

Visual insights from IPCC

Hands-on session PRISMA summer school

Kaj-Ivar van der Wijst

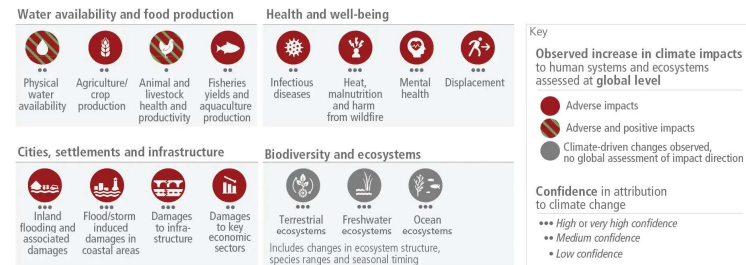
July 2025

Part 1

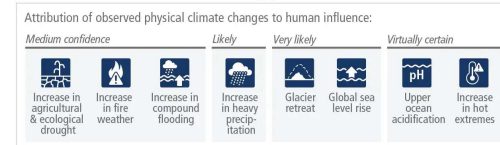
Visualization in IPCC

Adverse impacts from human-caused climate change will continue to intensify

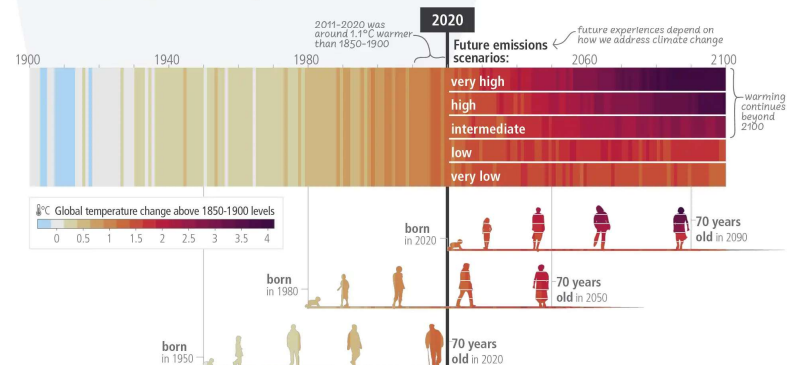
a) Observed widespread and substantial impacts and related losses and damages attributed to climate change



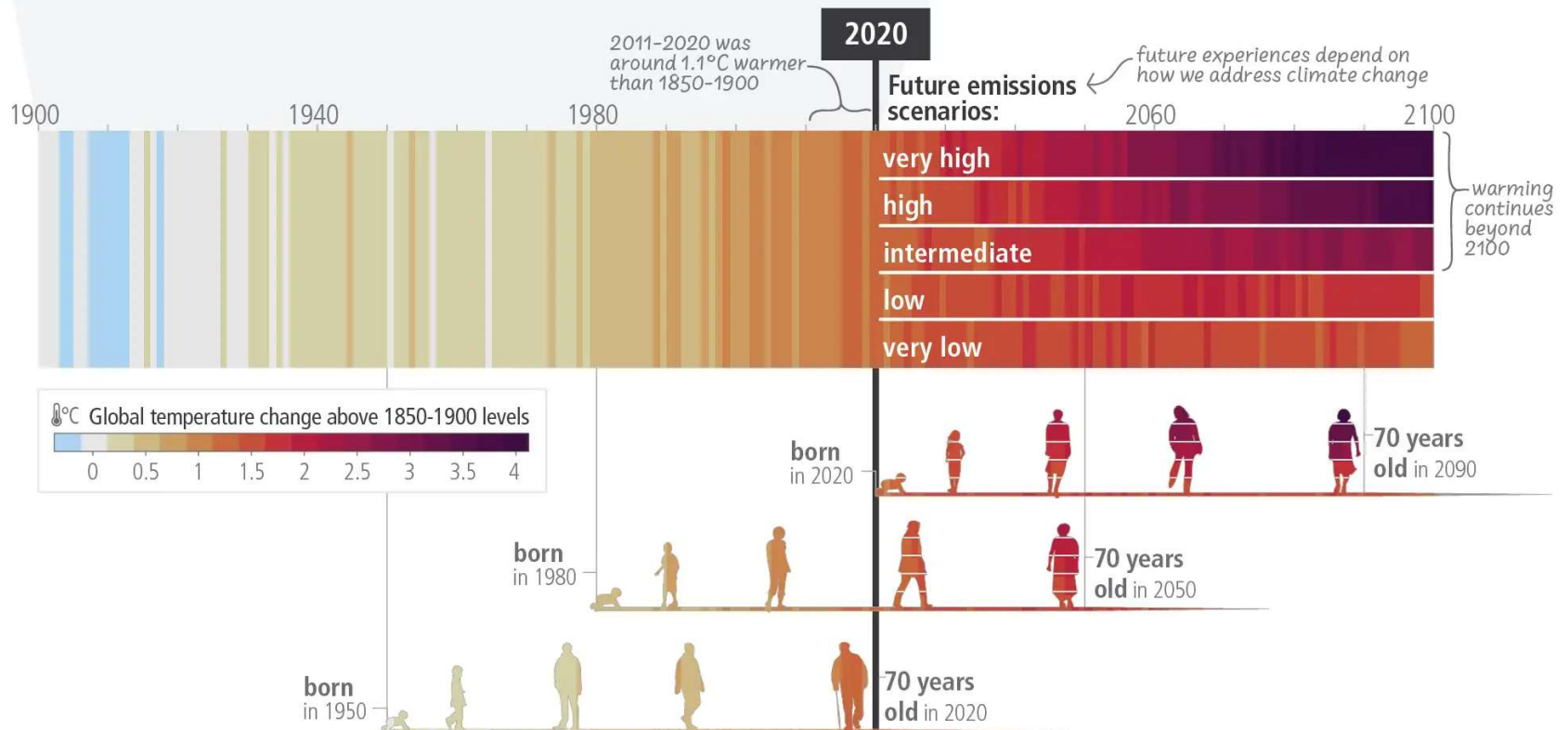
b) Impacts are driven by changes in multiple physical climate conditions, which are increasingly attributed to human influence



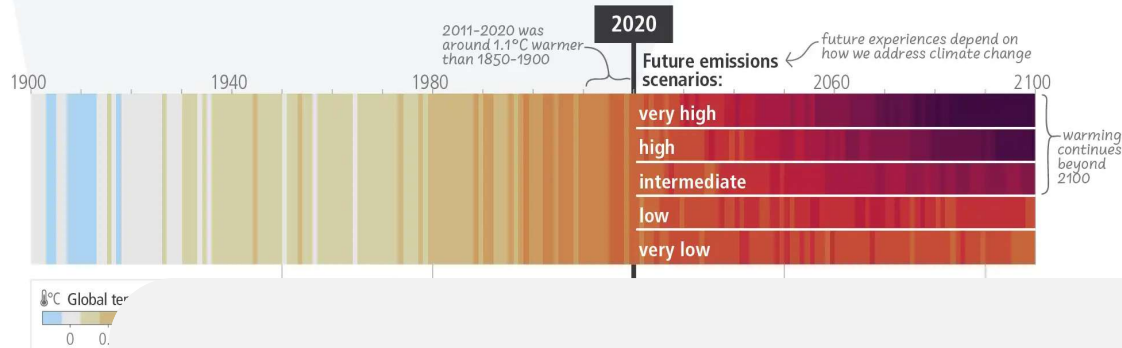
c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term



c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term



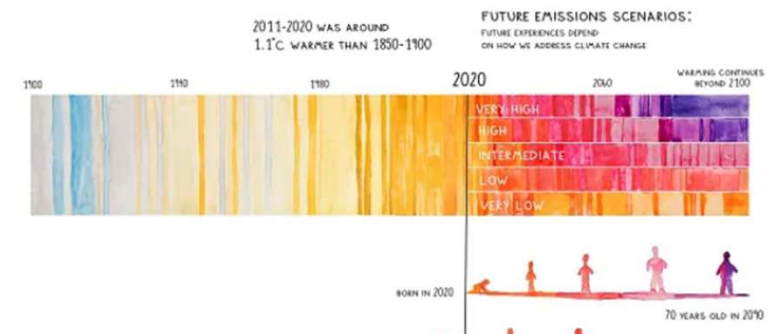
c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term



Nicole Kelner
@NicoleKelner

How current and future generations could have different experiences with climate change

THE EXTENT TO WHICH CURRENT AND FUTURE GENERATIONS WILL EXPERIENCE A HOTTER AND DIFFERENT WORLD DEPENDS ON CHOICES NOW AND IN THE NEAR-TERM



REPORT
E. KELNER

“...Then there was an emotional challenge. With the hundreds of tiny brush strokes, it created a uniquely tactile experience of feeling each of the warming scenarios (...)”

1,317 Likes 447 Retweets

Figure SPM.1

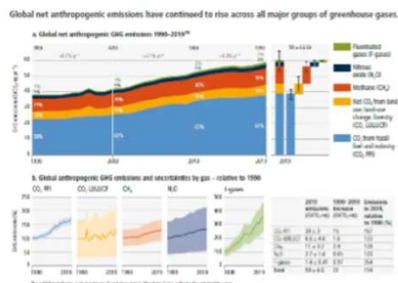


Figure SPM.2

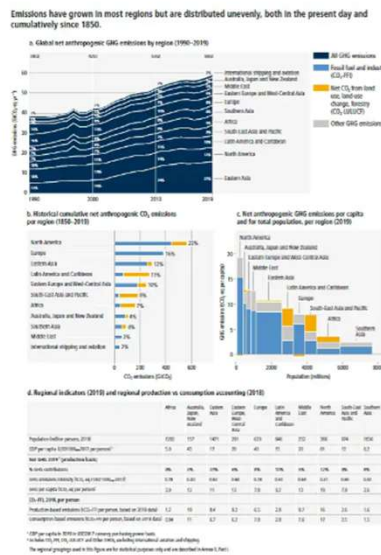


Figure SPM.3

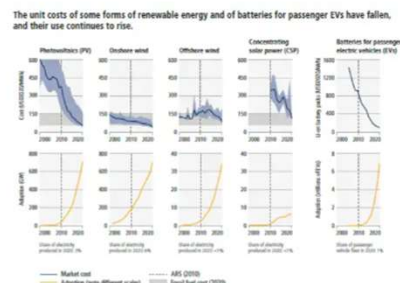
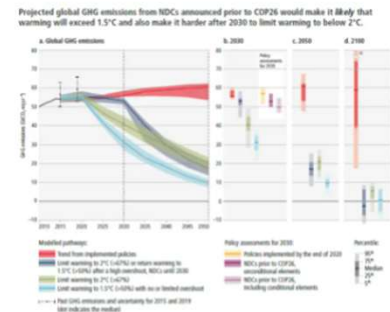


Figure SPM.4



125

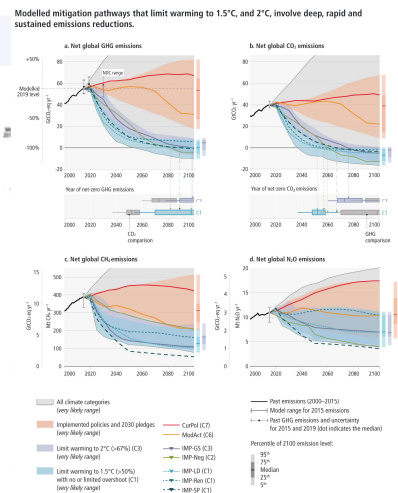


Figure SPM.6



Figure SPM.7

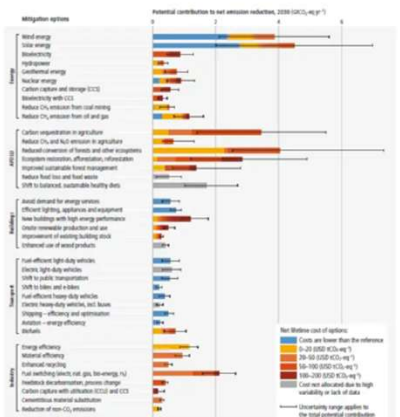
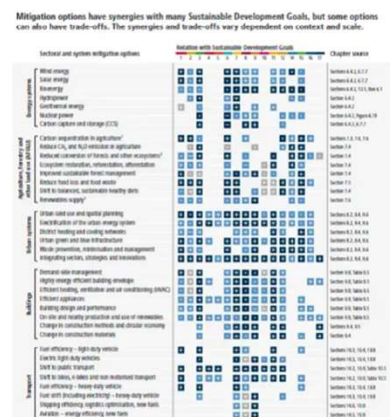


Figure SPM.8



Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.

