

IEEE PES Distinguished Lecture
AUST, Dhaka, Bangladesh
28 December 2022

Keynote Speech

The Climate Change Challenge IEEE's Role in Bringing Technology to Meet the Challenge

Prof. Saifur Rahman

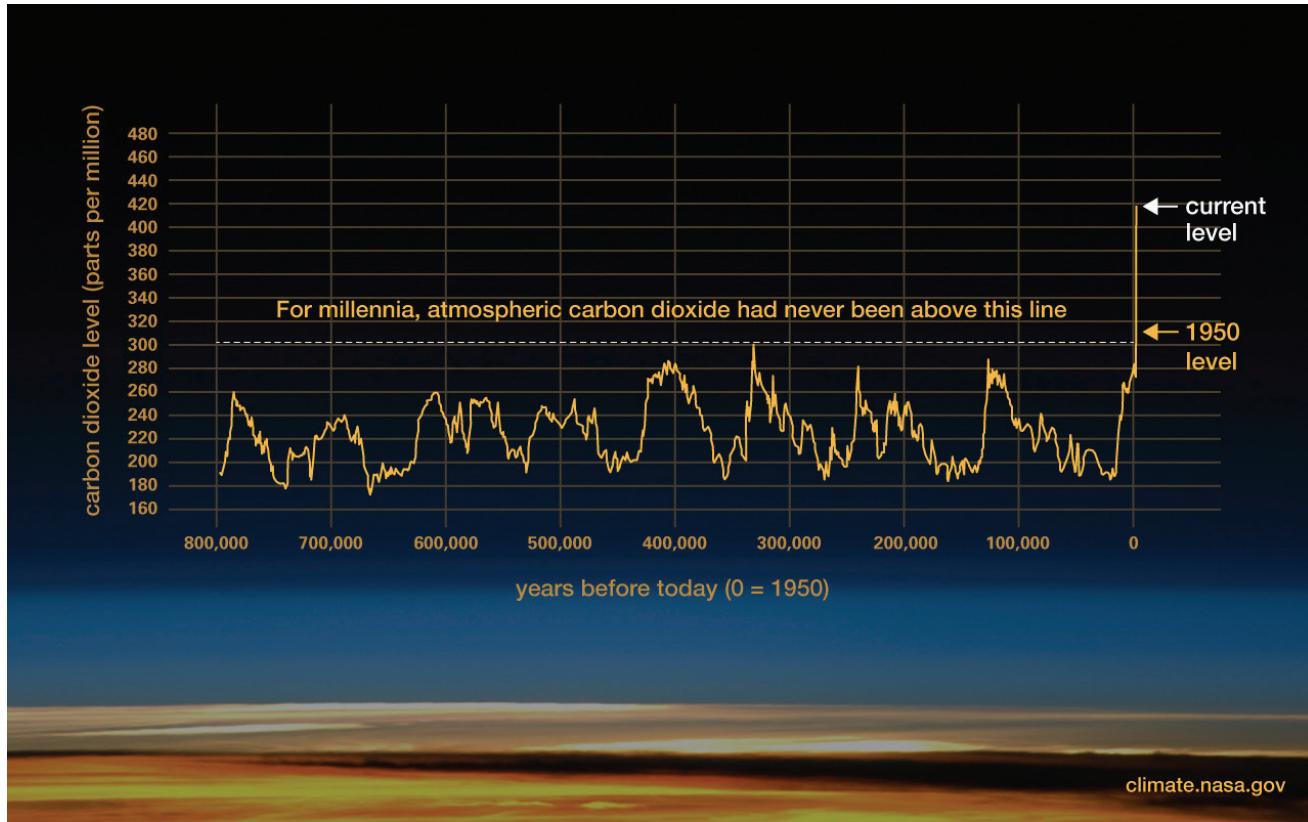
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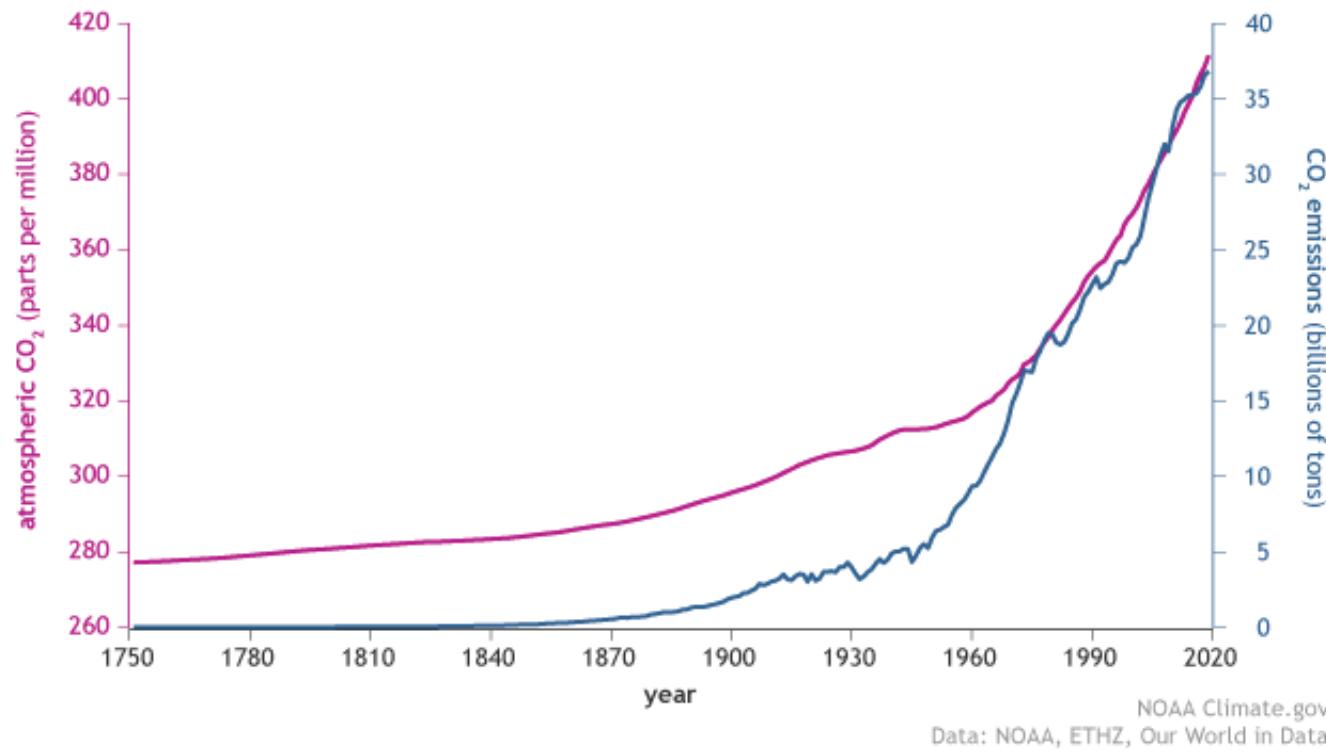
What is Carbonization ?



