Viksit Bharat 2047: Transition from Gas-Based Energy to Renewable Energy for a Sustainable Future

Avnish Kumar Arora, *Devendra Kumar Gangwar, Saurabh Ahalawat*

Department of Chemistry, Vardhaman College Bijnor

How to Cite this Article:

Arora, A. K. (2026). Viksit Bharat 2047: Transition from Gas-Based Energy to Renewable Energy for a Sustainable Future. International Journal of Creative and Open Research in Engineering and Management, 02(03). https://doi.org/10.55041/ijcope.v2i3.236

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Abstract

The Viksit Bharat 2047 is the vision of how India will be transformed into a developed economy by the India 100-year independence anniversary. One of the aspects of this vision is the shift in gas-based energy systems into electricity-powered technologies in many areas of life like households, transportation, and industry. Gas fuels such as the liquefied petroleum gas (LPG) and natural gas are successful in this area but they also cause greenhouse gases and environmental pollution. A more efficient and cleaner option would be electrification by renewable sources of energy like solar and wind power. The rethinking of the way is what helps the country to drive the growth of the economy without the principles of carbon intensity and so, the country does not have to sacrifice environmental integrity in the name of achieving the prosperity. This paper discusses the significance of replacing gas with renewable energy sources, explains the electrification opportunities in the sector by sector, analyses the obstacles related to the shift, and explains the policy actions that are needed to facilitate the shift. The paper concludes that a renewable energy expansion coupled with electrification will be very instrumental in attaining sustainable development and energy security in India by 2047.

Keywords: Energy transition, Electrification, Renewable energy, Sustainable development, clean energy

1. Introduction

Viksit Bharat 2047 is a vision of India that outlines the multi-decadal efforts of the country to radically redesign the socioeconomic landscape of the country, with an aim of becoming a fully developed economy by the year 2047 the centenary year of Indian independence [1]. At the core of this change is the radical redesign of the national energy system which entails the calculated abandonment of conventional reliance on fossil fuels in favour of a "Green Frontier" based on high-efficiency electrical systems. Energy is a key element of economic growth and social advancement and China is one of the quickest emerging economies which has witnessed a fast growth in the energy demand and is expected to increase threefold by 2047 to sustain a developed society with an industrialized economy [2]. The system has traditionally been very fossil fuel dependent but the Government of India has now implemented strategies of long-term plans to encourage sustainable development and decrease the carbon emission by creating a tremendous scaling of non- fossil capacity [3].

One of the key points of this roadmap is the controlled process of gas-based systems replacement with new technologies that use electricity as a source in households, transport, and heavy industry. Although such fuels as LPG and CNG are considered a bridge fuel in the past, they are still carbon correlated and still contribute to the acceleration of global warming and increase in public health crises due to the release of nitrogen oxides and methane leakage [4]. Deep electrification on the other hand, when coupled with a grid of solar, wind, and green hydrogen, will be a way to a zero-emission lifecycle and a more efficient and scalable alternative to the combustion engine [5]. This transition is granular, as, at the domestic level, it is necessary to transition to the areas of induction cooking and heat pump; at the transportation level, Electric Vehicles (EVs) should be used in most new sales; and in industry, high-temperature thermal processes should be electrified [6].

The journey is not smooth though. The enormous cost of grid modernization approximated in trillions of dollars and the technical difficulties of large-scale energy storage to address renewable intermittency are among the daunting obstacles [7]. Socio-economic equity is also the requirement of the populations that are already reliant on the gas economy to avoid the unjust transition. Finally, a powerful system of policy interventions, such as the Production-Linked Incentives (PLI) of battery and solar manufacturing, and the active development of the Green Energy Corridor of power delivery will be required [8]. Renewable energy integration has become a strategic necessity towards energy security which will make India less susceptible to the unstable international fuel markets and shocks in foreign supplies [9]. Concluding on the study, as the country gets deep electrified and a decarbonized power grid, this will be the core of sustainable development in India, which will see the country rise to the forefront of the green energy revolution by 2047 [10].

2. Need for Transition from Gas to Renewable Energy

2.1 Environmental Sustainability

Gas-based fuels automatically emit carbon dioxide, methane fumes and other nitrogen oxides that are strong contributors to the greenhouse effect and global warming [11]. Although natural gas has been commonly sold as a bridge fuel due to its low level of particulate emissions compared to coal, its lifecycle carbon footprint cannot be reconciled with long-term net-zero goals and has the potential to result into the slow acidification of the atmosphere [12]. The Intergovernmental Panel on Climate Change argues that a swift and fundamental shift in the reliance of the fossil fuel sector, through all sectors, is a fundamental requirement to curb the world temperature at 1.5 °C above pre-industrial levels (IPCC, 2022) [13]. When co-ordinated with the decarbonization of the electrical grid in terms of large-scale solar and wind installations, strategic electrification provides a clear way forward to the end of tailpipe and chimney emissions. This move assists India in meeting its Nationally Determined Contributions (NDCs) in the Paris Agreement, and reducing the increasing cost of public health related to air pollution in urban areas (United Nations, 2015) [14].