Net zero CO₂ and net zero GHG emissions are possible through different modelled mitigation pathways.

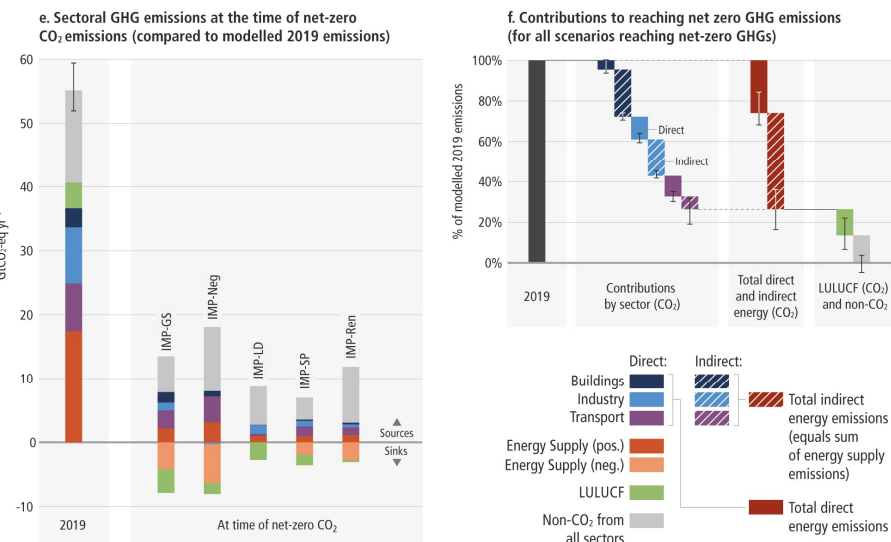
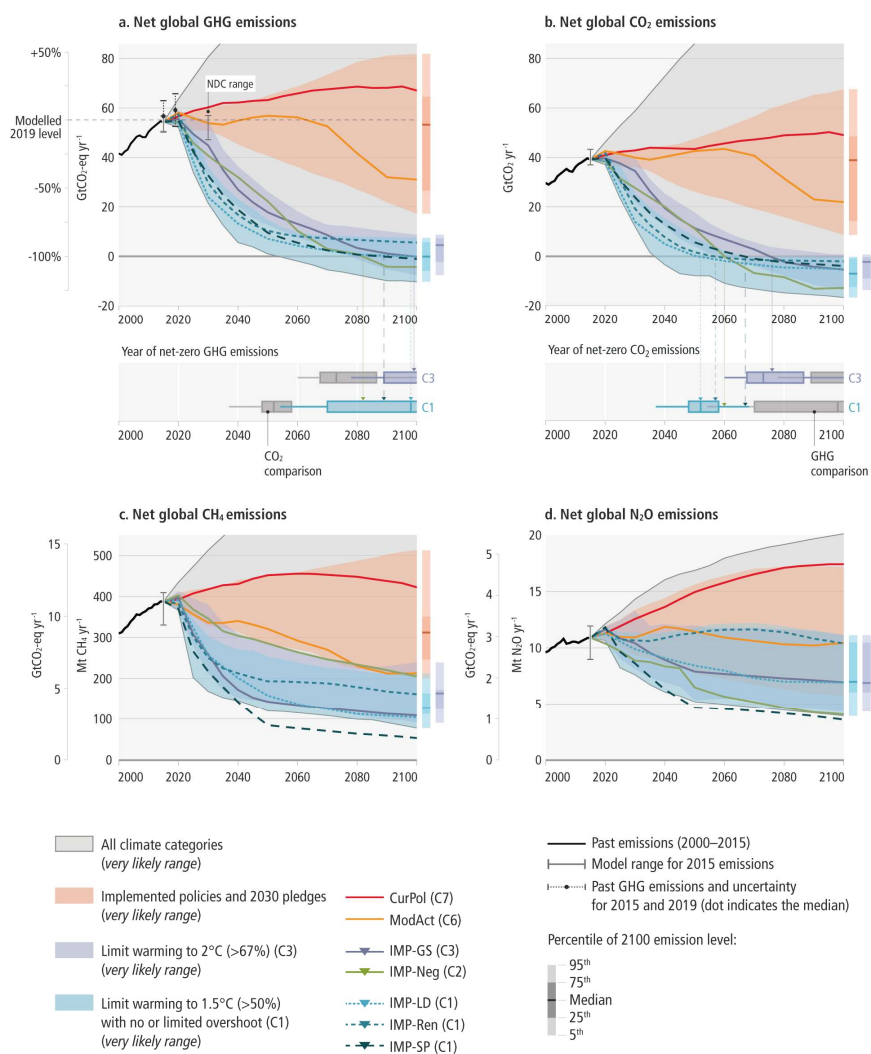
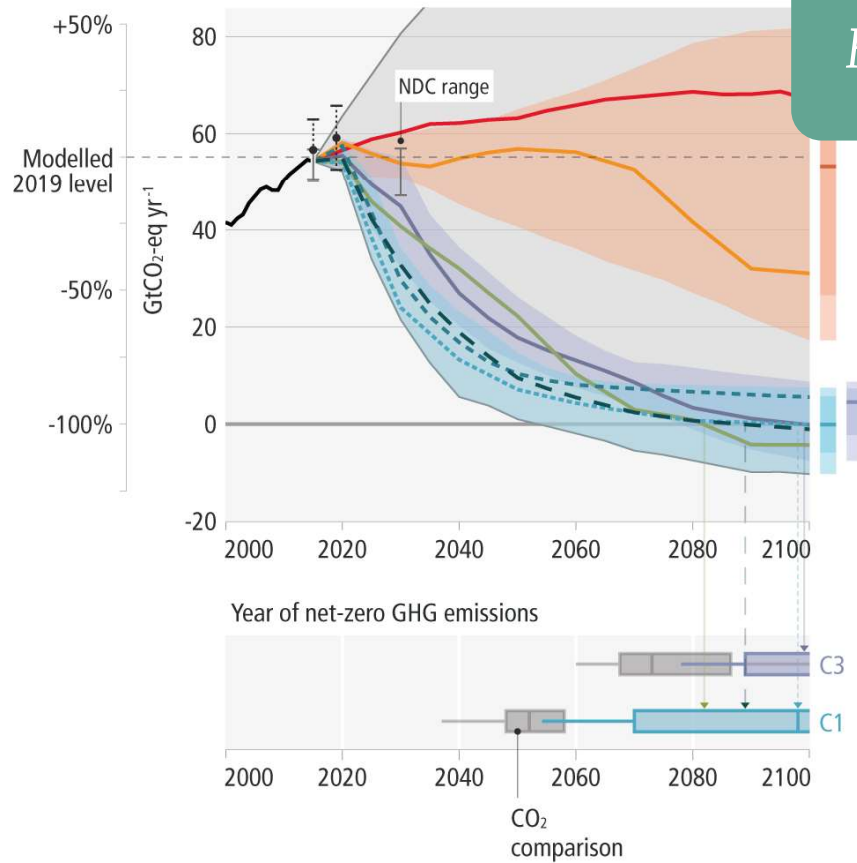


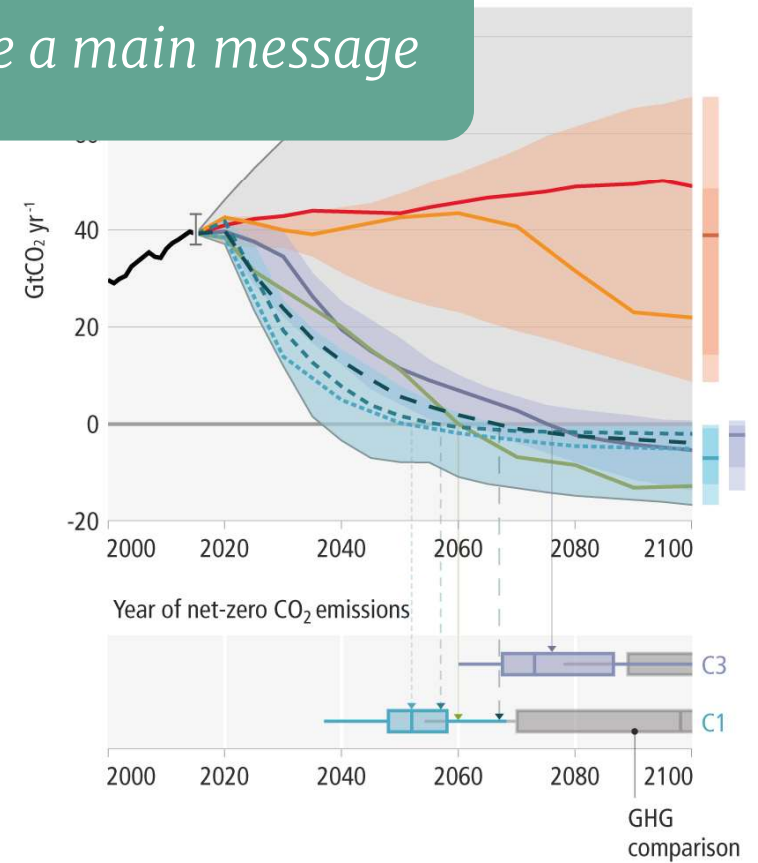
Figure SPM.5 (continued): Illustrative Mitigation Pathways (IMPs) and net zero CO₂ and GHG emissions strategies. Panels a and b show the development of global GHG and CO₂ emissions in modelled global pathways (upper sub-panels) and the associated timing of when GHG and CO₂ emissions reach net zero (lower sub-panels). Panels c and d show the development of global CH₄ and N₂O emissions, respectively. Coloured ranges denote the 5th to 95th percentile across pathways. The red ranges depict emissions pathways assuming policies that were implemented by the end of 2020 and pathways assuming implementation of NDCs (announced prior to COP26). Ranges of modelled pathways that limit warming to 1.5°C (>50%) with no or limited overshoot are shown in light blue (category C1) and pathways that limit warming to 2°C (>67%) are shown in light purple (category C3). The grey range comprises all assessed pathways (C1–C8) from the 5th percentile of the lowest warming category (C1) to the 95th percentile of the highest warming category (C8). The modelled pathway ranges are compared to the emissions from two pathways illustrative of high emissions (CurPol and ModAct) and five IMPs: IMP-LD, IMP-Ren, IMP-SP, IMP-Neg and IMP-GS. Emissions are harmonised to the same 2015 base year. The vertical error bars in 2015 show the 5–95th percentile uncertainty range of the non-harmonised emissions across the pathways, and the uncertainty range, and median value, in emission estimates for 2015 and 2019. The vertical error bars in 2030 (panel a) depict the assessed range of the NDCs, as announced prior to COP26 (Figure SPM.4).²³ Panel e shows the sectoral contributions of CO₂ and non-CO₂ emissions sources and sinks at the time when net zero CO₂ emissions are reached in the IMPs. Positive and negative emissions for different IMPs are compared to the GHG emissions from the year 2019. Energy supply (neg.) includes BECCS and DACCS. DACCS features in only two of the five IMPs (IMP-Ren and IMP-GS) and contributes <1% and 64%, respectively, to the net negative emissions in Energy Supply (neg.). Panel f shows the contribution of different sectors and sources to the emissions reductions from a 2019 baseline for reaching net zero GHG emissions. Bars denote the median emissions reductions for all pathways that reach net zero GHG emissions. The whiskers indicate the p5–p95 range. The contributions of the service sectors (transport, buildings, industry) are split into direct (demand-side) as well as indirect (supply-side) CO₂ emissions reductions. Direct emissions represent demand-side emissions due to the fuel use in the respective demand sector. Indirect emissions represent upstream emissions due to industrial processes and energy conversion, transmission and distribution. In addition, the contributions from the LULUCF sector and reductions from non-CO₂ emissions sources (green and grey bars) are displayed. [3.3, 3.4]

Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.

