

# IEEE's role in Promoting Clean-tech Solutions for Climate Sustainability



**Prof. Saifur Rahman**

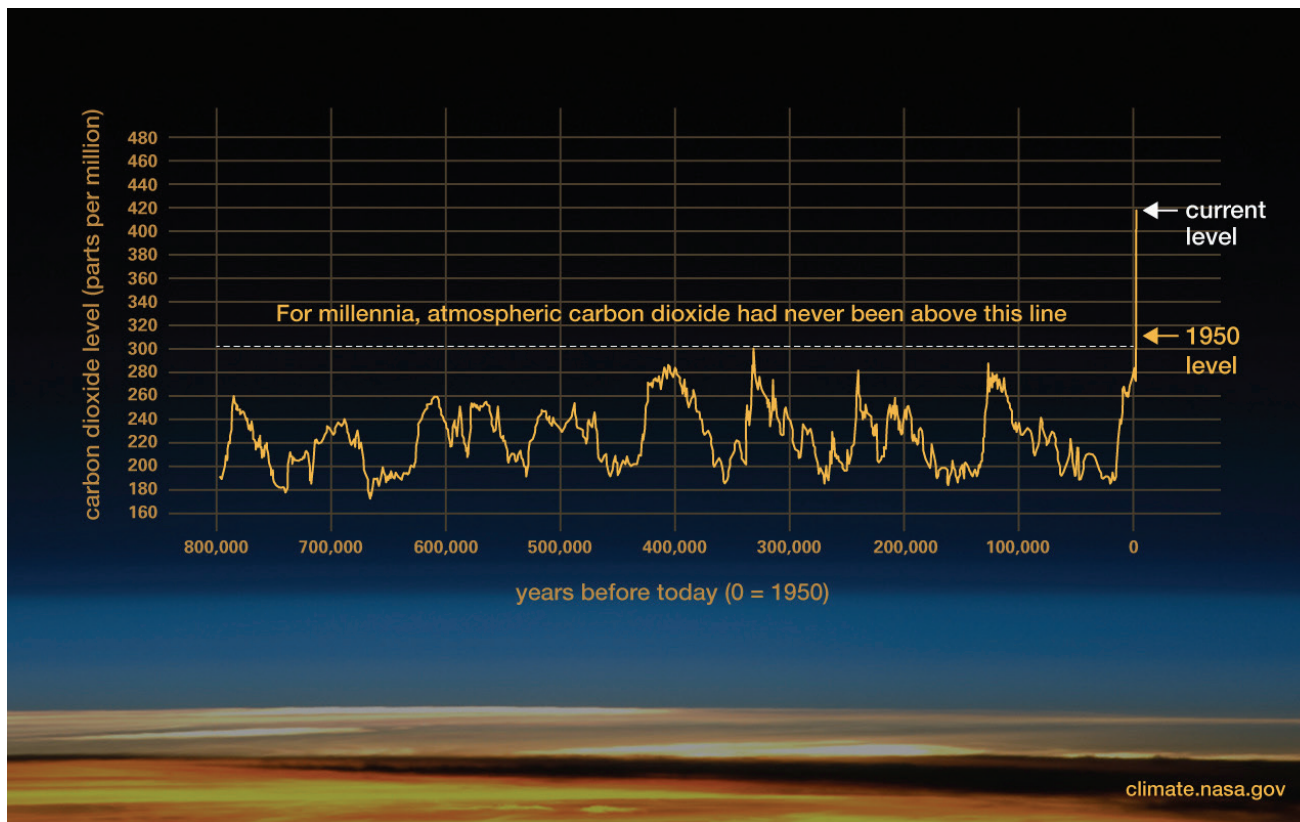
2023 IEEE President & CEO

[www.srahman.org](http://www.srahman.org)

