Climate Change and Sustainability

Dr. Saifur Rahman, 2023 IEEE President and CEO

10th IEEE Conference on Technologies for Sustainability

Portland, Oregon, 20 April 2023

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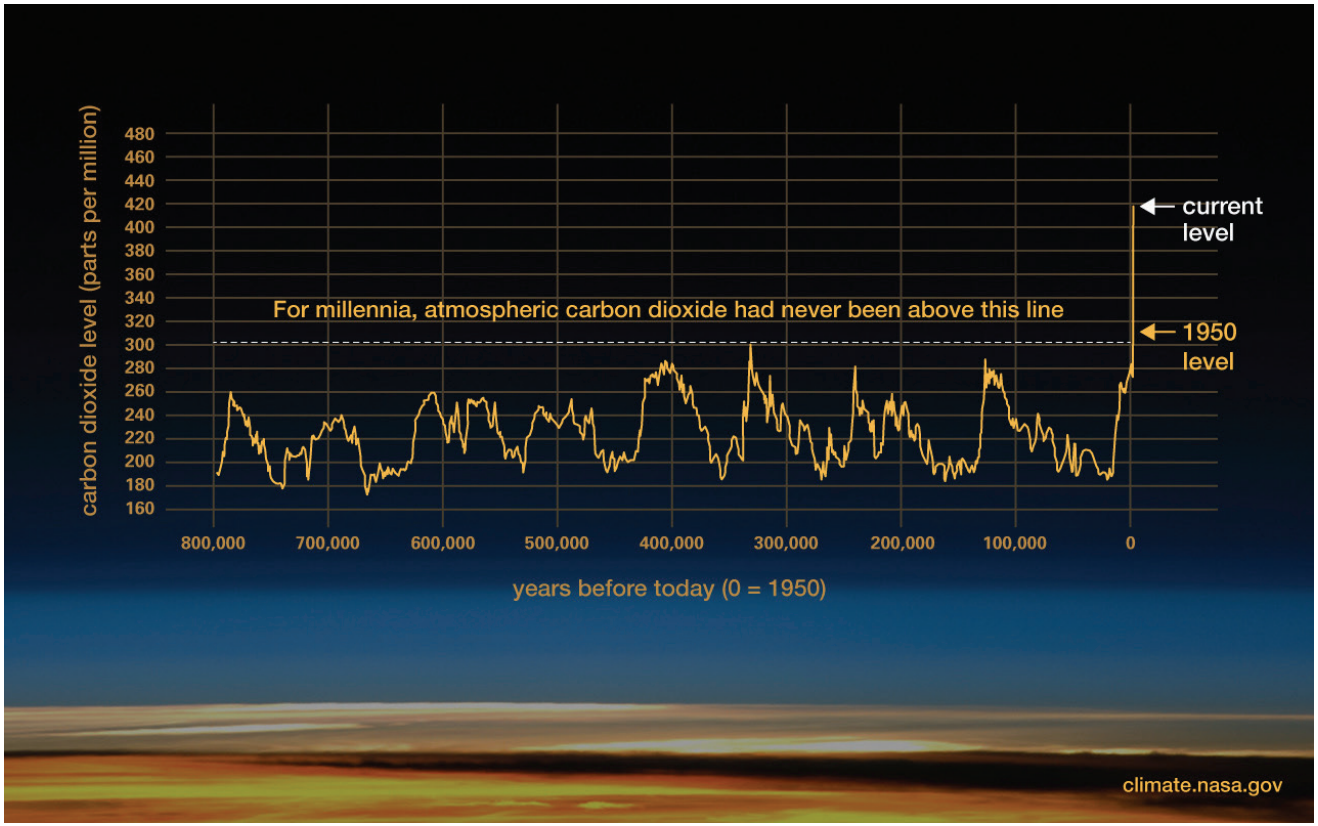
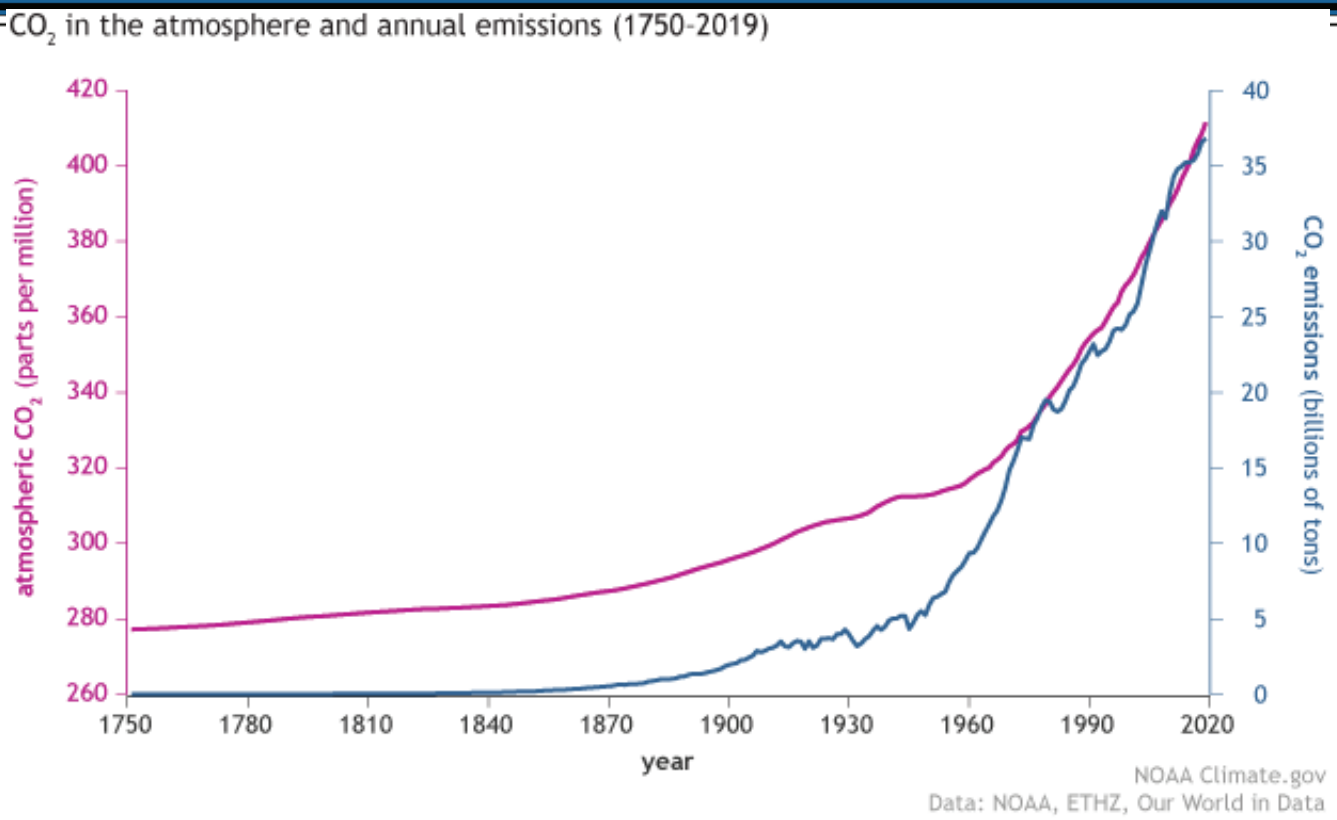
Primary cause for Climate Change