2.2 Energy Efficiency

In thermodynamic terms, electric technologies are always superior to their gas-based counterparts with regard to the primary energy conversion and useful work output [15]. As an example, magnetic induction cooktops excite the molecules of the cooking vessel itself, making them high energy efficient (an efficiency of about 8590 percent energy saved), but in contrast to a gas burner, traditional gas burners do not have a high concentration of the energy they produce, but instead radiate it into the surrounding air, which often goes to waste (only 4060 percent efficiency). Likewise, in the industrial and automotive industry, electric motors use more than 90 percent of electrical energy to perform mechanical labour, which is a real contrast to internal combustion engines or gas turbines that dissipate most of their energy into waste heat (International Energy Agency, 2023) [17]. These efficiency gains over time become reflected in the form of reduced unit energy efficiency, thermal stress to the environment and substantial savings in costs of operation by both the household and the manufacturers which in effect increase the overall productivity of the economy [18].

2.3 Energy Security

The energy structure of India is extremely prone to any external shock because the country is importing more than 85 per cent of its crude oil and about half of its natural gas demands [19]. Such excessive dependence on imported hydrocarbons puts the domestic economy at the mercy of heightened volatility of prices, currency variations and the vagaries of global geopolitical conflicts that can destroy supply chains at any given time [20]. With a shift to an electricity-based model based on the use of domestic renewable resources, namely—the enormous solar capacity of the Thar Desert or the wind corridors along the coastline; India can radically reduce its import bill and fiscal deficit (NITI Aayog, 2021) [21]. Enhancing the domestic grid and absorbing the local micro-grids in it will guarantee the energy future of the nation is determined by the geography and not the market whims around the world, which are the fundamental basis of energy sovereignty of the nation [22].

3. Electrification of Major Sectors

3.1 Household Cooking

Household cooking is one of the main sources of consumption of Liquefied Petroleum Gas (LPG) in India that accounts for a massive part of the residential energy footprint [23]. The switch to the new technologies of electric cooking, namely, high-efficiency induction cooktops and automated electric pressure cookers, can be viewed as a sophisticated, carbon-neutral option to the conventional flame-based techniques [24]. These modern appliances use electromagnetic induction to directly transfer energy to the cookware, which reduces the amount of heat lost to the environment drastically and avoids the dangerous release of pollutants to the indoor air, such as carbon monoxide and nitrogen dioxide [25]. These technologies indirectly increase the long-term respiratory health and domestic safety of millions of people, especially those living in overcrowded or poorly ventilated homes (World Bank, 2022) to increase indoor air quality. As India's power grid is becoming increasingly reliable under the "Saubhagya" and "RDSS" schemes, the large-scale uptake of "e-cooking" is expected to hit fossil fuel imports of power plants hard, while protecting households from the price volatility of gas cylinders [27].

3.2 Transportation Sector

The transportation sector is a carbon-intensive engine of the economy currently running on imported petrol and diesel fuels, which contribute to severe smog in cities [28]. Electric Vehicles (EVs) from nimble two wheelers to humongous interstate transit buses are rolling out as the answer to the question of what can be the definitive successor to the internal combustion engine. Although they do not emit tailpipe emissions like their gas-dependent counterparts, EVs emit zero tailpipe emissions, which is an immediate remedy to the health crisis experienced by people in India due to the emission of particulate matter in its metropolitan centres [29]. Active governmental systems, like the FAME-II and an array of state-specific EV regulations, are aimed at speeding up this transition by stimulating the production of batteries and charging systems locally (NITI Aayog, 2021) [30]. When these fleets of vehicles are integrated with a grid powered with high-capacity solar and wind farms, the carbon footprint of the nation's mobility can be cut by a whopping 70% or more, ensuring a truly green transit ecosystem by 2047 [31].