Keynote Speech  
PES-HAC Congress  
15 October 2023



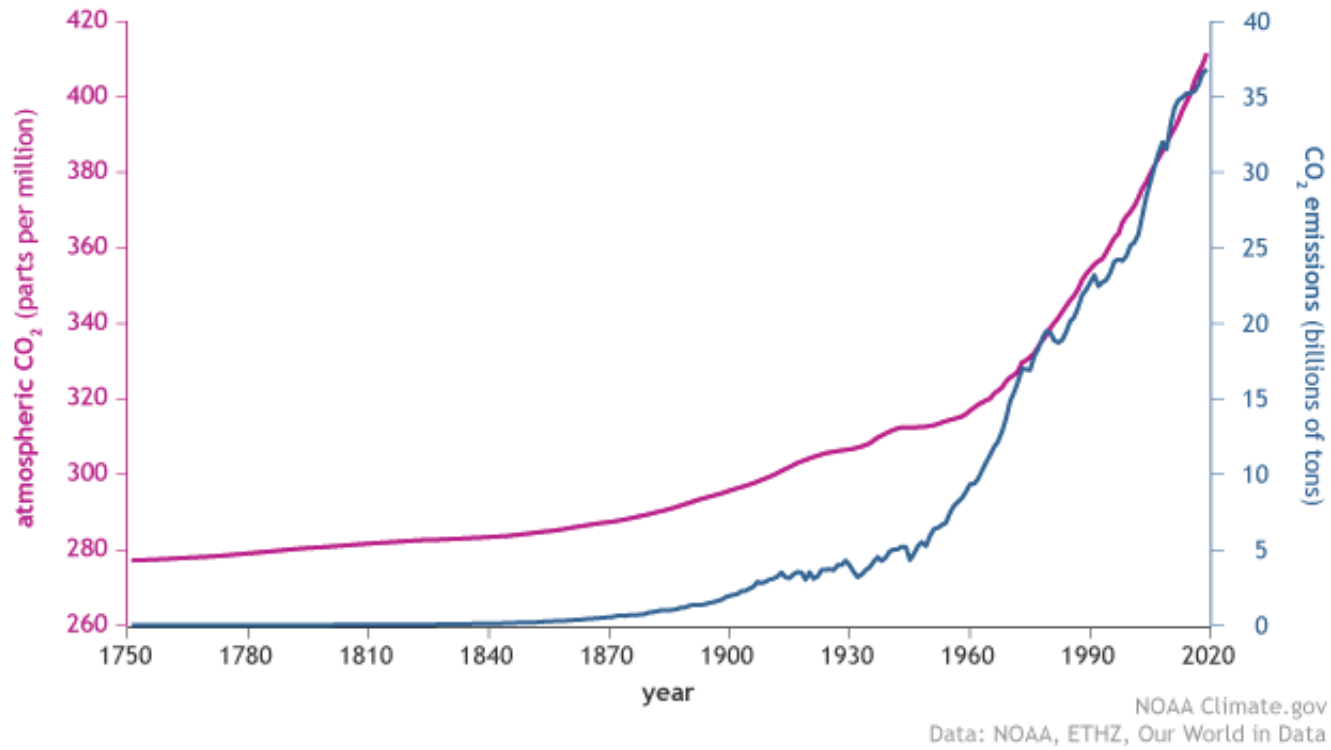
What is Carbonization ?



Source: NASA

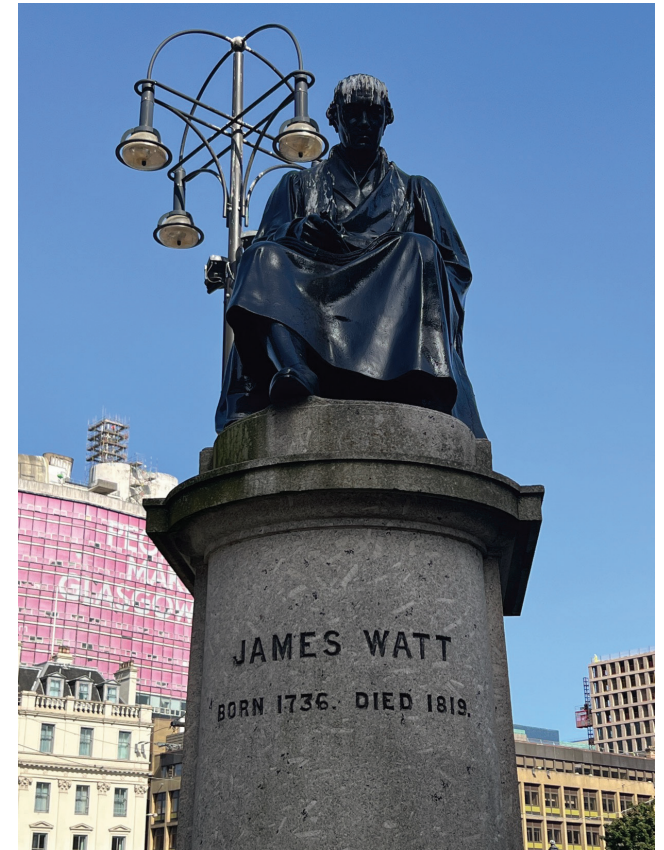
[https://climate.nasa.gov/climate\\_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/](https://climate.nasa.gov/climate_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/)

