

PAYNE INSTITUTE COMMENTARY SERIES: VIEWPOINT

SCALING UP ENERGY EFFICIENCY IN EMERGING MARKETS:
GLOBAL EXPERIENCES, CHALLENGES AND OPPORTUNITIES

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The current world population of 7.6 billion is expected to reach 9.8 billion in 2050¹. By the same year, the World Energy Council (WEC) projects that the world's energy demand will increase by 80%², adding the equivalent of China and India, driven primarily by growth in developing countries, which are expected to make up 65% of the world's energy consumption, up from 54% as of 2010³.

Historically, energy consumption has been coupled with income growth, yet experiences over the last fifty years have shown that rising income is possible with declining energy use. Among 30 countries that have experienced the largest energy use declines in modern history, 57% are developed economies including the UK, Germany, and Italy, while 17% are nations of the former Soviet Union that have undergone rapid modernization, including Ukraine and Romania⁴. This de-coupling of energy use from GDP growth is driven by policy reforms, pricing, and business decisions geared at transitioning away from fossil fuels.

As developing economies will play an increasingly critical role in driving global economic growth, their lack of established sound policy frameworks and mechanisms to reduce energy intensity risk negating any

¹ <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>

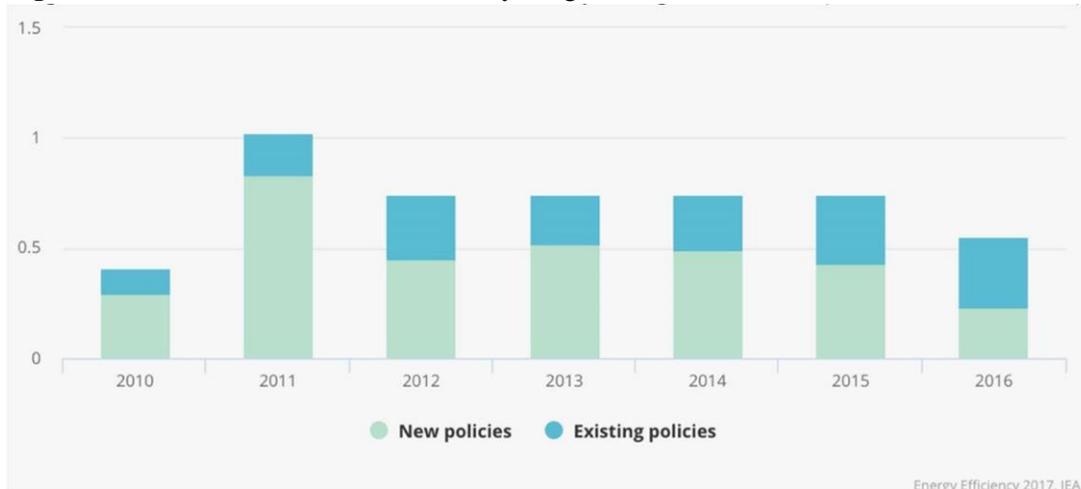
² https://www.worldenergy.org/wp-content/uploads/2013/09/World-Energy-Scenarios_Composing-energy-futuresto-2050_Full-report.pdf

³ <https://www.eia.gov/todayinenergy/detail.php?id=14011>

⁴ <https://www.csis.org/analysis/must-energy-transition-be-slow-not-necessarily>

progress that has been made to shift the global economy to a cleaner and more efficient energy system. Today, fossil fuels account for approximately 80% of global energy consumption, a proportion that the International Energy Agency (IEA) stresses should decrease to 64% by 2040 in order to effectively address climate change⁵. At the current rates of policy implementation (Figure A), energy consumption, and greenhouse gas emissions (GHG) growth, the global economy risks missing its climate targets. The UN has warned that a 2.7 degree increase in temperature by 2040 would lead to catastrophic economic consequences that will cost the global economy an estimated US\$5.4 trillion⁶ - which would particularly affect the global food supply chain, and the most vulnerable populations.

Figure A: Annual Growth of the EE Policy Progress Index (Source: IEA, 2016)



This policy brief argues that reducing energy intensity while addressing the challenges of meeting future global energy needs requires a multi-pronged approach that incorporates energy-efficiency at its core, and that increasingly focuses on transitioning developing economies. Experience has shown that energy efficiency is one of the most critical and cost-effective instruments that contributes to energy supply security, economic competitiveness, improvement in livelihoods, and environmental sustainability. According to the IEA, over the 2000-2016 period, improvements in energy efficiency were primarily responsible for energy savings of 12% – equivalent to US\$ 2.2 trillion, or twice the size of the Australian economy⁷.