Carbonization



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



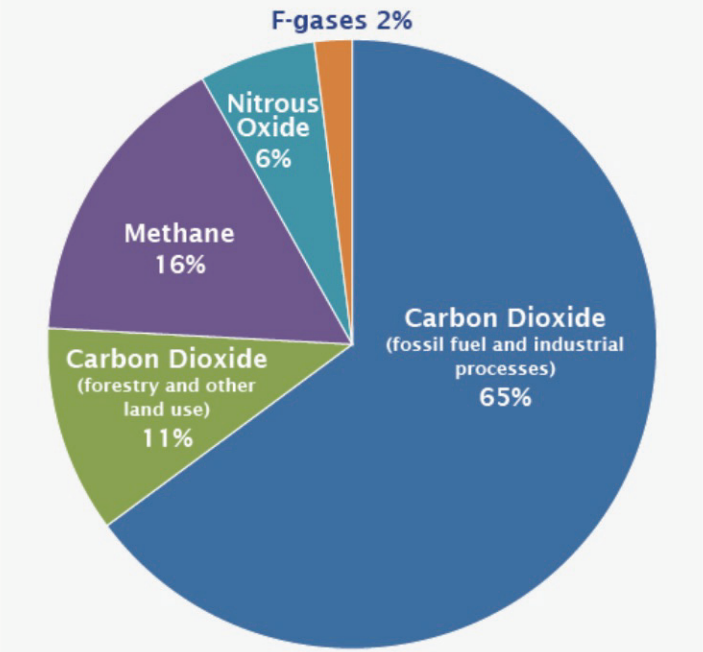
Source: State of the Planet
https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/

