



# Futuristic Growth Of India Towards Sustainable Development For Economic Resilience

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## Abstract

One of the developing nations with the fastest-growing economies is India. By using smart houses and smart city technologies, the entire city may be managed in terms of water, heat, and electricity. Hardware and software businesses continue to update at a significant and quickening rate. The main areas of attention include robotics, IoT, advanced production of materials, green computing, quantum computing, and climate change adaptation technologies. In 2047, when software technology dominates the globe, software development has undergone a radical transformation. An unparalleled rate of advancement is being made in several convergent areas. One of the biggest challenges to humanity is climate change, which is brought on by human-caused global warming. Global net carbon emissions due to human activity would need to decline by 2030 and reach net zero emission through green financing by roughly 2047 to keep global warming to 1.5 °C. The ongoing development of the hydrogen economy in India in terms of three dimensions namely production, storage, and commercialization. Hydrogen will be essential in decarbonizing the Indian economy by 2047 due to its adaptability. By 2020, an operational hydrogen economy was planned according to India's hydrogen energy strategy. Rapid advancements in digital technology have sparked new industrial revolution phenomena known as Industry 4.0. Modern technologies introduced in this revolution facilitate the interconnection of all components across sectors, especially in the Energy Transition that helps to improvise the economy after the post covid.

**Keywords:** smart city, net zero, hydrogen economy, industry 4.0, green finance.

## Introduction

The World is run by Software Industries like healthcare and the auto sector is being completely transformed by software. All sectors are heavily reliant on IT, software, and electronics for innovation. Products

and solutions need to fulfill an increasing number of standards while also being affordable, conveniently flexible, and able to take advantage of established and new industry platforms with aspirations for improved air quality, sustainable development, and climate change mitigation, India has an economy that is quickly growing. Each of these objectives has particular difficulties to overcome, and there may be trade-offs among them.

The key determinants of the nation's economy are agriculture, production, and services. India is an agriculture-based nation, with that being the major aspect in the year 1947; but, in following years, it would place a greater emphasis on production and services. Before 2030, India will have a two-digit GDP. This paper (Christof Ebert and Steve Counsell, 2017) examines the products and solutions needed to fulfill an increasing number of standards while also being affordable, conveniently flexible, and able to take advantage of established and new industry platforms. New rivals are entering the market with innovative products that, in certain circumstances, get around the reliance on antiquated technologies. The amount of electrically enabled functions has increased dramatically during the last few decades.

This article ((Karthick, A. V., et al., 2014, 2022, 2019) portrays Machine Learning, Big Data, Cloud Computing, and Information Theory are all disciplines that are combined to form the multidisciplinary area of artificial intelligence. The main benefit of machine learning is that it builds on existing knowledge, enabling machines to learn for themselves and make accurate predictions. It is a method of decision-making that is used in many industries, including social media, healthcare, and finance. The amount of data in Big Data and Cloud Computing is always growing and is handled with the aid of machine learning in a way that uses less energy. One of the rapidly growing areas of computer science and information technology is cloud computing. Businesses are using digital technology more and more, which has brought attention to the value of cyber security as a new type of risk. Every library in the world now offers e-content learning, one of the cutting-edge information system-based learning environments.

This paper (Hanne Kauko et al., 2023) discloses the there was through energy-saving measures, the deployment of heat pumps, and the use of alternative energy sources for heating, this rise might be partially prevented. Norwegian electricity consumption might be significantly reduced by reducing energy provided to buildings and increasing the usage of district heating, which would also enhance the flexibility of the energy system when the grid is at its busiest.

(Shuliang Ren et al., 2022) the paper portrays that End-of-life vehicles (ELVs) provide both possibilities and difficulties for protecting the environment and conserving resources. A mismatch between recycling capacity and demand including overcapacity and under-capacity has been created in China as a result of the recycling industry's unchecked and disorderly development, with detrimental effects including resource waste and environmental degradation. It is crucial to analyze spatiotemporal trends and assess the matching of recycling capacity to support sustainable growth.