CO<sub>2</sub> 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/>

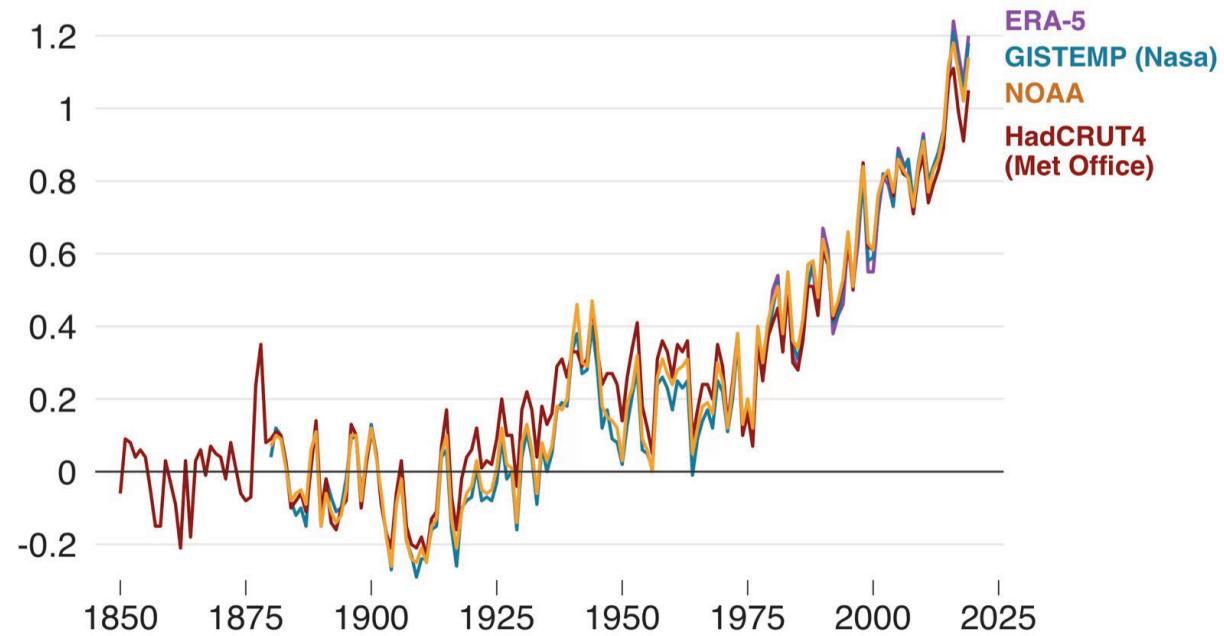




# Impacts of Carbonization

## Temperature rise since 1850

Global mean temperature change from pre-industrial levels, °C



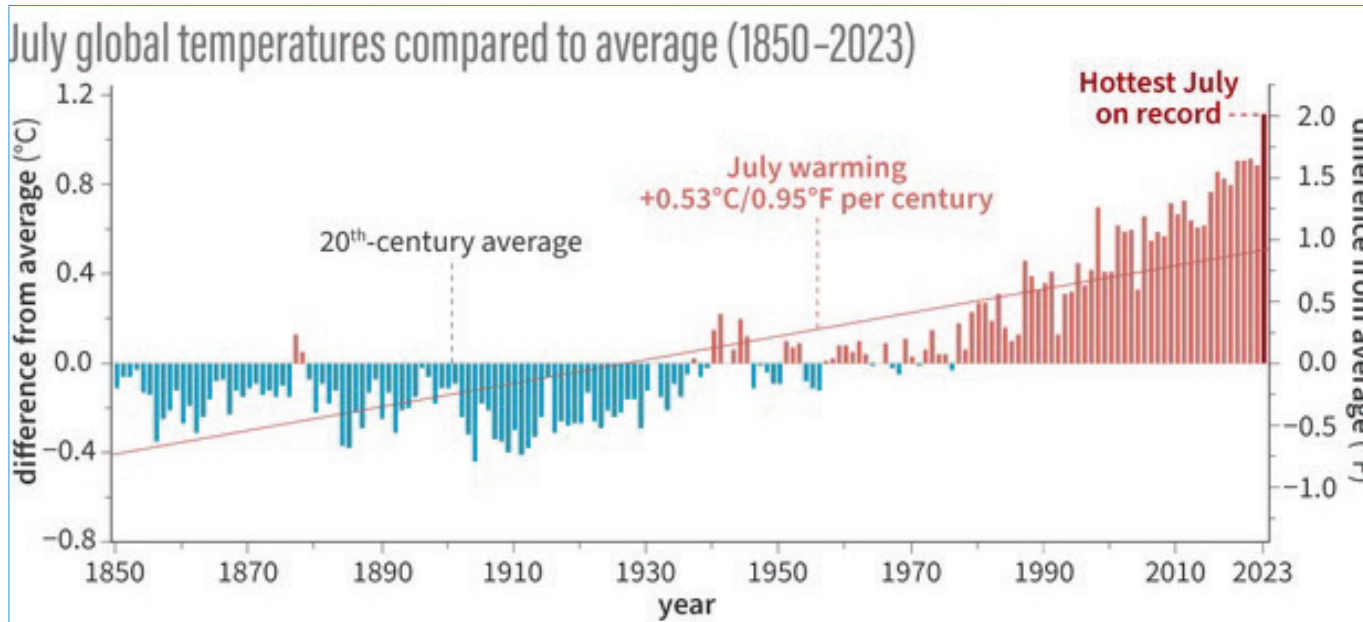
Source: Met Office

BBC

Source: <https://www.bbc.com/news/science-environment-51111176>

Temperature rise of 1.5 – 2.0 °C = Point of No Return

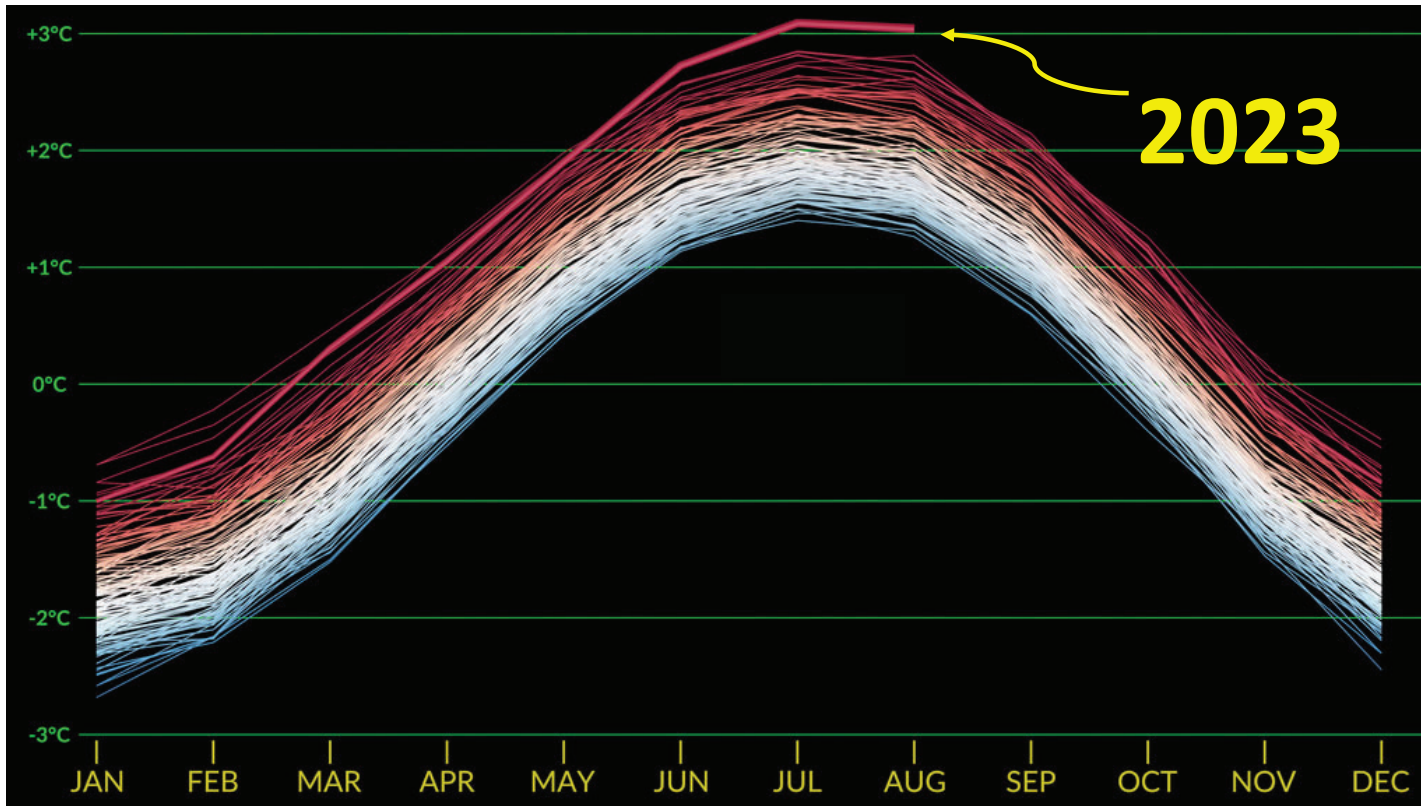
# Global Climate Summary for July 2023



July temperatures compared to the 20th-century average for each year from 1850 through 2023, which set a new record for the hottest July. NOAA Climate.gov image, based on data from NOAA National Centers for Environmental Information.

The July global surface temperature was 1.12°C (2.02°F) above the 20th-century average of 15.8°C (60.4°F), making it the warmest July on record. This marked the first time a July temperature exceeded 1.0°C (1.8°F) above the long-term average.

July 2023 was 0.20°C (0.36°F) warmer than the previous July record from 2021. July 2023 marked the 47th-consecutive July and the 533rd-consecutive month with temperatures at least nominally above the 20th-century average.



Monthly temperature anomalies from 1880 to August 2023 measured with respect to the baseline period 1951-1980.

This graph includes the seasonal cycle showing that June 2023, July 2023, and August 2023 were each consecutively the warmest month on record.

# Climate Impacts

Floods

Droughts

Wildfires



# Climate-change Impacts



Pethi Belaid/Agence France-Presse — Getty Images





