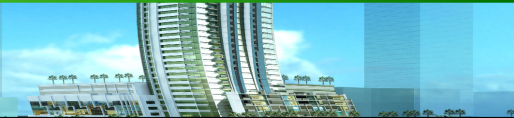


BEYOND
SMART CITIES

ENERGY SIMULATION OF HIGH PERFORMANCE GREEN BUILDINGS
FOR ENERGY AND GREEN BUILDING SPECIALISTS
KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM



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SMART CITIES

ENERGY ISSUES AND POLICY
FOR ENERGY AND GREEN BUILDING PROFESSIONALS
KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
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LEARNING OBJECTIVES



- India is making energy security a priority
- Significant progress in sustainable development
- Energy technology and innovation enables "Make in India"
- Towards more robust energy data and policy governance
- Energy and climate policy
- Key recommendations
- Climate change
- The Paris Agreement



ENERGY SECURITY

With a population of 1.4 billion and one of the world's fastest-growing major economies, India will be vital for the future of the global energy markets.

The Government of India has made impressive progress in recent years in increasing citizens' access to electricity and clean cooking. It has also successfully implemented a range of energy market reforms and carried out a huge amount of renewable electricity deployment, notably in solar energy.

Looking ahead, the government has laid out an ambitious vision to bring secure, affordable and sustainable energy to all its citizens.

This in-depth review aims to assist the government in meeting its energy policy objectives by setting out a range of recommendations in each area, with a focus on energy system transformation, energy security and energy affordability. The review also highlights a number of important lessons from the rapid development of India's energy sector that could help inform the plans of other countries around the world.



INDIA IS MAKING GREAT STRIDES TOWARDS AFFORDABLE, SECURE & CLEANER ENERGY

Ensuring Indian citizens have access to electricity and clean cooking has been at the top of the country's political agenda. Around 750 million people in India gained access to electricity between 2000 and 2019, reflecting strong and effective policy implementation.

The IEA highly commends the Government of India for this outstanding result and supports its efforts to shift the focus towards reaching isolated areas and ensuring round-the-clock reliability of electricity supply.

The government of India has also made significant progress in reducing the use of traditional biomass in cooking, the chief cause of indoor air pollution that particularly affects women and children.

The government has encouraged clean cooking with liquefied petroleum gas. India continues to promote cleaner cooking and off-grid electrification solutions, including a shift toward using solar photovoltaics (PV) for cooking and charging batteries.



MAJOR ENERGY REFORMS LEAD TO GREATER EFFICIENCY

The IEA commends India for its continuous pursuit of market opening and greater use of market-based solutions through ambitious energy sector reforms. Increased access to affordable energy has raised the living standards of all segments of the population.

The IEA welcomes the government's decisions to allow private-sector investment in coal mining, and to open up the country's oil and gas retail markets. The creation of functioning energy markets will ensure economic efficiency in the management of the coal, gas and power sectors, which is critical to achieving energy security and supporting the country's economic growth. This will be increasingly important in the future, as energy demand and investment needs increase in line with India's economic expansion.

The government is working to improve the financial viability of the power sector. Faced with the challenge of some "stressed assets" in coal and gas-fired generation, it has been implementing a package of measures to enhance the economic efficiency of coal and gas supply for power generation and the availability of finance. The creation of a competitive wholesale power market will be vital for improving the utilisation of India's generation capacity.



INDIA IS MAKING ENERGY SECURITY A PRIORITY +

India's electricity security has improved markedly through the creation of a single national power system and major investments in thermal and renewable capacity. India's power system is currently experiencing a major shift to higher shares of variable renewable energy, which is making system integration and flexibility priority issues. The Government of India has supported greater interconnections across the country and now requires the existing coal fleet to operate more flexibly. It is also promoting affordable battery storage.

International experience suggests that a diverse mix of flexibility investments is needed for the successful system integration of wind and solar PV. This flexibility is available not only from the coal fleet – it can also come from natural gas capacity, variable renewables themselves, energy storage, demand-side response and power grids. Many of these solutions are not yet fully utilised in India.

