

# Climate Change and Net-zero Transition A Roadmap for Industrializing Countries

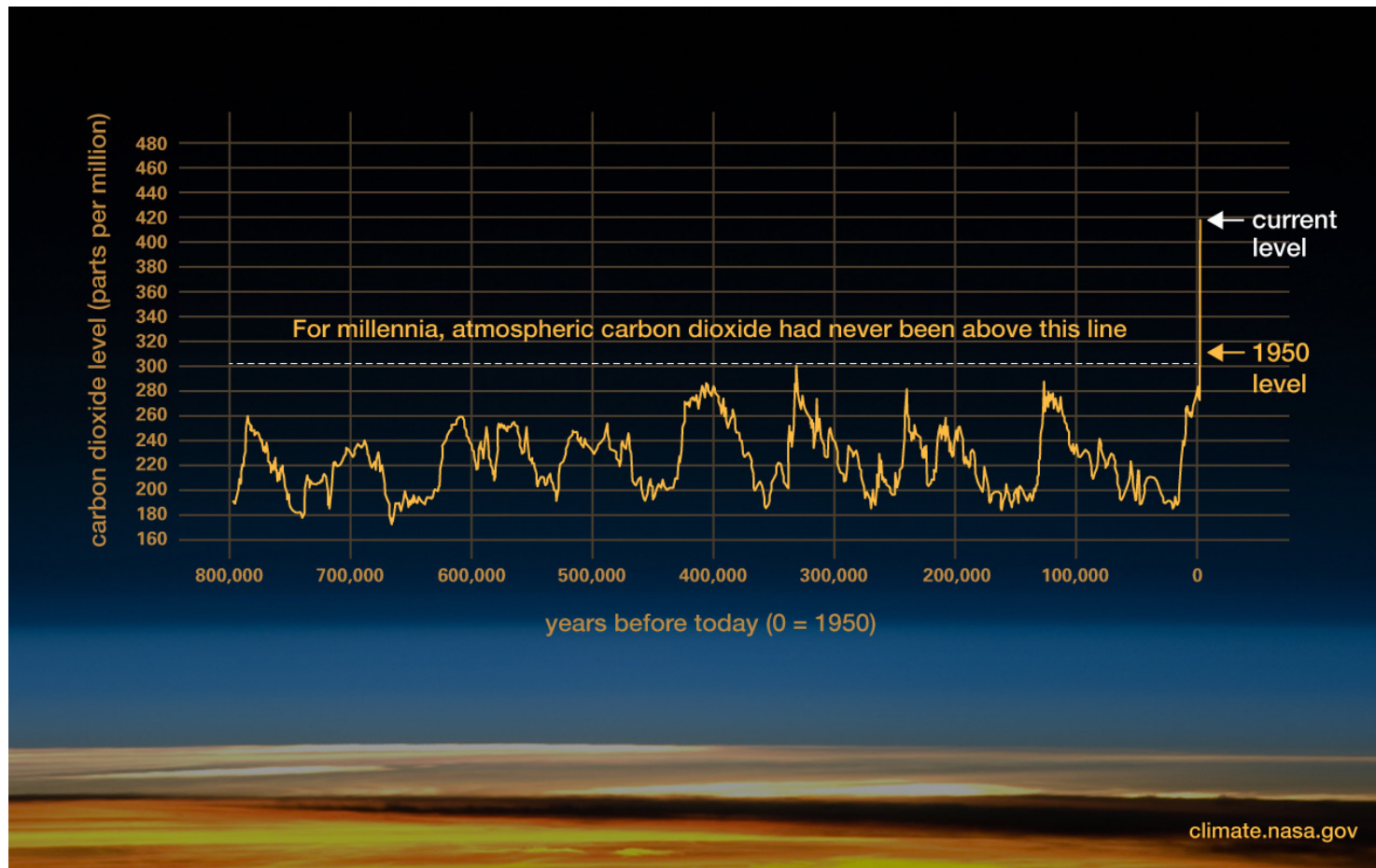
*Prof. Saifur Rahman, 2023 IEEE President & CEO  
Preserve Planet Earth Climate Change Conference  
IUB, Dhaka, Bangladesh, 23 Sep 2023*