Global CO_2 Emissions Due to Fossil Fuels in 2021

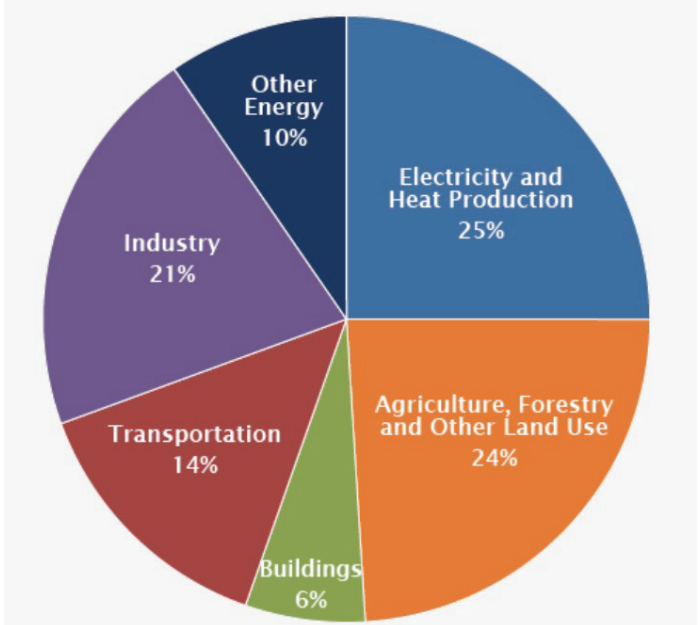
Coal	15.3 billion tons
Nat. Gas	7.5 billion tons
Oil	10.7 billion tons

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

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

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. -

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2008 China Snowstorm

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Electrification to Reduce Fossil Fuel Use

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

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 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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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

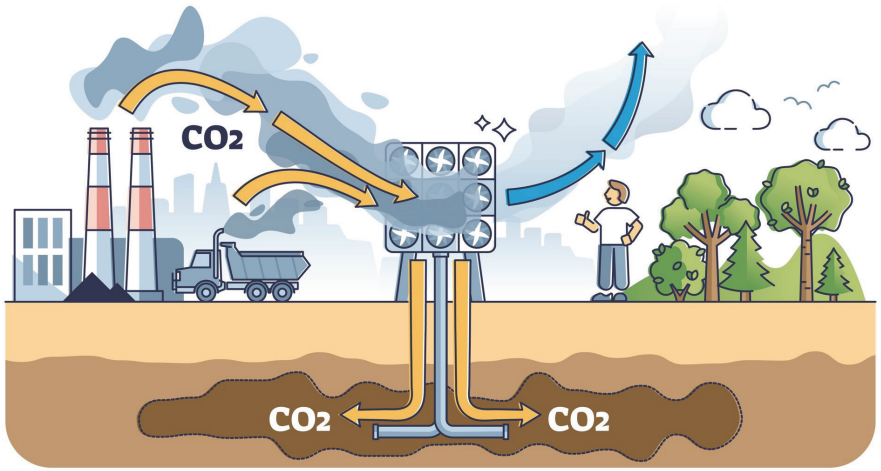
Highly Efficient Fossil-fuel Power Plants

