The Role of the Technologist in Promoting Clean-tech Solutions for Climate Sustainability

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2023 IEEE President & CEO

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Invited Talk

Institut Teknologi Bandung

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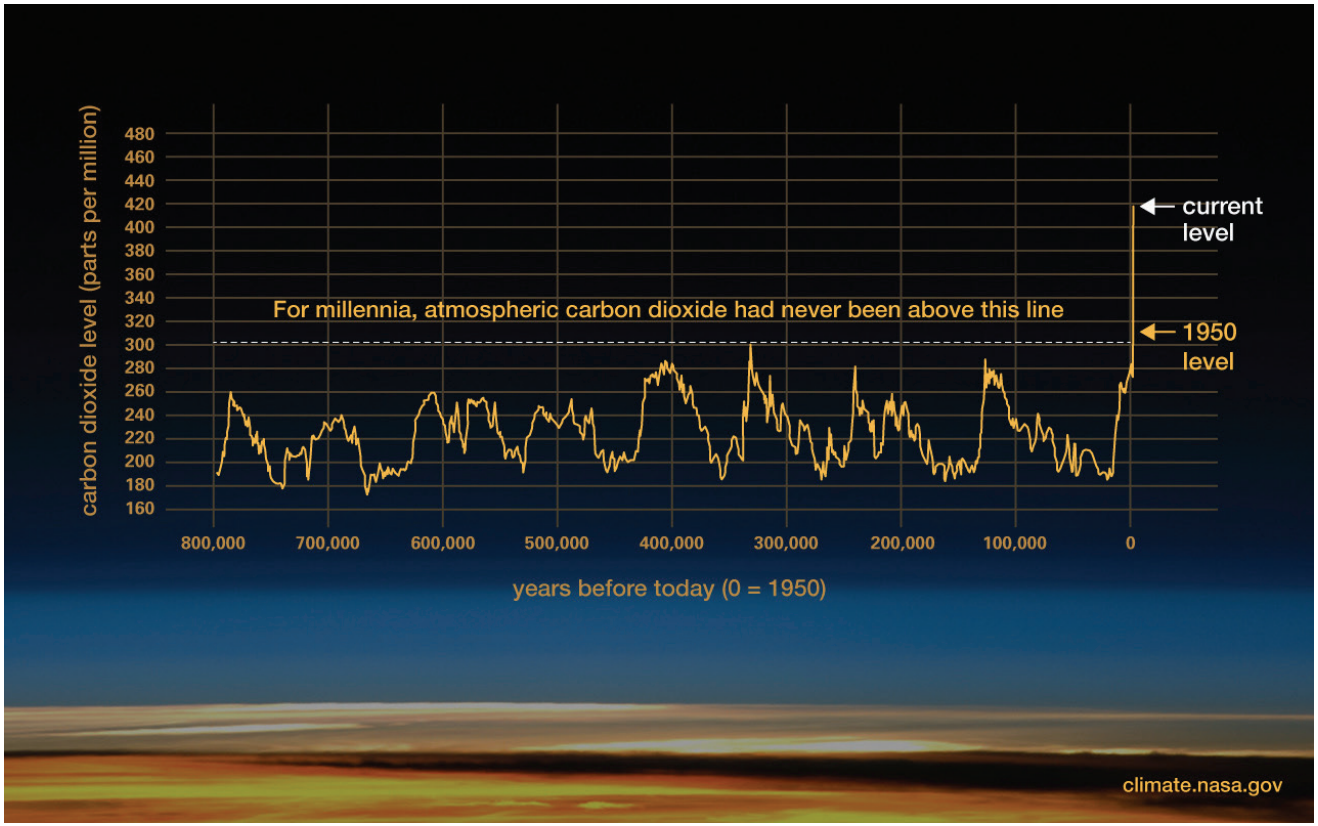
Bandung, Indonesia