# Carbonization is Challenging Climate Sustainability



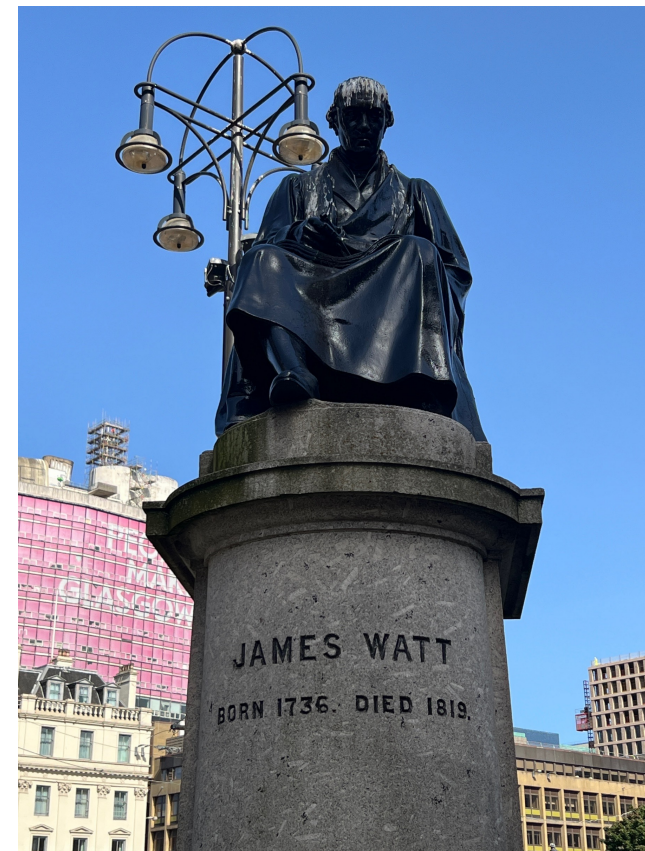
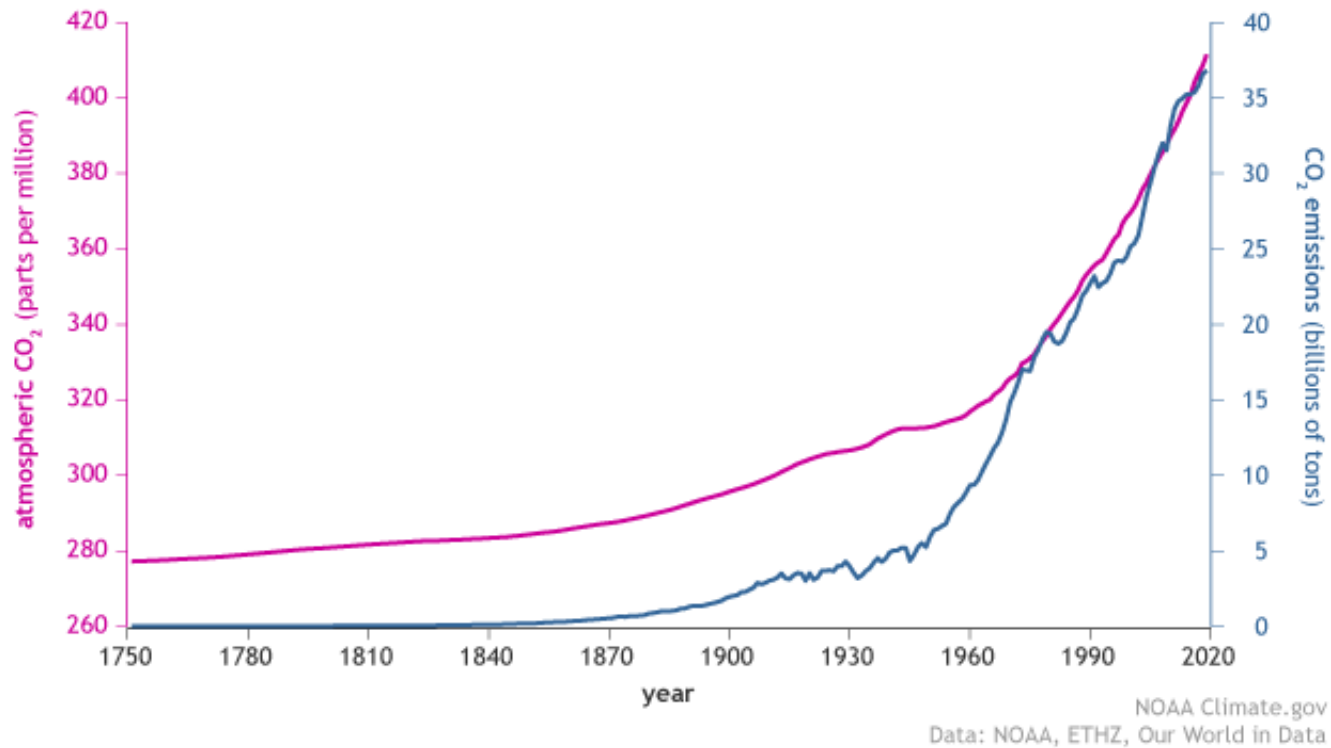
# What is Carbonization?



