
# AN ECONOMY-WIDE QUANTIFIED GOAL ON ENERGY EFFICIENCY IN INDIA

WORKING PAPER

**Abstract**

The Energy Conservation Act (EC), 2001, provides a framework for promoting efficient use of energy and energy conservation in India. To strengthen government actions and policies, including the implementation of nationally determined contributions, clearly defined energy-efficient targets are pivotal. An economy-wide energy efficiency target would aid in planning and implementation. This policy brief reviews existing metrics and international practices. The brief advocates for a policy approach to set and achieve economy-wide energy efficiency targets that can drive action-oriented policies and motivate the government to attain pre-determined outcomes.

**Keywords**

energy efficiency, SDG 7, climate action, goal setting

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ENERGY AGRICULTURE ENVIRONMENT HABITAT RESOURCE SECURITY CLIMATE HEALTH & NUTRITION

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# Contents

## 1. Introduction: Energy Efficiency as the First Fuel

Energy is an integral requirement for a country's socio-economic and industrial development. Conventional energy sources lead to GHG (greenhouse gas) emissions. According to International Energy Agency (IEA) report on 'Net Zero by 2050' (2021), the energy sector accounts for three-quarters of global emissions. The Paris Agreement calls for nations to stabilize global temperature rise to 1.5-2 degrees Celsius. This requires nations to reach net zero emission status by the mid of the century. In recent COP annual meetings, nations have declared their commitment to achieving net zero emissions by 2050. However, developing nations have major infrastructural and investment reliance on conventional sources/energy systems and lesser proliferation of renewable technologies. It is anticipated that the developing countries will continue to face the challenge of ensuring reliable and efficient energy supply to their citizens for consistent economic growth and, hence, a delayed net zero timeline.

Decarbonization of the energy sector requires both demand- and supply-side interventions. Increasing the share of renewables and cleaner energy generation is a model of supply-side interventions. On the other hand, incentivizing the adoption of energy-efficient products (electronics and energy systems) for commercial and residential sector utilities is an important demand-side intervention.

Energy efficiency is the ratio between an energy conversion process's useful output and input. Environmental and Energy Study Institute defines energy efficiency as the process of using less energy to perform the same task—that is, eliminating energy waste. It is a low-hanging fruit because of its cost-effectiveness and the relative costs involved in other mitigation options. Improving energy efficiency in our homes, businesses, schools, governments, and industries—which are the major consumers of natural gas and electricity in a country—is one of the most constructive, cost-effective ways to address the challenges of high energy prices, energy security and independence, air pollution, and carbon emissions. According to the IEA report on 'Multiple Benefits of Energy Efficiency' (2019), global GHG emissions in 2017 were reduced by 12% due to energy efficiency measures since 2000, with respect to the baseline scenario of no such interventions. SDG (Sustainable Development Goal) 7.3 target calls for worldwide progress on energy efficiency by doubling the rate of improvement in energy efficiency globally by 2030.

The contribution of energy efficiency as a mitigation strategy to abate emissions was studied by different research and intergovernmental organizations. In the IEA sustainable development scenario, a broad evolution of the energy sector to achieve SDG 7, 13, and 3.9, 40% of the emissions abatement needed by 2040 could be accounted for from energy efficiency measures (IEA. 2021b). Belaïd and Massié (2023) assessed the contribution of energy efficiency for Saudi Arabia's net zero target. They concluded that energy efficiency could contribute up to one-fifth to the 2060 net zero target of the country. Dahir and Mahi (2022) confirmed that energy efficiency significantly reduces $CO_2$ emissions and improves environmental quality in both the long run and the short run in BRICS nations. Yuan et al. (2023) show that increasing energy efficiency reduces environmental deterioration and improves resource utilization, thus positively contributing to green economic growth in China. Murshed et al. (2022) found in

their study that a 1% rise in energy efficiency level increases the energy sustainability index[1] for Sub-Saharan Africa by 11% in the long run.

Chaturvedi and Shukla (2014) studied the role of energy efficiency in India's climate change mitigation and found that the final energy demand and emissions in India are significantly reduced with energy efficiency improvements. It further says that energy efficiency policies play a significant role in emission reduction, especially for India's building and transportation sectors. TERI report on 'India: Transforming to a Net Zero Emission Energy System' concluded that in the case of a business-as-usual scenario, the primary energy demand would double between the period of 2020–50, however, due to the significant energy efficiency gains from electrification and deployment of low-carbon energy infrastructure, it could be reduced by 20% (TERI, 2021). The LiFE (Lifestyle for Environment) initiative introduced by the Indian government also has a positive linkage to energy efficiency and emission reduction. According to the IEA report on 'LiFE Lessons from India', the worldwide adoption of the actions and measures targeted by LiFE, including behavioural changes and sustainable consumer choices, would reduce the annual global $CO_2$ emissions by more than 2 billion tonne (Gt) in 2030 (IEA, 2023a). TERI study on Energy Efficiency (2018) evaluated the potential of energy savings from energy-efficient measures under two scenarios. The reference scenario considered the continued adoption rate of energy-efficient technologies and processes. In contrast, the efficient scenario considered a higher penetration level of efficient options and swift phase-out of inefficient alternatives. The study estimated that energy efficiency measures could result in energy savings of 338 Mtoe over the period 2021–41 as compared to the reference scenario in India.

