

Climate Change and Sustainability

*Dr. Saifur Rahman, 2023 IEEE President and CEO
10th IEEE Conference on Technologies for Sustainability
Portland, Oregon, 20 April 2023*



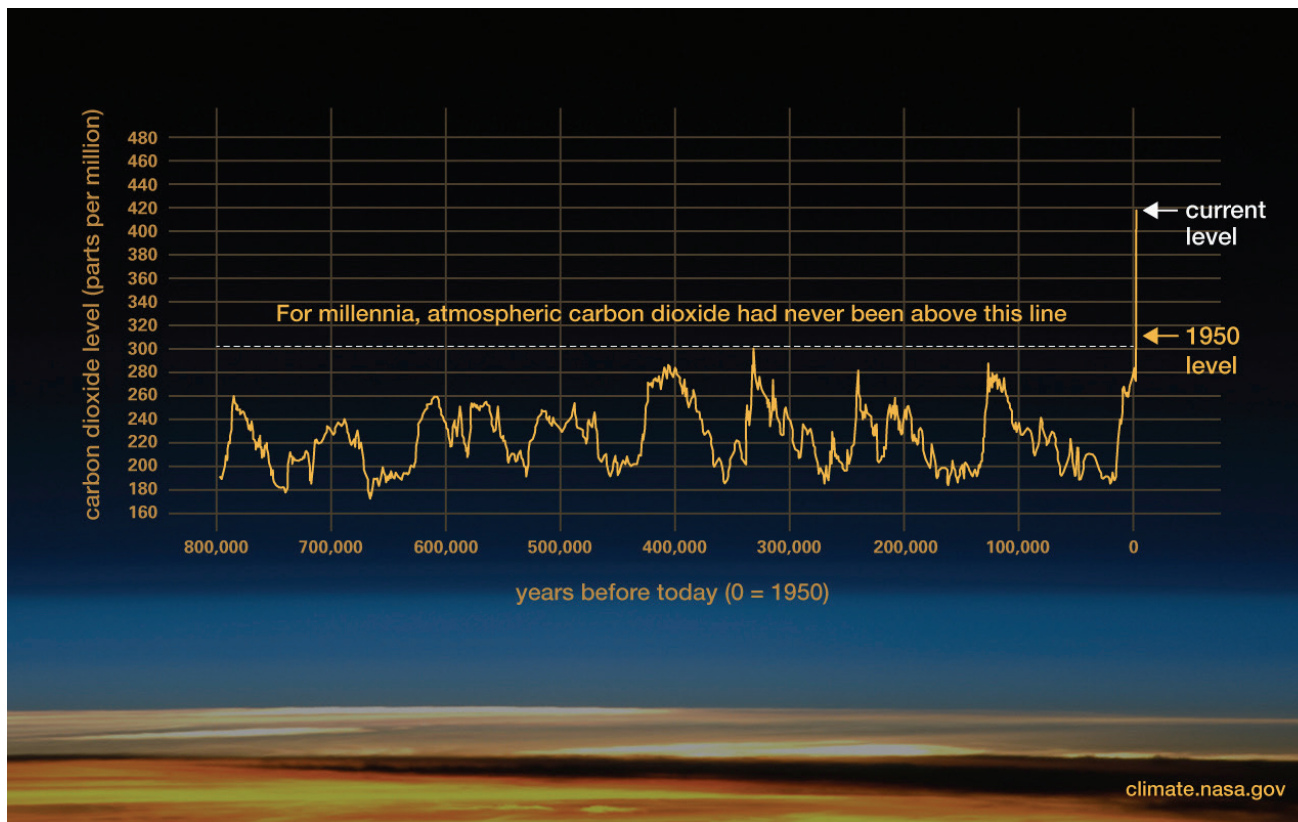
Primary cause for Climate Change

Carbonization

**Climate
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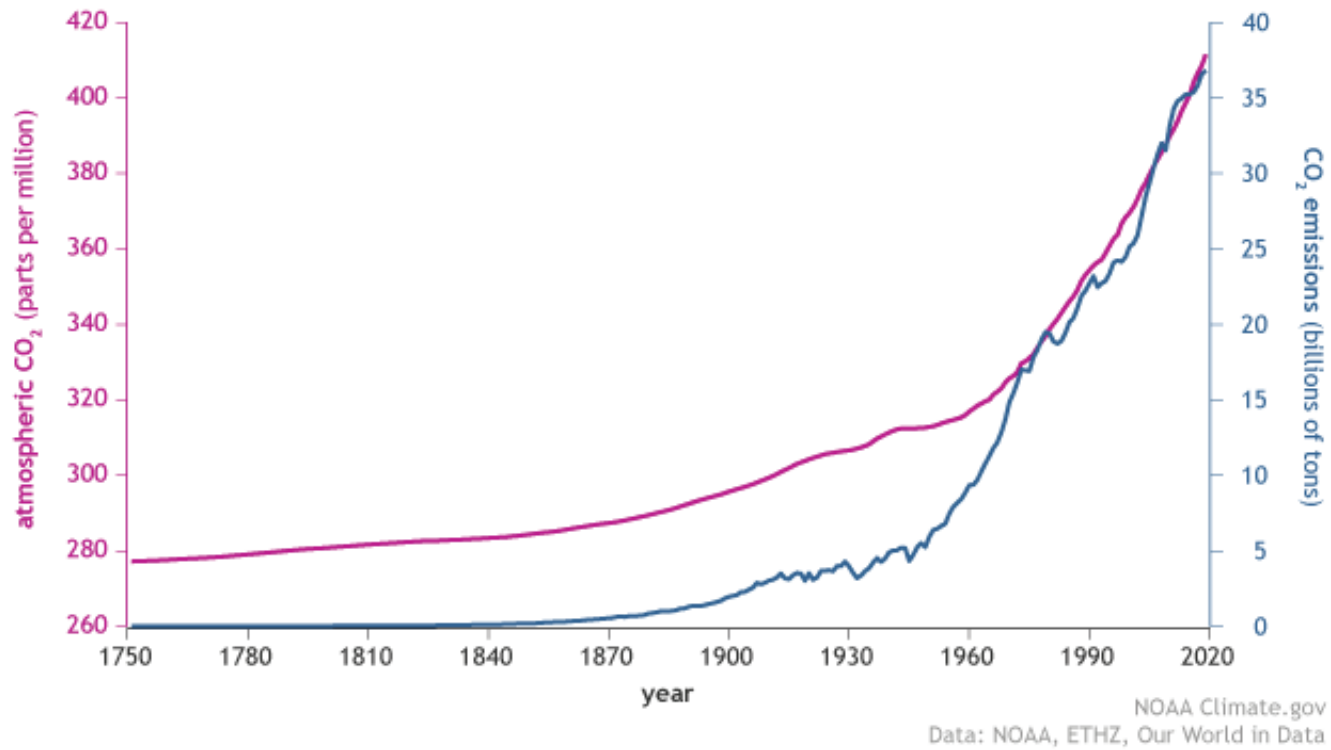


