Global Prospects for a Low Carbon Future

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Sustainable Development International

January 25, 2021

EEE FORUM

ETHICS AND ECOLOGICAL ECONOMICS FORUM
https://eeeforum.org/

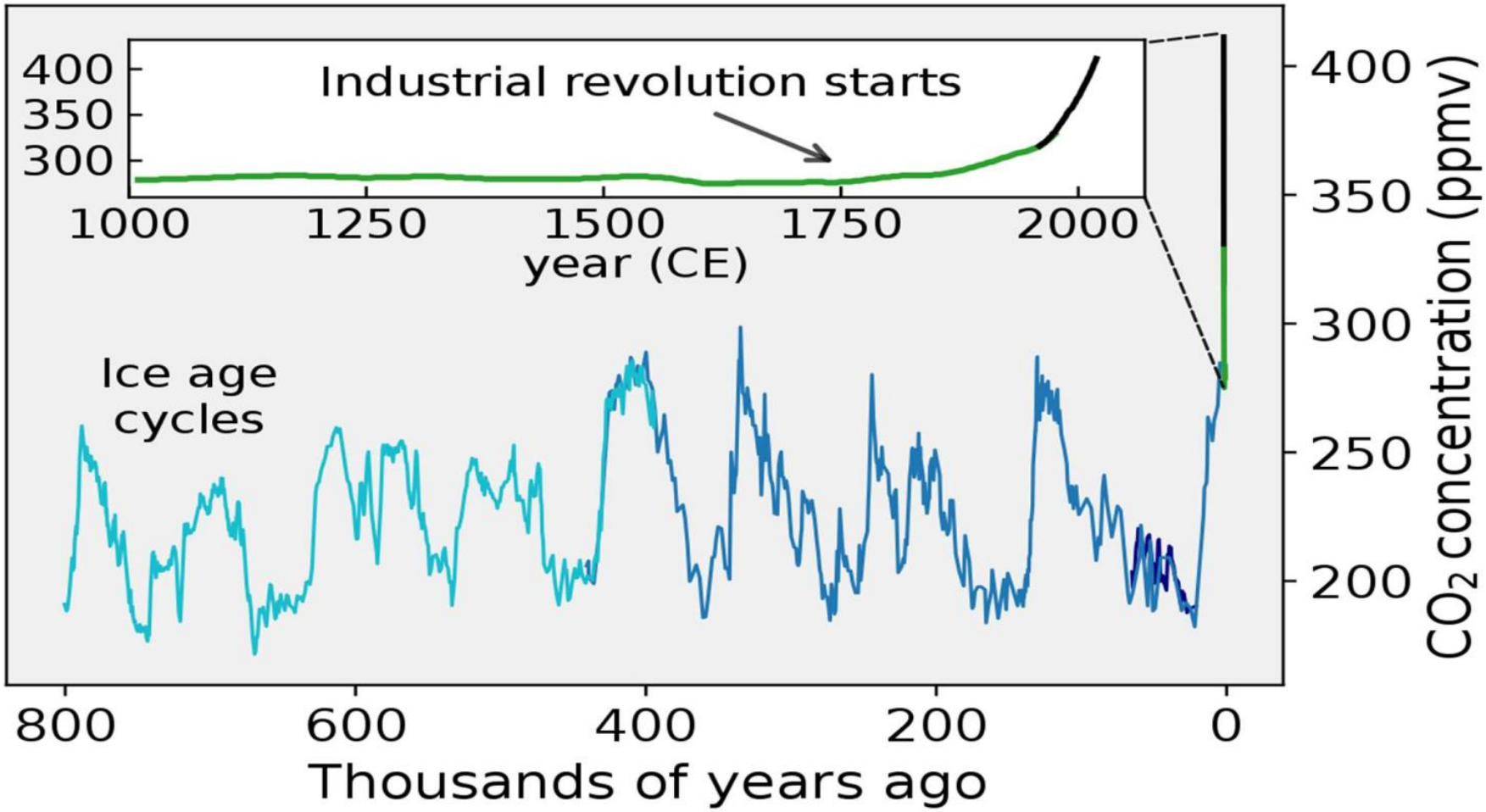
The Ugly

The Ugly

The Ugly

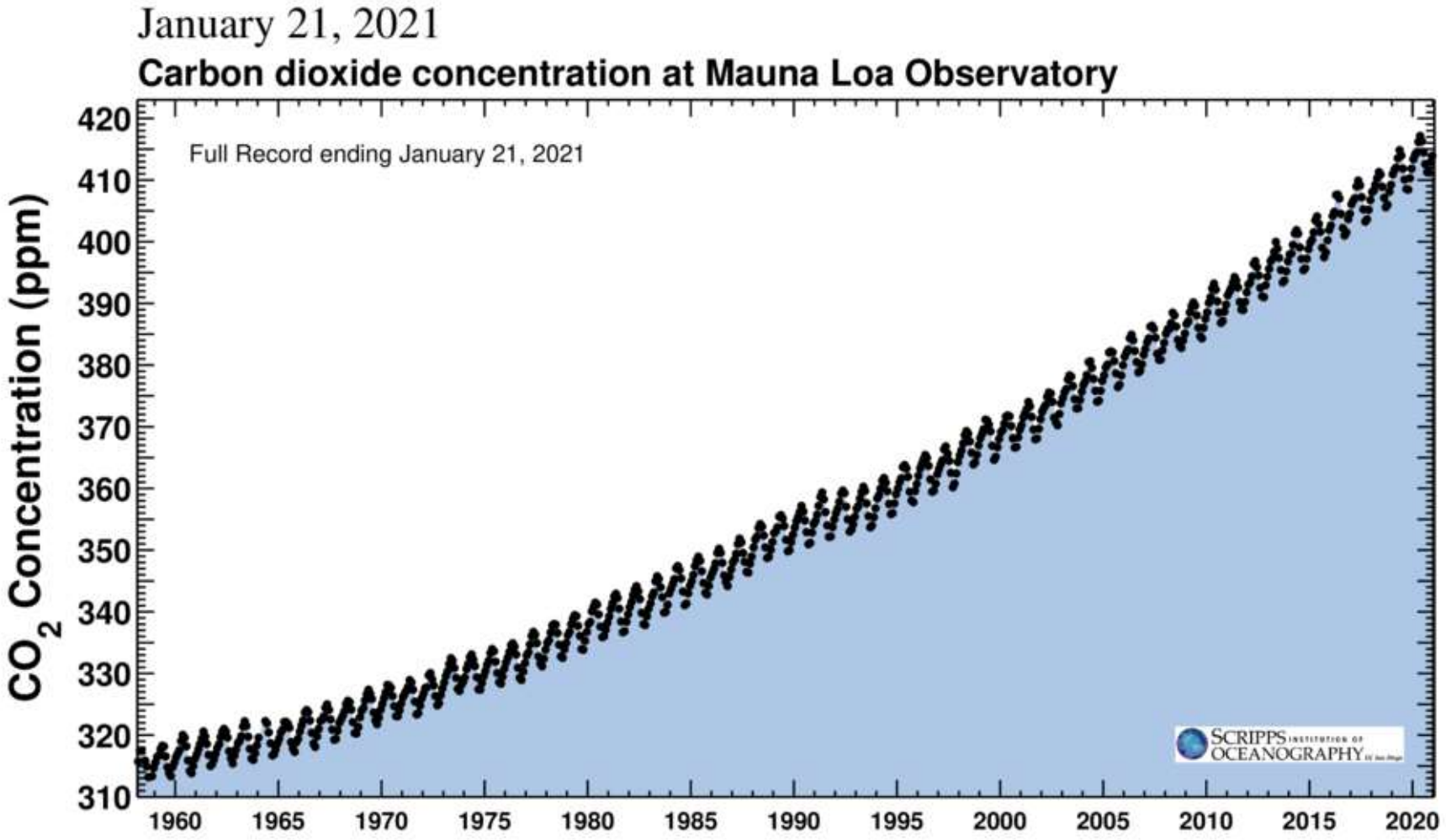
Change

CO2 concentrations over the last 800,000 years



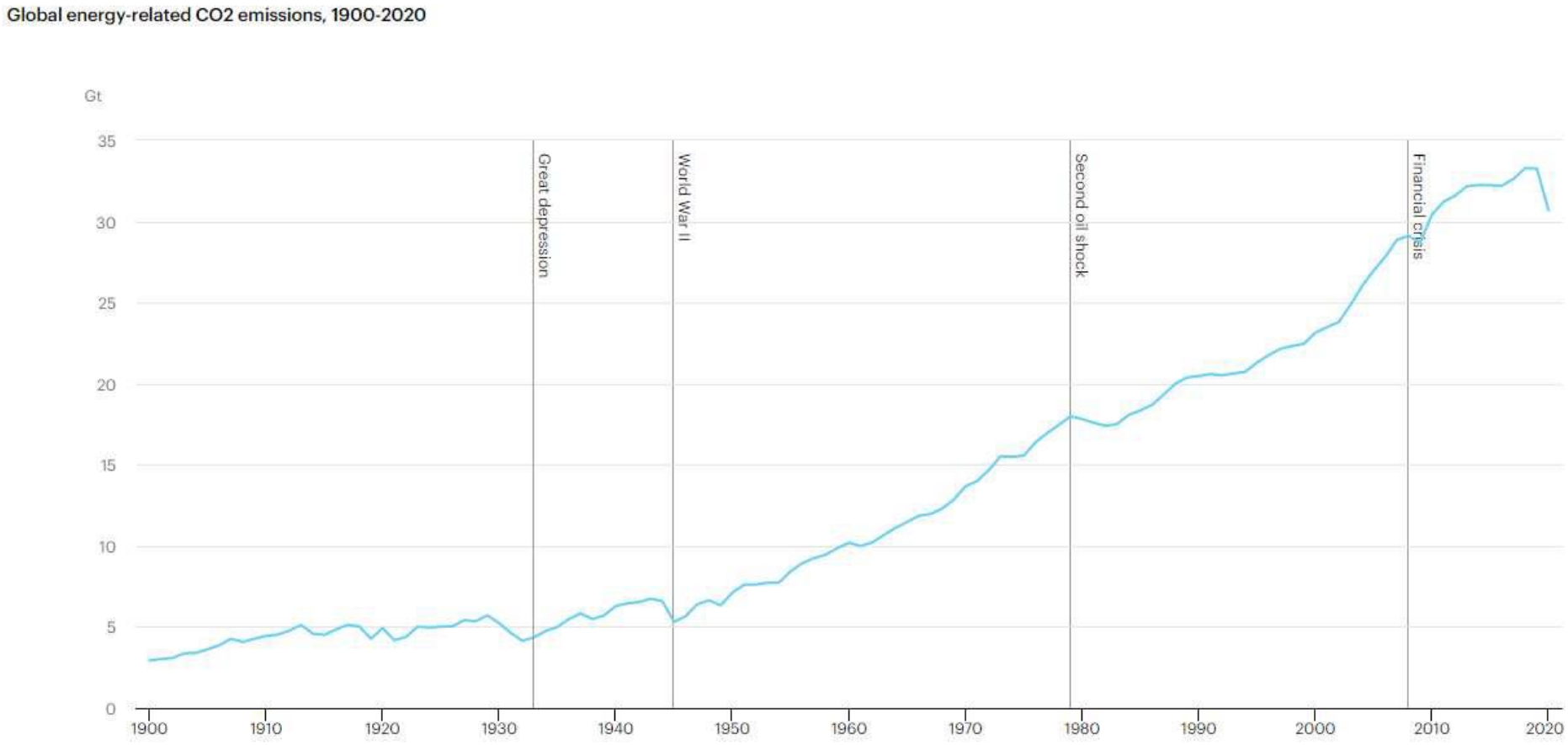
Femke Nijsse - File:Carbon Dioxide 800kyr.svg

The Keeling Curve – 415.29 ppm’