## 2. Indicators of Energy Efficiency

Among the various categories of energy efficiency indicators, energy consumption is the most relatable from the economic activity context. It is the total energy required for a given process and measured in tonnes or kWh of fuel consumed (gas, diesel, coal, biomass, electricity) or $CO_2$ emissions (ODYSSEE, 2020). On the other hand, the most widely used energy efficiency indicator is 'Energy intensity.' National Indicator Framework on SDG (2021), developed by the Ministry of Statistics and Programme Implementation (MoSPI) Government of India, measures 'energy intensity' in terms of primary energy and GDP (gross domestic product) (in megajoules per rupee). While energy intensity has the advantage that it depicts the trend of delinking energy consumption from economic growth, energy intensity as an indicator has been criticized as sectoral energy intensities are influenced by changes in the economy's structure, changing the ratio over time, thus making intercountry comparison complicated. The implications of energy efficiency measures are difficult to capture as economic activity, policies, population, and several other factors impact energy use. Thus, countries record the energy efficiency targets under various categories depending on the availability of data, reporting methodology, and their expertise. Table 1 lists the different energy efficiency indicators adopted by different countries.

[1] Energy Sustainability Index was used to indicate the level of energy sustainability defined by the enhanced access of energy resources to meet current demand without compromising future supply constraints.

*Table 1: Economy-wide energy efficiency indicators*

| Indicator | Definition | Pros | Cons | Countries |
|---|---|---|---|---|
| Energy intensity | Energy consumption per unit of GDP | Highlights trend of decoupling of energy consumption and economic growth | The indicator is influenced by economic activity and structural changes and is not always linked to energy use reduction; the indicator may improve, but energy use may increase | SDG, China |
| Energy productivity | Activity per unit of energy consumed | | The indicator is influenced by economic activity and structural changes and is not always linked to a reduction in energy use; the indicator may improve, but energy use may increase | Australia, the United States of America |
| Energy consumption | The energy required for a given process. It is measured in relation to the projection year or base year | Aligned with environmental benefits of energy efficiency, such as emission reduction | Indicator is influenced by economic growth and structural changes | European Union, Germany |
| Energy elasticity | The ratio of energy consumption growth to activity growth | Suitable for countries lacking disaggregated data on energy use | Difficult to understand | Indonesia |
| Policy progress | Initiatives and impacts of energy efficiency policies | Encourages policy leadership | Difficult to measure | Mexico, India |
| Transactional | Adoption rate/ share of energy efficient goods or services in market/ economy. | Encouragement in sales of energy-efficient products and services | Capture only a part of the energy efficiency market and are a subset of the national energy efficiency target | Japan |

*Source: IEA (2017)*

## 3. Energy Efficiency Landscape in India

Energy efficiency in India is governed by the Energy Conservation Act (EC), 2001, which provides a framework for promoting efficient use of energy and energy conservation in India. The Act mandated the setting up of the 'Bureau of Energy Efficiency' (BEE, formed in 2002) as a statutory body at the central level to implement the Energy Conservation Act's mandate and promote energy efficiency in India. The Act empowers BEE to set up standards and labelling of equipment and appliances, energy conservation building codes for commercial buildings, and energy consumption norms for energy-intensive industries. To encourage the participation of states, the Act directs the setting up of State Designated Agencies (SDA) to implement the Act and promote energy efficiency.

Further, to mitigate the adverse impact of climate change, the Indian government launched the National Action Plan on Climate Change (NAPCC) in 2008. The plan aimed to sustainably fulfil India's developmental aspirations by including eight submissions. National Mission for Enhanced Energy Efficiency (NMEEE) was one of its eight submissions. The objective of NMEEE is to strengthen the market for energy efficiency through the implementation of innovative business models in the energy efficiency sector. NMEEE comprised four initiatives: Perform, Achieve and Trade, Energy Efficiency Financing Platform (EEFP), Market Transformation for Energy Efficiency (MTEE), and Framework for Efficient Economic Development (FEEED).

