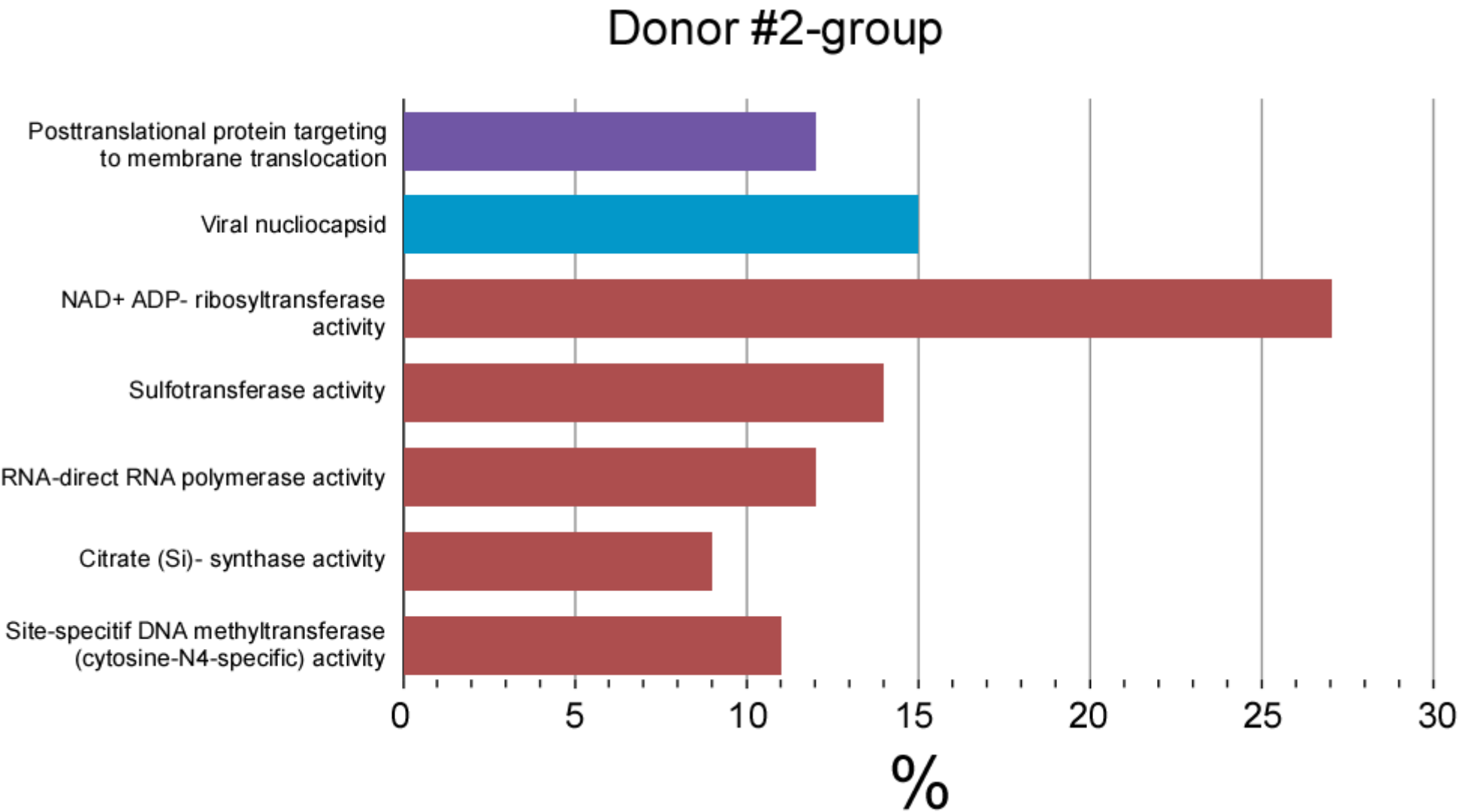
Voronoi tessellation

tessellation is fancy word for
tiling



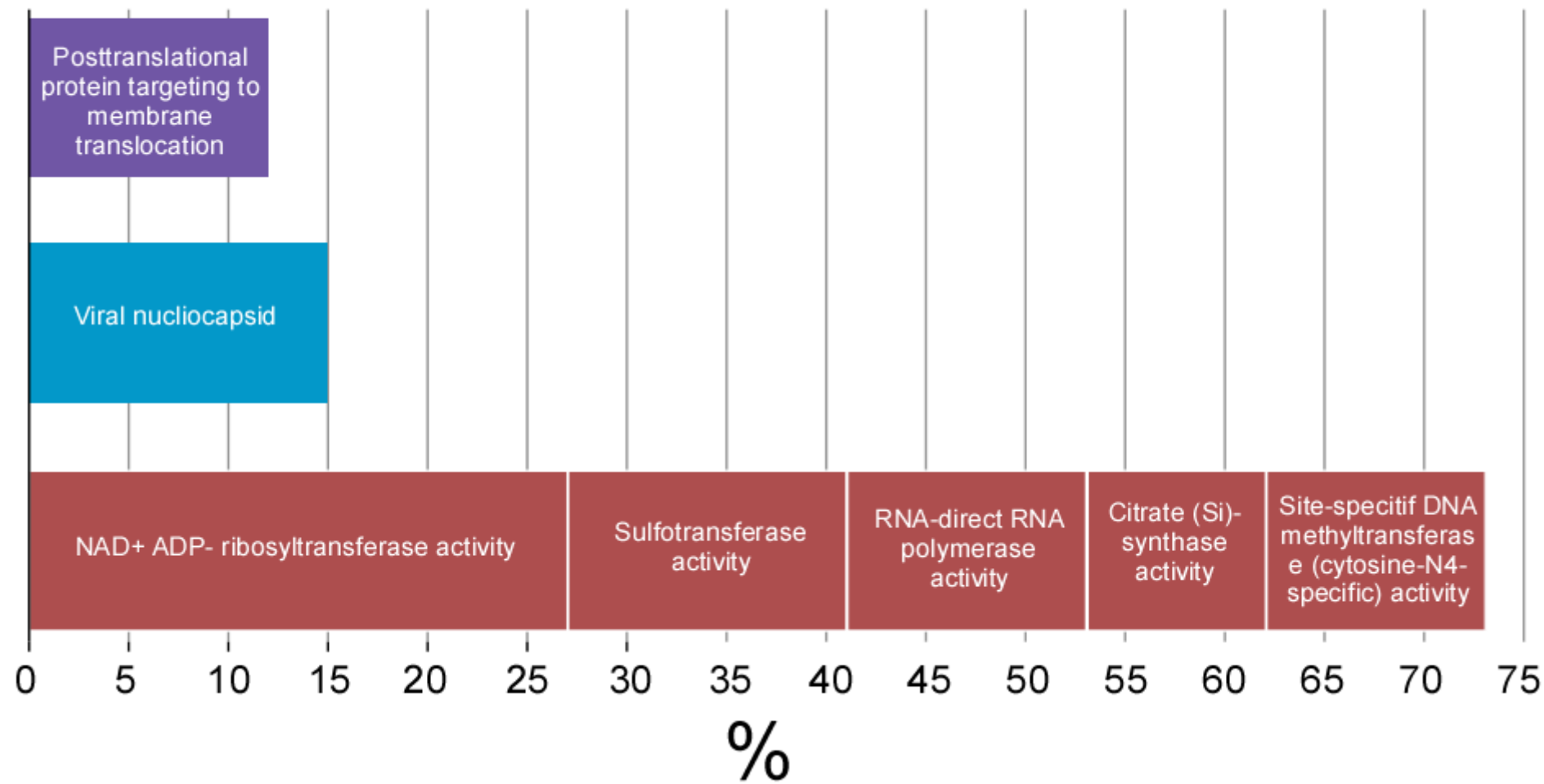
Baruch et al., "Fecal microbiota transplant promotes response in immunotherapy-refractory melanoma patients",
Science 05 Feb 2021, DOI: 10.1126/science.abb5920

