

Climate Change

IEEE: Enabling Innovation and Technology Solutions

The global engineering view:
Delivering an equitable, sustainable and low carbon resilient world

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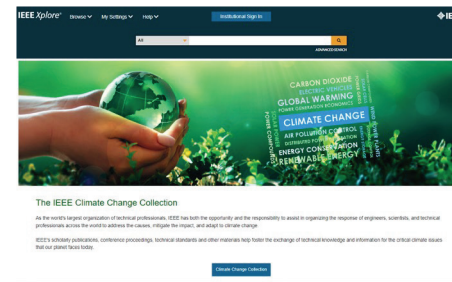
IEEE Climate Change Collection

- As the world's largest organization of technical professionals with 400,000+ members, IEEE has both the opportunity and the responsibility to assist in organizing the response of engineers, scientists, and technical professionals around the world to address the causes, mitigate the impact, and adapt to climate change.
- IEEE Climate Change Collection: IEEE publications with relevance to addressing the impact of climate change available on IEEE *Xplore* and the new Climate Change website.

Climate Change

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Climate-change.ieee.org



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- **An unprecedented level of awareness of climate change and the role of decarbonization in enabling environmental sustainability moving forward.**
 - **Major focus placed on the carbon produced through electricity generation, as it is responsible for roughly 30% of emissions globally.**

