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Responsibility and justice in the face of climate change

Presentation at a hearing of the German Ethics Council
23 Februar 2023, 13:00 – 17.00

Prof. Dr. Dr. Jörg Tremmel
Extraordinary Professor
Institute for Political Science
Eberhard Karls University Tübingen

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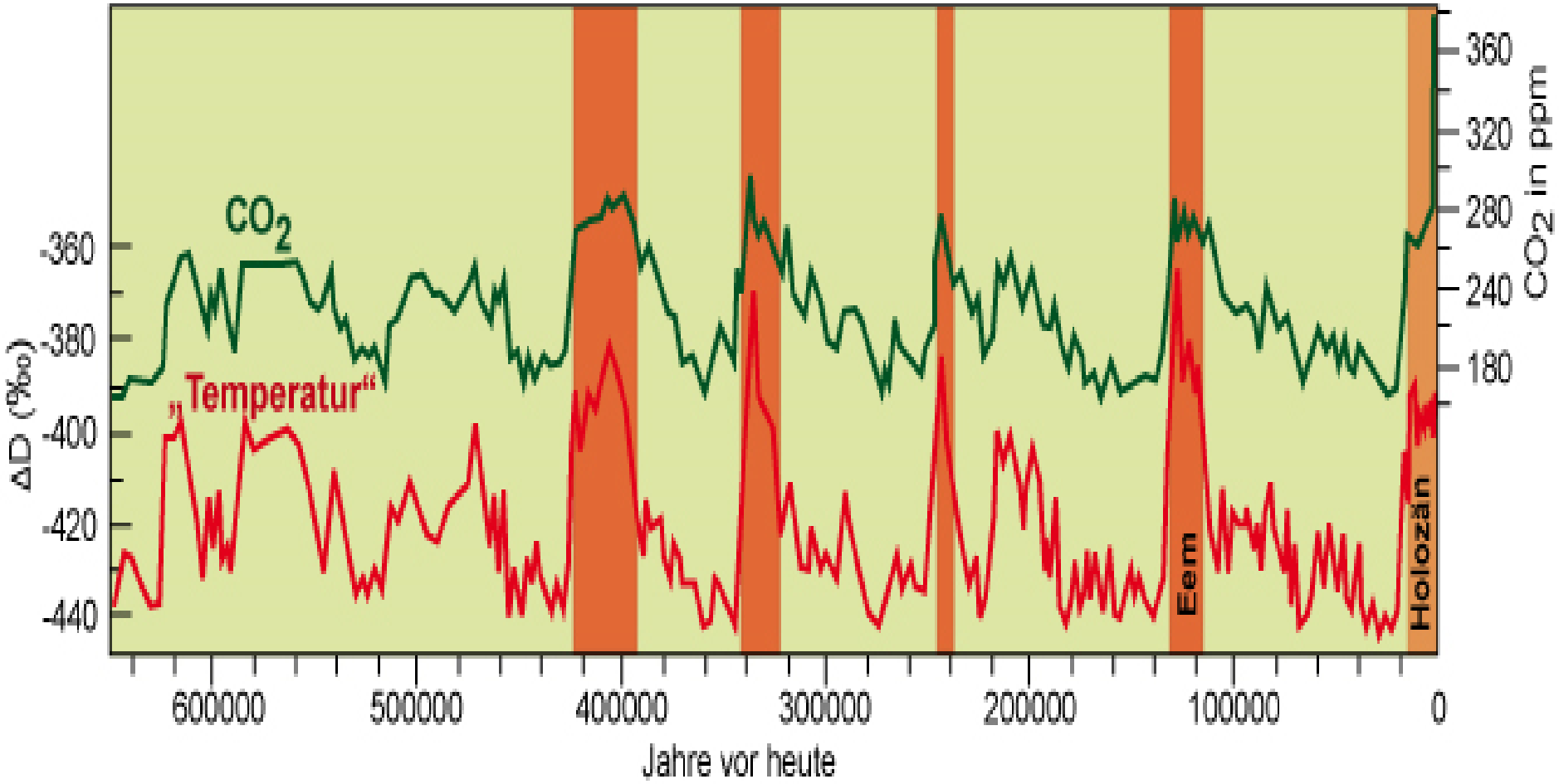
Global warming, rising see levels, extreme weather events: a crisis/catastrophe for humans and other species

The interdependence of CO2-Emissions and temperature shifts



Quelle: https://wiki.bildungsserver.de/klimawandel/index.php/Eiszeitalter. Datengrundlage: IPCC (2007): Climate Change 2007, Working Group I: The Science of Climate Change, Technical Summary, Figure TS.1.

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Tipping points and the danger of a new longterm hothouse earth epoch

In Earth's history, CO2 concentration and temperature changes have been closely correlated. If humanity exceeds 350 ppm for an extended period of time, then the Earth is at risk of transitioning to a stable new state for a few thousand years (see red highlighted bars in the figure of the previous slide). This is then referred to as a Hothouse Earth (Steffen at al 2018) or a new hot period. Hot tides are characterized by the fact that the glaciosphere has largely disappeared (i.e., there is no more ice at the North Pole and no more large glaciers outside of Antarctica), which could cause sea levels to be 15-25 m higher than today.

Despite all climate policies and mitigation efforts, the rate of increase of CO2 concentration in the earth's atmosphere is currently accelerating. In the 1970s it was 0.7 ppm/year, in the 1980s 1.6 ppm/year, in the 1990s 2.2 ppm per year, and currently about 2.6 ppm per year (IPCC Working Group I 2021; Latif 2020, 55-66) - to the highest concentration in millenia: 421 ppm.

Quellen:
Steffen, Will et al (2018): Trajectories of the Earth System in the Anthropocene. PNAS. 115 (33): 8252-8259. https://doi.org/10.1073/pnas.1810141115; IPCC WG I (2021). Climate change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press. www.ipcc.ch/report/ sixth-assessment-report-working-group-i/
Latif, Mojib (2020): Heißzeit: Mit Vollgas in die Klimakatastrophe - und wie wir auf die Bremse treten. München.

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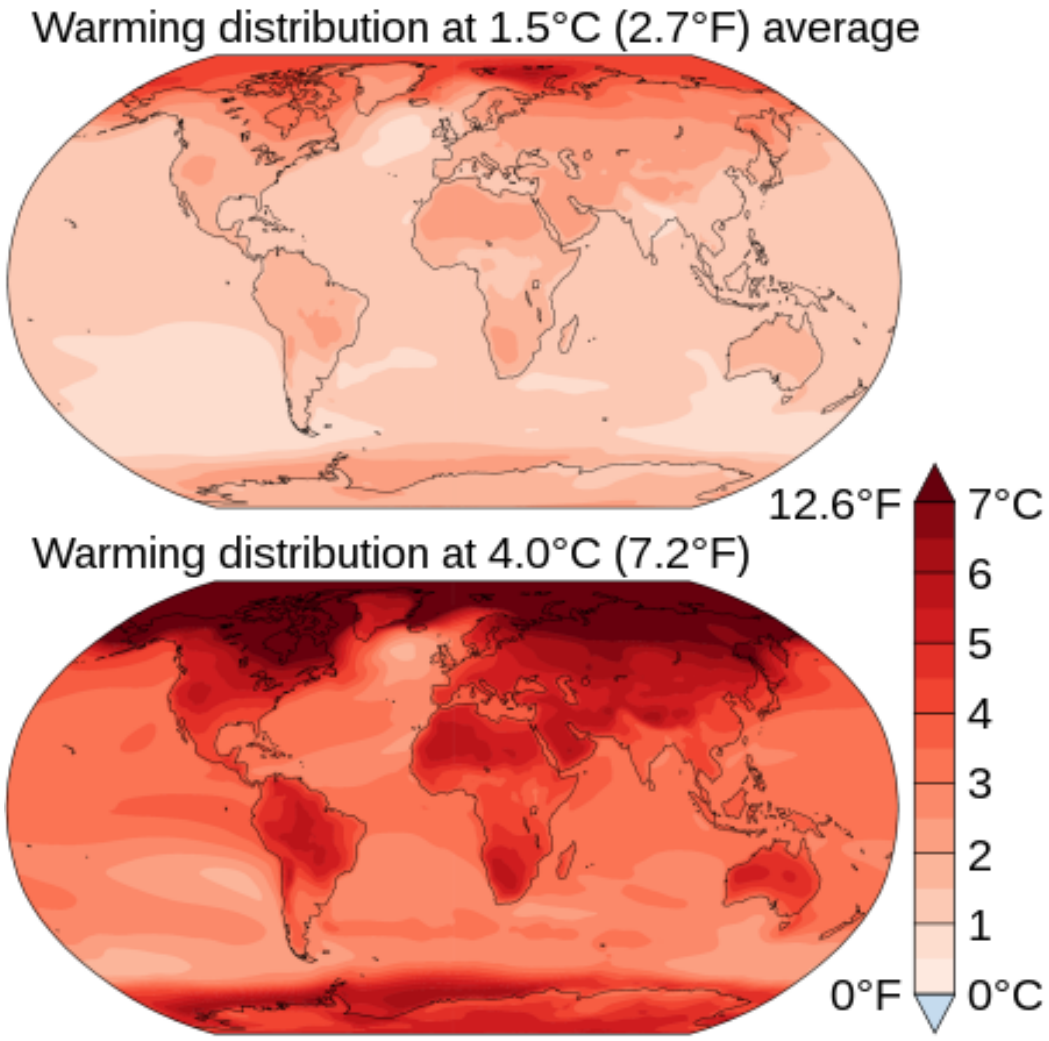
Global warming, rising see levels, extreme weather events: a crisis/catastrophe for humans and other species



Projected global surface temperature changes relative to 1850–1900:

Big differences between 1.5 and 4 degrees

Source: Wikipedia. https://en.wikipedia.org/wiki/Climate_change.

