Energy Efficiency in Kerala

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Abstract

One positive impact of the 1973 oil crises has been the concerted effort across the world to reduce energy consumption through energy use efficiency improvements. Improving energy efficiency ensures the objective of conserving energy and thus promoting sustainable development. Recognition of this fact has now appeared in terms of including the aim of improving efficiency as an important component of electrical energy policy in all the countries across the globe. Conserving electrical energy through energy efficiency measures can meet the high challenge of increasing energy demands at reasonable costs in a sustainable manner. Moreover, improving energy efficiency also has the potential of reducing the environmental and health threats associated with the use of hydrocarbons and of encouraging clean energy systems.

Improving energy efficiency is expected to reduce energy demand through its rational use in the end-use devices; every unit of energy input consumed will bring in greater amount of useful energy output. Such improvements can manage energy demand in better ways and contribute highly to a better environment. The present study is a documentation of the current pattern and trend of energy efficiency in the global, Indian and Kerala scenarios.

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1. Introduction

One positive impact of the 1973 oil crises has been the concerted effort across the world to reduce energy consumption through energy use efficiency improvements. Improving energy efficiency ensures the objective of conserving energy and thus promoting sustainable development. Recognition of this fact has now appeared in terms of including the aim of improving efficiency as an important component of electrical energy policy in all the countries across the globe. Conserving electrical energy through energy efficiency measures can meet the high challenge of increasing energy demands at reasonable costs in a sustainable manner. Moreover, improving energy efficiency also has the potential of reducing the environmental and health threats associated with the use of hydrocarbons and of encouraging clean energy systems.

Energy conservation is usually defined as a deliberate reduction in using energy below some level that would prevail otherwise (Munasinghe and Schramm 1983). This may be achieved at both the ends of supply and demand, and works through load management of electricity usage, including direct (mechanical) controls on end-use equipments and power cuts on supply side and time-differential tariffs and other management measures on the demand side. "Load management meets the dual objectives i) of reducing growth in peak load, thus nipping the need for capacity expansion, and ii) of shifting a portion of the load from the peak to the base-load plants, thereby securing some savings in peaking fuels. By moving toward achieving these objectives electric utilities stand to win a cut in operating and capacity costs, share the gain with the consumers and provide a partial solution to the country's energy dilemma." (Pillai 2002: 4-5).

In this study, our focus is on electrical energy conservation by means of efficiency improvements. Improving energy efficiency is expected to reduce energy demand through its rational use in the end-use devices; every unit of energy input consumed will bring in greater amount of useful energy output. The energy efficiency of most of the end-use appliances that we use is pretty low, with consequent losses and higher demand for inputs, leading to environmental damages. This in turn suggests that improving energy efficiency can manage energy demand in better ways and contribute highly to a better environment. It is estimated that the cumulative total energy savings from higher energy efficiency standards for residential and commercial appliances in the US for the period 2010–2030 would be nearly 26 quads (1 quad ≈ 293,071,000,000 kilowatt-hours) (Rosenquist et al., 2004).

2. Energy Efficiency: Global Background

According to the International Energy Agency (IEA, 2018), the primary energy demand has grown by 39% and the global economy by nearly 85% since 2000. "The forces driving energy demand, led by strong economic growth, outpaced progress on energy efficiency. As a result energy intensity – primary energy use per unit of gross domestic product (GDP) – fell by just 1.7% in 2017, the slowest rate of improvement since 2010" (IEA, 2018: 17). IEA points out that in fact the higher economic activity would have led to a much higher energy demand, without energy efficiency progress. "Efficiency improvements made since 2000 prevented 12% additional energy use in 2017" (ibid).

The International Energy Agency generally traces three types of energy efficiency policy: mandatory codes and standards; market-based instruments; and incentives (ibid). "In 2017, 34% of global energy use was covered by mandatory energy efficiency policies, but progress implementing new policies was slow for a second year running. Utility obligation programmes remained largely unchanged in 2017. Spending on energy efficiency incentives in 16 major economies was estimated to be around USD 27 billion" (ibid).