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)

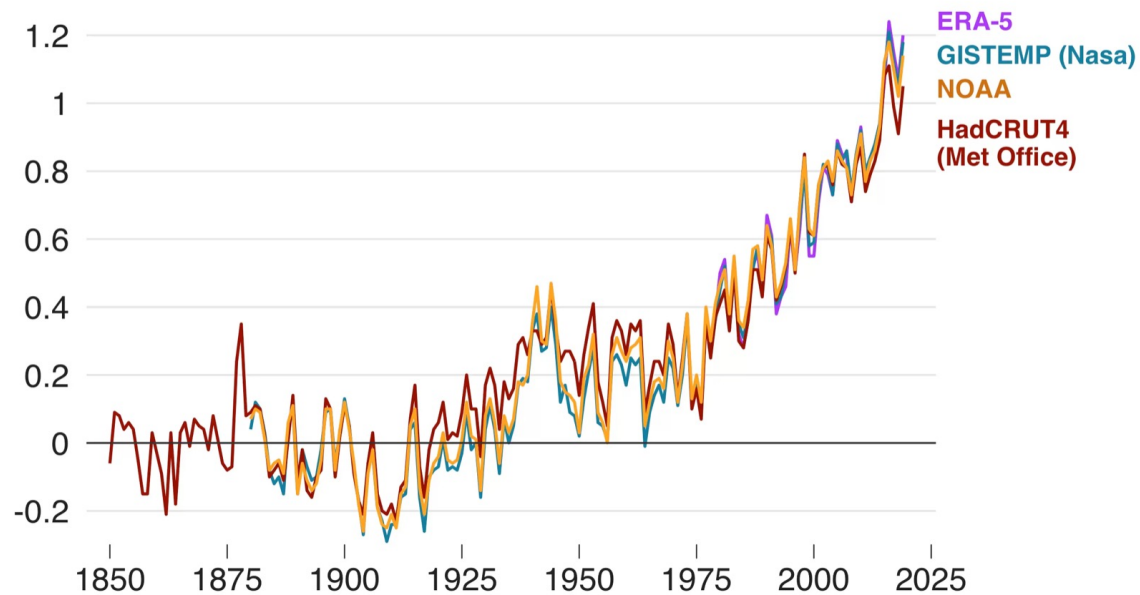


Source: State of the Planet  
<https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/>

# 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>

Paris Climate Sustainability Goal: Limit to 1.5 deg C Rise

Temperature rise of 2.0 deg C → Point of No Return



Advancing Technology for Humanity

# Climate-change Impacts



Pethi Belaid/Agence France-Presse — Getty Images





# 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>



# Beijing



Floods inundate a village in Baoding city, Hebei province, on 02 August 2023.

Source: <https://www.cnn.com/2023/08/04/china/china-northeast-hebei-beijing-flooding-recovery-intl-hnk/index.html>



Zhuozhou, north China's Hebei Province, 02 August 2023

Source: <https://english.aawsat.com/world/4466926-beijing-records-hottest-rainfall-least-140-years-causing-severe-flooding-and-21>



# 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)



# 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**

# 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

# 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>

# Droughts in 2022



The Jialing Riverbed at the confluence with the Yangtze River is exposed due to drought on August 18, 2022 in Chongqing, **China**.