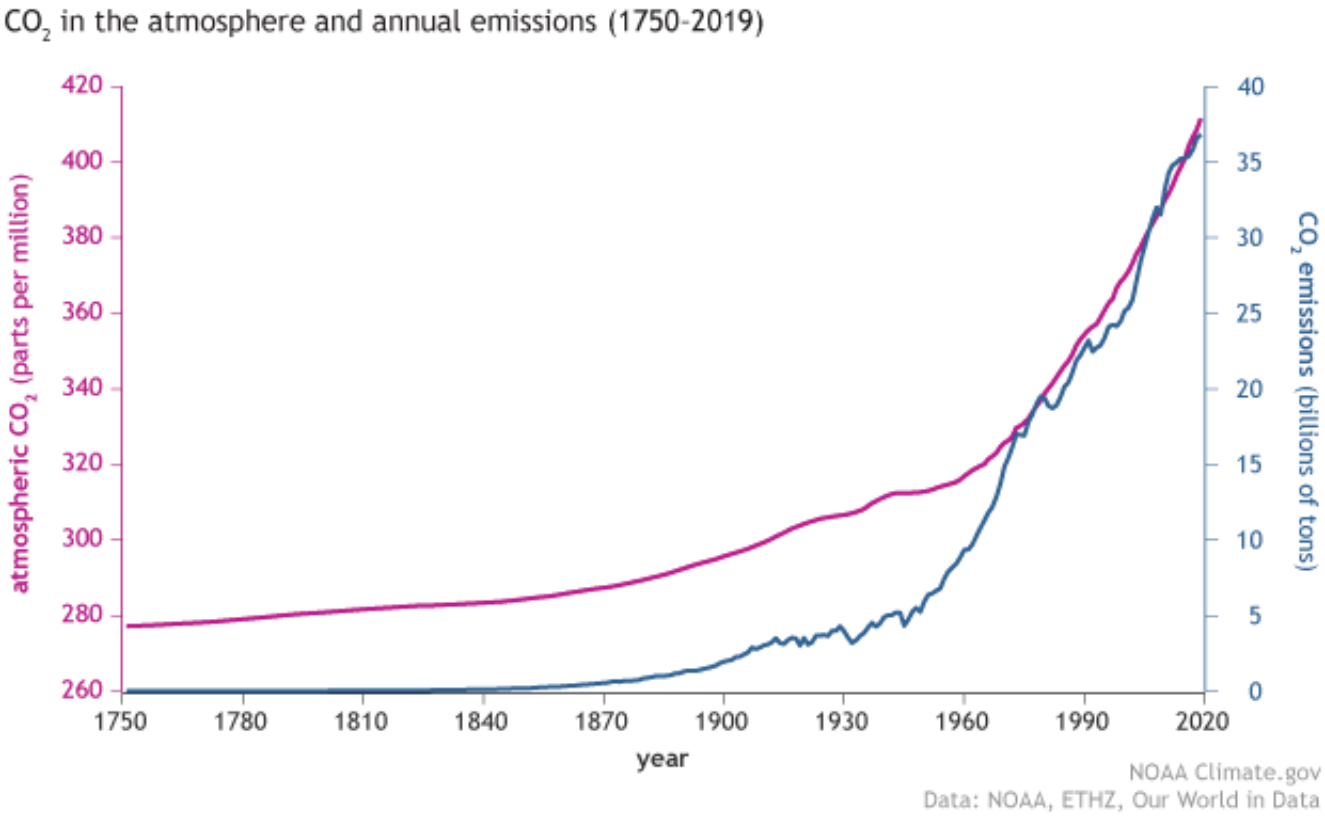
IEEE

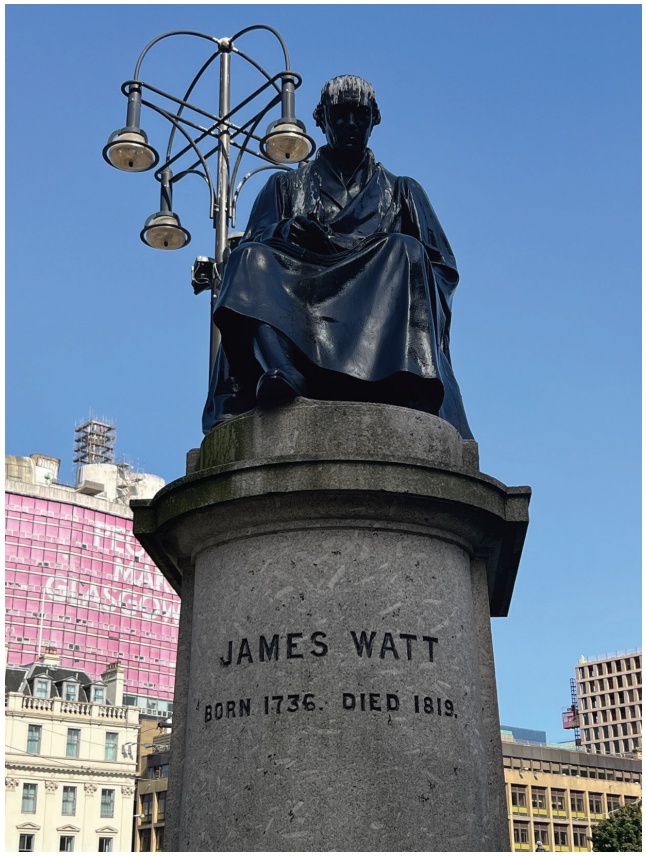
Advancing Technology for Humanity

What is Carbonization ?



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



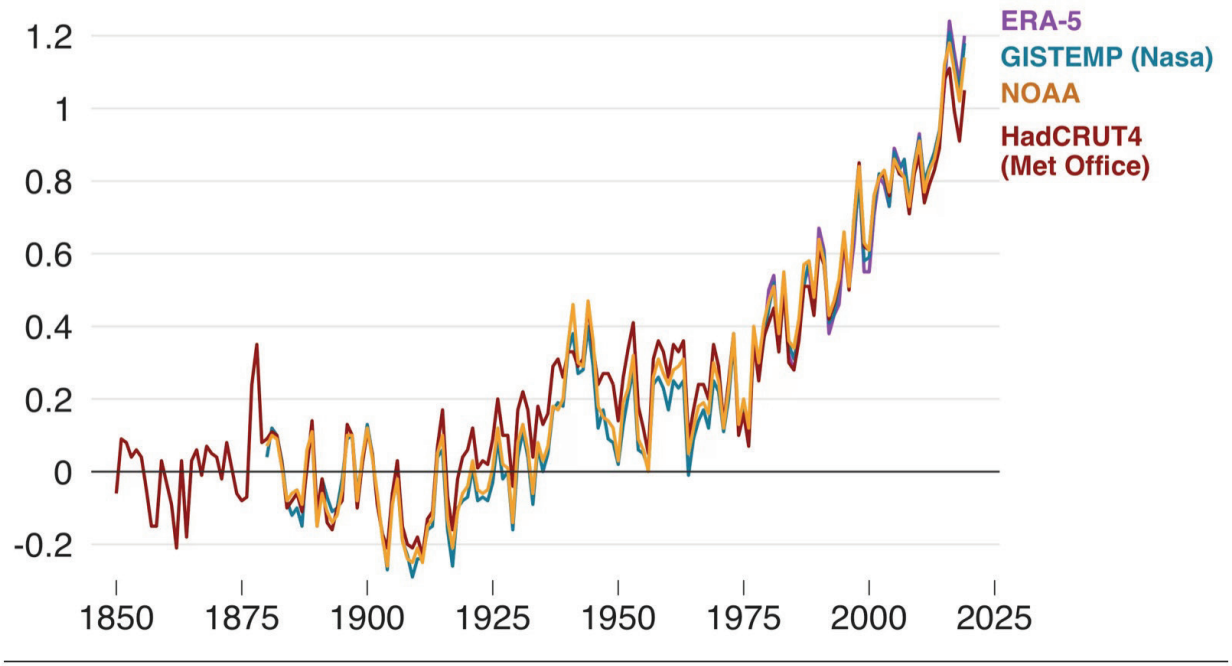


Source: State of the Planet
https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/