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

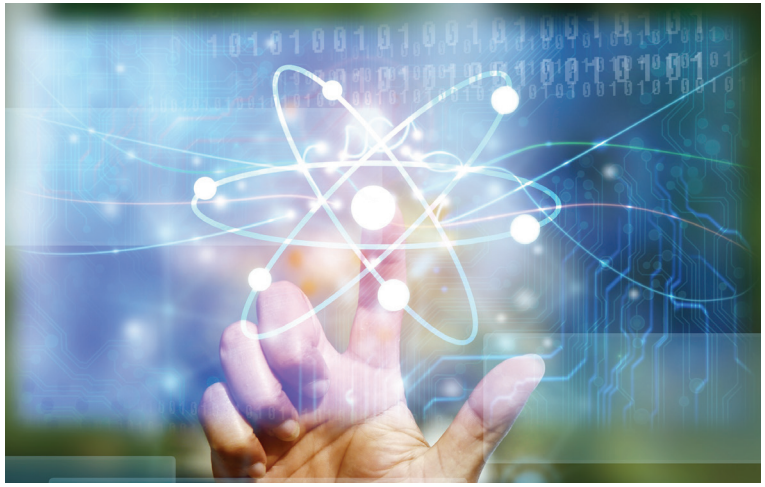
We all are impacted by climate change

- 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

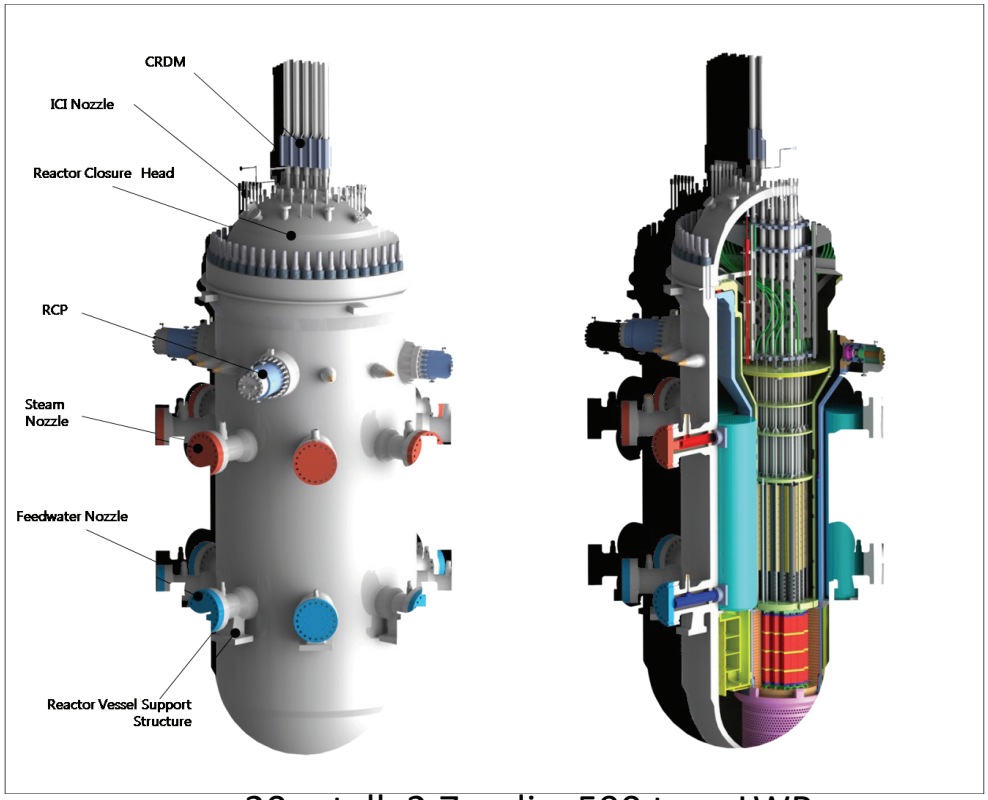
Advanced Nuclear Technologies

Diverse solutions to address climate change

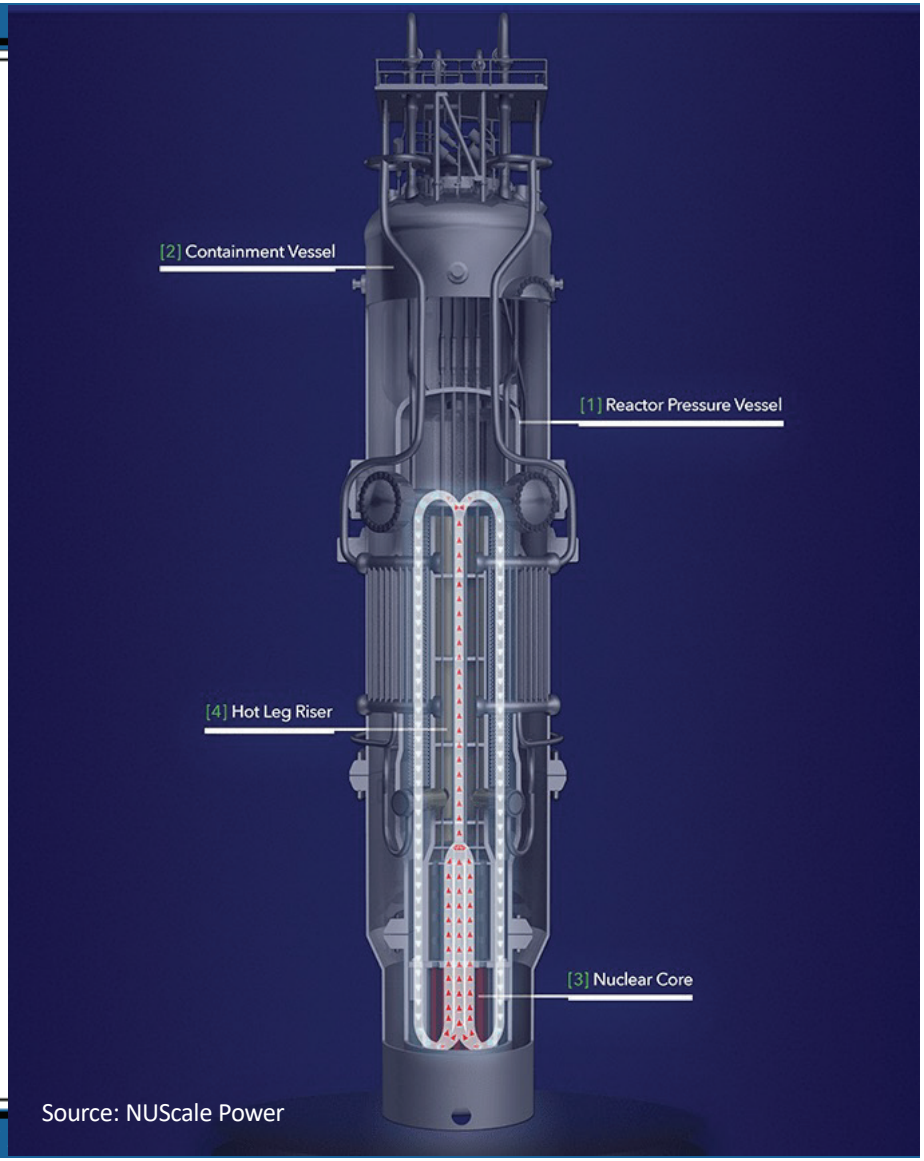
- Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
  - Smaller and can be built more quickly than more traditional nuclear reactors
- Ramping up the development of SMRs can help to produce energy when and where needed
- This energy could be integrated into existing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



