IEEE SA STANDARDS ASSOCIATION

2030+

Imagine The Future We Can Build Together

IEEE SusTech Initiative

Sustainability Through Technology

IEEE Building the Path to Sustainability with Technology

IEEE SusTech Conference 2024, Portland, OR

April 15, 2024

Maike Luiken

sagroups.ieee.org/planetpositive2030

IEEE

I am *Committed to a Better World for All*

maike.luiken@ieee.org

Maike Luiken, Ph.D.

- Chair, IEEE Planet Positive 2030, IEEE SA
- Co-Chair, IEEE SusTech Initiative - FDC
- Chair, IEEE P7800™ Standards Working Group
- Vice-Chair, IEEE P7801™ Standards Working Group
- IEEE Vice President - MGA, 2021
- IEEE Canada President, 2018 -19
- Managing Director - R&D, Carbovate Development Corp.
- Adjunct Research Professor, Western University, London, Canada
- Senior Member, IEEE; member, IEEE-HKN
- Fellow, Engineering Institute of Canada
- Editorial Focus Advisor & Associate Editor, IEEE Canadian Review
- Member, IEEE Canadian Foundation Board of Directors

Education is the Catalyst of Sustainability
Interaction is the Catalyst of Innovation

I live and work in Sarnia, Ontario, Canada
A community that continually transforms itself.

Sarnia-Lambton brings together Natural Beauty, Education, Industry and Agriculture on the shore of Lake Huron with easy access to the Canadian and US markets.

Setting the stage

Our Context

OUR CONTEXT

Global Challenges – Global Crises – Climate Emergency

Immense, existential, challenges are threatening the very existence of societies, biodiversity and biospheres.

- The **impacts of climate change**: global, regional and local
- The **continuing increases of GHG emissions** in the atmosphere, and hence further global warming & ongoing pollution
- The need for an affordable, clean, renewable, sustainable, **reliable resilient energy supply for all**
- The **lack** of **ubiquitous access to potable water**
- The **growth of 'waste'** - the need for a **circular economy**
- The **lack of equity and inclusion**
- Others …

Our planet is in urgent need of and ready for solutions that address these challenges & crises.

This requires three types of "technologies" or "innovations" (Mark Carney, Values, 2021)

- **Engineering / Technology – YOUR *expertise is here***
- **Political**
- **Financial**

The Goal:
Long-Term Sustainability of the Planetary Biosphere

The **Challenges** include:

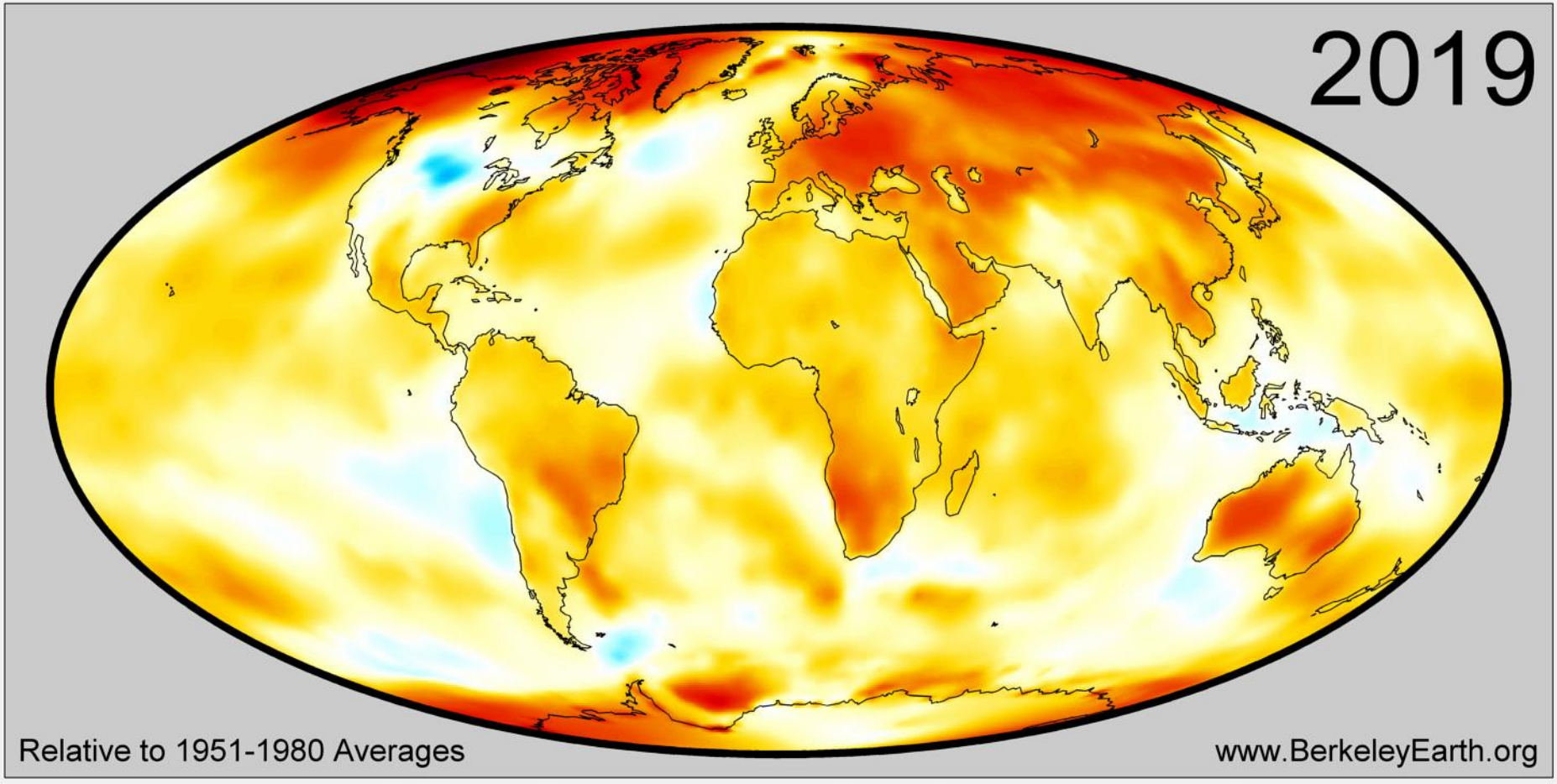
- **Achieving the UN SDGs** (United Nations Sustainable Development Goals)
- Addressing **accelerating climate change and climate change damage** caused by global warming – SDG 13
  The most urgent issues is the level of greenhouse gases (GHGs) in the atmosphere – we need:
  - **Prevention of further - as much as possible – elevation of GHG levels in the atmosphere** -> mitigation
  - At the same time, **adaptation to current impacts** (and those to come) from global warming (more and worse severe weather, the ocean level rising …) AND
  - Next, **reduction the GHG levels in the atmosphere to closer to pre-industrial levels** (further mitigation)
- **Regeneration** of the earth's ecosystems --- for the long term
- Achieving a **Circular Economy - No Waste – maintaining Resources Availability**

UN Sustainable Development Goals (17)

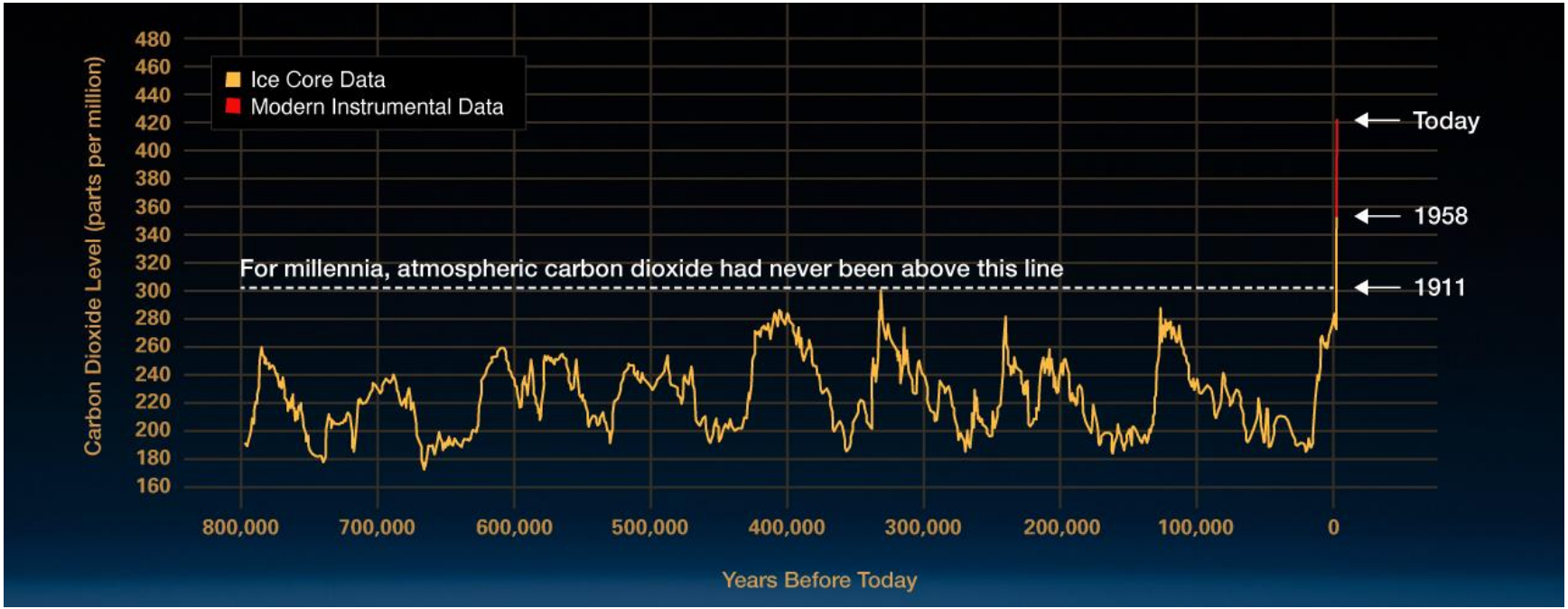
to end poverty, protect the planet, and ensure prosperity for all --- *by 2030*