In 2022, the efforts towards energy efficiency measures were further empowered with the amendment of the Energy Conservation Act. The Energy Conservation (Amendment) Bill, 2022, authorized the central government to specify a carbon credit trading scheme. It mandated that the designate consumers (DC) meet a minimum part of their energy needs from non-fossil fuel sources. Further, the Bill amends the Energy Conservation Code to the 'Energy Conservation and Sustainable Building Code', which provides energy efficiency norms for offices and residential buildings with a connected load of 100 KW or contract load of 120-kilo volt-ampere (kVA).

The industry sector is India's largest energy consumer, and the PAT (Perform, Achieve and Trade) Scheme of BEE is a regulatory market-based mechanism to reduce the specific energy consumption[2] in energy-intensive countries. PAT sets an individual (firm-wise) target of reducing Specific Energy Consumption (SEC), i.e. energy use per unit of production for DCs (Designated Consumers) in energy-intensive sectors. Designated consumers are listed in Table 2. The energy saved is traded as energy saving certificates (ESCerts) that are traded at the Power Exchanges. One ESCert equals saving 1 MtOE (Metric tonne of oil equivalent) of energy consumed. As per the recent amendment in the Energy Conservation Act empowering BEE to set up the carbon market in India, these ESCerts will be transformed into a carbon-dominated certificate to promote an energy efficiency-based carbon market in India.

[2] Specific Energy Consumption: A specific energy consumption (or specific consumption in short) is the quotient describing the total energy consumption per unit of output or service in the physical unit (e.g. GJ or toe per ton of steel, kWh per $m^2$, litres of fuel per km).

*Table 2: Number of DCs covered under PAT and their annual energy consumption*

| # | Sectors | Total No. of DCs | Annual Energy Consumption (in Million Tonnes of Oil Equivalent) |
|---|---|---|---|
| 1. | Aluminium | 14 | 14.53 |
| 2. | Cement | 175 | 28.47 |
| 3. | Chlor-Alkali | 23 | 2.56 |
| 4. | Fertilizer | 37 | 8.26 |
| 5. | Iron and Steel | 204 | 66.73 |
| 6. | Paper and Pulp | 48 | 2.71 |
| 7. | Textiles | 168 | 2.60 |
| 8. | Thermal Power Plant | 239 | 158.59 |
| 9. | Refinery | 20 | 21.30 |
| 10. | Railways | 26 | 3.37 |
| 11. | DISCOMs | 96 | 16.35 |
| 12. | Petrochemical | 8 | 3.82 |
| 13. | Buildings | 133 | 0.12 |
| | Total | 1195 | 321.19 |

*Source: BEE, Impact of Energy Efficiency Measures for the Year 2021-22.*

The Standards and Labelling (S&L) programme of BEE helps consumers make informed decisions about various energy-consuming appliances based on their energy efficiency, therefore helping consumers determine the cost-saving potential of the marketed appliance.

The building sector in India consumes more than 30% of the total electricity in the country and is expected to increase further due to rising urbanization (MoSPI, Energy Statistics, 2023). Hence, optimization is needed for building energy demand in the existing and upcoming constructions. Through the Energy Conservation Building Code, BEE defines minimum energy norms for commercial buildings with a connected load of 100 kW or contract demand of 120 kVA and/or more, along with renewable energy integration and life cycle cost of building.

The transport sector accounts for 10% of India's total energy consumption, which is estimated to be 57 Mtoe (MOSPI, Energy Statistics, 2023). A large part of the energy demand in the sector is met through imported crude oil, thus making the sector vulnerable to fluctuations in international prices. Switching to electric vehicles (EVs) is a viable option for a shift towards sustainable transport. The adoption of EVs diversifies energy needs, and BEE is promoting the manufacturing and adoption of EVs in India by setting up public charging infrastructure.

The contribution of different energy efficiency programmes/schemes and certification rating systems of BEE and other national organizations helps in carbon emission abatement. The energy savings due to such initiatives are studied and published periodically. Table 3 represents the energy savings from such initiatives for 2021–22.