# Beijing



Flooded street after heavy rains in Zhuozhou, in northern China's Hebei province August 2, 2023. (AFP)

Source: <https://english.aawsat.com/features/4470081-what-caused-record-rainfall-beijing-and-northern-china>



Residents are evacuated by rubber boats through flood waters in Zhuozhou in northern China's Hebei province, south of Beijing, Wednesday, Aug. 2, 2023. China's capital has recorded its heaviest rainfall in at least 140 years over the past few days. Among the hardest hit areas is Zhuozhou, a small city that borders Beijing's southwest. (Andy Wong/AP)

Source: [https://www.stripes.com/theaters/asia\\_pacific/2023-08-02/beijing-china-rainfall-deaths-10925575.html/](https://www.stripes.com/theaters/asia_pacific/2023-08-02/beijing-china-rainfall-deaths-10925575.html/)

# Flooding in Pakistan – August 2022



Source: <https://www.npr.org/sections/pictureshow/2022/08/30/1119979965/pakistan-floods-monsoon-climate>



Source: <https://www.nytimes.com/2022/09/07/briefing/climate-change-heat-waves-us-europe.html>



# Brazil



Aerial view of the area affected by an extratropical cyclone in Rio Grande do Sul State, Brazil  
(AGENCIA RBS/AFP via Getty Images)  
Sept 2023

# Flooding in Libya



Thousands of Lives Lost



# Greece



A vehicle crosses a flooded road in the city of Volos, central Greece (AFP via Getty Images) Sept 2023



Cars in a flooded road in the city of Volos, central Greece (AFP via Getty Images) Sept 2023

# Droughts in 2022



Dry riverbed in **Italy** (Po River) due to worst drought in 70 years, June 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 August 18, 2022 in **Chongqing, China**.