Source: NASA

https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/



CO₂ in the atmosphere and annual emissions (1750-2019)



Source: State of the Planet
<https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/>



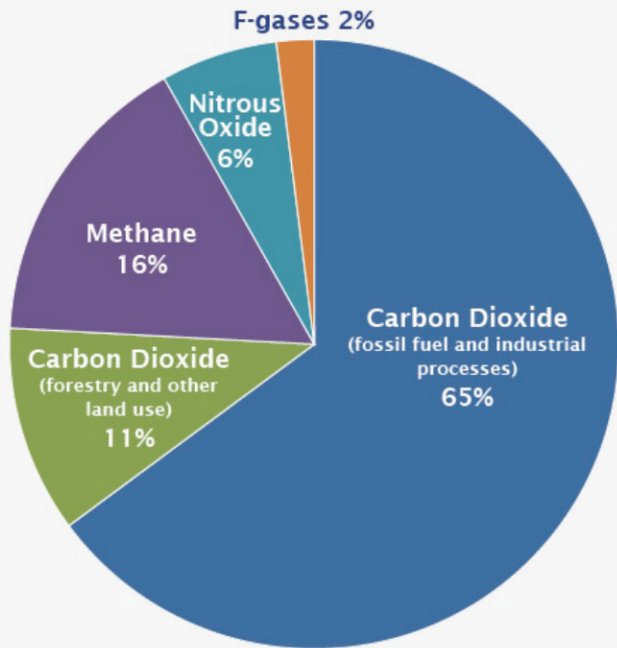
Global CO₂ Emissions Due to Fossil Fuels in 2021