a. Net global GHG emissions



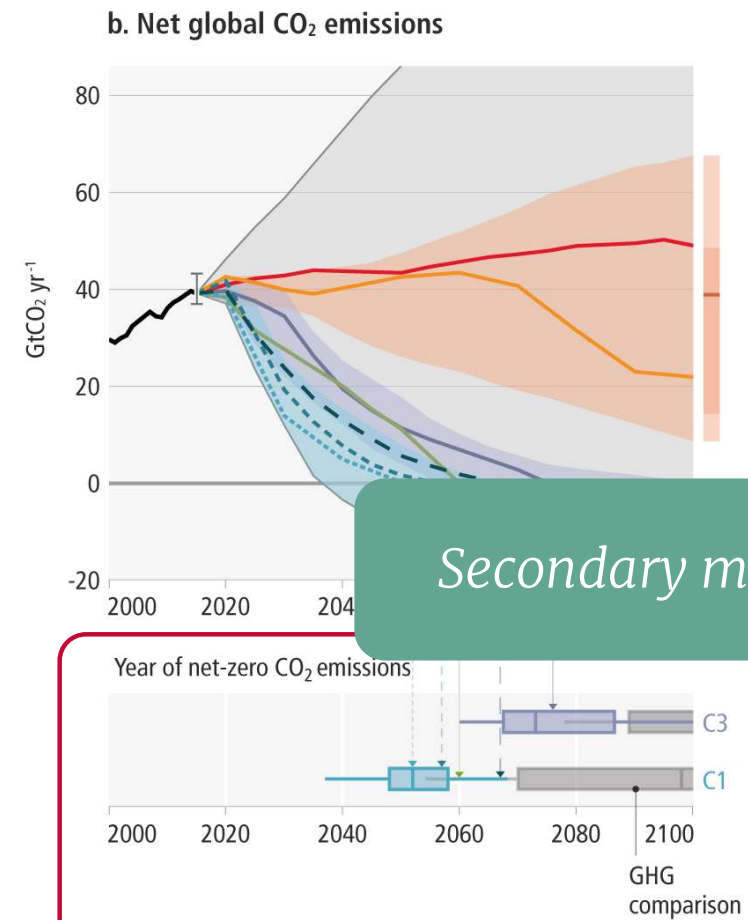
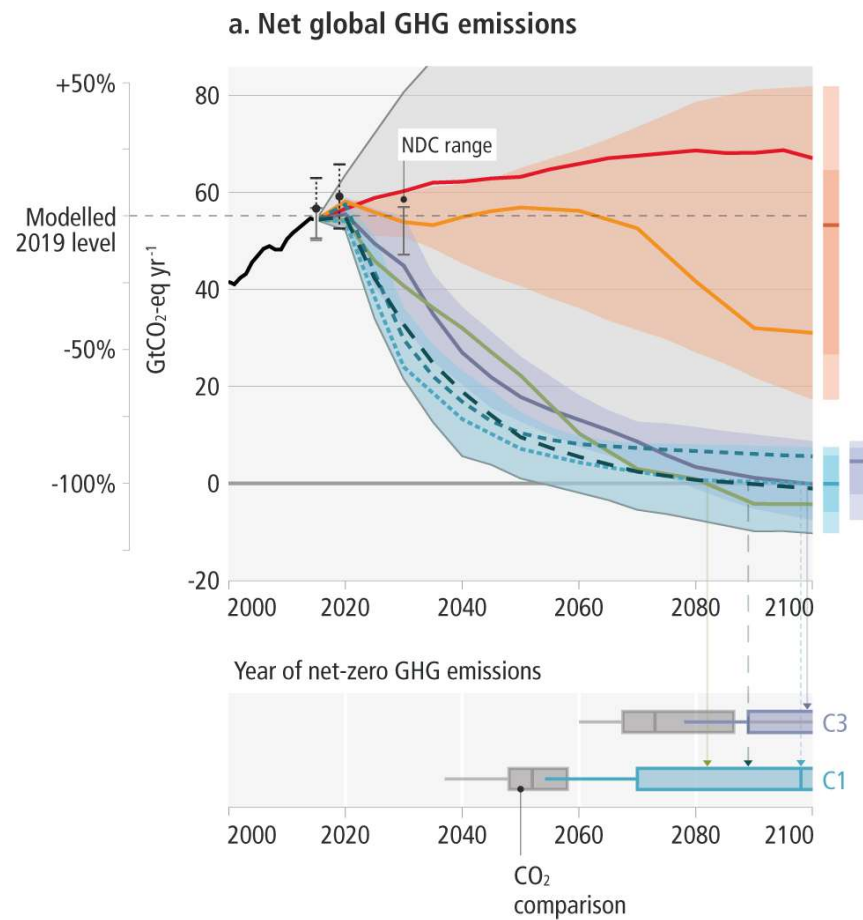
Have a main message
























c. Net global CH₄ emissions

d. Net global N₂O emissions

Modelled mitigation pathways that limit warming to 1.5°C, and 2°C, involve deep, rapid and sustained emissions reductions.

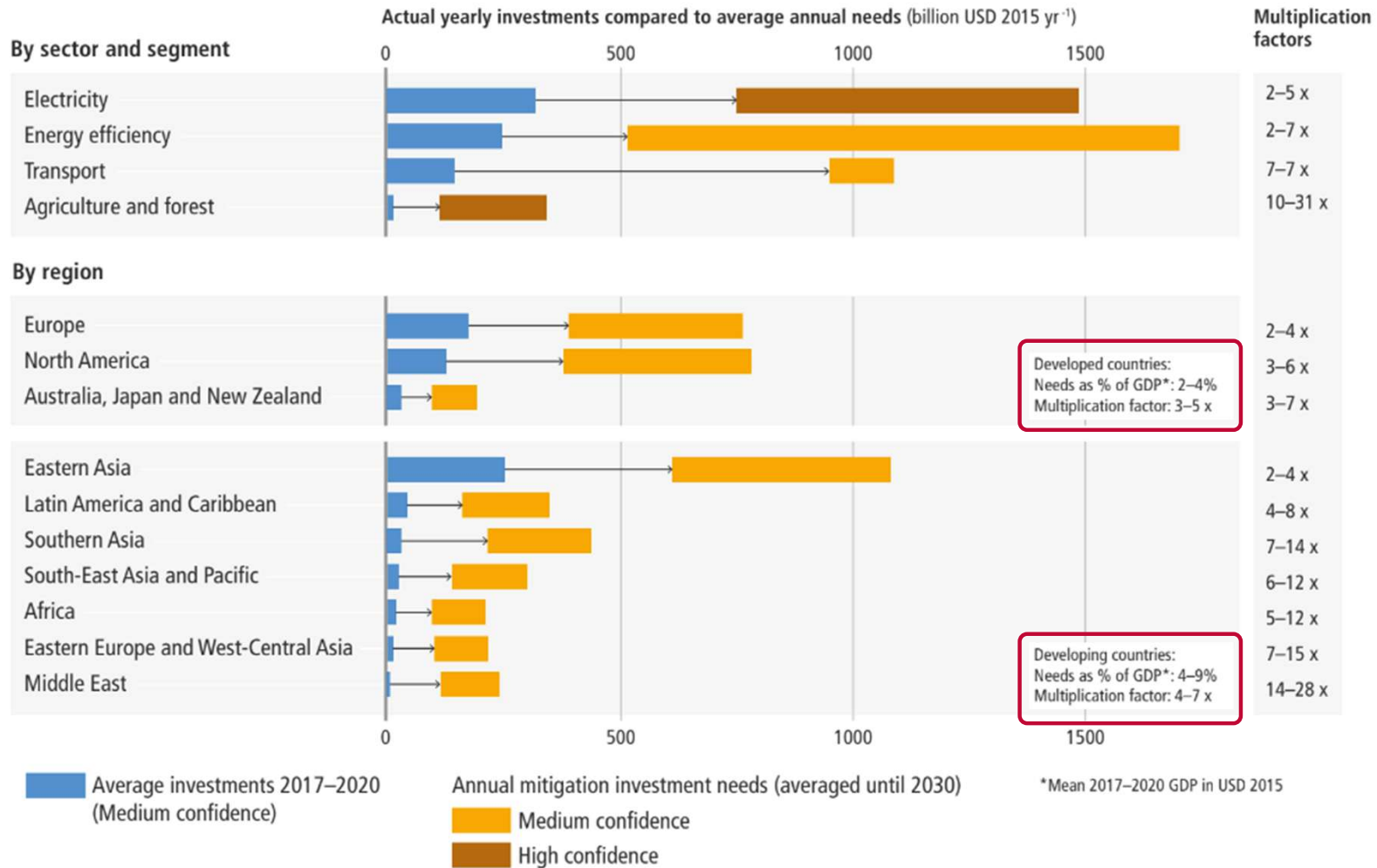


Secondary message

Figure SPM 1	Figure SPM 2	Figure SPM 3	Figure SPM 4
Name ↑	Owner		Last modified ▼
 Figure SPM.1	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.2	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.3	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.4	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.5	 Renee van Diemen	Mar 18, 2022 Renee	
 Figure SPM.6	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.7	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.8	 Renee van Diemen	Mar 16, 2022 Renee	
 Figure SPM.9	 Renee van Diemen	Mar 16, 2022 Renee	
 TSUGuidance_FiguresProcess.docx 	 Renee van Diemen	Mar 17, 2022 Renee	

Mitigation investments fall short of investment needs across all sectors and segments, particularly in developing countries.

29-8-2025





Role of data visualisation: two steps

Step 1:

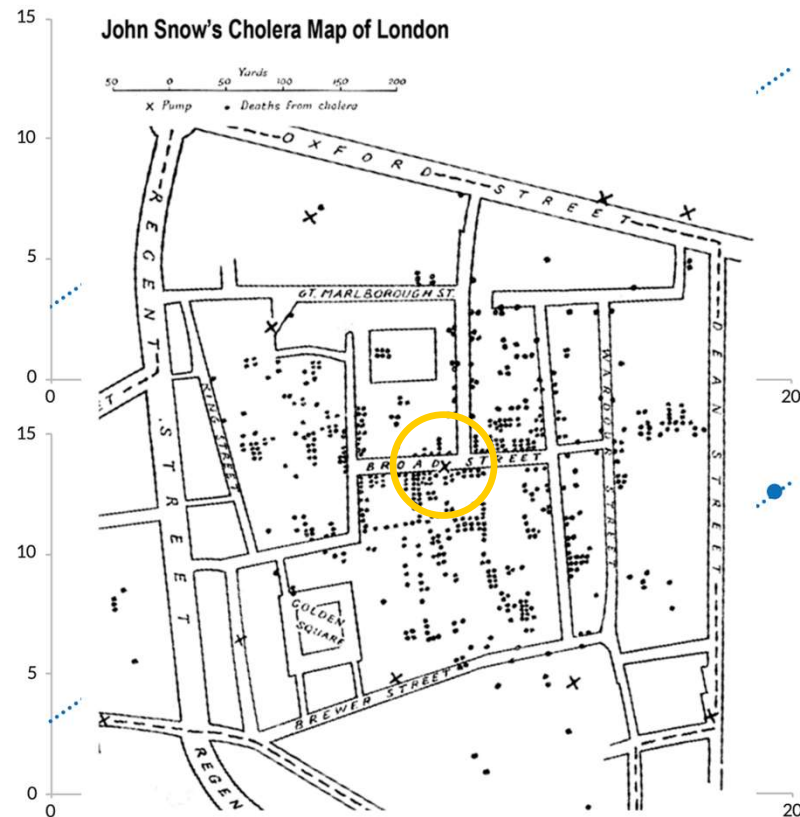
Show the data

Step 2:

Tell a message

Data set
Variable
Obs. No.

Mean
Variance
Correlation
Regression



	4
	y
8	6.6
8	5.8
8	7.7
8	8.8
8	8.5
8	7.0
8	5.3
9	12.5
8	5.6
8	7.9
8	6.9
0	7.5
0	4.1
.817	
3 + 0.5x	

Role of data visu

2024 was the hottest year on record and the first to breach 1.5C

Distribution of average daily surface air temperatures compared with pre-industrial average, by year, degrees Celsius



Latin American birth rates are falling fast, in some cases running below the UN's low-fertility scenario

Total fertility rate*, projections vs actual data



*Average number of births per woman. See full definition at foot of article

Sources: UN World Population Prospects; Institute for Health Metrics and Evaluation; International Institute for Applied Systems Analysis; FT analysis of national statistics agencies

FT graphic: John Burn-Murdoch / @burnmurdoch

© FT

Source: ERA5, Copernicus • Pre-industrial period is 1850-1900 • Blocks show the interquartile range (IQR), whiskers represent the daily temperature anomalies within 1.5xIQR from the first or third quartile. Values outside of this are shown as circles.