3.3 Industrial Applications

Natural gas and coal have traditionally been employed in the industrial sector in high-temperature thermal treatment, as well as, steam generation and chemical production. The deep electrification of these systems - by the use of electric arc furnaces (EAF), precision induction heating and industrial scale electric boilers - is a fundamental shift in manufacturing efficiency and control [32]. Beyond just substituting fuel, electrification enables extremely granular digital control of thermal cycles, which helps with material waste and structural consistency of products such as steel and glass [33]. Furthermore, the combination of "Power-to-X" technologies and thermal energy storage allows factories to shift their heavy loads to coincide with the hours of highest renewable energy generation, e.g. midday peaks in solar energy [34].

Such synergy of industrial electrification and clean energy lowers not only the carbon intensity of Indian exports but also brings the manufacturing industry to the requirements of the global "Green Industry" standard, insuring its competitiveness in the long term (International Renewable Energy Agency, 2023) [35].

4. Role of Renewable Energy

Renewable energy sources are the fundamental catalysts that ensure that mass electrification is converted into true long-term environmental benefits and not simply to the point of burning carbon and just transfer it from the place of combustion to the power plant [36] (Fig 1). India has realized unprecedented heights in the use of renewable energy in the last ten years to emerge as one of the world leaders in switching to the low-carbon grid. Solar and wind energy have come out of fringes and centre stage in terms of share in the total installed electricity generation capacity of the country as a result of aggressive competitive bidding, favourable policy by the infrastructure and the ever-decreasing cost of the photovoltaic modules [37]. REN21 (2023) states that swift and consistent growth in renewable energy facilities is the most practical way of breaking the cycle of reliance on fossil fuels and the vulnerability of the national economy to the natural instability of the world hydrocarbon markets [38].

India is also investing in state-of-the-art Battery Energy Storage Systems (BESS) and pumped hydro resources to cope with natural intermittency of solar and wind resources; such systems will guarantee continuity and reliability of power supply even when the resources are not available [39]. And the implementation of Smart Grids technologies, including AI-based demand prediction and load balancing, is essentially improving electricity supply resilience based on renewable sources [40]. Such technical improvements permit the grid to have a greater hosting capacity enabling it to take the spike in demand of millions of new electric cooktops and vehicles without destabilizing it [41]. However, eventually, the combination of high-capacity green generation and smarter distribution networks is the core of Viksit Bharat 2047 energy strategy that will offer India a clean source of power, domestic, and inexhaustible energy to make the country developed and self-reliant [42]. Although natural gas was a long-term advocate of cleaner choice over coal, up-to-date statistics show that deep electrification has become the best way to reduce carbon in India. By early 2026 the carbon intensity of the Indian electrical grid has inflected critically (Table 1).

Table 1: Comparative Carbon Intensity and Environmental Impact of Fuel Sources (2025-26)

Fuel/Technology	**CO_2 Emissions (Typical Units)**	**Primary Environmental Impact**
Natural Gas (Heating/Cooking)	~2.0 kg CO_2 per kg of fuel	Direct fossil fuel combustion; methane leakage.
Petrol/Diesel (Transport)	~2.3 - 2.6 kg CO_2 per litre	High PM2.5 and NOx; tailpipe GHGs.
Grid Electricity (2025-26)	**0.736 t CO_2/MWh**	Indirect; declining as renewables scale.
Green Hydrogen	**Zero (at point of use)**	Eliminates emissions in "hard-to-abate" sectors.

Figure 1: Energy Transition Pathway for Sustainable Development

5. Challenges in the Energy Transition

Regardless of the numerous positive implications of deep electrification, a shift in energy systems based on gas-emitting technologies to electricity-powered ones has some systemic and structural obstacles that need to be overcome to achieve the 2047 goals.

5.1 Infrastructure Development and Grid Modernization

To accomplish large scale electrification requires a titanic increase in the national electricity generation capability specifically with the need to firm up renewable energy sources to serve peak loads [43]. In addition to generation, currently available transmission and distribution (T&D) networks are in need of considerable technical improvements in order to accommodate the two-way electricity flow and the spike of demand posed by the decentralized sources such as residential EV chargers and industrial induction furnaces [44]. To reduce the loss of transmission and guarantee that the green energy of resource-rich areas should be brought to the industrial centres and remote villages with high reliability, it is necessary to strengthen the so-called last-mile connectivity and deploy high-voltage direct current (HVDC) lines [45].

5.2 Economic hindrance and the capital expenditure

One of the main impediments to swift implementation is the difference in initial capital outlay electric cars, large capacity industrial boilers, and more modern home appliances may require larger initial outlay payments than their internal combustion or gas-fired counterparts [46]. Although such technologies have lower operational costs throughout their life cycle, the unavailability of low-cost funding and the high cost of the lithium-ion battery storage remain the drawbacks to small-scale industries and households with middle-income levels [47]. It is essential to fill this gap in viability by subsidizing, imposing tax incentives and new models of leasing to make the transition more economically inclusive. The mapping sector-specific opportunities of electrification of energy are described in figure 2.