Coal	15.3 billion tons
Nat. Gas	7.5 billion tons
Oil	10.7 billion tons

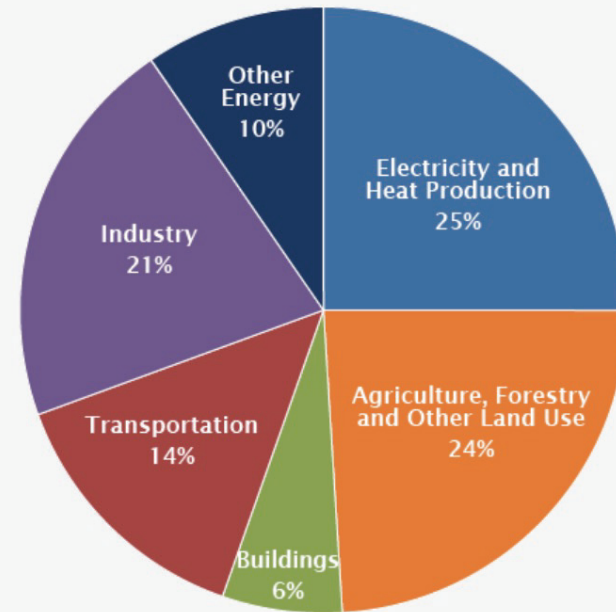
Source: IEA Global Energy Review: CO₂ Emissions in 2021
<https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2>



Global Greenhouse Gas Emissions by Gas



Global Greenhouse Gas Emissions by Economic Sector



Source: [IPCC \(2014\)](#)

<https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>



Visible Impacts of Climate Change

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Africa, China, and Florida, USA



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Hurricane Isabel struck the Mid-Atlantic region of the USA between 18-19 September 2003



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2023 January Flooding in New Zealand



Aljazeera News, The Waiohiki Bridge is washed away in Napier. [Kerry Marshall/Getty Images]



Flash flood caused by torrential rains in Auckland area in late January 2023

<https://youtu.be/5r2AzhxEvXM>

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Hurricane Sandy New York, New Jersey 2012



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Droughts in 2022



<https://idsb.tmgrup.com.tr/ly/uploads/images/2022/07/08/217454.jpg>

The Jialing Riverbed at the confluence with the Yangtze River is exposed due to drought on 18 August 2022, in Chongqing, **China**

Dry riverbed in **Italy** (Po River) due to worst drought in 70 years, June 2022



<https://image.cnbcfm.com/>

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Wildfires in the US



July 2021: The Dixie fire burned close to a million acres in **California's** Lassen county over three months and became the first fire to cross the Sierra Nevada. Photograph: Noah Berger/AP

Peaks glowing with thousands of spot fires on 13 June 2022, in Flagstaff, **Arizona**.
Rob Schumacher/The Republic



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Wildfires in Europe, Summer of 2022



Southwestern France, July 17, 2022



Central Portugal, July 13, 2022



Brandenburg, Germany, August 2022



Greece, July 2022



Northern Spain, June 2022



Central Italy, July 2022

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“The number of wildfires in 2022 in the EU have nearly quadrupled the 15-year average”

Source: CNN according to Copernicus, EU Earth observation program

Siberia: Wildfires in June 2021



The Greenpeace Russia team has documented forest fires in the Krasnoyarsk region.

JULIA PETRENKO / GREENPEACE



In this June 16, 2021 photo, firefighters work at the scene of forest fire near Andreyevsky village outside Tyumen, western Siberia, Russia. -

Copyright AP Photo/Maksim Slutsky, File

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2008 China Snowstorm



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Electrification to Reduce Fossil Fuel Use

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Electric vehicle



Heat pump as opposed to
oil/gas furnace

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Heavy electrification will **double** electricity demand in 10-15 years

We need to rethink how we use and produce electricity

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Reduce Carbon Emissions from Electricity Production



Reduce Carbon Emissions

1. Use less electricity, energy efficiency
2. Use low carbon fossil fuel power plants
3. Use H₂ & other storage technologies
4. Promote more renewables
5. Accept some nuclear
6. Promote cross-border power transfer

Customers Controlling Buildings Optimized for Savings

Measured energy savings across deployments

20% HVAC Energy Savings

25% Lighting Energy Savings

Occupant satisfaction: spaces controlled by a building automation systems are more comfortable due to more consistent temperature profiles and healthier air quality through consistent monitoring of environmental factors (CO₂ levels, PM 2.5).



