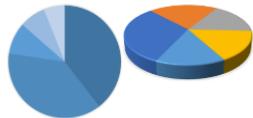


Creating more effective charts

Richard Layton

2024-02-13

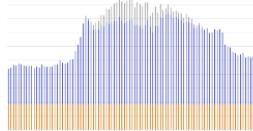
Perception, reasoning, and credibility



Effective alternatives to pie charts



Effective alternatives to bar charts



Aligning the design to the story



Advice from experts

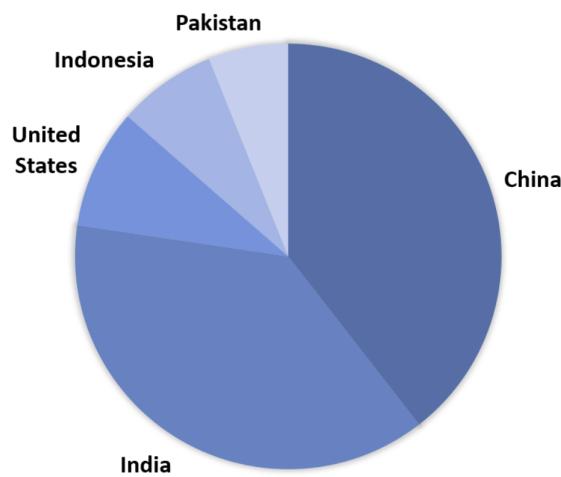
Richard Layton resides online at

- <https://www.graphdoctor.com>
- <https://github.com/graphdr>

Creating More Effective Graphs by Naomi Robbins (2013) inspired the session title and Chapter 2, “Limitations of some common graphs,” inspired our exercises.

§ Effective alternatives to pie charts

Judging pie slices is a low-accuracy task



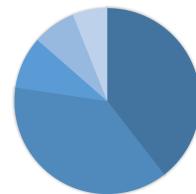
- Visually estimate each country's percentage
- Fill-in the blanks in the table
- Total should be 100%

Country	Percentage
China	
India	
United States	
Indonesia	
Pakistan	

Data source: World Bank (2022)

Judging values along a common axis is a high-accuracy task

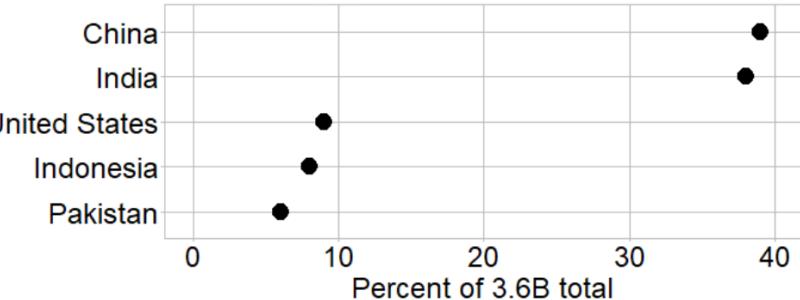
- The new chart displays the same data
- *Visually estimate* the percentages using the new chart
- Fill-in the blanks in the table



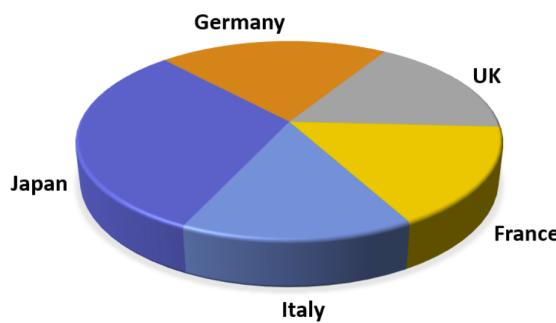
The data from the pie chart is shown below as dots along a common scale.