Small Modular Reactors (SMR)



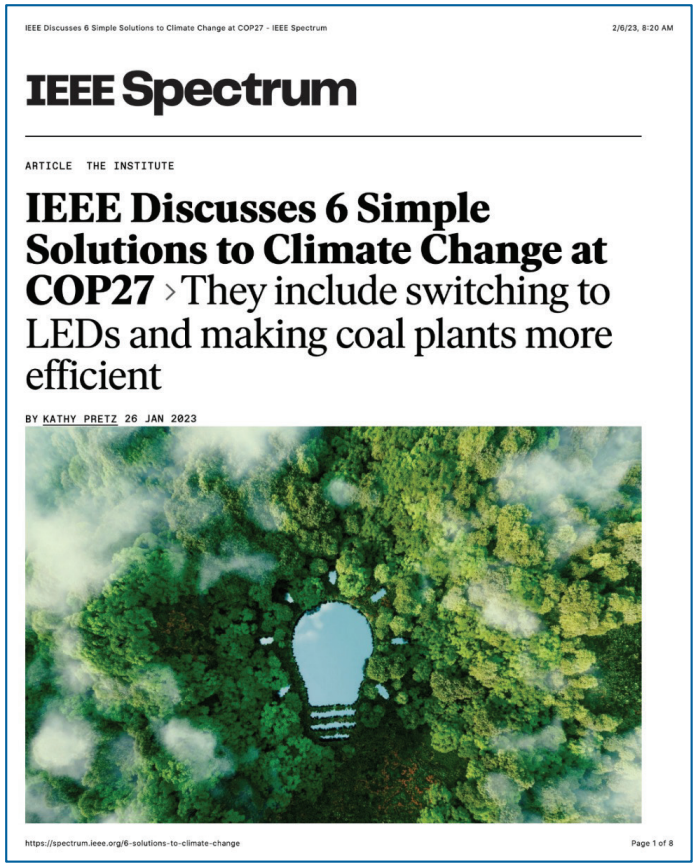
20m tall, 2.7m dia. 590 tons LWR
4.95% enrichment 50 – 60 MWe



Source: NUScale Power

IEEE can be a solution partner

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



IEEE Discusses 6 Simple Solutions to Climate Change at COP27 - IEEE Spectrum 2/6/23, 8:20 AM

IEEE Spectrum

ARTICLE THE INSTITUTE

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

BY KATHY PRETZ 26 JAN 2023

https://spectrum.ieee.org/6-solutions-to-climate-change Page 1 of 8

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

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Advancing Technology 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

COP27
SHARM EL-SHEIKH
EGYPT2022

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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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COP27 Side Event