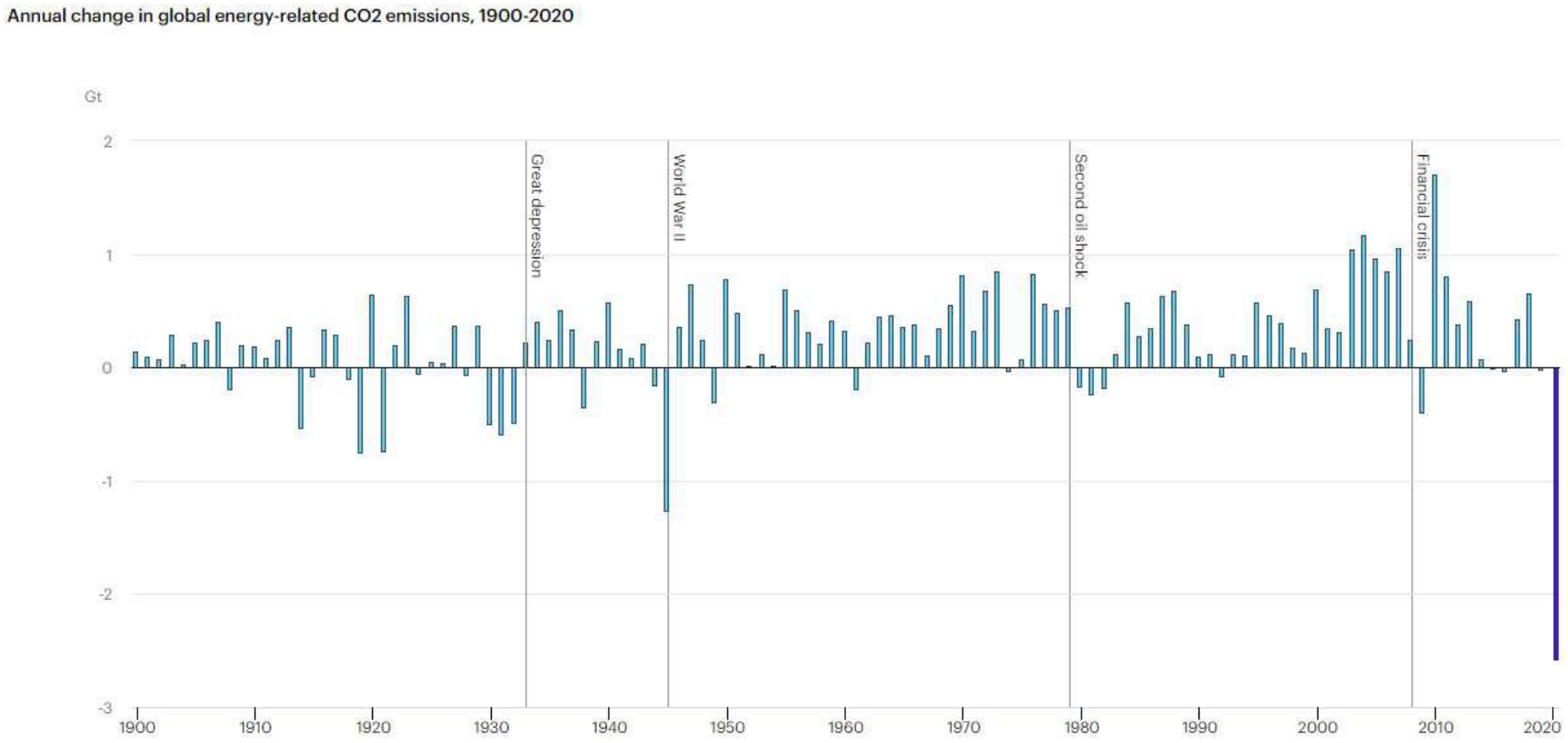
The Keeling Curve (ucsd.edu) SCRIPPS Institution of Oceanography

Global Energy Related CO2 Emissions 1900 -2020



https://www.iea.org/reports/global-energy-review-2020/global-energy-and-co2-emissions-in-2020

Annual Change Global Energy Related CO2 Emissions 1900-2020



https://www.iea.org/reports/global-energy-review-2020/global-energy-and-co2-emissions-in-2020

Why Has a Drop in Global CO2 Emissions Not Caused CO2 Levels in the Atmosphere to Stabilize?

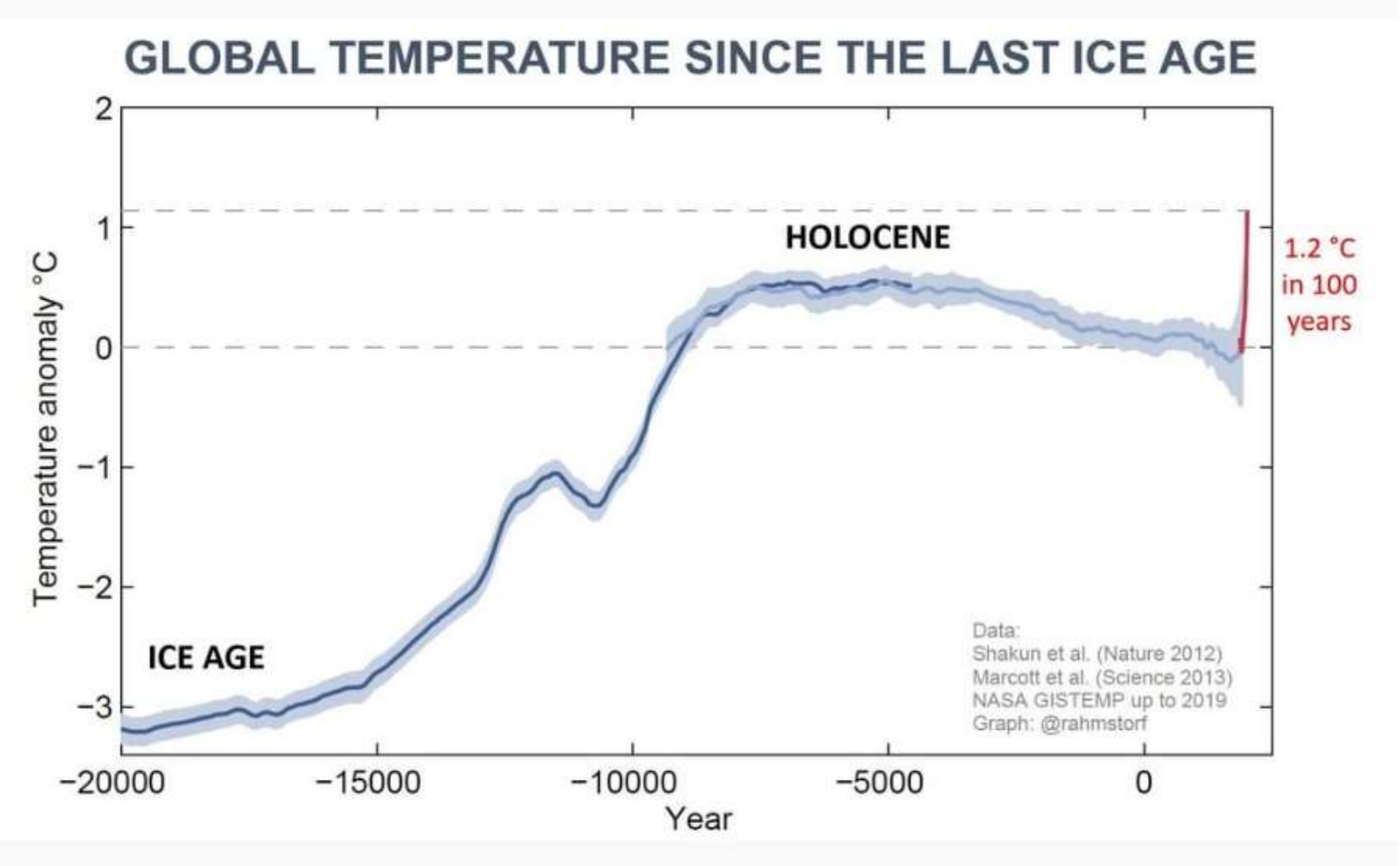
CO2 is released into the atmosphere from the burning of fossil fuels:

- 50% remains in the atmosphere,
- 25% is absorbed by land plants and trees,
- 25% is absorbed into areas of the ocean.

SCRIPPS Director Ralph Keeling:
The ocean and land sinks for CO2 currently offset only about 50 percent of the emissions.
The equivalent of 50 percent of the emissions is still accumulating in the atmosphere, even with level emissions.
To stabilize CO2 levels would require ran immediate roughly 50 percent cut in emissions, at which point the remaining emissions would be fully offset by the sinks.

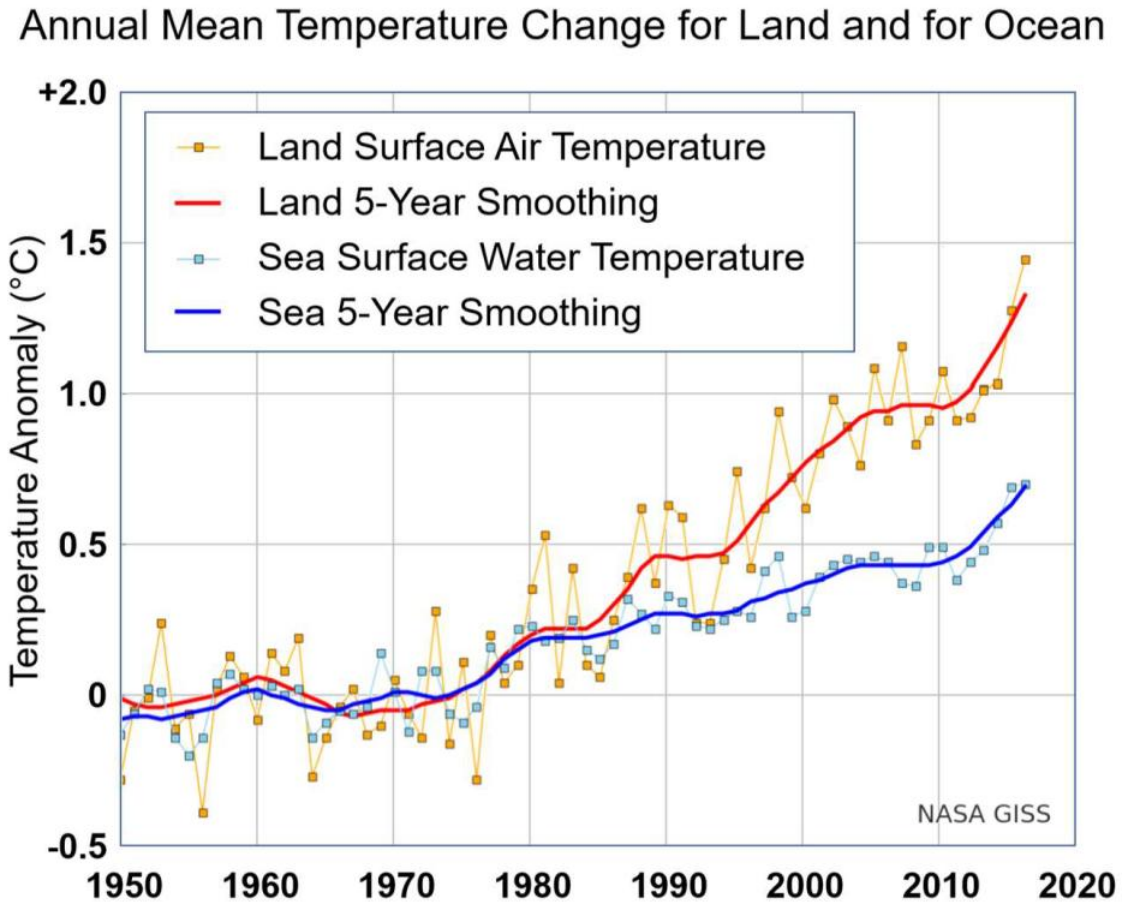
The Keeling Curve (ucsd.edu) SCRIPPS Institution of Oceanography