ENRICHED MICROBIOTA IN FECAL TRANSPLANTATION



ENRICHED MICROBIOTA IN FECAL TRANSPLANTATION

Donor #2-group



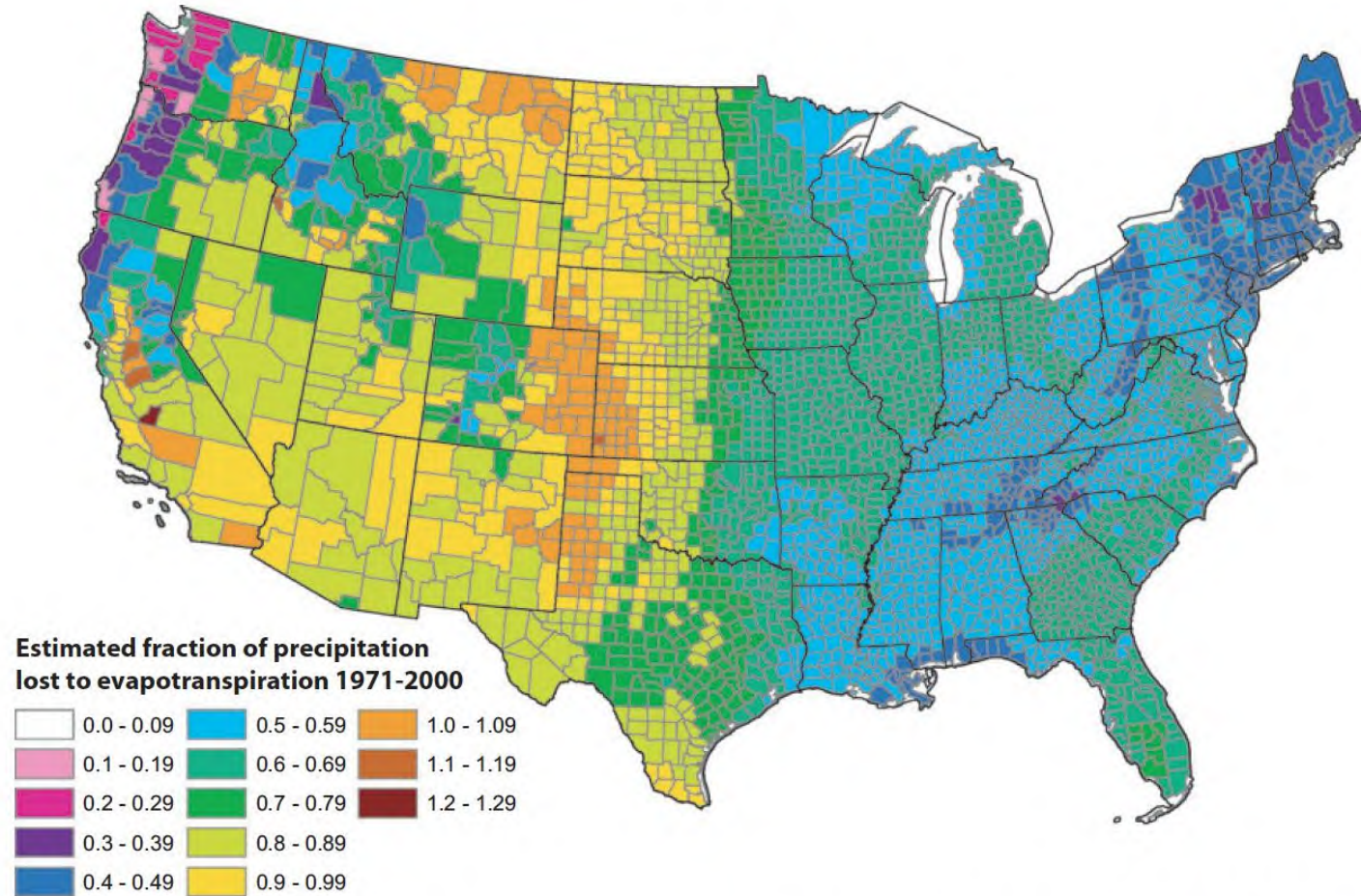
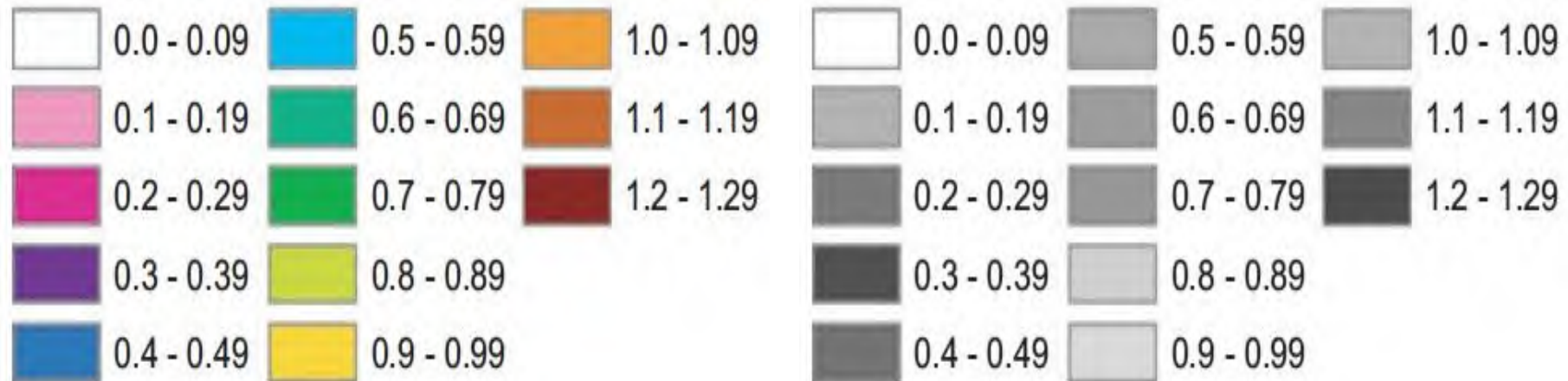


FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

Sanford, W.E. and Selnick, D.L., 2013. Estimation of Evapotranspiration Across the Conterminous United States Using a Regression With Climate and Land-Cover Data. *JAWRA Journal of the American Water Resources Association*, 49(1), pp.217-230.

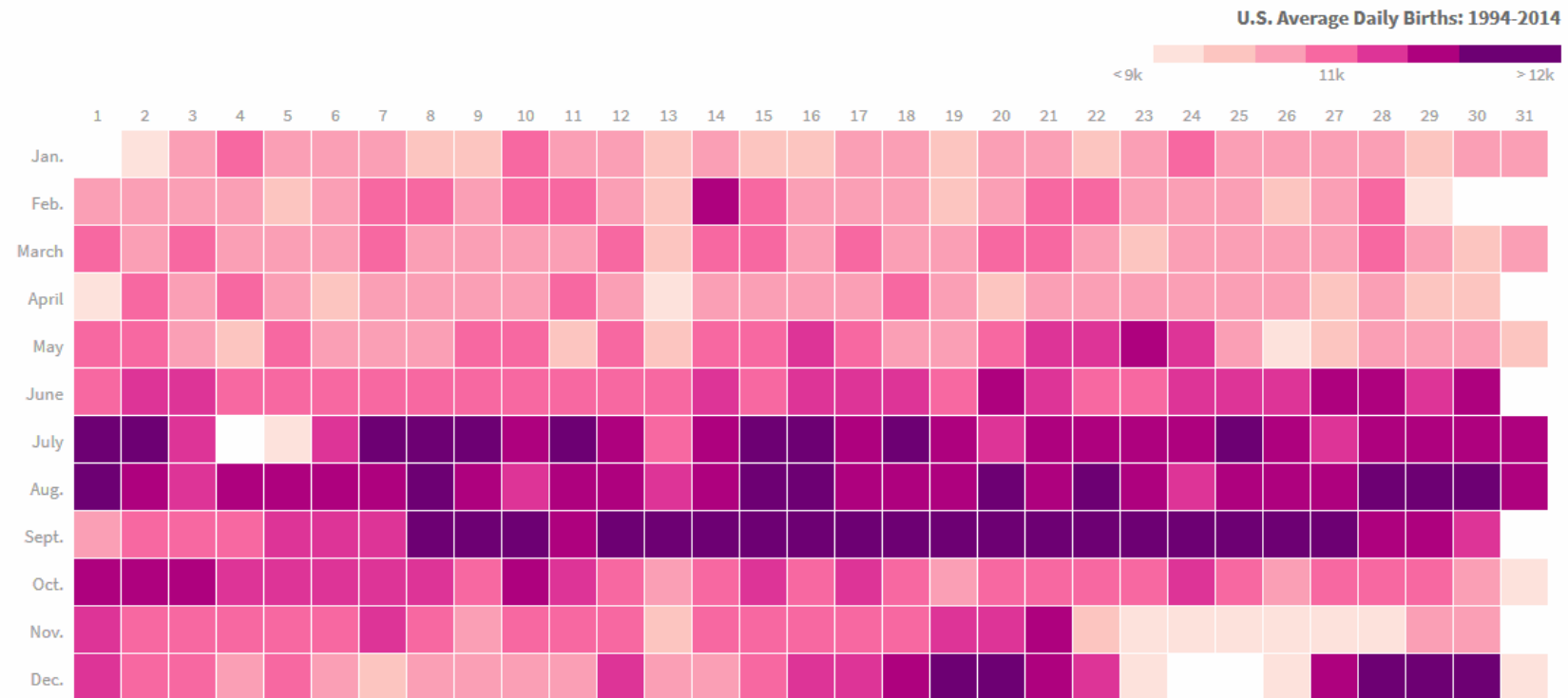
<https://eagereyes.org/basics/rainbow-color-map>

ABRUPT CHANGE IN LUMINANCE



HOW POPULAR IS YOUR BIRTHDAY?