Step 1:

Show the data

Types of graphs



Which types of graphs can you think of?



Line



Bar



Scatter



Area



Pie



Map

(Choropleth,
Location,
Bubble...)



Table



Other

Principles of visual design

Step 1:

Show the data

How do viewers perceive
the data?

Perceptual Ranking Diagram

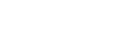
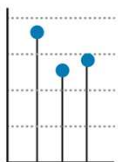
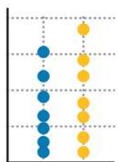
Step 2:

Tell a message

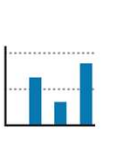
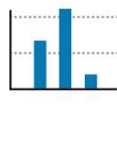
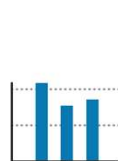
How can you guide the viewer
towards your message?

**Gestalt Principles of Visual
Perception**

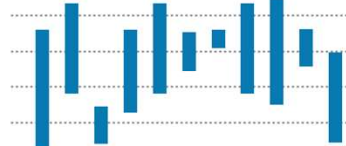
Position along common scales



Position along identical



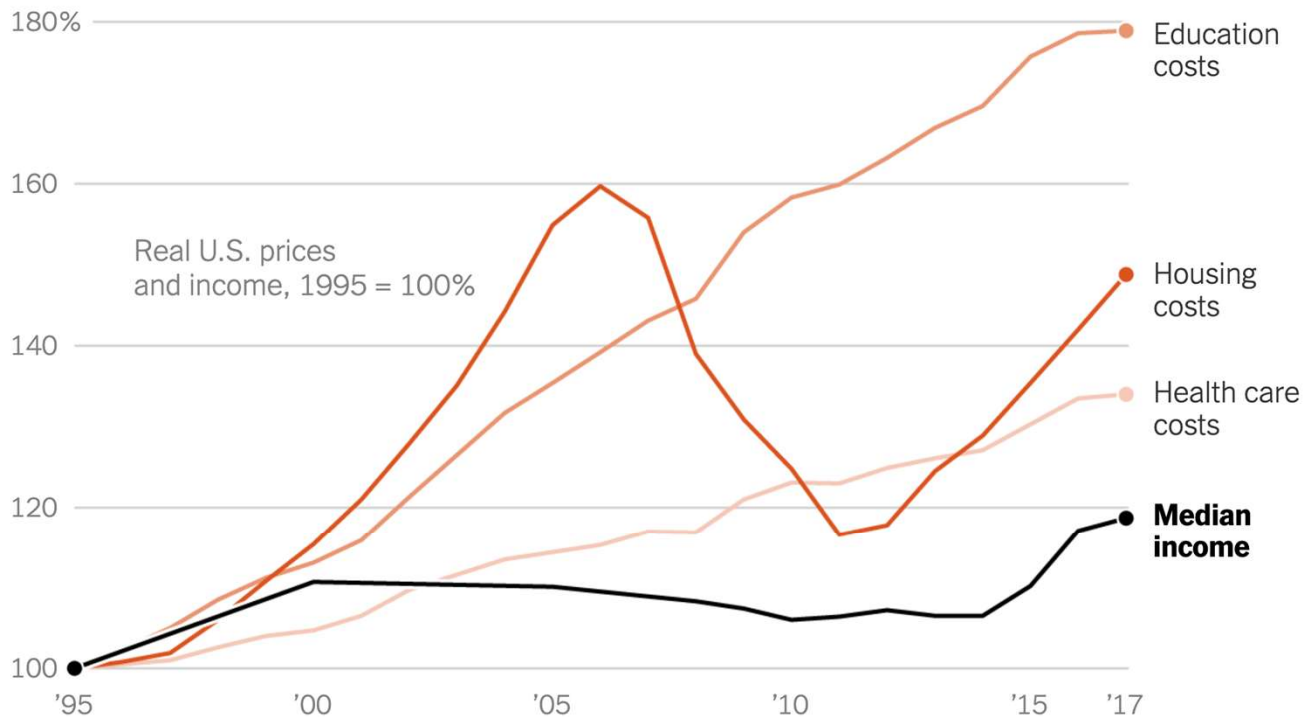
Length



Direction/slope



Rising Costs Outpace Income Growth



Enable accurate estimates

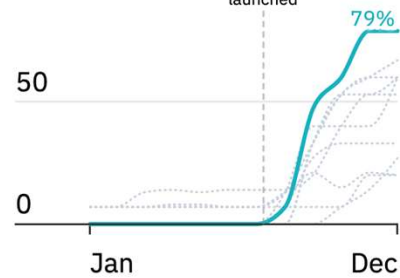
May enable general estimates

Position along common scales

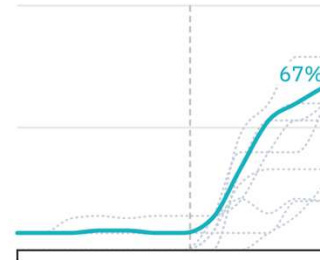
Proportion of top news websites blocking OpenAI's crawlers during 2023

USA

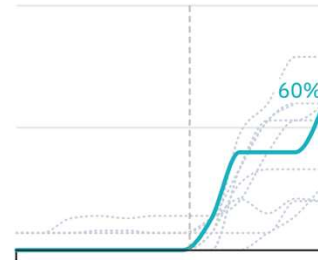
100%



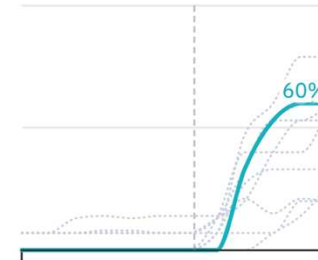
Denmark



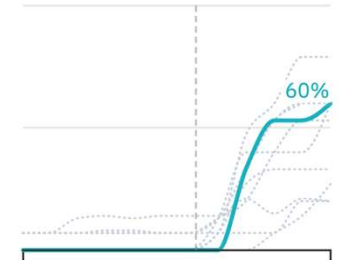
Germany



India

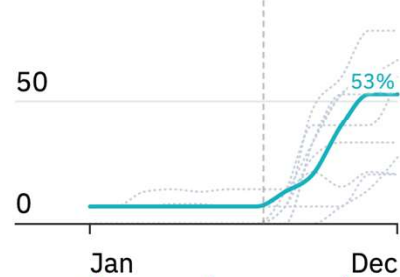


Norway

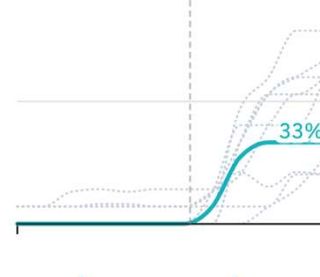


UK

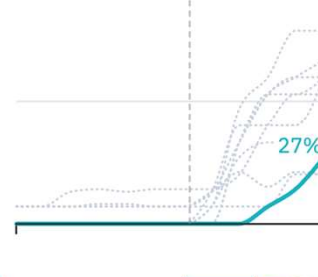
100%



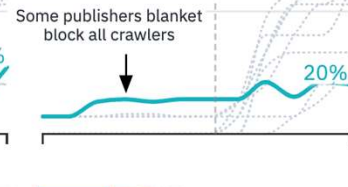
Brazil



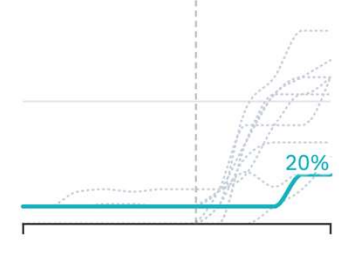
Spain



Mexico



Poland



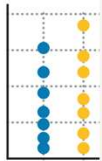
Enable accurate estimates



May enable general estimates

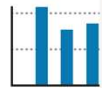


Position

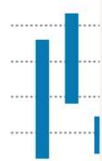


7 hours

Position



Length



Direction

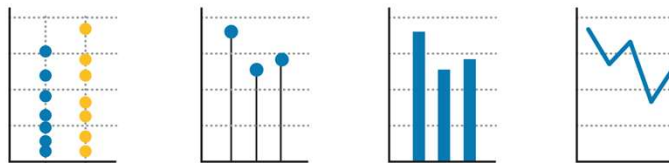


In all countries, men spend less time engaged in unpaid and domestic work compared to women

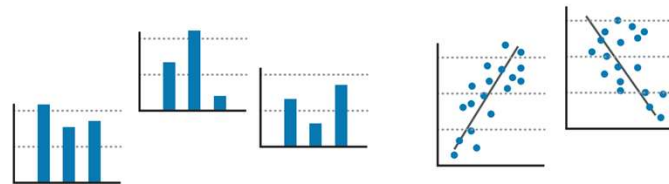
Proportion of time spent on unpaid care and domestic work, most recent value (2001-2020)

Women Men

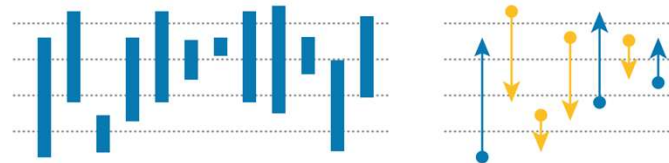
Position along common scales



Position along identical, nonaligned scales



Length



Direction/slope

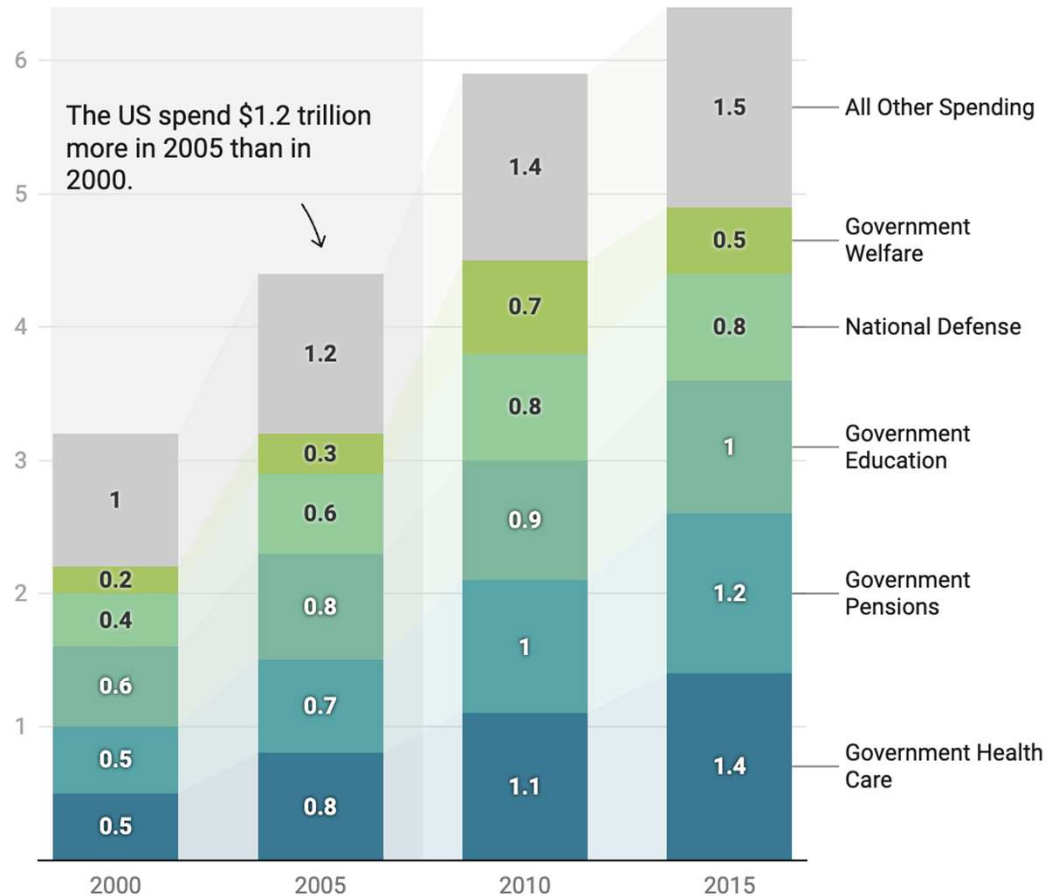


Angle



15 years of US government spending

In trillion US-Dollars, from 2000 to 2015.



