IEEE Building the Path to Sustainability with Technology

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sagroups.ieee.org/planetpositive2030
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- Chair, IEEE Planet Positive 2030, IEEE SA
- Co-Chair, IEEE SusTech Initiative - FDC
- Chair, IEEE P7800™ Standards Working Group
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- IEEE Vice President - MGA, 2021
- IEEE Canada President, 2018 -19
- Managing Director - R&D, Carbovate Development Corp.
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- Member, IEEE Canadian Foundation Board of Directors

I am Committed to a Better World for All

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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
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

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Topics

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

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.

Annual global greenhouse gas emissions
in gigatonnes of carbon dioxide-equivalents

150 Gt

100 Gt

50 Gt

Greenhouse gas emissions up to the present

No climate policies
4.1 – 4.8 °C
Expected emissions in a baseline scenario if countries had not implemented climate reduction policies.

Current policies
2.5 – 2.9 °C
Emissions with current climate policies in place result in warming of 2.5 to 2.9°C by 2100.

Pledges & targets (2.1°C)
Emissions if all countries delivered on reduction pledges result in warming of 2.1°C by 2100.

2°C pathways
1.5°C pathways

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.
Licensed under CC-BY by the authors Hannah Ritchie & Max Roser,
CO₂ emissions by fuel or industry type, World

Data source: Global Carbon Budget (2023)
Greenhouse gas emissions\(^1\) are measured in tonnes of carbon dioxide-equivalents\(^2\) over a 100-year timescale.

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\(_2\)eq) which take account of the amount of warming that each molecule of different gases creates.

2. **Carbon dioxide equivalents (CO\(_2\)eq)**: 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\(_2\)eq). This takes all greenhouse gases into account, not just CO\(_2\). To express all greenhouse gases in carbon dioxide equivalents (CO\(_2\)eq), 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\(_2\)eq over 100 years, we’d multiply each gas by its GWP over a 100-year timescale (GWP100). Total greenhouse gas emissions – measured in CO\(_2\)eq – are then calculated by summing each gas’ CO\(_2\)eq value.

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**Data source**: Climate Watch (2023) | [OurWorldInData.org/co2-and-greenhouse-gas-emissions](http://OurWorldInData.org/co2-and-greenhouse-gas-emissions) | [CC BY](http://creativecommons.org/licenses/by/4.0/)
Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.

- Transportation: 11.9%
- Road transport: 11.9%
- Aviation: 3.8%
- Shipping: 0.4%
- Energy use in buildings: 17.5%
- Commercial: 6.6%
- Residential buildings: 10.9%
- Agriculture, Forestry & Land Use: 18.4%
- Waste: 3.2%
- Energy in Industry: 5.2%
- Other industry: 10.6%
- Iron and steel: 7.2%
- Food & tobacco: 1.0%
- Paper & pulp: 0.8%
- Other manufacturing: 0.5%
- Chemical & petrochemical: 3.6%
- Cement: 3%
- Energy in Agriculture & Fishing: 1.7%
- Fugitive emissions from energy production: 5.8%
- Unallocated fuel combustion: 1.8%
- Landfill: 1.2%
- Wastewater: 1.3%
- Chemicals: 2.2%
- Crop burning: 5.3%
- Rice cultivation: 4.2%
- Deforestation: 2.2%
- Landfills: 1.1%
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.

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

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)

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The Challenge: Net Zero Primary Energy Consumption by 2050

Global primary energy consumption by source

The breakdown of primary energy is shown based on the ‘substitution’ method which takes account of inefficiencies in energy production from fossil fuels. This is based on global energy for 2019.

84.3% of global energy comes from fossil fuels
(in 2000 it was 86.1%)

Oil 33.1%  Coal 27%  Gas 24.3%

*Other renewables* includes geothermal, biomass, wave and tidal. It does not include traditional biomass which can be a key energy source in lower income settings.


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


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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

What could make “it” happen? Sustainable Procurement

Potential Impact of Globally Sustainable Procurement

“Give me a lever long enough and a fulcrum on which to place it, and I shall move the world.”
— Archimedes —

GHG emissions -> Net Zero Waste

Need standard data and access/reporting tools to support purchase decisions

SP by large companies

SP used by governments in other COP countries

SP used by Provinces, Territories, Cities, and Municipalities

SP used by the Federal Government

Us
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

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What is needed?

Moving from
- Making “technology” work and
- Making “technology” interoperable
- Making “technology” safe
to
- Making “technology” sustainable
What is IEEE doing?

- Focus Groups – Cooperate – Converse – Discuss ..
- Build Technology Roadmaps - Standards - ...
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

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Some of the Initiatives led by IEEE and its Committees

IEEE Planet Positive 2030

sagroups.ieee.org/planetpositive2030
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

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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

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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

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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 - ...
Some of the Initiatives led by IEEE and its Committees

IEEE FDC SusTech Initiative

https://cmte.ieee.org/futuredirections/projects/climate-tech/
Future Directions SusTech Initiative

A community of researchers and technologists solving the climate crisis

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
- 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

July ‘23 October ‘23 April ‘24 May ‘24
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IEEE Technical Community for Climate Change

https://sagroups.ieee.org/planetpositive2030/
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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/


➢ 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/


➢ Young Professionals Climate and Sustainability Task Force - https://yp.ieee.org/climate-sustainability-task-force/


➢ IEEE TAB Climate Change Program - TAB Climate Change Program - IEEE Technical Community Spotlight
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IEEE Standards

https://sagroups.ieee.org/planetpositive2030/
IEEE Standards Association’s Expanding Areas

- Pharmaceutical & Life Sciences
- Mobility & Automotive
- Agriculture
- Societal
- Energy
- Healthcare
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/](https://standards.ieee.org/ieee/7800/11039/)
- **P7801** Recommended Practice for Technical Knowledge Commons Initiatives and Platforms: [https://standards.ieee.org/ieee/7801/11197/](https://standards.ieee.org/ieee/7801/11197/)
- **P7803** Recommended Practice for Inclusive Sustainable Smart Cities: [https://standards.ieee.org/ieee/7803/11412/](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:
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Engage, Participate, Contribute! Together we can and will succeed!

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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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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!
Imagine The Future We Can Build Together

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You are invited. Join IEEE Initiatives Today!