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





# 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**.  
Schumacher/The Republic



# 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

**“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](#)



# Algeria/Tunisia



Burnt vehicles are pictured in the aftermath of a wildfire in Bejaia, Algeria July 25. REUTERS/Ramzi Boudina

Source: <https://www.reuters.com/world/africa/deadly-fires-rage-along-algeria-coast-spread-tunisia-2023-07-25/>

- Death toll at least 34 fatalities, including 10 firefighters in Algeria
- At least 26 others have been injured.
- Over 1,500 people evacuated in Bejaia, Bouira, and Jijel, Algeria
- Over 2500 evacuated from Maloula and Tabarka in Tunisia

Source: Crisi24

<https://crisis24.garda.com/>

Wednesday 26/07/2023



A man inspects the remains of a burnt vehicle in the aftermath of a forest fire near the town of Melloula in northwestern Tunisia close to the border with Algeria, July 26, 2023. (AFP)

Source: <https://thearabweekly.com/tunisia-algeria-contain-wildfires-heatwave-sweeps-across-north-africa>

# Algeria/Tunisia



Fethi Belaid/Agence France-Presse — Getty Images

Forest fire in northwestern Tunisia, close to the border with Algeria, July 24, 2023



Aftermath of forest fire in northwestern Tunisia, close to the border with Algeria

Source: <https://www.nytimes.com/article/wildfires-greece-italy-algeria.html>



# Siberia: Wildfires in June 2020 and 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

# Greece

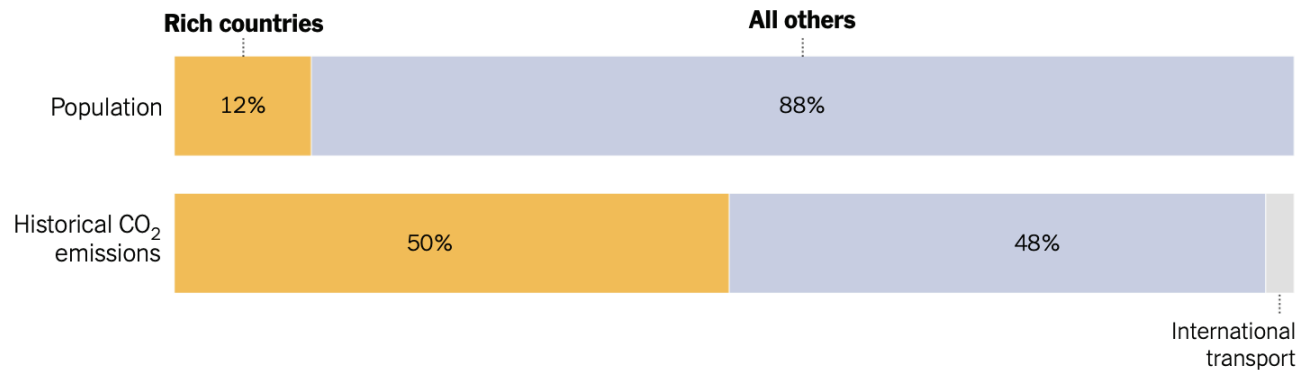


Before/After image of Fire Damage in Kiotari Rhodes, Greece  
Source: Maxar Technologies via BBC. **July 2023**



## Who Has the Most Historical Responsibility for Climate Change (population based)

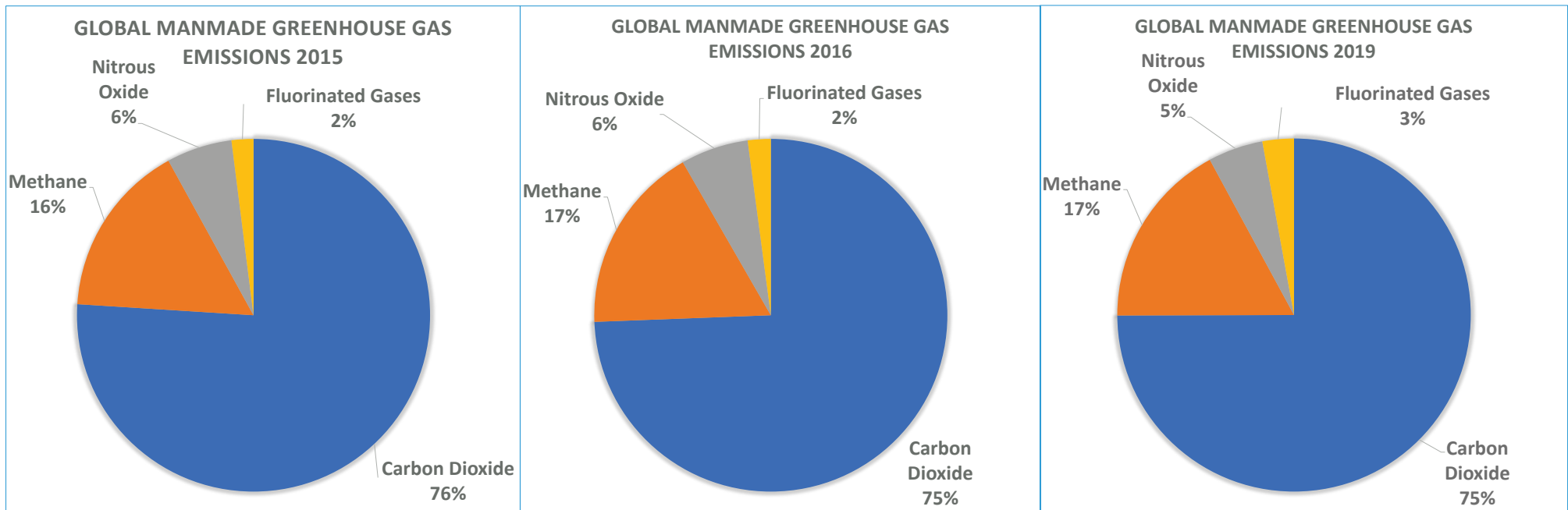
Rich countries, including the United States, Canada, Japan and much of western Europe, account for just 12 percent of the global population today but are responsible for 50 percent of all the planet-warming greenhouse gases released from fossil fuels and industry over the past 170 years.