Global Temperature Since Ice Age



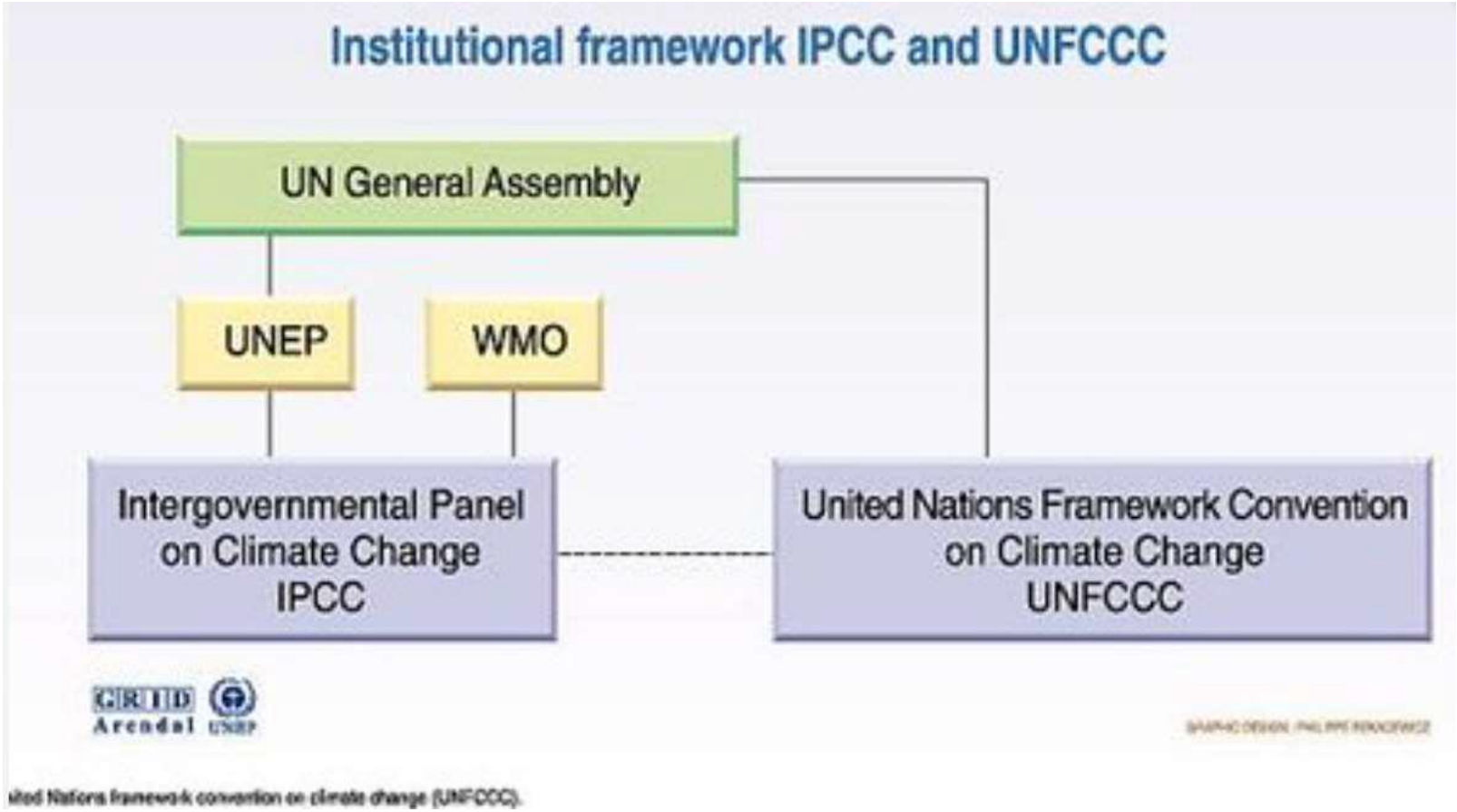
Stefan Rahmstorf - Climate scientist. Professor of Physics of the Oceans at Potsdam University. Head of Earth System Analysis at PIK.

The Bad - Land Ocean Temperatures



NASA Goddard Institute for Space Studies - 14 November 2019
http://data.giss.nasa.gov/gistemp/graphs/
https://sos.noaa.gov/datasets/ocean-atmosphere-co2-exchange/

IPCC and UNFCCC - Institutional Framework



UNEP - UN Environment Programme

WMO – World Meteorological Organization

https://www.grida.no/resources/6454

The UNFCCC - Timeline

UNFCCC – United Nations Framework Convention on Climate Change – International Treaty

- November 1988 - World Meteorological Organization WMO and UN Environment Programme (UNEP) establish the **Intergovernmental Panel on Climate Change - IPCC**.
- June 1992 - Rio Earth Summit – UNFCCC Opens for Signature U.S. Signed 1992, not ratified
- March 1994 - UNFCCC Treaty Enters into Force – 50th Ratification, Russia, 196 Parties Signed
- December 1997 - Kyoto Protocol Adopted by COP3
- July 2001 – Operational rulebook for the 1997 Kyoto Protocol – minus U.S.
- February 16, 2005 – Ratified - Kyoto Protocol an international treaty – minus U.S.

Key Milestones in the Evolution of International Climate Policy
https://unfccc.int/timeline/

The UNFCCC – Paris Agreement

- 2013 - IPCC releases its Fifth Assessment Report (AR5) on impacts, adaptation and vulnerability. Kyoto Agreement is not working
- 2015 - COP21 - Paris Agreement adopted - 195 nations.
  *Under the Paris Agreement, each Party shall prepare, communicate and maintain successive Nationally Determined Contributions (NDCs) that it intends to achieve. Parties shall pursue domestic **mitigation** measures, with the aim of achieving the objectives of such contributions.*
- April 2016, the United States became a signatory to the Paris Agreement,
- September 2016 - Accepted by executive order in, effective November 4, 2016.
- June 1, 2017 U.S. Announced intent to withdraw – formal notice effective **Nov 4, 2020.**
- **Jan 21, 2021 -** the U.S. will be rejoining the UNFCCC – Paris Agreement

Key Milestones in the Evolution of International Climate Policy
https://unfccc.int/timeline/

The Good - Greta Thunberg, et al

- CNN – No. 1 News Story of the Year
- Bloomberg COP25: “I’m here because Trump isn’t.”
- Pelosi and entourage of half dozen Congressional Reps at COP25: “We will be back very soon.”
- 10 minutes at the ISES –International Solar Energy Society booth.

The Top Five Global Coal **Producing** Countries

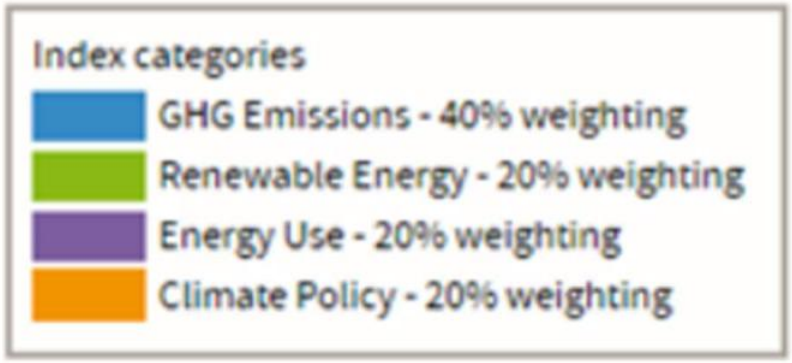
- China - 3,474mt (metric tonnes) rising 2.9%, peak of 3,749mt in 2013 - projected peak in 2023.
- India - 764mt, a rise of 5.3%
- U.S. - 684mt, 2019 610mt, 2020 540mt
  - *2019 - 25% coal power, 2020 - 22% coal power*
- Australia – 500mt – steady
- Indonesia – 474mt – steady (10mt in 1990)

https://www.power-technology.com/features/top-five-coal-producing-countries-world/

The Good The Bad The Ugly
CCPI – Climate Change Performance Index

The top 4 in 2020 CCPI ranking:

- Sweden (4)
- United Kingdom (5)
- Denmark (6)
- Morocco (7)



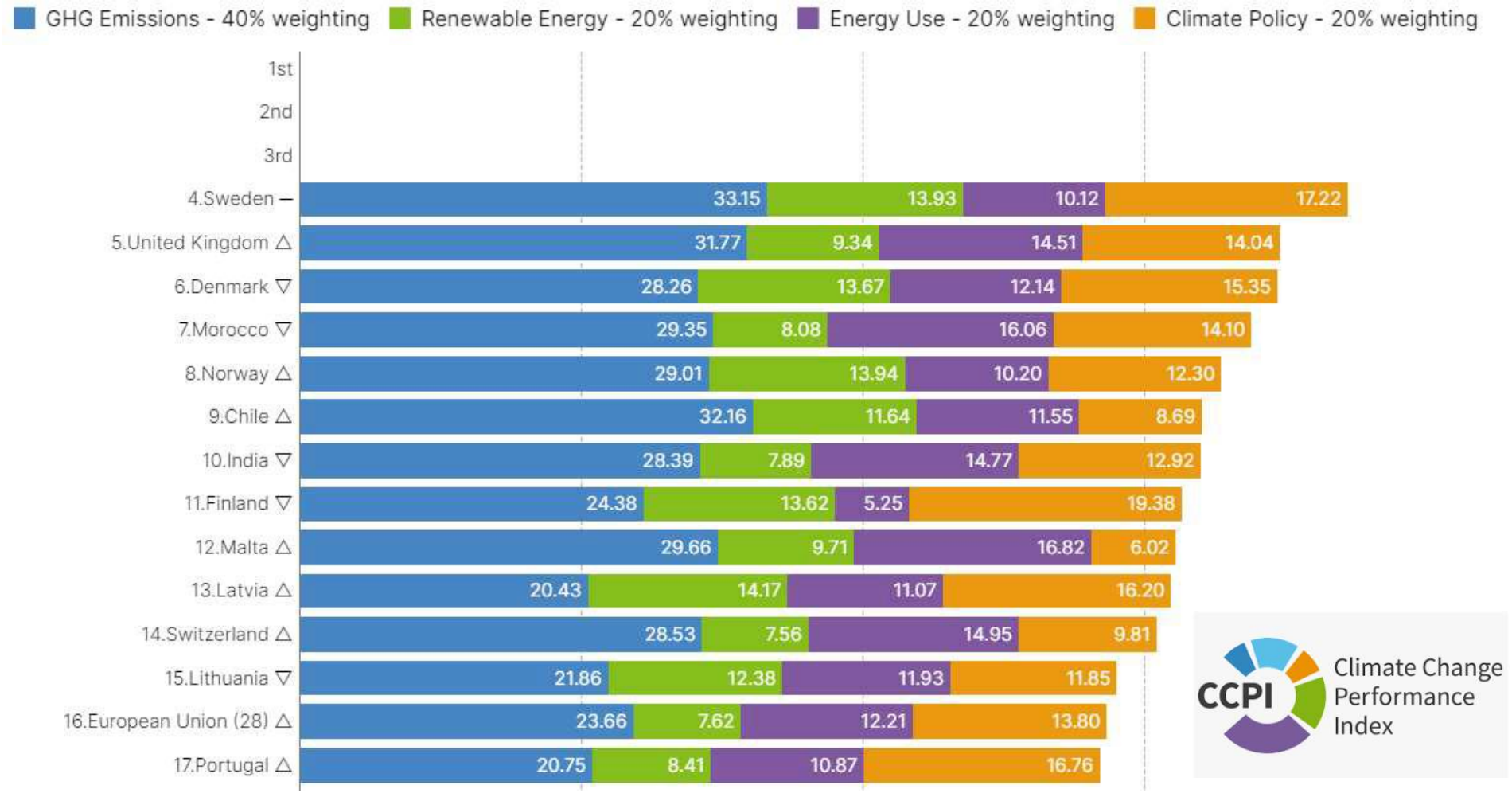
Bottom five are:

- Islamic Republic of Iran (57),
- Republic of Korea (South) (58),
- Chinese Taipei (Taiwan) (59),
- Saudi Arabia (60)
- United States (61), rated low or very low across almost all categories.