To fully activate a diverse set of flexibility options, it is critical for the government to put in place electricity market reforms that enable the appropriate price signals and create a robust regulatory framework.

INDIA IS MAKING ENERGY SECURITY A PRIORITY +

To improve oil security, the government has prioritised reducing oil imports, increasing domestic upstream activities, diversifying its sources of supply and increasing Indian investments in overseas oil fields in the Middle East and Africa. Commendably, India is promoting domestic production with a major upstream reform, the Hydrocarbon Exploration and Licencing Policy (HELP), and is progressively building up dedicated emergency oil stocks. India's strategic petroleum reserve supplements the commercial storage available at refineries.

The government aims to increase the share of natural gas in the country's energy mix to 15% by 2030, from 6% today. The IEA welcomes this ambition, which would allow India to improve the environmental sustainability and flexibility of its energy system. Increasing domestic gas production has been a key government priority, as output has unexpectedly come in below forecast levels over the past few years. India has five operating terminals for liquefied natural gas. Projects under construction could result in up to 11 additional terminals over the next seven years.

SIGNIFICANT PROGRESS IN SUSTAINABLE DEVELOPMENT

India has made important progress towards meeting the United Nations Sustainable Development Goals, notably Goal 7 on delivering energy access. Both the energy and emission intensities of India's gross domestic product (GDP) have decreased by more than 20% over the past decade. This represents commendable progress even as total energy-related carbon dioxide (CO₂) emissions continue to rise. India's per capita emissions today are 1.6 tonnes of CO₂, well below the global average of 4.4 tonnes, while its share of global total CO₂ emissions is some 6.4%.

India is an active player at international fora in the fight against climate change. The country's Nationally Determined Contribution under the Paris Agreement sets out targets to reduce the emissions intensity of its economy and increase the share of non-fossil fuels in its power generation capacity while also creating an additional carbon sink by increasing forest and tree cover.

Although the emissions intensity of India's GDP has decreased in line with targeted levels, progress towards a low-carbon electricity supply remains challenging.

SIGNIFICANT PROGRESS IN SUSTAINABLE DEVELOPMENT +

India has been addressing energy-related environmental pollution since the 1980s, including air, water, land and waste issues. Reducing the health impacts of air pollution is a key priority. Over the years, the government has been progressively strengthened rules to combat air pollution, and adopted the National Clean Air Programme (NCAP), which focuses on monitoring and enforcement.

Real progress on the ground has so far been limited, with the deadline for the enforcement of stringent air pollution standards for thermal power plants pushed back from 2017 to 2021/22. However, the implementation of the NCAP is expected to help improve this issue.

India is particularly vulnerable to climate change impacts and is exposed to growing water stress, storms, floods and other extreme weather events. Adaptation and resilience of the energy system to these extreme climate conditions should be a high political priority. Furthermore, the energy sector is a large water user. As India's energy demand continues to grow, the government should ensure that energy planning takes into account the water- energy nexus, as well as future space cooling needs.

ENERGY TECHNOLOGY & INNOVATION ENABLES "MAKE IN INDIA"

Energy research, development and deployment (RD&D) can be a strong enabler of India's energy policy goals while also contributing to broader national priorities such as the "Make in India" manufacturing initiative. Through the initiative, the government is working to attract global companies to produce solar PV, lithium batteries, solar charging infrastructure and other advanced technologies in India. The government is strengthening its innovation efforts in a broad range of energy technology areas, including cooling, electric mobility, smart grids and advanced biofuels.

India's innovation-specific policy support have been important in driving energy technology development. As part of its climate policy agenda, the government has pursued a mission- based approach in many policy areas, including solar, water and energy. India has also been a leader in Mission Innovation and other multilateral collaborations, including the IEA Technology Collaboration Programmes. Recent years have shown a marked increase in clean energy RD&D funding, especially as India works to double its spending over five years under Mission Innovation. However, funding efforts are spread both thinly and widely across the government and its public sector companies.

TOWARDS MORE ROBUST ENERGY DATA AND POLICY GOVERNANCE

Under the leadership of the prime minister, NITI Aayog fulfils an inter-ministerial co-ordinating role for national energy policy. A number of different ministries have responsibility for separate components of the energy sector. As energy policies become more intertwined, it is becoming increasingly desirable to strengthen co-ordination and develop a framework for the government's long-term energy agenda.