This article (Lishan Yang et al., 2023) summarizes the accurately quantifies the carbon emission path by taking uncertainty factors into account, such as the demand for transport in the post-COVID-19 pandemic

period, identify gaps between this path and emission reduction targets, and provide mitigation measures to reduce aviation's carbon emissions. However, based on the ideal emission scenario, China would need to lower its emissions by around 82% to 91% to meet the net-zero carbon emissions objective for global aviation. In light of the global net-zero aim, China's civil aviation sector will be under intense pressure to cut emissions. The most effective strategy to cut aviation emissions by 2050 is to adopt sustainable aviation fuels. To facilitate China's civil aviation industry's contribution to reducing climate change, it will also be necessary to develop a new generation of aircraft that introduces new materials and upgrading technology, implement additional carbon absorption measures, and use carbon trading markets.

## Review of Literature

For a long time, historians have cautioned us about making predictions, especially those involving communication technologies. This paper (Ran Wei, 2022) shows the adoption of mobile phone technology appears to be an exception, though. The projections were incorrect, but not in the way that was anticipated. Global adoption of mobile phones happened far more quickly than anticipated. Mobile phones and other gadgets are currently regarded as the fastest-disseminating technology in human history, according to a saying. More crucially, significant technological advancements brought about by increased audio and video capacity on 4G networks have ushered in two-way live chatting as well as other big increases in audio and visual content in mobile communication. One may perform live programs such as streaming broadcasts or podcasts using an iPhone. TikTok, a widely used social network for sharing videos, serves as an illustration of the kind of video-centric services and applications made possible by 4G networks. It is important to remember that mobile users measured in millions are the ones who are defining and rethinking how mobile media are utilized as resourceful tools for carrying out everyday activities, staying in touch with loved ones, and finding entertainment whenever and wherever.

The current image of smart home technology is that it is mostly employed by 'tech-savvy' consumers with bigger expenditures. However, you can manage the electricity, heat, and water in your entire house with smart home technologies. This study (Alaux, Nicolas, et al., 2023) explores the potential of smart home technology to help the government achieve its climate change goals and to lessen a house's negative environmental effects by lowering carbon emissions. There is an urgent need to examine the relationship between the construction industry and its environmental impact in terms of greenhouse gases and air pollution because it is responsible for 50% of the energy demand and around 50% of the greenhouse gas emissions. The literature has looked at a variety of tactics to deal with operational emissions, which are often the largest contribution to overall emissions, to minimize the greenhouse gas (GHG) emissions of buildings. As a result, embodied emissions are receiving more attention, both as a result of the relative proportion of operational emissions declining and as a result of the rising demand for raw materials, such as the use of more thermal insulation in buildings. The decarbonization of the electrical system is one of these measures that may assist reduce embodied emissions in building materials. Future manufacturing technologies can be considered as a



long-term investment since larger mitigating impacts would start to show up in the 2040s and 2050s. Critical analyses of renewable energy sources and carbon capture and storage also draw attention to the inherent difficulties of such important technology.

This paper (Rezaei, Nima, et al., 2023) narrates the perspectives on cognitive semiotics as a combined field of science in 2050, along with thinking abilities like computational thinking, scientific thinking, and critical thinking, early childhood education and its significance in developing a new intelligence and social and emotional learning; the role of the arts in education and preparing students for systems thinking and thinking sustainability; future forms of education and learning; and the role of integrated science in this topic.