*Table 3: Scheme-wise energy and monetary savings from the energy efficiency measures in the year 2021–22*

| Program/ Scheme | Sector | Electricity Savings | Thermal Savings | Total Energy Savings | GHG Reduction | Monetary Savings | Monetary Savings |
|---|---|---|---|---|---|---|---|
| | | (BU) | (MTOE) | (MTOE) | (MtCO2) | (INR Crore) | (USD Million) |
| PAT- III | Large Industry | 0.62 | 1.59 | 1.59 | 1.59 | 3205.30 | 389.42 |
| PAT- II | | 36.47 | 10.95 | 14.08 | 68.43 | 42020.59 | 5105.26 |
| PAT- I | | 3.01 | 9.25 | 8.67 | 31.00 | 9500.00 | 1154.19 |
| PCRA EE Programs | | 0.01 | 0.00027 | 0.0009 | 0.0044 | 5.98 | 0.72 |
| PRSF | MSME | 0.05 | - | 0.0041 | 0.04 | 28.74 | 3.49 |
| 4E | | 0.03 | 0.00010 | 0.0026 | 0.02 | 151.87 | 18.45 |
| GFS | | 0.01 | - | 0.0009 | 0.01 | 128.36 | 15.59 |
| BEE-GEF-EESL | | 0.0015 | 0.0018 | 0.0019 | 0.009 | 4.49 | 0.54 |
| BEE-UNIDO-SME | | | | 0.0057 | 0.038 | 36.72 | 4.46 |
| BEE-FLCTD | | 0.0009 | 0.0000657 | 0.00007 | 0.002 | 1.11 | 0.13 |
| ECBC | Commercial | 0.1609 | - | 0.0121 | 0.1303 | 25.46 | 3.09 |
| BEE Star Rating | Buildings | 0.2492 | - | 0.0214 | 0.2019 | 39.43 | 4.79 |
| Green Building Rating Programme (GRIHA) | | 0.0882 | | 0.0076 | 0.0714 | 13.96 | 1.69 |
| ENS | Residential Buildings | 0.0024 | - | 0.00021 | 0.0019 | 0.38 | 0.05 |
| S&L | Multiple (Appliances) | 70.43 | 0.02 | 6.06 | 57.05 | 42258.92 | 5134.21 |
| | Others (AgDSM, SEAC, etc.) | 0.4693 | | 0.041 | 0.37 | 281.57 | 34.20 |
| UJALA | LED Lamps | 47.78 | - | 4.10 | 38.70 | 19112.00 | 2321.99 |
| | LED (Private Market) | 82.00 | - | 7.05 | 67.00 | 32800.00 | 3985.0 |
| SLNP | Municipal | 8.52 | - | 0.73 | 5.87 | 5109.60 | 620.71 |
| FAME | Transport | | 0.14 | 0.14 | 0.53 | 1559.88 | 189.51 |
| CAFE | | | 1.89 | 1.89 | 5.69 | 4436.35 | 539 |
| Total | | 249.89 | 23.85 | 44.43 | 280.77 | 160720.8 | 19526.66 |

*Source: BEE, Impact of Energy Efficiency Measures for the Year 2021-22*

Since the setting up of BEE, there has been a significant improvement in energy efficiency initiatives in India. This is evident from the trends in the overall total energy saving witnessed in the past years, as presented in Figure 1. The energy savings derived from energy efficiency measures have increased from 2.46 Mtoe in 2012–13 to 44.43 Mtoe in 2021–22.