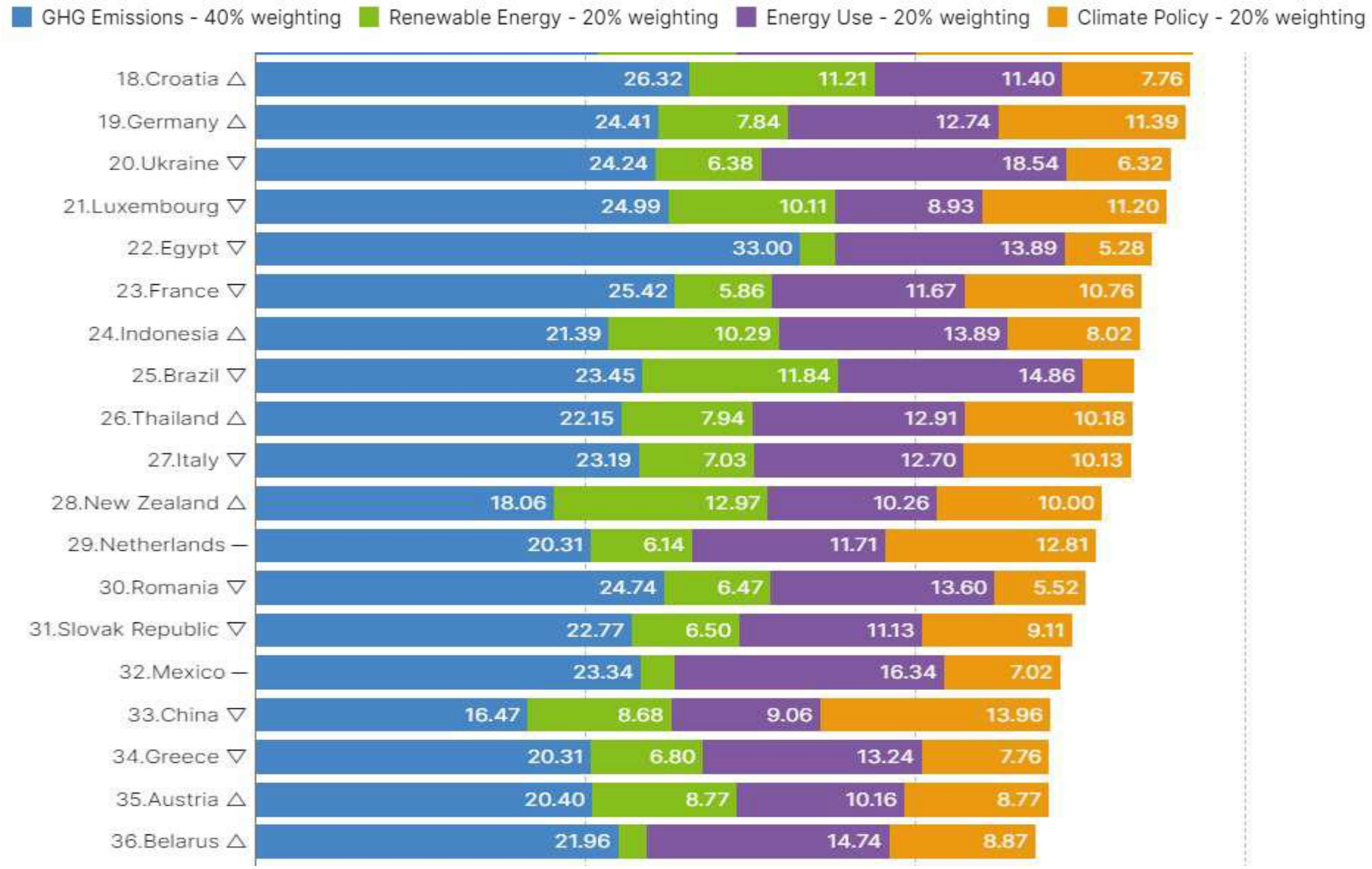
Published annually since 2005 by Germanwatch, the NewClimate Institute, and the Climate Action Network https://www.climate-change-performance-index.org/

CCPI – Climate Change Performance Index

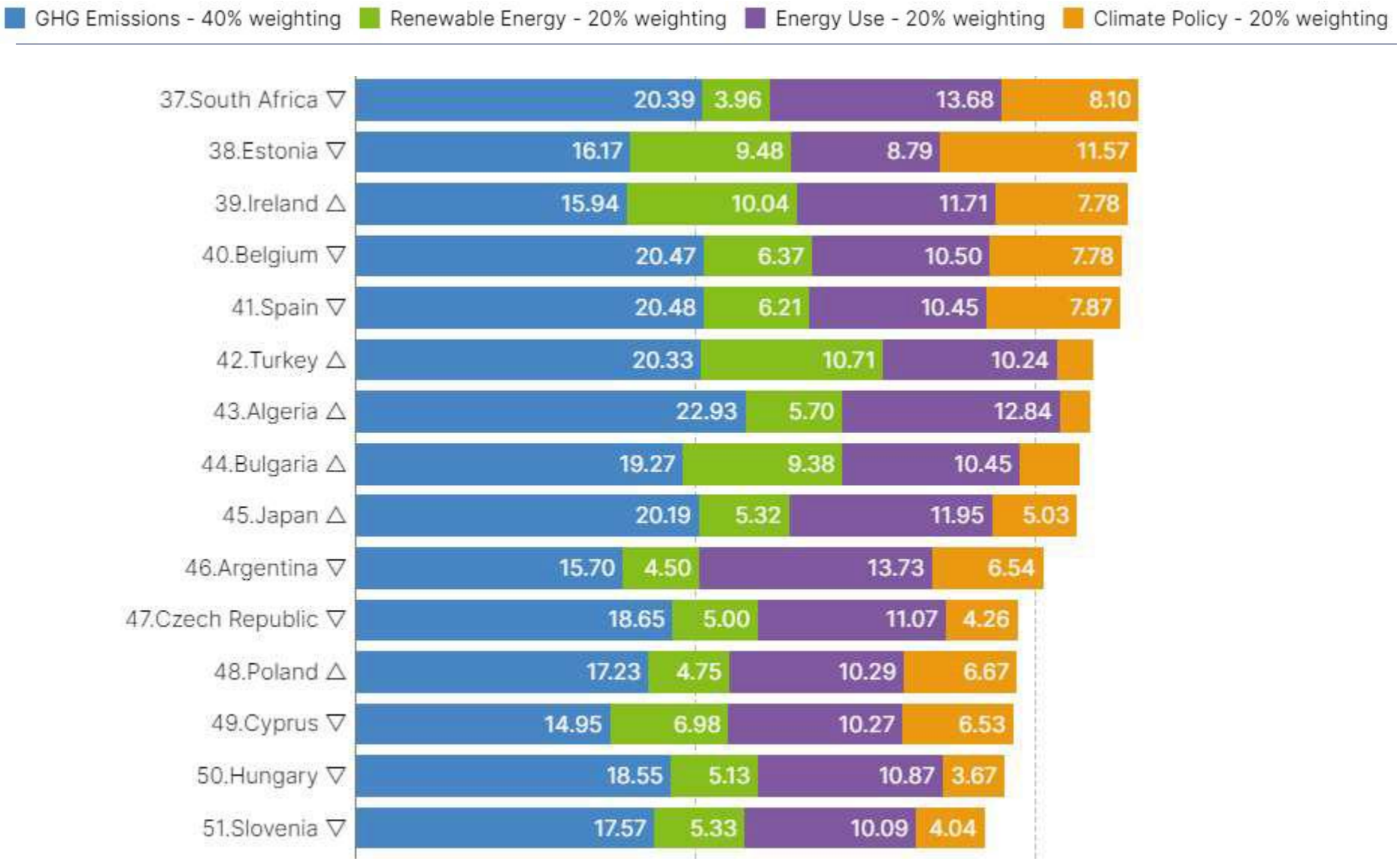
An aggregated performance in 14 indicators within four categories: GHG Emissions - Renewable Energy - Energy Use - Climate Policy



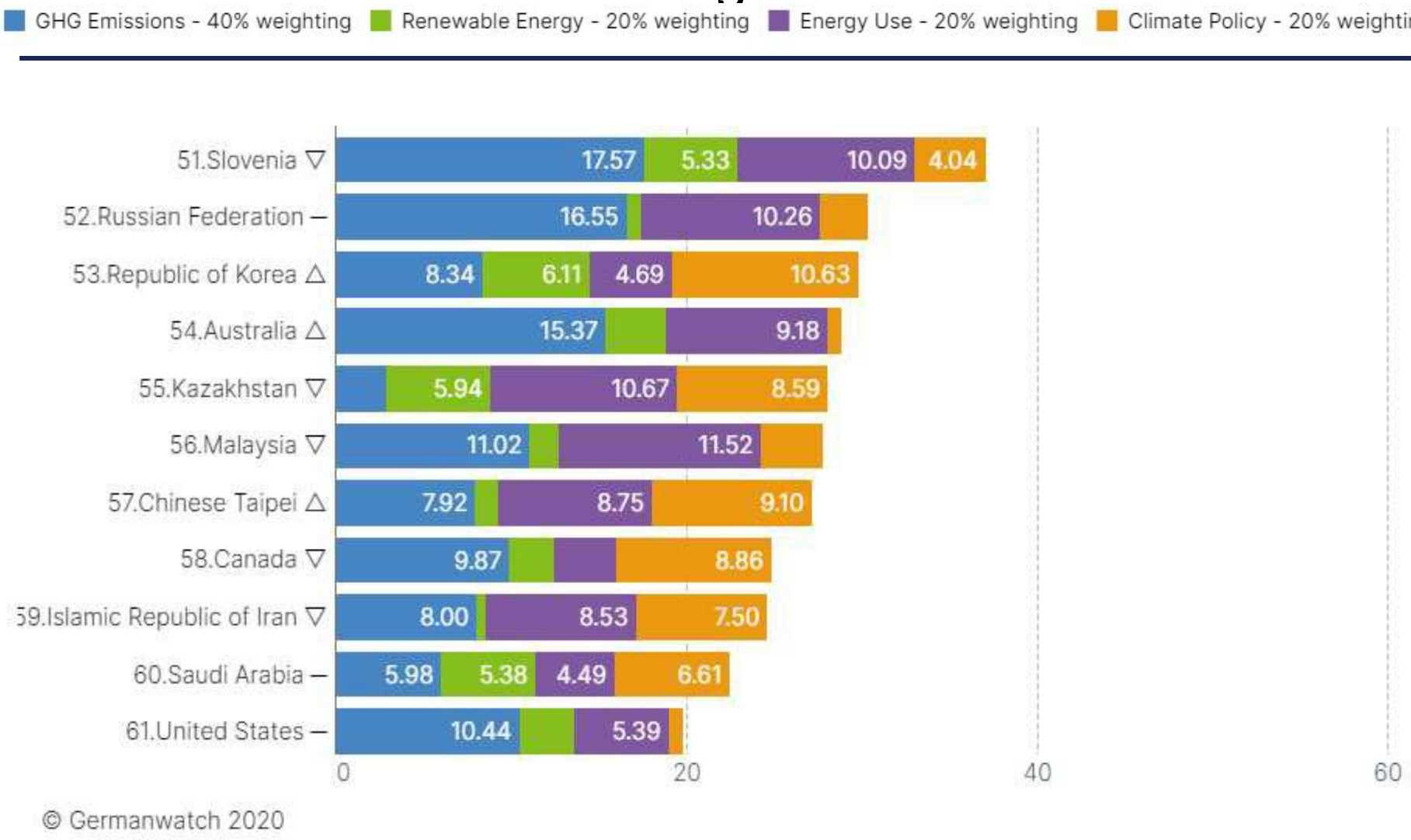
CCPI – Climate Change Performance Index



CCPI – Climate Change Performance Index

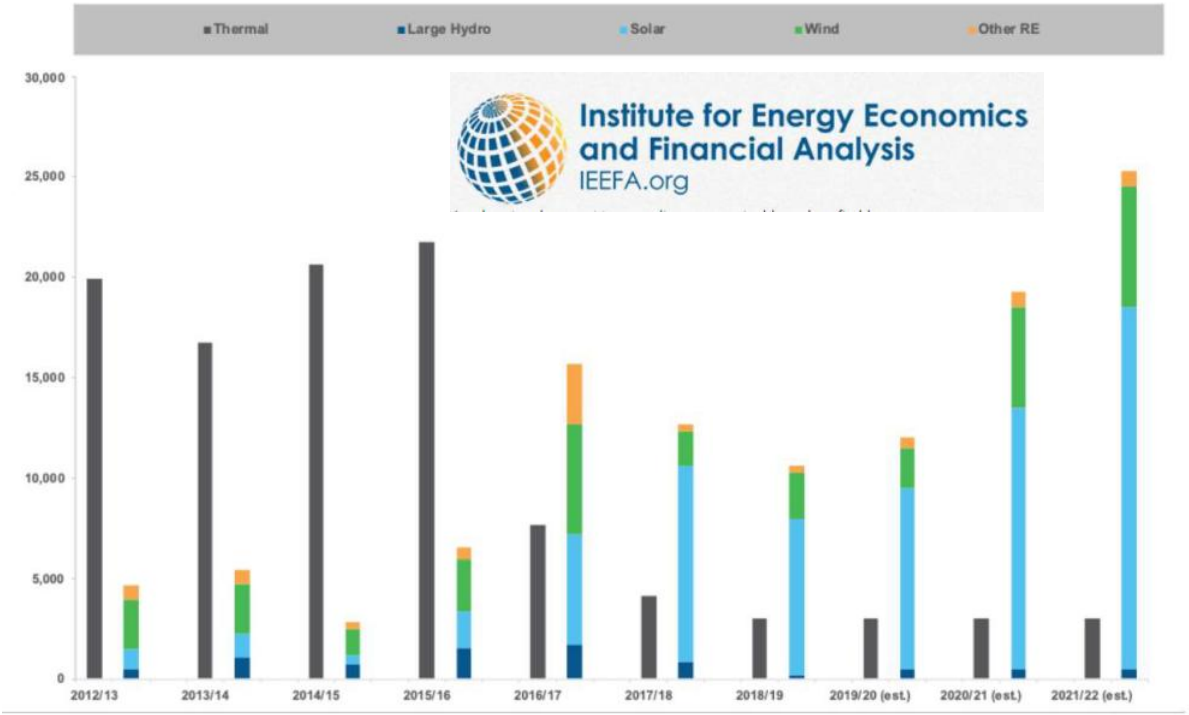


CCPI – Climate Change Performance Index



IEEFA - India gets out of coal and into renewables

India Thermal and Renewable Power Capacity Additions (MW)



$40 billion of new investment, a doubling of renewable energy capacity in three years, to 83 gigawatts by September 2019, with another 45 gigawatts of large scale hydro-electricity.
Solar USD 3 Cents per kilowatt-hour.

