The Role of Nuclear Micro Reactors to Reach net-zero by 2050

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Outline

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- Challenges
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  - Global Carbon Emission
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  - Power Requirement by 2050
- Solutions
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- Future Development
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Method

- Study utilizes traditional analysis method that carries the publicly available information of various technical, non-technical documents, reports, talk and publications from International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA) and the International Energy Agency (IEA), and expert advisors of this field.
- The research carries calculations, comparisons and modeling to know the current power requirement and to provide future power requirement.
- All earlier document are analyzed and documented such as that can be helpful to make a potential use of Nuclear based Small Modular Reactor (SMRs) technology specifically Micro Reactor (MRs) technology in the clean energy transition.
- The study also emphasis various activities to spread awareness, and to provide clean energy solutions to the industries.

Introduction

- To Harness Efficient, Reliable and Sustainable Nuclear Energy.
- Utilization of Nuclear Power Plant Technology Specially Micro Reactor (MRs) Technology for the clean energy transition and achieving net zero emission by 2050.
- Increase Nuclear Power Plant Technology for wide range of Applications to reduce carbon emission as committed in the Global Climate Change Summit at Paris in 2015.
- Micro Reactor technology is in research and underlines by International licensing agencies to provide an ecosystem from nuclear supply chain to Waste Disposal.
- To harmonize MRs regulation to prepare for international safeguards and to de-risk MR projects for attracting investment from private entities.
- Easy to Manufacture, Assemble, Install and Commission for Long Power Requirement
- Provide Consistent, Clean, High base and Carbon free Electricity to all remote place and clean industrial energy use.

Challenges (Micro Reactor)

- Technological Challenges
  - Energy Storage and Grid Connectivity: Remote Power Generation is possible that mitigates storage and grid connectivity issue.
  - Domestic and Industrial Applications: Wide Range of Peaceful Power and Non-power Application for a Developing Country.
  - Carbon Capture and Storage (CCS) System: Additional Development for Carbon capture system that directly captures carbon from the atmosphere or other processing.
- Non-Technological Challenges
  - Initial Investment and Cost: Initial Development cost is high but further capital cost is less compare to large-scale power plant.
  - Policy and Regulation: A little Change and Support in Policy and Local governance to address this global climate without any national disputes and concerns.
  - Long-Term Sustainability: It has long-term and sustainable nuclear material availability.
  - Social Challenges: Spread awareness to adopt the social change.

Other Challenges (Renewable Energy)

- Carbon Emission
  - Low Carbon Residue and High base Electricity over other renewable energy sources
- Size
  - Large space requirement to generate electricity from current Renewable Energy Sources to fulfill current power requirement (Solar, Wind, Hydro, Geothermal)
- Safety & Security
  - Two Different terms to optimize risk and to provide consistency for longer period
- Time
  - A few months timing for other renewable source and around 7-10 years for Large Nuclear reactor to build same capacity requirement
- Cost
  - Longer the product development time will increase cost of your product
- Application
  - Remote location and Grid Power loss is high and can be quite less.

Global Carbon Emission Issue

Paris Conference Agreement
15th Dec, 2015
to
Reduce Carbon Emission
and
Global Commitment to Reach