Energy Efficiency Applications

Consider light bulbs

- Provide more energy efficient applications and tools globally
- The amount of electricity required to run an LED light bulb is less than 15% of what is needed to run an incandescent light bulb producing the same amount of light
- Providing developing nations with lightbulbs that are more energy efficient can ensure that energy consumption and carbon emissions are being reduced requiring lesser investments in power generation, transmission & distribution



Highly Efficient Fossil-fuel Power Plants

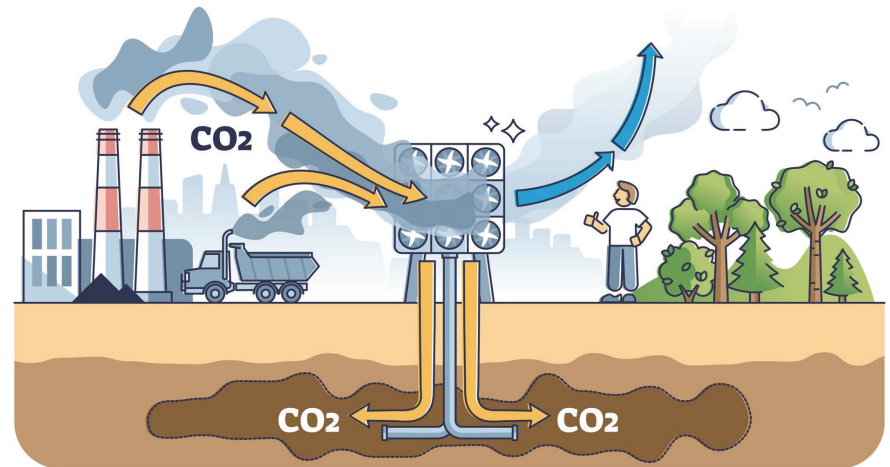
With Carbon Capture and Storage

- ▶ Combined Cycle Gas/Steam Power Plant
- ▶ Ultra-supercritical steam power plant



Carbon Capture & Storage Systems (CCS)

- ▶ Can help ensure that emissions created during the energy generation phase will not be emitted into the atmosphere
- ▶ These technologies have the potential to significantly reduce carbon emissions in energy systems across the board



Renewable Energy Integration

Build more strategically from the start

- ▶ Focus on where energy is needed most, via three core components:
 - Energy generation
 - Transmission
 - Distribution



Hydrogen and Storage Solutions

Optimize renewable energy solutions being integrated into energy grids



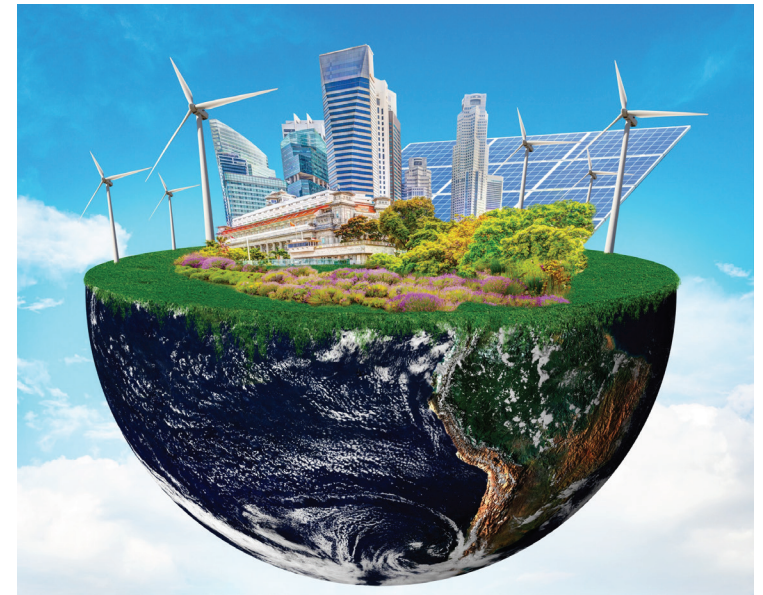
- ▶ Low-carbon hydrogen will help emerging economies to meet climate goals in and of itself
 - Provide for diverse energy portfolios
 - Improving resilience
 - Lowering costs
- ▶ Storage solutions serve as optimizers for other renewable energy solutions
 - Ensure that electricity generated during off-peak hours does not go to waste



