

Creating more effective charts

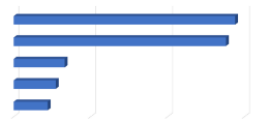
Richard Layton

2024-02-13

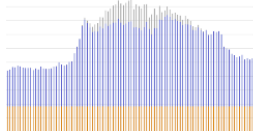
Perception, reasoning, and credibility



Effective alternatives to pie charts



Effective alternatives to bar charts



Aligning the design to the story



Advice from experts

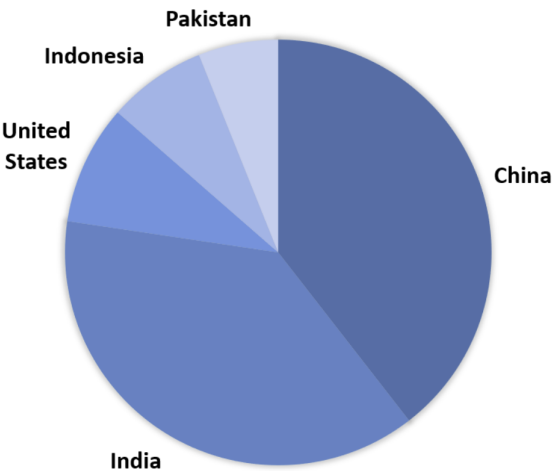
Richard Layton resides online at

- <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



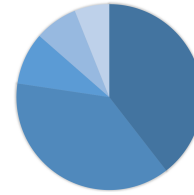
- Visually estimate each country's percentage
- Fill-in the blanks in the table
- Total should be 100%

| Country       | Percentage |
|---------------|------------|
| China         |            |
| India         |            |
| United States |            |
| Indonesia     |            |
| Pakistan      |            |

Data source: World Bank (2022)

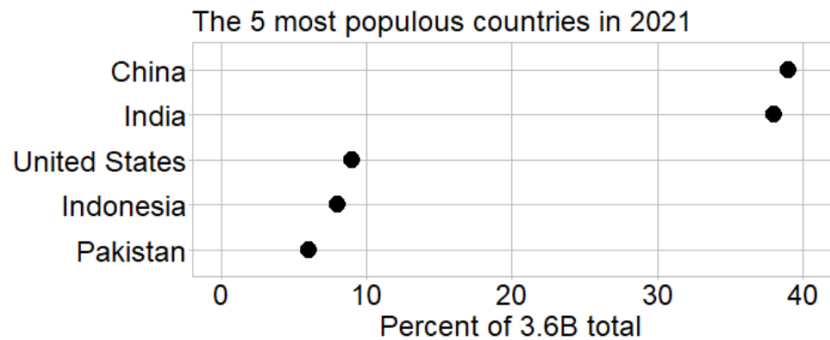
*Judging values along a common axis is a high-accuracy task*

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

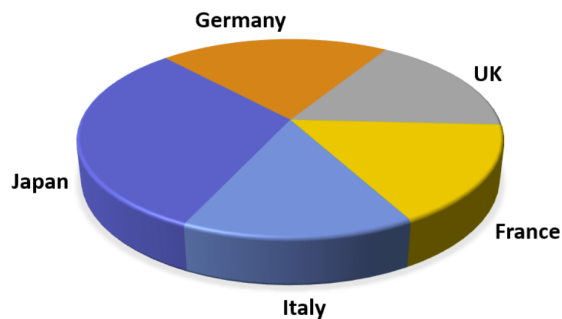


The data from the pie chart is shown below as dots along a common scale.

| Country       | Percentage |
|---------------|------------|
| China         |            |
| India         |            |
| United States |            |
| Indonesia     |            |
| Pakistan      |            |



*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)