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

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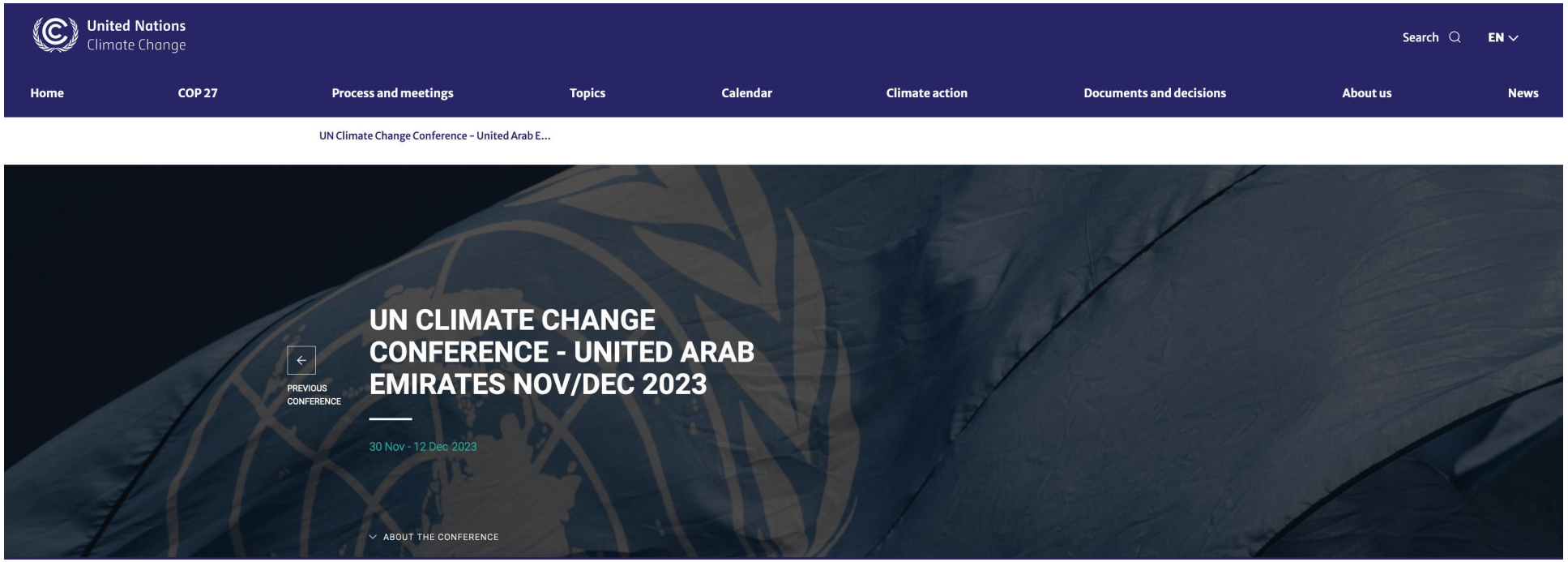
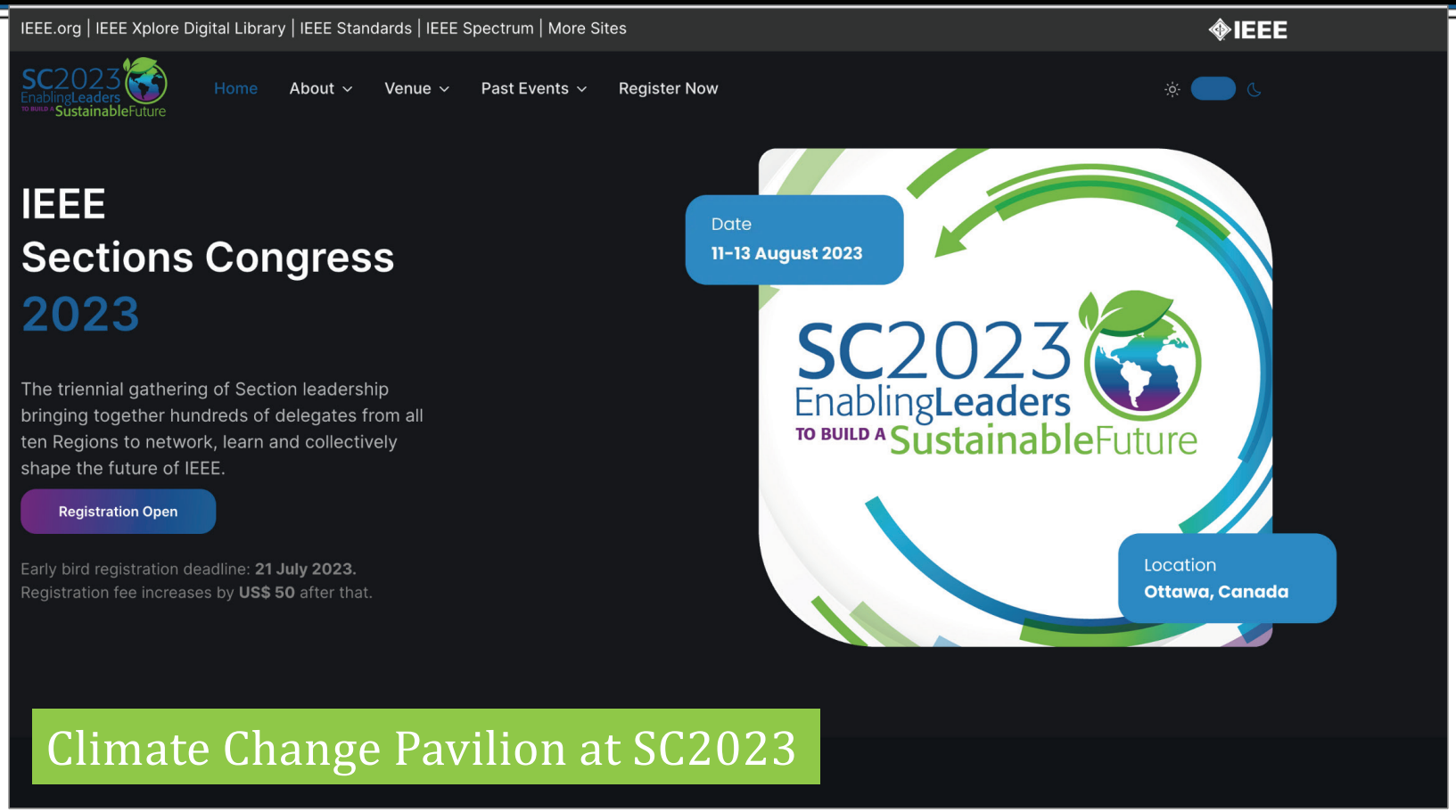
Energy Day 15 Nov 2022

