

# 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.

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[climate-change.ieee.org](http://climate-change.ieee.org)

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The screenshot shows the homepage of Climate-change.ieee.org. At the top, there is a banner with the text "MAKING A DIFFERENCE" and several images related to renewable energy and infrastructure. Below the banner, there are three main sections: "TECHNICAL INITIATIVES", "POLICIES", and "CLIMATE CHANGE INITIATIVES". The "CLIMATE CHANGE INITIATIVES" section is expanded, showing a large image of a hand holding a globe over a green landscape, with text overlaying it. Below this image, there is a heading "The IEEE Climate Change Collection" and a brief description of its purpose. To the right of this section, there are two columns of icons and text: "PROVIDING TECHNICAL EXPERTISE" and "BUILDING TECHNICAL COMMUNITY". The "PROVIDING TECHNICAL EXPERTISE" column includes icons for "IEEE Xplore", "IEEE Standards", and "IEEE Conferences". The "BUILDING TECHNICAL COMMUNITY" column includes icons for "IEEE Member Societies", "IEEE Regional Activities", and "IEEE Digital Library". The bottom of the page features a footer with links to "Climate Change Home", "Contact Us", "About Us", and "Log In".

- 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

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## 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



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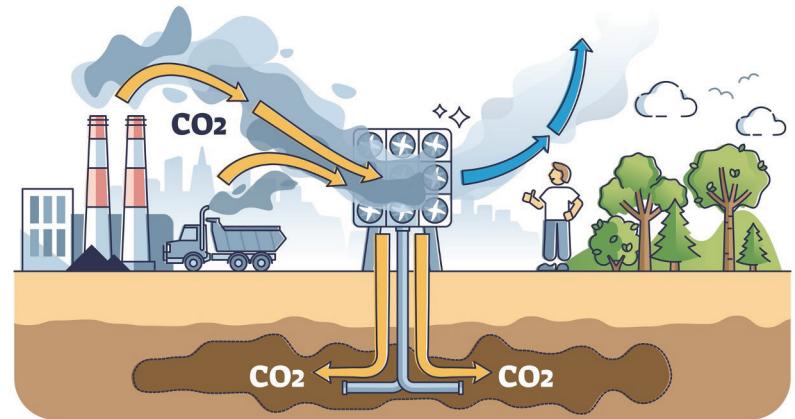
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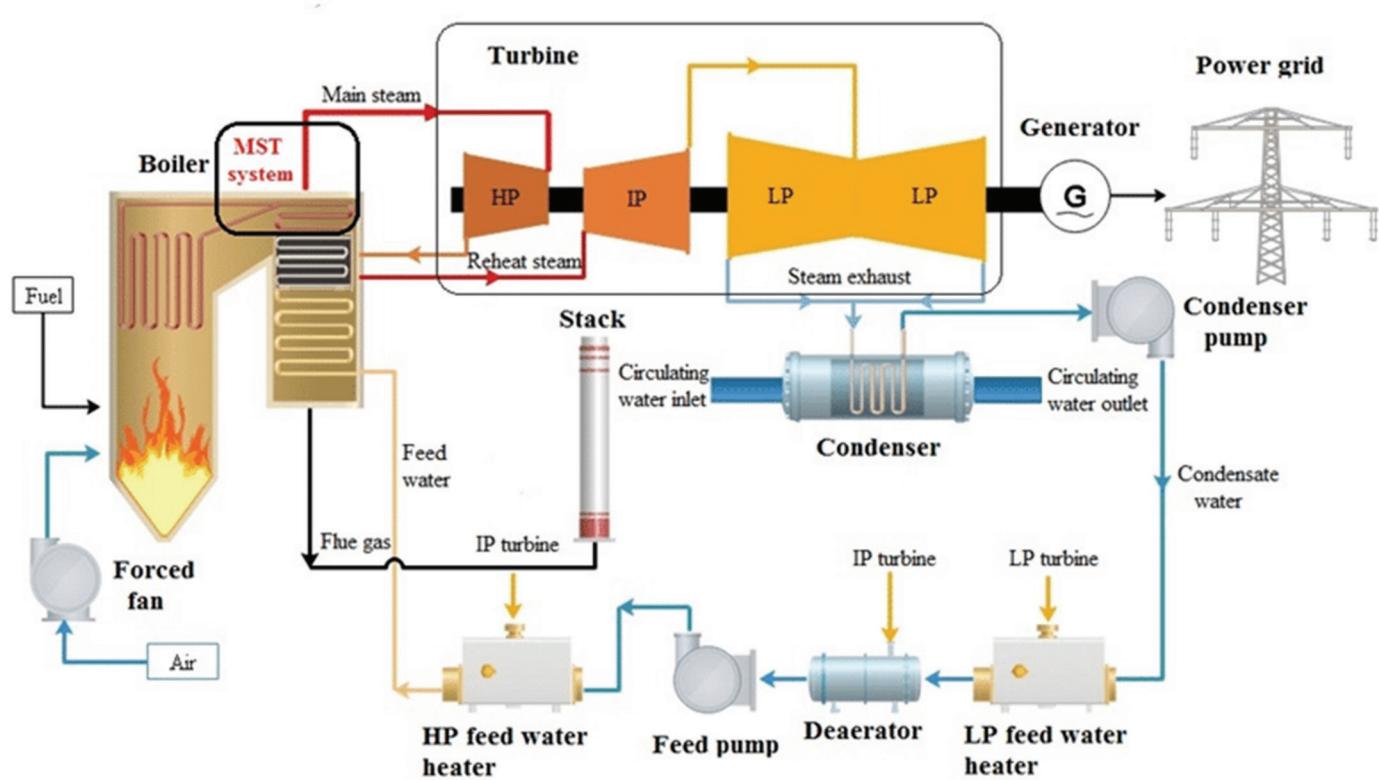
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## Carbon Capture & Storage Systems (CCS)