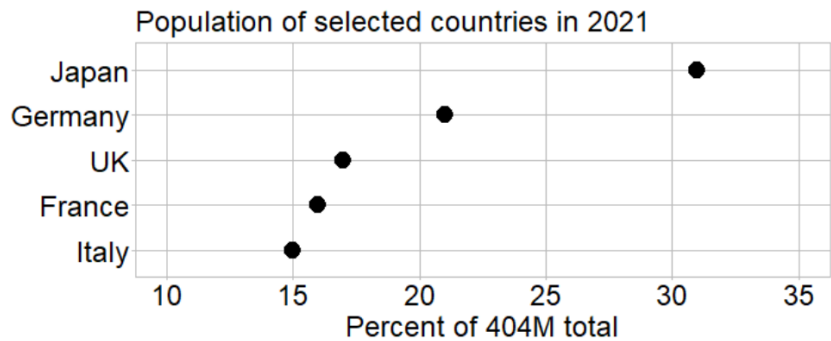
*Again, a common scale improves our visual judgments*

- 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   |            |

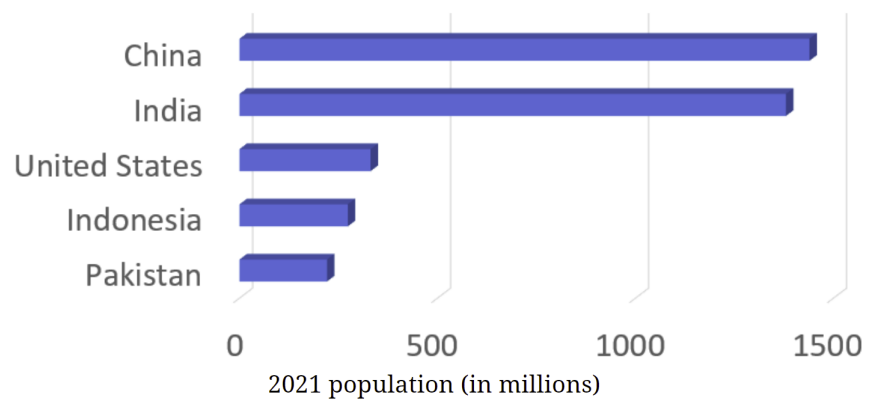


*§ Effective alternatives to bar charts*

*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      |          |

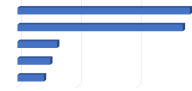


Data source: World Bank (2022)

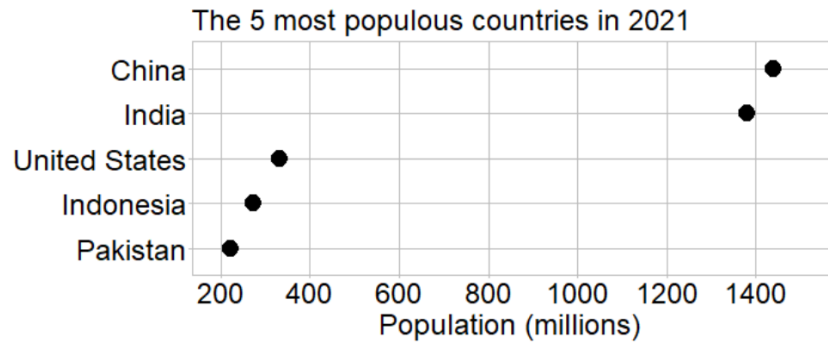
Same data—without 3D effects—along a common scale

- 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      |          |



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



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

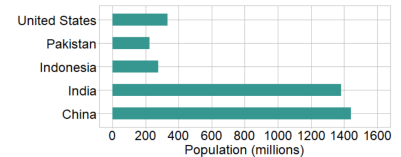
- Zero baseline avoids deception
- Ordered by data values
- Only the endpoint encodes information

Consider dot charts for

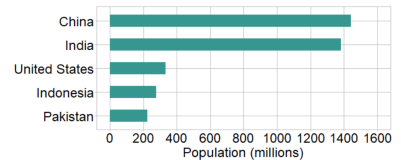
- Visually comparing quantities
- Replacing most pie and bar charts