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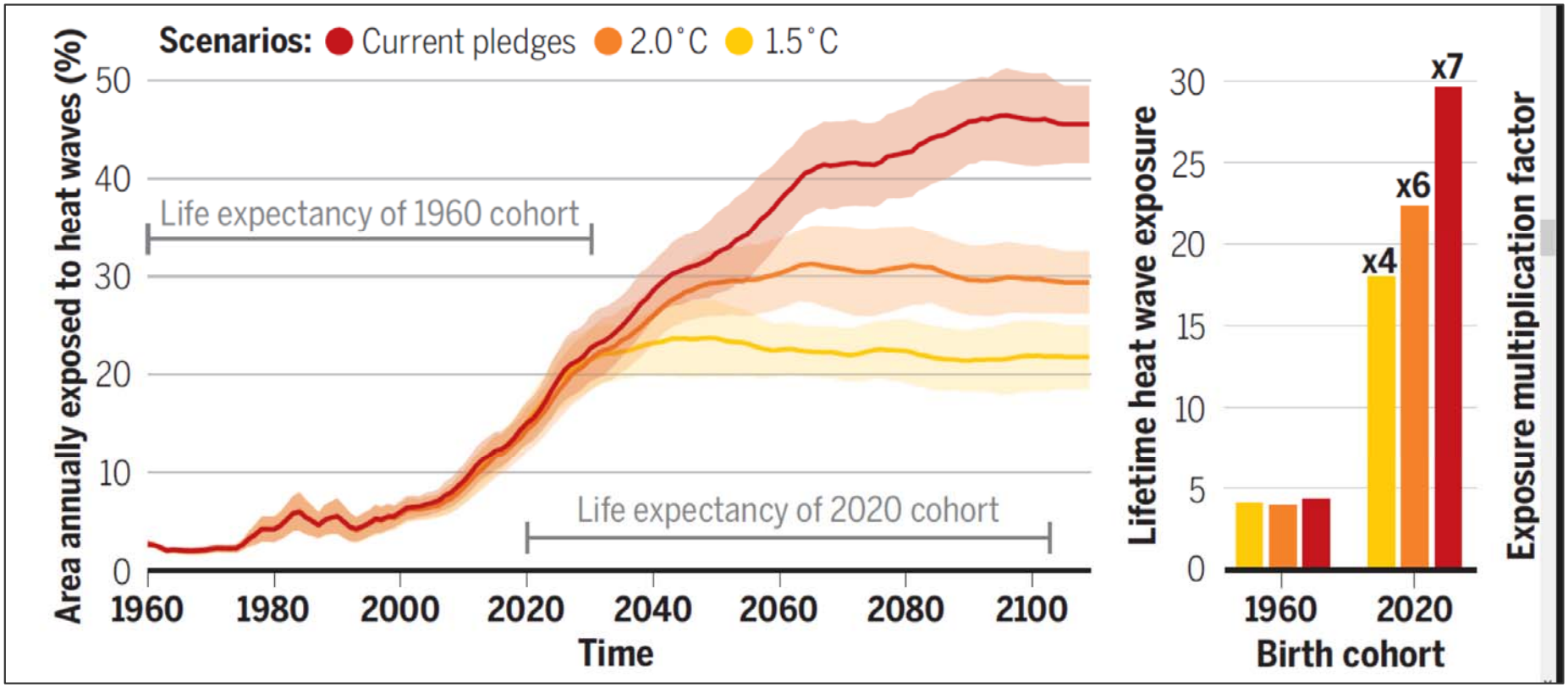
From a period to a cohort perspective



"The standard scientific paradigm is to assess climate change in discrete time windows or at discrete levels of warming , [which is] a "period" approach that inhibits quantification of how much more extreme events a particular generation will experience over its lifetime compared with another. By developing a "cohort" perspective to quantify changes in lifetime exposure to climate extremes and compare across generations." In those countries that are already hot today it may become impossible to work outside during daytime.

Source: Thiery, Wim/Lange, Stefan/Rogelj, Joeri/Schleussner, Carl-Friedrich et al. (2021): Intergenerational Inequities in Exposure to Climate Extremes. In: Science 374, Heft 6564/2021. URL: https://www.science.org/doi/10.1126/science.abi7339.

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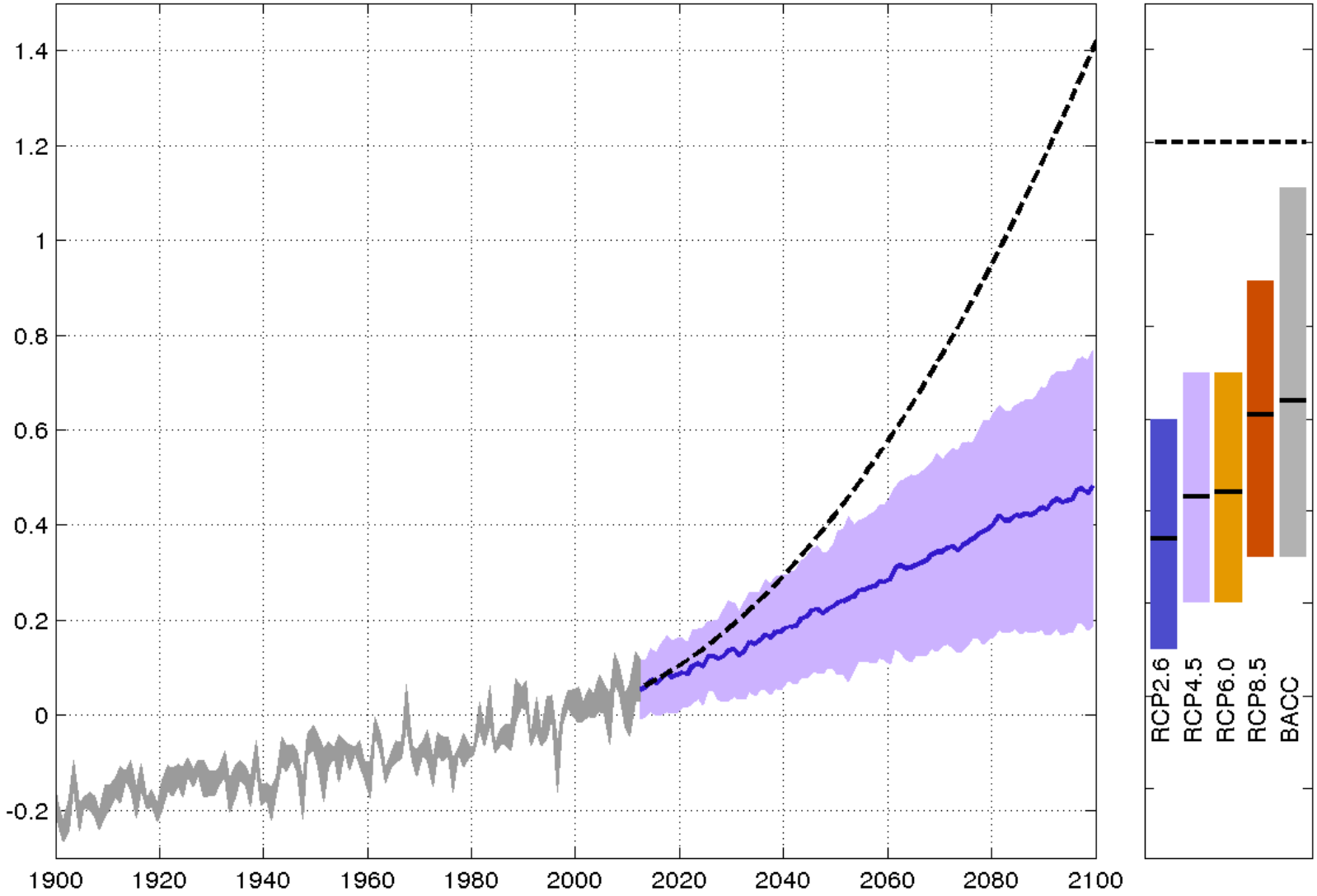
Global warming, rising see levels, extreme weather events: a crisis/catastrophe for humans and other species



Source: Wikipedia. https://en.wikipedia.org/wiki/Climate_change.