Impacts of Carbonization

Temperature rise since 1850

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



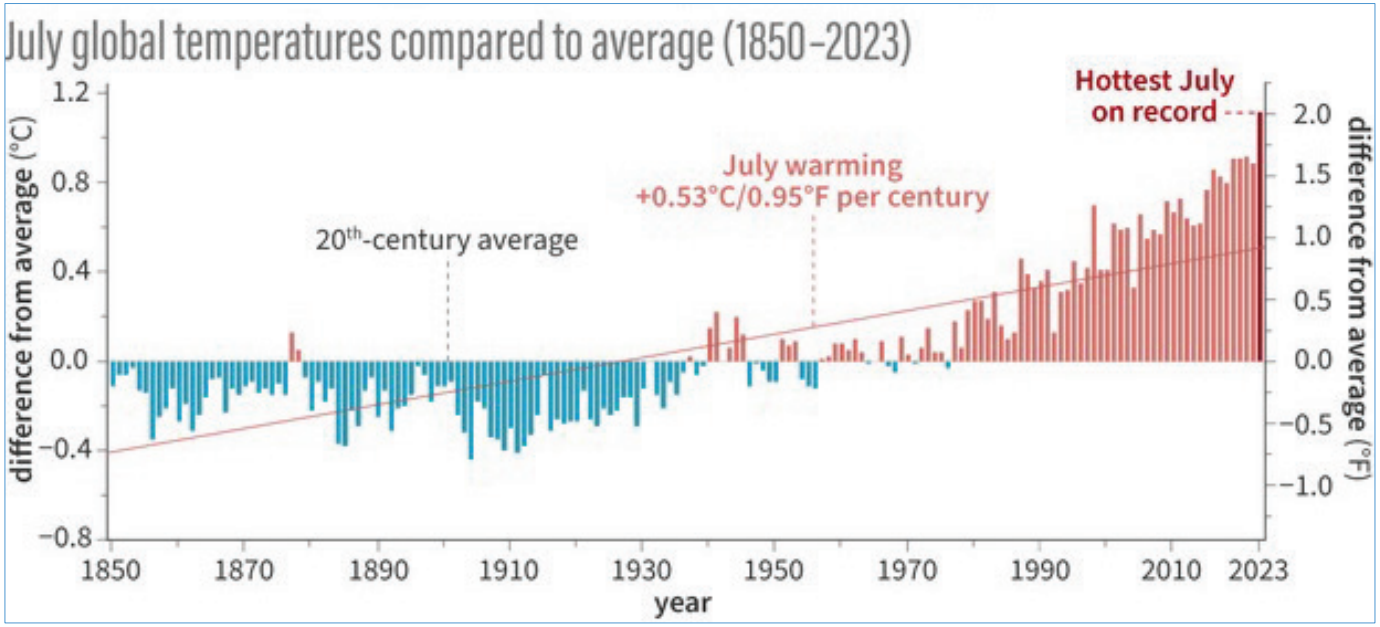
Source: Met Office

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

Global Climate Summary for July 2023

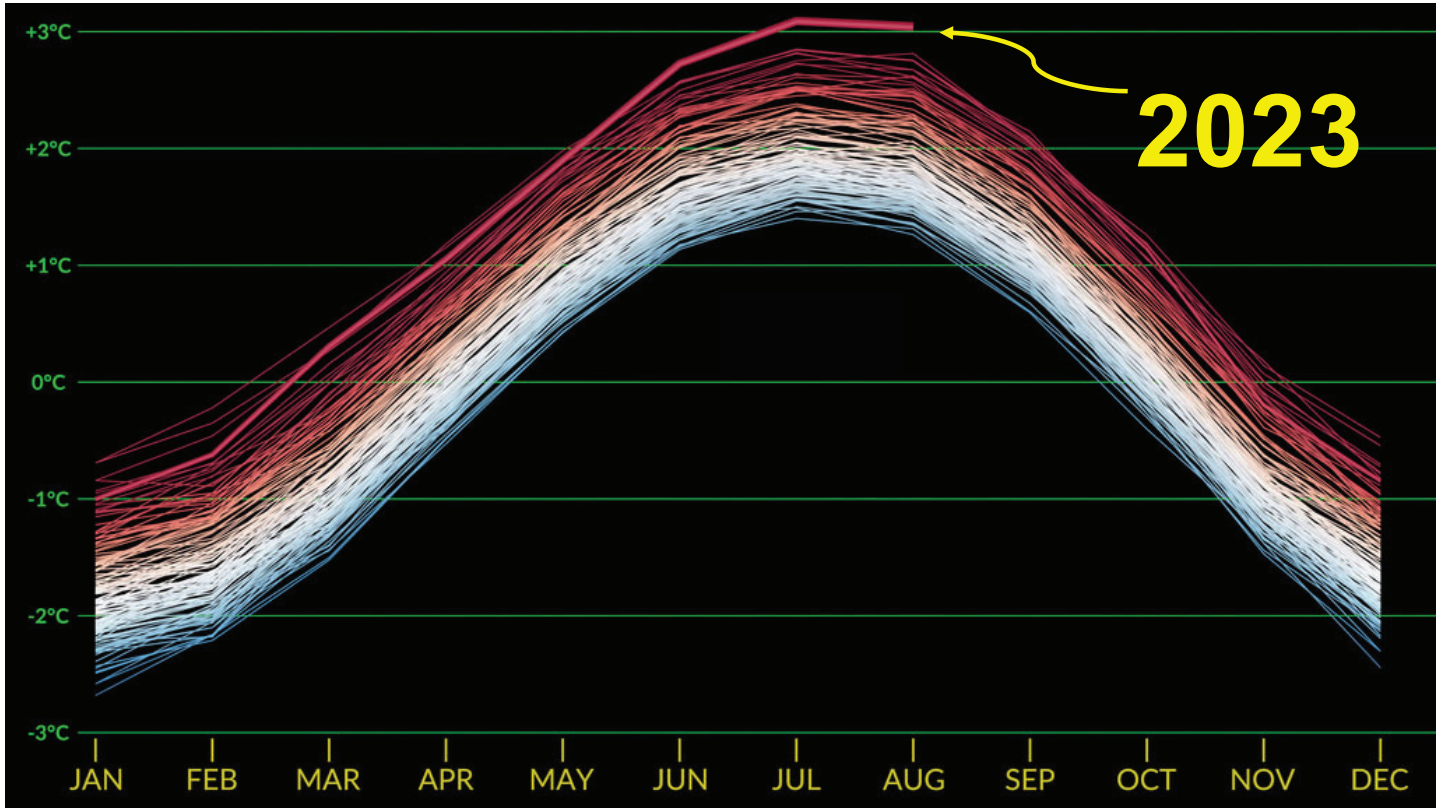


July temperatures compared to the 20th-century average for each year from 1850 through 2023, which set a new record for the hottest July. NOAA Climate.gov image, based on data from NOAA National Centers for Environmental Information.

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.

https://www.climate.gov/news-features/understanding-climate/global-climate-summary-july-2023



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

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/

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 Sept 2023
(AGENCIA RBS/AFP via Getty Images)

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

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

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. -

Greece

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

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).