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

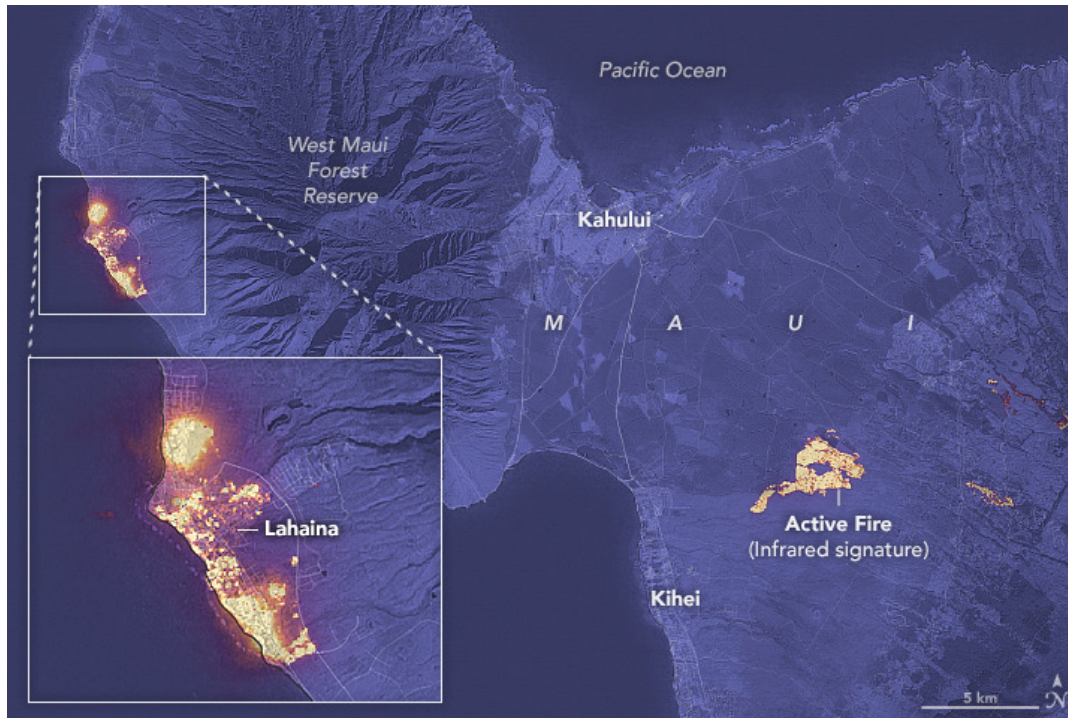
Dry river bed in **Italy** (Po River) due to worst drought in 70 years, June 2022



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



# Hawaii



NASA imagery showing the signature of the fire at 10:25 p.m. local time on August 8, 2023, as observed by the [Operational Land Imager](#) (OLI) on the [Landsat 8](#) satellite.

Much of Lahaina, a town with a resident population of nearly 13,000 people, appeared to be on fire at the time of the image.

Toll as of Aug 15, 2023

- At least 110 dead
- More than 11,000 people evacuated
- Widescale power outages
- Cell phone disruptions

Source: <https://earthobservatory.nasa.gov/images/151688/devastation-in-maui>, NASA Earth Observatory





# Hawaii



**Hawaii Fires** This combination of satellite images provided by Maxar Technologies shows an overview of Lahaina Square on Maui, Hawaii, on June 25, 2023, left, and an overview of the same area on Wednesday, Aug. 9, following a wildfire that tore through the heart of the Hawaiian island. (Maxar Technologies via AP)

Maxar Technologies via AP

E

# Greece



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

# 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



# 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



# How Do We De-Carbonize?



# The industrializing world needs sustainable, affordable, and accessible energy sources



# We Need Energy Transition But From Whose Perspective?



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



**To more efficiently facilitate the global shift towards low-carbon electricity, the following six areas should be our priority.**



