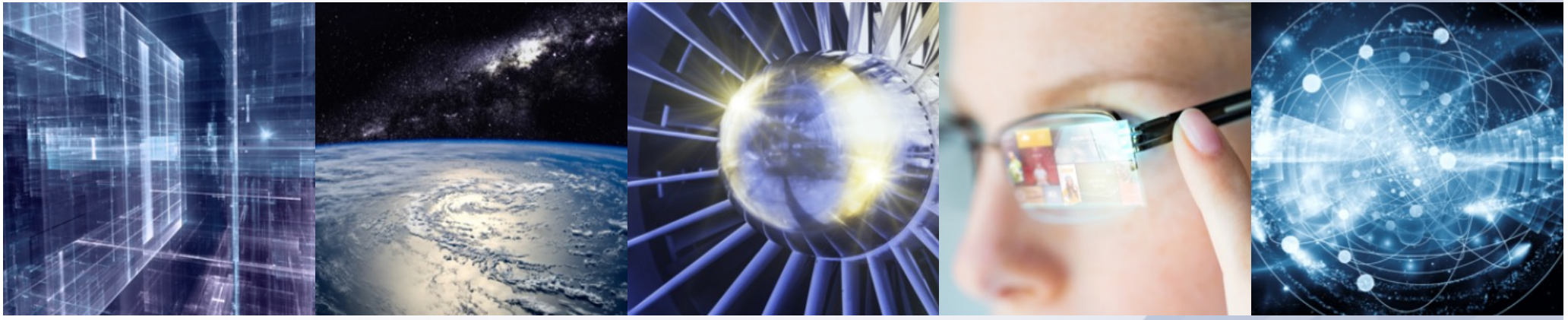

Opportunities for Low-Carbon Electricity for Climate Change Mitigation

Distinguished Lecture, JC Bose Science Heritage Museum, Kolkata

Professor Saifur Rahman, IEEE Life Fellow
2023 IEEE President
19 July 2024

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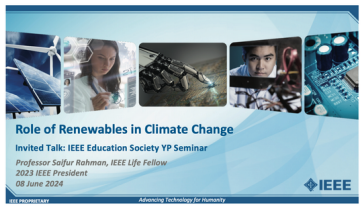
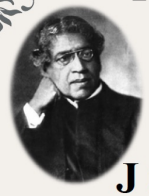
PPT slides are available at
www.srahman.org

Date	Recent and Upcoming Presentations and Webinars	Webinar/Presentation Slides
08 June 2024 ***IEEE YP Seminar***	**Role of Renewables in Climate Change** Invited Talk, IEEE Education Society YP Seminar This lecture explains what carbonization is, addresses its causes and impacts. It then offers technological solutions to reduce CO2 emissions from the electric power sector which is responsible over 30% of global Carbon emissions. In order to address the reduction of carbon emissions from the electric power sector, a collaborative approach between the industrialized nation states and emerging economies is necessary. This will involve a portfolio of solutions with low-carbon generation from wind, solar, hydro and nuclear, storage, cross-border power transfer and advanced technology focusing on energy efficiency. This talk also discusses the IEEE Climate Change program and related activities. Saifur Rahman, PhD Joseph Loring Professor of Electrical Engineering and Director Virginia Tech Advanced Research Institute, USA IEEE President 2023	

INVITATION



SIR J C BOSE TRUST

J C Bose Science Heritage Museum

PRESENTS

Distinguished Lecture

"Opportunities for low-carbon electricity for Climate Change Mitigation"

Speaker

Prof. Saifur Rahman, PhD

2023 IEEE President and CEO

Joseph Loring Professor of Electrical &Computer Engineering

Founding Director of Advanced Research Institute at Virginia Tech,

Virginia, USA

SIR J C BOSE TRUST

04.01.2024

Prof. Saifur Rahman
Life Fellow & President of IEEE
Director, Virginia Tech Advanced Research Institute, USA
Virginia Tech Research Center - Arlington
900 N. Glebe Road
Arlington, VA 22203
Email: srahman@vt.edu

Dear Prof. Rahman,

Greetings of the day from Sir J C Bose Science Heritage Museum, Acharya Bhaban, Sir J C Bose Trust, (a Trust founded by Bose himself in 1931).

With kind regards,

Parul Chakrabarti

.....

Prof. Parul Chakrabarti, PhD, FNASc, FAScT
Secretary and Trustee, Sir J C Bose Trust
Coordinator, J C Bose Science Heritage Museum (JCBSHM)
www.jcbosescienceheritagemuseum.org
Former Professor & Chairperson, Department of Chemistry
Director (O), Bose Institute, Kolkata
Attachment: Annexure A&B

Seated (L to R): Meghnad Saha, (Astrophysicist). Sir Jagadish Chandra Bose (Biologist & Physicist), Jnan Chandra Ghosh (Chemistry Electrolysis and Ionization) Standing (L to R): Snehamoy Dutt(Physicist) Satyendranath Bose(Bose Einestein theory) Debendra Mohan Bose,(Physicist) N R Sen(Physicist & mathematician) . Jnanendra Nath Mukherjee, (Chemistry , Colloid Chemistry) N C Nag. (Biologist)

First IEEE Milestones in India

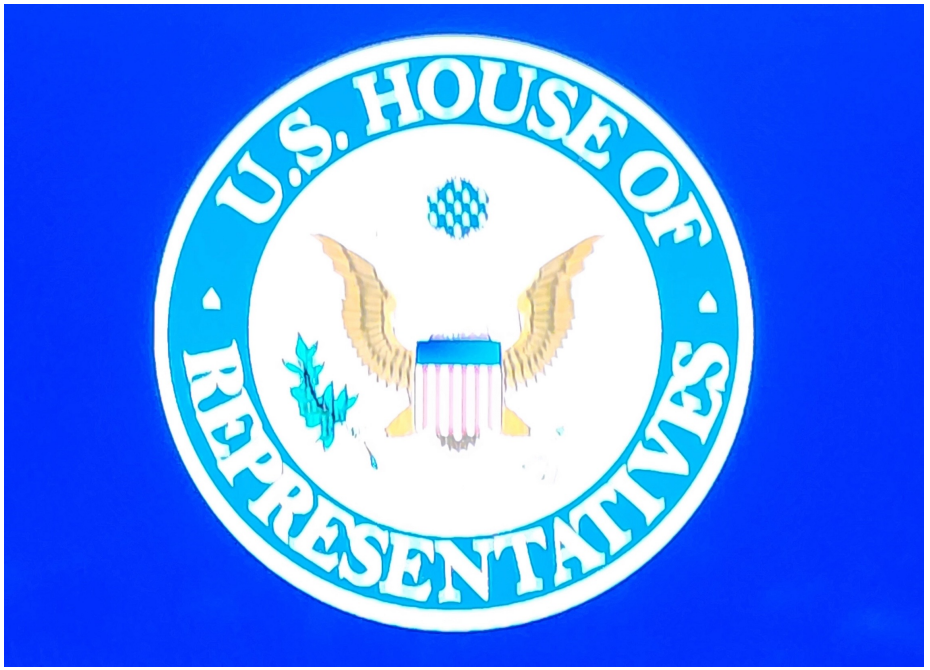
The work of J.C. Bose and C.V. Raman to be recognized