Cross-Border Energy Transfer

We all are impacted by climate change

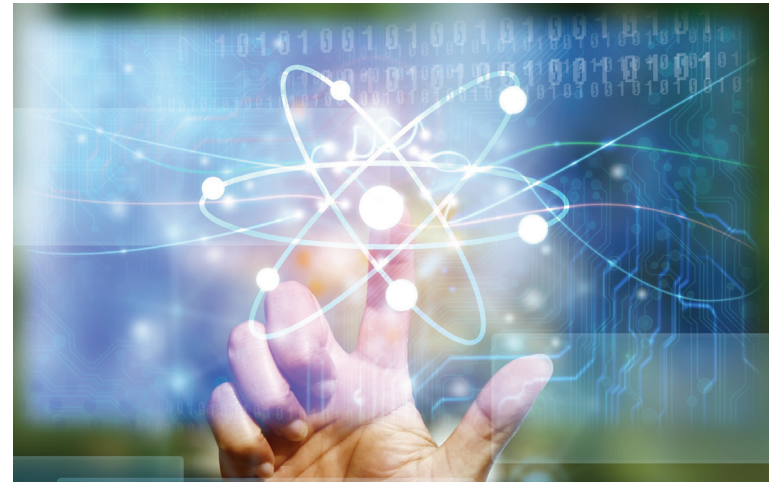
- ▶ As we are in this fight together, our solutions should be collaborative to secure better outcomes for all countries, regardless of location
- ▶ The International Energy Agency (IEA) has identified three main modes of cross-border energy integration:
 - Bilateral
 - Multilateral
 - Unified