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



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

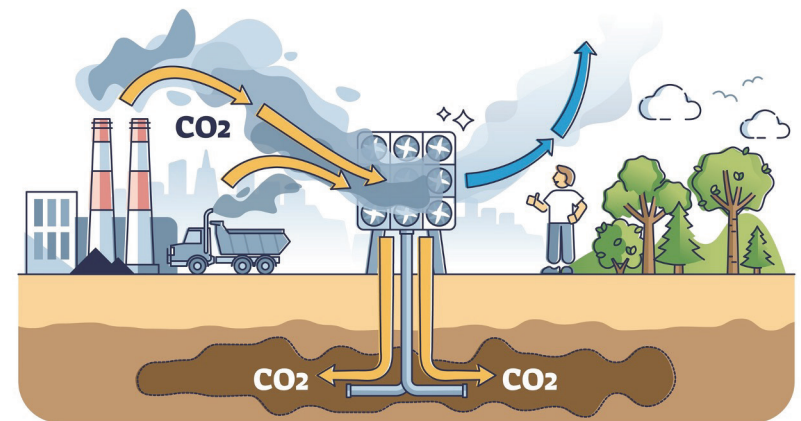
Carbon capture and storage

- Combined cycle gas/steam power plant
- Ultra-supercritical steam power plant

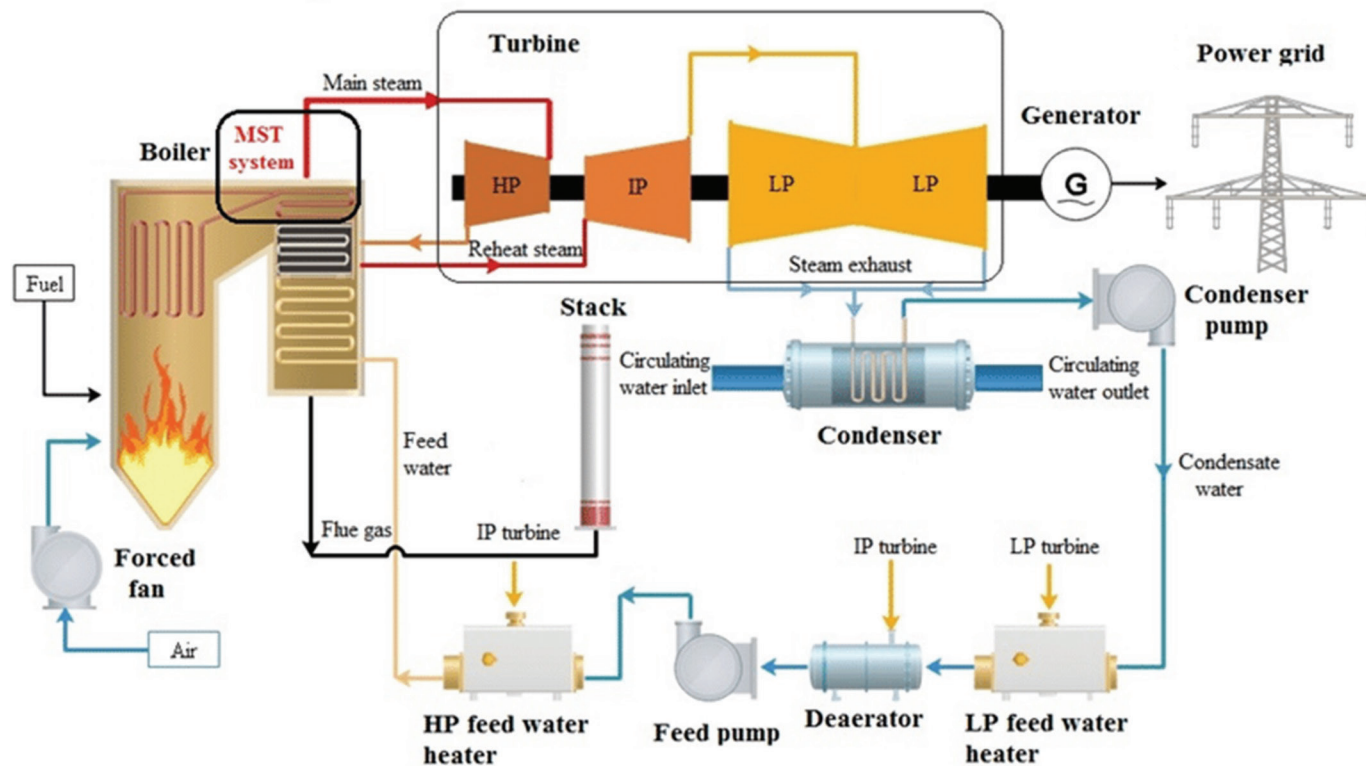


Carbon Capture & Storage Systems (CCS)

- 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



Simplified layout of a 1000 MW coal-fired ultra-supercritical power plant



Eemshaven Ultra-supercritical Steam Power Plant

The Netherlands



Power Plant: Two units rated 800MW each

Efficiency: 46.2%

Temp: 609°C

Steam Turbine: Siemens SST5-6000

Built: 2014

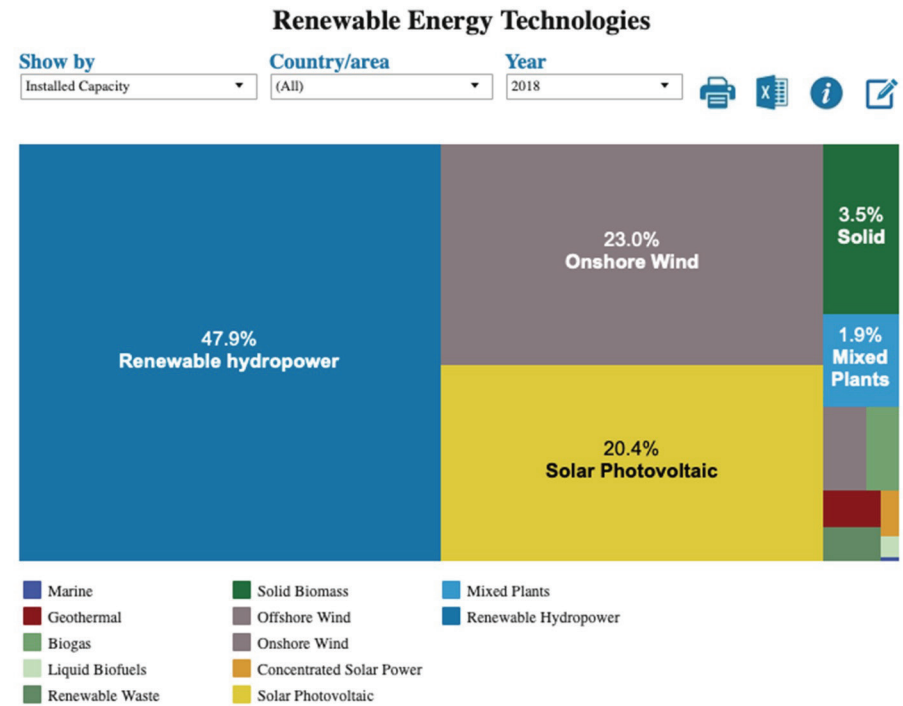
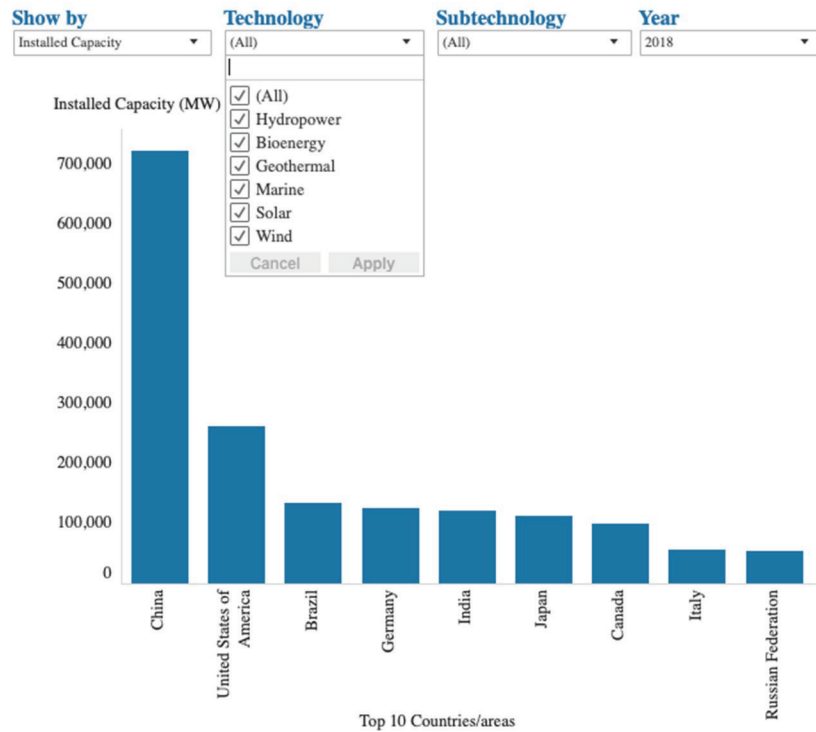
Renewable Energy Integration