Enable accurate estimates



May enable general estimates

Area

Enable accurate estimates

Volum

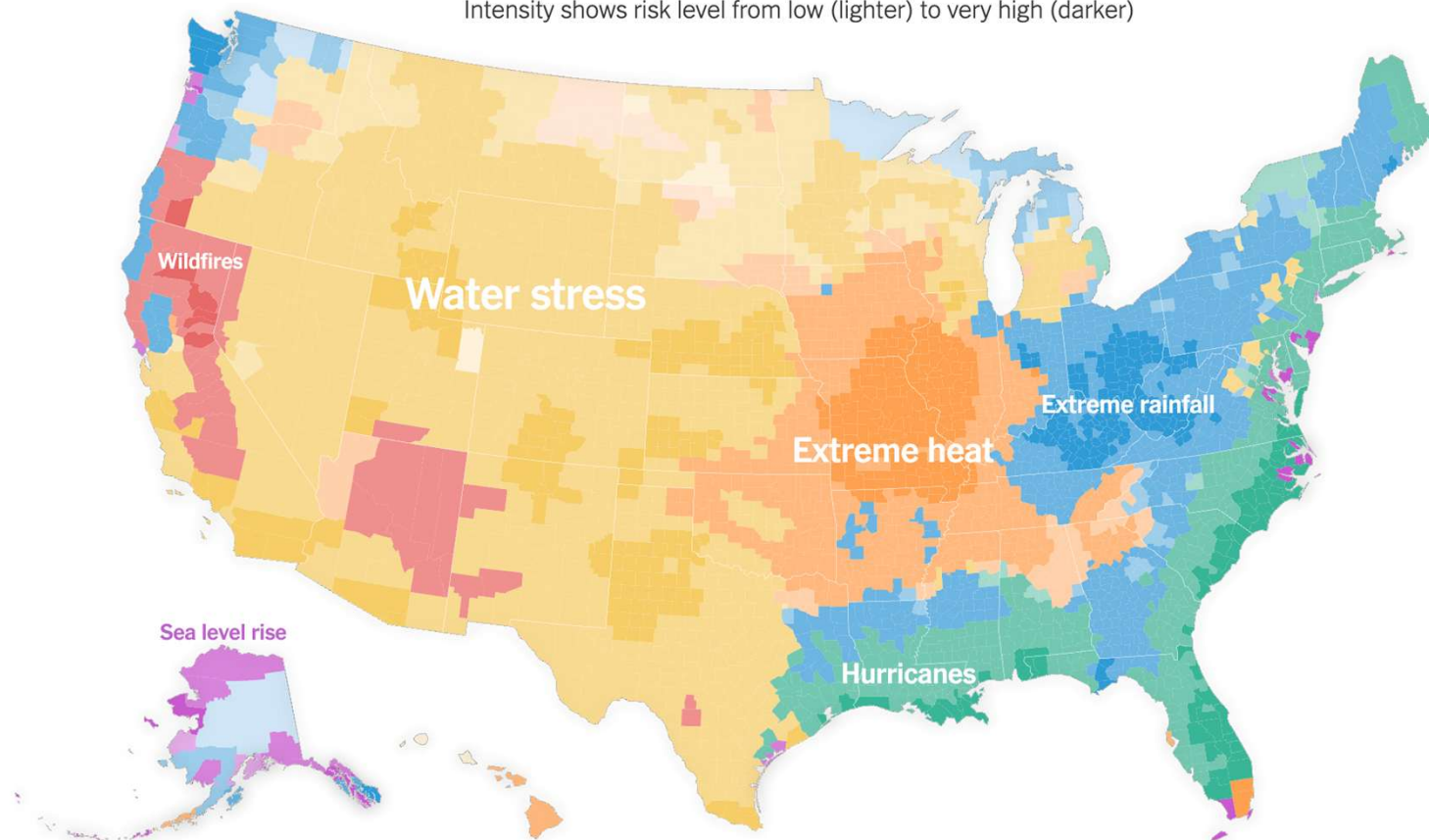
Shadir

Color I

May enable general estimates

What to call climate change where you live

Intensity shows risk level from low (lighter) to very high (darker)



ersity
ioenix

Private

Principles of visual design

Step 1:

Show the data

How do viewers perceive
the data?

Perceptual Ranking Diagram

Step 2:

Tell a message

How can you guide the viewer
towards your message?

**Gestalt Principles
of Visual Perception**

Step 2:

Tell a message

Gestalt Principles

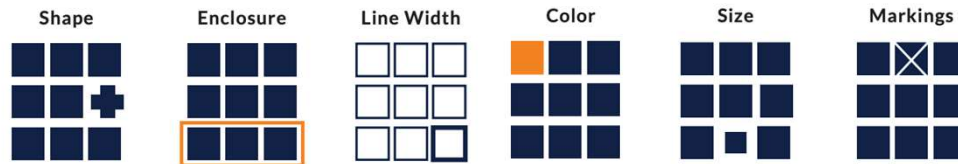
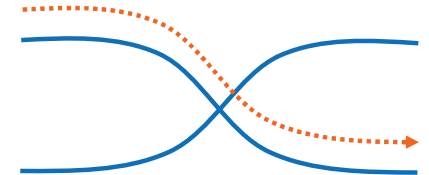
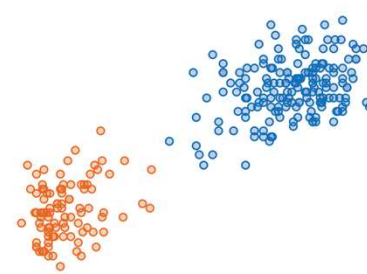
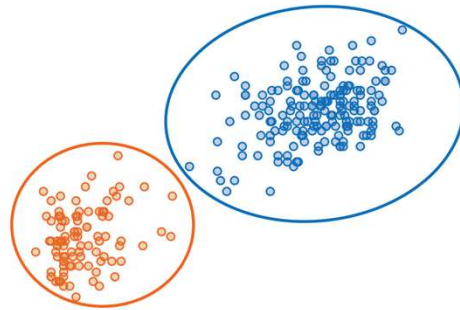
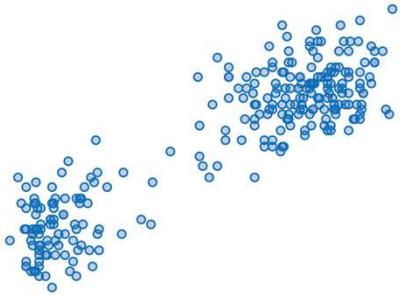
Enclosure

Similarity

Continuity

Preattentive processing

Proximity

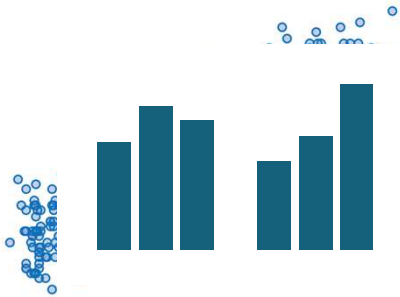


Step 2:

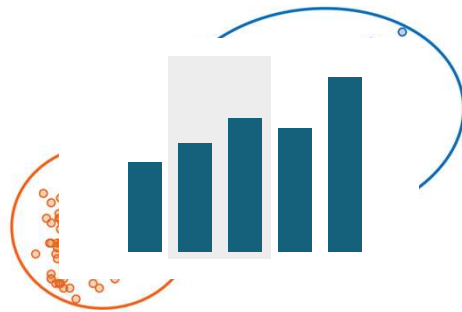
Tell a message

Gestalt Principles

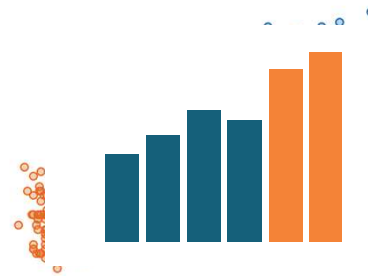
Proximity



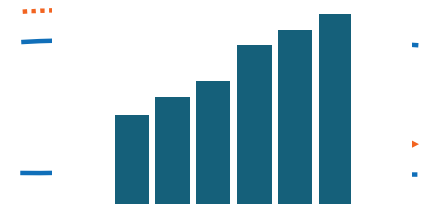
Enclosure



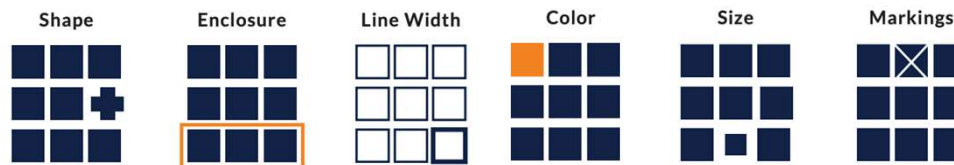
Similarity



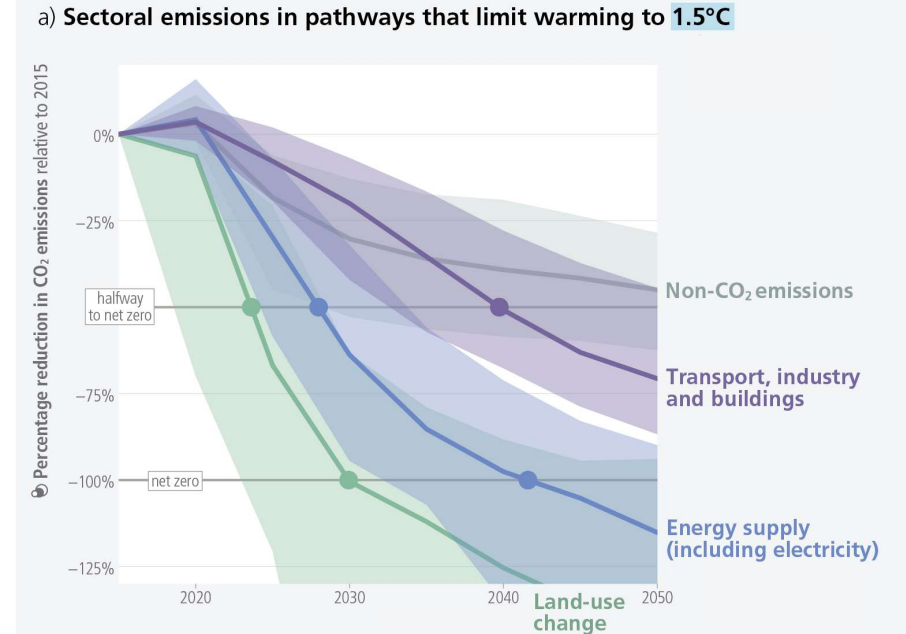
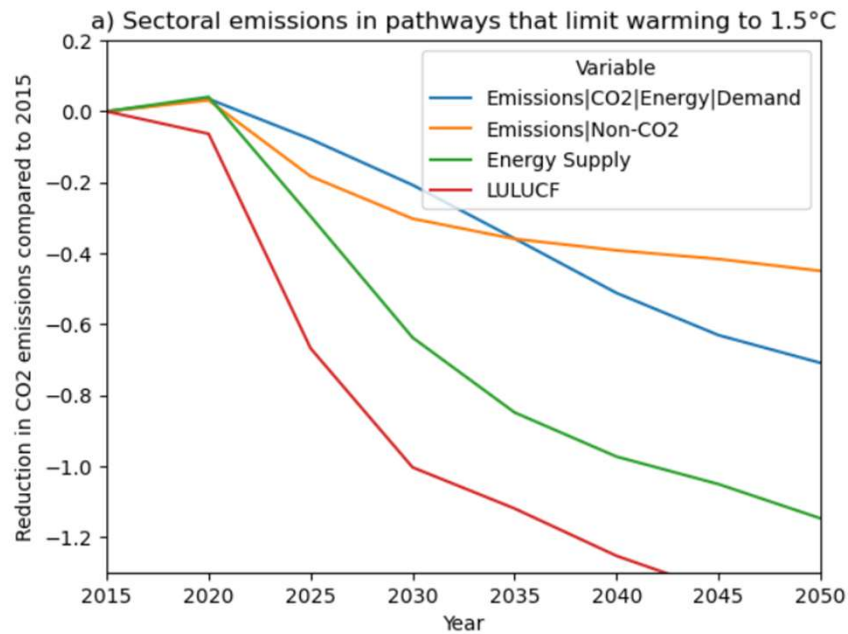
Continuity