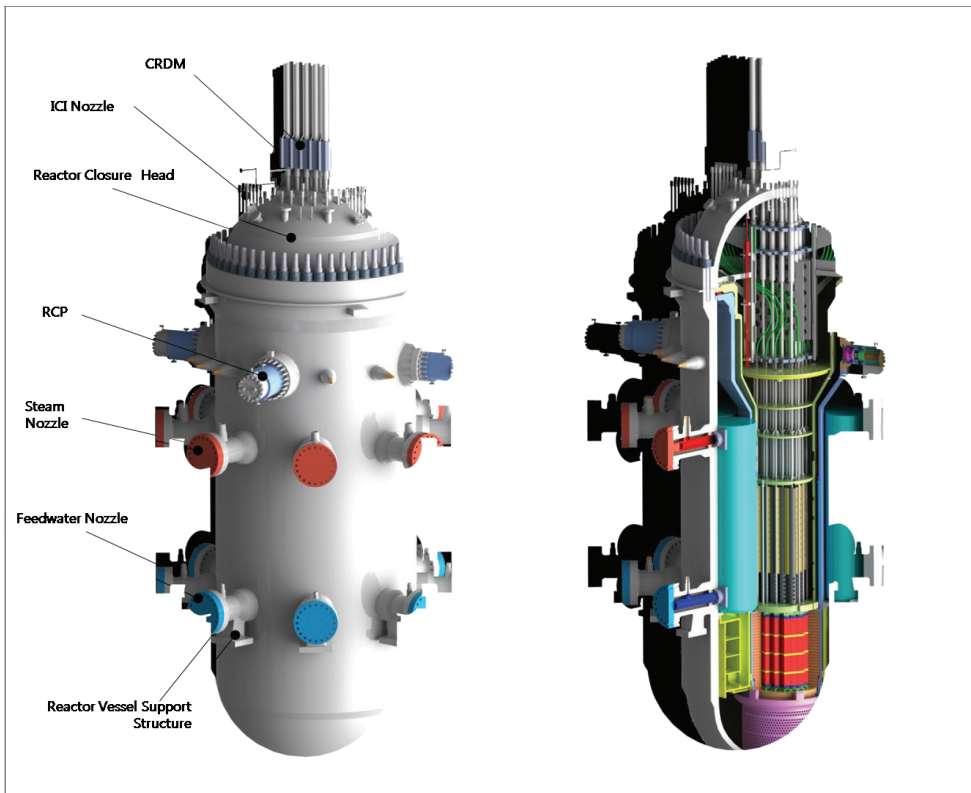
Advanced Nuclear Technologies

Diverse solutions to address climate change

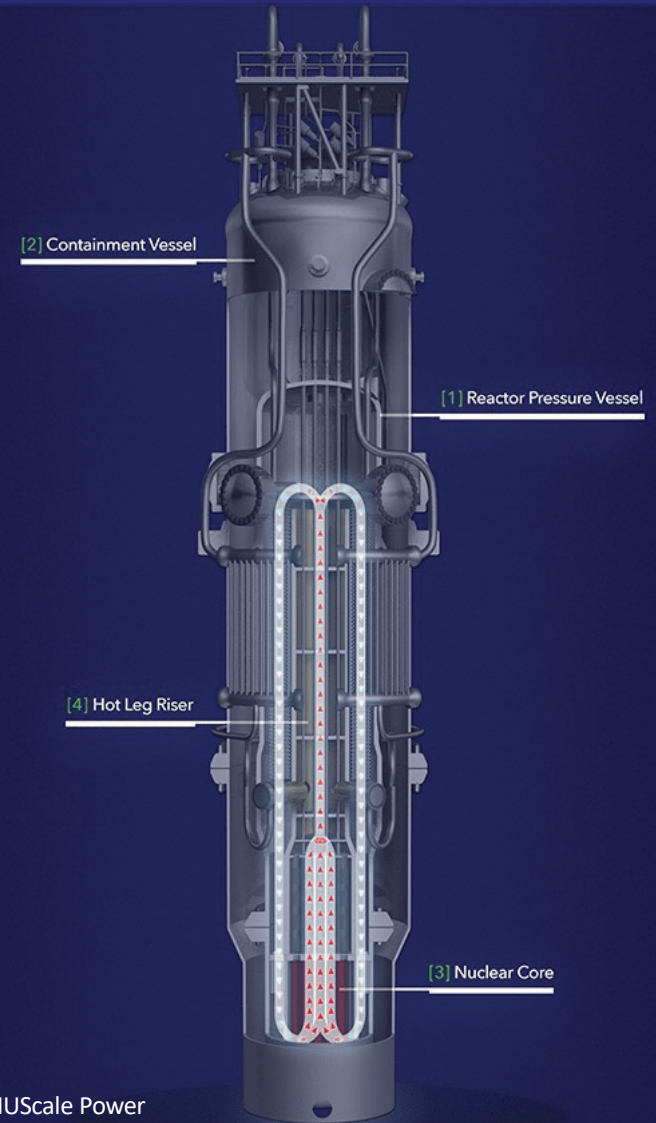
- ▶ Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
 - Smaller and can be built more quickly than more traditional nuclear reactors
- ▶ Ramping up the development of SMRs can help to produce energy when and where needed
- ▶ This energy could be integrated into existing power grids
 - helping to provide improved resiliency while simultaneously reducing emissions



Small Modular Reactors (SMR)



20m tall, 2.7m dia. 590 tons LWR
4.95% enrichment 50 – 60 MWe



Source: NUScale Power

IEEE can be a solution partner

<https://spectrum.ieee.org/6-solutions-to-climate-change>



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IEEE's Global Presence in the Climate Change Sustainability Debates and Discussions

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for Humanity*

What Can We Do to Serve Humanity?

Clean Tech Solutions for Climate Sustainability



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**Ongoing Climate Change Activities
Across the Organization**



IEEE at UN Climate Change Conference



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IEEE's Role in Education/Training/Research

Energy Transition Education Network



Presentation at the IRENA Pavilion
Sharm El-Shaikh, Egypt , 10 Nov 2022

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United Nations
Framework Convention on
Climate Change
COP27
SHARM EL-SHEIKH
EGYPT 2022

The global engineering view: Delivering an equitable,
sustainable and low carbon resilient world

November 10, 2022 / 11:30 – 13:00 am Egypt time (GMT + 2) / 10:30 – 12:00 CET (GMT + 1)



Davide Sironi
Chair, WFEO
Committee on
Engineering and the
Environment



Jianping Wu
Member, WFEO
Committee on
Engineering and the
Environment



Valentina Putino
Member, WFEO
Committee on Disaster
Risk Management



Saifur Rahman
Virginia Tech
Advanced Research
Institute, 2022 IEEE
President Elect



Tariq S. Durrani
University of
Strathclyde, Life
Fellow of IEEE



Afazul Feriogue
School of Climate
Change and
Adaptation

This is a Side Event organized by the World Federation of Engineering Organizations (WFEO) in collaboration with the Engineering Institute of Canada (EIC) and IEEE.

The speakers will cover the following topics:

- Exploring the engineering role in building climate resilience of cities and reducing risk for local communities.
- Understanding decarbonization through the lens of both industrialized and emerging economies, utilizing low carbon energy solutions.
- Showcasing the importance of women and future leaders.

The event will take place in the Akhenaten room.

The event is organized by:



Learn more about how IEEE is making a difference at [iseeclimatechange.org](https://www.ieeeclimatechange.org).

COP27 Side Event

In Collaboration with the
World Federation of Engineering
Organizations and the Engineering
Institute of Canada

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Energy Day 15 Nov 2022



UN Climate Change Pavilion



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IEEE at UN Climate Change Conference (COP28) in UAE in Dec 2023



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UN Climate Change Conference - United Arab E...