Country	Percentage
China	
India	
United States	
Indonesia	
Pakistan	

The 5 most populous countries in 2021



3D effects distort our judgment even further



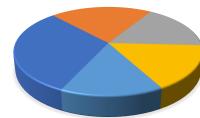
- *Visually estimate* each country's percentage
- Fill-in the blanks in the table
- Total should be 100%

Country	Percentage
Japan	
Germany	
UK	
France	
Italy	

Data source: World Bank (2022)

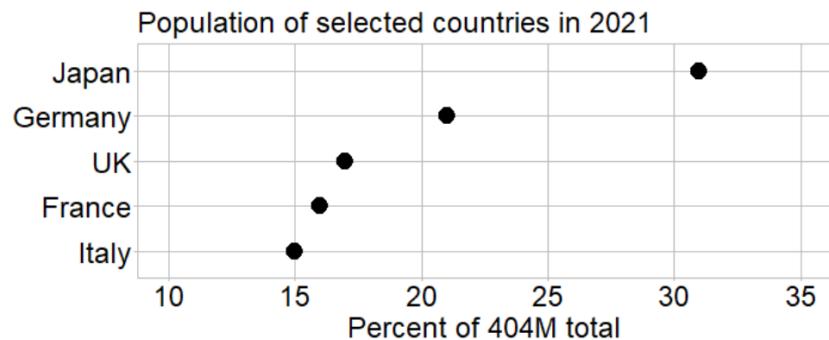
Again, a common scale improves our visual judgments

- The new chart displays the same data
- *Visually estimate* the percentages using the new chart
- Fill-in the blanks in the table



The data from the pie chart is shown below as dots along a common scale.

Country	Percentage
Japan	
Germany	
UK	
France	
Italy	

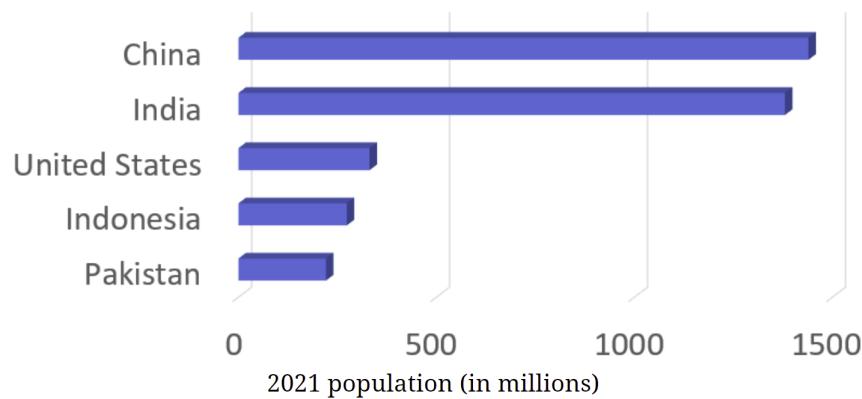


§ Effective alternatives to bar charts

3D effects always distort our judgment

- *Visually estimate* each country's population in millions
- Fill-in the blanks in the table

Country	Millions
China	
India	
United States	
Indonesia	
Pakistan	

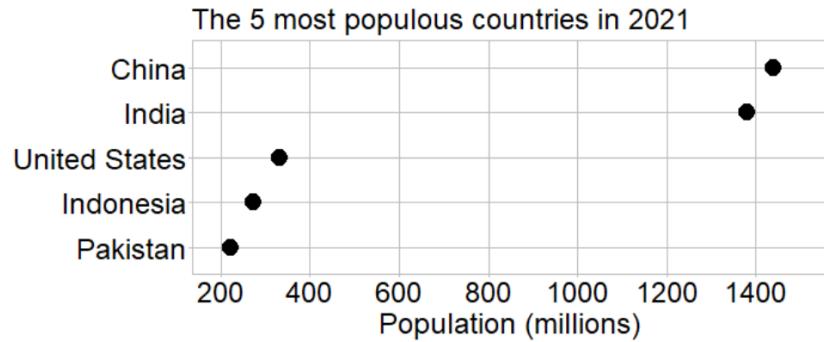


Data source: World Bank (2022)