Preattentive processing



A simple example



Five principles of data visualisation

Principle 1: Show what's important

Principle 2: Reduce the clutter

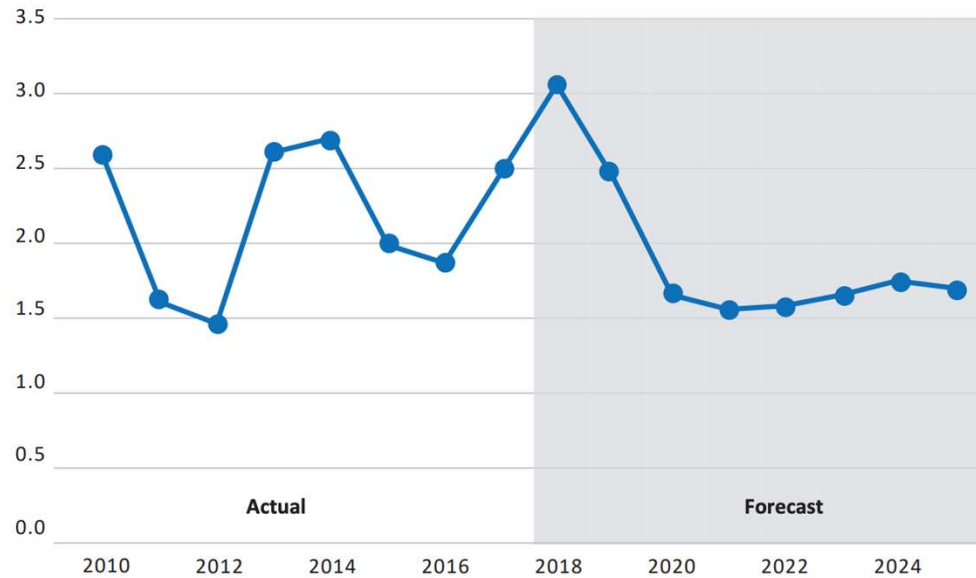
Principle 3: Integrate graphics and text

Principle 4: Avoid too much information

Principle 5: Start with gray

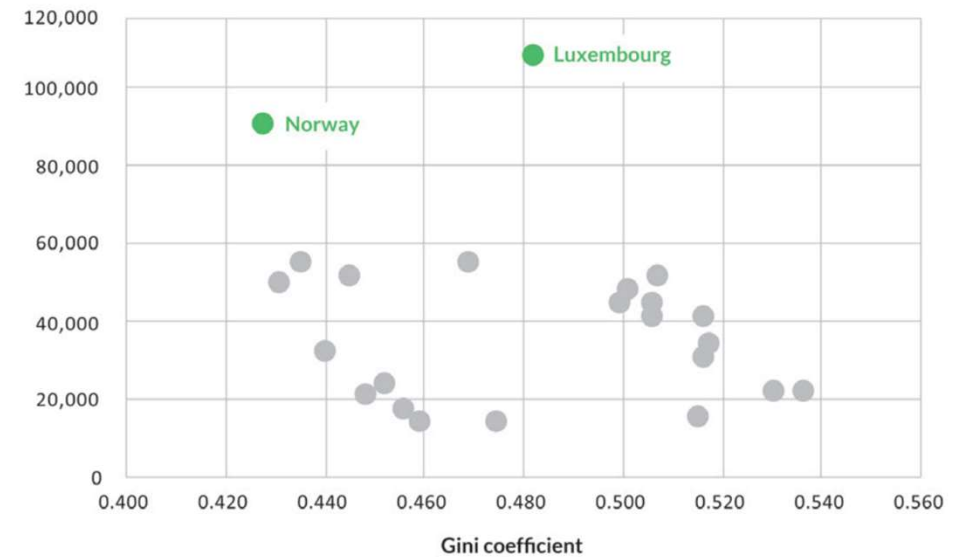
Principle 1: Show what's important

US Real GDP growth is projected to decline and stabilize around 1.7%



Source: Congressional Budget Office

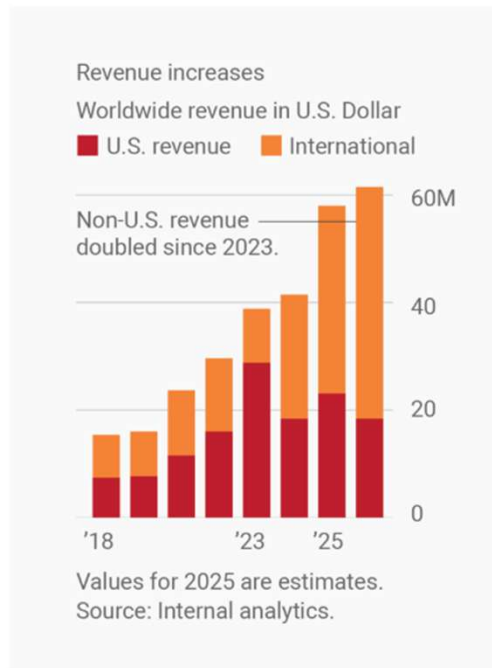
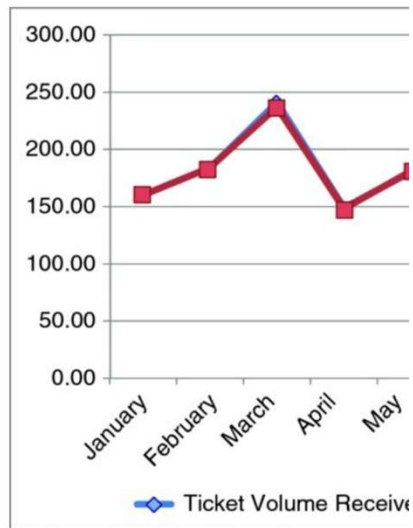
Relationship between per capita GDP and inequality



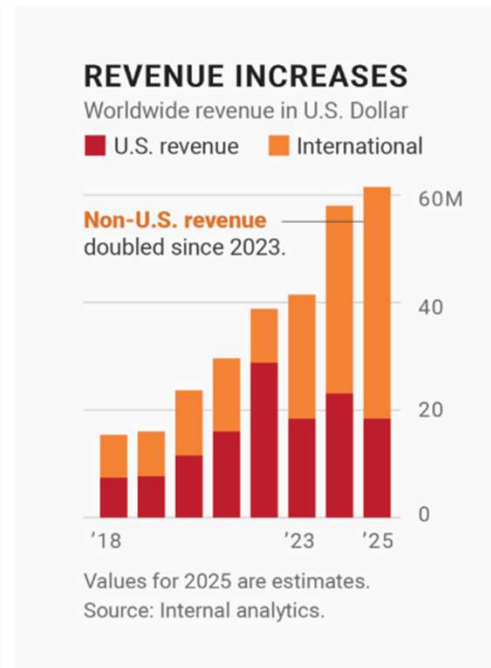
Source: The World Bank

Principle 2: Reduce the clutter

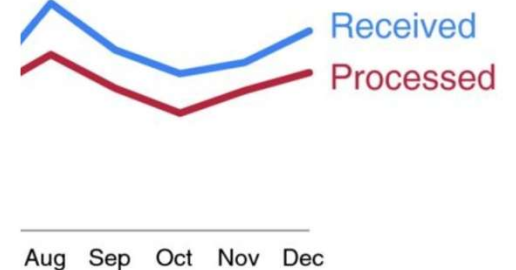
Lead the eye with font sizes, styles, and colors



NOT IDEAL: TOO LITTLE CONTRAST



BETTER: ENOUGH CONTRAST

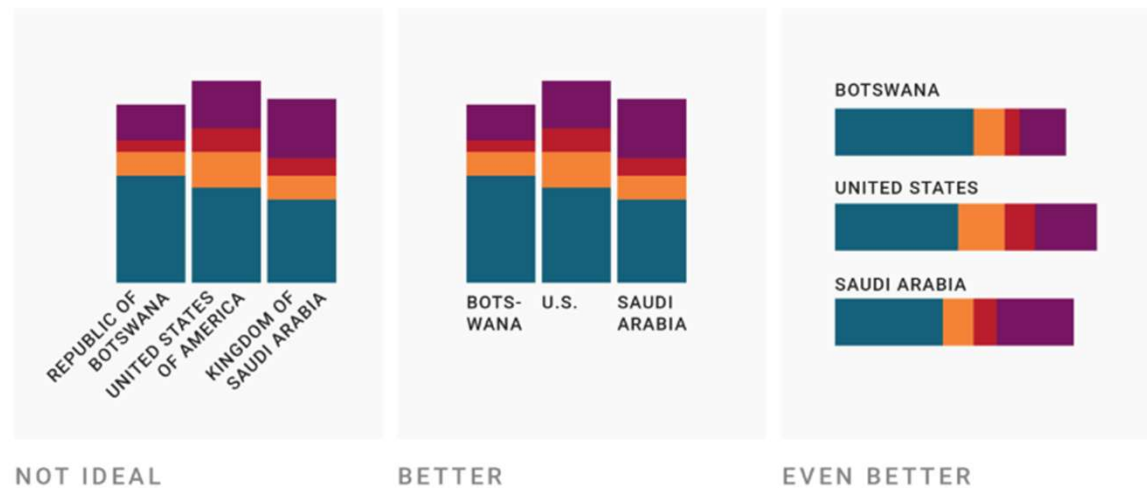


Viley & Sons, Incorporated, 2015

From: N

Principle 3: Integrate graphics and text

A. Label directly

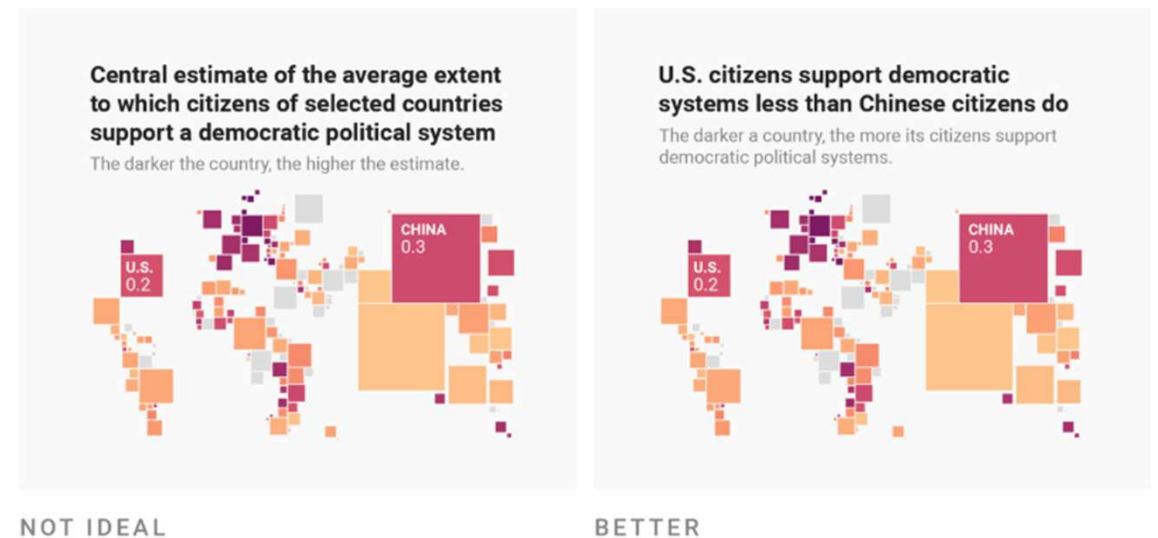


Reference: <https://blog.datawrapper.de/text-in-data-visualizations/>

Principle 3: Integrate graphics and text

- A. Label directly
- B. Add intent and subtitle

Use straightforward phrasings

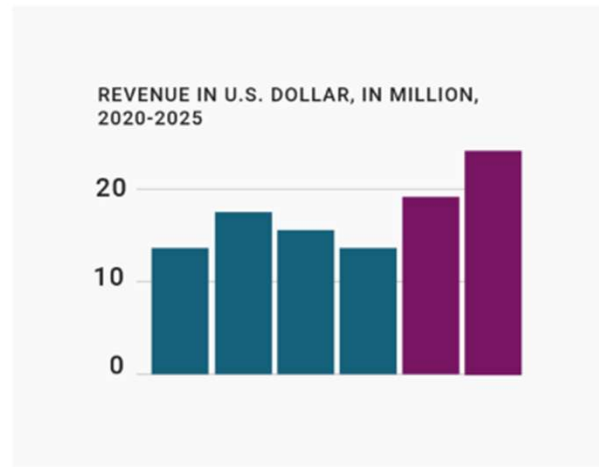


Source: USDA Milk Production Report (2024)