By IVAN BERGER 7 September 2012

Technological achievements in India are being honored with **IEEE Milestones in Electrical Engineering and Computing**

IEEE Jagadish Chandra Bose Medal in Wireless Communications

Establishment Ceremony in Washington DC, USA on 12 Jan 2024

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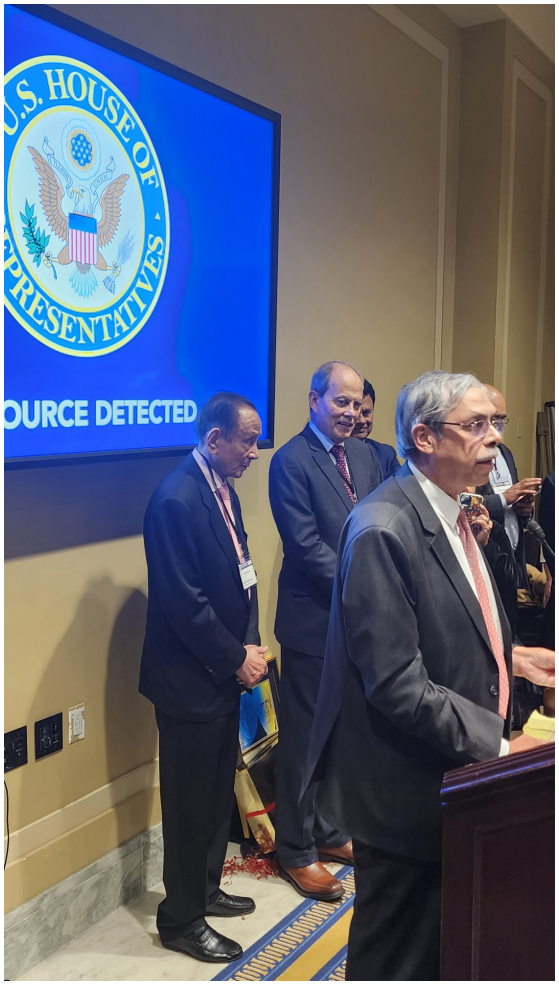
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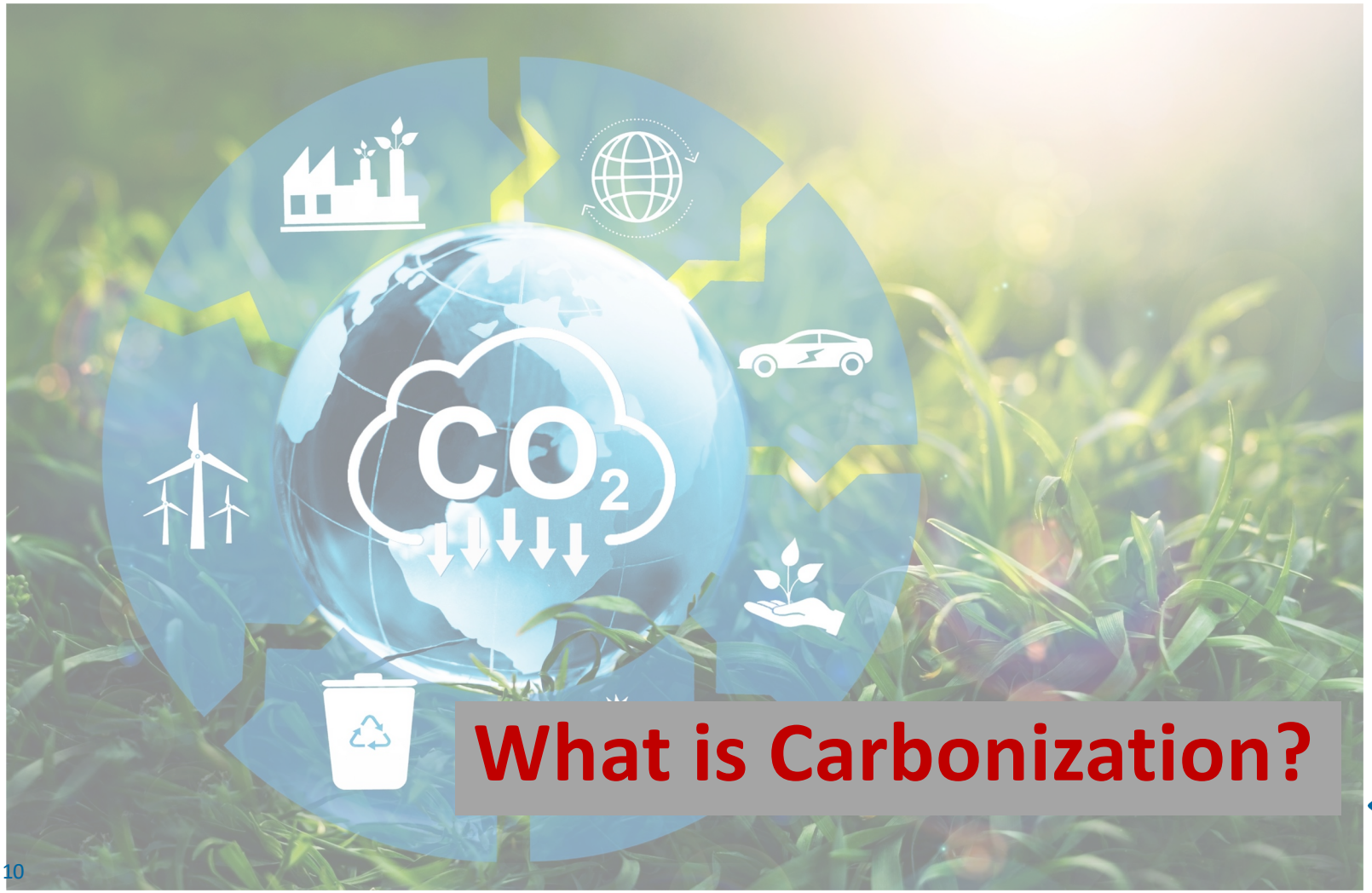
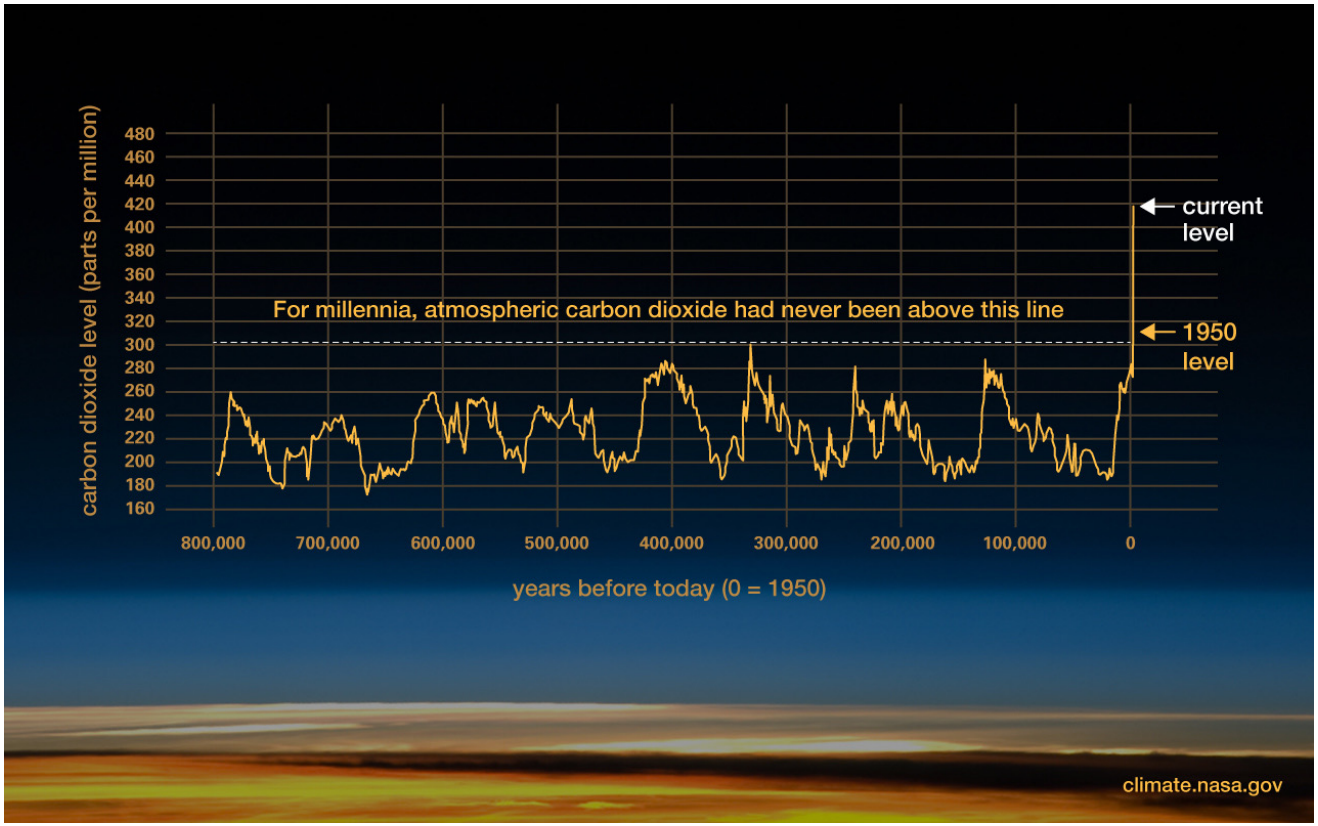
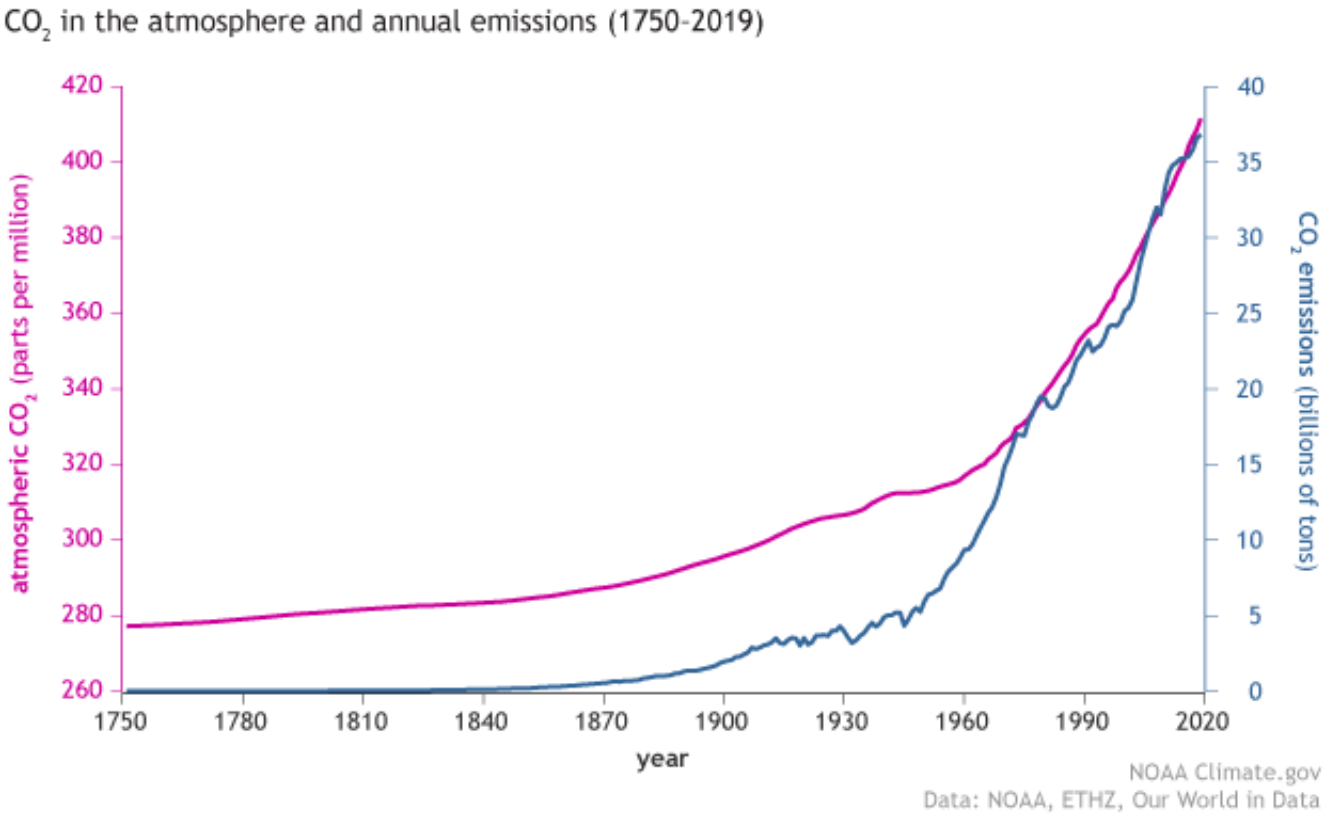
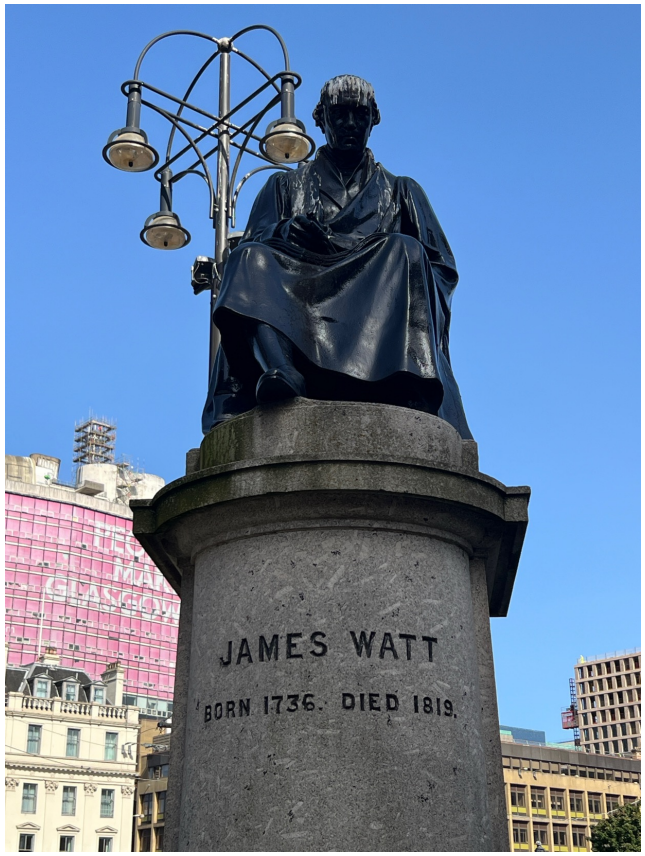


What is Carbonization?