Topics

- Global Warming
- Carbon Dioxide levels in the Atmosphere
- Scenarios
- GHG emissions
- Global Energy System Transformation


2019
Relative to 1951-1980 Averages
www.BerkeleyEarth.org
-7
-4
-2
-1
-0.5
0
0.5
1
2
4
7
Temperature Anomaly (° C)

Carbon Dioxide levels over time



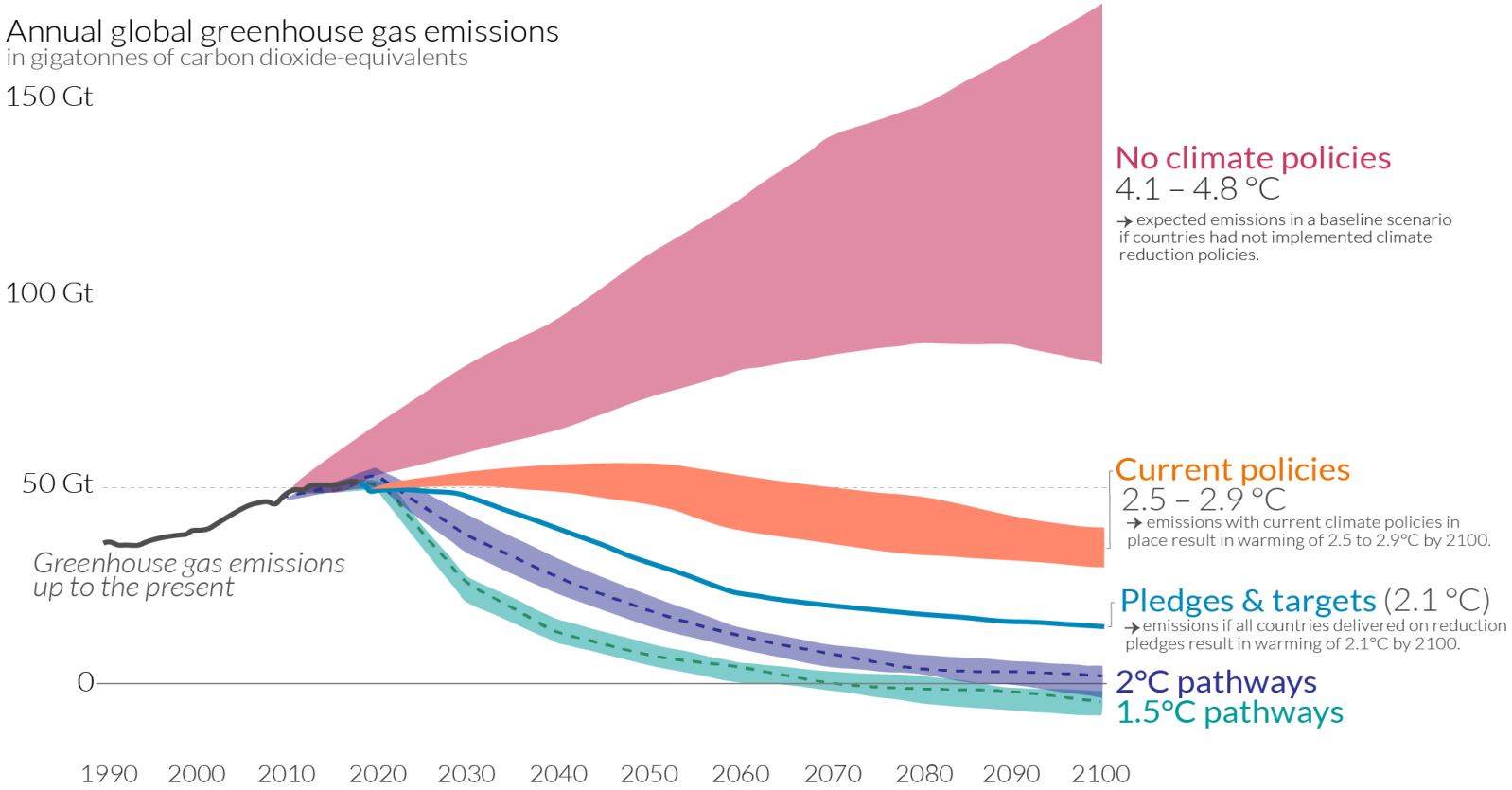
This graph, based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements, provides evidence that atmospheric CO2 has increased since the Industrial Revolution.

Luthi, D., et al.. 2008; Etheridge, D.M., et al. 2010; Vostok ice core data/J.R. Petit et al.; NOAA Mauna Loa CO2 record. Find out more about ice cores (external site).

Global greenhouse gas emissions and warming scenarios

– Each pathway comes with uncertainty, marked by the shading from low to high emissions under each scenario.
– Warming refers to the expected global temperature rise by 2100, relative to pre-industrial temperatures.

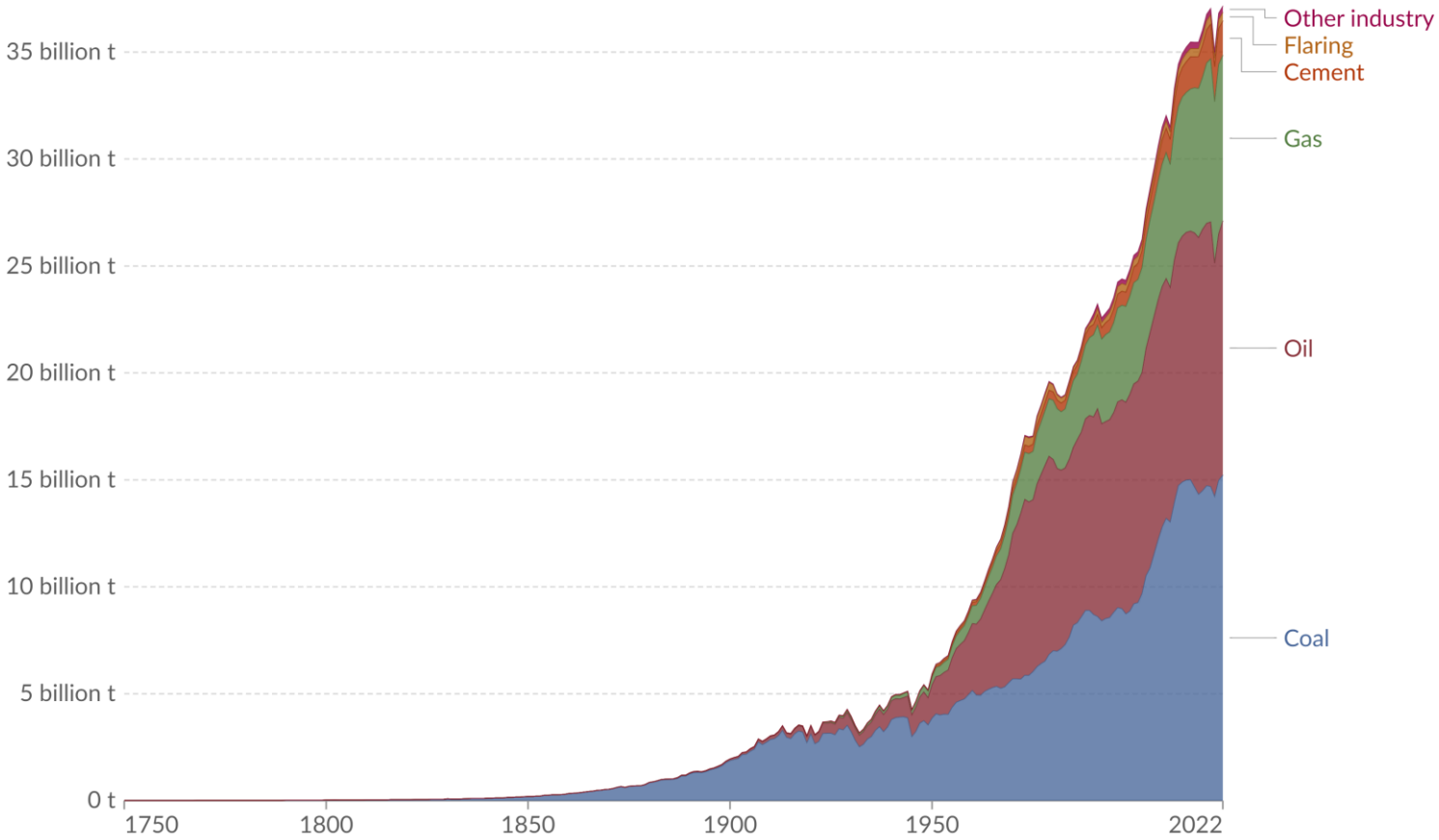
Our World in Data



Data source: Climate Action Tracker (based on national policies and pledges as of November 2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

Last updated: April 2022.