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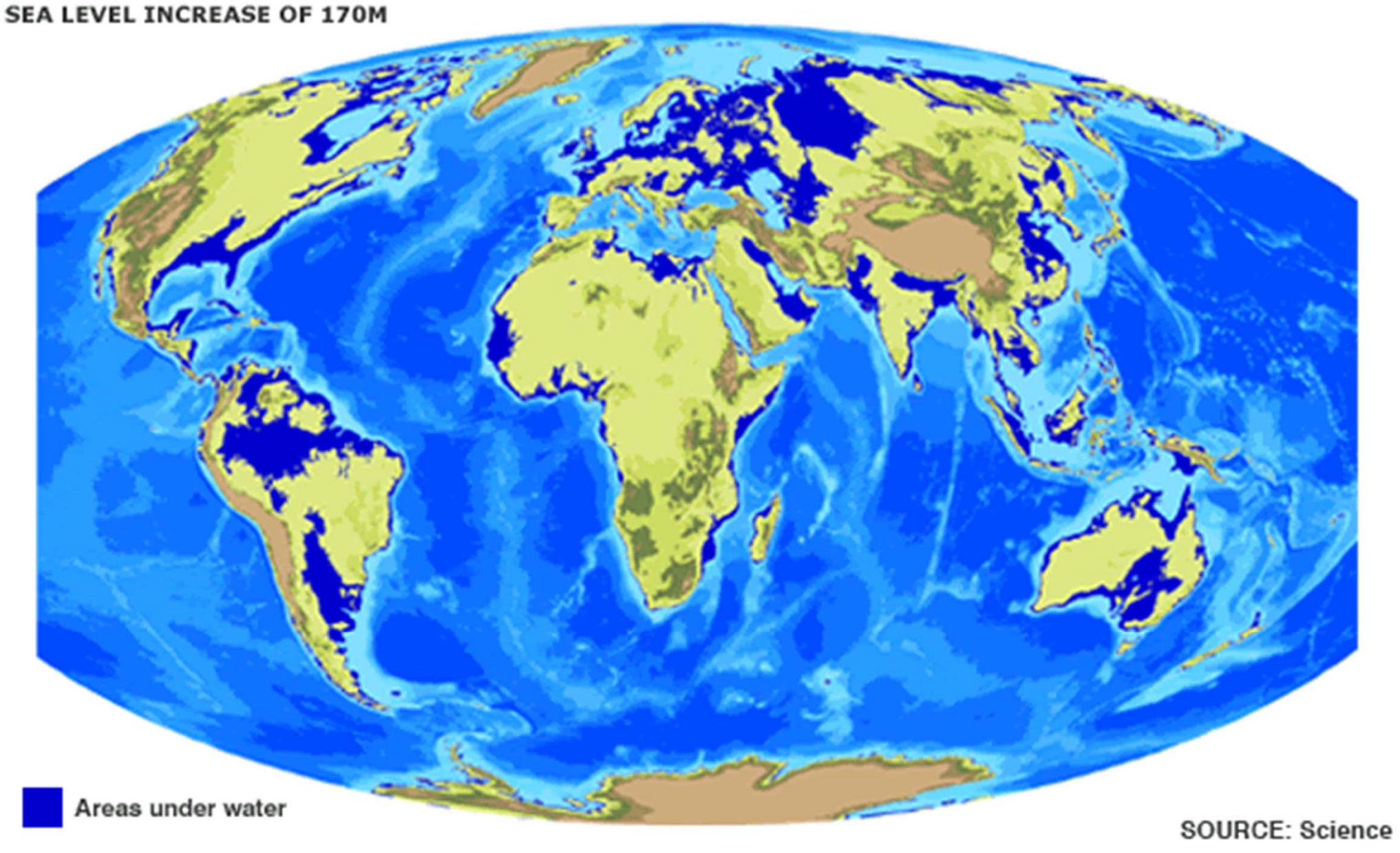
Global warming, rising see levels, extreme weather events: a crisis/catastrophe for humans and other species



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Germany‘s coastline around Hamburg at 780 ppm in the year 2095 (similar for Oslo or Bergen etc.)

Source: Ward, Peter D. (2021): The Flooded Earth. Our Future in a World without Ice Caps. New York: Perseus Books (dt. bei Oekom in München)

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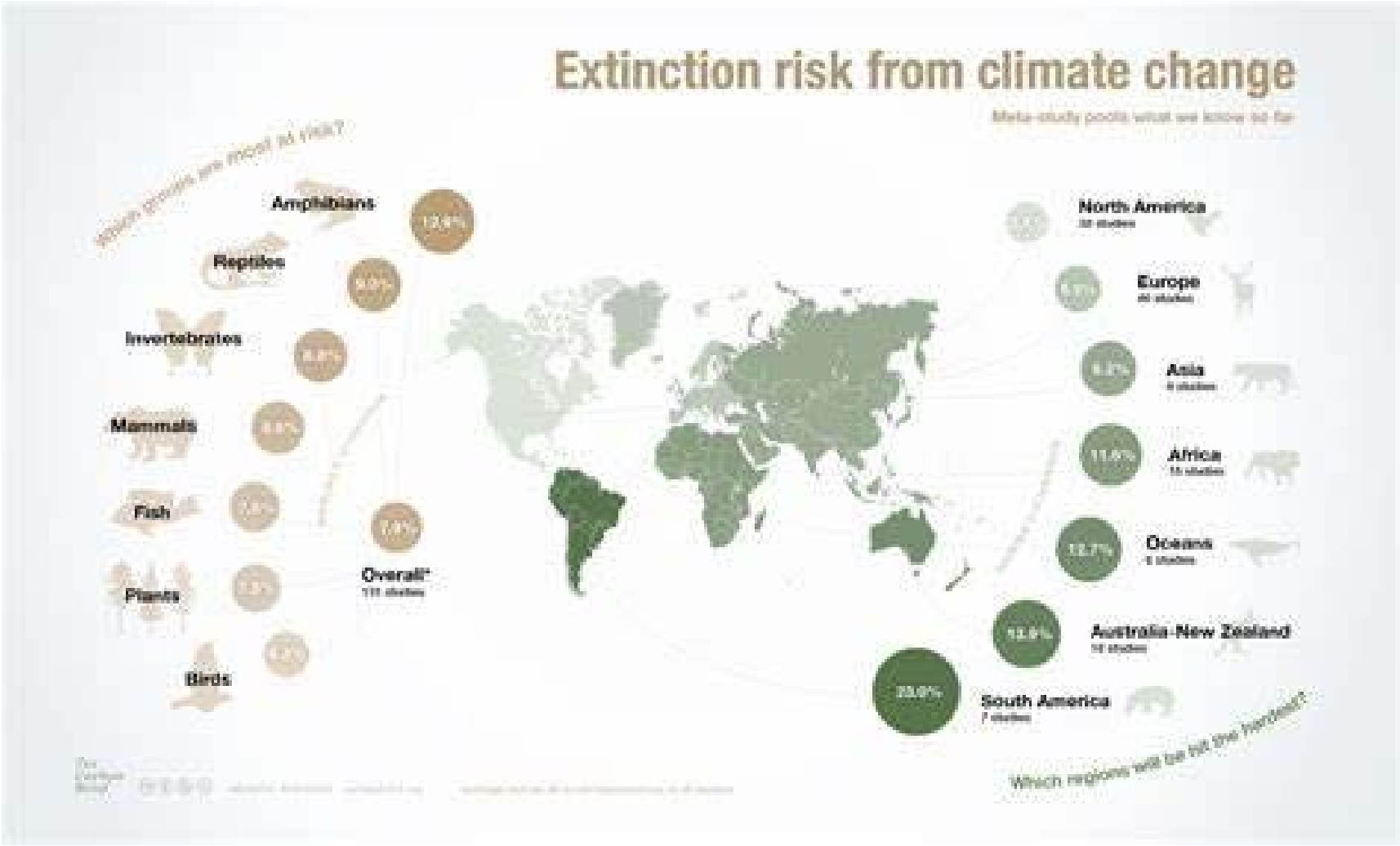
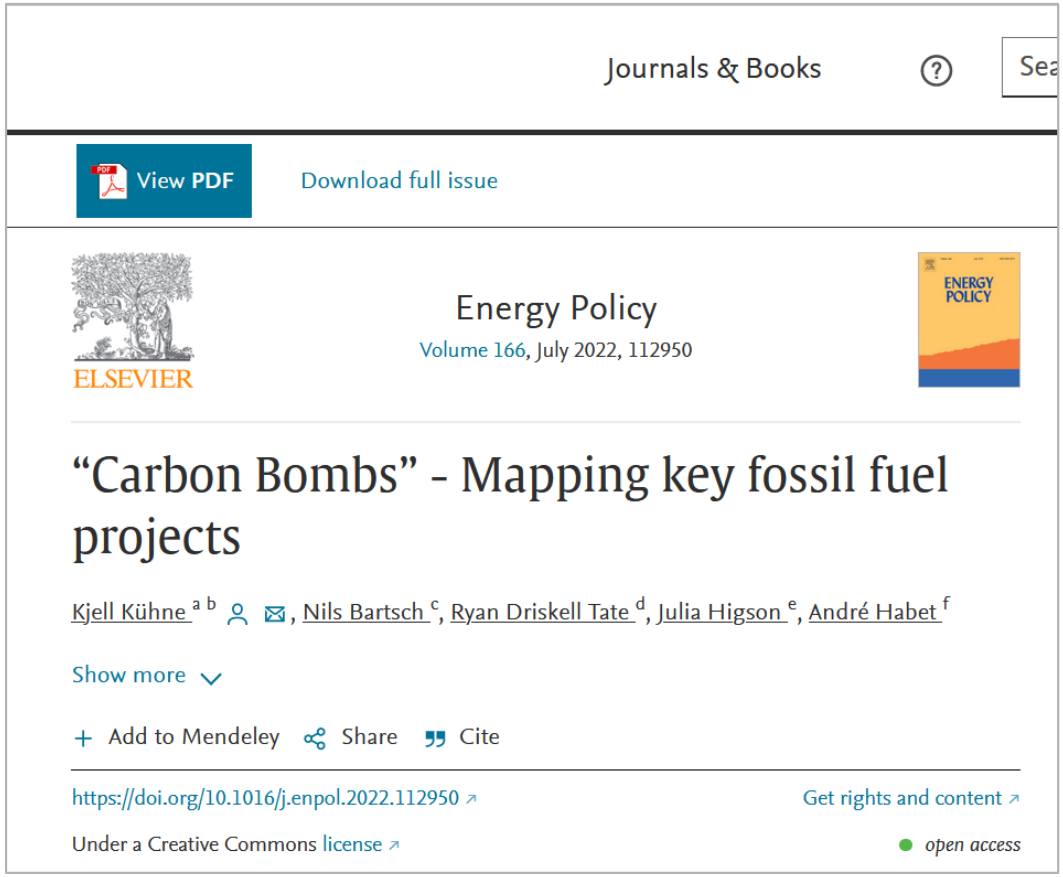
Global warming and species extinction

Global warming is projected to commit over one-third of the Earth's animal and plant species to extinction by 2050 if current greenhouse gas emissions trajectories continue — a catastrophic loss that would irreversibly reduce biodiversity and alter both ecosystems and human societies across the globe.