India's initial target of 175 gigawatts of renewable energy capacity by 2022 was expanded to a target of 275 gigawatts by 2027. In September 2019, Prime Minister Modi proclaimed a new target of 450 gigawatts by 2030, or another $500 billion of investment in the coming decade.
https://ieefa.org/india-gets-out-of-coal-and-into-renewables/

The Good – International Solar Alliance

ISA Framework Agreement – COP22 – Marrakesh Nov 2016

- Address the specific financial and solar technology deployment needs of the solar resource rich countries located between the Tropic of Cancer and the Tropic of Capricorn.
- 84 countries have signed the ISA Framework Agreement
- 63 countries have signed and ratified the ISA Framework Agreement. Headquarters in India - France
- Initial goal to raise and invest **$1 Trillion by 2030 for 1 Trillion watts installed solar capacity**.

isolaralliance.org/Index.aspx

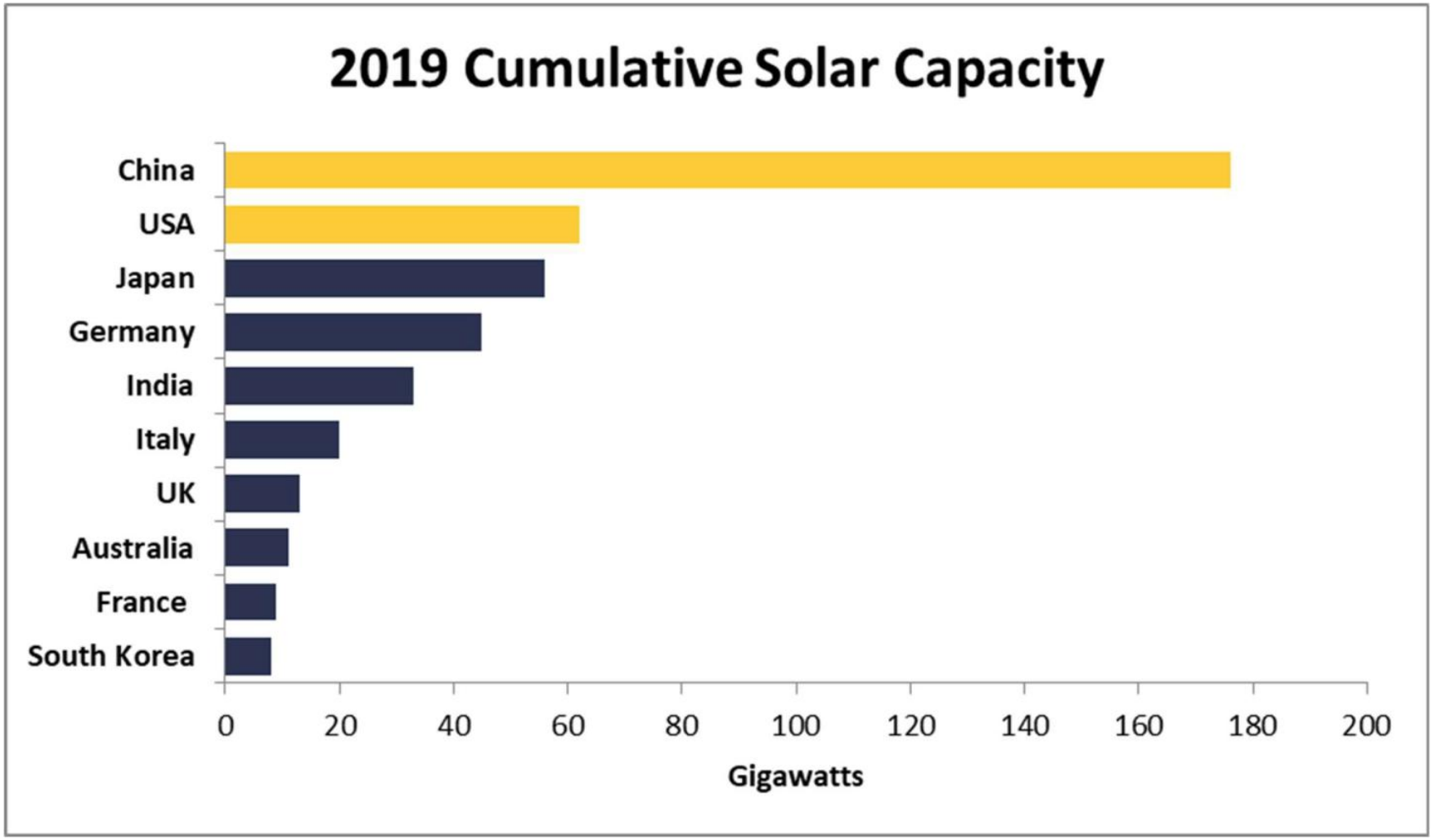
The Good – Will China Save the Planet?

‘ Will China Save the Planet?’ by Barbara Finamore, NATURAL RESOURCES DEFENSE COUNCIL - NRDC’s senior strategic director for Asia, witnessed the birth of China’s clean energy movement in June 1991. NRDC’s China Clean Energy Project – 30 people work in NRDC’s China office.

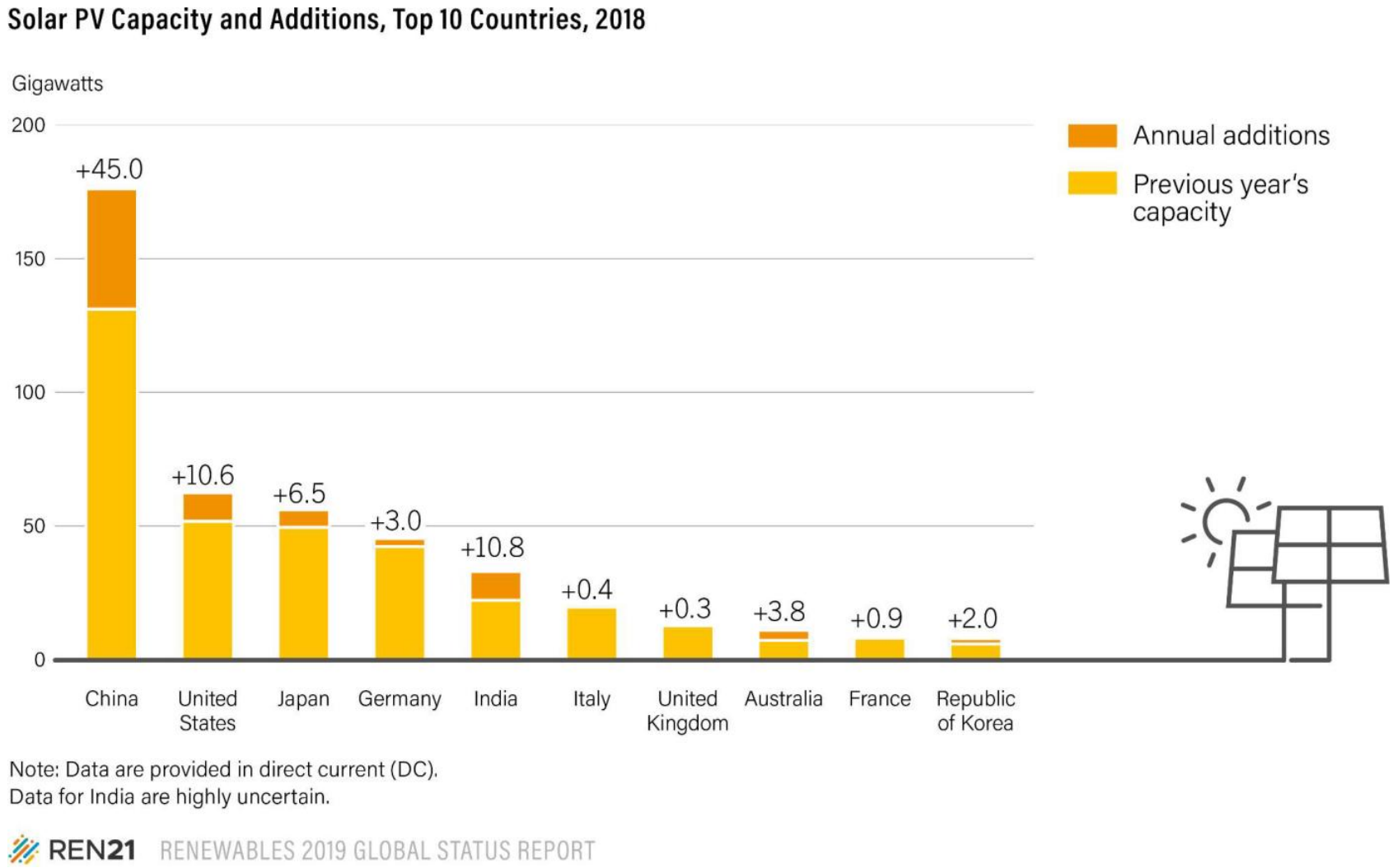
- China led global investment in solar - 7th successive year - $91.2 B
- China accounted for 32 per cent of the global total investment,
- China has 95%+ of the world’s electric buses,
- **Carbon program in 82 cities and 5 provinces to reach ‘Peak Carbon’ in 2-3 years and continue reducing after that.**

https://www.nrdc.org/stories/will-china-save-planet
https://www.nrdc.org/stories/keeping-close-watch-chinas-climate-transition
https://www.renewableenergyworld.com/2019/03/06/chinas-renewable-energy-installed-capacity-grew-12-percent-across-all-sources-in-2018/