UN Climate Change Pavilion

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





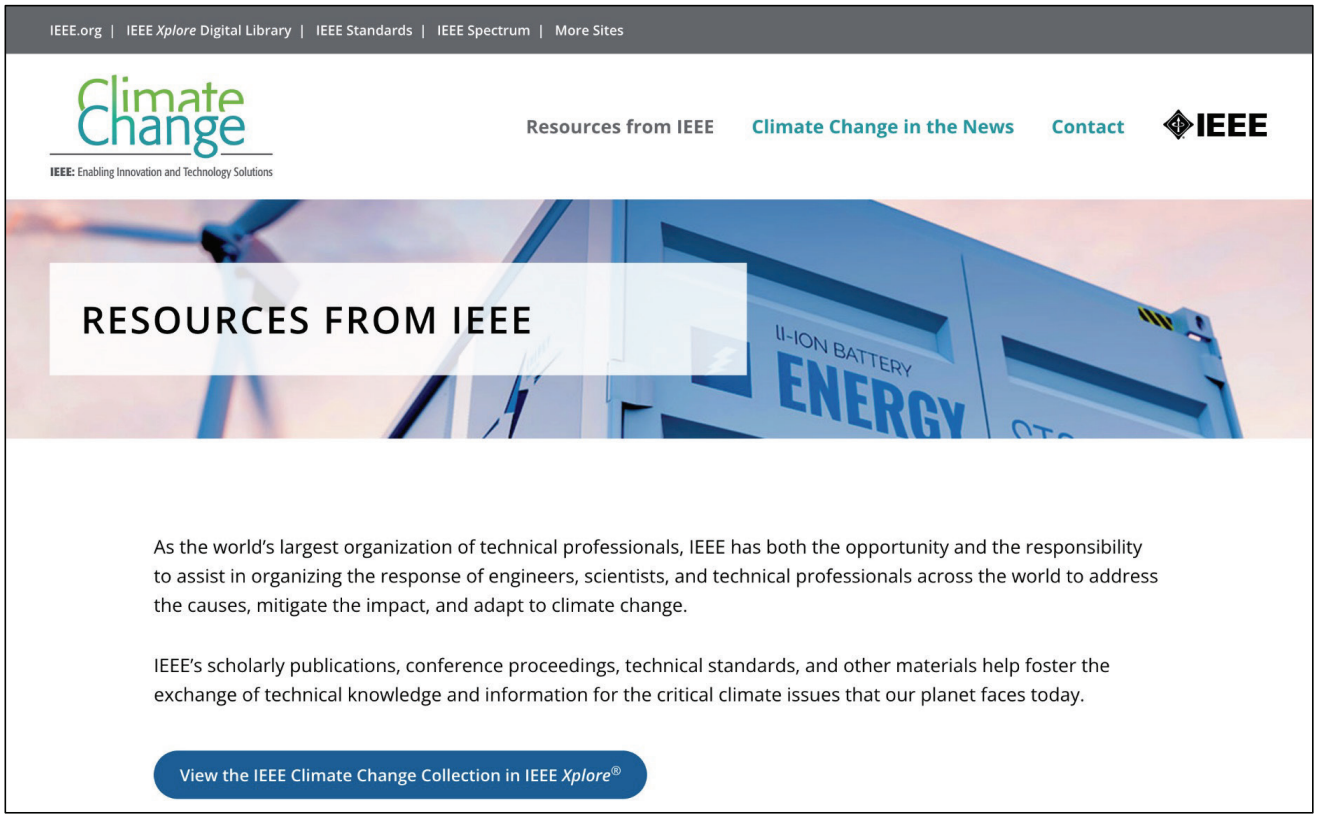
Climate Change Pavilion at SC2023

IEEE Climate Change Website

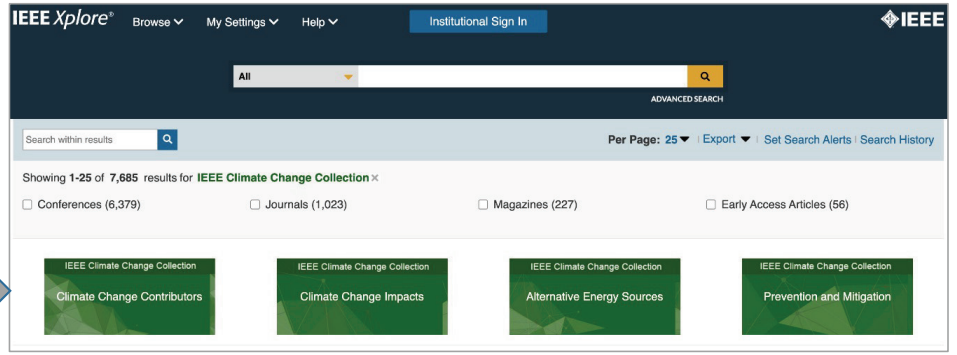
https://climate-change.ieee.org

Email: ccircc@ieee.org

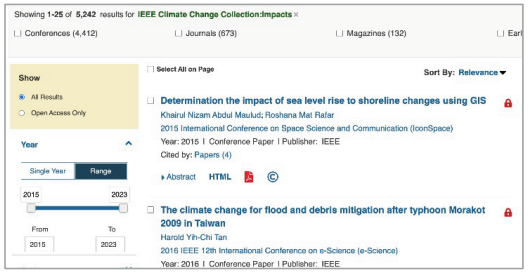
IEEE Climate Change Collection (ICCC)



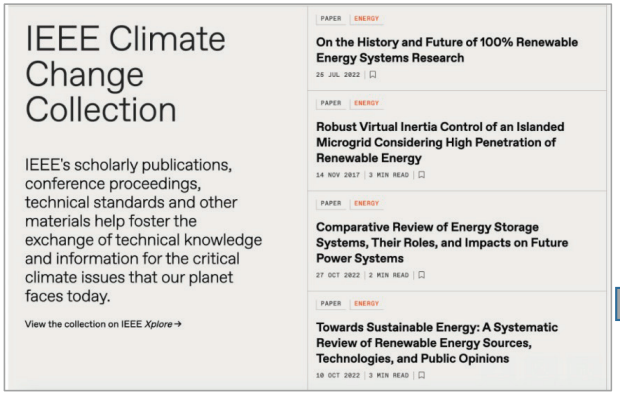
Links to Spectrum

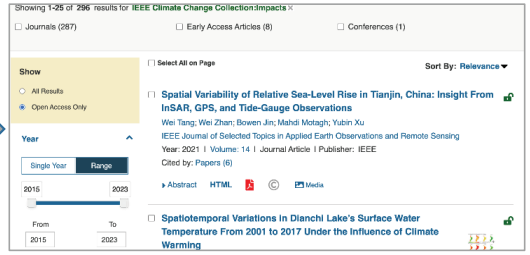


Visitors must visit two landing pages before before they can begin to hunt for material relevant to them. Experienced Xplore users will find what they need, but newbies might be frustrated.



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