Source: The New York Times article "Who Has The Most Historical Responsibility for Climate Change?" by [Nadia Popovich](#) and [Brad Plumer](#), Nov. 12, 2021 (<https://www.nytimes.com/interactive/2021/11/12/climate/cop26-emissions-compensation.html>)

# Global Anthropogenic Greenhouse Gas Emissions by Gas 2015, 2016 & 2019

Fluorinated Gases include: HFC, PFC and SF6



Source: <https://www.c2es.org/content/international-emissions/>

Source: <https://ourworldindata.org/greenhouse-gas-emissions#annual-greenhouse-gas-emissions-how-much-do-we-emit-each-year>

Source: UNEP Emissions Gap Report 2020 <https://www.unep.org/emissions-gap-report-2020>

# Opportunities of Decarbonization in the Electric Power Supply Industry

Source: IEEE Spectrum, Jan 2023



## Reduce Carbon Emissions

1. Use less electricity, energy efficiency
2. Use low carbon fossil fuel power plants
3. Use H<sub>2</sub> & 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 (CO<sub>2</sub> levels, PM 2.5).



## Eemshaven ultra-supercritical steam power plant, The Netherlands



Power Plant: Two units rated 800MW each

Efficiency: 46.2%

Temp: 609 deg C

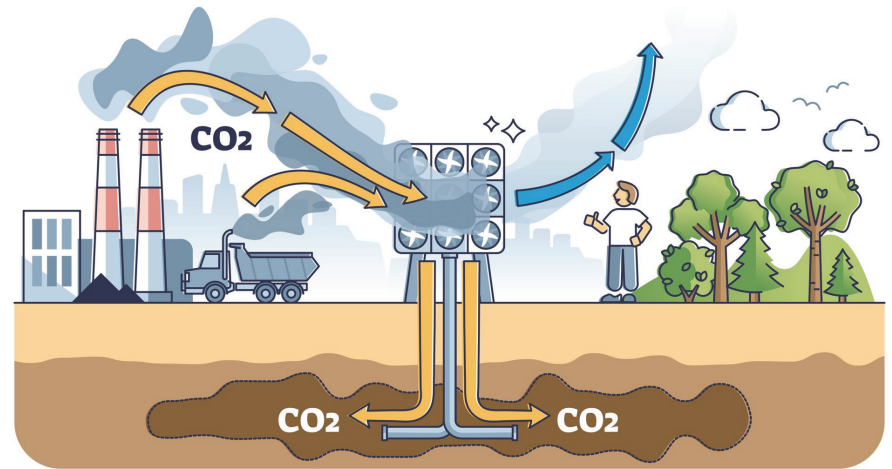
Steam Turbine: Siemens SST5-6000

Built: 2014



# 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





# 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

# Renewable Energy Integration

*Whitelee Windfarm, Glasgow, Scotland*



# Kenya School of Monetary Studies, Nairobi

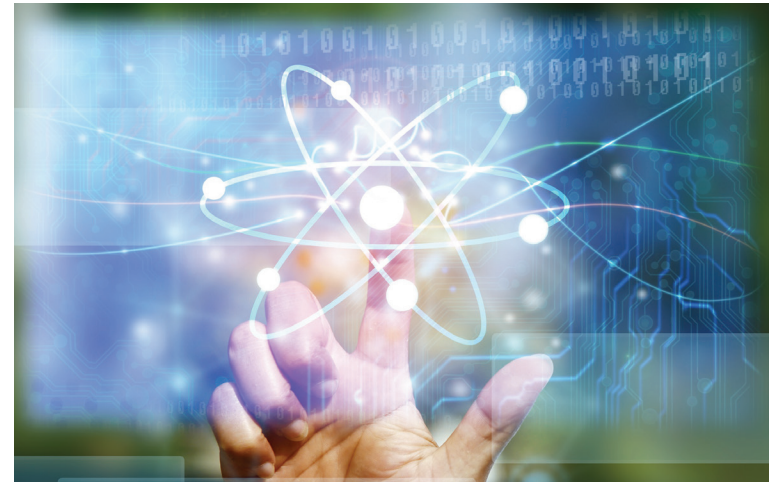




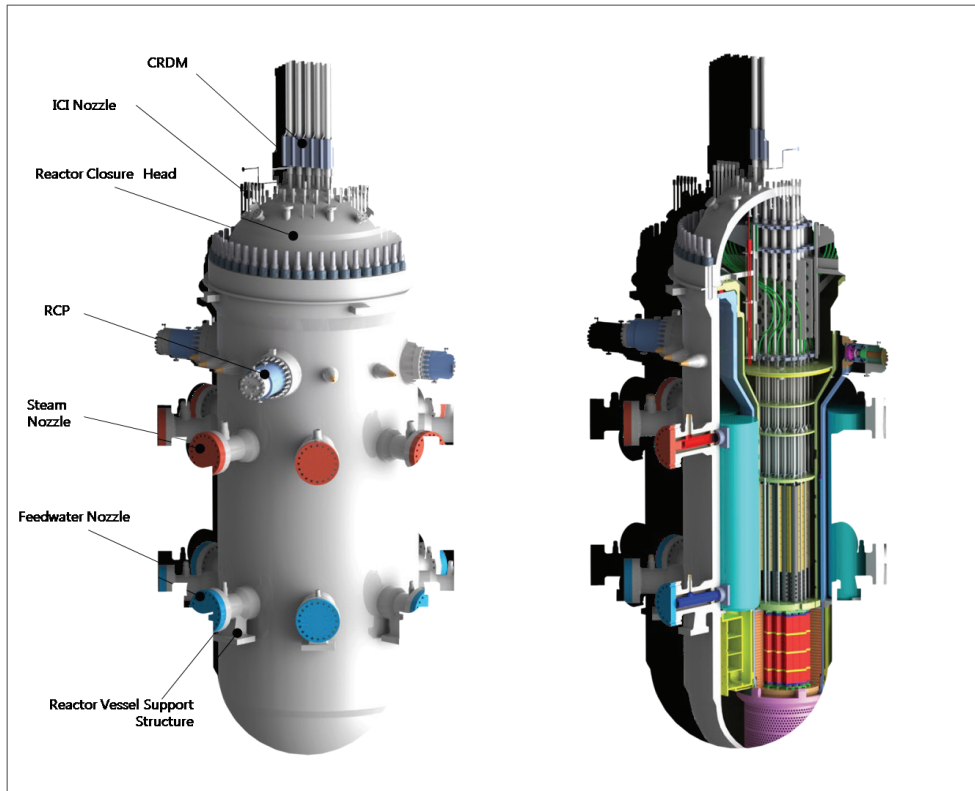
# Advanced Nuclear Technologies

*Diverse solutions to address climate change*

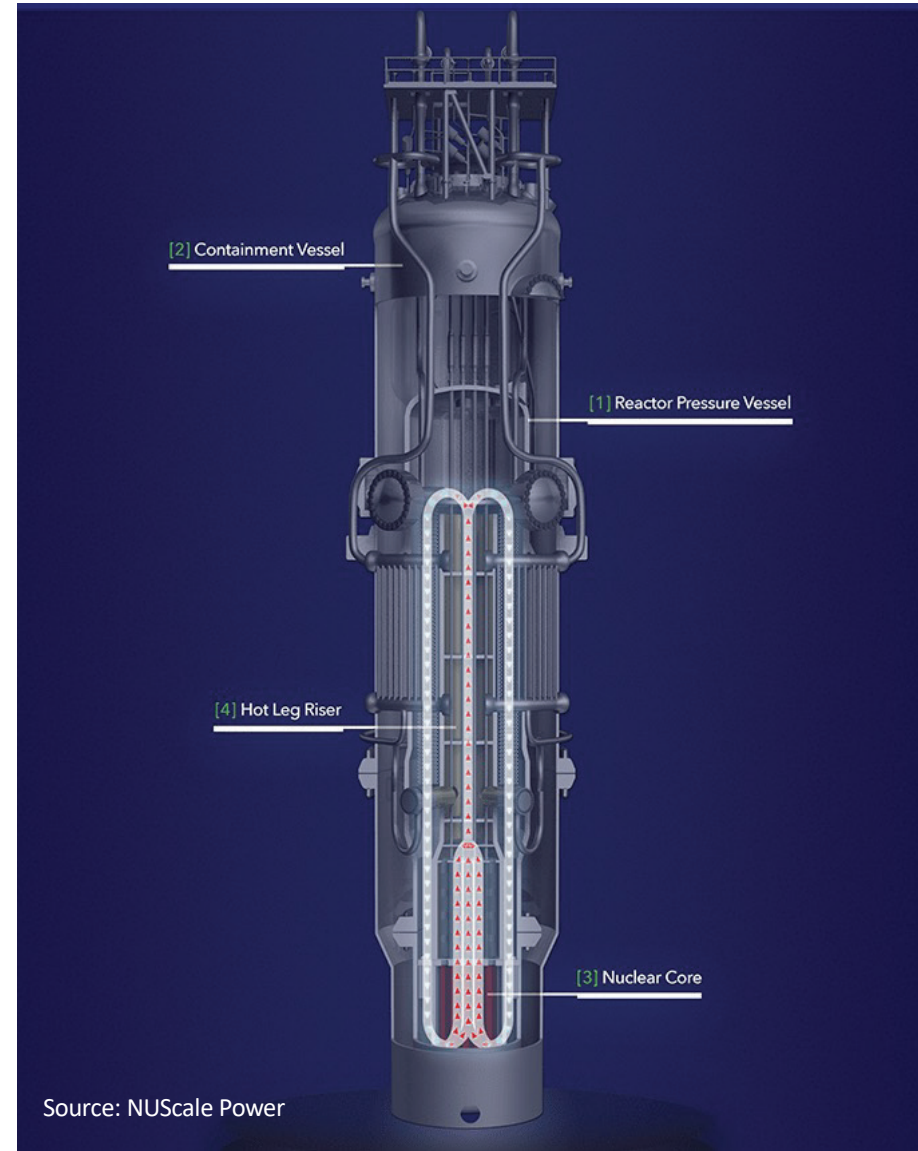
- Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
  - Smaller and can be built more quickly than more traditional nuclear reactors
- Ramping up the development of SMRs can help to produce energy when and where needed
- This energy could be integrated into existing 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