Build more strategically from the start

- Focus on where energy is needed most, via three core components:
 - Energy generation
 - Transmission
 - Distribution



Total Installed Renewable Energy Capacity Top Ten Countries (2018)



Hydrogen and Storage Solutions

Optimize renewable energy solutions being integrated into energy grids

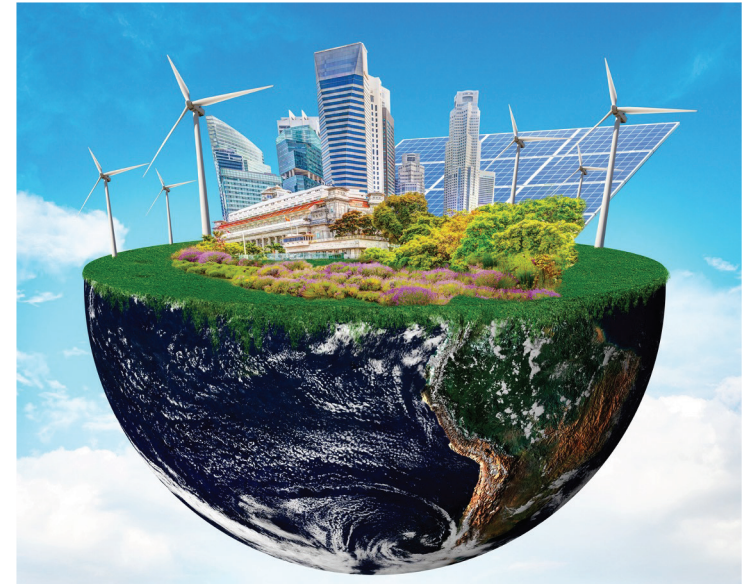
- Low-carbon hydrogen will help emerging economies to meet climate goals in and of itself
 - Provide for diverse energy portfolios
 - Improving resilience
 - Lowering costs
- Storage solutions serve as optimizers for other renewable energy solutions
- Ensure that electricity generated during off-peak hours does not go to waste



Cross-Border Energy Transfer

No Transition without Transmission

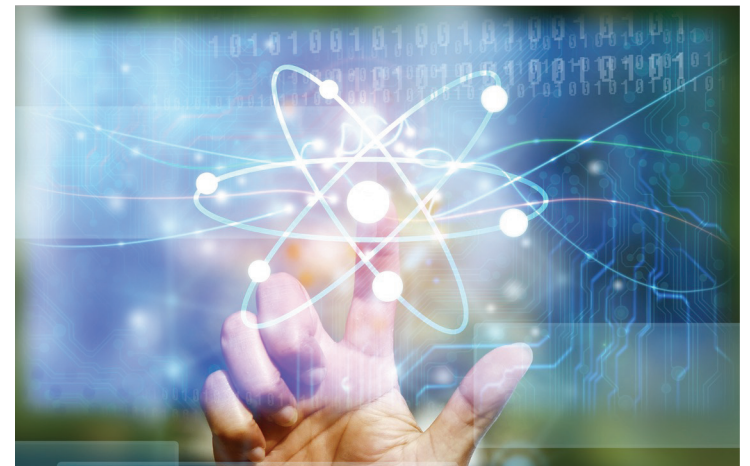
- As we are in this fight together, our solutions should be collaborative to secure better outcomes for all countries, regardless of location
- The International Energy Agency (IEA) has identified three main modes of cross-border energy integration:
 - Bilateral
 - Multilateral
 - Unified