Energy efficiency has become essential to the environment and economic growth. The global energy-related carbon dioxide (CO_2) emissions rose by 1.6% in 2017, with a grim prospect of continued growth, far from the climate goals (International Energy Agency, 2018). Energy efficiency is accepted as the cheapest way to reduce global emission of greenhouse gases (such as carbon dioxide, methane, nitrous oxide and sulfur hexafluoride) (Enkvist, Nauclér, and Rosander, 2007). They have developed a cost curves approach in terms of abatement cost in euros per ton of avoided emissions of greenhouse gases (by calculating the annual additional operating cost (including depreciation) less potential cost savings (for example, from reduced energy consumption) divided by the amount of emissions avoided; note that this formula implies negative costs if there are considerable cost savings). "The abatement cost for wind power, for example, should be understood as the additional cost of producing electricity with this zero-emission technology instead of the cheaper fossil fuel-based power production it would replace. The abatement potential of wind power is our estimate of the feasible volume of emissions it could eliminate at a cost of 40 euros a ton or less." (ibid.)

According to the International Energy Agency (IEA: *World Energy Outlook 2006*), the global energy-related CO_2 emissions, under the current situation, would increase by 55% between 2004 and 2030, or 1.7% per year; and that power generation would contribute half of the increase in global emissions over this period with developing countries accounting for over three-quarters of the increase. Indian contribution also was found to be very high (IEA, 2006: 41). The Report states that "[p]olicies that encourage the more efficient production and use of energy contribute almost 80% of the avoided CO_2 emissions. …. More efficient use of fuels, mainly through more efficient cars and trucks, accounts for almost 36% of the emissions saved. More efficient use of electricity in a wide range of applications, including lighting, air-conditioning, appliances and industrial motors, accounts for another 30%. More efficient energy production contributes 13%. Renewables and biofuels together yield another 12% and nuclear the remaining 10%." (IEA, 2006: 42). According to the Report, "the new policies and measures analysed yield financial savings that far exceed the initial extra investment cost for consumers ….. On average, an additional dollar invested in more efficient electrical equipment, appliances and buildings avoids more than two dollars in investment in electricity supply. This ratio is highest in non-OECD countries. ….. The payback periods of the additional demand-side investments are very short, ranging from one to eight years. They are shortest in developing countries …." (IEA, 2006: 43).

It is estimated that efficiency gains made since 2000 have "prevented 12% more greenhouse gas emissions and 20% more fossil fuel imports, including over USD 30 billion (United States dollars) in avoided oil imports in IEA countries" (IEA, 2018: 17).

3. Energy Efficiency: Indian Background

The Government of India has made excellent strides in Energy Efficiency over the last 15 years since the enactment of the ground-breaking Energy Conservation Act in 2001. This Act was instrumental in the formation of the Bureau of Energy Efficiency (BEE) and the State Designated Agencies (SDA) in the States. It also put in place the much-needed institutional framework for formulating energy efficiency policies and implementing them. Since then, BEE has developed the Energy Conservation Building Code, a fairly successful Standards and Labelling programme for the most energy-intensive appliances and an ambitious & innovative industrial energy efficiency programme, Perform Achieve and Trade (PAT). Another milestone is NITI Aayog's energy scenario modelling tool India Energy Security Scenarios (IESS) 2047 which offers a platform to facilitate academic and policy discourse about potential pathways for the Indian energy sector. There is substantial potential to impact energy efficiency and reduce energy demand by 2047.

Energy efficiency policy framework in India rests on the Energy Conservation Act, enacted in 2001 and amended in 2010. This Act in turn is reinforced through the National Mission on Energy Efficiency, one of the eight missions under the 2008 National Action Plan on Climate Change. The Act led to the formation of the Bureau of Energy Efficiency (BEE) under the Ministry of Power, and the State Designated Agencies (SDA) in the States in order to realise the institutional framework for formulating energy efficiency policies and implementing them. The SDAs, being the State counterparts of the BEE, "have contributed significantly towards creating awareness on efficient use of energy among consumers and manufacturers, implementing demonstration projects, and supporting execution of BEE's programmes in States" (Government of India, 2018a: v). The BEE was instrumental in developing and implementing a number of initiatives such as the Energy Conservation Building Code, an expansion of the Standards and Labelling programme for the most energy-intensive cooling appliances like room air conditioners, fans and refrigerators, an innovative industrial energy efficiency programme called

Perform Achieve and Trade (PAT), and the extension of fuel efficiency standards to commercial heavy-duty vehicles. "India has recently implemented performance standards for electric motors at the IE2 level. Unlike in other major economies, however, these standards are not mandatory" (IEA, 2018: 151).