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



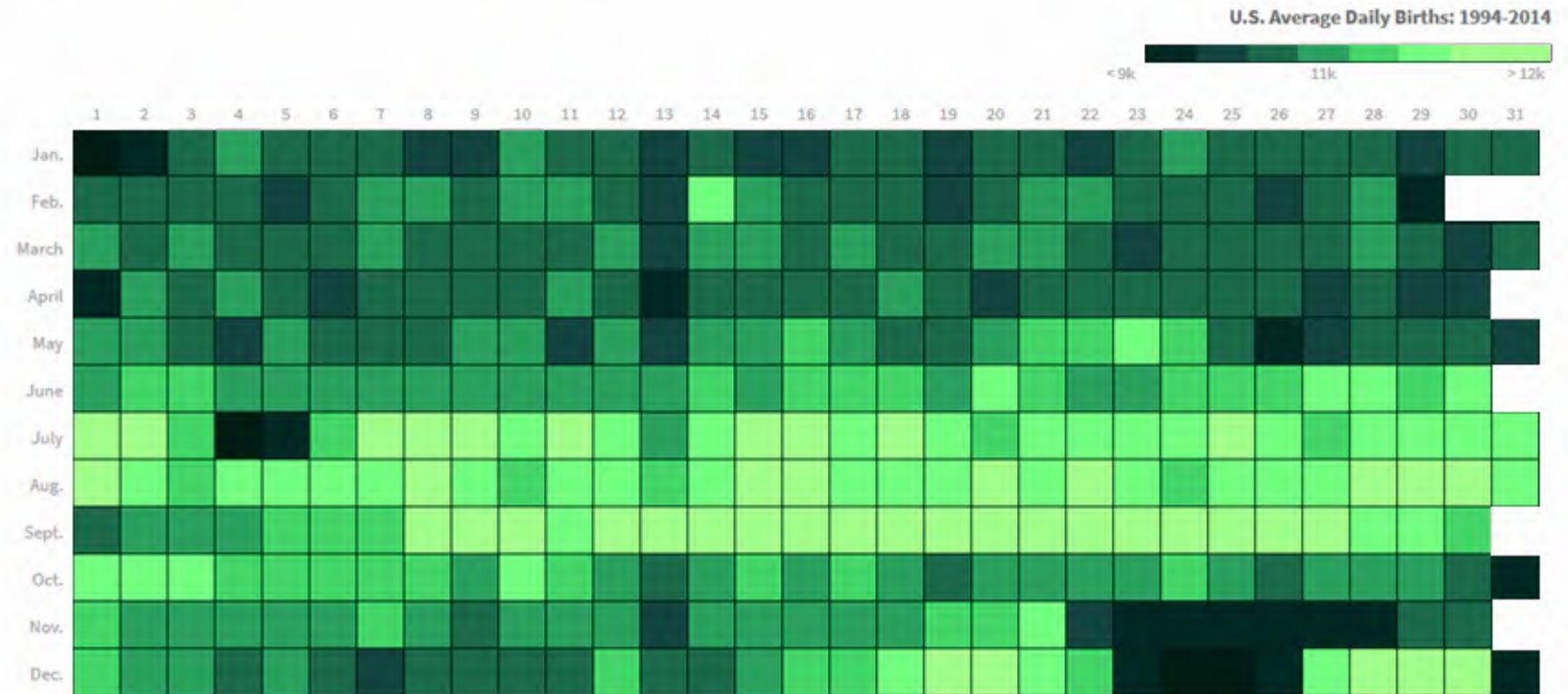
Notes: The conception date, purely for illustration, is 266 days prior to birth. It represents a hypothetical "moment of conception" based on the normal gestation period for humans, 280 days, minus the average time for ovulation, two weeks.

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

Credit: Matt Stiles/The Daily Viz

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



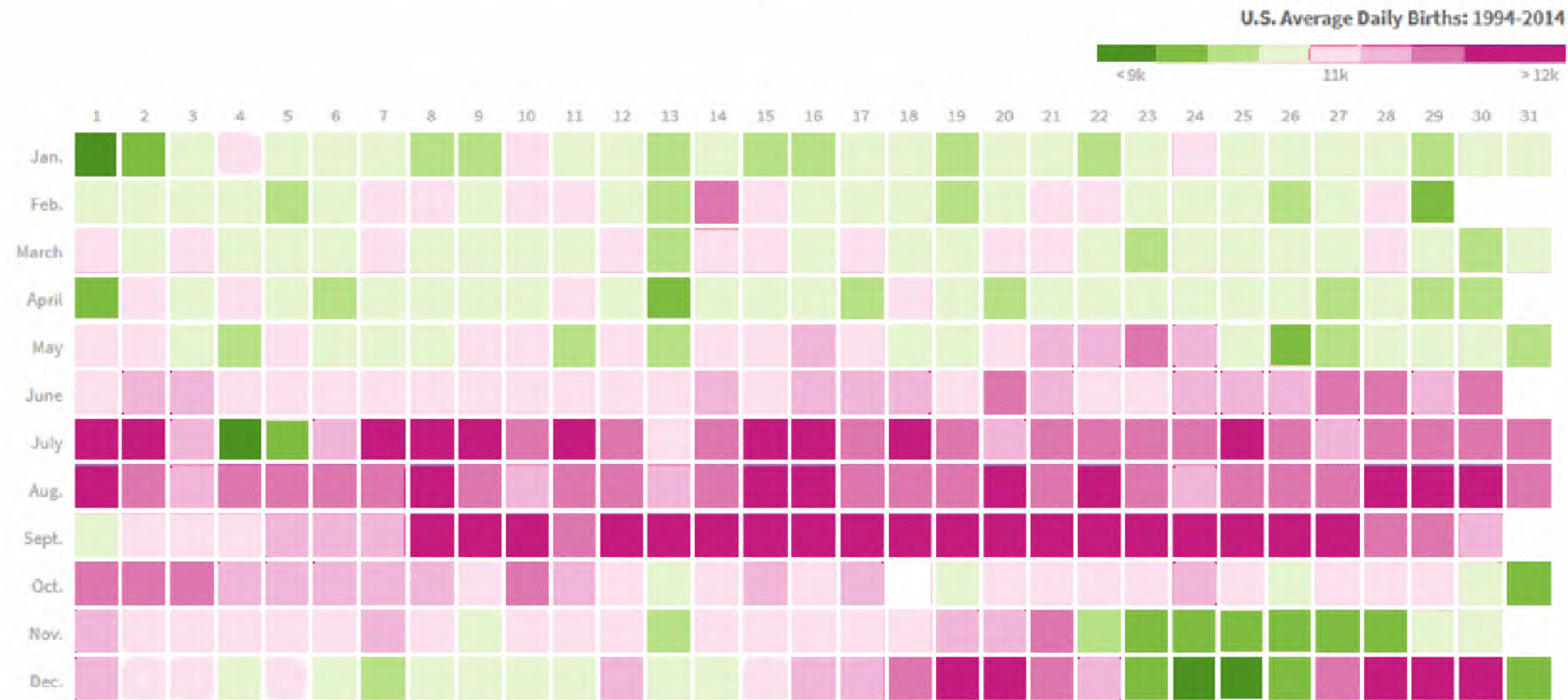
Notes: The conception date, purely for illustration, is 266 days prior to birth. It represents a hypothetical "moment of conception" based on the normal gestation period for humans, 280 days, minus the average time for ovulation, two weeks.

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

Credit: Matt Stiles/[The Daily Viz](#)

HOW POPULAR IS YOUR BIRTHDAY?