# 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<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

Energy savings from air conditioning control: 10-15%

Energy savings from lighting control: 10-15%



# 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



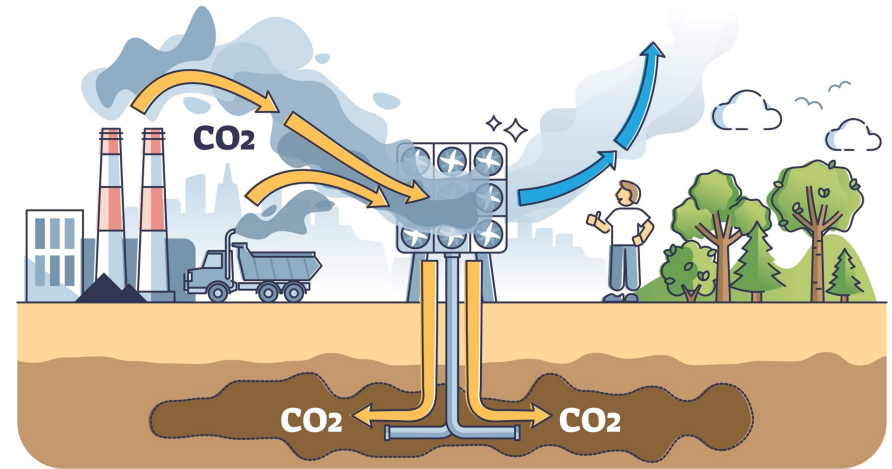
# Highly Efficient Fossil-fuel Power Plants



- Combined Cycle Gas/Steam Power Plant
- Ultra-supercritical steam power plant

# Carbon Capture & Storage Systems (CCS)

- Direct Air Capture (DAC) 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 and Storage



**IEEE**

# Wind Energy Development

*Whitelee Windfarm, Glasgow, Scotland*





# Wildorado Wind Ranch-Siemens



**LOCATION: Wildorado, TX**  
25 miles west of Amarillo in  
Oldham, Potter and Randall  
Counties

**SIZE: 161 MW**

COMMERCIAL OPERATIONS  
DATE: April 2007

**UTILITY: Xcel Energy**  
(Southwestern Public Service  
Company)

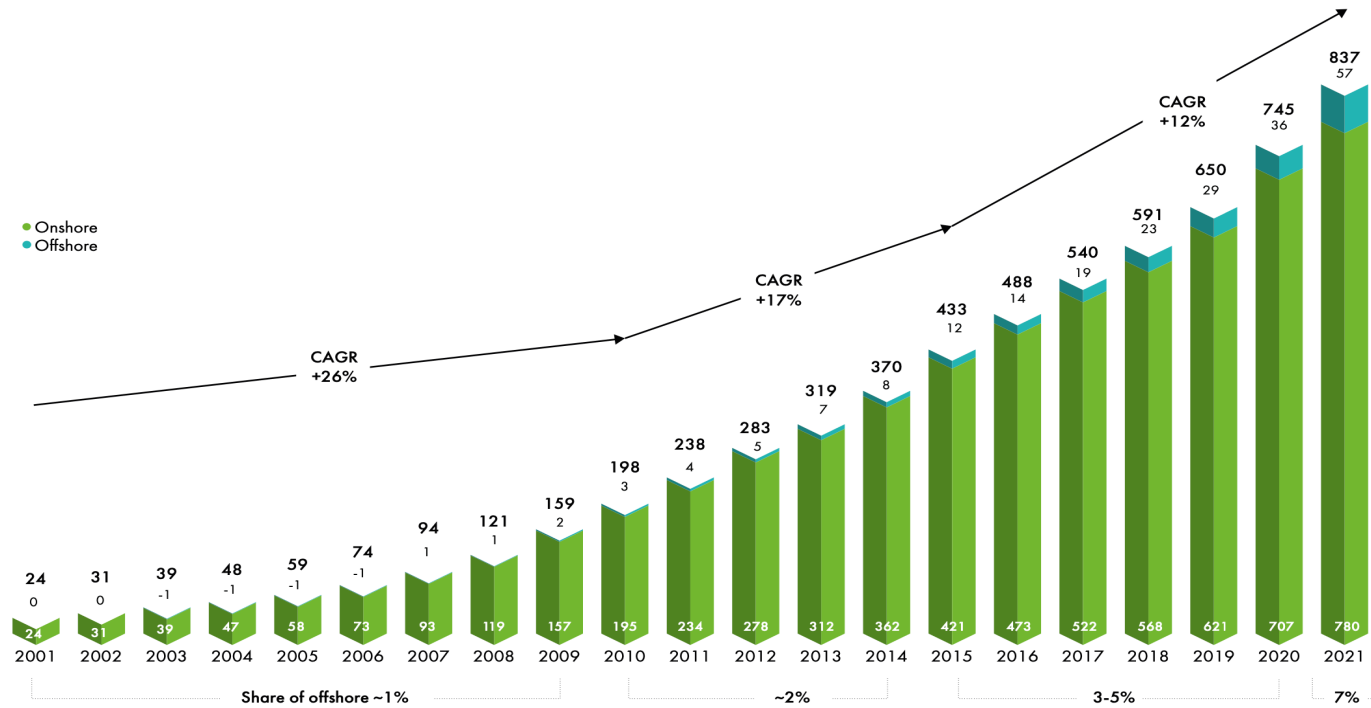
**TURBINE EQUIPMENT:**  
70 Siemens 2.3 MW Mk II