Net Zero By 2050

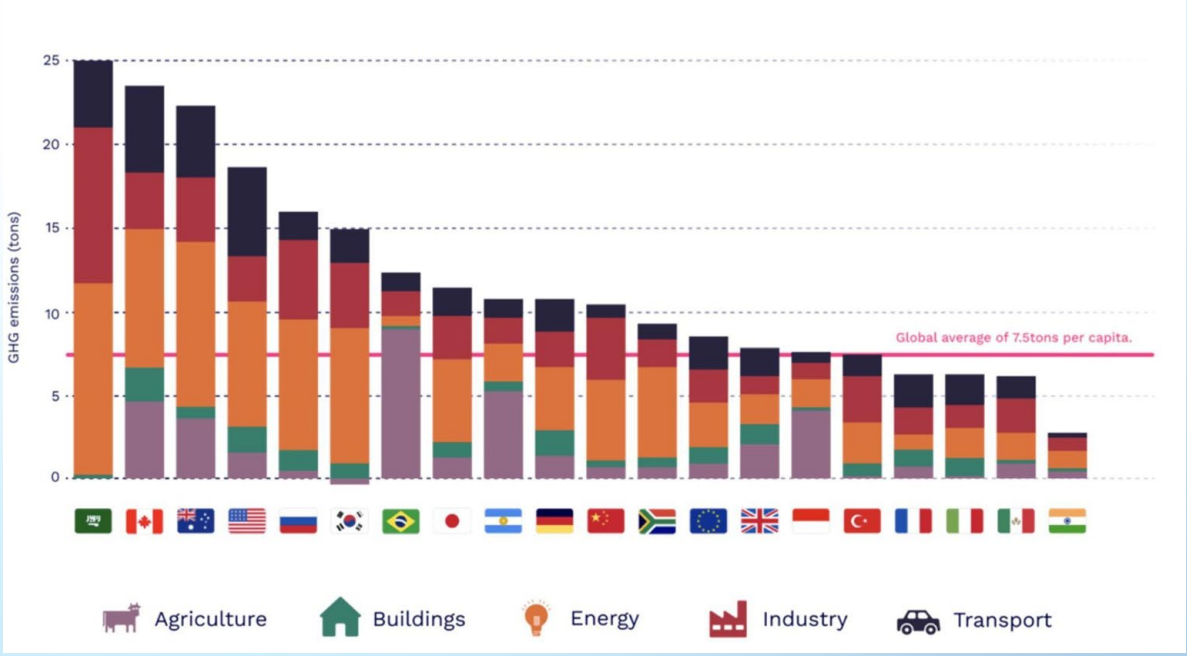
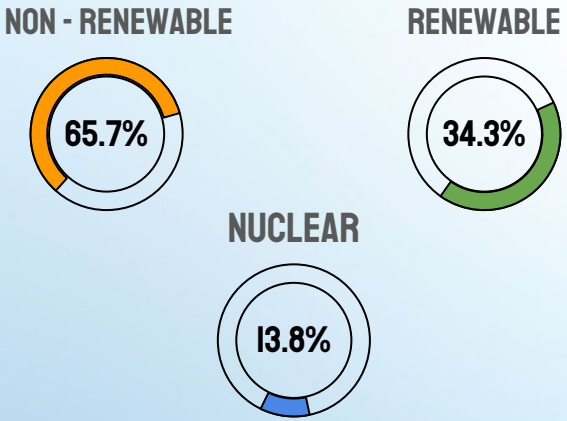


Fig. Global Co2 Emission of various industries

Global Energy Production



Total Power Generation

28,000 TWh

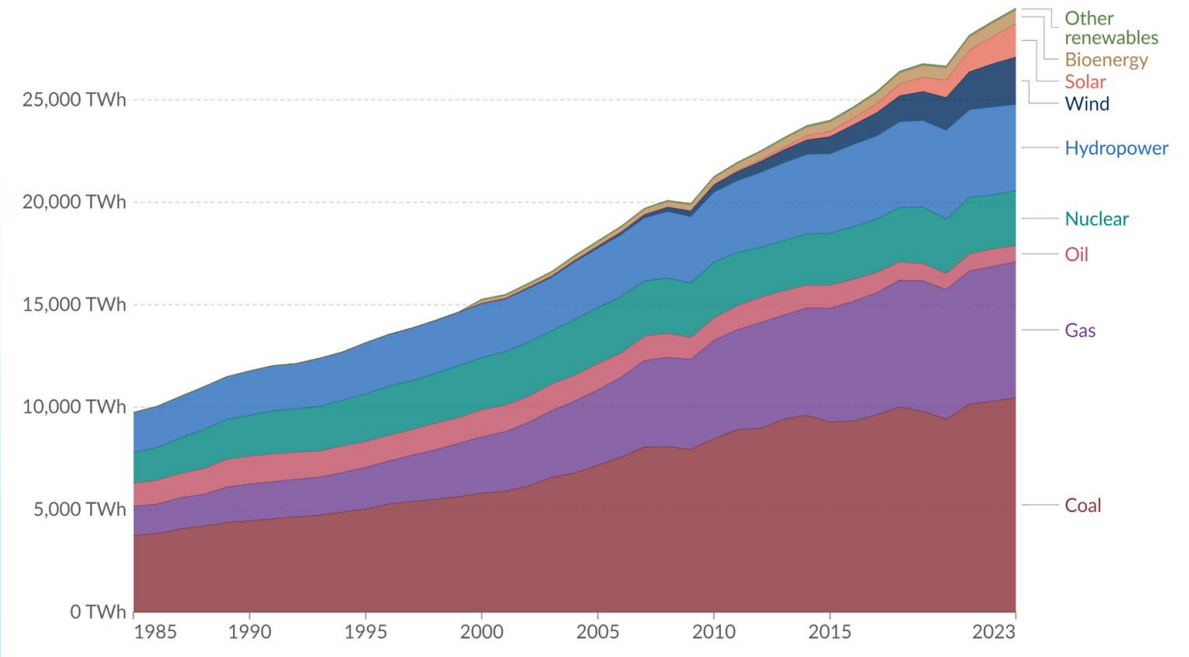
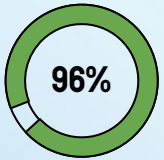