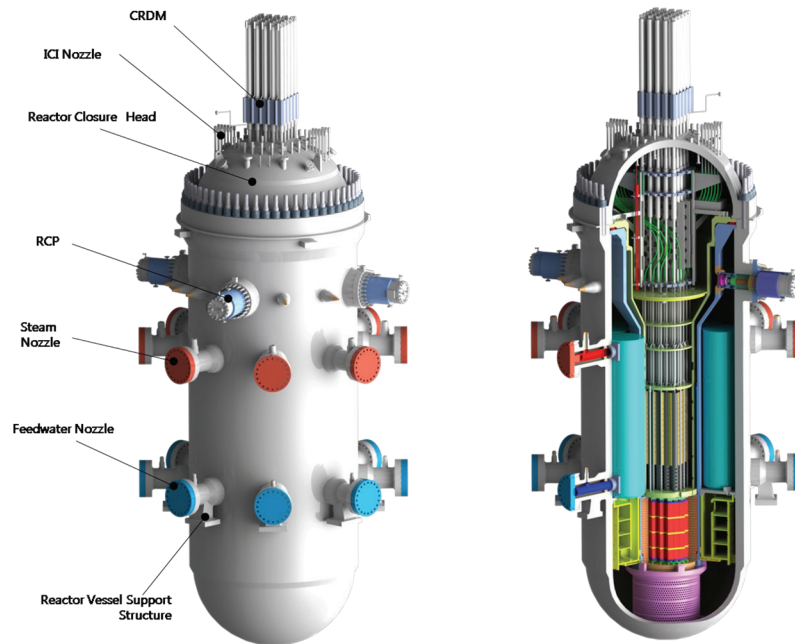
Advanced Nuclear Technologies

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

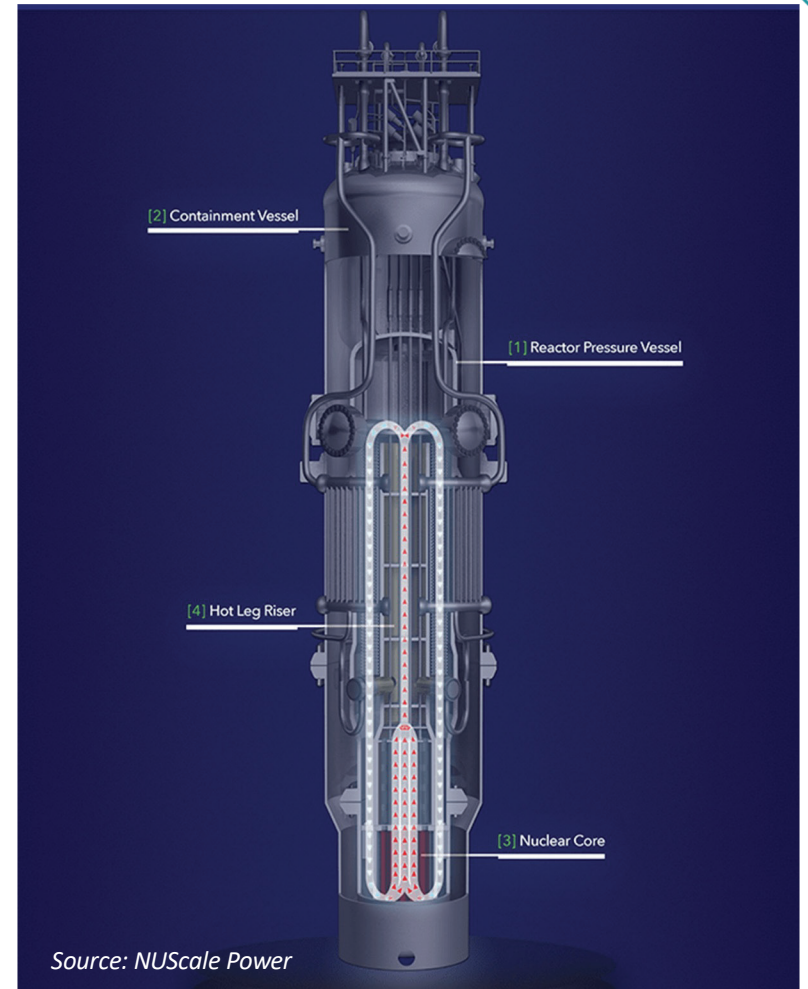


Small Modular Reactors (SMR)



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

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Source: NUScale Power

So, What is the Bottom Line?

Diverse solutions to address climate change

- Efforts in the electric power sector to replace 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?



Thank you.

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