CO_2 emissions by fuel or industry type, World



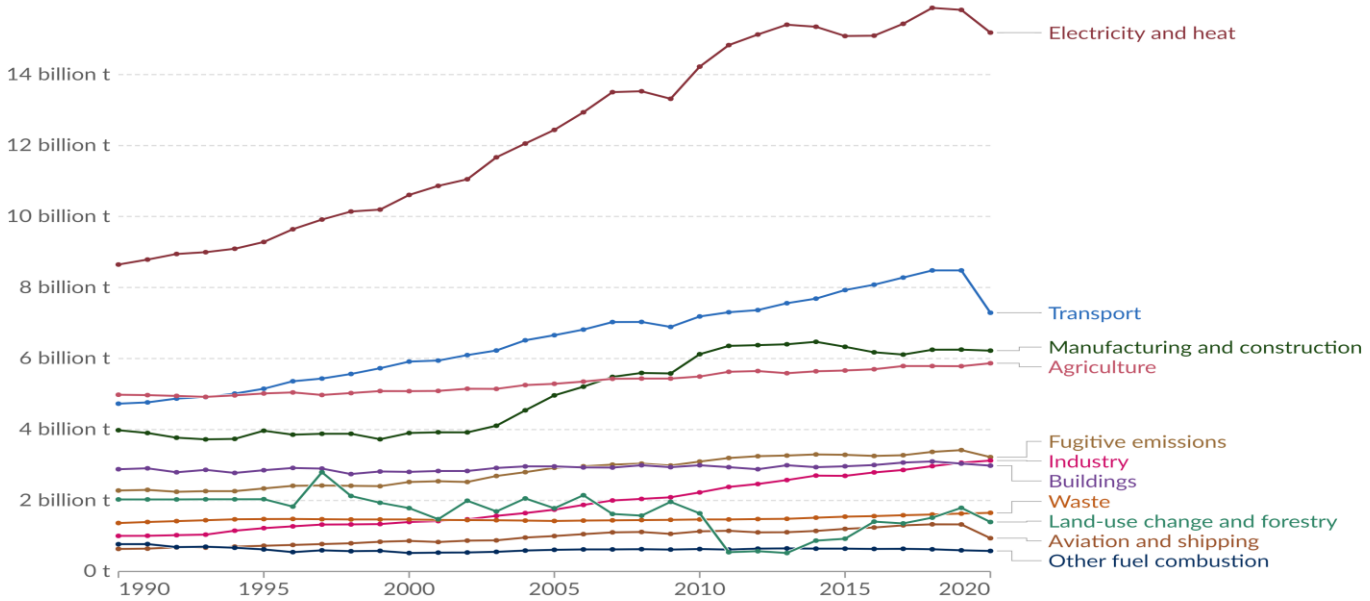
Data source: Global Carbon Budget (2023)

OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

Greenhouse gas emissions by sector, World

Our World in Data

Greenhouse gas emissions[1] are measured in tonnes of carbon dioxide-equivalents[2] over a 100-year timescale.



Data source: Climate Watch (2023)

OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

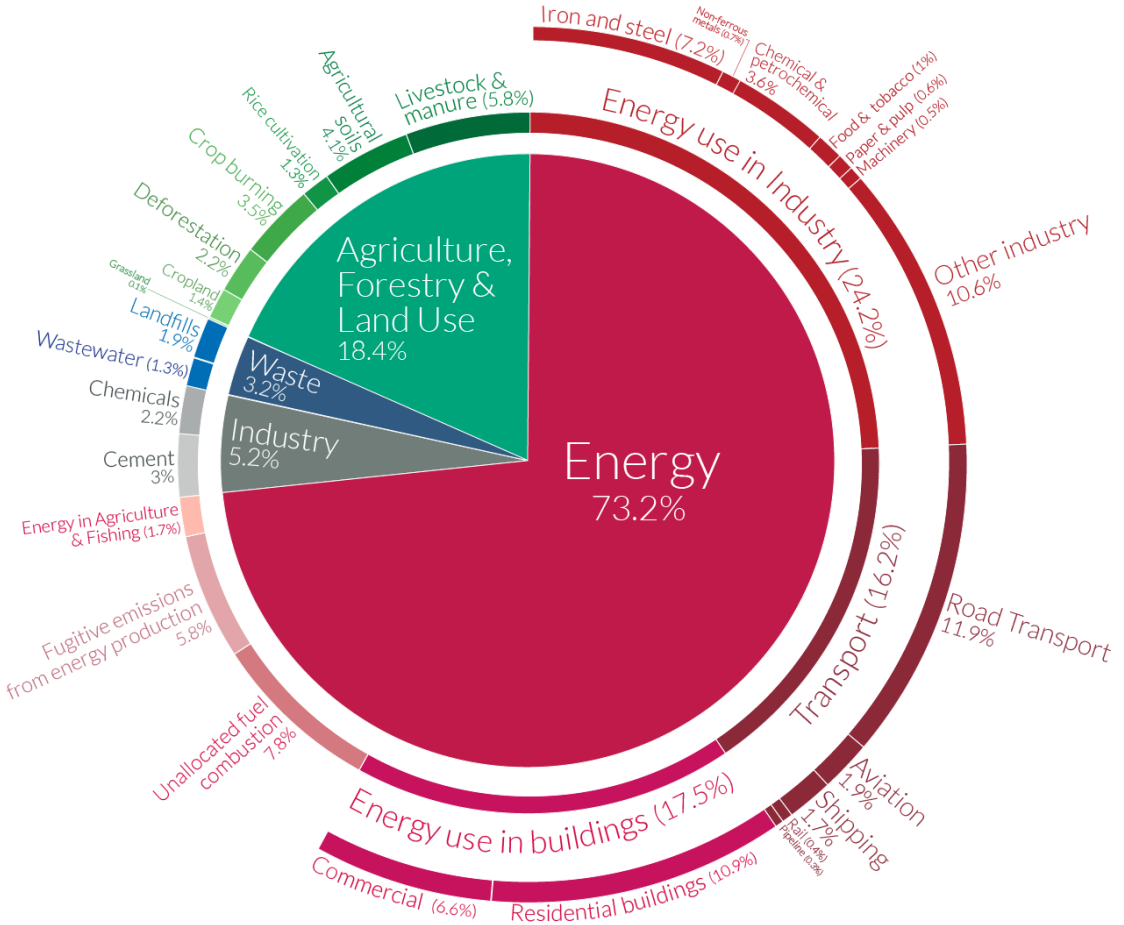
1. Greenhouse gas emissions: A greenhouse gas (GHG) is a gas that causes the atmosphere to warm by absorbing and emitting radiant energy. Greenhouse gases absorb radiation that is radiated by Earth, preventing this heat from escaping to space. Carbon dioxide (CO_2) is the most well-known greenhouse gas, but there are others including methane, nitrous oxide, and in fact, water vapor. Human-made emissions of greenhouse gases from fossil fuels, industry, and agriculture are the leading cause of global climate change. Greenhouse gas emissions measure the total amount of all greenhouse gases that are emitted. These are often quantified in carbon dioxide equivalents (CO_2eq) which take account of the amount of warming that each molecule of different gases creates.

2. Carbon dioxide equivalents (CO_2eq): Carbon dioxide is the most important greenhouse gas, but not the only one. To capture all greenhouse gas emissions, researchers express them in "carbon dioxide equivalents" (CO_2eq). This takes all greenhouse gases into account, not just CO_2. To express all greenhouse gases in carbon dioxide equivalents (CO_2eq), each one is weighted by its global warming potential (GWP) value. GWP measures the amount of warming a gas creates compared to CO_2. CO_2 is given a GWP value of one. If a gas had a GWP of 10 then one kilogram of that gas would generate ten times the warming effect as one kilogram of CO_2. Carbon dioxide equivalents are calculated for each gas by multiplying the mass of emissions of a specific greenhouse gas by its GWP factor. This warming can be stated over different timescales. To calculate CO_2eq over 100 years, we'd multiply each gas by its GWP over a 100-year timescale (GWP100). Total greenhouse gas emissions – measured in CO_2eq – are then calculated by summing each gas' CO_2eq value.

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.

Our World in Data



Sustainable Clean Energy – is Mandatory

Sustainability: The UN's Brundtland Commission, 1987, defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." *True sustainability is when all generations, present and future, everywhere can meet their basic needs.*