“Carbon Bombs“… leave it in the ground

Carbon Bombs =
Oil and gas extraction projects which, if executed, will lead to >1 Gt CO2 emissions each.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ELSEVIER

Energy Policy
Volume 166, July 2022, 112950

“Carbon Bombs” - Mapping key fossil fuel projects

Kjell Kühne [a b], Nils Bartsch [c], Ryan Driskell Tate [d], Julia Higson [e], André Habet [f]

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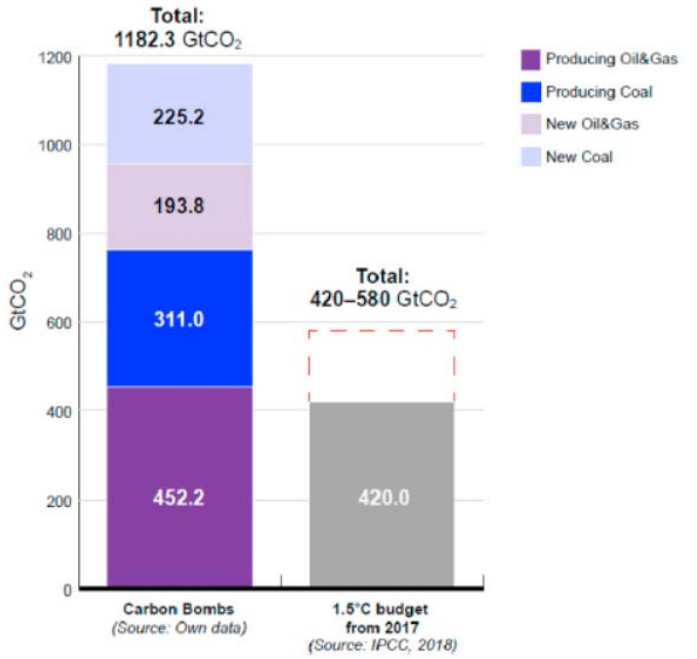
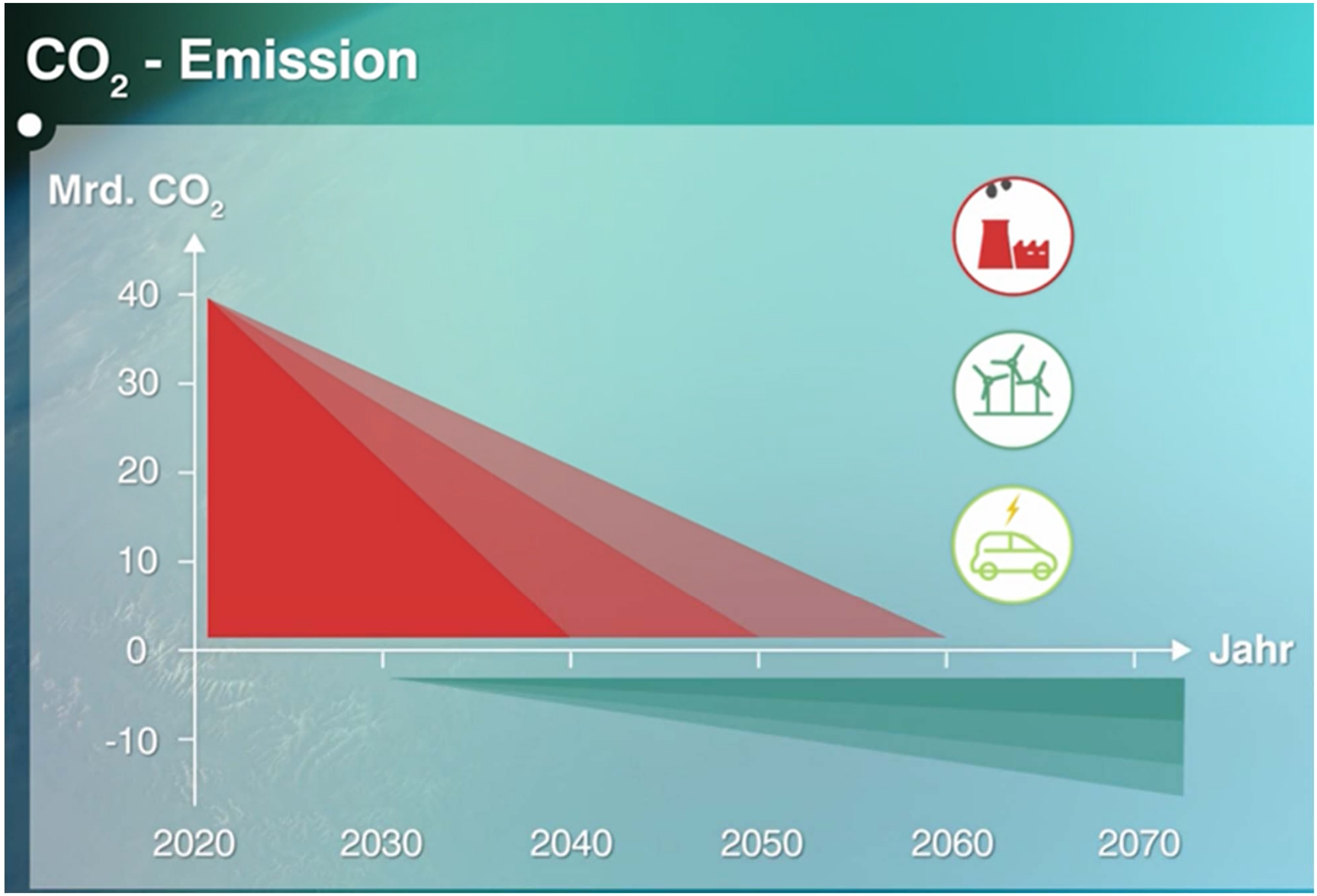
These projects would shatter the 1.5C climate goal.



Leave this coal, oil and gas in the ground!

Source:
Kühne, K / Bartsch, N / Tate, RD / Higson, J / Habet, A (2022): “Carbon Bombs” - Mapping key fossil fuel projects. Energy Policy, vol. 166. https://doi.org/10.1016/j.enpol.2022.112950.


CO_2 - Emission
Mrd. CO_2
40
30
20
10
0
-10
Jahr
2020
2030
2040
2050
2060
2070

Key Questions: Is there an individual responsibility to stop being a carbon dioxid emitter?

How personal and how individual is the responsibility that arises from the climate crisis? It is true that governmental framework conditions should make climate-friendly behavior by individuals easier. Nevertheless, there will always remain a large decision area in which individuals have to make the (morally relevant) decision whether they want to behave in a climate-friendly way or not. The state should not be responsible for private vacation flights, for example.

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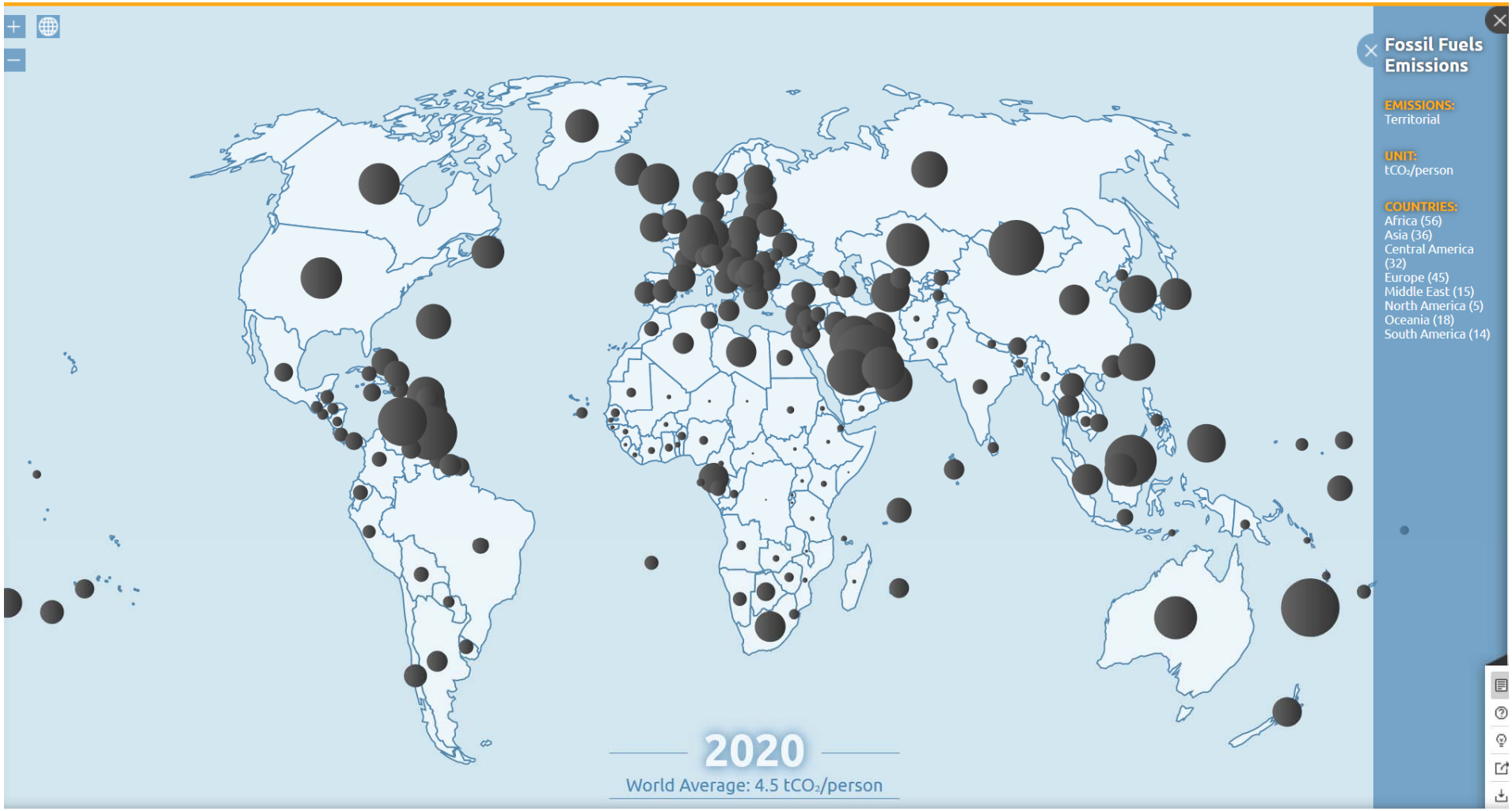
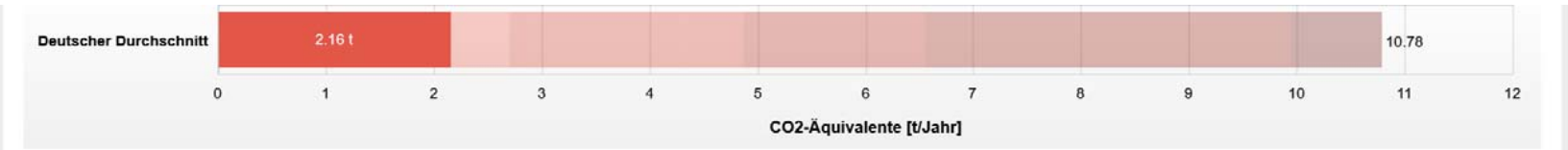
CO_2-emissions (in t) per head (in 2020)