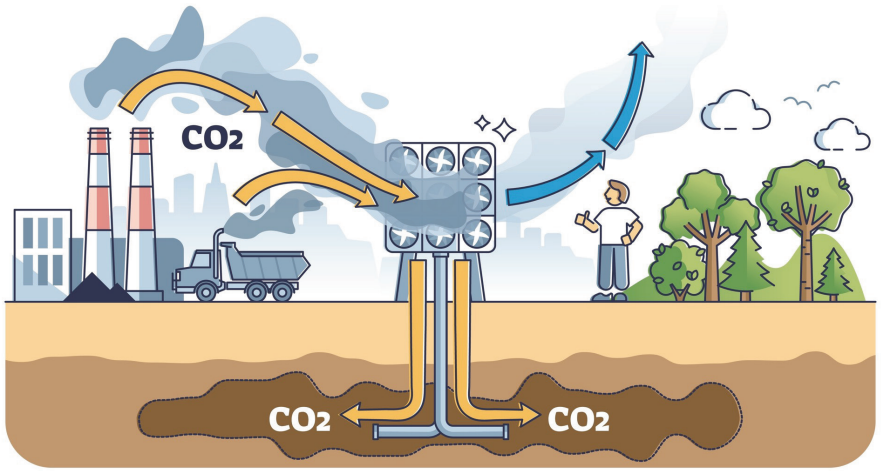
IEEE

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

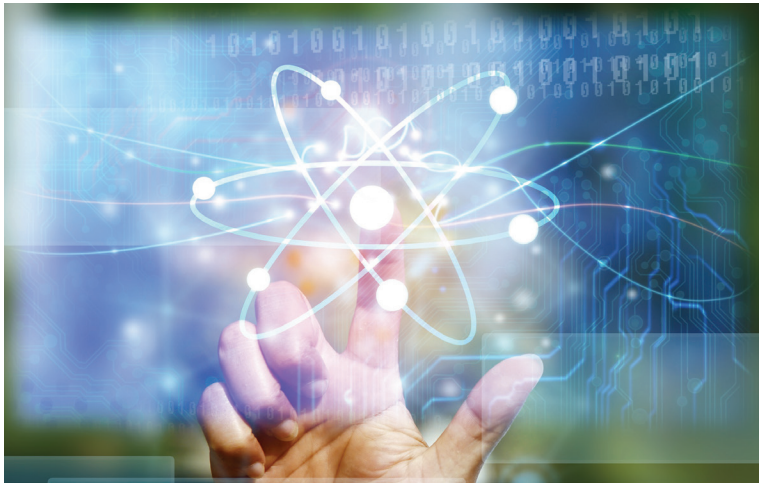
Whitelee Windfarm, Glasgow, Scotland

Kenya School of Monetary Studies, Nairobi

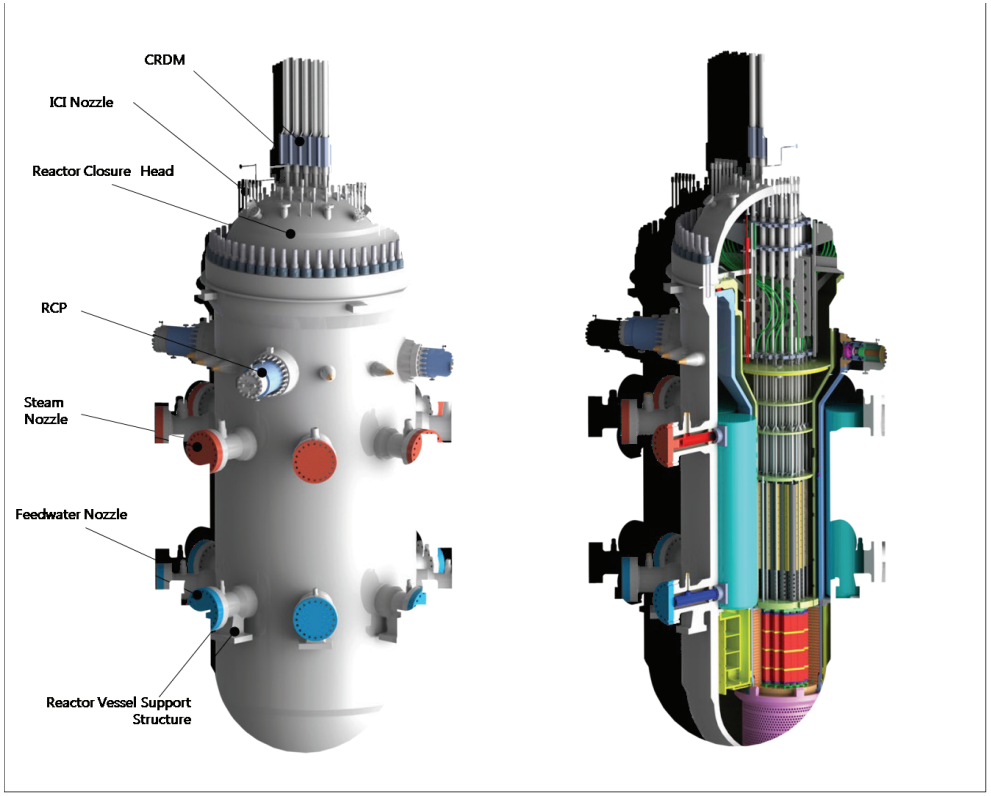
Advanced Nuclear Technologies

Diverse solutions to address climate change