This paper (Vats, Garima, et al., 2022) examines whether adequate opportunities exist for full decarbonization of the Indian energy sector and highlights where enough choices for full decarbonization by 2050 do not exist. The study suggests transformative levels of electrification, energy efficiency improvements, and a switch towards decarbonized fuels (largely green hydrogen, decarbonizes electricity, and bio-energy) as the three mainstays of India's decarbonization strategy that could plausibly shift the energy sector towards a net-zero emissions future. The study also indicates that the heavy freight and industrial sectors face challenges in achieving full decarbonization because of a lack of adequate technological solutions. Accordingly, residual emissions of about 1.3 gigatonnes in the system would require carbon sequestration options, including both technological and nature-based solutions, to achieve net-zero emissions. This study is expected to encourage further deliberations and deep dives into energy sub-sectors, which would benefit planners and policymakers in delineating India's sustainable energy transition strategy. As per the IEA (2021) report, although 44 countries and the European Union had pledged to fulfill a net-zero emissions (NZE) target by the end of the first quarter of 2021, a scenario-based assessment of this suggests that the temperature rise would still be in the order of 2.1 °C in 2100, even with a timely fulfillment of all these pledges. Carbon neutrality assessments have also gained significant traction in the past few years, albeit largely from a sub-sector or industry perspective.

## **Futuristic Growth towards Sustainability**

India's rapid population growth and steady industrialization mean that energy demand will grow in industry, transport, electricity, and cooling. Due to greenhouse gas emissions reduction targets, fossil fuels will be less preferred to meet energy demand and consumption. Significantly, the transport sector will move toward green fuels, including hydrogen. However, most hydrogen is now produced from fossil fuels through partial oxidation or steam reforming natural gas or coal gasification. This article (Kar, Sanjay Kumar, et al., 2023) examines the continuous progress of hydrogen regarding its production, storage, and commercialization in India. Given its versatility in nature, hydrogen shall play a crucial role in decarbonizing the Indian economy by 2050. India's hydrogen energy roadmap was envisioned for an operational hydrogen economy by 2020. The objectives of the hydrogen roadmap remained unfulfilled. We found that inadequate infrastructural developments, lack of proactive policies, insufficient investment in the hydrogen value chain, slow market

readiness, and a shortage of public awareness have contributed to the hydrogen economy's derailment in India. The proposed National hydrogen energy mission aims to revive India's hydrogen economy. Stakeholders should focus on hydrogen research, development, value chain development, and hydrogen technology commercialization.

Reducing the use of conventional biomass in buildings can bring primary emissions of carbonaceous particulates considerably below the levels of 2015. However, to significantly lower SO<sub>2</sub> and NO<sub>x</sub> emissions below 2015 levels, actions that are more aggressive than the existing plans would probably be needed. The pricing of greenhouse gas (GHG) emissions and the construction of natural gas infrastructure have the most effects on total changes to the energy system in comparison to the reference scenario among the single policy examples taken into consideration.

The highest decreases in air pollution concentrations and radiative forcing are caused by aggressive GHG policies and air pollution control, respectively. Ambitious GHG policies and air pollution reduction plans, however, vary in how much other policy goals they help or hinder. Applying GHG and air pollution control policies jointly can, at least in part, counteract forcing increases brought on by lower aerosols from ambitious air pollution regulations. (Brinda Yarlagadda et al., 2022). The built environment has the greatest potential for revolutionary climate action on a global scale. The construction industry is one of the most important end-use industries for a future free of carbon emissions. Building activities account for 28% of global greenhouse gas (GHG) emissions<sup>3</sup>, while embodied CO<sub>2</sub> emissions from materials and construction account for 11% (Figure 1), making up around 40% of total GHG emissions worldwide. The sector with the fastest rate of growth is the construction industry. Some of the best chances for lowering emissions are found in new construction and building renovations.

This paper (Reshma Singh, 2022) summarizes that buildings are an inherent home for rooftop solar, wind, energy storage in electric and thermal, and electric transport charging infrastructure, which makes the context for building decarbonization even more important. Reducing resource waste and using creative circularity are also huge opportunities. This article (Shreya Nivesh, 2022) shows the evaluation and distribution of water resources depend on an understanding of the resources that are available and the demands of people who utilize them. It is crucial to managing water resources effectively and rationally so that they may be divided among the many sectors of activity since agriculture, drinking water, animal husbandry, and industry are the key sectors that use the basin's water resources.