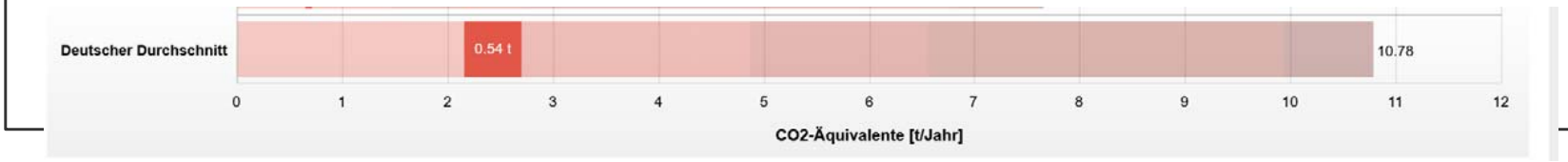
Quelle: http://www.globalcarbonatlas.org/en/CO2-emissions

10,78 t: The structure of the carbon footprint of the average inhabitant of Germany

Residential sector: Average at 2.16 t, reducible to 0.41 t



Electricity sector: Average at 0.54 t, reducible to 0.0 t

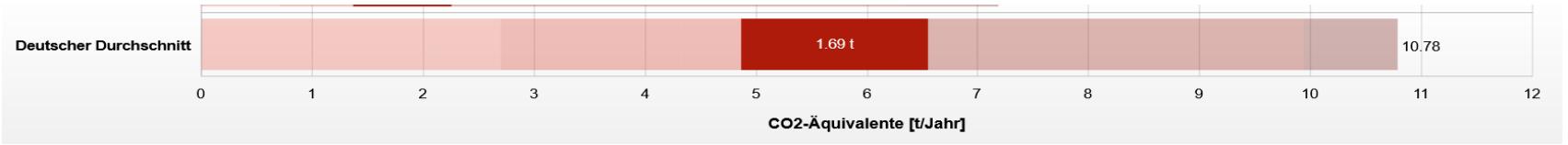


Mobility and travel sector: Average at 2.16 t, reducible to 0,0 t

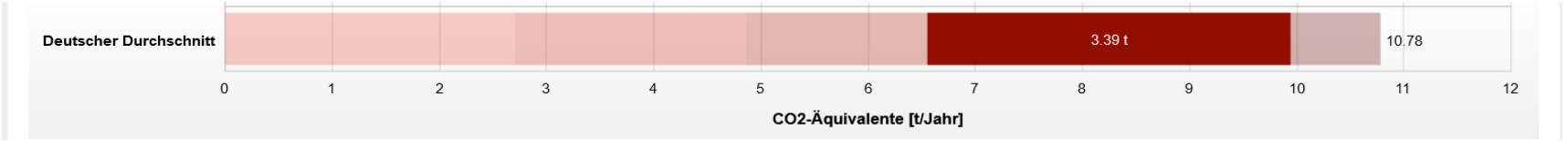
https://uba.co2-rechner.de/en_GB/; https://uba.co2-rechner.de/de_DE/;
https://www.umweltbundesamt.de/publikationen/der-uba-co2-rechner-fuer-privatpersonen

10,78 t: Der Aufbau des CO2-Fußabdrucks des/der durchschnittlichen Einwohners/in von D

Nutrition/food sector: Average at 1.69 t, reducible to 0.88 t



Other miscellaneous consumption: Average at 3.39 t, reducible to 0.1



Remaining quantity missing from the average value (10.78 t): 0.84 t

"Public consumption/public emissions": unavoidable personal carbon footprint that arises simply from using Germany's public infrastructure (e.g. roads, hospitals....). This value decreases year by year as the state successively makes its infrastructure more climate-friendly.

https://uba.co2-rechner.de/de_DE/; https://www.umweltbundesamt.de/publikationen/der-uba-co2-rechner-fuer-privatpersonen

Average CO2 footprint compared with a very climate-friendly person in Germany

Meine CO_2-Bilanz

Start | Wohnen | Strom | Mobilität | Ernährung | Sonstiger Konsum | Mein Ergebnis

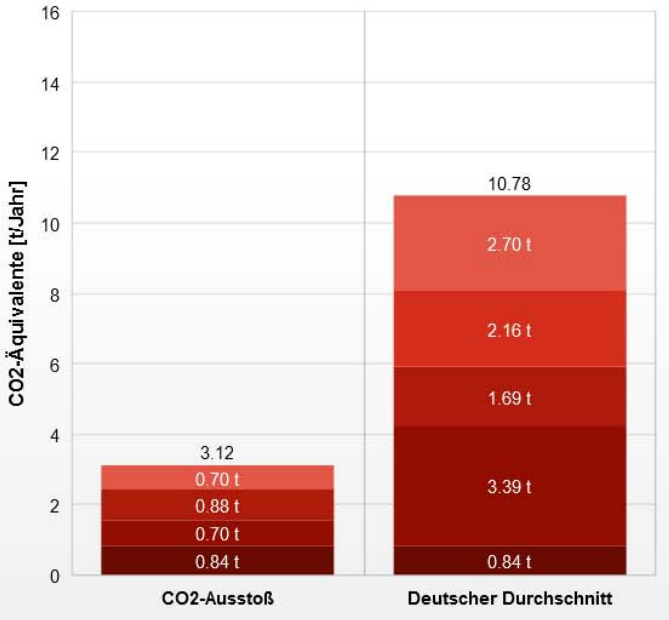
Mein Ergebnis

im Vergleich | mit Vermeidung

	CO_2-Ausstoß	Deutscher Durchschnitt
Wohnen	0,65 t	2,16 t
Strom	0,06 t	0,54 t
Mobilität	0,00 t	2,16 t
Ernährung	0,88 t	1,69 t
Sonstiger Konsum	0,70 t	3,39 t
Öffentliche Emissionen	0,84 t	0,84 t
Ergebnis	3,13 t	10,78 t

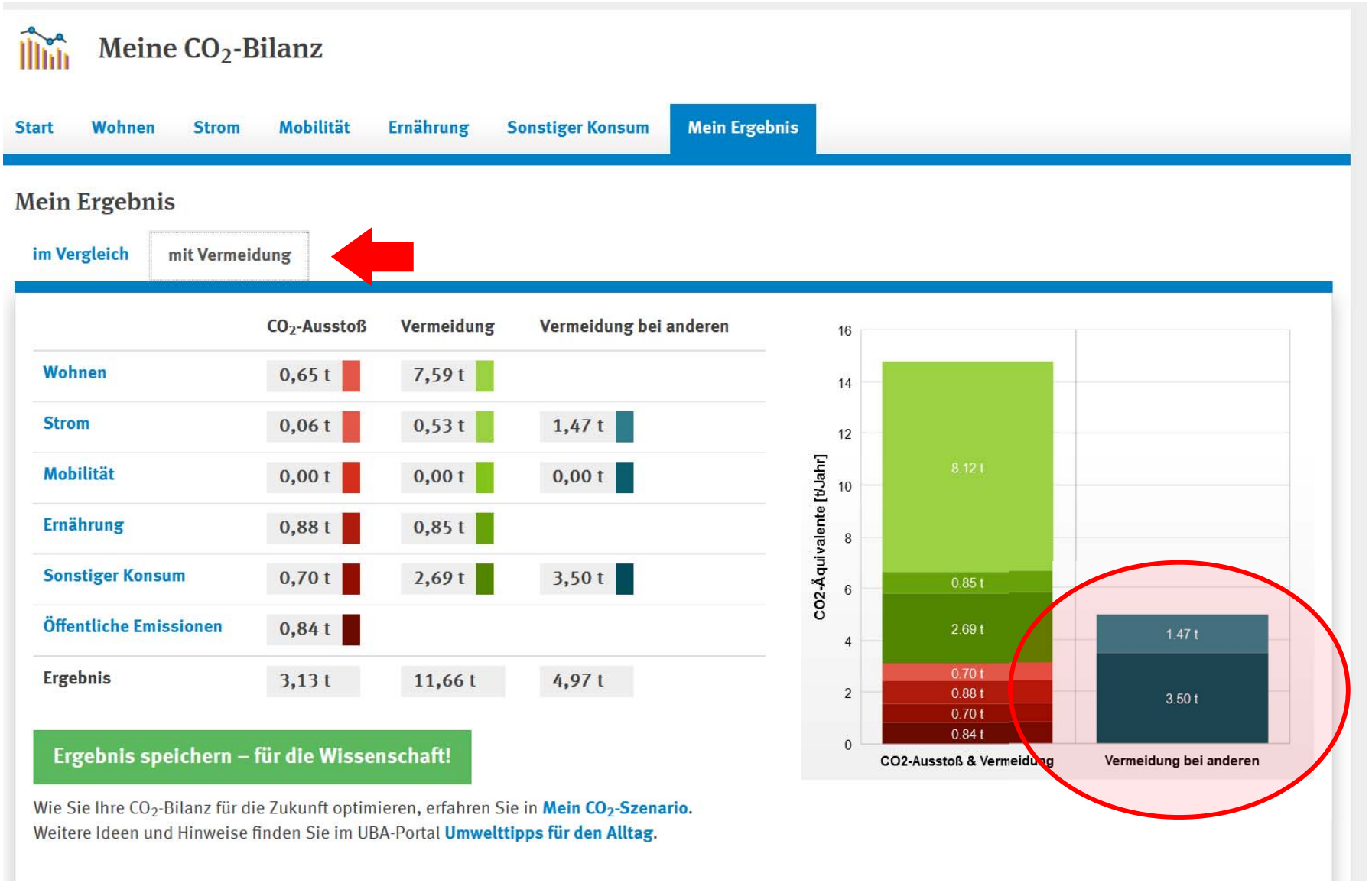
Ergebnis speichern – für die Wissenschaft!