This is particularly needed to create visibility for all stakeholders in the energy sector. The draft National Energy Policy by NITI Aayog, currently under consultation, is an excellent framework and should be adopted swiftly to guide policy making, implementation and enforcement across central and state governments.

Good quality and timely energy data are vital for monitoring, reviewing progress and enforcing the implementation of energy policies. The government has identified the critical importance of energy data and is taking action to improve their collection and dissemination. The IEA welcomes recent progress in the bilateral relationship between India and the IEA on energy statistics, which has led to the creation of cross-ministerial working groups co-ordinated by NITI Aayog.

KEY RECOMMENDATIONS - THE GOVERNMENT OF INDIA SHOULD:

- ✓ Establish permanent energy policy co-ordination in the central government, with an overarching national energy policy framework to support the development of a secure, sustainable and affordable energy system.
- ✓ Continue to encourage investment in India's energy sector by:
 - ensuring full non-discriminatory access to energy transport networks
 - working with the states to implement power sector and tariff policy reforms with a focus on smooth integration of variable renewable energy and power system flexibility
 - moving from government allocation of energy supplies to allocation by market pricing
 - further rationalising subsidies and cross-subsidies.
- ✓ Prioritise actions to foster greater energy security by:
 - reinforcing oil emergency response measures with larger dedicated emergency stocks and improved procedures, including demand restraint action and proper analysis of risks by using oil disruption scenarios and capitalising on international engagement
 - strengthening the resilience of India's energy infrastructure, based on a robust analysis of the water-energy nexus and cooling demand, notably when planning future investment.

KEY RECOMMENDATIONS - THE GOVERNMENT OF INDIA SHOULD:

- ✓ Improve the collection, consistency, transparency and availability of energy data across the energy system at central and state government levels.
- ✓ Adopt a co-ordinated cross-government strategy for energy RD&D, which enables impact-oriented measurement and dissemination of results.
- ✓ Ensure India's international energy collaboration continues to be strong and mutually beneficial, highlighting the country's energy successes and supporting continued opportunities to learn from international best practices.

CLIMATE CHANGE

✓ Ozone layer depletion

- Ozone is highly reactive and easily broken down by man-made chlorine and bromine compounds.
- The ozone depletion process begins when CFCs (used in refrigerator and air conditioners) after several years, they reach the stratosphere by diffusion.
- Strong UV light breaks apart the ODS molecules. CFCs, HCFCs, carbon tetrachloride, methyl chloroform release chlorine atoms, and halons and methyl bromide release bromine atoms.
- It is the chlorine and bromine atom that actually destroys ozone, not the intact ODS molecule.
- It is estimated that one chlorine atom can destroy from 10,000 to 100,000 ozone molecules before it is finally removed from the stratosphere

CLIMATE CHANGE +



✓Global warming

- Over the last 100 years, it was found out that the earth is getting warmer although in the previous 8000 years temperature has been relatively constant.
- The present temperature is 0.3 - 0.6 °C warmer than it was 100 years ago.
- The key greenhouse gases (GHG) causing global warming is carbon dioxide. CFC's, even though they exist in very small quantities, are significant contributors to global warming.
- Fossil fuel combustion, world energy use has emerged at the center of the climate change debate.

CLIMATE CHANGE +



✓Loss of biodiversity

- Biodiversity refers to the variety of life on earth, The number of species of plants, animals, micro organisms, the enormous diversity of genes in species
- The World Resource Institute reported the link between biodiversity and climate change.
- Rapid global warming can affect ecosystems chances to adapt naturally.
- Over the past 150 years, deforestation has contributed an estimated 30 percent of the atmospheric build-up of CO2. It is also a significant driving force behind the loss of genes, species, and critical ecosystem services.

CLIMATE CHANGE +



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THE PARIS AGREEMENT

✓The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016.

✓Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels.

✓To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century, achieve a climate neutral world by mid-century.

✓The Paris Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.



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