Fig. Global Electricity Production by source 2023

Power Requirement By 2050

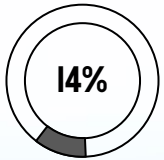
RENEWABLE



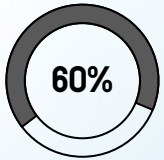
Power Requirement

72,000 TWh

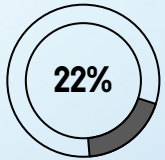
NUCLEAR



SOLAR PV



OTHER RE



NON - RENEWABLE

For 1 MW SOLAR PV 3.5 ACRE LAND is required

151,200,000,000 ACRE LAND
required for 43,200 TWh (43,200,000,000 MWh)

Earth has only

1,260,000,000 ACRE LAND

Our Global CO2 Emission Commitment

Solution

- **Requirement for Nuclear Energy**
  - High-Base Electricity with Sustainable Energy Production
  - Three types of Nuclear Power Plants
    - Large-scale nuclear reactors that generate more than 300 MW of electricity,
    - Small Modular Nuclear Reactors that generate electricity from 20 MW to 300 MW
    - Micro Reactors that generate up to 20 MW of electricity.
  - All nuclear power plant types have their benefits and limitations but only Micro Reactor seems Promising to achieving net-zero carbon emissions.
- **Role of Micro Reactor**
  - Advance Factory Manufacturable Design and scope for Large-scale Production.
  - Remote Grid connection reducing transmission loss and GHG emissions efficiently.
  - Low space requirement by Micro Reactors over the other traditional energy production.
  - Wide Range of Application in glass, steel, aluminum, other metal refineries, transportation, military, and other relevant applications.

Scope of Micro Reactor Development

- Flexibility: A small-sized Micro Reactor that can be easily fabricated and installed in various remote locations.
- Scalability and Modulation: Customisable and Scalable Micro Reactors Development to make Small Modular Reactors from Micro Reactor
- Cost-Effectiveness: Large Scale Manufacturing cost will be lowest compared to large-scale reactors.
- Safety: Advanced, Inherent and Passive Safety Systems.
- Environmental Impact: Zero Carbon residue with high power requirements.