- 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



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Source: [https://www.researchgate.net/publication/343169041\\_An\\_Efficient\\_Robust\\_Predictive\\_Control\\_of\\_Main\\_Steam\\_Temperature\\_of\\_Coal-Fired\\_Power\\_Plant](https://www.researchgate.net/publication/343169041_An_Efficient_Robust_Predictive_Control_of_Main_Steam_Temperature_of_Coal-Fired_Power_Plant)

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# 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

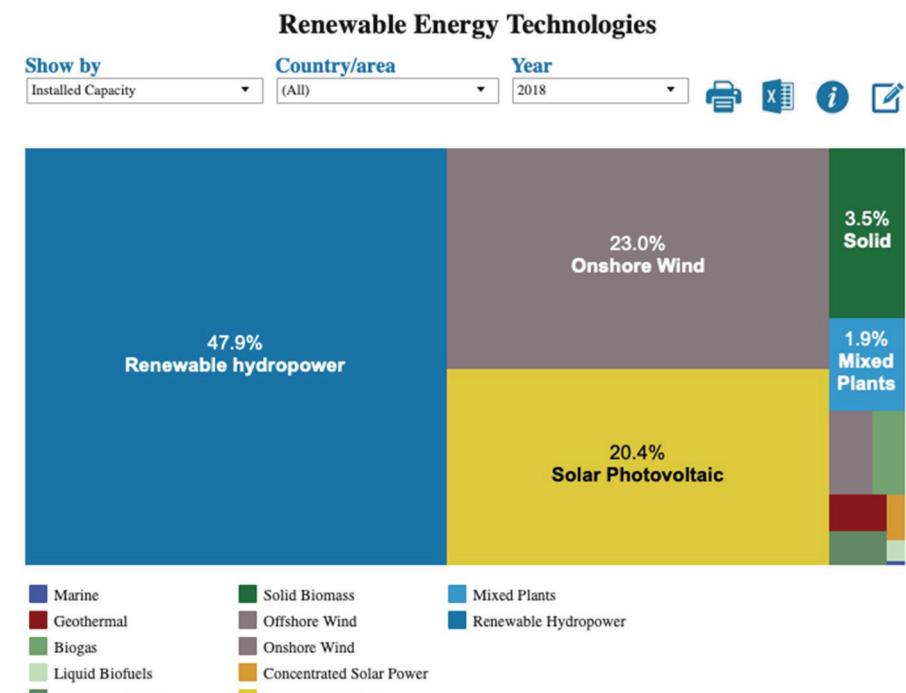
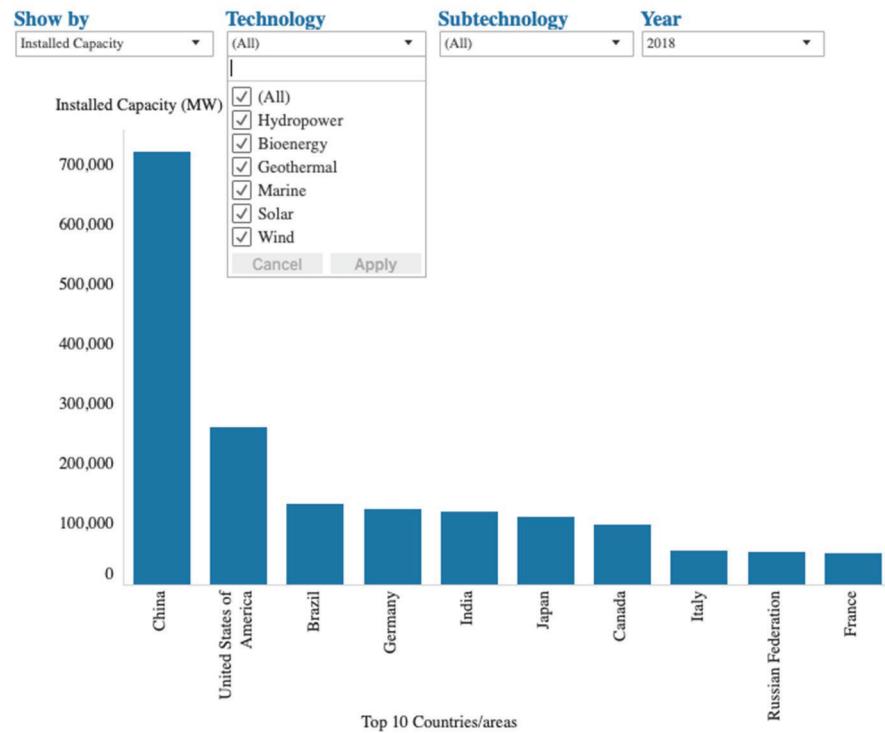
# Renewable Energy Integration

*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*

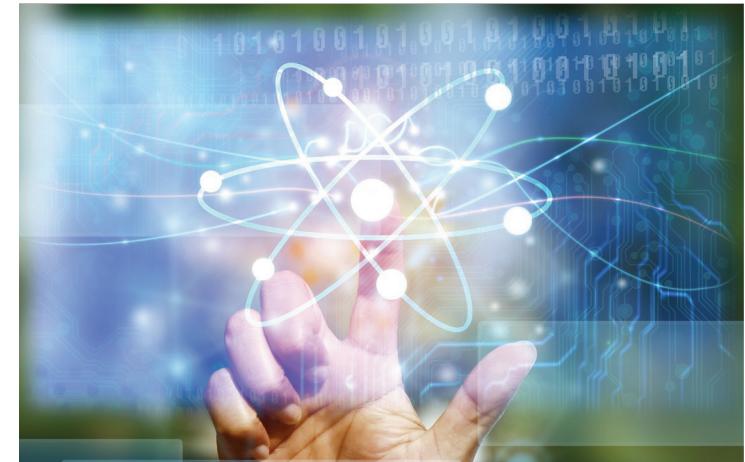
- As we are in this fight together, our solutions should be collaborative to secure better outcomes for all countries, regardless of location
- The International Energy Agency (IEA) has identified three main modes of cross-border energy integration:
  - Bilateral
  - Multilateral
  - Unified