India, the fifth-largest economy in the world, depends on 20% of its GDP on agriculture and related industries. The agricultural industry includes many different tasks including clearing land, irrigating it, growing crops, harvesting them, and preparing food, among other things. Renewable solar energy has emerged as a leading energy source that may lessen the farmer's dependence on the usage of conventional energy sources to satisfy the country's present agricultural energy needs. Regular use of fossil fuels causes their depletion and results in significant CO<sub>2</sub> emissions into the atmosphere. By 2050, it is predicted that 4600 GW of solar energy systems deployed will prevent around 4 gigatons of CO<sub>2</sub> emissions annually.

As a result, solar energy is now acknowledged as one of the most promising renewable options for producing heat and power through solar technology for farming as well as numerous industrial activities. This paper (Ch. Mohan Sai Kumar et al., 2023) analyzes the current state, significance, accessibility, and use of solar energy technology in a variety of ongoing agricultural activities in India. Along with various restrictions on solar energy's widespread usage in India, this evaluation also emphasizes the socioeconomic significance, environmental effect, economic analysis, SWOT analysis, and future technical potential of its uses.

This paper (Mohd Irfan et al., 2023) portrays that Energy efficiency improvements are marketed as a practical strategy to cut the rising carbon emissions in the Indian transport sector. The panel stochastic frontier approach is used in this work to evaluate the energy efficiency of all modes of transport in India from 2000 to 2014. The long-term effect of energy efficiency improvements on carbon emissions is also examined using the panel fully modified least square (FMOLS) and panel dynamic ordinary least square (DOLS) estimators. The empirical findings point to an inverted U-shaped trend for land travel and a large rise in energy efficiency for air travel with higher instability. However, the trend in energy efficiency for water transportation only shows a minor uptick with nearly stable movement. The long-run effect reveals that a 1% increase in energy efficiency will reduce carbon emissions in the transportation sector by more than 1%, between 1.343 (FMOLS) and 1.665% (DOLS). Based on such findings, a few implications are discussed to achieve a low-carbon energy system. However, the energy efficiency trend for water transportation only exhibits a slight improvement with a movement that is essentially steady. This paper (V. Eyring et al., 2005) shows the long-term effect, a 1% gain in energy efficiency will result in a reduction in carbon emissions from the transport sector of between 1.343 (FMOLS) and 1.665% (DOLS), or more than 1%. A few consequences are addressed to establish a low-carbon energy system in light of these findings. First, impending legislation and compliance with future regulations through technical advancements are necessary for the development of credible future technology scenarios. In this paper (Liang, Xue, et al., 2022) the energy sector has been affected by digitization in the age of Industry 4.0 and how it relates to the Sustainable Development Goals. to decrease GHG emissions and boost energy efficiency in DCs. In addition, the impacts of waste heat recovery and LFG use on economics and sustainable development

This paper (Karthick, AV, and S. Gopalsamy, 2023) summarizes the role of technology in business resilience after the covid pandemic. Tensions and contradictions are amplified by the pandemic crisis, digital change, and sustainability dynamics that follow. Resources are needed to keep things running, but they should also be utilized to automate tasks, modernize technology, and keep people employed in places that appreciate them. With the right tools and techniques, digital organizations may develop into more sustainable enterprises by enhancing their transparency and accountability.

## Conclusion

With aspirations for improved air quality, sustainable development, and climate change mitigation, India has an economy that is quickly growing. Each of these objectives has particular difficulties to overcome, and

there may be trade-offs among them. Therefore, the unmet needs and shortages might be greatly reduced by introducing new irrigation technology, expanding agricultural practices on farms, and building water retention and conservation structures. India now ranks 130th on the Human Development Index, but by 2047 it will be inside the top 10. India must carefully consider its plans its energy transition over the subsequently few decades. Like every other country, India recognizes the need to pursue a sustainable development path and the need to contain global carbon budgets to levels that would contain temperature rise to well below 2 °C. To not just identify the primary fuels that should be further examined, this research aimed to investigate the feasible possibilities in the energy industry.

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