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





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

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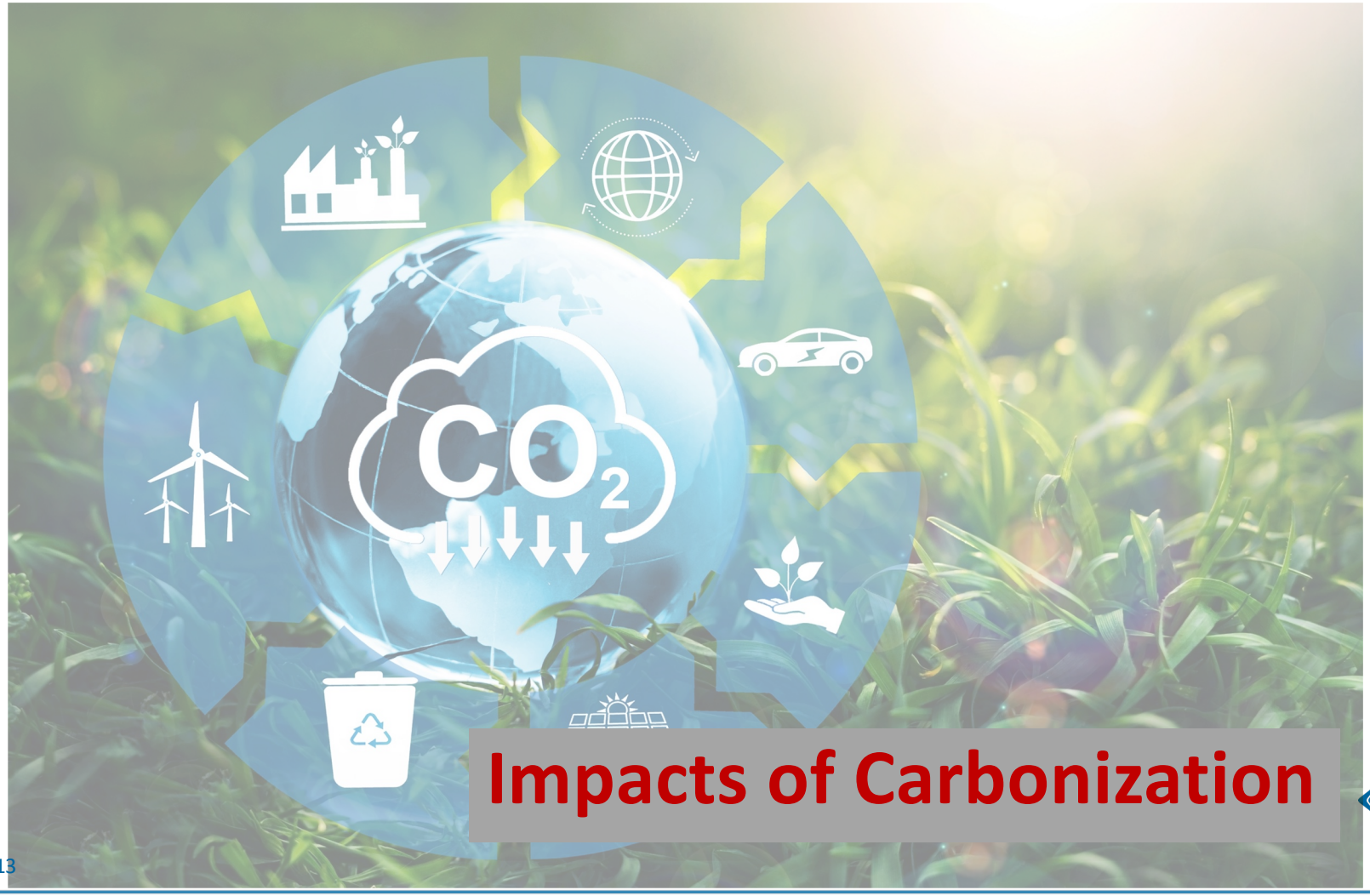
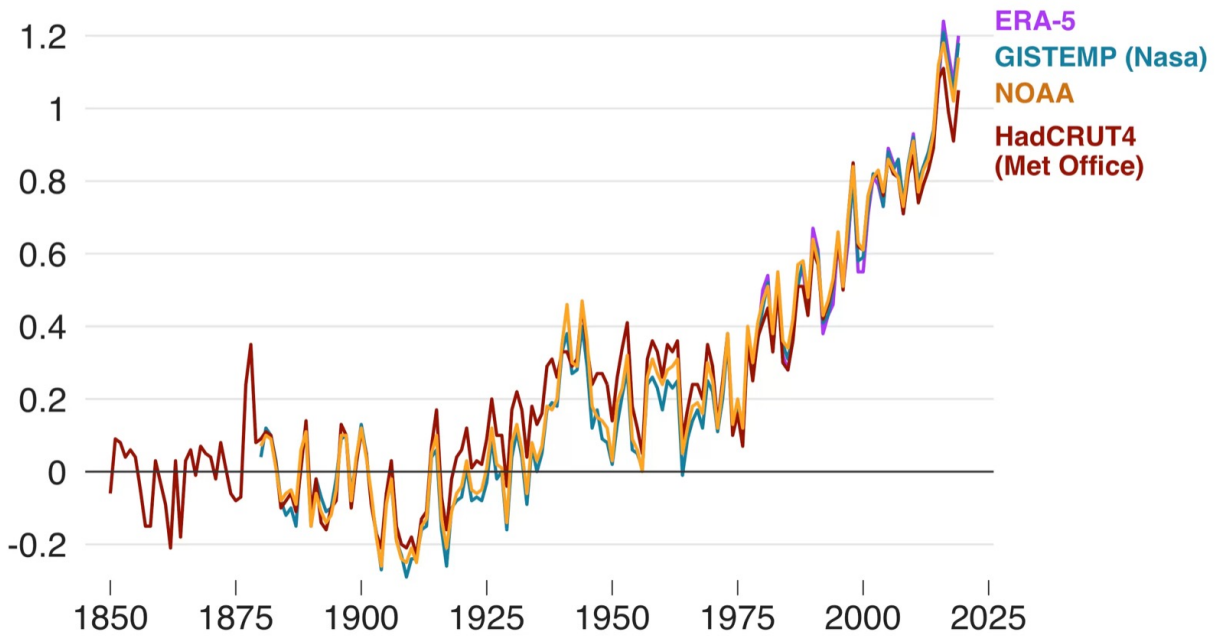