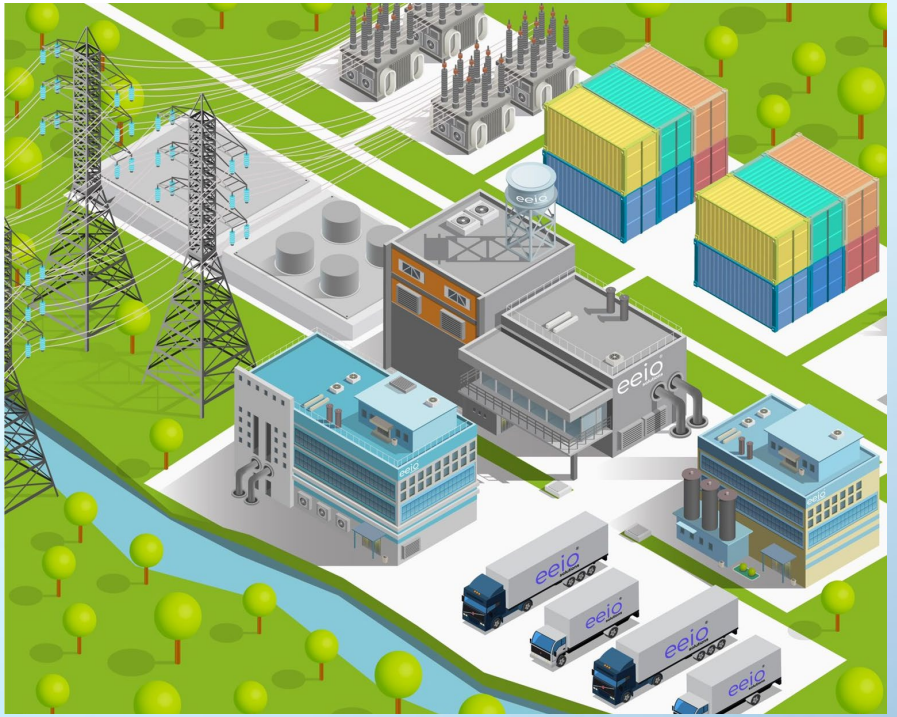


Fig. Overview of Eeio Micro Reactors

Scope of Micro Reactor Development

Micro Reactors with power upto 10 MW are designed and developed to meet the demand of heavy industry workloads and helping them to reduce the carbon footprint along the way. Company also suggest the Modular Micro Reactor to make Small Modular Reactor that includes power requirement up to 300 MW with zero carbon Emission.

- Size
  - Micro Reactors are compact in size and has high base electricity generation
- Safety & Security
  - It is added with the advanced autonomous system to protect it from the various incidents.
- Time
  - Micro Reactors are fabricated in the Workshop so the construction time will be up to 1 year
- Cost
  - Associated cost will be drastically down as it can be produced in Large scale Production.
- Application
  - The product can be sent to any remote location with wide power application

Future Developments

- Nuclear Micro Reactors Ecosystem design and development
  - Limited knowledge of Nuclear Industries as there is a shortfall of Nuclear Experts
- De-risk Micro Reactor Project development
  - Government opens this sector to encourage Private Companies and Startups
- Clean Energy Transition - Steps to achieve net zero carbon emission by 2050
  - Nuclear Micro Reactors can be deployed to various industries and government entities with high energy demand and high carbon emission.
  - All Renewable Energy field needs to be boosted to achieve net zero by 2050
- Policy and Regulations
  - Domestic Regulation changes required with International Co-operations.
- Limited availability of Venture capitalist for this sector.
  - Public Awareness is low
  - Test and Validation takes long time

Conclusion

- In the adoption of clean energy, there are plenty cleaner energy options to move our carbon emission to the net zero.
- All nations have announced their clean energy options to achieve net zero emissions.
- International Energy Agency has a forecast for reducing fossil fuel and double the global nuclear power capacity by 2050 in their net zero emission scenario.
- Nuclear power can play a major role in the renewable energy contribution for availing the high base load power and grid balancing.
- Current nuclear reactor Innovation provides inherent safe and cheap technology with recently concepted Small Modular Reactors (SMRs) and Micro Reactors(MRs) designs to give access for clean energy.
- This triggers everyone to rethink their understanding about the nuclear energy vs their current energy goals.

Conclusion

- SMRs and MRs can be installed to remote off-grid locations like mountains, forest, etc. It also plays a crucial role to achieve clean energy transition goals effectively.
- Most recent concept of Micro Reactor (MRs) will change the vision of every community in such a way to feel the advantages of controlled and optimized safety, size, time and cost of this reactor for a potential deployment in the various locations.

- Eeio Solutions is an Ahmedabad based start-up company working on Micro Reactors development to set a global benchmark. Our Company is the first private Indian company to conceptualize and design their Micro Reactor system to be part of change for achieving net zero emission goal.

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Questions ?

Thank You

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Contact us for updates

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Appendix

Greenhouse gases Calculation Method:

- GHG emission = 0.001 * Fuel Usage * High heat value *Emission factor.

Solar PV Surface Calculation :

- Total Power Output = Total Area x Solar Irradiance x Conversion Efficiency.
  1KW = 1000 Watts = Total Area x 1000 Watts/m2 x 0.18
  Total Area = 1000/180 = **5.56 m2**
- For, 1 MW = 1000 KW = **5560 m2** Surface Area

Solar PV Land Calculation

- Land Required = Surface Area x 2.5 m2 = 5560 m2 x 2.5 m2 = 13,900 m2
- Total Land Required = 13,900 m2 / 4046 m2 = **3.43 Acre**