Sector	Current Energy Source	Electric Alternative
Household Cooking	LPG	Induction Cooktop
Transportation	Petrol/Diesel	Electric Vehicles (EVs)
Industry	Natural Gas	Electric Furnaces (EAFs)
Heating	Gas Heaters	Heat Pumps (Air/Geothermal)

Fig 2: Sectoral Energy Transition Toward Electrification

5.3 Changes in Public Awareness and Behaviour

Technical and economic readiness must be accompanied by a paradigm shift in the consumer behaviour. Widespread adoption of the electric technologies is frequently hindered by "range anxiety" in the transport sector and lack of familiarity with electric cooking safety and efficiency in the domestic sector (Asian Development Bank, 2022) [48]. Comprehensive public awareness campaigns, community-led demonstrations and transparent labelling of energy efficiency are needed to establish trust among consumers and stimulate a voluntary change in age-old fossil fuel habits [49].

6. The future outlook and the policy measures

To close the deficit between the current pattern of energy consumption and the ambitious targets of Viksit Bharat 2047, it is necessary to have a multi-pronged policy framework. These measures need to go beyond the mere infrastructure and focus on financial viability, technological innovation, and societal acceptance [50].

- Aggressive Expansion of Renewable Capacity: The government has to continue to support large scale solar and wind parks through simplified land acquisition and solid "Plug and Play" infrastructure. Establishing a stable regulatory environment for "Round-the-Clock" (RTC) renewable power is critical to replace gas-based baseload generation [51].
- Specific Financial Help: To reduce initial expensive costs the Production Linked Incentive (PLI) schemes must be incorporated to cover domestic production of induction cooktops, industrial heat pumps, and solid-state batteries. Debtors can also be de-risked by allowing direct benefit transfers, or low interest, Green Loans, to Small and Medium Enterprises (SMEs) and low-income households [52].

- Infrastructure Modernization: An investment into a "Smart and Resilient Grid" is a matter of necessity. It involves the implementation of the advanced metering infrastructure (AMI) and the reinforcement of the inter-regional transmission corridors so that excess renewable energy in a state can be made available to serve the industrial needs of another state without overload [53].
- R&D and Technological Sovereignty: Funding (both a significant portion of it publicly and privately) should be directed towards Research and Development, in particular towards indigenous battery chemistries (such as Sodium-ion) and Green Hydrogen integration. This decreases reliance on global supply chains on a technological platform and creates a localized "Green Tech" ecosystem [54].
- Strategic Public Awareness: It is high time that national campaigns shift to "E-Swayam" or other such branding of electric cooking and mobility as was the case in the case of LPG under the project called Ujjwala. Demonstration of the safety, cost-efficacy, and health benefits of these technologies is critical to achieving a shift to a voluntary, mass-market [55].

The successful implementation of these measures will serve not only to decarbonize the economy, but will also generate millions of "green jobs" making India a global centre of sustainable energy export [56].

7. Conclusion

The transformation of old systems of using gas-fired power structures to innovative electricity-powered technologies is not only a technical change, but it is also a preliminary condition to high-income status and the implementation of the Viksit Bharat 2047 vision. Promoting the systematic electrification of key areas, including domestic cooking, urban transport, and heavy industry, India can uncouple its fast economic development with the intensive use of energy based on carbon. This transition does not only offset the increasing dangers of the global climatic alteration but also satisfies the domestic urgent demands of lessening the costs of general well-being and maximizing resource output by high thermodynamic effectiveness. Moreover, the shift to an all-electric economy can act as an effective defines of the geopolitical weaknesses of the hydrocarbon-based energy structure, and thus can strengthen national sovereignty.

As the renewable energy capacity is and will further grow exponentially and the governments introduce progressive policies, like the Green Hydrogen Mission and the National Smart Grid Mission, India has a unique opportunity to catapult the country into a new development model. A decarbonized grid and digitized energy consumption bring about a resilient future-ready infrastructure that can help support the dreams of 1.4 billion citizens. With the adoption of such an electrified frontier and development of a vibrant clean-tech ecosystem, the country can be assured that its centenary-long independent history is characterized by sustainability, inclusivity, and unquestionable global leadership in green energy revolution. It is the journey of 2047, which is not only how to arrive at a place of prosperity, but how to create a prosperous future which will essentially be run by the sun, the wind, and the unstoppable spirit of Indian innovation.

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