Good - Global PV Capacity = 505 GW at end of 2018

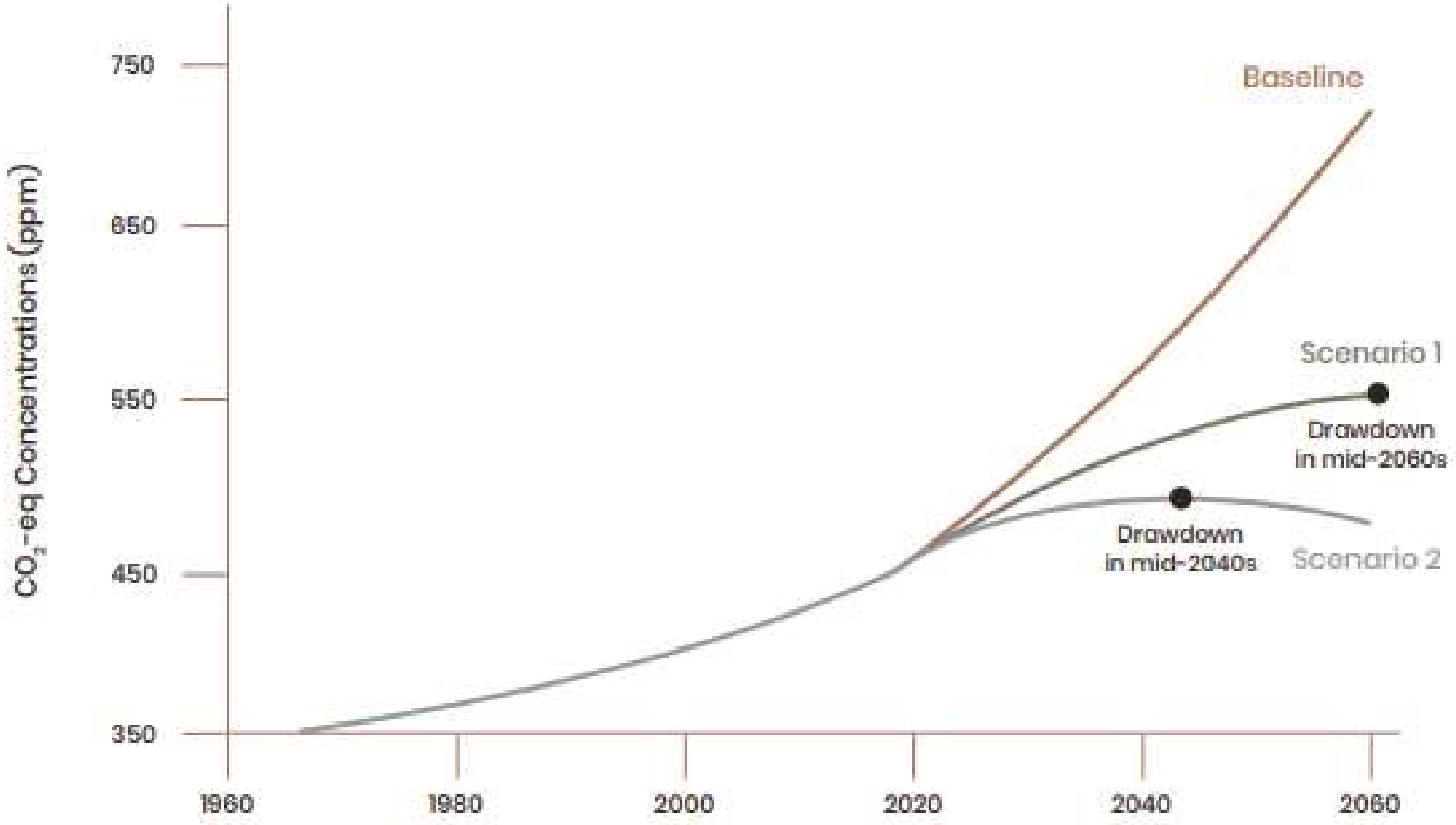


Global PV Capacity Additions: Top 10 Countries

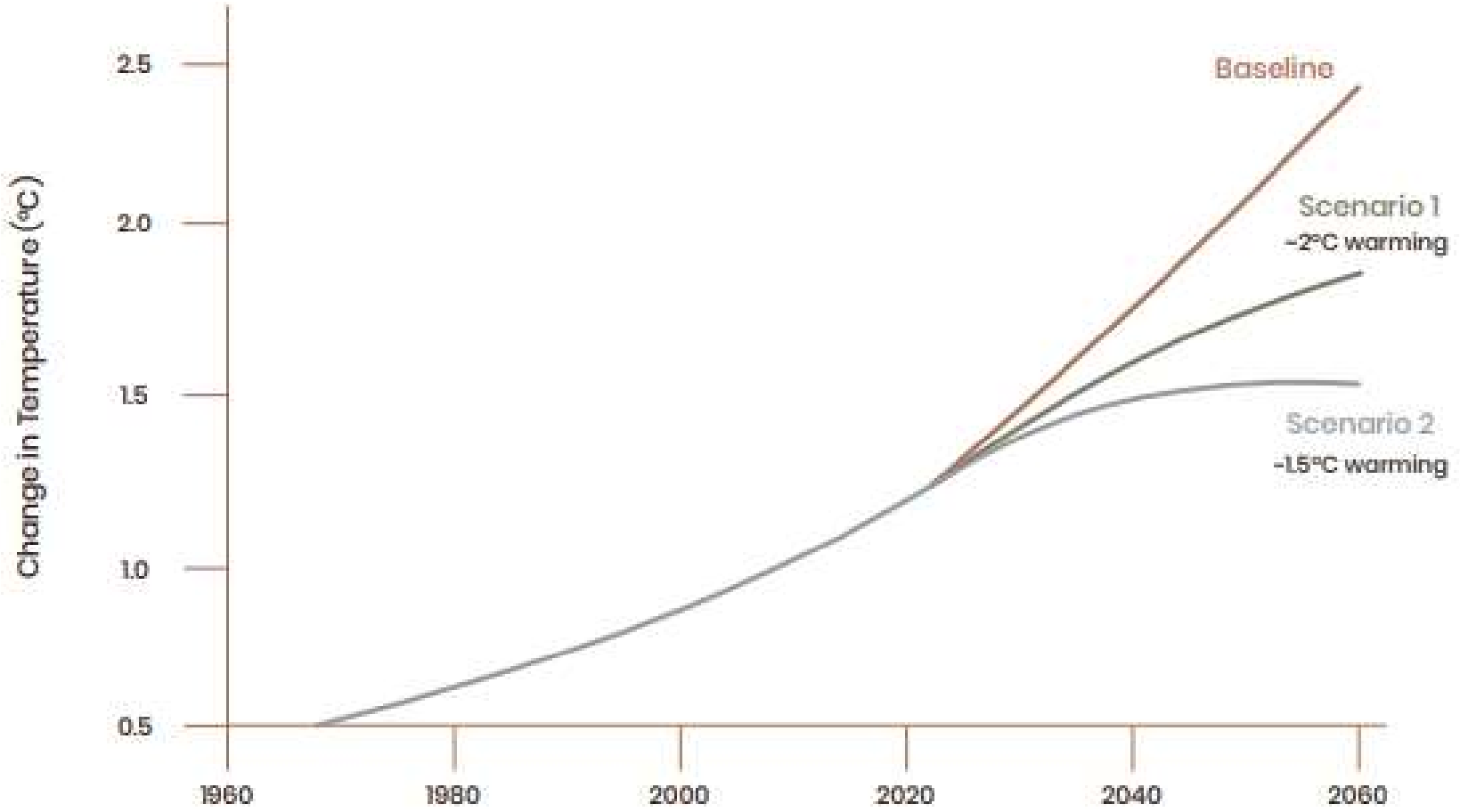


Project Drawdown – 2020 Review

Project Drawdown – 2020 Review
CO2 -eq (Gt) Concentrations (1960–2060)



Project Drawdown – 2020 Review
Temperature Change (1960–2060)



Project Drawdown – 2020 Review

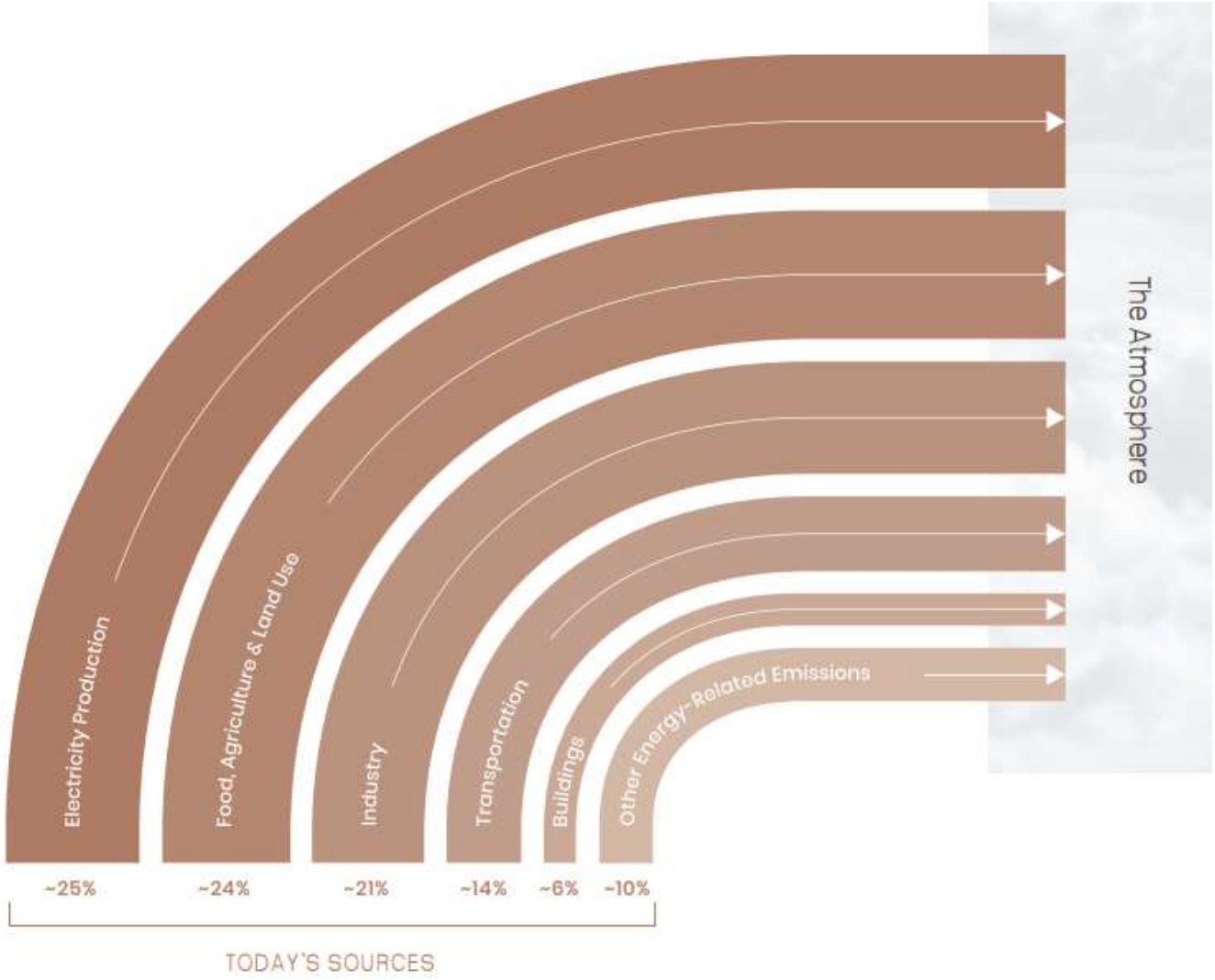
2 SCENARIOs - CO2-eq (Gt) Reduced / Sequestered 2020 –2050
TOTAL: MIN 649.2 - MAX 1,113.5