The IEA Report has also highlighted an Indian initiative towards energy efficiency; acknowledging the supremacy of light emitting diode (LED) bulb in efficiency, as it consumes less electricity, lasts longer, and does not contain harmful mercury, the Government of India launched a programme in 2014, called UJALA (Unnat Jyoti by Affordable LEDs for All), to promote LED bulbs in Indian households. "Energy Efficiency Services Limited (EESL), an Indian state-owned "super" energy services company (ESCO) [under Ministry of Power], has radically pushed down the price of LEDs available in the market and helped to create local manufacturing jobs to meet the need for energy efficient lighting. LEDs now cost less than USD 1 (around INR 60), down 80% from the first round of procurement in 2014. Through its Unnati Jyoti by Affordable LEDs for ALL (UJALA) programme, EESL has replaced over 308 million lamps with LEDs, without the need for any subsidies." (IEA, 2018: 152, Box 6.4.). Similarly, EESL has undertaken a bulk procurement of 100,000 super-efficient air conditioners as a demand aggregation strategy that successfully brought down the cost of high-efficiency equipment (Government of India, 2018b: 3). "Mission Innovation (MI) launched on 30 November 2015, during COP21 in Paris in the presence of the Prime Minister of India, is a global platform to foster and promote R&D for accelerated and affordable clean energy innovation. India is a key member of this global initiative and is a member of all seven Innovation Challenges" (ibid).

According to the IEA, energy efficiency improvements in India in the residential buildings and industry and service sectors since 2000 have helped to avoid an additional 6% more energy use in 2017 (IEA, 2018: 149). "Efficiency improvements also prevented nearly 145 Mt CO_2-eq in emissions and 5% more imports of fossil fuels in 2017" (ibid; Mt CO_2-eq = metric tons carbon dioxide equivalent, a standard unit for measuring carbon footprints, based on the global warming potential of greenhouse gases). Nearly 70% of this gain came from the industry and service sectors, where the gross value added more than tripled during the period from 2000, and structural changes were responsible for avoiding 1% more energy use. The latter is explained in terms of the shifts in "economic activity from energy-intensive industry sectors to less-intensive manufacturing and service sectors"; however, the "impact of these changes was almost completely offset by structural changes that boosted energy use, specifically increases in residential building floor area and appliance ownership, shifts to less efficient modes of transport, and decreasing vehicle occupancy rates" (ibid).

Another milestone was the first edition of the State Energy Efficiency Preparedness Index, brought out by the Alliance for an Energy Efficient Economy (AEEE) under the leadership of the Bureau of Energy Efficiency (BEE) aligned with NITI Aayog, that assesses State policies and programmes aimed at improving energy efficiency in buildings, industries, municipalities, transportation, agriculture and electricity distribution companies (DISCOMs). Energy efficiency indicators in each sector in each State are developed to measure the impact of State-level energy efficiency initiatives. Both qualitative and quantitative indicators, including outcome-based indicators, are used. The indicators include information on sector-wise energy consumption, energy saving potential and the States' influence in implementing energy efficiency in terms of their policies and regulations, financing mechanisms, and institutional capacity. The Index is formed from 63 indicators, with 59 across the sectors of buildings, industry, municipalities, transport, agriculture and DISCOMs; and 4 cross-cutting indicators.