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)



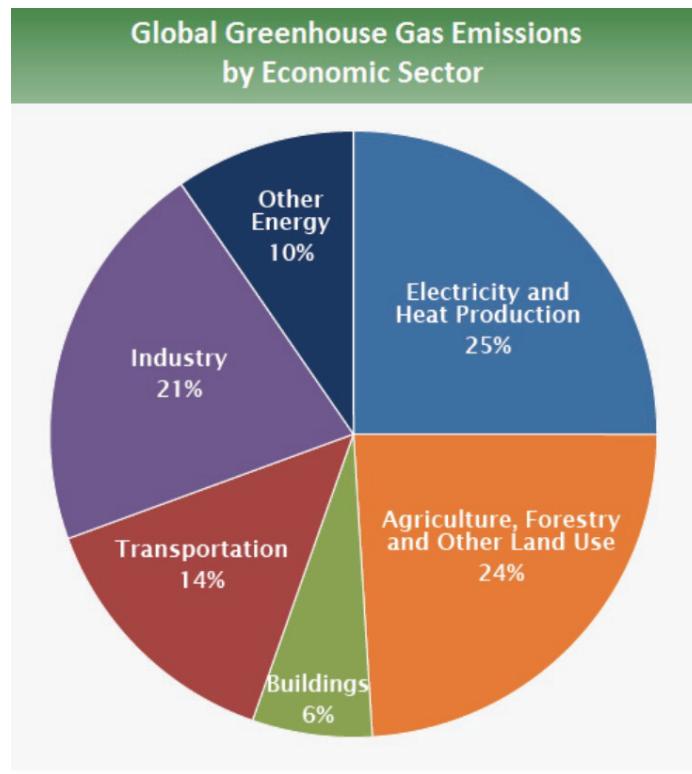
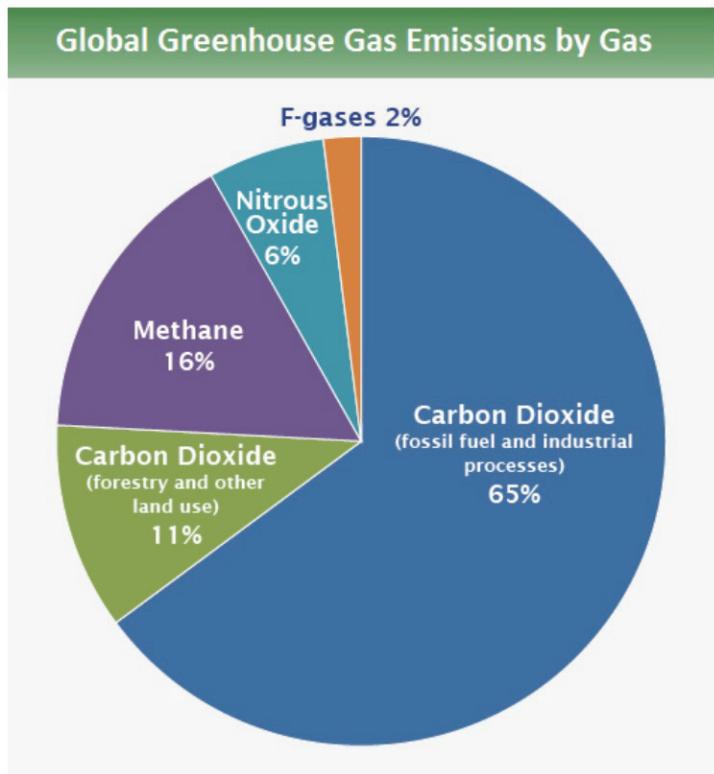
Source: State of the Planet
<https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/>