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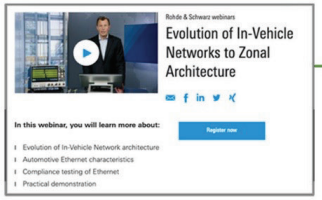
The Ecosystem for IEEE's Climate Sustainability Work

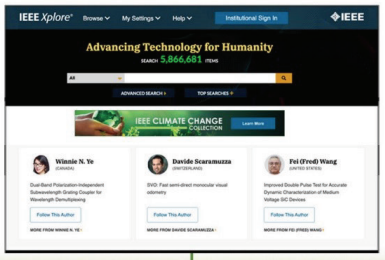
IEEE Spectrum: Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change; Coverage of Conferences and Standards)

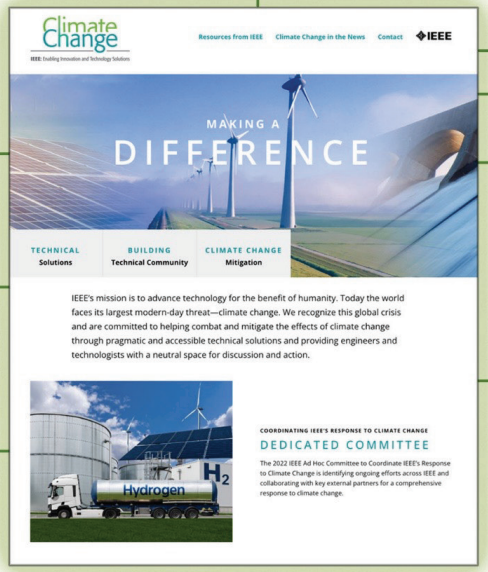
Social Media

Sponsored Content From Industry



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





Jobs From IEEE Job Site

Conferences

Standards

IEEE SA STANDARDS ASSOCIATION

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

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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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