Wie Sie Ihre CO_2-Bilanz für die Zukunft optimieren, erfahren Sie in Mein CO_2-Szenario.
Weitere Ideen und Hinweise finden Sie im UBA-Portal Umwelttipps für den Alltag.



Quelle: https://uba.co2-rechner.de/de_DE/

Extention of the balance sheet: personal CO2 removal



Quelle: https://uba.co2-rechner.de/de_DE/

Objections: 1. technical impossibility, 2. shift in focus, 3. financial overload, 4. moral overload.

1. objection: there are no technical (and also no biological) solutions for individuals to realize individual negative emissions at all yet.

2. objection: discussing personal negative emissions could have the effect that individuals make less effort to avoid CO2.

3. objection: personal zero-emissions target leads to financial overload

4. objection: as long as others don't commit to this personal zero-emissions goal, I don't have to either

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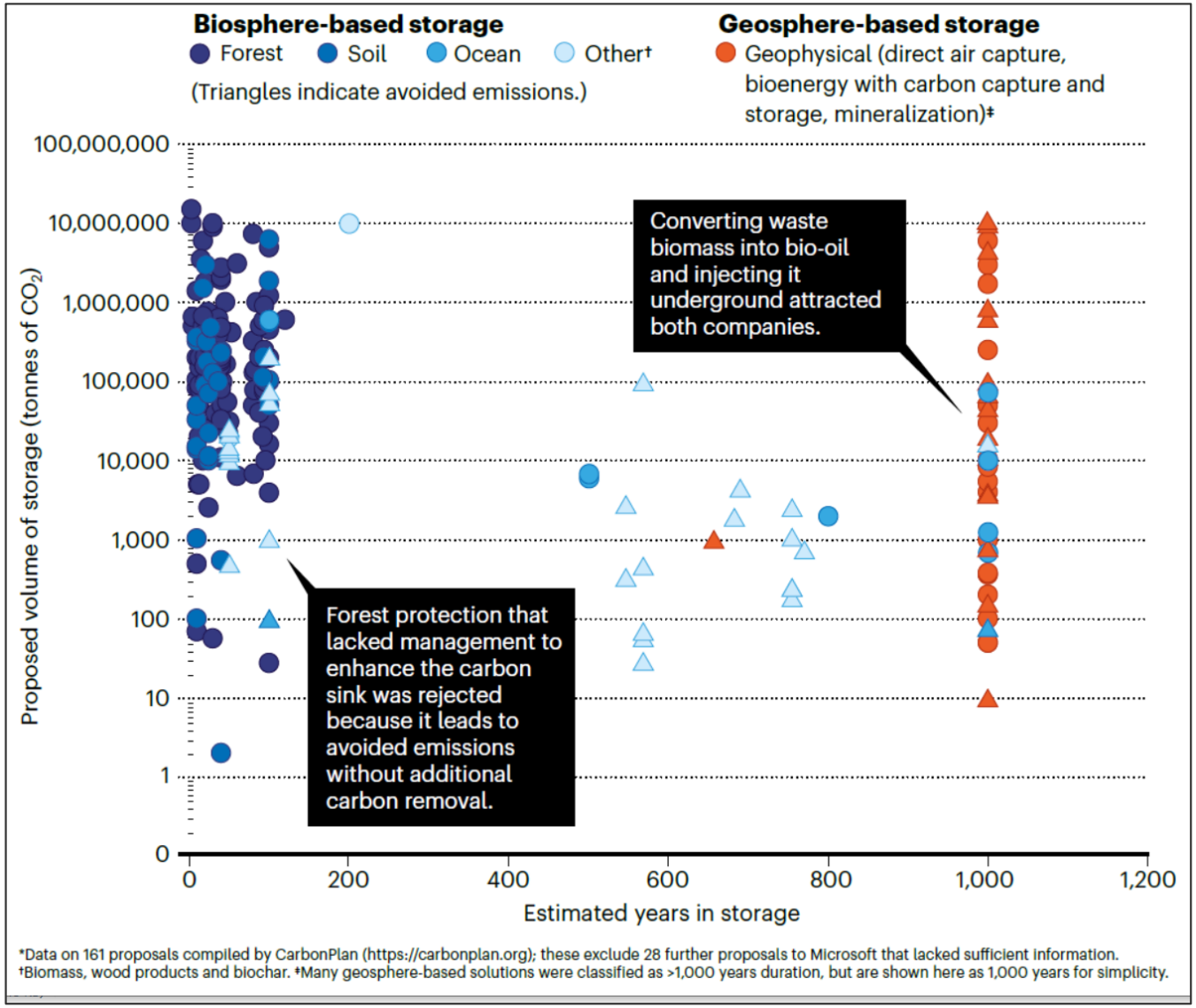
Biosphere-based storage vs. geosphere-based storage: different benefits / drawbacks for each

In 2020, around 200 proposals for locking away CO2 were submitted in response to a million dollars bid by Microsoft and Stripe, another firm. Of these, 95% used nature-based storage, which is less durable than geosphere-based. Few options were available for permanent removal. Only 2 million tons CO2 removal were judged with the gold standard.



*Joppa et al (2021): Microsoft's million-tonne CO_2 removal purchase – lessons for net zero. In: Nature, vol. 597: 629-632.

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Compensating my holiday flights in 2022

The technology I use to remove my CO_2 for my holiday flights is based on "direct air capture" and geological storage.
It captures CO_2 from the air and puts it deep underground, where it mineralises and turns to stone.
Air is drawn in through a fan located inside a collector. A filter traps the carbon dioxide particles. When the filter is completely full of CO_2, the collector closes, and the temperature rises to about 100°C.
The CO_2 is then transported deep underground, where it reacts with basalt rock through a natural process, transforms into stone, and remains there for over 10,000 years.

 Reversal of the CO_2-emissions of a holiday flight from Frankfurt (GER) to Tirana (AL): 310 kg CO_2

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The benefits of direct air capture (DAC)

• Traditional carbon offsets are typically a trade of avoided emissions through certified emission reduction projects that absorb or avoid CO_2. It can lead to reduced emissions, but not to zero and negative emissions that we need to deliver to keep global warming under 1.5 degrees.

• Reforestation measures make sense and are effective, because trees or forests are efficient, environmentally friendly, inexpensive and easily multipliable CO2 stores. However, a study by the University of Zurich in 2019 concluded that global reforestation of forests covering an area of 9,000,000 sq km could absorb two-thirds of man-made CO2 emissions (Bastin et al 2019)*.

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The benefits of direct air capture (DAC)

Direct air capture advantages:

• Efficient land usage: DAC plants require less land than other techniques. E.g., on a land area of 0.42 acres, our Orca plant can remove 4,000 tons of CO_2 from the air every year, which is almost 1,000 times more effective than trees. The same land would host around 220 trees with an estimated capacity of 22kg each, i.e., only 4.62 tons of CO_2 per year. Efficient land usage is a significant factor in a world where food is scarce and good soils are needed for its production.

•Location-independent: CO_2 is in the air at the same concentration everywhere in the world. This means that DAC plants can be located anywhere as they do not need to be attached to an emissions source. They are only required to be placed near a renewable energy source and in a place where CO_2 can be stored.

• Highly scalable and measurable: DAC plants are based on a modular technology design, making them highly scalable. It can can also be measured exactly how much CO_2 our machines capture.

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Certificate solutions for individuals exist now – Ought implies Can!

All Direct Air Capture facilities to remove gigatons of CO2 from the air would only need a few hundred sq km. Iceland alone could remove megatons of CO2 in 2030 and gigatons in 2050, according to the Prime Minister. Green electricity is available there in large quantities, so no new CO2 is released when the plants are operated.

A Climeworks plant on Iceland

Certificates, such as those sold by Climeworks, directly help to expand capacity. The cost per ton of CO2 filtered and mineralized could decrease if scaling effects are achieved. So far, there are relatively few companies that have mastered this technology. If that changes, CO2 removal by DAC will become more affordable on an individual basis.

*Bastin, Jean-Francois / Finegold, Yelena / Garcia, Claude et al (2019): The global tree restoration potential. In: Science 6448, pp. 76-79, https://science.sciencemag.org/content/365/6448/76.

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2. Objection (discussing personal negative emissions ensures that individuals make less effort to avoid CO2)**: false**

The discussion about the duty of personal negative emissions will not stop Individuals (or companies) from avoiding CO2. On the contrary!

> From the moral point of view….
>
> 'Strikingly, "do no harm" and "clean up your own mess" are the two sides of the same coin: those who fail to fulfill the first responsibility ordinarily incur the second responsibility. If one does contribute to harm, in violation of the negative responsibility, it becomes one's positive responsibility to correct it (…).'
>
> (Shue 2017: 593)

Each individual will limit all CO2-intensive activities except those that he/she really cherishes, according to the personal welfare function. The negative impact for the climate is always zero, after all.

Source: Shue, Henry (2017): Responsible for What? Carbon Producer CO2 Contributions and the Energy Transition. Climatic Change144 (4): 591–596.