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

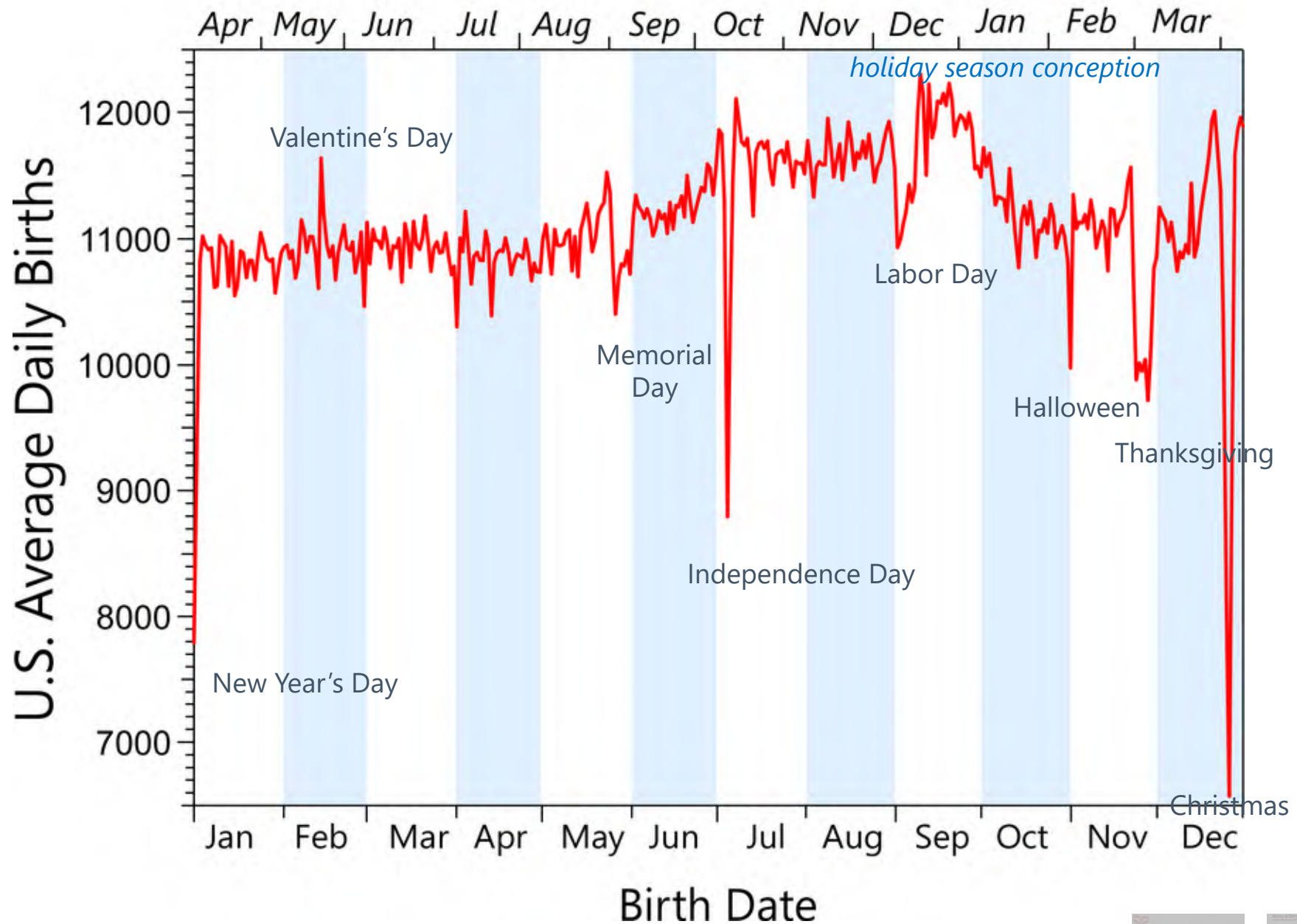


Notes: The conception date, purely for illustration, is 266 days prior to birth. It represents a hypothetical "moment of conception" based on the normal gestation period for humans, 280 days, minus the average time for ovulation, two weeks.

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

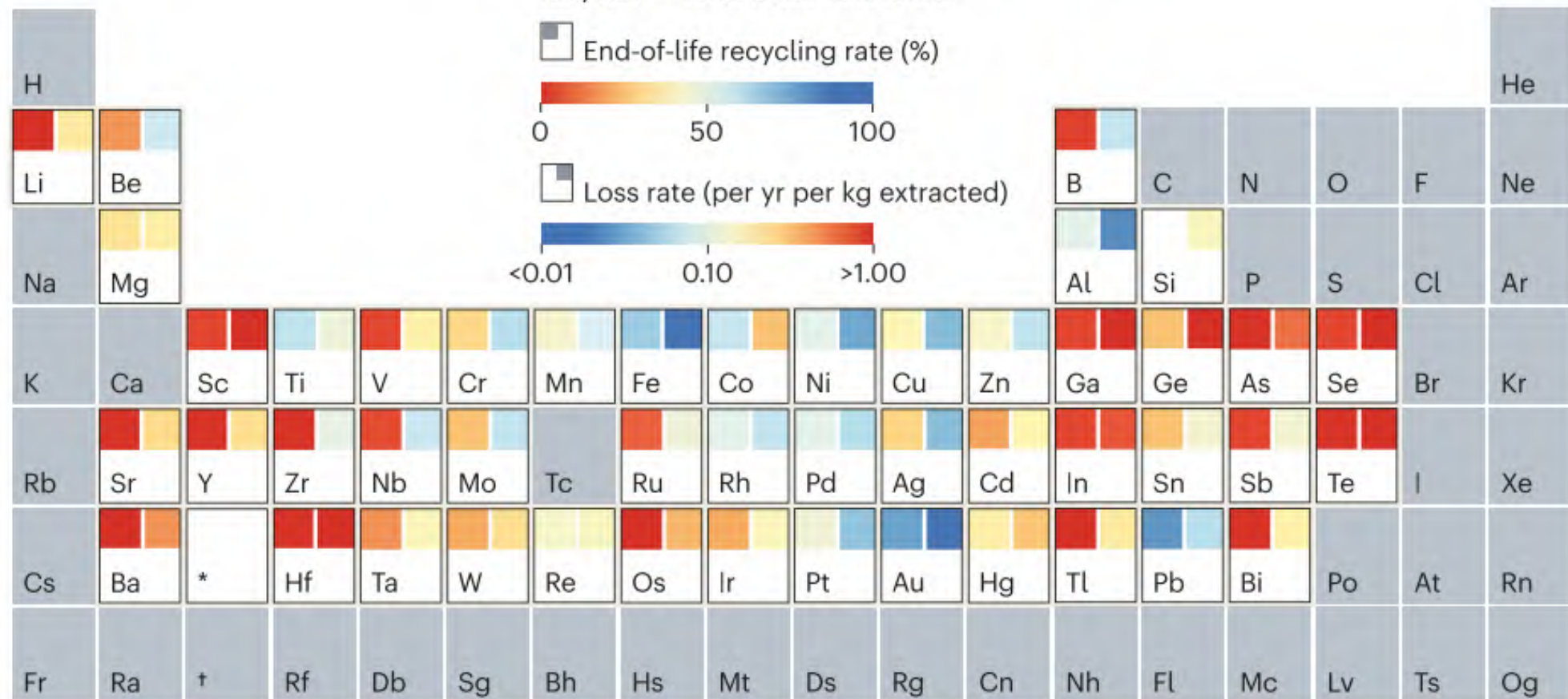
Credit: Matt Stiles/[The Daily Viz](#)

Approximate Conception Date



SCRAP METAL

In general, metals with a higher end-of-life recycling rate — the percentage of scrap that is functionally recycled — have lower loss rates.



*Lanthanide series

†Actinide series

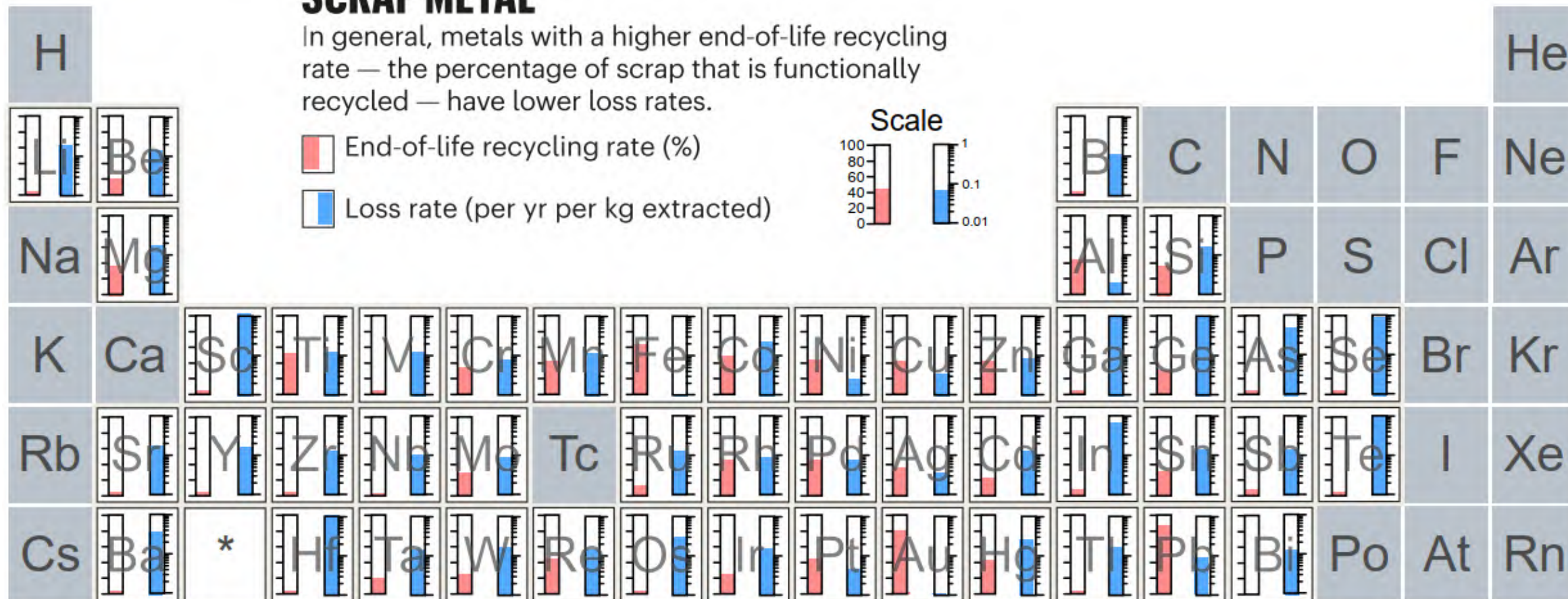
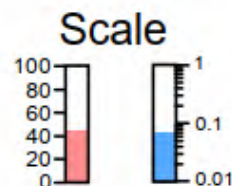
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