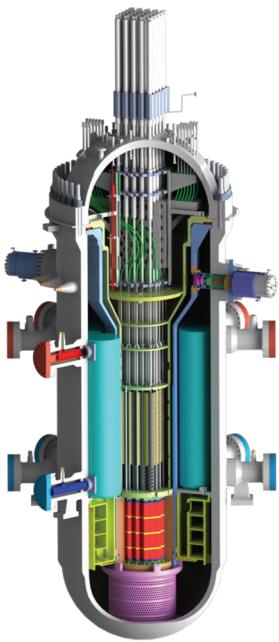
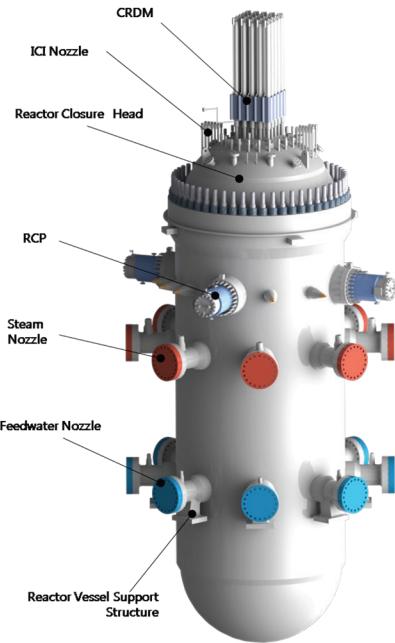
# Advanced Nuclear Technologies

*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



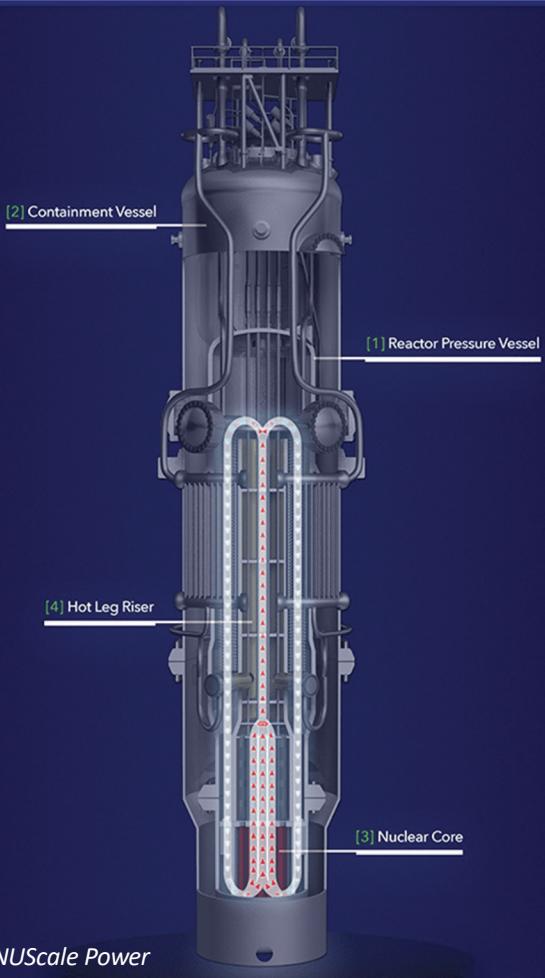
## Small Modular Reactors (SMR)



20m tall, 2.7m dia. 590 tons LWR

4.95% enrichment 50 – 60 MWe

[climate-change.ieee.org](http://climate-change.ieee.org)



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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