Impacts of Carbonization

Temperature rise since 1850

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

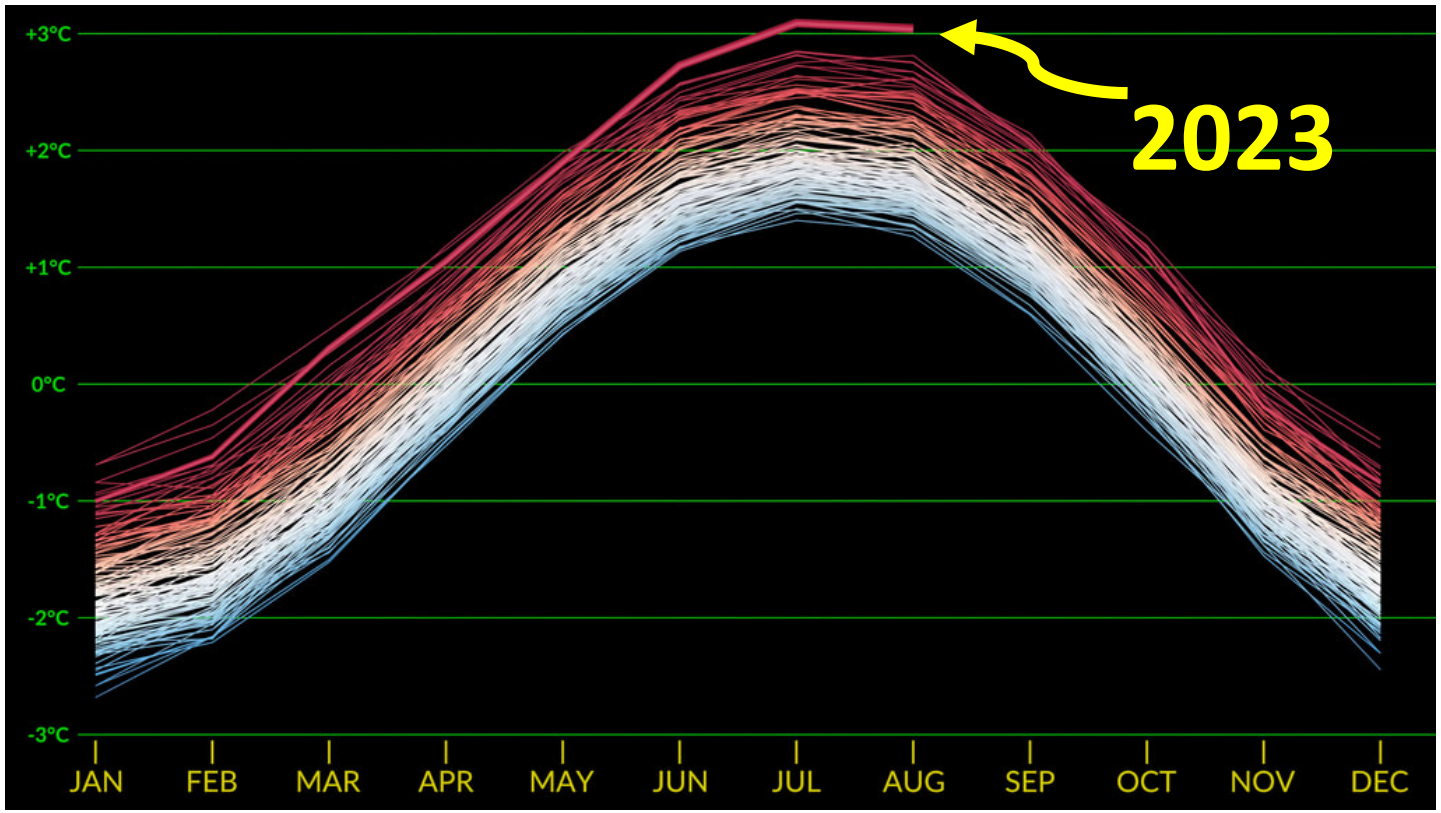


Source: Met Office

BBC

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

Temperature rise target is below 1.5. More than 2.0℃ Point of No Return



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.

Source: https://svs.gsfc.nasa.gov/14407

Climate-change Impacts

Fethi Belaid/Agence France-Presse — Getty Images

Heat Wave in Delhi – May 2024

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

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

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

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

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. -

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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_2 & 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_2 levels, PM 2.5).

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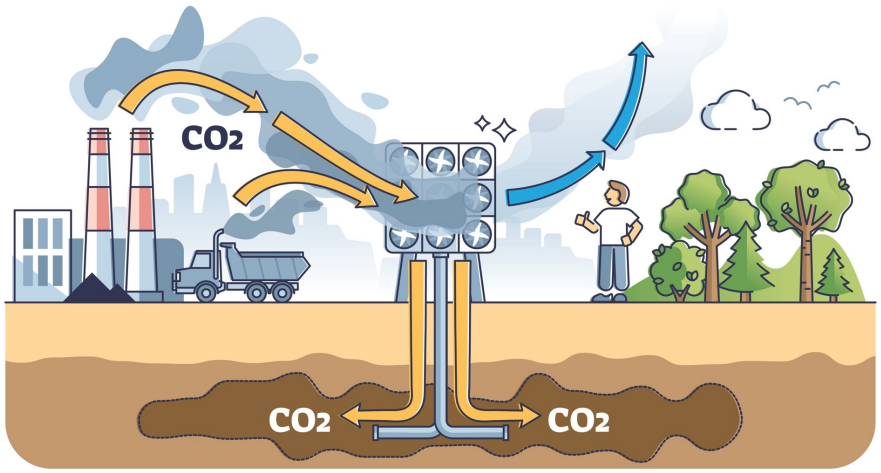
Carbon Capture & Storage Systems (CCS)

- 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 for integration 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