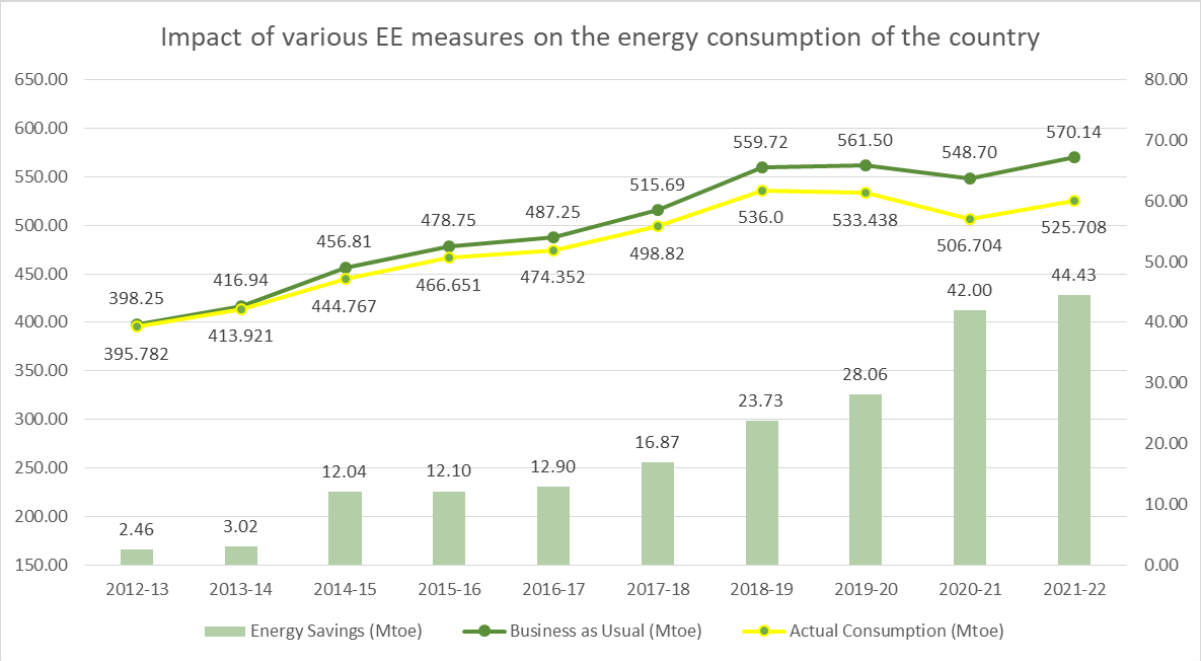


*Figure 1: Energy saving from energy efficiency measures in India (in Mtoe)*

*Source: BEE, Impact of Energy Efficiency Measures for the Year 2021-22*

**Impact of various EE interventions has been evaluated using India conversion factors for coal derived from weighted average methodology rather than using a single representative GCV (Gross Calorific Value) for all grades of coal.*

Apart from BEE, Energy Efficiency Services Limited (EESL), an ESCO (Energy Service Companies), enables consumers, industries, and governments to manage their energy needs effectively through energy-efficient technologies. Central Electricity Regulatory Commission (CERC) is the market regulator for the trading of ESCerts, while Power System Operation Corporation Limited (POSOCO) is entrusted with the responsibility of the Registry. India Energy Exchange (IEX) and Power Exchange India Limited (PXIL) are power trading platforms that enable efficient market trading of ESCerts. There are other stakeholders at the national, state, and sectoral levels, such as think tanks, accredited energy auditors, and managers involved in the energy efficiency system, and it is significant to collaborate with them in the phase of policy formulation.

## 4. International Energy Efficiency Targets

Several countries have realized the importance of energy efficiency in achieving net zero emissions and defined explicit targets for energy efficiency as a part of their national climate mitigation policy. This section discusses the economy-wide energy efficiency target-setting approach of a few economies to understand their coverage, indicators selection, timeframe, and their relationship with other policies and goals.

### *4.1 European Union*

The European Union's Green Deal is its ambitious climate strategy to be the world's first carbon-neutral continent by 2050. Therefore, the EU has revised its Energy Efficiency Directive along with other energy and climate rules to ensure that its 2030 climate target of reducing GHG emissions by at least 55% compared to the 1990 level can be met (EU, *Energy Efficiency Directive*, 2023a). To meet its 2030 target, it has included energy efficiency measures in sectors with the highest potential for energy saving, such as building, industry, transport, and power sectors.

The EU recast the Energy Efficiency Directive in 2021 to adopt an increased and binding EU energy efficiency target to collectively ensure an additional energy consumption reduction of 9% in 2030 compared to the projections of the 2020 Reference Scenario. This target corresponds to a reduction of 36% of final energy consumption and 39% of primary energy consumption by 2030 compared to the 2007 Reference Scenario (EU, *Energy Efficiency Targets*, 2023b). In 2022, the Commission increased the energy efficiency target from 9% to 13% compared to the 2023 reference scenario; however, these negotiations for this proposal are still underway. In July 2023, the EU Parliament defined the new rules for member countries, where each member has to reach at least up to the level of 11.7% by 2030 (compared to the reference scenario of 2020). It also suggests the progressive energy consumption reduction approach, where member countries can start with an annual reduction target of 1.3% until 2025 and reach 1.9% by the end of the decade (European Parliament, 2023).

### *4.2 Germany*

Germany has set itself the goal of reducing GHG emissions by at least 55% by 2030 (compared to 1990 levels). To achieve its overall climate target for 2030, the country will have to both massively expand renewables and significantly reduce its energy consumption. Therefore, the German government has set a national efficiency target for 2030 to reduce primary energy consumption by 30% compared to 2008.

To this, the German government recently introduced the new Energy Efficiency Act (EnEG), which sets the first cross-sectoral framework for achieving improved energy efficiency (*The Energy Efficiency Act*, 2023). The new legislation is also consistent with the revised EU Energy Efficiency Directive and Germany's own climate targets.

The Act set a target of more than 550 TWh (Terawatt hour) reduction in final energy consumption by 2030 compared to 2008 (*The Energy Efficiency Act*, 2023). The Act mandates companies with annual energy consumption exceeding 15 gigawatt hours to implement energy or environmental management systems and document and publish their energy efficiency measures in detail. In addition, new data centres will be obliged to utilize waste heat and make economical use of cooling system power.