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>

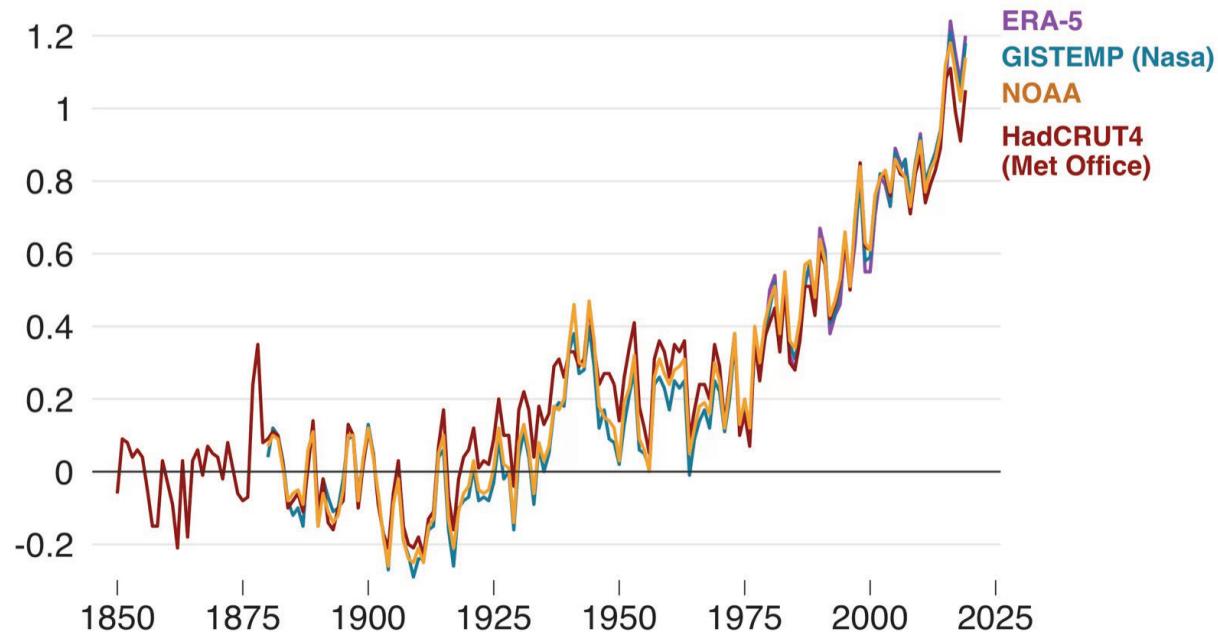


Source: [IPCC \(2014\)](https://www.ipcc.ch/report/ar5/)
<https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>

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



Source: Craig Dearden-Phillips: Don't be a polar bear
<https://www.thirdsector.co.uk/craig-dearden-phillips-dont-polar-bear/management/article/1488091>

Climate Change Hits Poor and the Rich Alike

Florida, China and Africa





Hurricane Isabel struck the Mid-Atlantic region of USA between Sept. 18-19, 2003.

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>

China





Hurricane Sandy

New York, New Jersey 2012



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 August 18, 2022 in Chongqing, **China**.

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



<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 June 13, 2022 in
Flagstaff, Arizona.
Schumacher/The Republic



Wildfires in Europe - Summer of 2022



Southwestern France, July 17, 2022



Central Portugal, July 13, 2022



© Jan Woitas/dpa/picture alliance
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. -

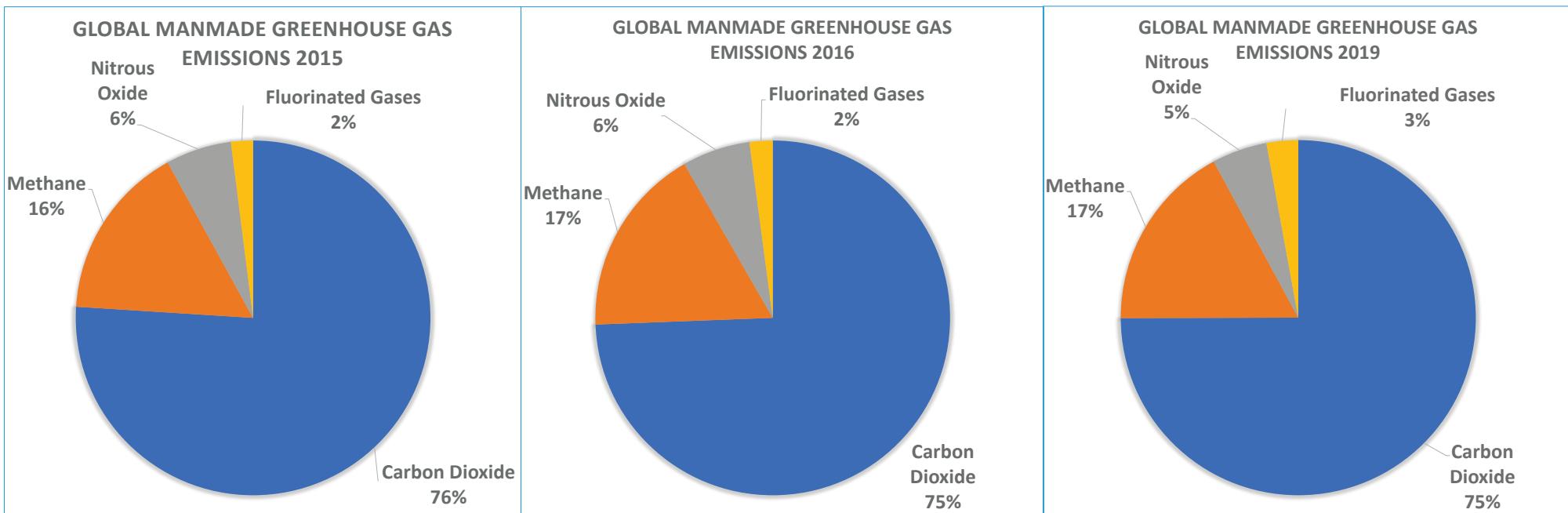
Copyright: AP Photo/Maksim Slutsky, File