SCRAP METAL

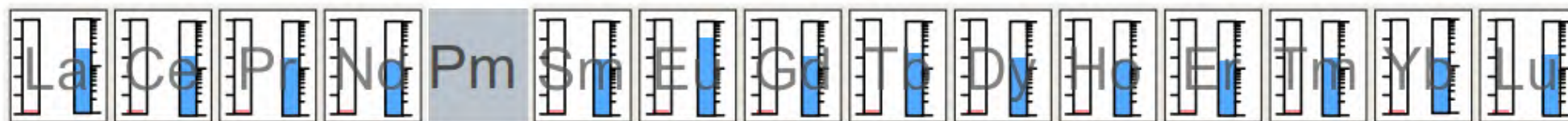
In general, metals with a higher end-of-life recycling rate — the percentage of scrap that is functionally recycled — have lower loss rates.

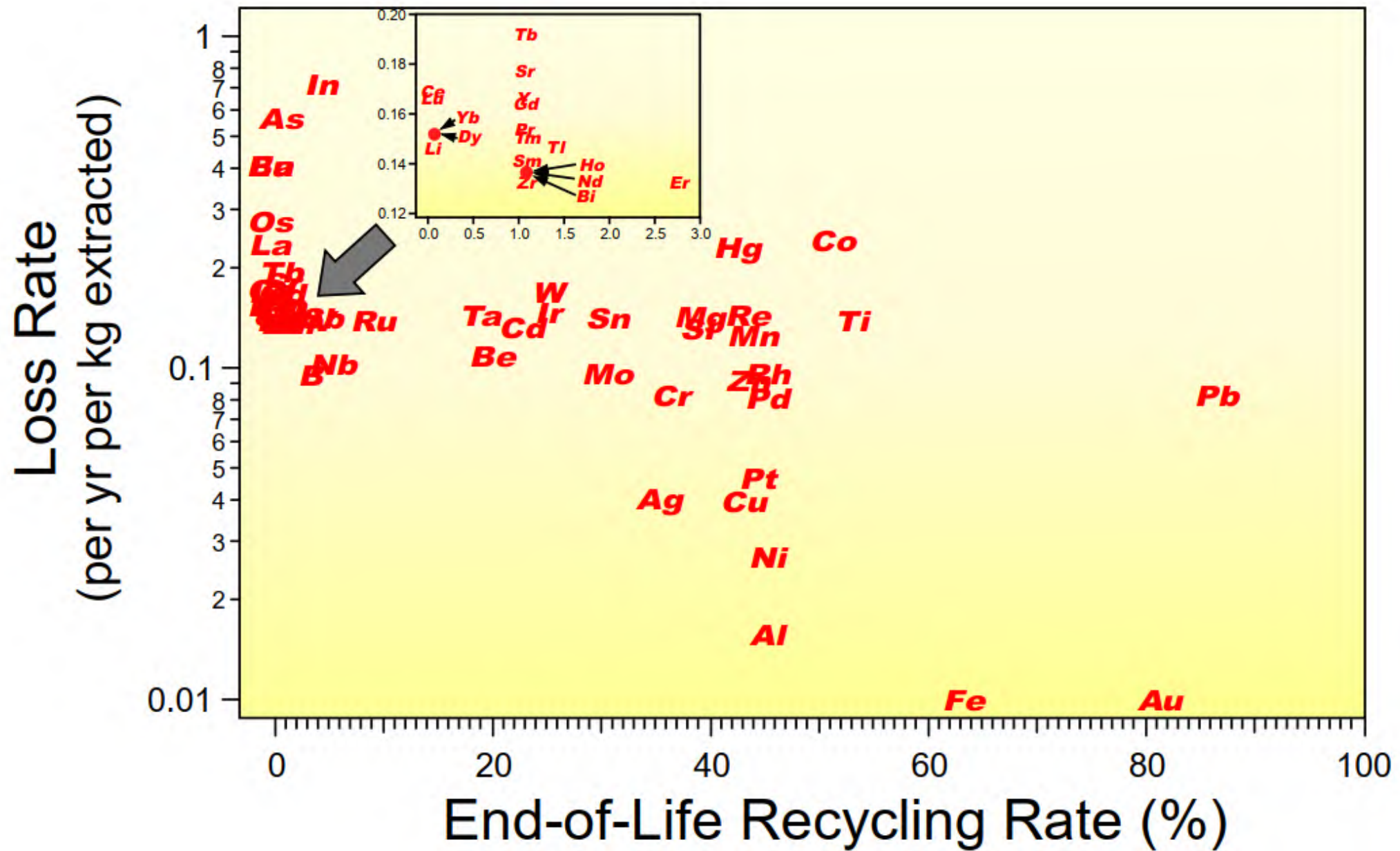
End-of-life recycling rate (%)

Loss rate (per yr per kg extracted)



*Lanthanide series

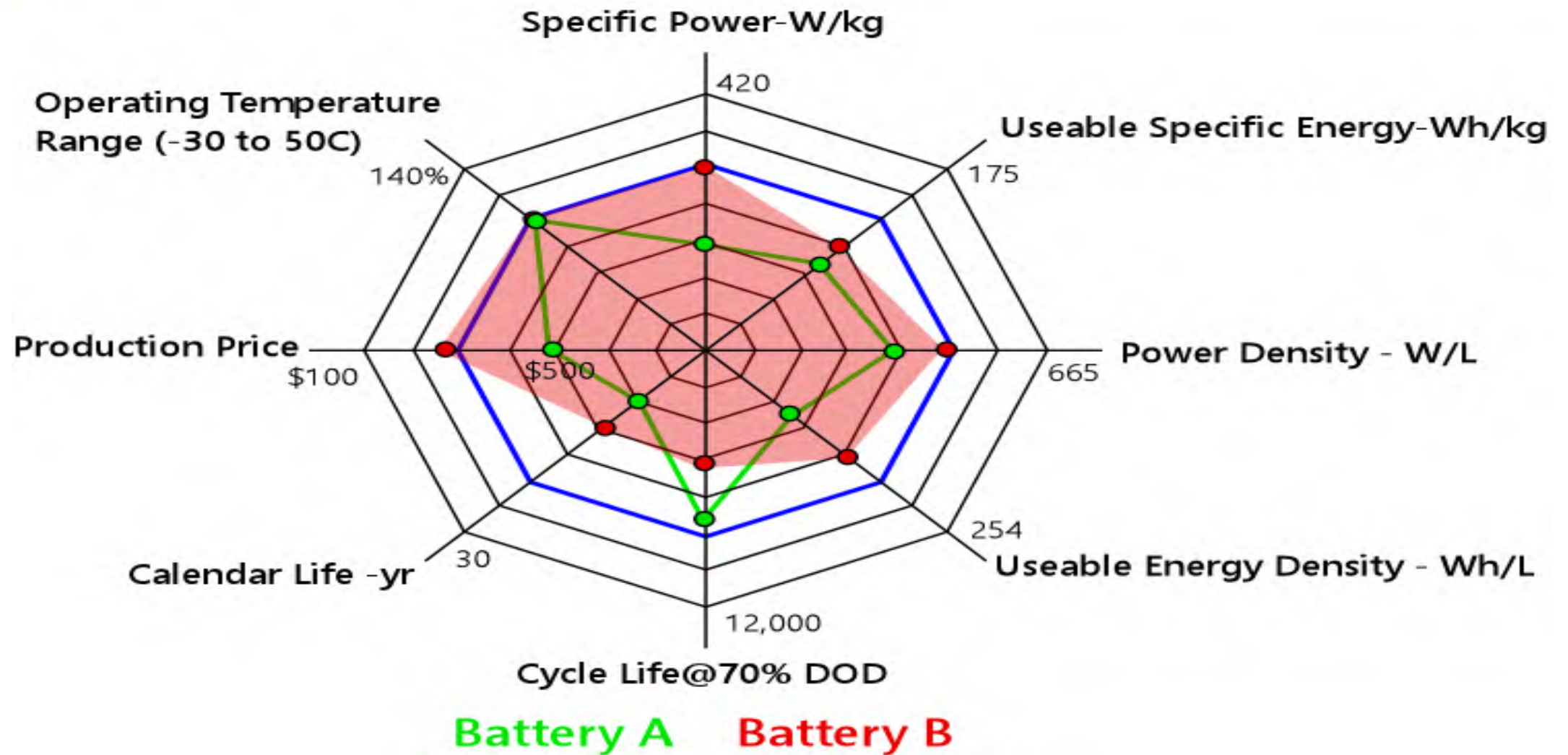




In general, metals with a higher end-of-life recycling rate have lower loss rates.