### *4.3 Australia*

Under the National Energy Productivity Plan (NEPP) (commenced in December 2015 and continues through to 2030), the Australian government, along with states and territories, has committed to an energy productivity target of a 40% improvement by 2030 from investments in energy through more productive energy services and from 2015 (IEA, 2023b). According to the National Energy Productivity Plan (NEPP), implementing all cost-effective energy

efficiency measures could save up to 359 PJ of energy and 54 $MtCO_2$ equivalent in 2030. The NEPP is expected to contribute more than a quarter of the savings required to meet Australia's 2030 GHG emission reduction target.

### *4.4 Thailand*

Thailand developed a '20-year Energy Efficiency Development Plan' in 2011 with a target of reducing energy intensity by 25% in 2030 compared to 2005 (Ministry of Energy, 2011). This target was revised in 2015 to a 30% reduction in energy intensity in 2036 compared to 2010 resulting in an overall energy saving of 56,142 ktoe. An estimated 85% of the total energy saving would be accounted for from the thermal sector, while the remaining 15% will be in the power sector (Ministry of Energy, 2015).

### *4.5 United States*

The U.S. Department of Energy, Council on Competitiveness and Alliance to Save Energy have joined forces to undertake in 'Accelerate Energy Productivity 2030', an initiative aimed at doubling the US energy productivity from 2010 levels by 2030. It is projected that doubling the energy productivity of the US by 2030 could lead to an overall saving of US$ 327 billion, of which US$ 95 billion will account for the building sector, US$ 137 billion in the transport sector, and US$ 94 billion in the industry sector (U.S. Department of Energy, 2015).

### *4.6 South Korea*

South Korea, in its 'Third Energy Master Plan', has set a target to reduce energy consumption by 18.6% below the 2017 BAU (business as usual) level by 2040. An estimated 39.2 Mtoe reduction by BAU in 2040 is planned, and to this end, the government will improve demand management by sector, including industry, buildings, and transportation. Specifically, the sector will manage energy efficiency targets, including industry, buildings, and transportation. A 21% energy intensity reduction is targeted in the industry sector, while a 38% reduction is targeted in the building sector. In the transport sector, it is targeted to double the average fuel efficiency of passenger vehicles while improving the average fuel efficiency of heavy-duty vehicles by 1.5 times, along with distributing 8.3 million EVs and 2.9 million hydrogen vehicles by 2040 (Ministry of Trade, Industry and Energy, 2019).

### *4.7 Argentina*

Argentina intends to implement energy efficiency measures to reduce energy demand by 8.8% by 2030, in comparison to the current estimations that have been previously made without considering these measures (Undersecretariat of Renewable Energy & Energy Efficiency. Main Programs and Lines of Work. October 2019). To achieve its energy efficiency target, the government promotes companies to set up the energy management system (EMS) in a flexible and participatory manner. In 2019, it was estimated that the EMS has led to energy savings of about 4–7% for electricity networks and 5–8% for natural gas networks. Whereas within the transportation sector, for making a comparative assessment, lightweight vehicle manufacturers are mandated to put an informative label mentioning fuel consumption and emission intensity. To ensure reduced energy consumption, buildings and electric and gas appliances are also being labelled under the Energy Efficiency Plan.

### *4.8 China*

China's 13th Five-Year Plan (2016–20) had set the target of a 15% improvement in energy intensity from the 2015 level by 2020 and annual energy savings of 560 Mtoe. In its economy-wide energy efficiency target, China intended to improve energy intensity at the rate of 4.7% per year between 2015 and 2030.

In 2022, the Chinese regulators released an action plan boosting industrial energy efficiency with detailed major targets and tasks to achieve them. China aims to cut the energy consumption per unit of the added value of large industrial enterprises [annual revenues of more than 20 million yuan (around $2.99 million)] by 13.5% from the 2020 level. The plan also sets targets for a wide range of industries to increase the proportion of energy-efficient motors to over 70% and more than 80% for energy- efficient transformers by 2025. It is expected that putting a cap on industrial energy consumption will play a crucial role in achieving China's carbon peak (2030) and carbon neutrality (2060) goals. With IEA collaboration, China has developed Energy Efficiency Roadmap 2050 and is working on devising sector-specific action plans and energy efficiency targets (IEA. 2021a).