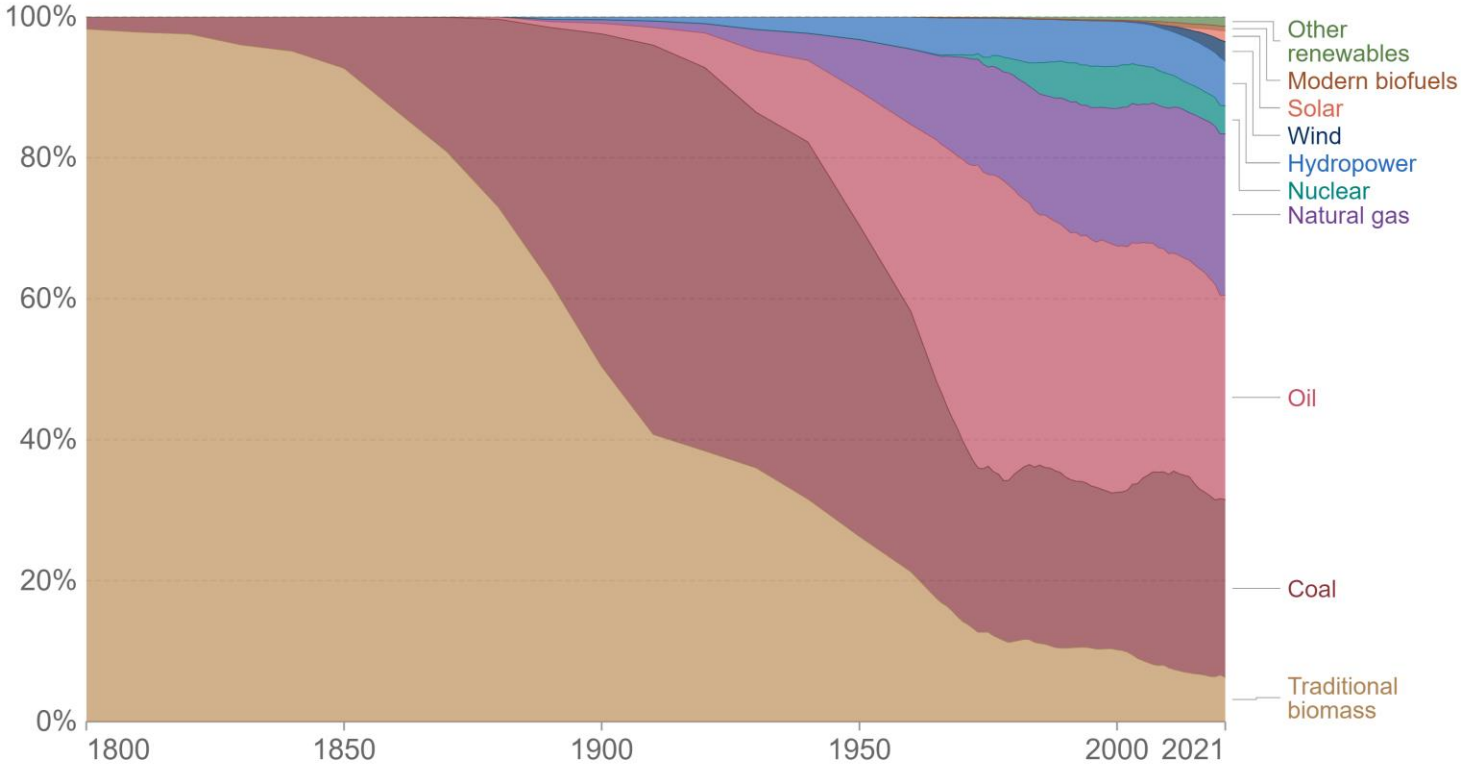
Sustainable Energy is the sustainable provision of energy in such a way that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

"Energy is the golden thread that connects economic growth, increased social equity and a healthy environment. Sustainable development is not possible without sustainable energy."
Ban KI-Moon, 10 APRIL 2014

--> Global Energy Systems Transformation

Global primary energy consumption by source

Primary energy is calculated based on the 'substitution method' which takes account of the inefficiencies in fossil fuel production by converting non-fossil energy into the energy inputs required if they had the same conversion losses as fossil fuels.



Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy
OurWorldInData.org/energy • CC BY

Global primary energy consumption is in the order of 176,400 TWh (2021)

Global primary energy consumption by source

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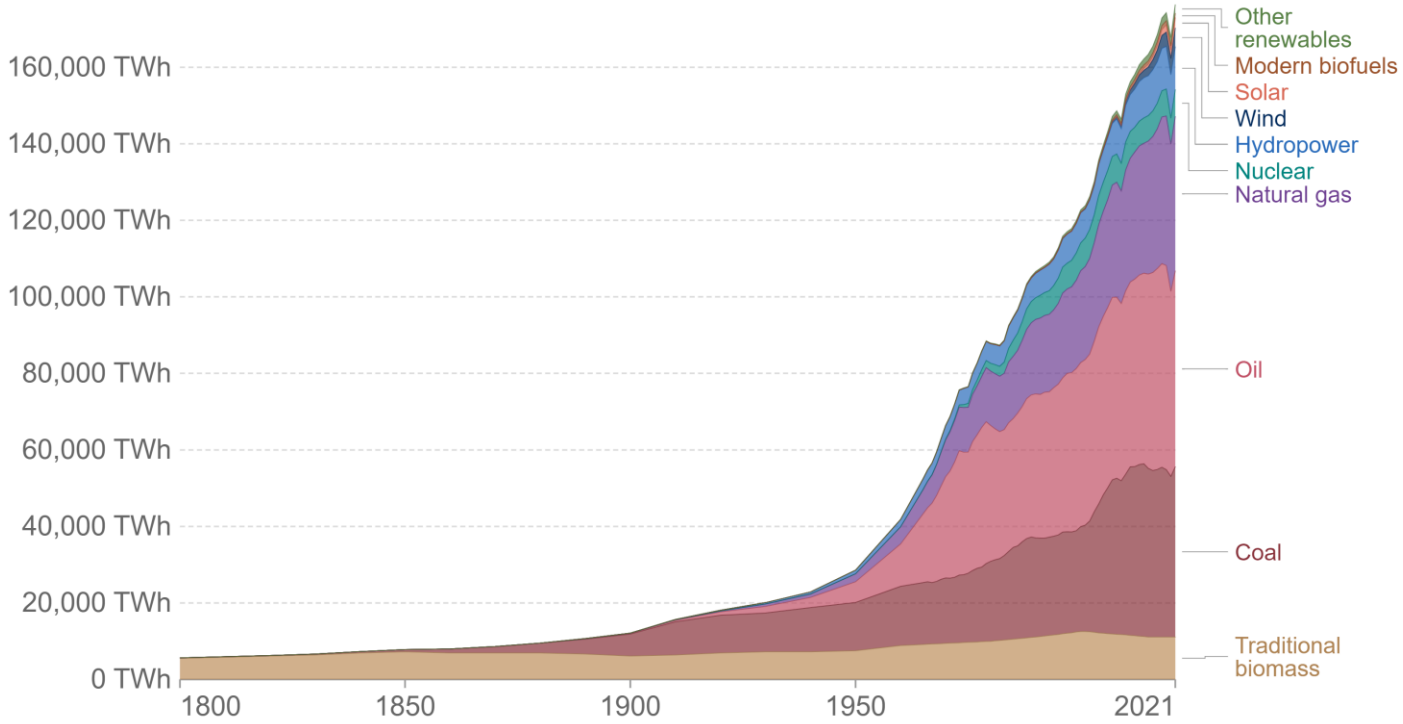
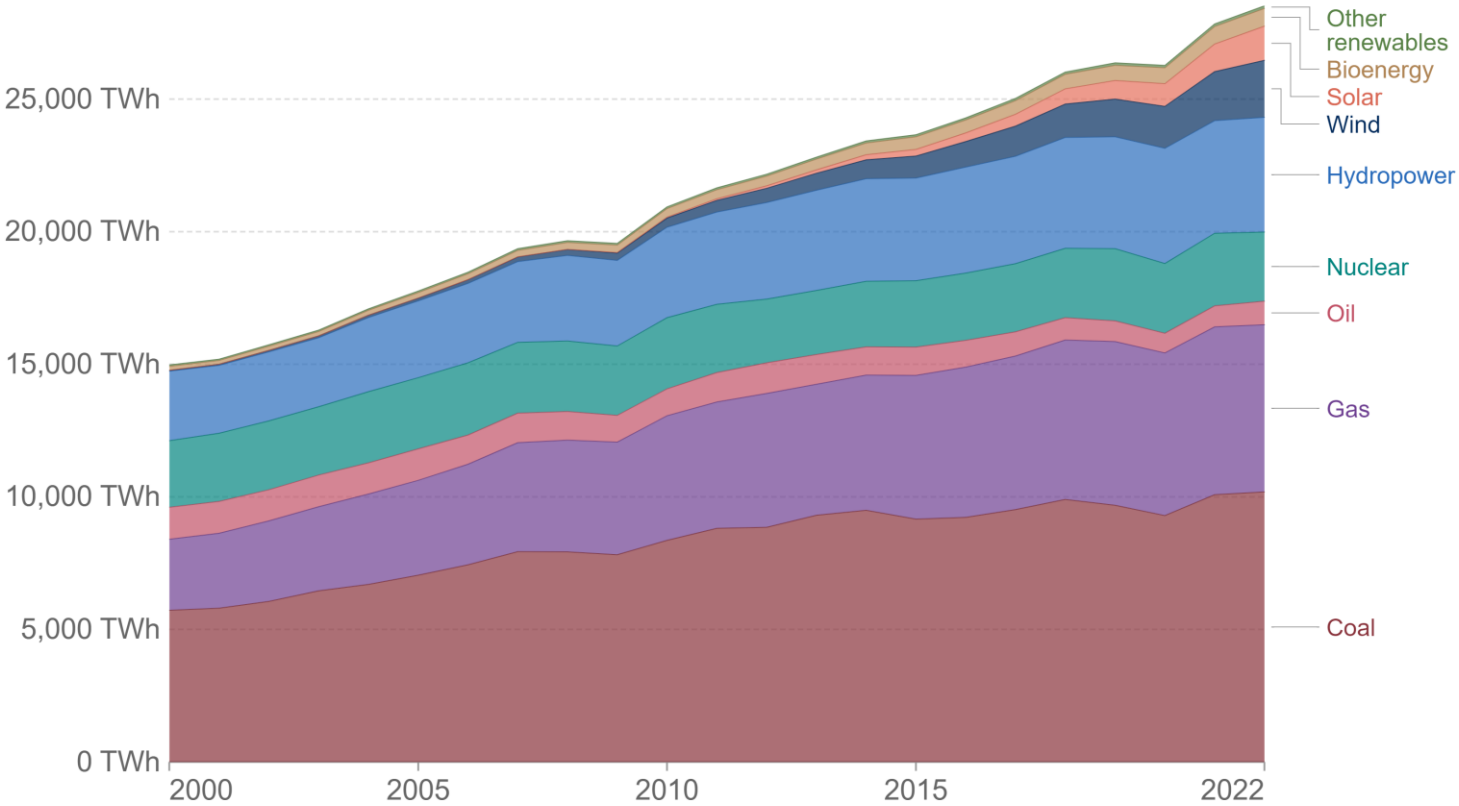