Source: <http://www.nikkiphotography.com/category/environmental-issues/>  
<http://www.cielowind.com/projects/completed-developments/wildorado-wind-ranc>



# Global Installed Wind Capacity (GW) 2001-2021 (Cumulative)

Historic development of total installations (GW)



# Net-zero Campus

## Hashemite University in Amman Jordan



# Roof-mounted Solar in a School in Morocco



# Roof-top Solar Photovoltaics



Virginia



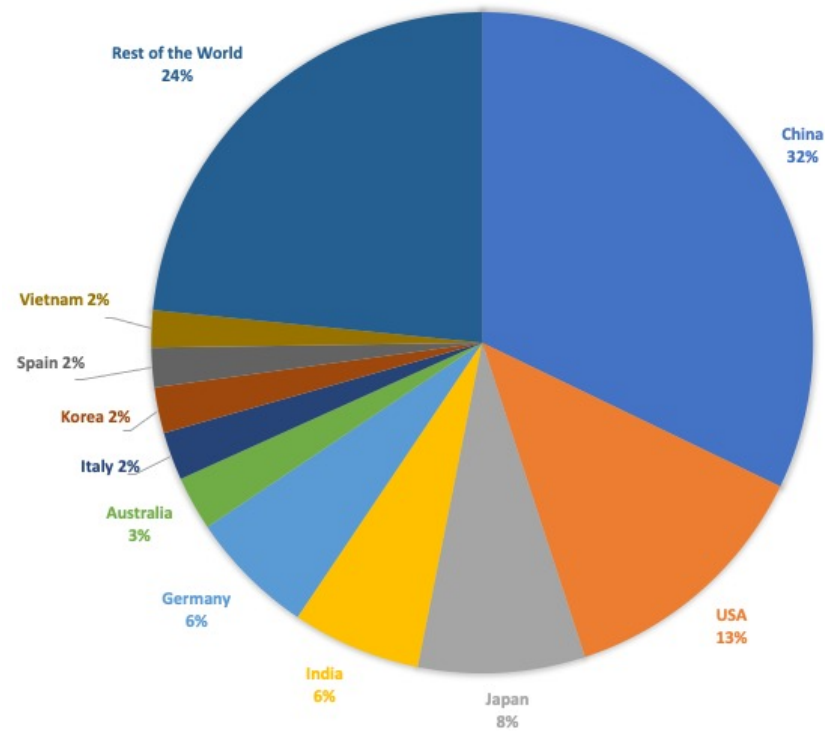
Dhaka City



# Kenya School of Monetary Studies, Nairobi



# Global Cumulative Installed PV Capacity Showing Top 10 Countries End of 2021(942GW)



# How About Hydro?

**Very site-specific  
Already fully developed  
in industrialized countries**



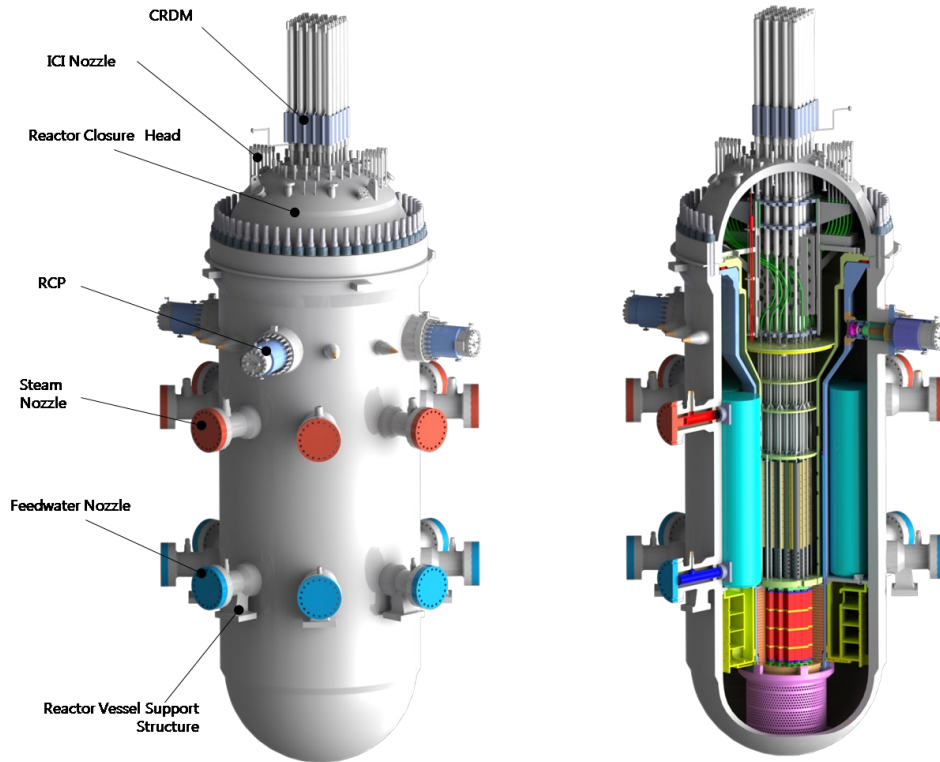