Same data—without 3D effects—along a common scale

- The new chart displays the same data
- Visually estimate the percentages using the new chart
- Fill-in the blanks in the table

Country	Millions
China	
India	
United States	
Indonesia	
Pakistan	



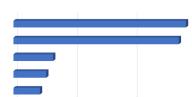
With a zero baseline and no 3D effects, bars are OK

- Zero baseline avoids deception
- Ordered by data values
- Only the endpoint encodes information

Consider dot charts for

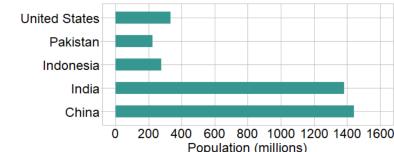
- Visually comparing quantities
- Replacing most pie and bar charts

Notes

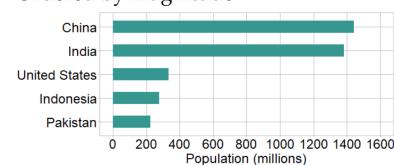


The data from the 3D bar chart is shown below as dots along a common scale.

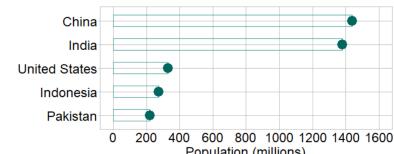
Default bar chart:



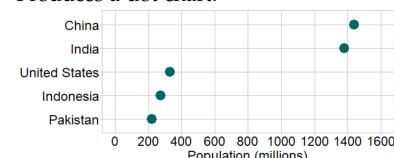
Ordered by magnitude:



Omitting the fill color:



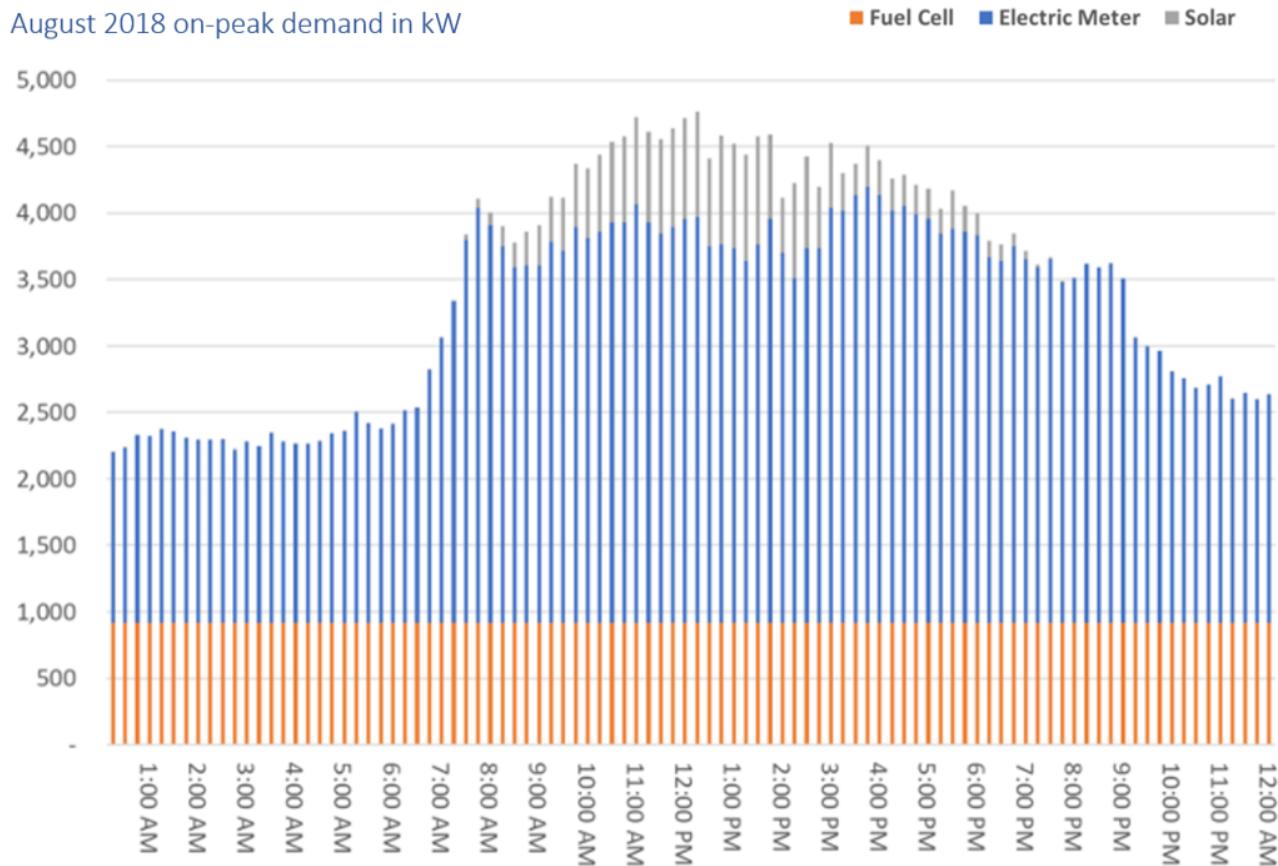
Produces a dot chart:



§ Aligning the design to the story

Redesigning a chart to find what stories might be in the data

THE APPENDIX OF THE USD ENERGY REPORT includes this stacked-column chart.

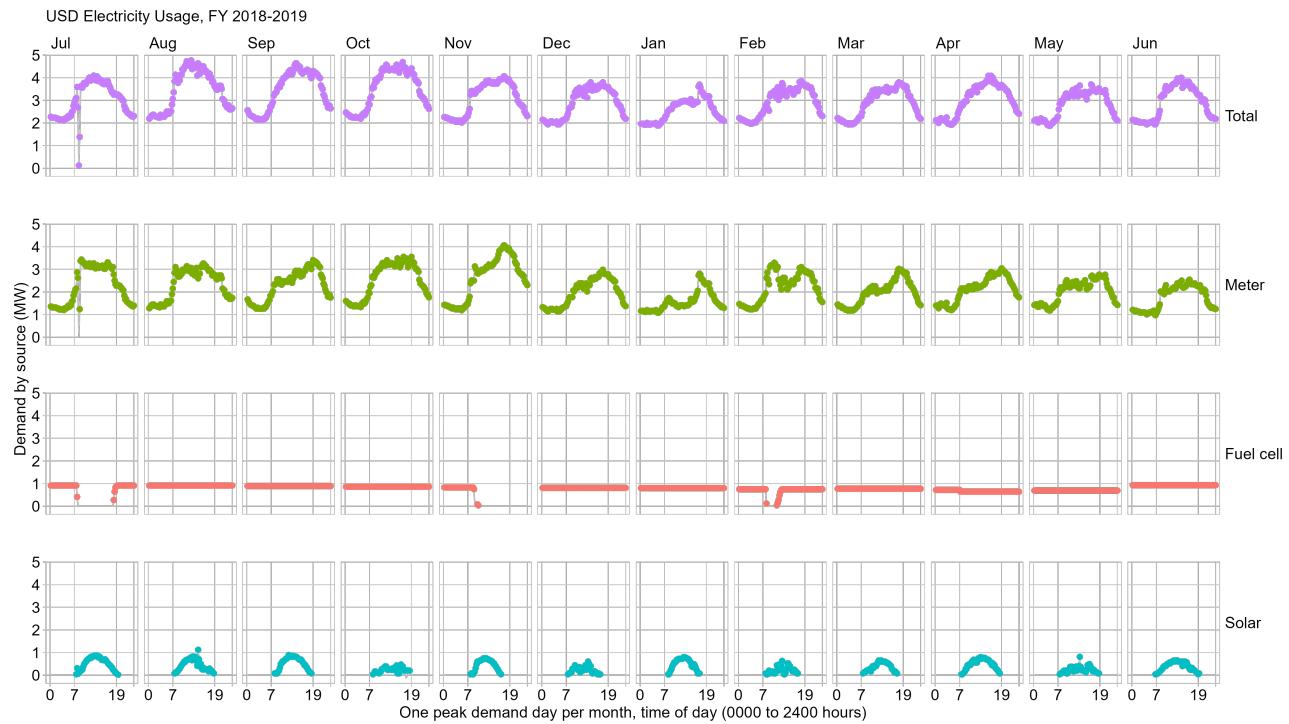


AFTER WE DISCUSS THESE DATA, write your thoughts in response to these prompts:

- What does the chart show clearly?
- What does the chart not show clearly?
- Describe the problems faced by a reader trying to compare and contrast trends over 12 months (12 charts like this one).

Redesign

In this multi-faceted chart, we can see the trends for each of the three demand sources independently of one another, plus the total in the top row, spanning the full year.