The WEC's World Energy analysis to 2050 show that energy efficiency and energy conservation are absolutely crucial in dealing with demand outstripping supply – both require a change in consumer priorities and have cost implications across industries – and hence capital is required to finance energy efficiency measures in terms of an initial investment before it can pay off. Ramping up the transition to an energy efficient future can be a major development and investment opportunity for the developing world, as countries have the potential to propel growth, attract capital, spur innovation, and create high productivity jobs - but the speed and scale of incorporating energy efficiency presents a complex challenge for policy makers and leaders, who are faced with the need to provide affordable housing, deliver products and services, and create opportunities under short-term horizons and tight fiscal constraints.

⁵ <https://www.iea.org/weo2017>

⁶ <http://www.ipcc.ch/report/sr15/>

⁷ <https://www.iea.org/newsroom/energynapsots/economic-value-of-improved-energy-intensity.html>

This policy brief describes the benefits of energy efficiency, while providing an overview of the challenges faced by the sector in developing and transitioning markets. This brief also aims to highlight some of the effective solutions and proven practices to help scale energy efficiency investments and achieve energy savings for sustainable growth.

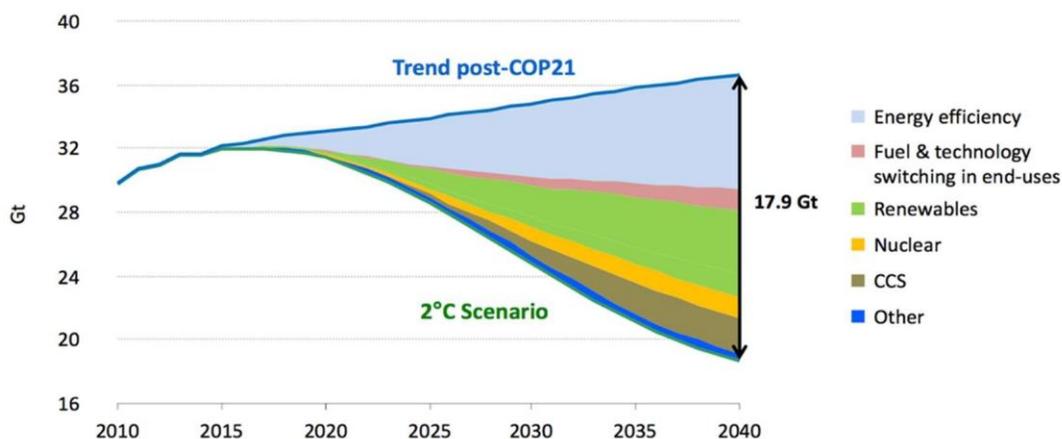
Rational

Governments and industry: Energy efficiency can ease infrastructure bottlenecks by avoiding or delaying capital-intensive investments in new power supply without affecting economic growth. Reducing peak load through load management can reduce generation costs. Reducing overall generation through energy efficiency reduces fuel imports (primarily oil and gas), which lowers import dependence, reduces import bills and overall energy costs, and improves the competitiveness of the economy. In sectors with energy subsidies, energy efficiency helps mitigate the burden on the Government budget. In terms of project economics, energy efficiency options almost always have positive financial returns and are almost always cheaper than installing new supply.

Consumers: Energy efficiency allows lower energy consumption for the same end-use energy services which lowers energy costs for consumers. This leads to higher affordability, which is particularly important for low-income groups, and creates a more attractive environment for tariff reform. At the same time, reducing energy demand leads to higher system reliability which in turn lowers outage costs and raises productivity and income. Compared to other economic activities, energy efficiency can also generate significant employment from additional business activities in the manufacturing and service sectors, such as appliance substitution and public lighting.

Local and Global Environment: The reduction in fossil fuel consumption from energy efficiency results in lower local and regional environmental pollution, thus alleviating stresses on human health. At a broader level, about 60 percent of GHGs globally come from the energy sector. It is estimated by the IEA that under a baseline scenario, the implementation of key energy efficiency policies could result in avoiding over a third of the anticipated increase in GHG emissions by 2050, and 60 percent of the GHGs from the energy sector (Figure B).