2008 China Snowstorm



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

Fluorinated Gases include: HFC, PFC and SF6

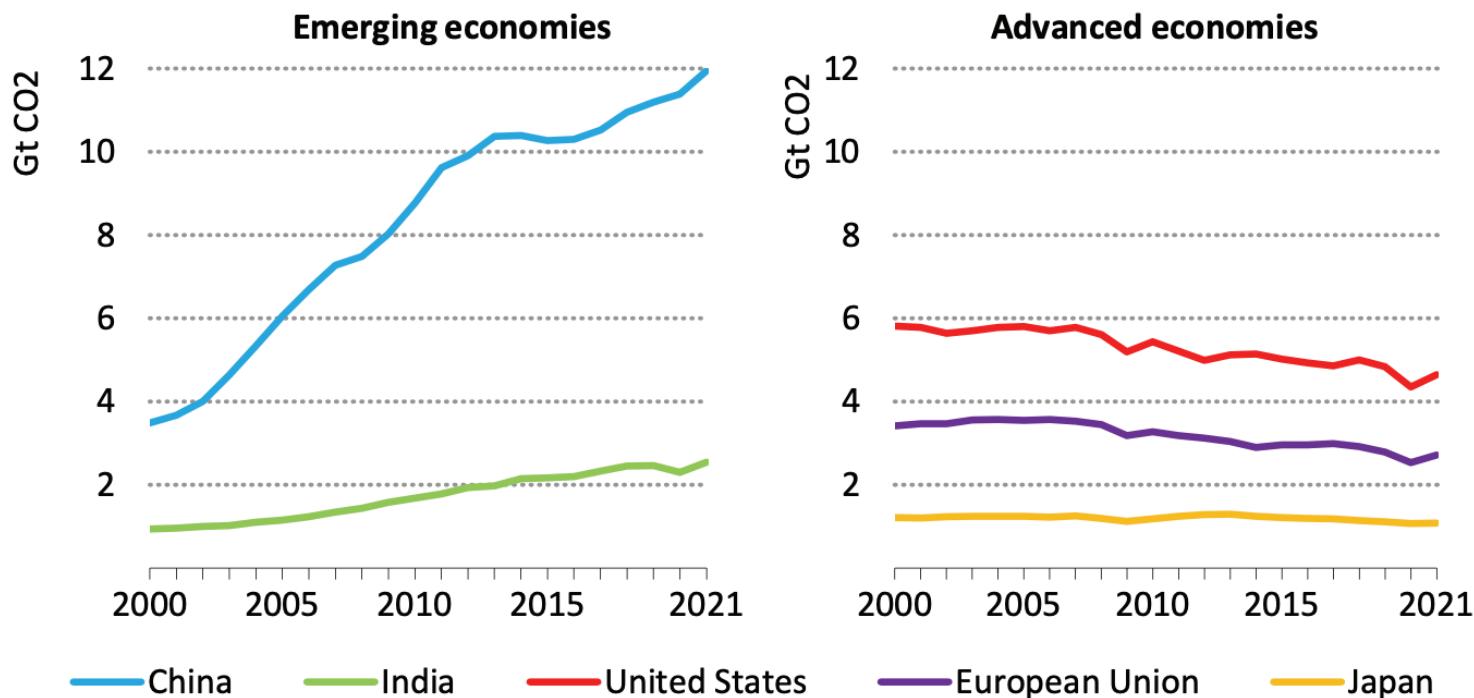


Source: <https://www.c2es.org/content/international-emissions/>

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>

CO2 emissions in selected emerging and advanced economies, 2000-2021

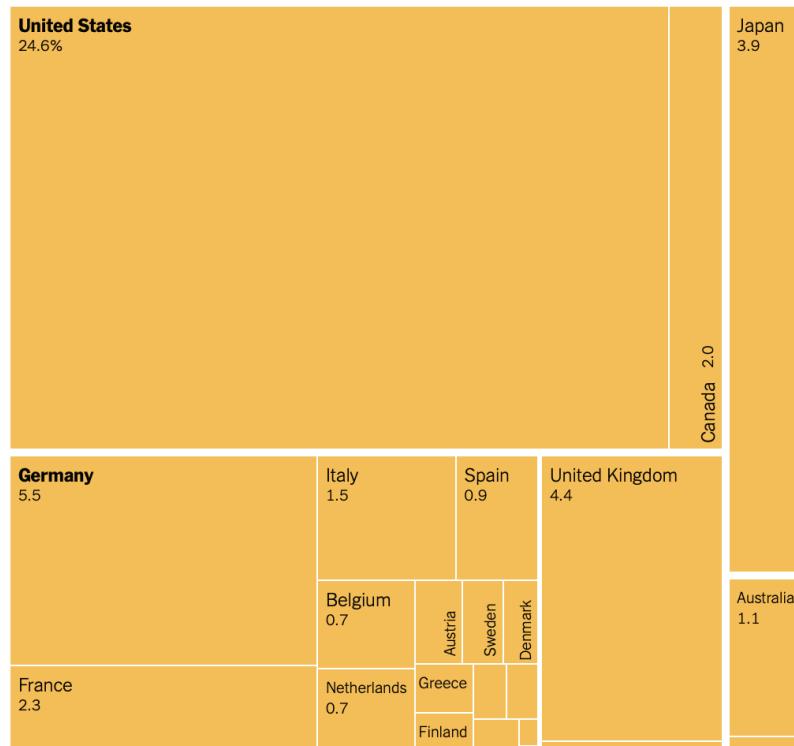