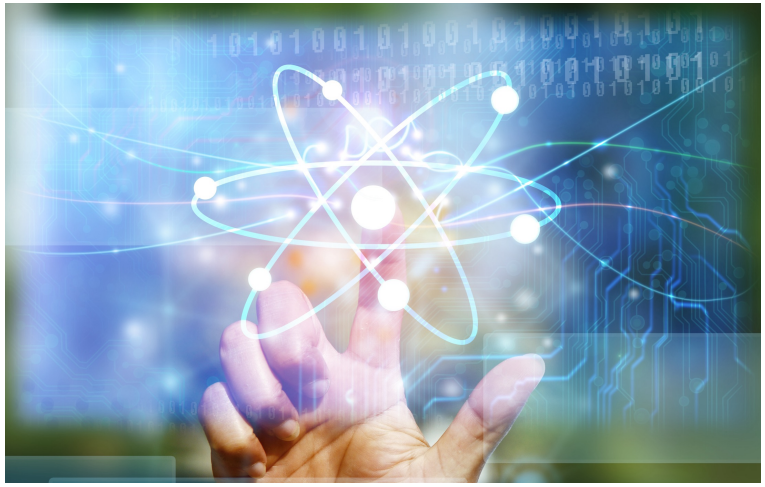
Whitelee Windfarm, Glasgow, Scotland

Kenya School of Monetary Studies, Nairobi

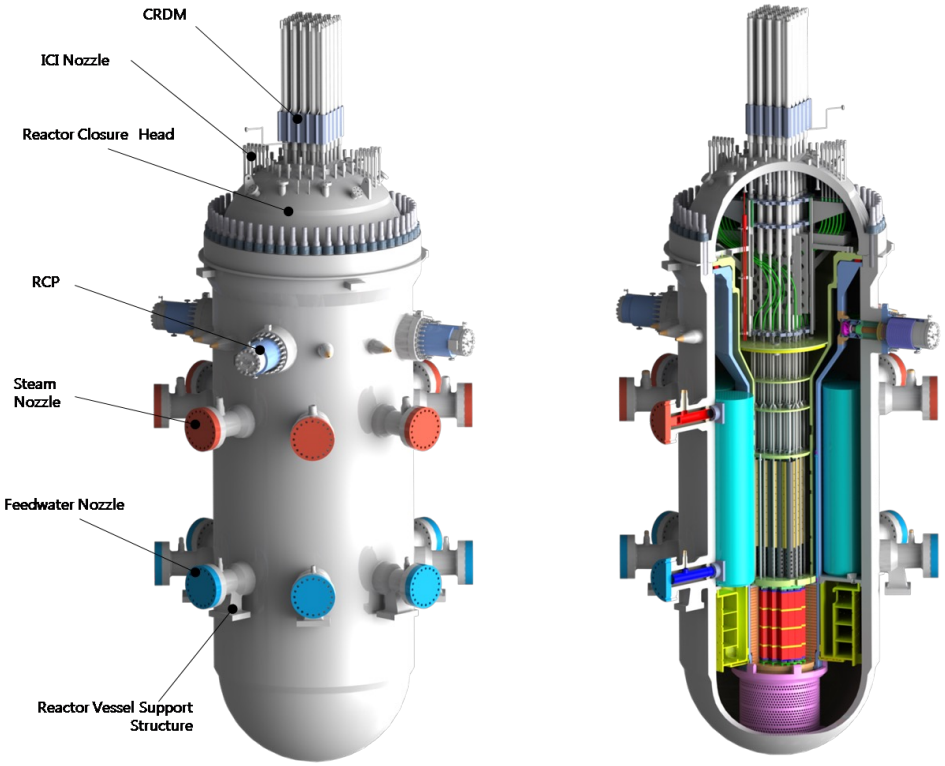
Advanced Nuclear Technologies

Diverse solutions to address climate change

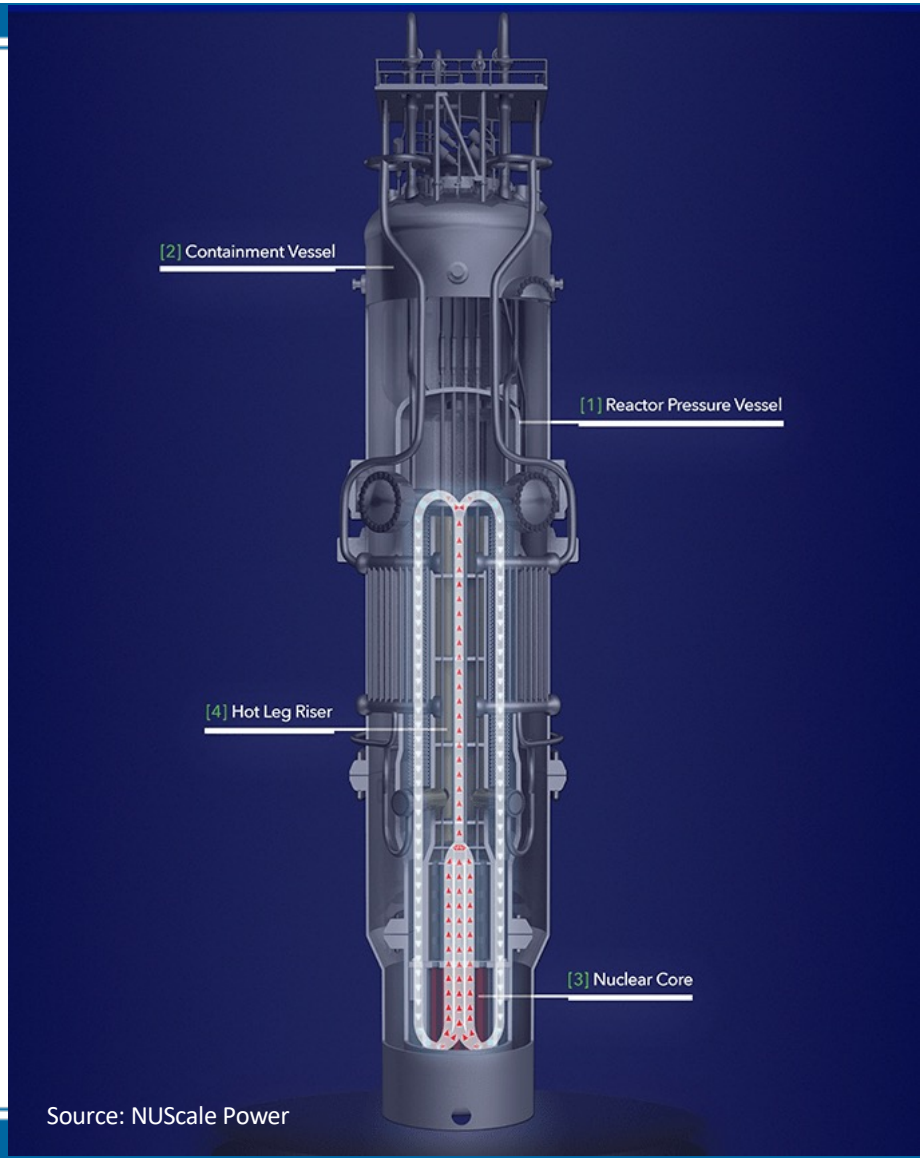
- Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
  - Smaller and can be built more quickly than more traditional nuclear reactors
- Ramping up the development of SMRs can help to produce energy when and where needed
- This energy could be integrated into existing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



Source: NUScale Power

Cross-Border Energy Transfer

No Transition without Transmission

- 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

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What Can you Do to Serve Humanity?