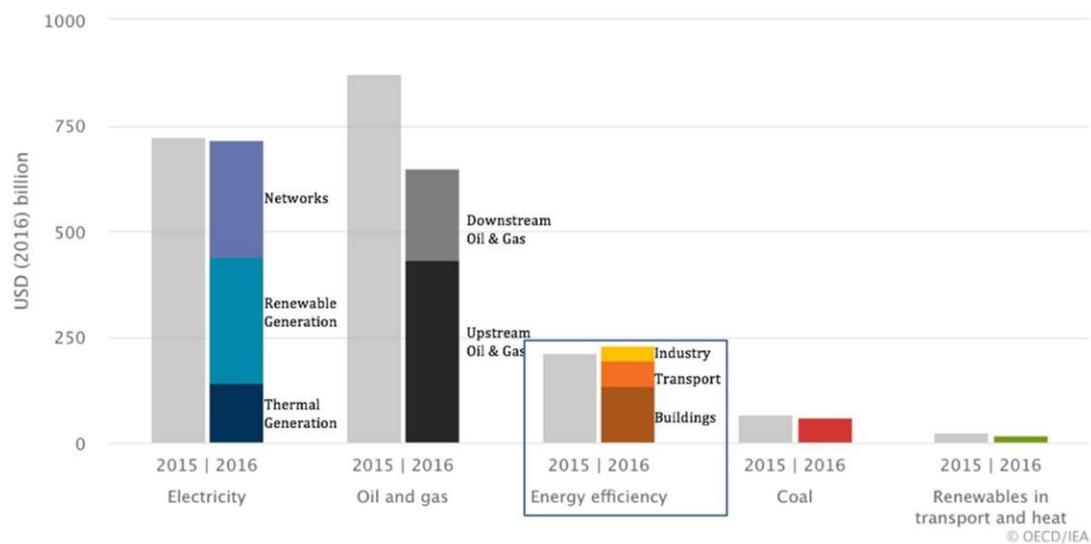
Figure B: GHG Mitigation from Energy Efficiency (Source: IEA, 2017)



The Opportunity

According to the IEA, the world’s growing primary energy needs will require over US\$2.7 trillion in per-year energy supply infrastructure investment by 2040⁸. Meeting the growth in energy demand through traditional energy development models is unsustainable from both environmental and energy security perspectives. Linking the energy efficiency efforts of different stakeholders presents the most significant opportunity for economic growth and energy savings, especially when considering the historical track-record of savings generated, and the low and starting base of investments directed to the sector (Figure C).

Figure C: Global Energy Investments (Source: OECD/IEA, 2016)



The IEA reported in 2017 that investments in energy efficiency rose by 9% over 2016, totaling US\$216 billion. Europe and China accounted for most of the growth, while US\$133 billions of those investments, or 62%, were directed to the buildings sector alone⁹. The International Finance Corporation, a member of the World Bank Group assessed 21 developing countries that make up 48% of global greenhouse emissions and identified investment opportunities of US\$23 trillion from 2016 to 2030¹⁰. The majority of these opportunities is tied to the buildings, industrial, and transport sectors.

Studies have shown that investing in energy efficiency technology and systems offer more substantial returns than generation. For instance, an analysis by the European Commission of over 10,000 individual

⁸ <https://doi.org/10.1080/14693062.2016.1258633>

⁹ <https://www.iea.org/wei2018/>

¹⁰ https://www.ifc.org/wps/wcm/connect/51183b2d-c82e-443e-bb9b-68d9572dd48d/3503-IFCClimate_Investment_Opportunity-Report-Dec-FINAL.pdf?MOD=AJPERES

projects shows that the median price to save a unit of energy (3 euro cents/kWh) was over eight times lower than the average retail price to consume one (24 euro cents/kWh)¹¹.