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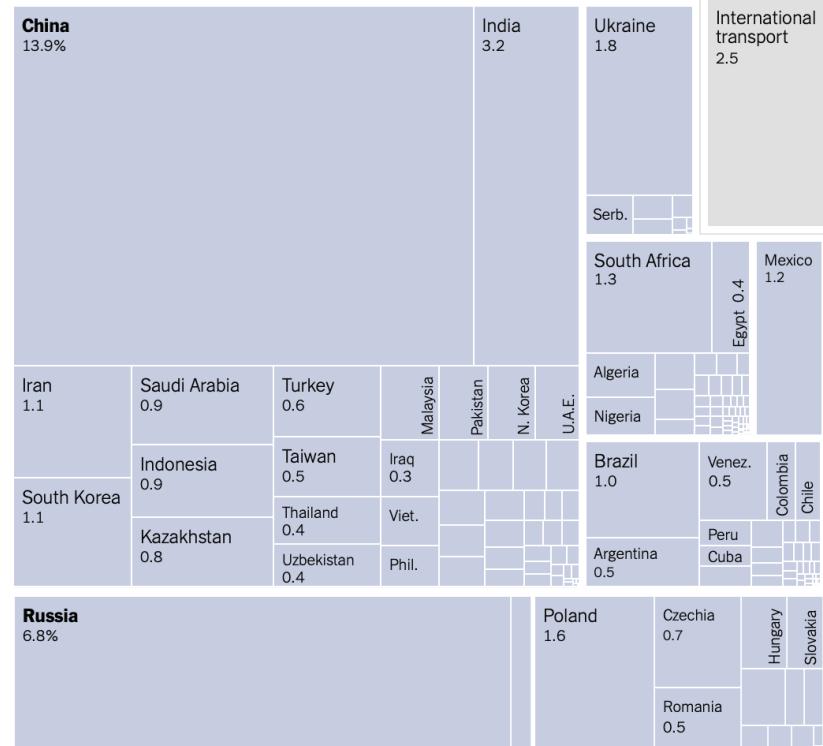
Source: IEA Global Energy Review: CO2 Emissions in 2021
<https://www.iea.org/reports/global-energy-review-co2-emissions-in-2021-2>

Who Has The Most Historical Responsibility for Climate Change

23 rich, developed countries are responsible for half of all historical CO₂ emissions.



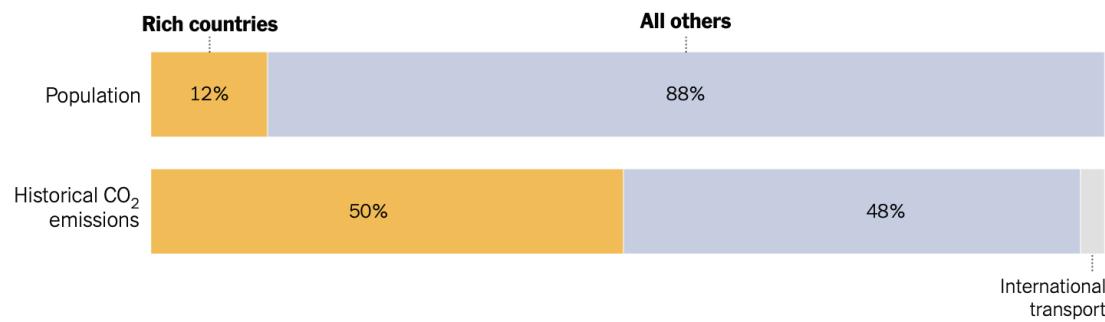
More than 150 countries are responsible for the other half.