Clean-Tech Solutions for Climate Sustainabilty

IEEE's Climate Change Program

Climate Change

IEEE: Enabling Innovation and Technology Solutions

https://climate-change.ieee.org

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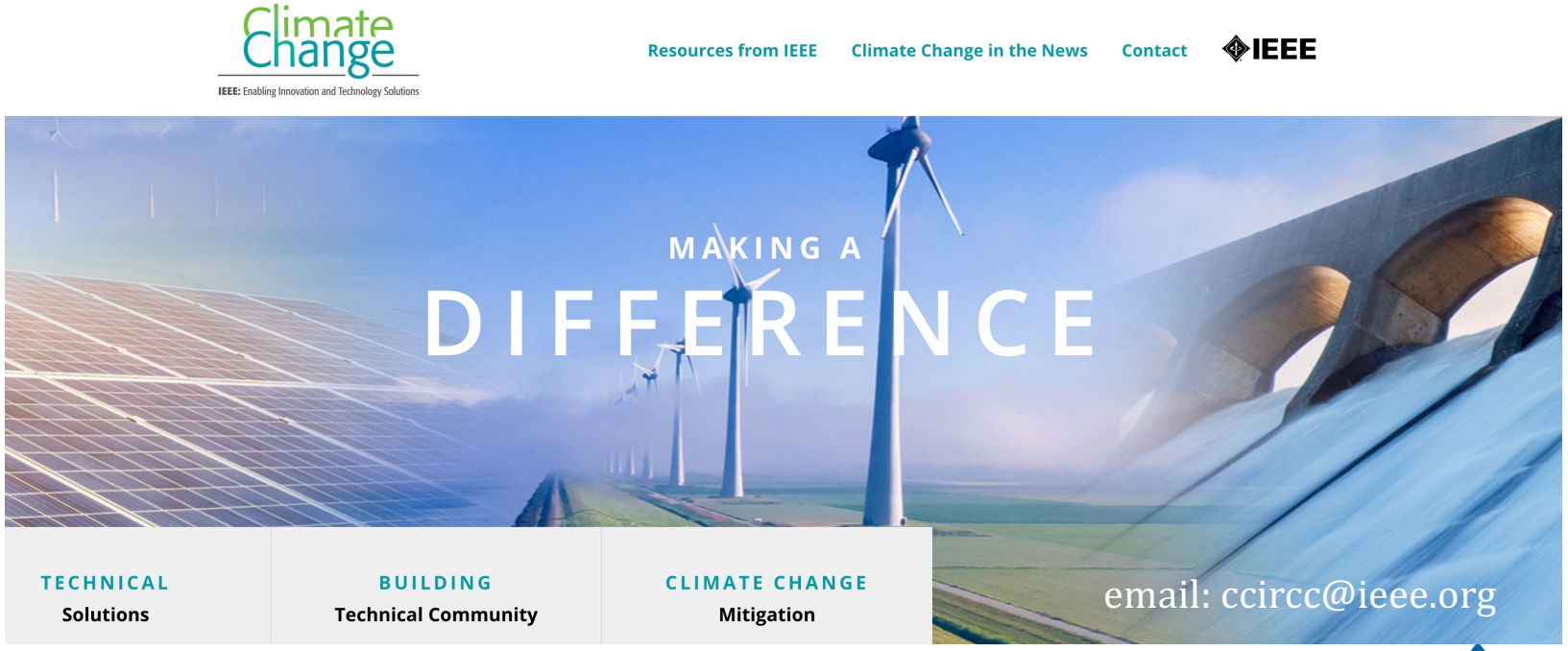
IEEE Climate Change Program

https://climate-change.ieee.org



Climate Change
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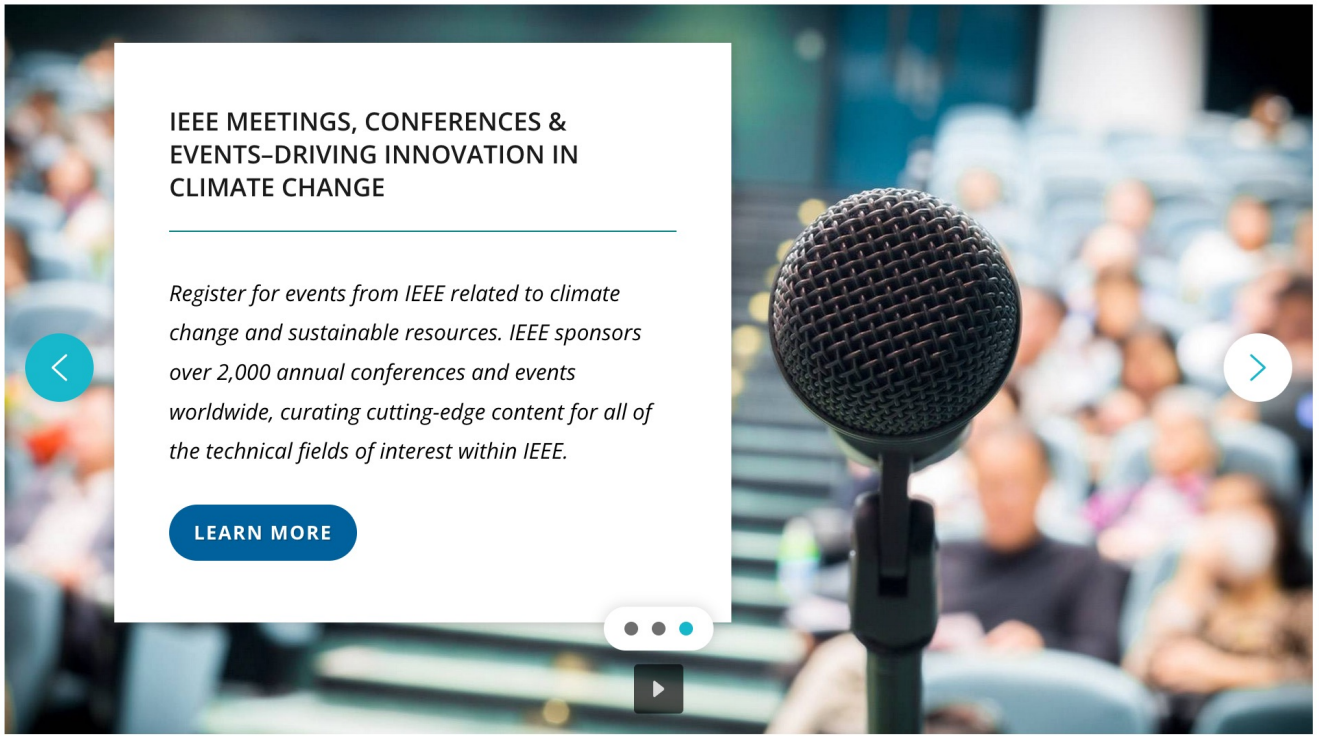

https://climate-change.ieee.org

Climate Change

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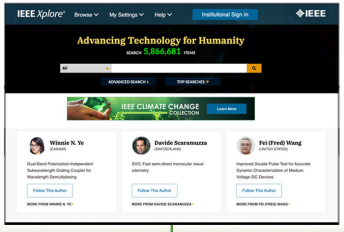
Ecosystem for IEEE's Climate Sustainability Work

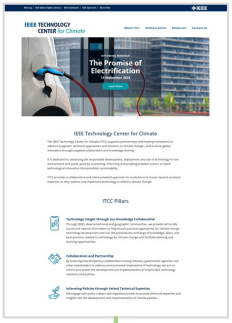
IEEE Spectrum: Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change; Coverage of Conferences and Standards)