Energy Efficiency Challenges

Despite the enormous benefits of energy efficiency, its implementation has traditionally faced technical, institutional, political, and financial challenges in all countries. Experience shows that to achieve larger and faster deployment of energy efficiency programs, it is necessary to overcome a number of barriers and market imperfections, including:

- Higher initial capital costs. Both industry and consumers are deterred from spending on energy efficiency equipment because of the typically higher upfront costs.
- Non-economic energy prices. Low and subsidized energy prices and inadequate electricity tariffs make energy efficiency less economic by not saving consumers the full costs of the energy avoided.
- Additionally, the external benefits from reduced energy use, such as improvements to the local environment and human health, are difficult to quantify and often not accounted for in energy prices.
- Inadequate regulatory, institutional and legal frameworks. The expansion of market-based energy savings approaches and private sector participation, such as through energy service companies (ESCOs), is often hindered by ill- adapted regulations and laws and absence of adequate incentives for supply-side energy efficiency investments.
- In addition, energy efficiency expansion is hampered by weak institutions and enforcement. The delivery of energy efficiency results is driven by the ability of the public agencies to organize, transform and develop new and nascent markets for energy efficiency goods and services, and for local private sectors to adopt state-of-the-art energy efficiency technologies and practices.
- Regulatory mechanisms can be the least-cost way to transform markets but require effective local institutions, which can take years to cultivate. Additionally, weak institutions can undermine government policy frameworks and initiatives, including to enforce energy efficiency regulations or to coordinate different levels of government, the private sector and civil society in a concerted energy efficiency effort.
- Uninformed investors. Banks and other financial institutions typically have little familiarity with energy efficiency investments, and consider energy efficiency investments high risk compared to traditional, asset-based financing. Because many individual energy efficiency investments are small and have high transactions costs, financiers need to bundle small and dispersed energy efficiency projects.
- Data and analysis limitations. Without sufficient systems and skills to measure and verify energy savings, the range of energy efficiency agents (consumers, government, investors) will not implement energy efficiency measures on a large scale.

Options for Promoting Energy Efficiency

¹¹ https://ec.europa.eu/energy/sites/ener/files/documents/006_peter_sweatman_seif_dublin_28-09-17.pdf

There are a wide range of approaches, interventions and programs for promoting energy efficiency in emerging and developing countries across all major sectors and end-uses that address the demand, supply and conservation dimensions of energy efficiency. Many programs were pioneered in OECD countries beginning in the 1970s and have since been replicated and adapted increasingly in developing countries. Each energy efficiency market transformation practice and model come with its own strengths and shortcomings, and fall under three broad categories: (1) incentive- based market driven approaches; (2) regulatory policy interventions; and (3) informational programs.

Incentive-based energy efficiency through Utility Demand Side Management (DSM): While utility DSM was born out of North American regulatory initiatives, many developing countries – ranging from Argentina, Brazil, India, Mexico, Pakistan, Philippines, South Africa, Sri Lanka, Thailand, Uruguay, to Vietnam – have implemented DSM programs in local electric utilities. Regulators traditionally mandate utilities to undertake DSM, with energy efficiency costs recovered through utility bills. California has been one of the most successful examples in the U.S. at implementing DSM programs, where between 2016 and 2017, a total of US\$1.2 million led to annual savings of 1,119GWh¹². Additionally, from 1991-2016, Thailand’s generating utility, EGAT, saved 4,208MW and 14,356 thousand tons of CO2 emissions through its DSM program¹³. From 2000-04, Brazilian power utilities invested almost US\$200 million which saved 500 MW and 1,500 GWh/year.

Incentive-based Programmatic Deployment of energy efficiency Appliances and Equipment: The penetration of residential energy efficiency end-use appliances, such as refrigerators and light bulbs, has often relied on large-scale programmatic interventions by Governments, mainly implemented through utilities. Dozens of countries (e.g., Bangladesh, Bolivia, China, Ethiopia, India, Mexico, Philippines, Rwanda, South Africa, Sri Lanka, Thailand, Uganda, Vietnam) have promoted efficient light bulbs, mostly CFLs, through bulk procurement and distribution Bulk purchases, utility financing, and negotiated bulk discounts have been successful at bringing down incremental costs. Other programs have focused on chillers (Thailand, India, Philippines), motors (China), biodiesel (Sweden, France, Bulgaria), refrigerators (Brazil) and air conditioners (Thailand). Successful programs all had strong upfront market research and effective public campaigns.

Market Transformation through Regulation and Policy Actions: Strategic interventions for market transformation have longer-term goals to shift the market on a sustained basis. These mainly rely on introduction of mandatory energy efficiency standards, labeling systems and building codes (See Figure 3 in Annex), but also adopt bulk purchase/market aggregation, and marketing/promotion approaches. The biggest challenge has generally been how to best overcome the incremental costs for the efficient models, and thus incentivize end users to change their purchasing behaviors, though this has been aided in recent years as energy efficiency technology costs have fallen. The bulk of these programs have been in developed countries through standards and labeling. In the European Union, for example, energy consumption for refrigerators has declined 45 percent since the labels were first introduced, with similar results for air conditioning. One of the key lessons is that effective enforcement and robust monitoring systems are required for policies such energy efficiency standards and codes to produce real impacts.