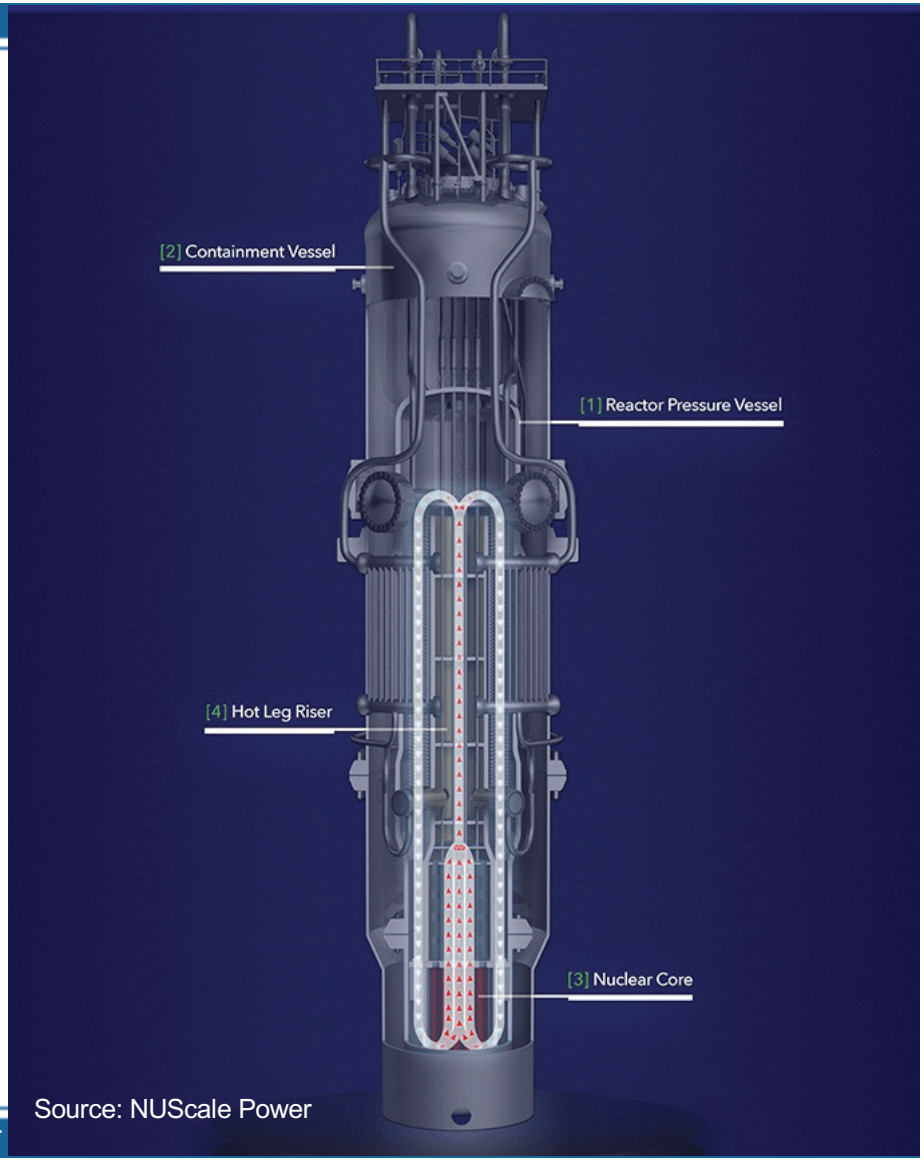
- Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
  - Smaller and can be built more quickly than more traditional nuclear reactors
- Ramping up the development of SMRs can help to produce energy when and where needed
- This energy could be integrated into existing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