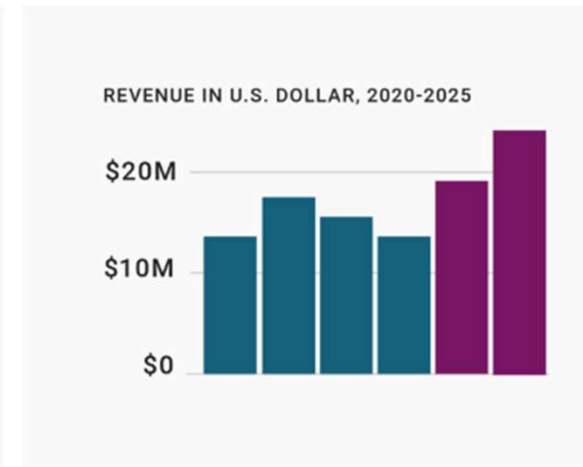
Principle 3: Integrate graphics and text

- A. Label directly
- B. Add intent and subtitle
- C. Add annotations

Repeat the units your data is measured in



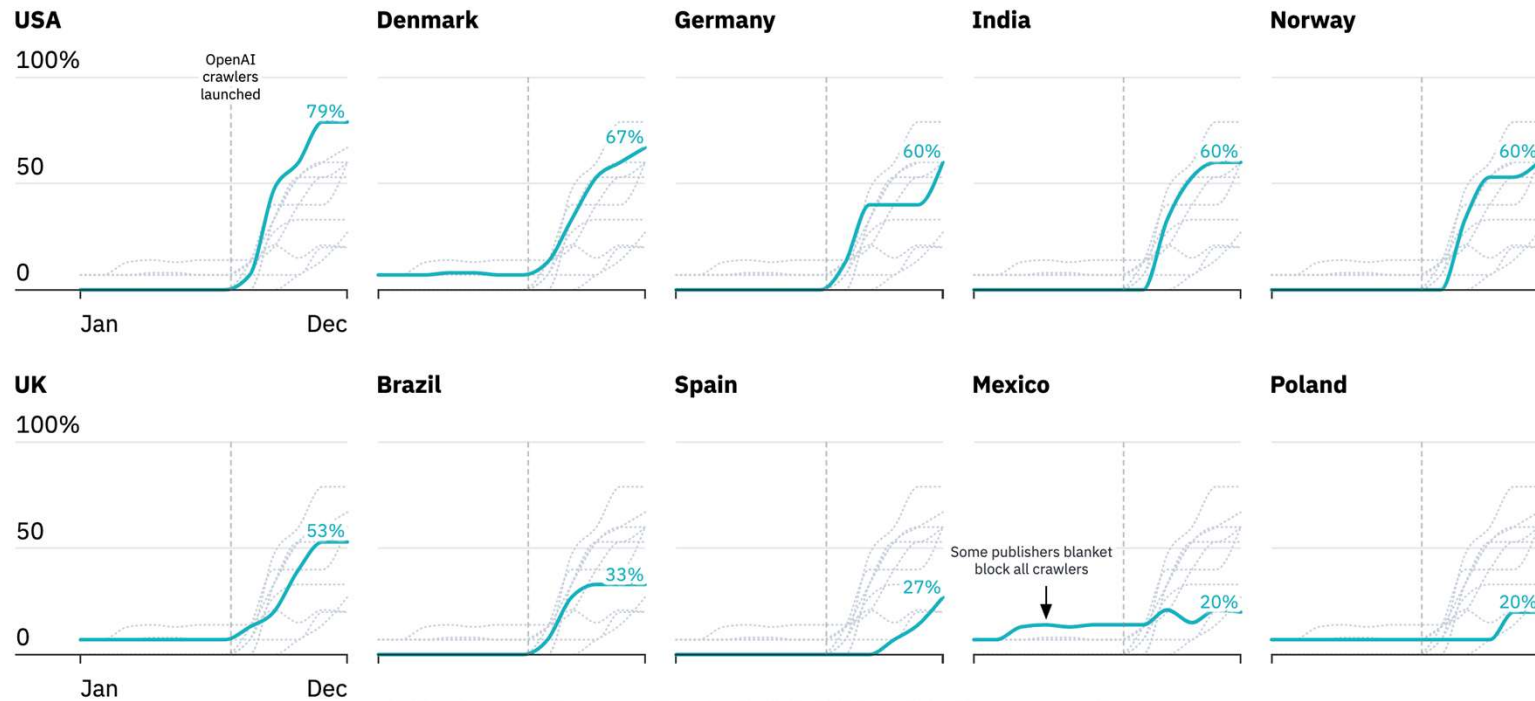
NOT IDEAL



BETTER

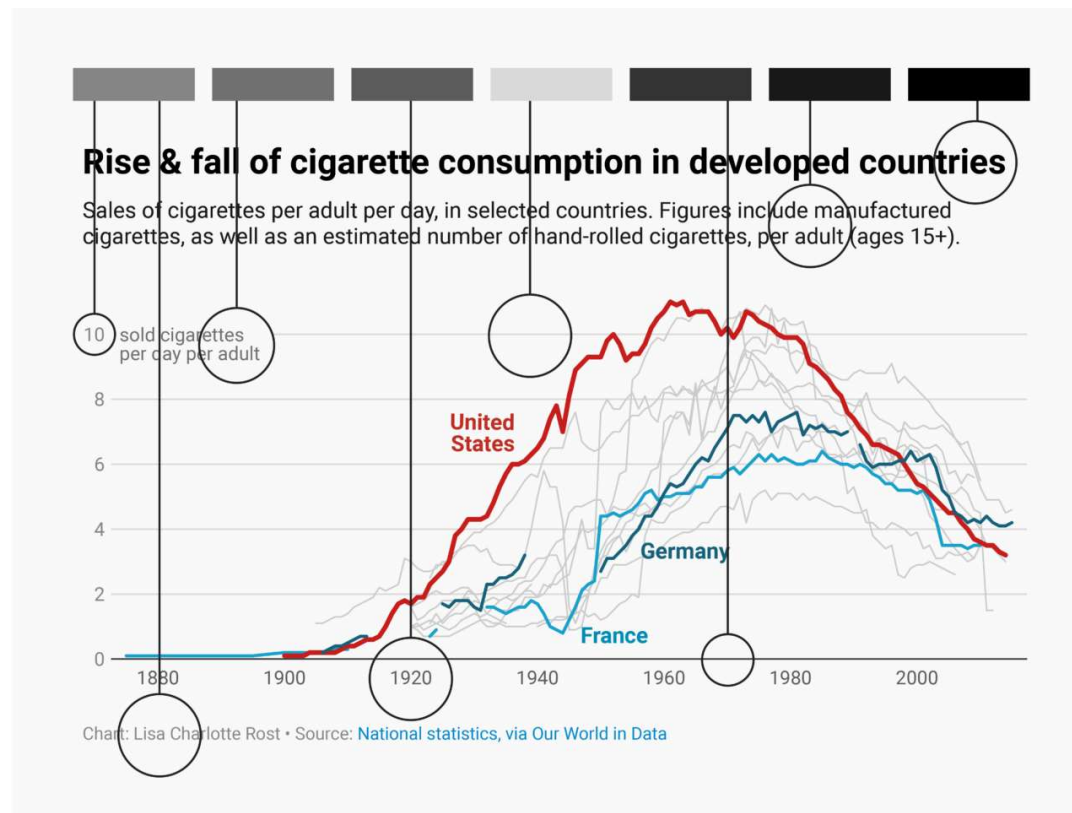
Principle 4: Avoid too much information

Proportion of top news websites blocking OpenAI's crawlers during 2023



$m (M_{\oplus})$

Principle 5: Start with gray



Five principles of data visualisation

Principle 1: Show what's important

Principle 2: Reduce the clutter

Principle 3: Integrate graphics and text

Principle 4: Avoid too much information

Principle 5: Start with gray

Art that integrates data visualizations can help bridge the US political divide over climate change

29-8-2025

July 7, 2023 | By [Elise Mahon](#) | For news media 



A painting by Diane Burko entitled “Summer Heat, 2020” depicts red, orange and blue motifs of wildfires and melting glaciers that overlap with maps that appear to drip over a graph of global atmospheric carbon dioxide levels. Research from the University of Wisconsin–Madison has shown that combining climate data with visually engrossing art can make data more meaningful to viewers and bridge political divides related to climate science. **Painting by Diane Burko**

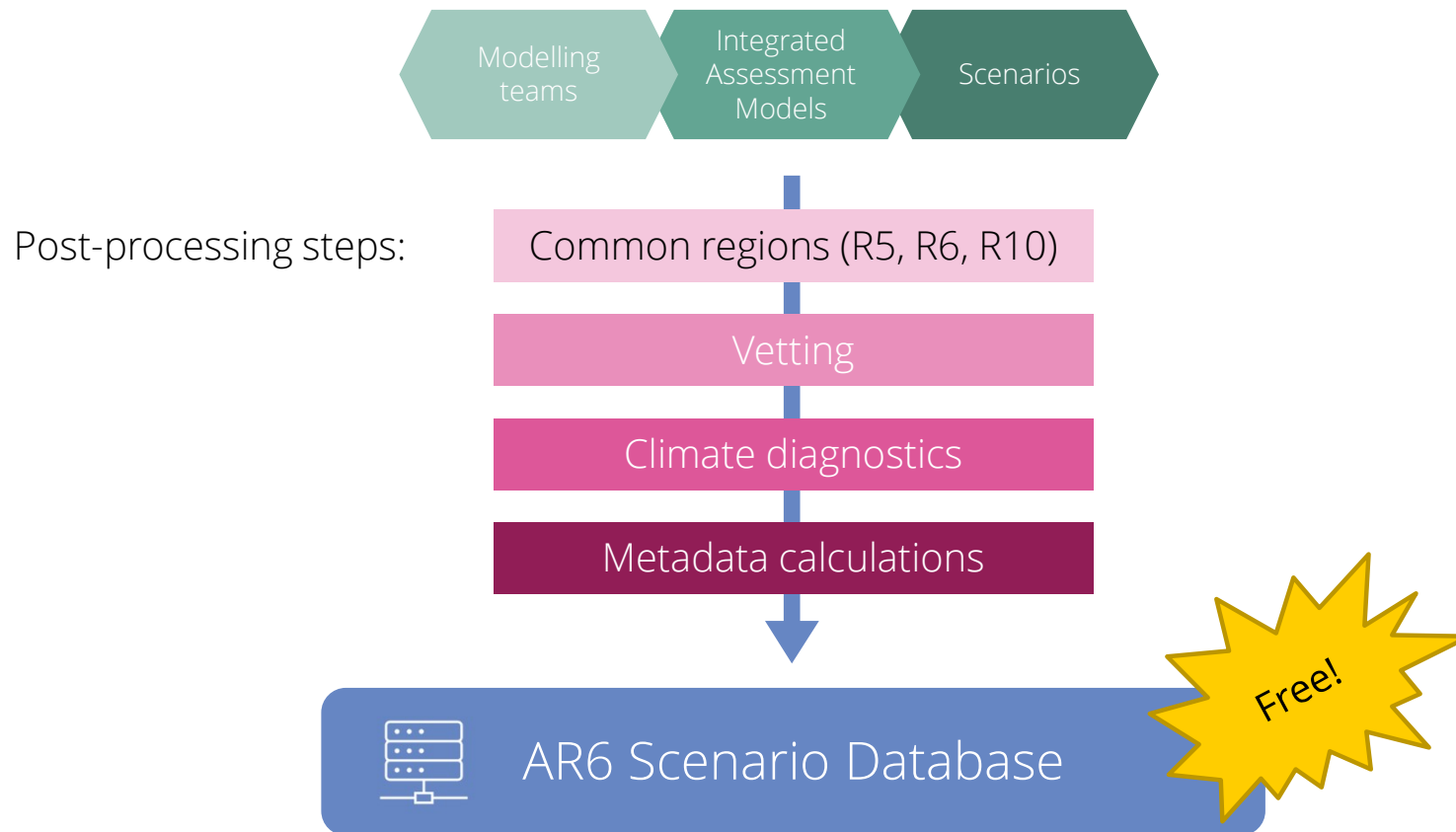
Extra references:

- <https://www.climatica.lamarea.com/climate-figure-ipcc-arlene-birt-ar6/>
- <https://blog.datawrapper.de/10-ways-to-use-fewer-colors-in-your-data-visualizations/>
- <https://blog.datawrapper.de/colors-for-data-vis-style-guides/>
- <https://blog.datawrapper.de/text-in-data-visualizations/>
- <https://blog.datawrapper.de/guide-what-to-consider-when-creating-tables/>
- <https://blog.datawrapper.de/category/datavis-dos-and-donts/>
- <https://chartio.com/learn/business-intelligence/5-data-visualization-best-practices/>
- <https://knowablemagazine.org/article/mind/2019/science-data-visualization>
- <https://infographics.economist.com/2019/AChristmasGiftForYou/AYearInGraphicDetail.pdf>

Part 3

Creating your own figures

Where do these numbers come from?