MJPhD





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

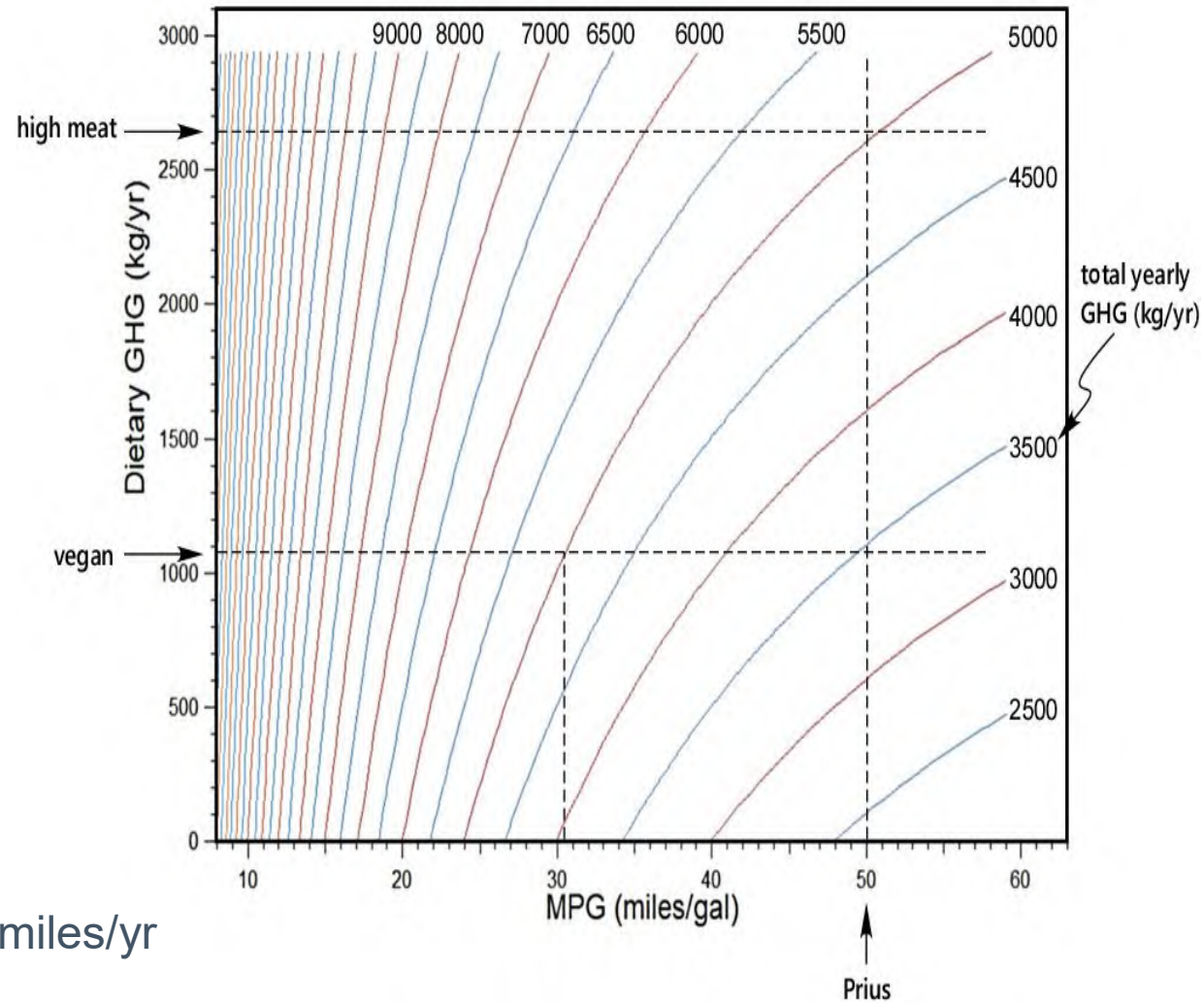
WHICH IS BETTER FOR THE ENVIRONMENT?

A MEAT-EATER IN A PRIUS



A VEGAN IN A HUMMER

VEGAN/MEAT-EATER DRIVING COMPARISON

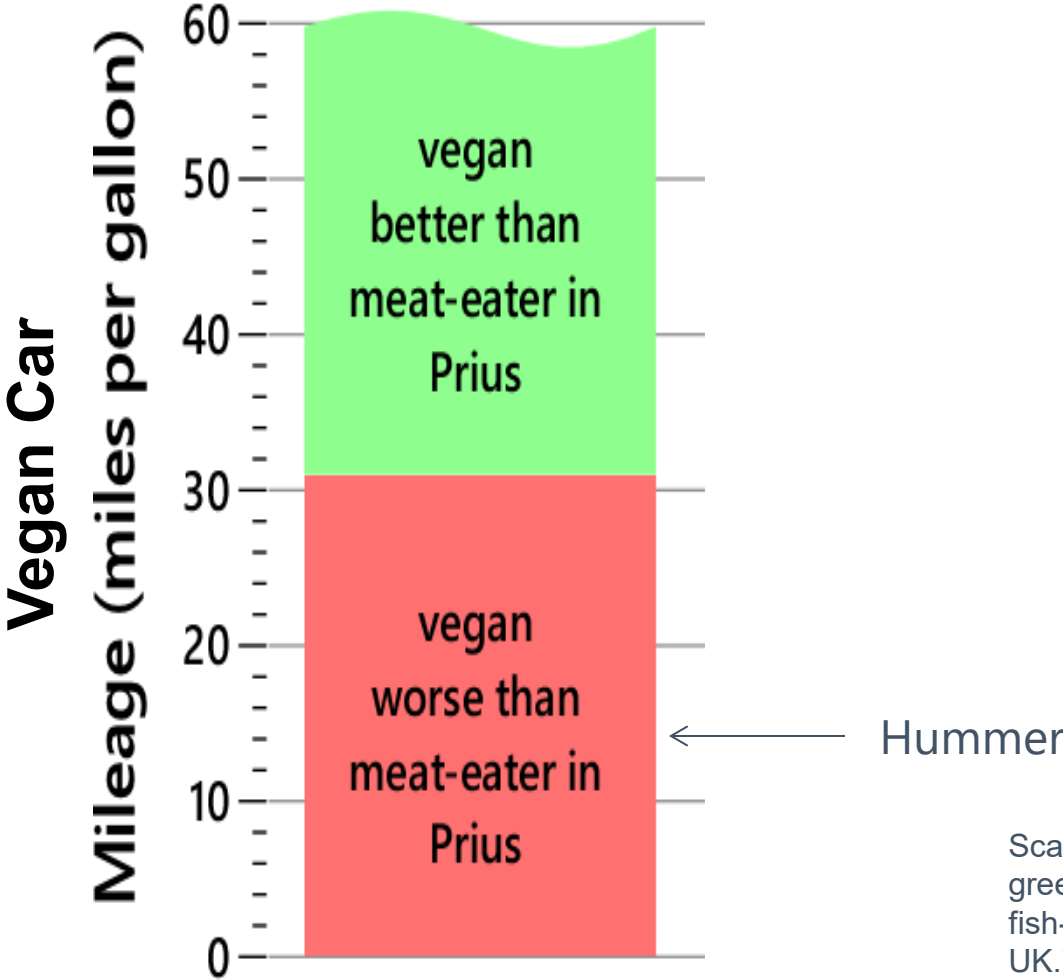


assumes 13,476 miles/yr

nomograph

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



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.

