

# Are energy production and consumption mechanisms today ensuring sustainable development? If not, why?

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*Abstract—For as long as the world's demand for energy keeps rising, so will our pursuit of burning more of these resources, no matter the environmental damages they cause. Renewable energy such as solar, wind and hydropower are exploding, yet challenges abound from environmental impacts to resource extraction, land use conflicts and lack of social equity or fairness. The study shows these problems in multiple perspectives at local, national (India), and global scales and serves as a reminder that despite the huge commitment, expansion of renewable capacity still falls short of the rate that the world needs. Despite significant investments, the growth of renewable capacity is still not enough to meet the 2030 sustainability targets. These efforts could be undercut by concerns over rare earth mining, as well as land displacement from massive projects and growing inequalities. Though renewable energy is viable, full sustainability can be obtained only with fundamental changes.*

## I. INTRODUCTION

An energy source is a crucial element of socio-economic growth. As technology evolved, scientists discovered fossil fuels such as coal, oils, and natural gases, which humanity began using widely due to their availability and harnessed them efficiently.

With the increasing population and changes in energy demand, there has been a significant rise in energy production. Also, the economic growth of developing nations in the previous decades has caused an accelerated increase in energy consumption rates across domestic and various industrial sectors.

While the long-term depletion of fossil fuels is inevitable and their damaging impacts on the globe are well-documented, global energy demand in 2024 saw significant reliance on these sources, contributing to record-high carbon emissions. Projections for 2025 suggest global coal demand will largely remain flat at

high levels, underscoring the ongoing challenge and complexity of the energy transition [1]. Due to these concerns, scientists looked for alternatives in terms of renewable energy sources, to provide us with a possibility to use them in the future.

The concentrated awareness on a sustainable energy supply led to an increasing focus on short-term stored energy, which could be from wind, hydropower, solar, biomass, and geothermal energies.

While the world largely believes in renewable energy, some resources indicate that these might not inherently adhere to environmental, social, and economic sustainability. For example, mining neodymium and other rare earth metals for wind turbines can be as damaging as mining coal. Submerging complete ecosystems by building hydropower dams can be destructive enough to question their sustainability [2].

Workers' welfare and decent wages are important to ensure social sustainability, as opposed to multinationals exploiting local communities. Globally, fossil fuel consumption subsidies still significantly outweigh those for renewables, creating a clear market distortion. Despite this, investment in clean energy surged to \$2 trillion in 2024, surpassing fossil fuel investments by \$800 billion [3].

Only when we deal with all these aspects and balance them can we address the issue of energy sustainability in real terms.

## II. LOCAL PERSPECTIVE

Depending on the present rate of energy consumption, will there be enough left for future generations? Even today, hundreds of millions of people are living without access to electricity. Concerns over the equity

of energy transition are rising dramatically, and affordability is emerging as a growing crisis, specifically in advanced economies, as the prices between household and wholesale electricity broaden [4].

The means of production and utilization play an important role in determining if energy is sustainable. For example, clearing land for large-scale solar farms or hydropower dams that submerge complete villages and cause ecological disruption cannot be universally considered sustainable ways to create or use energy without careful mitigation [5].

### III. NATIONAL PERSPECTIVE

According to the International Energy Agency (IEA), India's energy demand will increase more than that of any other country over the next two decades with its rising population.

The Indian renewable energy sector continues to be one of the most attractive markets globally. India has demonstrated a strong commitment to sustainable energy, setting an ambitious target of 500 GW of non-fossil fuel-based energy capacity by 2030 [6]. Demonstrating remarkable progress, India reached a significant milestone by June 30, 2025, with 50.1% of its total installed electricity capacity now sourced from non-fossil fuels, achieving its Paris Agreement target five years ahead of schedule [7]. As of early to mid-2025, India's total installed renewable energy capacity (including large hydro) stood at approximately 234 GW, contributing to an overall non-fossil fuel capacity of around 485 GW (including large hydro and nuclear) [8, 9].

To meet its escalating energy demand, India is vigorously deploying solar and wind energy, while simultaneously addressing challenges of financing needs and environmental impacts. While installed capacity is high, thermal power still generates over 70% of India's actual electricity, highlighting the ongoing challenge of integrating intermittent renewable sources and strengthening grid infrastructure [10].

If renewable energy is advanced with the aim of maximizing potential, forest and agricultural lands could be impacted. Contributions and incentive programs aimed at facilitating low-impact renewable energy deployment can be a beneficial approach.

### IV. GLOBAL PERSPECTIVE

Energy is central to nearly every major challenge and prospect the world faces today. Despite significant strides, almost 666 million people globally still lack basic access to electricity as of mid-2025, even with the global electrification rate reaching nearly 92%. The current pace of progress remains insufficient to achieve universal access by 2030, with a disproportionate 85% of those without access residing in sub-Saharan Africa [11, 12]. The lack of access to reliable and clean energy reserves is a central barrier to improvement around the globe.

To solve this problem, The International Renewable Energy Agency (IRENA), an intergovernmental organization, supports countries in their efforts towards a sustainable energy future and serves as the central platform for international co-operation, technology, resource, and financial knowledge on renewable energy [13]. IRENA promotes the overall adoption and sustainable use of all forms of renewable energy, including bioenergy, hydropower, ocean, geothermal, solar, and wind energy, in the pursuit of sustainable development, energy access, energy protection, and low-carbon economic growth and wealth [13].

### V. CONCLUSION

Looking ahead, new and renewable energies are increasingly poised to become the main energy sources. While fossil fuels are inevitably running out, renewables are proving useful in many areas such as ongoing cost reductions, generating jobs, growing future industries, and satisfying energy and environmental targets. In 2024, the world saw a record addition of 585 GW of renewable capacity, accounting for over 90% of total global power expansion [12]. Moreover, most new renewable electricity generation capacity installed in 2024 was demonstrably cheaper than even the lowest-cost new fossil fuel capacity [14]. Energies of solar, wind, and biomass can meet local energy demands and assist in improving environmental protection. Current problems related to energy demand facilitate an enormous need for renewable energy.

Starting with sustainable energy as a goal while utilizing renewable energy resources might have minimal impact on nature and people, making energy

abundant, cheap, sustainable, and available. However, for this to be truly realized, it is crucial to continually address inherent challenges. Despite record additions, global growth rates are not yet on track to meet the ambitious target of tripling renewable power capacity by 2030. Furthermore, critical issues such as the environmental and social impacts of raw material extraction for renewable technologies, large-scale land use for projects, ensuring worker welfare, and the urgent need for adequate energy storage solutions to manage grid stability (as seen in India's challenges with integrating variable renewables) must be comprehensively addressed.

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