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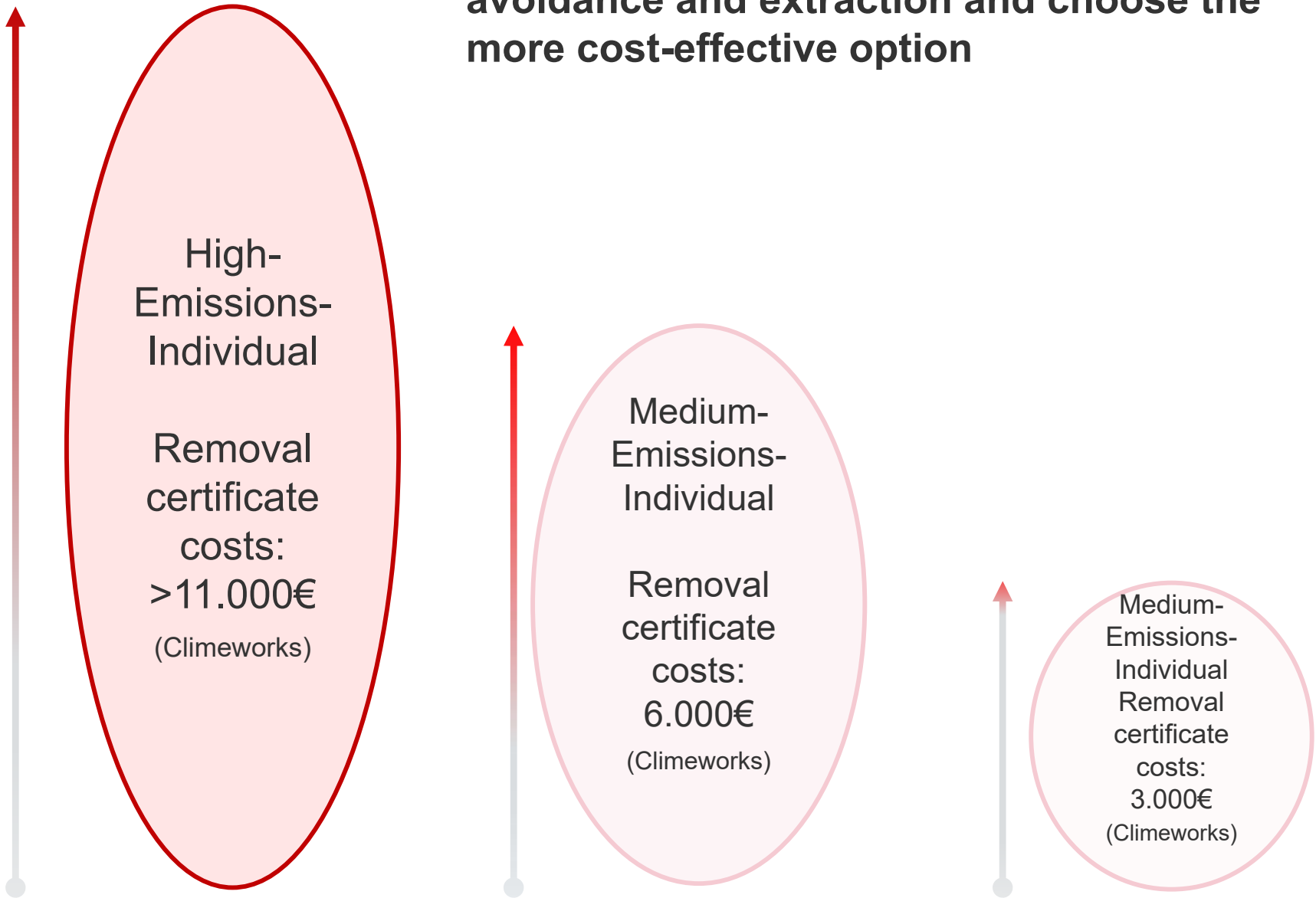
In fact, CO2 avoidance saves money in this framework. The individual will consider his or her own preferences when choosing between avoidance and extraction and choose the more cost-effective option



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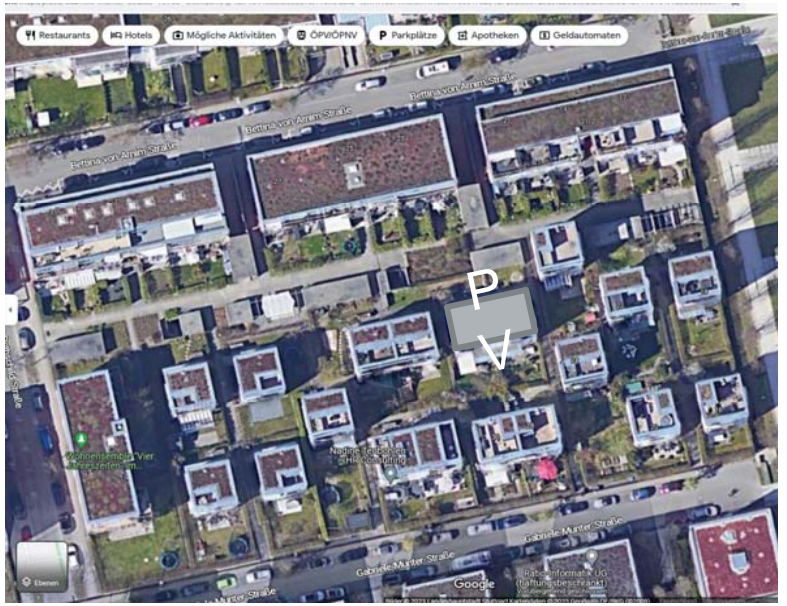
3. Objection (personal zero-emissions target leads to financial overload): **It depends!**

Could be true for some, but certainly not for all.

The carbon footprint of the lower-income half of the world's population in all emissions is 12%.

The world's highest-income 10% are responsible for a total of 48% of global CO2 emissions.*



*** Quellen: Chancel, L (2022): Global carbon inequality over 1990–2019. Nature Sustainability, vol.5:931-938; Bruckner, B et al (2022): Impacts of poverty alleviation on national and global carbon emissions. Nature Sustainability 5:311–320.**

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The IPCC stance on Carbon Dioxide Removal

Der IPCC weist seit Jahren beharrlich in seinen Berichten darauf hin, dass die Erderwärmung nur begrenzt werden kann, wenn die Menschheit Negativemissionen erzeugt, also durch aktives Handeln CO2 aus der Atmosphäre entnimmt:

„Alle Pfade, welche die globale Erwärmung ohne oder mit geringer Überschreitung auf 1,5 °C begrenzen, projizieren die Nutzung von Kohlendioxidentnahme (Carbon Dioxide Removal, CDR) in einer Größenordnung von 100–1.000 Gt CO2 im Verlauf des 21. Jahrhunderts. CDR würde genutzt werden, um verbleibende Emissionen auszugleichen, und um – in den meisten Fällen – netto negative Emissionen zu erzielen, um die globale Erwärmung nach einem Höchststand wieder auf 1,5 °C zurückzubringen. (…) Zu bestehenden und potenziellen CDR-Maßnahmen gehören unter anderem Aufforstung und Wiederaufforstung, Landrenaturierung und Kohlenstoffsequestrierung in Böden, BECCS, direkte Abscheidung von Kohlendioxid aus der Luft mit anschließender Speicherung (Direct Air Carbon Capture and Storage, DACCS) sowie beschleunigte Verwitterung und Ozean-Alkalisierung.“

(IPPC 2018a: 21)

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More literature on Direct Air Capture and Negative Emissions Technologies

European Academies' Science Advisory Council (2018): Negative emission technologies: What role in meeting Paris Agreement targets? EASAC policy report no. 35. https://easac.eu/publications/details/easac_net/.

Nationale Akademie der Wissenschaften Leopoldina / acatech – Deutsche Akademie der Technikwissenschaften / Union der deutschen Akademien der Wissenschaften (2022): Was sind negative Emissionen, und warum brauchen wir sie? https://doi.org/10.48669/ESYS_2022-2

National Academies of Sciences, Engineering, and Medicine (2018): Negative Emissions Technologies and Reliable Sequestration: A Research Agenda. https://www.nationalacademies.org/our-work/developing-a-research-agenda-for-carbon-dioxide-removal-and-reliable-sequestration.

Shayegh S, Bosetti V and Tavoni M (2021): Future Prospects of Direct Air Capture Technologies: Insights From an Expert Elicitation Survey. Front. Clim. 3:630893. doi: 10.3389/fclim.2021.630893

Smith, Stephen M / Geden, Oliver / Minx, Jan C / Nemet, Gregory F (2022): The State of Carbon Dioxid Removal. A global, independent scientific assessment of Carbon Dioxide Removal. https://static1.squarespace.com/static/633458017a1ae214f3772c76/t/63c8876b8b92bf2549e83ed5/1674086272412/SoCDR-1st-edition.pdf

Aktuelle Podcasts:

https://www.tagesspiegel.de/wirtschaft/klima-podcast-gradmesser-67-ccs-co2-in-die-erde-statt-in-die-atmosphare-9249744.html. (27.1.23).

https://www.deutschlandfunk.de/ccs-vorbild-verzehnfachung-von-islands-co2-verpressung-dlf-cec974ef-100.html (5.1.23)

https://www.deutschlandfunk.de/co2-speicherung-in-deutschem-boden-100.html (16.1.23)

https://www.deutschlandfunk.de/co2-aus-der-luft-filtern-was-kann-die-direct-air-capture-100.html (2.11.21)

Webseiten: https://ccsknowledge.com; https://www.1pointfive.com/; https://climeworks.com (dort auch diverse Geschäftsberichte), https://www.co2ketzin.de/startseite; https://www.climaterepair.cam.ac.uk/ bzw. z.T. https://www.climaterepair.cam.ac.uk/resources-publications

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4. Objection (moral overload: as long as others don't commit to this personal zero-emissions goal, I don't have to either) **- false**

1) Let us assume that 10 people could prevent, without endangering themselves, an event in which 10 other people would die in the period of the next 80 years. Would they then have the duty or responsibility to prevent this event?
2) Let's assume that 1000 people could prevent an event without endangering themselves, in which 1000 other people would die within the next 80 years. Would they then have the duty or responsibility to prevent this event?
3) Let's assume that 1 million people could prevent an event without endangering themselves, in which 1 million other people would die within the next 80 years. Would this group of people then have the duty or responsibility to prevent this event? From my point of view, the answer to the last question is yes, just like the questions before. Individual responsibility does not disappear with the increasing number of actors.