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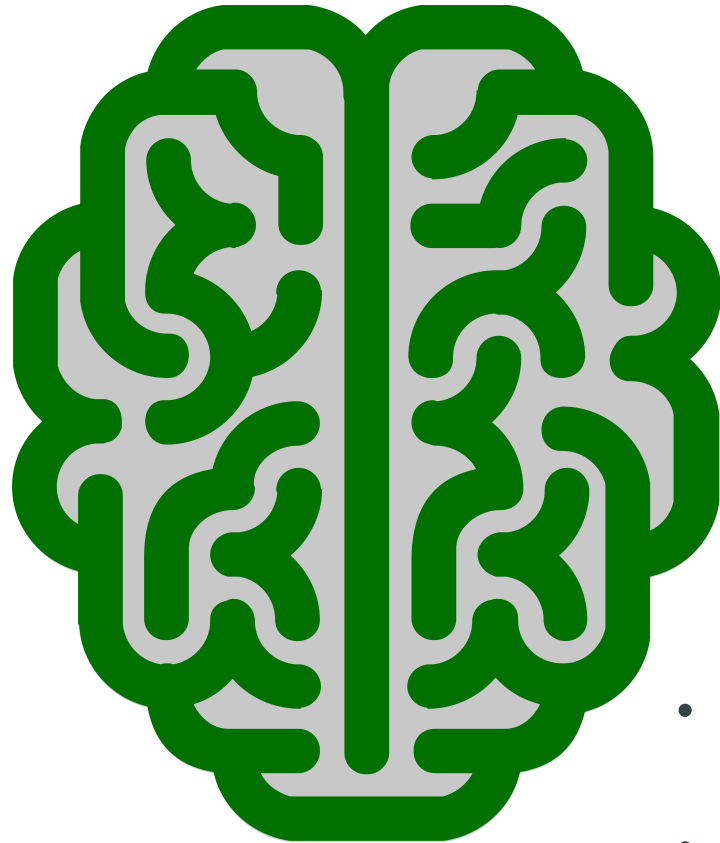
graphs used to gain
understanding are unlikely
to be good for presentation

PREPARE PLOTS FOR YOUR AUDIENCE

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

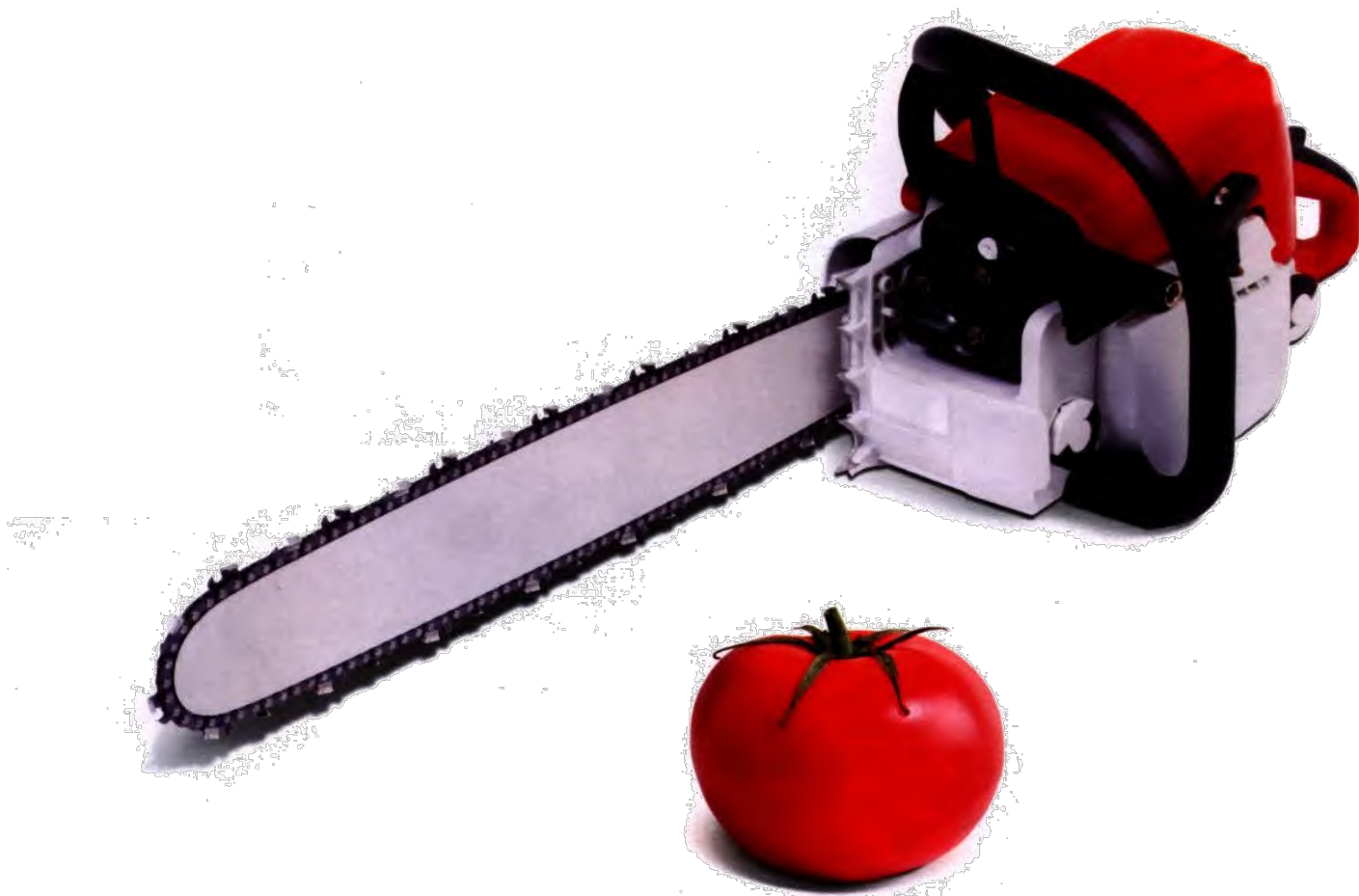


Tools
Tactics
Strategy
Audience
Goal



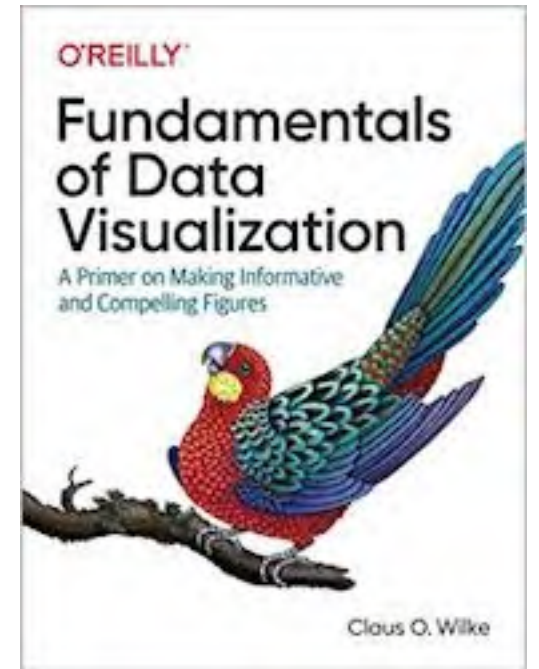
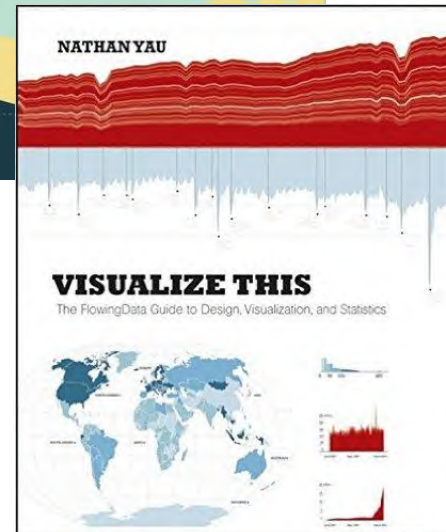
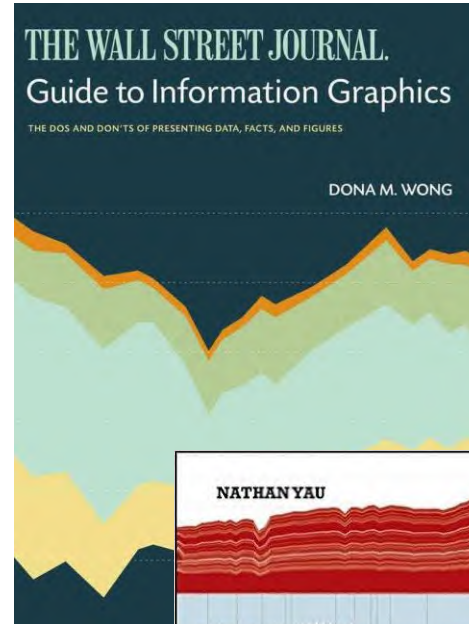
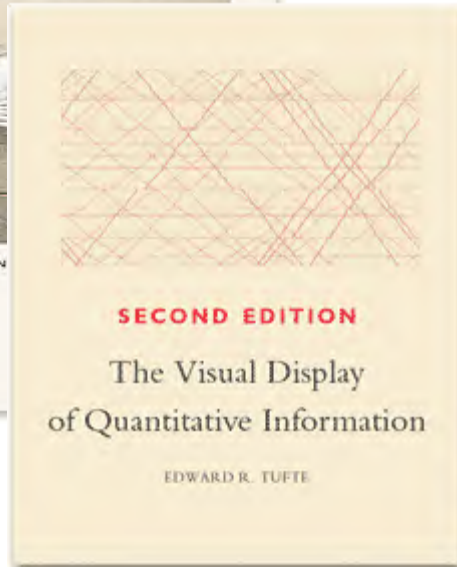
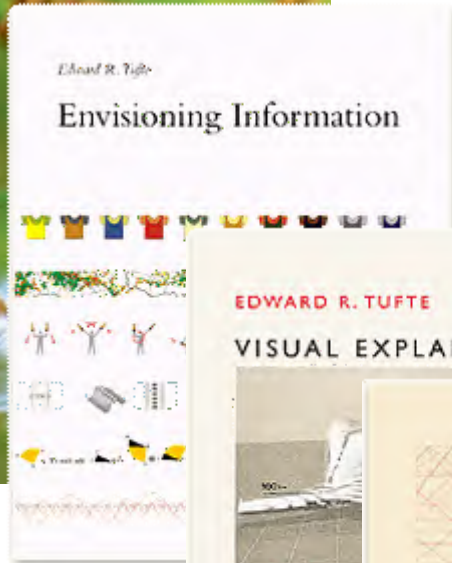
ready