Source: Our World in Data based on Vaclav Smil (2017) and BP Statistical Review of World Energy
OurWorldInData.org/energy • CC BY

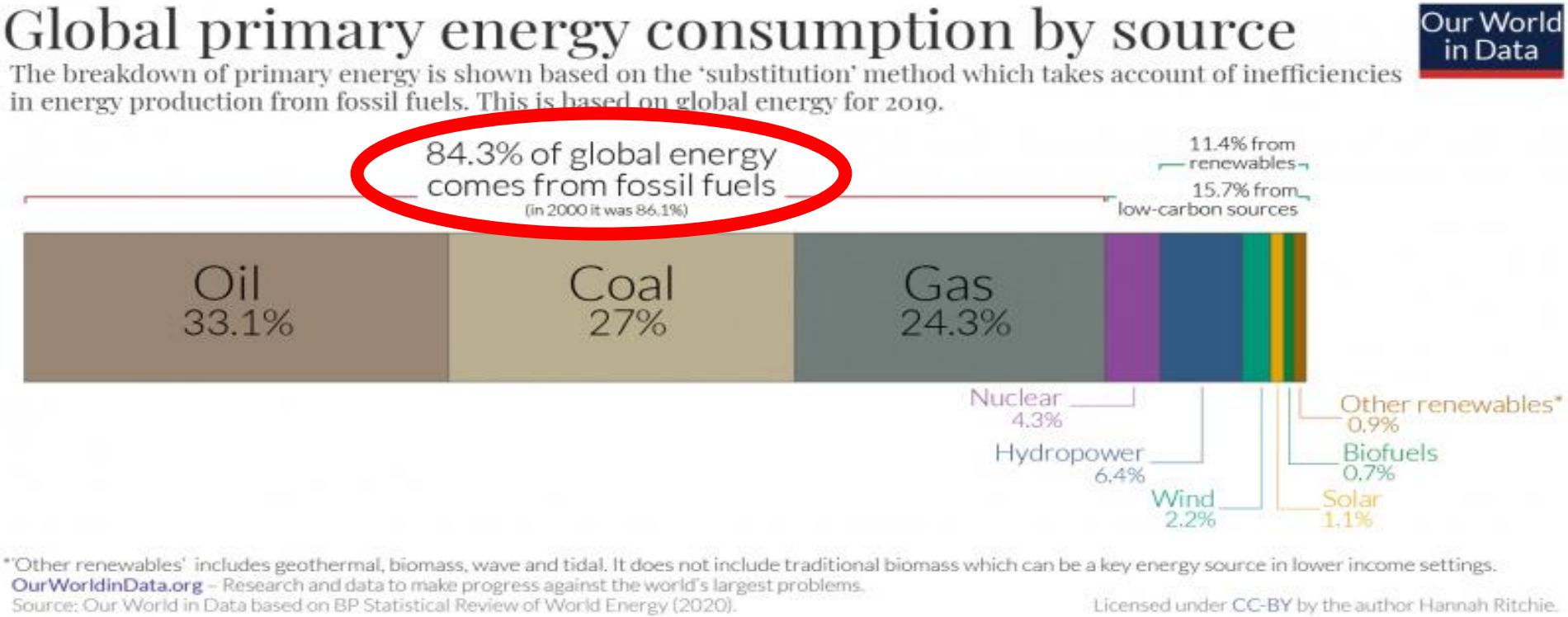
Global primary energy consumption is in the order of 176,400 TWh (2021)

Electricity production by source, World



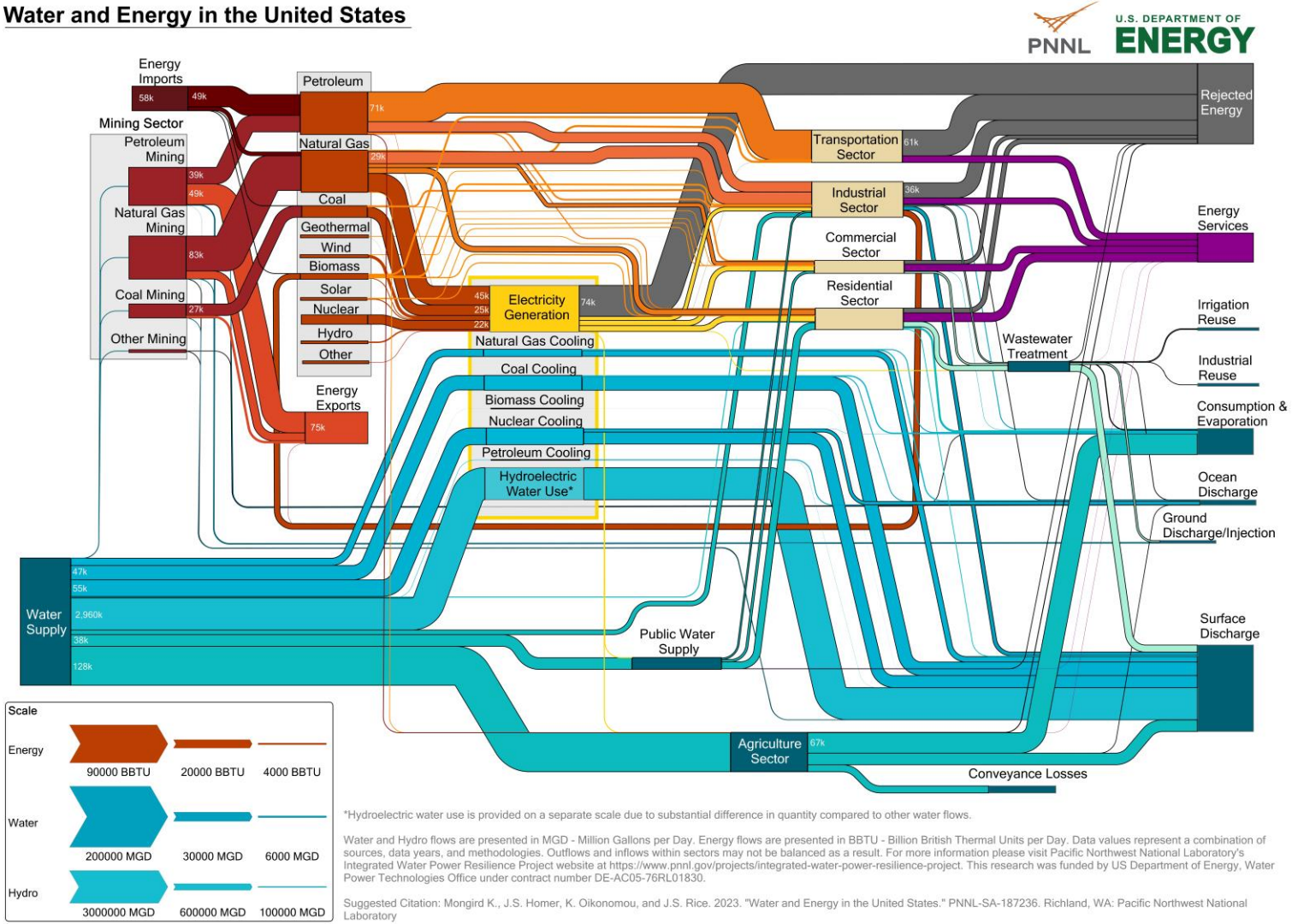
Source: Our World in Data based on BP Statistical Review of World Energy (2022); Ember (2023)
Note: 'Other renewables' includes waste, geothermal, wave and tidal.
OurWorldInData.org/energy • CC BY

The Challenge: Net Zero Primary Energy Consumption by 2050



Topic

- Energy and Water Use - Opportunities



*Hydroelectric water use is provided on a separate scale due to substantial difference in quantity compared to other water flows.

Water and Hydro flows are presented in MGD - Million Gallons per Day. Energy flows are presented in BBTU - Billion British Thermal Units per Day. Data values represent a combination of sources, data years, and methodologies. Outflows and inflows within sectors may not be balanced as a result. For more information please visit Pacific Northwest National Laboratory's Integrated Water Power Resilience Project website at https://www.pnnl.gov/projects/integrated-water-power-resilience-project. This research was funded by US Department of Energy, Water Power Technologies Office under contract number DE-AC05-76RL01830.