AFTER WE DISCUSS THESE DATA, write your thoughts in response to these prompts:

- What observations (even obvious ones) can you make?
- What attributes of this design, compared to the original stacked-bar chart, *help the reader* to find stories in the data?

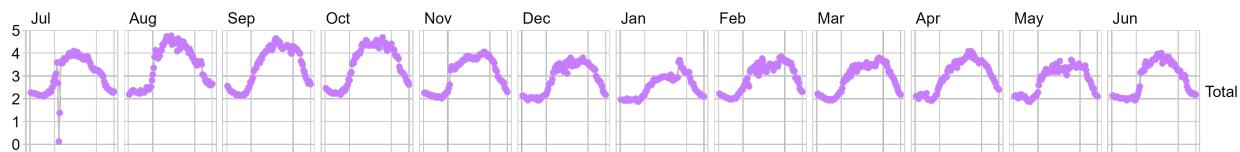
A second redesign

Electrical power is recorded on the peak demand day in each month. The three measured quantities (solar, fuel cell, and metered kW) are dependent on two discrete time variables.

month of the fiscal year, from July 2018 to June 2019

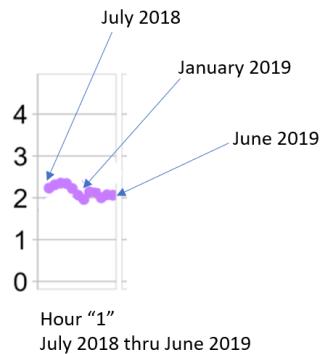
time of day in 15-minute discrete intervals from 12:15 am to the following midnight (or, using a 24 hour clock, from 0015 hours to 2400 hours).