Innovative Financing Mechanisms for energy efficiency Implementation: A wide range of financing mechanisms, including credit lines, concessional finance, revolving funds, special purpose funds (including

¹² California Electric and Gas Utility Cost Report – April 2018

¹³ EGAT Annual Report 2016

equity, mezzanine), partial credit guarantees and loss reserves, and special purpose vehicles, have been used, often in conjunction with multilateral financing and carbon markets, to mobilize investor capital and invigorate capital markets. Dedicated energy efficiency financing programs have been launched in some 50+ countries worldwide, including China, India, Philippines, Russia, Thailand, Tunisia, Turkey, several U.S. states, and Uruguay. Eastern Europe successes over the past 10 years include: The Ukrainian Energy Efficiency Fund, a new initiative by the government to provide homeowners with energy efficiency renovations, was launched in 2018 with US\$115 million in commitments from the EU, Germany, and the World Bank¹⁴; Bulgaria's energy efficiency fund, launched in 2006, which has supported more than 195 projects valued at US\$49 million as of December 2017¹⁵; a loan guarantee program in Hungary launched in 1997 that reached US\$93 million in total investments; South Korea created the Korean Energy Management Company (KEMCO) to help finance energy efficiency projects. KEMCO's voluntary agreement program alone resulted in some US\$3.9 billion between 1999 and 2004. By 2015, KEMCO was renamed the Korean Energy Agency (KEA), and achieved a total energy saving of 3,600 kilojoules¹⁶.

Market Transformation through Energy Service Company (ESCO) Development: As specialized commercially-operated companies, ESCOs can play an important role in delivering EE activities that help end users identify, package, finance, implement, and monitor energy savings projects. ESCOs are designed to address a number of the existing barriers to energy efficiency investments while taking on project performance, and sometimes also credit risks. The global ESCO market has grown rapidly since the 1980s, and as of 2016, ESCOs generated total revenues of US\$27 billion, and employed over 1 million people¹⁷. This growth has been largely concentrated in China, the US, and the EU, which accounted for 56%, 25%, and 10% of total ESCO generated revenues respectively as of 2016. With the rest of the world accounting for 8% of total revenues, or US\$2.7 billion, the potential for ESCO development is significant. Developing countries including Brazil, India, Thailand, and the Philippines, have had successful experiences with small-scale, government backed ESCO projects, yet significant financial, institutional, and technological barriers remain.

Behavioral Change/Education: Motivating people to change their behavior to reduce the energy they consume – to conserve – requires education and outreach. It is crucial to help consumers understand that electricity and fossil fuels are a limited resource and many forms of its production cause environmental damage. For example, in Uruguay, the program “Energy Efficiency Uruguay,” teaches the importance of energy efficiency to its population, starting with the youngest children and instilling in them the necessity to teach other adults and children around them. Educating consumers of the economic benefits of efficiency is just as important for alleviating household expenditures. A Consumer Reports study shows that the average consumer in the U.S. could save on average US\$3,000 per car and US\$5,000 per truck if fuel economy standards increased to an average of 40 miles per gallon (mpg) by 2025.

Awareness Through Data Collection: Energy market participants recognize the importance of a strong statistical foundation for guiding policy and measuring opportunities, risks, and results. Although OECD

¹⁴ https://eeas.europa.eu/delegations/ukraine/43125/eu-and-ukraine-sign-%E2%82%AC50-million-agreementsupport-energy-efficiency-fund_en

¹⁵ Global Audit Services – Energy Efficiency and Renewable Sources Fund – Financial Statement 2017

¹⁶

http://www.energy.or.kr/renew_eng/download/download.aspx?path=%2Fglobal_file%2F12%2FKEA+Annual+Report+2014_lores.pdf&filename=KEA+Annual+Report+2014_lores.pdf

¹⁷ https://www.iea.org/emr16/files/medium-term-energy-efficiency-2016_WEB.PDF

countries have realized improvements in practices that have supported their energy efficiency development efforts, more detailed analysis on the investment landscape and its outlook remains constrained by data quality and comparability. The situation is even more challenging in developing and transitioning economies. Linking the efforts of market participants – including energy service providers, governments, corporates, third-party auditors, and multilateral agencies – is critical in developing and maintaining informed energy efficiency strategies.