UN CLIMATE CHANGE
CONFERENCE - UNITED ARAB
EMIRATES NOV/DEC 2023

PREVIOUS
CONFERENCE

30 Nov - 12 Dec 2023

ABOUT THE CONFERENCE



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IEEE Sections Congress 2023

The triennial gathering of Section leadership bringing together hundreds of delegates from all ten Regions to network, learn and collectively shape the future of IEEE.

Registration Open

Early bird registration deadline: **21 July 2023**.
Registration fee increases by **US\$ 50** after that.

Date
11-13 August 2023



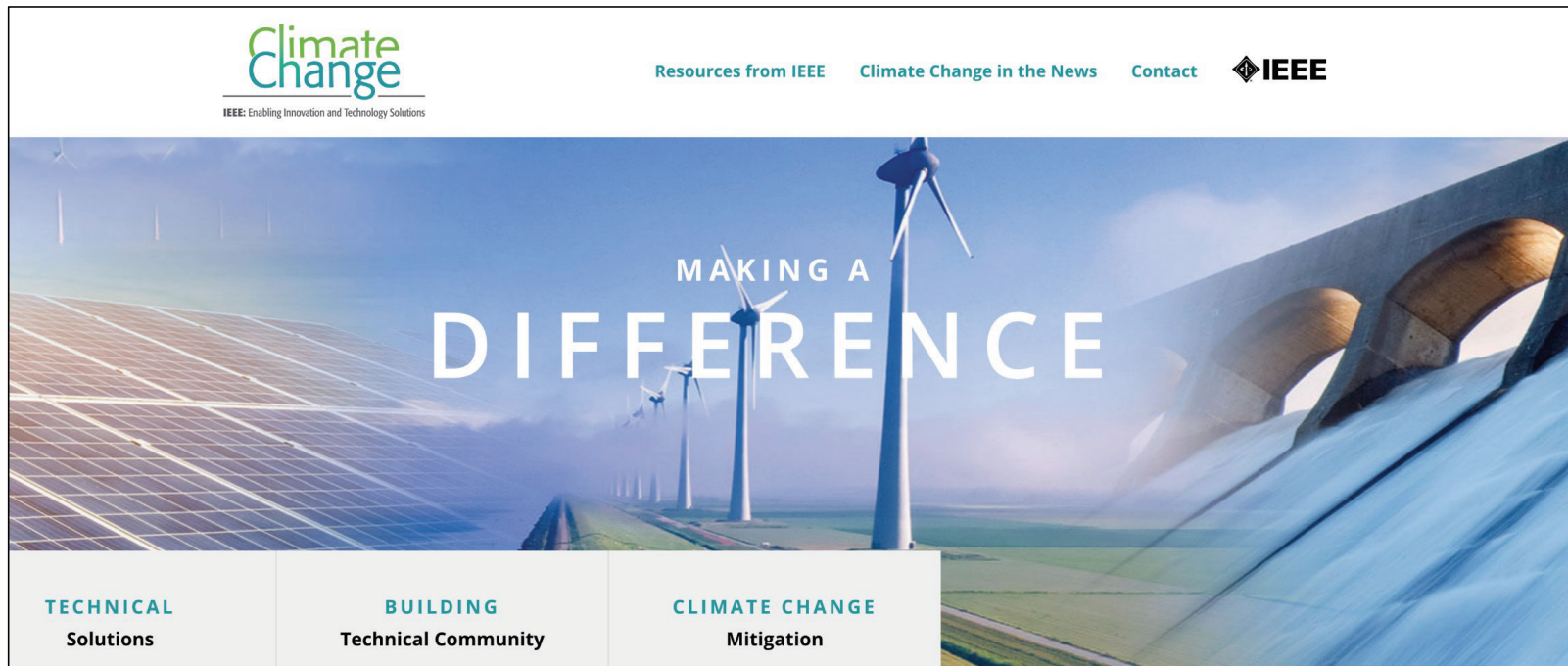
Location
Ottawa, Canada

Climate Change Pavilion at SC2023



IEEE Climate Change Website

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



Climate Change

IEEE: Enabling Innovation and Technology Solutions

Email: ccircc@ieee.org



IEEE Climate Change Collection (ICCC)

IEEE.org | IEEE Xplore Digital Library | IEEE Standards | IEEE Spectrum | More Sites

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Resources from IEEE Climate Change in the News Contact IEEE

RESOURCES FROM IEEE

As the world's largest organization of technical professionals, IEEE has both the opportunity and the responsibility to assist in organizing the response of engineers, scientists, and technical professionals across the world to address the causes, mitigate the impact, and adapt to climate change.