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

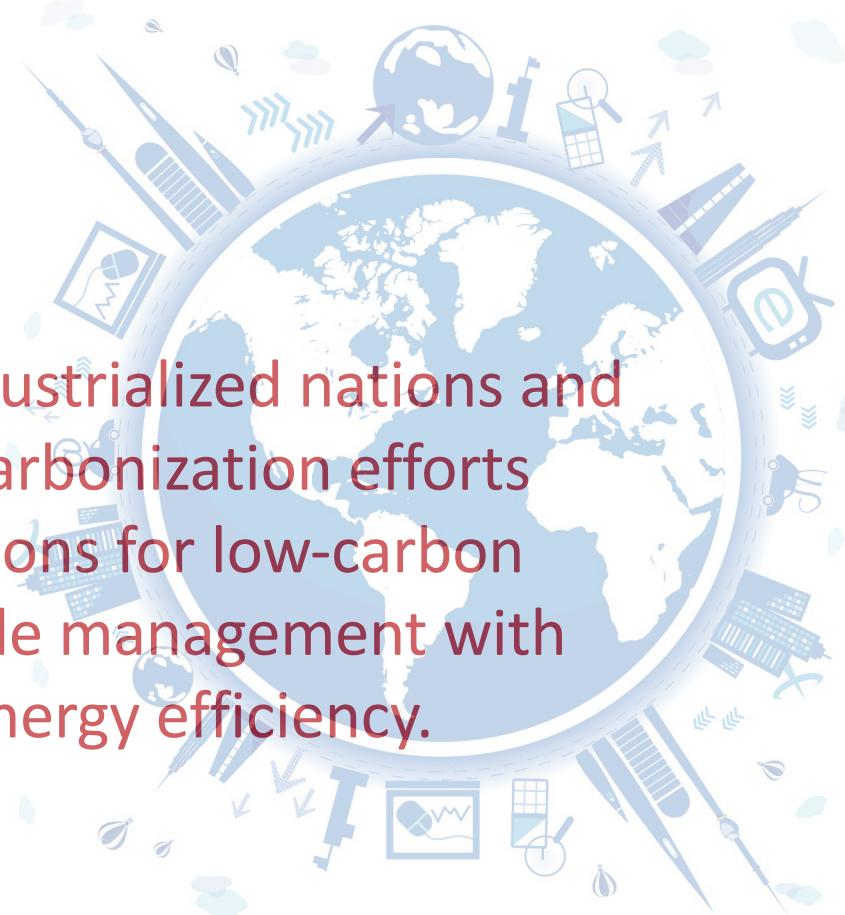
Who Has The Most Historical Responsibility for Climate Change

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 By [Nadja Popovich](#) and [Brad Plumer](#), Nov. 12, 2021
(<https://www.nytimes.com/interactive/2021/11/12/climate/cop26-emissions-compensation.html>)

Navigating the tension between industrialized nations and emerging economies for global decarbonization efforts requires a diverse portfolio of solutions for low-carbon generation, storage and demand side management with advanced technology focusing on energy efficiency.



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



Air conditioning and Lighting



Increasing the AC temp setting by
2 deg F can save 10% electricity



Energy Efficiency Applications

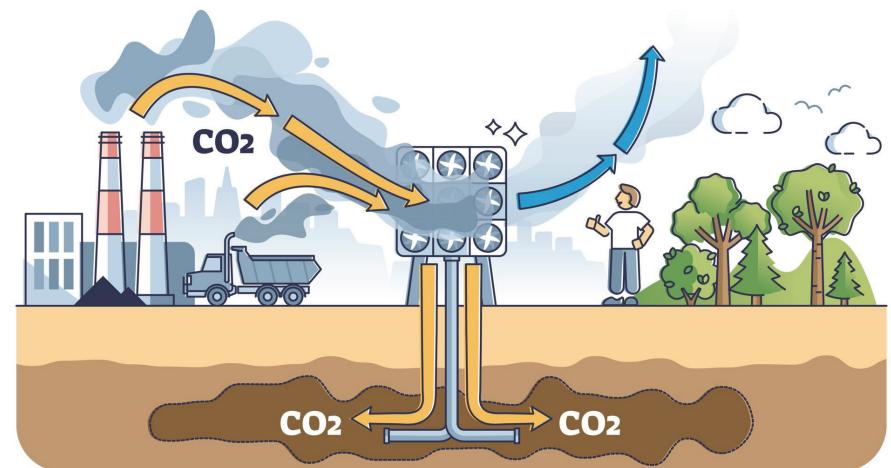
Consider light bulbs

- 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
- In industrial applications, LED bulbs use 25% electricity compared to sodium-sulfer bulbs



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

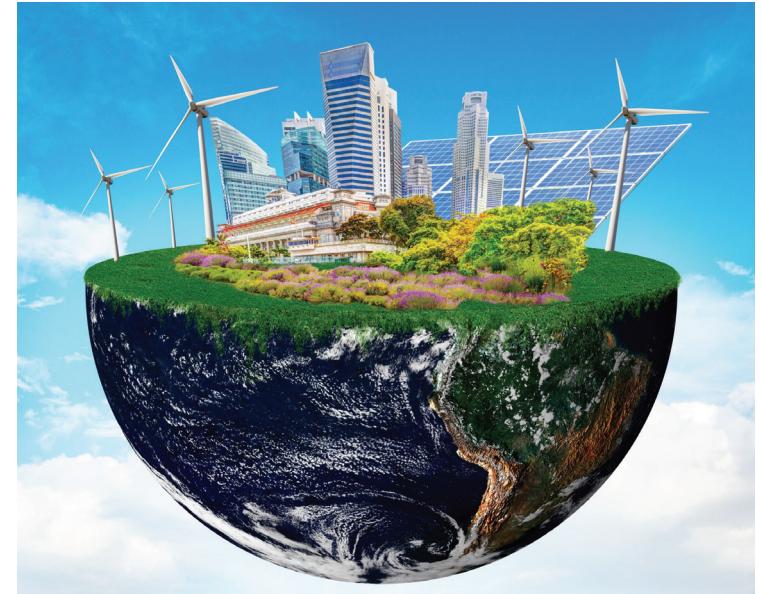


- Low-carbon hydrogen will help emerging economies to meet climate goals in and of itself
 - Provide for diverse energy portfolios
 - Improving resilience
 - Lowering costs
- Storage solutions serve as optimizers for other renewable energy solutions
 - Ensure that electricity generated during off-peak 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