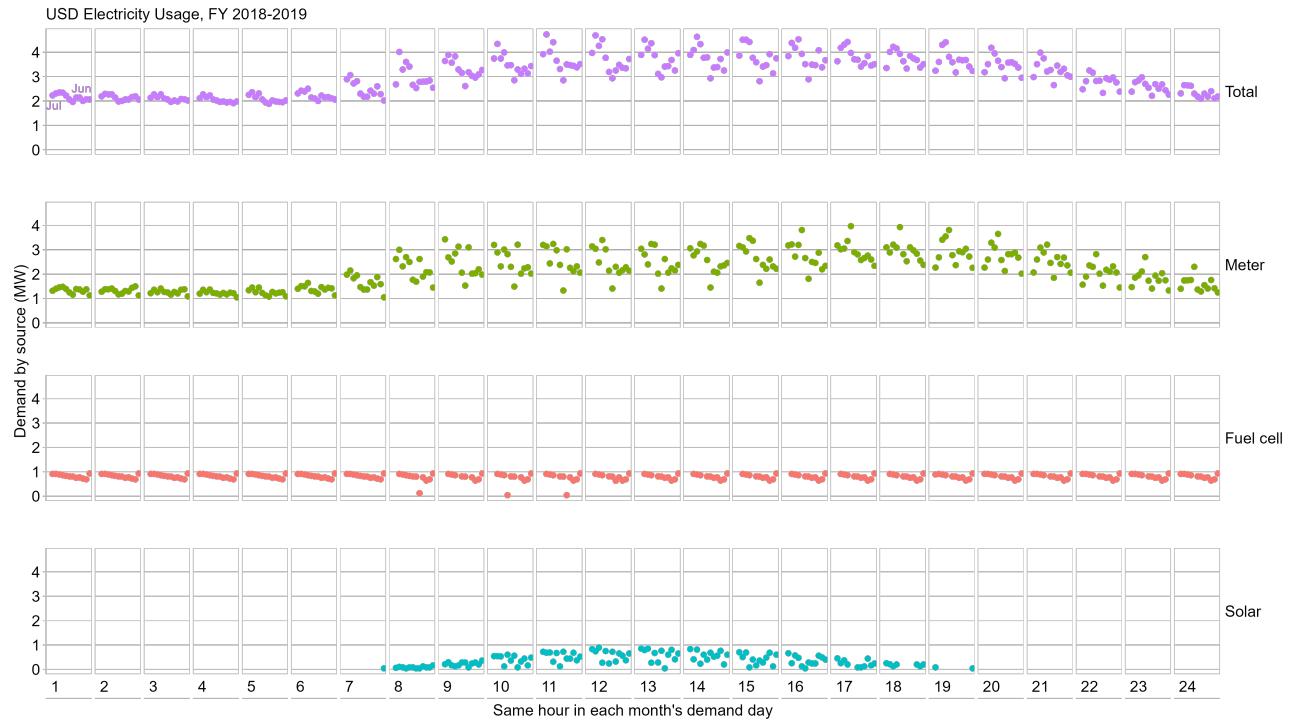
In the previous design, we used time of day for the horizontal scale of each panel and month to organize the sequence of panels.



Conceptually, a discrete sequence of 15-minute intervals over a day and a discrete sequence of months over a year are quite similar—just different intervals over different spans.

Thus, we can switch the graphical roles of the two discrete time variables. We can use fiscal-year months for the horizontal scale of each panel and time of day to organize the sequence of panels.





AFTER WE DISCUSS THESE DATA, write your thoughts in response to these prompts:

- What observations can you make?
- Both of the new charts (panels ordered by month and panels ordered by hour) are certainly more compact than the 12 original charts in the report appendix. Why do you think the authors presented the charts they did?

§ Advice from experts

Match the expert to the advice.

FILL IN THE BLANKS with letters A–D.

Expert	Letter	Emphasizes the importance of
A. Alberto Cairo	_____	message
B. Jean-luc Doumont	_____	variables
C. Stephanie Evergreen	_____	revealing the complex
D. Edward Tufte	_____	knowing your main point
	_____	not lying to yourself

Ideas to consider

- Characterize the data structure and content

- Explore a story's context, causality, and complexity

- Align visual and verbal logic by revising iteratively

- Edit to suit the rhetorical goals for each audience

- Control every pixel—avoid thoughtless conformity

- Question are you seeing only what you want to believe?

References

- Cairo, Alberto. 2019. *How Charts Lie*. New York: W.W. Norton.
- Clarke, Steven, Michael Anderson, Daniela Aramayo, Dominic Molinari, Arthur Tseng, Zoe Warp, and John Ko. 2021. “University of San Diego Energy Master Plan.” Anaheim, CA: Willdan Energy Solutions.
- Doumont, Jean-luc. 2009. *Trees, Maps, and Theorems*. Belgium: Principia.
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- Robbins, Naomi. 2013. *Creating More Effective Graphs*. Wayne, NJ: Chart House.
- Tufte, Edward. 1983. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press.
- World Bank. 2022-01. “Population total for United States.” Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/POPTOTUSA647NWDB>.