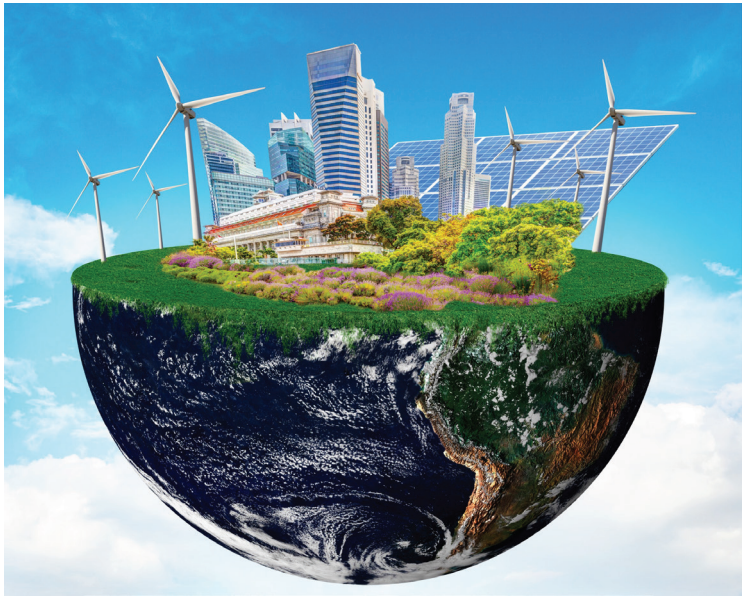


Source: NUScale Power

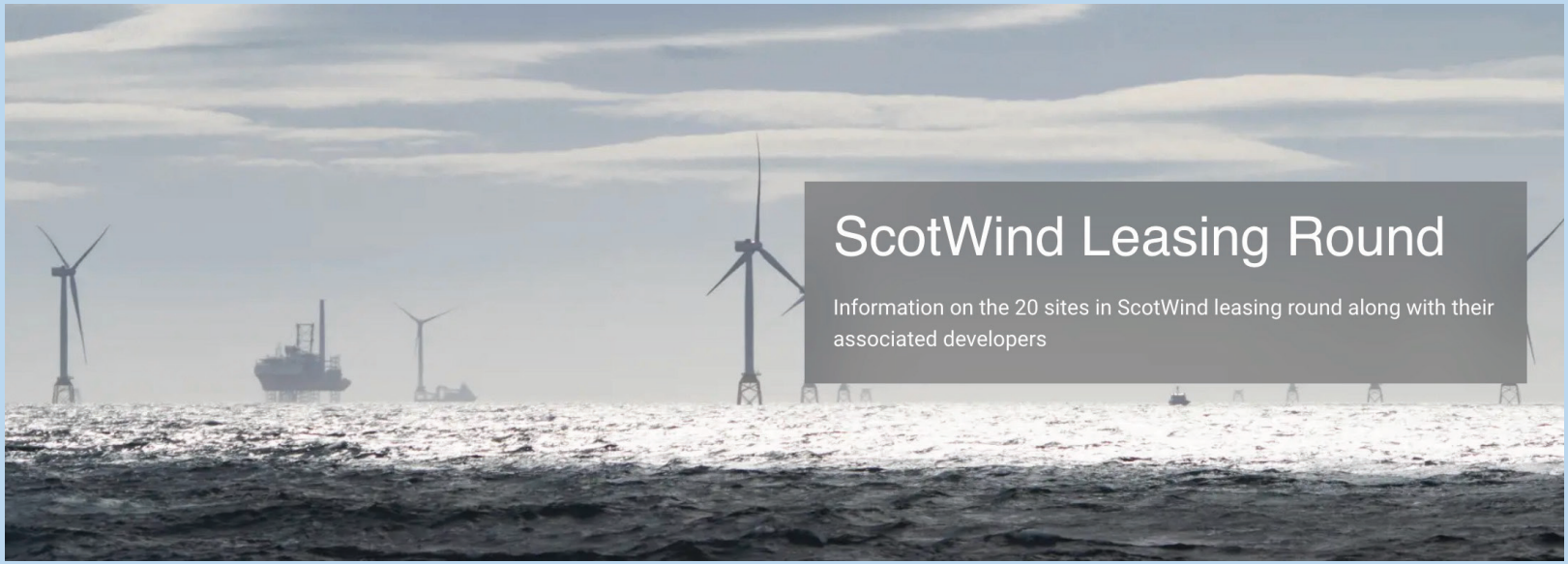
Cross-Border Energy Transfer

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



Some Case-specific Examples



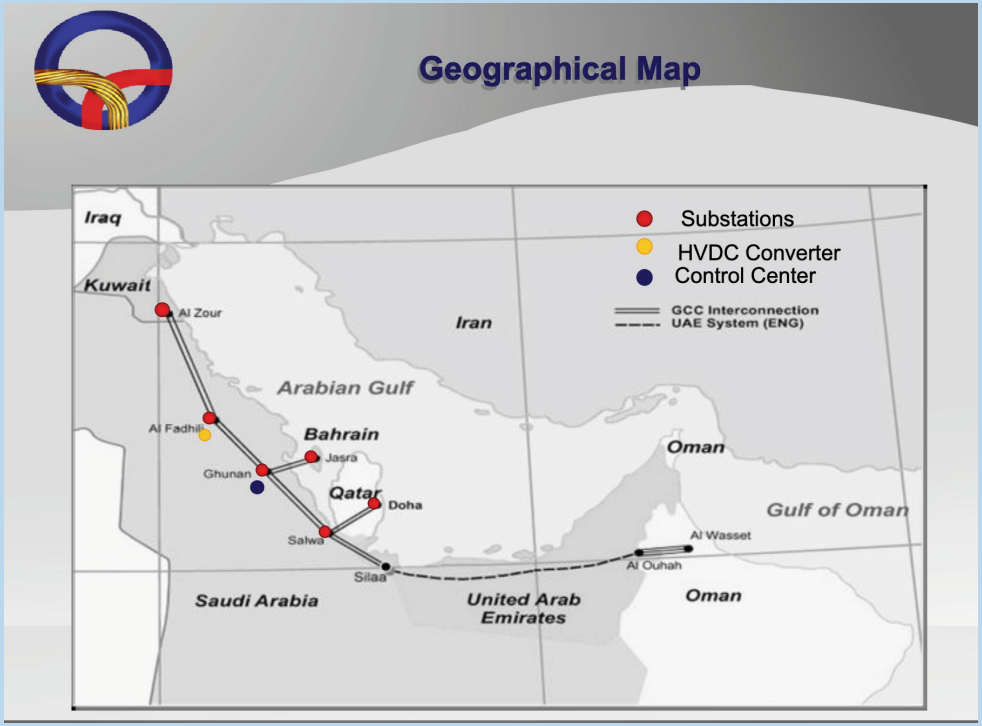
ScotWind leasing round on the 17th of January 2022: **25 GW**