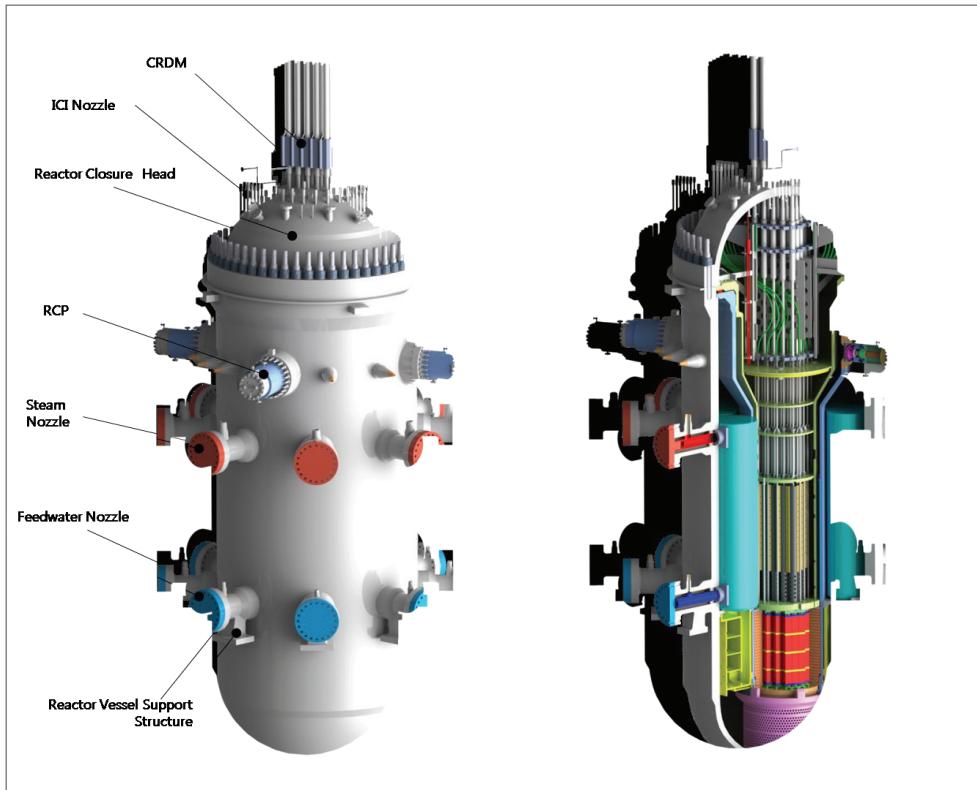
Advanced Nuclear Technologies

Diverse solutions to address climate change

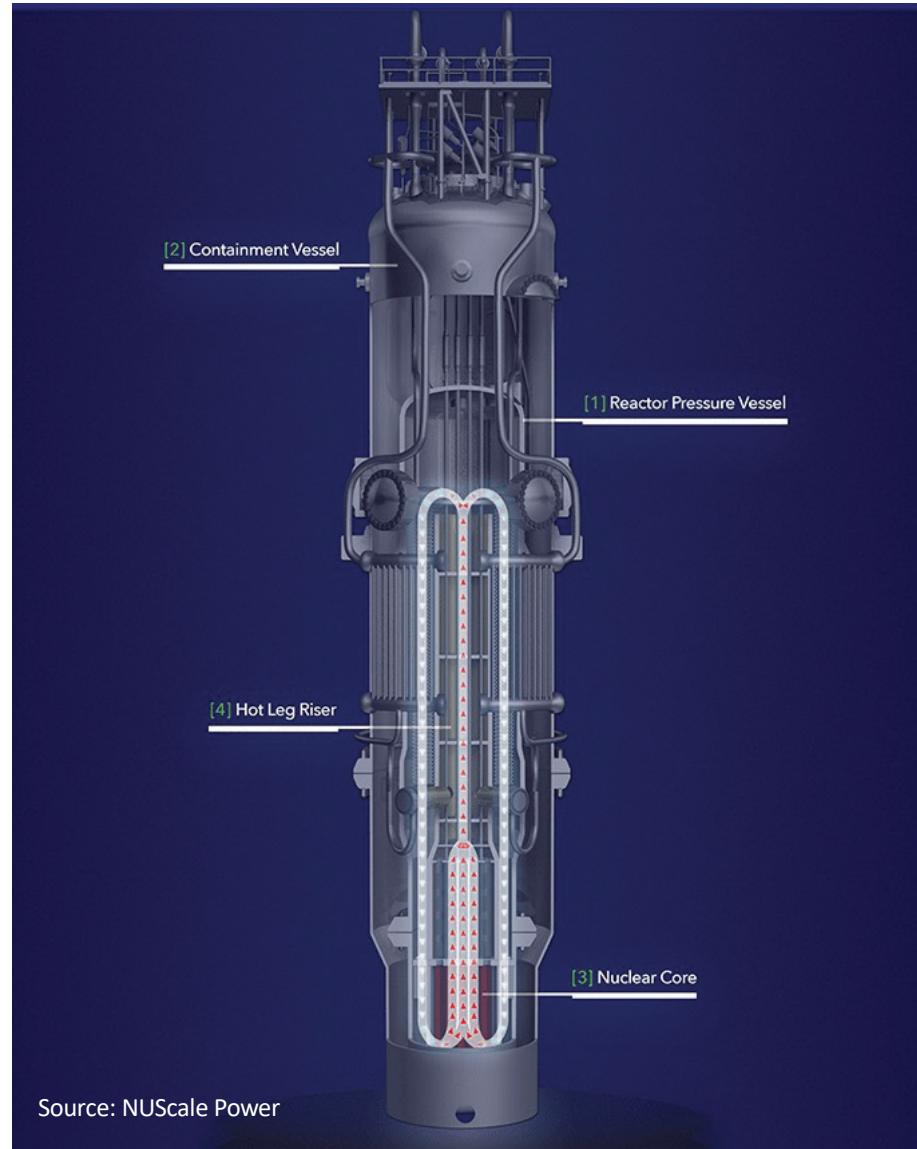
- Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
 - Smaller and can be built more quickly than more traditional nuclear reactors
- Ramping up the development of SMRs can help to produce energy when and where needed
- This energy could be integrated into existing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