Drawdown Solutions Framework

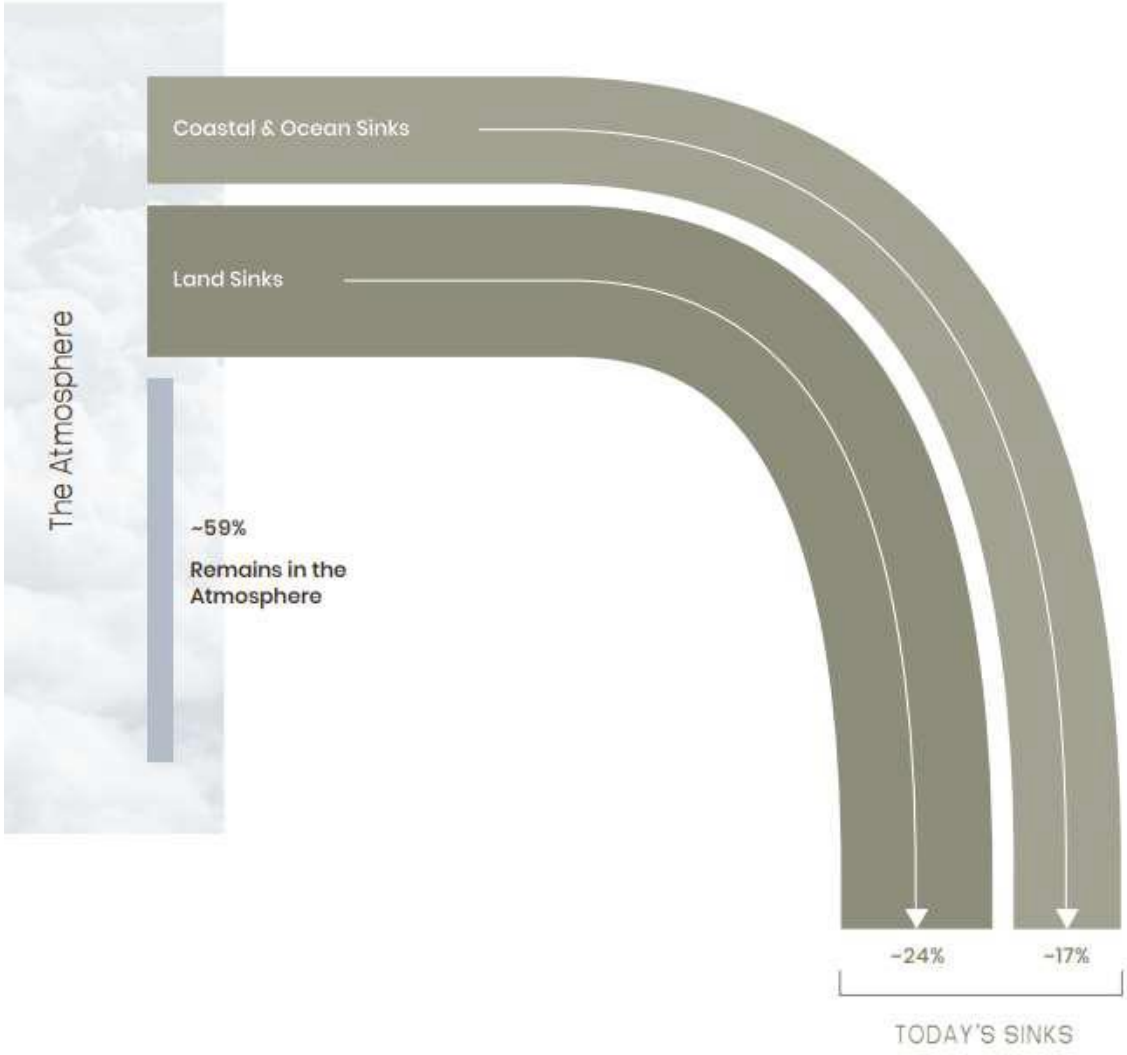
Reduce carbon dioxide, methane, nitrous oxide, fluorinated gases
- Heat-trapping greenhouse gases come from six sectors:

- ~25% Electricity Production
- ~24% Food, Agriculture & Land Use
- ~21% Industry
- ~14% Transportation
- ~6% Buildings
- ~10% Other Energy-Related Emissions

Project Drawdown – 2020 Review

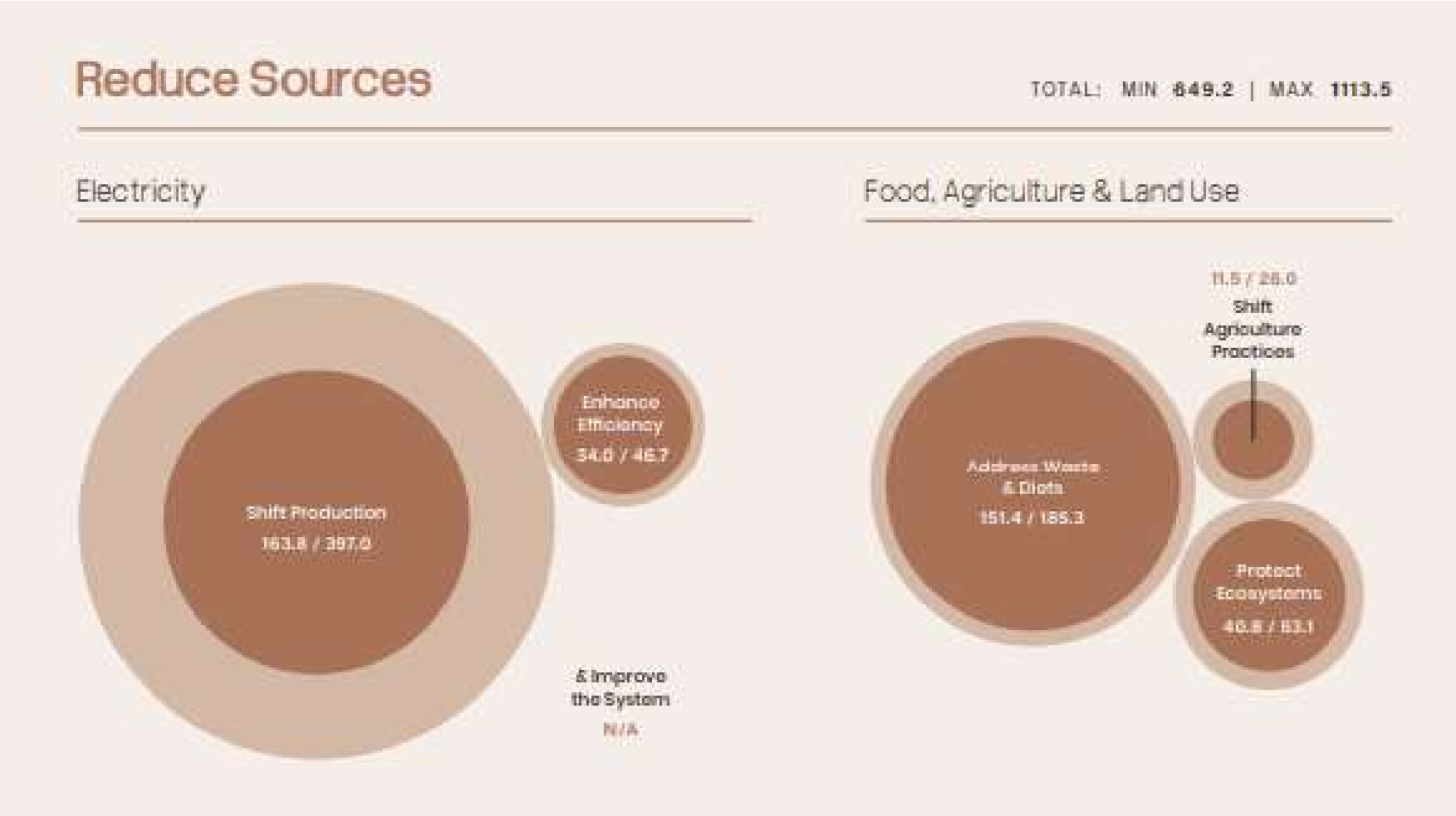


Project Drawdown – 2020 Review

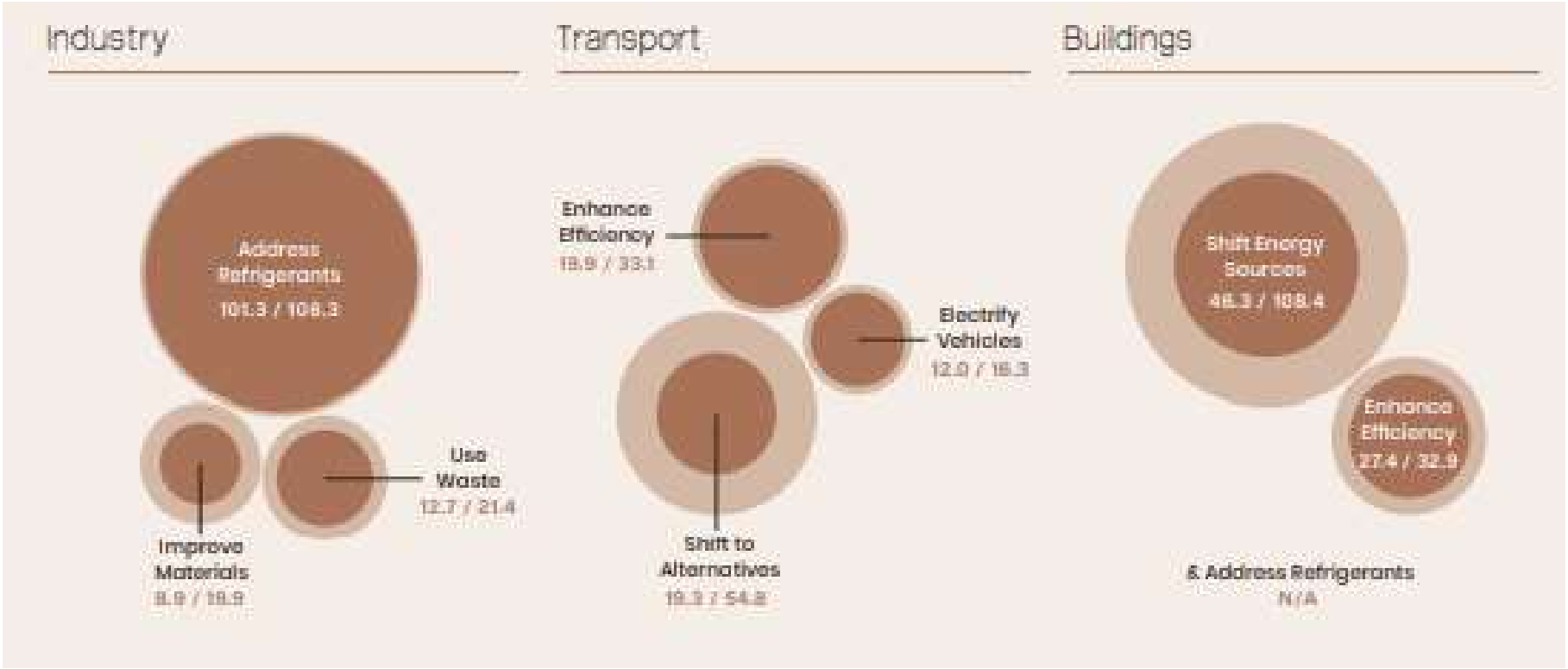


Greenhouse gas sinks are the counterpoint to these sources.
~59% of heat-trapping emissions stay in the atmosphere,
~24% are removed by plants on land
~17% are taken up by oceans.

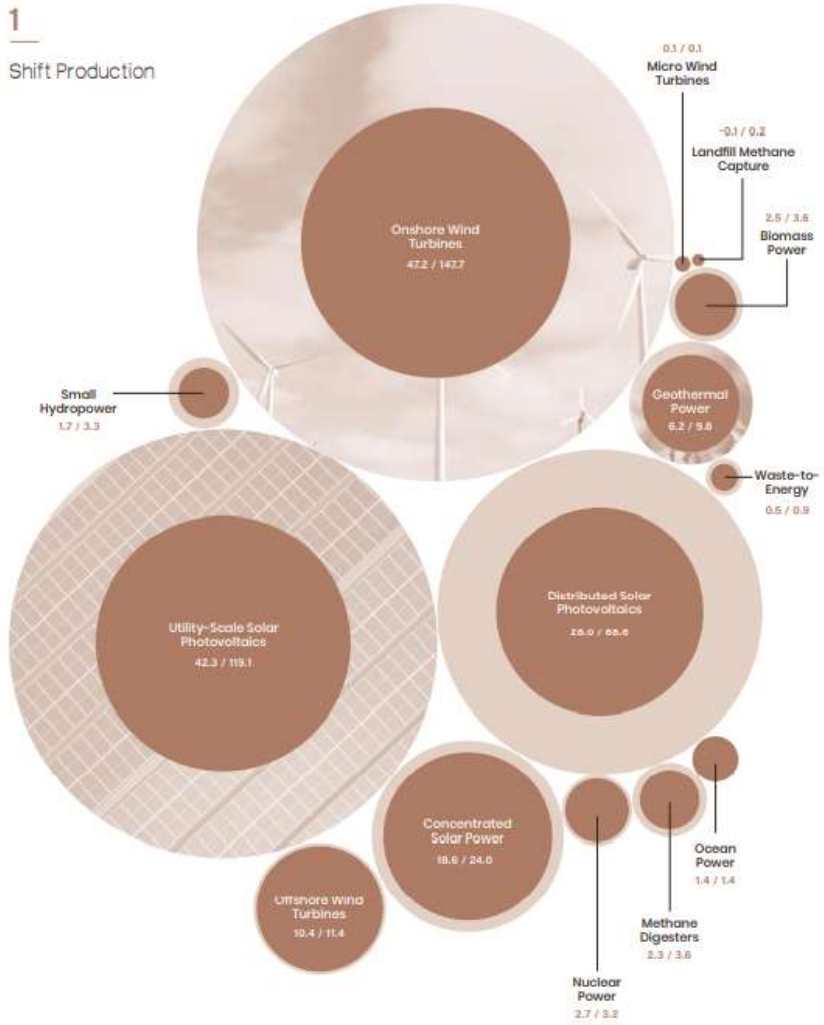
Project Drawdown – 2020 Review



Project Drawdown – 2020 Review



Project Drawdown – 2020 Review



Electricity Shift Production:

- Onshore wind
- Utility scale solar PV
- Distributed solar PV
- Concentrated solar
- Geothermal power
- Offshore wind
- Methane digesters
- Nuclear power
- Biomass power
- Ocean power
- Waste to energy
- Micro wind
- Landfill methane

Project Drawdown – 2020 Review
Table of Solutions

** Gigatons CO2 Equivalent Reduced / Sequestered (2020–2050)*

SOLUTION	SECTOR(S)	SCENARIO 1 *	SCENARIO 2 *
Onshore Wind Turbines	Electricity	47.21	147.72
Utility-Scale Solar Photovoltaics	Electricity	42.32	119.13
Reduced Food Waste	Food, Agriculture, and Land Use / Land Sinks	87.45	94.56
Plant-Rich Diets	Food, Agriculture, and Land Use / Land Sinks	65.01	91.72
Health and Education	Health and Education	85.42	85.42
Tropical Forest Restoration	Land Sinks	54.45	85.14
Improved Clean Cookstoves	Buildings	31.34	72.65
Distributed Solar Photovoltaics	Electricity	27.98	68.64
Refrigerant Management	Industry / Buildings	57.75	57.75
Alternative Refrigerants	Industry / Buildings	43.53	50.53
Silvopasture	Land Sinks	26.58	42.31
Peatland Protection and Rewetting	Food, Agriculture, and Land Use / Land Sinks	26.03	41.93
Tree Plantations (on Degraded Land)	Land Sinks	22.24	35.94
Perennial Staple Crops	Land Sinks	15.45	31.26
Temperate Forest Restoration	Land Sinks	19.42	27.85

https://www.drawdown.org/solutions/table-of-solutions

Project Drawdown – 2020 Review

Onshore Wind

47.21–147.72	$0.84–1.66	$3.88–10.12
GIGATONS	TRILLION $US	TRILLION $US
CO2 EQUIVALENT REDUCED / SEQUESTERED (2020–2050)	NET FIRST COST (TO IMPLEMENT SOLUTION)	LIFETIME NET OPERATIONAL SAVINGS

Offshore Wind

10.44–11.42	$632.19–720.77	$673.17–794.31
GIGATONS	BILLION $US	BILLION $US
CO2 EQUIVALENT REDUCED / SEQUESTERED (2020–2050)	NET FIRST COST (TO IMPLEMENT SOLUTION)	LIFETIME NET OPERATIONAL SAVINGS

Utility Scale Solar Photovoltaics

42.32–119.13	$-1.53–-0.29	$12.98–26.42
GIGATONS	TRILLION $US	TRILLION $US
CO2 EQUIVALENT REDUCED / SEQUESTERED (2020–2050)	NET FIRST COST (TO IMPLEMENT SOLUTION)	LIFETIME NET OPERATIONAL SAVINGS

Project Drawdown – 2020 Review

High Efficiency Heat Pumps

4.16–9.29
GIGATONS
CO2 EQUIVALENT
REDUCED / SEQUESTERED
(2020–2050)

$76.67–116.82
BILLION $US
NET FIRST COST
(TO IMPLEMENT SOLUTION)

$1.09–2.50
TRILLION $US
LIFETIME NET
OPERATIONAL SAVINGS

Distributed Solar Photovoltaics

27.98–68.64
GIGATONS
CO2 EQUIVALENT
REDUCED / SEQUESTERED
(2020–2050)

$255–479.59
BILLION $US
NET FIRST COST
(TO IMPLEMENT SOLUTION)

$7.89–13.53
TRILLION $US
LIFETIME NET
OPERATIONAL SAVINGS

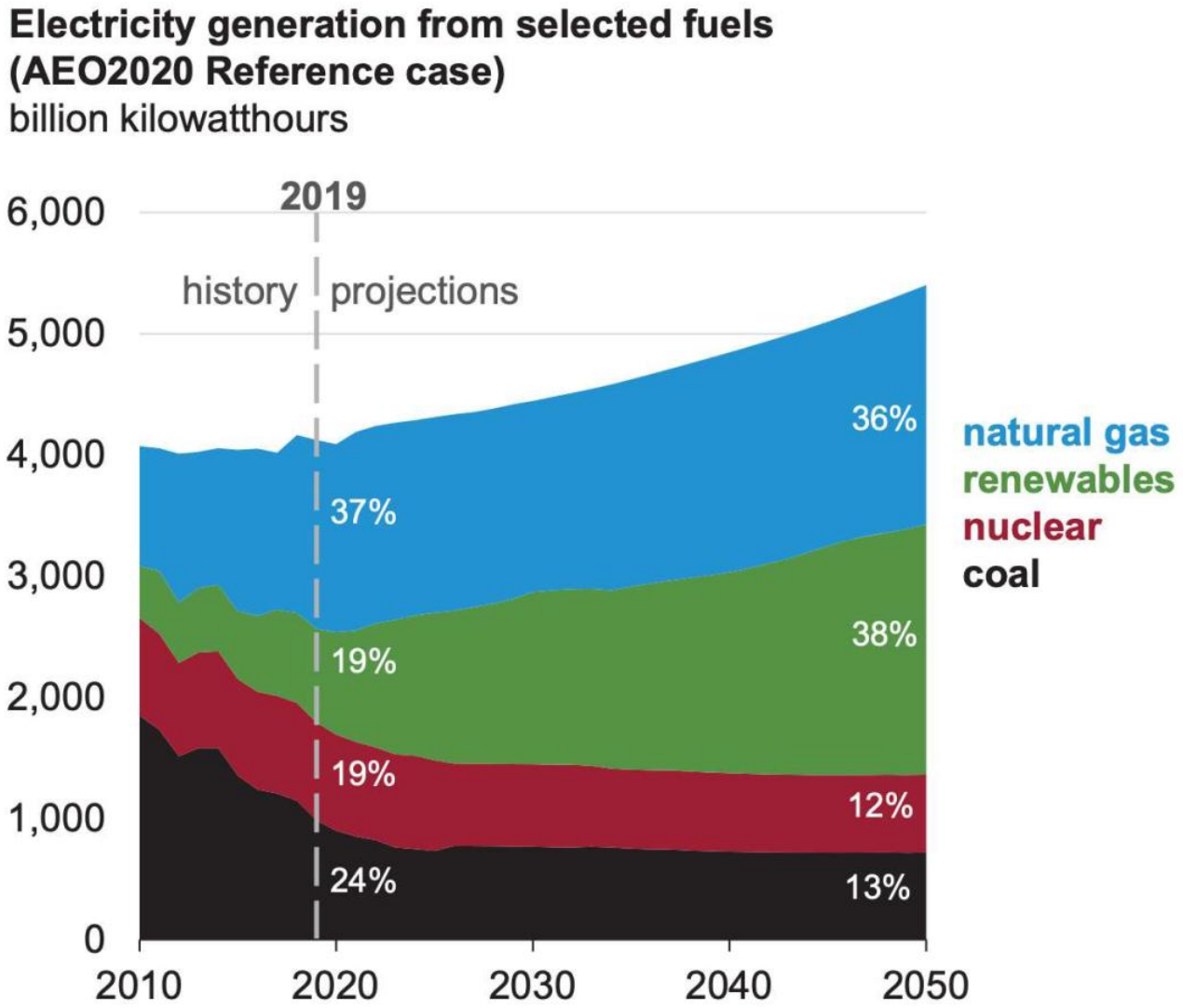
Solar Hot Water

3.59–14.29
GIGATONS
CO2 EQUIVALENT
REDUCED / SEQUESTERED
(2020–2050)

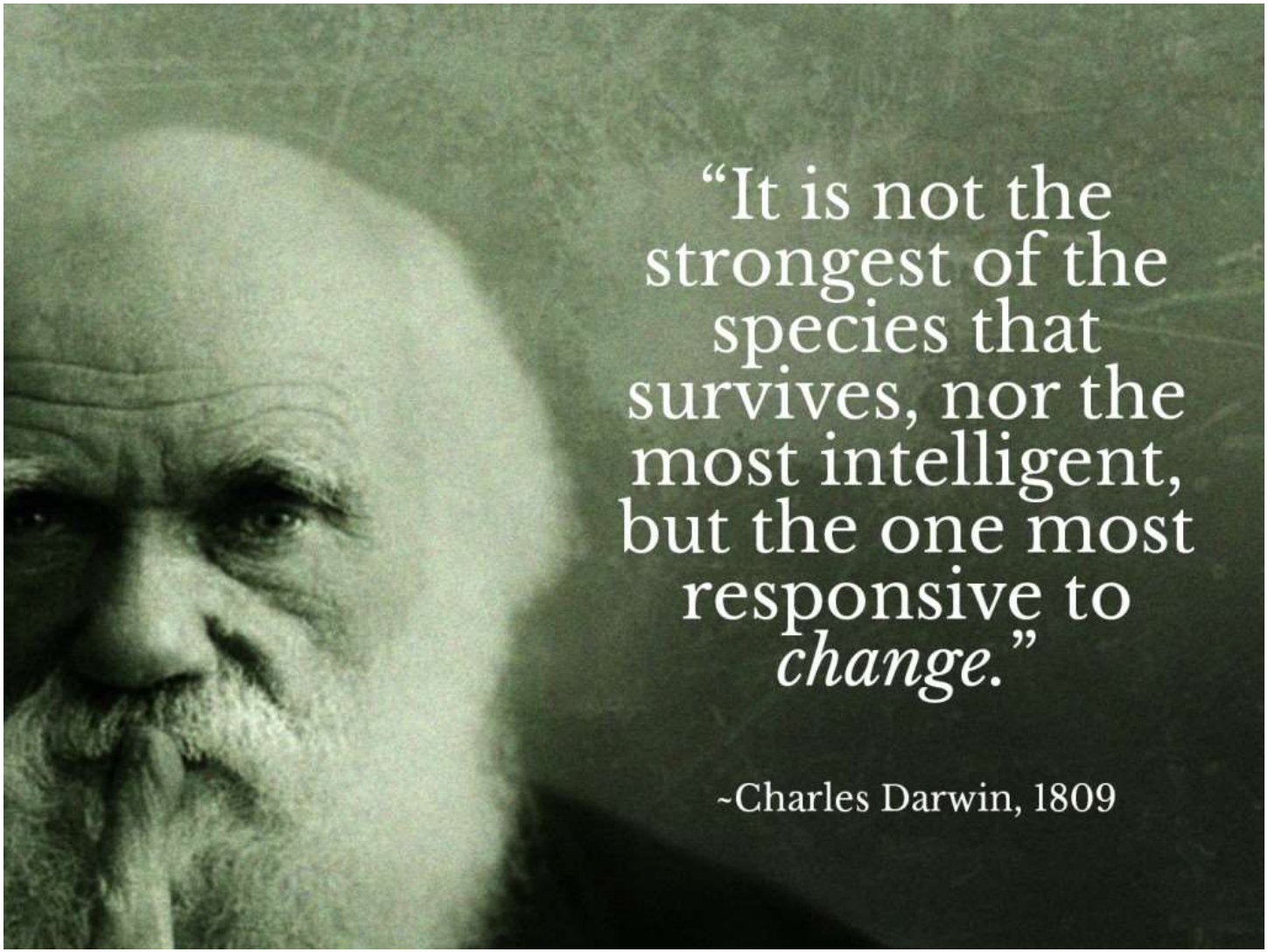
$0.72–2.67
TRILLION $US
NET FIRST COST
(TO IMPLEMENT SOLUTION)

$0.29–1.14
TRILLION $US
LIFETIME NET
OPERATIONAL SAVINGS

EIA 2050 Projections - Electrical Generation



Change


"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to *change.*"
~Charles Darwin, 1809

Thank You!

Global Prospects for a Low Carbon Future

Questions?

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January 25, 2021

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