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

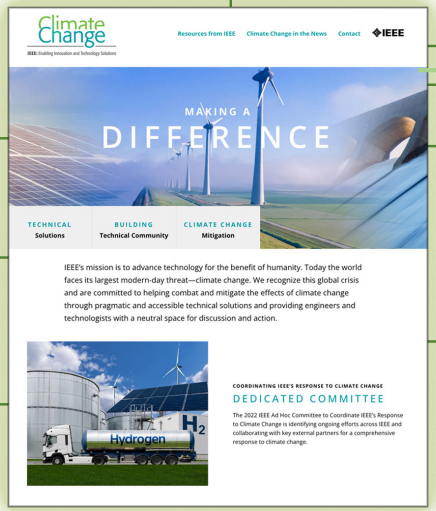


Jobs From IEEE Job Site

IEEE Technology Center for Climate



Conferences



Standards

Social Media

Newsletters

IEEE Climate Change newsletter

Sponsored Content From Industry

https://climate-change.ieee.org

Examples of Global Engagements

IEEE at UN COP28
Dubai, December 2023

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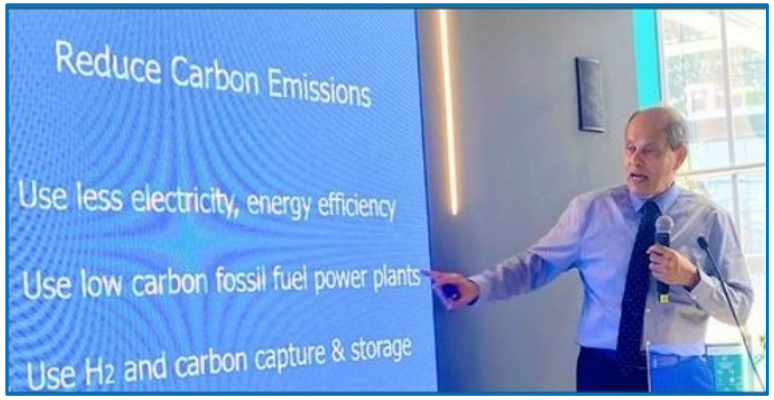
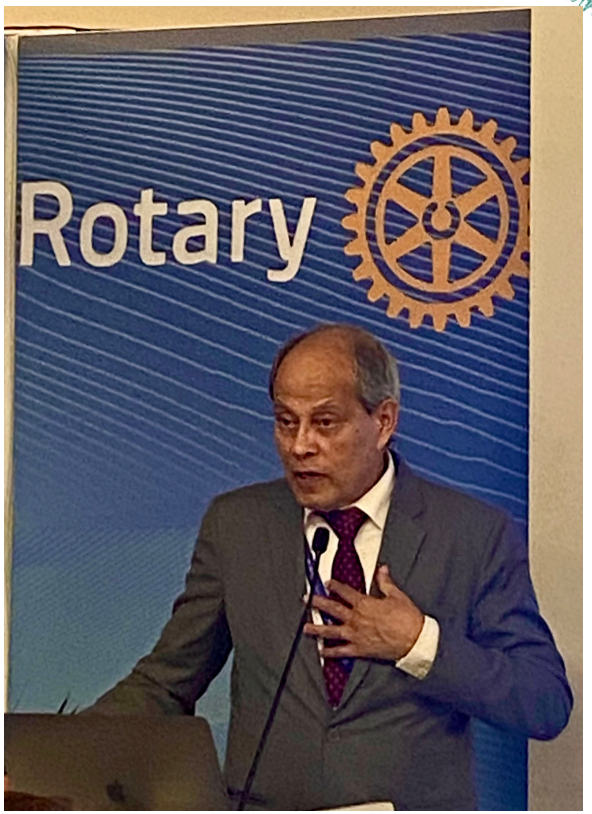


COP28 UAE

IEEE


Energy Transition
Rotary Pavillion - 1st Floor, Zone B7
Building 89, near COP28 Health Pavilion
December 5th - 11:00am
Salvador Rico
Yaseen Jaffer
President UAE Association of Rotary Clubs
Prof Saifur Rahman
President of IEEE
Helmut Von Struve
CEO Siemens
COP28 UAE
Rotary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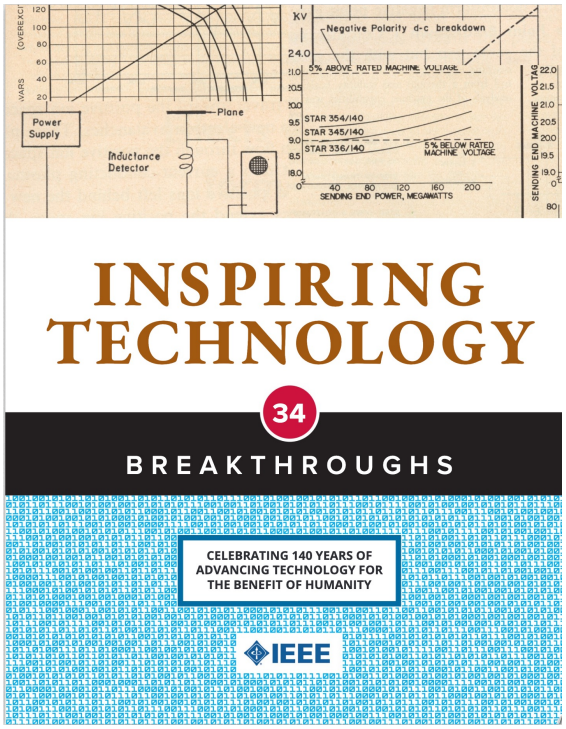

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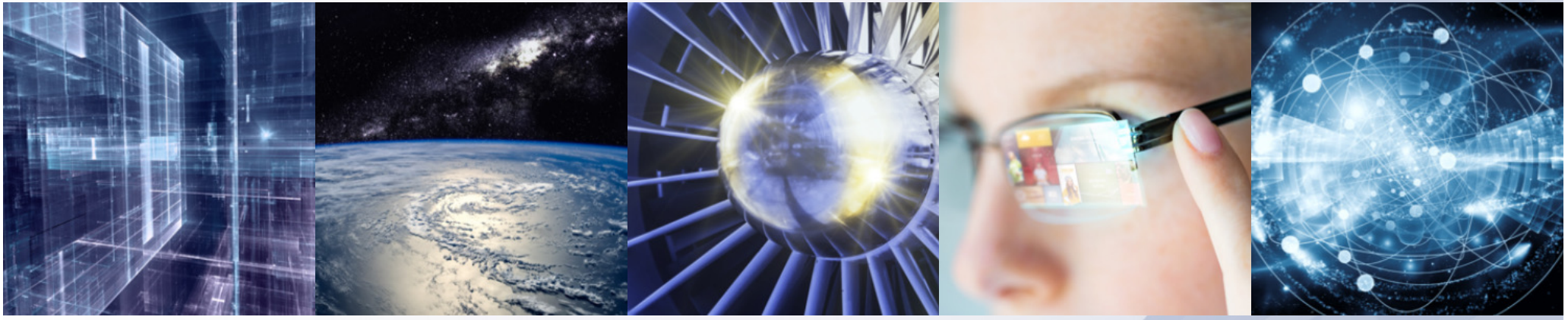

Thank You

Saifur Rahman, 2023 IEEE President

s.rahman@ieee.org

Web: www.srahman.org

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