# Advanced Nuclear Technologies

## *Diverse solutions to address climate change*

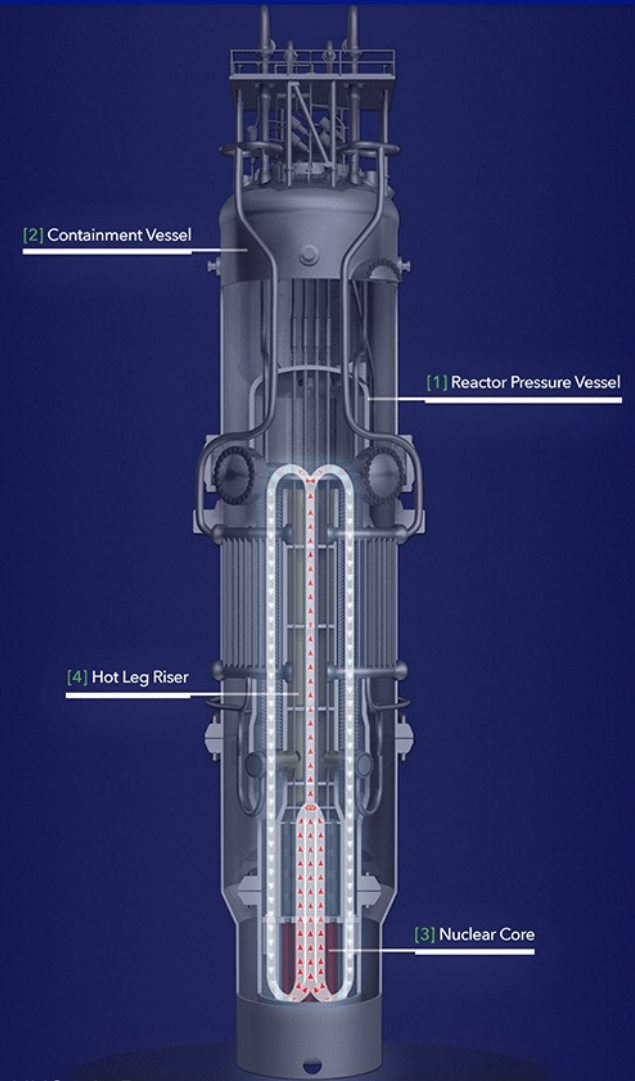
- ▶ Advanced nuclear technologies, such as small modular reactors (SMRs), can play a role
  - Smaller and can be built more quickly than more traditional nuclear reactors
- ▶ Ramping up the development of SMRs can help to produce energy when and where needed
- ▶ This energy could be integrated into existing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

*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



# Mitigation or Adaptation?

Some believe the time for mitigation is over  
Only approach left is adaptation

Mitigation will allow more time for technology  
development and adaptation



Thank you  
web: [www.srahman.org](http://www.srahman.org)