The review of different countries' energy efficiency measures highlights that both developed and developing economies have adopted detailed action plan approach for setting energy and energy efficiency targets in emission-intensive sectors. Their energy efficiency targets are largely consistent with their climate mitigation goals. The energy efficiency target of the European Union and Germany is in line with the 'Fit for 55' plan of the EU. Australia plans to derive almost one-fourth of its GHG emission reduction through energy efficiency, while China explicitly mentions that its energy efficiency plan will play a vital role in achieving carbon peak and carbon neutrality targets. Countries such as South Korea, China, and Thailand have developed a commendable detailed energy efficiency plan for their economies, along with setting specific timebound and quantitative sectoral road maps with the objective of meeting the national mitigation goals.

## 5. Rationale of an Economy-wide Energy Efficiency Target for India

Clearly defined goals, setting targets, and tracking indicators are pivotal for achieving the desired objective(s) of a policy. The Paris Agreement requires countries to commit to reducing their emissions with periodic revisions over time. The NDCs (Nationally Determined Contributions) and net zero emission targets are directing national actions on climate change (Jain, 2022). As countries implement various mitigation measures as part of their NDCs, it is essential to find the optimum pathway while achieving developmental goals. Currently, India has four quantified climate targets, which consider the timeframe of 2030. As declared in COP26, India's enhanced NDCs include: Reduce emissions intensity of its GDP by 45% by 2030 from the 2005 level; Achieve 50% cumulative electric power-installed capacity from non-fossil fuel-based energy resources by 2030, with the help of the transfer of technology and international finance; Create additional carbon sink of 2.5 to 3 billion tonne of $CO_2$ equivalent through additional forest and tree cover by 2030; Reach net zero by 2070.

Energy efficiency measures help in improving the industrial production process by reducing energy consumption and, thereby, the costs and emission intensity. An economy-wide quantified timebound energy efficiency goal encourages the government to make energy

efficiency policies and programmes more rigorous, with a regular MRV (Monitoring, Reporting and Verification) mechanism. National targets encourage countries to adopt frameworks for estimating energy efficiency savings from various policies and also send a clear signal and long-term perspective for institutions and market players. As per *India Energy Outlook 2021*, India's energy demand is estimated to grow by 25–35% between 2019 and 2030, which will lead to higher emissions. Energy efficiency measures devised for energy-intensive sectors will lead to significant energy savings. The reduction in energy demand due to energy efficiency is a suitable approach for India to ensure energy access and energy security, thus ensuring the achievement of SDG 7.[3]

The process of setting up the economy-wide target highlights the long-term perspective that helps in identifying short-term actions and future opportunities and finding the best leverage for achieving that target. The scientific approach of setting up the energy-efficiency target helps to reduce costs, enhance resilience to changing regulations, induce investment in improvement technologies and products, foster innovation and competitiveness among producers, and sustainable choice adoption among consumers.

An economy-wide energy efficiency target will support India's international climate commitments and facilitate in achieving the NDC. It complements the energy transition process by electrification, reduction of energy intensity, and reduction of total costs of the energy systems. India's Mission LiFE will get an impetus as the energy efficiency target will facilitate in steering society's behaviour of using energy-efficient technologies and practices. Along with bringing behavioural change in consumers, it will send the right market signals and enable the production of energy-efficient products.

## 6. Economywide Energy Efficiency Target: Possible Approaches for India

The economy-wide energy efficiency target would help identify the best consistent, and most cost-effective energy transition pathways. It will also help in determining future energy tariffs and identifying the scale of energy efficiency measures to the point where it will have a positive impact on emission reduction, energy savings, and energy provisions with respect to measures costs.

Taking lessons from the different approaches adopted by different economies and the current standing of India's energy efficiency measures, a possible approach for setting up an economy-wide energy efficiency target needs to be backed by realistic assumptions and quantified estimation. Three possible approaches for India to set an economy-wide energy efficiency have been discussed in this brief.

### *6.1 Energy Efficiency Target through Energy Modelling*

In the energy modelling framework, the energy efficiency target is suggested as a key variable for reducing future energy consumption. The target could be inserted in the energy model framework in two manners: in the first case, the target could be defined as an independent variable (the value could be fixed considering the nation's GDP growth, future energy demand, current proliferation of energy-efficient products, etc.) with other variables, such as renewables share in energy generation, emissions intensity, etc. It could be a simulation-based

[3] SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all

modelling exercise to find the best possible energy transition pathway. The model will provide valuable insights regarding production costs, future electricity prices, and how the different energy transition pathways will impact the economy in the defined timeframe.

In the second case, the energy modelling framework could help determine the economy-wide energy efficiency target assuming the target to be a dependent variable, factored upon future energy demand, the share of renewable energy generation, emissions intensity, monetary constraints, etc. It could be an optimization-based modelling exercise to find the optimum target value that could assist in achieving a consistent and cost-effective energy transition pathway.