Suggested Citation: Mongird K., J.S. Homer, K. Oikonomou, and J.S. Rice. 2023. "Water and Energy in the United States." PNNL-SA-187236. Richland, WA: Pacific Northwest National Laboratory

US Pacific Northwest National Laboratory

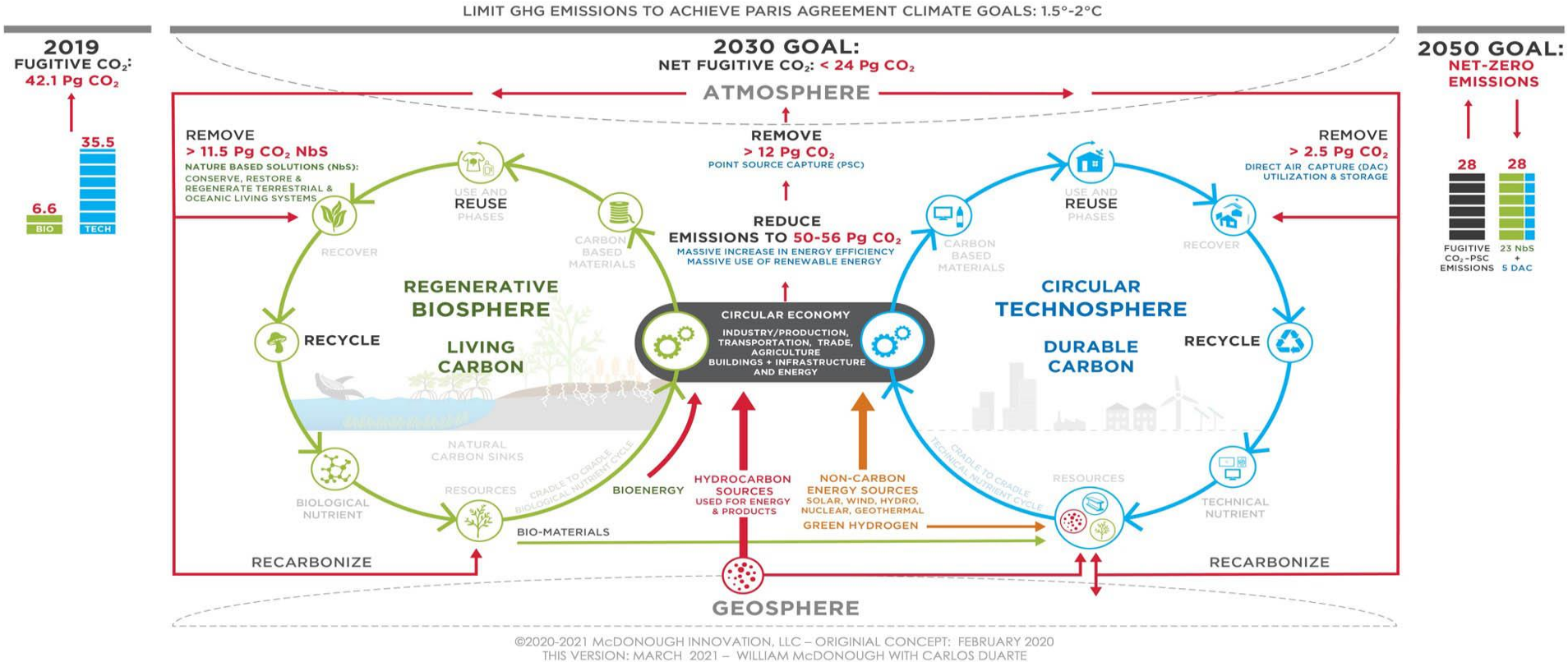
Integrated Water Power Resilience Project

https://www.pnnl.gov/projects/integrated-water-power-resilience-project

Topics

- Circular Economy
- Circular Carbon Economy
- Commodity Transformation
- Sustainable Supply Systems
- Sustainable Procurement

Carbon is essential for life – Too much greenhouse gases in the atmosphere is catastrophic to life!



circular carbon economy

design for the regenerative biosphere and circular technosphere

Many ways to change the way we handle ‘permanent’ or Techno Carbon and other materials

Smarter product use and manufacture	R0	Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
	R1	Rethink	Make product use more intensive (e.g. through sharing products or by putting multi-functional products on market).
	R2	Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources
Extend lifespan of product and its parts	R3	Reuse	Re-use by another consumer of discarded product which is still in good condition and fulfils its original function
	R4	Repair	Repair and maintenance of defective product so it can be used with its original function
	R5	Refurbish	Restore an old product and bring it up to date
	R6	Remanufacture	Use parts of discarded product in a new product with the same function
	R7	Repurpose	Use discarded products or its part in a new product with a different function
Useful application of materials	R8	Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
	R9	Recovery	Incineration of material with energy recovery

Morseletto, P. (2020). Targets for a circular economy. *Resources, Conservation and Recycling*, *153*, 104553. https://doi.org/10.1016/j.resconrec.2019.104553

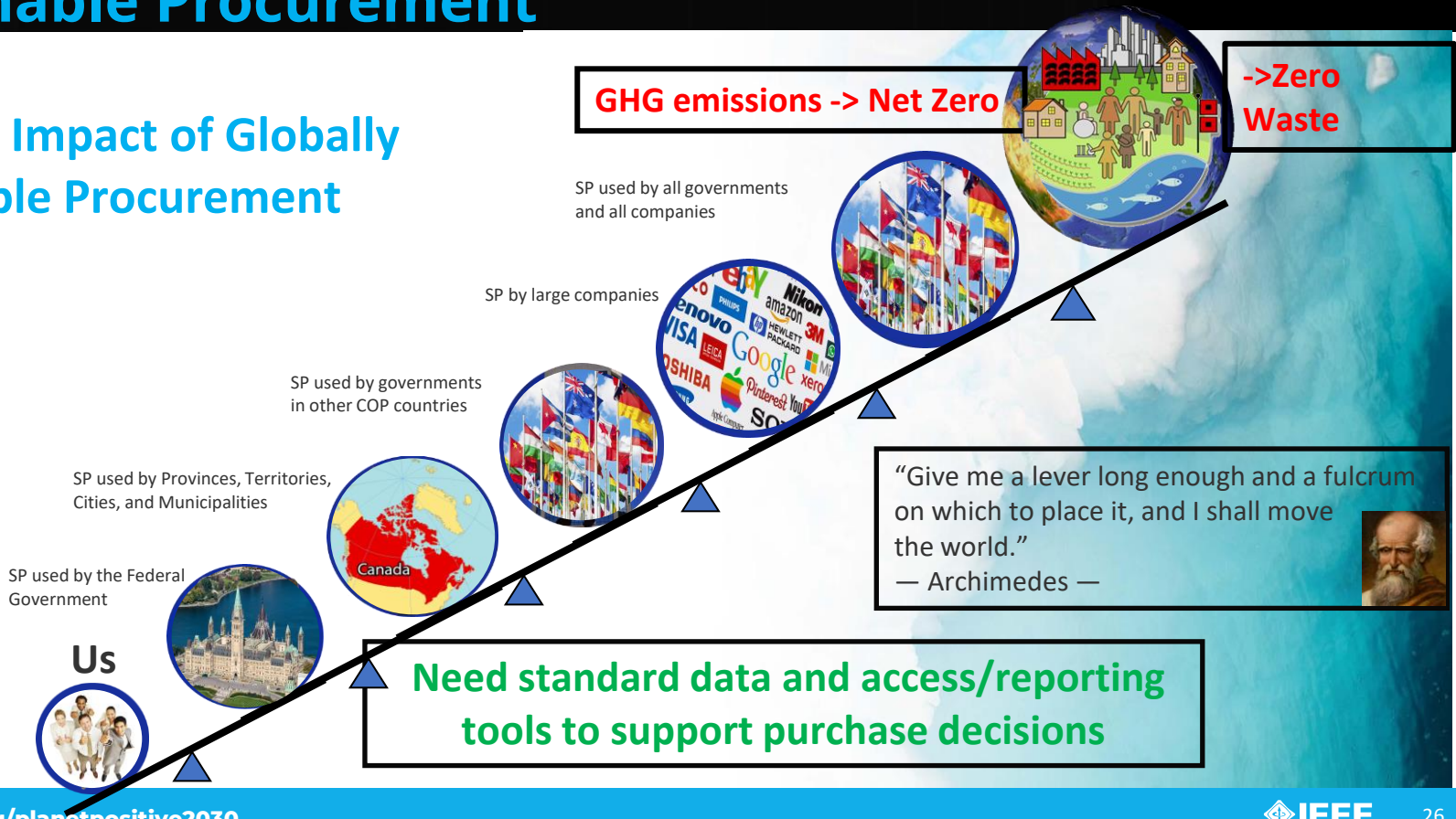
Top Drivers of Sustainable Procurement in Private Corporations

- Mandatory *regulations* --- *e.g. EU Digital Product Passport (DPP)*
- *Leadership* / top management commitment
- Alignment of sustainability with the organization's *purpose, culture, and values*
- *Peer pressure* within the company's industry sector
- *Stakeholder pressure* (governments, consumers, investors, bankers)
- *Risk management* (reputational / image damage)
- Convincing *business case*

"Sustainable Public Procurement: 2022 Global Review, Part 2," UN Environmental Programme, January 2022.
Based on data collected in 2021 on 314 organizations across 92 countries via a Stakeholder Survey, plus data gathered on SP activities of 45 countries in a National Government Questionnaire, plus interviews with 26 sustainable procurement experts, plus a literature review.

What could make "it" happen?
Sustainable Procurement

Potential Impact of Globally Sustainable Procurement



IEEE Mission

IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity.