Notes

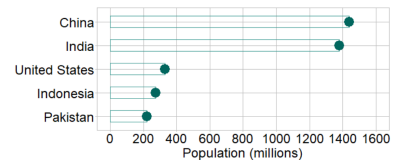
Default bar chart:



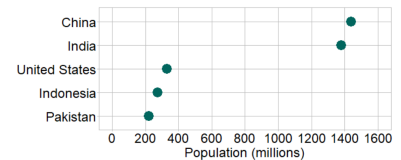
Ordered by magnitude:



Omitting the fill color:



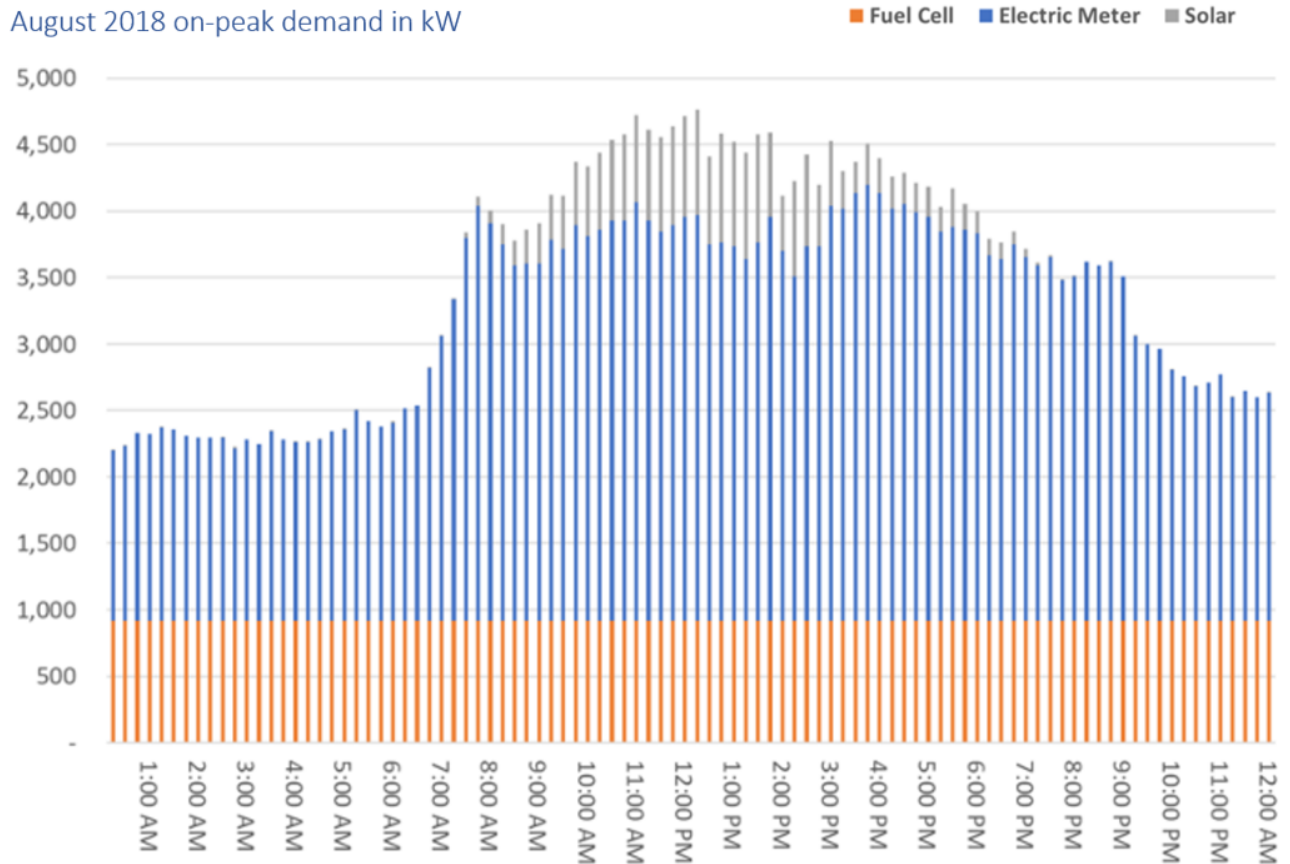
Produces a dot chart:



### § *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.

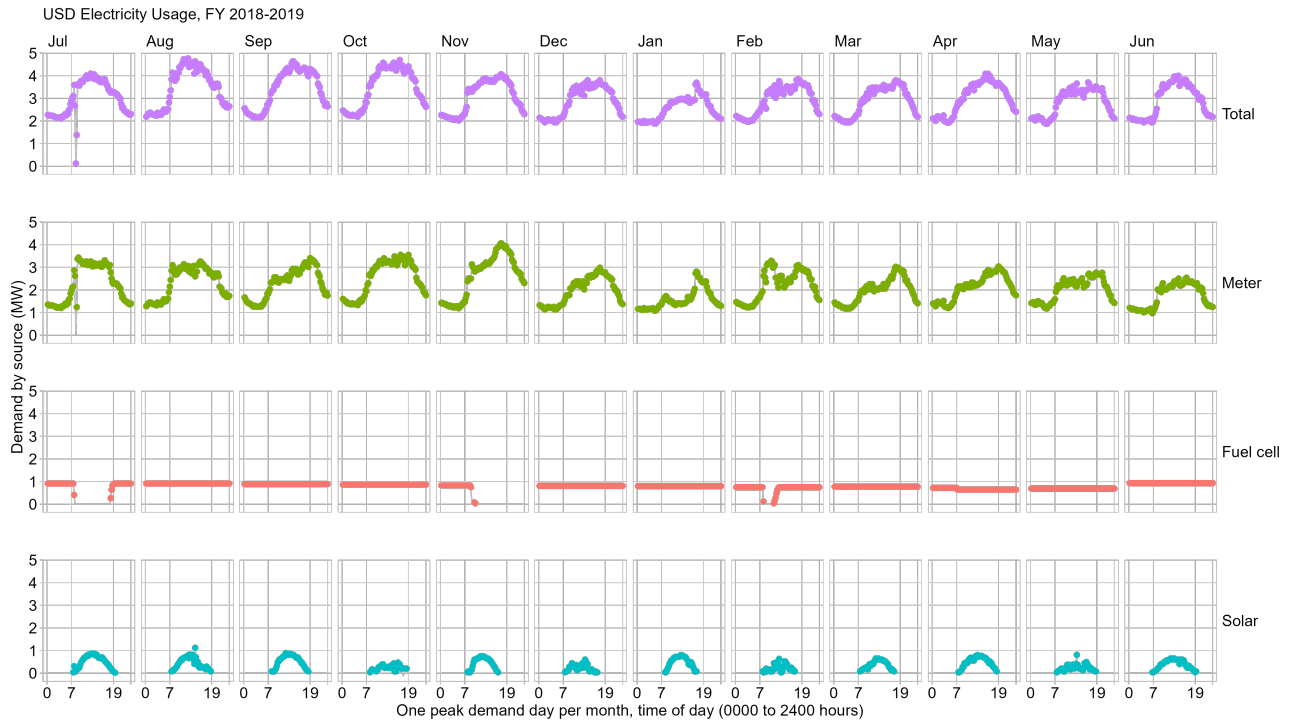


AFTER WE DISCUSS THESE DATA, write your thoughts in response to these prompts:

- 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?