Note: Tipping points are relevant to the debate, but so far they do not provide scientific confirmation for 4. objection. A point from which further 'runaway' climate change would be unavoidable has not yet been reached.

*** Literature (pro and contra): Johnson 2003; Sinnott-Armstrong 2005; Sandel 2010; Cripps 2013; Hourdequin 2010; Nolt 2013; Schwenkenbecher 2014, Morgan-Knapp/Goodman 2015; Gesang 2017, Burri 2020.**

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Summary: Reducing one’s footprint to zero is required "from the moral point of view".

Climate change is threatening our very existence, and dealing with this crisis is one of the greatest challenges of our time. How personal and how individual is the responsibility that arises from this? There is a responsibility to reduce one's personal carbon footprint to net zero. This applies even if others do not act in this way. An increase in the number of actors capable of taking action does not lead to the disappearance of individual responsibility. It has been possible for some years to reduce the personal CO2 footprint to zero by changing one's lifestyle, combined with financing negative emissions. This is possible for many millions of inhabitants of rich countries (or for rich individuals in poorer countries) without financial overload. Through further research and CO2 storage worldwide, the cost of personal negative emissions would be able to fall sharply in the medium term (from now 1000€ to around 200€ per ton for the gold standard).

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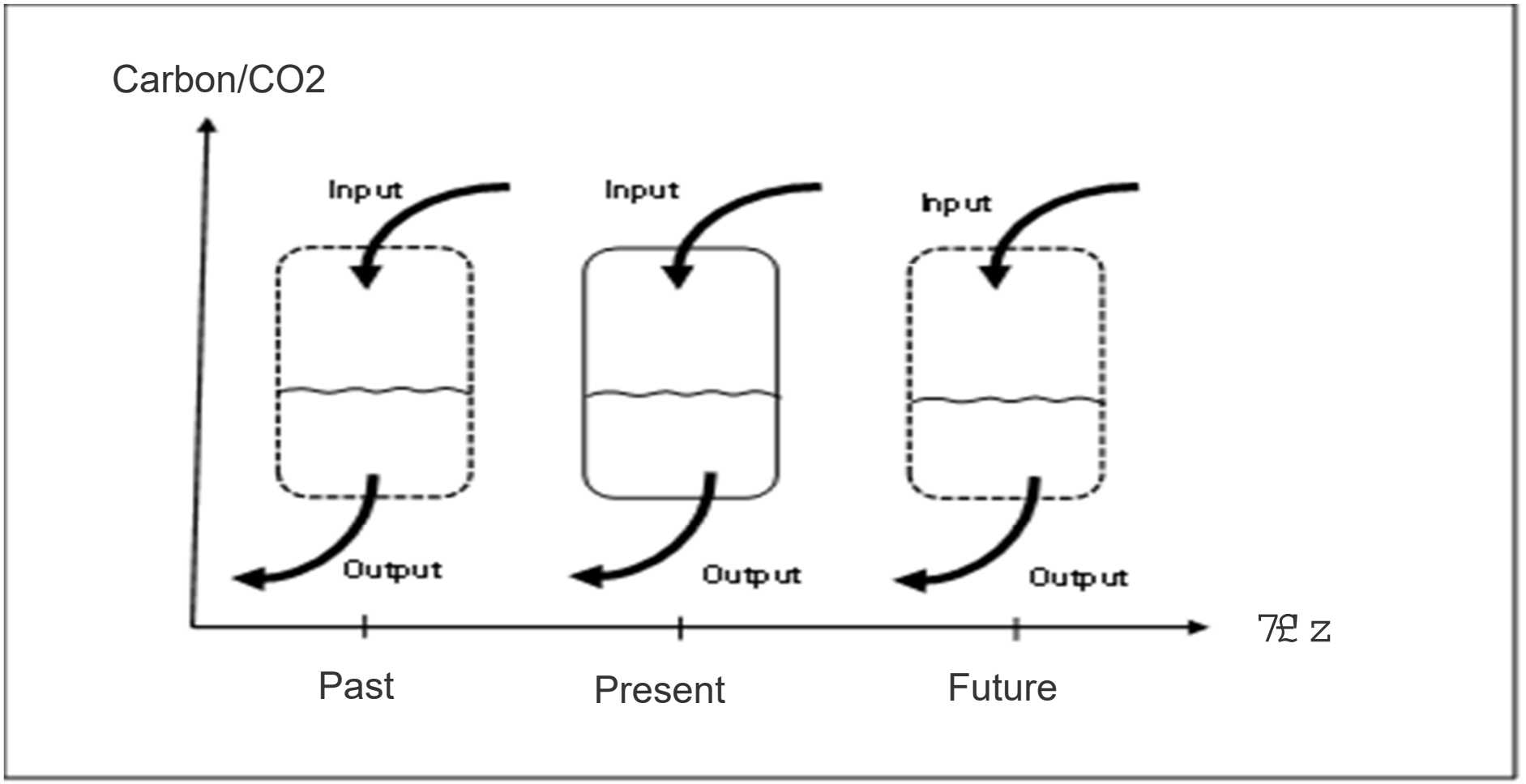
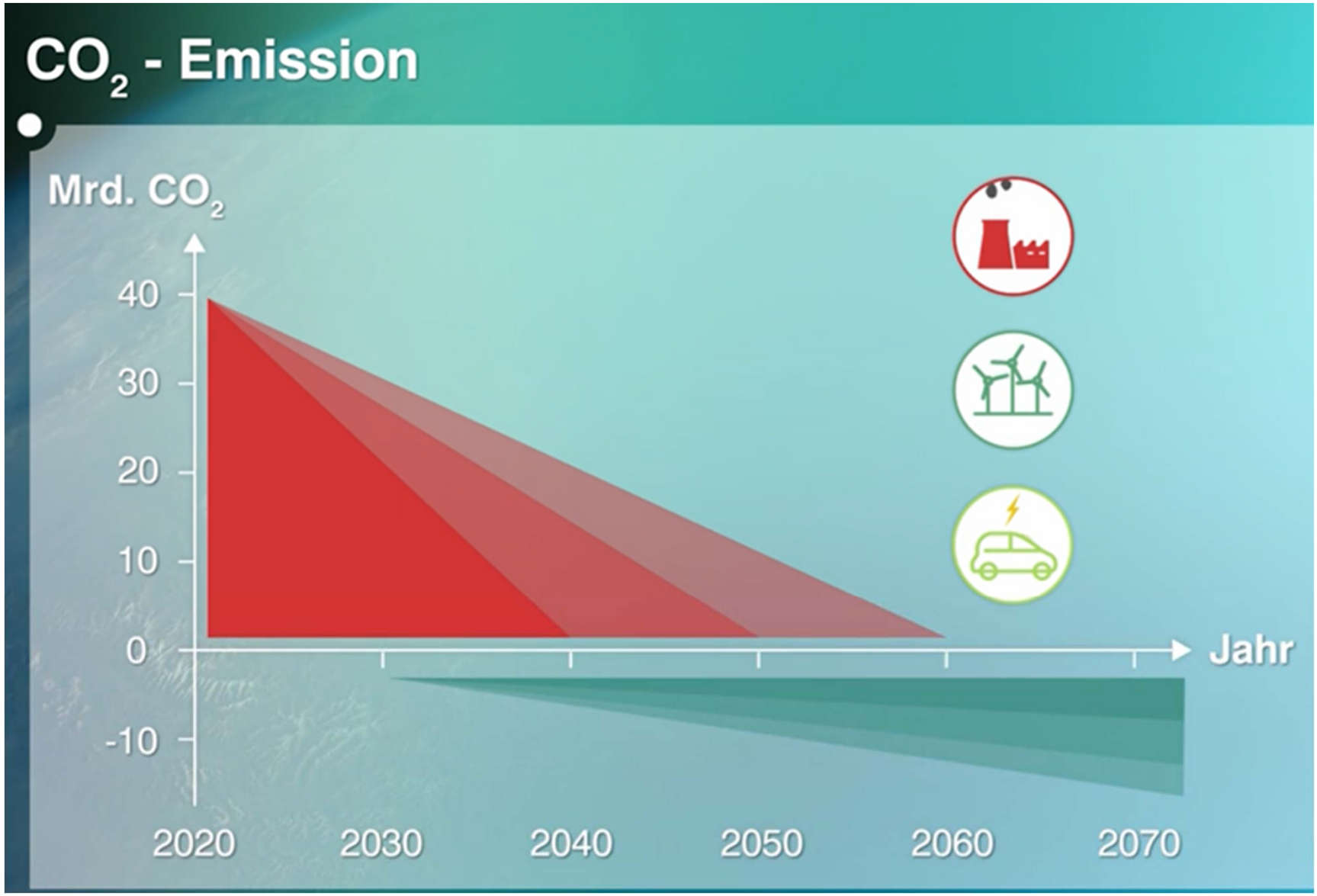
From the individual to the societal dimension: The Carbon Cycle from 2050 until forever

The world will have to spend up to 3 percent of its GNP on carbon dioxide removal in the future. And it must do so permanently. A permanent duty of care for the climate has arisen for mankind and there will (have to) be a permanent carbon cycle in the sense of a dynamic equilibrium in the future.




CO_2 - Emission
Mrd. CO_2
40
30
20
10
0
-10
Jahr
2020
2030
2040
2050
2060
2070

Takk. Danke. Thanks.

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