Demand for Electricity in Scotland in 2030: **6 GW**

LONDON, Aug 24 (Reuters) - British authorities have given planning consent for a new 2 gigawatt (GW) subsea power link between Scotland and England

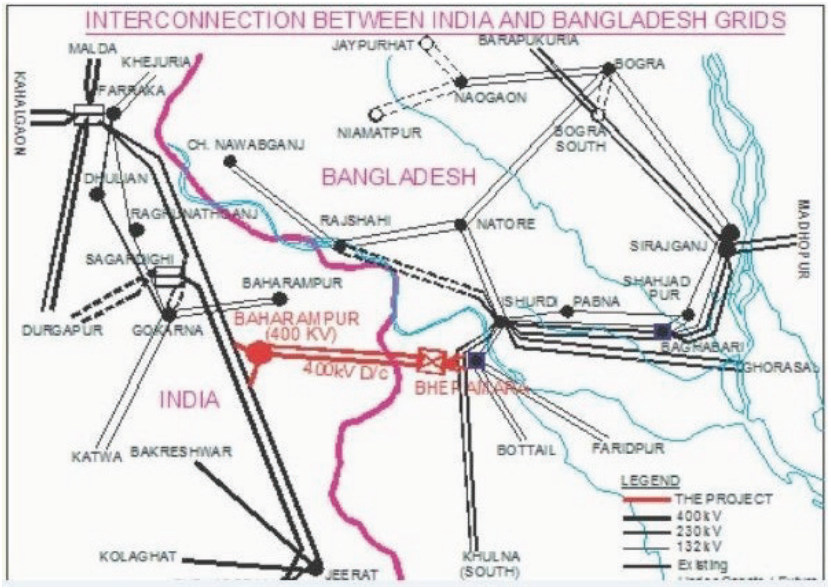
The Eastern Green Link 2 will be developed by National Grid and Scottish and Southern Electricity Networks Transmission.

Gulf Coordination Council Interconnection



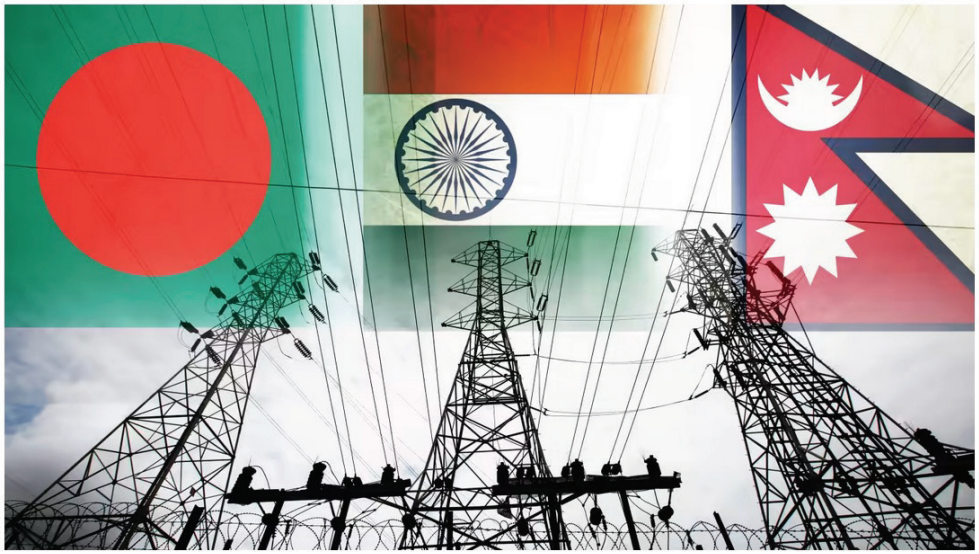
Major Benefit: Reduction of Reserve Requirements
Also Helpful in Dealing with Intermittent Sources (PV)

Bangladesh-India Interconnection (HVDC link)



Bangladesh-India 400 KV Double-Circuit 1,000 MW Line

Allows Bangladesh to buy cheaper electricity
and solar electricity when available



Bangladesh, India and Nepal are expected to soon finalize an agreement that would allow power sharing across Indian transmission lines. (Source photos by AP and Reuters)

Nepal needs to attract investment by developing a market outside
In Nepal electricity demand is less in summer than in winter
It is opposite in India and Bangladesh due to high air conditioning load

Industry tends to locate in areas of low-carbon electricity to help meet their own net-zero targets for scope II and scope III emissions

Low-carbon, cheaper and non-intermittent electricity

545 km of underwater-underground transmission line
from Québec, Canada to New York City

Vietnam has opted to boost hydroelectricity imports from Laos

The limited electricity transmission capacity from the South to the North poses a major challenge.

It is easier to import hydro-electricity from Laos to shore up power supply for the North, given the shorter transmission distance.