- 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*

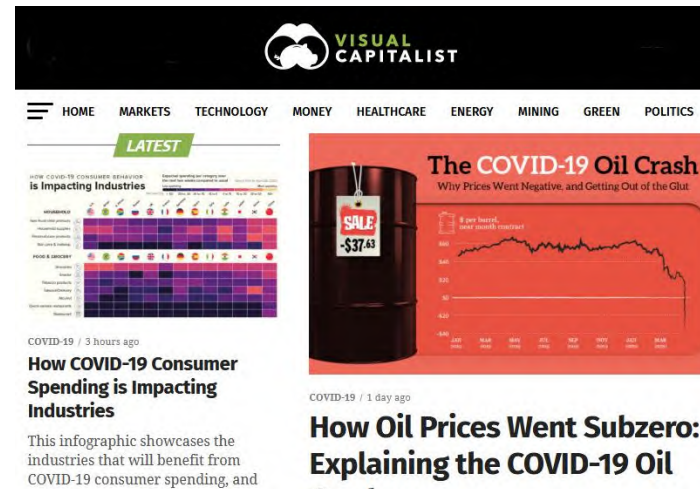
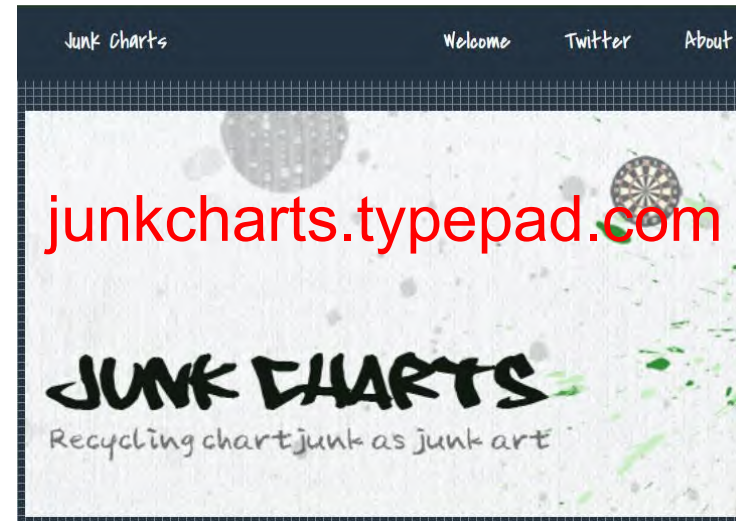
FAVORITE REFERENCES – DISPLAY OF INFORMATION



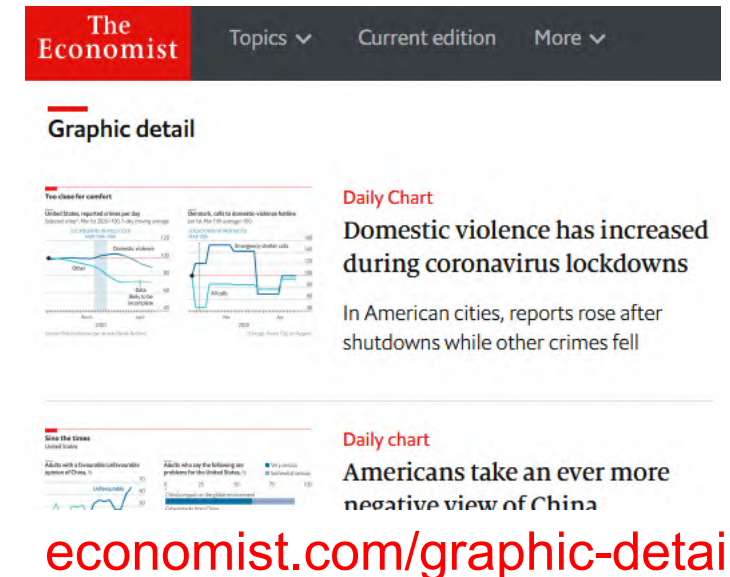
FAVORITE DATA VISUALIZATION WEBSITES - SAMPLES



howmuch.net

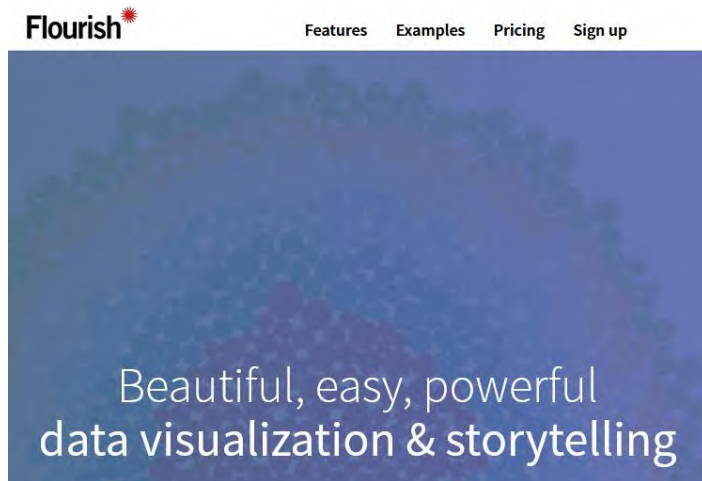


visualcapitalist.com

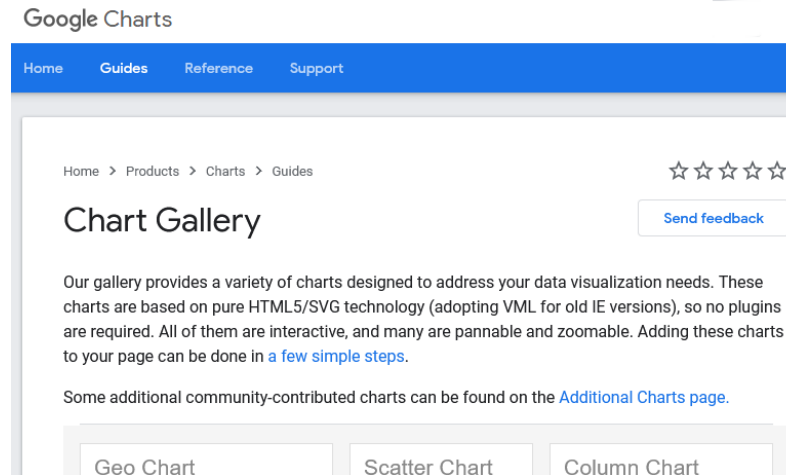


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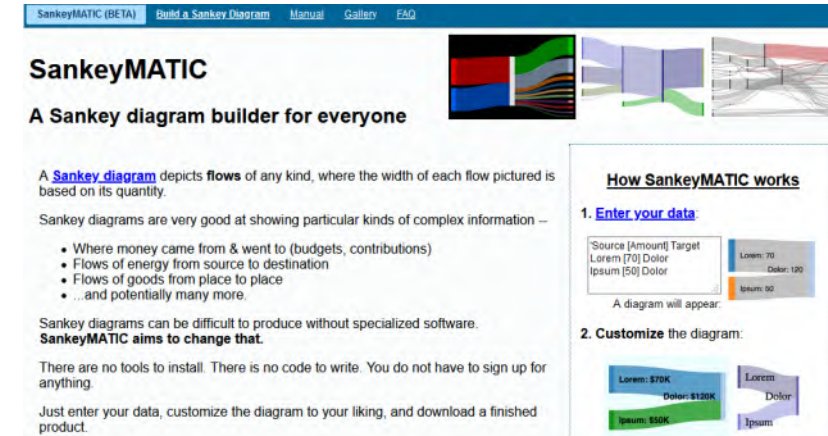
FAVORITE DATA VISUALIZATION WEBSITES - TOOLS



flourish.studio



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



sankeymatic.com

HAVE SOME FUN WITH GRAPHS

<https://www.mjphd.net/Workshop/forFun.html>



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