US Chief Climate Negotiator Senator John Kerry at COP27



Electrification to Reduce Fossil Fuel Use

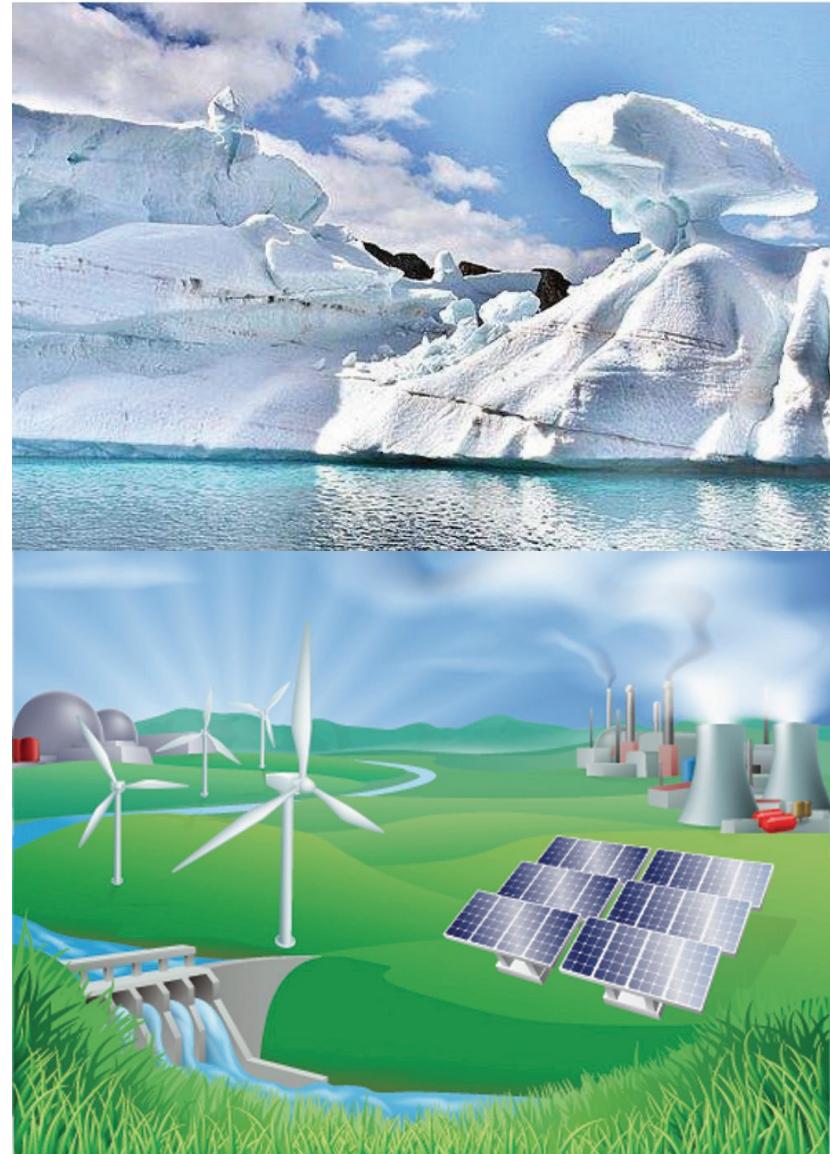


Electric Vehicle



So, What is the bottom line?

- Efforts in the electric power sector by replacing fossil fuel with renewables and nuclear will help
- But if emission from the transportation sector continues to rise, the power sector contributions will not be enough
- Large scale Electric Vehicle deployment will help, but question remains – how will the EV be powered



Bangladesh contributes a minuscule amount in the global CO2 budget

Bangladesh can continue to grow with coal-based power sector

Or, Bangladesh can be an example of emerging low-carbon economy

US has agreed to provide USD 20 billion in public and private funds to Indonesia to help the country reduce its future coal-fired generation

IEEE Climate Change Website

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



Email: ccirc@ieee.org

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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.

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THANK YOU!

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