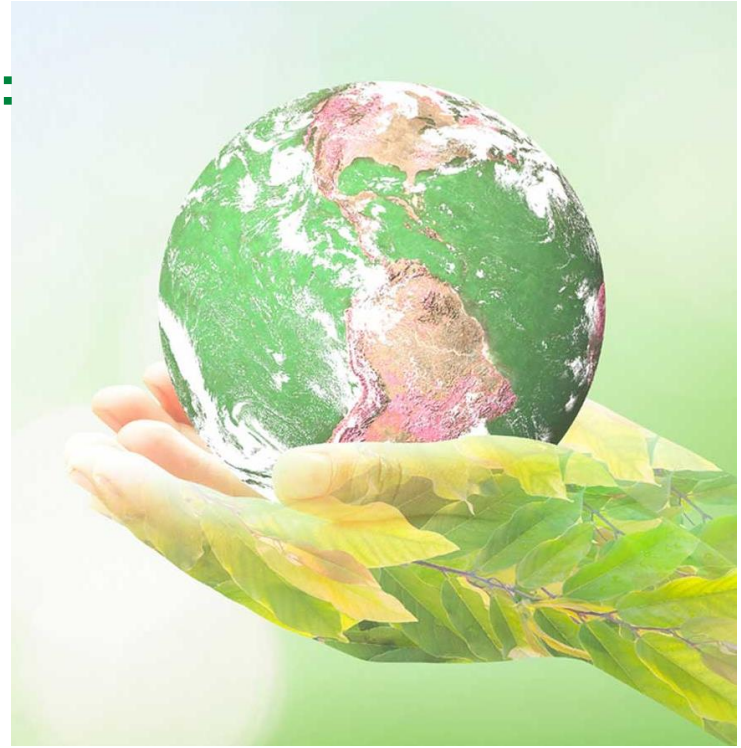
Meeting Global Challenges through Technological Transformation

Addressing these challenges through responsible technological transformation:

From building alternative energy solutions to developing new approaches to growing and cultivating agricultural crops, technology and innovation continue to transform the way we live and how we protect the planet.

In fact, technological innovation and universal deployment of technical infrastructure is required to achieve the UN SDGs, such as:

- Power Systems, Communications Connectivity/Internet
- Health Care Infrastructure, Transportation etc.



… and Metrics

What is needed?

Moving from
- Making “technology” work and
- Making “technology” interoperable
- Making “technology” safe
to
- Making “technology” sustainable

Safety Culture –>
Sustainability Culture

What is IEEE doing?

-> Focus Groups – Cooperate – Converse – Discuss ..

-> Build Technology Roadmaps - Standards - …

IEEE

Some of the Initiatives led by IEEE and its Committees

IEEE Planet Positive 2030

IEEE FDC SusTech Initiative

IEEE Standards

IEEE TAB Climate Change Program

IEEE Climate Change Activities on the Climate Change Website

IEEE Technology Center for Climate

….. Many others

Some of the Initiatives led by IEEE and its Committees

IEEE Planet Positive 2030

IEEE SA STANDARDS ASSOCIATION

20 30+

Imagine The Future We Can Build Together

Maike Luiken, PhD
Chair, IEEE Planet Positive 2030

John C. Havens
IEEE SA Staff Lead, IEEEPlanet Positive 2030
IEEE SA Sustainability Practice Lead
Executive Director, The IEEE Global AI Ethics Initiative

The IEEE Planet Positive 2030 Initiative

What is IEEE Planet Positive 2030?

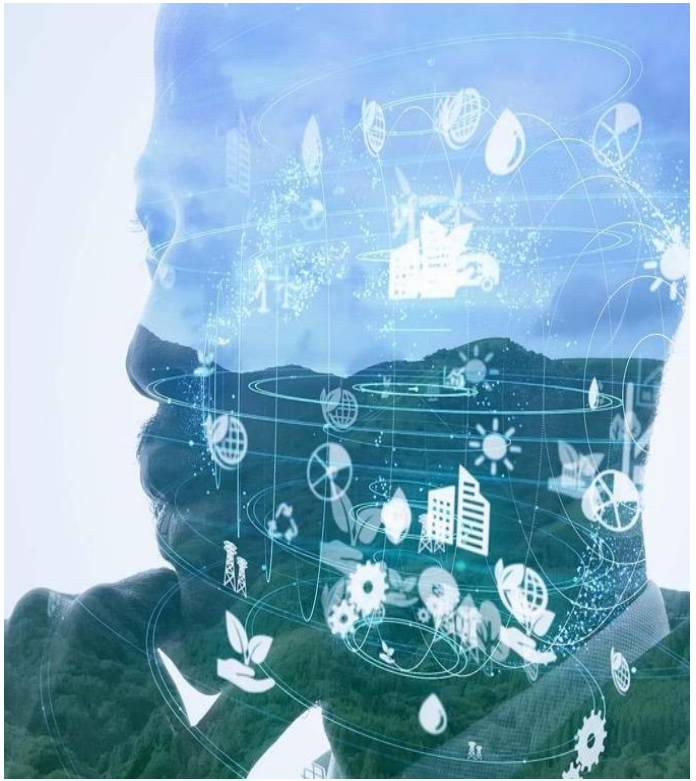
Planet Positive 2030 is an open, global initiative that is focused on developing practical paths to achieve a sustainable planet —a Planet Positive future for 2030 and beyond.

What do we mean by “Planet Positive?”

“Positive” = identifying how to ‘give back’ more to the Planet than is ‘removed’ (“regenerative” versus “climate neutral”) and not harming the biosphere/planet -> circular economies.

Why “2030?”

While the year 2050 is the goal for zero net GHG emissions, to get there we need to achieve a 50% reduction from 2005 levels by the year 2030.



IMAGINE THE FUTURE
WE CAN BUILD TOGETHER

Two "Impossible" Goals

1. **Transform society and infrastructure** to achieve Planet Positivity.

2. **Identify the technological solutions** we need to design, innovate and deploy to reach Planet Positive 2030.

Join The Initiative

IEEE Planet Positive 2030 Deliverables

Our Planet Positive 2030 Projects

IEEE Planet Positive 2030 Compendium:
Strong Sustainability by Design

Impact Accountability / Assessment Framework:
Accountable Sustainability by Design

Follow-through Goals:

- Provide ready Access to Knowledge, Best Practices
- Connect People for Action
- Be a Catalyst for Solutions
- Ensure widespread open and transparent communications
- Influence policy for immediate and impactful action
- **Change how technology and standards are designed and created to prioritize planet and people first**

IEEE Planet Positive 2030

Strong Sustainability *by Design* - Compendium

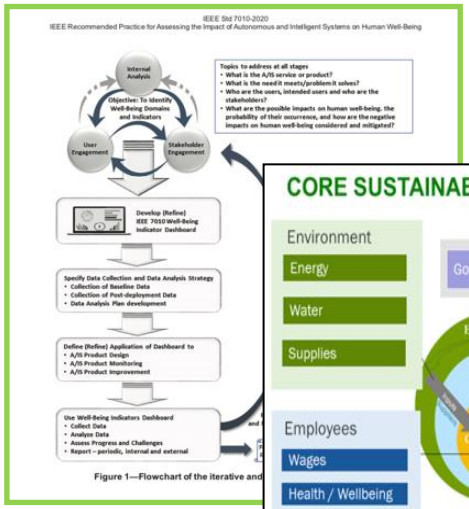
- Guiding Principles
- Metrics / Indicators
- Economics / Regulation
- Global Methodologies
- Ecosystems:
  - Forests and Trees
  - Rivers and Lakes
  - Towns and Cities
  - Ocean and Coasts
  - Farmlands and Grasslands, Mountains and Peatlands
- Human Wisdom and Culture
- Sustainability Commons
- The Arts
- … others may be added

Draft Compendium released in June 2023
Version 1 targeted to be available: June 2024

Planet Positive 2030 - Project 2
Impact Assessment Framework
Accountable Sustainability *by Design*

Measuring What Matters

- Utilizing metrics such as the UN SDGs and/or ESG metrics is how to best measure progress towards Planet Positive 2030 goals.
- The Impact Assessment Framework will complement the Strong Sustainability by Design compendium and will be based on UN SDGs, ESGs and/or other available Impact Assessment tools (environmental, infrastructure, climate, …) and reporting systems / templates.
- IEEE has created the IEEE 7010™-2020 Standard that features a Wellbeing Impact Assessment. It will be used in conjunction with tools like the ones created by Sustainability Advantage: “Basic Sustainability Assessment Tool (BSAT)”. The goal is to provide a pragmatic assessment framework and tools that educate about and enable accountability.



Basic Sustainability Assessment Tool (BSAT) for SMEs

- *Simple tool to identify and report net zero and sustainability metrics for an organization*
- *Free, open-source* Excel workbook … tailorable
- ***SME-friendly … only 20 multiple-choice questions***
- *Comprehensive*… scores on *all* core sustainability issues, *all* SDGs, and *all* non-financial capitals (Natural, Human, Social)
- Based on *SDG Action Manager* and *Future-Fit Business Benchmark*
- *Science-based* goals … assesses % progress toward them
- *Bonuses for Positive Impacts* … products & services, donations
- *Educational* … suggests ways to improve performance and scores
- *Action oriented* … prioritization criteria

What is needed? Convening Focus Groups for Sectors / Context Areas / …

For specific contexts (geographic - social - …):

- identification of
  - technology gaps
  - technology maturity
  - …
- working with stakeholder groups - community, industry, business, academia, policy makers
- accelerate the pace of solutions implementation and scale-up
- education

-> Build Technology Roadmaps - Standards - …

IEEE SusTech Initiative
Sustainability Through Technology

Some of the Initiatives led by IEEE and its Committees

IEEE FDC SusTech Initiative

IEEE FUTURE DIRECTIONS

Future Directions SusTech Initiative

A community of researchers and technologists solving the climate crisis

IEEE SusTech Initiative
Sustainability Through Technology

Energy

Low-C Emissions Energy Technologies Roadmapping

- Energy Storage
- Grid Modernization
- Renewables Scale-up

The Ocean

Measurement, Reporting and Verification (MRV) of Marine Carbon Dioxide Removal (mCDR)

- Webinars
- Technology Working Groups

Buildings

Registration Open!