The study finds that most of the States have implemented one or more national programmes of BEE and EESL, while a few have their own (State-level) initiatives as well. For example, even though most of the States have implemented UJALA for energy efficient lighting in the building sector, only less than half of them have notified the Energy Conservation Building Code (ECBC) and incorporated ECBC in municipal building bye-laws. In terms of energy efficiency preparedness, it is found that Kerala, with 77 points, leads among the States and union territories, followed by Rajasthan (68) and Andhra Pradesh (66.5).

4. Energy Efficiency: Kerala Background

Fuel wood, petroleum products and electric power are the conventional sources of energy in Kerala. Power sector of Kerala is comparatively small (her installed capacity is less than one percent of all-India capacity), and is heavily dependent on hydro-power, capacity expansion of which is limited in terms of unavailability of technically favourable sites and of unfavourable ecological impacts. High population density and fragile ecology have already precluded the nuclear option from Kerala. The only other alternative, fossil-fuel-fired thermal stations, itself is again limited, such that Kerala at present is heavily dependent on power import; thus in 2016-17, import accounted for about 84% of the total energy available in the State. It is worth noting at the same time that Kerala was declared a fully electrified State on May 29, 2017 (Government of Kerala, 2018: Box 5.12).

Considering the limited availability of fossil fuels and their unlimited contribution to global warming, Government of Kerala has turned to alternative sources of power generation, especially from environment friendly non-conventional energy sources, such as municipal waste, agro waste, industrial waste, sewage and other biomass, small-hydel units, solar photo voltaic, wind, tide, wave, geothermal etc. Agency for Non-conventional Energy and Rural Technology (ANERT), an autonomous body under the Power Department of Kerala Government, is the nodal agency for the implementation and propagation of non-conventional sources of energy in the State. It is also the nodal agency in the State for the Ministry of New and Renewable Energy Sources (MNRE) of Government of India.

Energy Management Centre (EMC) is the State designated agency of the Bureau of Energy Efficiency for promoting energy conservation and energy efficiency through enforcing Energy Conservation Act, 2001 in Kerala.

As already stated, Kerala has ranked first among the Indian States in the first edition of the energy efficiency preparedness index of the Alliance for an Energy Efficient Economy (AEEE). The index has 21 indicators in the buildings sector "to capture the States' initiatives and progress on energy efficiency in buildings, covering various aspects such as Energy Conservation Building Code (ECBC), programmes and incentives for ECBC construction and energy efficient appliances, institutional capacity for supporting energy efficiency in buildings, energy savings and energy intensity" (Government of India, 2018a: 11). Kerala has got the highest 29 out of 30 scores in the buildings sector energy efficiency preparedness. In the industrial sector with 13 indicators for energy efficiency preparedness, Kerala has bagged again the highest 21 out of 25 scores. In the municipalities sector with 9 indicators, primarily focussed on public infrastructure such as street lighting and water pumping, Kerala has come third (with 7 out of 10 scores) after Maharashtra (with a score of 8) and Tamil Nadu (with 7.5). In the transport sector with 5 indicators, with 3 indicators for energy efficiency of State Road Transport Corporations (SRTC) and 2 for electric and hybrid vehicles, Kerala has lagged behind a number of States, with a score of only 6 out of 15. In the agriculture and DISCOMs sector with 11 indicators, related to demand side management (DSM) regulations, programmes and savings, and transmission and distribution (T&D) losses for DISCOMs in the State, Kerala has come third with 10 out of 15 scores.

5. Conclusion

The linkage between energy intensity and energy efficiency with productivity is expected to impart valuable knowledge to evolve policies in the State's power sector for the socio-economic growth and development. Returns from enhancing energy productivity and in turn from lowering energy intensity of the economic activities significantly contribute in general to the economy as a whole, and in particular to energy security and mitigation of carbon foot print.

This in turn requires an examination into the extent to which aggregate energy intensity trends are attributable to shifts in the underlying sectoral structure and efficiency improvements within individual sectors.

The energy productivity and economic prosperity index can quantifiably measure the effectiveness with which energy resources are being used; and this can give signals to policy makers to plan for a high energy-productivity growth and sustainable development scenario. The State can achieve higher economic output per unit of energy input either by changes in economic structure or through technical energy efficiency gains.

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