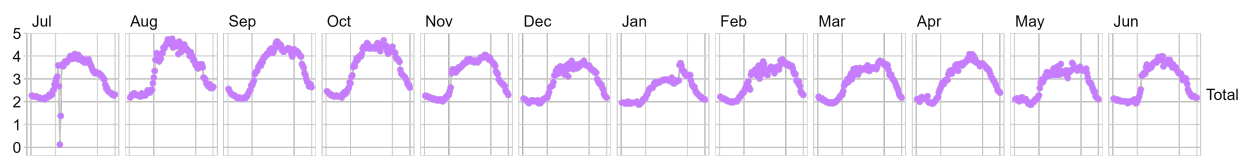
### *A second redesign*

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

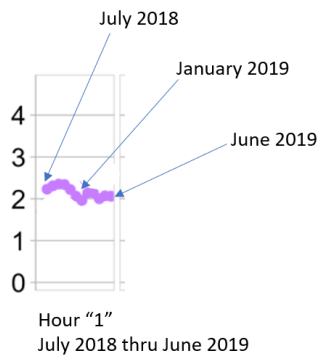
*time of day* in 15-minute discrete intervals from 12:15 am to the following midnight (or, using a 24 hour clock, from 0015 hours to 2400 hours).

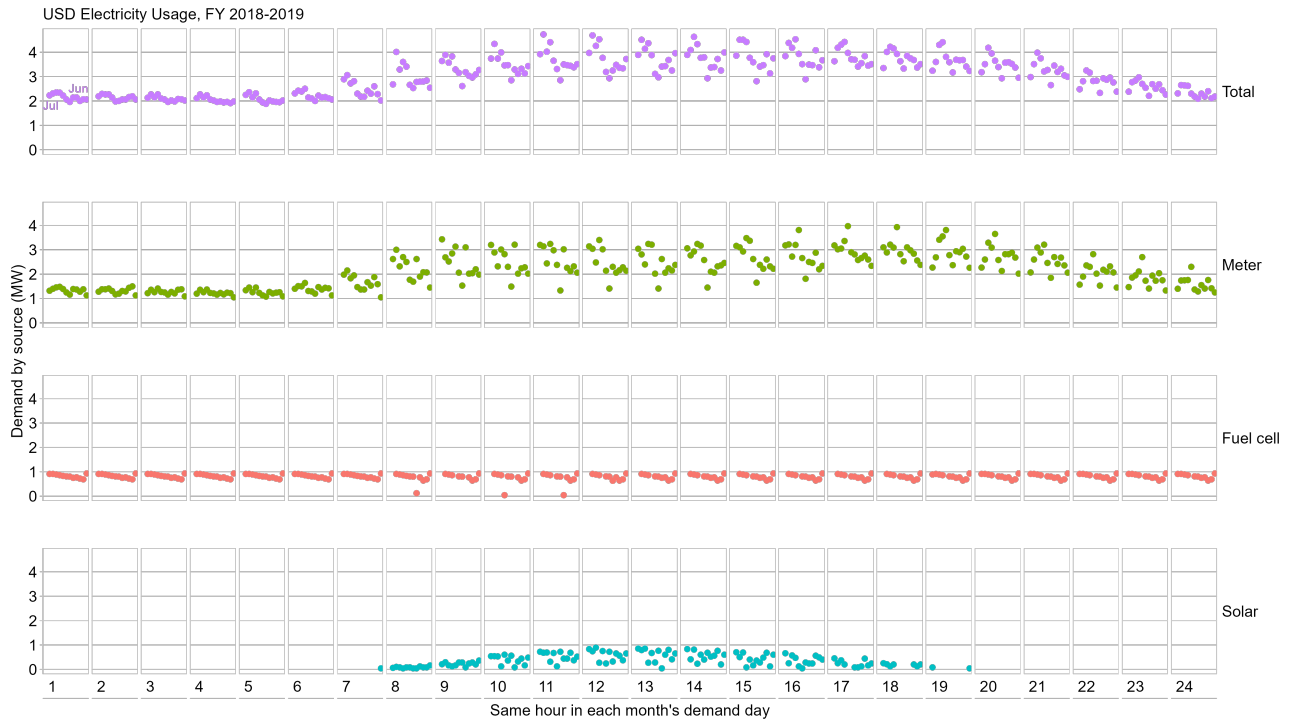
In the previous design, we used time of day for the horizontal scale of each panel and month to organize the sequence of panels.



Conceptually, a discrete sequence of 15-minute intervals over a day and a discrete sequence of months over a year a 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.
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- 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>.