Supply-side energy efficiency Improvement Considerations: The IEA estimates that between 21 and 29 EJ can be saved worldwide each year by improving the efficiency of coal, natural gas, and oil-fired power plants, with the largest savings coming from increased efficiency in coal plants (15 to 21 EJ). Over half of this potential is in developing countries, which tend on average to have lower power plant efficiencies. In Denmark, supercritical coal-fired power plants reach efficiency levels of 43 percent compared to the global average for coal plants of around 30 percent. The use of combined-cycle natural gas turbines (CCGT) allows power plants to reach efficiencies of 60 percent, increasing the average efficiency of gas plants in Brazil and India by 24 and 17 percent respectively. Cogeneration or combined heat and power systems (CHP), which use excess heat from power plants for industrial or district heating needs or excess heat from industry for power generation, provide significant energy efficiency potential. In Mexico, cogeneration potential in industry is estimated to be equivalent to about one-fifth of the country's power generation capacity. On the transmission and distribution side, both technical and non-technical losses can be reduced through more efficient transmission lines, reducing electricity theft, and increasing electricity metering. Promoting supply-side energy efficiency investments requires a combination of elements, notably a supportive regulatory framework, vision from industry leaders, and financing.

Global Actions for Scale Up: Lessons learned and future actions for implementation

The vast experience with energy efficiency market transformation in developing countries indicates that energy efficiency implementation requires a long-term, dedicated focus, with action plans on multiple fronts. History is replete with instances where developing countries experienced only short-term decoupling of energy consumption with income growth. In Egypt, fossil fuel consumption fell when the Aswan hydropower dam came online, yet started to grow again by the mid-1970s¹⁸. To ensure the long-term success and appeal of energy efficiency, governments can promote the scale-up by taking actions on four fronts.

Develop energy efficiency legislation and supporting regulations to signal government commitment to energy efficiency, and provide institutional and strategic mandates, funding mechanisms, and other critical elements of a national program. Such frameworks must take into account the local institutional and governance context, legal environment, technical and management capacities, and the level of market development.

Develop energy efficiency programs and set targets to convert the broad policies into concrete actions with lines of accountability. This involves market assessments to identify target sectors and prevailing market barriers, interventions with concerned stakeholders including the private sector, initiation of pilots to test institutional arrangements and market response, incorporation of energy efficiency into key planning

¹⁸ <https://www.csis.org/analysis/must-energy-transition-be-slow-not-necessarily>

functions (e.g., power sector and urban development plans), development of incentive and financing schemes, implementation monitoring (including data collection) and evaluation.

Build capacity to strengthen implementation, build know-how, and address program deficiencies. Targeted consumer education and marketing will also be critical to ensure strong program participation rates and, thus, help achieve targets.

Program replication and scale-up to shift from early pilots and demonstrations to large-scale, market-based schemes. Presenting the energy efficiency business case to market participants including commercial banks, corporates, equipment suppliers and service providers, and helping to organize the market to deliver scalable solutions in a sustainable manner are critical steps to help ensure the savings are of a sufficient scale to achieve the agenda targets. On the global level, collective efforts of various institutions have to be mobilized, and their convening force amongst member countries needs to be utilized to push the energy efficiency acceleration agenda further. Key international efforts can include:

- Increased international cooperation and coordination, especially between developing and industrialized countries, to transfer best implementation practices, expand policy work, and guide innovation and investments.
- Harmonize and streamline international financing procedures, for simpler access to financing sources (e.g., Green Funds, Global Environment Facility, carbon financing, blended finance facilities) for country- level energy efficiency programs.
- Support improved certification of energy efficiency equipment, through international recognized energy efficiency certification agencies, to help better identify quality goods and avoid creating redundant national certification and testing systems.

To accelerate the trajectory of current efforts, energy efficiency needs to be understood as a critical tool to reduce energy intensity, enhance energy security, reduce vulnerability to fluctuating energy prices, increase industrial and commercial competitiveness, and create jobs. With a strong push from the international community, in conjunction with individual actions on the local and national levels, it is possible to significantly increase the rate of energy efficiency implementation, thereby increasing equitable economic prosperity and security.



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