Clean-tech Solutions for Climate Sustainability

Climate Change

IEEE: Enabling Innovation and Technology Solutions

https://climate-change.ieee.org

IEEE Climate Change Program

https://climate-change.ieee.org

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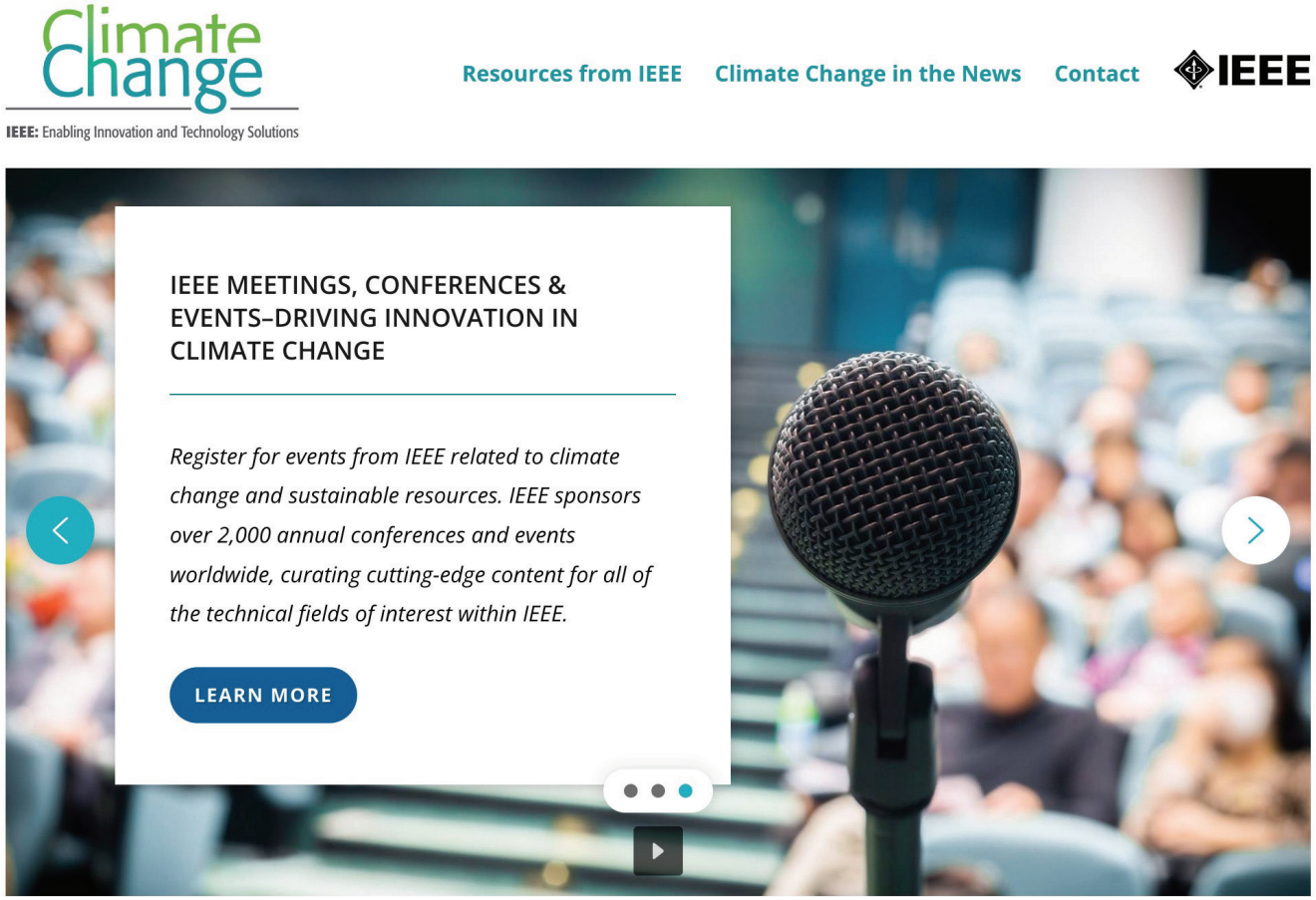

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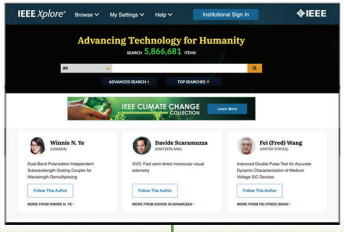
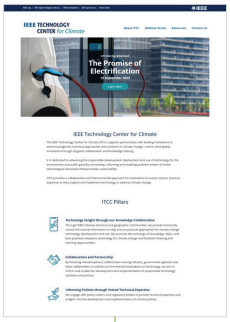
IEEE Spectrum: Climate Change News Feed; Podcasts; Features; Archives; Journal Watch Posts (Xplore); The Institute (Engineers of Climate Change; Coverage of Conferences and Standards)

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

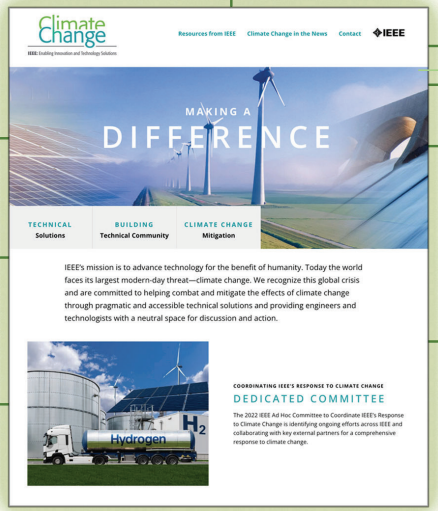


Jobs From IEEE Job Site

IEEE Technology Center for Climate



Conferences



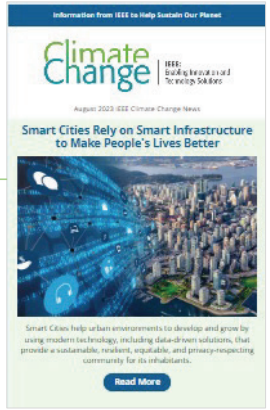
Standards

IEEE SA STANDARDS ASSOCIATION

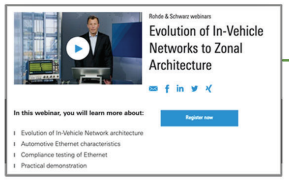
Social Media

Newsletters

IEEE Climate Change newsletter



Sponsored Content From Industry



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