IEEE's scholarly publications, conference proceedings, technical standards, and other materials help foster the exchange of technical knowledge and information for the critical climate issues that our planet faces today.

[View the IEEE Climate Change Collection in IEEE Xplore®](#)



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Links to Spectrum



Spectrum just launched a curated page that links directly to articles in Xplore's Climate Change Collection

IEEE Climate Change Collection

IEEE's scholarly publications, conference proceedings, technical standards and other materials help foster the exchange of technical knowledge and information for the critical climate issues that our planet faces today.

[View the collection on IEEEXplore →](#)

On the History and Future of 100% Renewable Energy Systems Research
28 JUL 2022

Robust Virtual Inertia Control of an Islanded Microgrid Considering High Penetration of Renewable Energy
14 NOV 2022

Comparative Review of Energy Storage Systems, Their Roles, and Impacts on Future Power Systems
27 OCT 2022

Towards Sustainable Energy: A Systematic Review of Renewable Energy Sources, Technologies, and Public Opinions
18 OCT 2022

Visitors must visit two landing pages before before they can begin to hunt for material relevant to them. Experienced Xplore users will find what they need, but newbies might be frustrated.



The Ecosystem for IEEE's Climate Sustainability Work

IEEE Spectrum: Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change); Coverage of Conferences and Standards)

IEEE Discusses 6 Simple Solutions to Climate Change at COP27 · They include switching to LEDs and making coal plants more efficient

BY KATHY PRETZ | 28 JAN 2023 | 4 MIN READ

Simple, effective solutions that can help lessen the impact of climate change already exist. Some of them still need to be implemented, though, while others need to be improved.

Social Media



Sponsored Content From Industry

Evolution of In-Vehicle Networks to Zonal Architecture

In this webinar, you will learn more about:

- Evolution of In-Vehicle Network architecture
- Automotive Ethernet characteristics
- Compliance testing of Ethernet
- Practical demonstration

Xplore: Engineers to Follow; Journal Watch Articles (free); Climate Change Articles

IEEE Xplore Advancing Technology for Humanity

SEARCH 5,866,681 ITEMS

IEEE CLIMATE CHANGE

- Winnie N. Ye: Dual-Band Polarization-Independent Metasurface-Enabled Grating Coupler for Resonant Light Coupling
- David Scazzamotta: 3000-Foot-annular-resonator virtual antenna
- Fai (Fred) Wang: Improved Double-Pulse Test for Accurate Dynamic Characterization of Resonant Voltage IGBT Devices

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MAKING A DIFFERENCE

TECHNICAL SOLUTIONS | BUILDING TECHNICAL COMMUNITY | CLIMATE CHANGE MITIGATION

IEEE's mission is to advance technology for the benefit of humanity. Today the world faces its largest modern-day threat—climate change. We recognize this global crisis and are committed to helping combat and mitigate the effects of climate change through pragmatic and accessible technical solutions and providing engineers and technologists with a neutral space for discussion and action.

COORDINATING IEEE'S RESPONSE TO CLIMATE CHANGE DEDICATED COMMITTEE

The 2022 IEEE Ad Hoc Committee to Coordinate IEEE's Response to Climate Change is identifying ongoing efforts across IEEE and collaborating with key external partners for a comprehensive response to climate change.

Jobs From IEEE Job Site

IEEE JOB Site

FEATURED JOBS

- Senior System Architect
- Senior Test System Architect
- Senior Project Manager

Conferences



Standards

IEEE SA
STANDARDS ASSOCIATION

Newsletters

IEEE Spectrum

Tech Alert 2 FEBRUARY 2023

Here's How Apple is Making Their Humanoid Robot - Is now the right time for useful, affordable, general-purpose humanoid?

AI Goes To K Street: ChatGPT Turns Lobbyist - Automated influence campaigns could spell trouble for society.



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IEEE Publications Board has
started work on publishing a
journal like IEEE Access

IEEE Access[®]

Multidisciplinary :: Rapid Review :: Open Access Journal

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Our efforts can be the seeds to help combat and mitigate the effects of climate change through pragmatic and accessible technical solutions and by providing engineers and technologists with a neutral space for discussion and action.





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