AR6 Scenario Database

AR6_Scenarios_Database_World_v1.0.csv



	Model	Scenario	Region	Variable	Unit	2010	2015	2020	2025
0	AIM/CGE 2.0	ADVANCE_2030_WB2C	World	Emissions CO	Mt CO/yr	904.755100	879.310600	852.854200	827.269500
1	AIM/CGE 2.0	ADVANCE_2030_WB2C	World	Emissions CO2	Gt CO2/yr	38.149301	41.259128	43.970330	43.521059
2	AIM/CGE 2.0	ADVANCE_2030_WB2C	World	Emissions CO2 AFOLU	Gt CO2/yr	5.634540	5.800530	5.621604	4.800204

AR6 Scenario Database

AR6_Scenarios_Database_metadata_indicators_v1.0.xlsx



Model	Scenario	Category	Category_name	Category_subset	Subset_C
AIM/CGE 2.0	SSP1-26	C3	C3: limit warming to 2°C (>67%)	C3a_Immediate_Action	N
AIM/CGE 2.0	SSP1-34	C5	C5: limit warming to 2.5°C (>50%)	C5	N
AIM/CGE 2.0	SSP1-45	C6	C6: limit warming to 3°C (>50%)	C6	N
AIM/CGE 2.0	SSP1-Baseline	C7	C7: limit warming to 4°C (>50%)	C7	N
AIM/CGE 2.0	SSP4-26	C3	C3: limit warming to 2°C (>67%)	C3a_Immediate_Action	N
...

`datavar(...)`

Calculations:

Required:

- Variable name

Optional:

- Year
- Region

`.select(...)`

Selections:

Optional:

- Dictionary with meta-columns
 - Keys: meta-column name
 - Values: “all” or list of items

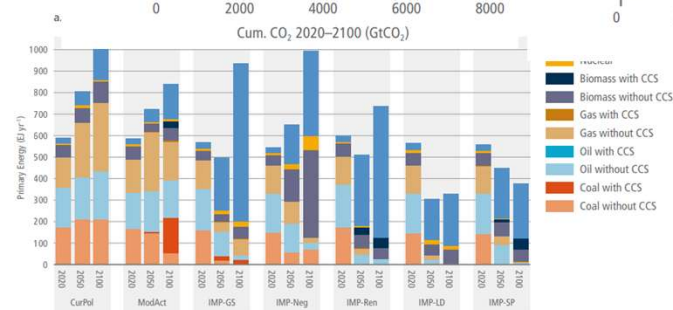
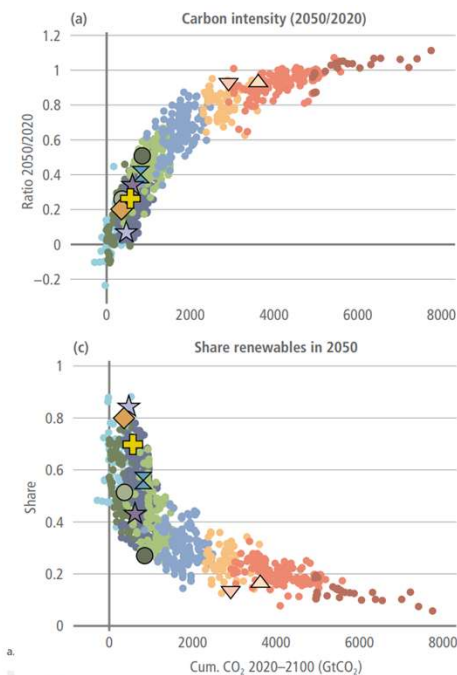
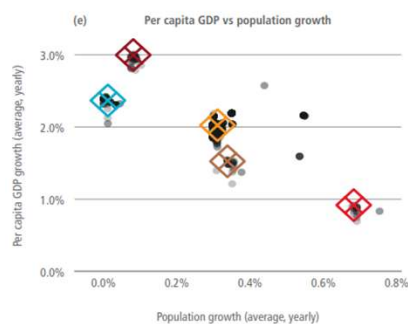
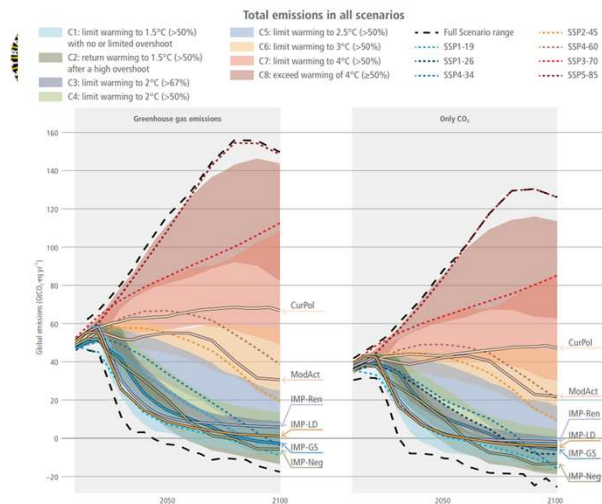
Assignment 1: reproduce a Chapter 3 figure

1. Select your data using `selection = datavar(...).select(...)`
2. Make your figure using Plotly Express:

`px.line(...), px.scatter(...), px.area(...), px.bar(...)`

3. Add an intent:

`fig.update_layout(title="Intent")`



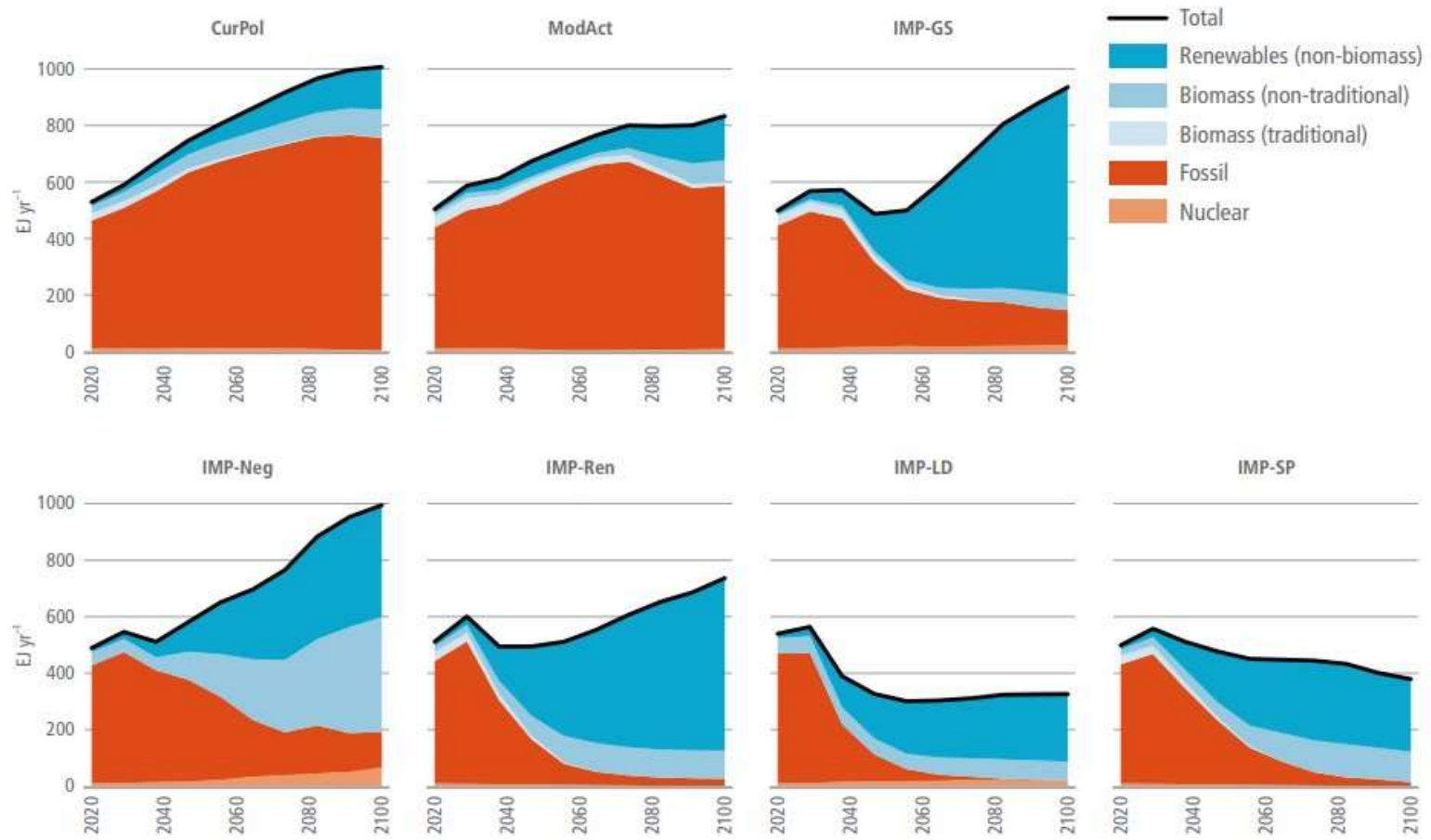
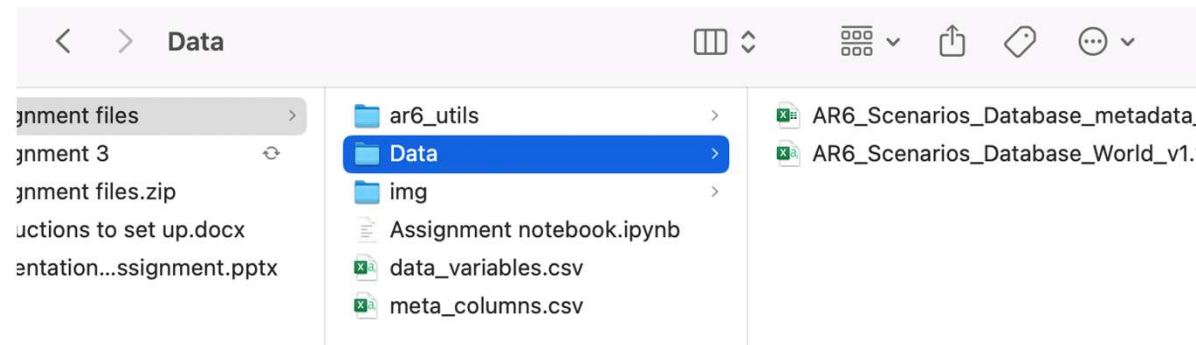


Figure 3.8 | The energy system in each of the illustrative pathways (IPs).

Getting started

1. Download workshop files and unzip:
<https://edu.nl/enr33>
2. Download AR6 database and unzip in **same folder**:



<https://data.ece.iiasa.ac.at/ar6/#/downloads>

(specifically: **AR6_Scenarios_Database_World_v1.1**)

3. Install plotly
(**pip install plotly** or **conda install -c plotly plotly**)
4. Open Jupyter and open **Workshop summer school.ipynb**
5. Have fun!