Roadmap to Low-C Emissions Building Materials & Architecture

Upcoming Workshop IEEE SusTech2024

Arctic Regions

Energy and Climate Technologies for the Arctic

Register Now!

Upcoming Workshop Anchorage AK May 3-4, 2024

Some of the Initiatives led by IEEE and its Committees

IEEE **Technical Community** for

Climate Change

Some of the Initiatives led by IEEE and its Committees

Climate Change

IEEE: Enabling Innovation and Technology Solutions

https://climate-change.ieee.org/

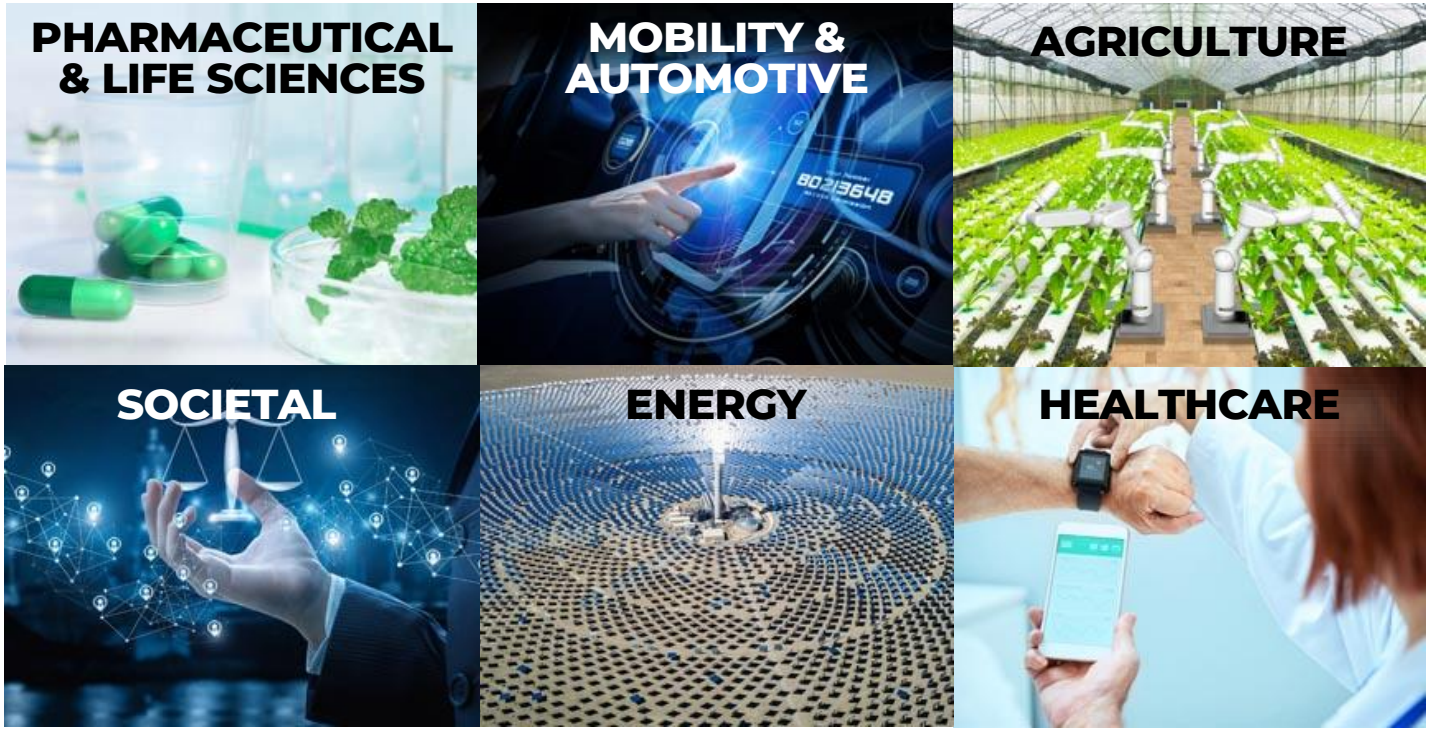
Important IEEE Links

- Planet Positive 2030 - https://sagroups.ieee.org/planetpositive2030/
  - Newsletters - https://sagroups.ieee.org/planetpositive2030/newsletter/
  - Strong Sustainability by Design & Accountable Sustainability by Design - https://sagroups.ieee.org/planetpositive2030/our-work/
- IEEE SusTech Initiative, IEEE Future Directions - https://cmte.ieee.org/futuredirections/projects/climate-tech/
- IEEE Climate Change - https://climate-change.ieee.org/
  - Newsletters - https://climate-change.ieee.org/signup/
  - Articles - https://climate-change.ieee.org/resources/xplore/
  - Events - https://climate-change.ieee.org/resources/events/
- IEEE Technical Communities - https://www.ieee.org/membership-catalog/productdetail/showProductDetailPage.html?product=CMYCC962
- IEEE Standards - https://standards.ieee.org/industry-connections/sustainable-infrastructures-development/
- Young Professionals Climate and Sustainability Task Force - https://yp.ieee.org/climate-sustainability-task-force/
- Women in Engineering - https://wie.ieee.org/news-events/conferences/ieee-wie-day/
- MCE – IEEE Event Sustainability Guide - https://ieeemce.org/planning-basics/ieee-event-sustainability-guide/
- IEEE Humanitarian Activities Board - https://htb.ieee.org/
- IEEE TAB Climate Change Program - TAB Climate Change Program - IEEE Technical Community Spotlight

Some of the Initiatives led by IEEE and its Committees

IEEE Standards

IEEE Standards Association's Expanding Areas



IEEE Planet Positive 2030 - Standards Development

- **P7800** Recommended Practice for Addressing Sustainability, Environmental Stewardship and Climate Change Challenges in Professional Practice: https://standards.ieee.org/ieee/7800/11039/
- **P7801** Recommended Practice for Technical Knowledge Commons Initiatives and Platforms: https://standards.ieee.org/ieee/7801/11197/
- **P7802** Standard for Measurement and Verification of Reduction of Greenhouse Gases for Climate Action Projects and Solutions: https://standards.ieee.org/ieee/7802/11238
- **P7803** Recommended Practice for Inclusive Sustainable Smart Cities: https://standards.ieee.org/ieee/7803/11412/

You are invited to participate! Interested? Please contact: maike.luiken@ieee.org

Engage, Participate, Contribute!

- *Join the IEEE Planet Positive 2030 Initiative*
- *Share the "Strong Sustainability by Design" Compendium widely*
- *Join the Planet Positive 2030 Accountability Framework Team and test BSAT*
- *Join the Future Directions Committee's IEEE SusTech Initiative*
- *Engage with the TAB Climate Change Program TAB Climate Change Program - IEEE Technical Community Spotlight*
- *Join one or more Standards Development Activities*
- *Engage with the Young Professionals Climate and Sustainability Task Force https://yp.ieee.org/climate-sustainability-task-force/*
- *Form a Local Group focused on Climate Change and/or Sustainability challenges in your Section, at your Student Branch in your city, your location*
- *Join other Initiatives across IEEE*
- *Propose a new initiative*

Interested? Please contact:

maike.luiken@ieee.org

Engage, Participate, Contribute!

Together we can and will succeed!

Engage, Participate, Contribute!

Opportunity to engage at the local level.

- ***Form a Local Group focused on Climate Change and/or Sustainability challenges in your Section, at your Student Branch in your city, your location***

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Engage, Participate, Contribute!

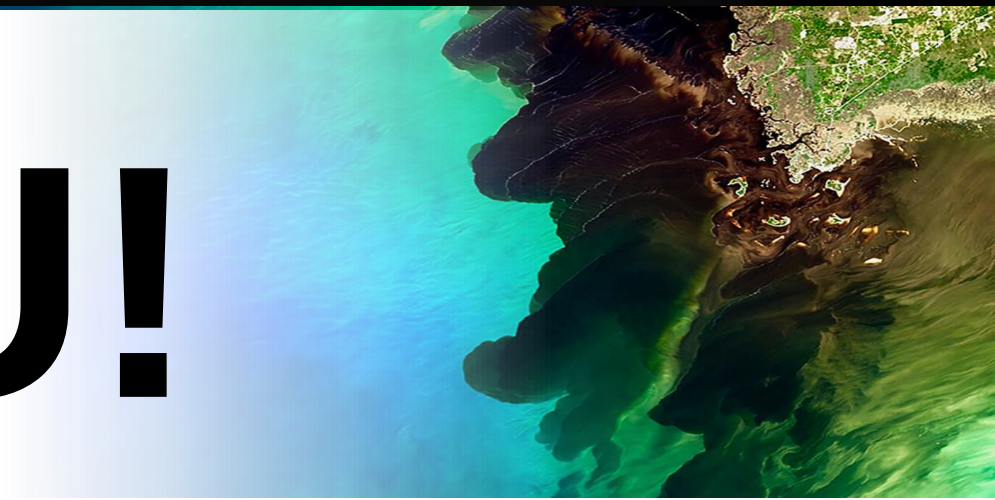
Together we can and will succeed!

IEEE Mission

IEEE's core purpose is to foster technological innovation and excellence for the benefit of humanity.

What else do we need?

YOU!



AND … Your Families, Your Friends, Your Colleagues, Your Communities …

It will take all of us working together to succeed!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Imagine The Future We Can Build Together

IEEE SusTech Initiative

Sustainability Through Technology

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You are invited. Join IEEE Initiatives Today!