Considering India's Net Zero target year to be 2070, the target could be defined in three time periods: short term (2030), medium term (2045–50), and long-term (2070). As the scope of energy efficiency policy measures has been broadened in the recent past, the year 2022[4] could be defined as the reference period. The energy intensity target corresponding to final energy consumption or primary energy consumption with the reference scenario could be estimated.

### *6.2 Sectoral Aggregation*

Various policies and regulations, such as ECBC, PAT, S&L, and CAFE, are designed to encourage energy-efficient technologies or process adoption at the sectoral level and have delivered positive outcomes in energy savings and emissions reductions.

However, there is a variation in the implementation technique of the energy efficiency measures for different sectors. For instance, the rating system used for buildings/ appliances is backed by quantitative energy usage or consumption assessment. Monitoring of achieving targets set in the PAT Scheme also is undertaken.

Adopting a bottom-up process under the sectoral aggregation approach, sector-specific targets could be defined via stakeholders' consultation based on sectoral contribution to GDP, energy consumption, and emission intensity. Rigorous sectoral targets will compel actions and encourage governments and economic sectors to achieve certain predetermined outcomes. The sectoral aggregation approach will provide sectors with greater ownership of targets, thus improving chances of achieving them. Further, the sectoral targets could be aggregated, which could lead to an economy-wide energy-efficiency target. Another method of finalizing the sectoral target could be devised through models in which sectoral economic, energy use and environmental factors will be weighed, and that will provide insights on how and what targets should be defined for individual sectors. It will be an analytical approach to set up the target, and thus, realistic dynamics of the market need to be well considered.

The national-level aggregation of sectoral contribution will complement the efforts towards NDCs and make the implementation swifter. Within this approach, the inclusion of various sectors/subsectors in the purview of energy efficiency could be planned in the short, medium, and long term with periodic revision. To monitor the national-level improvement in energy consumption, it is suggested that BEE administers sectoral energy efficiency targets along

[4] There has been a revision in BEE energy efficiency-related programmes in 2018. However, considering the economic implications that occurred during the COVID-19 years and the recent amendment of the EC Act, the year 2022 could present a normalized situation for the reference period (IEA. 2021c).

with concerned ministries and improvises on the existing accounting procedure for energy saving and then translates them into emission reduction and monetary savings.

### *6.3 Federal Units Aggregation*

Presently, energy efficiency initiatives are majorly devised at the central level, and state agencies play their role in the implementation and enforcement stage only. Indian states differ in their energy sources, generation, and distribution capacity due to geographical, economic, and societal aspects.

Under the federal unit approach, the policy progress indicator of energy efficiency is suggested. The states could determine their individual targets, and their aggregation could be used for an economy-wide energy efficiency target. In this manner, the state agencies could be given a leadership role in devising energy efficiency compliance mechanisms and providing targets in a mandated format rather than being directives. Alternatively, the central energy efficiency target could be determined in an analytical or consultative manner. Further, the states will be allocated individual targets based on their contribution to energy generation and emissions intensity.

This approach will encourage states to devise more action-oriented energy efficiency-related norms and help make cleaner and cost-effective energy and economic progress. It will feature the central government's attention to the regions/states that require financial, regulatory, and technological support to achieve their targets. This approach emphasizes the determination of central- and state-level targets for similar reference and cut-off periods and focuses on the shared responsibility concept.

## 7. Conclusion

Energy efficiency refers to the process of reducing energy input to generate the same level of output, thereby leading to a reduction in energy wastage. India's efforts towards energy efficiency were initiated two decades ago, with the enactment of the Energy Conservation Act (EC), 2001 and the establishment of the BEE in 2002. BEE serves as the nodal agency and implements various programmes/schemes to ensure the adoption of energy-efficient technologies and processes among industries, buildings, and residential sectors. These measures are directive in nature and require volunteering from the users, thereby creating the need for more stringent norms. Studies have confirmed positive linkages between energy efficiency interventions/targets in reducing energy demand and emissions. Recent climate target encourages nations to declare quantified goals so that their contribution to global efforts can be appropriately monitored and verified. This method is also adopted in the case of sustainable development goals, where goals are backed by quantified targets and corresponding indicators. Developed and developing economies are adopting different indicators and methods for setting up their economy-wide energy efficiency targets. It is imperative to consider the state- and sectoral-level dynamics before determining the target. An approach to set and achieve economy-wide energy efficiency targets can drive action-oriented policies and motivate the government to attain pre-determined outcomes. Energy efficiency targets could also help plan and implement the measures for different sectors/subsectors on time. An economy-wide energy efficiency target will not only complement India's nationally determined contributions but also help in a coordinated approach for a swifter energy transition.

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