# 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







*Advancing Technology  
for Humanity*

**Clean-tech Solutions for Climate Sustainability**

# IEEE at UN Climate Change Conference



# Global Alliance of Universities on Climate





# Presentation at GAUC



# Partnership with International Renewable Energy Agency (IRENA)

## Energy Transition Education Network

**ETEN Founding Partners**

**Convened by:**  **IRENA**  
International Renewable Energy Agency

**PERMANENT MISSION OF THE UNITED ARAB EMIRATES INTERNATIONAL RENEWABLE ENERGY AGENCY (IRENA)**  **البعثة الدائمة الإمارات العربية المتحدة الوكالة الدولية للطاقة المتجددة (إيرينا)**

**Partners:**  **unesco** **Teach For All**  
A Global Network

 **unicef** **for every child**  **Higher Education Sustainability Initiative** **HESI+10**  
Celebrating 10 years with Higher Education Sustainability Impact

 **IEEE**  
Advancing Technology for Humanity

 **ENERGY TRANSITION EDUCATION NETWORK**  **IRENA at COP27**

# Climate Change

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**IEEE:** Enabling Innovation and Technology Solutions

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



# IEEE Climate Change Program

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



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email: [ccircc@ieee.org](mailto:ccircc@ieee.org)



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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, events, 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.



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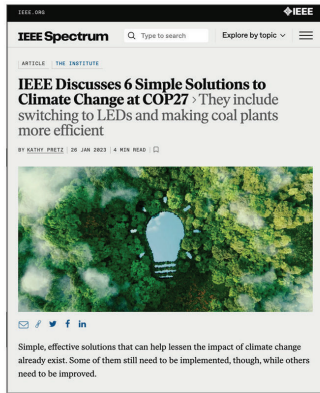


IEEE: Enabling Innovation and Technology Solutions

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

# Ecosystem for IEEE's Climate Sustainability Work

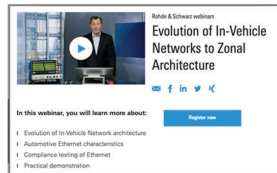
**IEEE Spectrum:** Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change); Coverage of Conferences and Standards



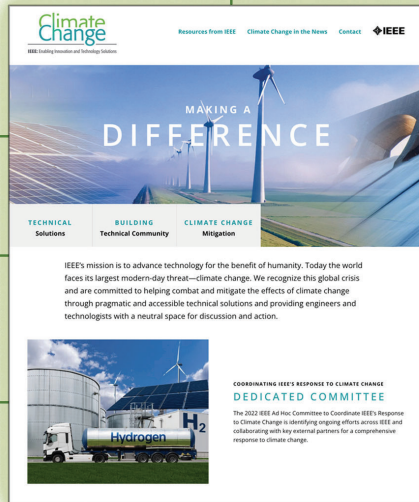
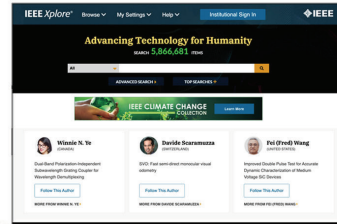
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**Xplore:** Engineers to Follow; Journal Watch Articles (free); Climate Change Articles



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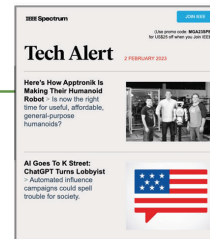
**Conferences**



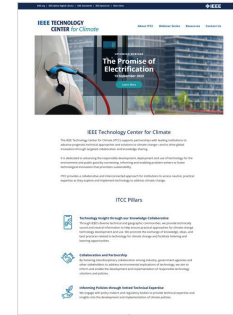
**Standards**



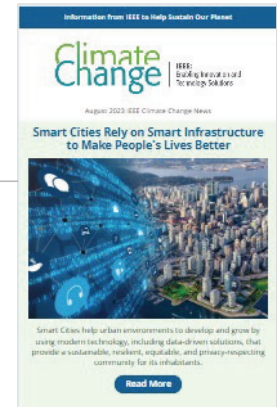
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